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Prepared by
Ramboll US Consulting, Inc.
Emeryville, California

Date

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BASELINE HEALTH RISK ASSESSMENT REPORT FOR OU-1 SOILS, REVISION 2

NEVADA ENVIRONMENTAL RESPONSE TRUST SITE HENDERSON, NEVADA

RAMBOLL

Baseline Health Risk Assessment Report for OU-1 Soils, Revision 2

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

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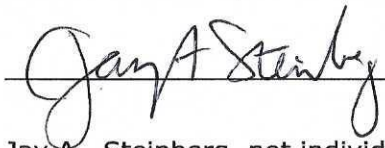
Signature:  Not Individually, but Solely as President of the Trustee

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Date: 5/6/22

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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
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5/6/2022

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Date	**May 6, 2022**
Prepared by	**Ramboll**
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ACRONYMS AND ABBREVIATIONS

1×10^{-4}	one hundred in a million
1×10^{-6}	one in a million
α	false rejection error rate
ABS	Soil Absorption Factor
ACD	Agricultural Chemicals Division
ACM	asbestos-containing material
ADD	average daily dose
AECOM	AECOM, Inc.
AF	adherence factor
AP	ammonium perchlorate
AS	analytical sensitivity
AT	averaging time
atm	atmosphere
ATT_{in}	Indoor Attenuation Factor
ATSDR	Agency for Toxic Substances & Disease Registry
β	false acceptance rate
BaP	benzo(a)pyrene
BaPEq	benzo(a)pyrene equivalent
BCA	bias-corrected accelerated
BCL	basic comparison level
bgs	below ground surface
BHC	benzene hexachloride, also known as hexachlorocyclohexane
BHRA	baseline health risk assessment
BMI	Black Mountain Industrial
box plot	box-and-whisker plot
BRC	Basic Remediation Company
BTEX	benzene, toluene, ethylbenzene, and total xylenes
BW	body weight
C_{soil}	Soil Concentration
CAL/EPA	California Environmental Protection Agency
CAMU	Corrective Action Management Unit

CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CF	Conversion Factor
CFR	Code of Federal Regulations
cm	centimeter
cm^2	square centimeter
cm^3	cubic centimeter
COPC	chemical of potential concern
CN-	free cyanide
CSF	cancer slope factor
CSM	conceptual site model
CTE	central-tendency exposure
cy	cubic yard
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DQI	data quality indicator
DU	decision unit
DUE	data usability evaluation
DVSR	data validation summary report
ECA	excavation control area
ED	exposure duration
EDA	exploratory data analysis
EF	exposure frequency
EMD	EMD Acquisition LLC
ENSR	ENSR Corporation
Envirogen	Envirogen Technologies, Inc.
ENVIRON	ENVIRON International Corporation
EPC	exposure point concentration
ET	exposure time
EU	exposure unit
Exponent	Exponent, Inc.

°F	degrees Fahrenheit
f	fiber
FDA	Food and Drug Administration
FS	feasibility study
g	gram
GEI	GEI Consultants
Geosyntec	Geosyntec Consultants
GRAS	Generally Recognized as Safe
GWETS	groundwater extraction and treatment system
HDPE	high density polyethylene
HEAST	Health Effects Assessment
HI	hazard index
HQ	hazard quotient
HRA	health risk assessment
IF	Intake Factor
Integral	Integral Consulting, Inc.
IQR	interquartile range
IR	Ingestion Rate
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
IWF	interceptor well field
J	estimated value
J+	estimated value, biased high
J-	estimated value, biased low
kg	kilogram
LADD	lifetime average daily dose
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
LOAEL	lowest-observed-adverse-effect level
LOEL	lowest-observed-effect level
LOU	Letter of Understanding
m^3	cubic meter
MDL	method detection limit

mg	milligram
mm HG	millimeter of mercury
mol	mole
mph	miles per hour
MRL	minimal risk level
MS	matrix spike
MSD	matrix spike duplicate
MTBE	methyl tertiary butyl ether
NCP	National Contingency Plan
NDEP	Nevada Division of Environmental Protection
Neptune	Neptune and Company, Inc.
NERT	Nevada Environmental Response Trust
NFA	No Further Action
NOAEL	no-observed-adverse-effect level
NOEL	no-observed-effect level
Northgate	Northgate Environmental Management, Inc.
NRC	National Research Council
NSF	risk coefficient for population of non-smoking females
NSM	risk coefficient for population of non-smoking males
OCH	organochlorine herbicide
OCP	organochlorine pesticide
OEHHA	Office of Environmental Health Hazard Assessment
Operations Area	the area comprising the Site, excluding Sale Parcels E, F, and G
OPP	organophosphorus pesticide
OSSM	Olin Chlor-Alkali/Stauffer/Syngenta/Montrose
OU-1	Operable Unit 1
OU-2	Operable Unit 2
OU-3	Operable Unit 3
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEF	particulate emission factor
PES	PES Environmental, Inc.
Phase A	

Investigation	Phase A Source Area Investigation
Phase B Investigation	Phase B Source Area Investigation
ppm	parts per million
PPRTV	Provisional Peer Reviewed Toxicity Values
PQL	practical quantitation limit
p-value	calculated probability
Q/C	site-specific dispersion factor
Q-Q	quartile to quartile
Q1	quartile 1
Q3	quartile 3
Qal	quaternary alluvial deposit
QAPP	Quality Assurance Project Plan
QC	quality control
R	rejected value
Ra	radium
Ramboll	Ramboll US Consulting, Inc.
Ramboll Environ	Ramboll Environ US Corporation
RAO	Remedial Action Objective
RAW	Removal Action Workplan
RBA_{oral}	Relative bioavailability for oral ingestion
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
RPD	relative percent difference
RSL	regional screening level
RZ	remediation zone
SD	standard deviation
SF	risk coefficient for population of smoking females
SIM	selective ion monitoring
Site	Nevada Environmental Response Trust Site
SM	risk coefficient of population of smoking males

SMP	Site Management Plan
SOP	standard operating procedure
SQL	sample quantitation limit
SRC	site related chemical
SVOC	semi-volatile organic compound
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
TF	Transfer Factor
Th	thorium
TIMET	Titanium Metals Corporation
TPH	total petroleum hydrocarbons
Tronox	Tronox, LLC
Trust	Nevada Environmental Response Trust
U	uranium
UCL	upper confidence limit
µg	microgram
µm	micron or micrometer
UMCf	Upper Muddy Creek Formation
U.S.	United States
USEPA	United States Environmental Protection Agency
VER	vacuum enhanced recovery
VOC	volatile organic compound
WHO	World Health Organization
Wood	Wood Environment & Infrastructure Solutions, Inc.

EXECUTIVE SUMMARY

This baseline health risk assessment (BHRA) for soils within the BHRA Study Area (defined below) of Operable Unit 1 (OU-1) was conducted by Ramboll US Consulting, Inc. (Ramboll) on behalf of the Nevada Environmental Response Trust (NERT or the Trust) to evaluate potential risks to workers within the BHRA Study Area from exposures to residual levels of chemicals, radionuclides, and asbestos in soils.

The 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). The risk results and conclusions from the BHRA will be evaluated in the Feasibility Study (FS) to determine if soil remediation is necessary in the BHRA Study Area to satisfy the remedial action objectives (RAOs).

A BHRA report for OU-1 soils was submitted to the Nevada Division of Environmental Protection (NDEP) on January 31, 2020 (Ramboll 2020a), and NDEP comments were received on June 9, 2020 (NDEP 2020). Revision 1 of the BHRA report was submitted to NDEP on October 14, 2021, to address NDEP comments (Ramboll 2021d) and was consistent with the agreements reached during a meeting with NDEP and its consultants on July 8, 2020; NDEP comments on Revision 1 of the BHRA report were received on December 22, 2021 (NDEP 2021). This Revision 2 of the BHRA for OU-1 soils has been prepared to address the additional NDEP comments and is consistent with the agreements reached during a meeting with NDEP and its consultants on January 18, 2022 and the recommendations in a technical memorandum prepared by NDEP's consultant with regard to spatial plots (Neptune 2022). As requested by NDEP, an annotated response to comment has been provided alongside this revised report.

OU-1, designated for the RI/FS currently in progress, comprises approximately 346 acres located within the Black Mountain Industrial (BMI) Complex in unincorporated Clark County, Nevada; it is surrounded by the City of Henderson (Figures ES-1 and ES-2). OU-1 consists of property owned by NERT (the "NERT Site" or "Site", approximately 267 contiguous acres and approximately 8 acres of the non-contiguous Sale Parcel E) as well as three parcels (former Sale Parcels C, D, and H, comprising 71 acres) which are no longer owned by NERT (Figure ES-3).[1] Within the Site, the Operations Area is a 257-acre area used by the Trust for environmental response and its tenant EMD Acquisition LLC (EMD) for the operation of a chemical manufacturing business. The Operations Area excludes three sale parcels (Sale Parcels E, F, and G, comprising 18 acres) at the Site that are not currently used by the Trust or its tenant. Consistent with the 2017 Interim Report on the identification of chemicals of potential concern (COPCs) and decision units (DUs) for OU-1 soils (Ramboll Environ US Corporation [Ramboll Environ] 2017a), the BHRA Study Area (Figure ES-4) is an approximately 142-acre non-contiguous area within the Operations Area, excluding remediation zone A (RZ-A), a contiguous 28-acre area in the southern portion of the Operations Area, and 38 excavation control areas (ECAs) (approximately 87 acres). Besides

[1] Prior to May 2020, OU-1 and the NERT Site were exchangeable terms, both referring to property owned by NERT. Since May 2020, the NERT Site excludes the three parcels (former Sale Parcels C, D, and H) which are no longer owned by NERT, while OU-1 still refers to the same area as before, consisting of the NERT Site and Sale Parcels C, D, and H.

the risk for the BHRA Study Area being evaluated under this BHRA, the risks for all other properties within OU-1 were/are being evaluated and/or managed as follows:

- Separate post-remediation health risk assessments (HRAs) for Parcels C, D, F, G, and H were completed in late 2017 and early 2018, all of which have been granted No Further Action (NFA) determinations by NDEP.
- An HRA was previously completed for RZ-A and was approved by NDEP in August 2010.
- The 38 ECAs are subject to the Site Management Plan (SMP) (Ramboll 2020b), which describes measures to mitigate risks to human health and the environment related to potential exposures to residual chemicals during periods of typical Site operations.
- A separate HRA is being performed for Parcel E since this parcel is not contiguous with the Operations Area. There were no reported industrial activities on Parcel E and an extraction well field, and the recharge trench for a groundwater extraction and treatment system (GWETS) jointly operated by Olin, Stauffer Chemical Company (Stauffer), Syngenta, and Montrose Chemical Company (Montrose) (collectively referred to as OSSM) is present on the parcel.

Complete vapor intrusion pathways for volatile organic compounds (VOCs) released from soil gas and groundwater have also been identified in the Operations Area. A separate BHRA report for OU-1 soil gas and groundwater was submitted to NDEP on September 29, 2021 (Ramboll 2021a). A response to comment letter is currently under preparation to respond to NDEP comments received on March 9, 2022, and is anticipated to be submitted in the second quarter of 2022. However, there are no anticipated changes in the health risk estimates for the vapor intrusion pathway from soil gas and groundwater in OU-1, and the cumulative risks associated with potential exposures to chemicals in soil and to VOCs in air resulting from vapor intrusion are presented in this OU-1 Soil BHRA report, Revision 2.

Separate BHRA reports are being prepared for Operable Unit 2 (OU-2) and Operable Unit 3 (OU-3). The BHRA for OU-2 addresses the potential risks associated with the vapor intrusion pathway for volatile compounds released from soil gas and groundwater in the NERT Off-Site Study Area component of OU-2 west of Pabco Road and was submitted to NDEP on July 23, 2021. The forthcoming BHRA for OU-3 will address the potential health risks associated with the direct contact and vapor intrusion pathways due to potential migration of the contaminants present in groundwater from OU-1. The BHRA Work Plan for OU-3 (Ramboll 2022a) was submitted to NDEP on February 28, 2022 and is currently under NDEP review.

This BHRA followed the procedures outlined in the United States Environmental Protection Agency (USEPA) risk assessment guidance and applicable NDEP guidance. The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] § 300) is cited as the basis for the target cancer risk range established by NDEP (2017a). According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one in a million (1×10^{-6}) to one hundred in a million (1×10^{-4}). According to the NCP and NDEP (2017a), 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 in OU-1,

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

The OU-1 Soil BHRA, Revision 2 has been prepared to address NDEP's December 22, 2021 comments on the October 14, 2021 OU-1 Soil BHRA Report, Revision 1 (Ramboll 2021d) to incorporate additional spatial bubble plots to provide additional supporting information for spatial exploration analysis of the soil COPCs identified in this BHRA.

The Site, including the Operations Area, has been the subject of extensive environmental investigations and removal actions. The primary field investigations for soils in the BHRA Study Area included the following[2]:

- Phase A Source Area Investigation (Phase A Investigation) in 2006;
- Phase B Source Area Investigation (Phase B Investigation) in 2008 to 2009;
- Phase B Supplemental Investigation in 2009;
- Pre-confirmation sampling in 2010;
- Confirmation sampling in 2011;
- Phase 1 RI sampling in 2014;
- Phase 2 RI sampling in 2017;
- Unit 4 and 5 Buildings Investigation in 2016;
- Pre-excavation sampling for dioxin in 2018 associated with a soil removal action near the southwest corner of the GW-11 Pond.

Soil removal actions were conducted in the Operations Area of OU-1 in 2010 and 2011 to minimize potential health risks associated with the continued presence of contaminated soil. Over 570,000 cubic yards (cy) of soil and over 284,000 tons of manganese tailings were removed. In October 2013, over 1,100 tons of soil were excavated in ECA #E3 (Facilities at East End of the Beta Ditch). In April 2019, soil excavation was conducted near the southwest corner of the GW-11 Pond to remove dioxin-impacted soils in this area. Over 2,700 tons of soil were removed as part of this action. In some areas, impacted soils (with chemical concentrations greater than NDEP's basic comparison levels [BCLs]) and incompletely characterized soils were left in place due to access or other constraints precluding soil excavation. Such areas are designated as ECAs and risks are mitigated through the SMP (Ramboll 2020b). In other areas, soil characterization was completed as part of the more recent RI sampling activities in 2014 to 2017. This BHRA focused on potential post-removal health risks associated with residual chemical concentrations in non-ECA soils in the BHRA Study Area.

[2] The soil investigations were conducted historically by other parties between 2006 and February 2011, and more recently by the Trust since February 2011.

Soil analytical data collected from 0-10 feet below ground surface (bgs) in areas that were not excavated during the 2010-2011 soil removal actions or 2019 dioxin-impacted soil removal near the GW-11 Pond were assessed through the data processing and DUE steps of this risk assessment (see Section 4.1), and data representative of current Site conditions were selected for purposes of the BHRA. The soil conceptual site model (CSM), COPCs, and estimated cancer risks and noncancer HIs are summarized as follows:

- Soil COPCs were selected according to a multi-step process, including a concentration/toxicity screen, a background evaluation for metals and radionuclides, and chemical-specific considerations. The BHRA Study Area was divided into nine EUs based on risk-relevant spatial patterns as well as current land use, existing Site features, and exposures for current workers within the BHRA Study Area (i.e., employees and contractors of EMD, EMD tenants, and the Trust) (see Figure ES-5). For the background evaluation, as recommended by Neptune (2017), the regional Basic Remediation Company (BRC)/TIMET data set was used for the northern portion of the BHRA Study Area (EU-1 through EU-7) and the RZ-A background data set was used for the southern portion of the BHRA Study Area (EU-8 and EU-9). The COPCs identified through these steps for soils in each individual EU are summarized in Table ES-1.
- Based on the refined CSM developed by NERT for the Operations Area, potential exposure to soil was evaluated for indoor commercial/industrial workers, outdoor commercial/industrial workers (including utility/maintenance workers in EU-4), and construction workers via direct contact with soil (i.e., incidental ingestion, dermal contact, and inhalation of airborne particulates and vapors) within the BHRA Study Area. Commercial/industrial workers were assumed to have direct contact with shallow soils (0–2 feet bgs) when minimum soil excavation occurs, or with surface and subsurface soils (0–10 feet bgs) when soils from depths of up to 10 feet bgs could be brought to the surface during excavation or other activities. Construction workers were assumed to have direct contact with surface and subsurface soils (0–10 feet bgs) during excavation or other activities. Utility/maintenance workers in EU-4 were assumed to occasionally conduct soil or groundwater well sampling and only have direct contact with shallow soils (0–2 feet bgs) in the Central Retention Basin. This scenario is most representative of the likely current activities in this area.
- Excess lifetime cancer risks and noncancer HIs associated with soil direct contact were estimated for all soil COPCs except asbestos based on the 95% UCL on the mean soil concentration (or the maximum detected concentration if a 95% UCL could not be calculated due to limited detections) at the 0-2 feet depth interval and at the 0-10 feet depth interval within the BHRA Study Area. The results are presented in Table ES-2 and summarized below.

  Cancer Risks:

  - For EU-1, EU-4, EU-5, EU-6, and EU-8, excess lifetime cancer risks (excluding contribution from background metals in soil) were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations.

- For EU-2, EU-3, and EU-9, excess lifetime cancer risks (excluding contribution from background metals in soil) were within the NDEP acceptable risk range of 10^{-6} to 10^{-4} for one or more worker populations. The maximum estimated excess lifetime cancer risk was 8×10^{-6} in EU-2 for outdoor commercial/ industrial workers exposed to soil at the 0-2 feet depth interval, 3×10^{-5} in EU-3 for outdoor commercial/industrial workers exposed to soil at the 0-2 feet depth interval, and 2×10^{-5} in EU-9 for outdoor commercial/industrial workers exposed to soil at the 0-10 feet depth interval. The cancer risk driver for these EUs was dioxin toxicity equivalent (TEQ). It should be noted that the Site-specific action level of 0.0027 milligram per kilogram (mg/kg) for dioxin TEQ approved by NDEP (2010d) corresponds to a cancer risk of 6×10^{-5}. The cancer risks for dioxin TEQ in these EUs (maximum at 3×10^{-5}) were lower than the cancer risk associated with the Site-specific action level. Further, the dioxin TEQ exceeded the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker in a few samples collected in EU-2, EU-3, and EU-9 (Figure ES-5), but these limited exceedances were not of concern from a cancer risk perspective as described above.
- For EU-7, excess lifetime cancer risks (excluding contribution from background metals in soil) were at or near the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers. The maximum estimated excess lifetime cancer risk was 4×10^{-6} for outdoor commercial/industrial workers exposed to soil at the 0-10 feet depth interval. The cancer risk driver was chromium VI, the cancer risks of which ranged from 9×10^{-7} to 3×10^{-6}.
- Arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at a few locations in each EU except EU-8 (Figure ES-5). However, arsenic was not identified as a soil COPC in EU-1, EU-2, EU-3, EU-5, EU-6, and EU-7 based on comparison of the distribution of all the arsenic samples in each EU against the BRC/TIMET regional background data set. Also, the estimated cancer risks for arsenic were below 10^{-6} when calculated based on the 95% UCL on the mean concentration of all soil samples collected in EU-4 and EU-9 and excluding the contribution from arsenic in background soil. In summary, the limited arsenic sample locations exceeding the maximum BRC/TIMET background value were not of concern.

Noncancer HIs:

- For EU-1, EU-2, EU-3, and EU-9, noncancer HIs (excluding contribution from background metals in soil) were below the NDEP target HI of greater than one for all worker populations.
- For EU-4, EU-5, EU-6, EU-7, and EU-8, noncancer HIs (excluding contribution from background metals in soil) were above the NDEP target HI of greater than one for construction workers. The noncancer HI (excluding contribution from background metals in soil) was also above the NDEP target HI of greater than one for outdoor commercial/industrial workers exposed to soil at 0-10 feet bgs in EU-8. The maximum noncancer HI was two in EU-4, three in EU-

5, two for EU-6, two for EU-7, and seven in EU-8 for construction workers. The noncancer HI driver for EU-4, EU-7, and EU-8 was perchlorate, the maximum noncancer hazard quotient (HQ) of which was seven. The noncancer HI driver for EU-5 and EU-6 was manganese, the maximum noncancer HQ of which was three.

- It should be noted that the exceedances of the target level for noncancer HIs in EU-8 was due to the elevated perchlorate concentration in a single soil sample, compared to relatively low perchlorate concentrations in other samples collected in this EU.
- The calculation of noncancer HQs for construction workers (i.e., for perchlorate and manganese) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 milligram per day [mg/day]). No subchronic toxicity values were available for perchlorate and manganese, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.
- An exposure time of eight hours per day and an exposure frequency of 250 days per year were also assumed for construction workers. However, under current conditions of EU-4, only utility/maintenance workers are anticipated to occasionally conduct soil or groundwater well sampling (e.g., one hour per day, one day per month) in this area.

- With regard to asbestos (long amphibole and chrysotile fibers), a best estimate and an upper-bound estimate of potential cancer risk via inhalation of airborne particulates were calculated for all worker populations in all nine EUs. The results are presented in Table ES-3 and summarized below.

  Long Chrysotile Fibers:

  - The best estimates and upper-bound estimates of combined risks for death from lung cancer and mesothelioma associated with potential inhalation exposure to long chrysotile fibers were less than 1×10^{-6} for all worker populations in all nine EUs, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
  - Further, the counts of long chrysotile fibers were not above the level of five or more fibers per sample specified in the *Removal Action Work Plan for Phase B Soil Remediation of Remediation Zones RZ-B through RZ-E* (the RAW) (Northgate Environmental Management, Inc. [Northgate] 2010a) in any samples.

  Long Amphibole Fibers:

  - For indoor and outdoor commercial/industrial workers (including outdoor utility/maintenance workers in EU-4), the best estimates and upper-bound estimates of combined risks for death from lung cancer and mesothelioma

associated with potential inhalation exposure to long amphibole fibers in all nine EUs were below or near the lower end of the NDEP acceptable risk range.

  - For construction workers, the best estimates of combined risks for death from lung cancer and mesothelioma associated with potential inhalation exposure to long amphibole fibers in all nine EUs were below or near the lower end of the NDEP acceptable risk range. The upper-bound estimates of risks from long amphibole fibers for construction workers in all the nine EUs were at the lower end or within the NDEP acceptable risk range, ranging from 1×10^{-6} in EU-2 to 2×10^{-5} in EU-4.
  - It should be noted that the upper-bound risk estimates for long amphibole fibers were based on an observed count of zero fibers in all the EUs except EU-3 and in EU-9[3], while the counts of long amphibole fibers were at or above the RAW specified level of one or more fibers per sample (Northgate 2010a) only at three sample locations in EU-3 and one sample location in EU-9.

- In addition to sources of contamination present within the BHRA Study Area, contaminated surface soils associated with industrial operations on adjacent neighboring sites were also considered potential former and/or current sources of contaminants to OU-1. Through a quantitative evaluation based on the results of soil investigations and risk assessments prepared for the Olin, Stauffer Chemical Company (Stauffer), Syngenta, and Montrose Chemical Company (Montrose) (collectively referred to as OSSM) site and the TIMET site, potential exposures to chemicals in soil in these neighboring sites via inhalation of airborne particulates and vapors are not expected to pose unacceptable carcinogenic or noncarcinogenic health effects to populations within the BHRA Study Area.

The cumulative cancer risk and noncancer HI for each receptor population in the BHRA Study Area[4] were estimated by summing the estimated excess lifetime cancer risk and noncancer HI for chemicals from Table 9-1 via direct contact with soil (0-2 or 0-10 feet bgs) and VOCs from via inhalation of soil gas (5 or 15 feet bgs) migrating to air (Ramboll 2021a). The risk results for soil gas were used for cumulative risk characterization whenever available because soil gas data is generally the preferred line of evidence for assessing vapor intrusion risks as opposed to groundwater data, as described in agency guidance (USEPA 2015). Asbestos risks were evaluated separately from chemical risks because these risk estimates are not additive. The cumulative risks are presented in Table ES-3 and summarized below:

Cumulative Cancer Risks:

- For EU-4, EU-5, and EU-8, the excess lifetime cumulative cancer risks due to direct contact with COPCs in soil and migration of VOCs in soil gas were at or below the

[3] For asbestos, risks are estimated even in the case of zero fiber counts. As discussed in detail in Neptune (2015), the risk assessment results are affected by the calculation of the 95% UCL assuming a Poisson distribution, which for a fiber count of zero in soil samples, yields an upper-bound value of 3 fibers per gram (f/g) of soil.

[4] The BHRA Study Area is an approximately 142-acre non-contiguous area within the Operations Area (Figure ES-4), excluding RZ-A and 38 ECAs. As described in Ramboll (2021a), the focus of the OU-1 Soil Gas and Groundwater BHRA is the Operations Area. Therefore, the cumulative risk from soil and soil gas was only evaluated for the BHRA Study Area.

lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations.

- For EU-1, EU-2, EU-3, EU-6, EU-7, and EU-9, the excess lifetime cumulative cancer risks due to direct contact with COPCs in soil and migration of VOCs in soil gas were within or at the higher end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for one or more worker populations. The maximum estimated excess lifetime cumulative cancer risk was 8×10^{-6} in EU-1, 1×10^{-4} in EU-2, and 1×10^{-5} in EU-6 for indoor commercial/industrial workers, and 3×10^{-5} in EU-3, 4×10^{-6} in EU-7, and 2×10^{-5} in EU-9 for outdoor commercial/industrial workers.
    - For indoor commercial/industrial workers in EU-1, EU-2, and EU-6 as well as indoor commercial/industrial workers exposed to soil at 0-2 feet bgs and soil gas at 5 feet bgs in EU-9, the cumulative cancer risk driver chemical was chloroform in soil gas, and the cumulative cancer risk driving pathway was inhalation of soil gas migrating to indoor air.
    - For indoor commercial/industrial workers in EU-7, the cumulative cancer risk driver chemicals were chromium VI in soil and chloroform in soil gas. Direct contact with soil and inhalation of soil gas migrating to indoor air contributed approximately equally to the cumulative cancer risks.
    - For indoor commercial/industrial workers exposed to soil at 0-10 feet bgs and soil gas at 5 feet bgs or exposed to soil at 0-2 feet bgs and soil gas at 15 feet bgs in EU-9, the cumulative cancer risk driver chemicals were dioxin TEQ in soil and chloroform in soil gas, and direct contact with soil and inhalation of soil gas migrating to indoor air contributed approximately equally to the cumulative cancer risks.
    - For outdoor commercial/industrial workers in EU-2, all worker populations in EU-3, as well as indoor commercial/industrial workers exposed to soil at 0-10 feet bgs and soil gas at 15 feet bgs, outdoor commercial/industrial workers, and construction workers in EU-9, the cumulative cancer risk driver chemical was dioxin TEQ in soil, and the cumulative cancer risk driving pathway was direct contact with soil.
    - For outdoor commercial/industrial workers and construction workers in EU-7, the cumulative cancer risk driver chemical was chromium VI in soil, and the cumulative cancer risk driving pathway was direct contact with soil.

Cumulative Noncancer HIs:

- For EU-1, EU-2, EU-3, and EU-9, the cumulative noncancer HIs due to direct contact with COPCs in soil and migration of VOCs in soil gas were below the NDEP target HI of greater than one.
- For EU-4, EU-5, EU-6, EU-7, and EU-8, the cumulative noncancer HIs due to direct contact with COPCs in soil and migration of VOCs in soil gas were above the NDEP target HI of greater than one for construction workers. The cumulative noncancer HI was also above the NDEP target HI of greater than one for outdoor commercial/ industrial workers exposed to 0-10 feet bgs soil and soil gas at 5 or 15 feet bgs in EU-8. The maximum cumulative noncancer HI was two in EU-4, three in EU-5, two

for EU-6, two for EU-7, and seven in EU-8 for construction workers. The cumulative noncancer HI driver chemical was perchlorate in EU-4, EU-7, and EU-8, and manganese in EU-5 and EU-6. The cumulative noncancer HI driving pathway was direct contact with soil.

In summary, potential exposure to COPCs in soil as well as potential cumulative exposure to COPCs in soil and VOCs in soil gas are not expected to pose unacceptable carcinogenic human health risks under the conditions and assumptions evaluated in any of the nine EUs in the BHRA Study Area. Potential exposure to COPCs in soil as well as potential cumulative exposure to COPCs in soil and VOCs in soil gas do not pose unacceptable noncarcinogenic health risks under the conditions and assumptions evaluated in EU-1, EU-2, EU-3, or EU-9. The calculated noncancer HIs associated with potential exposure to COPCs in soil and the calculated cumulative noncancer HIs associated with potential exposure COPCs in soil and VOCs in soil gas were above the target level under a construction worker scenario for EU-4, EU-5, EU-6, EU-7, and EU-8 as well as an outdoor commercial/industrial worker scenario for EU-8, based on the presence of perchlorate or manganese in soil in these EUs. These noncancer HI exceedances were due to the conservative exposure assumptions and toxicity values used for the construction worker scenario in all EUs and the elevated perchlorate concentration in a single soil sample collected in EU-8.

1. INTRODUCTION

This baseline health risk assessment (BHRA) report for soils within the BHRA Study Area, a 142-acre area within Operable Unit 1 (OU-1), was prepared by Ramboll US Consulting, Inc. (Ramboll) on behalf of the Nevada Environmental Response Trust (NERT or the Trust) and presents an evaluation of potential risks to workers within the BHRA Study Area from exposures to residual levels of chemicals, asbestos, and radionuclides[5] in soils.

The 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). The risk results and conclusions from the BHRA will be evaluated in the Feasibility Study (FS) to determine if soil remediation is necessary in the BHRA Study Area to satisfy the remedial action objectives (RAOs).

A BHRA report for OU-1 soils was submitted to the Nevada Division of Environmental Protection (NDEP) on January 31, 2020 (Ramboll 2020a), and NDEP comments were received on June 9, 2020 (NDEP 2020). Revision 1 of the BHRA report was submitted to NDEP on October 14, 2021, to address NDEP comments (Ramboll 2021d) and was consistent with the agreements reached during a meeting with NDEP and its consultants on July 8, 2020; NDEP comments on Revision 1 of the BHRA report were received on December 22, 2021 (NDEP 2021). This Revision 2 of the BHRA for OU-1 soils has been prepared to address NDEP comments and is consistent with the agreements reached during a meeting with NDEP and its consultants on January 18, 2022 and the recommendations in a technical memorandum prepared by NDEP's consultant with regard to spatial plots (Neptune 2022). As requested by NDEP, an annotated response to comment has been provided alongside this revised report.

OU-1, designated for the RI/FS currently in progress, comprises approximately 346 acres within the Black Mountain Industrial (BMI) Complex in unincorporated Clark County, Nevada; it is surrounded by the City of Henderson (Figures 1-1 and 1-2). OU-1 consists of property owned by NERT (the "NERT Site" or "Site", approximately 267 contiguous acres and approximately 8 acres of the non-contiguous Sale Parcel E) as well as three parcels (former Sale Parcels C, D, and H, comprising 71 acres) which are no longer owned by NERT (Figure 1-3).[6] Within the Site, the Operations Area[7] is a 257-acre area used by the Trust for environmental response and its tenant EMD Acquisition LLC (EMD) for the operation of a chemical manufacturing business. Tronox, LLC (Tronox) leased approximately 113 acres within the Operations Area from February 2011 to August 2018, on which it initially operated a chemical manufacturing business (Figure 1-4). In August 2018, Tronox's

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

[6] Prior to May 2020, OU-1 and the NERT Site were exchangeable terms, both referring to property owned by NERT. Since May 2020, the NERT Site excludes the three parcels (former Sale Parcels C, D, and H) which are no longer owned by NERT, while OU-1 still refers to the same area as before, consisting of the NERT Site and Sale Parcels C, D, and H.

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

Henderson operations were purchased by EMD and EMD assumed the lease with the Trust, which is continuing similar manufacturing operations at the Site. The Operations Area excludes three sale parcels (Sale Parcels E, F, and G, comprising 18 acres) at the Site that are not currently used by the Trust or its tenant.

The BHRA Study Area is an approximately 142-acre non-contiguous area within the Operations Area (Figure 1-5). The BHRA Study Area excludes 115 acres of the Operations Area consisting of remediation zone A (RZ-A), which is a contiguous 28-acre area in the southern portion of the Operations Area (see Section 3.1.2), and 38 excavation control areas (ECAs) (approximately 87 acres).

Besides the risk for the BHRA Study Area being evaluated under this BHRA, the risks for all other properties within OU-1 were/are being evaluated and/or managed. Separate post-remediation health risk assessments (HRAs) for Parcels C, D, F, G, and H were completed in late 2017 and early 2018, all of which have been granted No Further Action (NFA) determinations by NDEP. An HRA has been previously completed for RZ-A and was approved by NDEP in August 2010 (see Section 3.1.2). The 38 ECAs are subject to the Site Management Plan (SMP) (Ramboll 2020b), which describes measures to mitigate risks to human health and the environment related to potential exposures to residual contaminants during periods of typical Site operations. Considering the risk mitigation measures in place, NDEP concurred during a meeting in July 2015 that a BHRA would not be required for the ECAs (Ramboll Environ 2015b). The Trust reviewed information on the historical use of Parcel E, and investigated soil, soil gas, and groundwater in Parcel E. A separate HRA is being performed for Parcel E because Parcel E is not contiguous with the Operations Area and there were no reported industrial activities in this area.

1.1 Scope of OU-1 Soil Baseline Health Risk Assessment

According to the BHRA Work Plan (ENVIRON 2014b) prepared as part of the RI/FS Work Plan (ENVIRON 2014a), key steps of the BHRA for OU-1 soils include: 1) selection of chemicals of potential concern (COPCs) in soil for quantitative evaluation of cancer risks and noncancer hazards; and 2) identification of exposure units (EUs) for evaluation. To address these key steps, three interim reports were prepared prior to the OU-1 soil BHRA. In May 2015, the first interim report, Preliminary Selection of Facility Area COPCs (2015 Interim COPC Report) (Ramboll Environ 2015a) was submitted to NDEP; that report focused primarily on the identification of COPCs. In July 2015, representatives of NDEP, NDEP consultants, the Trust, and Ramboll Environ met to discuss the 2015 Interim COPC Report, and more generally, to identify a path forward for the soil BHRA (Ramboll Environ 2015b).

In August 2016, the second interim report, Identification of COPCs and Exposure Units for Soils (2016 Interim COPC/Exposure Unit Report) (Ramboll Environ 2016a) was submitted to NDEP. The 2016 Interim COPC/EU Report updated the list of soil COPCs for the BHRA Study Area[8] consistent with the approach agreed upon during the July 2015 meeting. In addition, soil analytical data as part of the Phase 1 Data Gap Remedial Investigation (Phase 1 RI) were added to the risk assessment data set, and the data usability evaluation (DUE) and a

[8] The 2015 interim COPC report identified COPCs for areas referred to as "outside ECA soils" and "inside ECA soils." Consistent with the decision to exclude ECAs from the BHRA, the 2016 interim COPC/EU report identified COPCs for "outside ECA soils," or equivalently, the BHRA Study Area.

preliminary identification of EUs were included. In December 2016, NDEP provided comments on the 2016 Interim COPC/EU Report (NDEP 2016).

In November 2017, the third interim report, Identification of COPCs and Decision Units for OU-1 Soils, Revision 1 (2017 Interim COPC/DU Report) (Ramboll Environ 2017a) was submitted to NDEP. The 2017 Interim COPC/DU Report: 1) updated the soil BHRA data set based on the most recent information about the Site, ECA, and sale parcel boundaries, sample depths, relevance to 2010-2011 soil removal actions, and inaccessibility for soil contact beneath the Mn-2 Pond; 2) expanded the DUE based on NDEP comments; 3) updated the list of soil COPCs for the entire BHRA Study Area using the most recent NDEP Basic Comparison Levels (BCLs) (NDEP 2017a) for the concentration/toxicity screen; 4) divided the BHRA Study Area into three DUs[9] based on risk-relevant spatial patterns; 5) performed a DU-specific background comparison by using the regional Basic Remediation Company (BRC)/Titanium Metals Corporation (TIMET) data set (BRC and TIMET 2007) for the northern portion of the BHRA Study Area and the RZ-A background data set for the southern portion of the BHRA Study Area; and 6) conducted DU-specific DUEs and COPC identifications. In December 2017, NDEP approved the 2017 Interim COPC/DU Report (NDEP 2017b).

The OU-1 Soil BHRA Report was first submitted to NDEP on January 31, 2020 (Ramboll 2020a). In this BHRA report, the soil BHRA data set presented in the 2017 Interim COPC/DU Report was updated by incorporating additional soil data from more recent investigations (i.e., Phase 2 Data Gap Remedial Investigation [Phase 2 RI], Unit Buildings 4 and 5 Investigation, and treatability studies). The COPC selection and DU identification were also updated using the same methodology as described in the 2017 Interim COPC/DU Report. Further, the exposure assessment, toxicity assessment, and risk characterization for the evaluation of soil exposure pathways in OU-1 were conducted. NDEP comments on this BHRA report were received on June 9, 2020 (NDEP 2020).

The OU-1 Soil BHRA, Revision 1 was prepared and submitted on October 14, 2021 to address the NDEP June 9, 2020 comments on the January 31, OU-1 Soil BHRA Report as follows:

1) The OU-1 soil BHRA data set has been updated resulting from:
    a. Work performed collaboratively by Ramboll and NDEP's consultant, Neptune and Company, Inc. (Neptune), in July 2020 through April 2021 to resolve data inconsistencies between the NDEP/BMI database and the NERT project database;
    b. NERT Site boundary changes because the former Sale Parcels C, D, and H are no longer owned by NERT (since May 2020);
    c. Removal of treatability study data from the BHRA because treatability study results were not collected for site characterization purposes and were not validated to the level required for site characterization and risk assessment by the Quality Assurance Project Plan (QAPP, Ramboll Environ 2017b);

[9] The term "Decision Unit" was used in place of the term "Exposure Unit" in the 2017 interim COPC/DU report.

2) At the July 8, 2020, meeting with NDEP, NDEP consultants, the Trust, and Ramboll, it was agreed that the OU-1 soil BHRA Study Area would be further divided into nine EUs based on spatial risk analysis and current land use to replace the three DUs identified in the January 31, 2020 OU-1 Soil BHRA Report; and the DUE and risk characterization have been conducted for each of the nine EUs;
3) Recalculating the 95% upper confidence limits (UCLs) for COPCs in soil using R codes developed by Neptune instead of the ProUCL software;
4) Adding discussion of uncertainties associated with toxicity values of risk drivers; and
5) Expanding the risk analysis for populations within the BHRA Study Area related to exposures to airborne releases of particulates and vapors from soil in neighboring sites by including soil data from newly identified investigation reports for the Olin Chlor Alkali/Stauffer/Syngenta/ Montrose (OSSM) site and the TIMET site.

NDEP comments on the OU-1 BHRA Report, Revision 1 were received on December 22, 2021 (NDEP 2021). This Revision 2 of the BHRA for OU-1 soils has been prepared to address NDEP comments and is consistent with the agreements reached during a meeting with NDEP and its consultants on January 18, 2022 and the recommendations in a technical memorandum prepared by NDEP's consultant with regard to spatial plots (Neptune 2022). Additional spatial bubble plots have been incorporated in this report to support a better spatial exploration analysis of the soil COPCs identified in this BHRA.

Complete vapor intrusion pathways for volatile organic compounds (VOCs) released from soil gas and groundwater have also been identified in the Operations Area. A separate BHRA report for OU-1 soil gas and groundwater was submitted to NDEP on September 29, 2021 (Ramboll 2021a). A response to comment letter is currently under preparation to respond to NDEP comments received on March 9, 2022, and is anticipated to be submitted in the second quarter of 2022. However, there are no anticipated changes in the health risk estimates for the vapor intrusion pathway from soil gas and groundwater in OU-1, and the cumulative risks associated with potential exposures to chemicals in soil and to VOCs in air resulting from vapor intrusion are presented in this OU-1 Soil BHRA report, Revision 2.

Complete direct contact pathways were not identified for groundwater, which is not used as a source of drinking water in OU-1. Leaching of soil contaminants to groundwater is being addressed as a separate evaluation within the RI Report for OU-1 and OU-2 (Ramboll 2021b).

Currently, the NERT RI Study Area collectively consists of multiple study areas (Figure 1-2). These include the original NERT RI Study Area which consisted of the NERT Site Study Area[10] and the NERT Off-Site Study Area, as established in 2012. The Downgradient Study Area was added in 2015. The Eastside Study Area, which consists of the Eastside Sub-Area and the Northeast Sub-Area was established in 2016. In 2017, the RI Study Area was divided into three OUs via the RI/FS Work Plan Addendum, Phase 3 RI, Revision 1 (Ramboll Environ 2017c) which was subsequently approved by NDEP on October 27, 2017. Separate

[10] The original "NERT Site Study Area" area was established as part of the original NERT RI/FS Work Plan in 2012 where it was referred to as simply the "NERT Site." The NERT Site Study Area is identical to the OU-1 area, includes Sale Parcels C, D, and H, and refers to the property owned by the Trust after February 14, 2011 and prior to May 8, 2020.

BHRA reports are being prepared for Operable Unit 2 (OU-2) and Operable Unit 3 (OU-3) (Figure 1-2). The OU-2 BHRA (Ramboll 2021c) addressed the potential risks associated with the vapor intrusion pathway for volatile compounds released from soil gas and shallow groundwater in the NERT Off-Site Study Area component of OU-2 west of Pabco Road and was submitted to NDEP on July 23, 2021. The forthcoming OU-3 BHRA will address the potential health risks associated with the direct contact and vapor intrusion pathways due to potential migration of contaminants present in groundwater from OU-1. The BHRA Work Plan for OU-3 (Ramboll 2022a) was submitted to NDEP on February 28, 2022 and is currently under NDEP review.

1.2 Report Organization

The following elements are included in the remainder of this report:

- Section 2 provides an overview of OU-1, including background, climate, and geologic and hydrogeological setting.
- Section 3 summarizes soil investigations and soil removal actions conducted in the Operations Area from 2006 through 2018.
- Section 4 identifies the sources of soil analytical data available for the BHRA and presents the DUE, including the data analysis step of the DUE.
- Section 5 presents the methodology and results of COPC identification.
- Section 6 discusses how the EUs were determined and the results of EU-specific DUEs and COPC identifications.
- Section 7 describes the exposure assessment.
- Section 8 provides the toxicity assessment.
- Section 9 discusses the methodology and results of risk characterization.
- Section 10 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 11 provides the data quality assessment.
- Section 12 presents the cumulative cancer risks and noncancer hazards.
- Section 13 summarizes the BHRA and presents conclusions regarding current conditions within the BHRA Study Area.
- Section 14 lists the references cited in this report.

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

2. OVERVIEW

The following sections provide an overview of the background, climate, geologic, and hydrogeological setting in OU-1. Additional details are provided in the RI/FS Work Plan (ENVIRON 2014a) and the RI Report for OU-1 and OU-2 (Ramboll 2021b).

2.1 Background

The 346-acre OU-1 is located approximately 13 miles southeast of the City of Las Vegas in an unincorporated area of Clark County, Nevada, within Sections 12 and 13 of Township 22 S, Range 62 E (Figures 1-1 and 1-2). OU-1 is located within the BMI complex, which consists of several facilities that are owned and/or operated by various entities. The City of Henderson surrounds the BMI complex, which consists of several facilities that are owned and/or operated by various entities (Figure 2-1). Prior to May 2020, OU-1 was designated as property owned by NERT, which was also referred to as the NERT Site, consisting of the Operations Area and six sale parcels (Sale Parcels C, D, E, F, G, and H). Since May 2020, three parcels (former Sale Parcels C, D, and H) are no longer owned by NERT, which reduced the NERT Site to the Operations Area plus three remaining sale parcels (Parcels E, F, and G), while OU-1 remains the same in size, consisting of the NERT Site as well as Parcels C, D, and H (Figure 1-3). EMD currently leases a portion of the Operations Area from the Trust, on which it operates a chemical manufacturing facility.

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

OU-1 has been the subject of extensive environmental investigations and removal actions since the 1970s. In 1994, NDEP issued a Letter of Understanding (LOU) identifying 70 specific areas or items of interest[11] at the Site and the level of environmental investigation required for each LOU (NDEP 1994). The locations of LOUs at the Site are shown in Figure 2-2. In 2005, a Conceptual Site Model (CSM) Report (2005 CSM Report) was prepared for the Site, which was the first comprehensive effort to integrate information from the soil and groundwater investigations conducted to date in order to document information on Site-specific sources, release mechanisms, transport pathways, exposure routes, and potentially exposed populations (ENSR Corporation [ENSR] 2005). Historical Site investigations conducted since completion of the 2005 CSM Report include primarily the Phase A and Phase B Source Area Investigations (Phase A and Phase B Investigations), which were designed to further characterize soil, groundwater, and soil gas across the Site, as described in the RI/FS Work Plan (ENVIRON 2014a) and the RI Report for OU-1 and OU-2 (Ramboll

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

2021b). Tronox continued field investigation and remediation efforts at the Site until February 13, 2011. On February 14, 2011, the Trust took title to the Site and entered into an Interim Consent Agreement with NDEP. The soil investigations conducted at the Site since the formation of the Trust include primarily the Phase 1 RI, the Phase 2 RI, and the Unit 4 and 5 Buildings Investigation. Section 3 provides details about the soil investigations and soil removal actions conducted historically by other parties and more recently by the Trust within OU-1.

2.2 Climate

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

2.3 Geologic and Hydrogeological Setting

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

OU-1 is located on Quaternary alluvial deposits (Qal) that slope north towards Las Vegas Wash. The thickness of the alluvial deposits ranges from less than 20 feet to more than 50 feet beneath OU-1. Soil types identified in soil borings within OU-1 include poorly sorted gravel, silty gravel, poorly sorted sand, well sorted sand, and silty sand (ENSR 2005). The Upper Muddy Creek Formation (UMCf) of Tertiary age occurs in the Las Vegas Valley as valley-fill deposits that are coarse-grained near mountain fronts and become progressively finer-grained toward the center of the valley. Where encountered beneath the Site, the UMCf is composed of at least two thicker units of fine-grained sediments of clay and silt (the first and second fine-grained facies, respectively) interbedded with at least two thinner units of coarse-grained sediments of sand, silt, and gravel (the first and second coarse-grained facies, respectively) (Ramboll 2021b).

Across OU-1, the depth to groundwater ranges from approximately 20 to 60 feet below ground surface (bgs), with the majority of the samples between 30 and 45 feet bgs. Groundwater is generally deepest in the southernmost portion of the Site. The groundwater flow direction at the Site is generally north to north-northwesterly, whereas north of the Site, the direction changes slightly to the north-northeast (ENVIRON 2014a, Ramboll 2021b).

A major feature of the alluvial deposits is the stream-deposited sands and gravels that were laid down within paleochannels that were eroded into the surface of the UMCf during infrequent flood runoff periods. These deposits are thickest within the paleochannel boundaries, which are narrow and linear and trend northeastward. As described in the RI Report for OU-1 and OU-2, the paleochannels act as preferential pathways for groundwater flow, which significantly influence the chemical distribution in the alluvium (Ramboll 2021b). Additional details on the regional and local geology and hydrogeology, including information on the water-bearing zones, are provided in the RI/FS Work Plan (ENVIRON 2014a) and the RI Report for OU-1 and OU-2 (Ramboll 2021b).

3. SOIL INVESTIGATIONS AND REMOVAL ACTIONS

The following sections summarize soil investigations and soil removal actions conducted within the Operations Area (including the BHRA Study Area) of OU-1 since the 2005 CSM (ENSR 2005). These investigations include historical investigations and removal actions (i.e., those conducted before the formation of the Trust) as well as activities conducted within the Operations Area as part of the RI. The soil samples collected during these investigations provide the soil analytical data for this BHRA. The soil data from treatability studies are not included in the BHRA because treatability study results were not collected for site characterization purposes and were not validated to the level required for site characterization and risk assessment by the QAPP (Ramboll Environ 2017b). The uncertainties associated with excluding the soil data from treatability studies are further discussed in Section 10.1.1.

3.1 Historical Soil Investigations and Removal Actions

The following sections describe the historical soil investigations and soil removal actions conducted prior to the NERT RI. Soil data from historical soil investigations remaining at 0-10 feet bgs after soil removal actions within the BHRA Study Area are included in the soil BHRA data set.

3.1.1 Historical Soil Investigations

In 2005, a CSM report (ENSR 2005) was prepared for OU-1 that integrated information from soil and groundwater investigations conducted prior to 2005 to document information on sources, release mechanisms, transport pathways, exposure routes, and potential receptors. Historical investigations conducted in OU-1 since completion of the 2005 CSM Report include the Phase A and Phase B Investigations, which were designed to further characterize soil, groundwater, and soil gas across OU-1 (ENSR 2006, 2007a, 2008a, AECOM, Inc. [AECOM] 2008).

The objectives of the Phase A Investigation were to refine the 2005 CSM, further characterize conditions in OU-1, and provide data for future risk assessments. To identify and characterize the distribution of site-related chemicals (SRCs) in soils, the investigation focused on soil conditions associated with the 192 SRCs identified in the 2005 CSM Report and their suspected source areas. A total of 127 soil samples were collected in November and December 2006 from 27 suspected source area locations. The sample locations were selected based on results of past investigations, as presented in the CSM report (ENSR 2005), information on chemical use in OU-1, and the 70 LOU study areas identified by NDEP in 1994 (NDEP 1994). In addition to the 192 SRCs previously identified, 44 additional constituents were analyzed for and reported by the laboratory (ENSR 2007a).

During the Phase A Investigation, soil samples were collected at depths of 0.5 to 1 foot and at 10 feet intervals thereafter, until groundwater was encountered (ENSR 2006). The samples were analyzed for metals; VOCs, including fuel oxygenates; semivolatile organic compounds (SVOCs); polychlorinated biphenyls (PCBs); dioxins and furans; total petroleum hydrocarbons (TPH as gasoline, diesel, and oil range organics); organochlorine herbicides (OCHs); organochlorine pesticides (OCPs); and organophosphate pesticides (OPPs). In addition, analyses were conducted for radionuclides, asbestos (surface soil samples only), and wet chemistry constituents. Not all samples were analyzed for all analytes, and at

some locations, samples were collected at more frequent depth intervals. Samples were also collected from a manganese ore and tailings stockpile located at the time north of the Leach Plant in OU-1 (Figure 1-4) for analysis of metals and radionuclides.

Considering the results of the Phase A Investigation, the objective of the Phase B Investigation was to further characterize and evaluate the LOUs in the Operations Area and evaluate their potential impact on soils. Samples were collected at initial soil depths of 0.5 and 10 feet bgs, at the capillary fringe, and at the midpoint between 10 feet bgs and the capillary fringe, without exceeding 20 feet between each vertical sample. Judgmental samples were collected at 0.5 and 10 feet bgs in locations where certain surface features were noted, e.g., minor stains or above-ground pipelines. Soil samples were analyzed for the following analytical groups and analytes: metals (including hexavalent chromium), VOCs, SVOCs, organic acids, PCB Aroclors and congeners, dioxins/furans, OCPs, OPPs, TPH, chlorate, perchlorate, cyanide, formaldehyde, and radionuclides. In addition, surface samples were collected from 0 to 2 inches and analyzed for asbestos fibers. Samples for wet chemistry and geotechnical parameters were also collected (AECOM 2008).

Supplemental sampling of soils for the Phase B Investigation was conducted in December 2009 in accordance with two Tronox memoranda entitled Scope for Additional Sampling of Area I (Northgate Environmental Management, Inc. [Northgate] 2009a) and Scope for Additional Sampling of Area II (Northgate 2009b). A total of 129 soil samples were collected at or near Phase B Investigation locations where reported concentrations of constituents exceeded NDEP BCLs. The purpose of the sampling was to fill remaining data gaps in the pre-excavation data and to provide additional information for excavation planning.

3.1.2 Soil Removal Actions

This section discusses multiple soil removal actions conducted in OU-1 prior to the NERT RI. Soil data at 0-10 feet bgs within the BHRA Study Area from the pre-confirmation and confirmation sampling events that have not been excavated are included in the soil BHRA data set.

Soil removal actions were conducted in 2010 and 2011 in response to a 2009 order issued by NDEP to Tronox to remove impacted soil from OU-1 to minimize potential health risks associated with the continued presence of contaminated soil (NDEP 2009a). The Phase A and B investigations identified a number of contaminants within the upper 10 feet of soil with reported concentrations greater than NDEP worker BCLs or modified risk-based goals (as agreed upon by NDEP). These constituents included metals; SVOCs (including hexachlorobenzene); PCBs; OCPs; dioxins/furans; asbestos; and perchlorate. Based on the investigation findings, a detailed scope of work for soil removal was developed, as presented in the *Removal Action Work Plan for Phase B Soil Remediation of Remediation Zones RZ-B through RZ-E* (the RAW) (Northgate 2010a), which included a strategy for excavating accessible impacted soil within the upper 10-foot bgs horizon in contaminated portions of OU-1.

For purposes of soil excavation activities, the Operations Area was divided into five RZs based roughly on geographic groupings of elevated detections and CSM considerations (Northgate 2010b), as follows:

- RZ-A: area in the southern portion of OU-1;
- RZ-B: area around the Unit Buildings;
- RZ-C: ammonium perchlorate (AP) production area, Koch Materials area, pond and diesel storage tank area, and manganese tailings stockpile;
- RZ-D: former Trade Effluent Ponds and AP pad/drum recycling area (including the former hazardous waste landfill); and
- RZ-E: Beta Ditch.

For RZ-A, the results of an HRA for soils (Northgate 2010c) indicated that exposures to residual chemicals in the upper 10 feet of soil were below NDEP's point of departure for cancer risks and noncancer effects. Specifically, the estimated cancer risks were less than one-in-a-million (1×10^{-6}) for indoor commercial workers, outdoor commercial/industrial workers, and construction workers, and the noncancer hazard indices (HIs) were less than one. The upper-bound risks of death from lung cancer or mesothelioma for asbestos exposures to outdoor commercial/industrial workers were less than or equal to 1×10^{-6} for long chrysotile and amphibole fibers. The best estimate and upper-bound risk estimate for construction workers were less than or equal to 1×10^{-6} for long chrysotile fibers and ranged from zero to 6×10^{-5} for long amphibole fibers. Based on the HRA results, NDEP concurred with Northgate (NDEP 2010a) and RZ-A was not included in the soil removal action.

For RZ-B through RZ-E, Voronoi/Thiessen polygons were generated to define areas of impacted or contaminated soils (Northgate 2010a). The Northgate RAW defined contaminated soil as areas with concentrations exceeding worker BCLs or other NDEP-approved concentrations. The remediation strategy consisted of: 1) excavation of soils within designated polygons; 2) sampling of discolored soil; 3) removal of discolored soil where contaminant concentrations were above BCLs or otherwise deemed appropriate to remove; and 4) designation of ECAs for physical obstructions and/or inaccessible areas, including certain areas with contaminants above BCLs and/or discolored soil left in place.

To further define the areas for excavation (i.e., the polygons), pre-confirmation sampling was conducted from April to November 2010 in accordance with a pre-confirmation sampling work plan (Northgate 2010b). Borings were advanced during the pre-confirmation sampling program, as follows: 1) 84 borings at existing locations (adjacent to Phase A and B investigation sampling locations); and 2) 91 borings at new locations. Data from existing locations were used to establish polygon depths, while data from new locations were used to define the horizontal and vertical extent of excavation of near-surface soils (i.e., 0 to 10 feet bgs soils).

Discolored soil was encountered in various locations during removal activities. Some areas of discolored soil were removed, taking into consideration: 1) the location of the discolored soil; 2) available analytical results from adjacent or nearby areas; 3) the anticipated extent of discolored soil; and 4) the excavation activities currently in progress. Other areas of discolored soil were sampled and evaluated to determine if the soil should be removed or could be left in place in accordance with the Work Plan for Evaluation of Discolored Soil and Confirmation Soil Sampling in Visually-Impacted Areas (ENVIRON 2011). Where removal of

discolored soil was conducted, confirmation soil samples were collected to verify that remaining soil concentrations were below BCLs. Typically, if the analytical results indicated that concentrations were above BCLs, additional soil was removed, and additional confirmation soil sampling was performed.

The soil removal action was conducted between August 2010 and November 2011, in which accessible soils with concentrations greater than BCLs were removed down to a maximum depth of 10 feet bgs. An estimated 567,770 cubic yards (cy) of contaminated soil (not including asbestos-containing material [ACM]) were removed during this period. An estimated 11,026 cy of asbestos-containing soil and 1,419 linear feet of ACM piping were also removed and disposed of as part of the soil removal action. Excavated areas were partially backfilled and graded with clean fill from sources within and outside OU-1. The final grading plan included construction of two retention basins: the Central Retention Basin and the Northern Retention Basin (shown in Figure 1-4). Areas with contaminated soils left in place (constituent concentrations greater than BCLs) and/or incompletely characterized soils due to physical obstructions and/or inaccessibility were designated as ECAs. The 38 current ECAs (which are subject to change depending on future investigations and/or future removal actions consistent with the SMP) are listed in Appendix A of the most recent SMP (Ramboll 2020b). Removal activities and post-removal conditions at the Site are described in detail in the Revised Interim Soil Removal Action Completion Report (ENVIRON 2012), which was approved by NDEP on December 17, 2012.

A removal action was also conducted at the manganese tailings stockpile, as presented in the Manganese Tailings Removal Technical Memorandum (Northgate 2012). The manganese tailings stockpile was located in RZ-C, north of the Manganese Leach Plant and south of the Mn-1 Pond (in the current location of the Mn-2 Pond which was constructed in 2013, as shown in Figure 1-4). The area is approximately 8.6 acres and was used from 1975 through 2004 for the disposal of manganese tailings from the leach plant process. Manganese tailings from all former storage locations in OU-1 were consolidated to this location and covered with soil sometime prior to 1985. Since 2004, manganese tailings from Tronox operations (through August 2018) and then from EMD operations (from August 2018 to present) have been shipped to a landfill outside OU-1.

In 2010, a total of 284,232 tons of manganese tailings and minor debris were removed from the manganese tailings stockpile as part of the removal action. The excavation work was conducted in two separate mobilizations: first, 280,572 cy of manganese tailings were removed; then, in accordance with a request from NDEP, a confirmation sampling program was implemented. Based on the results of the confirmation sampling program, which indicated elevated levels of manganese, cobalt, arsenic, and/or asbestos (Northgate 2010a, 2010d), an additional 3,660 cy of shallow soil was removed concurrent with Phase B soil remediation in accordance with the RAW and Appendix A of the Revised Excavation Plan for Phase B Soil Remediation of RZ-C, Addendum to the Remedial Action Work Plan (Northgate 2010d).

One ECA has been remediated since the ECAs were established in 2012. ECA #E3 (Facilities at East End of the Beta Ditch) was remediated with excavation of over 1,100 tons of soil in October 2013, concurrent with TIMET's excavation and grading of their property.

Confirmation soil sample results were collected. The activities are detailed in the Excavation of Beta Ditch at NERT-TIMET Property Line report (ENVIRON 2014c).

3.2 Remedial Investigation

The following sections describe the soil investigations focused on OU-1 that were performed as part of the ongoing NERT RI.

3.2.1 Phase 1 Remedial Investigation

Per the RI/FS Work Plan (ENVIRON 2014a), 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 within OU-1 (previously equal to the NERT Site) and in the NERT Off-Site Study Area (including what is now parts of OU-2 and OU-3).

The Phase 1 RI for soil focused on eight investigation areas (Areas 1 through 8) within OU-1. Soil investigation was performed in Areas 2 through 8 in October through December 2014. Soil samples from Area 1 (which is designated as an ECA, outside the BHRA Study Area) were collected as part of a subsequent RI Modification between December 2018 and March 2019 upon the completion of the AP-5 Pond decommissioning in September 2018.

In Areas 2 through 8, approximately 450 soil samples were collected for chemical analysis. The results of the Phase 1 RI were summarized in the Technical Memorandum, Remedial Investigation Data Evaluation (the "RI Tech Memo"; Ramboll Environ 2016b). Data gaps to be addressed in the Phase 2 RI were identified in the same submittal.

Soil data at 0-10 feet bgs within the BHRA Study Area from the Phase 1 RI are included in the soil BHRA data set.

3.2.2 Phase 2 Remedial Investigation

In accordance with the RI Tech Memo (Ramboll Environ 2016b), the Trust implemented a Phase 2 RI from February to November 2017.[12] Field work was conducted both within OU-1 and within the NERT Off-Site Study Area (including what is now parts 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 to address any remaining data gaps identified subsequent to the Phase 1 RI.

Within OU-1, 57 borings were installed as part of the Phase 2 RI throughout the Operations Area, from just north of the Unit Buildings to the northern boundary of the Operations Area. Approximately 957 soil samples were collected for chemical analysis.

Soil data at 0-10 feet bgs within the BHRA Study Area from the Phase 2 RI are included in the soil BHRA data set.

[12] Fifteen Phase 2 RI Modifications were also conducted from April 2017 to April 2019; however, there were no soil data at 0-10 feet bgs within the BHRA Study Area from these Phase 2 RI modifications that are included in the soil BHRA data set.

3.2.3 Phase 3 Remedial Investigation

As discussed in the RI/FS Work Plan Addendum: Phase 3 RI, Revision 1 (Ramboll Environ 2017c), the Trust implemented a Phase 3 RI from December 2017[13] to November 2018[14] 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 perchlorate and chlorate migrating from OU-1 to the Eastside Study Area via the Beta Ditch. The Eastside Study Area is sub-divided into the Eastside Sub-Area (located in OU-2) and the Northeast Sub-Area (located in OU-3). 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 results of Phase 1, Phase 2, and Phase 3 RI (including various RI Modifications), along with the results of the Unit 4 and 5 Buildings Investigation (see Section 3.2.4 below), were incorporated into the RI Report for OU-1 and OU-2 (Ramboll 2021b), and relevant results will be incorporated into a subsequent RI Report for OU-3.

No Phase 3 RI soil samples were collected within the BHRA Study Area and, therefore, this investigation is not a data source for the BHRA.

3.2.4 Unit 4 and 5 Buildings Investigation

As part of the RI/FS, the Unit 4 and 5 Buildings Investigation Work Plan (Tetra Tech 2015) was submitted to NDEP on March 30, 2015, and approved by NDEP on April 13, 2015. The work plan documented the proposed environmental investigation in the area of the Unit 4 and 5 Buildings to determine the nature of contamination and the vertical extent of impacted soil and groundwater underneath the Unit 4 and 5 Buildings. The work plan replaced Section 5.4.1.2 of the RI/FS Work Plan and included demolition of the Unit 4 Building floor, construction of an access ramp, and an environmental investigation using conventional drilling techniques on the basement level of the building. The work was divided into three field mobilizations and subsequent reporting, as summarized below.

First Field Mobilization

Field work for the first mobilization was conducted in late 2015 and included advancing four borings near the four exterior corners of the Unit 4 Building cell floor and collecting soil samples and discrete-depth groundwater samples from each borehole. The objective of the first mobilization was to obtain preliminary lithologic and analytical data that would be used as a baseline to direct and refine the scope of work for the second field mobilization.

Results of the first field mobilization are summarized in the Technical Memorandum: Unit 4 and 5 Buildings Investigation First Mobilization (Tetra Tech 2016a), which was submitted to NDEP on May 6, 2016, and approved on June 28, 2016 following submittal of a response to NDEP comments on June 24, 2016 (Tetra Tech 2016b). Soil samples were collected from

[13] Prior to the start of the Phase 3 RI, well inspections were performed as part of Phase 3 RI Modification No. 1 beginning in August 2017.

[14] Additionally, 13 Phase 3 RI Modifications (to date) were planned or implemented beginning in December 2017 and are continuing as of the date of this report. None of the Phase 3 RI Modifications involved the collection of soil data within OU-1.

four boreholes outside of the four corners of the Unit 4 Building. Since these soil borings were located within ECA B1, these soil samples are not included in the soil BHRA data set.

Second Field Mobilization

Field work for the second mobilization was conducted from June 2016 to January 2017 and was summarized in the *Technical Memorandum: Unit 4 and 5 Buildings Investigation Second Mobilization* (Tetra Tech 2017a), which was submitted to NDEP on May 4, 2017. NDEP approved this memorandum on June 8, 2017, along with a request for a written response about how their comments on the memorandum will be addressed in the third mobilization or final RI Report. A response to NDEP comments was submitted to NDEP on July 12, 2017 (Tetra Tech 2017b) and approved by NDEP on August 15, 2017.

Sixty-nine boreholes were advanced throughout the investigation area as part of the second field mobilization, including 47 boreholes along five transects, three boreholes in the vicinity of a sump located along the southwest corner of the Unit 4 Building basement, and additional 19 boreholes that were added during the second mobilization to delineate the extent of chemical contamination within the investigation area. Borings were advanced to depths ranging from 90 to 250 feet. Soil and discrete-depth groundwater samples were collected from the borings at selected intervals and analyzed for perchlorate, hexavalent chromium, total chromium, VOCs, total dissolved solids (groundwater only), nitrate and sulfate, and chlorate.

Soil data at 0-10 feet bgs within the BHRA Study Area from the second field mobilization are included in the soil BHRA data set.

Third Field Mobilization

Field work associated with the third mobilization was commenced in August 2017 and completed in December 2017. The third mobilization included advancement of four angled boreholes and installation of 20 groundwater monitoring wells to verify the results obtained from discrete-depth groundwater samples collected from temporary wells (Tetra Tech 2020). However, since the soil samples collected during the third mobilization were either at depths greater than 10 feet bgs or located within an ECA, the data from the third mobilization are not included in the soil BHRA data set.

The results from all three field mobilizations were summarized in the Unit 4 and 5 Buildings Investigation Source Area Characterization Report (Tetra Tech 2020).

3.3 Soil Removal Action of Dioxin-Impacted Soil Near GW-11 Pond

During the preparation of the 2017 Interim COPC/DU Report (Ramboll Environ 2017a), a dioxin-impacted area was identified through a spatial risk analysis near the southwest corner of the GW-11 Pond, with dioxin toxicity equivalent (TEQ) data exceeding the Site-specific action level in one soil sample (SSAK5-03) collected at 2.5 feet bgs from the 2010 pre-confirmation sampling event and three soil samples (RISB-50, 51, and 52) collected at 0.5 feet bgs from the Phase 1 RI in 2014.

Pre-excavation sampling activities were conducted in September 2018 in accordance with the *Work Plan and SMP-Required Contingency Plan, Pre-Excavation Sampling for Dioxin Soil*

Remediation (Ramboll 2018) to delineate laterally and vertically the extent of the dioxin-impacted area and inform excavation plans for impacted soils. A total of 16 delineation soil samples (including two field duplicates) were collected at multiple depths between 0.5 and 5 feet bgs at three soil borings along the northwestern boundary of the preliminary excavation area defined by the previously excavated soil polygons, three soil borings co-located with the Phase 1 RI soil sampling locations (RISB-50, 51, and 52), and one soil boring co-located with the 2010 pre-confirmation soil sampling location (SSAK5-03). These delineation samples were analyzed for dioxins/furans. Based on the delineation sampling results, the excavation area was determined to be approximately 0.4 acres with excavation depths ranging from 1.5 to 4 feet bgs, respectively (Ramboll 2019a). The soil removal activities included excavation, soil backfill, compaction, and restoration (Ramboll 2020c).

Ten soil samples, including six delineation samples, one sample collected from the 2010 pre-confirmation sampling event, and three samples collected from the Phase 1 RI in 2014, were collected within the soil excavation area. As these samples have been removed, they are not included in the soil BHRA data set.

4. DATA USABILITY EVALUATION AND DATA ANALYSIS

This section presents the DUE. Section 4.1 presents the first component of the DUE, in which the available soil data 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. Through statistical summaries, background evaluation (for soil metals and radionuclides only), spatial plots, and other exploratory analyses, the data are reviewed relative to our current understanding of the BHRA Study Area (as represented by the CSM) and for possible data gaps.

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 United States Environmental Protection Agency's (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 2010b). 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.

In this section, Criteria I through VI are evaluated for the entire BHRA Study Area and not for the individual EUs. It is noted that the conclusions reached for Criteria I through V for the BHRA Study Area also apply to the individual EUs. Review of the EU-specific data relative to Criterion VI is discussed in Section 6.3.

The soil data set evaluated using the data quality criteria is 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 (Table 4-1) using the worksheet templates provided by NDEP (2010b).

4.1.1 Soil Data Set and Data Processing

The soil BHRA data set comprises the analytical results that remain representative of current conditions within the BHRA Study Area. Specifically, the data set includes samples collected at 0-10 feet bgs[15] as part of the following investigations:

- "Remaining" soil samples[16] collected from the Phase A Investigation in 2006;
- "Remaining" soil samples collected from the Phase B Investigation in 2008 and 2009;
- "Remaining" soil samples collected from the Phase B Supplemental Investigation in 2009;
- "Remaining" pre-confirmation soil samples collected in 2010;
- "Remaining" confirmation soil samples collected in 2011 to inform the soil removal actions;
- Soil samples collected from the Phase 1 RI in 2014;
- Soil samples collected from the Phase 2 RI in 2017;
- Soil samples collected from the Unit 4 and 5 Buildings Investigation in 2016 (second mobilization); and
- "Remaining" pre-excavation dioxin samples collected near the southwest corner of the GW-11 Pond in 2018.

For each soil sample collected from the above investigations, sampling locations were verified relative to current Operations Area, ECA, and sale parcel boundaries. Samples were excluded from the soil BHRA data set if: 1) locations were outside the current boundaries of the BHRA Study Area; 2) the sampling depths were greater than 10 feet bgs; 3) locations were beneath the Mn-2 Pond and currently inaccessible for soil contact; or 4) location and/or depth information were not available. In addition, samples collected at four locations (TSB-GJ-02, TSB-GJ-03, TSB-GJ-04, and TSB-GR-02) previously believed to be in Parcel G, are now considered to be within the BHRA Study Area[17]; these samples are also included in the soil BHRA data set.

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. The following steps of data processing were completed:

- Standardize chemical names and Chemical Abstract Service (CAS) registry numbers;

[15] In this and all remaining sections of the report, the 0 to 10 feet interval refers to the post-excavation soil horizon (i.e., following any excavation, backfilling, and grading) unless otherwise stated.

[16] "Remaining" soil samples refer to soil samples collected in areas that were not excavated during the 2010-2011 soil removal actions or the 2019 dioxin-impacted soil removal action near the GW-11 Pond as described in Section 3 and for which analytical results remain representative of current conditions.

[17] In the January 31, 2020 OU-1 Soil BHRA Report, samples collected at three locations (TSB-GJ-03, TSB-GJ-04, and TSB-GR-02) previously believed to be in Parcel G, were considered to be within the BHRA Study Area. In Revision 1 and 2 of this BHRA, due to the slight changes of Parcel G boundary, samples collected at TSB-GJ-02 are also considered to be within the BHRA Study Area.

- Standardize reporting units, i.e., convert the results of all the analytes except for radionuclides and asbestos to the unit of milligrams per kilogram (mg/kg);
- Standardize analytical method names;
- Standardize sample identification codes;
- Standardize chemical groups to make sure there is only one chemical group associated with each analyte and to facilitate the discussion in the exploratory data analysis (EDA) (Section 4.2) by chemical groups (not analytical groups). For example, chlorate and perchlorate are discussed separately as Chlorine Oxyanions, not together with other inorganics called by the laboratory as "General Chemistry";
- Review the data validation status to ensure the NERT project database has the correct validation status, and unvalidated data are excluded from the BHRA data set;
- 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 benzo(a)pyrene (BaP) in the same sample – one by USEPA Method 8270 and the other by USEPA Method 8270 Selective Ion Monitoring (SIM) – the result used in the BHRA was identified as that from the 8270 SIM analysis because of the greater sensitivity (lower reporting limits) of this method;
- Enter BCLs[18] and confirm that BCLs correspond to the chemical form or species reported. For example, the database compared analytical results for phosphorus with the BCL for white phosphorus. There is no evidence to suggest that white phosphorus is present in BHRA Study Area soils. The most abundant form of phosphorus in soil is orthophosphate. Analytical methods were reviewed to confirm that the analyses were not for white phosphorus; and
- Develop database queries and confirm that queries returned the correct output.

The above steps were necessary due to the approximately 12-year period over which the soil data were collected and the differences in sampling, analysis, and data entry across investigations. This can be understood in the context of soil 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, data validation summary reports (DVSRs), and other supporting documents were reviewed. Data points were considered unusable for risk assessment if information could not be located to confirm and/or correct an identified issue. Soil data excluded from the BHRA data set during data processing are summarized in Appendix A, Table A-1.

To ensure calculation consistency, dioxin TEQs were calculated (or recalculated) using the results for dioxins, furans, and dioxin-like PCBs and the World Health Organization (WHO)

[18] For chemicals with very low toxicity, the health-based BCLs can be greater (less conservative) than the BCLs based on concentration-limit value of 100,000 mg/kg, or one million parts per million (ppm). For health-based considerations for the purpose of the BHRA, the NDEP-calculated health risk-based BCLs from the BCL calculation table (NDEP 2017a) were used instead of the BCLs based on concentration-limit value of 100,000 mg/kg for these chemicals in the DUE evaluations.

toxicity equivalency factors (TEFs) scheme (van den Berg et al. 2006). BaP equivalents (BaPEqs) were also calculated (or recalculated) for the seven carcinogenic polycyclic aromatic hydrocarbons (PAHs) (i.e., BaP, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene) for which USEPA has derived TEFs (USEPA 2021a). Nondetects were addressed using the Kaplan-Meier approach from USEPA's TEQ calculator.[19]

TPH data were excluded from the soil BHRA data set, consistent with NDEP guidance (NDEP 2017a). TPH was evaluated through the indicator chemicals, including benzene, toluene, ethylbenzene, and total xylenes (BTEX); methyl tert-butyl ether (MTBE); and PAHs. Over 550 samples in the BHRA data set were analyzed for PAHs and over 400 samples were analyzed for BTEX and MTBE (Appendix B). These samples provide an adequate data set for evaluating TPH.

The soil BHRA data set, which is presented in Appendix B (Table B-1 for chemical and radionuclide data, Table B-2 for dioxin/furan/dioxin-like PCB and carcinogenic PAH data used for the dioxin TEQ and BaPEq calculations, and Table B-3 for asbestos data), includes 1,285 soil samples collected from 0-10 feet bgs at 504 locations, consisting of 1011 soil samples at 394 locations collected from the historical investigations, 264 soil samples at 107 locations collected from the RI (i.e., Phase 1 RI, Phase 2 RI, and Unit 4 and 5 Buildings Investigation), and 10 soil samples at seven locations collected from the pre-excavation sampling for dioxin near the southwest corner of the GW-11 Pond.

Compared to the OU-1 Soil BHRA Report submitted in January 2020 (Ramboll 2020a), additional soil samples were added to the BHRA data set resulting from the minor changes to the Site and parcel boundaries as well as reconfirmation of soil sample depths after the 2010-2011 soil removal actions, and the soil samples from treatability studies were removed because treatability study results were not collected for site characterization purposes and were not validated to the level required for site characterization and risk assessment by the QAPP (Ramboll Environ 2017b). The soil samples which have been changed in the current BHRA data set are identified in Appendix B, Table B-4.

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

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 BHRA Study Area data collection efforts, as listed in Table 4-1.

4.1.3 Criterion II – Documentation

The objective of the documentation review is to ensure that each analytical result can be associated with a specific sampling location and that the procedures used to collect the samples are appropriate. As part of this DUE step, Ramboll completed a comprehensive review of the soil samples collected and reported in the documents listed under Criterion I

[19] https://www.epa.gov/superfund/risk-assessment-dioxin-superfund-sites#tefsteqs

and/or in the NERT project database. The steps completed during the review are listed in Table 4-1. Figure 4-1 depicts the location of all soil samples included in the BHRA data set; the analytical results for each sample are included in Appendix B.

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 set is described in Table 4-1, which is based on the distribution of sample locations from both historical and recent investigations. Sample coverage is considered adequate for purposes of the BHRA.

The analytical methods used in the BHRA Study Area investigations are described in Table 4-1. The USEPA analytical methods were adequate for characterizing potential contaminants in soils 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 Table 4-1.

During Ramboll's review of the analytical results reported in the NDEP-approved DVSRs for historical investigations before 2011, Ramboll noted that for some samples, nondetect results were reported to the practical quantitation limit (PQL) rather than the SQL. Based on review of the laboratory data packages, the procedure for evaluating these results consisted of the following steps which are consistent with current NDEP guidance on the use of censoring limits (NDEP 2008a).

- If a chemical was detected above the PQL, then the value was reported.
- If the chemical was detected above the SQL, but below the PQL, the value was reported and flagged as a J value.
- If there was no indication that the chemical was detected, it was reported as a non-detect value at the SQL.

In the soil BHRA data set, nondetect results are reported to the SQL whenever it is available; otherwise, nondetect results are reported to the method detection limit (MDL). Only when either a SQL or a MDL is not available, the nondetect results are reported to the PQL.

For some VOC, SVOC, and general chemistry data from the Phase A Investigation, SQLs are only available in hard copy laboratory analytical reports, but not included in either the BMI database or the NERT project database. In this BHRA, risk results were calculated using the PQLs in the NERT project database, and then compared to risk results based on the sample-

independent MDLs in the NERT project database. Discussion of such uncertainties is included in Section 10.1.6.

For analytes where the detection frequency was less than 100%,[20] the SQLs from the BHRA data set were compared to 0.1 times the BCL (0.1×BCL)[21] (NDEP 2017a), or other screening levels described in Section 5.1, to confirm that they were sufficiently low for risk characterization. Table 4-2 presents the results of the SQL evaluation along with the screening levels. Chemicals with SQLs above screening levels are summarized in Table 4-1.

Overall, the SQLs were sufficiently low for risk characterization. The impacts of the few exceptions with SQLs above 0.1xBCL on the overall risk evaluation are further discussed in Section 10.1.2.

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 Table 4-1. 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 usable for risk assessment purposes. These data qualifications are further discussed below as a component of Criterion VI.

4.1.7 Criterion VI – Data Quality Indicators

The project QAPPs (ENSR 2008b, AECOM and Northgate 2009, ENVIRON 2014d, Ramboll Environ 2017b) identified five data quality indicators (DQIs) to ensure that the overall quality of the data is sufficient to support the risk assessment, as follows: completeness, comparability, representativeness, precision, and accuracy. The DQIs provide quantitative and qualitative measures for evaluating the risk assessment data as they relate to uncertainties in the selection of COPCs, characterization of EPCs, and risk descriptors used in support of the BHRA and the risk management decisions that will be made for the BHRA Study 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.

As discussed previously in Section 3.1.2, soil removal actions were conducted in the Operations Area in 2010 and 2011 to minimize potential health risks associated with the continued presence of contaminated soil. Areas designated for removal were identified based on the results of the Phase A and B investigations, pre-confirmation sampling, and supplemental sampling conducted to provide additional information for excavation planning. Approximately 570,000 cy of soil and 284,000 tons of manganese tailings were removed (ENVIRON 2012, Northgate 2012). Additionally, in October 2013, over 1,100 tons of soil were excavated in ECA #E3 (Facilities at East End of the Beta Ditch) (ENVIRON 2014c). Over 1,100 individual samples were marked as "removed" in the project database. Also, as discussed in Section 3.3, soil excavation was conducted near the southwest corner of the

[20] Based on NDEP (2008a), the uncensored data for radionuclides were used in the BHRA; therefore, the detection frequency for radionuclides is 100% and radionuclide data are not included in the SQL evaluation.
[21] The lower of the indoor and outdoor commercial/industrial worker BCL was used for the comparison.

GW-11 Pond in April 2019 to remove dioxin-impacted soils in this area. The area designated for soil excavation was identified based on the dioxin TEQ results of the pre-confirmation sampling and Phase 1 RI, as well as supplemental delineation sampling conducted to provide additional information for excavation planning. Over 2,700 tons of soil were removed as part of this action (Ramboll 2020c). Ten soil samples fall within the excavation area and are considered removed samples. As noted in Section 4.1.1, the removed soil samples are not included in the BHRA data set.

The DQI evaluation is presented in Table 4-1. 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 Table 4-1 and listed in Appendix A, Table A-2, all data are deemed to be usable for risk assessment purposes.

4.2 Data Analysis

As described in NDEP guidance (NDEP 2010b), 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 EDA steps, as described in the following sections, include 1) preparation of summary statistics for the BHRA data set (Section 4.2.1), 2) evaluation of background conditions for metals and radionuclides (Section 4.2.2), and 3) preparation and review of spatial plots for detected analytes (Section 4.2.3). Section 4.2.4 discusses the results of the EDA in comparison with the OU-1 CSM.

4.2.1 Summary Statistics

This section presents summary statistics for the entire BHRA Study Area. Summary statistics for individual EUs are presented in Section 6.4.

Summary statistics for analytical data collected from the shallow soils (i.e., sample locations currently located between 0 and 10 feet bgs) are presented as follows:

- Table 4-3 – Soil sampling results for asbestos (long amphibole and chrysotile fibers);
- Table 4-4 – Summary statistics for chlorine oxyanions, metals, other inorganics, and radionuclides; and
- Table 4-5 – Summary statistics for organic compounds including dioxin TEQs and BaPEqs.

Tables 4-4 and 4-5 include analytes detected in one or more soil samples; Appendix C presents summary statistics for all analytes (i.e., detected analytes and analytes reported at less than the SQL in all samples). Individual sample locations are shown in Figure 4-1. In developing the summary statistics, soil samples with primary and field duplicate results were treated as independent samples. The effects of duplicate treatment on the overall risk evaluation are further discussed in Section 10.1.7.

For most analytes, the summary statistics are based on the results of between 100 and 800 samples, although for some analytes the analytical data set is much more limited (<20 samples). However, the analytes with limited sample size were never detected (e.g., chlorite, some pesticides, SVOCs, and VOCs) and/or were not NERT COPCs as provided in

the RI Report for OU-1 and OU-2 (Ramboll 2021b) (e.g., lithium, chlorite, fluoride, and some SVOCs and VOCs). Therefore, the limited sample size for these analytes does not have any impact on the overall risk evaluation.

Considering the data validation conducted by Ramboll and DVSRs reviewed and approved by NDEP for each soil investigation, and based on the DUE discussed in Section 4.1, the OU-1 soil BHRA data set is considered adequate for risk assessment purposes.

Table 4-3 presents the soil data summary results for asbestos (long amphibole and chrysotile fibers). Results are reported in terms of the number of long fibers (i.e., >10 micrometer [µm] long and <0.4 µm wide) observed in the sample. As shown in Table 4-3, one or more long amphibole fibers were observed in four out of 134 samples in the BHRA Study Area, and one or more long chrysotile fibers were observed in 27 out of 134 samples in the BHRA Study Area.

4.2.2 Background Evaluation

To support the EDA, a background evaluation was first conducted for the entire BHRA Study Area. A separate background evaluation was conducted for each EU to identify EU-specific metal and radionuclide COPCs (see Section 6.4).

As identified in the NDEP-approved BHRA Work Plan, analytical results for 0 to 10 feet soil samples within RZ-A were used as the background data set for metals (ENVIRON 2014b).[22] A detailed discussion of this data set is presented in the Revised Technical Leaching Memorandum (Northgate 2010e). In summary, 31 soil samples, including three field duplicates, were collected from 14 borings[23] within RZ-A during the Phase B Investigation; 16 of these samples were collected between 0 and 2 feet bgs and 15 samples were collected between 10 and 11.5 feet bgs. Consistent with the background evaluation conducted for the Parcels Soil HRA (Northgate 2014), one Phase A boring location (SA02) and five Phase B boring locations (RSAU4, RSAU5, SA28, SA146, and SA147) within LOU 62 (former State Industries, Inc. operational area and boron source area) were excluded from the RZ-A background data set due to elevated concentrations of boron and other metals (arsenic, chromium, cobalt, iron, molybdenum, nickel, platinum, and sodium).[24]

The RZ-A samples identified for the metals background evaluation are also used for the radionuclide background evaluation for the entire BHRA Study Area. The NDEP-approved BHRA Work Plan (ENVIRON 2014b) states that the McCullough background data set presented in the *Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity* (BRC and TIMET 2007) would be used for the radionuclide background evaluation. However, in comments on the Parcels Soil HRA (NDEP 2015a), NDEP clarified that the RZ-A data set (and not the McCullough data) should also be used for the

[22] As noted in the BHRA Work Plan, NDEP investigated the differences observed in metals concentrations among available BMI background data sets and determined that the RZ-A data set was appropriate for statistical background analysis of metals at the Tronox facility (presently OU-1) (NDEP 2010c).

[23] As shown on Appendix D, Figure D-1, RSAT7, RSAT8, and RSAS6 are located outside the boundaries of RZ-A and OU-1. These three samples outside OU-1 are retained in the background data set.

[24] Although metals concentrations in these samples were elevated relative to background, the results of the RZ-A HRA indicated that exposures to residual chemicals in the upper 10 feet of soil were below risk levels of concern (see Section 3.1.2).

radionuclides. The RZ-A data set used for the background evaluation of both metals and radionuclides and the background sample locations are included in Appendix D.

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

Box plots provide a visual comparison between the BHRA Study Area and background data. For each data set, the "box" in the box-and-whisker plot encompasses the central 50 percent of the results (i.e., the results from the 25th to 75th percentiles, or equivalently, between quartile 1 [Q1] and quartile 3 [Q3]). Substantial overlap between the boxes for background and BHRA Study Area data indicates that the BHRA Study Area data may not be significantly different from background. The whiskers demarcate one "step" above the 75th percentile and one "step" below the 25th percentile. One "step" is defined as 1.5 times the interquartile range (IQR, the difference between the 75th and 25th percentiles). Data points above and below the whiskers are considered potential outliers from the distribution and are shown on the plots as open circles for non-detected values and as crosses for detected values. As used here, "outliers" may indicate potential areas of high concentrations for spatial analysis.

The computer statistical software program R was used to perform all statistical tests, and a copy of the R codes used in the background evaluation is presented in Appendix E.[25] Specifically, statistical background comparisons were performed using the t-test, Gehan test, Quantile test, and Slippage test. This suite of tests is sometimes referred to as "Gilbert's Toolbox." The t-test is a parametric test (i.e., an underlying condition is that the data or log-transformed data are normally distributed). In contrast, the Gehan test, Quantile test, and Slippage test are nonparametric, and thus do not require that the data are normally or lognormally distributed (USEPA 2002a, NDEP 2009b). These tests are described below:

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

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

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

the data, which is equivalent to using the Gehan ranking system. The Gehan ranking system is used to rank non-detects with the detected concentrations (NDEP 2009b).

The Quantile test evaluates "tail effects" that are not specifically considered in the Wilcoxon Rank Sum test. The Quantile test looks for differences in the right tails (upper end of the distribution), rather than evaluating central tendency. The Quantile test was performed using a defined quantile of 0.80, consistent with the approach used in the Parcels Soil HRA (Northgate 2014).

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

NDEP guidance (2008b) recommends including field duplicates in a data set when the variance of the duplicates is similar to the variance of the primary samples. As noted in the guidance, field duplicate samples represent a discrete and unique measurement of soil chemical conditions proximal to the primary sample (unlike split samples). For the background evaluation presented in this report, soil samples with primary and field duplicate results were treated as independent samples, consistent with Option 2 in NDEP guidance (NDEP 2008b). The effects of duplicate treatment on the overall risk evaluation are further discussed in Section 10.1.7.

Consistent with NDEP guidance (NDEP 2009b), non-detect results are considered to be censored results at the detection limit for non-parametric tests, which use the Gehan ranking scheme to rank non-detects. For the parametric tests (i.e., t-test), the Gehan ranking scheme cannot be used, and non-detect results are set equal to non-censored results at one half the limit of detection.

The results of all statistical tests included in Gilbert's Toolbox are presented in Appendix E. However, given the large amount of data, the Shapiro-Wilk test is very likely to reject a hypothesis of normality or of any other distribution. On the other hand, t-tests are very robust to deviations from underlying normality assumptions (a large amount of data points causes the mean to be approximately normal). Therefore, the results of the t-tests are not reasonable to use in the background evaluation of a large amount of data. As requested by NDEP (2016), the determination of background consistency was only based on the results of the non-parametric tests.

Metals

The background evaluation for metals in the BHRA Study Area is presented in Appendix E, as follows:

- Table E-1 presents summary statistics for each metal, including the total number of samples, number of detections, percent detections, minimum SQL, maximum SQL, minimum detected value, maximum detected value, median, mean, and standard deviation. Consistent with NDEP guidance (NDEP 2008c), the median, mean, and

standard deviation are calculated based on detected concentrations only. The results of the Shapiro-Wilk test are also presented;

- Table E-2 includes the calculated probability (p-values) for the four statistical tests and the overall determination as to whether BHRA Study Area soil concentrations are greater than background levels (five results are shown in the table because the t-test was performed twice, once on the raw data set and once on the log-transformed data set);
- Figures E1-1 through E1-32 present box plots for background metals in soils and for BHRA Study Area soils (upper 10 feet); and
- Figures E2-1 through E2-32 present normal and lognormal Q-Q plots for background metals in soils and for BHRA Study Area soils (upper 10 feet).

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

Radionuclides

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

- Table E-3 presents summary statistics for each radionuclide, including the total number of samples, number of detections, percent detections, minimum detected value, maximum detected value, median, mean, and standard deviation. Consistent with NDEP guidance (NDEP 2008c), the median, mean, and standard deviation are calculated based on detected concentrations. The results of the Shapiro-Wilk test are also presented;
- Table E-4 includes the p-values for the four statistical tests and the overall determination as to whether BHRA Study Area soil concentrations are greater than background levels (five results are shown in the table because the t-test was performed twice, once on the raw data set and once on the log-transformed data set);
- Tables E-5a and E-5b present the results of the equivalence testing for secular equilibrium of the uranium decay series (U-238 chain) and thorium decay series (Th-232 chain), respectively;
- Table E-6 presents the correlation matrices for the uranium decay series and the thorium decay series;
- Figures E1-33 through E1-40 present the box plots for background radionuclides in soils and for BHRA Study Area soils (upper 10 feet); and
- Figures E2-33 through E2-40 present normal and lognormal Q-Q plots for background radionuclides in soils and for BHRA Study Area soils (upper 10 feet).

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

4.2.3 Spatial Analysis

Spatial quartile plots were prepared for detected chemicals in the BHRA Study Area to illustrate the spatial distribution of the data, identify potential areas of high concentrations, and compare the results to the expectations of the CSM. Each spatial quartile plot presents the following information:

- A grid overlay, using 200 × 200 feet squares;
- Sample locations within the grid;
- Areas occupied by ECAs; and
- Chemical concentrations. The concentration shown in each square is the maximum detected concentration for all samples within the square for soils from 0-10 feet bgs, unless results for all samples within the square were reported as less than the detection limits; concentration bins are defined as follows:
    - Dark green – concentrations < detection limits;
    - Light green – concentrations <Q1;
    - Yellow – concentrations within the IQR;
    - Orange – concentrations >Q3 and <=(Q3 + 1.5×IQR); and
    - Red – concentrations >(Q3 + 1.5×IQR).

Spatial quartile plots are presented for 47 analytes, as follows:

- Chlorine Oxyanions – chlorate and perchlorate;
- Metals – all metal COPCs (identified in Section 5), metals with concentrations greater than background, and specific metals identified as potential contaminants at certain LOUs (with the exception of iron and sodium). Additional metals for which plots were prepared include those commonly associated with industrial operations (e.g., copper);
- Other Inorganics – all other inorganic COPC(s) (identified in Section 5);
- Radionuclides – U-238, Th-232, and U-235 (the parent radionuclides); and
- Organics – all organic COPCs (identified in Section 5) and organic chemicals with a detection frequency of five percent or greater (with the exception of common field/laboratory contaminants). In addition, certain organics (e.g., dichlorodiphenyltrichloroethane [DDT]/dichlorodiphenyldichloroethylene [DDE]) were selected for plotting to enable spatial analysis of chemically-related contaminants.

The plots are presented in Appendix F1 (organized alphabetically by chemical name) and discussed in the following section. Spatial concentration plots based on continuous concentrations for the COPCs were also prepared and are presented in Appendix F2 and further discussed in Section 5.4.

4.2.4 Comparison with Conceptual Site Model

Results from the EDA (i.e., summary statistics, background evaluation, and spatial analysis) were used to compare the BHRA data set to the expectations of the OU-1 CSM as summarized in the RI Report for OU-1 and OU-2 (Ramboll 2021b). This section focuses on the comparison of EDA results to the CSM components of historical operations, sources of impacts, and migration and distribution of contaminants in OU-1. The EDA results (including the review of the Appendix F spatial quartile plots) are presented in Table 4-6 for chlorine oxyanions, metals, other inorganics, and radionuclides, and in Table 4-7 for organic compounds.

- **Chlorine Oxyanions.** Chlorate and perchlorate manufacturing operations have been conducted within the BHRA Study Area since approximately 1945 (Ramboll Environ 2016b). These compounds were detected throughout the BHRA Study Area (Appendix F, Figures F1-10 and F1-31), and were identified as NERT COPCs in soil as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b). Although the 2010-2011 removal actions addressed chlorate and perchlorate concentrations greater than the industrial worker BCL in the upper 10 feet of soil (relative to original site grades), localized areas remain in which perchlorate concentrations are above BCLs within 10 feet of the post-removal ground surface, since backfill of excavated areas was not placed to original grade in all locations. The highest concentrations are found in the central portion of the Site, consistent with the former chlorate and perchlorate production activities in this area and the discharge of process streams to the Beta Ditch and surface impoundments.
- **Metals.** The 2011 NDEP Action Memorandum (NDEP 2011) identified "metals" as possible contaminants at LOUs within the BHRA Study Area. Individual metals specifically identified as potential contaminants at certain LOUs within the BHRA Study Area included arsenic, barium, boron, cadmium, chromium (total), hexavalent chromium, cobalt, iron, lead, magnesium, manganese, molybdenum, nickel, platinum, selenium, titanium, tungsten, and zinc. Sodium was also identified, presumably referring to its salts. Individual metals identified as NERT COPCs in soil (Ramboll 2021b) were antimony, arsenic, barium, boron, chromium VI, cobalt, lead, magnesium, manganese, and nickel. Results of the background evaluation of BHRA Study Area metals (Appendix E) show that among the specific metals identified as potential contaminants at certain LOUs, post-removal soil concentrations were greater than background (as compared with the RZ-A background set) for arsenic, barium, chromium (total), cobalt, iron, magnesium, manganese, sodium, and tungsten. Boron, hexavalent chromium, and selenium had low detection frequencies, suggesting that background comparison results may not be applicable. For metals not identified as potential contaminants at certain LOUs, post-removal soil concentrations were greater than background (as compared with the RZ-A background set) for thallium and vanadium. The spatial plot for thallium (Appendix F1, Figure F1-37) and vanadium (Appendix F1, Figure F1-45) shows elevated concentrations in the central and eastern area of the Site, suggesting a possible historical presence along with other metals.
- **Other Inorganics.** This group of inorganic compounds as presented in Table 4-6 includes common industrial chemicals that are used as chemical feedstocks and/or expected to be present in process waste streams. With the exception of nitrate, all

compounds were not identified as NERT COPCs in the Operations Area (Ramboll 2021b). These compounds are generally highly soluble when present as free anions or cations. Many of these compounds are physiological electrolytes and/or occur naturally in foods. Although all of the listed inorganics occur naturally in soil, RZ-A background data sets are not available to conduct a background analysis. At the concentrations detected in soil, these inorganics do not present human health concerns. Generally, these inorganics are of greater concern when detected as contaminants in groundwater than when present at elevated concentrations in soil.

- **Radionuclides.** Radionuclides in the U-238 and Th-232 decay series and for U-235 were included in the OU-1 Soil BHRA data set. Although radionuclides are not known to be associated with any of the former operations identified for the Operations Area and no specific source areas were identified, these naturally-occurring chemicals were included as analytes in the BHRA Study Area soil investigations since Phase A Investigation (listed as SRCs in 2006) and through the Phase 2 RI as described in Section 3. The available radionuclide data were evaluated in the RI, and radionuclides were not identified as NERT COPCs in soil (Ramboll 2021b).
- **Dioxins/Furans.** As shown in Table 4-5, dioxins/furans were detected in 99% of the soil samples collected within the BHRA Study Area. This high detection frequency is not unexpected given that: 1) analytical detection limits are very low (usually less than 0.001 mg/kg); and 2) dioxin/furans are formed during various combustion processes (in the presence of a source of hydrocarbons and chlorine) and are by-products of the production of certain chlorinated chemicals, including pesticides. Dioxins/furans are typically detected in shallow surface soils as a result of airborne deposition. They are extremely persistent in soils and will accumulate over time in the presence of a continuing source. Dioxin-impacted soils with dioxin TEQs exceeding the Site-specific action level (0.0027 mg/kg) were identified and targeted for removal in 2010/2011 and 2018; however, soils with residual concentrations above the Site-specific action level remain. Sixteen dioxins/furans, 2,3,7,8-tetrachlorodibenzo-p-dioxin, 2,3,7,8-tetrachlorodibenzofuran, and 14 dioxin-like PCB congeners, were identified as NERT COPCs in soil (Ramboll 2021b).
- **PAHs.** PAHs are ubiquitous environmental contaminants and formed during incomplete combustion of organic materials. The detection frequencies of PAHs in the BHRA Study Area were generally very low. Three PAHs, 1-methylnapthalene, BaP, and 2-methylnapthalene, were identified as NERT COPCs in soil (Ramboll 2021b).
- **OCPs and Other Organochlorine Compounds.** OCPs and chlorinated by-products of pesticides and other manufacturing processes involving chlorine have been detected in the BHRA Study Area. These chemicals include aldrin, chlordane, DDT, dichlorodiphenyldichloroethane (DDD), and DDE (Appendix F1, Figures F1-17 through F1-18), benzene hexachloride (BHC, also known as hexachlorocyclohexane) (Appendix F1, Figure F1-6), dieldrin (Appendix F1, Figure F1-19), endosulfan, endrin, hexachlorobenzene (Appendix F1, Figure F1-22), methoxychlor, PCBs, and toxaphene (Appendix F1, Figure F1-40) (see above for a separate discussion of dioxins/furans). The detection of these compounds is consistent with former site operations, including the manufacture of chlorobenzenes and DDT by Hardesty/AMECCO from 1945 to 1949 (Kleinfelder 1993, Ramboll Environ 2016b), as

well as the manufacture of chlorinated compounds at the adjacent OSSM site. At the OSSM site, Stauffer produced lindane at the former Lindane Plant from 1946 through 1958, and Montrose produced organic chemicals, including chlorobenzene, PCBs, chloral, and 4,4'-dichlorobenzil from 1947 through 1983. In addition to possible air emissions (and deposition) from these processes, associated wastes streams were conveyed to the former Beta Ditch which then crossed OU-1 between 1971 and 1976 (Ramboll Environ 2016b). Beta-BHC, hexachlorobenzene[26], and PCB Aroclor-1260 were identified as NERT COPCs in soil (Ramboll 2021b).

- **OPPs.** Only two OPPs were detected in the BHRA Study Area with very low detection frequencies (i.e., dimethoate and stirophos). These two OPPs were not listed as NERT COPCs in soil (Ramboll 2021b), and NDEP did not identify these specific pesticides as potential contaminants at any LOUs.
- **SVOCs.** Eight SVOCs were detected in the BHRA Study Area with low detection frequencies, including six phthalates, hexachlorobutadiene, and octachlorostyrene. Phthalates were not listed as NERT COPCs in soil (Ramboll 2021b) and are common field/laboratory contaminants. Hexachlorobutadiene was not listed as a NERT COPC in soil (Ramboll 2021b), although it can be a byproduct of reactions involving chlorine and hydrocarbons. Octachlorostyrene was not listed as a NERT COPC in soil (Ramboll 2021b). It is highly persistent in soil. It is a by-product of many industrial chemical processes, and forms during incineration and combustion processes involving chlorinated compounds.
- **VOCs.** Consistent with results observed in investigations at other industrial facilities within the BMI Complex, a number of VOCs were detected in soils, but at low frequencies (typically less than 3%). The primary exceptions are chloroform (detected in 21% of soil samples, widely present in groundwater beneath the Site and the adjacent OSSM and TIMET sites [Ramboll Environ 2016b, Ramboll 2021b]), formaldehyde (detected in all three samples collected, not a NERT COPC in soil), and certain VOCs that have been identified by USEPA (1989) as "common laboratory contaminants", including acetone, 2-butanone, methylene chloride, and toluene (detection frequencies ranging from 19 to 47%). Only two VOCs (chloroform and methylene chloride) were identified as NERT COPCs in soil (Ramboll 2021b). All the VOCs in OU-1 soil were detected at low concentrations, not indicative of a potential source area.

[26] Hexachlorobenzene was listed as a NERT COPC in soil under the chemical group of SVOCs, not the chemical group of OCPs. It was considered an OCP in this BHRA because the USEPA Method 8081 for OCPs is a more appropriate and specific analytical method for hexachlorobenzene than the USEPA Method 8270 for SVOCs.

5. IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

This BHRA includes the following elements:

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

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

- Exposure Factors Handbook (USEPA 2011);
- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA 2004a);
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002b);
- Soil Screening Guidance for Radionuclides (USEPA 2000);
- Technical Support Document for a Protocol to Assess Asbestos-Related Risk, Final Draft (USEPA 2003);
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009a); and
- User's Guide and Background Technical Document for NDEP BCLs for Human Health for the BMI Complex and Common Areas (NDEP 2017a).

The section presents the methodology and results of COPC identification for the BHRA Study Area. The EU identification, exposure assessment, toxicity assessment, and risk characterization are discussed in Sections 6, 7, 8, and 9, respectively.

Soil COPCs for quantitative evaluation in the BHRA are identified following a two-tiered process. The first tier, presented in this section, is the identification of COPCs for the entire BHRA Study Area based on the following three-step approach:

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

The chemicals that "fail" these steps are retained as COPCs for the BHRA Study Area and those that "pass" are excluded as COPCs,[27] as described in Sections 5.1 through 5.3 and shown in Figure 5-1.

The second tier of the process is division of the BHRA Study Area into EUs using a COPC-specific, risk-based spatial analysis and a series of spatial plots of concentrations, cancer risks, and noncancer HIs, and then the identification of COPCs specific to each EU, which are presented in Section 6.

5.1 Step 1 – Concentration/Toxicity Screen

The concentration/toxicity screen is conducted to identify those chemicals that could contribute significantly to the cancer risk and/or noncancer hazard estimate (i.e., the HI). The BHRA data set identified in Section 4 is the starting point for the concentration/toxicity screen. The screen considers the maximum detected concentrations for all analytes detected in one or more soil samples from the 0 to 10 feet depth interval[28] in the BHRA Study Area and chemical-specific toxicity, as reflected in the BCL (or other criteria established for the Site); specifically, a chemical is excluded as a COPC if the maximum detected concentration is less than or equal to 0.1×BCL. Chemicals that pass this screen for the entire BHRA Study Area are eliminated as COPCs. Chemicals that fail this screen (i.e., are present at concentrations greater than 0.1×BCL) are further screened under Step 2 and/or Step 3.

For most analytes, the BCL used for the concentration/toxicity screen is the minimum of the indoor and outdoor commercial/industrial worker BCL (NDEP 2017a). Because BCLs have not been established for all BHRA Study Area analytes, surrogate values were identified where possible. Surrogates and other chemical-specific exceptions, as well as the results of the screen, are presented in Table 5-1 and discussed as below.

Surrogates

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

[27] The three screening steps are consistent with the COPC identification steps outlined in the BHRA Work Plan (ENVIRON 2014b). However, as agreed upon by NDEP (Ramboll Environ 2015b), the order of the steps has been changed.

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

Analyte	Surrogate
Acenaphthylene	Acenaphthene
gamma-Chlordane	Chlordane
Cyanide (total)	Free cyanide (CN-)
Chromium (total)	Chromium III
2,4'-DDE	4,4'-DDE
Endosulfan I	Endosulfan
Endosulfan sulfate	Endosulfan
Endrin ketone	Endrin
Ethyl tert-butyl ether	Methyl tert-butyl ether
ortho-Phosphate	Phosphoric acid
Phosphorus (total)	Phosphoric acid

Surrogates were identified for all but eight analytes (calcium, palladium, potassium, silicon, sodium, sulfate, sulfur, and octachlorostyrene). By default, these analytes are carried forward to Step 2 (metals) and Step 3 (all other analytes) of the COPC selection process.

Chemicals with Non-Health Based BCLs

In general, the BCLs listed in the BCL table are health-based. However, for soil BCLs, there are two exceptions as follows (NDEP 2017a):

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

For the concentration/toxicity screening, the health-based BCLS for commercial/industrial workers are used (NDEP 2017a). The chemicals for which health-based BCLs are used in place of non-health based BCLs are identified in Table 5-1.

Arsenic, Dioxin TEQs, and Lead

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

- For arsenic, the maximum detected concentration is compared to the Site-specific remediation goal of 7.2 mg/kg (NDEP 2010d), which is the maximum arsenic concentration reported for the BRC/TIMET background data set (BRC and TIMET 2007); arsenic would be eliminated as a COPC if the maximum concentration is less than or equal to this screening value.

- For dioxin TEQs, the maximum detected value is compared to the Site-specific action level of 0.0027 mg/kg; this value was derived based on an *in vitro* soil bioaccessibility study conducted using soils at the NERT Site (Northgate 2010f); NDEP approved this value based on the information presented in the study (NDEP 2010d).

USEPA has not established toxicity values (i.e., a cancer slope factor [CSF] or reference dose [RfD]) for lead (USEPA 2021a). Instead, USEPA used a blood-lead model to establish a regional screening level (RSL) of 800 mg/kg, which NDEP has adopted as the BCL for commercial/industrial workers. Because the health endpoint for lead (i.e., a blood lead concentration) is not cancer risk or noncancer hazard quotient (HQ), the maximum detected concentration is compared directly to the commercial/industrial worker BCL of 800 mg/kg, and not to 0.1×BCL.

Asbestos

BCLs have not been established for asbestos (long amphibole and chrysotile fibers). Exposure and risk assessments for asbestos are highly dependent on sample size. Even for the case where fibers are not identified (i.e., zero fibers), upper-bound cancer risk estimates can be greater than 1×10^{-6}, depending on sample size. For these reasons, long amphibole and chrysotile fibers are retained as COPCs per NDEP guidance (Neptune 2015).

Results of Concentration/Toxicity Screen

The concentration/toxicity screen is presented in Table 5-1. For each listed chemical, the maximum detected concentration and the BCL (or other screening value) are presented. The final column indicates whether the chemical "passed" or "failed" the screen or did not have a screening level. Of the 137 detected analytes listed in Table 5-1, 102 chemicals passed, 27 chemicals failed based on the comparison against BCL (or other screening criteria), and eight chemicals did not have a screening level. Chemicals that "failed" or that did not have a screening level are carried forward to Steps 2 and/or 3 (as indicated with blue highlighting in Table 5-1).

5.2 Step 2 – Background Evaluation

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

The metals and radionuclides that either failed the concentration/toxicity screen or for which a screening level was not available for screening are listed in Tables 5-2 and 5-3, respectively. The results of the background evaluation presented in Section 4.2.2 and Appendix E are also included in Tables 5-2 and 5-3. Of the 12 metals carried forward from Step 1, two metals (calcium and potassium)[29] were present at concentrations consistent with background and are eliminated as COPCs. Five metals (arsenic, cobalt, manganese,

[29] NDEP (2017a) notes that calcium and potassium are essential nutrients and do not need to be evaluated in a BHRA.

sodium, and thallium) were present at concentrations greater than background, and background data were not available for four metals (palladium, silicon, sulfur, and zirconium). In addition, background comparison results may not be applicable for chromium VI due to low detection frequency (<25%) in both the BHRA Study Area and RZ-A background data sets; however, chromium VI concentrations in the BHRA Study Area were greater than background based on the box plot (Appendix E, Figure E1-10) and the Q-Q plot (Appendix E, Figure E2-10). Therefore, except calcium and potassium, all the other metals are carried forward to Step 3 (as indicated with blue highlighting in Table 5-2).

For radionuclides, as presented in the NDEP flowchart (Appendix G), when approximate secular equilibrium[30] is exhibited in an isotope decay chain, in theory radionuclides in the same decay chain should yield similar background comparison results; therefore, if any radionuclide is greater than background, all the radionuclides in that decay chain would be carried forward in the risk assessment. When approximate secular equilibrium is not exhibited in an isotope decay chain, individual radionuclides that fail the background evaluation would be carried forward in the risk assessment. As indicated in Table 5-3, both the U-238 and Th-232 decay series were found to be in secular equilibrium in the BHRA Study Area, and statistical testing indicated that activities of all the radionuclides were consistent with RZ-A background levels.

However, the validity of the statistical testing is complicated by several issues associated with sample preparation and analytical methods for radionuclides in both the BHRA Study Area and the RZ-A background data sets. Similar issues have previously been identified by NDEP in the radionuclide analytical data sets for soil samples collected across the BMI Complex (NDEP 2009c). RZ-A background samples were collected and analyzed in 2009, while BHRA Study Area samples were collected and analyzed between 2006 and 2017, i.e., both before and after NDEP issued guidance for evaluating radionuclide data (NDEP 2009c). Over this time period, samples were submitted for analysis to different analytical laboratories and analyzed using different preparation and analytical methods. For example, the analytical methods for Ra-228 included both beta spectroscopy and gamma spectroscopy, depending on the laboratory, which may be the reason for the lack of correlation with Ra-228 in the Th-232 decay chain (Appendix E, Table E-6). It was also unexpected that for the RZ-A background data set, the Th-232 decay chain was not in secular equilibrium (Appendix E, Table E-5b).

Given the factors above, the results of background analysis for radionuclides must be interpreted with caution, and it is difficult to consider them as a reliable basis for the COPC selection. Therefore, all radionuclides are retained as COPCs for further EU-specific evaluation in Section 6.

5.3 Step 3 – Chemical-Specific Evaluations

For the final step of COPC identification, chemicals commonly recognized as having low toxicity and for which a BCL was not available (such that a concentration/toxicity screen could not be conducted) were further reviewed. These chemicals are macronutrients and

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

essential micronutrients (i.e., those listed on the Generally Recognized as Safe [GRAS] list developed by the U.S. Food and Drug Administration [FDA][31]), including:

- Silicon (essential nutrient; present in foods, with a typical dietary intake of over 20 mg/day in adults);
- Sodium (essential macronutrient, required in large quantities; high consumption from foods; GRAS); NDEP (2017a) identifies sodium as an element that typically does not need to be included in a risk assessment because of its low toxicity; and
- Sulfur, sulfate (essential macronutrients, required in large quantities; high consumption from foods; GRAS).

Silicon, sodium, sulfur, and sulfate were eliminated as COPCs based on their low toxicity.

5.4 Summary of Chemicals of Potential Concern in BHRA Study Area Soils

The COPCs identified for BHRA Study Area soils are listed in Table 5-4. The 31 COPCs include chlorate and perchlorate, seven metals, ammonia, eight radionuclides (U-238 and Th-232 decay series, and U-235), 11 organic compounds, and two asbestos fibers. For two COPCs (palladium and octachlorostyrene), BCLs (and associated toxicity values) are not available; in the absence of toxicity values, these COPCs were evaluated qualitatively. Also, RZ-A background data are not available for palladium and zirconium and therefore a background evaluation cannot be conducted.

Spatial intensity plots were developed for most COPCs, including chlorate, perchlorate, arsenic, chromium VI, cobalt, manganese, thallium, zirconium, ammonia, U-238, Th-232, and U-235 (the parent radionuclides), dioxin TEQ, BaPEq, naphthalene, beta-BHC, 4,4'-DDE, 4,4'-DDT, dieldrin, hexachlorobenzene, toxaphene, bis(2-ethylhexyl)phthalate, and long amphibole and chrysotile fibers (Figures 5-2 through 5-18).[32] Plots were not prepared for palladium and octachlorostyrene for which BCLs are not available, and their spatial distributions are presented in the spatial quartile plots (Appendix F1, Figures F1-30 and F1-29, respectively).

Each COPC spatial intensity plot presents the following information:

- A grid overlay, using 200×200 feet squares;
- Sample locations within the grid;
- Areas occupied by ECAs; and
- COPC concentrations. The concentration shown in each square is the maximum detected concentration from all samples collected from 0-10 feet deep soil within the square, unless results for all samples within the square were reported as less than

[31] http://www.ecfr.gov/cgi-bin/text-idx?SID=e956d645a8b4e6b3e34e4e5d1b690209&mc=true&node=pt21.3.184&rgn=div5

[32] In addition to the spatial quartile plots discussed in Section 4.2.3 (and included in Appendix F1) as part of the Data Analysis, additional spatial intensity plots were developed for most COPCs. The two sets of plots differ in the concentration bins used for plotting. The concentration bins for the spatial quartile plots are based on quartiles of the data distribution. The concentration bins used for the spatial intensity plots are based on the BCLs or other screening criteria.

the detection limits; concentrations are binned relative to BCLs or other screening criteria, as shown on the individual plots. Results for samples reported as less than the detection limit are colored dark green.

Moreover, consistent with the agreements reached during a meeting with NDEP and its consultants on January 18, 2022 and the recommendations in a technical memorandum prepared by NDEP's consultant with regard to spatial plots (Neptune 2022), spatial bubble plots based on continuous concentrations were also prepared for the same COPCs listed above for spatial intensity plots.[33] Each spatial concentration plot presents the following information:

- Sample locations;
- Chemical concentrations: the concentration shown at each circle is the maximum detected concentration for soils from 0-10 feet bgs at each sample location. If the results for all samples at that location were reported as less than the detection limits, a small white circle is plotted. Otherwise, the size of the circle increases with the maximum detected concentrations; concentrations are screened against the selected BCLs or action levels for concentration/toxicity screen and defined as the following continuous color ramp:
- Blue – concentration <= 0.01 x BCL;
- Green – concentrations = 0.05 x BCL;
- Yellow – concentrations = 0.1 x BCL;
- Orange – concentrations = 0.5 x BCL; and
- Red – concentrations >= BCL.

These spatial concentration plots are presented in Appendix F2 (organized alphabetically by chemical name) and discussed below:

- The maximum concentrations of ammonia, beta-BHC, bis(2-ethylhexyl)phthalate, chlorate, 4,4'-DDE, 4,4'-DDT, dieldrin, naphthalene, thallium, and toxaphene were either below 0.01 x BCLs or reported less than detection limits in the majority of sample locations;
- The maximum concentrations of cobalt were mostly below 0.1 x BCL;
- The maximum concentrations of Th-232, U-235, and zirconium were between 0.1 x BCL and 0.5 BCL in all or the majority of detected sample locations;
- Seven COPCs, including, arsenic, BaPEq, chromium VI, dioxin TEQ, manganese, hexachlorobenzene, and perchlorate exceeded BCLs in different areas of concern and are discussed further below.

[33] Spatial concentration plots were not prepared for the long amphibole and chrysotile fibers due to lack of BCLs or action levels, and for U-238, Th-232, U-235 (the parent radionuclides) and thallium because they are consistent with the background levels (see discussions in Sections 5.2 and 6.4).

Arsenic

As shown on Figure F2-2, the maximum concentrations of arsenic exceeded a maximum BRC/TIMET background level of 7.2 mg/kg at 19 locations, among which three of them were located around the Central Retention Basin, 11 were located in the northern portion of the Operations Area, four were located in the central portion of the Operations Area, and one was located in the southern portion of the Operations Area. Maximum detected concentrations at sample locations in all portions of the Site were mostly reported between the BRC/TIMET background level and 0.5 x the BRC/TIMET background level.

Benzo(a)pyrene (TEQ)

As shown on Figure F2-3, the maximum concentrations of benzo(a)pyrene (TEQ) exceeded a BCL of 0.32 mg/kg at three locations, among which one was located around the Central Retention Basin and the other two were in the southern portion of the Operations Area outside the EMD leasehold and the EMD facility fence line. Maximum detected concentrations at sample locations in the northern and central portions of the Operations Area were mostly reported less than the detection limit.

Chromium VI

As shown on Figure F2-7, the maximum concentrations of chromium VI exceeded a BCL of 7.0 mg/kg at five locations, among which four of them were in the central portion of the Operations Area and one was located in the southern portion of the Operations Area within the EMD manufacturing area. Maximum detected concentrations at sample locations in the northern portion of the Operations Area were mostly reported less than the detection limits.

Dioxin TEQ

As shown in Figure F2-16, the maximum concentrations of dioxin TEQ exceeded the Site-Specific Action Level of 0.0027 mg/kg at four locations, among which one of them was in the southern portion of the Operations Area outside of the EMD leasehold and the other three were in the northern portion of the Operations Area. Maximum detected concentrations at sample locations were mostly below 0.01 x the Site-Specific Action Level in the central and southern portions of the Operations Area and mostly below 0.5 x the Site-Specific Action Level in the northern portion of the Operations Area.

Hexachlorobenzene

As shown on Figure F2-12, the maximum concentrations of hexachlorobenzene exceeded a BCL of 1.3 mg/kg at two sample locations, both of which were located in the northern portion of the Operations Area. Maximum detected concentrations at sample locations in the central and southern portions of the Operations Area were mostly below 0.5 x BCL.

Manganese

As shown on Figure F2-13, the maximum concentrations of manganese exceeded a BCL of 28,100 mg/kg at only one location, which was in the central portion of the EMD leasehold in the Operations Area, where the Mn-1 and Mn-2 Ponds and several buildings occupied by

EMD were located. Maximum detected concentrations at sample locations in the southern and north-western portions of the Operation Area were mostly below 0.01 x BCL.

Perchlorate

As shown on Figure F2-15, the maximum concentrations of perchlorate exceeded a BCL of 910 mg/kg at eight locations, among which five of them are clustered in the Central Retention Basin and the rest are spread out in the west-central, north-central, and southern portions of the Operations Area and all are outside the EMD leasehold and the EMD facility fence line. Maximum detected concentrations at sample locations in the southern and western portions of the Operation Area are mostly below 0.01 x BCL.

U-238

As shown on Figure F2-21, the maximum concentrations of U-238 exceeded a BCL of 1.4 pCi/g at 17 locations, among which two of them were in the south-western portion of the Operation Area within the rectangular area west of RZ-A, one was located in the central portion of the Operations Area, six of them were located in the Central Retention Basin, one was in the central and northern portion of the EMD leasehold, and seven were located in the norther portion of the Operation Area. Maximum detected concentrations at these locations did not exceed background concentrations (Table 5-3).

As shown in these spatial concentration plots, the spatial distributions for the soil COPCs are consistent with the spatial quartile plots shown in Appendix F1 and the spatial intensity plots shown in Figures 5-2 through 5-18.

In Section 6, for the purpose of identifying EUs, the spatial intensity plots and the spatial concentration plots were reviewed along with other spatial plots for concentrations, cancer risks, and noncancer HIs to identify possible localized areas in which concentrations, cancer risks, or noncancer HIs tend to be at the upper end of the data distribution.

6. IDENTIFICATION OF EXPOSURE UNITS

The EUs define the spatial boundaries of the individual subareas within the BHRA Study Area for which exposures and risks were estimated in the OU-1 Soil BHRA. USEPA risk assessment guidance (USEPA 1989) recommends using a concentration term that represents "a reasonable estimate of the concentration likely to be contacted over time", when assessing exposures and risk. The purpose of the EU identification is to avoid "diluting" or lowering EPCs by averaging concentrations from localized areas in which concentrations tend to be at the upper end of the distribution (if present) with samples collected from areas with significantly lower concentrations.

Spatial data analysis for the soil COPCs considered to establish the EUs are described in Section 6.1. The EUs determined are described in Section 6.2. EU-specific DUEs and COPC identifications are presented in Sections 6.3 and 6.4, respectively.

6.1 Spatial Risk Analysis

As presented in Section 4, tables of summary statistics were prepared for 47 detected soil analytes. As presented in Section 5.1.1, through a three-step COPC selection process, 31 soil COPCs were identified for the entire BHRA Study Area; spatial intensity plots and spatial concentration plots (presented in Appendix F) were prepared for most COPCs. Since a total of 31 COPCs were identified, it is difficult to systematically review the spatial plots of all the COPCs in order to evaluate the spatial patterns in concentrations that could be used to identify EUs. To reduce the dimensions of the spatial data analysis by focusing EUs on risk-relevant spatial patterns, spatial risk plots (as described below) were prepared according to the two health endpoints of cancer risk and noncancer hazard. In addition, since arsenic and dioxin TEQ were evaluated based on the comparison to Site-specific screening criteria, the concentrations plots for these two COPCs were prepared separately. Finally, asbestos spatial plots were prepared based on fiber counts. Spatial risk/concentration plots were created with the data separated into three depth intervals: 0-10 feet bgs, 0-2 feet bgs (surface soil), and 2-10 feet bgs (subsurface soil), except that only the surface soil depth interval was applicable to asbestos spatial plots.

In summary, the following spatial risk/concentration plots were created:

- Dioxin TEQ: The maximum detected concentration at each location was compared to the Site-specific action level of 0.0027 mg/kg within three specific depth intervals (0-10, 0-2, and 2-10 ft bgs, respectively) (Figures 6-1a through 6-1c);
- Arsenic: The maximum detected concentration at each location was compared to the maximum BRC/TIMET background value of 7.2 mg/kg within three specific depth intervals (0-10, 0-2, and 2-10 ft bgs, respectively) (Figures 6-2a through 6-2c);
- Cancer Risk: Cancer risks for each carcinogenic COPC (excluding dioxin TEQ, arsenic, and radionuclides), calculated as a ratio of the maximum detected concentration at each location to the commercial/industrial BCL for cancer effects (corresponding to a cancer risk of 10^{-6}), were summed for all carcinogenic COPCs in soil within three specific depth intervals (0-10, 0-2, and 2-10 ft bgs, respectively) (Figures 6-3a through 6-3c);

- Noncancer HI: HQs for each COPC (excluding dioxin TEQ and arsenic), calculated as a ratio of the maximum detected concentration at each location to the commercial/industrial BCL for noncancer effects (corresponding to a noncancer HQ of one), were summed for all COPCs in soil within three specific depth intervals (0-10, 0-2, and 2-10 ft bgs, respectively) (Figures 6-4a through 6-4c);
- Radionuclide Cancer Risk: Cancer risks for each radionuclide, calculated as a ratio of the maximum detected concentration at each location to the commercial/industrial BCL for cancer effects (corresponding to a cancer risk of 10^{-6}), were summed for all radionuclides within three specific depth intervals (0-10, 0-2, and 2-10 ft bgs, respectively) (Figures 6-5a through 6-5c); and
- Long Amphibole/Chrysotile Fiber: Maximum fiber count at each location in surface soil (Figures 6-6 and 6-7).

The spatial patterns of the risk/concentration plots are discussed below:

Dioxin TEQ

As indicated in Figure 6-1a, dioxin TEQs exceeded the Site-specific action level of 0.0027 mg/kg at three scattered locations in the northern portion of the BHRA Study Area (north of the Lhoist North America Facility), two of which were at 0-2 feet bgs (Figure 6-1b) and one of which was at 2-10 feet bgs (Figure 6-1c). Dioxin TEQ also exceeded the Site-specific action level at one location in the southern portion of the Site, at 2-10 feet bgs (Figure 6-1c).

Arsenic

As indicated in Figure 6-2a, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at several scattered locations throughout the northern portion of the BHRA Study Area, while only one arsenic concentration in the southern portion of the BHRA Study Area slightly exceeded the maximum BRC/TIMET background value. Most of the soil samples with arsenic concentration exceedances were collected at 2-10 feet bgs (Figure 6-2c). The maximum arsenic concentration in soils at 0-2 feet bgs was 12 mg/kg (DS-C45-2) and the maximum arsenic concentration in soils at 2-10 feet bgs was 34 mg/kg (EE-C25-1).

Cancer Risk

As indicated in Figure 6-3a, all the estimated cancer risks from COPCs in soil (excluding dioxin TEQ, arsenic, and radionuclides) were below or within the NDEP acceptable cancer risk range of 10^{-6} to one hundred in a million (10^{-4}). Estimated cancer risks at eight locations in the northern portion of the BHRA Study Area were above 10^{-6}, four of which were clustered within a small area just north of the Lhoist North America Facility. Cancer risks at two scattered locations in the southern portion of the BHRA Study Area were above 10^{-6} but below 10^{-5}. The maximum estimated cancer risk over the entire BHRA Study Area was 2×10^{-5} at SA106 and RIDB-25. Most of the cancer risks exceeding 10^{-6} occurred at 2-10 feet bgs (Figure 6-3c). The cancer risk drivers included chromium VI (at five locations), hexachlorobenzene (at three locations), and BaPEq (at two locations).

Noncancer Hazard Index

As indicated in Figure 6-4a, the estimated noncancer HIs from COPCs in soil (excluding dioxin TEQ and arsenic) at five locations were above the NDEP threshold of greater than one, three of which were in the Central Retention Basin and south of the former AP-5 Pond and former Beta Ditch. The HI exceedances occurred at both 0-2 feet bgs (Figure 6-4b) and 2-10 feet bgs (Figure 6-4c). The major chemical contributor to the noncancer HI was perchlorate. Contamination of underlying soil in the Central Retention Basin with perchlorate resulted from 1) the AP plant and associated waste containment ponds as well as other facilities located south of the former Beta Ditch, and 2) percolation of wastewater from the unlined Beta Ditch related to former operations at the NERT Site.

Radionuclide Cancer Risk

As indicated in Figures 6-5a through 6-5c, the estimated radionuclide cancer risks were either below or at 2×10^{-4} at all depth intervals throughout the BHRA Study Area. The estimated radionuclide cancer risks were generally higher in the northern portion of the BHRA Study Area than in the southern portion of the BHRA Study Area. Ra-226 and Th-228 were the major contributors to the radionuclide cancer risks.

To provide a point of comparison from a health risk perspective between radionuclides in BHRA Study Area soils and background soils, the total radionuclide cancer risks for the RZ-A background soils and BRC/TIMET regional background soils were also estimated based on the 95% UCL on the mean soil activity, calculated by the R codes provided by Neptune.[34] The results of background radionuclide cancer risks are presented in Table 6-1, and the UCL output files along with a copy of the R codes used in the UCL calculation are included in Appendix H. As indicated in Table 6-1, the radionuclide cancer risks for both RZ-A background and BRC/TIMET regional background were 2×10^{-4}. Therefore, although the radionuclide cancer risks for the BHRA Study Area were slightly above the NDEP acceptable risk range of 10^{-6} to 10^{-4}, they are consistent with background in the area.

Asbestos

As indicated in Figure 6-6, at three Phase 1 RI surface sample locations (RISB-10, RISB-12 and RISB-14) in the northern portion of the BHRA Study Area and one sample location (SSAS8-04) in the southeast corner of the BHRA Study Area, counts of long amphibole fibers were greater than the RAW specified level[35] of one (1) or more fibers per sample (Northgate 2010a). As indicated in Figure 6-7, for all surface soil samples throughout the BHRA Study Area, counts of long chrysotile fibers were less than the level presented in the RAW (five or more fibers per sample, Northgate 2010a).In addition, as indicated in the spatial plots provided in this report (i.e., Figures 5-3 through 5-6, Figures 6-2a through 6-2c, and spatial plots in Appendix F) and in the analyses conducted by Neptune (2017), concentrations of some metals (e.g., arsenic, cobalt, and manganese) and some

[34] The radionuclide data used in the 95% UCL calculation were not censored based on NDEP guidance (NDEP 2008a). The higher UCL value generated between the bias-corrected accelerated bootstrap method (BCA UCL) and the t-test method was selected when the two UCL values were not significantly different from each other (relative percent difference [RPD] <= 50%). Neptune provided Ramboll with a copy of the R codes used for the UCL calculation on May 18, 2020.

[35] The RAW does not specifically use the term "trigger level" or identify remediation goals; however, areas identified for asbestos abatement were those in which amphibole counts were one or more fibers or chrysotile counts were five or more fibers in soil samples (Northgate 2010a).

radionuclides (e.g., U-238) in the southern portion of the Site appear lower than in the northern portion of the Site.

6.2 Determination of Exposure Units

The BHRA Study Area has been separated into nine EUs as shown in Figure 6-8, consistent with the outcome of a meeting attended by NDEP, NDEP consultants, the Trust, and Ramboll on July 8, 2020. NERT's approach in the January 31, 2020, OU-1 Soil BHRA Report was to divide the Operations Area into three DUs. This approach was consistent with previous discussions between NERT, NDEP, and their consultants (Ramboll Environ 2017a). After review of the January 31, 2020, OU-1 Soil BHRA Report, NDEP directed NERT to divide the BHRA Study Area into more EUs that were consistent with current land use and potential human health exposures. Based on discussions during the July 8, 2020, meeting, NDEP and NERT agreed that nine EUs would be appropriate given the current use of the BHRA Study Area. These nine EUs define the spatial boundaries of the individual subareas within the BHRA Study Area for which exposures and risks were estimated in this BHRA. The basis for the division of the subareas is as follows:

1) First, the BHRA Study Area is divided into the northern portion (north of the Lhoist North America Facility) and the southern portion (south of the Lhoist North America Facility) because in the northern portion there were 1) higher concentrations of metals (e.g., arsenic, cobalt, and manganese) and radionuclides (e.g., U-238), and 2) more soil sample locations with dioxin TEQ exceeding the Site-specific action level of 0.0027 mg/kg, arsenic concentrations exceeding the BRC/TIMET background value of 7.2 mg/kg, total cancer risks exceeding the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}, total noncancer HIs exceeding the NDEP target HI of one, or the counts of long amphibole fibers exceeding the RAW specified level.
2) Further, based on the spatial analysis of concentrations and risks of COPCs as well as current land use, existing Site features, and exposures for current workers within the BHRA Study Area (i.e., employees and contractors of EMD, EMD tenants, and the Trust), the northern portion is further divided into seven EUs (EU-1 through EU-7), and the southern portion is further divided into two EUs (EU-8 and EU-9).

The nine EUs are described below.

- **EU-1** is a 16-acre area in the northwestern portion of the Operations Area. The land is vacant with the exception of a high-voltage power line that crosses the property in a linear north-south direction. The immediate area surrounding each power line has been designated as an ECA because impacted soil could not be removed from the area close to the power line poles without risking damage to the poles. EU-1 is located outside the EMD leasehold. The boundaries of EU-1 are identified considering the current access road, which establishes the southern boundary of EU-1, and the GW-11 pond and the GWETS located to the east. Arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at three locations within EU-1.
- **EU-2** is a 36-acre area in the west-northcentral portion of the Operations Area located outside the EMD leasehold. EU-2 includes mostly-vacant areas in the west and portions of the GWETS in the east (e.g., the fluidized bed reactors, AP-5

treatment/storage tanks, sludge processing building, and part of the barrier wall and interceptor well field [IWF] extraction wells); however, many of the GWETS operational areas are classified as ECAs and are therefore not included in the BHRA. EU-2 also includes an office trailer used for Trust operations, field staging areas and trailers used by the Trust's consultants, an office trailer used by the GWETS Operator, Envirogen Technologies, Inc. (Envirogen), the AP-6 Pond, scattered non-operational railroad tracks, monitoring wells, and concrete block walls. The EU-2 boundaries are identified considering the EMD leasehold to the north, east, and south, the current access road to the north, and the Central Retention Basin to the south. Within EU-2, arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at a single location, and the dioxin TEQ exceeds the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker at another single location. The total cancer risks for a commercial/industrial worker are above 10^{-6} but below 10^{-5} at two scattered locations within EU-2, and the major risk driver is hexachlorobenzene. Exceedances of arsenic, dioxin TEQ, and total cancer risk, are not co-located within EU-2.

- **EU-3** is a 23-acre area occupying the northern portion of the EMD leasehold in the northeastern portion of the Operations Area. EU-3 includes a majority of the Northern Retention Basin, the associated drainage channel, part of the barrier wall and IWF extraction wells, a leasehold debris pile[36], and numerous monitoring wells. The boundaries of EU-3 are established primarily within the EMD leasehold, north of the Mn-1 Pond. Within EU-3, the arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at five locations, and the dioxin TEQs exceed the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker at two locations. The total cancer risk for a commercial/industrial worker is above 10^{-5} at a single location within EU-3, and the major risk driver is hexachlorobenzene. Long amphibole fibers are detected at three locations within EU-3. Co-located exceedances are observed within EU-3 at three locations for dioxin TEQ/total cancer risk, arsenic/long amphibole fiber, and dioxin TEQ/arsenic/long amphibole fiber.
- **EU-4** is the Central Retention Basin, south of the former AP-5 Pond and former Beta Ditch, with a total area of 8.4 acres. EU-4 is located outside the EMD leasehold. The Basin has a flat bottom with slopped sides. There is a ramp on the west side of the Basin that allows for vehicles to drive in. The former Beta Ditch and current drainage channel also enters the Basin on the west side. In the southwest corner of the Basin, there is a large stormwater outfall with rock stabilization. A photograph log of the Central Retention Basin is presented in Appendix I. Because of its geography and existing features, no regular commercial/industrial or construction activity is expected in this area. Therefore, the Central Retention Basin has a potentially different exposure profile than other EUs. The total noncancer HIs for a commercial/industrial worker are above one at three locations within EU-4 south of the former Beta Ditch, mainly due to elevated perchlorate concentrations in this

[36] Pursuant to the Trust Agreement, the Trust is only responsible for the presence or release, prior to or on February 14, 2011, of hazardous substances in or into the environment at, on or below any portion of the Site. Therefore, the Trust is only responsible for releases of hazardous substances from the Leasehold Debris Pile that occurred on or before February 14, 2011. Any releases of hazardous substances after February 14, 2011 and any removal of the Leasehold Debris Pile from the leasehold is not a Trust obligation.

area. The total cancer risk for a commercial/industrial worker is above 10^{-6} but below 10^{-5} at a single location within EU-4, and the major risk drivers are hexachlorobenzene and BaPEq. The arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at four locations within EU-4. Co-located exceedances are observed within EU-4 at one location for arsenic/total cancer risk.

- **EU-5** is a 20-acre area occupying the central portion of the EMD leasehold in the Operations Area. EU-5 includes the Mn-1 and Mn-2 Ponds and several buildings occupied by EMD. The boundaries of EU-5 are established within the EMD leasehold, south of EU-3, north of the Unit Buildings and leach plant, as well as an area with several EMD buildings and a gate in the western end that provides access from the EMD leasehold to 5th Street. The arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at two scattered locations within EU-5. No exceedance for any other health endpoint is observed in this EU.
- **EU-6** is a 13-acre area in the west-central portion of the Operations Area. The land is mostly vacant with the exception of scattered monitoring wells; one road (5th Street), located in the western half of EU-6; and a concrete paved area, located near the southern EU-6 boundary. EU-6 is located outside the EMD leasehold and the EMD facility fence line. The boundaries of EU-6 are established considering the EMD facility fence line to the north and east, and roadways (4th Street and Avenue F) to the west and south. Arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at a single location within EU-6. No exceedance for any other health endpoint is observed in this EU.
- **EU-7** is a 4.8-acre area in the central portion of the Operations Area, located outside the EMD leasehold but within the EMD facility fence line. The land is mostly vacant with some fencing, except that natural gas and diesel fuel pipelines run through this area. Discolored soil is present at several locations, which are classified as ECAs and not evaluated in the BHRA. The boundaries of EU-7 are established by the EMD facility fence line to the north, west, and south, and by the EMD leasehold to the east. Arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at two locations within EU-7. The total estimated cancer risks for a commercial/industrial worker are above 10^{-6} at four clustered locations within EU-7 (the total estimated cancer risk at one out of the four locations is above 10^{-5} but below 10^{-4}), and the major risk driver is chromium VI. The total noncancer HI for a commercial/industrial worker is above one at a single location within EU-7, and the major risk driver is perchlorate. Co-located exceedances are observed within EU-7 at two locations for total cancer risk/total noncancer HI and arsenic/total cancer risk.
- **EU-8** is a 4.8-acre area located outside the EMD leasehold and the EMD facility fence line in the southern portion of the Operations Area. This area is primarily vacant, except that rail lines run along the southern portion of EU-8. The boundaries of EU-8 are established considering the EMD facility fence line to the south, roadways (4th Street and Avenue F) to the north, the Parcel F boundary to the west, and the Lhoist North America Facility boundary to the east. The total noncancer HI for a commercial/industrial worker is above one at a single location within EU-8, and the major risk driver is perchlorate. No exceedance for any other health endpoint is observed in this EU.

- **EU-9** is a 16-acre area in the southern portion of the Operations Area that includes most of the EMD manufacturing area, a rectangular area west of RZ-A with a dirt access road, and an entrance road from Lake Mead Boulevard to the EMD facility. The Unit Buildings in this area house the primary manufacturing operations and various ancillary operations (e.g., security, shipping/receiving). The majority of EU-9 is located within the EMD leasehold and/or EMD facility fence line. Much of this area has been designated as an ECA (e.g., Unit Buildings, leach plant), and is not evaluated in the BHRA. RZ-A is also not evaluated in the BHRA, because an HRA was previously completed for RZ-A and was approved by NDEP in August 2010. Within EU-9, arsenic concentrations exceed the maximum BRC/TIMET background value of 7.2 mg/kg at a single location, and the dioxin TEQ exceeds the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker at another single location. The total cancer risks for a commercial/industrial worker are above 10^{-6} but below 10^{-5} at two scattered locations within EU-9, and the major risk drivers are BaPEq and chromium VI, respectively. Long amphibole fibers are detected at a single location within EU-9. A co-located exceedance is observed within EU-9 at one location for dioxin TEQ/total cancer risk.

6.3 Data Usability Evaluation for Individual Exposure Units

In Section 4, the DUE was conducted to evaluate the usability of soil BHRA data for the entire BHRA Study Area. The conclusions reached for Criteria I through V for the BHRA Study Area also apply to the individual EUs. In this section, the EU-specific data are reviewed relative to the five DQIs of Criterion VI. The EU identification for each BHRA data point is included in Appendix B.

6.3.1 Completeness

As discussed in Table 4-1, completeness for the DVSR of each individual investigation meet the completeness goals of 90% established in the QAPPs (ENSR 2008b, AECOM and Northgate 2009, ENVIRON 2014d, Ramboll Environ 2017b). The conclusions also apply to the individual EUs. Rejected data ("R" qualified) associated with soil samples at 0-10 feet bgs in each EU of the BHRA Study Area are summarized in Appendix A, Table A-2, and these data are excluded from the EU-specific BHRA data set. Completeness was also calculated for the soil BHRA data set (Appendix B, Table B-1) for each individual EU as > 99.8%. The impacts of rejected data on the overall risk evaluation are further discussed in Section 10.1.3.

6.3.2 Comparability

As discussed in Table 4-1, different reporting limits for the same analyte in soil may 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 4-2. For most of the analytes, the SQLs are well below 0.1xBCL (or other screening criteria). In each EU, there are some soil analytes with SQLs exceeding 0.1xBCL (or other screening criteria), as summarized in Table 6-2 and discussed below.

EU-1

- For eight analytes (including OCPs, PAHs, and SVOCs), the SQLs exceeded 0.1xBCL in 4.0% to 12% of the samples reported as nondetects, and the SQLs exceeded the BCL in 0% to 4.4% of the samples reported as nondetects.
- For zirconium, the SQLs exceeded 0.1xBCL in one out of three samples reported as nondetects, and no SQLs exceeded the BCL, while the detection frequency was 82% (14 out of 17 samples).
- Benzidine and n-nitroso-di-n-propylamine were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in all 15 samples reported as nondetects. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in all 17 samples reported as nondetects, and no SQLs exceeded the BCL.

EU-2

- For six analytes (including OCPs and PAHs), the SQLs exceeded 0.1xBCL in 2.4% to 13% of the samples reported as nondetects, and the SQLs exceeded the BCL in 0% to 2.1% of the samples reported as nondetects.
- For zirconium, the SQL exceeded 0.1xBCL in the only sample reported as a nondetect but did not exceed the BCL, while the detection frequency was 93% (13 out of 14 samples).
- Benzidine, bis(2-chloroethyl) ether, n-nitroso-di-n-propylamine, and pentachlorophenol were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in all 12 samples reported as nondetects. For bis(2-chloroethyl) ether and pentachlorophenol, the SQLs exceeded 0.1xBCL in four out of 14 samples reported as nondetects, and no SQLs exceeded the BCL. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in all 14 samples reported as nondetects, and no SQLs exceeded the BCL.

EU-3

- For 17 analytes (including metals, OCPs, OPPs, PAHs, the PCB Aroclor 1260, and SVOCs), the SQLs exceeded 0.1xBCL in 0.75% to 24% of the samples reported as nondetects, and the SQLs exceeded the BCL in 0% to 2.0% of the samples reported as nondetects.
- For arsenic, the SQLs exceeded the maximum BRC/TIMET background level of 7.2 mg/kg in 10 out of 12 samples reported as nondetects, while the detection frequency was 92% (135 out of 147 samples).
- For zirconium, the SQL exceeded 0.1xBCL in all 12 samples reported as nondetect and no SQLs exceeded the BCL, while the detection frequency was 76% (37 out of 49 samples).
- Benzidine, n-nitroso-di-n-propylamine, and five PCB Aroclors (1221, 1232, 1242, 1248, and 1254) were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in all 41 samples reported as nondetects. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in all 49 samples reported as nondetects, and the SQLs exceeded the BCL in one out of 49 samples reported as nondetects.

For the five PCB Aroclors, the SQLs exceeded 0.1xBCL in one out of three samples reported as nondetects, and no SQLs exceeded the BCL.

EU-4

- For four analytes (including OCPs and PAHs), the SQLs exceeded 0.1xBCL in 7.7% to 17% of the samples reported as nondetects, and the SQLs exceeded the BCL in 0% to 9.4% of the samples reported as nondetects.
- Benzidine and n-nitroso-di-n-propylamine were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in the only one sample reported as nondetect. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in the two samples reported as nondetects, and no SQLs exceeded the BCL.

EU-5

- For five analytes (including OCPs and SVOCs), the SQLs exceeded 0.1xBCL in 2.9% to 25% of the samples reported as nondetects, and no SQLs exceeded the BCL.
- Benzidine and n-nitroso-di-n-propylamine were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in all three samples reported as nondetects. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in all four samples reported as nondetects, and no SQLs exceeded the BCL.

EU-6

- For BaPEq, dieldrin, and hexachlorobenzene, the SQLs exceeded 0.1xBCL in 4.9% to 19% of the samples reported as nondetects, and the SQLs exceeded the BCL in 0% to 2.4% of the samples reported as nondetects.
- Benzidine and n-nitroso-di-n-propylamine were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in all four samples reported as nondetects. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in all seven samples reported as nondetects, and no SQLs exceeded the BCL.

EU-7

- For three analytes (including OCPs, PAHs, and SVOCs), the SQLs exceeded 0.1xBCL in 2.6% to 11% of the samples reported as nondetects, and no SQLs exceeded the BCL.
- For BaPEq, the SQLs exceeded 0.1xBCL in eight out of 28 samples reported as nondetects, and the SQLs exceeded the BCL in six out of 28 samples reported as nondetects, while the detection frequency was 20% (seven out of 35 samples).
- For hexachlorobenzene, the SQLs exceeded 0.1xBCL in 8 out of 25 samples reported as nondetects, and the SQLs exceeded the BCL in two out of 25 samples reported as nondetects, while the detection frequency was 34% (13 out of 38 samples).
- Benzidine and n-nitroso-di-n-propylamine were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in the two samples reported as nondetects. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in the two samples reported as nondetects, and no SQLs exceeded the BCL.

EU-8

- Benzidine, dieldrin, and n-nitroso-di-n-propylamine were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in the two samples reported as nondetects. For dieldrin, the SQLs exceeded 0.1xBCL in one out of 11 samples reported as nondetects, and no SQLs exceeded the BCL. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in the two samples reported as nondetects, and no SQLs exceeded the BCL.

EU-9

- For 13 analytes (including metals, OCPs, PAHs, SVOCs, and VOCs), the SQLs exceeded 0.1xBCL in 0.71% to 22% of the samples reported as nondetects, and the SQLs exceeded the BCL in 0% to 5.9% of the samples reported as nondetects.
- For hexachlorobenzene, the SQLs exceeded 0.1xBCL in 2 out of 42 samples reported as nondetects, and the SQLs exceeded the BCL in one out of 42 samples reported as nondetects, while the detection frequency was 19% (10 out of 52 samples).
- Benzidine and n-nitroso-di-n-propylamine were never detected. For benzidine, the SQLs exceeded 0.1xBCL and the BCL in all six samples reported as nondetects. For n-nitroso-di-n-propylamine, the SQLs exceeded 0.1xBCL in seven out of 17 samples reported as nondetects, and the SQLs exceeded the BCL in one out of 17 samples reported as nondetects.

The impacts of SQLs above 0.1xBCL on the overall risk evaluation are further discussed in Section 10.1.2.

Also, differences in sample preparation and analytical methods exist between the data set for each EU and the RZ-A background and BRC/TIMET regional background data set for both metals and radionuclides, which may affect the statistical testing results of background evaluation. The impacts of different sample preparation and analytical methods on the overall risk evaluation are further discussed in Section 10.1.4.

6.3.3 Representativeness

As discussed in Table 4-1, the spatial representativeness of the BHRA data set for the BHRA Study Area was achieved by following both judgmental and random sampling approaches. The concentration representativeness of the BHRA data set for the BHRA Study Area was achieved by using standard methods for sampling and analysis for all the investigations. These conclusions reached for the BHRA Study Area also apply to the individual EUs.

6.3.4 Precision

As presented in Appendix A, Table A-3, in the soil BHRA data set, there were 39, 19, 73, 37, 12, 19, 7, 1, and 21 pairs of primary and field duplicate results qualified due to RPD or PQL criterion exceedance for EU-1 through EU-9, respectively. For laboratory duplicates, there were 50, 131, 67, 79, 123, 91, 41, 12, and 63 sample results qualified due to RPD or PQL criterion exceedance for EU-1 through EU-9, respectively (see DVSRs tables in Appendix A). The effects of these qualified data on the overall risk evaluation are further discussed in Sections 10.1.5 and 10.1.6.

6.3.5 Accuracy

The soil analytical data were evaluated in DVSRs presented in Appendix A, with a subset of the data qualified with a J qualifier (J, J-, or J+) based on method blank, field duplicate, and/or other quantitation issues (525 out of 7,026 data points for EU-1, 956 out of 11,162 data points for EU-2, 704 out of 14,125 data points for EU-3, 591 out of 5,204 data points for EU-4, 664 out of 8,790 data points for EU-5, 563 out of 6,094 data points for EU-6, 390 out of 4,207 data points for EU-7, 88 out of 1,171 data points for EU-8, and 808 out of 15,217 data points for EU-9, see Appendix B, Table B-1); that is, the reported value was estimated, with no (J), low (J-), or high (J+) bias. The potential impacts of the J qualified data on the overall risk evaluation are further discussed in Section 6.1.6.

6.4 Identification of Chemicals of Potential Concern for Soils in Individual Exposure Units

As discussed in Section 5, the COPCs for the entire BHRA Study area (Table 5-4) were first identified to focus the spatial risk/concentration analysis (see Section 6.1) on those chemicals that failed the concentration/toxicity screen for the purpose of EU identification. In this section, EU-specific COPCs were identified from the list of the BHRA Study Area COPCs following the same methodology as described in Section 5. The analytes eliminated as BHRA Study Area COPCs were not re-visited for the individual EUs, based on the following considerations:

- Metals and other inorganics: with the exception of calcium and potassium, the metals and other inorganics not identified as COPCs were eliminated based on 1) the concentration/toxicity screen (using the maximum detected concentration for the BHRA Study Area) or 2) the chemical-specific considerations discussed in Section 5.3. The results of the screening are the same, whether applied to the BHRA Study Area or to an individual EU. Although calcium and potassium were eliminated based on the background evaluation, these metals are of very low toxicity and would have been eliminated as BHRA Study Area COPCs even if present at concentrations greater than background (NDEP 2017a).
- Organic compounds: the concentration/toxicity screen was the only criterion used to eliminate organic compounds as COPCs. The maximum detected concentration across the BHRA Study Area was used for this screen. The results of the screen are the same, whether applied to the BHRA Study Area or to an individual EU.

For chemicals identified as COPCs for the BHRA Study Area, as shown in Table 5-4, it is possible that when evaluated for individual EUs, they would pass the concentration/toxicity screen if the maximum detected concentration in a certain EU is lower than the maximum detected concentration in the entire BHRA Study Area. Also, for metals and radionuclides, the results of the background evaluation may change (e.g., the concentrations of a metal are greater than background levels when considered within the entire BHRA Study Area but are consistent with background levels in a certain EU). For these reasons, the COPCs identified for the BHRA Study Area were further evaluated in this section for each individual EU.

6.4.1 Step 1 – Concentration/Toxicity Screen

The EU-specific summary statistics and concentration/toxicity screen for the 29 non-asbestos COPCs identified for the BHRA Study Area are presented in Table 6-3. For each listed chemical, the maximum detected concentration and the BCL (or other screening value) are presented. The final column indicates whether the chemical "passed" or "failed" the screen or did not have a screening level. The chemicals that "failed" the screen or that did not have a screening level (as indicated with blue highlighting in Table 6-3) are carried forward to Step 2 and/or 3, and those that "passed" the screen are excluded as COPCs. The results of concentration/toxicity screen for each EU are discussed as follows:

- EU-1: Twelve chemicals passed, 15 chemicals failed based on the comparison against the BCL (or other screening criteria), one chemical (octachlorostyrene) did not have a screening level, and one chemical (palladium) was not analyzed.
- EU-2: Ten chemicals passed, 18 chemicals failed based on the comparison against the BCL (or other screening criteria), and one chemical (octachlorostyrene) did not have a screening level.
- EU-3: Eleven chemicals passed, 17 chemicals failed based on the comparison against the BCL (or other screening criteria), and one chemical (octachlorostyrene) did not have a screening level.
- EU-4: Twelve chemicals passed, 15 chemicals failed based on the comparison against the BCL (or other screening criteria), one chemical (octachlorostyrene) did not have a screening level, and one chemical (palladium) was not analyzed.
- EU-5: Ten chemicals passed, 17 chemicals failed based on the comparison against the BCL (or other screening criteria), one chemical (octachlorostyrene) did not have a screening level, and one chemical (palladium) was not analyzed.
- EU-6: Ten chemicals passed, 17 chemicals failed based on the comparison against the BCL (or other screening criteria), one chemical (octachlorostyrene) did not have a screening level, and one chemical (palladium) was not analyzed.
- EU-7: Ten chemicals passed, 17 chemicals failed based on the comparison against the BCL (or other screening criteria), one chemical (octachlorostyrene) did not have a screening level, and one chemical (palladium) was not analyzed.
- EU-8: Sixteen chemicals passed, 12 chemicals failed based on the comparison against the BCL (or other screening criteria), and one chemical (palladium) was not analyzed.
- EU-9: Thirteen chemicals passed, 14 chemicals failed based on the comparison against the BCL (or other screening criteria), and two chemicals (palladium and octachlorostyrene) did not have screening levels.

Table 4-3 presents the soil data summary results for asbestos (long amphibole and chrysotile fibers) for each EU. As shown in Table 4-3, one or more long amphibole fibers were observed in three out of 21 samples in EU-3 and one out of 32 samples in EU-9, while no long amphibole fibers were observed in any other EU. Also, one or more long chrysotile fibers were observed in three out of seven samples in EU-1, six out of 34 samples in EU-2, two out of 21 samples in EU-3, one out of two samples in EU-4, one out of 12 samples in

EU-6, one out of seven samples in EU-7, three out of five samples in EU-8, and 10 out of 32 samples in EU-9, while no long chrysotile fibers were observed in EU-5. As discussed in Section 5.1, exposure and risk assessments for asbestos are highly dependent on sample size, and even for the case where fibers are not identified (i.e., zero fibers), upper-bound cancer risk estimates can be greater than 1×10^{-6}, depending on sample size. For these reasons, amphibole and chrysotile are retained as COPCs for all nine individual EUs.

6.4.2 Step 2 – Background Evaluation

In this section, a background evaluation was conducted for each EU to identify EU-specific metal and radionuclide COPCs. As indicated in the spatial plots in this report (i.e., Figures 5-3 through 5-6, Figures 6-2a through 6-2c, and spatial quartile plots in Appendix F) and in the analyses conducted by Neptune (2017), the concentrations of some metals (e.g., arsenic, cobalt and manganese) and some radionuclides (e.g., U-238) in the southern portion of the Site were lower than in the northern portion of the Site, suggesting that background conditions in the northern and southern portion of the Site may be different. As recommended by Neptune (2017), the regional BRC/TIMET data set was used for the northern portion of the BHRA Study Area (EU-1 through EU-7) and the RZ-A background data set was used for the southern portion of the BHRA Study Area (EU-8 and EU-9).

The RZ-A background data set is described in Section 4.2.2. A detailed discussion of the BRC/TIMET regional background data set is presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC and TIMET 2007). The BRC/TIMET regional background data set is a combination of soil background data collected by ENVIRON for the City of Henderson in 2003 and by BRC/TIMET in 2005. Specifically, as recommended by NDEP (2018), the 95 McCullough samples collected from 30 sampling locations on 10 undeveloped properties near and upgradient from the Site at 0 to 0.5, 4 to 6, and 9 to 11 feet bgs as part of the 2005 BRC/TIMET study were used in the background evaluation for the northern portion of the BHRA Study Area (EU-1 through EU-7), which is located north of the McCullough Range on alluvial soils generated from McCullough Range substrate. The sampling locations of the 2005 BRC/TIMET study were presented in Appendix A of the *Background Shallow Soil Summary Report, BMI Complex and Common Areas Vicinity*, prepared by BRC and TIMET (BRC and TIMET 2007), which were locations outside OU-1 in relatively close proximity to the Site but were upgradient and sufficiently distant so that impacts from Site operations were not likely. The RZ-A and BRC/TIMET background data sets used for the background evaluation are included in Appendix D.

The EU-specific background evaluation was conducted using the same methodology as described in Section 4.2.2, with the results of statistical tests, side-by-side box plots, and Q-Q plots presented in Appendix J. As discussed in Section 4.2.2, the results of the t-tests are not reasonable to use in the background evaluation of a large amount of data. Therefore, the determination of background consistency was only based on the results of non-parametric tests for analytes with large sample size (>100) and based on the results of both parametric and non-parametric tests for analytes with small sample size (<=100).

The metals and radionuclides in each individual EU that either failed the concentration/ toxicity screen or for which a BCL was not available for screening are listed in Tables 6-4 and 6-5, respectively. The results of the background evaluation are also presented in the tables and summarized as follows:

- EU-1: Both metals carried forward from Step 1 (arsenic and zirconium) were present at concentrations consistent with background. Of the eight radionuclides carried forward from Step 1, all concentrations were consistent with background.
- EU-2: Both metals carried forward from Step 1 (arsenic and zirconium) were present at concentrations consistent with background. Of the eight radionuclides carried forward from Step 1, one radionuclide (Th-228) failed the statistical testing for background consistency, while concentrations of all other radionuclides were consistent with background.
- EU-3: Of the four metals carried forward from Step 1, arsenic and zirconium were present at concentrations consistent with background, while manganese was present at concentrations greater than background. In addition, background comparison results may not be applicable for chromium VI due to low detection frequency (<25%) in the EU-3 and BRC/TIMET regional background data sets (Appendix J, Table J-1). Of the eight radionuclides carried forward from Step 1, all concentrations were consistent with background.
- EU-4: Of the three metals carried forward from Step 1, zirconium was present at concentrations consistent with background, while arsenic was present at concentrations greater than background. In addition, background comparison results may not be applicable for chromium VI due to low detection frequency (<25%) in the BRC/TIMET regional background data set (Appendix J, Table J-1). Of the eight radionuclides carried forward from Step 1, one radionuclide (Th-230) failed the statistical testing for background consistency, while concentrations of all other radionuclides were consistent with background.
- EU-5: Of the five metals carried forward from Step 1, arsenic and zirconium were present at concentrations consistent with background, while cobalt and manganese were present at concentrations greater than background. In addition, background comparison results may not be applicable for chromium VI due to low detection frequency (<25%) in the EU-5 and BRC/TIMET regional background data sets (Appendix J, Table J-1). Of the eight radionuclides carried forward from Step 1, all concentrations were consistent with background.
- EU-6: Of the five metals carried forward from Step 1, arsenic and zirconium were present at concentrations consistent with background, while manganese was present at concentrations greater than background. In addition, background comparison results may not be applicable for chromium VI and thallium due to low detection frequency (<25%) in the EU-6 and/or BRC/TIMET regional background data sets (Appendix J, Table J-1). Of the eight radionuclides carried forward from Step 1, one radionuclide (Th-228) failed the statistical testing for background consistency, while concentrations of all other radionuclides were consistent with background.
- EU-7: Of the four metals carried forward from Step 1, arsenic, manganese, and zirconium were present at concentrations consistent with background. In addition, background comparison results may not be applicable for chromium VI due to low detection frequency (<25%) in the BRC/TIMET regional background data set (Appendix J, Table J-1). Of the eight radionuclides carried forward from Step 1, all concentrations were consistent with background.

- EU-8: RZ-A background data were not available for the only metal (zirconium) carried forward from Step 1. Of the seven radionuclides carried forward from Step 1, all concentrations were consistent with background.
- EU-9: Of the four metals carried forward from Step 1, arsenic was present at concentrations greater than background. RZ-A background data were not available for two metals (palladium and zirconium). In addition, background comparison results may not be applicable for chromium VI due to low detection frequency (<25%) in the EU-9 and RZ-A background data sets (Appendix J, Table J-1). Of the eight radionuclides carried forward from Step 1, all concentrations were consistent with background.

Background comparison results may not be applicable for chromium VI in EU-3, EU-4, EU-5, EU-6, EU-7, and EU-9 due to low detection frequency in the EU and/or background data sets. However, the chromium VI concentrations in these individual EUs are greater than background concentrations based on the box plots (Appendix J, Figures J1-2A and J1-2B) and Q-Q plots (Appendix J, Figures J2-2C, J2-2D, J2-2E, J2-2F, J2-2G, and J2-2I). Therefore, chromium VI is retained as a COPC for these EUs.

For thallium in EU-6, background comparison results may not be applicable due to low detection frequency in the BRC/TIMET background data set. Review of the box plot (Appendix J, Figure J1-6A) and Q-Q plot (Appendix J, Figure J2-5F) showed that thallium concentrations in EU-6 are mostly lower than background concentrations. Therefore, thallium is not retained as a COPC for EU-6.

For radionuclides, as presented in the NDEP flowchart (Appendix G), when approximate secular equilibrium is exhibited in an isotope decay chain, in theory radionuclides in the same decay chain should yield similar background comparison results; therefore, if any radionuclide is greater than background, all the radionuclides in that decay chain would be carried forward in the risk assessment. When approximate secular equilibrium is not exhibited in an isotope decay chain, individual radionuclides that fail the background evaluation would be carried forward in the risk assessment. As indicated in Table 6-5, secular equilibrium is only exhibited in the U-238 decay chain for EU-3, EU-4, EU-5, EU-6, EU-7, and EU-9, and only exhibited in the Th-232 decay chain for EU-1, EU-3, EU-8, and EU-9. Also, it is unexpected that in the U-238 decay chain in EU-4, which is at secular equilibrium, the radionuclides both passed and failed the background comparisons (see Table 6-5). Similar issues have previously been identified by NDEP in the radionuclide analytical data sets for soil samples collected across the BMI Complex (NDEP 2009c).

Sample preparation and analytical methods were important factors in explaining some of the radionuclide data anomalies. The BRC/TIMET regional background samples were collected and analyzed in 2005, the RZ-A background samples were collected and analyzed in 2009, and the BHRA Study Area samples were collected and analyzed between 2006 and 2017, i.e., both before and after NDEP issued guidance for evaluating radionuclide data (NDEP 2009c). Over this period, samples were submitted for analysis to different analytical laboratories and analyzed using different preparation and analytical methods. For example, the analytical methods for Ra-228 included both beta spectroscopy and gamma spectroscopy, depending on the laboratory, which may be the reason for the lack of correlation with Ra-228 in the Th-232 decay chain (Appendix J, Table J-6). It was also

unexpected that for the RZ-A background data set, the Th-232 decay chain was not in secular equilibrium (Appendix J, Table J-5b).

Given that the validity of the statistical testing is complicated by several issues identified above, it is difficult to interpret the results of the background evaluation for radionuclides and consider them as a reliable basis for the COPC selection. To provide a point of comparison from a health risk perspective, the total radionuclide cancer risk at each sampling location was compared to the total radionuclide cancer risks for the RZ-A background soils and BRC/TIMET regional background soils. As indicated in Figures 6-5a through 6-5c, the estimated total radionuclide cancer risks were either below or at 2×10^{-4} at all depth intervals throughout the BHRA Study Area, which were consistent with the estimated total radionuclide cancer risks for the RZ-A background and BRC/TIMET regional background data sets (Table 6-1). Radionuclides are not known to be associated with any of the former operations at the Site. Based on the above discussion, radionuclides were not identified as COPCs for any EU. The impacts of excluding radionuclides as COPCs on the overall risk evaluation are further discussed in Section 10.2.1.

6.4.3 Step 3 – Chemical-Specific Evaluations

Since chemicals commonly recognized as having low toxicity and for which a BCL was not available (i.e., macronutrients or essential micronutrients) were already eliminated as COPCs for the BHRA Study Area in Section 5.3, no COPC is further eliminated in this step for the EU-specific evaluation.

6.4.4 Summary of Chemicals of Potential Concern for Individual Exposure Units

The COPCs identified for soils in each individual EU are listed in Table 6-6, and summarized as follows:

- EU-1: The eight soil COPCs identified for EU-1 are perchlorate, BaPEq, three OCPs (beta-BHC, 4,4’-DDE, and hexachlorobenzene), octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).
- EU-2: The 11 soil COPCs identified for EU-2 are perchlorate, dioxin TEQ, six OCPs (beta-BHC, 4,4'-DDE, 4,4'-DDT, dieldrin, hexachlorobenzene, and toxaphene), octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).
- EU-3: The 10 soil COPCs identified for EU-3 are perchlorate, two metals (chromium VI and manganese), dioxin TEQ, BaPEq, two OCPs (4,4'-DDE and hexachlorobenzene), octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).
- EU-4: The nine soil COPCs identified for EU-4 are perchlorate, two metals (arsenic and chromium VI), ammonia, BaPEq, hexachlorobenzene, octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).
- EU-5: The 10 soil COPCs identified for EU-5 are perchlorate, three metals (chromium VI, cobalt, and manganese), two PAHs (BaPEq and naphthalene), hexachlorobenzene, octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).

- EU-6: The nine soil COPCs identified for EU-6 are perchlorate, two metals (chromium VI and manganese), BaPEq, two OCPs (beta-BHC and hexachlorobenzene), octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).
- EU-7: The nine soil COPCs identified for EU-7 are chlorate and perchlorate, chromium VI, two PAHs (BaPEq and naphthalene), hexachlorobenzene, octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).
- EU-8: The seven soil COPCs identified for EU-8 are perchlorate, zirconium, BaPEq, beta-BHC, bis(2-ethylhexyl)phthalate, and asbestos (long amphibole and chrysotile fibers).
- EU-9: The 10 soil COPCs identified for EU-9 are four metals (arsenic, chromium VI, palladium, and zirconium), dioxin TEQ, BaPEq, hexachlorobenzene, octachlorostyrene, and asbestos (long amphibole and chrysotile fibers).

For two COPCs (palladium and octachlorostyrene), BCLs (and associated toxicity values) are not available; in the absence of toxicity values, these COPCs are evaluated qualitatively in Section 10.2.4. Also, RZ-A background data are not available for palladium and zirconium, and therefore a background evaluation cannot be conducted for zirconium in EU-8 as well as palladium and zirconium in EU-9. These two metals are further discussed in comparison to the regional BRC/TIMET background data set (BRC and TIMET 2007) in Section 10.2.4. Lastly, for arsenic and other metals identified as COPCs, an evaluation of the background contribution to the total cancer risks and noncancer HIs was performed (see Section 9.1).

7. EXPOSURE ASSESSMENT

The exposure assessment analyzes chemical releases and the physical setting, identifies exposed populations and exposure pathways, and estimates exposure concentrations and chemical intakes for the identified pathways. This exposure assessment includes the updated OU-1 CSM (as presented in this section and also included in the RI Report for OU-1 and OU-2 [Ramboll 2021b]), estimation of EPCs, and exposure assumptions and calculations, as discussed in the following sections.

7.1 Conceptual Site Model and Exposure Scenarios

To evaluate the human health risks posed by a site, it is necessary to identify the populations that may potentially be exposed to the chemicals present and to determine the pathways by which these exposures may occur. Specifically, a CSM outlines information relevant to conducting the exposure assessment by 1) evaluating potential chemical sources and releases, 2) identifying populations that could potentially be exposed to chemicals present, and 3) identifying complete exposure pathways and routes through which human exposure might occur. The CSM is an important tool in guiding site characterization, evaluating data quality in the context of potential risks to exposure populations, and developing exposure scenarios.

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 SRCs[37] 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 encompassed both the NERT Site and downgradient areas (the extent of the RI Study Area at the time), 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 environmental conditions within and outside of the NERT Site. In this BHRA, the CSM for the Operations Area in OU-1 has been updated by incorporating the findings from the RI Report for OU-1 and OU-2 (Ramboll 2021b) and is presented in Figure 7-1. The historical operations, sources of impacts and migration, and distribution of contaminants are discussed in Section 4.2.4 as the last step of the DUE, while the elements of the OU-1 CSM evaluated as part of the exposure assessment in the BHRA are discussed below.

[37] The term SRC was historically used in the 2005 CSM report (ENSR 2005). In the RI Report for OU-1 and OU-2 (Ramboll 2021b), the term NERT COPC was used.

7.1.1 Potential Chemical Sources and Release Mechanisms

In 1994, NDEP identified 70 LOUs[38] at the Site (source areas at the Site for further investigation, NDEP 1994, Figure 2-2), which consisted of areas that were then used for chemical production (e.g., Unit Buildings 4 and 5), areas that are no longer active (e.g., the former AP Plant and associated facilities), and/or areas where near surface soil contamination has been addressed (e.g., former surface water impoundments that have been closed). Following the comprehensive investigation of source areas within the Site during the Phase 1 and Phase 2 RI, the following areas have been identified as the significant current sources of contamination in OU-1 (Ramboll 2021b):

- Unit Buildings 4 and 5;
- Former Beta Ditch;
- Former AP plant and associated facilities;
- Features north of the IWF/barrier wall (i.e., former trade effluent ponds, former IWF recharge trenches).

In addition to sources of contamination present within the Site, contaminated surface soils and groundwater associated with industrial operations on adjacent neighboring sites are considered potential former and/or current sources of contaminants to OU-1 (Figure 2-1). These adjacent neighboring sites include:

- OSSM site to the west of OU-1;
- Lhoist North America Facility (formerly Chemstar, a lime producer) surrounded by OU-1;
- TIMET site to the east of OU-1.

Details about the operational activities and associated contaminants for these adjacent neighboring sites are described in the RI Report for OU-1 and OU-2 (Ramboll 2021b).

Historical releases from potential source areas have been documented or inferred from field investigations. As indicated in the CSM (Figure 7-1), chemicals were released from potential sources within and outside of OU-1 through several primary release mechanisms, such as spills/leaks and infiltration/overtopping to soils and runoff to surface water from potential sources within OU-1, as well as groundwater transport (particularly from the OSSM site to the west of OU-1), storm water runoff to soils, wind erosion/mechanical disturbance of surface soil particulates to outdoor air, and volatilization of VOCs in soil to outdoor air from potential sources outside OU-1. In addition to the potential primary release mechanisms, secondary/tertiary release mechanisms included wind erosion/mechanical disturbance of surface soil particulates to outdoor air, migration of VOCs in the subsurface through the soil column to indoor air, outdoor air, or trench air, and leaching from soils to groundwater. The potentially contaminated exposure media in the Operations Area in OU-1 include air, soil, and groundwater. Potential exposures to surface water (i.e., runoff) by

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

populations within the BHRA Study Area were not quantitatively evaluated in the BHRA because such exposures would be intermittent and of short duration.

7.1.2 Potentially Exposed Human Populations and Exposure Pathways

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

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

As noted previously, the land within OU-1 is currently used by the Trust for environmental response and its tenant EMD for the operation of their chemical manufacturing business. Tronox leased approximately 113 acres within the Operations Area from February 2011 to August 2018. In August 2018, the lease was assigned to EMD, which is continuing similar manufacturing operations within the leasehold area at the Site. Future land use in the Operations Area will continue to be restricted to industrial and/or commercial purposes through a land-use covenant. Accordingly, the potentially exposed populations in all EUs evaluated in the BHRA Study Area are indoor commercial/industrial workers, outdoor commercial/industrial workers (including utility/maintenance workers in EU-4 as described in Section 7.3), and construction workers, consistent with the BHRA Work Plan (ENVIRON 2014b) and USEPA guidance (2002b).

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

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

Current and future populations located outside the OU-1 boundary include indoor and outdoor commercial/industrial workers as well as residents who could be exposed to airborne chemicals (vapors and particulates) emitted during routine operations or construction projects (USEPA 2002b). OU-1 is located within the BMI complex, surrounding by several industrial facilities, including the OSSM site and BMI Corrective Action Management Unit (CAMU) to the west, Lhoist North America Facility (surrounded by OU-1), the TIMET site to the east, various industrial facilities to the north, and a mixture of commercial and residential properties to the south. The nearest residents are located approximately 1,550 feet away from the northern OU-1 boundary and approximately 500 feet away from the southern OU-1 boundary. The potential risks to populations within the NERT Off-Site Study Area of OU-2 (to the north of OU-1 and west of Pabco Road) were evaluated in the OU-2 BHRA report (Ramboll 2021c). A qualitative discussion of the

potential risks to populations in the areas to the west, east, and south of OU-1 is presented in Section 10.2.2.1.

This BHRA focused on the direct contact pathways associated with residual levels of chemicals, asbestos, and radionuclides in soils in the BHRA Study Area. Based on the source and release mechanisms presented in the CSM, the following receptor populations and exposure pathways were identified for quantitative evaluation:

- Indoor commercial/industrial workers[39]
    - Incidental soil ingestion[40]
    - Inhalation of airborne dust particulates[38,41]
    - External exposure from soil[42]
    - Inhalation of vapors migrating from soil to outdoor air
- Outdoor commercial/industrial workers (including utility/maintenance workers in EU-4)
    - Incidental soil ingestion[38]
    - Dermal contact with soil
    - Inhalation of airborne soil particulates[38,39]
    - External exposure from soil[40]
    - Inhalation of vapors migrating from soil to outdoor air
- Construction workers
    - Incidental soil ingestion[38]
    - Dermal contact with soil
    - Inhalation of airborne soil particulates[38,39]
    - External exposure from soil[40]
    - Inhalation of vapors migrating from soil to trench air

NDEP concurred with a list of SRCs presented in the 2005 CSM Report (ENSR 2005) that had been identified based on a review of historical Site operations and practices, as well as those at neighboring facilities. Soil samples collected in OU-1 were analyzed for chlorine oxyanions (chlorate and perchlorate), metals and other inorganics, radionuclides, asbestos,

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

[40] Includes radionuclide exposures; however, as noted in Section 6.4.2, radionuclides were not selected as soil COPCs for the nine EUs.

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

[42] Includes only radionuclide exposures; however, as noted in Section 6.4.2, radionuclides were not selected as soil COPCs for the nine EUs.

dioxins/furans, organic acids, PAHs, PCBs, OCPs, OPPs, SVOCs, and VOCs. As discussed previously in Table 4-1, soil samples were collected at both random and judgmental locations (i.e. locations identified based on understanding of OU-1 conditions and professional judgment), with judgmental locations targeting the LOUs that had been identified as source areas. Soil contamination in many of the source areas in OU-1 was addressed in the 2010-2011 soil removal actions and 2012 manganese tailings removal program, as described in Section 3.1.2. In some areas, impacted soils (with chemical concentrations greater than BCLs) as well as incompletely characterized soils were left in place due to access or other constraints precluding soil excavation. Such areas are designated as ECAs and risks are mitigated through the SMP (Ramboll 2020b). In other areas, soil characterization was completed as part of the more recent NERT RI sampling activities completed between 2014 and 2017. This BHRA focused on potential post-removal health risks associated with residual chemical concentrations in non-ECA soils in the BHRA Study Area.

Commercial/industrial workers were assumed to have direct contact with shallow soils (0–2 feet bgs) when minimum soil excavation occurs that could bring subsurface soil to the surface, or with surface and subsurface soils (0–10 feet bgs) when soils from depths of up to 10 feet bgs could be brought to the surface during excavation or other activities. Construction workers were assumed to have direct contact with surface and subsurface soils (0–10 feet bgs) during excavation or other activities. To be conservative, construction workers were assumed to be exposed to vapors migrating from soil while standing in a 10-foot trench in the unsaturated zone, placing them closer to the potential source.

The potential risks to populations within the BHRA Study Area related to exposures to airborne releases of particulates and vapors from soil in neighboring sites were evaluated quantitatively based the results of soil investigations and risk assessments prepared by OSSM and TIMET (see discussion Section 9.2).

Complete vapor intrusion pathways via inhalation of vapors migrating from soil gas or shallow groundwater to indoor, outdoor, or trench air have also been identified in OU-1. The most significant source of VOCs in soil gas and shallow groundwater is the trespassing VOC groundwater plume originating from the neighboring OSSM site to the west of OU-1. However, there is also chloroform contamination in groundwater originating at the Unit 4 and 5 Buildings that is a source of chloroform in soil gas. Potential human health risks associated with vapor intrusion pathways were evaluated in the OU-1 soil gas and groundwater BHRA report (Ramboll 2021a). The cumulative risks associated with potential exposures to chemicals in soil and to VOCs in air resulting from vapor intrusion are presented in this BHRA report (See Section 12).

Exposure via domestic use of groundwater was not evaluated because groundwater in OU-1 is not and will not 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 due to the groundwater depth being greater than 10 feet bgs.

7.2 Exposure Point Concentrations

An EPC of a COPC is the estimated concentration of that chemical in an environmental medium to which a receptor (i.e., a member of a potentially exposed population) is exposed

over an assumed duration of exposure. EPCs are used in the dose equation for evaluating the potential exposure (dose) of each receptor and exposure pathway. The derivation of EPCs for soil, airborne soil particulates in outdoor air, and soil vapors in outdoor or trench air are described in the following sections.

7.2.1 Soil

Soil EPCs were used to estimate direct-contact soil exposures (i.e., incidental ingestion and dermal contact[43]) for indoor and outdoor commercial/industrial workers and construction workers within the BHRA Study Area. The soil EPCs were also used to derive air EPCs for airborne particulates and vapors, as presented in Sections 7.2.2 and 7.2.3.

The soil EPC was calculated as the 95% UCL on the mean soil concentration of all soil samples collected in the 0-2 feet depth interval and all soil samples collected in the 0-10 feet depth interval within each EU, respectively, unless a 95% UCL could not be calculated due to limited detections, in which case the soil EPCs were set to be the maximum detected concentrations. This assumption is representative for a reasonable maximum exposure (RME) estimate. The R codes provided by Neptune were used to calculate the UCLs, and the non-detect results were treated as detects at one half of SQL. The higher value generated between the BCA UCL and the t-test UCL was selected as the EPC when the two UCL values were not significantly different from each other (RPD <= 50%). When the two UCL values were significantly different from each other (RPD > 50%), the t-test UCL was selected as the EPC if the data followed a normal distribution, and the BCA UCL was selected as the EPC if the data did not follow a normal distribution. The UCL output files along with a copy of the R codes used in the UCL calculation are included in Appendix H. The soil EPCs for each EU are presented in Tables 7-1a and 7-1b.

In addition, to evaluate the contribution of background metals to the total risk, background soil EPCs were also calculated as the 95% UCL on the mean soil concentration of the BRC/TIMET regional background data set and the RZ-A background data set, unless a 95% UCL could not be calculated due to limited detections, in which case the soil EPCs were set to be the maximum detected concentrations. Since statistical analysis showed no significant difference in background data across different depth intervals up to 10 feet bgs (Neptune 2018) and to ensure adequate sample size, the soil EPCs were not calculated separately for the 0-2 feet depth interval and the 0-10 feet depth interval for the BRC/TIMET regional background data set and the RZ-A background data set. The soil EPCs for background metals are presented in Table 7-1c.

7.2.2 Air: Airborne Soil/Dust Particulates

Exposure to COPCs bound to soil/dust particles was evaluated using USEPA's particulate emission factor (PEF) approach (USEPA 2002b). The PEF relates COPC concentrations in soil to the COPC concentrations in airborne soil/dust particles. The Site-specific dispersion factor (Q/C) used in the calculations is based on information for Las Vegas, Nevada, as presented in Appendix E of USEPA (2002b). The calculation of a PEF is also a function of

[43] In accordance with USEPA (2002b) guidance, dermal contact is not considered to be a complete exposure pathway for the indoor worker.

the areal extent of Site surface contamination, which is assumed to correspond to the area of each EU.

For indoor and outdoor commercial/industrial workers, the PEF is estimated based on emissions from wind erosion of surface soils and was calculated using the equations presented by Neptune (2015). The PEF for construction workers includes two components: (1) emissions from unpaved roads; and (2) emissions from wind erosion, excavation, dozing, grading, and tilling (USEPA 2002b). These two components were calculated and then combined into a single PEF using the equations presented in Neptune (2015). The parameters used to estimate the PEFs are presented in Table 7-2.

The calculation of air EPCs for chemicals and asbestos are discussed below. The air EPCs for chemicals are presented in Tables 7-1a through 7-1c. For asbestos, the soil concentrations and air EPCs (and associated health risks) were calculated using NDEP's "asbestos guidance riskcalcs.xls" spreadsheet, and are presented in Appendix K.

Air EPCs for Chemicals

The air EPCs for chemicals bound to soil/dust particles were derived from soil EPCs by applying the PEFs, as follows:

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

where:

EPC_{air}	=	Air Exposure Point Concentration (microgram per cubic meter [µg/m^3])
EPC_{soil}	=	Soil Exposure Point Concentration (mg/kg)
CF	=	Conversion Factor (1000 µg/mg)
PEF	=	Particulate Emission Factor (cubic meter per kilogram [m^3/kg])

Air EPCs for Asbestos

Exposures to asbestos are evaluated for the inhalation pathway only. Air EPCs for asbestos were derived based on the concentration of asbestos in surface soils (only surface samples were analyzed for asbestos), consistent with the NDEP guidance (Neptune 2015) which is based on the protocols described in USEPA guidance (USEPA 2003) and has been modified for application to the BMI Complex. Asbestos concentrations in surface soils were estimated for fibers identified as carcinogenic, specifically, fibers of dimensions >10 µm long and <0.4 µm wide, using the following equation:

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

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

where:

C_{soil}	=	Soil Concentration (fiber per gram [f/g])
f	=	Number of long fibers observed in soil samples (unitless)
AS	=	Analytical Sensitivity (f/g) [44]
N	=	Sample Size

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

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

where:

f_{UCL}	=	95% UCL of the number of long fibers observed in soil samples from a Poisson distribution (unitless)
f	=	Number of long fibers observed in soil samples (unitless)
$\chi^2_{0.95}$	=	Chi-squared distribution at 95%

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

The air EPCs were derived from soil concentrations by applying the PEFs, as follows:

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

where:

EPC_{air}	=	Air Exposure Point Concentration (f/m^3)
C_{soil}	=	Soil Concentration (f/g)
PEF	=	Particulate Emission Factor (m^3/kg)
CF	=	Conversion Factor (1000 g/kg)

[44] The laboratory results are reported as "structures"; however, the term "fibers" is used herein for simplicity.

7.2.3 Outdoor and Trench Air: Volatile Compounds Migrating from Soil

The following subsections describe the derivation of EPCs in outdoor or trench air for volatile compounds migrating from soil, including the description of the source term, the fate and transport modeling, and the calculation of air EPCs.

Source Term

Volatile compounds detected in soil can potentially migrate through the unsaturated zone to outdoor or trench air. For this evaluation, the soil EPCs described in Section 7.2.1 were used as the source term to model the outdoor and trench air concentrations (i.e., the EPCs in the exposure medium or air).

Fate and Transport Modeling

The migration of chemicals detected in soil is quantified for the purposes of this assessment through an intermedia transfer factor. When the transfer factor is multiplied by the source concentration of a chemical in soil (in µg/kg), the product is the predicted steady-state concentration in outdoor or 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.

For populations in the BHRA Study Area, Ramboll developed transfer factors for the following scenarios:

- Transport of soil from one centimeter (cm) bgs into outdoor air.
- Transport of soil from one cm bgs below the base into a 10-foot construction trench.

The intermedia transfer factors were estimated using the Jury model as described in USEPA (2002b). This model is conservative because it assumes that the chemical source has infinite mass and does not include other attenuation processes that typically would reduce the amount of vapor migration, such as biodegradation, leaching from infiltration, and lateral diffusion.

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 volatile soil COPCs that were used in these calculations are presented in Table 7-3. Based on guidance from USEPA (2021a), only chemicals that easily volatilize are included in the evaluation of vapor migration. These include chemicals with a Henry's Law constant of greater than 1×10^{-5} atmosphere-cubic meter per mole ($atm\text{-}m^3/mol$) or a vapor pressure of greater than 1 millimeter of mercury (mm Hg), i.e., ammonia, naphthalene, hexachlorobenzene, and octachlorostyrene. The source of all physical/chemical properties is noted in Table 7-3. 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 was:

1) NDEP values from the BCL table (NDEP 2017a);
2) USEPA values from the Johnson and Ettinger model (USEPA 2017);
3) USEPA values from the RSL tables (USEPA 2021b); and

4) USEPA values from EPISuite (USEPA 2012a) combined with using surrogate chemicals for diffusivities in air and water.

As reported in the draft 2010 Site-Wide Soil Gas HRA[45] (Northgate and Exponent Inc. [Exponent] 2010), soil samples were collected to determine soil properties representative of the unsaturated zone in the Operations Area. Soil samples were collected at 16 locations at depths of 9 to 15 feet bgs (mostly at 10 feet) throughout the Operations Area to determine volumetric water content, total porosity, dry bulk density, and grain density in accordance with NDEP guidance (NDEP 2010e). The average of the 15 soil property results measured from 9-10 feet bgs (as shown in Table 7-4) within the Operations Area was used for modeling purposes in this BHRA. One sample collected at a depth of 15 feet bgs was not included as it represents wetter than average conditions within the Operations Area. Soil sampling locations and boring logs are included in Appendix L.

A review of OU-1 stratigraphy and boring logs indicated that these soil samples collected at 9-10 feet bgs are representative of the entire Qal stratigraphic unit and there is not expected to be significant variation laterally or with depth within that stratigraphic unit. In general, the groundwater table occurs between zero and 10 feet below the base of the Qal in the underlying fine-grained UMCf. In some places, the groundwater table occurs above the base of the Qal. For simplicity and to be conservative, the entire vadose zone was modeled as Qal with no UMCf included. Each soil sample was also plotted on a ternary diagram to determine the soil type for the Jury model. The soil samples clustered near the border between sand and loamy sand, with the average soil type being loamy sand (Table 7-4). This is generally consistent with the soil types identified in the soil borings within OU-1 (Ramboll 2021b), including poorly sorted gravel, silty gravel, poorly sorted sand, well sorted sand, and silty sand.

Depth to the top and base of soil contamination was determined based on conservative worst-case assumptions. It was assumed that the soil could be contaminated with volatile compounds from one cm bgs extending down to the water table.

When modeling the above-ground outdoor air scenario, the Q/C model described in USEPA (2002b) was used with the area of each EU. For the construction trench scenario, a box model was used to simulate dispersion. Construction trench dimensions of 10 feet deep, 20 feet long, and five feet wide were assumed. For this box model, the air flow through the construction trench was controlled by a Site-specific windspeed that was reduced by a factor of 10 to ensure it would be conservative for a construction trench scenario where the breathing zone may be a few feet bgs.

The modeling parameters are presented in Table 7-5. Table 7-6 summarizes the transfer factors from soil to outdoor air and trench air. The conservative nature of the model input parameters and modeling uncertainties are discussed in Section 10.2.2.3.

EPC Calculation

[45] 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.

Using the soil EPC for each volatile COPC as the source term, outdoor and trench air EPCs were modeled using the Jury model and a basic diffusion model, respectively. The air EPCs for volatile COPCs migrating from soil were calculated as follows:

$$EPC_{air} = EPC_{soil} \times \mathrm{TF} \times CF$$

where:

EPC_{air}	=	Air Exposure Point Concentration (µg/m^3)
EPC_{soil}	=	Soil Exposure Point Concentration (mg/kg)
TF	=	Transfer Factor (µg/m^3 per µg/kg)
CF	=	Conversion Factor (1000 µg/mg)

The calculated vapor EPCs in outdoor air and trench air for the volatile COPCs (ammonia, naphthalene, hexachlorobenzene, and octachlorostyrene) are presented in Tables 7-1a and 7-1b based on the soil EPCs at 0-2 and 0-10 feet bgs depth intervals as the source term concentrations, respectively.

7.3 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., soil, air), and the frequency, intensity, and duration of contact with that medium. In order to quantify exposures, an upper-bound estimate of the theoretical intake was developed for each of the potentially exposed human populations via each of the exposure pathways identified in the CSM, and the exposure dose was calculated by multiplying the EPC in the exposure medium by the intake factor. For carcinogens, lifetime average daily dose (LADD), based on chronic lifetime exposure averaged over a 70-year lifetime, is used in the risk characterization, while for noncarcinogens, average daily dose (ADD), based on exposure averaged over the exposure period, is used (USEPA 1989). This section provides the equations and assumptions used to develop the intake factors used in the risk characterization.

7.3.1 Chemicals

The exposure assumptions and calculated intake factors for chemicals are presented in Table 7-7. Exposure assumptions recommended by NDEP (2017a) were used for the indoor and outdoor commercial/industrial workers. For the construction workers, exposure assumptions recommended by USEPA (2021a) were used, except that a trench scenario was evaluated assuming that the construction workers could be exposed to volatile compounds migrating from soil to air in a construction trench when conducting excavation activities for four hours per day, 30 days per year for one year, per NDEP's comment on the soil gas HRA for Parcels C, D, F, G, and H (NDEP 2017b, General Comment #3). Currently, no commercial/industrial workers are regularly working in the Central Retention Basin (EU-4), and only some workers occasionally conduct soil or groundwater well sampling in this area. Therefore, an outdoor commercial/ industrial worker scenario (i.e., utility/maintenance workers) was also evaluated for EU-4, conservatively assuming potential exposure through direct contact with shallow soils (0–2 feet bgs) would occur one hour per day, one day per month for five years.

Soil Ingestion

The intake factor for soil ingestion was calculated using the following equation (USEPA 1989):

$$IF_{soil.ing} = \frac{IR_S \times EF \times ED \times CF}{BW \times AT}$$

where:

$IF_{soil.ing}$	=	Intake Factor for soil ingestion (kg of soil/kg body weight-day)
IR_s	=	Soil Ingestion Rate (mg of soil/day)
EF	=	Exposure Frequency (day/year)
ED	=	Exposure Duration (year)
BW	=	Body Weight (kg)
AT	=	Averaging Time (day)
CF	=	Conversion Factor (kg of soil/mg of soil)

Dermal Contact with Soil

The intake factor for dermal contact with soil was calculated using the following equation (USEPA 2004a):

$$IF_{soil.derm} = \frac{AF \times SA_s \times EF \times ED \times CF}{BW \times AT}$$

where:

$IF_{soil.derm}$	=	Intake Factor for dermal contact with soil (kg of soil/kg body weight-day)
AF	=	Adherence Factor (mg of soil/square centimeter [cm^2])
SA_s	=	Skin Surface Area for soil contact (cm^2/day)
EF	=	Exposure Frequency (day/year)
ED	=	Exposure Duration (year)
BW	=	Body Weight (kg)
AT	=	Averaging Time (day)
CF	=	Factor (kg of soil/mg of soil)

Inhalation of Airborne Particulates or Vapor Migrating from Soil to Air

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

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

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)

7.3.2 Asbestos

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

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

where:

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

8. TOXICITY ASSESSMENT

The purpose of 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).

Oral CSFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, and 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 exposure to potentially carcinogenic chemicals. The CSF and IUR are defined as an upper-bound estimate of the probability of an individual developing cancer per unit intake or concentration of a potential carcinogen over a lifetime. With CSFs and IURs, a higher value implies a more potent carcinogenic potential.

Noncancer oral RfDs, which are expressed in units of mg/kg-day, and 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 exposure to chemicals. The RfD and RfC are intended to represent the dose or concentration of a chemical that is not expected to cause adverse health effects, assuming daily exposure over the exposure duration, even in sensitive individuals, with a substantial margin of safety. With RfDs and RfCs, a lower value implies a more potent toxicant.

The toxicity values used for chemicals and asbestos are discussed in the following subsections.

8.1 Chemicals

For chemicals, an initial list of chronic toxicity values was developed based on the values used by NDEP for the derivation of the 2017 BCLs (NDEP 2017a). 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 2017 BCL table against the identified source to confirm that the most current values were being used. Particularly, the most recent toxicity values from IRIS (USEPA 2021c) were used for BaPEq.

For COPCs not listed in the 2017 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 2021b) were used; and
- For COPCs for which toxicity values were not available from any of the sources listed, the toxicity values from surrogate chemicals (chemicals with similar chemical structure) were used.

For construction workers assumed to be present at the BHRA Study Area for one year and outdoor utility/maintenance workers who were assumed to be present in EU-4 for five years, subchronic toxicity values were used whenever available for the evaluation of adverse noncancer effects in accordance with recommendations by USEPA (2021a). The subchronic toxicity values were obtained from the USEPA RSL table (USEPA 2021b), which generally follows the hierarchy of sources as below:

- USEPA Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV);
- Agency for Toxic Substances & Disease Registry (ATSDR) Minimal Risk Levels (MRLs);
- USEPA PPRTV Appendix Values; and
- USEPA's Health Effects Assessment (HEAST) Summary Tables.

Specific dermal route toxicity values have not yet been developed for any chemicals. Consistent with NDEP and USEPA guidance, potential health effects associated with dermal exposure were calculated using the oral toxicity values.

Route-to-route extrapolation was not applied, which is consistent with the updated BCL Guidance (NDEP 2017a) and *Risk Assessment Guidance for Superfund, Part F, Supplemental Guidance for Inhalation Risk Assessment* (USEPA 2009a).

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

The chronic and subchronic toxicity values for the soil COPCs are presented in Table 8-1. The uncertainties in the selection of toxicity values are further discussed in Section 10.2.3.

8.2 Asbestos

The IURs for asbestos are based on the estimated additional deaths from lung cancer or mesothelioma due to constant lifetime exposure, which are calculated using the following equation (Neptune 2015):

$$R = 0.5 \times \Big(\big(0.786 \times (NSM + NSF)\big) + \big(0.214 \times (SM + SF)\big) \Big)$$

where:

R	=	Estimated additional deaths from lung cancer or mesothelioma per 100,000 persons from constant lifetime exposure to 0.0001 transmission electron microscopy fiber per cubic centimeter (f/cm^3) longer than 10 µm and thinner than 0.4 µm
NSM	=	Risk coefficient for population of non-smoking males
NSF	=	Risk coefficient for population of non-smoking females
SM	=	Risk coefficient for population of smoking males
SF	=	Risk coefficient for population of smoking females

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

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

where:

IUR	=	Inhalation Unit Risk (f/cm^3)$^{-1}$
R	=	Estimated additional deaths from lung cancer or mesothelioma per 100,000 persons from constant lifetime exposure to 0.0001 f/cm^3 longer than 10 µm and thinner than 0.4 µm

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

9. 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. Potential excess lifetime cancer risks and noncancer adverse health effects for each non-asbestos COPC in soil of the BHRA Study Area were characterized separately. In addition, potential cancer risks associated with exposure to asbestos in soil of the BHRA Study Area were characterized separately from carcinogenic chemicals. Furthermore, the potential risks to populations within the BHRA Study Area related to exposures to airborne releases of particulates and vapors from soil in neighboring sites were evaluated quantitatively based the results of soil investigations and risk assessments prepared for those sites under the oversight of NDEP.

The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] § 300) is cited as the basis for the target cancer risk range established by NDEP (2017a). According to the NCP, lifetime incremental cancer risks posed by a site should not exceed 1 x 10^{-6} to 1 x 10^{-4}.[46] According to the NCP and NDEP (2017a), noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., an HI greater than one).

It should be noted that the cancer risk and noncancer hazard estimated in this BHRA do not represent absolute estimates in OU-1, since generic and conservative assumptions were used, which are likely to overestimate actual exposures and calculated risks. Exceedance of the target cancer risk range of 10^{-6} to 10^{-4} or the target noncancer HI of greater than one does not indicate that adverse impacts to human health are occurring or will occur but suggests that further evaluation may be warranted.

9.1 Soil in BHRA Study Area

9.1.1 Cancer Risks: Chemicals

The excess lifetime cancer risk is estimated as the upper-bound incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen at a given concentration. The equation used to calculate cancer risk for indoor commercial/industrial workers due to exposure via incidental soil ingestion and inhalation of airborne dust particulates and vapor is as follows:

$$Cancer\ Risk = (EPC_{soil} \times IF_{soil.ing} \times RBA_{oral} \times CSF_{oral}) + (EPC_{air} \times IF_{inh} \times IUR)$$

where:

EPC_{soil}	=	Soil Exposure Point Concentration (mg/kg)
EPC_{air}	=	Air Exposure Point Concentration (µg/m^3)
$IF_{soil.ing}$	=	Intake Factor for soil ingestion (kg of soil/kg body weight-day)
IF_{inh}	=	Intake Factor for air inhalation (unitless)

[46] According to NDEP (2017a), the acceptability of any calculated incremental cancer risk is generally evaluated relative to the target risk range of 10^{-6} to 10^{-4} described in the NCP.

RBA_{oral}	=	Relative Bioavailability for oral ingestion (unitless)
CSF_{oral}	=	Oral Cancer Slope Factor (mg/kg body weight-day)$^{-1}$
IUR	=	Inhalation Unit Risk (µg/m^3)$^{-1}$

A RBA_{oral} was assumed to be 24% for dioxin TEQ, which was derived based on a study that evaluated the bioaccessibility of dioxins in soils collected from the Site (Northgate 2010f) and used in the calculation of the NDEP-approved Site-specific action level of 0.0027 mg/kg. The RBA_{oral} value for all the other COPCs was conservatively assumed to be 100%.

The equation used to calculate cancer risk for outdoor commercial/industrial workers (including outdoor utility/maintenance workers in EU-4) and construction workers due to exposure via incidental soil ingestion, dermal contact, and inhalation of airborne soil particulates and vapor is as follows:

$$\textit{Cancer Risk} = EPC_{soil} \times (IF_{soil.ing} \times RBA_{oral} + IF_{soil.derm} \times ABS) \times CSF_{oral} + EPC_{air} \times IF_{inh} \times IUR$$

where:

EPC_{soil}	=	Soil Exposure Point Concentration (mg/kg)
EPC_{air}	=	Air Exposure Point Concentration (µg/m^3)
$IF_{soil.ing}$	=	Intake Factor for soil ingestion (kg of soil/kg body weight-day)
$IF_{soil.derm}$	=	Intake Factor for dermal contact with soil (kg of soil/kg body weight-day)
IF_{inh}	=	Intake Factor for air inhalation (unitless)
RBA_{oral}	=	Relative Bioavailability for oral ingestion (unitless)
ABS	=	Soil Absorption Factor (unitless)
CSF_{oral}	=	Oral Cancer Slope Factor (mg/kg body weight-day)$^{-1}$
IUR	=	Inhalation Unit Risk (µg/m^3)$^{-1}$

ABS used in the risk calculation are presented in Table 8-1.

The detailed calculation of cancer risks for each receptor population in each EU are presented in Appendix K. The estimated excess lifetime cancer risk for each carcinogenic COPC was conservatively summed for each EU, regardless of the type of cancer, to estimate the total cancer risk from soil COPCs for an exposed individual. The cancer risk results for the nine EUs in OU-1 are shown for each COPC and exposure route in Appendix K, Tables K-1 through K-27. The cancer risk results for the nine EUs in OU-1 are summarized in Table 9-1 and discussed as follows:

EU-1

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-1 were 2 x 10^{-7} (0-2 feet bgs) and 1 x 10^{-7} (0-10 feet bgs) for indoor commercial/industrial workers, 2 x 10^{-7} (both 0-2 and 0-10 feet bgs) for outdoor commercial/industrial workers, and 2 x 10^{-8} (0-10 feet bgs) for construction workers, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at three locations within EU-1 (Figure 6-8). However, when comparing the distribution of all 49 arsenic samples in EU-1 against the BRC/TIMET regional background data set, arsenic concentrations were consistent with the background levels based on statistical testing (see Appendix J), and therefore arsenic was not identified as a soil COPC in EU-1. In summary, the three arsenic sample locations exceeding the maximum BRC/TIMET background value were not of concern and were not included in the cancer risk calculation due to consistency between the arsenic concentration distribution over the entire EU-1 and the BRC/TIMET regional background data set.

Given these findings, potential exposure to COPCs in soil in EU-1 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-1.

EU-2

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-2 were 3 x 10^{-6} (both 0-2 and 0-10 feet bgs) for indoor commercial/industrial workers, and 8 x 10^{-6} (0-2 feet bgs) and 7 x 10^{-6} (0-10 feet bgs) for outdoor commercial/industrial workers, which were within the NDEP acceptable risk range of 10^{-6} to 10^{-4}; and 9 x 10^{-7} (0-10 feet bgs) for construction workers, which was below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- The cancer risk driver was dioxin TEQ for indoor and outdoor commercial/industrial workers, the concentrations of which would correspond to cancer risks of 3 x 10^{-6} (0-2 feet bgs) and 2 x 10^{-6} (0-10 feet bgs) for indoor commercial/industrial workers, and 7 x 10^{-6} (0-2 feet bgs) and 6 x 10^{-6} (0-10 feet bgs) for outdoor commercial/industrial workers.
- It should be noted that the Site-specific action level for dioxin TEQ (0.0027 mg/kg) would correspond to a cancer risk of 6 x 10^{-5} for an outdoor commercial/industrial worker (Northgate 2010f), which is higher than the cancer risks listed above for dioxin TEQ in EU-2.
- Further, as described in Section 6.2, the dioxin TEQ exceeded the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker in only one out of 107 samples collected in EU-2 (Figure 6-8), but this singular exceedance was not of concern from a cancer risk perspective as described above.
- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at one location within EU-2 (Figure 6-8). However, when comparing the distribution of all 84 arsenic samples in EU-2 against the BRC/TIMET regional background data set, arsenic concentrations were consistent

with the background levels based on statistical testing (see Appendix J), and therefore arsenic was not identified as a soil COPC in EU-2. In summary, the one arsenic sample location exceeding the maximum BRC/TIMET background value was not of concern and were not included in the cancer risk calculation due to consistency between the arsenic concentration distribution over the entire EU-2 and the BRC/TIMET regional background data set.

Given these findings, potential exposure to COPCs in soil in EU-2 is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-2.

EU-3

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-3 were 1×10^{-5} (0-2 feet bgs) and 5×10^{-6} (0-10 feet bgs) for indoor commercial/industrial workers, 3×10^{-5} (0-2 feet bgs) and 1×10^{-5} (0-10 feet bgs) for outdoor commercial/ industrial workers, and 2×10^{-6} (0-10 feet bgs) for construction workers, which were within the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- The cancer risk driver was dioxin TEQ for all worker populations, the concentrations of which would correspond to cancer risks of 9×10^{-6} (0-2 feet bgs) and 5×10^{-6} (0-10 feet bgs) for indoor commercial/industrial workers, 3×10^{-5} (0-2 feet bgs) and 1×10^{-5} (0-10 feet bgs) for outdoor commercial/industrial workers, and 2×10^{-6} (0-10 feet bgs) for construction workers.
- It should be noted that the Site-specific action level for dioxin TEQ (0.0027 mg/kg) would correspond to a cancer risk of 6×10^{-5} for an outdoor commercial/industrial worker (Northgate 2010f), which is higher than the cancer risks listed above for dioxin TEQ in EU-3.
- Further, as described in Section 6.2, the dioxin TEQ exceeded the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker in only two out of 151 samples collected in EU-3 (Figure 6-8), and these limited exceedances were not of concern from a cancer risk perspective as described above.
- Chromium VI was the metal COPC with carcinogenic effects in EU-3. However, the contributions from background chromium VI concentrations in soil to cancer risks were negligible, i.e., chromium VI was not detected in the BRC/TIMET regional background data set.
- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at five locations within EU-3 (Figure 6-8). However, when comparing the distribution of all 147 arsenic samples in EU-3 against the BRC/TIMET regional background data set, arsenic concentrations were consistent with the background levels based on statistical testing (see Appendix J), and therefore arsenic was not identified as a soil COPC in EU-3. In summary, the five arsenic sample locations exceeding the maximum BRC/TIMET background value were not of concern and were not included in the cancer risk calculation due to consistency between the arsenic concentration distribution over the entire EU-3 and the BRC/TIMET regional background data set.

Given these findings, potential exposure to COPCs in soil in EU-3 is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-3.

EU-4

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-4 were 1×10^{-6} (both 0-2 feet bgs and 0-10 feet bgs) for indoor commercial/industrial workers, 4×10^{-7} (0-10 feet bgs) for construction workers, and 2×10^{-8} (0-2 feet bgs) for outdoor utility/maintenance workers, which were at or below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}; and 2×10^{-6} (0-2 feet bgs) and 3×10^{-6} (0-10 feet bgs) for outdoor commercial/industrial workers, which were within the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- The cancer risk driver was arsenic for outdoor commercial/industrial workers, the concentrations of which would correspond to cancer risks of 2×10^{-6} (0-2 feet bgs) and 3×10^{-6} (0-10 feet bgs).
- Excluding contribution from background metals in soil, the excess lifetime cancer risks due to exposure to chemicals in soil in EU-4 were 2×10^{-7} (0-2 feet bgs) and 4×10^{-7} (0-10 feet bgs) for indoor commercial/industrial workers, 3×10^{-7} (0-2 feet bgs) and 7×10^{-7} (0-10 feet bgs) for outdoor commercial/industrial workers, 1×10^{-7} (0-10 feet bgs) for construction workers, and 3×10^{-9} (0-2 feet bgs) for outdoor utility/maintenance workers, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at four locations within EU-4 (Figure 6-8). However, as indicated in Appendix K, Tables K-10 through K-12, the estimated cancer risks for arsenic were below 10^{-6} when calculated based on the 95% UCL on the mean concentration of 70 soil samples collected in EU-4 and excluding the contribution from background arsenic in soil. In summary, the four arsenic sample locations exceeding the maximum BRC/TIMET background value were not of concern because the arsenic cancer risks over the entire EU-4 were minimal after excluding the background contribution.

Given these findings, potential exposure to COPCs in soil in EU-4 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-4.

EU-5

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-5 were 1×10^{-7} (both 0-2 and 0-10 feet bgs) for indoor commercial/industrial workers, 2×10^{-7} (0-2 feet bgs) and 1×10^{-7} (0-10 feet bgs) for outdoor commercial/industrial workers, and 3×10^{-7} (0-10 feet bgs) for construction workers, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- Excluding contribution from background metals in soil, the excess lifetime cancer risks due to exposure to chemicals in soil in EU-5 remained the same for indoor and

outdoor commercial/industrial workers and decreased to 2×10^{-7} (0-10 feet bgs) for construction workers.

- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at two locations within EU-5 (Figure 6-8). However, when comparing the distribution of all 129 arsenic samples in EU-5 against the BRC/TIMET regional background data set, arsenic concentrations were consistent with the background levels based on statistical testing (see Appendix J), and therefore arsenic was not identified as a soil COPC in EU-5. In summary, the two arsenic sample locations exceeding the maximum BRC/TIMET background value were not of concern and were not included in the cancer risk calculation due to consistency between the arsenic concentration distribution over the entire EU-5 and the BRC/TIMET regional background data set.

Given these findings, potential exposure to COPCs in soil in EU-5 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-5.

EU-6

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-6 were 2×10^{-7} (0-2 feet bgs) and 1×10^{-7} (0-10 feet bgs) for indoor commercial/industrial workers, 3×10^{-7} (0-2 feet bgs) and 2×10^{-7} (0-10 feet bgs) for outdoor commercial/industrial workers, and 5×10^{-8} (0-10 feet bgs) for construction workers, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- Chromium VI was the metal COPC with carcinogenic effects in EU-6. However, the contributions from background chromium VI concentrations in soil to cancer risks were negligible, i.e., chromium VI was not detected in the BRC/TIMET regional background data set.
- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at one location within EU-6 (Figure 6-8). However, when comparing the distribution of all 72 arsenic samples in EU-6 against the BRC/TIMET regional background data set, arsenic concentrations were consistent with the background levels based on statistical testing (see Appendix J), and therefore arsenic was not identified as a soil COPC in EU-6. In summary, the one arsenic sample location exceeding the maximum BRC/TIMET background value was not of concern and were not included in the cancer risk calculation due to consistency between the arsenic concentration distribution over the entire EU-6 and the BRC/TIMET regional background data set.

Given these findings, potential exposure to COPCs in soil in EU-6 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-6.

EU-7

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-7 were 1×10^{-6} (0-2 feet bgs) and 2×10^{-6} (0-10 feet bgs) for indoor commercial/industrial workers, 2×10^{-6} (0-2 feet bgs) and 4×10^{-6} (0-10 feet bgs) for outdoor commercial/

industrial workers, and 2 x 10^{-6} (0-10 feet bgs) for construction workers, which were at or near the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.

- The cancer risk driver was chromium VI for all worker populations, the concentrations of which would correspond to cancer risks of 9 x 10^{-7} (0-2 feet bgs) and 2 x 10^{-6} (0-10 feet bgs) for indoor commercial/industrial workers, 2 x 10^{-6} (0-2 feet bgs) and 3 x 10^{-6} (0-10 feet bgs) for outdoor commercial/industrial workers, and 2 x 10^{-6} (0-10 feet bgs) for construction workers.
- Chromium VI was the metal COPC with carcinogenic effects in EU-7. However, the contributions from background chromium VI concentrations in soil to cancer risks were negligible, i.e., chromium VI was not detected in the BRC/TIMET regional background data set.
- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at two locations within EU-7 (Figure 6-8). However, when comparing the distribution of all 51 arsenic samples in EU-7 against the BRC/TIMET regional background data set, arsenic concentrations were consistent with the background levels based on statistical testing (see Appendix J), and therefore arsenic was not identified as a soil COPC in EU-7. In summary, the two arsenic sample locations exceeding the maximum BRC/TIMET background value were not of concern and were not included in the cancer risk calculation due to consistency between the arsenic concentration distribution over the entire EU-7 and the BRC/TIMET regional background data set.

Given these findings, potential exposure to COPCs in soil in EU-7 is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-7.

EU-8

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-8 were 2 x 10^{-7} (0-2 feet bgs) and 1 x 10^{-7} (0-10 feet bgs) for indoor commercial/industrial workers, 4 x 10^{-7} (0-2 feet bgs) and 3 x 10^{-7} (0-10 feet bgs) for outdoor commercial/industrial workers, and 4 x 10^{-8} (0-10 feet bgs) for construction workers, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.

Given these findings, potential exposure to COPCs in soil in EU-8 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-8.

EU-9

- The excess lifetime cancer risks due to exposure to chemicals in soil in EU-9 were 1 x 10^{-6} (0-2 feet bgs) and 7 x 10^{-6} (0-10 feet bgs) for indoor commercial/industrial workers, 2 x 10^{-6} (0-2 feet bgs) and 2 x 10^{-5} (0-10 feet bgs) for outdoor commercial/industrial workers, and 3 x 10^{-6} (0-10 feet bgs) for construction workers, which were at the lower end or within the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- The cancer risk driver was arsenic for the 0-2 feet bgs exposure scenarios, the concentrations of which would correspond to cancer risks of 8 x 10^{-7} for indoor commercial/industrial workers and 2 x 10^{-6} for outdoor commercial/industrial

workers. The cancer risk driver was dioxin TEQ for the 0-10 feet bgs exposure scenarios, the concentrations of which would correspond to cancer risks of 6×10^{-6} for indoor commercial/industrial workers, 2×10^{-5} for outdoor commercial/industrial workers, and 2×10^{-6} for construction workers.

- Excluding contribution from background metals in soil, the excess lifetime cancer risks for the 0-2 feet bgs exposure scenarios were 5×10^{-7} for indoor commercial/ industrial workers and 1×10^{-6} for outdoor commercial/industrial workers, which were below or at the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}. The excess lifetime cancer risks for the 0-10 feet bgs exposure scenarios were 6×10^{-6} for indoor commercial/industrial workers, 2×10^{-5} for outdoor commercial/ industrial workers, and 2×10^{-6} for construction workers, which were within the NDEP acceptable risk range of 10^{-6} to 10^{-4} and driven by dioxin TEQ as discussed above.
- As described in Section 6.2, arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at one location within EU-9 (Figure 6-8). However, as indicated in Appendix K, Tables K-25 through K-27, the estimated cancer risks for arsenic were below 10^{-6} when calculated based on the 95% UCL on the mean concentration of 61 soil samples collected in EU-9 and excluding the contribution from arsenic in background soil. In summary, the one arsenic sample location exceeding the maximum BRC/TIMET background value was not of concern because the arsenic cancer risks over the entire EU-9 were minimal after excluding the background contribution.
- It should be noted that the Site-specific action level for dioxin TEQ (0.0027 mg/kg) would correspond to a cancer risk of 6×10^{-5} for an outdoor commercial/industrial worker (Northgate 2010f), which is higher than the cancer risks listed above for dioxin TEQ in EU-9.
- Further, as described in Section 6.2, the dioxin TEQ exceeded the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker in only one out of 36 samples collected in EU-9 (Figure 6-8), but this singular exceedance was not of concern from a cancer risk perspective as described above.

Given these findings, potential exposure to COPCs in soil in EU-9 is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cancer risk results for EU-9.

9.1.2 Noncancer Health Effects: Chemicals

The likelihood of noncancer adverse effects is quantified by the development of an HQ. The HQ represents the ratio of the estimated exposure to a noncarcinogen at a given concentration to a value that is believed not to produce noncancer adverse health effects. The equation used to calculate noncancer HQ for indoor commercial/industrial workers due to exposure via incidental soil ingestion and inhalation of airborne dust particulates and vapor is as follows:

$$HQ = EPC_{soil} \times IF_{soil.ing} \times RBA_{oral}/RfD_{oral} + EPC_{air} \times IF_{inh}/RfC_{inh}$$

where:

HQ	=	Hazard Quotient
EPC_{soil}	=	Soil Exposure Point Concentration (mg/kg)
EPC_{air}	=	Air Exposure Point Concentration (µg/m^3)
$IF_{soil.ing}$	=	Intake Factor for soil ingestion (kg of soil/kg body weight-day)
IF_{inh}	=	Intake Factor for air inhalation (unitless)
RBA_{oral}	=	Relative Bioavailability for oral ingestion (unitless)
RfD_{oral}	=	Oral Reference Dose (mg/kg body weight-day)
RfC_{inh}	=	Inhalation Reference Concentration (µg/m^3)

The equation used to calculate the noncancer HQ for outdoor commercial/industrial workers (including outdoor utility/maintenance workers in EU-4) and construction workers due to exposure via incidental soil ingestion, dermal contact, and inhalation of airborne soil particulates and vapor is as follows:

$$HQ = EPC_{soil} \times (IF_{soil.ing} \times RBA_{oral} + IF_{soil.derm} \times ABS)/RfD_{oral} + EPC_{air} \times IF_{inh}/RfC_{inh}$$

where:

HQ	=	Hazard Quotient
EPC_{soil}	=	Soil Exposure Point Concentration (mg/kg)
EPC_{air}	=	Air Exposure Point Concentration (µg/m^3)
$IF_{soil.ing}$	=	Intake Factor for soil ingestion (kg of soil/kg body weight-day)
RBA_{oral}	=	Relative Bioavailability for oral ingestion (unitless)
$IF_{soil.derm}$	=	Intake Factor for dermal contact with soil (kg of soil/kg body weight-day)
IF_{inh}	=	Intake Factor for air inhalation (unitless)
ABS	=	Soil Absorption Factor (unitless)
RfD_{oral}	=	Oral Reference Dose (mg/kg body weight-day)
RfC_{inh}	=	Inhalation Reference Concentration (µg/m^3)

The detailed calculation of noncancer HQs for each receptor population in each EU is presented in Appendix K. The estimated noncancer HQ for each COPC was conservatively summed for each EU, regardless of the target organ, to estimate the total noncancer HI from soil COPCs for an exposed individual. The noncancer HI results for the nine EUs in OU-1 are shown for each COPC and exposure route in Appendix K, Tables K-1 through K-27. The noncancer HI results for the nine EUs in OU-1 are summarized in Table 9-1 and discussed as follows:

EU-1

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-1 were 0.05 (0-2 feet bgs) and 0.03 (0-10 feet bgs) for indoor commercial/industrial workers, 0.09 (0-2 feet bgs) and 0.06 (0-10 feet bgs) for outdoor commercial/industrial workers, and 0.3 (0-10 feet bgs) for construction workers, which were below the NDEP target HI of greater than one.

Given these findings, potential exposure to COPCs in soil in EU-1 does not pose an unacceptable noncarcinogenic health effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the noncancer HI results for EU-1.

EU-2

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-2 were 0.2 (0-2 feet bgs) and 0.1 (0-10 feet bgs) for indoor commercial/industrial workers, 0.4 (0-2 feet bgs) and 0.3 (0-10 feet bgs) for outdoor commercial/industrial workers, and 0.5 (0-10 feet bgs) for construction workers, which were below the NDEP target HI of greater than one.

Given these findings, potential exposure to COPCs in soil in EU-2 does not pose an unacceptable noncarcinogenic health effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the noncancer HI results for EU-2.

EU-3

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-3 were 0.3 (0-2 feet bgs) and 0.2 (0-10 feet bgs) for indoor commercial/industrial workers, 0.8 (0-2 feet bgs) and 0.4 (0-10 feet bgs) for outdoor commercial/industrial workers, and one (0-10 feet bgs) for construction workers, which were below the NDEP target HI of greater than one.
- Excluding contribution from background metals in soil, the noncancer HIs due to exposure to chemicals in soil in EU-3 remained the same for indoor and outdoor commercial/industrial workers, and decreased to 0.6 (0-10 feet bgs) for construction workers.

Given these findings, potential exposure to COPCs in soil in EU-3 does not pose an unacceptable noncarcinogenic health effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the noncancer HI results for EU-3.

EU-4

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-4 were 0.6 (0-2 feet bgs) and 0.4 (0-10 feet bgs) for indoor commercial/industrial workers, one (0-2 feet bgs) and 0.6 (0-10 feet bgs) for outdoor commercial/industrial workers, and 0.05 (0-2 feet bgs) for outdoor utility/maintenance workers, which were below the NDEP target HI of greater than one. The estimated noncancer HI due to

exposure to chemicals in soil in EU-4 was two (0-10 feet bgs) for construction workers, which was above the NDEP target HI of greater than one.

- The noncancer HI driver for construction workers was perchlorate, the concentration of which would correspond to a noncancer HQ of two.
- The contribution from background metals in soil was negligible, and the noncancer HIs remained the same for all worker populations after excluding the background contribution.
- The calculation of noncancer HQs for construction workers (solely driven by perchlorate) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust), a very conservative default soil ingestion rate (330 mg/day), and an exposure time of eight hours per day and an exposure frequency of 250 days per year in EU-4. Under current conditions, only some utility/maintenance workers employed by NERT or its subcontractors are anticipated to occasionally conduct soil or groundwater well sampling (e.g., one hour per day, one day per month) in EU-4 located outside the EMD leasehold area. No subchronic toxicity values were available for perchlorate, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, the calculated noncancer HI associated with potential exposure to COPCs in soil at 0-10 feet bgs in EU-4 was above the target level under a conservative construction worker scenario, due to the presence of perchlorate in soil in the Central Retention Basin. However, potential exposure to COPCs in soil in EU-4 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers or outdoor utility/maintenance workers.

EU-5

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-5 were 0.2 (0-2 feet bgs) and 0.1 (0-10 feet bgs) for indoor commercial/industrial workers, and 0.3 (0-2 feet bgs) and 0.2 (0-10 feet bgs) for outdoor commercial/industrial workers, which were below the NDEP target HI of greater than one. The estimated noncancer HI due to exposure to chemicals in soil in EU-5 was three (0-10 feet bgs) for construction workers, which was above the NDEP target HI of greater than one.
- The noncancer HI driver for construction workers was manganese, the concentration of which would correspond to a noncancer HQ of three.
- Excluding contribution from background metals in soil, the noncancer HIs for the 0-10 feet bgs exposure scenarios remained the same for all worker populations, and decreased to 0.1 and 0.2 for the 0-2 feet bgs exposure scenarios of indoor and outdoor commercial/industrial workers, respectively.
- The calculation of noncancer HQs for construction workers in EU-5 located within the EMD leasehold area (solely driven by manganese) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for

manganese, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, the calculated noncancer HI associated with potential exposure to COPCs in soil at 0-10 feet bgs in EU-5 was above the target level under a construction worker scenario, due to the presence of manganese in soil in this EU. However, potential exposure to COPCs in soil in EU-5 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers.

EU-6

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-6 were 0.1 (0-2 feet bgs) and 0.06 (0-10 feet bgs) for indoor commercial/industrial workers, and 0.2 (0-2 feet bgs) and 0.1 (0-10 feet bgs) for outdoor commercial/industrial workers, which were below the NDEP target HI of greater than one. The estimated noncancer HI due to exposure to chemicals in soil in EU-6 was three (0-10 feet bgs) for construction workers, which was above the NDEP target HI of greater than one.
- The noncancer HI driver for construction workers was manganese, the concentration of which would correspond to a noncancer HQ of three.
- Excluding contribution from background metals in soil, the noncancer HIs were 0.09 (0-2 feet bgs) and 0.05 (0-10 feet bgs) for indoor commercial/industrial workers, 0.2 (0-2 feet bgs) and 0.09 (0-10 feet bgs) for outdoor commercial/industrial workers, and two (0-10 feet bgs) for construction workers.
- The calculation of noncancer HQs for construction workers in EU-6 located outside the EMD leasehold area (solely driven by manganese) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for manganese, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, the calculated noncancer HI associated with potential exposure to COPCs in soil at 0-10 feet bgs in EU-6 was above the target level under a construction worker scenario, due to the presence of manganese in soil in this EU. However, potential exposure to COPCs in soil in EU-6 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers.

EU-7

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-7 were 0.08 (0-2 feet bgs) and 0.3 (0-10 feet bgs) for indoor commercial/industrial workers, and 0.1 (0-2 feet bgs) and 0.5 (0-10 feet bgs) for outdoor commercial/industrial workers, which were below the NDEP target HI of greater than one. The estimated noncancer HI due to exposure to chemicals in soil in EU-7 was two (0-10 feet bgs) for construction workers, which was above the NDEP target HI of greater than one.
- The noncancer HI driver for construction workers was perchlorate, the concentration of which would correspond to a noncancer HQ of one.

- The contributions from background metals in soil to noncancer HIs were negligible, i.e., chromium VI was not detected in the BRC/TIMET regional background data set.
- The calculation of noncancer HQs for construction workers in EU-7 located outside the EMD leasehold area (solely driven by perchlorate) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for perchlorate, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, the calculated noncancer HI associated with potential exposure to COPCs in soil at 0-10 feet bgs in EU-7 was above the target level under a construction worker scenario, due to the presence of perchlorate in soil in this EU. However, potential exposure to COPCs in soil in EU-7 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers.

EU-8

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-8 were 0.007 (0-2 feet bgs) and 1 (0-10 feet bgs) for indoor commercial/industrial workers, and 0.01 (0-2 feet bgs) for outdoor commercial/industrial workers, which were below the NDEP target HI of greater than one. The estimated noncancer HIs due to exposure to chemicals in soil in EU-8 were two (0-10 feet bgs) for outdoor commercial/industrial workers and seven (0-10 feet bgs) for construction workers, which were above the NDEP target HI of greater than one.
- The noncancer HI driver for outdoor commercial/industrial workers and construction workers was perchlorate, the concentrations of which would correspond to noncancer HQs of two and seven, respectively. It should be noted that among all six soil samples collected at 0-10 feet bgs in EU-8, the perchlorate concentrations were very low ranging from 0.99 to 59 mg/kg, except that the perchlorate concentration in one sample at five feet bgs at RI-20 was elevated at 2,400 mg/kg (see Appendix B, Table B-1). The elevated perchlorate concentration in this one sample led to an EPC of 1,600 mg/kg based on the 95% UCL on the mean concentration of soil samples collected at 0-10 feet bgs in EU-8 (see Table 7-1b) as well as the exceedances of the target level for noncancer HIs.
- The contributions from background zirconium in soil to noncancer HIs cannot be evaluated, because zirconium was not analyzed in the RZ-A background data set.
- The calculation of noncancer HQs for construction workers in EU-8 located outside the EMD leasehold area (solely driven by perchlorate) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for perchlorate, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, the calculated noncancer HIs associated with potential exposure to COPCs in soil at 0-10 feet bgs in EU-8 were above the target level under outdoor

commercial/industrial worker and construction worker scenarios, due to the elevated perchlorate concentration in a single soil sample collected in this EU. However, potential exposure to COPCs in soil in EU-8 does not pose an unacceptable noncarcinogenic health effect to indoor commercial/industrial workers.

EU-9

- The estimated noncancer HIs due to exposure to chemicals in soil in EU-9 were 0.1 (0-2 feet bgs) and 0.3 (0-10 feet bgs) for indoor commercial/industrial workers, 0.2 (0-2 feet bgs) and 0.7 (0-10 feet bgs) for outdoor commercial/industrial workers, and 0.8 (0-10 feet bgs) for construction workers, which were below the NDEP target HI of greater than one.
- The contribution from background metals in soil was negligible, and the noncancer HIs remained the same for all worker populations after excluding the background contribution.

Given these findings, potential exposure to COPCs in soil in EU-9 does not pose an unacceptable noncarcinogenic health effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the noncancer HI results for EU-9.

9.1.3 Cancer Risks: Asbestos

The equation for assessing inhalation cancer risk for asbestos is analogous to that used for other inhalation carcinogens (Neptune 2015), as follows:

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

where:

EPC_{air}	=	Air Exposure Point Concentration (f/m^3)
IF_{inh}	=	Intake Factor for air inhalation (unitless)
IUR	=	Inhalation Unit Risk $(f/cm^3)^{-1}$

The inhalation cancer risks for asbestos (combined risks associated with death from lung cancer and mesothelioma) were calculated using NDEP's "asbestos guidance riskcalcs.xls" spreadsheet, and are presented in Appendix K. The best estimate and upper-bound estimate of asbestos cancer risks for the nine EUs in OU-1 are summarized in Table 9-2 and discussed below.

As shown in Table 9-2, the best estimates and upper-bound estimates for all worker populations from potential inhalation exposure to long chrysotile fibers were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} in all nine EUs. Further, the counts of long chrysotile fibers were not above the RAW specified level of five or more fibers per sample (Northgate 2010a) in any samples (Figure 6-7).

For long amphibole fibers, the best estimates and upper-bound estimates for indoor and outdoor commercial/industrial workers (including outdoor utility/maintenance workers in EU-4) were below the lower end of the NDEP acceptable risk range in all EUs, except for the

upper-bound estimate for outdoor commercial/industrial workers in EU-4 (2×10^{-6}). The best estimates of risks from long amphibole fibers for construction workers were zero (no detection of long amphibole fibers) in all EUs, except for 1×10^{-6} in EU-9 and 2×10^{-6} in EU-3 which were at or near the lower end of the NDEP acceptable risk range. The upper-bound estimates of risks from long amphibole fibers for construction workers were at the lower end or within the NDEP acceptable risk range, ranging from 1×10^{-6} in EU-2 to 2×10^{-5} in EU-4. It should be noted that the upper-bound risk estimates for long amphibole fibers were based on an observed count of zero fibers in all EUs except EU-3 and in EU-9,[47] while the counts of long amphibole fibers were at or above the RAW specified level of one or more fibers per sample (Northgate 2010a) only at three sample locations in EU-3 and one sample location in EU-9 (Figure 6-6). Overall, potential exposure to asbestos in soil in all nine EUs is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. Uncertainties in the risk estimates for asbestos, including the impact of sample size, are discussed in Section 10.2.2.2.

9.2 Soil in Neighboring Sites

In addition to sources of contamination present within the NERT Site, contaminated surface soils and groundwater associated with industrial operations on adjacent neighboring sites are also considered potential former and/or current sources of contaminants to OU-1 (Figure 2-1). The potential risks for populations outside OU-1 related to exposures to airborne releases of particulates and vapors from soil in neighboring sites were evaluated quantitatively based on the results of soil investigations and risk assessments prepared by those responsible for those properties or others on behalf of the owners under the oversight of NDEP, as summarized in Table 9-3 and discussed in the following subsections. Whereas this report is limited to potential risks from adjacent soils to the east (TIMET), west (OSSM), and surrounded by the NERT BHRA Study Area (Lhoist North America Facility), the potential risks from the trespassing OSSM VOC groundwater plume originating from the west of OU-1 were evaluated in the OU-1 soil gas and groundwater BHRA report (Ramboll 2021a).

9.2.1 OSSM Site

The OSSM site is located to the west of OU-1. The layout of the OSSM site is presented in Figure 1.2 of Wood Environment & Infrastructure Solutions, Inc. (Wood 2020). Two risk assessment reports were identified for the Closed Ponds Area and Former Tank Farm as well as for the Former Benzene Storage Tank Site Assessment Area, while 10 soil investigation reports were identified for the Former Plant Site, the Beta and Western Ditch System, the Historical Caustic Storage Area, and another 10 LOUs present on the OSSM site.

The Human Health Risk Assessment for Closed Ponds Area and Former Tank Farm (Integral Consulting, Inc. [Integral] 2017) and the *Screening Level Risk Evaluation for Former Benzene Storage Tank Site Assessment Area* (Geosyntec Consultants [Geosyntec] 2012) both assessed the potential excess lifetime cancer risks and noncancer adverse health effects for a commercial/industrial outdoor worker scenario at the OSSM site. The exposure

[47] For asbestos, risks are estimated even in the case of zero fiber counts. As discussed in detail in Neptune (2015), the risk assessment results are affected by the calculation of the 95% UCL assuming a Poisson distribution, which for a fiber count of zero in soil samples, yields an upper-bound value of 3 f/g of soil (also see the discussion in Section 10.2.2.2).

pathways included ingestion, dermal contact, inhalation of vapors migrating from subsurface soils, and inhalation of fugitive dusts (or airborne particulates) from surface soils.

- In the Former Tank Farm (LOUs 18 and 19), the excess lifetime cancer risks for all four exposure pathways combined were below or within the NDEP acceptable risk range of 10^{-6} to 10^{-4}, while the excess lifetime cancer risks for inhalation of vapors and airborne particulates only were below the lower end of the NDEP acceptable risk range (less than 10^{-6}). The noncancer HIs for outdoor commercial/industrial workers were below the NDEP target HI of greater than one.
- In the Closed Ponds Area (LOUs 6, 15, 16, and 17), the excess lifetime cancer risks for all four exposure pathways combined were below or at the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}. The excess lifetime cancer risks for inhalation of vapors and airborne particulates only were below the lower end of the NDEP acceptable risk range (less than 10^{-6}). The noncancer HIs for outdoor commercial/industrial workers were below the NDEP target HI of greater than one.
- In the Former Benzene Storage Tank Site Assessment Area (LOUs 3 and 21), the excess lifetime cancer risks for all four exposure pathways combined were below or within the NDEP acceptable risk range of 10^{-6} to 10^{-4}, while the excess lifetime cancer risks for inhalation of vapors and airborne particulates only were below the lower end of the NDEP acceptable risk range (less than 10^{-6}) (by comparing against the soil BCLs for inhalation of airborne particulates and soil vapors). The noncancer HIs for outdoor commercial/industrial workers were below the NDEP target HI of greater than one. NDEP (2019) has determined that no further assessment or remediation of the top 10 feet soil in this area is required for an outdoor industrial/ commercial scenario at the OSSM site.

Since populations in the NERT BHRA Study Area would be exposed to much lower airborne particulate and vapor concentrations than workers at the OSSM site due to long-distance travel and mixing with ambient air before reaching the NERT BHRA Study Area, potential exposure to chemicals in soil in these areas does not pose an unacceptable carcinogenic or noncarcinogenic health effect to populations in the NERT BHRA Study Area.

Soil data (0-10 feet bgs) in the Former Plant Site obtained from Geosyntec (2017), in the Beta and Western Ditch System obtained from Hargis + Associates, Inc. (2017), and in the Historic Caustic Storage Area obtained from Wood (2020) were compared against the soil BCLs for inhalation of airborne particulates and soil vapors[48] (NDEP 2017a). Most analytes did not exceed the BCLs, except for the following:

- In the Former Plant Site (LOUs 1, 2, 4, 5, 13, 14, 20, 22, and 23), hexachlorobenzene exceeded the BCL in three of the 101 samples collected at 0-10 feet bgs, and 1,2-dibromo-3-chloropropane, 1,2,4-trichlorobenze, carbon tetrachloride, chloroform, and benzene exceeded their BCLs in one, one, two, five, and seven out of 104 samples collected at 0-10 feet bgs, respectively. For these chemicals, the exceedance frequencies were low (3.0%, 1.0%, 1.0%, 1.9%, 4.8%,

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

and 6.7%, respectively). Further, benzene is well known to degrade naturally due to aerobic respiration at many sites.

- In the northern segment of the Beta Ditch Extension, hexachlorobenzene exceeded the BCL in five out of the 35 samples collected at 0-10 feet bgs, and the exceedance frequency reached 14%. The distance between those five sample locations and the NERT BHRA Study Area ranged approximately from 0.05 miles to 0.25 miles, and hexachlorobenzene that volatilizes from soil in those sample locations will be subject to air dispersion which will lower the concentrations in the air before it reaches the NERT BHRA Study Area.

Soil data (0-10 feet bgs) were obtained from PES (2013) for LOUs 4, 5, and 9 as well as the uncapped areas of LOU 12, PES (2015) for LOUs 4 and 9, PES (2016) for LOUs 8 and 10 as well as capped areas of LOU 12, Wood (2018) for LOUs 17 and 20, PES (2018) for LOU 29, and Hargis + Associates, Inc. (2018 and 2020) for LOU 30. These soil data were compared against the soil BCLs for inhalation of airborne particulates and soil vapors (NDEP 2017a). Most analytes did not exceed the BCLs, except for the following:

- In LOU 8 (Former Agricultural Chemicals Division [ACD] plant), benzene exceeded the BCL in one out of 87 soil samples collected at 10 feet bgs or shallower, and the exceedance frequency was low (1.1%). Further, benzene is well known to degrade naturally due to aerobic respiration at many sites.
- In LOU 10 (Former Lindane Plant) and the capped areas of LOU 12 (Former BHC Cake Piles 1 and 2 and Former Haul Route), which were assessed together, and the uncapped areas of LOU 12 (BHC Cake Pile 3), alpha-BHC exceeded the BCL in one out of 87 and 42 soil samples collected at 0-10 feet bgs, respectively, and the exceedance frequencies were low (1.1% and 2.4%, respectively).
- In the uncapped areas of LOU 12, benzene exceeded the BCL in two out of eight soil samples collected at 0-10 feet bgs. The distance between LOU 12 and the NERT Site is approximately 0.5 miles, and benzene that volatilizes from soil in this area will be subject to air dispersion which will lower the concentrations in the air before it reaches the NERT BHRA Study Area. Further, benzene is well known to degrade naturally due to aerobic respiration at many sites.

In summary, although some exceedances of the soil BCLs for inhalation of airborne particulates and soil vapors were observed for shallow soil samples collected in the Former Plant Site, the Beta and Western Ditch System, and LOUs 8, 10, and 12, most of the exceedance frequencies were low. Further, populations in the NERT BHRA Study Area would be exposed to much lower airborne particulate and vapor concentrations than workers at the OSSM site due to long-distance travel and mixing with ambient air before reaching the NERT Site. Therefore, potential exposure to chemicals in soil in these areas is not expected to pose an unacceptable carcinogenic or noncarcinogenic health effect to populations in the NERT BHRA Study Area.

The two risk assessment reports (Integral 2017 and Geosyntec 2012) and two soil investigation reports (Hargis + Associates, Inc. 2018 and Wood 2020) included asbestos results in shallow soils for the Dichlorobenzil Warehouse, the Former Tank Farm, the Former Benzene Storage Tank Site Assessment Area, the Former Underground Benzene Storage

Tanks Area, and Historic Caustic Storage Area. The inhalation cancer risks for asbestos to indoor and outdoor commercial/industrial workers in the NERT BHRA Study Area were calculated by Ramboll using the "off-site" receptor scenario in NDEP's "asbestos guidance riskcalcs.xls" spreadsheet based on the asbestos data combined from the four OSSM reports. The best estimates and upper-bound estimates of cancer risks associated with death from lung cancer and mesothelioma for indoor and outdoor commercial/industrial workers in the NERT BHRA Study Area from potential inhalation of both long chrysotile fibers and long amphibole fibers were all at or below 8×10^{-7}, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}. Therefore, potential exposure to asbestos in soil within these areas at the OSSM site does not pose an unacceptable carcinogenic health effect to populations in the NERT BHRA Study Area.

Seven soil investigation reports (Geosyntec 2017, Hargis + Associates, Inc. 2017, PES 2013, PES 2015, PES 2016, PES 2018, and Wood 2018) also included some asbestos sampling results in shallow soils, but without sufficient information (i.e., fiber type and dimension, AS for individual soil samples) to calculate the inhalation cancer risks to workers in the NERT BHRA Study Area. Asbestos samples were collected in the Former Plant Site, in the Beta and Western Ditch System, in LOUs 4, 5, 8, 10, 12, 17, and 20, and in the vicinity of LOU 29. Asbestos fibers were not detected in LOU 5 or 12, or in the vicinity of LOU 29, but were detected in the Former Plant Site, the Beta and Western Ditch System, and LOUs 4, 8, 10, 17 and 20. For the Former Plant Site, Geosyntec (2017) compared the estimated asbestos soil concentration to the BCL calculated based on the size of this area, and no exceedance was observed. Low asbestos soil concentrations were observed in the Beta and Western Ditch System, ranging from < 0.25% to 0.5% (Hargis + Associates, Inc. 2017). There is an overlying clay and soil cover cap in LOU 4 and an overlying engineered asphalt-concrete cap in LOUs 8 and 10, which limit the exposure to asbestos in soil (PES 2013, 2016). Although the AS values for individual soil samples were not reported, Wood (2018) calculated the risks associated with asbestos in soil samples, which were negligible to populations present in or near LOUs 17 and 20. In summary, potential exposure to asbestos in soil within these areas at the OSSM site is not expected pose an unacceptable carcinogenic health effect to populations in the NERT BHRA Study Area.

9.2.2 TIMET Site

The TIMET site is located east of OU-1. As indicated in Figure 1 of Appendix A in GEI Consultants, Inc. (GEI 2020a), this property is divided into several management areas. Soil data (0-10 feet bgs) were obtained from 16 soil investigation/request for administrative closure reports identified for 19 management areas and compared against the soil BCLs for inhalation of airborne particulates and soil vapors (NDEP 2017a):

- No analytes exceeded the BCLs for Areas 5 and 8 (GEI 2015a), Area 6 (GEI 2015b), Area 10 (GEI 2017a), Area 11 (GEI 2019a), Area 15 (GEI 2017b), Area 16 (GEI 2020a), Area 17 (GEI 2020b), Area 18 (GEI 2020c), Area 19 (GEI 2019b), Area 21 (GEI 2016), and Area 22 (GEI 2017c).
- In the Pond SW-1 Area located in Area 13 (GEI 2015c and 2017d), chloroform and hexachlorobenzene exceeded the BCL in two and seven out of 10 soil samples collected at 0-10 feet bgs, respectively. Since 2015, excavation activities have occurred, and a high strength geotextile and geomembrane liner system was installed in 2018 (GEI 2019c).

- In Area 9 assessed in the *Request for Administrative Closure Area 9* (GEI 2015d), hexachlorobenzene exceeded the BCL in two out of three soil samples collected at 0-10 feet bgs. According to GEI (2015d), transport of soils by wind and water erosion from Area 9 would be prevented by the high-density polyethylene (HDPE) liner, geosynthetic clay liner, concrete, or asphalt over 87% of the area and coverage by type 2 stone in the remaining 13% of the area. NDEP (2015b) confirmed that the soil remedial actions are sufficient to be protective of human health and the environment under the current land uses and with the engineered controls in place for the referenced area.
- In Areas 1, 2, 3, 4, and 7 assessed together in the *Request for Administrative Closure Areas 1, 2, 3, 4, and 7* (GEI 2015e), hexachlorobenzene exceeded the BCL in seven out of 146 soil samples collected at 0-10 feet bgs, and the exceedance frequency was low (4.8%).

In summary, although some exceedances of the soil BCLs for inhalation of airborne particulates and soil vapors were observed for shallow soil samples collected in the Pond SW-1 Area, Area 9, and Areas 1, 2, 3, 4, and 7, either the exceedance frequency was low or certain types of remediation have been undertaken. Further, populations in the NERT BHRA Study Area would be exposed to much lower airborne particulate and vapor concentrations than workers at the TIMET site due to long-distance travel and mixing with ambient air before reaching the NERT BHRA Study Area. Therefore, potential exposure to chemicals in soil at the TIMET site is not expected to pose an unacceptable carcinogenic or noncarcinogenic health effect to populations in the NERT BHRA Study Area.

The reports for Areas 1, 2, 3, 4, and 7 (GEI 2015e), Areas 5 and 8 (GEI 2015a), Area 6 (GEI 2015b), Area 10 (GEI 2017a), Area 11 (GEI 2019a), Area 15 (GEI 2017b), and Area 19 (GEI 2019b) of the TIMET site included asbestos results in shallow soils. The inhalation cancer risks for asbestos to indoor and outdoor commercial/industrial workers in the NERT BHRA Study Area were calculated by Ramboll using the "off-site" receptor scenario in NDEP's "asbestos guidance riskcalcs.xls" spreadsheet based on the asbestos data combined from these management areas. The best estimates and upper-bound estimates of cancer risks associated with death from lung cancer and mesothelioma for indoor and outdoor commercial/industrial workers in the NERT BHRA Study Area from potential inhalation exposure to both long chrysotile fibers and long amphibole fibers were all at or below 9×10^{-7}, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}. Therefore, potential exposure to asbestos in soil within these areas at the TIMET site does not pose an unacceptable carcinogenic health effect to populations in the NERT BHRA Study Area.

Five soil investigation reports (GEI 2016, 2017c, 2020a, 2020b, and 2020c) also included some asbestos sampling results in shallow soils, but without sufficient information (i.e., fiber type and dimension, AS for individual soil samples) to calculate the inhalation cancer risks to workers in the NERT BHRA Study Area. Asbestos samples were collected and analyzed in Areas 16, 17, 18, 21, and 22. Asbestos fibers were not detected in Areas 16, 17, and 21, but were detected in Areas 18 and 22. Low asbestos soil concentration (<1% chrysotile) was observed in one sample in Area 18 (GEI 2020c). For Area 22, GEI (2017c) stated that the area of asbestos presence had been excavated and the surrounding soils were paved/repaved in July 2017; therefore, potential exposure associated with asbestos in soil

samples was low. In summary, potential exposure to asbestos in soil within these areas at the TIMET site is not expected to pose an unacceptable carcinogenic health effect to populations in the NERT BHRA Study Area.

9.2.3 Lhoist North America Facility

The Lhoist North America Facility is surrounded by the OU-1 boundary. No soil investigation data or risk assessment reports were identified for this facility; therefore, the potential risks from exposures of populations in the NERT BHRA Study Area to airborne releases of particulates and vapors from soil in the Lhoist North America Facility could not be evaluated.

10. UNCERTAINTY ANALYSIS

The process of risk assessment has inherent uncertainties associated with the calculations and assumptions used in the BHRA. 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.

10.1 Uncertainties Identified in the Data Usability Evaluation

10.1.1 Site Characterization Data

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

Soil data used in the OU-1 soil BHRA came from investigations following both judgmental and random sampling approaches, with judgmental samples collected at LOUs that had been identified as source areas. Soil samples collected from these locations were analyzed for the full suite of chemicals. Also, adequate soil samples were collected at 0-10 feet bgs. Overall, the placement of the soil sample locations was deemed representative to evaluate the soil conditions in the BHRA Study Area in the context of the CSM, and the relative uncertainty in the Site characterization data was considered to be low.

In addition to the soil BHRA data set, baseline (pre-treatment) soil data at 0-10 feet bgs were also collected from 20 locations in the Central Retention Basin during the Soil Flushing Treatability Study (Tetra Tech 2017c), from two locations in the former AP production area during the AP Area Down and Up Flushing Treatability Study (Tetra Tech 2018a), from nine locations in the Central Retention Basin during the In-Situ Chromium Treatability Study (Tetra Tech 2018b), and from four locations in the vicinity of the IWF within the former AP production area during the Vacuum Enhanced Recovery Treatability Study (Tetra Tech 2018c). The soil data from these treatability studies are not included in the BHRA because treatability study results were not collected for site characterization purposes and were not validated to the level required for site characterization and risk assessment by the QAPPs (Ramboll Environ 2017b). However, the risks associated with the baseline soil data from treatability studies (see Appendix M) are evaluated in this uncertainty analysis section in comparison with the risk results discussed in Section 9.1.

By comparing the baseline soil data from the treatability studies against the BCLs (or other applicable screening criteria), arsenic and perchlorate were identified as the only two chemicals that required further evaluation. Arsenic concentration was above the maximum BRC/TIMET background value of 7.2 mg/kg at only one location with the Central Retention Basin (47 mg/kg at six feet bgs in TT-TP1-B2-6 from the Soil Flushing Treatability Study, see Appendix M). If this sample is incorporated into the EPC calculation for arsenic in EU-4 at 0-10 feet bgs, the EPC would change from 5.5 mg/kg (see Table 7-1b) to 7.0 mg/kg, and the corresponding cancer risks would increase slightly but would still be at or below the lower end of NDEP acceptable risk range of 10^{-6} to 10^{-4}.

The noncancer HIs for commercial/industrial workers exposed to soil at 0-10 feet bgs calculated using baseline soil data from the treatability studies are presented in Figure 10-1, and perchlorate was the dominant driver chemical. As indicated in Figure 10-1, there were ten treatability sample locations with noncancer HIs above one, nine of which were located in Central Retention Basin. If the baseline soil data collected in the Central Retention Basin from the In-Situ Chromium Treatability Study and the Soil Flushing Treatability Study (see Appendix M) are incorporated into the EPC calculation for perchlorate, the EPC at 0-2 feet bgs would decrease from 890 mg/kg (see Table 7-1a) to 670 mg/kg, and the corresponding noncancer HIs would decrease slightly and would still be at or below one. The EPC at 0-10 feet bgs would increase from 560 mg/kg (see Table 7-1b) to 1,690 mg/kg; the corresponding noncancer HIs would increase from 0.4 to 1 for indoor commercial/ industrial workers, from 0.6 to 2 for outdoor commercial/industrial workers, and from 2 to 7 for construction workers.

10.1.2 Detection Limit

For soil analytes for which the detection frequency was less than 100%, the SQLs from the soil BHRA data set were compared to 0.1xBCL (or other applicable screening criteria) to confirm that they were sufficiently low for risk characterization (see Sections 4.1.5 and 6.3). As presented in Table 6-2, most of the SQLs in the BHRA Study Area were less than the screening levels, with a few exceptions in each EU (see Table 6-2). The impacts of SQLs above 0.1xBCL on the overall risk evaluation are discussed below.

EU-1

- For BaPEq and hexachlorobenzene: These chemicals were identified as soil COPCs for EU-1 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation (see Tables 7-1a and 7-1b). Therefore, SQLs above 0.1xBCL for these chemicals do not have any impact on the risk evaluation for EU-1.
- For aldrin, bis(2-chloroethyl) ether, dieldrin, heptachlor epoxide, n-nitroso-di-n-propylamine, pentachlorophenol, toxaphene, and zirconium: These chemicals were not identified as soil COPCs for EU-1. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-1, it would not have an impact on the overall risk evaluation.
- For benzidine which was never detected in EU-1: The SQLs ranging from 0.69 mg/kg to 1.5 mg/kg exceeded 0.1xBCL in all the 15 samples collected in this EU. This chemical was not identified as a soil COPC for EU-1. The SQLs would correspond to a cancer risk of 10^{-4} in only one out of all the 15 samples, while the estimated cancer risks associated with the SQLs in all other samples would be within the target cancer risk range. Further, assuming benzidine was detected at half of the SQL in each sample, a cancer risk would be 4×10^{-5} based on the 95% UCL over the mean concentration in EU-1. The estimated noncancer HQ associated with the maximum SQL of this chemical would be 0.0005 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT

COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-1 is not expected to have a significant impact on the risk evaluation.

EU-2

- For dieldrin, hexachlorobenzene, and toxaphene: These chemicals were identified as soil COPCs for EU-2 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation, except for dieldrin at 0-2 feet bgs (see Tables 7-1a and 7-1b). Although the maximum SQL of dieldrin at 0-2 feet bgs (0.086 mg/kg, see Table 6-2) was higher than the maximum detected concentration used in the risk calculation (0.00027 mg/kg, see Table 7-1a), the estimated cancer risk associated with this SQL value for a commercial/industrial scenario is below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}, and the estimated noncancer HQ for a commercial/industrial scenario is below the NDEP target HQ of greater than one. Therefore, SQLs above 0.1xBCL for these chemicals do not have an impact on the risk evaluation for EU-2.
- For aldrin, BaPEq, bis(2-chloroethyl) ether, heptachlor epoxide, n-nitroso-di-n-propylamine, pentachlorophenol, and zirconium: These chemicals were not identified as soil COPCs for EU-2. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-2, it would not have an impact on the overall risk evaluation.
- For benzidine which was never detected in EU-2: The SQLs ranging from 0.67 mg/kg to 1.5 mg/kg exceeded 0.1xBCL in all the 12 samples collected in this EU. This chemical was not identified as a soil COPC for EU-2. The SQLs would correspond to a cancer risk of 10^{-4} in only three out of all the 12 samples, while the estimated cancer risks associated with the SQLs in all other samples would be within the target cancer risk range. Further, assuming benzidine was detected at half of the SQL in each sample, a cancer risk would be 5×10^{-5} based on the 95% UCL over the mean concentration in EU-2. The estimated noncancer HQ associated with the maximum SQL of this chemical would be 0.0005 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-2 is not expected to have a significant impact on the risk evaluation.

EU-3

- For BaPEq and hexachlorobenzene: These chemicals were identified as soil COPCs for EU-3 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation (see Tables 7-1a and 7-1b). Therefore, SQLs above 0.1xBCL for these chemicals do not have any impact on the risk evaluation for EU-3.

- For 4-chloroaniline, 3,3'-dichlorobenzidine, dieldrin, 2,4-dinitrotoluene, hexachlorocyclopentadiene, hexachloroethane, 1-methylnaphthalene, niobium, nitrobenzene, six PCB Aroclors (1221, 1232, 1242, 1248, 1254, and 1260) thallium, toxaphene, and zirconium: These chemicals were not identified as soil COPCs for EU-3. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are at or below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-3, it would not have an impact on the overall risk evaluation.
- For arsenic, bis(2-chloroethyl) ether, 2,6-dinitrotoluene, n-nitroso-di-n-propylamine, and pentachlorophenol: These chemicals were not identified as soil COPCs for EU-3. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are within the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/ industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-3, it would not be expected to have an impact on the overall risk evaluation.
- For benzidine which was never detected in EU-3: The SQLs ranging from 0.66 mg/kg to 37 mg/kg exceeded 0.1xBCL in all the 41 samples collected in this EU. This chemical was not identified as a soil COPC for EU-3. The SQLs would correspond to a cancer risk at or above 10^{-4} in only four out of all the 41 samples collected in this EU, while the estimated cancer risks associated with the SQLs in all other samples would be within the target cancer risk range. Further, assuming benzidine was detected at half of the SQL in each sample, a cancer risk would be 2×10^{-4} based on the 95% UCL over the mean concentration in EU-3. The estimated noncancer HQ associated with the maximum SQL of this chemical would be 0.01 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-3 is not expected to have a significant impact on the risk evaluation.

EU-4

- For BaPEq and hexachlorobenzene: These chemicals were identified as soil COPCs for EU-4 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation (see Tables 7-1a and 7-1b). Therefore, SQLs above 0.1xBCL for these chemicals do not have any impact on the risk evaluation for EU-4.
- For dieldrin, n-nitroso-di-n-propylamine, and toxaphene which were never detected: These chemicals were not identified as soil COPCs for EU-4. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP

target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-4, it would not have an impact on the overall risk evaluation.

- For benzidine which was analyzed for in only one sample collected in this EU and was not detected: The SQL of 0.73 mg/kg exceeded 0.1xBCL of 0.0011 mg/kg. This chemical was not identified as a soil COPC for EU-4. The estimated cancer risk associated with the SQL would be 7×10^{-5} for a commercial/industrial scenario, which is within the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQ associated with the SQL of this chemical would be 0.0003 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-4 is not expected to have an impact on the risk evaluation.

EU-5

- For hexachlorobenzene: This chemical was identified as a soil COPC for EU-5 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation (see Tables 7-1a and 7-1b). Therefore, SQLs above 0.1xBCL for this chemical do not have any impact on the risk evaluation for EU-5.
- For bis(2-chloroethyl) ether, dieldrin, 2,6-dinitrotoluene, n-nitroso-di-n-propylamine, and pentachlorophenol: These chemicals were not identified as soil COPCs for EU-5. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-5, it would not have an impact on the overall risk evaluation.
- For benzidine which was never detected in EU-5: The SQLs ranging from 0.69 mg/kg to 1.7 mg/kg exceeded 0.1xBCL in all the three samples collected in this EU. This chemical was not identified as a soil COPC for EU-5. The SQLs would correspond to a cancer risk above 10^{-4} in only one out of all the three samples, while the estimated cancer risks associated with the SQLs in all other samples would be within the target cancer risk range. Further, assuming benzidine was detected at half of the SQL in each sample, a cancer risk would be 9×10^{-5} based on the 95% UCL over the mean concentration in EU-5. The estimated noncancer HQ associated with the maximum SQL of this chemical would be 0.0006 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-5 is not expected to have a significant impact on the risk evaluation.

EU-6

- For BaPEq and hexachlorobenzene: These chemicals were identified as soil COPCs for EU-6 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation (see Tables 7-1a

and 7-1b). Therefore, SQLs above 0.1xBCL for these chemicals do not have any impact on the risk evaluation for EU-6.

- For dieldrin and n-nitroso-di-n-propylamine: These chemicals were not identified as soil COPCs for EU-6. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-6, it would not have an impact on the overall risk evaluation.
- For benzidine which was never detected in EU-6: The SQLs ranging from 0.69 mg/kg to 0.72 mg/kg exceeded 0.1xBCL in all the four samples collected in this EU. This chemical was not identified as a soil COPC for EU-6. The estimated cancer risk associated with the maximum SQL would be 6×10^{-5} for a commercial/industrial scenario, which is within the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQ associated with the maximum SQL of this chemical would be 0.0003 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-6 is not expected to have an impact on the risk evaluation.

EU-7

- For BaPEq, hexachlorobenzene, and naphthalene: These chemicals were identified as soil COPCs for EU-7 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation (see Tables 7-1a and 7-1b), except for BaPEq and naphthalene at 0-2 feet bgs (see Tables 7-1a and 7-1b). Although the maximum SQLs of BaPEq and naphthalene at 0-2 feet bgs (2.4 and 3.3 mg/kg, respectively, see Table 6-2) were higher than the maximum detected concentrations used in the risk calculation (0.017 and 0.0014 mg/kg, respectively, see Table 7-1a), the estimated cancer risks associated with these SQL values for a commercial/industrial scenario are below or near the lower end of the target cancer risk range of 10^{-6} to 10^{-4}, and the estimated noncancer HQ for a commercial/industrial scenario is below the NDEP target HQ of greater than one. Therefore, SQLs above 0.1xBCL for these chemicals are not expected to have an impact on the risk evaluation for EU-7.
- For 1,4-dioxane, n-nitroso-di-n-propylamine, and toxaphene: These chemicals were not identified as soil COPCs for EU-7. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/ industrial scenario are below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-7, it would not have an impact on the overall risk evaluation.
- For benzidine which was never detected in EU-7: The SQLs ranging from 0.70 mg/kg to 0.73 mg/kg exceeded 0.1xBCL in the two samples collected in this EU. This chemical was not identified as a soil COPC for EU-7. The estimated cancer risk

associated with the maximum SQL would be 7 x 10^{-5} for a commercial/industrial scenario, which is within the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQ associated with the maximum SQL of this chemical would be 0.0003 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-7 is not expected to have an impact on the risk evaluation.

EU-8

- For dieldrin and n-nitroso-di-n-propylamine: These chemicals were not identified as soil COPCs for EU-8. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-8, it would not have an impact on the overall risk evaluation.
- For benzidine which was never detected in EU-8: The SQLs of 0.70 mg/kg exceeded 0.1xBCL in the two samples collected in this EU. This chemical was not identified as a soil COPC for EU-8. The estimated cancer risk associated with the SQLs would be 6 x 10^{-5} for a commercial/industrial scenario, which is within the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQ associated with the SQLs of this chemical would be 0.0003 for a commercial/ industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-8 is not expected to have an impact on the risk evaluation.

EU-9

- For BaPEq, hexachlorobenzene, and zirconium: These chemicals were identified as soil COPCs for EU-9 (see Section 6.4.4), and the 95% UCLs calculated using both detected and nondetected data were used as the soil EPCs in the risk calculation (see Tables 7-1a and 7-1b). Therefore, SQLs above 0.1xBCL for these chemicals do not have any impact on the risk evaluation for EU-9.
- For bis(2-chloroethyl) ether, 4-chloroaniline, 1,2-dibromo-3-chloropropane, 3,3'-dichlorobenzidine, dieldrin, 2,4-dinitrotoluene, 2,6-dinitrotoluene, hexachlorocyclopentadiene, hexachloroethane, and toxaphene: These chemicals were not identified as soil COPCs for EU-9. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are at or below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-9, it would not have an impact on the overall risk evaluation.
- For n-nitroso-di-n-propylamine and pentachlorophenol: These chemicals were not identified as soil COPCs for EU-9. The estimated cancer risks associated with the maximum SQLs of these chemicals for a commercial/industrial scenario are within

the target cancer risk range of 10^{-6} to 10^{-4}. The estimated noncancer HQs associated with the maximum SQLs of these chemicals for a commercial/ industrial scenario are below the NDEP target HQ of greater than one. Therefore, even if these chemicals were identified as soil COPCs for EU-9, it would not be expected to have an impact on the overall risk evaluation.

- For benzidine which was never detected in EU-9: The SQLs ranging from 0.67 mg/kg to 15 mg/kg exceeded 0.1xBCL in all the six samples collected in this EU. This chemical was not identified as a soil COPC for EU-9. The SQLs would correspond to a cancer risk at or above 10^{-4} in only two out of all the six samples collected in this EU, while the estimated cancer risks associated with the SQLs in all other samples would be within the target cancer risk range. Further, assuming benzidine was detected at half of the SQL in each sample, a cancer risk would be 4×10^{-4} based on the 95% UCL over the mean concentration in EU-9. The estimated noncancer HQ associated with the maximum SQL of this chemical would be 0.005 for a commercial/industrial scenario, which is below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), excluding benzidine as a COPC for EU-9 is not expected to have a significant impact on the risk evaluation.

In summary, SQLs above 0.1xBCL are not expected to have a significant impact on the overall risk evaluation for the nine EUs.

10.1.3 Completeness

The rejected ("R" qualified) data associated with soil samples at 0-10 feet bgs in all the nine EUs are summarized in Appendix A, Table A-2. The percent completeness for the soil BHRA data set is greater than 99.8% for each EU, which meets the completeness goals of 90% established in the QAPPs (ENSR 2008b, AECOM and Northgate 2009, ENVIRON 2014d, Ramboll Environ 2017b). Most of the rejected data were either nondetects or below 0.1XBCL, and these data are not expected to have an impact on the COPC selection or EPC calculation. The exceptions of rejected data above 0.1xBCL included benzidine in EU-1 through EU-6 and EU-9, reported as nondetects ranging from 0.65 mg/kg to 1.6 mg/kg, and five carcinogenic PAHs in EU-5, reported as nondetects at a BaPEq of 0.044 mg/kg (see Table A-2). However, these rejected values were lower than the maximum SQLs in the corresponding EUs (see Table 6-2), except for benzidine in EU-2 and BaPEq in EU-5:

- For benzidine in EU-2, the estimated cancer risks associated with the rejected data (0.74 and 1.6 mg/kg, respectively) would be 7×10^{-5} and 1×10^{-4} for a commercial/industrial scenario, which are within or at the higher end of the target cancer risk range of 10^{-6} to 10^{-4}; the estimated noncancer HQs associated with the rejected data would be 0.0003 and 0.0006 for a commercial/industrial scenario, which are below the NDEP target HQ of greater than one. Given that benzidine is not a NERT COPC as provided in the RI Report for OU-1 and OU-2 (Ramboll 2021b), the rejected data are not expected to have a significant impact on the risk evaluation.
- For PAHs in EU-5, the estimated cancer risk associated with the BaPEq value of the rejected data (0.044 mg/kg) would be 1×10^{-7} for a commercial/industrial scenario, which is below the lower end of the target cancer risk range of 10^{-6} to 10^{-4}; and the noncancer HQ is not evaluated for carcinogenic PAHs. Further, BaPEq was identified

as a soil COPC for EU-5 (see Section 6.4.4), and the EPCs at both 0-2 and 0-10 ft bgs were recalculated by incorporating the BaPEq value of the rejected data into the 95% UCL calculation. Results indicated that the changes of EPCs are negligible, and therefore, the rejected PAH data would not affect the risk results.

Additionally, for most individual analytes shown in Table A-2, the percent completeness is greater than 90% and meets the completeness goals established in the QAPPs; given the small percentage of rejected data and that there is no apparent spatial grouping of rejected data, these rejected data are not expected to have a significant impact on the spatial coverage of the soil BHRA data set. A few exceptions where the percent completeness is less than 90% exist for the following analytes:

- Benzidine in EU-1 through EU-6 and EU-9 (percent completeness = 50 to 88%)
- Benzyl alcohol in EU-5 (percent completeness = 75%)
- Cyanide (total) in EU-1, EU-6, EU-7, and EU-9 (percent completeness = 67 to 81%)
- Niobium in EU-3 (percent completeness = 84%)
- Nitrite in EU-9 (percent completeness = 74%)

Although the spatial coverage of the soil BHRA data set for these analytes is limited by the rejected data, as discussed above, these data are not expected to have a significant impact on the risk evaluation due to the relatively lower concentrations reported for these COPCs.

10.1.4 Comparability

As discussed in Section 6.3.2, different reporting limits for the same analyte in soil may impact the comparability of the data sets. For most of the analytes, the SQLs are well below 0.1xBCL (or other applicable screening criteria). In each EU, there are some soil analytes with SQLs exceeding 0.1xBCL (or other applicable screening criteria), as summarized in Table 6-2, and their impacts on the overall risk evaluation are discussed in Section 10.1.2. In summary, different reporting limits for the same soil analyte are not expected to have a significant impact the overall risk evaluation.

Also, differences in sample preparation and analytical methods exist between the data sets for each EU and the RZ-A background and BRC/TIMET regional background data set for both metals and radionuclides, which may affect the statistical testing results of the background evaluation. As discussed in Section 6.4.2 and shown in Table 6-4, arsenic in EU-1 through EU-3 and EU-5 through EU-7, manganese in EU-7, thallium in EU-6, and zirconium in EU-1 through EU-7 were excluded as soil COPCs based on the statistical testing results of the background evaluation. As indicated in the box plots and Q-Q plots in Appendix J, the concentrations in the majority of samples for arsenic in EU-1 through EU-3 and EU-5 through EU-7, manganese in EU-7, and thallium in EU-6, as well as in all samples for zirconium in EU-1 through EU-7 were well below the BRC/TIMET regional background levels, providing adequate margin of safety. In addition, radionuclides were excluded as soil COPCs based on the calculation of total cancer risks, not the statistical testing results of the background evaluation. Therefore, potential changes of statistical testing results of the background evaluation due to the incomparability issues of analytical methods are not expected to have a significant impact on the COPC selection and overall risk evaluation.

10.1.5 Precision

As presented in Appendix A, Table A-3, in the soil BHRA data set, there were 39, 19, 73, 37, 12, 19, 7, 1, and 21 pairs of primary and field duplicate results qualified due to RPD or PQL criterion exceedance for EU-1 through EU-9. Soil samples with qualified primary and field duplicate results were treated as independent samples in the BHRA. The impacts of field duplicate data qualified due to RPD or PQL criterion exceedance are discussed as follows:

- First, only beta-BHC in EU-1 was identified as a soil COPC based on the maximum concentration detected within a pair of primary and field duplicate samples qualified due to RPD or PQL criterion exceedance (see Table 6-3). The maximum detected concentration used for concentration/toxicity screen was 0.23 mg/kg in RSAH3-0.5B, while the concentration detected in the field duplicate sample of RSAH3009-0.5B was 0.065 mg/kg (see Table A-3). If the average between the primary and field duplicate results (0.15 mg/kg) is selected for this sample pair instead, the second highest detected concentration in EU-1 (0.17 mg/kg in RSAL3-1BPC, see Appendix B, Table B-1) would be used for concentration/toxicity screen which is equal to 0.1xBCL, and beta-BHC would therefore not be identified as a soil COPC. However, since beta-BHC was not a cancer risk or noncancer HI driver chemical for any worker population in EU-1 (see Tables K-1 through K-3), excluding it as a COPC would not have a significant impact on the overall risk evaluation.
- Second, the limited amount of duplicate data qualified due to RPD or PQL criterion exceedance for metals in Table 6-4 (0 to 3.7%) would not significantly change statistical testing results of the background evaluation and the selection of metal COPCs. In addition, radionuclides were excluded as COPCs based on the calculation of total cancer risks, not the statistical testing results of the background evaluation, and the amount of duplicate data qualified due to RPD or PQL criterion exceedance for radionuclides was limited (0.30%); therefore, the field duplicate data qualified due to RPD or PQL criterion exceedance would not affect the exclusion of radionuclides as soil COPCs.
- Finally, the effects of duplicate data qualified due to RPD or PQL criterion exceedance on the EPCs of the driver COPCs for both cancer risks and noncancer HIs (after excluding the metal background contribution, see Appendix K) were evaluated by removing the duplicate data qualified due to RPD or PQL criterion exceedance from the BHRA data set and recalculating the EPCs. The following driver COPCs contained duplicate data qualified due to RPD or PQL criterion exceedance:
    - Hexachlorobenzene in EU-1 (a driver for cancer risk for all scenarios at both 0-2 and 0-10 feet bgs)
    - Perchlorate in EU-1 (a driver for noncancer HI for all scenarios at both 0-2 and 0-10 feet bgs)
    - Dioxin TEQ in EU-2 (a driver for cancer risk for all scenarios at both 0-2 and 0-10 feet bgs; a driver for noncancer HI for indoor and outdoor commercial/ industrial worker at 0-2 feet bgs)
    - Dioxin TEQ in EU-3 (a driver for cancer risk for all scenarios at both 0-2 and 0-10 feet bgs; a driver for noncancer HI for indoor and outdoor commercial/ industrial worker scenarios at 0-2 feet bgs)

- Arsenic in EU-4 (a driver for cancer risk for all scenarios at 0-10 feet bgs)
- Chromium VI in EU-5 (a driver for cancer risk for indoor and outdoor commercial/industrial worker at 0-2 feet bgs)
- Manganese in EU-5 (a driver for noncancer HI for all scenarios at 0-10 feet bgs)
- Hexachlorobenzene in EU-6 (a driver for cancer risk for indoor and outdoor commercial/industrial worker at 0-10 feet bgs)
- Dioxin TEQ in EU-9 (a driver for cancer risk for outdoor commercial/ industrial worker scenario at 0-2 feet bgs and all scenarios at 0-10 feet bgs)

The recalculated EPCs for the above COPCs after removing the duplicate samples qualified due to RPD or PQL criterion exceedance would change slightly (from -13 to 8.5%) compared to the EPCs used in the risk calculation (Tables 7-1a and 7-1b). Given such small changes, the cancer risks and the noncancer HQs resulting from these COPCs would also change to a limited extent. Therefore, the field duplicate data qualified due to RPD or PQL criterion exceedance are not expected to have a significant impact on the overall risk evaluation.

For laboratory duplicates, there were 50, 131, 67, 79, 123, 91, 41, 12, and 63 sample results qualified due to RPD or PQL criterion exceedance for EU-1 through EU-9 (see DVSRs tables in Appendix A). The effects of these qualified data on the overall risk evaluation are further discussed in Section 10.1.6 below along with other J qualified data.

10.1.6 Accuracy

The soil analytical data were evaluated in DVSRs presented in Appendix A, with a subset of the data qualified with a J qualifier (J, J-, or J+) based on method blank, field duplicate, and/or other quantitation issues (525 out of 7,026 data points for EU-1, 956 out of 11,162 data points for EU-2, 704 out of 14,125 data points for EU-3, 591 out of 5,204 data points for EU-4, 664 out of 8,790 data points for EU-5, 563 out of 6,094 data points for EU-6, 390 out of 4,207 data points for EU-7, 88 out of 1,171 data points for EU-8, and 808 out of 15,217 data points for EU-9, see Appendix B, Table B-1); that is, the reported value was estimated, with no (J), low (J-), or high (J+) bias. The potential impact of the J qualified data on the overall risk analysis was evaluated:

J and J+ Qualified Data:

- A review of the J and J+ qualified data indicated that the estimated results were either below the 0.1xBCL (or other applicable screening criteria) or below/equal to the maximum detected concentration used in the COPC selection (Appendix A, Table A-5). The following analytes were identified as COPCs based on a maximum detected concentration with a J qualifier (see Table 6-3):
  - Ammonia in EU-4
  - beta-BHC in EU-1
  - Dieldrin in EU-2
  - Manganese in EU-3

  - Octachlorostyrene in EU-2, EU-6, EU-7, and EU-9
  - Toxaphene in EU-2

- No BCL or toxicity value is available for octachlorostyrene, and this chemical is discussed qualitatively in Section 10.2.4. For other analytes, except beta-BHC in EU-1 and ammonia in EU-4, the J qualified concentrations were more than two folds above the 0.1xBCL, and the actual concentrations are still likely above the 0.1xBCL. Therefore, the J qualified data of these analytes do not affect the COPC selection. For beta-BHC in EU-1 and ammonia in EU-4, the J qualified concentrations were only slightly above the 0.1xBCL, but these analytes were not cancer risk or noncancer HI driver chemicals for any worker population in EU-1 or EU-4 (see Tables K-1 through K-3 and Tables K-10 through K-12), and therefore, correction for the bias of J or J+ qualified data and excluding these analytes as COPCs would not have a significant impact on the overall risk evaluation.
- Further, given the limited amount of J or J+ qualified data for metals in Table 6-4 (0 to 20%), the J or J+ qualified data would not significantly change statistical testing results of the background evaluation and the selection of metal COPCs. In addition, radionuclides were excluded as COPCs based on the calculation of total cancer risks, not the statistical testing results of the background evaluation, and the amount of J or J+ qualified data for radionuclides was limited (17%); therefore, the J or J+ qualified data would not affect the exclusion of radionuclides as soil COPCs.
- Finally, the effects of J and J+ qualified data on the EPCs of the driver COPCs for both cancer risks and noncancer HIs (after excluding the metal background contribution, see Appendix K) were evaluated:
  - For most of the driver COPCs, the amount of J or J+ qualified data was limited (0 to 20%). Therefore, the J or J+ qualified data would not affect the overall risk evaluation.
  - For hexachlorobenzene in EU-1 (a driver for cancer risk for all scenarios at both 0-2 and 0-10 feet bgs) and in EU-4 (a driver for cancer risk for indoor and outdoor commercial/industrial worker and outdoor utility/ maintenance worker scenarios at 0-2 feet bgs), the amount of J or J+ qualified data ranged from 21 to 48%. Since the cancer risks resulting from hexachlorobenzene (2 x 10-7 at maximum) were well below the lower end of the target cancer risk range of 10-6 to 10-4, correction for the bias of J or J+ qualified data does not have a significant impact on the overall risk evaluation.
  - For dioxin TEQ in EU-2 (a driver for cancer risk for all scenarios at both 0-2 and 0-10 feet bgs), EU-3 (a driver for cancer risk for all scenarios at both 0-2 and 0-10 feet bgs), and EU-9 (a driver for cancer risk for outdoor commercial/industrial worker scenario at 0-2 feet bgs and all scenarios at 0-10 feet bgs), the amount of J or J+ qualified data ranged from 26 to 53%. Since the cancer risks resulting from dioxin TEQ (3 x 10-5 at maximum) were well below the cancer risk of 6 x 10-5 which the Site-specific action level (0.0027 mg/kg) would correspond to, correction for the bias of J or J+ qualified data does not have a significant impact on the overall risk evaluation.

- For perchlorate in EU-1, dioxin TEQ in EU-2 and EU-3, manganese in EU-6, and zirconium in EU-9 (drivers for noncancer HI for indoor and outdoor commercial/industrial worker scenarios at 0-2 feet bgs), the amount of J or J+ qualified data ranged from 21 to 29%. Since the noncancer HQs resulting from these COPCs (0.8 at maximum) were well below the target HQ of greater than one, correction for the bias of J or J+ qualified data does not have a significant impact on the overall risk evaluation.

In summary, the J and J+ qualified data are 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 either significantly below the 0.1xBCL (or other applicable screening criteria) or below/equal to the maximum detected concentration used in the COPC selection (Appendix A, Table A-5). Only naphthalene in EU-5 and beta-BHC in EU-6 were identified as COPCs based on a maximum detected concentration with a J- qualifier, and the J- qualified concentrations were significantly higher than 0.1xBCL (see Table 6-3). However, these analytes were not cancer risk or noncancer HI driver chemicals for any worker population in EU-5 or EU-6 (see Tables K-13 through K-18), and therefore, correction for the low bias of J- qualified data and excluding these analytes as COPCs would not have a significant impact on the overall risk evaluation.
- Further, there is a limited amount of J- qualified data for metals in Table 6-4 (0 to 8.3%), with the exception of zirconium in EU-1 (47%) and EU-4 (50%). A review of the Q-Q plots for zirconium in EU-1 and EU-4 (Appendix J, Figures J2-6A and J2-6D) demonstrates that after correction for the low bias of J- qualified data, the zirconium concentrations in EU-1 and EU-4 would still be well below the BRC/TIMET regional background. Therefore, the J- qualified data would not significantly change statistical testing results of the background evaluation and the selection of metal COPCs. In addition, radionuclides were excluded as COPCs based on the calculation of total cancer risks, not the statistical testing results of the background evaluation, and the amount of J- qualified data for radionuclides was limited (0.69%); therefore, the J- qualified data would not affect the exclusion of radionuclides as soil COPCs.
- Finally, the effects of J- qualified data on the EPCs of the driver COPCs for both cancer risks and noncancer HIs (after excluding the metal background contribution, see Appendix J) were evaluated. For all the driver COPCs, the amount of J- qualified data was limited (0 to 12%). Therefore, the J- qualified data would not affect the overall risk evaluation.

In summary, the J- qualified data are 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, where possible, Ramboll queried the censored (or nondetect) data for blank contamination from the project database, and

changed them from nondetected values (U qualified) to detected values at reported concentrations (J qualified), if there were detections between the SQL and the PQL. The revisions of censored data for blank contamination are summarized in Appendix A, Table A-4. Both the censored data and the reported concentrations were lower than 0.1xBCL (or other applicable screening criteria), except for Ra-226 in SA121009-0.5B. However, radionuclides were excluded as COPCs based on the calculation of total cancer risks, not by comparison against 0.1xBCL. Therefore, none of the analytes affected by blank contamination was identified as a soil COPC. In addition, the revisions of data associated with blank contamination to estimated detected values may affect the background evaluation for some metals (e.g., antimony, boron, cadmium, mercury, molybdenum, platinum, selenium, thallium, tin, and tungsten); however, these metals all passed the concentration/toxicity screen (Table 5-1) and would not be identified as soil COPCs. 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.

For some VOC, SVOC, and general chemistry data from Phase A Investigation, SQLs are only available in hard copy laboratory analytical reports, but not included in either the BMI database or the NERT project database. In this BHRA, risk results were conservatively calculated using the PQLs in the NERT project database. According to Table 6-6 and Appendix B, Table B-1, chlorate in EU-7 was the only COPC that could be affected by the PQLs from Phase A Investigation. Chlorate was not detected in SA11-10 at eight feet bgs from Phase A Investigation, with a PQL of 5.4 mg/kg and a MDL of 1 mg/kg. When using the MDL instead of the PQL from this sample in the EPC calculation for chlorate in EU-7 at 0-10 feet bgs, the EPC would decrease from 5,010 mg/kg (see Table 7-1b) to 5,000 mg/kg. Therefore, using the PQL from Phase A Investigation in the EPC calculation does not have a significant impact on the overall risk evaluation.

10.1.7 Duplicate Treatment

Soil samples with primary and field duplicate results were treated as independent samples in the risk evaluation, although the variance of the duplicate and primary samples was not tested. The impacts are discussed as follows:

- First, several analytes were identified as soil COPCs based on the maximum concentration detected in a sample with a duplicate:
    - BaPEq was identified as a soil COPC in EU-6 (see Table 6-3). The maximum detected concentration used for concentration/toxicity screen was 0.26 mg/kg in SA9-10D, while BapEq was not detected in its primary sample of SA9-10. Since there were several detected concentrations in EU-6 greater than 0.1xBCL (see Appendix B, Table B-1), BaPEq would be identified as a soil COPC for EU-6 regardless of how the duplicates were treated.
    - beta-BHC was identified as a soil COPC in EU-1 (see Table 6-3). The maximum detected concentration used for concentration/toxicity screen was 0.23 mg/kg in RSAH3-0.5B, while the concentration detected in the field duplicate sample of RSAH3009-0.5B was 0.065 mg/kg. If the average between the primary and field duplicate results (0.15 mg/kg) is selected for this sample pair instead, the second highest detected concentration in EU-1 (0.17 mg/kg in RSAL3-1BPC, see Appendix B, Table B-1) would be used for

concentration/toxicity screen which is equal to 0.1xBCL, and beta-BHC would therefore not be identified as a soil COPC. However, since beta-BHC was not a cancer risk or noncancer HI driver chemical for any worker population in EU-1 (see Tables K-1 through K-3), excluding it as a COPC would not have a significant impact on the overall risk evaluation.

- beta-BHC was identified as a soil COPC in EU-6 (see Table 6-3). The maximum detected concentration used for concentration/toxicity screen was 0.27 mg/kg in SA180-0.5B, while the concentration detected in the field duplicate sample of SA180-0.5BD was 0.23 mg/kg. If the average between the primary and field duplicate results (0.25 mg/kg) is selected for this sample pair instead, the average would still be the maximum detected concentration and greater than 0.1x BCL. Therefore, beta-BHC would be identified as a soil COPC for EU-6 regardless of how the duplicates were treated.
- 4,4'-DDE was identified as a soil COPC in EU-2 (see Table 6-3). The maximum detected concentration used for concentration/toxicity screen was 6.0 mg/kg in SSAM3-01-7BPC, while the concentration detected in the field duplicate sample of SSAM3-01-7FD was 5.8 mg/kg. If the average between the primary and field duplicate results (5.9 mg/kg) is selected for this sample pair instead, the average would still be the maximum detected concentration and greater than 0.1x BCL. Therefore, 4,4'-DDE would be identified as a soil COPC for EU-2 regardless of how the duplicates were treated.
- Hexachlorobenzene was identified as a soil COPC in EU-7 (see Table 6-3). The maximum detected concentration used for concentration/toxicity screen was 0.96 mg/kg in SA11-0.5, while hexachlorobenzene was not detected in its field duplicate sample of SA11-0.5D. Since there were several detected concentrations in EU-7 greater than 0.1xBCL (see Appendix B, Table B-1), hexachlorobenzene would be identified as a soil COPC for EU-7 regardless of how the duplicates were treated.
- Octachlorostyrene as a soil COPC in EU-7 (see Table 6-3). The maximum detected concentration was 0.21 mg/kg in SA11-0.5, while octachlorostyrene was not detected in its field duplicate sample of SA11-0.5D (see Appendix B, Table B-1). Since there was not BCL available for octachlorostyrene, it would be identified as a soil COPC for EU-7 regardless of how the duplicates were treated.
- Palladium as a soil COPC in EU-9 (see Table 6-3). The maximum detected concentration was 0.53 mg/kg in TSB-GJ-02-0-FD, while the concentration detected in the primary sample of TSB-GJ-02-0 was 0.51 mg/kg (see Appendix B, Table B-1). Since there was not BCL available for palladium, it would be identified as a soil COPC for EU-9 regardless of how the duplicates were treated.

- Second, given the limited amount of duplicate data for metals in Table 6-4 (0 to 20%), treatment of duplicate samples is not expected to significantly change statistical testing results of the background evaluation and the selection of metal COPCs. In addition, radionuclides were excluded as COPCs based on the calculation

of total cancer risks, not the statistical testing results of the background evaluation, and the amount of duplicate data for radionuclides was limited (9.9%); therefore, treatment of duplicate samples would not affect the exclusion of radionuclides as soil COPCs.

- Third, the effects of duplicate data on the EPCs of the driver COPCs for both cancer risks and noncancer HIs (after excluding the metal background contribution, see Appendix K) were evaluated by removing the duplicate samples from the BHRA data set and recalculating the EPCs. The recalculated EPCs for the driver COPCs after removing the duplicate samples would change slightly (from -14 to 27%) compared to the EPCs used in the risk calculation (Tables 7-1a and 7-1b). Given such small changes, the cancer risks and the noncancer HQs resulting from these COPCs would also change to a limited extent. Therefore, the field duplicate data are not expected to have a significant impact on the overall risk evaluation.
- Finally, the asbestos risk calculations employed both primary and field duplicate samples, resulting in an increase of sample size and decrease of pooled AS. As indicated in Table 4-3, except for EU-4 and EU-8 without any field duplicate sample, EU-1, EU-2, EU-3, EU-6, and EU-7 contain one field duplicate sample, EU-5 contains two field duplicate samples, and EU-9 contains four field duplicate samples. Excluding the field duplicate samples from the above EUs would slightly increase the calculated cancer risks from both long amphibole fibers and long chrysotile fibers (up to 17%), but would not change the overall risk conclusions.

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

10.2 Uncertainties Identified in the Risk Assessment

10.2.1 Identification of Chemicals of Potential Concern

Chemicals detected in at least one soil sample were included in the COPC selection process. Six out of 89 detected chemicals in EU-1, nine out of 93 detected chemicals in EU-2, eight out of 89 detected chemicals in EU-3, seven out of 84 detected chemicals in EU-4, eight out of 93 detected chemicals in EU-5, seven out of 86 detected chemicals in EU-6, seven out of 85 detected chemicals in EU-7, five out of 68 detected chemicals in EU-8, and eight out of 103 detected chemicals in EU-9 were identified as soil COPCs. For most of the chemicals that were not selected as soil COPCs, the maximum detected concentrations were generally a factor of 10, if not a factor of 100 or more, lower than the screening levels (see Table 5-1); therefore, exclusion of these chemicals from the quantitative risk assessment is not expected to have a significant impact on the overall results of the BHRA. It should be noted that, for a few chemicals, the SQLs were higher than the screening levels in a few soil samples (see Table 6-2). The impacts of SQLs above 0.1xBCL on the risk evaluation are discussed in Section 10.1.2.

Surrogate BCLs were used for the toxicity screen and COPC selection for acenaphthylene, gamma-chlordane, chromium (total), cyanide (total), 2,4'-DDE, endosulfan I, endosulfan sulfate, endrin ketone, ethyl tert-butyl ether, ortho-phosphate, and phosphorus (total) in the absence of NDEP-derived BCLs for these compounds. As shown in Table 5-1, these compounds were excluded as soil COPCs based on the toxicity screen. The surrogates identified are considered to be toxicologically representative of these compounds and given

that the ratios of the BCLs to the maximum detected concentrations were at least a factor of 100 and generally a factor of 1,000 or more, the detected concentrations of these compounds would not be expected to contribute significantly to the total risk estimates.

Besides the essential nutrients (calcium, potassium, silicon, sodium, sulfate, and sulfur), no representative surrogate was identified for palladium and octachlorostyrene. These two chemicals were identified as soil COPCs and are discussed qualitatively in Section 10.2.4.

Based on the comparison to BRC/TIMET regional background for EU-1 through EU-7 and to RZ-A background for EU-8 and EU-9 (see Table 6-4), metals identified as being above background were retained as COPCs. For chromium in EU-3 through EU-7 and EU-9 as well as thallium in EU-6, there are insufficient detections in the background and/or EU-specific soil data sets to make a determination. Based on the review of box plots and Q-Q plots in Appendix J, chromium was retained as a COPC for those six EUs, while thallium was excluded as a COPC for EU-6 with adequate margin of safety. Further, arsenic in EU-1 through EU-3 and EU-5 through EU-7 as well as zirconium in EU-1 through EU-7 were identified as being consistent with background. Based on the review of box plots and Q-Q plots in Appendix J, arsenic and zirconium were excluded as COPCs for the above EUs with adequate margin of safety. Finally, palladium and zirconium were retained as COPCs for EU-8 and/or EU-9 despite that RZ-A background data are not available for these two metals. Overall, although there were some uncertainties with the background evaluation for metals, such uncertainties are not expected to have a significant impact on the selection of soil COPCs and overall risk evaluation.

Th-228 in EU-2 and EU-6 as well as Th-230 in EU-4 failed the statistical testing of background consistency (see Table 6-5) but given that the validity of the statistical testing is confounded by several issues (see discussion in Section 6.4.2), radionuclides were excluded as soil COPCs based on a comparison of cancer risks between BHRA Study Area soils and site/regional background soils. As indicated in Figures 6-5a through 6-5c, the estimated total radionuclide cancer risks were slightly above the higher end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} at several locations throughout the BHRA Study Area but were consistent with the estimated total radionuclide cancer risks for the RZ-A background and BRC/TIMET regional background data sets (Table 6-1). Excluding radionuclides as soil COPCs is not expected to have a significant impact on the overall risk evaluation.

10.2.2 Exposure Assessment

Exposure Scenarios

The exposure assessment in this BHRA is based on a 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 an outdoor commercial/industrial worker within BHRA Study Area incidentally ingests 100 mg of soil per day, 225 days per year, for 25 years. These and other upper-bound, default exposure assumptions most likely overestimate the potential health risks associated with the BHRA Study Area.

As discussed in USEPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002b), evaluation of exposures to members of the public entering an operating facility is generally not warranted for two reasons: (1) public access is restricted or controlled at industrial sites and (2) while the public may have access to a property, exposures of an on-site worker would be much higher than those of a visitor because workers spend substantially more time at a site. Accordingly, visitors and trespassers in the BHRA Study Area were not quantitatively evaluated in the BHRA. The potential health risks for commercial/industrial workers in the BHRA Study Area were estimated to be below the levels of concern (except that the estimated noncancer HI for outdoor commercial/industrial workers exposed to soil at 0-10 feet bgs in EU-8 was slightly above the NDEP target HI of greater than one, see discussion in Section 9.1.2), and the potential health risks for visitors and trespassers would also be below the levels of concern.

Populations outside OU-1 include indoor and outdoor commercial/industrial workers as well as residents. The potential risks to populations within the NERT Off-Site Study Area component of OU-2 located to the north of OU-1 and west of Pabco Road are evaluated in the OU-2 BHRA report (Ramboll 2021c), while the potential risks to populations in the areas to the west, east, and south of OU-1 were not quantitatively evaluated in this BHRA.

Populations outside OU-1 could be exposed to airborne chemicals (vapors and particulates) emitted during events such as routine operations or construction projects (USEPA 2002b). For inhalation of airborne particulates, the PEF for the construction worker within the BHRA Study Area (on the order of 10^{+6} m^3/kg) is much lower (approximately 200 times lower) than the PEF during and after construction for receptors outside OU-1 (on the order of 10^{+9} m^3/kg) (see NDEP's "asbestos guidance riskcalcs.xls" spreadsheets presented in Appendix K). Therefore, populations outside OU-1 would be exposed to much lower airborne particulate concentrations than construction workers within the BHRA Study Area. As compared with other exposure factors that may be higher (but much lower than 200 folds) for the populations outside OU-1, the exposures through inhalation of airborne particulates by populations outside OU-1 are expected to be lower than the exposures by construction workers within the BHRA Study Area. For inhalation of volatile compounds migrating from soil in the BHRA Study Area, the risks associated with exposures by workers within the BHRA Study Area were well below the levels of concern (see Appendix K), and volatile compounds would travel long distance and mix with ambient air before reaching the populations outside OU-1. Therefore, the potential health risks for population outside OU-1 associated with inhalation of soil vapor migrating from the BHRA Study Area would also be below the levels of concern.

EPCs

The soil EPCs for non-asbestos soil COPCs were calculated as the 95% UCL on the mean soil concentration for the 0-2 feet depth interval and 0-10 feet depth interval within each EU (unless a 95% UCL could not be calculated due to limited detection, in which case the soil EPCs were set to be the maximum detected concentrations). This assumption is representative for a RME estimate. It is very unlikely that receptors are exposed to COPCs in the BHRA Study Area soils at concentrations higher than the 95% UCLs over an extended period of time.

Consistent with NDEP guidance (Neptune 2015), asbestos EPCs were estimated using a methodology that differs from that used to estimate the EPCs for other soil COPCs. For asbestos, the estimated EPCs are highly dependent on sample size. As described in Section 7.2.2, the soil concentration used to estimate asbestos air EPC was equal to the number of long fibers detected multiplied by the pooled AS. For the best estimate, the number of long fibers observed in the soil samples collected in each EU was used in the calculation. For the upper-bound estimate, the 95% UCL on the number of long fibers observed in the soil samples collected in each EU assuming a Poisson distribution was used in the calculation. Pooled AS, which was used in both calculations, is a function of sample size. Specifically, pooled AS decreases with increasing sample size (the equation for calculating pooled AS is presented in Section 7.2.2), resulting in a lower estimate of soil concentration and hence, a lower asbestos air EPC as sample size increases.

For the special case in which no fibers were detected, as was the case for amphibole long fibers in EU-1, EU-2, and EU-4 through EU-8 as well as chrysotile long fibers in EU-5 (see Table 4-3), the best estimate risk was zero (i.e., amphibole or chrysotile long fibers were not detected in any samples, so that both the soil concentration and air EPC were zero); while for the upper-bound estimate, the 95% UCL of the Poisson distribution for the case in which no fibers were detected was three fibers, and the risk was a function of the small sample size. As shown in Table 9-2, although amphibole long fibers were not detected in EU-1, EU-2, and EU-4 through EU-8, the upper-bound estimates of risks to outdoor commercial/ industrial workers in EU-4 and construction workers in EU-1 and EU-4 through EU-8 were above 10^{-6}.

Fate-and-Transport Modeling

The fate-and-transport modeling for soil is limited to estimating PEFs of airborne particulates and transfer factors of soil vapor for construction workers and commercial/industrial workers. PEFs were estimated according to USEPA guidance (2002b) based on a combination of site-specific and default input parameters. For most soil COPCs, inhalation of airborne particulates did not contribute significantly to the overall risk estimates, because exposures via incidental ingestion and dermal contact were much higher (see Appendix K); therefore, the uncertainty in the PEFs is not expected to significantly impact the conclusions of the BHRA. However, the exceptions exist for the following COPCs:

- Asbestos, which was evaluated as a carcinogen only for the inhalation route of exposure for all scenarios in all EUs;
- Chromium VI in EU-6 and EU-7 for cancer risks of the construction worker scenario;
- Cobalt in EU-5 for cancer risks of all scenarios; and
- Manganese in EU-3, EU-5, and EU-6 for noncancer HIs of the construction worker scenario.

For the above COPCs, the potential uncertainty in the PEFs could contribute to the overall risk estimates. This is particularly important for the construction worker scenario because the estimated PEFs were large relative to the commercial/ industrial scenario (see Table 7-2). The PEF for construction accounted for several potential sources of particulates, including wind erosion, excavation, dozing, grading, and tilling; however, the largest

contributor to the overall PEF was driving over unpaved roads. The input parameters were based on default values recommended by USEPA (2002b). USEPA provides the basis for most of these default values, but did not provide the basis for the default assumptions for the average weight of the vehicle (eight tons) and the number of vehicles that will drive across the area every day (30). The applicability of these and other assumptions to future construction at the individual EUs is unknown; however, it is strongly believed that, in combination, these assumptions are more likely to overestimate than underestimate potential health risks, especially when dust control measures will be required during any future construction activities. Further, the area of each EU was conservatively used as the areal extent of surface contamination when calculating PEFs, assuming contamination of asbestos, chromium VI, cobalt, and manganese were randomly distributed across the EUs with no obvious source area.

The Jury model was used to estimate outdoor and trench air concentrations from measured soil concentrations. As discussed in Section 7.2.3, the Jury model has numerous assumptions and limitations, each of which may over- or underestimate the predicted air concentration. In this case, soil physical parameters specific to OU-1 were used in the modeling, which reduced the uncertainty in the model estimates.

The soil properties used for the Jury model were conservatively selected assuming that the entire unsaturated zone in the BHRA Study Area is Qal. This is a conservative assumption in that, for areas where the UMCf is part of the unsaturated zone, the finer-grained UMCf would act to reduce vapor transport of COPCs. Further, the soil properties specific to OU-1 used in the model (Table 7-4) were based on samples collected in the Qal. To be additionally conservative the one sample collected from below 10 feet bgs was not used in the evaluation due to extraordinarily wet soil properties measured at that location.

It was conservatively assumed that transport of soil vapor would occur from 1 cm bgs into outdoor air for the above-ground outdoor air scenario, and for the construction scenario, the trench would be located only 1 cm above the soil sample, allowing for maximum potential exposure. The extent of soil contamination was conservatively chosen to extend from 1 cm bgs all the way down to the groundwater table. This is very conservative because it is assumed that the entire vadose zone contains soil at the upper-bound concentrations (i.e., 95% UCL).

When modeling the above-ground outdoor air scenario, the area of each EU was conservatively used as the areal extent of surface contamination, assuming contamination of volatile COPCs were randomly distributed across the EUs with no obvious source area.

When modeling the dispersion in the construction trench scenarios, a box model was used to simulate dispersion, and the air flow through the construction trench was controlled by a windspeed in OU-1 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 airflow through the trench or are shallower than 10 feet, potentially increasing the breathing zone to above the ground surface. It was also conservatively assumed that air containing volatile COPCs would be migrating from the walls of the trench in addition to the base to maximize exposure potential.

Normally, soil gas data, not soil data, are used to evaluate vapor intrusion risk from subsurface to trench air for construction workers. Among the four volatile compounds identified as soil COPCs (ammonia, naphthalene, hexachlorobenzene, and octachlorostyrene), only naphthalene was included in the soil gas risk evaluation in the OU-1 Soil Gas and Groundwater BHRA Report (Ramboll 2021a), while the other three chemicals were not analyzed in any soil gas samples collected within the Operations Area of OU-1. Since naphthalene was not a risk driver in either soil or soil gas, although the vapor intrusion risk from naphthalene may be double counted for construction workers by modeling migration from both soil and soil gas to trench air, its impact on the overall risk evaluation is minimal.

In summary, the assumptions used in the fate-and-transport modeling to estimate PEFs of airborne particulates and transfer factors of soil vapor are considered to be conservative and overestimate worker exposures through the inhalation of airborne particulates and soil vapor pathways.

10.2.3 Toxicity Assessment

One of the largest sources of uncertainty in any risk assessment is the limited understanding of toxicity to humans who are exposed to lower concentrations generally encountered in the environment than those used in toxicity studies. The majority of the available toxicity data are from animal studies; these data are extrapolated using mathematical models or multiple uncertainty factors to predict what might occur in humans. Sources of uncertainty and/or conservatism in the toxicity criteria used in this 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 driver COPCs with cancer risks above 10^{-6} (chromium VI and dioxin TEQ) or noncancer HQs above one (manganese and perchlorate), zirconium with noncancer toxicity criteria obtained from the PPRTV appendix, and asbestos.

Chromium VI

Chromium VI was the cancer risk driver in EU-7 (see Section 9.1.1). Ingestion was the driving pathway for indoor and outdoor commercial/industrial workers, and inhalation of airborne particulates was the driving pathway for construction workers (See Appendix K, Tables K-19 through K-21).

The oral CSF for chromium VI is obtained from OEHHA Toxicity Criteria Database based primarily on a mouse drinking water study (California Environmental Protection Agency [Cal/EPA] 2011). The tumors of the small intestine in male mice were considered in the

derivation of oral CSF, and OEHHA used a multistage model in the USEPA Benchmark Dose Software to estimate the lower-bound dose associated with a 10 percent incidence of tumors, and then scaled it to a human equivalent dose based on the ratio of mouse to human body weight to the ¾ power. Adequate numbers of animals were treated and observed, and the risks estimates derived are supported by oral carcinogenicity data from other studies. Therefore, the uncertainty associated with the oral CSF for chromium VI is expected to be low.

The IUR for chromium VI is obtained from IRIS based primarily on an epidemiological study of the correlation between occupational exposure to chromium and lung cancer among workers in the chromate industry (USEPA 2021c). USEPA used a multistage model to estimate the air concentration of total chromium corresponding to an extra cancer risk of 10^{-6}. USEPA assumed the cancer mortality observed was due to chromium VI, which was further assumed to be no less than one-seventh of total chromium, because trivalent chromium compounds have not been reported as carcinogenic by any route of administration. In this BHRA, the IRIS IUR value for total chromium was multiplied by seven to account for an assumed ratio of 6:1 for chromium III to chromium VI and convert it to an IUR value for chromium VI. Results from epidemiological studies of chromium exposure are consistent across investigators and countries, and a dose relationship between chromium exposure and lung tumors has been clearly established. One uncertainty associated with the IUR for chromium VI is the epidemiological studies usually assumed that the smoking habits of chromate workers were similar to those of the US white male population. Such an assumption may lead to overestimation of the risk, since it is generally accepted that the proportion of smokers is higher for industrial workers than for the general population.

Dioxin TEQ

Dioxin TEQ was the cancer risk driver in EU-2, EU-3, and EU-9 (see Section 9.1.1). Ingestion was the driving pathway for all worker populations (See Appendix K, Tables K-4 through K-9 and K-25 through K-27). The oral CSF for 2,3,7,8- tetrachlorodibenzo-p-dioxin used for dioxin TEQ is obtained from OEHHA Toxicity Criteria Database based primarily on a carcinogenicity bioassay with mice (Cal/EPA 2009). The male mouse hepatic adenoma and carcinoma data were considered in the derivation of oral CSF, which were converted into equivalent human exposures by applying appropriate scaling factors. A linearized multistage procedure was used to develop an IUR value, and the oral CSF was derived by route-to-route extrapolation. There are several limitations with the data used in the oral CSF derivation. For example, the number of treatment groups and the dose range in the bioassay may not have been large enough to include a dose level which produced no effect. The most significantly increased tumor incidences only occurred in the high-dose level groups, but a statistically significant dose-related trend was found in all groups. The carcinogenicity of dioxins has been under reassessment by USEPA since 2011, and the uncertainty associated with the oral CSF for dioxin TEQ used in this BHRA could be high.

Manganese

Manganese was the noncancer risk driver in EU-5 and EU-6 for construction workers (see Section 9.1.2), and inhalation of airborne particulates was the driving pathway (see Appendix K, Tables K-15 and K-18). In this BHRA, the inhalation subchronic RfC for

manganese used the inhalation chronic RfC as a surrogate, which is obtained from IRIS based primarily on an epidemiological study of male workers exposed to manganese dioxide dust in a Belgian alkaline battery plant (USEPA 2021c). The critical effect considered in the derivation of the inhalation chronic RfC was impairment of neuro-behavioral function. USEPA applied a composite uncertainty factor of 1,000 to the lowest-observed-adverse-effect level (LOAEL) to account for intraspecies differences for potentially susceptible individuals, using LOAEL as the point of departure, and database limitations (i.e., less-than-chronic periods of exposure, lack of developmental data, and potential but unquantified differences in the toxicity of different forms of manganese). The uncertainty associated with the inhalation chronic RfC for manganese is expected to be medium. The critical study found indications of neurobehavioral dysfunction similar to the results of other human studies, and the exposure history of the workers was well characterized. However, the study did not identify a no-observed-adverse-effect level (NOAEL) for neurobehavioral effects, or directly provide information on the particle size distribution of manganese. The duration of exposure was relatively limited (approximately 5.3 years). Moreover, the workers were relatively young (approximately 31.3 years old). These temporal limitations raise concerns that longer durations of exposure and/or interactions with aging might result in the detection of adverse effects at lower concentrations. Finally, the effects of manganese on development and reproduction have not been studied adequately, and only insufficient information on the developmental toxicity as well as female reproductive function by inhalation exposure exists.

Perchlorate

Perchlorate was the noncancer risk driver in EU-4 and EU-7 for construction workers as well as EU-8 for outdoor commercial/industrial workers and construction workers (see Section 9.1.2). Ingestion was the driving pathway (See Appendix K, Tables K-12, K-21, K-23b, and K-24). The oral chronic RfD for perchlorate (also used as a surrogate for the oral subchronic RfD) in this BHRA is obtained from IRIS based primarily on an epidemiological study of healthy adult volunteers who were exposed to potassium perchlorate in drinking water (USEPA 2021c). The critical effect considered in the derivation of the oral chronic RfD was radioactive iodide uptake inhibition in the thyroid, which is not an adverse effect but a key biochemical event that precedes all potential thyroid-mediated effects of perchlorate exposure; therefore, basing the oral RfD on this endpoint is a more conservative approach than traditional hazard assessment. USEPA applied an intraspecies uncertainty factor of 10 to the no-observed-effect level (NOEL) to protect the most sensitive population, the fetuses of pregnant women who might have hypothyroidism or iodide deficiency. The uncertainty associated with the oral chronic RfD for perchlorate is expected to be low. The critical study was well conducted and provided a clear dose-response curve for radioiodide uptake inhibition in adult humans, although it is limited by small numbers of subjects (n=7) in the lowest dose group. The critical study is supported by other human clinical studies, occupational and environmental epidemiologic studies, and studies of long-term perchlorate administration to patients with hyperthyroidism. The RfD derivation is based on a no-effect level for a well-characterized biochemical precursor effect (iodide uptake inhibition), accompanied by an uncertainty factor for susceptible populations, which should protect the health of even the most sensitive populations, because a dose that does not inhibit thyroid iodide uptake will not affect thyroid function, even in subjects with an abnormal thyroid gland or a very low iodide intake.

Zirconium

The oral chronic and subchronic RfD for zirconium is a screening toxicity value taken from an appendix of a PPRTV assessment, which was based on one drinking water and feed study over a lifetime to rats and one drinking water and feed study over a lifetime to mice (USEPA 2012b). The critical effect considered in the derivation of the oral RfD was higher cholesterol levels in male rats which is not an adverse effect; therefore, basing the oral RfD on this endpoint is a more conservative approach than traditional hazard assessment. USEPA applied a composite uncertainty factor of 10,000 to the lowest-observed-effect level (LOEL) to account for interspecies extrapolation between rats and humans, no acceptable two-generation reproductive or developmental toxicity studies, intraspecies differences for potentially susceptible individuals, and using LOEL as the point of departure. USEPA concluded that insufficient data were available to derive provisional toxicity values for zirconium, and there is considerably more uncertainty associated with the appendix screening oral RfD. Although zirconium was identified as a soil COPC in EU-8 and EU-9 (see Table 6-6), the estimated noncancer HQs were always well below the target HQ of greater than one for any worker population in any EU (see Appendix K, Tables K-22 through K-27). Therefore, the uncertainty associated with the oral RfD for zirconium is not expected to have a significant impact on the overall risk evaluation.

Asbestos

The potential risk associated with exposure to long amphibole and chrysotile fibers in soil was assessed based on methodology from USEPA (2003), as specified in NDEP's asbestos risk assessment guidance (Neptune 2015). The methodology distinguishes between different fiber types (chrysotile and amphiboles) and sizes (greater than 10 µm in length and less than 0.4 µm in width). USEPA (2003) developed two sets of risk coefficients—one set is "optimized" based on the entirety of the available data, and the other set is "conservative" based on data from a single epidemiology study. Per NDEP guidance (Neptune 2015), the optimized risk coefficients were used in this BHRA, which are considered more appropriate for assessing asbestos risk from soil at the BMI Complex and Common Areas. In addition, the risk coefficients are intended to assess long-term average exposure, such as commercial/industrial workers within the BHRA study area. Applying this methodology to short-term workers such as construction workers in all the nine EUs and utility/ maintenance workers in EU-4, as was done in this BHRA, increases uncertainty[49] in the risk estimates (USEPA 2003).

10.2.4 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 this BHRA, potential health risks were quantified for indoor and outdoor commercial/industrial workers and construction workers associated with soil direct contact (including incidental ingestion, dermal contact, and inhalation of airborne particulates and vapors) within BHRA Study Area. Given the highly conservative nature of the exposure

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

parameters used to characterize these pathways, especially for the RME scenario, it is highly unlikely that the same receptor would be exposed at that level over the entire duration of exposure. These conservative estimates of exposure were then combined with even more conservative estimates of toxicity values to estimate the magnitude (noncancer) or likelihood (cancer) of potential effects. Because of all the conservative assumptions built 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 are no data on chemical interactions in humans exposed to chemical mixtures at the dose levels typically observed in environmental exposures, animal studies suggest that synergistic effects will not occur at levels of exposure below their individual effect levels (Seed et al. 1995). As exposure levels approach the individual effect levels, a variety of interactions may occur, including additive, synergistic, and antagonistic interactions (Seed et al. 1995).

USEPA guidance for risk assessment of chemical mixtures (USEPA 1986) recommends assuming an additive effect following exposure to multiple chemicals. Subsequent recommendations by other parties, such as the National Research Council (NRC 1988) and the Presidential/Congressional Commission on Risk Assessment and Risk Management (Risk Commission 1997), have also advocated a default assumption of additivity. As currently practiced in this BHRA, risk assessments of chemical mixtures summed cancer risks regardless of tumor type, and summed noncancer HQs regardless of toxic endpoint or mode of action. Given the available experimental data, this approach likely overestimates potential risks associated with simultaneous exposure to multiple chemicals. Asbestos risks were evaluated separately from other chemical risks. These risk estimates are not additive because of differences in the basis for the carcinogenic toxicity criteria between chemicals and asbestos. For chemicals, the oral CSFs and IURs are defined as the 95% UCLs of the probability of a carcinogenic response, whereas the IURs for asbestos are based on the estimated number of additional deaths from lung cancer and mesothelioma.

For two soil COPCs (palladium and octachlorostyrene), toxicity values are not available; in the absence of toxicity values, these COPCs were not evaluated quantitatively. For octachlorostyrene, considering the low detection frequency in each EU (0 to 23%, see Table 6-3), the exclusion of this soil COPC from quantitative risk assessment is not expected to have a significant impact on the risk estimates or overall conclusions of the BHRA. Palladium is a COPC in EU-9 with 100% detection; however, RZ-A background data are not

available for this metal. When compared to BRC/TIMET regional background data (ranging from 0.16 mg/kg to 1.5 mg/kg, Appendix D), the maximum detected concentration of palladium in EU-9 (0.53 mg/kg, Table 6-3) fell near the lower end of the range of regional background concentrations. Therefore, palladium concentrations in EU-9 were consistent with regional background, and the exclusion of this soil COPC from quantitative risk assessment is not expected to have a significant impact on the risk estimates or overall conclusions of the BHRA.

Although zirconium was identified as a soil COPC in EU-8 and EU-9 (see Table 6-6), RZ-A background data are not available for this metal. When compared to BRC/TIMET regional background data (ranging from 86 mg/kg to 179 mg/kg, Appendix D), the maximum detected concentrations of zirconium in EU-8 and EU-9 (22 and 25 mg/kg, respectively, Table 6-3) fell below the lower end of the range of regional background concentrations. Therefore, zirconium concentrations in EU-8 and EU-9 were consistent with (or even below) regional background, and conservatively retaining this chemical as a soil COPC in the quantitative risk assessment is likely to overestimate the overall risk.

As discussed in Section 10.2.1, radionuclides were excluded as soil COPCs in the quantitative risk evaluation due to consistency with background risks. Another source of uncertainty for radionuclides risk is the inhalation of radon gas (radon-222) within a commercial building, which is not addressed in the radionuclide BCLs (NDEP 2017a). This exposure pathway could be a significant contributor to potential human health risks, potentially of greater concern than exposure to Ra-226 via soil ingestion, inhalation of particulates, and external irradiation, particularly if activities of Ra-226 are elevated in soils beneath a building. However, as indicated in Table 6-5 and Appendix J, the activities of Ra-226 in the nine EUs were consistent with (or even lower than) the RZ-A and BRC/TIMET regional background; therefore, activities of Ra-226 are not considered elevated in soils beneath a building in any EU, and the risk associated with inhalation of radon-222 within a commercial building should not be a concern. Excluding radionuclides as soil COPCs is not expected to have a significant impact on the overall risk evaluation.

In summary, assumptions used in each step of risk assessment contribute to the overall uncertainty in the 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 risks, if any, posed by residual chemicals in soils within the BHRA Study Area.

11. DATA QUALITY ASSESSMENT

Data quality assessment is an analysis that is performed after the risk assessment is complete to determine whether enough data have been collected to support the risk-based decisions that are recommended by the risk assessment. The results of the data quality assessment are discussed below.

In this BHRA, the evaluation of the cancer risk or noncancer HI was based on the 95% UCL, which is a measure of mean concentration. Therefore, the data quality assessment was conceptualized as a statistical test of comparing the mean of the population cancer risk or noncancer HI with target cancer risk or target noncancer HI. In a hypothesis testing framework, a t-test can be used to evaluate the possibility that the mean of the population cancer risk or noncancer HI is greater than or less than the target cancer risk or the target noncancer HI. The null hypothesis is that the mean of the population cancer risk or noncancer HI is the same as the cancer risk or noncancer HI based on the 95% UCL of sample results ($Mean_0$). The alternative hypothesis is that the mean of the population cancer risk or noncancer HI is equal to or greater than the target cancer risk or noncancer HI ($Mean_1$) if $Mean_0$ is less than $Mean_1$, or the mean of the population cancer risk or noncancer HI is equal to or less than the target cancer risk or noncancer HI if $Mean_0$ is greater than $Mean_1$.

A combination of depth interval, EU, and cancer risk/noncancer HI was considered as one scenario. For each scenario, the data for the receptor population with the maximum total cancer risk/noncancer HI after excluding the metal background contribution was used in our calculation. Tables 11-1 and 11-2 show the scenarios using soil data at 0-2 feet bgs and 0-10 feet bgs, respectively. As indicated in Tables 11-1 and 11-2, a total of 36 scenarios were selected. The sample size of the chemical as the cancer risk or noncancer HI driver for each 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).

The number of samples required to support the risk assessment depends on false rejection error rate (α), false acceptance rate (β), $Mean_0$, $Mean_1$, and standard deviation (SD) of the total cancer risk/noncancer HI in a scenario. A value of 5% was used for both α and β. $Mean_0$ is defined as the total cancer risk or noncancer HI based on the 95% UCL of sample results in the corresponding scenario. It was assumed that the SD of total cancer risk/noncancer HI is similar to the SD of cancer risk/noncancer HQ from the driver chemical. In the G*Power program, the target cancer risk ($Mean_1$) was set to be 1.49×10^{-6} or 6.49×10^{-5} (dioxin TEQ only), which can be rounded to 1×10^{-6} or 6×10^{-5} (cancer risk for the Site-specific action level of 0.0027 mg/kg). The target noncancer HI ($Mean_1$) was set to be 1.49, which can be rounded to 1. For scenarios where a metal COPC is the driver chemical and contribution from background soil exist, the target cancer risk or noncancer HI ($Mean_1$) was set to be 1.49×10^{-6} or 1.49 plus the background contribution from all metals.

As shown in Tables 11-1 and 11-2, for 29 out of 36 scenarios, the number of soil samples required to support risk assessment is smaller than the number of samples collected in the EUs. With α and β equal to 5%, the null hypothesis that the mean of the population cancer risk or noncancer HI is the same as the cancer risk or noncancer HI based on the 95% UCL

of sample results is not rejected for these scenarios. Since the cancer risks and noncancer HIs based on the 95% UCL of sample results were below the targets for these scenarios except for cancer risk at 0-10 feet bgs in EU-7, the mean of the population cancer risks and noncancer HIs are also considered to be below the targets for these scenarios except for cancer risk at 0-10 feet bgs in EU-7. The estimated cancer risk to outdoor commercial/industrial workers exposed to soil at 0-10 feet bgs in EU-7 based on the 95% UCL of sample results was within the NDEP acceptable risk range of 10^{-6} to 10^{-4}, and therefore the mean of the population cancer risk to outdoor commercial/industrial workers exposed to soil at 0-10 feet bgs in EU-7 is also considered to be within the NDEP acceptable risk range of 10^{-6} to 10^{-4}.

For the noncancer HI at 0-2 feet bgs in EU-4, the number of soil samples required to support risk assessment (29) is higher than the number of samples collected in EU-4 (22), primarily due to the relatively large SD (0.77) of noncancer HQ from the driver COPC of perchlorate (Table 11-1). With α and β equal to 5%, the null hypothesis that the mean of the population noncancer HI is the same as the noncancer HI based on the 95% UCL of sample results is rejected for this scenario. Since the noncancer HI for outdoor commercial/industrial workers exposed to soil at 0-2 feet bgs in EU-4 based on the 95% UCL of sample results was below the target noncancer HI, the alternative hypothesis that the mean of the population noncancer HI for outdoor commercial/industrial workers exposed to soil at 0-2 feet bgs in EU-4 is equal to or greater than the target noncancer HI is accepted. Although the sample count collected was low, the treatability study soil samples can be used to support the risk conclusion for EU-4. As indicated in Section 10.1.1, additional baseline soil data were collected in EU-4 from the In-Situ Chromium Treatability Study and the Soil Flushing Treatability Study (see Appendix M). If these treatability study samples are incorporated into the 95% UCL calculation, the noncancer HI and the SD of the noncancer HQ from the driver COPC of perchlorate would remain relatively the same, while the sample size would increase from 22 to 51 which is higher than the unchanged number of soil samples required to support risk assessment (29). Therefore, taking into account the treatability study samples, adequate soil samples were collected to support risk assessment; since the noncancer HI for outdoor commercial/industrial workers exposed to soil at 0-2 feet bgs in EU-4 based on the 95% UCL of sample results was below the target noncancer HI, the mean of the population noncancer HI for outdoor commercial/ industrial workers exposed to soil at 0-2 feet bgs in EU-4 is also considered to be below the target noncancer HI.

For the cancer risk at 0-2 feet bgs in EU-7, the number of soil samples required to support risk assessment (80) is higher than the number of samples collected in EU-7 (10), primarily due to the relatively large SD (1.1×10^{-6}) of cancer risk from the driver COPC of chromium VI (Table 11-1). With α and β equal to 5%, the null hypothesis that the mean of the population cancer risk is the same as the cancer risk based on the 95% UCL of sample results is rejected for this scenario. Since the cancer risk to outdoor commercial/industrial workers exposed to soil at 0-2 feet bgs in EU-7 based on the 95% UCL of sample results was above the target cancer risk of 1.49×10^{-6} (rounded to 1×10^{-6}), the alternative hypothesis that the mean of the population cancer risk to outdoor commercial/industrial workers exposed to soil at 0-2 feet bgs in EU-7 is equal to or less than the target cancer risk of 10^{-6} is accepted. Therefore, although sufficient soil samples were not collected at 0-2

feet bgs in EU-7, the cancer risk calculated based on the 95% UCL of sample results is likely to overestimate the mean of the population cancer risk in EU-7.

For the noncancer HIs at 0-10 feet bgs in EU-4 through EU-8, the number of soil samples required to support risk assessment (71, 126, 311, 128, and 7, respectively) is higher than the number of samples collected in EU-4 through EU-8 (49, 107, 53, 35, and 6, respectively), primarily due to the relatively large SD of noncancer HQ from the driver COPC of perchlorate or manganese. With α and β equal to 5%, the null hypothesis that the mean of the population noncancer HI is the same as the noncancer HI based on the 95% UCL of sample results is rejected for these scenarios. Since the noncancer HIs for construction workers exposed to soil at 0-10 feet bgs in EU-4 through EU-8 based on the 95% UCL of sample results were above the target cancer HI, the alternative hypothesis that the mean values of the population noncancer HIs for construction workers exposed to soil at 0-10 feet bgs in EU-4 through EU-8 are equal to or less than the target noncancer HI is accepted. Therefore, although sufficient soil samples were not collected at 0-10 feet bgs in EU-4 through EU-8, the noncancer HIs calculated based on the 95% UCL of sample results are likely to overestimate the mean values of the population noncancer HIs in these EUs.

In summary, based on the data quality assessment, for the majority of the scenarios evaluated in this BHRA, the number of soil samples collected in each EU is sufficient for the purpose of risk characterization. For the remaining few scenarios with cancer risks or noncancer HIs calculated based on the 95% UCL of sample results exceeding the targets (i.e., cancer risk at 0-2 feet bgs in EU-7, noncancer HIs at 0-10 feet bgs in EU-4 through EU-8), sufficient soil samples were not collected, but the cancer risks or noncancer HIs calculated based on the 95% UCL of sample results are likely to overestimate the mean of the population cancer risk or noncancer HI in these EUs.

12. CUMULATIVE RISK

The cumulative cancer risk and noncancer HI for each receptor population in the BHRA Study Area[50] were estimated by summing the estimated excess lifetime cancer risk and noncancer HI for COPCs via direct contact with soil (0-2 or 0-10 feet bgs, excluding contribution from background metals in soil[51]) (Table 9-1) and for VOCs via inhalation of soil gas (5 or 15 feet bgs) migrating to air (Ramboll 2021a)[52]. The risk results for soil gas were used for cumulative risk characterization whenever available because soil gas data is generally the preferred line of evidence for assessing vapor intrusion risks as opposed to groundwater data, as described in agency guidance (USEPA 2015). Asbestos risks were evaluated separately from chemical risks because these risk estimates are not additive. The basis for the carcinogenic toxicity criteria between chemicals and asbestos is different; for chemicals, the CSFs and IURs are defined as the 95% UCLs of the probability of a carcinogenic response, whereas the IURs for asbestos in soil are based on the estimated number of additional deaths from lung cancer and mesothelioma. The cumulative risks in each EU (along with the soil risk results discussed in Section 9.1 of this report and the applicable soil gas risk results discussed in the BHRA Report for OU-1 Soil Gas and Groundwater [Ramboll 2021a]) are presented in Table 12-1 and discussed below:

EU-1

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-1 were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations except indoor commercial/industrial workers exposed to soil at 0-2 or 0-10 feet bgs and soil gas at 5 feet bgs, for which the excess lifetime cumulative cancer risks were 8×10^{-6} and within the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- For indoor commercial/industrial workers, the cumulative cancer risk driver chemical was chloroform in soil gas, and the cumulative cancer risk driving pathway was inhalation of soil gas migrating to indoor air.
- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-1 were below the NDEP target HI of greater than one.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-1 is not expected to pose an unacceptable carcinogenic health risk or noncarcinogenic health

[50] As described in Section 1, the BHRA Study Area is an approximately 142-acre non-contiguous area within the Operations Area (Figure 1-5), excluding RZ-A and 38 ECAs. As described in Ramboll (2021a), the focus of the OU-1 Soil Gas and Groundwater BHRA is the Operations Area. Therefore, the cumulative risk from soil and soil gas was only evaluated for the BHRA Study Area.

[51] As discussed in Section 9.1.1, in the nine EUs, either arsenic was not identified as a soil COPC based on background comparison or the estimated cancer risks for arsenic were below 10^{-6} when excluding the contribution from arsenic in background soil. Therefore, arsenic did not contribute to the soil risks or cumulative risks significantly.

[52] The BHRA Report for OU-1 Soil Gas and Groundwater was submitted to NDEP on September 29, 2021 (Ramboll 2021a). Like discussed in the previous sections of this OU-1 Soil BHRA Report, the risk results presented in the BHRA Report for OU-1 Soil Gas and Groundwater were also calculated based on conservative assumptions. Refer to Ramboll (2021a) for more details.

effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cumulative risk characterization for EU-1.

EU-2

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-2 were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for construction workers, and within or at the higher end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for indoor commercial/ industrial workers (1×10^{-4} at maximum) and outdoor commercial/industrial workers (8×10^{-6} at maximum).
- For indoor commercial/industrial workers, the cumulative cancer risk driver chemical was chloroform in soil gas, and the cumulative cancer risk driving pathway was inhalation of soil gas migrating to indoor air. In addition, the cancer risks from direct contact with dioxin TEQ in soil were also above 10^{-6}.
- For outdoor commercial/industrial workers, the cumulative cancer risk driver chemical was dioxin TEQ in soil, and the cumulative cancer risk driving pathway was direct contact with soil.
- It should be noted that the Site-specific action level for dioxin TEQ (0.0027 mg/kg) would correspond to a cancer risk of 6×10^{-5} for an outdoor commercial/industrial worker (Northgate 2010f), which is higher than the cancer risks associated with dioxin TEQ in soil in EU-2.
- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in EU-2 were below the NDEP target HI of greater than one.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-2 is not expected to pose an unacceptable carcinogenic health risk or noncarcinogenic health effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cumulative risk characterization for EU-2.

EU-3

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-3 were within the NDEP acceptable risk range of 10^{-6} to 10^{-4} for indoor commercial/industrial workers (1×10^{-5} at maximum), outdoor commercial/industrial workers (3×10^{-5} at maximum), and construction workers (2×10^{-6} at maximum).
- For all worker populations, the cumulative cancer risk driver chemical was dioxin TEQ in soil, and the cumulative cancer risk driving pathway was direct contact with soil.
- It should be noted that the Site-specific action level for dioxin TEQ (0.0027 mg/kg) would correspond to a cancer risk of 6×10^{-5} for an outdoor commercial/industrial worker (Northgate 2010f), which is higher than the cancer risks associated with dioxin TEQ in soil in EU-3.

- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-3 were below the NDEP target HI of greater than one.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-3 is not expected to pose an unacceptable carcinogenic health risk or noncarcinogenic health effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cumulative risk characterization for EU-3.

EU-4

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-4 were at or below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations.
- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-4 were below the NDEP target HI of greater than one for all worker populations except construction workers, for which the cumulative noncancer HIs were two and above the NDEP target HI of greater than one.
- For construction workers, the cumulative noncancer HI driver chemical was perchlorate, and the cumulative noncancer HI driving pathway was direct contact with soil.
- The calculation of noncancer HQs for construction workers (solely driven by perchlorate) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust), a very conservative default soil ingestion rate (330 mg/day), and an exposure time of eight hours per day and an exposure frequency of 250 days per year in EU-4. Under current conditions only some utility/maintenance workers are anticipated to occasionally conduct soil or groundwater well sampling (e.g., one hour per day, one day per month) in this area. No subchronic toxicity values were available for perchlorate, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-4 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. The calculated cumulative noncancer HIs were above the target level under a conservative construction worker scenario, due to the presence of perchlorate in soil in the Central Retention Basin. However, potential cumulative exposure to chemicals in soil and soil gas in EU-4 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers or outdoor utility/maintenance workers.

EU-5

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-5 were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations.

- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-5 were below the NDEP target HI of greater than one for all worker populations except construction workers, for which the cumulative noncancer HIs were three and above the NDEP target HI of greater than one.
- For construction workers, the cumulative noncancer HI driver chemical was manganese, and the cumulative noncancer HI driving pathway was direct contact with soil.
- The calculation of noncancer HQs for construction workers (solely driven by manganese) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for manganese, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-5 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. The calculated cumulative noncancer HIs were above the target level under a construction worker scenario, due to the presence of manganese in soil in this EU. However, potential cumulative exposure to chemicals in soil and soil gas in EU-5 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers.

EU-6

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-6 were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations except indoor commercial/industrial workers, for which the excess lifetime cumulative cancer risks were from 9×10^{-6} to 1×10^{-5} and within the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
- For indoor commercial/industrial workers, the cumulative cancer risk driver chemical was chloroform in soil gas, and the cumulative cancer risk driving pathway was inhalation of soil gas migrating to indoor air.
- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-6 were below the NDEP target HI of greater than one for all worker populations except construction workers, for which the cumulative noncancer HIs were two and above the NDEP target HI of greater than one.
- For construction workers, the cumulative noncancer HI driver chemical was manganese, and the cumulative noncancer HI driving pathway was direct contact with soil.
- The calculation of noncancer HQs for construction workers (solely driven by manganese) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against

dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for manganese, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-6 is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. The calculated cumulative noncancer HIs were above the target level under a construction worker scenario, due to the presence of manganese in soil in this EU. However, potential cumulative exposure to chemicals in soil and soil gas in EU-6 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers.

EU-7

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-7 were within the NDEP acceptable risk range of 10^{-6} to 10^{-4} for indoor commercial/industrial workers (4×10^{-6} at maximum), outdoor commercial/industrial workers (4×10^{-6} at maximum), and construction workers (2×10^{-6} at maximum).
- For indoor commercial/industrial workers, the cumulative cancer risk driver chemicals were chromium VI in soil and chloroform in soil gas. Direct contact with soil and inhalation of soil gas migrating to indoor air contributed approximately equally to the cumulative cancer risks.
- For outdoor commercial/industrial workers and construction workers, the cumulative cancer risk driver chemical was chromium VI in soil, and the cumulative cancer risk driving pathway was direct contact with soil.
- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-7 were below the NDEP target HI of greater than one for all worker populations except construction workers, for which the cumulative noncancer HIs were two and above the NDEP target HI of greater than one.
- For construction workers, the cumulative noncancer HI driver chemical was perchlorate, and the cumulative noncancer HI driving pathway was direct contact with soil.
- The calculation of noncancer HQs for construction workers (solely driven by perchlorate) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for perchlorate, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-7 is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. The calculated cumulative noncancer HIs were above the target

level under a construction worker scenario, due to the presence of perchlorate in soil in this EU. However, potential cumulative exposure to chemicals in soil and soil gas in EU-7 does not pose an unacceptable noncarcinogenic health effect to indoor or outdoor commercial/industrial workers.

EU-8

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-8 were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations.
- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-8 were below the NDEP target HI of greater than one for indoor commercial/industrial workers and for outdoor commercial/industrial workers exposed to soil at 0-2 feet bgs and soil gas at 5 or 15 feet bgs. For outdoor commercial/industrial workers and construction workers exposed to soil at 0-10 feet bgs and soil gas at 5 or 15 feet bgs, the cumulative noncancer HIs were two and seven, respectively, both of which were above the NDEP target HI of greater than one.
- For outdoor commercial/industrial workers and construction workers, the cumulative noncancer HI driver chemical was perchlorate, and the cumulative noncancer HI driving pathway was direct contact with soil. It should be noted that the exceedances of the target level for noncancer HIs in EU-8 was due to the elevated perchlorate concentration in a single soil sample, compared to relatively low perchlorate concentrations in other samples collected in this EU (see discussion in Section 9.1.2).
- The calculation of noncancer HQs for construction workers (solely driven by perchlorate) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for perchlorate, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-8 does not pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated. The calculated cumulative noncancer HIs were above the target level under outdoor commercial/industrial worker and construction worker scenarios, due to the elevated perchlorate concentration in a single soil sample collected in this EU. However, potential cumulative exposure to chemicals in soil and soil gas in EU-8 does not pose an unacceptable noncarcinogenic health effect to indoor commercial/industrial workers.

EU-9

- The excess lifetime cumulative cancer risks due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-9 were at the lower end or within the NDEP acceptable risk range of 10^{-6} to 10^{-4} for indoor commercial/industrial workers (1×10^{-5} at maximum), outdoor commercial/industrial workers (2×10^{-5} at maximum), and construction workers (2×10^{-6} at maximum).

- For indoor commercial/industrial workers exposed to soil at 0-2 feet bgs and soil gas at 5 feet bgs, the cumulative cancer risk driver chemical was chloroform in soil gas, and the cumulative cancer risk driving pathway was inhalation of soil gas migrating to indoor air. For indoor commercial/industrial workers exposed to soil at 0-10 feet bgs and soil gas at 5 feet bgs or exposed to soil at 0-2 feet bgs and soil gas at 15 feet bgs, the cumulative cancer risk driver chemicals were dioxin TEQ in soil and chloroform in soil gas, and direct contact with soil and inhalation of soil gas migrating to indoor air contributed approximately equally to the cumulative cancer risks. For indoor commercial/industrial workers exposed to soil at 0-10 feet bgs and soil gas at 15 feet bgs, the cumulative cancer risk driver chemical was dioxin TEQ in soil, and the cumulative cancer risk driving pathway was direct contact with soil.
- For outdoor commercial/industrial workers and construction workers, the cumulative cancer risk driver chemical was dioxin TEQ in soil, and the cumulative cancer risk driving pathway was direct contact with soil.
- It should be noted that the Site-specific action level for dioxin TEQ (0.0027 mg/kg) would correspond to a cancer risk of 6×10^{-5} for an outdoor commercial/ industrial worker (Northgate 2010f), which is higher than the cancer risks associated with dioxin TEQ in soil in EU-9.
- The cumulative noncancer HIs due to direct contact with COPCs in soil (presented herein) and migration of VOCs in soil gas in EU-9 were below the NDEP target HI of greater than one.

Given these findings, potential cumulative exposure to chemicals in soil and soil gas in EU-9 is not expected to pose an unacceptable carcinogenic health risk or noncarcinogenic health effect under the conditions and assumptions evaluated. Therefore, additional assessment is not warranted based on the cumulative risk characterization for EU-9.

Asbestos Risks

The cancer risks associated with potential inhalation exposure to asbestos in soil are discussed in Section 9.1.3. In summary, potential exposure to asbestos in soil in all nine EUs is not expected to pose an unacceptable carcinogenic health risk under the conditions and assumptions evaluated.

13. SUMMARY AND CONCLUSIONS

This BHRA was conducted to evaluate potential risks to workers within the BHRA Study Area, a 142-acre area within the Operations Area of OU-1, from exposures to residual levels of chemicals, radionuclides, and asbestos in soils. The BHRA followed the procedures outlined in USEPA's risk assessment guidance, applicable NDEP guidance, and approved work plans (ENVIRON 2014b, Ramboll Environ 2017a). A BHRA report for OU-1 soils was submitted to NDEP on January 31, 2020 (Ramboll 2020a), and NDEP comments were received on June 9, 2020 (NDEP 2020). Revision 1 of the BHRA report was submitted to NDEP on October 14, 2021, to address NDEP comments (Ramboll 2021d) and was consistent with the agreements reached during a meeting with NDEP and its consultants on July 8, 2020; NDEP comments on Revision 1 of the BHRA report were received on December 22, 2021 (NDEP 2021). This Revision 2 of the BHRA for OU-1 soils has been prepared to address NDEP comments and is consistent with the agreements reached during a meeting with NDEP and its consultants on January 18, 2022 and the recommendations in a technical memorandum prepared by NDEP's consultant with regard to spatial plots (Neptune 2022). As requested by NDEP, an annotated response to comment has been provided alongside this revised report.

Complete vapor intrusion pathways for VOCs released from soil gas and groundwater have also been identified in the Operations Area. A separate BHRA report for OU-1 soil gas and groundwater was submitted to NDEP on September 29, 2021 (Ramboll 2021a). A response to comment letter is currently under preparation to respond to NDEP comments received on March 9, 2022, and is anticipated to be submitted in the second quarter of 2022. However, there are no anticipated changes in the health risk estimates for the vapor intrusion pathway from soil gas and groundwater in OU-1, and the cumulative risks associated with potential exposures to chemicals in soil and to VOCs in air resulting from vapor intrusion are presented in this OU-1 Soil BHRA report, Revision 2.

The NCP (40 CFR § 300) is cited as the basis for the target cancer risk range established by NDEP (2017a). According to the NCP, lifetime incremental cancer risks posed by a site should not exceed 1×10^{-6} to 1×10^{-4}. According to the NCP and NDEP (2017a), noncarcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., an HI greater than one). It should be noted that the cancer risk and noncancer hazard estimated in this BHRA do not represent absolute estimates in OU-1, since generic and conservative assumptions were used, which are likely to overestimate actual exposures and calculated risks. Exceedance of the target cancer risk range of 10^{-6} to 10^{-4} or the target noncancer HI of greater than one does not indicate that adverse impacts to human health are occurring or will occur but suggests that further evaluation may be warranted.

Soil removal actions were conducted in the Operations Area of OU-1 in 2010 and 2011 to minimize potential health risks associated with the continued presence of contaminated soil. Over 570,000 cy of soil and over 284,000 tons of manganese tailings were removed (ENVIRON 2012, Northgate 2012). In October 2013, over 1,100 tons of soil were excavated in ECA #E3 (Facilities at East End of the Beta Ditch). In April 2019, soil excavation was conducted near the southwest corner of the GW-11 Pond to remove dioxin-impacted soils in this area. Over 2,700 tons of soil were removed as part of this action (Ramboll 2020c). In some areas, impacted soils (with chemical concentrations greater than NDEP's BCLs) and

incompletely characterized soils were left in place due to access or other constraints precluding soil excavation. Such areas are designated as ECAs and risks are mitigated through the SMP (Ramboll 2020b). In other areas, soil characterization was completed as part of the more recent RI sampling activities in 2014 to 2017. This BHRA focused on potential post-removal health risks associated with residual chemical concentrations in non-ECA soils in the BHRA Study Area.

Soil analytical data collected from the top 10 feet bgs in areas that were not excavated as discussed above were assessed through the data processing and DUE steps of this risk assessment (see Section 4.1), and data representative of current Site conditions were selected for purposes of the BHRA. The soil CSM, COPCs, and estimated cancer risks and noncancer HIs are summarized as follows:

- Soil COPCs were selected according to a multi-step process, including a concentration/toxicity screen, a background evaluation for metals and radionuclides, and chemical-specific considerations. The BHRA Study Area was divided into nine EUs based on risk-relevant spatial patterns as well as current land use, existing Site features, and exposures for current workers within the BHRA Study Area (i.e., employees and contractors of EMD, EMD tenants, and the Trust). For the background evaluation, as recommended by Neptune (2017), the regional BRC/TIMET data set was used for the northern portion of the BHRA Study Area (EU-1 through EU-7) and the RZ-A background data set was used for the southern portion of the BHRA Study Area (EU-8 and EU-9). The COPCs identified through these steps for soils in each individual EU are summarized in Table 6-6.
- Based on the refined CSM developed by NERT for the Operations Area, potential exposure to soil was evaluated for indoor commercial/industrial workers, and outdoor commercial/industrial workers (including utility/maintenance workers in EU-4), and construction workers via direct contact with soil (i.e., incidental ingestion, dermal contact, and inhalation of airborne particulates and vapors) within the BHRA Study Area. Commercial/industrial workers were assumed to have direct contact with shallow soils (0–2 feet bgs) when minimum soil excavation occurs, or with surface and subsurface soils (0–10 feet bgs) when soils from depths of up to 10 feet bgs could be brought to the surface during excavation or other activities. Construction workers were assumed to have direct contact with surface and subsurface soils (0–10 feet bgs) during excavation or other activities. Utility/maintenance workers in EU-4 were assumed to occasionally conduct soil or groundwater well sampling and only have direct contact with shallow soils (0–2 feet bgs) in the Central Retention Basin. This scenario is most representative of the likely current activities in this area.
- Excess lifetime cancer risks and noncancer HIs associated with soil direct contact were estimated for all soil COPCs except asbestos based on the 95% UCL on the mean soil concentration (or the maximum detected concentration if a 95% UCL could not be calculated due to limited detections) at the 0-2 feet depth interval and at the 0-10 feet depth interval within the BHRA Study Area as summarized below.

  Cancer Risks:

- For EU-1, EU-4, EU-5, EU-6, and EU-8, excess lifetime cancer risks (excluding contribution from background metals in soil) were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations.
- For EU-2, EU-3, and EU-9, excess lifetime cancer risks (excluding contribution from background metals in soil) were within the NDEP acceptable risk range of 10^{-6} to 10^{-4} for one or more worker populations. The maximum estimated excess lifetime cancer risk was 8×10^{-6} in EU-2 for outdoor commercial/ industrial workers exposed to soil at the 0-2 feet depth interval, 3×10^{-5} in EU-3 for outdoor commercial/industrial workers exposed to soil at the 0-2 feet depth interval, and 2×10^{-5} in EU-9 for outdoor commercial/industrial workers exposed to soil at the 0-10 feet depth interval. The cancer risk driver for these EUs was dioxin TEQ. It should be noted that the Site-specific action level of 0.0027 mg/kg for dioxin TEQ approved by NDEP (2010d) corresponds to a cancer risk of 6×10^{-5}. The cancer risks for dioxin TEQ in these EUs (maximum at 3×10^{-5}) were lower than the cancer risk associated with the Site-specific action level. Further, the dioxin TEQ exceeded the Site-specific action level of 0.0027 mg/kg for a commercial/industrial worker in a few samples collected in EU-2, EU-3, and EU-9 (Figure 6-8), but these limited exceedances were not of concern from a cancer risk perspective as described above.
- For EU-7, excess lifetime cancer risks (excluding contribution from background metals in soil) were at or near the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers. The maximum estimated excess lifetime cancer risk was 4×10^{-6} for outdoor commercial/ industrial workers exposed to soil at the 0-10 feet depth interval. The cancer risk driver was chromium VI, the cancer risks of which ranged from 9×10^{-7} to 3×10^{-6}.
- Arsenic concentrations exceeded the maximum BRC/TIMET background value of 7.2 mg/kg at a few locations in each EU except EU-8 (Figure 6-8). However, arsenic was not identified as a soil COPC in EU-1, EU-2, EU-3, EU-5, EU-6, and EU-7 based on comparison of the distribution of all the arsenic samples in each EU against the BRC/TIMET regional background data set. Also, the estimated cancer risks for arsenic were below 10^{-6} when calculated based on the 95% UCL on the mean concentration of all soil samples collected in EU-4 and EU-9 and excluding the contribution from background arsenic in soil. In summary, the limited arsenic sample locations exceeding the maximum BRC/TIMET background value were not of concern.

Noncancer HIs:

- For EU-1, EU-2, EU-3, and EU-9, noncancer HIs (excluding contribution from background metals in soil) were below the NDEP target HI of greater than one for all worker populations.
- For EU-4, EU-5, EU-6, EU-7, and EU-8, noncancer HIs (excluding contribution from background metals in soil) were above the NDEP target HI of greater than one for construction workers. The noncancer HI (excluding contribution

from background metals in soil) was also above the NDEP target HI of greater than one for outdoor commercial/industrial workers exposed to soil at 0-10 feet bgs in EU-8. The maximum noncancer HI was two in EU-4, three in EU-5, two for EU-6, two for EU-7, and seven in EU-8 for construction workers. The noncancer HI driver for EU-4, EU-7, and EU-8 was perchlorate, the maximum noncancer HQ of which was seven. The noncancer HI driver for EU-5 and EU-6 was manganese, the maximum noncancer HQ of which was three.

- It should be noted that the exceedances of the target level for noncancer HIs in EU-8 was due to the elevated perchlorate concentration in a single soil sample, compared to relatively low perchlorate concentrations in other samples collected in this EU.
- The calculation of noncancer HQs for construction workers (i.e., for perchlorate and manganese) is considered conservative and assumed no worker protection (e.g., direct hand to mouth contact, no gloves, no respirator or other protection against dust) and a very conservative default soil ingestion rate (330 mg/day). No subchronic toxicity values were available for perchlorate and manganese, and the chronic toxicity values were conservatively used in the noncancer HQ calculation for construction workers.
- An exposure time of eight hours per day and an exposure frequency of 250 days per year were also assumed for construction workers. However, under current conditions of EU-4, only utility/maintenance workers are anticipated to occasionally conduct soil or groundwater well sampling (e.g., one hour per day, one day per month) in this area.

- With regard to asbestos (long amphibole and chrysotile fibers), a best estimate and an upper-bound estimate of potential cancer risk via inhalation of airborne particulates were calculated for all worker populations in all nine EUs as summarized below.

  Long Chrysotile Fibers:

  - The best estimates and upper-bound estimates of combined risks for death from lung cancer and mesothelioma associated with potential inhalation exposure to long chrysotile fibers were less than 1×10^{-6} for all worker populations in all nine EUs, which were below the lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4}.
  - Further, the counts of long chrysotile fibers were not above the RAW specified level of five or more fibers per sample (Northgate 2010a) in any samples.

  Long Amphibole Fibers:

  - For indoor and outdoor commercial/industrial workers (including outdoor utility/maintenance workers in EU-4), the best estimates and upper-bound estimates of combined risks for death from lung cancer and mesothelioma

associated with potential inhalation exposure to long amphibole fibers in all nine EUs were below or near the lower end of the NDEP acceptable risk range.

  - For construction workers, the best estimates of combined risks for death from lung cancer and mesothelioma associated with potential inhalation exposure to long amphibole fibers in all nine EUs were below or near the lower end of the NDEP acceptable risk range. The upper-bound estimates of risks from long amphibole fibers for construction workers in all the nine EUs were at the lower end or within the NDEP acceptable risk range, ranging from 1×10^{-6} in EU-2 to 2×10^{-5} in EU-4.
  - It should be noted that the upper-bound risk estimates for long amphibole fibers were based on an observed count of zero fibers in all the EUs except EU-3 and in EU-9[53], while the counts of long amphibole fibers were at or above the RAW specified level of one (1) or more fibers per sample (Northgate 2010a) only at three sample locations in EU-3 and one sample location in EU-9.

- In addition to sources of contamination present within the BHRA Study Area, contaminated surface soils associated with industrial operations on adjacent neighboring sites were also considered potential former and/or current sources of contaminants to OU-1. Through a quantitative evaluation based on the results of soil investigations and risk assessments prepared for the OSSM site and TIMET site, potential exposures to chemicals in soil in these neighboring sites via inhalation of airborne particulates and vapors are not expected to pose unacceptable carcinogenic or noncarcinogenic health effects to populations within the NERT BHRA Study Area.

The cumulative cancer risk and noncancer HI for each receptor population in the BHRA Study Area were estimated by summing the estimated excess lifetime cancer risk and noncancer HI for COPCs via direct contact with soil (0-2 or 0-10 feet bgs) discussed above and presented in Table 9-1 and for VOCs via inhalation of soil gas (5 or 15 feet bgs) migrating to air (Ramboll 2021a)[54]. The risk results for soil gas were used for cumulative risk characterization whenever available because soil gas data is generally the preferred line of evidence for assessing vapor intrusion risks as opposed to groundwater data, as described in agency guidance (USEPA 2015). Asbestos risks were evaluated separately from chemical risks because these risk estimates are not additive. The cumulative risks are summarized below:

Cumulative Cancer Risks:

- For EU-4, EU-5, and EU-8, the excess lifetime cumulative cancer risks due to direct contact with COPCs in soil and migration of VOCs in soil gas were at or below the

[53] For asbestos, risks are estimated even in the case of zero fiber counts. As discussed in detail in Neptune (2015), the risk assessment results are affected by the calculation of the 95% UCL assuming a Poisson distribution, which for a fiber count of zero in soil samples, yields an upper-bound value of 3 f/g of soil.

[54] The BHRA Report for OU-1 Soil Gas and Groundwater was submitted to NDEP on September 29, 2021 (Ramboll 2021a). Like discussed in the previous sections of this OU-1 Soil BHRA Report, the risk results presented in the BHRA Report for OU-1 Soil Gas and Groundwater were also calculated based on conservative assumptions. Refer to Ramboll (2021a) for more details.

lower end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for all worker populations.

- For EU-1, EU-2, EU-3, EU-6, EU-7, and EU-9, the excess lifetime cumulative cancer risks due to direct contact with COPCs in soil and migration of VOCs in soil gas were within or at the higher end of the NDEP acceptable risk range of 10^{-6} to 10^{-4} for one or more worker populations. The maximum estimated excess lifetime cumulative cancer risk was 8×10^{-6} in EU-1, 1×10^{-4} in EU-2, and 1×10^{-5} in EU-6 for indoor commercial/industrial workers, and 3×10^{-5} in EU-3, 4×10^{-6} in EU-7, and 2×10^{-5} in EU-9 for outdoor commercial/industrial workers.
    - For indoor commercial/industrial workers in EU-1, EU-2, and EU-6 as well as indoor commercial/industrial workers exposed to soil at 0-2 feet bgs and soil gas at 5 feet bgs in EU-9, the cumulative cancer risk driver chemical was chloroform in soil gas, and the cumulative cancer risk driving pathway was inhalation of soil gas migrating to indoor air.
    - For indoor commercial/industrial workers in EU-7, the cumulative cancer risk driver chemicals were chromium VI in soil and chloroform in soil gas. Direct contact with soil and inhalation of soil gas migrating to indoor air contributed approximately equally to the cumulative cancer risks.
    - For indoor commercial/industrial workers exposed to soil at 0-10 feet bgs and soil gas at 5 feet bgs or exposed to soil at 0-2 feet bgs and soil gas at 15 feet bgs in EU-9, the cumulative cancer risk driver chemicals were dioxin TEQ in soil and chloroform in soil gas, and direct contact with soil and inhalation of soil gas migrating to indoor air contributed approximately equally to the cumulative cancer risks.
    - For outdoor commercial/industrial workers in EU-2, all worker populations in EU-3, as well as indoor commercial/industrial workers exposed to soil at 0-10 feet bgs and soil gas at 15 feet bgs, outdoor commercial/industrial workers, and construction workers in EU-9, the cumulative cancer risk driver chemical was dioxin TEQ in soil, and the cumulative cancer risk driving pathway was direct contact with soil.
    - For outdoor commercial/industrial workers and construction workers in EU-7, the cumulative cancer risk driver chemical was chromium VI in soil, and the cumulative cancer risk driving pathway was direct contact with soil.

Cumulative Noncancer HIs:

- For EU-1, EU-2, EU-3, and EU-9, the cumulative noncancer HIs due to direct contact with COPCs in soil and migration of VOCs in soil gas were below the NDEP target HI of greater than one.
- For EU-4, EU-5, EU-6, EU-7, and EU-8, the cumulative noncancer HIs due to direct contact with COPCs in soil and migration of VOCs in soil gas were above the NDEP target HI of greater than one for construction workers. The cumulative noncancer HI was also above the NDEP target HI of greater than one for outdoor commercial/ industrial workers exposed to soil at 0-10 feet bgs and soil gas at 5 or 15 feet bgs in EU-8. The maximum cumulative noncancer HI was two in EU-4, three in EU-5, two

for EU-6, two for EU-7, and seven in EU-8 for construction workers. The cumulative noncancer HI driver chemical was perchlorate in EU-4, EU-7, and EU-8, and manganese in EU-5 and EU-6. The cumulative noncancer HI driving pathway was direct contact with soil.

In summary, potential exposure to COPCs in soil as well as potential cumulative exposure to COPCs in soil and VOCs in soil gas are not expected to pose unacceptable carcinogenic human health risks under the conditions and assumptions evaluated in any of the nine EUs in the BHRA Study Area. Potential exposure to COPCs in soil as well as potential cumulative exposure to COPCs in soil and VOCs in soil gas do not pose unacceptable noncarcinogenic health risks under the conditions and assumptions evaluated in EU-1, EU-2, EU-3, or EU-9. The calculated noncancer HIs associated with potential exposure to COPCs in soil and the calculated cumulative noncancer HIs associated with potential exposure COPCs in soil and VOCs in soil gas were above the target level under a construction worker scenario for EU-4, EU-5, EU-6, EU-7, and EU-8 as well as an outdoor commercial/industrial worker scenario for EU-8, based on the presence of perchlorate or manganese in soil in these EUs. These noncancer HI exceedances were due to the conservative exposure assumptions and toxicity values used for the construction worker scenario in all EUs and the elevated perchlorate concentration in a single soil sample collected in EU-8.

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TABLES

TABLE ES-1. COPCs Identified for Soils (0-10 ft bgs) in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	COPC	EU-1	EU-2	EU-3	EU-4	EU-5	EU-6	EU-7	EU-8	EU-9
Chlorine Oxyanions	Chlorate							X		
	Perchlorate	X	X	X	X	X	X	X	X	
Metals	Arsenic				X					X
	Chromium VI			X	X	X	X	X		X
	Cobalt					X				
	Manganese			X		X	X			
	Palladium [1],[2]									X
	Zirconium [2]								X	X
Other Inorganics	Ammonia				X					
Dioxin/Furans	2,3,7,8-TCDD TEQ*		X	X						X
PAHs	BaPEq*	X		X	X	X	X	X	X	X
	Naphthalene					X		X		
Pesticides - OCPs	beta-BHC	X	X				X		X	
	4,4'-DDE	X	X	X						
	4,4'-DDT		X							
	Dieldrin		X							
	Hexachlorobenzene	X	X	X	X	X	X	X		X
	Toxaphene		X							
SVOCs	Bis(2-Ethylhexyl)phthalate								X	
	Octachlorostyrene [1]	X	X	X	X	X	X	X		X
Asbestos	Long amphibole fibers	X	X	X	X	X	X	X	X	X
	Long chrysotile fibers	X	X	X	X	X	X	X	X	X

Notes:

bgs = below ground surface
ft = feet
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
BRC = Basic Remediation Company
COPC = Chemical of Potential Concern
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
EU = Exposure unit
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
TIMET = Titanium Metals Corporation
* Methodology for equivalent calculations explained in text

[1] Retained as a COPC in the absence of a BCL or other screening level. This COPC is discussed qualitatively in the uncertainty analysis section.

[2] RZ-A background data are not available for this chemical, and therefore a background evaluation cannot be conducted for EU-8 and/or EU-9. This chemical is further discussed in comparison to the regional BRC/TIMET background data set in the uncertainty analysis section.

TABLE ES-2. Estimated Soil Cancer Risks and Noncancer Hazard Indices for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Indoor Commercial/Industrial Worker (0-2 feet bgs)		Indoor Commercial/Industrial Worker (0-10 feet bgs)		Outdoor Commercial/Industrial Worker (0-2 feet bgs)		Outdoor Commercial/Industrial Worker (0-10 feet bgs)		Construction Worker (0-10 feet bgs)		Outdoor Utility/Maintenance Worker in EU-4 (0-2 feet bgs)	
	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
With Contribution from Metals in Background Soil												
EU-1	2E-07	0.05	1E-07	0.03	2E-07	0.09	2E-07	0.06	2E-08	0.3	--	--
EU-2	3E-06	0.2	3E-06	0.1	8E-06	0.4	7E-06	0.3	9E-07	0.5	--	--
EU-3	1E-05	0.3	5E-06	0.2	3E-05	0.8	1E-05	0.4	2E-06	1	--	--
EU-4	1E-06	0.6	1E-06	0.4	2E-06	1	3E-06	0.6	4E-07	2	2E-08	0.05
EU-5	1E-07	0.2	1E-07	0.1	2E-07	0.3	1E-07	0.2	3E-07	3	--	--
EU-6	2E-07	0.1	1E-07	0.06	3E-07	0.2	2E-07	0.1	5E-08	3	--	--
EU-7	1E-06	0.08	2E-06	0.3	2E-06	0.1	4E-06	0.5	2E-06	2	--	--
EU-8	2E-07	0.007	1E-07	1	4E-07	0.01	3E-07	2	4E-08	7	--	--
EU-9	1E-06	0.1	7E-06	0.3	2E-06	0.2	2E-05	0.7	3E-06	0.8	--	--
Without Contribution from Metals in Background Soil												
EU-1	2E-07	0.05	1E-07	0.03	2E-07	0.09	2E-07	0.06	2E-08	0.3	--	--
EU-2	3E-06	0.2	3E-06	0.1	8E-06	0.4	7E-06	0.3	9E-07	0.5	--	--
EU-3	1E-05	0.3	5E-06	0.2	3E-05	0.8	1E-05	0.4	2E-06	0.6	--	--
EU-4	2E-07	0.6	4E-07	0.4	3E-07	1	7E-07	0.6	1E-07	2	3E-09	0.05
EU-5	1E-07	0.1	1E-07	0.1	2E-07	0.2	1E-07	0.2	2E-07	3	--	--
EU-6	2E-07	0.09	1E-07	0.05	3E-07	0.2	2E-07	0.09	5E-08	2	--	--
EU-7	1E-06	0.08	2E-06	0.3	2E-06	0.1	4E-06	0.5	2E-06	2	--	--
EU-8	2E-07	0.007	1E-07	1	4E-07	0.01	3E-07	2	4E-08	7	--	--
EU-9	5E-07	0.1	6E-06	0.3	1E-06	0.2	2E-05	0.7	2E-06	0.8	--	--

Notes:
-- = Not applicable
bgs = below ground surface
EU = Exposure unit
HI = Hazard index

TABLE ES-3. Summary of Cumulative Estimated Risks for OU-1 Soil and Soil Gas
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Exposure [1],[2]	Indoor Commercial/Industrial Worker						Outdoor Commercial/Industrial Worker						Construction Worker						Outdoor Utility/Maintenance Worker in EU-4					
		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk	
		Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
EU-1	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	2E-07	0.05	8E-06	0.01	8E-06	0.06	2E-07	0.09	2E-09	0.000003	2E-07	0.09	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.03	8E-06	0.01	8E-06	0.04	2E-07	0.06	2E-09	0.000003	2E-07	0.06	2E-08	0.3	3E-11	0.0000004	2E-08	0.3	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	2E-07	0.05	5E-07	0.0007	7E-07	0.05	2E-07	0.09	5E-09	0.000008	2E-07	0.09	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.03	5E-07	0.0007	6E-07	0.03	2E-07	0.06	5E-09	0.000008	2E-07	0.06	2E-08	0.3	7E-12	0.0000002	2E-08	0.3	--	--	--	--	--	--
	Asbestos - Best Estimate	4E-09	--	--	--	4E-09	--	1E-08	--	--	--	1E-08	--	1E-07	--	--	--	1E-07	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	3E-07	--	--	--	3E-07	--	6E-07	--	--	--	6E-07	--	6E-06	--	--	--	6E-06	--	--	--	--	--	--	--
EU-2	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	3E-06	0.2	3E-05	0.03	3E-05	0.2	8E-06	0.4	2E-09	0.000003	8E-06	0.4	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	3E-06	0.1	3E-05	0.03	3E-05	0.2	7E-06	0.3	2E-09	0.000003	7E-06	0.3	9E-07	0.5	1E-10	0.000002	9E-07	0.5	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	3E-06	0.2	1E-04	0.1	1E-04	0.3	8E-06	0.4	5E-09	0.000008	8E-06	0.4	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	3E-06	0.1	1E-04	0.1	1E-04	0.2	7E-06	0.3	5E-09	0.000008	7E-06	0.3	9E-07	0.5	1E-09	0.00002	9E-07	0.5	--	--	--	--	--	--
	Asbestos - Best Estimate	2E-09	--	--	--	2E-09	--	4E-09	--	--	--	4E-09	--	4E-08	--	--	--	4E-08	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	6E-08	--	--	--	6E-08	--	1E-07	--	--	--	1E-07	--	1E-06	--	--	--	1E-06	--	--	--	--	--	--	--
EU-3	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	1E-05	0.3	4E-07	0.001	1E-05	0.3	3E-05	0.8	2E-09	0.000003	3E-05	0.8	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	5E-06	0.2	4E-07	0.001	6E-06	0.2	1E-05	0.4	2E-09	0.000003	1E-05	0.4	2E-06	0.6	2E-12	0.00000004	2E-06	0.6	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	1E-05	0.3	4E-08	0.00008	1E-05	0.3	3E-05	0.8	5E-09	0.000008	3E-05	0.8	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	5E-06	0.2	4E-08	0.00008	5E-06	0.2	1E-05	0.4	5E-09	0.000008	1E-05	0.4	2E-06	0.6	5E-13	0.00000001	2E-06	0.6	--	--	--	--	--	--
	Asbestos - Best Estimate	9E-08	--	--	--	9E-08	--	2E-07	--	--	--	2E-07	--	2E-06	--	--	--	2E-06	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	2E-07	--	--	--	2E-07	--	5E-07	--	--	--	5E-07	--	5E-06	--	--	--	5E-06	--	--	--	--	--	--	--
EU-4	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs) [3]	2E-07	0.6	3E-07	0.0004	5E-07	0.6	3E-07	1.0	2E-09	0.000003	3E-07	1	--	--	--	--	--	--	2E-08	0.05	3E-12	0.00000002	2E-08	0.05
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	4E-07	0.4	3E-07	0.0004	7E-07	0.4	7E-07	0.6	2E-09	0.000003	7E-07	0.6	1E-07	2.4	1E-12	0.00000002	1E-07	2	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs) [3]	2E-07	0.6	9E-07	0.002	1E-06	0.6	3E-07	1.0	5E-09	0.000008	3E-07	1	--	--	--	--	--	--	2E-08	0.05	7E-12	0.00000005	2E-08	0.05
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	4E-07	0.4	9E-07	0.002	1E-06	0.4	7E-07	0.6	5E-09	0.000008	7E-07	0.6	1E-07	2.4	1E-11	0.0000002	1E-07	2	--	--	--	--	--	--
	Asbestos - Best Estimate	2E-09	--	--	--	2E-09	--	6E-09	--	--	--	6E-09	--	6E-08	--	--	--	6E-08	--	7E-12	--	--	--	7E-12	--
	Asbestos - Upper-Bound Estimate	8E-07	--	--	--	8E-07	--	2E-06	--	--	--	2E-06	--	2E-05	--	--	--	2E-05	--	2E-09	--	--	--	2E-09	--

TABLE ES-3. Summary of Cumulative Estimated Risks for OU-1 Soil and Soil Gas
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Exposure [1],[2]	Indoor Commercial/Industrial Worker						Outdoor Commercial/Industrial Worker						Construction Worker						Outdoor Utility/Maintenance Worker in EU-4					
		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk	
		Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
EU-5	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.1	5E-07	0.0006	6E-07	0.1	2E-07	0.2	2E-09	0.000003	2E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.1	5E-07	0.0006	6E-07	0.1	1E-07	0.2	2E-09	0.000003	1E-07	0.2	2E-07	2.8	2E-12	0.00000003	2E-07	3	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.1	4E-07	0.0007	6E-07	0.1	2E-07	0.2	5E-09	0.000008	2E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.1	4E-07	0.0007	5E-07	0.1	1E-07	0.2	5E-09	0.000008	1E-07	0.2	2E-07	2.8	6E-12	0.0000003	2E-07	3	--	--	--	--	--	--
	Asbestos - Best Estimate	0E+00	--	--	--	0E+00	--	0E+00	--	--	--	0E+00	--	0E+00	--	--	--	0E+00	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	1E-07	--	--	--	1E-07	--	3E-07	--	--	--	3E-07	--	3E-06	--	--	--	3E-06	--	--	--	--	--	--	--
EU-6	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	2E-07	0.09	9E-06	0.01	9E-06	0.1	3E-07	0.2	2E-09	0.000003	3E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.05	9E-06	0.01	9E-06	0.07	2E-07	0.09	2E-09	0.000003	2E-07	0.09	5E-08	2.1	4E-11	0.0000005	5E-08	2	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	2E-07	0.09	1E-05	0.01	1E-05	0.1	3E-07	0.2	5E-09	0.000008	3E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.05	1E-05	0.01	1E-05	0.07	2E-07	0.09	5E-09	0.000008	2E-07	0.09	5E-08	2.1	1E-10	0.000002	5E-08	2	--	--	--	--	--	--
	Asbestos - Best Estimate	4E-10	--	--	--	4E-10	--	1E-09	--	--	--	1E-09	--	1E-08	--	--	--	1E-08	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	1E-07	--	--	--	1E-07	--	3E-07	--	--	--	3E-07	--	3E-06	--	--	--	3E-06	--	--	--	--	--	--	--
EU-7	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	1E-06	0.08	1E-06	0.002	2E-06	0.08	2E-06	0.1	2E-09	0.000003	2E-06	0.1	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	2E-06	0.3	1E-06	0.002	4E-06	0.3	4E-06	0.5	2E-09	0.000003	4E-06	0.5	2E-06	1.9	6E-12	0.00000008	2E-06	2	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	1E-06	0.08	1E-06	0.002	2E-06	0.08	2E-06	0.1	5E-09	0.000008	2E-06	0.1	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	2E-06	0.3	1E-06	0.002	4E-06	0.3	4E-06	0.5	5E-09	0.000008	4E-06	0.5	2E-06	1.9	2E-11	0.0000003	2E-06	2	--	--	--	--	--	--
	Asbestos - Best Estimate	6E-10	--	--	--	6E-10	--	1E-09	--	--	--	1E-09	--	2E-08	--	--	--	2E-08	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	2E-07	--	--	--	2E-07	--	5E-07	--	--	--	5E-07	--	5E-06	--	--	--	5E-06	--	--	--	--	--	--	--
EU-8	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)[4]	2E-07	0.007	7E-08	0.0004	2E-07	0.008	4E-07	0.01	2E-09	0.000003	4E-07	0.01	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)[4]	1E-07	1.1	7E-08	0.0004	2E-07	1	3E-07	2	2E-09	0.000003	3E-07	2	4E-08	7.3	3E-13	0.00000004	4E-08	7	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)[5]	2E-07	0.007	1E-07	0.03	3E-07	0.03	4E-07	0.01	5E-09	0.000008	4E-07	0.01	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)[5]	1E-07	1.1	1E-07	0.03	2E-07	1	3E-07	2	5E-09	0.000008	3E-07	2	4E-08	7.3	7E-11	0.0004	4E-08	7	--	--	--	--	--	--
	Asbestos - Best Estimate	5E-09	--	--	--	5E-09	--	1E-08	--	--	--	1E-08	--	1E-07	--	--	--	1E-07	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	3E-07	--	--	--	3E-07	--	7E-07	--	--	--	7E-07	--	7E-06	--	--	--	7E-06	--	--	--	--	--	--	--

TABLE ES-3. Summary of Cumulative Estimated Risks for OU-1 Soil and Soil Gas
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Exposure [1],[2]	Indoor Commercial/Industrial Worker						Outdoor Commercial/Industrial Worker						Construction Worker						Outdoor Utility/Maintenance Worker in EU-4					
		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk	
		Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
EU-9	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	5E-07	0.1	4E-06	0.01	4E-06	0.1	1E-06	0.2	2E-09	0.000003	1E-06	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	6E-06	0.3	4E-06	0.01	1E-05	0.3	2E-05	0.7	2E-09	0.000003	2E-05	0.7	2E-06	0.8	2E-11	0.0000005	2E-06	0.8	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	5E-07	0.1	6E-07	0.001	1E-06	0.1	1E-06	0.2	5E-09	0.000008	1E-06	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	6E-06	0.3	6E-07	0.001	7E-06	0.3	2E-05	0.7	5E-09	0.000008	2E-05	0.7	2E-06	0.8	8E-12	0.0000002	2E-06	0.8	--	--	--	--	--	--
	Asbestos - Best Estimate	6E-08	--	--	--	6E-08	--	1E-07	--	--	--	1E-07	--	1E-06	--	--	--	1E-06	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	2E-07	--	--	--	2E-07	--	3E-07	--	--	--	3E-07	--	3E-06	--	--	--	3E-06	--	--	--	--	--	--	--

Notes:

-- = Not applicable

bgs = below ground surface

ft = feet

BHRA = Baseline health risk assessment

EU = Exposure unit

HI = Hazard index

OU = Operable unit

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

[2] Unless noted, the cancer risks and noncancer HIs in soil gas for indoor commercial/industrial workers and construction workers were the maximum results in each EU among the soil gas sample locations collected during the Remedial Investigation. The cancer risks and noncancer HIs in soil gas for outdoor commercial/industrial workers were the same in all the EUs, which were calculated based on the 95% upper confidence limits (UCLs) on the mean concentrations over the entire Operations Area. These risk results are presented in the OU-1 Soil Gas and Groundwater BHRA Report (Ramboll 2021).

[3] The cancer risks and noncancer HIs in soil gas for outdoor utility/maintenance workers in EU-4 were calculated based on the risk results for outdoor commercial/industrial workers scaled by exposure parameters presented in Table 7-7.

[4] The cancer risks and noncancer HIs in soil gas at 5 ft bgs for indoor commercial/industrial workers and construction workers in EU-8 were the risk results at SG74 collected during the Phase B Soil Gas Investigation since no soil gas samples were collected during the Remedial Investigation in this EU.

[5] The cancer risks and noncancer HIs at shallow groundwater well location M-97 were used as a surrogate for soil gas risk results at 15 ft bgs for indoor commercial/industrial workers and construction workers in EU-8, since no soil gas samples at a deep depth closer to groundwater were collected in this EU.

Source:

Ramboll. 2021. Baseline Health Risk Assessment Report for OU-1 Soil Gas and Groundwater, Nevada Environmental Response Trust Site, Henderson, Nevada. September 13. Under NDEP review.

TABLE 4-1. Data Usability Evaluation

Nevada Environmental Response Trust Site

Henderson, Nevada

Data Usability Criterion *(description of criterion)*	**Evaluation Result**
I. Reports to the Risk Assessor *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 soil investigations completed within the BHRA Study Area are reported in the following documents. **Historical Investigations** <u>*Phase A Investigation (between November 1 and December 8, 2006)*</u> • *Phase A Work Plan* (ENSR 2006, approved by NDEP on October 26, 2006) • *Phase A Source Area Investigation Results Report* (ENSR 2007a, approved by NDEP on November 30, 2007) • *Phase A DVSR* (ENSR 2007b, approved by NDEP on December 17, 2007) <u>*Phase B Investigation (between June 11 and July 11, 2008 and between June 2 and November 5, 2009)*</u> • *Phase B Work Plan Areas I-IV* (AECOM 2008, approved by NDEP on January 16, 2009) • (A Phase B investigation results report was not identified.) • *DVSR, Phase B Investigation Area I Soil* (Northgate 2010g, approved by NDEP on January 20, 2010) • *DVSR, Phase B Investigation Area II Soil* (Northgate 2010h, approved by NDEP on February 18, 2010) • *DVSR, Phase B Investigation Area III Soil* (Northgate 2010i, approved by NDEP on March 17, 2010) • *DVSR, Phase B Investigation Area IV Soil* (Northgate 2010j, approved by NDEP on March 29, 2010) <u>*Phase B Supplemental Investigation (between December 9 and December 22, 2009)*</u> • *Phase B Scope for Additional Sampling Area I* (Northgate 2009a, approved by NDEP on November 24, 2009)

[1] DVSRs are provided in Appendix A.

TABLE 4-1. Data Usability Evaluation

Nevada Environmental Response Trust Site

Henderson, Nevada

	• *Phase B Scope for Additional Sampling Area II* (Northgate 2009b, approved by NDEP on December 11, 2009) • (A Phase B supplemental investigation results report was not identified.) • *DVSR, Phase B Shallow Soil Supplemental Sampling Areas I and II* (Neptune 2010, approved by NDEP on July 28, 2010) *Soil Removal Pre-Confirmation Sampling (between April 6 and November 12, 2010)* • *Pre-Confirmation Sampling Work Plan* (Northgate 2010b, approved by NDEP on March 30, 2010) • (A pre-confirmation sampling results report was not identified.) • *DVSR, Pre-Confirmation Sampling Remediation Zone B* (Northgate 2010k, approved by NDEP on August 20, 2010) • *DVSR, Pre-Confirmation Sampling Remediation Zone C* (Northgate 2010l, approved by NDEP on September 1, 2010) • *DVSR, Pre-Confirmation Sampling Remediation Zone D* (Northgate 2010m, approved by NDEP on October 8, 2010) • *DVSR, Pre-Confirmation Sampling Remediation Zone E* (Northgate 2010n, approved by NDEP, an approval letter was not identified[2]) • *DVSR, Additional Pre-Confirmation Sampling* (Northgate 2011, approved by NDEP on April 25, 2013) *Confirmation and Completion Sampling for the Soil Removal Action (between February 9 and August 31, 2011)* • *Confirmation Soil Sampling Work Plan* (ENVIRON 2011, approved by NDEP on May 12, 2011) • *Interim Soil Removal Action Completion Report* (ENVIRON 2012, approved by NDEP on December 17, 2012)

[2] NDEP provided two minor comments on this DVSR on August 26, 2010, and Northgate resubmitted the DVSR and the electronic data deliverable on September 9, 2010 and October 11, 2010. The data from this DVSR were uploaded to the BMI database. Therefore, it is assumed that this DVSR was approved.

TABLE 4-1. Data Usability Evaluation

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	• *DVSR, Revision 4, February to August 2011 Soil Remediation Completion Sampling* (Laboratory Data Consultants 2013, approved by NDEP on February 13, 2014) *Other Removal Actions* • *Excavation of Beta Ditch at NERT-TIMET Property Line* (ENVIRON 2014c, NDEP approved June 3, 2014) *Samples not included in the above investigations* Samples at four locations (TSB-GJ-02, TSB-GJ-03, TSB-GJ-04, and TSB-GR-02), collected as part of the previous Parcel G investigation, map within the BHRA Study Area. These samples have been removed from the parcels risk assessment data set and are now included in the OU-1 soil BHRA data set. The DVSRs associated with samples from these four locations (ERM-West, Inc. 2008, Northgate 2010o) were approved by NDEP on April 3, 2008 and July 28, 2010. **Remedial Investigations** *Phase 1 RI (between October 23 and December 18, 2014) and Phase 2 RI (between February 22 and June 30, 2017)* • *Remedial Investigation and Feasibility Study Work Plan* (ENVIRON 2014a, approved by NDEP on July 2, 2014) • *Remedial Investigation Data Evaluation Technical Memorandum* (Ramboll Environ 2016b, approved by NDEP on July 13, 2016) • *OU-1 and OU-2 Remedial Investigation Report* (Ramboll 2021b, under NDEP review) • *DVSR, October through December 2014 Soil Remedial Investigation Sampling* (Ramboll 2019b, approved by NDEP on May 30, 2019) • *DVSR, Asbestos Data Associated with the Phase 1 Remedial Investigation* (Ramboll Environ 2017d, approved by NDEP on June 14, 2018)

TABLE 4-1. Data Usability Evaluation

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	• *DVSR, Parcel C Soil Remedial Investigation Sampling[3], November through December 2014 and September 2016* (Ramboll Environ 2017d, approved by NDEP on January 19, 2018) • *DVSR, Phase 2 Remedial Investigation, February through June 2017 Data* (Ramboll 2019e, approved by NDEP on July 10, 2019) <u>*Unit 4 and 5 Buildings Investigation (between July 1 and December 6, 2016 for the second mobilization)*</u> • *Unit 4 and 5 Buildings Investigation Work Plan* (Tetra Tech 2015, approved by NDEP on April 13, 2015) • *Technical Memorandum: Unit 4 and 5 Buildings Investigation Second Mobilization* (Tetra Tech 2017a, approved by NDEP on June 8, 2017) • *Unit 4 and 5 Buildings Investigation Source Area Characterization Report* (Tetra Tech 2020, approved by NDEP on January 13, 2020) • *DVSR, Unit 4/5 Buildings Investigation* (Tetra Tech 2019, approved by NDEP on February 21, 2019) **Soil Removal Action of Dioxin-Impacted Soil Near GW-11 Pond** • *Work Plan and SMP-Required Contingency Plan, Pre-Excavation Sampling for Dioxin Soil Remediation* (Ramboll 2018, approved by NDEP on August 24, 2018) • *Soil Excavation Work Plan, SMP-Required Notifications and Contingency Plan – Dioxin Soil Remediation Area* (Ramboll 2019a, approved by NDEP on January 14, 2019) • *Report of Soil Removal Action, Dioxin Soil Remediation Area* (Ramboll 2020c, approved by NDEP on March 16, 2020) • *DVSR, Dioxin Impacted Soil Removal Action* (Ramboll 2019d, approved by NDEP on December 19, 2019) Overall, the available reports, and the accompanying laboratory reports and DVSRs, are considered complete for BHRA purposes.

[3] Soil samples from two locations (RISB-47 and RISB-48) were included in the Parcel C Soil Remedial Investigation Sampling DVSR, although these two locations are located within the Operations Area, not Parcel C.

TABLE 4-1. Data Usability Evaluation

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II. Documentation *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 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): • Identification of "removed" samples and re-assignment of sample depths: Following the manganese tailings and soil removal actions (described in Section 3.1.2) and the remediation of dioxin-impacted soil near GW-11 Pond, samples that had been collected within an excavated area were tagged in the NERT project database as "removed." The "remaining" samples were reviewed, as follows: for each sample, the sample location and depth (as reported in the original investigation) were reviewed and the top and bottom depths were re-assigned, as needed, to reflect the post-excavation depth. The re-assignment was necessary because not all excavated areas were back-filled to original grade. For example, a sample with a pre-excavation top depth of 10 feet bgs in an area for which soil was excavated to 8 feet bgs and then backfilled with five feet of clean soil, was reassigned a top depth of 7 feet bgs. • 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. (Approximately 23 samples were missing this information.) The geographic location of each "remaining" sample was confirmed relative to the current boundaries of the Operations Area, ECAs, and parcels. Samples located outside the BHRA Study Area were removed from the BHRA data set, and samples collected as part of a parcel investigation but actually located in the BHRA Study Area were moved into the BHRA data set. • 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 2008b, AECOM and Northgate 2009, ENVIRON 2014d, Ramboll Environ 2017b). 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. The available information is adequate to relate each analytical result retained in the risk assessment data set to a geographic location, depth interval, and sampling procedure.
III. Data Sources *Confirmation that source areas are adequately*	**Historical Investigations** Samples were collected in accordance with the work plans listed under Criterion I. Both judgmental and random sampling approaches were followed, with judgmental samples collected at LOUs that had been

sampled and that analytical methods are appropriate to identify COPCs and estimate EPCs.	identified as source areas. Following each investigation, results were reviewed in consultation with NDEP and areas for additional sampling were identified. As part of the work plans and the QAPPs, the use of standard USEPA analytical methods (listed under Criterion IV) was approved by NDEP. Analyses were conducted by NDEP-certified laboratories for the classes of chemical compounds identified as SRCs, including chlorine oxyanions (chlorate and perchlorate), metals and other inorganics, radionuclides, asbestos, dioxins/furans, organic acids, PCBs, OCPs, OPPs, SVOCs (including PAHs), and VOCs. **Remedial Investigation** As part of the ongoing RI/FS (ENVIRON 2014a, Ramboll Environ 2016b, Ramboll 2021b), surface and subsurface soil samples were collected in OU-1 during Phase 1 and Phase 2 RI to address spatial data gaps identified through the review of available historical soil data. In addition, the Unit 4 and 5 Buildings Investigation was conducted to provide scale-appropriate data density to characterize the vertical and horizontal extent of impacted soil underneath the Unit 4 and 5 Buildings and the nearby area. Review of the analytical results indicates that these spatial data gaps have been addressed. The specific analyses conducted (asbestos, chlorine oxyanions, metals and other inorganics, VOCs, SVOCs, OCPs, OPPs, PCBs, dioxins/furans, organic acids, and radionuclides) were identified based on the review of the historical sampling results; Analyses with standard USEPA analytical methods (listed under Criterion IV) were conducted by NDEP-certified laboratories.
IV. Analytical Methods and Detection Limits *Confirm that analytical methods appropriately identify the chemical form or species and that the SQL is at or below a*	Standard analytical methods were used for all analyses as listed below. **Historical Investigations** • USEPA Method 6020 or 6010 (metals) • USEPA Method 7199 or 7196A (chromium VI) • USEPA Method 7471 (mercury) • USEPA Method 350.1 (ammonia) • USEPA Method 540-R-97-028 (asbestos)

TABLE 4-1. Data Usability Evaluation

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concentration appropriate for the BHRA.	• USEPA Method 9056 or 300 (bromide, chloride, nitrate, ortho-phosphate, sulfate) • USEPA Method 365.1 or 6020 (phosphorus) • USEPA Method 9056, 300 or 300.1 (chlorate) • USEPA Method 9012A (cyanide [total]) • USEPA Method 300.1 (chlorite) • USEPA Method 300 (fluoride) • USEPA Method 9056 or 353.2 (nitrite) • USEPA Method 314.0 (perchlorate) • USEPA Method 8081 or 8151 (OCPs) • USEPA Method 8082 (PCB Aroclors) • USEPA Method 1668A (PCB congeners) • USEPA Method 8290 or 8290 Screen (dioxins/furans) • DOE EML HASL 300 (Th, U) • DOE EML HASL 300, USEPA Method 901.1, or USEPA Method 903.1 (Ra-226) • DOE EML HASL 300, USEPA Method 901.1, or USEPA Method 904.0 (Ra-228) • USEPA Method 8141A (OPPs) • USEPA Method 8260 or 8015 (VOCs) • USEPA Method 8270 SIM or 8270 (SVOCs, including PAHs) • USEPA Method 8315A (formaldehyde) • HPLC-UV per Alpha (organic acids)

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	Remedial Investigation • USEPA Method 6020 or 6010 (metals) • USEPA Method 7199 (chromium VI) • USEPA Method 7471 (mercury) • SM 4500 (ammonia) • USEPA Method 540-R-97-028 (asbestos) • USEPA Method 300 (bromide, chloride, nitrate, nitrite, ortho-phosphate, sulfate) • USEPA Method 300.1 (chlorate) • USEPA Method 314.0 (perchlorate) • USEPA Method 8081 (OCPs) • USEPA Method 8082 (PCB Aroclors) • USEPA Method 1668A (PCB congeners) • USEPA Method 8290 (dioxins/furans) • DOE EML HASL 300 (Th, U) • USEPA Method 903.0 (Ra-226) • USEPA Method 904.0 (Ra-228) • USEPA Method 8141A (OPPs) • USEPA Method 8260 (VOCs) • USEPA Method 8270 or 8270 SIM (SVOCs, including PAHs) • USEPA Method 8270 (organic acids) The above methods are adequate to characterize the corresponding chemical groups in soil.

TABLE 4-1. Data Usability Evaluation

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	The SQLs were evaluated to confirm that they were sufficiently low for risk characterization (i.e., below 0.1xBCL as established in NDEP [2017a] or other screening levels described in Section 5.1). As shown in Table 4-2, maximum SQLs were less than the stated screening levels, with the following exceptions: • For 28 analytes (including metals, OCPs, OPPs, PAHs, PCB Aroclors, SVOCs and VOCs), the SQLs exceeded 0.1xBCL in 0.15 to 11% of the samples reported as nondetects. • For arsenic, the SQLs exceeded the maximum BRC/TIMET background value of 7.2 mg/kg in 10 out of 13 samples reported as nondetects, while the detection frequency was 98% (656 out of 669 samples). • For hexachlorobenzene, the SQLs exceeded 0.1xBCL in 265 out of 367 samples reported as nondetects, while the detection frequency was 49% (346 out of 713 samples). • For zirconium, the SQLs exceeded 0.1x BCL in 15 out of 21 samples reported as nondetects, while the detection frequency was 82% (93 out of 114 samples). • Benzidine and n-nitroso-di-n-propylamine were reported as less than detection limits in all samples; the SQLs exceeded 0.1xBCL in 100% and 91% of the nondetected samples, 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 Section 10.1.2.
V. Data Review *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, 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. The NDEP-approved DVSRs listed in Criterion I for soil data included in the BHRA data set are provided in Appendix A, in which the names and qualifications of the reviewers, the specific data validation procedures, and the qualification findings are presented. Each DVSR includes the following tabular summaries of the data qualifications: • Summary of data qualified due to holding time exceedances

TABLE 4-1. Data Usability Evaluation

Nevada Environmental Response Trust Site

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	• Summary of data qualified due to detection below quantitation limit • Summary of data qualified due to laboratory blank contamination • Summary of data qualified due to field blank contamination • Summary of data qualified due to matrix spike (MS)/matrix spike duplicate (MSD) recovery exceedances • Summary of data qualified due to laboratory control spike (LCS) recovery exceedances • Summary of data qualified due to field/laboratory duplicate • Summary of data qualified due to surrogate recovery exceedances • Summary of data qualified due to calibration violations • Summary of data qualified due to calibration range exceedances • Summary of data qualified due to internal standard recovery exceedances • Summary of data qualified due to serial dilutions • Summary of qualified data results • Summary of rejected data results These data qualifications are further discussed below as a component of Criterion VI.
VI. Data Quality Indicators *Document that sampling and analysis DQIs are evaluated using criteria specific to the risk assessment.*	<u>Completeness</u> 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. First, completeness was reviewed as reported in the DVSR prepared for each individual investigation contributing to the soil BHRA data set. Depending on the specific DVSR, 99.5% to 100% completeness was archived based on validated data, with 0% to 0.5% of the data qualified as rejected ("R" qualified).

TABLE 4-1. Data Usability Evaluation

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	Rejected ("R" qualified) data associated with post-remediation soil samples at 0-10 feet bgs in the BHRA Study Area are summarized in Appendix A, Table A-2. Completeness for the soil BHRA data set for the BHRA Study Area (Appendix B) was calculated as 99.9%. In summary, the completeness for the soil BHRA data meets the goal of 90% established in the QAPPs. Rejected data are excluded from the soil BHRA data set, and a discussion of how these rejected data occurrences potentially affect the overall risk evaluation is presented in Section 10.1.3. <u>Comparability</u> Comparability is a qualitative characteristic expressing the confidence with which one data set can be combined with another for purposes of estimating exposure. More specifically, comparability is a qualitative expression of the measure of confidence that two or more data sets may contribute to a common analysis. In general, comparability of data is maximized by using standard methods for sampling and analysis, reporting data, and data validation. Soil samples identified for the 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 12 years. 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 4-2. For most of the analytes, the SQLs are well below 0.1xBCL (or other applicable screening criteria); therefore, different reporting limits for the same analyte would not affect the overall risk evaluation. There are a few analytes with SQLs exceeding 0.1xBCL (or other applicable screening criteria), and their impacts on the overall risk evaluation are further discussed in Section 10.1.2. Of particular concern are possible differences in the background and the BHRA Study Area data sets for both metals and radionuclides as a result of different sample preparation methods, modified (or different) analytical methods, and possible systematic differences among the internal laboratory SOPs. For example, the Q-Q plots for iron and titanium indicate that the BHRA Study Area concentrations are generally less than background, i.e., in the lower concentration range (see Section 4.2.2). These observations indicate possible differences in the data sets, possibly associated with sample extraction, analytical methods, or other less-identifiable differences across the SOPs used by the different laboratories. For radionuclides, such issues

	were even more obvious, and may be important factors in explaining some of the radionuclide data anomalies. RZ-A background samples were collected and analyzed in 2009, while Operations Area samples were collected and analyzed between 2006 and 2017, i.e., both before and after NDEP issued guidance for evaluating radionuclide data (NDEP 2009c). Over this time period, samples were submitted for analysis to different analytical laboratories and analyzed using different preparation and analytical methods. The impacts of different sample preparation and analytical methods on the overall risk evaluation are further discussed in Section 10.1.4. Representativeness Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or an environmental condition. There is no standard method or formula for evaluating representativeness, which is a qualitative term. Spatial representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific investigation, and by collection of an adequate number of samples from locations identified in relation to the investigation objectives. Concentration representativeness is achieved by obtaining analytical results of sufficient quality, as specified in the QAPPs. Spatial representativeness was discussed previously under Criterion III. As noted, both judgmental and random sampling approaches were followed, with judgmental samples collected at LOUs that had been identified as source areas, ensuring that the post-excavation data provide a conservative representation of current conditions within the BHRA Study Area in the context of the CSM. The objectives of the sampling programs were met, considering the phased approach used to delineate contaminated areas. 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 concentrations at the locations sampled. Precision Precision is a measure of the degree of agreement between replicate measurements of the same source (field precision) or sample (analytical precision). Field precision is evaluated by calculating the 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 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 QAPP (see Table 2 of ENVIRON [2014d]). Field precision for the BHRA Study Area samples was assessed by evaluating the field duplicate results in accordance with the *Statistical Analysis Recommendations for Field Duplicates and Field Splits* (NDEP 2008b), where the primary sample and field duplicate are independent samples. A total of 228 pairs of primary and field duplicate results were qualified due to RPD or PQL criterion exceedance (see Appendix A, Table A-3). For laboratory duplicates, there were 657 sample results qualified due to RPD or PQL criterion exceedance (see DVSR tables in Appendix A). All data with precision exceedances were qualified as "J/Estimated" or "UJ/Estimated non-detected" and are determined to be usable for purposes of the BHRA, and the effects of these qualified data on the overall risk evaluation are further discussed in Sections 10.1.5 and 10.1.6. <u>Accuracy</u> 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: • Holding times; • Field and laboratory blanks; • MS/MSD percent recovery; • Surrogate spike recovery; and

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	• LCS percent recovery. All qualified results (i.e., U, J, J-, and J+ qualified data) for the soil analytes are presented in Appendix B along with the reason codes for these qualified results. 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 10.1.6. Data collected before 2012 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, where possible, Ramboll queried the censored data for blank contamination from the project database, and changed them from nondetected values (U qualified) to detected values at reported concentrations (J qualified), if there were detections between the SQL and the PQL. The revisions of censored data for blank contamination are summarized in Appendix A, Table A-4, and the impacts on the overall risk evaluation are further discussed in Section 10.1.6. In summary, with the exception of the rejected data listed in Appendix A, Table A-2, all data are acceptable through the DQI evaluation and deemed to be usable for risk assessment purposes.

TABLE 4-2. Evaluation of Sample Quantitation Limits
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Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
Chlorine Oxyanions	Chlorate	38,900	mg/kg	347	276	80	0.024	5.8	0	0	--
	Perchlorate	908	mg/kg	522	502	96	0.0099	0.17	0	0	--
Metals	Antimony	519	mg/kg	346	80	23	0.40	4.9	0	0	--
	Arsenic	7.2	mg/kg	669	656	98	0.88	9.9	10	--	Maximum BRC/TIMET background
	Barium	238,000	mg/kg	349	348	99.7	3.8	3.8	0	0	Use health-based BCL instead of non-health based upper-limit
	Boron	259,000	mg/kg	349	335	96	12	13	0	0	Use health-based BCL instead of non-health based upper-limit
	Cadmium	1,260	mg/kg	349	151	43	0.040	1.3	0	0	--
	Chromium VI	7.0	mg/kg	394	71	18	0.10	0.45	0	0	--
	Cobalt	385	mg/kg	399	383	96	1.0	2.6	0	0	--
	Copper	36,700	mg/kg	349	339	97	5.0	5.2	0	0	--
	Lead	800	mg/kg	410	396	97	5.0	5.2	0	--	--
	Mercury	389	mg/kg	350	272	78	0.0020	0.017	0	0	Use Mercury compounds BCL
	Molybdenum	6,490	mg/kg	349	210	60	0.080	5.2	0	0	--
	Nickel	24,700	mg/kg	349	334	96	5.0	5.2	0	0	--
	Niobium	130	mg/kg	106	4	3.8	1.5	30	0	10	--
	Palladium	N/A	mg/kg	30	10	33	0.048	0.060	--	--	--
	Platinum	649	mg/kg	198	143	72	0.0070	0.024	0	0	--
	Selenium	6,490	mg/kg	265	26	9.8	0.11	1.0	0	0	--
	Silver	6,490	mg/kg	349	52	15	0.20	3.9	0	0	--
	Sulfur	N/A	mg/kg	30	18	60	360	430	--	--	--
	Thallium	13	mg/kg	349	194	56	0.073	4.9	0	11	--
	Tungsten	1,040	mg/kg	302	203	67	0.000011	13	0	0	--
	Zirconium	104	mg/kg	114	93	82	5.1	26	0	15	--
Other Inorganics	Ammonia	6,140	mg/kg	201	36	18	0.061	7.9	0	0	--
	Bromide	441,000	mg/kg	214	24	11	0.063	28	0	0	Use health-based BCL instead of non-health based upper-limit
	Chloride	113,000	mg/kg	211	201	95	0.60	4.7	0	0	Use health-based BCL instead of non-health based upper-limit (consider chloride as non-volatile)
	Chlorite	38,900	mg/kg	10	0	0	0.040	0.040	0	0	--
	Cyanide (total)	179	mg/kg	132	2	1.5	0.13	0.57	0	0	Conservatively use BCL for free cyanide (CN-) as a surrogate
	Fluoride	51,900	mg/kg	10	2	20	0.25	0.27	0	0	--
	Nitrate	2,080,000	mg/kg	303	267	88	0.21	4.0	0	0	Use health-based BCL instead of non-health based upper-limit
	Nitrate/Nitrite	130,000	mg/kg	104	85	82	4.9	7.1	0	0	Minimum BCL of nitrate and nitrite, use health-based BCL instead of non-health based upper-limit
	Nitrite	130,000	mg/kg	288	42	15	0.0010	11	0	0	Use health-based BCL instead of non-health based upper-limit
	Sulfate	N/A	mg/kg	219	217	99	0.52	1.5	--	--	--
	ortho-Phosphate	30,400,000	mg/kg	53	9	17	1.1	6.5	0	0	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit
Dioxins/Furans	2,3,7,8-TCDD TEQ*	0.0027	mg/kg	553	550	99	0.0000024	0.0000026	0	--	Site-specific action level
Other Organics	Benzenesulfonic acid	649,000	mg/kg	27	0	0	0.25	0.25	0	0	Use health-based BCL instead of non-health based upper-limit
	4-Chlorobenzenesulfonic acid	117	mg/kg	27	0	0	0.25	0.25	0	0	--
	o,o-Dimethyl Phosphorodithioate	130,000	mg/kg	27	0	0	1.3	1.3	0	0	Use health-based BCL instead of non-health based upper-limit
	Diethylphosphorodithioate	104,000	mg/kg	27	0	0	0.25	0.25	0	0	Use health-based BCL instead of non-health based upper-limit
	Phthalic acid	1,830,000	mg/kg	57	0	0	0.25	70	0	0	Use health-based BCL instead of non-health based upper-limit

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Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
PAHs	Acenaphthene	118	mg/kg	566	7	1.2	0.000031	1.1	0	0	--
	Acenaphthylene	118	mg/kg	566	6	1.1	0.000024	1.8	0	0	Use acenaphthene as a surrogate
	Anthracene	4.3	mg/kg	566	14	2.5	0.000037	1.8	0	1	--
	BaPEq*	0.32	mg/kg	566	90	16	0.000028	2.4	15	29	--
	Benzo(g,h,i)perylene	25,300	mg/kg	565	56	9.9	0.000037	1.7	0	0	--
	Fluoranthene	33,700	mg/kg	566	73	13	0.000046	3.9	0	0	--
	Fluorene	93	mg/kg	566	3	0.53	0.000021	1.9	0	0	--
	1-Methylnaphthalene	81	mg/kg	112	4	3.6	0.00026	8.3	0	1	--
	2-Methylnaphthalene	368	mg/kg	566	10	1.8	0.000017	3.9	0	0	--
	Naphthalene	18	mg/kg	724	37	5.1	0.00032	3.3	0	1	--
	Phenanthrene	25	mg/kg	566	68	12	0.000058	1.8	0	0	--
	Pyrene	44	mg/kg	566	95	17	0.000031	1.3	0	0	--
PCBs	Aroclor-1016	33	mg/kg	48	0	0	0.0091	0.19	0	0	--
	Aroclor-1221	1.1	mg/kg	48	0	0	0.028	0.43	0	1	--
	Aroclor-1232	1.1	mg/kg	48	0	0	0.011	0.19	0	1	--
	Aroclor-1242	1.1	mg/kg	48	0	0	0.018	0.29	0	1	--
	Aroclor-1248	1.1	mg/kg	48	1	2.1	0.018	0.19	0	1	--
	Aroclor-1254	1.1	mg/kg	48	0	0	0.0098	0.19	0	1	--
	Aroclor-1260	1.1	mg/kg	152	4	2.6	0.0086	0.34	0	1	--
Pesticides - OCPs	Aldrin	0.21	mg/kg	367	3	0.82	0.000070	0.058	0	7	--
	alpha-BHC	0.49	mg/kg	367	16	4.4	0.000099	0.049	0	0	--
	beta-BHC	1.7	mg/kg	367	177	48	0.00025	0.15	0	0	--
	delta-BHC	334	mg/kg	367	7	1.9	0.000086	0.092	0	0	--
	gamma-BHC	2.8	mg/kg	367	3	0.82	0.000086	0.11	0	0	--
	alpha-Chlordane	7.3	mg/kg	367	0	0	0.00010	0.074	0	0	Use chlordane as a surrogate
	gamma-Chlordane	7.3	mg/kg	367	1	0.27	0.000088	0.061	0	0	Use chlordane as a surrogate
	Chlordane (total)	7.3	mg/kg	250	1	0.40	0.00021	0.23	0	0	--
	2,4'-DDD	15	mg/kg	10	0	0	0.00012	0.0091	0	0	Use 4,4'-DDD as a surrogate
	2,4'-DDE	9.5	mg/kg	118	20	17	0.000092	0.0083	0	0	Use 4,4'-DDE as a surrogate
	4,4'-DDD	15	mg/kg	367	17	4.6	0.00017	0.13	0	0	--
	4,4'-DDE	9.5	mg/kg	367	166	45	0.000078	0.091	0	0	--
	4,4'-DDT	7.5	mg/kg	367	133	36	0.00017	0.091	0	0	--
	Dieldrin	0.16	mg/kg	367	4	1.1	0.000075	0.091	0	28	--
	Endosulfan I	5,500	mg/kg	367	2	0.54	0.000086	0.046	0	0	Use endosulfan as a surrogate
	Endosulfan II	5,500	mg/kg	367	0	0	0.000091	0.091	0	0	Use endosulfan as a surrogate
	Endosulfan sulfate	5,500	mg/kg	367	2	0.54	0.000090	0.091	0	0	Use endosulfan as a surrogate
	Endrin	30	mg/kg	367	2	0.54	0.000086	0.091	0	0	--
	Endrin aldehyde	30	mg/kg	367	0	0	0.00011	0.091	0	0	Use endrin as a surrogate
	Endrin ketone	30	mg/kg	367	10	2.7	0.00012	0.11	0	0	Use endrin as a surrogate
	Heptachlor	0.81	mg/kg	366	0	0	0.000088	0.049	0	0	--
	Heptachlor epoxide	0.40	mg/kg	367	0	0	0.00011	0.098	0	7	--

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Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
Pesticides - OCPs	Hexachlorobenzene	0.23	mg/kg	713	346	49	0.00028	10	18	265	--
	Methoxychlor	4,580	mg/kg	367	16	4.4	0.00026	0.45	0	0	--
	Toxaphene	2.3	mg/kg	367	1	0.27	0.0073	3.6	2	19	--
	2,4,5-TP	7,330	mg/kg	1	0	0	0.021	0.021	0	0	--
Pesticides - OPPs	Atrazine	11	mg/kg	16	0	0	0.012	0.15	0	0	--
	Chlorpyrifos	916	mg/kg	57	0	0	0.0062	0.082	0	0	--
	Coumaphos	N/A	mg/kg	57	0	0	0.0027	0.036	--	--	--
	Dasanit	N/A	mg/kg	57	0	0	0.0078	0.10	--	--	--
	Demeton (O + S)	37	mg/kg	16	0	0	0.0072	0.096	0	0	--
	Demeton-O	37	mg/kg	57	0	0	0.0051	0.067	0	0	Use demeton as a surrogate
	Demeton-S	37	mg/kg	57	0	0	0.0047	0.062	0	0	Use demeton as a surrogate
	Diazinon	732	mg/kg	57	0	0	0.0070	0.093	0	0	--
	Dibrom	1.3	mg/kg	57	0	0	0.022	0.29	0	1	--
	Dichlorovos	8.8	mg/kg	57	0	0	0.0071	0.094	0	0	--
	Dimethoate	183	mg/kg	57	4	7.0	0.0068	0.090	0	0	--
	Disulfoton	52	mg/kg	57	0	0	0.0074	0.098	0	0	--
	EPN	13	mg/kg	57	0	0	0.0035	0.047	0	0	--
	Ethoprop	N/A	mg/kg	57	0	0	0.0047	0.063	--	--	--
	o-Ethyl o-2,4,5-trichlorophenyl ethyl-phosphonothioate	N/A	mg/kg	57	0	0	0.0060	0.080	--	--	--
	Famphur	N/A	mg/kg	57	0	0	0.0031	0.041	--	--	--
	Fenthion	N/A	mg/kg	57	0	0	0.0084	0.11	--	--	--
	Guthion	2,750	mg/kg	57	0	0	0.0034	0.045	0	0	--
	Malathion	18,300	mg/kg	57	0	0	0.0045	0.059	0	0	--
	Merphos	1.0	mg/kg	57	0	0	0.0049	0.065	0	0	--
	Methyl parathion	229	mg/kg	57	0	0	0.0061	0.081	0	0	--
	Mevinphos	N/A	mg/kg	57	0	0	0.0044	0.059	--	--	--
	Parathion	5,500	mg/kg	57	0	0	0.0051	0.067	0	0	--
	Phorate	183	mg/kg	57	0	0	0.0055	0.073	0	0	--
	Prothiophos	N/A	mg/kg	57	0	0	0.0038	0.050	--	--	--
	Ronnel	27	mg/kg	57	0	0	0.015	0.19	0	0	--
	Simazine	21	mg/kg	16	0	0	0.021	0.28	0	0	--
	Stirophos	107	mg/kg	57	1	1.8	0.0042	0.055	0	0	--
	Sulfotepp	458	mg/kg	57	0	0	0.0060	0.080	0	0	--
	Sulprofos	N/A	mg/kg	57	0	0	0.0041	0.054	--	--	--
	Thionazin	N/A	mg/kg	57	0	0	0.0054	0.071	--	--	--
SVOCs	Acetophenone	2,520	mg/kg	10	0	0	0.034	0.036	0	0	--
	Aniline	450	mg/kg	114	0	0	0.034	4.7	0	0	--
	Azobenzene	33	mg/kg	10	0	0	0.034	0.036	0	0	--
	Benzenethiol	1,260	mg/kg	10	0	0	0.12	0.13	0	0	--
	Benzidine	0.011	mg/kg	86	0	0	0.66	37	86	86	--
	Benzoic acid	3,670,000	mg/kg	111	0	0	0.034	19	0	0	Use health-based BCL instead of non-health based upper-limit

TABLE 4-2. Evaluation of Sample Quantitation Limits
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Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
SVOCs	Benzyl alcohol	91,600	mg/kg	113	0	0	0.034	8.3	0	0	--
	Bis(2-chloro-1-methylethyl) ether	1,020	mg/kg	10	0	0	0.034	0.036	0	0	--
	Bis(2-chloroethoxy)methane	2,750	mg/kg	114	0	0	0.034	7.4	0	0	--
	Bis(2-chloroethyl) ether	1.3	mg/kg	114	0	0	0.034	3.9	2	13	--
	Bis(2-ethylhexyl)phthalate	183	mg/kg	561	99	18	0.0040	5.0	0	0	--
	Bis(4-chlorophenyl) disulfide	N/A	mg/kg	10	0	0	0.20	0.22	--	--	--
	Bis(4-chlorophenyl) sulfone	733	mg/kg	10	0	0	0.33	0.33	0	0	--
	4-Bromophenyl-phenyl ether	N/A	mg/kg	114	0	0	0.034	4.2	--	--	--
	Butylbenzylphthalate	1,350	mg/kg	561	9	1.6	0.000072	4.6	0	0	--
	Carbazole	128	mg/kg	10	0	0	0.034	0.036	0	0	--
	4-Chloro-3-methylphenol	91,600	mg/kg	114	0	0	0.034	3.9	0	0	--
	4-Chloroaniline	18	mg/kg	114	0	0	0.034	7.4	0	2	--
	2-Chloronaphthalene	175	mg/kg	114	0	0	0.034	3.7	0	0	--
	2-Chlorophenol	6,490	mg/kg	114	0	0	0.034	3.9	0	0	--
	4-Chlorophenyl-phenyl ether	N/A	mg/kg	114	0	0	0.034	4.7	--	--	--
	4-Chlorothioanisole	N/A	mg/kg	10	0	0	0.0077	0.0083	--	--	--
	4-Chlorothiophenol	N/A	mg/kg	10	0	0	0.19	0.20	--	--	--
	Di-n-butylphthalate	91,600	mg/kg	561	87	16	0.00099	5.0	0	0	--
	Di-n-octylphthalate	9,160	mg/kg	561	2	0.36	0.000033	5.0	0	0	--
	Dibenzofuran	171	mg/kg	114	0	0	0.034	3.7	0	0	--
	3,3'-Dichlorobenzidine	5.7	mg/kg	114	0	0	0.034	8.3	1	2	--
	2,2'-/4,4'-Dichlorobenzil	389	mg/kg	10	0	0	0.070	0.70	0	0	Use 4,4-dichlorobenzil as a surrogate
	2,4-Dichlorophenol	3,220	mg/kg	114	0	0	0.034	3.7	0	0	--
	Diethylphthalate	733,000	mg/kg	561	5	0.89	0.0037	5.3	0	0	Use health-based BCL instead of non-health based upper-limit
	2,4-Dimethylphenol	18,300	mg/kg	114	0	0	0.034	7.2	0	0	--
	Dimethylphthalate	9,160,000	mg/kg	561	56	10	0.000028	3.7	0	0	Use health-based BCL instead of non-health based upper-limit
	2,4-Dinitrophenol	1,830	mg/kg	114	0	0	0.33	18	0	0	--
	2,4-Dinitrotoluene	8.3	mg/kg	114	0	0	0.034	4.5	0	2	--
	2,6-Dinitrotoluene	2.4	mg/kg	114	0	0	0.034	5.3	1	4	--
	1,4-Dioxane	36	mg/kg	455	0	0	0.00016	7.1	0	1	--
	Diphenyl disulfide	N/A	mg/kg	10	0	0	0.029	0.031	--	--	--
	Diphenyl sulfide	N/A	mg/kg	10	0	0	0.0036	0.0039	--	--	--
	Diphenyl sulfone	733	mg/kg	10	0	0	0.0067	0.0073	0	0	--
	1,2-Diphenylhydrazine	3.2	mg/kg	10	0	0	0.034	0.036	0	0	--
	Hexachlorobutadiene	6.1	mg/kg	440	5	1.1	0.00028	0.036	0	0	--
	Hexachlorocyclopentadiene	8.2	mg/kg	114	0	0	0.13	7.4	0	2	--
	Hexachloroethane	9.3	mg/kg	114	0	0	0.034	7.4	0	2	--
	Hydroxymethyl phthalimide	N/A	mg/kg	10	0	0	0.044	0.047	--	--	--
	Isophorone	2,700	mg/kg	114	0	0	0.034	3.7	0	0	--
	2-Methylphenol	45,800	mg/kg	114	0	0	0.079	4.5	0	0	--
	3&4-Methylphenol	45,800	mg/kg	114	0	0	0.067	7.4	0	0	Minimum BCL of 4-methylphenol and 3-methylphenol

TABLE 4-2. Evaluation of Sample Quantitation Limits
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
SVOCs	2-Nitroaniline	8,880	mg/kg	114	0	0	0.034	3.7	0	0	--
	3-Nitroaniline	3,660	mg/kg	114	0	0	0.034	7.4	0	0	Use 4-nitroaniline as a surrogate (noncancer endpoint)
	4-Nitroaniline	128	mg/kg	114	0	0	0.13	7.4	0	0	--
	Nitrobenzene	25	mg/kg	561	0	0	0.000054	3.9	0	1	--
	2-Nitrophenol	7,330	mg/kg	114	0	0	0.034	7.4	0	0	Use 4-nitrophenol as a surrogate
	4-Nitrophenol	7,330	mg/kg	114	0	0	0.14	7.8	0	0	--
	n-Nitroso-di-n-propylamine	0.37	mg/kg	114	0	0	0.034	3.9	2	104	--
	n-Nitrosodiphenylamine	524	mg/kg	114	0	0	0.034	4.5	0	0	--
	Octachlorostyrene	N/A	mg/kg	559	78	14	0.00012	130	--	--	--
	Pentachlorobenzene	19	mg/kg	10	0	0	0.034	0.036	0	0	--
	Pentachlorophenol	4.5	mg/kg	114	0	0	0.33	19	2	13	--
	Phenol	275,000	mg/kg	114	0	0	0.034	5.0	0	0	Use health-based BCL instead of non-health based upper-limit
	Pyridine	1,300	mg/kg	561	0	0	0.00082	14	0	0	--
	1,2,4,5-Tetrachlorobenzene	8.0	mg/kg	10	0	0	0.034	0.036	0	0	--
	2,4,5-Trichlorophenol	91,600	mg/kg	114	0	0	0.034	7.2	0	0	--
	2,4,6-Trichlorophenol	233	mg/kg	114	0	0	0.034	4.2	0	0	--
VOCs	Acetone	1,040,000	mg/kg	440	207	47	0.0014	0.028	0	0	Use health-based BCL instead of non-health based upper-limit
	Acetonitrile	3,750	mg/kg	10	0	0	0.0020	0.0022	0	0	--
	t-Amyl methyl ether	70,900	mg/kg	430	0	0	0.000053	0.0065	0	0	Use methyl tert-butyl ether as a surrogate (noncancer endpoint)
	Benzene	5.8	mg/kg	440	2	0.45	0.00014	0.0065	0	0	--
	Bromobenzene	679	mg/kg	440	0	0	0.00020	0.0065	0	0	--
	Bromochloromethane	692	mg/kg	440	0	0	0.00015	0.0065	0	0	--
	Bromodichloromethane	1.4	mg/kg	440	2	0.45	0.00011	0.0065	0	0	--
	Bromoform	104	mg/kg	440	1	0.23	0.00012	0.0074	0	0	--
	Bromomethane	33	mg/kg	440	0	0	0.00025	0.013	0	0	--
	2-Butanone	28,400	mg/kg	440	84	19	0.00042	0.019	0	0	--
	tert Butyl alcohol	21,300	mg/kg	427	10	2.3	0.0034	0.037	0	0	--
	n-Butylbenzene	108	mg/kg	440	1	0.23	0.00028	0.0065	0	0	--
	sec-Butylbenzene	145	mg/kg	440	0	0	0.00025	0.0065	0	0	--
	tert-Butylbenzene	183	mg/kg	440	0	0	0.00021	0.0065	0	0	--
	Carbon disulfide	735	mg/kg	10	0	0	0.00055	0.00060	0	0	--
	Carbon tetrachloride	3.2	mg/kg	440	1	0.23	0.00022	0.0065	0	0	--
	Chlorobenzene	18,300	mg/kg	440	7	1.6	0.00013	0.0065	0	0	--
	Chloroethane	2,110	mg/kg	440	0	0	0.00021	0.0074	0	0	--
	Chloroform	1.5	mg/kg	440	93	21	0.00014	0.0065	0	0	--
	Chloromethane	510	mg/kg	440	0	0	0.00020	0.0065	0	0	--
	2-Chlorotoluene	907	mg/kg	440	0	0	0.00026	0.0065	0	0	--
	4-Chlorotoluene	18,300	mg/kg	440	0	0	0.00026	0.0065	0	0	--
	Cumene	91,600	mg/kg	440	0	0	0.00018	0.0065	0	0	--
	p-Cymene	647	mg/kg	440	1	0.23	0.00024	0.0065	0	0	--
	1,2-Dibromo-3-chloropropane	0.071	mg/kg	440	0	0	0.00030	0.0074	0	1	--

TABLE 4-2. Evaluation of Sample Quantitation Limits
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
VOCs	Dibromochloromethane	43	mg/kg	440	0	0	0.00016	0.0065	0	0	--
	1,2-Dibromoethane	0.18	mg/kg	430	0	0	0.00015	0.0065	0	0	--
	Dibromomethane	21,000,000	mg/kg	440	0	0	0.00016	0.0065	0	0	Use health-based BCL instead of non-health based upper-limit
	1,2-Dichlorobenzene	376	mg/kg	440	6	1.4	0.00015	0.0065	0	0	--
	1,3-Dichlorobenzene	373	mg/kg	440	0	0	0.00013	0.0065	0	0	--
	1,4-Dichlorobenzene	475	mg/kg	440	5	1.1	0.00011	0.0065	0	0	--
	Dichlorodifluoromethane	403	mg/kg	440	0	0	0.00025	0.0074	0	0	--
	1,1-Dichloroethane	17	mg/kg	440	1	0.23	0.00011	0.0065	0	0	--
	1,2-Dichloroethane	2.3	mg/kg	440	0	0	0.00017	0.0065	0	0	--
	1,1-Dichloroethene	1,100	mg/kg	440	4	0.91	0.00018	0.0065	0	0	--
	1,2-Dichloroethene	2,360	mg/kg	10	0	0	0.00055	0.00059	0	0	Minimum BCL of trans-1,2-Dichloroethene and cis-1,2-Dichloroethene
	cis-1,2-Dichloroethene	2,360	mg/kg	440	1	0.23	0.00015	0.0065	0	0	--
	trans-1,2-Dichloroethene	18,300	mg/kg	440	0	0	0.00020	0.0065	0	0	--
	1,2-Dichloropropane	5.0	mg/kg	440	0	0	0.00017	0.0065	0	0	--
	1,3-Dichloropropane	18,300	mg/kg	440	0	0	0.00018	0.0065	0	0	--
	2,2-Dichloropropane	73	mg/kg	440	0	0	0.00016	0.0065	0	0	Use 1,2-dichloropropane as a surrogate (noncancer endpoint)
	1,1-Dichloropropene	27,500	mg/kg	440	0	0	0.00020	0.0065	0	0	Use 1,3-dichloropropene as a surrogate (noncancer endpoint)
	cis-1,3-Dichloropropene	26	mg/kg	440	0	0	0.00017	0.0065	0	0	Use 1,3-dichloropropene as a surrogate
	trans-1,3-Dichloropropene	26	mg/kg	440	0	0	0.00018	0.0065	0	0	Use 1,3-dichloropropene as a surrogate
	Diisopropyl ether	2,260	mg/kg	430	0	0	0.00012	0.0065	0	0	--
	Dimethyl disulfide	N/A	mg/kg	10	0	0	0.00021	0.00023	--	--	--
	2,2-Dimethylpentane	N/A	mg/kg	10	0	0	0.00028	0.00030	--	--	--
	2,3-Dimethylpentane	N/A	mg/kg	10	0	0	0.00023	0.00025	--	--	--
	2,4-Dimethylpentane	N/A	mg/kg	10	0	0	0.00019	0.00021	--	--	--
	3,3-Dimethylpentane	N/A	mg/kg	10	0	0	0.00020	0.00022	--	--	--
	Ethanol	15,100,000	mg/kg	16	0	0	0.20	60	0	0	Use health-based BCL instead of non-health based upper-limit
	Ethylbenzene	233	mg/kg	412	1	0.24	0.00019	0.0065	0	0	--
	Ethyl tert-butyl ether	70,900	mg/kg	430	2	0.47	0.00012	0.0065	0	0	Use methyl tert-butyl ether as a surrogate (noncancer endpoint)
	Ethylene glycol	1,830,000	mg/kg	6	0	0	53	60	0	0	Use health-based BCL instead of non-health based upper-limit
	3-Ethylpentane	N/A	mg/kg	10	0	0	0.00021	0.00023	--	--	--
	n-Heptane	220	mg/kg	10	0	0	0.00016	0.00018	0	0	--
	2-Hexanone	1,650	mg/kg	440	0	0	0.00028	0.019	0	0	--
	Iodomethane	1,510	mg/kg	10	0	0	0.00026	0.00028	0	0	--
	Methanol	1,750,000	mg/kg	6	0	0	53	60	0	0	Use health-based BCL instead of non-health based upper-limit
	Methyl tert-butyl ether	238	mg/kg	440	5	1.1	0.00015	0.0065	0	0	--
	4-Methyl-2-pentanone	3,360	mg/kg	440	0	0	0.00031	0.013	0	0	--
	Methylene Chloride	1,550	mg/kg	440	107	24	0.00025	0.019	0	0	--
	2-Methylhexane	N/A	mg/kg	10	0	0	0.00020	0.00022	--	--	--
	3-Methylhexane	N/A	mg/kg	10	0	0	0.00014	0.00015	--	--	--
	2-Nitropropane	0.066	mg/kg	10	0	0	0.0018	0.0019	0	0	--
	n-Nonyl aldehyde	379	mg/kg	10	0	0	0.00089	0.00096	0	0	Use acetaldehyde as a surrogate (noncancer endpoint)

TABLE 4-2. Evaluation of Sample Quantitation Limits
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
							Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
VOCs	n-Propylbenzene	264	mg/kg	440	0	0	0.00025	0.0065	0	0	--
	Styrene	867	mg/kg	440	2	0.45	0.00016	0.0065	0	0	--
	1,1,1,2-Tetrachloroethane	10	mg/kg	440	0	0	0.00014	0.0065	0	0	--
	1,1,2,2-Tetrachloroethane	3.2	mg/kg	440	0	0	0.00014	0.0065	0	0	--
	Tetrachloroethene	117	mg/kg	440	2	0.45	0.00024	0.0065	0	0	--
	Toluene	817	mg/kg	440	91	21	0.00013	0.0065	0	0	--
	1,2,3-Trichlorobenzene	151	mg/kg	440	2	0.45	0.00035	0.0065	0	0	--
	1,2,4-Trichlorobenzene	125	mg/kg	440	6	1.4	0.00037	0.0065	0	0	--
	1,3,5-Trichlorobenzene	285	mg/kg	10	0	0	0.00068	0.00074	0	0	Use 1,2,4-trichlorobenzene as a surrogate (noncancer endpoint)
	1,1,1-Trichloroethane	638	mg/kg	440	1	0.23	0.00010	0.0065	0	0	--
	1,1,2-Trichloroethane	5.8	mg/kg	440	0	0	0.00015	0.0065	0	0	--
	Trichloroethene	6.9	mg/kg	440	13	3.0	0.00012	0.0065	0	0	--
	Trichlorofluoromethane	1,210	mg/kg	440	5	1.1	0.00016	0.0065	0	0	--
	1,2,3-Trichloropropane	0.12	mg/kg	440	0	0	0.00026	0.0065	0	0	--
	1,1,2-Trichloro-1,2,2-trifluoroethane	900	mg/kg	14	0	0	0.00054	0.0055	0	0	--
	1,2,4-Trimethylbenzene	218	mg/kg	440	10	2.3	0.00022	0.0065	0	0	--
	1,3,5-Trimethylbenzene	182	mg/kg	440	1	0.23	0.00019	0.0065	0	0	--
	2,2,3-Trimethylbutane	N/A	mg/kg	10	0	0	0.00021	0.00023	--	--	--
	Vinyl acetate	2,750	mg/kg	10	0	0	0.00018	0.00019	0	0	--
	Vinyl chloride	2.2	mg/kg	440	1	0.23	0.00015	0.0065	0	0	--
	m,p-Xylene	387	mg/kg	417	8	1.9	0.00041	0.0074	0	0	Minimum BCL of m-xylene and p-xylene
	o-Xylene	434	mg/kg	417	4	0.96	0.00030	0.0037	0	0	--
	Xylenes (total)	259	mg/kg	127	0	0	0.00081	0.013	0	0	--

Notes:

-- = Not applicable
mg/kg = milligram per kilogram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
BRC = Basic Remediation Company
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
EPN = Ethyl P-nitrophenyl benzenethiophosphate
N/A = No screening level available
NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticide
OPP = Organophosphorus pesticide
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
SQL = Sample Quantitation Limit
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
TIMET = Titanium Metals Corporation
TP = Trichlorophenoxy
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text
[1] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 2017), unless noted.

Source:

NDEP. 2017. User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. Revision 14, July.

TABLE 4-3. Soil Sampling Results for Asbestos (Long Amphibole and Chrysotile Fibers)
Nevada Environmental Response Trust Site
Henderson, Nevada

Investigation	Sample ID	EU	Sample Type	Sample Date	Start Depth (ft bgs)	Long Amphibole Fiber Count (s/sample)	Long Chrysotile Fiber Count (s/sample)	Long Asbestos Analytical Sensitivity (s/g PM_{10})
Pre-Confirmation Sampling	RSAM7-1.00BPC	EU-2	N	6/16/2010	0.5	0	0	2746057
	RSAO6-0.33BPC	EU-7	N	4/15/2010	0	0	0	2990000
	RSAO6-0.33BPC-FD	EU-7	FD	4/15/2010	0	0	0	2980000
	RSAS8-0.33BPC	EU-9	N	4/8/2010	1.5	0	0	2970000
	SA05-033BPC	EU-9	N	5/13/2010	1	0	0	2770000
	SA11-0.33BPC	EU-7	N	4/12/2010	0	0	0	2960000
	SA121-0.33BPC	EU-9	N	4/7/2010	0.5	0	3	2980000
	SA136-0.33BPC	EU-9	N	4/8/2010	1	0	0	2990000
	SA151-0.33BPC	EU-5	N	4/12/2010	0.5	0	0	2970000
	SA189-0.33BPC	EU-2	N	5/3/2010	0.5	0	0	3000000
	SA77-0.33BPC	EU-9	N	4/20/2010	1	0	0	2990000
	SA77-0.33BPC_FD	EU-9	FD	4/20/2010	1	0	0	2990000
	SSAK2-01-0.00BPC	EU-1	N	4/15/2010	2.5	0	0	2980000
	SSAK2-01-0.00BPC_FD	EU-1	FD	4/15/2010	2.5	0	0	2980000
	SSAK5-02-0.00BPC	EU-2	N	4/21/2010	0	0	0	2990000
	SSAK5-03-0.00BPC	EU-2	N	5/12/2010	0	0	0	2960000
	SSAL2-03-0.00BPC	EU-2	N	4/28/2010	0	0	3	2960000
	SSAL3-03-0.00BPC	EU-1	N	5/11/2010	0	0	3	2500000
	SSAL4-02-0.00BPC	EU-2	N	4/15/2010	0	0	0	3000000
	SSAL4-02-0.00BPC_FD	EU-2	FD	4/15/2010	0	0	0	2990000
	SSAL4-03-0.00BPC	EU-2	N	4/15/2010	0	0	0	2990000
	SSAL5-01-0.00BPC	EU-2	N	5/13/2010	0	0	0	2670000
	SSAL5-02-0.00BPC	EU-2	N	5/13/2010	0	0	0	2710000
	SSAL7-03-0.00BPC	EU-2	N	4/23/2010	0.5	0	0	2970000
	SSAM4-01-0.67BPC	EU-2	N	8/3/2010	1	0	0	2990000
	SSAM4-03-0.00BPC	EU-2	N	8/3/2010	0	0	0	2970000
	SSAM4-04-0.00BPC	EU-2	N	6/28/2010	0.5	0	0	2980000
	SSAM7-01-0.00BPC	EU-3	N	4/22/2010	0	0	0	2970000
	SSAM7-02-0.33BPC	EU-2	N	4/19/2010	0.5	0	0	2960000
	SSAM7-08-0.00BPC	EU-3	N	8/23/2010	0.5	0	1	2707393
	SSAN3-01-0.00BPC	EU-6	N	4/9/2010	0	0	0	2990000
	SSAN3-02-0.00BPC	EU-5	N	4/8/2010	0	0	0	2990000
	SSAN4-01-0.00_1_BPC	EU-2	N	10/28/2010	2	0	2	2509647
	SSAN5-01-0.00BPC	EU-5	N	4/12/2010	0	0	0	2960000
	SSAN6-05-0.00BPC	EU-7	N	4/12/2010	0	0	1	2980000
	SSAN7-03-0.00BPC	EU-5	N	5/12/2010	0.5	0	0	2550000
	SSAN7-03-0.00BPC_FD	EU-5	FD	5/12/2010	0.5	0	0	2460000
	SSAO5-01-0.00BPC	EU-6	N	4/20/2010	0.5	0	0	3000000
	SSAO5-01-0.00BPC_FD	EU-6	FD	4/20/2010	0.5	0	0	2990000
	SSAO6-04-0.00BPC	EU-7	N	4/12/2010	0	0	0	2990000
	SSAO7-01-0.00BPC	EU-7	N	4/12/2010	0	0	0	2990000
	SSAQ3-04-0.00_1_BPC	EU-8	N	9/24/2010	0	0	2	2670000
	SSAQ4-01-0.00BPC	EU-9	N	4/7/2010	0	0	3	2990000
	SSAQ4-02-0.00BPC	EU-9	N	4/9/2010	0	0	0	2980000
	SSAS8-01-0.00BPC	EU-9	N	5/19/2010	1	0	0	2640000
	SSAS8-02-0.00BPC	EU-9	N	8/18/2010	0	0	1	2970000
	SSAS8-03-0.33BPC	EU-9	N	8/18/2010	0	0	0	2970000
	SSAS8-04-0.00BPC	EU-9	N	8/16/2010	0	3	0	2960000
	SSAS8-04-0.33BPC	EU-9	N	8/16/2010	0.33	0	0	2960000

TABLE 4-3. Soil Sampling Results for Asbestos (Long Amphibole and Chrysotile Fibers)
Nevada Environmental Response Trust Site
Henderson, Nevada

Investigation	Sample ID	EU	Sample Type	Sample Date	Start Depth (ft bgs)	Long Amphibole Fiber Count (s/sample)	Long Chrysotile Fiber Count (s/sample)	Long Asbestos Analytical Sensitivity (s/g PM_{10})
Phase A [1]	SA18	EU-1	N	12/3/2006	0	0	2	2995000
	SA21	EU-1	N	12/2/2006	0	0	0	2935000
	SA6	EU-9	N	12/7/2006	0.5	0	0	2846000
	SA7	EU-9	N	12/7/2006	0	0	1	2988000
	SA8	EU-9	N	12/7/2006	0.5	0	2	2997000
Phase B	RSAH3-0.0	EU-1	N	6/11/2008	0.5	0	1	2998000
	RSAK4-0.0	EU-2	N	6/12/2008	0	0	1	2991000
	RSAK6-0.0	EU-2	N	6/17/2008	0	0	0	2976000
	RSAL4-0.0	EU-2	N	6/12/2008	0	0	0	2999000
	RSAL5-0.0	EU-2	N	6/12/2008	0	0	1	2966000
	RSAL6-0.0B	EU-2	N	9/16/2009	0	0	0	2960000
	RSAL7-0.0	EU-3	N	6/17/2008	0	0	0	2981000
	RSAL8-0.0	EU-3	N	6/17/2008	0	0	0	2991000
	RSAM2-0.0	EU-2	N	6/18/2008	0	0	0	2959000
	RSAM3-0.0	EU-2	N	6/18/2008	0.5	0	0	2966000
	RSAM4-0.0	EU-2	N	6/18/2008	0	0	0	2969000
	RSAM6-0.0B	EU-2	N	7/17/2009	0	0	0	2960000
	RSAN2-0.0	EU-6	N	6/18/2008	1	0	0	2985000
	RSAN3-0.0	EU-5	N	6/18/2008	0	0	0	2983000
	RSAN4-0.0	EU-5	N	6/18/2008	0	0	0	2983000
	RSAN5-0.0B	EU-5	N	7/28/2009	0	0	0	2960000
	RSAN7-0.0B	EU-5	N	8/4/2009	0.5	0	0	2960000
	RSAO2-0.0	EU-6	N	6/16/2008	0	0	0	2975000
	RSAP5-0.0B	EU-8	N	8/7/2009	0.5	0	2	2980000
	RSAP7-0.0B	EU-9	N	10/27/2009	0	0	0	3000000
	RSAQ4-0.0B	EU-8	N	8/7/2009	0.5	0	0	2960000
	RSAQ7-0.0B	EU-9	N	10/2/2009	0	0	0	2960000
	RSAS5-0.0B	EU-9	N	9/24/2009	0.5	0	1	2970000
	SA100-0.0	EU-2	N	6/18/2008	0.5	0	0	2969000
	SA103-0.0B	EU-8	N	8/7/2009	0	0	2	2970000
	SA122-0.0B	EU-9	N	9/11/2009	3.5	0	2	2990000
	SA123-0.0B	EU-2	N	7/13/2009	1	0	3	2960000
	SA126-0.0B	EU-9	N	8/5/2009	0.5	0	0	2980000
	SA138-0.0B	EU-8	N	8/7/2009	0	0	0	3000000
	SA144-0.0B	EU-3	N	7/29/2009	0.5	0	0	2980000
	SA144009-0.0B	EU-3	FD	7/29/2009	0.5	0	0	2980000
	SA145-0.0B	EU-3	N	7/23/2009	0	0	0	2960000
	SA151-0.0B	EU-5	N	7/28/2009	0	0	0	2980000
	SA151009-0.0B	EU-5	FD	7/28/2009	0	0	0	2980000
	SA152-0.0	EU-1	N	6/16/2008	0	0	0	2827000
	SA157-0.0B	EU-5	N	10/2/2009	0	0	0	2960000
	SA158-0.0B	EU-5	N	8/7/2009	0	0	0	2980000
	SA166-0.0	EU-6	N	6/18/2008	0	0	0	2969000
	SA170-0.0B	EU-9	N	8/11/2009	1.5	0	0	2960000
	SA170009-0.0B	EU-9	FD	8/11/2009	1.5	0	0	2980000
	SA176-0.0	EU-6	N	6/18/2008	0	0	0	2991000
	SA185-0.0B	EU-6	N	7/31/2009	0.5	0	1	2990000
	SA186-0.0B	EU-6	N	7/31/2009	0	0	0	2980000
	SA197-0.0B	EU-4	N	7/13/2009	0	0	0	2980000
	SA200-0.0B	EU-7	N	7/29/2009	0.5	0	0	2960000
	SA211-0.0B	EU-9	N	8/7/2009	0.5	0	0	2990000

TABLE 4-3. Soil Sampling Results for Asbestos (Long Amphibole and Chrysotile Fibers)
Nevada Environmental Response Trust Site
Henderson, Nevada

Investigation	Sample ID	EU	Sample Type	Sample Date	Start Depth (ft bgs)	Long Amphibole Fiber Count (s/sample)	Long Chrysotile Fiber Count (s/sample)	Long Asbestos Analytical Sensitivity (s/g PM_{10})
Phase B	SA211009-0.0B	EU-9	FD	8/7/2009	0.5	0	0	2990000
	SA212-0.0B	EU-9	N	8/7/2009	0	0	1	2960000
	SA31-0.0B	EU-9	N	9/15/2009	0	0	0	2980000
	SA47-0.0	EU-6	N	6/19/2008	0.5	0	0	2969000
	SA54-0.0B	EU-6	N	7/29/2009	1	0	0	2970000
	SA55-0.0	EU-6	N	6/18/2008	0	0	0	2978000
	SA62-0.0B	EU-3	N	7/17/2009	0	0	0	2960000
	SA64-0.0B	EU-4	N	7/13/2009	0	0	1	3000000
	SA67-0.0	EU-2	N	6/18/2008	0	0	0	2978000
	SA69-0.0	EU-2	N	6/18/2008	0	0	0	2991000
	SA70-0.0B	EU-2	N	7/13/2009	0.5	0	0	2980000
	SA71-0.0B	EU-3	N	7/17/2009	0	0	0	2960000
	SA73-0.0B	EU-2	N	9/16/2009	0	0	0	2980000
	SA74-0.0	EU-2	N	6/12/2008	0	0	0	2969000
	SA75-0.0	EU-2	N	6/12/2008	0	0	0	2978000
	SA85-0.0	EU-2	N	6/18/2008	0	0	1	2991000
	SA87-0.0	EU-5	N	6/18/2008	0	0	0	2982000
RI Phase1	RISB-09-0.5-20141211	EU-3	N	12/11/2014	0.5	0	0	3000000
	RISB-09-5.0-20141211	EU-3	N	12/11/2014	5	0	0	2980000
	RISB-10-0.5-20141215	EU-3	N	12/15/2014	0.5	1	0	3000000
	RISB-10-5.0-20141215	EU-3	N	12/15/2014	5	0	0	2960000
	RISB-11-0.5-20141217	EU-3	N	12/17/2014	0.5	0	0	2970000
	RISB-11-5.0-20141217	EU-3	N	12/17/2014	5	0	0	3000000
	RISB-12-0.5-20141215	EU-3	N	12/15/2014	0.5	1	2	2980000
	RISB-12-5.0-20141216	EU-3	N	12/16/2014	5	0	0	2980000
	RISB-13-0.5-20141217	EU-3	N	12/17/2014	0.5	0	0	3000000
	RISB-13-5.0-20141218	EU-3	N	12/18/2014	5	0	0	2990000
	RISB-14-0.5-20141216	EU-3	N	12/16/2014	0.5	0	0	3000000
	RISB-14-5.0-20141216	EU-3	N	12/16/2014	5	1	0	2980000
Tronox Parcel-G	S2-PG-1-1-0.0	EU-9	N	4/8/2010	0	0	0	2990000
	S2-PG-1-1-0.0-FD	EU-9	FD	4/8/2010	0	0	0	2980000
	TSB-GJ-02-0	EU-9	N	11/19/2007	0	0	1	2972239
	TSB-GJ-03-0	EU-9	N	11/19/2007	0	0	0	2987831
	TSB-GR-02-0	EU-9	N	11/19/2007	0	0	1	2968961

Notes:

bgs = below ground surface

ft = feet

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

s/sample = fiber per sample

EU = Exposure unit

FD = Field Duplicate

N = Normal Sample

[1] The counts for long fibers were calculated as soil concentration divided by analytical sensitivity. Data on soil concentration and analytical sensitivity were obtained from Table J-1 in ENSR (2007) (Table J-1 is also included as Attachment B-2 in this report).

Source:

ENSR. 2007. Phase A Source Area Investigation Results Report, Tronox LLC Facility, Henderson, Nevada. September. NDEP approved November 30, 2007.

TABLE 4-4. Summary Statistics for Chlorine Oxyanions, Metals, Other Inorganics, and Radionuclides: Soil (0-10 ft bgs)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	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
Chlorine Oxyanions	Chlorate	mg/kg	347	276	80	0.024	5.8	0.045	20,900	3.2	160	1,370	8.8	SA106
	Perchlorate	mg/kg	522	502	96	0.0099	0.17	0.011	2,620	4.0	76	260	3.4	RSAM5
Metals	Aluminum	mg/kg	265	265	100	--	--	3,900	12,200	9,010	8,920	1,420	0.16	SA43
	Antimony	mg/kg	346	80	23	0.40	4.9	0.11	2.4	0.23	0.68	0.69	1.0	SA114
	Arsenic	mg/kg	669	656	98	0.88	9.9	0.58	34	3.3	3.8	2.2	0.57	EE-C25-1
	Barium	mg/kg	349	348	99.7	3.8	3.8	4.6	1,780	180	180	100	0.58	SA123
	Beryllium	mg/kg	198	198	100	--	--	0.22	0.71	0.47	0.47	0.074	0.16	SA86
	Boron	mg/kg	349	335	96	12	13	2.5	1,510	7.8	20	110	5.6	SA62
	Cadmium	mg/kg	349	151	43	0.040	1.3	0.040	8.9	0.13	0.25	0.74	2.9	SA103
	Calcium	mg/kg	198	198	100	--	--	9,930	62,500	26,500	27,400	9,280	0.34	RSAM2
	Chromium (total)	mg/kg	443	443	100	--	--	0.13	550	13	15	27	1.8	U4U5-15
	Chromium VI	mg/kg	394	71	18	0.10	0.45	0.11	110	0.60	4.2	15	3.5	SA106
	Cobalt	mg/kg	399	383	96	1.0	2.6	2.7	280	7.5	12	26	2.3	RSAO8
	Copper	mg/kg	349	339	97	5.0	5.2	5.5	160	18	19	11	0.56	RISB-12
	Iron	mg/kg	349	349	100	--	--	220	26,000	15,200	15,200	4,390	0.29	RI-6
	Lead	mg/kg	410	396	97	5.0	5.2	3.6	270	8.8	12	17	1.4	SA92
	Lithium	mg/kg	10	10	100	--	--	10	22	12	14	3.9	0.28	TSB-GJ-02
	Magnesium	mg/kg	398	398	100	--	--	5,300	130,000	10,000	15,100	20,500	1.4	RIDB-21
	Manganese	mg/kg	499	499	100	--	--	46	29,200	380	860	2,030	2.4	CS-C44-1
	Mercury	mg/kg	350	272	78	0.0020	0.017	0.0030	1.9	0.017	0.039	0.13	3.4	M-162D
	Molybdenum	mg/kg	349	210	60	0.080	5.2	0.15	55	0.49	1.1	4.7	4.3	RISB-12
	Nickel	mg/kg	349	334	96	5.0	5.2	4.4	160	15	16	9.7	0.60	RSAO8
	Niobium	mg/kg	106	4	3.8	1.5	30	2.2	9.2	3.0	4.3	3.3	0.75	TSB-GR-02
	Palladium	mg/kg	30	10	33	0.048	0.060	0.33	0.53	0.47	0.45	0.071	0.16	TSB-GJ-02
	Phosphorus (total)	mg/kg	276	276	100	--	--	110	1,600	860	850	250	0.30	RISB-09
	Platinum	mg/kg	198	143	72	0.0070	0.024	0.0050	0.16	0.011	0.015	0.017	1.1	SA64
	Potassium	mg/kg	198	198	100	--	--	1,230	6,120	2,160	2,310	650	0.28	SA141
	Selenium	mg/kg	265	26	9.8	0.11	1.0	0.11	1.5	0.80	0.67	0.48	0.72	RSAJ3
	Silicon	mg/kg	30	30	100	--	--	41	250	130	130	51	0.40	RISB-10
	Silver	mg/kg	349	52	15	0.20	3.9	0.020	7.6	0.12	0.29	1.0	3.6	SA201
	Sodium	mg/kg	198	198	100	--	--	200	11,700	750	1,150	1,280	1.1	SA106
	Strontium	mg/kg	302	302	100	--	--	35	810	190	200	99	0.49	SA15
	Sulfur	mg/kg	30	18	60	360	430	450	14,000	800	1,580	3,120	2.0	RISB-14
	Thallium	mg/kg	349	194	56	0.073	4.9	0.054	8.4	0.10	0.19	0.61	3.2	SA180
	Tin	mg/kg	198	198	100	--	--	0.40	12	4.2	3.8	1.8	0.46	RSAK8
	Titanium	mg/kg	198	198	100	--	--	360	1,270	750	740	180	0.24	SA166
	Tungsten	mg/kg	302	203	67	0.000011	13	0.0028	9.4	0.23	0.45	0.97	2.2	RIDB-3
	Uranium (total)	mg/kg	218	218	100	--	--	0.55	3.6	1.0	1.2	0.52	0.45	SA86

TABLE 4-4. Summary Statistics for Chlorine Oxyanions, Metals, Other Inorganics, and Radionuclides: Soil (0-10 ft bgs)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	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
Metals	Vanadium	mg/kg	282	282	100	--	--	3.0	78	43	43	14	0.32	RSAK8
	Zinc	mg/kg	265	265	100	--	--	18	300	33	37	25	0.68	RISB-37
	Zirconium	mg/kg	114	93	82	5.1	26	15	43	23	23	4.5	0.19	RIDB-27
Other Inorganics	Ammonia	mg/kg	201	36	18	0.061	7.9	0.13	680	1.9	47	140	3.1	RSAM5
	Bromide	mg/kg	214	24	11	0.063	28	0.20	83	1.1	4.7	17	3.6	SA15
	Chloride	mg/kg	211	201	95	0.60	4.7	0.90	6,670	75	380	800	2.1	RSAJ2
	Cyanide (total)	mg/kg	132	2	1.5	0.13	0.57	0.48	1.3	0.89	0.89	0.58	0.65	RSAJ2
	Fluoride	mg/kg	10	2	20	0.25	0.27	0.52	0.75	0.64	0.64	0.16	0.26	TSB-GJ-02
	Nitrate	mg/kg	303	267	88	0.21	4.0	1.2	2,280	23	62	170	2.7	SA15
	Nitrate/Nitrite	mg/kg	104	85	82	4.9	7.1	5.3	800	31	55	96	1.7	RIDB-3
	Nitrite	mg/kg	288	42	15	0.0010	11	0.090	220	0.48	9.5	36	3.8	RIDB-3
	ortho-Phosphate	mg/kg	53	9	17	1.1	6.5	2.4	2,900	21	490	970	2.0	SA11
	Sulfate	mg/kg	219	217	99	0.52	1.5	6.7	15,300	180	810	2,310	2.8	SA65
Radionuclides	Radium-226	pCi/g	297	297	100	--	--	0.069	2.5	0.92	0.93	0.37	0.40	SA92
	Radium-228	pCi/g	297	297	100	--	--	-0.19	3.3	1.2	1.2	0.51	0.43	SA70
	Thorium-228	pCi/g	280	280	100	--	--	-0.073	3.0	1.7	1.6	0.51	0.31	SA65
	Thorium-230	pCi/g	280	280	100	--	--	0.050	4.3	1.1	1.2	0.48	0.41	SA74
	Thorium-232	pCi/g	280	280	100	--	--	-0.011	2.5	1.5	1.5	0.46	0.31	SA189
	Uranium-234	pCi/g	196	196	100	--	--	0.27	3.4	1.0	1.1	0.44	0.40	SA128
	Uranium-235	pCi/g	196	196	100	--	--	-0.029	0.25	0.052	0.061	0.040	0.65	RSAK6
	Uranium-238	pCi/g	196	196	100	--	--	0.24	3.3	0.96	1.0	0.37	0.36	SA128

Notes:

-- = No value

bgs = below ground surface

ft = feet

mg/kg = milligram per kilogram

pCi/g = picocurie per gram

TABLE 4-5. Summary Statistics for Organic Compounds: Soil (0-10 ft bgs)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	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
Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	553	550	99	0.0000024	0.0000026	0.000000057	0.025	0.000015	0.00026	0.0012	4.7	RIDB-25
PAHs	Acenaphthene	mg/kg	566	7	1.2	0.000031	1.1	0.00062	0.70	0.026	0.12	0.26	2.2	EE-C25-1
	Acenaphthylene	mg/kg	566	6	1.1	0.000024	1.8	0.00066	0.22	0.0014	0.038	0.089	2.4	EE-C25-1
	Anthracene	mg/kg	566	14	2.5	0.000037	1.8	0.00055	0.30	0.0035	0.028	0.079	2.8	EE-C25-1
	BaPEq*	mg/kg	566	90	16	0.000028	2.4	0.000028	2.1	0.010	0.061	0.22	3.7	RI-25
	Benzo(g,h,i)perylene	mg/kg	565	56	9.9	0.000037	1.7	0.0014	1.4	0.013	0.059	0.19	3.3	RI-25
	Fluoranthene	mg/kg	566	73	13	0.000046	3.9	0.0017	2.7	0.011	0.073	0.32	4.3	RI-25
	Fluorene	mg/kg	566	3	0.53	0.000021	1.9	0.00052	1.1	0.0010	0.37	0.63	1.7	EE-C25-1
	1-Methylnaphthalene	mg/kg	112	4	3.6	0.00026	8.3	0.00062	5.6	0.0022	1.4	2.8	2.0	EE-C25-1
	2-Methylnaphthalene	mg/kg	566	10	1.8	0.000017	3.9	0.00077	7.9	0.0092	0.81	2.5	3.1	EE-C25-1
	Naphthalene	mg/kg	724	37	5.1	0.00032	3.3	0.0010	3.1	0.0014	0.16	0.60	3.8	EE-C25-1
	Phenanthrene	mg/kg	566	68	12	0.000058	1.8	0.0017	1.5	0.0057	0.064	0.23	3.6	EE-C25-1
	Pyrene	mg/kg	566	95	17	0.000031	1.3	0.0011	2.8	0.011	0.082	0.32	3.9	RI-25
PCBs	Aroclor-1248	mg/kg	48	1	2.1	0.018	0.19	0.091	0.091	0.091	0.091	--	--	RSAS5
	Aroclor-1260	mg/kg	152	4	2.6	0.0086	0.34	0.034	0.074	0.054	0.054	0.017	0.32	RI-5
Pesticides - OCPs	Aldrin	mg/kg	367	3	0.82	0.000070	0.058	0.00049	0.013	0.00052	0.0047	0.0072	1.5	RIDB-25
	alpha-BHC	mg/kg	367	16	4.4	0.000099	0.049	0.00024	0.012	0.00062	0.0019	0.0031	1.6	RSAQ4
	beta-BHC	mg/kg	367	177	48	0.00025	0.15	0.00072	0.87	0.011	0.042	0.096	2.3	SA67
	delta-BHC	mg/kg	367	7	1.9	0.000086	0.092	0.00048	0.0015	0.00059	0.00079	0.00038	0.48	SA86
	gamma-BHC	mg/kg	367	3	0.82	0.000086	0.11	0.00083	0.0019	0.0013	0.0013	0.00054	0.40	RSAQ4
	gamma-Chlordane	mg/kg	367	1	0.27	0.000088	0.061	0.0014	0.0014	0.0014	0.0014	--	--	RSAO7
	Chlordane (total)	mg/kg	250	1	0.40	0.00021	0.23	0.0030	0.0030	0.0030	0.0030	--	--	SA66
	2,4'-DDE	mg/kg	118	20	17	0.000092	0.0083	0.0016	0.053	0.0059	0.012	0.014	1.2	RIDB-25
	4,4'-DDD	mg/kg	367	17	4.6	0.00017	0.13	0.0014	0.032	0.0046	0.0078	0.0079	1.0	SSAL3-04
	4,4'-DDE	mg/kg	367	166	45	0.000078	0.091	0.00040	6.0	0.012	0.24	0.80	3.3	SSAM3-01
	4,4'-DDT	mg/kg	367	133	36	0.00017	0.091	0.00066	2.3	0.0095	0.095	0.26	2.8	SSAM2-01
	Dieldrin	mg/kg	367	4	1.1	0.000075	0.091	0.00027	0.059	0.016	0.023	0.028	1.2	SSAM2-01
	Endosulfan I	mg/kg	367	2	0.54	0.000086	0.046	0.00024	0.0015	0.00087	0.00087	0.00089	1.0	SSAL3-01
	Endosulfan sulfate	mg/kg	367	2	0.54	0.000090	0.091	0.0042	0.016	0.010	0.010	0.0083	0.83	BDT-4-S-15
	Endrin	mg/kg	367	2	0.54	0.000086	0.091	0.00070	0.0054	0.0031	0.0031	0.0033	1.1	SA180
	Endrin ketone	mg/kg	367	10	2.7	0.00012	0.11	0.00061	0.020	0.0012	0.0035	0.0059	1.7	SA86
	Hexachlorobenzene	mg/kg	713	346	49	0.00028	10	0.00032	27	0.056	0.23	1.5	6.3	RIDB-25
	Methoxychlor	mg/kg	367	16	4.4	0.00026	0.45	0.00050	0.38	0.0021	0.064	0.12	1.9	SSAM2-01
	Toxaphene	mg/kg	367	1	0.27	0.0073	3.6	0.62	0.62	0.62	0.62	--	--	SSAL3-04
Pesticides - OPPs	Dimethoate	mg/kg	57	4	7.0	0.0068	0.090	0.0091	0.013	0.011	0.011	0.0017	0.15	SA05
	Stirophos	mg/kg	57	1	1.8	0.0042	0.055	0.041	0.041	0.041	0.041	--	--	SA166
SVOCs	Bis(2-ethylhexyl)phthalate	mg/kg	561	99	18	0.0040	5.0	0.058	61	0.098	0.78	6.1	7.8	SSAP4-01
	Butylbenzylphthalate	mg/kg	561	9	1.6	0.000072	4.6	0.0033	0.053	0.0043	0.014	0.017	1.2	RSAL2

TABLE 4-5. Summary Statistics for Organic Compounds: Soil (0-10 ft bgs)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	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
SVOCs	Di-n-butylphthalate	mg/kg	561	87	16	0.00099	5.0	0.035	7.5	0.072	0.27	0.89	3.3	SSAP4-01
	Di-n-octylphthalate	mg/kg	561	2	0.36	0.000033	5.0	0.084	0.088	0.086	0.086	0.0028	0.033	SSAO4-01
	Diethylphthalate	mg/kg	561	5	0.89	0.0037	5.3	0.042	0.35	0.062	0.11	0.13	1.2	SA86
	Dimethylphthalate	mg/kg	561	56	10	0.000028	3.7	0.0015	0.79	0.053	0.12	0.17	1.4	BDT-1-S-10
	Hexachlorobutadiene	mg/kg	440	5	1.1	0.00028	0.036	0.00041	0.0045	0.00095	0.0017	0.0017	1.0	SA11
	Octachlorostyrene	mg/kg	559	78	14	0.00012	130	0.0021	3.7	0.067	0.13	0.42	3.2	RIDB-25
VOCs	Acetone	mg/kg	440	207	47	0.0014	0.028	0.0015	0.87	0.0097	0.023	0.066	2.9	U4U5-70
	Benzene	mg/kg	440	2	0.45	0.00014	0.0065	0.00075	0.033	0.017	0.017	0.023	1.4	RI-25
	Bromodichloromethane	mg/kg	440	2	0.45	0.00011	0.0065	0.00040	0.00069	0.00055	0.00055	0.00021	0.38	SSAO8-10
	Bromoform	mg/kg	440	1	0.23	0.00012	0.0074	0.0017	0.0017	0.0017	0.0017	--	--	SA102
	2-Butanone	mg/kg	440	84	19	0.00042	0.019	0.00056	0.027	0.0016	0.0034	0.0055	1.6	SSAO7-06
	tert Butyl alcohol	mg/kg	427	10	2.3	0.0034	0.037	0.0076	0.20	0.031	0.055	0.056	1.0	U4U5-70
	n-Butylbenzene	mg/kg	440	1	0.23	0.00028	0.0065	0.0022	0.0022	0.0022	0.0022	--	--	U4U5-19
	Carbon tetrachloride	mg/kg	440	1	0.23	0.00022	0.0065	0.00063	0.00063	0.00063	0.00063	--	--	RSAN3
	Chlorobenzene	mg/kg	440	7	1.6	0.00013	0.0065	0.00064	0.019	0.0012	0.0037	0.0068	1.8	RI-25
	Chloroform	mg/kg	440	93	21	0.00014	0.0065	0.00031	0.15	0.0013	0.0059	0.021	3.5	SA11
	p-Cymene	mg/kg	440	1	0.23	0.00024	0.0065	0.00055	0.00055	0.00055	0.00055	--	--	SSAN8-04
	1,2-Dichlorobenzene	mg/kg	440	6	1.4	0.00015	0.0065	0.00026	0.00078	0.00039	0.00043	0.00018	0.42	RI-25
	1,4-Dichlorobenzene	mg/kg	440	5	1.1	0.00011	0.0065	0.00056	0.016	0.0012	0.0040	0.0067	1.7	SA08
	1,1-Dichloroethane	mg/kg	440	1	0.23	0.00011	0.0065	0.0030	0.0030	0.0030	0.0030	--	--	SA08
	1,1-Dichloroethene	mg/kg	440	4	0.91	0.00018	0.0065	0.00055	0.0012	0.00081	0.00084	0.00027	0.32	SSAN8-04
	cis-1,2-Dichloroethene	mg/kg	440	1	0.23	0.00015	0.0065	0.0041	0.0041	0.0041	0.0041	--	--	RISB-57
	Ethylbenzene	mg/kg	412	1	0.24	0.00019	0.0065	0.00049	0.00049	0.00049	0.00049	--	--	RI-25
	Ethyl tert-butyl ether	mg/kg	430	2	0.47	0.00012	0.0065	0.00038	0.0011	0.00074	0.00074	0.00051	0.69	U4U5-16
	Formaldehyde	mg/kg	3	3	100	--	--	0.061	0.089	0.063	0.071	0.016	0.22	SA85
	Methyl tert-butyl ether	mg/kg	440	5	1.1	0.00015	0.0065	0.0011	0.0019	0.0014	0.0014	0.00029	0.21	U4U5-19
	Methylene Chloride	mg/kg	440	107	24	0.00025	0.019	0.00029	0.0082	0.00093	0.0013	0.0013	0.99	RSAM8
	Styrene	mg/kg	440	2	0.45	0.00016	0.0065	0.00028	0.0029	0.0016	0.0016	0.0019	1.2	U4U5-70
	Tetrachloroethene	mg/kg	440	2	0.45	0.00024	0.0065	0.00068	0.00088	0.00078	0.00078	0.00014	0.18	RI-25
	Toluene	mg/kg	440	91	21	0.00013	0.0065	0.00023	0.0036	0.00062	0.00074	0.00047	0.64	RI-25
	1,2,3-Trichlorobenzene	mg/kg	440	2	0.45	0.00035	0.0065	0.00081	0.0013	0.0011	0.0011	0.00035	0.33	SA11
	1,2,4-Trichlorobenzene	mg/kg	440	6	1.4	0.00037	0.0065	0.00065	0.0037	0.0012	0.0017	0.0012	0.71	SA11
	1,1,1-Trichloroethane	mg/kg	440	1	0.23	0.00010	0.0065	0.00095	0.00095	0.00095	0.00095	--	--	SA08
	Trichloroethene	mg/kg	440	13	3.0	0.00012	0.0065	0.00042	0.0021	0.0012	0.0012	0.00037	0.30	RISB-57
	Trichlorofluoromethane	mg/kg	440	5	1.1	0.00016	0.0065	0.00035	0.0017	0.0016	0.0013	0.00057	0.44	RSAN6
	1,2,4-Trimethylbenzene	mg/kg	440	10	2.3	0.00022	0.0065	0.00042	0.0026	0.00090	0.0012	0.00076	0.63	RI-26
	1,3,5-Trimethylbenzene	mg/kg	440	1	0.23	0.00019	0.0065	0.00050	0.00050	0.00050	0.00050	--	--	SSAO8-11
	Vinyl chloride	mg/kg	440	1	0.23	0.00015	0.0065	0.00028	0.00028	0.00028	0.00028	--	--	RSAM7

TABLE 4-5. Summary Statistics for Organic Compounds: Soil (0-10 ft bgs)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	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
VOCs	m,p-Xylene	mg/kg	417	8	1.9	0.00041	0.0074	0.00064	0.0023	0.0014	0.0014	0.00051	0.38	RISB-54
	o-Xylene	mg/kg	417	4	0.96	0.00030	0.0037	0.00046	0.0010	0.00065	0.00069	0.00024	0.34	RI-25

Notes:

-- = No value
bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
BaPEq = Benzo(a)pyrene equivalent
BHC = Hexachlorocyclohexane
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
OCP = Organochlorine pesticide
OPP = Organophosphorus pesticide
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text

TABLE 4-6. Exploratory Data Analysis: Comments for Chlorine Oxyanions, Metals, Other Inorganics and Radionuclides (0-10 ft bgs Soils)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration [1]	NERT COPCs Identified by RI [2]	Background Evaluation			Spatial Plot	Comment [3]
						Fail Statistical Testing for Background?	Table	Figure		
Chlorine Oxyanions	Chlorate	347	276	20,900	Yes	NA	NA	NA	Figure 5-2, F-10	Manufactured at the Site from approximately 1945-1998; chlorate and perchlorate are frequently co-located. The highest post-removal concentrations are found near the Unit Buildings, Beta Ditch, and ponds, corresponding to former manufacturing and disposal areas. Polygons with concentrations >38,900 mg/kg (chlorate) and 908 mg/kg (perchlorate) were targeted for removal in 2010/2011; however, soils with residual perchlorate concentrations remain in certain areas (see discusion in Section 4.2.4).
	Perchlorate	522	502	2,620	Yes	NA	NA	NA	Figure 5-2, F-31	
Metals	Aluminum	265	265	12,200	No	No	E-2	E1-1 E2-1	NA	NDEP did not identify aluminum as a specific contaminant at an LOU. Concentrations are consistent with background and <0.1xBCL.
	Antimony	346	80	2.4	Yes	LDF	E-2	E1-2 E2-2	NA	Although listed as a NERT COPC identified by the RI, NDEP did not identify antimony as a specific contaminant at an LOU. Concentrations are <0.1xBCL.
	Arsenic	669	656	34	Yes	Yes	E-2	E1-3 E2-3	Figure 5-3, F-2	Hardesty/AMECCO (LOU4) manufactured sodium arsenite solution. NDEP identified arsenic as a potential contaminant for LOU4 and LOU60 (Acid Drain system). Post-removal, scattered locations remain throughout the Study Area with concentrations >background. No clear spatial pattern.
	Barium	349	348	1,780	Yes	Yes	E-2	E1-4 E2-4	Figure F-3	NDEP identified barium as a potential contaminant at several LOUs, including the Storm Sewer System (#59); Acid Drain System (#60); former State Industries (#62); Kelley Trucking (#63); and Nevada Precast Concrete (#65). Barium concentrations are greater than background, with elevated concentrations detected in the former State Industries area and at scattered locations throughout the Study Area. But concentrations are <0.1xBCL.
	Beryllium	198	198	0.71	No	No	E-2	E1-5 E2-5	NA	NDEP did not identify beryllium as a specific contaminant at an LOU. Concentrations are consistent with background and <0.1xBCL.
	Boron	349	335	1,510	Yes	LDF	E-2	E1-6 E2-6	Figure F-8	Kerr-McGee manufactured boron at the Site beginning in approximately 1994, and EMD continues to operate a boron plant. The highest levels are located in the central and eastern areas of the Site. Study Area concentrations are <0.1xBCL.
	Cadmium	349	151	8.9	No	No	E-2	E1-7 E2-7	Figure F-9	NDEP identified cadmium as a potential contaminant in LOU60 (Acid drain system). Cadmium concentrations are consistent with background and <0.1xBCL.
	Calcium	198	198	62,500	No	No	E-2	E1-8 E2-8	NA	Although used extensively or formed as a waste product (e.g., calcium is a process waste from chlorate and manganese production), concentrations are consistent with background. Calcium background concentrations are high (~30,000 mg/kg), possibly masking calcium releases.
	Chromium (total)	443	443	550	No	Yes	E-2	E1-9 E2-9	Figure F-12	NDEP identified chromium (total) as associated with LOU32 (the groundwater remediation unit), LOU33 (sodium perchlorate platinum by-product filter), and LOU62 (State Industries, Inc site). Concentrations are greater than background, with the highest concentrations in the general area of the former P-2 and P-3 ponds and the groundwater barrier wall. Concentrations are <0.1xBCL.
	Chromium VI	394	71	110	Yes	LDF	E-2	E1-10 E2-10	Figure 5-4, F-13	In unimpacted soils, chromium VI concentrations are typically below detection limits (i.e., <0.5 mg/kg). Historically, hexavalent chromium (as sodium dichromate) was used extensively for production of sodium chlorate and sodium perchlorate. NDEP identified hexavalent chromium as a potential contaminant at over 25 LOUs. The highest concentrations of hexavalent chromium are co-located with chromium in the general area of the former P-2 and P-3 Ponds, which received process wastes containing hexavalent chromium from chlorate and perchlorate production.
	Cobalt	399	383	280	Yes	Yes	E-2	E1-11 E2-11	Figure 5-5, F-14	NDEP identified cobalt as a potential contaminant at LOU70 (US Vanadium Leasehold). Cobalt concentrations are greater than background; spatially, elevated concentrations generally co-locate with manganese, since it may be a by-product of manganese production.
	Copper	349	339	160	No	No	E-2	E1-12 E2-12	Figure F-15	NDEP did not identify copper as a specific contaminant at an LOU. Concentrations are consistent with background and <0.1xBCL.

TABLE 4-6. Exploratory Data Analysis: Comments for Chlorine Oxyanions, Metals, Other Inorganics and Radionuclides (0-10 ft bgs Soils)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration [1]	NERT COPCs Identified by RI [2]	Background Evaluation			Spatial Plot	Comment [3]
						Fail Statistical Testing for Background?	Table	Figure		
Metals	Iron	349	349	26,000	No	Yes	E-2	E1-13 E2-13	NA	NDEP identified iron as a potential contaminant at multiple LOUs. At the IWF, extracted groundwater was electrolytically treated to reduce chromium/other heavy metals and precipitate as iron oxide sludge (disposed of off-site). Iron is also associated with manganese ores. Post-removal concentrations are greater than background but <0.1xBCL.
	Lead	410	396	270	Yes	No	E-2	E1-14 E2-14	Figure F-23	NDEP identified lead as a potential contaminant at several LOUs, including the Storm Sewer System (LOU59); the Acid Drain System (LOU60); and State Industries (LOU62). Post-removal soil concentrations are consistent with background and less than the lead BCL.
	Lithium	10	10	22	No	NA	NA	NA	NA	Small sample size. RZ-A background data are not available. Concentrations are <0.1xBCL.
	Magnesium	398	398	130,000	Yes	Yes	E-2	E1-15 E2-15	Figure F-24	Produced at the Site from approximately 1942 to 1944. NDEP identified magnesium as a potential contaminant associated with numerous LOUs. Post-removal soil concentrations are greater than background but <0.1x the health-based BCL.
	Manganese	499	499	29,200	Yes	Yes	E-2	E1-16 E2-16	Figure 5-6, F-25	Produced at the Site since 1951; ongoing production by EMD. Highest concentrations are present primarily in the eastern portion of the Site that has been used for manganese production. Study Area concentrations are greater than background.
	Mercury	350	272	1.9	No	No	E-2	E1-17 E2-17	NA	NDEP did not identify mercury as a specific contaminant at an LOU. Concentrations are consistent with background and <0.1xBCL.
	Molybdenum	349	210	55	No	No	E-2	E1-18 E2-18	Figure F-26	US Vanadium Corporation (LOU70) formerly leased facilities at the Site for production of molybdenum compounds. Study Area concentrations are consistent with background and <0.1xBCL.
	Nickel	349	334	160	Yes	No	E-2	E1-19 E2-19	Figure F-28	NDEP identified nickel as a potential contaminant within the Storm Sewer System (LOU 59). Concentrations are consistent with background and <0.1xBCL.
	Niobium	106	4	9.2	No	NA	NA	NA	NA	Low detection frequency (<4%). RZ-A background data are not available. Concentrations are <0.1xBCL.
	Palladium	30	10	0.53	No	NA	NA	NA	Figure F-30	Small sample size. RZ-A background data are not available.
	Phosphorus (total)	276	276	1,600	No	NA	NA	NA	NA	NDEP did not identify phosphorus as a specific contaminant at an LOU. RZ-A background data are not available. *See related discussion for "phosphates."*
	Platinum	198	143	0	No	No	E-2	E1-20 E2-20	Figure F-33	NDEP identified platinum as a potential contaminant at the Platinum Drying Unit (LOU 15), sodium perchlorate platinum by-product filter (LOU33), and storm sewer system (LOU59). Study Area concentrations are consistent with background and <0.1xBCL.
	Potassium	198	198	6,120	No	No	E-2	E1-21 E2-21	NA	NDEP did not identify potassium as associated with contamination at an LOU. Concentrations are consistent with background.
	Selenium	265	26	1.5	No	LDF	E-2	E1-22 E2-22	Figure F-35	NDEP identified selenium as a potential contaminant within the Acid Drain System (LOU 60). Low detection frequency (<10%); concentrations are <0.1xBCL.
	Silicon	30	30	250	No	NA	NA	NA	NA	NDEP did not identify silicon as specific contaminant at an LOU. RZ-A background data are not available.
	Silver	349	52	7.6	No	LDF	E-2	E1-23 E2-23	NA	NDEP did not identify silver as a specific contaminant at an LOU. Low detection frequency (<15%); concentrations are <0.1xBCL.
	Sodium	198	198	11,700	No	Yes	E-2	E1-24 E2-24	NA	NDEP identified sodium as a potential contaminant at multiple LOUs. Concentrations are greater than background.

TABLE 4-6. Exploratory Data Analysis: Comments for Chlorine Oxyanions, Metals, Other Inorganics and Radionuclides (0-10 ft bgs Soils)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration [1]	NERT COPCs Identified by RI [2]	Background Evaluation			Spatial Plot	Comment [3]
						Fail Statistical Testing for Background?	Table	Figure		
Metals	Strontium	302	302	810	No	No	E-2	E1-25 E2-25	NA	NDEP did not identify strontium as a specific contaminant at an LOU. Concentrations are consistent with background and <0.1xBCL.
	Sulfur	30	18	14,000	No	NA	NA	NA	NA	*See discussion for "Other Inorganics."*
	Thallium	349	194	8.4	No	Yes	E-2	E1-26 E2-26	Figure 5-7, F-37	NDEP did not identify thallium as a specific contaminant at an LOU. Concentrations are greater than background, suggesting a possible historical presence at the Site.
	Tin	198	198	12	No	LDF	E-2	E1-27 E2-27	NA	NDEP did not identify tin as a specific contaminant at an LOU. Concentrations are <0.1xBCL.
	Titanium	198	198	1,270	No	No	E-2	E1-28 E2-28	Figure F-39	NDEP identified titanium as a potential contaminant at the former J.B Kelley Trucking (LOU 63) and Nevada Precast Concrete (LOU 65). Concentrations are consistent with background and <0.1xBCL.
	Tungsten	302	203	9.4	No	Yes	E-2	E1-29 E2-29	Figure F-41	US Vanadium (LOU70) formerly produced tungsten compounds at the Site. Concentrations are greater than background, with elevated tungsten concentrations are found in the eastern and northwestern areas of the Site. Concentrations are <0.1xBCL.
	Uranium (total)	218	218	3.6	No	No	E-2	E1-30 E2-30	Figure F-42	NDEP did not identify uranium as a specific contaminant at an LOU. Concentrations are consistent with background and <0.1xBCL.
	Vanadium	282	282	78	No	Yes	E-2	E1-31 E2-31	Figure F-45	NDEP did not identify vanadium as a specific contaminant at an LOU. Concentrations are greater than background but <0.1xBCL.
	Zinc	265	265	300	No	No	E-2	E1-32 E2-32	Figure F-46	NDEP identified zinc as a potential contaminant within the Storm Sewer System (LOU59). Soil concentrations are consistent with background and concentrations are <0.1xBCL.
	Zirconium	114	93	43	No	NA	NA	NA	Figure 5-8, F-47	RZ-A background data are not available.
Other Inorganics	Ammonia	201	36	680	No	NA	NA	NA	Figure 5-9, F-1	This group of inorganic compounds includes common industrial chemicals that are used as chemical feedstocks and/or expected to be present in process waste streams. These compounds are generally highly soluble when present as free anions or cations. Many of these compounds are physiological electrolytes and/or occur naturally in foods. Although all of the listed inorganics occur naturally in soil, RZ-A background data sets are not available to conduct a background analysis. At the concentrations detected in soil, these inorganics do not present human health concerns. (Many are physiological electrolytes and/or occur naturally in foods.) Generally, these inorganics are of greater concern when detected as contaminants in groundwater than when present at elevated concentrations in soil.
	Bromide	214	24	83	No	NA	NA	NA	NA	
	Chloride	211	201	6,670	No	NA	NA	NA	NA	
	Cyanide (total)	132	2	1.3	No	NA	NA	NA	NA	
	Fluoride	10	2	0.75	No	NA	NA	NA	NA	
	Nitrate	303	267	2,280	Yes	NA	NA	NA	NA	
	Nitrate/Nitrite	104	85	800	No	NA	NA	NA	NA	
	Nitrite	288	42	220	No	NA	NA	NA	NA	
	ortho-Phosphate	53	9	2,900	No	NA	NA	NA	NA	
	Sulfate	219	217	15,300	No	NA	NA	NA	NA	

TABLE 4-6. Exploratory Data Analysis: Comments for Chlorine Oxyanions, Metals, Other Inorganics and Radionuclides (0-10 ft bgs Soils)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration [1]	NERT COPCs Identified by RI [2]	Background Evaluation			Spatial Plot	Comment [3]
						Fail Statistical Testing for Background?	Table	Figure		
Radio-nuclides	Radium-226	297	297	2.5	No	No	E-4	E1-36 E2-36	NA	Radionuclides are not known to be associated with any of the former/current operations at the Site. Although no potential source areas were identified, soil samples were analyzed for radionuclides. Activities of all radionuclides are consistent with background levels. The results of background analysis must be interpreted with caution given the issues associated with sample preparation and analytical methods.
	Radium-228	297	297	3.3	No	No	E-4	E1-38 E2-38	NA	
	Thorium-228	280	280	3.0	No	No	E-4	E1-39 E2-39	NA	
	Thorium-230	280	280	4.3	No	No	E-4	E1-35 E2-35	NA	
	Thorium-232	280	280	2.5	No	No	E-4	E1-37 E2-37	Figure 5-10, F-38	
	Uranium-234	196	196	3.4	No	No	E-4	E1-34 E2-34	NA	
	Uranium-235	196	196	0	No	No	E-4	E1-40 E2-40	Figure 5-10, F-43	
	Uranium-238	196	196	3.3	No	No	E-4	E1-33 E2-33	Figure 5-10, F-44	

Notes:

bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BCL = Basic comparison level
COPC = Chemical of potential concern
EMD = EMD Acquisition LLC
ENSR = ENSR Corporation
IWF = Interceptor well field
LDF = Low detection frequency (<25%) in either site or background datasets. Background comparison results may not be applicable.
LOU = Letter of Understanding
NA = Not applicable
NDEP = Nevada Division of Environmental Protection
NERT = Nevada Environmental Response Trust
RI = Remedial Investigation
RZ-A = Remediation Zone A
Listed analytes are those detected in one or more samples in the Study Area.

[1] Concentrations are in mg/kg for all groups except radionuclides; radionuclide activities are in pCi/g.
[2] From Table 9-1 of the Ramboll (2021) RI Report for OU-1 and OU-2.
[3] Based on information from: ESNR 2005; ENVIRON 2011; NDEP 2011; Ramboll Environ 2016; and Ramboll 2021.
Statements as to whether an analyte was listed as a NERT COPC are based on the list of COPCs for OU-1 in Table 9-1 of the RI Report for OU-1 and OU-2 (Ramboll 2021).
Statements regarding NDEP's identification of an analyte as associated with an LOU are based on the NDEP 2011 Action Memorandum.
It is recognized that a specific analyte may have been identified as an LOU contaminant in other documents prepared for the Site.

Sources:

ENSR. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada. February. NDEP requested response to comments during the next monthly meeting October 22.
ENVIRON. 2011. Phase I Environmental Site Assessment of Tronox LLC, Clark County, Nevada. January.
NDEP. 2011. Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada. July.
Ramboll Environ. 2016. Technical Memorandum, Remedial Investigation Data Evaluation, Nevada Environmental Response Trust Site, Henderson, Nevada, dated May 2.
Ramboll. 2021. Remedial Investigation Report for OU-1 and OU-2, Nevada Environmental Response Trust Site, Henderson, Nevada. July 9.

TABLE 4-7. Exploratory Data Analysis: Comments for Organic Compounds (0-10 ft bgs Soils)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration (mg/kg)	NERT COPCs Identified by RI [1]	Spatial Plot	Comment [2]
Dioxin/Furans	2,3,7,8-TCDD TEQ*	553	550	0.025	Yes	Figure 5-11, F-36	Unintentional by-product of high-temperature processes, e.g., incomplete combustion and pesticide production (a source of chlorine is required). Highly persistent. High detection frequency due, in part, to sensitive analytical methods. Polygons with concentrations >0.0027 mg/kg targeted for removal in 2010/2011 and 2018; however, soils with residual concentrations >0.0027 mg/kg remain.
PAHs	Acenaphthene	566	7	0.70	No	NA	Expected to co-locate with BaPEqs.
	Acenaphthylene	566	6	0.22	No	NA	
	Anthracene	566	14	0.30	No	NA	
	BaPEq*	566	90	2.1	Yes	Figure 5-12, F-4	Listed as a NERT COPC identified by the RI, PAHs are ubiquitous environmental contaminants, formed during incomplete combustion of organic materials. The highest concentrations are located in the center of the Study Area, which was historically associated with diesel engine use.
	Benzo(g,h,i)perylene	565	56	1.4	No	Figure F-5	Expected to co-locate with BaPEqs.
	Fluoranthene	566	73	2.7	No	Figure F-21	
	Fluorene	566	3	1.1	No	NA	
	1-Methylnaphthalene	112	4	5.6	Yes	NA	Low detection frequencies, with the highest concentrations generally found in the area of the former diesel above-ground storage tanks.
	2-Methylnaphthalene	566	10	7.9	Yes	NA	
	Naphthalene	724	37	3.1	No	Figure 5-13, F-27	
	Phenanthrene	566	68	1.5	No	Figure F-32	Expected to co-locate with BaPEqs.
	Pyrene	566	95	2.8	No	Figure F-34	
PCBs	Aroclor-1248	48	1	0.091	No	NA	As reported in the Environmental Conditions Assessment (Kleinfelder 1993), in 1980 22 PCB-containing transformers were reported at the Site, but only 12 remained as of the date of the 1993 report. The Kleinfelder report also noted that in 1978, Tronox began storing PCBs and equipment in the area north of Unit 2. Post-removal concentrations are <0.1xBCL. Low detection frequency.
	Aroclor-1260	152	4	0.074	Yes	NA	
Pesticides - OCPs	Aldrin	367	3	0.013	No	NA	NDEP did not identify aldrin as a specific contaminant at an LOU. Low detection frequency (<1%). Post-removal concentrations are <0.1xBCL.
	alpha-BHC	367	16	0.012	No	NA	The former Stauffer facility (to the west) produced gamma-BHC (lindane) from 1946 through 1958; the alpha, beta, and delta isomers are by-products of lindane production. The highest concentrations were generally found in the western half of the Site.
	beta-BHC	367	177	0.87	Yes	Figure 5-15, F-6	
	delta-BHC	367	7	0.0015	No	NA	
	gamma-BHC	367	3	0.0019	No	NA	
	gamma-Chlordane	367	1	0.0014	No	NA	NDEP did not identify chlordane as a specific contaminant at an LOU. Low detection frequency (<1%). Post-removal concentrations are <0.1xBCL.
	Chlordane (total)	250	1	0.0030	No	NA	
	2,4'-DDE	118	20	0.053	No	Figure F-16	Historical information indicates that Hardesty/AMECCO (1946-1949, LOU4) listed DDT for production. While detected concentrations of DDT and related compounds at the Site are relatively low, significantly higher concentrations (DDT, 6,900 mg/kg; DDD,16,000 mg/kg; and DDE, 38,000 mg/kg) were reported in soil samples at the former Stauffer facility to the west (PES Environmental, Inc. 2016). 4,4'-DDT and 4,4'-DDE are mostly co-located; the highest concentrations are in the western/central portion of the Study Area.
	4,4'-DDD	367	17	0.032	No	NA	
	4,4'-DDE	367	166	6.0	No	Figure 5-14, F-17	
	4,4'-DDT	367	133	2.3	No	Figure 5-14, F-18	
	Dieldrin	367	4	0.059	No	Figure 5-15, F-19	NDEP did not identify dieldrin as a specific contaminant at an LOU. Very persistent in soils; low detection frequency (<2%).
	Endosulfan I	367	2	0.0015	No	NA	NDEP did not identify these pesticides as specific contaminants at an LOU. Very persistent in soils. Compounds were detected at low detection frequencies (<3%) and post-removal concentrations are <0.1xBCL.
	Endosulfan sulfate	367	2	0.016	No	NA	
	Endrin	367	2	0.0054	No	NA	
	Endrin ketone	367	10	0.020	No	NA	

TABLE 4-7. Exploratory Data Analysis: Comments for Organic Compounds (0-10 ft bgs Soils)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration (mg/kg)	NERT COPCs Identified by RI [1]	Spatial Plot	Comment [2]
Pesticides - OCPs	Hexachlorobenzene	713	346	27	Yes	Figure 5-16, F-22	Listed as a NERT COPC identified by the RI. Formed as a by-product during the manufacture of other chemicals involving chlorine, mainly solvents and pesticides.
	Methoxychlor	367	16	0.38	No	NA	NDEP did not identify these pesticides as a specific contaminant at an LOU. Low detection frequencies (<5%).
	Toxaphene	367	1	0.62	No	Figure 5-15, F-40	
Pesticides - OPPs	Dimethoate	57	4	0.013	No	Figure F-20	NDEP did not identify these pesticides as a specific contaminant at an LOU. Low detection frequency (<8%). Post-removal concentrations are <0.1xBCL.
	Stirophos	57	1	0.041	No	NA	
SVOCs	Bis(2-Ethylhexyl)phthalate	561	99	61	No	Figure 5-17, F-7	Bis(2-ethylhexyl)phthalate is a common field/laboratory contaminant. No clear spatial pattern.
	Butylbenzylphthalate	561	9	0.053	No	NA	Phthalates are common field/laboratory contaminants. Low detection frequencies (0.4 to 16%) and concentrations are <0.1xBCL.
	Di-n-butylphthalate	561	87	7.5	No	NA	
	Di-n-octylphthalate	561	2	0.088	No	NA	
	Diethylphthalate	561	5	0.35	No	NA	
	Dimethylphthalate	561	56	0.79	No	NA	
	Hexachlorobutadiene	440	5	0.0045	No	NA	Can be a byproduct of reactions involving chlorine and hydrocarbons. Low detection frequency (<2%). Post-removal concentrations are <0.1xBCL.
	Octachlorostyrene	559	78	3.7	No	Figure F-29	By-product of many industrial chemical processes; formed during incineration and combustion processes involving chlorinated compounds. Highly persistent.
VOCs	Acetone	440	207	0.87	No	NA	*See VOC comments below.*
	Benzene	440	2	0.033	No	NA	
	Bromodichloromethane	440	2	0.00069	No	NA	
	Bromoform	440	1	0.0017	No	NA	
	2-Butanone	440	84	0.027	No	NA	
	tert Butyl alcohol	427	10	0.20	No	NA	
	n-Butylbenzene	440	1	0.0022	No	NA	
	Carbon tetrachloride	440	1	0.00063	No	NA	
	Chlorobenzene	440	7	0.019	No	NA	
	Chloroform	440	93	0.15	Yes	Figure F-11	Although chloroform is the most prevalent groundwater VOC, there are no written records of its use at the Site. Tronox has communicated that chloroform was used in small quantities at the facility lab. Post-removal soil concentrations are low and not indicative of a potential source area.
	p-Cymene	440	1	0.00055	No	NA	*See VOC comments below.*
	1,2-Dichlorobenzene	440	6	0.00078	No	NA	Mono- and dichlorobenzenes were produced by Hardesty/Amecco from 1946-1949. Soil concentrations are very low and are not considered indicative of a potential source area. Low detection frequency.
	1,4-Dichlorobenzene	440	5	0.016	No	NA	
	1,1-Dichloroethane	440	1	0.0030	No	NA	*See VOC comments below.*
	1,1-Dichloroethene	440	4	0.0012	No	NA	
	cis-1,2-Dichloroethene	440	1	0.0041	No	NA	
	Ethylbenzene	412	1	0.00049	No	NA	
	Ethyl tert-butyl ether	430	2	0.0011	No	NA	
	Formaldehyde	3	3	0.089	No	NA	
	Methyl tert-butyl ether	440	5	0.0019	No	NA	
	Methylene Chloride	440	107	0.0082	Yes	NA	
	Styrene	440	2	0.0029	No	NA	
	Tetrachloroethene	440	2	0.00088	No	NA	

TABLE 4-7. Exploratory Data Analysis: Comments for Organic Compounds (0-10 ft bgs Soils)
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Number of Samples	Number of Detects	Maximum Detected Concentration (mg/kg)	NERT COPCs Identified by RI [1]	Spatial Plot	Comment [2]
VOCs	Toluene	440	91	0.0036	No	NA	A number of individual VOCs were listed as NERT COPCs identified by the RI and NDEP identified "VOCs" (as a general category) as possible contaminants at several LOUs. Several of the VOCs are common field/laboratory contaminants, for example, acetone, 2-butanone, methylene chloride, and toluene. These specific VOCs were detected at higher frequencies (but low concentrations) than the other listed VOCs, but the detected levels are not indicative of a source. Other than the common field/laboratory contaminants, detection frequencies and concentrations of the remaining VOCs are very low and are not indicative of a potential source.
	1,2,3-Trichlorobenzene	440	2	0.0013	No	NA	
	1,2,4-Trichlorobenzene	440	6	0.0037	No	NA	
	1,1,1-Trichloroethane	440	1	0.00095	No	NA	
	Trichloroethene	440	13	0.0021	No	NA	
	Trichlorofluoromethane	440	5	0.0017	No	NA	
	1,2,4-Trimethylbenzene	440	10	0.0026	No	NA	
	1,3,5-Trimethylbenzene	440	1	0.00050	No	NA	
	Vinyl chloride	440	1	0.00028	No	NA	
	m,p-Xylene	417	8	0.0023	No	NA	
	o-Xylene	417	4	0.0010	No	NA	

Notes:

bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic comparison level
BHC = Hexachlorocyclohexane
COPC = Chemical of potential concern
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
ENSR = ENSR Corporation
LOU = Letter of Understanding
NA = Not applicable
NDEP = Nevada Division of Environmental Protection
NERT = Nevada Environmental Response Trust
OCP = Organochlorine pesticides
OPP = Organophosphorus pesticides
PAH = Polycyclic aromatic hydrocarbons
PCB = Polychlorinated biphenyl
PES = PES Environmental, Inc.
RI = Remedial Investigation
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text
Listed analytes are those detected in one or more samples in the Study Area.

[1] From Table 9-1 of the Ramboll (2021) RI Report for OU-1 and OU-2.
[2] Based on information from: ENSR 2005; ENVIRON 2011; NDEP 2011; Ramboll Environ 2016; and Ramboll 2021.
Statements as to whether an analyte was listed as a NERT COPC are based on the list of COPCs for OU-1 in Table 9-1 of the RI Report for OU-1 and OU-2 (Ramboll 2021).
Statements regarding NDEP's identification of an analyte as associated with an LOU are based on the NDEP 2011 Action Memorandum.
It is recognized that a specific analyte may have been identified as an LOU contaminant in other documents prepared for the Site.

Sources:

ENSR. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada. February. NDEP requested response to comments during the next monthly meeting October 22.
ENVIRON. 2011. Phase I Environmental Site Assessment of Tronox LLC, Clark County, Nevada. January.
Kleinfelder. 1993. Environmental Conditions Assessment, Kerr-McGee Chemical Corporation, Henderson, Nevada Facility. April.
NDEP. 2011. Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada. July.
PES Environmental, Inc., 2016. Conceptual Site Model (revised), Vadose Zone, BHC Cake Pile 3 & Former BHC Haul Route (LOU No. 12), Former Stauffer Chemical Company Facility, Olin Chlor Alkali Products, Henderson, Nevada, February 12.
Ramboll Environ. 2016. Technical Memorandum, Remedial Investigation Data Evaluation, Nevada Environmental Response Trust Site, Henderson, Nevada, dated May 2.
Ramboll. 2021. Remedial Investigation Report for OU-1 and OU-2, Nevada Environmental Response Trust Site, Henderson, Nevada. July 9.

TABLE 5-1. Concentration/Toxicity Screen for the BHRA Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Detects		Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
						Maximum	Location of Maximum				
Chlorine Oxyanions	Chlorate	mg/kg	347	276	80	20,900	SA106	38,900	--	2	Fail
	Perchlorate	mg/kg	522	502	96	2,620	RSAM5	908	--	69	Fail
Metals	Aluminum	mg/kg	265	265	100	12,200	SA43	1,240,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Antimony	mg/kg	346	80	23	2.4	SA114	519	--	0	Pass
	Arsenic	mg/kg	669	656	98	34	EE-C25-1	7.2	Maximum BRC/TIMET background	--	Fail
	Barium	mg/kg	349	348	99.7	1,780	SA123	238,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Beryllium	mg/kg	198	198	100	0.71	SA86	2,540	--	0	Pass
	Boron	mg/kg	349	335	96	1,510	SA62	259,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Cadmium	mg/kg	349	151	43	8.9	SA103	1,260	--	0	Pass
	Calcium	mg/kg	198	198	100	62,500	RSAM2	N/A	--	N/A	N/A
	Chromium (total)	mg/kg	443	443	100	550	U4U5-15	1,950,000	Use chromium III as a surrogate, use health-based BCL instead of non-health based upper-limit	0	Pass
	Chromium VI	mg/kg	394	71	18	110	SA106	7.0	--	30	Fail
	Cobalt	mg/kg	399	383	96	280	RSAO8	385	--	9	Fail
	Copper	mg/kg	349	339	97	160	RISB-12	36,700	--	0	Pass
	Iron	mg/kg	349	349	100	26,000	RI-6	908,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Lead	mg/kg	410	396	97	270	SA92	800	--	--	Pass
	Lithium	mg/kg	10	10	100	22	TSB-GJ-02	2,600	--	0	Pass
	Magnesium	mg/kg	398	398	100	130,000	RIDB-21	5,200,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Manganese	mg/kg	499	499	100	29,200	CS-C44-1	28,100	--	23	Fail
	Mercury	mg/kg	350	272	78	1.9	M-162D	389	Use Mercury compounds BCL	0	Pass
	Molybdenum	mg/kg	349	210	60	55	RISB-12	6,490	--	0	Pass
	Nickel	mg/kg	349	334	96	160	RSAO8	24,700	--	0	Pass
	Niobium	mg/kg	106	4	3.8	9.2	TSB-GR-02	130	--	0	Pass
	Palladium	mg/kg	30	10	33	0.53	TSB-GJ-02	N/A	--	N/A	N/A
	Phosphorus (total)	mg/kg	276	276	100	1,600	RISB-09	9,630,000	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit, adjust BCL based on molecular weight	0	Pass
	Platinum	mg/kg	198	143	72	0.16	SA64	649	--	0	Pass
	Potassium	mg/kg	198	198	100	6,120	SA141	N/A	--	N/A	N/A
	Selenium	mg/kg	265	26	9.8	1.5	RSAJ3	6,490	--	0	Pass
	Silicon	mg/kg	30	30	100	250	RISB-10	N/A	--	N/A	N/A
	Silver	mg/kg	349	52	15	7.6	SA201	6,490	--	0	Pass
	Sodium	mg/kg	198	198	100	11,700	SA106	N/A	--	N/A	N/A
	Strontium	mg/kg	302	302	100	810	SA15	779,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Sulfur	mg/kg	30	18	60	14,000	RISB-14	N/A	--	N/A	N/A
	Thallium	mg/kg	349	194	56	8.4	SA180	13	--	1	Fail
	Tin	mg/kg	198	198	100	12	RSAK8	779,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Titanium	mg/kg	198	198	100	1,270	SA166	5,190,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Tungsten	mg/kg	302	203	67	9.4	RIDB-3	1,040	--	0	Pass
	Uranium (total)	mg/kg	218	218	100	3.6	SA86	3,830	--	0	Pass
	Vanadium	mg/kg	282	282	100	78	RSAK8	6,420	--	0	Pass

TABLE 5-1. Concentration/Toxicity Screen for the BHRA Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Detects		Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
						Maximum	Location of Maximum				
Metals	Zinc	mg/kg	265	265	100	300	RISB-37	389,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Zirconium	mg/kg	114	93	82	43	RIDB-27	104	--	93	Fail
Other Inorganics	Ammonia	mg/kg	201	36	18	680	RSAM5	6,140	--	1	Fail
	Bromide	mg/kg	214	24	11	83	SA15	441,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Chloride	mg/kg	211	201	95	6,670	RSAJ2	113,000	Use health-based BCL instead of non-health based upper-limit (consider chloride as non-volatile)	0	Pass
	Cyanide (total)	mg/kg	132	2	1.5	1.3	RSAJ2	179	Conservatively use BCL for free cyanide (CN-) as a surrogate	0	Pass
	Fluoride	mg/kg	10	2	20	0.75	TSB-GJ-02	51,900		0	Pass
	Nitrate	mg/kg	303	267	88	2,280	SA15	2,080,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Nitrate/Nitrite	mg/kg	104	85	82	800	RIDB-3	130,000	Minimum BCL of nitrate and nitrite, use health-based BCL instead of non-health based upper-limit	0	Pass
	Nitrite	mg/kg	288	42	15	220	RIDB-3	130,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	ortho-Phosphate	mg/kg	53	9	17	2,900	SA11	30,400,000	Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit	0	Pass
	Sulfate	mg/kg	219	217	99	15,300	SA65	N/A	--	N/A	N/A
Radionuclides	Radium-226	pCi/g	297	297	100	2.5	SA92	0.023	--	297	Fail
	Radium-228	pCi/g	297	297	100	3.3	SA70	0.041	--	293	Fail
	Thorium-228	pCi/g	280	280	100	3.0	SA65	0.025	--	276	Fail
	Thorium-230	pCi/g	280	280	100	4.3	SA74	8.4	--	243	Fail
	Thorium-232	pCi/g	280	280	100	2.5	SA189	7.4	--	261	Fail
	Uranium-234	pCi/g	196	196	100	3.4	SA128	11	--	65	Fail
	Uranium-235	pCi/g	196	196	100	0.25	RSAK6	0.35	--	158	Fail
	Uranium-238	pCi/g	196	196	100	3.3	SA128	1.4	--	196	Fail
Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	553	550	99	0.025	RIDB-25	0.0027	Site-specific action level	--	Fail
PAHs	Acenaphthene	mg/kg	566	7	1.2	0.70	EE-C25-1	50,500	Use health-based BCL instead of soil saturation level	0	Pass
	Acenaphthylene	mg/kg	566	6	1.1	0.22	EE-C25-1	50,500	Use acenaphthene as a surrogate; use health-based BCL instead of soil saturation level	0	Pass
	Anthracene	mg/kg	566	14	2.5	0.30	EE-C25-1	253,000	Use health-based BCL instead of soil saturation level	0	Pass
	BaPEq*	mg/kg	566	90	16	2.1	RI-25	0.32	--	25	Fail
	Benzo(g,h,i)perylene	mg/kg	565	56	9.9	1.4	RI-25	25,300	--	0	Pass
	Fluoranthene	mg/kg	566	73	13	2.7	RI-25	33,700	--	0	Pass
	Fluorene	mg/kg	566	3	0.53	1.1	EE-C25-1	33,700	Use health-based BCL instead of soil saturation level	0	Pass
	1-Methylnaphthalene	mg/kg	112	4	3.6	5.6	EE-C25-1	81	--	0	Pass
	2-Methylnaphthalene	mg/kg	566	10	1.8	7.9	EE-C25-1	3,370	Use health-based BCL instead of soil saturation level	0	Pass
	Naphthalene	mg/kg	724	37	5.1	3.1	EE-C25-1	18	--	2	Fail
	Phenanthrene	mg/kg	566	68	12	1.5	EE-C25-1	4,980	Use health-based BCL instead of soil saturation level	0	Pass
	Pyrene	mg/kg	566	95	17	2.8	RI-25	25,300	Use health-based BCL instead of soil saturation level	0	Pass
PCBs	Aroclor-1248	mg/kg	48	1	2.1	0.091	RSAS5	1.1	--	0	Pass
	Aroclor-1260	mg/kg	152	4	2.6	0.074	RI-5	1.1	--	0	Pass
Pesticides - OCPs	Aldrin	mg/kg	367	3	0.82	0.013	RIDB-25	0.21	--	0	Pass
	alpha-BHC	mg/kg	367	16	4.4	0.012	RSAQ4	0.49	--	0	Pass
	beta-BHC	mg/kg	367	177	48	0.87	SA67	1.7	--	11	Fail
	delta-BHC	mg/kg	367	7	1.9	0.0015	SA86	334	--	0	Pass

TABLE 5-1. Concentration/Toxicity Screen for the BHRA Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Detects		Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
						Maximum	Location of Maximum				
Pesticides - OCPs	gamma-BHC	mg/kg	367	3	0.82	0.0019	RSAQ4	2.8	--	0	Pass
	gamma-Chlordane	mg/kg	367	1	0.27	0.0014	RSAO7	7.3	Use chlordane as a surrogate	0	Pass
	Chlordane (total)	mg/kg	250	1	0.40	0.0030	SA66	7.3	--	0	Pass
	2,4'-DDE	mg/kg	118	20	17	0.053	RIDB-25	9.5	Use 4,4'-DDE as a surrogate	0	Pass
	4,4'-DDD	mg/kg	367	17	4.6	0.032	SSAL3-04	15	--	0	Pass
	4,4'-DDE	mg/kg	367	166	45	6.0	SSAM3-01	9.5	--	10	Fail
	4,4'-DDT	mg/kg	367	133	36	2.3	SSAM2-01	7.5	--	6	Fail
	Dieldrin	mg/kg	367	4	1.1	0.059	SSAM2-01	0.16	--	2	Fail
	Endosulfan I	mg/kg	367	2	0.54	0.0015	SSAL3-01	5,500	Use endosulfan as a surrogate	0	Pass
	Endosulfan sulfate	mg/kg	367	2	0.54	0.016	BDT-4-S-15	5,500	Use endosulfan as a surrogate	0	Pass
	Endrin	mg/kg	367	2	0.54	0.0054	SA180	389	Use health-based BCL instead of soil saturation level	0	Pass
	Endrin ketone	mg/kg	367	10	2.7	0.020	SA86	389	Use endrin as a surrogate; use health-based BCL instead of soil saturation level	0	Pass
	Hexachlorobenzene	mg/kg	713	346	49	27	RIDB-25	1.3	Use health-based BCL instead of soil saturation level	107	Fail
	Methoxychlor	mg/kg	367	16	4.4	0.38	SSAM2-01	4,580	--	0	Pass
	Toxaphene	mg/kg	367	1	0.27	0.62	SSAL3-04	2.3	--	1	Fail
Pesticides - OPPs	Dimethoate	mg/kg	57	4	7.0	0.013	SA05	183	--	0	Pass
	Stirophos	mg/kg	57	1	1.8	0.041	SA166	107	--	0	Pass
SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	561	99	18	61	SSAP4-01	183	--	1	Fail
	Butylbenzylphthalate	mg/kg	561	9	1.6	0.053	RSAL2	1,350	--	0	Pass
	Di-n-butylphthalate	mg/kg	561	87	16	7.5	SSAP4-01	91,600	--	0	Pass
	Di-n-octylphthalate	mg/kg	561	2	0.36	0.088	SSAO4-01	9,160	--	0	Pass
	Diethylphthalate	mg/kg	561	5	0.89	0.35	SA86	733,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Dimethylphthalate	mg/kg	561	56	10	0.79	BDT-1-S-10	9,160,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Hexachlorobutadiene	mg/kg	440	5	1.1	0.0045	SA11	6.1	--	0	Pass
	Octachlorostyrene	mg/kg	559	78	14	3.7	RIDB-25	N/A	--	N/A	N/A
VOCs	Acetone	mg/kg	440	207	47	0.87	U4U5-70	1,040,000	Use health-based BCL instead of non-health based upper-limit	0	Pass
	Benzene	mg/kg	440	2	0.45	0.033	RI-25	5.8	--	0	Pass
	Bromodichloromethane	mg/kg	440	2	0.45	0.00069	SSAO8-10	1.4	--	0	Pass
	Bromoform	mg/kg	440	1	0.23	0.0017	SA102	104	--	0	Pass
	2-Butanone	mg/kg	440	84	19	0.027	SSAO7-06	243,000	Use health-based BCL instead of soil saturation level	0	Pass
	tert Butyl alcohol	mg/kg	427	10	2.3	0.20	U4U5-70	4,220,000	Use health-based BCL instead of soil saturation level	0	Pass
	n-Butylbenzene	mg/kg	440	1	0.23	0.0022	U4U5-19	64,900	Use health-based BCL instead of soil saturation level	0	Pass
	Carbon tetrachloride	mg/kg	440	1	0.23	0.00063	RSAN3	3.2	--	0	Pass
	Chlorobenzene	mg/kg	440	7	1.6	0.019	RI-25	18,300	--	0	Pass
	Chloroform	mg/kg	440	93	21	0.15	SA11	1.5	--	0	Pass
	p-Cymene	mg/kg	440	1	0.23	0.00055	SSAN8-04	1,640	Use health-based BCL instead of soil saturation level	0	Pass
	1,2-Dichlorobenzene	mg/kg	440	6	1.4	0.00078	RI-25	10,700	Use health-based BCL instead of soil saturation level	0	Pass
	1,4-Dichlorobenzene	mg/kg	440	5	1.1	0.016	SA08	475	--	0	Pass
	1,1-Dichloroethane	mg/kg	440	1	0.23	0.0030	SA08	17	--	0	Pass
	1,1-Dichloroethene	mg/kg	440	4	0.91	0.0012	SSAN8-04	1,100	--	0	Pass
	cis-1,2-Dichloroethene	mg/kg	440	1	0.23	0.0041	RISB-57	2,600	Use health-based BCL instead of soil saturation level	0	Pass

TABLE 5-1. Concentration/Toxicity Screen for the BHRA Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Detects		Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
						Maximum	Location of Maximum				
VOCs	Ethylbenzene	mg/kg	412	1	0.24	0.00049	RI-25	233	--	0	Pass
	Ethyl tert-butyl ether	mg/kg	430	2	0.47	0.0011	U4U5-16	70,900	Use methyl tert-butyl ether as a surrogate (noncancer endpoint)	0	Pass
	Formaldehyde	mg/kg	3	3	100	0.089	SA85	80	--	0	Pass
	Methyl tert-butyl ether	mg/kg	440	5	1.1	0.0019	U4U5-19	238	--	0	Pass
	Methylene Chloride	mg/kg	440	107	24	0.0082	RSAM8	1,550	--	0	Pass
	Styrene	mg/kg	440	2	0.45	0.0029	U4U5-70	41,100	Use health-based BCL instead of soil saturation level	0	Pass
	Tetrachloroethene	mg/kg	440	2	0.45	0.00088	RI-25	117	--	0	Pass
	Toluene	mg/kg	440	91	21	0.0036	RI-25	66,600	Use health-based BCL instead of soil saturation level	0	Pass
	1,2,3-Trichlorobenzene	mg/kg	440	2	0.45	0.0013	SA11	1,040	Use health-based BCL instead of soil saturation level	0	Pass
	1,2,4-Trichlorobenzene	mg/kg	440	6	1.4	0.0037	SA11	125	--	0	Pass
	1,1,1-Trichloroethane	mg/kg	440	1	0.23	0.00095	SA08	39,400	Use health-based BCL instead of soil saturation level	0	Pass
	Trichloroethene	mg/kg	440	13	3.0	0.0021	RISB-57	6.9	--	0	Pass
	Trichlorofluoromethane	mg/kg	440	5	1.1	0.0017	RSAN6	389,000	Use health-based BCL instead of soil saturation level	0	Pass
	1,2,4-Trimethylbenzene	mg/kg	440	10	2.3	0.0026	RI-26	267	Use health-based BCL instead of soil saturation level	0	Pass
	1,3,5-Trimethylbenzene	mg/kg	440	1	0.23	0.00050	SSAO8-11	13,000	Use health-based BCL instead of soil saturation level	0	Pass
	Vinyl chloride	mg/kg	440	1	0.23	0.00028	RSAM7	2.2	--	0	Pass
	m,p-Xylene	mg/kg	417	8	1.9	0.0023	RISB-54	2,630	Minimum BCL of m-xylene and p-xylene; use health-based BCL instead of soil saturation level	0	Pass
	o-Xylene	mg/kg	417	4	0.96	0.0010	RI-25	3,090	Use health-based BCL instead of soil saturation level	0	Pass

Notes:

-- = Not applicable
COPC = Chemical of potential concern
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
BRC = Basic Remediation Company
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
N/A = BCL (other screening value) not available for screen
NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticide
OPP = Organophosphorus pesticide
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
TIMET = Titanium Metals Corporation
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text
[1] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 2017), unless noted.

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

Source:

NDEP. 2017. User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. Revision 14, July.

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

Nevada Environmental Response Trust Site

Henderson, Nevada

Chemical Name	Study Area Concentrations Greater than Background Levels?[1]
Arsenic	Yes
Calcium	No
Chromium VI[2]	LDF
Cobalt	Yes
Manganese	Yes
Palladium	NA
Potassium	No
Silicon	NA
Sodium	Yes
Sulfur	NA
Thallium	Yes
Zirconium	NA

Notes:

LDF = Low detection frequency (<25%) in either Study Area or background data sets. Background comparison results may not be applicable.

NA = Background data are not available

element is present at concentrations greater than background or background data are not available.

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

[2] For chromium VI, although background comparison results may not be applicable due to low detection frequency in both Study Area and RZ-A background data sets, concentrations in the Study Area are greater than background based on the box plot (Figure E1-10) and the Q-Q plot (Figure E2-10).

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

Nevada Environmental Response Trust Site

Henderson, Nevada

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

Notes:

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

[2] The validity of statistical testing for radionuclide background evaluation is confounded by differences in sample preparation and analytical methods between the Study Area and RZ-A background data sets. For a full discussion of these limitations, see Section 5.2 of the report.

TABLE 5-4. COPCs Identified for Soils (0-10 ft bgs) in the BHRA Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	COPC
Chlorine Oxyanions	Chlorate
	Perchlorate
Metals	Arsenic
	Chromium VI
	Cobalt
	Manganese
	Palladium [1],[2]
	Thallium
	Zirconium [2]
Other Inorganics	Ammonia
Radionuclides	Thorium-232 Series [3]
	Uranium-238 Series [3]
	Uranium-235 [3]
Dioxin/Furans	2,3,7,8-TCDD TEQ*
PAHs	BaPEq*
	Naphthalene
Pesticides - OCPs	beta-BHC
	4,4'-DDE
	4,4'-DDT
	Dieldrin
	Hexachlorobenzene
	Toxaphene
SVOCs	Bis(2-Ethylhexyl)phthalate
	Octachlorostyrene [1]
Asbestos	Long amphibole fibers
	Long chrysotile fibers

Notes:

bgs = below ground surface
ft = feet
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
COPC = Chemical of Potential Concern
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
* Methodology for equivalent calculations explained in text

[1] Retained as a COPC in the absence of a BCL or other screening level. This COPC is discussed qualitatively in the uncertainties analysis.

[2] RZ-A background data are not available for this chemical, and therefore a background evaluation cannot be conducted.

[3] Although statistical testing results indicate all decay products in the thorium-232 and uranium-238 decay series and uranium-235 are consistent with background, the radionuclides are retained for further evaluation for each individual exposure unit.

TABLE 6-1. Cancer Risks for Background Radionuclides in Soils

Nevada Environmental Response Trust Site

Henderson, Nevada

Chain	Radionuclide	Commercial/ Industrial BCL (pCi/g)	RZ-A Background		BRC/TIMET Background	
			95% UCL (pCi/g)	Cancer Risk	95% UCL (pCi/g)	Cancer Risk
Uranium-238	Uranium-238	1.4	1.1	7.9E-07	1.2	8.9E-07
	Uranium-234	11	1.2	1.0E-07	1.3	1.2E-07
	Thorium-230	8.4	1.2	1.4E-07	1.4	1.6E-07
	Radium-226	0.023	1.1	4.6E-05	1.2	5.3E-05
Thorium-232	Thorium-232	7.4	1.6	2.1E-07	1.7	2.3E-07
	Radium-228	0.041	1.4	3.5E-05	2.0	4.8E-05
	Thorium-228	0.025	1.8	7.3E-05	1.8	7.1E-05
Uranium-235	Uranium-235	0.35	0.065	1.9E-07	0.075	2.1E-07
Total Cancer Risk			**--**	**2E-04**	**--**	**2E-04**

Notes:

-- = Not applicable

pCi/g = picocurie per gram

BCL = Basic Comparison Level

UCL = Upper Confidence Limit

TABLE 6-2. Evaluation of Sample Quantitation Limits for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
								Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
EU-1	Metals	Zirconium	104	mg/kg	17	14	82	5.2	25	0	1	--
	PAHs	BaPEq*	0.32	mg/kg	73	5	6.9	0.00086	0.42	3	3	--
	Pesticides - OCPs	Aldrin	0.21	mg/kg	50	2	4.0	0.000070	0.046	0	2	--
		Dieldrin	0.16	mg/kg	50	0	0	0.00021	0.091	0	4	--
		Heptachlor epoxide	0.40	mg/kg	50	0	0	0.00011	0.046	0	2	--
		Hexachlorobenzene	1.3	mg/kg	94	46	49	0.00029	0.36	0	4	Use health-based BCL instead of soil saturation level
		Toxaphene	2.3	mg/kg	50	0	0	0.0097	1.7	0	3	--
	SVOCs	Benzidine	0.011	mg/kg	15	0	0	0.69	1.5	15	15	--
		Bis(2-Chloroethyl) ether	1.3	mg/kg	17	0	0	0.070	0.16	0	2	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	17	0	0	0.070	0.16	0	17	--
		Pentachlorophenol	4.5	mg/kg	17	0	0	0.34	0.79	0	2	--
EU-2	Metals	Zirconium	104	mg/kg	14	13	93	25	25	0	1	--
	PAHs	BaPEq*	0.32	mg/kg	97	12	12	0.000028	0.24	0	2	--
	Pesticides - OCPs	Aldrin	0.21	mg/kg	98	0	0	0.000070	0.058	0	5	--
		Dieldrin	0.16	mg/kg	98	4	4.1	0.00021	0.086	0	10	--
		Heptachlor epoxide	0.40	mg/kg	98	0	0	0.00011	0.098	0	5	--
		Hexachlorobenzene	1.3	mg/kg	140	101	72	0.00028	0.31	0	5	Use health-based BCL instead of soil saturation level
		Toxaphene	2.3	mg/kg	98	1	1.0	0.0097	3.6	2	10	--
	SVOCs	Benzidine	0.011	mg/kg	12	0	0	0.67	1.5	12	12	--
		Bis(2-Chloroethyl) ether	1.3	mg/kg	14	0	0	0.071	0.16	0	4	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	14	0	0	0.071	0.16	0	14	--
		Pentachlorophenol	4.5	mg/kg	14	0	0	0.34	0.80	0	4	--
EU-3	Metals	Arsenic	7.2	mg/kg	147	135	92	0.96	9.9	10	--	Maximum BRC/TIMET background
		Niobium	130	mg/kg	41	0	0	1.8	30	0	10	--
		Thallium	13	mg/kg	63	15	24	0.25	4.9	0	11	--
		Zirconium	104	mg/kg	49	37	76	25	26	0	12	--
	PAHs	BaPEq*	0.32	mg/kg	136	11	8.1	0.00087	0.25	0	1	--
		1-Methylnaphthalene	81	mg/kg	52	1	1.9	0.00026	8.3	0	1	--
	PCBs	Aroclor-1221	1.1	mg/kg	3	0	0	0.040	0.43	0	1	--
		Aroclor-1232	1.1	mg/kg	3	0	0	0.018	0.19	0	1	--
		Aroclor-1242	1.1	mg/kg	3	0	0	0.027	0.29	0	1	--
		Aroclor-1248	1.1	mg/kg	3	0	0	0.018	0.19	0	1	--
		Aroclor-1254	1.1	mg/kg	3	0	0	0.018	0.19	0	1	--
		Aroclor-1260	1.1	mg/kg	52	1	1.9	0.017	0.34	0	1	--
	Pesticides - OCPs	Dieldrin	0.16	mg/kg	107	0	0	0.00020	0.019	0	4	--
		Hexachlorobenzene	1.3	mg/kg	192	82	43	0.00028	3.9	1	4	Use health-based BCL instead of soil saturation level
		Toxaphene	2.3	mg/kg	107	0	0	0.015	0.28	0	1	--
	SVOCs	Benzidine	0.011	mg/kg	41	0	0	0.66	37	41	41	--
		Bis(2-Chloroethyl) ether	1.3	mg/kg	49	0	0	0.069	3.9	1	4	--
		4-Chloroaniline	18	mg/kg	49	0	0	0.13	7.4	0	1	--

TABLE 6-2. Evaluation of Sample Quantitation Limits for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
								Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
EU-3	SVOCs	3,3'-Dichlorobenzidine	5.7	mg/kg	49	0	0	0.15	8.3	1	1	--
		2,4-Dinitrotoluene	8.3	mg/kg	49	0	0	0.079	4.5	0	1	--
		2,6-Dinitrotoluene	2.4	mg/kg	49	0	0	0.094	5.3	1	2	--
		Hexachlorocyclopentadiene	8.2	mg/kg	49	0	0	0.13	7.4	0	1	--
		Hexachloroethane	9.3	mg/kg	49	0	0	0.13	7.4	0	1	--
		Nitrobenzene	25	mg/kg	133	0	0	0.0018	3.9	0	1	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	49	0	0	0.069	3.9	1	49	--
		Pentachlorophenol	4.5	mg/kg	49	0	0	0.33	19	1	4	--
EU-4	PAHs	BaPEq*	0.32	mg/kg	64	11	17	0.00089	0.45	5	5	--
	Pesticides - OCPs	Dieldrin	0.16	mg/kg	13	0	0	0.0013	0.020	0	1	--
		Hexachlorobenzene	1.3	mg/kg	68	45	66	0.00088	0.39	0	4	Use health-based BCL instead of soil saturation level
		Toxaphene	2.3	mg/kg	13	0	0	0.018	0.59	0	1	--
	SVOCs	Benzidine	0.011	mg/kg	1	0	0	0.73	0.73	1	1	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	2	0	0	0.074	0.077	0	2	--
EU-5	Pesticides - OCPs	Dieldrin	0.16	mg/kg	18	0	0	0.00026	0.018	0	1	--
		Hexachlorobenzene	1.3	mg/kg	52	18	35	0.00028	0.18	0	1	Use health-based BCL instead of soil saturation level
	SVOCs	Benzidine	0.011	mg/kg	3	0	0	0.69	1.7	3	3	--
		Bis(2-Chloroethyl) ether	1.3	mg/kg	4	0	0	0.074	0.18	0	1	--
		2,6-Dinitrotoluene	2.4	mg/kg	4	0	0	0.10	0.25	0	1	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	4	0	0	0.074	0.18	0	4	--
		Pentachlorophenol	4.5	mg/kg	4	0	0	0.36	0.90	0	1	--
EU-6	PAHs	BaPEq*	0.32	mg/kg	57	16	28	0.00086	0.45	1	2	--
	Pesticides - OCPs	Dieldrin	0.16	mg/kg	26	0	0	0.00026	0.019	0	5	--
		Hexachlorobenzene	1.3	mg/kg	64	23	36	0.00029	0.39	0	2	Use health-based BCL instead of soil saturation level
	SVOCs	Benzidine	0.011	mg/kg	4	0	0	0.69	0.72	4	4	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	7	0	0	0.073	0.077	0	7	--
EU-7	PAHs	BaPEq*	0.32	mg/kg	35	7	20	0.00087	2.4	6	8	--
		Naphthalene	18	mg/kg	43	4	9.3	0.00086	3.3	0	1	--
	Pesticides - OCPs	Hexachlorobenzene	1.3	mg/kg	38	13	34	0.00088	10	2	8	Use health-based BCL instead of soil saturation level
		Toxaphene	2.3	mg/kg	9	0	0	0.018	0.33	0	1	--
	SVOCs	Benzidine	0.011	mg/kg	2	0	0	0.70	0.73	2	2	--
		1,4-Dioxane	36	mg/kg	32	0	0	0.0050	7.1	0	1	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	2	0	0	0.075	0.077	0	2	--
EU-8	Pesticides - OCPs	Dieldrin	0.16	mg/kg	11	0	0	0.00023	0.018	0	1	--
	SVOCs	Benzidine	0.011	mg/kg	2	0	0	0.70	0.70	2	2	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	2	0	0	0.074	0.075	0	2	--
EU-9	Metals	Zirconium	104	mg/kg	17	12	71	5.1	26	0	1	--
	PAHs	BaPEq*	0.32	mg/kg	52	16	31	0.00089	0.042	0	8	--

TABLE 6-2. Evaluation of Sample Quantitation Limits for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Screening Levels[1]	Unit	No. of Samples	No. of Detects	% Detects	Nondetects				Screening Level Note
								Minimum SQL	Maximum SQL	No. of Samples Above Screen	No. of Samples Above 10% Screen	
EU-9	Pesticides - OCPs	Dieldrin	0.16	mg/kg	35	0	0	0.000075	0.018	0	2	--
		Hexachlorobenzene	1.3	mg/kg	52	10	19	0.00086	1.6	1	2	Use health-based BCL instead of soil saturation level
		Toxaphene	2.3	mg/kg	35	0	0	0.0073	0.58	0	3	--
	SVOCs	Benzidine	0.011	mg/kg	6	0	0	0.67	15	6	6	--
		Bis(2-Chloroethyl) ether	1.3	mg/kg	17	0	0	0.034	1.6	1	2	--
		4-Chloroaniline	18	mg/kg	17	0	0	0.034	3.0	0	1	--
		3,3'-Dichlorobenzidine	5.7	mg/kg	17	0	0	0.034	3.4	0	1	--
		2,4-Dinitrotoluene	8.3	mg/kg	17	0	0	0.034	1.8	0	1	--
		2,6-Dinitrotoluene	2.4	mg/kg	17	0	0	0.034	2.1	0	1	--
		Hexachlorocyclopentadiene	8.2	mg/kg	17	0	0	0.13	3.0	0	1	--
		Hexachloroethane	9.3	mg/kg	17	0	0	0.034	3.0	0	1	--
		n-Nitroso-di-n-propylamine	0.37	mg/kg	17	0	0	0.034	1.6	1	7	--
		Pentachlorophenol	4.5	mg/kg	17	0	0	0.33	7.6	1	2	--
	VOCs	1,2-Dibromo-3-chloropropane	0.071	mg/kg	140	0	0	0.00061	0.0074	0	1	--

Notes:

-- = Not applicable
mg/kg = milligram per kilogram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BRC = Basic Remediation Company
EU = Exposure Unit
NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticide
OPP = Organophosphorus pesticide
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
SQL = Sample Quantitation Limit
SVOC = Semivolatile organic compound
TIMET = Titanium Metals Corporation
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text
[1] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 2017), unless noted.

Source:

NDEP. 2017. User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. Revision 14, July.

TABLE 6-3. Summary Statistics and Concentration/Toxicity Screen for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects							Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
							Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum				
EU-1	Chlorine Oxyanions	Chlorate	mg/kg	31	29	94	0.22	5.2	0.14	1,200	1.8	90	260	2.8	RIDB-6	38,900	--	0	Pass
		Perchlorate	mg/kg	50	49	98	0.011	0.011	0.012	450	1.6	25	73	2.9	RIDB-6	908	--	5	Fail
	Metals	Arsenic	mg/kg	49	49	100	--	--	1.3	19	4.0	4.5	3.1	0.69	SSAJ2-06	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	31	0	0	0.10	0.22	--	--	--	--	--	--	--	7.0	--	--	Pass
		Cobalt	mg/kg	33	32	97	2.5	2.5	2.7	7.7	5.9	5.8	1.1	0.19	SA18	385	--	0	Pass
		Manganese	mg/kg	33	33	100	--	--	130	670	300	310	87	0.28	CS-DC-2	28,100	--	0	Pass
		Palladium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N/A	--	NS	NS
		Thallium	mg/kg	31	12	39	0.073	0.53	0.080	0.14	0.088	0.094	0.018	0.19	RSAH3	13	--	0	Pass
		Zirconium	mg/kg	17	14	82	5.2	25	20	30	23	24	3.0	0.13	RIDB-5	104	--	14	Fail
	Other Inorganics	Ammonia	mg/kg	14	3	21	0.061	6.7	0.40	2.5	2.2	1.7	1.1	0.67	RSAH3	6,140	--	0	Pass
	Radionuclides	Radium-226	pCi/g	31	31	100	--	--	0.20	1.9	0.99	1.0	0.39	0.37	RSAJ3	0.023	--	31	Fail
		Radium-228	pCi/g	31	31	100	--	--	0.37	2.7	1.2	1.3	0.46	0.34	RSAH3	0.041	--	31	Fail
		Thorium-228	pCi/g	30	30	100	--	--	0.055	2.7	1.7	1.6	0.52	0.33	RSAJ2	0.025	--	30	Fail
		Thorium-230	pCi/g	30	30	100	--	--	0.16	2.2	1.1	1.2	0.48	0.39	RIDB-5	8.4	--	26	Fail
		Thorium-232	pCi/g	30	30	100	--	--	0.16	2.2	1.6	1.5	0.46	0.31	SA152	7.4	--	27	Fail
		Uranium-234	pCi/g	13	13	100	--	--	0.31	2.2	1.0	1.0	0.54	0.52	RSAJ3	11	--	4	Fail
		Uranium-235	pCi/g	13	13	100	--	--	0.0063	0.088	0.049	0.047	0.025	0.52	RSAJ3	0.35	--	9	Fail
		Uranium-238	pCi/g	13	13	100	--	--	0.24	1.7	0.95	0.90	0.44	0.49	RSAJ3	1.4	--	13	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	90	90	100	--	--	0.00000012	0.0014	0.000011	0.00017	0.00034	2.0	RSAH3	0.0027	Site-specific action level	--	Pass
	PAHs	BaPEq*	mg/kg	73	5	6.9	0.00086	0.42	0.00094	0.066	0.012	0.027	0.031	1.2	CS-DC-2	0.32	--	2	Fail
		Naphthalene	mg/kg	73	4	5.5	0.00033	0.36	0.0011	0.0014	0.0011	0.0012	0.00014	0.12	SA152	18	--	0	Pass
	Pesticides - OCPs	beta-BHC	mg/kg	50	21	42	0.00025	0.046	0.0011	0.23	0.014	0.043	0.060	1.4	RSAH3	1.7	--	1	Fail
		4,4'-DDE	mg/kg	50	24	48	0.000078	0.091	0.00041	1.8	0.0084	0.12	0.37	3.0	RSAL3	9.5	--	1	Fail
		4,4'-DDT	mg/kg	50	23	46	0.00017	0.091	0.00066	0.38	0.0085	0.039	0.080	2.1	RSAL3	7.5	--	0	Pass
		Dieldrin	mg/kg	50	0	0	0.00021	0.091	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	94	46	49	0.00029	0.36	0.00088	1.0	0.10	0.21	0.26	1.3	CS-DC-2	1.3	Use health-based BCL instead of soil saturation level	20	Fail
		Toxaphene	mg/kg	50	0	0	0.0097	1.7	--	--	--	--	--	--	--	2.3	--	--	Pass
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	73	9	12	0.045	0.36	0.058	0.70	0.12	0.21	0.23	1.1	SSAL2-02	183	--	0	Pass
		Octachlorostyrene	mg/kg	71	8	11	0.0020	5.3	0.012	0.41	0.095	0.14	0.12	0.90	RSAH3	N/A	--	N/A	N/A
EU-2	Chlorine Oxyanions	Chlorate	mg/kg	76	63	83	0.043	0.055	0.052	23	1.8	4.1	5.2	1.3	RIDB-10	38,900	--	0	Pass
		Perchlorate	mg/kg	88	86	98	0.043	0.045	0.042	940	14	61	140	2.3	RISB-21	908	--	14	Fail
	Metals	Arsenic	mg/kg	84	83	99	0.88	0.88	1.2	8.6	3.0	3.3	1.4	0.43	RISB-20	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	42	2	4.8	0.10	0.20	0.35	0.42	0.39	0.39	0.049	0.13	RSAK6	7.0	--	0	Pass
		Cobalt	mg/kg	76	75	99	2.5	2.5	4.6	17	7.7	7.9	2.0	0.25	RISB-29	385	--	0	Pass
		Manganese	mg/kg	83	83	100	--	--	50	2,300	410	510	380	0.75	RISB-15	28,100	--	0	Pass
		Palladium	mg/kg	4	0	0	0.048	0.060	--	--	--	--	--	--	--	N/A	--	--	Pass
		Thallium	mg/kg	76	36	47	0.25	0.57	0.069	0.52	0.12	0.15	0.091	0.62	M-162D	13	--	0	Pass
		Zirconium	mg/kg	14	13	93	25	25	16	29	22	22	4.1	0.19	RIDB-15	104	--	13	Fail
	Other Inorganics	Ammonia	mg/kg	33	4	12	0.061	2.6	0.13	2.2	1.2	1.2	1.1	0.96	SA70	6,140	--	0	Pass
	Radionuclides	Radium-226	pCi/g	46	46	100	--	--	0.069	2.0	0.75	0.79	0.32	0.40	SA74	0.023	--	46	Fail
		Radium-228	pCi/g	46	46	100	--	--	0.27	3.3	1.2	1.2	0.54	0.45	SA70	0.041	--	46	Fail
		Thorium-228	pCi/g	46	46	100	--	--	-0.0077	2.8	1.8	1.8	0.44	0.25	SA82	0.025	--	45	Fail
		Thorium-230	pCi/g	46	46	100	--	--	0.050	4.3	1.1	1.2	0.55	0.46	SA74	8.4	--	42	Fail
		Thorium-232	pCi/g	46	46	100	--	--	0.017	2.5	1.6	1.6	0.38	0.24	SA189	7.4	--	45	Fail
		Uranium-234	pCi/g	36	36	100	--	--	0.68	2.8	0.91	1.1	0.46	0.42	SA74	11	--	9	Fail
		Uranium-235	pCi/g	36	36	100	--	--	0.017	0.25	0.059	0.073	0.045	0.61	RSAK6	0.35	--	34	Fail
		Uranium-238	pCi/g	36	36	100	--	--	0.71	2.5	0.92	1.1	0.38	0.36	SA74	1.4	--	36	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	107	107	100	--	--	0.00000011	0.0046	0.000038	0.00034	0.00066	1.9	RIDB-13	0.0027	Site-specific action level	--	Fail

TABLE 6-3. Summary Statistics and Concentration/Toxicity Screen for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects							Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
							Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum				
EU-2	PAHs	BaPEq*	mg/kg	97	12	12	0.000028	0.24	0.000028	0.027	0.0012	0.0060	0.0086	1.4	RSAK4	0.32	--	0	Pass
		Naphthalene	mg/kg	100	10	10	0.00073	0.33	0.0010	0.0067	0.0014	0.0020	0.0017	0.88	M-162D	18	--	0	Pass
	Pesticides - OCPs	beta-BHC	mg/kg	98	59	60	0.00067	0.15	0.0014	0.87	0.016	0.060	0.14	2.4	SA67	1.7	--	5	Fail
		4,4'-DDE	mg/kg	98	63	64	0.00024	0.086	0.00040	6.0	0.019	0.47	1.2	2.6	SSAM3-01	9.5	--	8	Fail
		4,4'-DDT	mg/kg	98	47	48	0.00058	0.086	0.00098	2.3	0.013	0.18	0.41	2.3	SSAM2-01	7.5	--	6	Fail
		Dieldrin	mg/kg	98	4	4.1	0.00021	0.086	0.00027	0.059	0.016	0.023	0.028	1.2	SSAM2-01	0.16	--	2	Fail
		Hexachlorobenzene	mg/kg	140	101	72	0.00028	0.31	0.00051	2.1	0.059	0.19	0.31	1.7	RSAK4	1.3	Use health-based BCL instead of soil saturation level	36	Fail
		Toxaphene	mg/kg	98	1	1.0	0.0097	3.6	0.62	0.62	0.62	0.62	--	--	SSAL3-04	2.3	--	1	Fail
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	97	19	20	0.0040	0.68	0.064	0.38	0.10	0.15	0.085	0.58	SSAL2-03	183	--	0	Pass
		Octachlorostyrene	mg/kg	97	22	23	0.00012	5.4	0.0021	0.25	0.037	0.066	0.074	1.1	RSAK4	N/A	--	N/A	N/A
EU-3	Chlorine Oxyanions	Chlorate	mg/kg	63	59	94	0.042	0.21	0.085	270	3.4	9.6	35	3.6	SA76	38,900	--	0	Pass
		Perchlorate	mg/kg	68	68	100	--	--	0.097	130	6.7	18	28	1.6	RISB-10	908	--	3	Fail
	Metals	Arsenic	mg/kg	147	135	92	0.96	9.9	0.58	12	3.3	3.8	1.7	0.45	RSAK8	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	59	11	19	0.15	0.45	0.17	3.8	0.45	0.82	1.0	1.3	RSAK8	7.0	--	3	Fail
		Cobalt	mg/kg	63	51	81	2.5	2.6	5.4	17	8.1	8.5	2.0	0.24	RIDB-12	385	--	0	Pass
		Manganese	mg/kg	110	110	100	--	--	46	6,300	380	530	690	1.3	DS-E14C-1/ DS-E14C-2	28,100	--	2	Fail
		Palladium	mg/kg	16	0	0	0.048	0.057	--	--	--	--	--	--	--	N/A	--	--	Pass
		Thallium	mg/kg	63	15	24	0.25	4.9	0.066	0.83	0.12	0.23	0.24	1.0	RSAK8	13	--	0	Pass
		Zirconium	mg/kg	49	37	76	25	26	15	43	25	25	5.0	0.20	RIDB-27	104	--	37	Fail
	Other Inorganics	Ammonia	mg/kg	30	10	33	0.061	2.6	0.32	3.5	2.8	2.2	1.1	0.48	RISB-10	6,140	--	0	Pass
	Radionuclides	Radium-226	pCi/g	63	63	100	--	--	0.092	2.5	0.92	0.88	0.45	0.51	SA92	0.023	--	63	Fail
		Radium-228	pCi/g	63	63	100	--	--	-0.19	2.6	1.1	0.98	0.54	0.55	RIDB-19	0.041	--	60	Fail
		Thorium-228	pCi/g	63	63	100	--	--	-0.073	2.3	1.7	1.4	0.72	0.50	RISB-10	0.025	--	60	Fail
		Thorium-230	pCi/g	63	63	100	--	--	0.10	2.3	1.1	1.1	0.49	0.47	SA76	8.4	--	50	Fail
		Thorium-232	pCi/g	63	63	100	--	--	-0.011	2.4	1.6	1.4	0.67	0.49	RISB-10	7.4	--	51	Fail
		Uranium-234	pCi/g	30	30	100	--	--	0.72	2.0	0.98	1.1	0.35	0.33	SA76	11	--	9	Fail
		Uranium-235	pCi/g	30	30	100	--	--	0.011	0.23	0.043	0.059	0.044	0.74	SA76	0.35	--	23	Fail
		Uranium-238	pCi/g	30	30	100	--	--	0.75	1.5	1.0	1.1	0.20	0.19	RISB-11	1.4	--	30	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	151	151	100	--	--	0.000000074	0.025	0.000043	0.00040	0.0021	5.2	RIDB-25	0.0027	Site-specific action level	--	Fail
	PAHs	BaPEq*	mg/kg	136	11	8.1	0.00087	0.25	0.00093	0.042	0.0084	0.0090	0.012	1.3	SSAK8-07	0.32	--	1	Fail
		Naphthalene	mg/kg	141	4	2.8	0.00033	0.22	0.0010	0.0056	0.0013	0.0023	0.0022	0.98	RIDB-18	18	--	0	Pass
	Pesticides - OCPs	beta-BHC	mg/kg	107	51	48	0.00064	0.0094	0.00072	0.063	0.0029	0.010	0.015	1.5	RISB-09	1.7	--	0	Pass
		4,4'-DDE	mg/kg	107	41	38	0.00024	0.018	0.00041	1.1	0.0082	0.11	0.22	2.1	BDT-4-S-15	9.5	--	1	Fail
		4,4'-DDT	mg/kg	107	32	30	0.00059	0.019	0.00079	0.37	0.011	0.039	0.073	1.9	BDT-4-S-15	7.5	--	0	Pass
		Dieldrin	mg/kg	107	0	0	0.00020	0.019	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	192	82	43	0.00028	3.9	0.00032	27	0.040	0.46	3.0	6.5	RIDB-25	1.3	Use health-based BCL instead of soil saturation level	19	Fail
		Toxaphene	mg/kg	107	0	0	0.015	0.28	--	--	--	--	--	--	--	2.3	--	--	Pass
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	133	24	18	0.044	5.0	0.060	0.15	0.096	0.095	0.015	0.16	SSAK8-08	183	--	0	Pass
		Octachlorostyrene	mg/kg	133	17	13	0.0035	130	0.0044	3.7	0.080	0.30	0.88	3.0	RIDB-25	N/A	--	N/A	N/A
EU-4	Chlorine Oxyanions	Chlorate	mg/kg	26	18	69	0.043	5.6	0.086	110	2.1	9.6	25	2.6	SA175	38,900	--	0	Pass
		Perchlorate	mg/kg	49	47	96	0.010	0.043	0.066	2,620	140	420	570	1.3	RSAM5	908	--	27	Fail
	Metals	Arsenic	mg/kg	70	70	100	--	--	1.7	15	4.5	5.0	2.1	0.42	RI-5	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	27	8	30	0.11	0.20	0.12	1.3	0.53	0.54	0.36	0.67	SA64	7.0	--	1	Fail
		Cobalt	mg/kg	27	27	100	--	--	3.2	8.4	6.6	6.3	1.5	0.24	SA104	385	--	0	Pass
		Manganese	mg/kg	29	29	100	--	--	150	1,500	300	350	250	0.70	SA165	28,100	--	0	Pass
		Palladium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N/A	--	NS	NS
		Thallium	mg/kg	27	21	78	0.077	0.51	0.054	0.18	0.095	0.097	0.028	0.29	SA60	13	--	0	Pass

TABLE 6-3. Summary Statistics and Concentration/Toxicity Screen for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects							Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
							Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum				
EU-4	Metals	Zirconium	mg/kg	2	2	100	--	--	19	29	24	24	7.1	0.29	RI-16	104	--	2	Fail
	Other Inorganics	Ammonia	mg/kg	24	11	46	0.061	6.8	0.90	680	41	150	240	1.6	RSAM5	6,140	--	1	Fail
	Radionuclides	Radium-226	pCi/g	27	27	100	--	--	0.45	2.0	1.2	1.2	0.42	0.35	SA64	0.023	--	27	Fail
		Radium-228	pCi/g	27	27	100	--	--	0.45	1.9	1.1	1.2	0.42	0.35	SA16	0.041	--	27	Fail
		Thorium-228	pCi/g	24	24	100	--	--	0.78	3.0	1.6	1.7	0.45	0.27	SA65	0.025	--	24	Fail
		Thorium-230	pCi/g	24	24	100	--	--	0.53	3.3	1.4	1.6	0.73	0.45	SA128	8.4	--	22	Fail
		Thorium-232	pCi/g	24	24	100	--	--	0.54	2.4	1.6	1.5	0.40	0.26	SA65	7.4	--	23	Fail
		Uranium-234	pCi/g	22	22	100	--	--	0.37	3.4	1.3	1.4	0.80	0.56	SA128	11	--	14	Fail
		Uranium-235	pCi/g	22	22	100	--	--	0.0047	0.17	0.075	0.076	0.047	0.62	SA128	0.35	--	16	Fail
		Uranium-238	pCi/g	22	22	100	--	--	0.38	3.3	1.1	1.3	0.75	0.57	SA128	1.4	--	22	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	41	41	100	--	--	0.00000021	0.0021	0.000085	0.00023	0.00046	2.0	SA175	0.0027	Site-specific action level	--	Pass
	PAHs	BaPEq*	mg/kg	64	11	17	0.00089	0.45	0.0013	0.40	0.025	0.081	0.12	1.5	SSAM5-03	0.32	--	5	Fail
		Naphthalene	mg/kg	66	1	1.5	0.00088	0.39	0.0011	0.0011	0.0011	0.0011	--	--	SA128	18	--	0	Pass
	Pesticides - OCPs	beta-BHC	mg/kg	13	9	69	0.00094	0.0068	0.0018	0.052	0.014	0.019	0.015	0.81	SA15	1.7	--	0	Pass
		4,4'-DDE	mg/kg	13	7	54	0.0016	0.0025	0.0030	0.20	0.037	0.073	0.083	1.1	SSAM5-03	9.5	--	0	Pass
		4,4'-DDT	mg/kg	13	7	54	0.0016	0.0061	0.0042	0.33	0.052	0.092	0.12	1.3	SSAM5-03	7.5	--	0	Pass
		Dieldrin	mg/kg	13	0	0	0.0013	0.020	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	68	45	66	0.00088	0.39	0.0042	0.76	0.13	0.19	0.18	0.94	SA49	1.3	Use health-based BCL instead of soil saturation level	22	Fail
		Toxaphene	mg/kg	13	0	0	0.018	0.59	--	--	--	--	--	--	--	2.3	--	--	Pass
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	64	12	19	0.047	0.80	0.077	0.85	0.16	0.29	0.29	1.0	SSAM5-03	183	--	0	Pass
		Octachlorostyrene	mg/kg	64	15	23	0.0037	2.5	0.013	0.68	0.064	0.10	0.16	1.6	SA86	N/A	--	N/A	N/A
EU-5	Chlorine Oxyanions	Chlorate	mg/kg	49	38	78	0.044	0.17	0.18	88	3.5	12	20	1.6	SA108	38,900	--	0	Pass
		Perchlorate	mg/kg	55	51	93	0.035	0.045	0.067	190	6.1	20	35	1.8	CS-C23-1	908	--	3	Fail
	Metals	Arsenic	mg/kg	129	129	100	--	--	1.6	12	3.3	3.6	1.6	0.44	DS-C45-2	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	36	6	17	0.10	0.20	0.36	2.0	1.2	1.2	0.71	0.58	SA108	7.0	--	4	Fail
		Cobalt	mg/kg	93	93	100	--	--	5.1	280	8.2	25	51	2.1	RSAO8	385	--	9	Fail
		Manganese	mg/kg	107	107	100	--	--	280	29,200	510	1,810	3,590	2.0	CS-C44-1	28,100	--	14	Fail
		Palladium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N/A	--	NS	NS
		Thallium	mg/kg	49	29	59	0.25	0.62	0.060	0.98	0.12	0.22	0.25	1.1	SA108	13	--	0	Pass
		Zirconium	mg/kg	4	4	100	--	--	15	25	16	18	4.6	0.25	RI-6	104	--	4	Fail
	Other Inorganics	Ammonia	mg/kg	28	3	11	0.061	0.41	0.16	0.22	0.19	0.19	0.031	0.16	RSAO8	6,140	--	0	Pass
	Radionuclides	Radium-226	pCi/g	32	32	100	--	--	0.42	1.7	0.81	0.88	0.32	0.36	RI-1	0.023	--	32	Fail
		Radium-228	pCi/g	32	32	100	--	--	0.19	2.0	1.2	1.2	0.44	0.38	SA143	0.041	--	32	Fail
		Thorium-228	pCi/g	32	32	100	--	--	1.3	2.3	1.7	1.8	0.27	0.15	SA149	0.025	--	32	Fail
		Thorium-230	pCi/g	32	32	100	--	--	0.66	1.5	1.0	1.1	0.25	0.23	RSAN4	8.4	--	28	Fail
		Thorium-232	pCi/g	32	32	100	--	--	1.1	2.2	1.6	1.6	0.24	0.15	SA150	7.4	--	32	Fail
		Uranium-234	pCi/g	28	28	100	--	--	0.27	1.7	0.98	0.98	0.28	0.29	SA158	11	--	8	Fail
		Uranium-235	pCi/g	28	28	100	--	--	-0.026	0.18	0.051	0.055	0.038	0.69	RSAN7	0.35	--	23	Fail
		Uranium-238	pCi/g	28	28	100	--	--	0.25	1.4	0.91	0.91	0.24	0.26	RSAO8	1.4	--	28	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	33	33	100	--	--	0.00000019	0.00043	0.0000077	0.000056	0.00011	2.0	RSAN7	0.0027	Site-specific action level	--	Pass
	PAHs	BaPEq*	mg/kg	44	8	18	0.00087	0.026	0.00087	0.087	0.0018	0.021	0.031	1.5	SSAN6-03	0.32	--	2	Fail
		Naphthalene	mg/kg	84	3	3.6	0.00032	0.12	0.0014	2.0	0.25	0.75	1.1	1.5	SSAO8-12	18	--	1	Fail
	Pesticides - OCPs	beta-BHC	mg/kg	18	8	44	0.00025	0.0016	0.0017	0.16	0.012	0.041	0.057	1.4	RI-1	1.7	--	0	Pass
		4,4'-DDE	mg/kg	18	4	22	0.000078	0.0040	0.0021	0.080	0.0082	0.025	0.037	1.5	RSAN7	9.5	--	0	Pass
		4,4'-DDT	mg/kg	18	5	28	0.00017	0.0019	0.0025	0.10	0.0037	0.023	0.043	1.9	RSAN7	7.5	--	0	Pass
		Dieldrin	mg/kg	18	0	0	0.00026	0.018	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	52	18	35	0.00028	0.18	0.0011	0.31	0.019	0.061	0.086	1.4	SA150	1.3	Use health-based BCL instead of soil saturation level	3	Fail
		Toxaphene	mg/kg	18	0	0	0.0097	0.18	--	--	--	--	--	--	--	2.3	--	--	Pass

TABLE 6-3. Summary Statistics and Concentration/Toxicity Screen for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects							Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
							Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum				
EU-5	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	43	10	23	0.044	0.28	0.089	0.39	0.11	0.14	0.090	0.64	SSAN6-03	183	--	0	Pass
		Octachlorostyrene	mg/kg	43	4	9.3	0.0036	6.1	0.0048	0.067	0.029	0.033	0.029	0.89	SA150	N/A	--	N/A	N/A
EU-6	Chlorine Oxyanions	Chlorate	mg/kg	31	12	39	0.024	1.2	0.13	2,580	12	280	750	2.7	SA186	38,900	--	0	Pass
		Perchlorate	mg/kg	31	23	74	0.0099	0.17	0.033	110	1.7	15	31	2.0	SA50	908	--	2	Fail
	Metals	Arsenic	mg/kg	72	72	100	--	--	1.4	16	3.3	3.5	1.8	0.50	SSAO3-06	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	33	5	15	0.10	0.20	0.28	2.6	0.66	0.96	0.95	0.99	SA185	7.0	--	2	Fail
		Cobalt	mg/kg	31	31	100	--	--	5.6	9.1	6.7	6.9	0.88	0.13	SA166	385	--	0	Pass
		Manganese	mg/kg	53	53	100	--	--	130	12,000	410	1,360	2,750	2.0	SA180	28,100	--	6	Fail
		Palladium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N/A	--	NS	NS
		Thallium	mg/kg	31	24	77	0.49	0.52	0.074	8.4	0.10	0.46	1.7	3.7	SA180	13	--	1	Fail
		Zirconium	mg/kg	7	7	100	--	--	15	25	22	21	3.2	0.15	RI-2	104	--	7	Fail
	Other Inorganics	Ammonia	mg/kg	26	2	7.7	0.061	0.79	0.32	0.64	0.48	0.48	0.23	0.48	RSAO5	6,140	--	0	Pass
	Radionuclides	Radium-226	pCi/g	31	31	100	--	--	0.47	1.8	1.0	0.95	0.30	0.32	RSAO2	0.023	--	31	Fail
		Radium-228	pCi/g	31	31	100	--	--	-0.058	2.1	1.1	1.1	0.49	0.44	RI-3	0.041	--	30	Fail
		Thorium-228	pCi/g	29	29	100	--	--	1.5	2.7	1.9	1.9	0.31	0.16	RSAO5	0.025	--	29	Fail
		Thorium-230	pCi/g	29	29	100	--	--	0.77	3.1	1.1	1.2	0.42	0.35	RI-2	8.4	--	27	Fail
		Thorium-232	pCi/g	29	29	100	--	--	0.95	2.3	1.7	1.7	0.33	0.19	RI-9	7.4	--	29	Fail
		Uranium-234	pCi/g	22	22	100	--	--	0.71	1.6	0.99	1.0	0.24	0.23	SA207	11	--	5	Fail
		Uranium-235	pCi/g	22	22	100	--	--	0.030	0.16	0.055	0.068	0.034	0.50	RSAO2	0.35	--	19	Fail
		Uranium-238	pCi/g	22	22	100	--	--	0.73	1.5	0.95	0.95	0.17	0.18	SA207	1.4	--	22	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	62	62	100	--	--	0.000000057	0.0012	0.0000011	0.000062	0.00018	3.0	SSAP3-01	0.0027	Site-specific action level	--	Pass
	PAHs	BaPEq*	mg/kg	57	16	28	0.00086	0.45	0.0010	0.26	0.026	0.054	0.073	1.3	SA09	0.32	--	6	Fail
		Naphthalene	mg/kg	57	9	16	0.00085	0.39	0.0010	0.015	0.0018	0.0036	0.0046	1.3	SA47	18	--	0	Pass
	Pesticides - OCPs	beta-BHC	mg/kg	26	12	46	0.00025	0.0094	0.0036	0.27	0.034	0.089	0.10	1.2	SA180	1.7	--	3	Fail
		4,4'-DDE	mg/kg	26	8	31	0.000078	0.019	0.0043	0.74	0.066	0.21	0.29	1.4	SA180	9.5	--	0	Pass
		4,4'-DDT	mg/kg	26	4	15	0.00017	0.019	0.0039	0.16	0.065	0.073	0.079	1.1	SA180	7.5	--	0	Pass
		Dieldrin	mg/kg	26	0	0	0.00026	0.019	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	64	23	36	0.00029	0.39	0.00048	0.70	0.030	0.081	0.15	1.9	SSAP3-01	1.3	Use health-based BCL instead of soil saturation level	2	Fail
		Toxaphene	mg/kg	26	0	0	0.0097	0.19	--	--	--	--	--	--	--	2.3	--	--	Pass
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	57	15	26	0.046	0.40	0.066	0.82	0.076	0.15	0.20	1.3	SSAO4-01	183	--	0	Pass
		Octachlorostyrene	mg/kg	57	6	11	0.0020	2.5	0.013	0.091	0.018	0.038	0.035	0.93	RSAO3	N/A	--	N/A	N/A
EU-7	Chlorine Oxyanions	Chlorate	mg/kg	19	17	89	0.054	5.4	0.045	20,900	29	1,900	5,280	2.8	SA106	38,900	--	2	Fail
		Perchlorate	mg/kg	35	33	94	0.035	0.035	0.051	1,400	59	180	350	2.0	SA106	908	--	14	Fail
	Metals	Arsenic	mg/kg	51	51	100	--	--	1.2	34	3.3	4.0	4.4	1.1	EE-C25-1	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	24	15	63	0.16	0.22	0.13	110	4.2	17	30	1.8	SA106	7.0	--	14	Fail
		Cobalt	mg/kg	28	28	100	--	--	5.5	9.0	7.3	7.3	0.82	0.11	SSAO7-01	385	--	0	Pass
		Manganese	mg/kg	36	36	100	--	--	220	7,970	350	600	1,270	2.1	EE-C25-1	28,100	--	1	Fail
		Palladium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N/A	--	NS	NS
		Thallium	mg/kg	24	19	79	0.075	0.54	0.077	0.22	0.091	0.097	0.030	0.31	SA200	13	--	0	Pass
		Zirconium	mg/kg	2	2	100	--	--	24	30	27	27	4.2	0.16	RI-12	104	--	2	Fail
	Other Inorganics	Ammonia	mg/kg	17	3	18	0.061	6.9	0.22	0.40	0.38	0.33	0.099	0.30	SA114	6,140	--	0	Pass
	Radionuclides	Radium-226	pCi/g	19	19	100	--	--	0.56	1.7	0.98	1.1	0.31	0.29	SA11	0.023	--	19	Fail
		Radium-228	pCi/g	19	19	100	--	--	0.86	2.2	1.4	1.5	0.40	0.27	SA102	0.041	--	19	Fail
		Thorium-228	pCi/g	15	15	100	--	--	0.66	2.3	1.6	1.6	0.40	0.25	RSAO6	0.025	--	15	Fail
		Thorium-230	pCi/g	15	15	100	--	--	0.83	1.5	1.1	1.1	0.15	0.13	RI-12	8.4	--	14	Fail
		Thorium-232	pCi/g	15	15	100	--	--	0.84	2.0	1.3	1.4	0.32	0.24	SA109	7.4	--	15	Fail
		Uranium-234	pCi/g	13	13	100	--	--	0.66	1.4	1.1	1.0	0.20	0.19	SA51	11	--	5	Fail
		Uranium-235	pCi/g	13	13	100	--	--	0.0040	0.10	0.038	0.041	0.023	0.55	SA106	0.35	--	8	Fail

TABLE 6-3. Summary Statistics and Concentration/Toxicity Screen for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects							Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
							Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum				
EU-7	Radionuclides	Uranium-238	pCi/g	13	13	100	--	--	0.37	1.4	0.97	0.95	0.23	0.24	SA51	1.4	--	13	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	27	27	100	--	--	0.000000068	0.0015	0.000027	0.00019	0.00037	2.0	SSAN6-05	0.0027	Site-specific action level	--	Pass
	PAHs	BaPEq*	mg/kg	35	7	20	0.00087	2.4	0.0050	0.29	0.014	0.053	0.10	1.9	EE-C25-1	0.32	--	1	Fail
		Naphthalene	mg/kg	43	4	9.3	0.00086	3.3	0.0013	3.1	0.0019	0.78	1.5	2.0	EE-C25-1	18	--	1	Fail
	Pesticides - OCPs	beta-BHC	mg/kg	9	3	33	0.00088	0.0019	0.0028	0.030	0.026	0.020	0.015	0.75	SA11	1.7	--	0	Pass
		4,4'-DDE	mg/kg	9	2	22	0.0016	0.0019	0.0075	0.012	0.0097	0.0097	0.0032	0.33	SA11	9.5	--	0	Pass
		4,4'-DDT	mg/kg	9	0	0	0.0016	0.012	--	--	--	--	--	--	--	7.5	--	--	Pass
		Dieldrin	mg/kg	9	0	0	0.0016	0.0044	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	38	13	34	0.00088	10	0.0013	0.96	0.033	0.17	0.28	1.6	SA11	1.3	Use health-based BCL instead of soil saturation level	3	Fail
		Toxaphene	mg/kg	9	0	0	0.018	0.33	--	--	--	--	--	--	--	2.3	--	--	Pass
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	34	2	5.9	0.045	4.9	0.099	0.41	0.25	0.25	0.22	0.86	SA11	183	--	0	Pass
		Octachlorostyrene	mg/kg	34	4	12	0.0036	6.1	0.0096	0.21	0.10	0.11	0.091	0.86	SA11	N/A	--	N/A	N/A
EU-8	Chlorine Oxyanions	Chlorate	mg/kg	6	6	100	--	--	0.92	9.9	5.6	5.7	2.9	0.52	SA138	38,900	--	0	Pass
		Perchlorate	mg/kg	6	6	100	--	--	0.99	2,400	6.0	410	970	2.4	RI-20	908	--	1	Fail
	Metals	Arsenic	mg/kg	6	6	100	--	--	2.0	4.3	3.3	3.2	0.93	0.29	RI-20	7.2	Maximum BRC/TIMET background	--	Pass
		Chromium VI	mg/kg	6	1	17	0.16	0.19	0.46	0.46	0.46	0.46	--	--	RI-21	7.0	--	0	Pass
		Cobalt	mg/kg	6	6	100	--	--	4.0	7.5	6.3	6.1	1.2	0.20	RSAP5	385	--	0	Pass
		Manganese	mg/kg	6	6	100	--	--	330	1,200	410	540	330	0.61	RI-21	28,100	--	0	Pass
		Palladium	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	N/A	--	NS	NS
		Thallium	mg/kg	6	4	67	0.51	0.51	0.088	0.15	0.13	0.12	0.032	0.26	SA103	13	--	0	Pass
		Zirconium	mg/kg	2	2	100	--	--	20	22	21	21	1.4	0.067	RI-20	104	--	2	Fail
	Other Inorganics	Ammonia	mg/kg	4	0	0	0.097	0.097	--	--	--	--	--	--	--	6,140	--	--	Pass
	Radionuclides	Radium-226	pCi/g	6	6	100	--	--	0.55	0.92	0.74	0.76	0.15	0.19	RI-20	0.023	--	6	Fail
		Radium-228	pCi/g	6	6	100	--	--	0.67	1.4	1.2	1.2	0.28	0.24	RSAQ4	0.041	--	6	Fail
		Thorium-228	pCi/g	6	6	100	--	--	0.94	1.6	1.3	1.3	0.22	0.17	RSAQ4	0.025	--	6	Fail
		Thorium-230	pCi/g	6	6	100	--	--	0.82	1.2	1.0	1.0	0.14	0.14	RSAQ4	8.4	--	5	Fail
		Thorium-232	pCi/g	6	6	100	--	--	0.93	1.5	1.4	1.3	0.23	0.18	RSAQ4	7.4	--	6	Fail
		Uranium-234	pCi/g	4	4	100	--	--	0.77	1.1	0.94	0.94	0.13	0.14	RSAQ4	11	--	0	Pass
		Uranium-235	pCi/g	4	4	100	--	--	-0.029	0.085	0.052	0.040	0.049	1.2	RSAQ4	0.35	--	3	Fail
		Uranium-238	pCi/g	4	4	100	--	--	0.77	1.1	0.97	0.96	0.16	0.16	RSAQ4	1.4	--	4	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	6	6	100	--	--	0.0000013	0.000046	0.0000067	0.000013	0.000017	1.4	SA103	0.0027	Site-specific action level	--	Pass
	PAHs	BaPEq*	mg/kg	8	4	50	0.00089	0.025	0.0062	0.34	0.044	0.11	0.15	1.4	SSAP4-01	0.32	--	3	Fail
		Naphthalene	mg/kg	8	1	13	0.00087	0.033	0.019	0.019	0.019	0.019	--	--	RI-21	18	--	0	Pass
	Pesticides - OCPs	beta-BHC	mg/kg	11	8	73	0.00071	0.0016	0.0019	0.29	0.050	0.092	0.11	1.2	RSAQ4	1.7	--	2	Fail
		4,4'-DDE	mg/kg	11	7	64	0.00026	0.0018	0.00089	0.10	0.013	0.025	0.036	1.4	SA103	9.5	--	0	Pass
		4,4'-DDT	mg/kg	11	7	64	0.00063	0.0018	0.0020	0.058	0.0062	0.018	0.021	1.2	SA103	7.5	--	0	Pass
		Dieldrin	mg/kg	11	0	0	0.00023	0.018	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	13	8	62	0.00030	0.075	0.00048	0.075	0.0059	0.019	0.027	1.4	SSAP4-01	1.3	Use health-based BCL instead of soil saturation level	0	Pass
		Toxaphene	mg/kg	11	0	0	0.017	0.18	--	--	--	--	--	--	--	2.3	--	--	Pass
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	8	1	13	0.049	0.54	61	61	61	61	--	--	SSAP4-01	183	--	1	Fail
		Octachlorostyrene	mg/kg	8	0	0	0.0036	2.5	--	--	--	--	--	--	--	N/A	--	--	Pass
EU-9	Chlorine Oxyanions	Chlorate	mg/kg	46	34	74	0.044	5.8	0.072	1,510	5.2	90	330	3.6	SA156	38,900	--	0	Pass
		Perchlorate	mg/kg	140	139	99	0.011	0.011	0.011	57	0.55	4.4	9.3	2.1	U4U5-16	908	--	0	Pass
	Metals	Arsenic	mg/kg	61	61	100	--	--	1.2	8.6	2.9	3.2	1.2	0.38	RI-24	7.2	Maximum BRC/TIMET background	--	Fail
		Chromium VI	mg/kg	136	23	17	0.11	0.21	0.11	11	0.24	1.0	2.3	2.2	U4U5-15	7.0	--	6	Fail
		Cobalt	mg/kg	42	40	95	1.0	2.6	3.2	8.8	7.0	6.8	1.3	0.19	SA05	385	--	0	Pass
		Manganese	mg/kg	42	42	100	--	--	110	1,290	330	360	170	0.46	SA07	28,100	--	0	Pass
		Palladium	mg/kg	10	10	100	--	--	0.33	0.53	0.47	0.45	0.071	0.16	TSB-GJ-02	N/A	--	N/A	N/A

TABLE 6-3. Summary Statistics and Concentration/Toxicity Screen for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	Analyte	Unit	No. of Samples	No. of Detects	% Detects	Nondetects		Detects							Screening Levels[1]	Screening Level Note	No. of Samples > 0.1 x Screening Level	Concentration/ Toxicity Screen Result
							Minimum	Maximum	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation	Location of Maximum				
EU-9	Metals	Thallium	mg/kg	42	34	81	0.081	0.52	0.074	0.38	0.12	0.15	0.075	0.52	SA07	13	--	0	Pass
		Zirconium	mg/kg	17	12	71	5.1	26	15	25	22	21	3.0	0.14	TSB-GR-02	104	--	12	Fail
	Other Inorganics	Ammonia	mg/kg	25	0	0	0.097	7.9	--	--	--	--	--	--	--	6,140	--	--	Pass
	Radionuclides	Radium-226	pCi/g	42	42	100	--	--	0.23	1.3	0.90	0.87	0.26	0.30	SA06	0.023	--	42	Fail
		Radium-228	pCi/g	42	42	100	--	--	0.22	2.4	1.5	1.4	0.55	0.40	SA31	0.041	--	42	Fail
		Thorium-228	pCi/g	35	35	100	--	--	0.20	2.2	1.6	1.6	0.38	0.25	TSB-GJ-04	0.025	--	35	Fail
		Thorium-230	pCi/g	35	35	100	--	--	0.33	2.0	1.1	1.1	0.33	0.30	TSB-GJ-04	8.4	--	29	Fail
		Thorium-232	pCi/g	35	35	100	--	--	0.058	2.0	1.4	1.3	0.35	0.26	RI-25	7.4	--	33	Fail
		Uranium-234	pCi/g	28	28	100	--	--	0.83	2.0	1.0	1.2	0.35	0.30	TSB-GJ-02	11	--	10	Fail
		Uranium-235	pCi/g	28	28	100	--	--	-0.027	0.15	0.050	0.057	0.034	0.59	SA31	0.35	--	23	Fail
		Uranium-238	pCi/g	28	28	100	--	--	0.79	1.6	0.96	1.0	0.21	0.20	TSB-GJ-02	1.4	--	28	Fail
	Dioxins/Furans	2,3,7,8-TCDD TEQ*	mg/kg	36	33	92	0.0000024	0.0000026	0.00000017	0.011	0.0000034	0.00035	0.0019	5.4	RI-25	0.0027	Site-specific action level	--	Fail
	PAHs	BaPEq*	mg/kg	52	16	31	0.00089	0.042	0.00090	2.1	0.0087	0.15	0.51	3.3	RI-25	0.32	--	5	Fail
		Naphthalene	mg/kg	152	1	0.66	0.00081	0.072	0.38	0.38	0.38	0.38	--	--	U4U5-19	18	--	0	Pass
	Pesticides - OCPs	beta-BHC	mg/kg	35	6	17	0.00036	0.028	0.0013	0.15	0.0095	0.032	0.058	1.8	TSB-GJ-04	1.7	--	0	Pass
		4,4'-DDE	mg/kg	35	10	29	0.00026	0.020	0.0019	0.91	0.0050	0.10	0.28	2.8	TSB-GJ-04	9.5	--	0	Pass
		4,4'-DDT	mg/kg	35	8	23	0.00044	0.034	0.0018	0.61	0.013	0.10	0.21	2.0	TSB-GJ-04	7.5	--	0	Pass
		Dieldrin	mg/kg	35	0	0	0.000075	0.018	--	--	--	--	--	--	--	0.16	--	--	Pass
		Hexachlorobenzene	mg/kg	52	10	19	0.00086	1.6	0.0019	0.52	0.013	0.10	0.20	1.9	SSAQ3-01	1.3	Use health-based BCL instead of soil saturation level	2	Fail
		Toxaphene	mg/kg	35	0	0	0.0073	0.58	--	--	--	--	--	--	--	2.3	--	--	Pass
	SVOCs	Bis(2-Ethylhexyl)phthalate	mg/kg	52	7	13	0.034	2.0	0.089	0.58	0.097	0.23	0.19	0.83	SSAQ5-07	183	--	0	Pass
		Octachlorostyrene	mg/kg	52	2	3.9	0.0036	52	0.15	0.21	0.18	0.18	0.042	0.24	SSAQ3-01	N/A	--	N/A	N/A

Notes:

-- = Not applicable
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
COPC = Chemical of Potential Concern
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
EU = Exposure unit
N/A = BCL (other screening value) not available for screen
NDEP = Nevada Division of Environmental Protection
NS = Not sampled
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
* Methodology for equivalent calculations explained in text
[1] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 2017), unless noted.

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

Source:

NDEP. 2017. User's Guide and Background Technical Document for NDEP Basic Comparison Levels (BCLs) for Human Health for the BMI Complex and Common Areas. Revision 14, July.

TABLE 6-4. Results of the Background Evaluation for Metals Carried Forward from the Concentration/Toxicity Screen for Individual Exposure Units

Nevada Environmental Response Trust Site

Henderson, Nevada

Exposure Unit	Chemical Name	Exposure Unit Concentrations Greater than Background Levels?[1]
EU-1	Arsenic	No
	Zirconium	No
EU-2	Arsenic	No
	Zirconium	No
EU-3	Arsenic	No
	Chromium VI[2]	LDF
	Manganese	Yes
	Zirconium	No
EU-4	Arsenic	Yes
	Chromium VI[2]	LDF
	Zirconium	No
EU-5	Arsenic	No
	Chromium VI[2]	LDF
	Cobalt	Yes
	Manganese	Yes
	Zirconium	No
EU-6	Arsenic	No
	Chromium VI[2]	LDF
	Manganese	Yes
	Thallium[3]	LDF
	Zirconium	No
EU-7	Arsenic	No
	Chromium VI[2]	LDF
	Manganese	No
	Zirconium	No
EU-8	Zirconium	N/A
EU-9	Arsenic	Yes
	Chromium VI[2]	LDF
	Palladium	N/A
	Zirconium	N/A

Notes:

COPC = Chemical of Potential Concern

EU = Exposure unit

LDF = Low detection frequency (<25%) in either EU or background data sets. Background comparison results may not be applicable.

N/A = Background data are not available

element is present at concentrations greater than background or background data are not available.

[1] Based on background evaluation presented in Appendix J.

[2] Although background comparison results may not be applicable due to low detection frequency in the EU, BRC/TIMET, and RZ-A background data sets, concentrations in EU-3, EU-4, EU-5, EU-6, EU-7 and EU-9 are greater than background based on the box plots (Figures J1-2A and J1-2B) and Q-Q plots (Figures J2-2C, J2-2D, J2-2E, J2-2F, J2-2G, and J2-2I). Therefore, retained as a COPC for these EUs.

[3] Although background comparison results may not be applicable due to low detection frequency in the BRC/TIMET background data set, concentrations in EU-6 are mostly lower than background based on the boxplot (Figure J1-6A) and the Q-Q plot (Figure J2-5F). Therefore, not retained as a COPC for EU-6.

TABLE 6-5. Results of the Background Evaluation for Radionuclides Carried Forward from the Concentration/Toxicity Screen for Individual Exposure Units

Nevada Environmental Response Trust Site

Henderson, Nevada

Exposure Unit	Chain	Secular Equilibrium?	Radionuclide	Exposure Unit Concentrations Greater than Background Levels?[1],[2]	Hydrofluoric Acid Digestion?
EU-1	Uranium-238	No	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	Yes	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	No	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes
EU-2	Uranium-238	No	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	No	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	Yes	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes
EU-3	Uranium-238	Yes	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	Yes	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	No	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes
EU-4	Uranium-238	Yes	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	Yes	
			Radium-226	No	
	Thorium-232	No	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	No	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes

TABLE 6-5. Results of the Background Evaluation for Radionuclides Carried Forward from the Concentration/Toxicity Screen for Individual Exposure Units

Nevada Environmental Response Trust Site

Henderson, Nevada

Exposure Unit	Chain	Secular Equilibrium?	Radionuclide	Exposure Unit Concentrations Greater than Background Levels?[1],[2]	Hydrofluoric Acid Digestion?
EU-5	Uranium-238	Yes	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	No	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	No	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes
EU-6	Uranium-238	Yes	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	No	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	Yes	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes
EU-7	Uranium-238	Yes	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	No	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	No	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes
EU-8	Uranium-238	No	Uranium-238	No	Yes
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	Yes	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	No	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes

TABLE 6-5. Results of the Background Evaluation for Radionuclides Carried Forward from the Concentration/Toxicity Screen for Individual Exposure Units

Nevada Environmental Response Trust Site

Henderson, Nevada

Exposure Unit	Chain	Secular Equilibrium?	Radionuclide	Exposure Unit Concentrations Greater than Background Levels?[1],[2]	Hydrofluoric Acid Digestion?
EU-9	Uranium-238	Yes	Uranium-238	No	Yes
			Uranium-234	No	
			Thorium-230	No	
			Radium-226	No	
	Thorium-232	Yes	Thorium-232	No	Yes
			Radium-228	No	
			Thorium-228	No	
	Uranium-235	Not Evaluated	Uranium-235	No	Yes

Notes:

BRC = Basic Remediation Company

COPC = Chemical of Potential Concern

EU = Exposure unit

TIMET = Titanium Metals Corporation

radionuclide is present at concentrations greater than background.

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

[2] The validity of statistical testing for radionuclide background evaluation is confounded by sample preparation and analytical method issues in the EU, BRC/TIMET, and RZ-A background data sets. For a full discussion of these limitations, see Section 6.4 of the report. No radionuclides are identified as COPCs in any EU, because the estimated total radionuclide cancer risks at all sample locations throughout the Study Area are consistent with the estimated total radionuclide cancer risks for the RZ-A background and BRC/TIMET regional background and radionuclides are not known to be associated with any of the former operations at the Site.

TABLE 6-6. COPCs Identified for Soils (0-10 ft bgs) in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	COPC	EU-1	EU-2	EU-3	EU-4	EU-5	EU-6	EU-7	EU-8	EU-9
Chlorine Oxyanions	Chlorate							X		
	Perchlorate	X	X	X	X	X	X	X	X	
Metals	Arsenic				X					X
	Chromium VI			X	X	X	X	X		X
	Cobalt					X				
	Manganese			X		X	X			
	Palladium [1],[2]									X
	Zirconium [2]								X	X
Other Inorganics	Ammonia				X					
Dioxin/Furans	2,3,7,8-TCDD TEQ*		X	X						X
PAHs	BaPEq*	X		X	X	X	X	X	X	X
	Naphthalene					X		X		
Pesticides - OCPs	beta-BHC	X	X				X		X	
	4,4'-DDE	X	X	X						
	4,4'-DDT		X							
	Dieldrin		X							
	Hexachlorobenzene	X	X	X	X	X	X	X		X
	Toxaphene		X							
SVOCs	Bis(2-ethylhexyl)phthalate								X	
	Octachlorostyrene [1]	X	X	X	X	X	X	X		X
Asbestos	Long amphibole fibers	X	X	X	X	X	X	X	X	X
	Long chrysotile fibers	X	X	X	X	X	X	X	X	X

Notes:

bgs = below ground surface
ft = feet
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
BRC = Basic Remediation Company
COPC = Chemical of Potential Concern
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
EU = Exposure unit
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
TIMET = Titanium Metals Corporation
* Methodology for equivalent calculations explained in text

[1] Retained as a COPC in the absence of a BCL or other screening level. This COPC is discussed qualitatively in the uncertainty analysis section.

[2] RZ-A background data are not available for this chemical, and therefore a background evaluation cannot be conducted for EU-8 and/or EU-9. This chemical is further discussed in comparison to the regional BRC/TIMET background data set in the uncertainty analysis section.

TABLE 7-1a. Soil EPCs and EPCs of Airborne Particulates and Vapors for Soil at 0-2 feet bgs in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	COPC	Soil EPC [1] (mg/kg)	Airborne Particulate EPC [1] (µg/m^3)	Vapor EPC [1] (µg/m^3)	
				Indoor and Outdoor Commercial/ Industrial Worker, including Outdoor Utility/Maintenance Worker in EU-4	Indoor and Outdoor Commercial/ Industrial Worker	Outdoor Utility/Maintenance Worker in EU-4
EU-1	Chlorine Oxyanions	Perchlorate	83	0.000081	--	--
	PAHs	BaPEq*	0.041	0.000000040	--	--
	Pesticides - OCPs	beta-BHC	0.057	0.000000056	--	--
	Pesticides - OCPs	4,4'-DDE	0.018	0.000000018	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.19	0.00000019	0.0024	--
	SVOCs	Octachlorostyrene[2]	0.41	0.00000040	0.00088	--
EU-2	Chlorine Oxyanions	Perchlorate	120	0.00013	--	--
	Dioxin/Furans	2,3,7,8-TCDD TEQ*	0.00055	0.00000000061	--	--
	Pesticides - OCPs	beta-BHC	0.16	0.00000018	--	--
	Pesticides - OCPs	4,4'-DDE	0.53	0.00000058	--	--
	Pesticides - OCPs	4,4'-DDT	0.12	0.00000013	--	--
	Pesticides - OCPs	Dieldrin[2]	0.00027	0.00000000030	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.25	0.00000027	0.0034	--
	Pesticides - OCPs	Toxaphene	0.18	0.00000020	--	--
	SVOCs	Octachlorostyrene[2]	0.25	0.00000027	0.00060	--
EU-3	Chlorine Oxyanions	Perchlorate	33	0.000034	--	--
	Metals	Chromium VI	0.32	0.00000033	--	--
	Metals	Manganese	590	0.00060	--	--
	Dioxin/Furans	2,3,7,8-TCDD TEQ*	0.0019	0.0000000020	--	--
	PAHs	BaPEq*	0.0093	0.0000000096	--	--
	Pesticides - OCPs	4,4'-DDE	0.0070	0.0000000072	--	--
	Pesticides - OCPs	Hexachlorobenzene	1.6	0.0000016	0.020	--
	SVOCs	Octachlorostyrene	0.89	0.00000092	0.0020	--
EU-4	Chlorine Oxyanions	Perchlorate	890	0.00079	--	--
	Metals	Arsenic	4.4	0.0000039	--	--
	Metals	Chromium VI	0.69	0.00000061	--	--
	Other Inorganics	Ammonia	320	0.00029	19	43
	PAHs	BaPEq*	0.078	0.000000069	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.24	0.00000022	0.0027	0.0060
	SVOCs	Octachlorostyrene	0.16	0.00000014	0.00032	0.00071

TABLE 7-1a. Soil EPCs and EPCs of Airborne Particulates and Vapors for Soil at 0-2 feet bgs in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	COPC	Soil EPC [1] (mg/kg)	Airborne Particulate EPC [1] (µg/m^3)	Vapor EPC [1] (µg/m^3)	
				Indoor and Outdoor Commercial/ Industrial Worker, including Outdoor Utility/Maintenance Worker in EU-4	Indoor and Outdoor Commercial/ Industrial Worker	Outdoor Utility/Maintenance Worker in EU-4
EU-5	Chlorine Oxyanions	Perchlorate	32	0.000033	--	--
	Metals	Chromium VI	0.87	0.00000087	--	--
	Metals	Cobalt	51	0.000052	--	--
	Metals	Manganese	2,660	0.0027	--	--
	PAHs	BaPEq*	0.020	0.000000020	--	--
	PAHs	Naphthalene[2]	0.0014	0.0000000014	0.000027	--
	Pesticides - OCPs	Hexachlorobenzene	0.045	0.000000045	0.00056	--
	SVOCs	Octachlorostyrene	0.031	0.000000031	0.000068	--
EU-6	Chlorine Oxyanions	Perchlorate	45	0.000042	--	--
	Metals	Chromium VI	0.83	0.00000079	--	--
	Metals	Manganese	3,320	0.0032	--	--
	PAHs	BaPEq*	0.043	0.000000041	--	--
	Pesticides - OCPs	beta-BHC	0.17	0.00000016	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.12	0.00000012	0.0015	--
	SVOCs	Octachlorostyrene	0.034	0.000000033	0.000071	--
EU-7	Chlorine Oxyanions	Chlorate	1,260	0.0010	--	--
	Chlorine Oxyanions	Perchlorate	97	0.000079	--	--
	Metals	Chromium VI	11	0.0000090	--	--
	PAHs	BaPEq*[2]	0.017	0.000000014	--	--
	PAHs	Naphthalene[2]	0.0014	0.0000000011	0.000022	--
	Pesticides - OCPs	Hexachlorobenzene	0.44	0.00000036	0.0045	--
	SVOCs	Octachlorostyrene[2]	0.21	0.00000017	0.00037	--
EU-8	Chlorine Oxyanions	Perchlorate	7.6	0.0000061	--	--
	Metals	Zirconium	NS	--	--	--
	PAHs	BaPEq*	0.22	0.00000018	--	--
	Pesticides - OCPs	beta-BHC	0.21	0.00000017	--	--
	SVOCs	Bis(2-ethylhexyl)phthalate	38	0.000031	--	--

TABLE 7-1a. Soil EPCs and EPCs of Airborne Particulates and Vapors for Soil at 0-2 feet bgs in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	COPC	Soil EPC [1] (mg/kg)	Airborne Particulate EPC [1] (µg/m^3)	Vapor EPC [1] (µg/m^3)	
				Indoor and Outdoor Commercial/ Industrial Worker, including Outdoor Utility/Maintenance Worker in EU-4	Indoor and Outdoor Commercial/ Industrial Worker	Outdoor Utility/Maintenance Worker in EU-4
EU-9	Metals	Arsenic	3.6	0.0000035	--	--
	Metals	Chromium VI	0.33	0.00000033	--	--
	Metals	Palladium	0.51	0.00000050	--	--
	Metals	Zirconium	21	0.000020	--	--
	Dioxin/Furans	2,3,7,8-TCDD TEQ*	0.000046	0.000000000045	--	--
	PAHs	BaPEq*	0.011	0.000000011	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.018	0.000000018	0.00022	--
	SVOCs	Octachlorostyrene[2]	ND	--	--	--

Notes:

-- = Not applicable
bgs = below ground surface
mg/kg = milligram per kilogram
µg/m^3 = microgram per cubic meter
BaPEq = Benzo[a]pyrene equivalent
BHC = Hexachlorocyclohexane
COPC = Chemical of Potential Concern
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
EU = Exposure unit
EPC = Exposure point concentration
ND = Not detected
NS = Not sampled
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
UCL = Upper confidence limit
* Methodology for equivalent calculations explained in text

[1] The 95% UCL on the mean concentration over 0-2 feet bgs was used as the EPC.

[2] The maximum detected concentration at 0-2 feet bgs over the EU was used as the soil EPC if the calculated 95% UCL was greater than the maximum detected concentration due to elevated detection limits.

TABLE 7-1b. Soil EPCs and EPCs of Airborne Particulates and Vapors for Soil at 0-10 feet bgs in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	COPC	Soil EPC [1] (mg/kg)	Airborne Particulate EPC [1] (µg/m^3)		Vapor EPC [1] (µg/m^3)	
				Indoor and Outdoor Commercial/ Industrial Worker	Construction Worker	Indoor and Outdoor Commercial/ Industrial Worker	Construction Worker
EU-1	Chlorine Oxyanions	Perchlorate	52	0.000050	0.012	--	--
	PAHs	BaPEq*	0.029	0.000000028	0.0000066	--	--
	Pesticides - OCPs	beta-BHC	0.033	0.000000032	0.0000075	--	--
	Pesticides - OCPs	4,4'-DDE	0.18	0.00000018	0.000041	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.16	0.00000016	0.000037	0.0020	0.027
	SVOCs	Octachlorostyrene[2]	0.41	0.00000040	0.000093	0.00088	0.012
EU-2	Chlorine Oxyanions	Perchlorate	93	0.00010	0.022	--	--
	Dioxin/Furans	2,3,7,8-TCDD TEQ*	0.00048	0.00000000053	0.00000012	--	--
	Pesticides - OCPs	beta-BHC	0.068	0.000000075	0.000016	--	--
	Pesticides - OCPs	4,4'-DDE	0.53	0.00000059	0.00013	--	--
	Pesticides - OCPs	4,4'-DDT	0.16	0.00000017	0.000038	--	--
	Pesticides - OCPs	Dieldrin	0.0051	0.0000000056	0.0000012	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.19	0.00000021	0.000045	0.0026	0.032
	Pesticides - OCPs	Toxaphene	0.17	0.00000019	0.000042	--	--
	SVOCs	Octachlorostyrene[2]	0.25	0.00000027	0.000060	0.00060	0.0074
EU-3	Chlorine Oxyanions	Perchlorate	25	0.000026	0.0059	--	--
	Metals	Chromium VI	0.44	0.00000045	0.00010	--	--
	Metals	Manganese	690	0.00071	0.16	--	--
	Dioxin/Furans	2,3,7,8-TCDD TEQ*	0.00096	0.00000000099	0.00000022	--	--
	PAHs	BaPEq*	0.012	0.000000012	0.0000028	--	--
	Pesticides - OCPs	4,4'-DDE	0.074	0.000000076	0.000017	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.76	0.00000078	0.00018	0.0097	0.13
	SVOCs	Octachlorostyrene	2.5	0.0000026	0.00059	0.0057	0.075
EU-4	Chlorine Oxyanions	Perchlorate	560	0.00050	0.12	--	--
	Metals	Arsenic	5.5	0.0000049	0.0012	--	--
	Metals	Chromium VI	0.34	0.00000030	0.000073	--	--
	Other Inorganics	Ammonia	150	0.00014	0.033	9.1	138
	PAHs	BaPEq*	0.057	0.000000050	0.000012	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.18	0.00000016	0.000038	0.0020	0.030
	SVOCs	Octachlorostyrene	0.16	0.00000014	0.000034	0.00031	0.0047

TABLE 7-1b. Soil EPCs and EPCs of Airborne Particulates and Vapors for Soil at 0-10 feet bgs in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	COPC	Soil EPC [1] (mg/kg)	Airborne Particulate EPC [1] (µg/m^3)		Vapor EPC [1] (µg/m^3)	
				Indoor and Outdoor Commercial/ Industrial Worker	Construction Worker	Indoor and Outdoor Commercial/ Industrial Worker	Construction Worker
EU-5	Chlorine Oxyanions	Perchlorate	28	0.000028	0.0065	--	--
	Metals	Chromium VI	0.47	0.00000047	0.00011	--	--
	Metals	Cobalt	36	0.000037	0.0084	--	--
	Metals	Manganese	2,620	0.0026	0.61	--	--
	PAHs	BaPEq*	0.014	0.000000014	0.0000032	--	--
	PAHs	Naphthalene	0.12	0.00000012	0.000028	0.0024	0.032
	Pesticides - OCPs	Hexachlorobenzene	0.048	0.000000049	0.000011	0.00061	0.0081
	SVOCs	Octachlorostyrene[2]	0.067	0.000000068	0.000015	0.00015	0.0020
EU-6	Chlorine Oxyanions	Perchlorate	22	0.000021	0.0050	--	--
	Metals	Chromium VI	0.45	0.00000043	0.00010	--	--
	Metals	Manganese	2,200	0.0021	0.49	--	--
	PAHs	BaPEq*	0.039	0.000000037	0.0000088	--	--
	Pesticides - OCPs	beta-BHC	0.076	0.000000072	0.000017	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.079	0.000000075	0.000018	0.00093	0.013
	SVOCs	Octachlorostyrene[2]	0.091	0.000000086	0.000020	0.00019	0.0027
EU-7	Chlorine Oxyanions	Chlorate	5,010	0.0041	1.0	--	--
	Chlorine Oxyanions	Perchlorate	290	0.00024	0.059	--	--
	Metals	Chromium VI	24	0.000019	0.0048	--	--
	PAHs	BaPEq*	0.18	0.00000015	0.000037	--	--
	PAHs	Naphthalene	0.37	0.00000030	0.000074	0.0058	0.096
	Pesticides - OCPs	Hexachlorobenzene	0.71	0.00000058	0.00014	0.0072	0.12
	SVOCs	Octachlorostyrene[2]	0.21	0.00000017	0.000042	0.00037	0.0062
EU-8	Chlorine Oxyanions	Perchlorate	1,600	0.0013	0.32	--	--
	Metals	Zirconium[2]	22	0.000018	0.0044	--	--
	PAHs	BaPEq*	0.17	0.00000014	0.000035	--	--
	Pesticides - OCPs	beta-BHC	0.13	0.00000011	0.000027	--	--
	SVOCs	Bis(2-ethylhexyl)phthalate	31	0.000025	0.0061	--	--

TABLE 7-1b. Soil EPCs and EPCs of Airborne Particulates and Vapors for Soil at 0-10 feet bgs in Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	COPC	Soil EPC [1] (mg/kg)	Airborne Particulate EPC [1] (µg/m^3)		Vapor EPC [1] (µg/m^3)	
				Indoor and Outdoor Commercial/ Industrial Worker	Construction Worker	Indoor and Outdoor Commercial/ Industrial Worker	Construction Worker
EU-9	Metals	Arsenic	3.5	0.0000034	0.00079	--	--
	Metals	Chromium VI	0.51	0.00000050	0.00012	--	--
	Metals	Palladium	0.49	0.00000048	0.00011	--	--
	Metals	Zirconium	20	0.000019	0.0045	--	--
	Dioxin/Furans	2,3,7,8-TCDD TEQ*	0.0013	0.0000000012	0.00000028	--	--
	PAHs	BaPEq*	0.21	0.00000020	0.000047	--	--
	Pesticides - OCPs	Hexachlorobenzene	0.095	0.000000093	0.000022	0.0012	0.016
	SVOCs	Octachlorostyrene[2]	0.21	0.00000021	0.000048	0.00045	0.0062

Notes:

-- = Not applicable
bgs = below ground surface
mg/kg = milligram per kilogram
µg/m^3 = microgram per cubic meter
BaPEq = Benzo[a]pyrene equivalent
BHC = Hexachlorocyclohexane
COPC = Chemical of Potential Concern
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
EU = Exposure unit
EPC = Exposure point concentration
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
UCL = Upper confidence limit
* Methodology for equivalent calculations explained in text

[1] The 95% UCL on the mean concentration over 0-10 feet bgs was used as the EPC.
[2] The maximum detected concentration at 0-10 feet bgs over the EU was used as the soil EPC if the calculated 95% UCL was greater than the maximum detected concentration due to elevated detection limits.

TABLE 7-1c. Soil EPCs and EPCs of Airborne Particulates for BRC/TIMET Regional Background Soil and RZ-A Background Soil

Nevada Environmental Response Trust Site
Henderson, Nevada

Area	COPC	Soil EPC [1] (mg/kg)	Airborne Particulate EPC [1] (µg/m^3)	
			Commercial/Industrial Worker	Construction Worker
BRC/TIMET Regional Background	Arsenic	4.4	0.0000048	0.0011
	Chromium VI	ND	--	--
	Cobalt	9.2	0.000010	0.0022
	Manganese	440	0.00048	0.11
RZ-A Background	Arsenic	2.6	0.0000025	0.00058
	Chromium VI	0.22	0.00000022	0.000050
	Palladium	NA	--	--
	Zirconium	NA	--	--

Notes:

-- = Not applicable

bgs = below ground surface

mg/kg = milligram per kilogram

µg/m^3 = microgram per cubic meter

BRC = Basic Remediation Company
COPC = Chemical of Potential Concern
EPC = Exposure point concentration
NA = Background data are not available
ND = Not detected
RZ-A = Remediation Zone A
TIMET = Titanium Metals Corporation
UCL = Upper confidence limit

[1] The 95% UCL on the mean concentration over 0-10 feet bgs was used as the EPC.

TABLE 7-2. Calculation of Particulate Emission Factors
Nevada Environmental Response Trust Site
Henderson, Nevada

Parameter	Symbol	Value EU-1	Value EU-2	Value EU-3	Value EU-4	Value EU-5	Value EU-6	Value EU-7	Value EU-8	Value EU-9	Unit	Reference
Indoor and Outdoor Commercial/Industrial Worker												
Fraction of vegetative cover	V	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	unitless	USEPA 2002
Mean annual wind speed	U_m	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	m/s	[1]
Equivalent threshold value of wind speed	U_t	11.32	11.32	11.32	11.32	11.32	11.32	11.32	11.32	11.32	m/s	USEPA 2002
Function dependent on U/U_t	F(x)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	unitless	USEPA 2002
Air dispersion factor for area source (calculated)	Q/C_{wind}	47.17	41.93	44.82	52.02	45.63	48.60	56.83	56.85	46.96	g/m^2-s per kg/m^3	USEPA 2002
Dispersion factor for area source - Constant A (Las Vegas, NV)	A	13.31	13.31	13.31	13.31	13.31	13.31	13.31	13.31	13.31	unitless	USEPA 2002
Dispersion factor for area source - Constant B (Las Vegas, NV)	B	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	unitless	USEPA 2002
Dispersion factor for area source - Constant C (Las Vegas, NV)	C	230.17	230.17	230.17	230.17	230.17	230.17	230.17	230.17	230.17	unitless	USEPA 2002
Areal extent of site surface contamination	A_{surf}	16.01	36.12	22.69	8.38	20.04	13.10	4.76	4.75	16.49	acre	Area of EU
Particulate emission factor (calculated)	**PEF**	**1.0E+09**	**9.1E+08**	**9.7E+08**	**1.1E+09**	**9.9E+08**	**1.1E+09**	**1.2E+09**	**1.2E+09**	**1.0E+09**	**m^3/kg**	**Neptune 2015**
Construction Worker												
Fraction of vegetative cover	V	0	0	0	0	0	0	0	0	0	unitless	USEPA 2002
Mean annual wind speed	U_m	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	m/s	[1]
Equivalent threshold value of wind speed	U_t	11.32	11.32	11.32	11.32	11.32	11.32	11.32	11.32	11.32	m/s	USEPA 2002
Function dependent on U/U_t	F(x)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	unitless	USEPA 2002
Areal extent of site surface contamination	A_{surf}	16.01	36.12	22.69	8.38	20.04	13.10	4.76	4.75	16.49	acre	Area of EU
Wet soil bulk density	r_{soil}	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	g/cm^3	[2]
Percent of soil moisture content	M	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	%	[2]
Areal extent of site excavation	A_{excav}	12,957	29,233	18,362	6,782	16,223	10,607	3,854	3,845	13,347	m^2	[3]
Depth of site excavation	d_{excav}	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	m	USEPA 2002
Number of times soil is dumped	N_A	2	2	2	2	2	2	2	2	2	unitless	USEPA 2002
Percent of soil silt content	s	10	10	10	10	10	10	10	10	10	%	[4]
Average dozing speed	S_{doz}	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	km/hr	USEPA 2002
Number of times area is dozed	N_{doze}	3	3	3	3	3	3	3	3	3	unitless	USEPA 2002
Length of dozer blade	B_d	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	m	USEPA 2002
Average grading speed	S_{grade}	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	km/hr	USEPA 2002
Number of times area is graded	N_{grade}	3	3	3	3	3	3	3	3	3	unitless	USEPA 2002
Length of dozer blade	B_g	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	m	USEPA 2002
Areal extent of site tilling	A_{till}	3.20	7.22	4.54	1.68	4.01	2.62	0.95	0.95	3.30	acre	[3]
Number of times soil is tilled	N_A	2	2	2	2	2	2	2	2	2	unitless	USEPA 2002
Subchronic dispersion factor for area source-Constant A	A	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	unitless	USEPA 2002
Subchronic dispersion factor for area source-Constant B	B	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	unitless	USEPA 2002
Subchronic dispersion factor for area source-Constant C	C	189.04	189.04	189.04	189.04	189.04	189.04	189.04	189.04	189.04	unitless	USEPA 2002
Length of road segment	L_R	254.53	382.31	303.00	184.15	284.81	230.29	138.82	138.65	258.33	m	[5]
Width of road segment	W_R	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	m	USEPA 2002
Mean vehicle weight	W	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	ton	USEPA 2002
Percent of moisture in dry road surface	M_{dry}	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	%	USEPA 2002
Number of days/year with at least 0.01 inches of precipitation	p	27	27	27	27	27	27	27	27	27	day	Neptune 2015
Number of vehicles for duration of construction	N_V	30	30	30	30	30	30	30	30	30	unitless	USEPA 2002
Length of road traveled per day	L_D	254.53	382.31	303.00	184.15	284.81	230.29	138.82	138.65	258.33	m/day	[5]
Subchronic dispersion factor for road segment-Constant A	A	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	12.94	unitless	USEPA 2002
Subchronic dispersion factor for road segment-Constant B	B	5.74	5.74	5.74	5.74	5.74	5.74	5.74	5.74	5.74	unitless	USEPA 2002
Subchronic dispersion factor for road segment-Constant C	C	71.77	71.77	71.77	71.77	71.77	71.77	71.77	71.77	71.77	unitless	USEPA 2002
Particulate emission factor (calculated)	**PEF**	**4.4E+06**	**4.2E+06**	**4.3E+06**	**4.7E+06**	**4.3E+06**	**4.5E+06**	**5.0E+06**	**5.0E+06**	**4.4E+06**	**m^3/kg**	**Neptune 2015**

TABLE 7-2. Calculation of Particulate Emission Factors
Nevada Environmental Response Trust Site
Henderson, Nevada

Notes:
g/cm^3 = gram per cubic centimeter
g/m^2-s per kg/m^3 = (gram per square meter per second) per (kilogram per cubic meter)
km/hr = kilometer per hour
m = meter
m/day = meter per day
m/s = meter per second
m^2 = square meter
m^3/kg = cubic meter per kilogram
EU = Exposure unit
USEPA = United States Environmental Protection Agency
WRCC = Western Regional Climate Center

[1] Average wind speeds for Las Vegas derived from WRCC (2010).
[2] Average value of top 10-foot samples reported in Northgate (2010).
[3] Assumed one fifth of the source area based upon USEPA (2002).
[4] Soil silt content varied from 5% to 10% among soil boring logs from multiple investigations at the Site. The value of 10% was selected to be conservative.
[5] Assumed the square root of the source area, based upon USEPA (2002).

Sources:
Neptune. 2015. Technical Guidance for the Calculation of Asbestos Related Risk in Soils for the Basic Management Incorporated (BMI) Complex and Common Areas. February.
Northgate and Exponent. 2010. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada, November 22.
USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
WRCC. 2010. Desert Research Institute: http://www.wrcc.dri.edu/htmlfiles/westwind.final.html#NEVADA.

TABLE 7-3. Physical/Chemical Properties of Volatile Chemicals
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Chemical [1]	Molecular Weight MW (g/mol)	Organic Carbon Partition Coefficient, K_{oc} (cm^3/g)	Diffusivity in Air, D_a (cm^2/s)	Diffusivity in Water, D_w (cm^2/s)	Pure Component Water Solubility, S (mg/L)	Henry's Law Constant at 25° C H (atm-m^3/mol)	Normal Boiling Point, T_B (^oK)	Critical Temperature, T_C (^oK)	Enthalpy of Vaporization at the Normal Boiling Point, ΔHv,b (cal/mol)	Source
Other Inorganics	Ammonia	17.03	1.32E+01	2.31E-01	2.23E-05	4.82E+05	1.61E-05	239.80	405.55	5581.00	NDEP (2017), USEPA (2017) for T_B, T_C and ΔH, and USEPA (2012) for Koc
PAHs	Naphthalene	128.18	1.54E+03	6.05E-02	8.38E-06	1.28E+02	4.40E-04	490.90	748.40	10373.00	NDEP (2017), USEPA (2017) for T_B, T_C and ΔH
Pesticides - OCPs	Hexachlorobenzene	284.78	6.20E+03	2.90E-02	7.85E-06	2.85E+02	1.70E-03	598.15	897.23	11703.45	NDEP (2017), USEPA (2017) for T_B, T_C and ΔH
SVOCs	Octachlorostyrene	379.71	5.51E+04	2.90E-02	7.85E-06	1.74E-03	2.30E-04	625.77	--	--	USEPA (2012) and hexachlorobenzene for diffusivities

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
EPISuite = Estimation Programs Interface Suite
g/mol = gram per mole
^{o}K = degrees Kelvin
mg/L = milligram per liter
NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
USEPA = United States Environmental Protection Agency

[1] Volatile compounds defined by USEPA (2021) as chemicals with vapor pressure greater than 1 millimeter (mm) Hg or Henry's Law constant greater than 0.00001 atm-m^3/mole.

Sources:

NDEP. 2017. 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 14, July.
USEPA. 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. Washington, DC, USA.
USEPA. 2017. EPA Spreadsheet for Modeling Subsurface Vapor Intrusion. Version 6.0. September.
USEPA. 2021. Regional Screening Levels User's Guide. November.

TABLE 7-4. Soil Properties Data

Nevada Environmental Response Trust Site
Henderson, Nevada

Sample ID [1]	Depth (ft)	Water-filled Porosity [2] (%Vb)	Dry Bulk Density [3] (g/cm^3)	Grain Density [4] (g/cm^3)	Soil Total Porosity [5] (%Vb)	Soil Type
SA56-10BSPLP	10	0.134	1.689	2.719	0.379	Loamy Sand
RSAM3-10BSPLP	10	0.145	1.593	2.674	0.404	Loamy Sand
SA166-10BSPLP	10	0.100	1.721	2.681	0.358	Loamy Sand
SA182-10BSPLP	10	0.182	1.740	2.601	0.331	Sandy Loam
RSAJ3-10BSPLP	10	0.154	1.770	2.682	0.340	Loamy Sand
RSAI7-10B	10	0.138	1.661	2.682	0.381	Sand
SA34-10BSPLP	10	0.169	1.738	2.696	0.355	Loamy Sand
SA52-15BSPLP [6]	15	0.239	1.405	2.710	0.481	Sand
RSAQ8-10BSPLP	10	0.148	1.697	2.695	0.370	Sand
RSAN8-10BSPLP	10	0.189	1.679	2.683	0.374	Loamy Sand
RSAQ4-10BSPLP	10	0.141	1.841	2.705	0.319	Sand
SA148-10BSPLP	10	0.119	1.762	2.732	0.355	Sand
SA30-9BSPLP	9	0.160	1.805	2.711	0.334	Sand
SA128-10BSPLP	10	0.156	1.654	2.654	0.377	Loamy Sand
SA102-10BSPLP	10	0.135	1.769	2.696	0.344	Sand
SA64-10BSPLP	10	0.148	1.717	2.651	0.352	Sand
Mean	9.93	0.148	1.722	2.684	0.358	Loamy Sand
Minimum	9	0.100	1.593	2.601	0.319	NA
Maximum	10	0.189	1.841	2.732	0.404	NA
Median	10	0.148	1.721	2.683	0.355	NA

Notes:

ft = feet

g/cm^3 = grams per cubic centimeter

ASTM = American Society for Testing and Materials

NA = not applicable

OU = Operable unit

Vb = Bulk volume

[1] The soil properties were reported in Northgate and Exponent (2010).

[2] As measured according to ASTM D 2216 and converted from mass-based water moisture to volumetric water content.

[3] As measured according to ASTM D 2937.

[4] As measured according to ASTM D 854.

[5] Calculated from dry bulk density and grain density.

[6] Sample not included in the evaluation because it represents wetter than average conditions in OU-1.

Source:

Northgate and Exponent. 2010. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada, November 22.

TABLE 7-5. Modeling Parameters
Nevada Environmental Response Trust Site
Henderson, Nevada

Parameter	Value	Units	Notes
Source/Receptor Parameters - Outdoor Scenarios			
Depth to top of soil contamination	1	cm	Conservative estimate
Depth to base of soil contamination	30	feet	Conservative estimate
Soil temperature at source	17	Celsius	Site-specific measurement
Soil Parameters			
USDA soil type	Loamy Sand	--	Site-specific estimate based on soil boring logs and site measurements. See text for further discussion.
Bulk density	1.722	g/cm^3	Site-specific measurement
Total porosity	0.358	unitless	Site-specific measurement
Water-filled porosity	0.148	unitless	Site-specific measurement
Fraction Organic Carbon	0.006	unitless	Default value, USEPA 2002
Air Dispersion Parameters			
Commercial Outdoor Air Scenario			
Site specific dispersion factor (Q/C) For EU-1:	47.18	g/m^2-s per kg/m^3	Based on the area of 16 acres in EU-1
Site specific dispersion factor (Q/C) For EU-2:	41.95	g/m^2-s per kg/m^3	Based on the area of 36 acres in EU-2
Site specific dispersion factor (Q/C) For EU-3:	44.73	g/m^2-s per kg/m^3	Based on the area of 23 acres in EU-3
Site specific dispersion factor (Q/C) For EU-4:	52.00	g/m^2-s per kg/m^3	Based on the area of 8.4 acres in EU-4
Site specific dispersion factor (Q/C) For EU-5:	45.65	g/m^2-s per kg/m^3	Based on the area of 20 acres in EU-5
Site specific dispersion factor (Q/C) For EU-6:	48.66	g/m^2-s per kg/m^3	Based on the area of 13 acres in EU-6
Site specific dispersion factor (Q/C) For EU-7:	56.75	g/m^2-s per kg/m^3	Based on the area of 4.8 acres in EU-7
Site specific dispersion factor (Q/C) For EU-8:	56.75	g/m^2-s per kg/m^3	Based on the area of 4.8 acres in EU-8
Site specific dispersion factor (Q/C) For EU-9:	46.75	g/m^2-s per kg/m^3	Based on the area of 16 acres in EU-9
Source/Receptor Parameters -10 foot Construction Trench Scenario			
Length of construction trench	609.6	cm	Assumed (20 feet)
Width of construction trench	152	cm	Assumed (5 feet)
Depth of construction trench	10	feet	Assumed
Windspeed	0.205	m/s	Conservative Estimate (1/20 of site-specific windspeed)
Site specific dispersion factor (Q/C_{vol})	17.08	g/m^2-s per kg/m^3	Site-specific estimate based on box model.

Notes:
-- =Not applicable
cm = centimeter
g/cm^3 = gram per cubic centimeter
g/m^2-s per kg/m^3 = (gram per square meter-second) per (kilogram per cubic meter)
m/s = meter per second
EU = Exposure unit
USDA = United States Department of Agriculture
USEPA = United States Environmental Protection Agency

Source:
USEPA. 2002. Supplemental Guidance for Developing. Soil Screening Levels for Superfund Sites. December

TABLE 7-6. Transfer Factors for Vapors from Soil to Outdoor Air and Trench Air

Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Chemical Group	COPC	TF for Soil Migrating to Commercial/Industrial Outdoor Air ($\mu g/m^3$ per $\mu g/kg$)	TF for Soil Migrating to Trench Air ($\mu g/m^3$ per $\mu g/kg$)	TF for Soil Migrating to Air (Outdoor Utility/Maintenance Worker in EU-4) ($\mu g/m^3$ per $\mu g/kg$)
EU-1	Pesticides - OCPs	Hexachlorobenzene	1.21E-05	1.68E-04	--
	SVOCs	Octachlorostyrene	2.15E-06	2.96E-05	--
EU-2	Pesticides - OCPs	Hexachlorobenzene	1.37E-05	1.68E-04	--
	SVOCs	Octachlorostyrene	2.41E-06	2.96E-05	--
EU-3	Pesticides - OCPs	Hexachlorobenzene	1.28E-05	1.68E-04	--
	SVOCs	Octachlorostyrene	2.26E-06	2.96E-05	--
EU-4	Other Inorganics	Ammonia	5.92E-05	9.02E-04	1.32E-04
	Pesticides - OCPs	Hexachlorobenzene	1.10E-05	1.68E-04	2.46E-05
	SVOCs	Octachlorostyrene	1.95E-06	2.96E-05	4.35E-06
EU-5	PAHs	Naphthalene	1.95E-05	2.61E-04	--
	Pesticides - OCPs	Hexachlorobenzene	1.25E-05	1.68E-04	--
	SVOCs	Octachlorostyrene	2.22E-06	2.96E-05	--
EU-6	Pesticides - OCPs	Hexachlorobenzene	1.18E-05	1.68E-04	--
	SVOCs	Octachlorostyrene	2.08E-06	2.96E-05	--
EU-7	PAHs	Naphthalene	1.57E-05	2.61E-04	--
	Pesticides - OCPs	Hexachlorobenzene	1.01E-05	1.68E-04	--
	SVOCs	Octachlorostyrene	1.78E-06	2.96E-05	--
EU-9	Pesticides - OCPs	Hexachlorobenzene	1.23E-05	1.68E-04	--
	SVOCs	Octachlorostyrene	2.16E-06	2.96E-05	--

Notes:

-- = Not applicable
µg/kg = microgram per kilogram
$\mu g/m^3$ = microgram per cubic meter
COPC = Chemical of Potential Concern
EU = Exposure unit
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
SVOC = Semivolatile organic compound
TF = Transfer Factor

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

Exposure Factors	Units	Symbol	Indoor Commercial/ Industrial Worker		Outdoor Commercial/ Industrial Worker		Construction Worker		Outdoor Utility/Maintenance Worker in EU-4	
			Value	Source	Value	Source	Value	Source	Value	Source
Population-Specific Exposure Assumptions										
Exposure Time	hours/day	ET	8	NDEP 2017a	8	NDEP 2017a	8	USEPA 2021	1	Site-specific
Exposure Time_Trench	hours/day	ET	--	--	--	--	4	VDEQ 2019	--	--
Exposure Frequency	days/year	EF	250	NDEP 2017a	225	NDEP 2017a	250	USEPA 2021	12	Site-specific
Exposure Frequency_Trench	days/year	EF	--	--	--	--	30	[1]	--	--
Exposure Duration	years	ED	25	NDEP 2017a	25	NDEP 2017a	1	USEPA 2021	5	Site-specific
Body Weight	kg_{BW}	BW	80	NDEP 2017a	80	NDEP 2017a	80	USEPA 2021	80	NDEP 2017a
Averaging Time for Carcinogens	days	AT_c	25,550	NDEP 2017a	25,550	NDEP 2017a	25,550	USEPA 2021	25,550	NDEP 2017a
Averaging Time for Noncarcinogens	days	AT_{nc}	9,125	NDEP 2017a	9,125	NDEP 2017a	365	USEPA 2021	1,825	NDEP 2017a
Soil Ingestion										
Soil Ingestion Rate	mg_{soil}/day	IR_s	50	NDEP 2017a	100	NDEP 2017a	330	USEPA 2021	100	NDEP 2017a
Conversion Factor	kg_{soil}/mg_{soil}	CF	1E-06	--	1E-06	--	1E-06	--	1E-06	--
Intake Factor for Soil Ingestion, cancer	kg_{soil}/kg_{BW}/day	$IF_{soil.ing\_c}$	1.5E-07	USEPA 1989	2.8E-07	USEPA 1989	4.0E-08	USEPA 1989	2.9E-09	USEPA 1989
Intake Factor for Soil Ingestion, noncancer	kg_{soil}/kg_{BW}/day	$IF_{soil.ing\_nc}$	4.3E-07	USEPA 1989	7.7E-07	USEPA 1989	2.8E-06	USEPA 1989	4.1E-08	USEPA 1989
Soil Dermal Contact										
Skin Surface Area for Soil Contact	cm^2/day	SAs	--	--	3,527	USEPA 2021	3,527	USEPA 2021	3,527	USEPA 2021
Adherence Factor	mg_{soil}/cm^2	AF	--	--	0.12	NDEP 2017a	0.3	USEPA 2021	0.12	NDEP 2017a
Conversion Factor	kg_{soil}/mg_{soil}	CF	--	--	1E-06	--	1E-06	--	1E-06	--
Intake Factor for Soil Dermal Contact, cancer	kg_{soil}/kg_{BW}/day	$IF_{soil.derm\_c}$	--	--	1.2E-06	USEPA 2004	1.3E-07	USEPA 2004	1.2E-08	USEPA 2004
Intake Factor for Soil Dermal Contact, noncancer	kg_{soil}/kg_{BW}/day	$IF_{soil.derm\_nc}$	--	--	3.3E-06	USEPA 2004	9.1E-06	USEPA 2004	1.7E-07	USEPA 2004
Inhalation of Airborne Particulates										
Conversion Factor	hour/day	CF	24	--	24	--	24	--	24	--
Intake Factor for Particulate Inhalation, cancer	unitless	$IF_{part.inh\_c}$	8.2E-02	USEPA 2009	7.3E-02	USEPA 2009	3.3E-03	USEPA 2009	9.8E-05	USEPA 2009
Intake Factor for Particulate Inhalation, noncancer	unitless	$IF_{part.inh\_nc}$	2.3E-01	USEPA 2009	2.1E-01	USEPA 2009	2.3E-01	USEPA 2009	1.4E-03	USEPA 2009
Inhalation of Vapor Migrating from Soil to Outdoor or Trench Air										
Conversion Factor	hour/day	CF	24	--	24	--	24	--	24	--
Intake Factor for Vapor Inhalation, cancer	unitless	$IF_{vapor.inh\_c}$	8.2E-02	USEPA 2009	7.3E-02	USEPA 2009	2.0E-04	USEPA 2009	9.8E-05	USEPA 2009
Intake Factor for Vapor Inhalation, noncancer	unitless	$IF_{vapor.inh\_nc}$	2.3E-01	USEPA 2009	2.1E-01	USEPA 2009	1.4E-02	USEPA 2009	1.4E-03	USEPA 2009

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

Notes:

-- = Not applicable
cm^2/day = square centimeter per day
kg_{BW} = kilogram of body weight
kg_{soil}/kg_{BW}/day = kilogram of soil per kilogram of body weight per day
kg_{soil}/mg_{soil} = kilogram of soil per milligram of soil
mg_{soil}/cm^2 = milligram of soil per square centimeter
mg_{soil}/day = milligram of soil per day
EU = Exposure unit
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. 2017a. User's Guide and Background Technical Documentation for the Nevada Division of Environmental Protection (NDEP) Basic Comparison Levels (BCLs) for Human Health and for the BMI Complex and Common Areas. Las Vegas, NV. July.

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

VDEQ. 2019. Virginia Unified Risk Assessment Model - VURAM User's Guide. July.

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

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. July.

USEPA. 2009. Risk Assessment Guidance for Superfund. Vol. 1: Part F, Supplemental Guidance for Inhalation Risk Assessment. Final. January.

USEPA. 2021. User's Guide for Regional Screening Levels for Chemical Contaminants at Superfund Sites. November.

TABLE 8-1. Toxicity Criteria and Dermal Absorption Factors for Soil COPCs
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Chemical	Oral Cancer Slope Factor (mg/kg-day)$^{-1}$		Inhalation Unit Risk (µg/m^3)$^{-1}$		USEPA Weight-of-Evidence Carcinogen Classification		Oral Chronic RfD (mg/kg-day)		Inhalation Chronic RfC (µg/m^3)		Oral Subchronic RfD (mg/kg-day)		Inhalation Subchronic RfC (µg/m^3)		RBA$_{oral}$ [1]	Soil Dermal Absorption Factor ABS$_{soil}$	
Chlorine Oxyanions	Chlorate	--	--	--	--	--	--	0.030	NDEP	--	--	0.030	NDEP [2]	--	--	1	--	--
Chlorine Oxyanions	Perchlorate	--	--	--	--	E	IRIS	0.00070	IRIS	--	--	0.00070	IRIS [2]	--	--	1	--	--
Metal	Arsenic	1.5	IRIS	0.0043	IRIS	A	IRIS	0.00030	IRIS	0.015	Cal/EPA	0.00030	IRIS [2]	0.015	Cal/EPA [2]	1	0.030	NDEP
Metal	Chromium VI	0.50	Cal/EPA	0.084	IRIS [3]	A	IRIS	0.0030	IRIS	0.10	IRIS	0.0050	ATSDR	0.30	ATSDR	1	--	--
Metal	Cobalt	--	--	0.0090	PPRTV	B1	PPRTV	0.00030	PPRTV	0.0060	PPRTV	0.0030	PPRTV	0.020	PPRTV	1	--	--
Metal	Manganese	--	--	--	--	D	IRIS	0.024	IRIS [4]	0.050	IRIS	0.024	IRIS [2] [4]	0.050	IRIS [2]	1	--	--
Metal	Palladium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
Metal	Zirconium	--	--	--	--	D	PPRTV	0.000080	PPRTV Appendix	--	--	0.000080	PPRTV Appendix	--	--	1	--	--
Other Inorganics	Ammonia	--	--	--	--	D	PPRTV	--	--	500	IRIS	--	--	100	PPRTV	1	--	--
Dioxin/Furans	2,3,7,8-TCDD TEQ*	130000	Cal/EPA	38	Cal/EPA	B2	USEPA 2018	0.00000000070	IRIS	0.000040	Cal/EPA	0.000000020	ATSDR	0.000040	Cal/EPA [2]	0.24	0.03	NDEP
PAHs	BaPEq*	1	IRIS	0.00060	IRIS	A	IRIS	0.00030	IRIS	0.0020	IRIS	0.00030	IRIS [2]	0.0020	IRIS [2]	1	0.13	NDEP
PAHs	Naphthalene	--	--	0.000034	Cal/EPA	C	IRIS	0.020	IRIS	3.0	IRIS	0.60	ATSDR	3.0	IRIS [2]	1	0.13	NDEP
Pesticides - OCPs	beta-BHC	1.8	IRIS	0.00053	IRIS	C	IRIS	0.000060	NDEP	--	--	0.00060	ATSDR	--	--	1	0.040	NDEP
Pesticides - OCPs	4,4'-DDE	0.34	IRIS	0.000097	Cal/EPA	B2	IRIS	--	--	--	--	0.00030	PPRTV	--	--	1	0.030	NDEP
Pesticides - OCPs	4,4'-DDT	0.34	IRIS	0.000097	IRIS	B2	IRIS	0.00050	IRIS	--	--	0.00050	HEAST	--	--	1	0.10	NDEP
Pesticides - OCPs	Dieldrin	16	IRIS	0.0046	IRIS	B2	IRIS	0.000050	IRIS	--	--	0.00010	ATSDR	--	--	1	0.10	NDEP
Pesticides - OCPs	Hexachlorobenzene	1.6	IRIS	0.00046	IRIS	B2	IRIS	0.00080	IRIS	--	--	0.000010	PPRTV	--	--	1	--	--
Pesticides - OCPs	Toxaphene	1.1	IRIS	0.00032	IRIS	B2	IRIS	--	--	--	--	0.00030	PPRTV	--	--	1	0.10	NDEP
SVOCs	Bis(2-ethylhexyl)phthalate	0.014	IRIS	0.0000024	Cal/EPA	B2	IRIS	0.020	IRIS	--	--	0.020	IRIS [2]	--	--	1	0.10	NDEP
SVOCs	Octachlorostyrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--

Notes:
-- = Not available
mg/kg-day = milligram per kilogram per day
µg/m^3 = microgram per cubic meter
ABS$_{soil}$ = Soil dermal absorption factor
ATSDR = Agency for Toxic Substances and Disease Registry (values as cited in USEPA 2021a)
BaPEq = Benzo(a)pyrene equivalent
BHC = Hexachlorocyclohexane
Cal/EPA = California Environmental Protection Agency (values as cited in USEPA 2021a)
COPC = Chemical of potential concern
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
IRIS = Integrated Risk Information System (USEPA 2021b)
NDEP = Nevada Division of Environmental Protection (NDEP 2017)
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
PPRTV = Provisional Peer Reviewed Toxicity Values for Superfund (values as cited in USEPA 2021a)
RBA$_{oral}$ = Relative bioavailability for oral ingestion
RfD = Reference dose
RfC = Reference concentration
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
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] A RBA$_{oral}$ was assumed to be 24% for 2,3,7,8-TCDD TEQ, which was derived based on a study that evaluated the bioaccessibility of dioxins in soils collected from the NERT Site (Northgate 2010) and used in the calculation of the NDEP-approved site-specific action level. The RBA$_{oral}$ value for all the other COPCs was conservatively assumed to be 100%.
[2] Use chronic value as surrogate
[3] The IRIS IUR value for total chromium was multiplied by seven to account for an assumed ratio of 6:1 for chromium III to chromium VI and convert it to an IUR value for chromium VI (USEPA 2021b).
[4] The IRIS RfD for manganese from all sources, including diet was corrected to account for the dietary contribution and uncertainties associated with non-food sources (USEPA 2021b).

Sources:
NDEP. 2017. Basic Comparison Level (BCL) Table. July.
Northgate. 2010. Results of Bioaccessibility Study for Dioxin/Furans in Soil, Tronox LLC, Henderson, Nevada. May 24. NDEP approved May 25, 2010.
USEPA. 2018. Prioritized Chronic Dose-Response Values for Screening Risk Assessments. June.
USEPA. 2021a. Regional Screening Levels User's Guide. November.
USEPA. 2021b. Integrated Risk Information System (IRIS). Available online at https://www.epa.gov/iris. Accessed on May 31, 2021.

TABLE 9-1. Estimated Soil Cancer Risks and Noncancer Hazard Indices for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Indoor Commercial/Industrial Worker (0-2 feet bgs)		Indoor Commercial/Industrial Worker (0-10 feet bgs)		Outdoor Commercial/Industrial Worker (0-2 feet bgs)		Outdoor Commercial/Industrial Worker (0-10 feet bgs)		Construction Worker (0-10 feet bgs)		Outdoor Utility/Maintenance Worker in EU-4 (0-2 feet bgs)	
	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
With Contribution from Metals in Background Soil												
EU-1	2E-07	0.05	1E-07	0.03	2E-07	0.09	2E-07	0.06	2E-08	0.3	--	--
EU-2	3E-06	0.2	3E-06	0.1	8E-06	0.4	7E-06	0.3	9E-07	0.5	--	--
EU-3	1E-05	0.3	5E-06	0.2	3E-05	0.8	1E-05	0.4	2E-06	1	--	--
EU-4	1E-06	0.6	1E-06	0.4	2E-06	1	3E-06	0.6	4E-07	2	2E-08	0.05
EU-5	1E-07	0.2	1E-07	0.1	2E-07	0.3	1E-07	0.2	3E-07	3	--	--
EU-6	2E-07	0.1	1E-07	0.06	3E-07	0.2	2E-07	0.1	5E-08	3	--	--
EU-7	1E-06	0.08	2E-06	0.3	2E-06	0.1	4E-06	0.5	2E-06	2	--	--
EU-8	2E-07	0.007	1E-07	1	4E-07	0.01	3E-07	2	4E-08	7	--	--
EU-9	1E-06	0.1	7E-06	0.3	2E-06	0.2	2E-05	0.7	3E-06	0.8	--	--
Without Contribution from Metals in Background Soil												
EU-1	2E-07	0.05	1E-07	0.03	2E-07	0.09	2E-07	0.06	2E-08	0.3	--	--
EU-2	3E-06	0.2	3E-06	0.1	8E-06	0.4	7E-06	0.3	9E-07	0.5	--	--
EU-3	1E-05	0.3	5E-06	0.2	3E-05	0.8	1E-05	0.4	2E-06	0.6	--	--
EU-4	2E-07	0.6	4E-07	0.4	3E-07	1	7E-07	0.6	1E-07	2	3E-09	0.05
EU-5	1E-07	0.1	1E-07	0.1	2E-07	0.2	1E-07	0.2	2E-07	3	--	--
EU-6	2E-07	0.09	1E-07	0.05	3E-07	0.2	2E-07	0.09	5E-08	2	--	--
EU-7	1E-06	0.08	2E-06	0.3	2E-06	0.1	4E-06	0.5	2E-06	2	--	--
EU-8	2E-07	0.007	1E-07	1	4E-07	0.01	3E-07	2	4E-08	7	--	--
EU-9	5E-07	0.1	6E-06	0.3	1E-06	0.2	2E-05	0.7	2E-06	0.8	--	--

Notes:
-- = Not applicable
bgs = below ground surface
EU = Exposure unit
HI = Hazard index

TABLE 9-2. Asbestos Cancer Risks for Individual Exposure Units
Nevada Environmental Response Trust Site
Henderson, Nevada

Exposure Unit	Risk Type	Indoor Commercial/Industrial Worker			Outdoor Commercial/Industrial Worker			Construction Worker			Outdoor Utility/Maintenance Worker		
		Amphibole Risk	Chrysotile Risk	Total Asbestos Risk	Amphibole Risk	Chrysotile Risk	Total Asbestos Risk	Amphibole Risk	Chrysotile Risk	Total Asbestos Risk	Amphibole Risk	Chrysotile Risk	Total Asbestos Risk
EU-1	Best Estimate	0E+00	4E-09	4E-09	0E+00	1E-08	1E-08	0E+00	1E-07	1E-07	--	--	--
	Upper-Bound Estimate	2E-07	9E-09	3E-07	6E-07	2E-08	6E-07	6E-06	2E-07	6E-06	--	--	--
EU-2	Best Estimate	0E+00	2E-09	2E-09	0E+00	4E-09	4E-09	0E+00	4E-08	4E-08	--	--	--
	Upper-Bound Estimate	6E-08	3E-09	6E-08	1E-07	7E-09	1E-07	1E-06	7E-08	1E-06	--	--	--
EU-3	Best Estimate	9E-08	8E-10	9E-08	2E-07	2E-09	2E-07	2E-06	2E-08	2E-06	--	--	--
	Upper-Bound Estimate	2E-07	2E-09	2E-07	5E-07	5E-09	5E-07	5E-06	5E-08	5E-06	--	--	--
EU-4	Best Estimate	0E+00	2E-09	2E-09	0E+00	6E-09	6E-09	0E+00	6E-08	6E-08	0E+00	7E-12	7E-12
	Upper-Bound Estimate	8E-07	1E-08	8E-07	2E-06	3E-08	2E-06	2E-05	3E-07	2E-05	2E-09	4E-11	2E-09
EU-5	Best Estimate	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	--	--	--
	Upper-Bound Estimate	1E-07	1E-09	1E-07	3E-07	3E-09	3E-07	3E-06	3E-08	3E-06	--	--	--
EU-6	Best Estimate	0E+00	4E-10	4E-10	0E+00	1E-09	1E-09	0E+00	1E-08	1E-08	--	--	--
	Upper-Bound Estimate	1E-07	2E-09	1E-07	3E-07	5E-09	3E-07	3E-06	5E-08	3E-06	--	--	--
EU-7	Best Estimate	0E+00	6E-10	6E-10	0E+00	1E-09	1E-09	0E+00	2E-08	2E-08	--	--	--
	Upper-Bound Estimate	2E-07	3E-09	2E-07	5E-07	7E-09	5E-07	5E-06	8E-08	5E-06	--	--	--
EU-8	Best Estimate	0E+00	5E-09	5E-09	0E+00	1E-08	1E-08	0E+00	1E-07	1E-07	--	--	--
	Upper-Bound Estimate	3E-07	1E-08	3E-07	7E-07	2E-08	7E-07	7E-06	3E-07	7E-06	--	--	--
EU-9	Best Estimate	6E-08	3E-09	6E-08	1E-07	6E-09	1E-07	1E-06	6E-08	1E-06	--	--	--
	Upper-Bound Estimate	1E-07	4E-09	2E-07	3E-07	9E-09	3E-07	3E-06	1E-07	3E-06	--	--	--

Notes:
-- = Not applicable
Best Estimate = Calculated based on the number of long fibers observed in soil samples.
EU = Exposure unit
Upper-Bound Estimate = Calculated based on the 95% upper confidence limit (UCL) of the number of long fibers observed in soil samples from a Poisson distribution.

TABLE 9-3. Summary of Risk Analysis for Soil in Neighboring Sites
Nevada Environmental Response Trust Site
Henderson, Nevada

Site	LOU/Area	Constituent [1]	Maximum Cancer Risk [2,3]	Maximum Noncancer HI [2,3]	Maximum Detected Concentration (mg/kg) [3]	BCL (mg/kg) [4]	Notes	Reference
Olin	Former Tank Farm (LOUs 18 and 19)	Chemicals	7E-07	0.001	--	--	--	Integral 2017
Olin	Closed Ponds Area (LOUs 6, 15, 16, and 17)	Chemicals	6E-09	0.000008	--	--	--	Integral 2017
Olin	Former Benzene Storage Tank Area (LOUs 3 and 21)	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	Geosyntec 2012
Olin	Former Plant Site (LOUs 1, 2, 4, 5, 13, 14, 20, 22, and 23)	Hexachlorobenzene	--	--	7.5	2.0	Exceedance frequency from the BCL is 3.0% (three of 101 samples).	Geosyntec 2017
Olin	Former Plant Site (LOUs 1, 2, 4, 5, 13, 14, 20, 22, and 23)	1,2-Dibromo-3-Chloropropane	--	--	0.64	0.072	Exceedance frequency from the BCL is 1.0% (one of 104 samples).	Geosyntec 2017
Olin	Former Plant Site (LOUs 1, 2, 4, 5, 13, 14, 20, 22, and 23)	1,2,4-Trichlorobenzene	--	--	578	289	Exceedance frequency from the BCL is 1.0% (one of 104 samples).	Geosyntec 2017
Olin	Former Plant Site (LOUs 1, 2, 4, 5, 13, 14, 20, 22, and 23)	Carbon Tetrachloride	--	--	59	3.4	Exceedance frequency from the BCL is 1.9% (two of 104 samples).	Geosyntec 2017
Olin	Former Plant Site (LOUs 1, 2, 4, 5, 13, 14, 20, 22, and 23)	Chloroform	--	--	101	1.5	Exceedance frequency from the BCL is 4.8% (five of 104 samples).	Geosyntec 2017
Olin	Former Plant Site (LOUs 1, 2, 4, 5, 13, 14, 20, 22, and 23)	Benzene	--	--	1,070	6.1	Exceedance frequency from the BCL is 6.7% (seven of 104 samples); natural degradation of benzene may occur in soils.	Geosyntec 2017
Olin	Beta and Western Ditch System	Hexachlorobenzene	--	--	12	2.0	Exceedance frequency from the BCL is 14% (five of 35 samples); distance between the five sample locations and the NERT Site ranged approximately from 0.05 miles to 0.25 miles.	Hargis + Associates, Inc. 2017
Olin	Historic Caustic Storage Area	Chemicals	--	--	--	--	No exceedances of the BCLs.	Wood 2020
Olin	Phosphoric Acid Pond and Three Trenches (LOU 4)	Chemicals	--	--	--	--	No exceedances of the BCLs.	PES 2013, 2015
Olin	Agricultural Chemicals Division Drum Burial Waste Management Area (LOU 5)	Chemicals	--	--	--	--	No exceedances of the BCLs.	PES 2013
Olin	Former Agricultural Chemicals Division Plant (LOU 8)	Benzene	--	--	48	6.1	Exceedance frequency from the BCL is 1.1% (one of 87 samples); natural degradation of benzene may occur in soils.	PES 2016
Olin	Leach Beds (LOU 9)	Chemicals	--	--	--	--	No exceedances of the BCLs.	PES 2013, 2015
Olin	Former Lindane Plant (LOU 10) and Former Benzene Hexachloride Cake Piles 1 and 2 and Former Haul Route (Capped Areas of LOU 12)	alpha-BHC	--	--	9,300	8,176	Exceedance frequency from the BCL is 1.1% (one of 87 samples).	PES 2016
Olin	Benzene Hexachloride Cake Pile 3 (Uncapped Areas of LOU 12)	alpha-BHC	--	--	706,000	8,176	Exceedance frequency from the BCL is 2.4% (one of 42 samples).	PES 2013
Olin	Benzene Hexachloride Cake Pile 3 (Uncapped Areas of LOU 12)	Benzene	--	--	17	6.1	Exceedance frequency from the BCL is 25% (two of eight samples); distance between LOU 12 and the NERT Site is approximately 0.5 miles; natural degradation of benzene may occur in soils.	PES 2013
Olin	Inactive CAPD Ponds 1, 3, 4, and 6 (LOUs 17 and 20)	Chemicals	--	--	--	--	No exceedances of the BCLs.	Wood 2018
Olin	Hydrochloric Acid/bis-Chloromethylether Release (LOU 29)	Chemicals	--	--	--	--	No exceedances of the BCLs.	PES 2018
Olin	Former Underground Benzene Storage Tanks Area (LOU 30)	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	Hargis + Associates, Inc. 2018, 2020
Olin	Dichlorobenzil Warehouse, Former Tank Farm, Former Benzene Storage Tank Area, Former Underground Benzene Storage Tanks Area, Historic Caustic Storage Area	Asbestos	8E-07	--	--	--	--	Integral 2017 and 2018, Geosyntec 2012, Wood 2020
TIMET	Areas 5 and 8	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2015a
TIMET	Area 6	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2015b
TIMET	Area 10	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2017a
TIMET	Area 11	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2019a
TIMET	Area 15	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2017b
TIMET	Area 16	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2020a
TIMET	Area 17	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2020b
TIMET	Area 18	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2020c
TIMET	Area 19	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2019b
TIMET	Area 21	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2016
TIMET	Area 22	Chemicals and Radionuclides	--	--	--	--	No exceedances of the BCLs.	GEI 2017c
TIMET	Area 13 (Pond SW-1)	Chloroform	--	--	2.6	1.5	Exceedance frequency from the BCL is 20% (two of 10 samples); excavation activities have occurred, and a geotextile and geomembrane line system was installed in 2018.	GEI 2015c, GEI 2017d, 2019c
TIMET	Area 13 (Pond SW-1)	Hexachlorobenzene	--	--	67	2.0	Exceedance frequency from the BCL is 70% (seven of 10 samples); excavation activities have occurred, and a geotextile and geomembrane line system was installed in 2018.	GEI 2015c, GEI 2017d, 2019c
TIMET	Area 9	Hexachlorobenzene	--	--	9.8	2.0	Exceedance frequency from the BCL is 67% (two of three samples); the HDPE liner, geosynthetic clay liner, concrete, or asphalt cover 87% of the area and the type 2 stone covers the remaining 13% of the area.	GEI 2015d
TIMET	Areas 1, 2, 3, 4, and 7	Hexachlorobenzene	--	--	63	2.0	Exceedance frequency from the BCL is 4.8% (seven of 146 samples).	GEI 2015e
TIMET	Areas 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 15, and 19	Asbestos	9E-07	--	--	--	--	GEI 2015a, 2015b, 2015e, 2017a, 2017b, 2019a, 2019b

Notes:
-- = Not applicable
bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
BCL = Basic comparison level
BHC = Hexachlorocyclohexane
CAPD = Chlor Alkali Products Division
DDD = Dichlorodiphenyldichloroethane
GEI = GEI Consultants, Inc.
Geosyntec = Geosyntec Consultants
HDPE = High-density polyethylene
HI = Hazard index
Integral = Integral Consulting, Inc.
LOU = Letter of Understanding
NDEP = Nevada Division of Environmental Protection
NERT = Nevada Environmental Response Trust
Olin = Olin Chlor Alkali Products
PES = PES Environmental, Inc.
TIMET = Titanium Metals Corporation
Wood = Wood Environment & Infrastructure Solutions, Inc.

TABLE 9-3. Summary of Risk Analysis for Soil in Neighboring Sites
Nevada Environmental Response Trust Site
Henderson, Nevada

[1] Chemicals, radionuclides, and asbestos are three distinct classes of analytes.
[2] For indoor and/or outdoor commercial/industrial workers present at the neighboring site exposed through inhalation of airborne particulates and vapors from soil only.
[3] For soil data collected from 10 ft bgs or shallower.
[4] The lower value of the soil BCL for inhalation of airborne particulates and vapors between indoor and outdoor industrial/commercial workers (NDEP 2017) was used for the comparison.

Sources:

GEI. 2015a. Request for Administrative Closure, Areas 5 and 8, Titanium Metals Corporation, Henderson, Nevada. July 28. NDEP approved July 30, 2015.
GEI. 2015b. Request for Administrative Closure, Area 6, Titanium Metals Corporation, Henderson, Nevada. July 30. NDEP approved August 5, 2015.
GEI. 2015c. Former SW-1 Pond Investigation Report, Titanium Metals Corporation, Henderson, Nevada. August 21. NDEP approved December 9, 2015.
GEI. 2015d. Request for Administrative Closure, Area 9, Titanium Metals Corporation, Henderson, Nevada. July 29. NDEP approved July 30, 2015.
GEI. 2015e. Request for Administrative Closure, Areas 1, 2, 3, 4, and 7, Titanium Metals Corporation, Henderson, Nevada. August 31. NDEP approved September 8, 2015.
GEI. 2016. Work Plan, Additional Investigation of Area 21, Titanium Metals Corporation, Henderson, Nevada. July 13. NDEP approved July 18, 2016.
GEI. 2017a. Supplemental Investigation Report and Request for Determination, Area 10, Titanium Metals Corporation, Henderson, Nevada. March 29. NDEP approved June 6, 2017.
GEI. 2017b. Request for Administrative Closure, Management Area 15, Titanium Metals Corporation, Henderson, Nevada. February 28. NDEP approved March 24, 2017.
GEI. 2017c. Supplemental Investigation Report and Request for Administrative Closure, Area 22, Titanium Metals Corporation, Henderson, Nevada. July 28. NDEP approved August 8, 2017.
GEI. 2017d. Request for Administrative Closure, Management Area 13, Titanium Metals Corporation, Henderson, Nevada. June 30. NDEP approved August 22, 2019.
GEI. 2019a. Request for Administrative Closure, Management Area 11, Titanium Metals Corporation, Henderson, Nevada. April 18. NDEP approved June 3, 2020.
GEI. 2019b. Request for Administrative Closure Management Area 19 (Updated with Supplemental Investigation Results and Excavation/Grading Plan), Titanium Metals Corporation, Henderson, Nevada. October 29. NDEP approved December 4, 2019.
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GEI. 2020b. Supplemental Investigation Report and Request for Administrative Closure, Area 17, Titanium Metals Corporation, Henderson, Nevada. October 31. NDEP approved December 3, 2020.
GEI. 2020c. Supplemental Investigation Report, Area 18, Titanium Metals Corporation, Henderson, Nevada. August 31. NDEP commented December 30, 2020.
Geosyntec. 2012. Screening Level Risk Evaluation, Former Benzene Storage Tank Site Assessment Area, Henderson, Nevada. January 9. NDEP commented June 18, 2012.
Geosyntec. 2017. Former Plant Site-Data Usability Evaluation and Conceptual Site Model Report, Henderson, Nevada. July 3. NDEP approved March 12, 2020.
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Hargis + Associates, Inc. 2018. Source Area Specific Conceptual Site Model, Former Underground Benzene Storage Tanks Area, Rev. 1. Former Montrose and Stauffer Facilities and Current Olin Facility. Henderson Nevada. May 18. Included as Attachment C to de maximis, inc. (2018) Resubmittal of the Request for No Further Action Determination, Former Under-Ground Benzene Storage Tank (FUBST), dated December 18, 2018. NDEP approved June 7, 2019.
Hargis + Associates, Inc. 2020. Letter Of Understanding Item #30, Soil And Soil Gas Investigation Summary Report, Stauffer Management Company, LLC, and Montrose Chemical Corporation Of California, Henderson, Nevada. July 1. NDEP approved October 20, 2020.
Integral. 2017. Human Health Risk Assessment, Closed Ponds Area and Former Tank Farm Montrose Chemical Corporation of California, Henderson, Nevada. January 31.
NDEP. 2017. Basic Comparison Level (BCL) Table. July.
PES. 2013. Revised Work Plan for Vadose Zone Characterization Environmental Conditions Investigation, LOU Area Nos. 4, 5, 8, 9, 10, and 12, Former Stauffer Chemical Company Facility Olin Chlor Alkali Products, Henderson, Nevada. February 28. NDEP approved April 30, 2013.
PES. 2015. Conceptual Site Model Leach Beds (LOU No. 9) and Phosphoric Acid Pond and Three Trenches (LOU No. 4), Former Stauffer Chemical Company Facility Olin Chlor Alkali Products, Henderson, Nevada. February 3. NDEP approved August 27, 2015.
PES. 2016. Conceptual Site Model for Vadose Zone and Data Usability Evaluation Summary Report-Former ACD Plant Areas (LOU Nos. 8, 10, and 12), Former Stauffer Chemical Company Facility, Olin Chlor Alkali Products, Henderson, Nevada. March 31. NDEP approved by March 12, 2020.
PES. 2018. Data Review and Closure Report April 17, 1984 HCL/BCME Release (LOU Item No. 29), Former Stauffer Chemical Company Facility Current Olin Chlor Alkali Products Facility, Henderson, Nevada. January 16. NDEP approved May 9, 2018.
Wood. 2018. Multi-Milestone Report Site - Investigation, Data Validation Summary, Conceptual Site Model, Data Usability Evaluation, and Remedial Alternative Study, Inactive CAPD Ponds 1, 3, 4 (LOU 17) and Inactive CAPD Pond 6 (LOU 20), Former Stauffer Chemical Company and Current Olin Chlor Alkali Products Facility, Henderson, Nevada. August 27. NDEP approved November 30, 2018.
Wood. 2020. Revised Multi-Milestone Report - Site Investigation, Data Validation Summary, Conceptual Site Model, Data Usability Evaluation and Exposure Assessment, Former Stauffer Chemical Company and Current Olin Chlor Alkali Products Facility, Henderson, Nevada. December 8. NDEP approved March 9, 2021.

TABLE 11-1. Soil Data Quality Assessment (0-2 feet bgs)
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	EU-1		EU-2		EU-3		EU-4		EU-5		EU-6		EU-7		EU-8		EU-9	
Cancer Risk or HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI
Target Cancer Risk or Target HI [1]	1.49×10^{-6}	1.49	6.49×10^{-5}	1.49	6.49×10^{-5}	1.49	1.49×10^{-6}	1.49	1.50×10^{-6}	1.53	1.49×10^{-6}	1.51	1.49×10^{-6}	1.49	1.49×10^{-6}	1.49	6.49×10^{-5}	1.50
Population with Maximum Cancer Risk/HI	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker	Outdoor Commercial/ Industrial Worker
Cancer Risk/HI based on 95% UCL[2]	2.2E-07	0.093	7.7E-06	0.36	2.6E-05	0.83	3.3E-07	1.0	2.1E-07	0.27	3.4E-07	0.17	1.9E-06	0.14	4.2E-07	0.014	1.1E-06	0.23
Cancer Risk/HI Driver	Hexachlorobenzene	Perchlorate	2,3,7,8-TCDD TEQ	2,3,7,8-TCDD TEQ	2,3,7,8-TCDD TEQ	2,3,7,8-TCDD TEQ	Hexachlorobenzene	Perchlorate	Chromium VI	Cobalt	Chromium VI	Manganese	Chromium VI	Perchlorate	Bis(2-ethylhexyl)phthalate	Perchlorate	2,3,7,8-TCDD TEQ	Zirconium
95% UCL of Driver Chemical Concentration (mg/kg)	0.19	83	0.00055	0.00055	0.0019	0.0019	0.24	889	0.87	51	0.83	3323	11	97	38	7.6	0.000046	21
Cancer Risk/HQ based on 95%UCL of Driver Chemical	1.6E-07	0.091	7.3E-06	0.22	2.5E-05	0.77	2.0E-07	1.0	1.2E-07	0.13	1.2E-07	0.12	1.6E-06	0.11	2.1E-07	0.0083	6.1E-07	0.20
SD of Driver Chemical Concentration (mg/kg)[3]	0.21	93	0.00059	0.00059	0.0030	0.0030	0.19	700	0.73	59	0.67	3269	8	51	27	3.3	0.000052	9.4
SD of Cancer Risk/HQ from Driver Chemical[4]	1.8E-07	0.10	7.7E-06	0.24	3.9E-05	1.20	1.6E-07	0.77	1.0E-07	0.15	9.6E-08	0.12	1.1E-06	0.056	1.5E-07	0.0036	6.8E-07	0.090
Number of Sample Required[5]	3	2	3	3	13	38	3	29	2	3	2	2	80	2	3	2	2	2
Sample Size [6]	40	26	69	69	72	72	25	22	15	43	15	24	10	11	5	4	28	9

Notes:
bgs = below ground surface
mg/kg = milligram per kilogram
BHRA = Baseline health risk assessment
COPC = Chemical of Potential Concern
EU = Exposure unit
HI = Hazard index
HQ = Hazard quotient
SD = Standard deviation
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
UCL = Upper confidence limit

[1] Target cancer risk is set as 1.49×10^{-6} or 6.49×10^{-5} (2,3,7,8-TCDD TEQ only), which can be rounded to 1×10^{-6} or 6×10^{-5} (cancer risk for the site-specific action level of 0.0027 mg/kg). 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 equal to or greater than the target cancer risk or target HI if the cancer risk or noncancer HI based on 95% UCL is less than the target, or the mean of population cancer risk or HI is equal to or less than the target cancer risk or target HI if the cancer risk or noncancer HI based on 95% UCL is greater than the target. For scenarios where a metal COPC is the driver chemical and contribution from background soil exist (cobalt in EU-5, manganese in EU-6, zirconium in EU-9, and chromium VI in EU-5, EU-6, and EU-7), the target cancer risk or noncancer HI was set as 1.49×10^{-6} or 1.49 plus the background contribution from all metals.

[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] SD of driver chemical concentration was calculated after substituting non-detects by half of detection limit.

[4] 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.

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

[6] Sample size is the number of samples analyzed for risk driver included in the BHRA analysis for each exposure scenario.

TABLE 11-2. Soil Data Quality Assessment (0-10 feet bgs)
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	EU-1		EU-2		EU-3		EU-4		EU-5		EU-6		EU-7		EU-8		EU-9	
Cancer Risk or HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI	Cancer Risk	HI
Target Cancer Risk or Target HI [1]	1.49×10^{-6}	1.49	6.49×10^{-5}	1.49	6.49×10^{-5}	2.02	3.54×10^{-6}	1.49	1.56×10^{-6}	2.06	1.49×10^{-6}	2.02	1.49×10^{-6}	1.49	1.49×10^{-6}	1.49	6.49×10^{-5}	1.53
Population with Maximum Cancer Risk/HI	Outdoor Commercial/ Industrial Worker	Construction Worker	Outdoor Commercial/ Industrial Worker	Construction Worker	Outdoor Commercial/ Industrial Worker	Construction Worker	Outdoor Commercial/ Industrial Worker	Construction Worker	Construction Worker	Construction Worker	Outdoor Commercial/ Industrial Worker	Construction Worker	Outdoor Commercial/ Industrial Worker	Construction Worker	Outdoor Commercial/ Industrial Worker	Construction Worker	Outdoor Commercial/ Industrial Worker	Construction Worker
Cancer Risk/HI based on 95% UCL[2]	1.9E-07	0.26	6.7E-06	0.46	1.3E-05	1.2	2.8E-06	2.4	2.9E-07	3.3	1.9E-07	2.6	4.0E-06	1.9	3.2E-07	7.3	1.8E-05	0.85
Cancer Risk/HI Driver	Hexachlorobenzene	Perchlorate	2,3,7,8-TCDD TEQ	Perchlorate	2,3,7,8-TCDD TEQ	Manganese	Arsenic	Perchlorate	Cobalt	Manganese	Hexachlorobenzene	Manganese	Chromium VI	Perchlorate	Bis(2-ethylhexyl)phthalate	Perchlorate	2,3,7,8-TCDD TEQ	Zirconium
95% UCL of Driver Chemical Concentration (mg/kg)	0.16	52	0.00048	93	0.0010	690	5.5	563	36	2621	0.079	2197	24	295	31	1601	0.0013	20
Cancer Risk/HQ based on 95%UCL of Driver Chemical	1.4E-07	0.21	6.3E-06	0.38	1.3E-05	0.81	2.6E-06	2.3	2.5E-07	3.1	6.6E-08	2.5	3.4E-06	1.2	1.7E-07	6.5	1.6E-05	0.70
SD of Driver Chemical Concentration (mg/kg)[3]	0.20	72	0.00066	139	0.0021	692	2.1	562	51	3592	0.099	2751	25	338	22	974	0.0018	8
SD of Cancer Risk/HQ from Driver Chemical[4]	1.7E-07	0.29	8.6E-06	0.56	2.7E-05	0.82	9.8E-07	2.3	3.5E-07	4.2	8.3E-08	3.1	3.5E-06	1.4	1.2E-07	3.9	2.4E-05	0.29
Number of Sample Required[5]	3	3	3	5	5	13	21	71	3	126	2	311	23	128	2	7	5	4
Sample Size [6]	94	50	107	88	151	110	70	49	93	107	64	53	24	35	8	6	36	17

Notes:
bgs = below ground surface
mg/kg = milligram per kilogram
BHRA = Baseline health risk assessment
COPC = Chemical of Potential Concern
EU = Exposure unit
HI = Hazard index
HQ = Hazard quotient
SD = Standard deviation
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
UCL = Upper confidence limit

[1] Target cancer risk is set as 1.49×10^{-6} or 6.49×10^{-5} (2,3,7,8-TCDD TEQ only), which can be rounded to 1×10^{-6} or 6×10^{-5} (cancer risk for the site-specific action level of 0.0027 mg/kg). 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 equal to or greater than the target cancer risk or target HI if the cancer risk or noncancer HI based on 95% UCL is less than the target, or the mean of population cancer risk or HI is equal to or less than the target cancer risk or target HI if the cancer risk or noncancer HI based on 95% UCL is greater than the target. For scenarios where a metal COPC is the driver chemical and contribution from background soil exist (manganese in EU-3, EU-5, and EU-6, arsenic in EU-4, cobalt in EU-5, chromium VI in EU-7, and zirconium in EU-9), the target cancer risk or noncancer HI was set as 1.49×10^{-6} or 1.49 plus the background contribution from all metals.

[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] SD of driver chemical concentration was calculated after substituting non-detects by half of detection limit.

[4] 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.

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

[6] Sample size is the number of samples analyzed for risk driver included in the BHRA analysis for each exposure scenario.

TABLE 12-1. Summary of Cumulative Estimated Risks for OU-1 Soil and Soil Gas
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Exposure [1],[2]	Indoor Commercial/Industrial Worker						Outdoor Commercial/Industrial Worker						Construction Worker						Outdoor Utility/Maintenance Worker in EU-4					
		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk	
		Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
EU-1	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	2E-07	0.05	8E-06	0.01	8E-06	0.06	2E-07	0.09	2E-09	0.000003	2E-07	0.09	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.03	8E-06	0.01	8E-06	0.04	2E-07	0.06	2E-09	0.000003	2E-07	0.06	2E-08	0.3	3E-11	0.0000004	2E-08	0.3	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	2E-07	0.05	5E-07	0.0007	7E-07	0.05	2E-07	0.09	5E-09	0.000008	2E-07	0.09	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.03	5E-07	0.0007	6E-07	0.03	2E-07	0.06	5E-09	0.000008	2E-07	0.06	2E-08	0.3	7E-12	0.0000002	2E-08	0.3	--	--	--	--	--	--
	Asbestos - Best Estimate	4E-09	--	--	--	4E-09	--	1E-08	--	--	--	1E-08	--	1E-07	--	--	--	1E-07	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	3E-07	--	--	--	3E-07	--	6E-07	--	--	--	6E-07	--	6E-06	--	--	--	6E-06	--	--	--	--	--	--	--
EU-2	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	3E-06	0.2	3E-05	0.03	3E-05	0.2	8E-06	0.4	2E-09	0.000003	8E-06	0.4	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	3E-06	0.1	3E-05	0.03	3E-05	0.2	7E-06	0.3	2E-09	0.000003	7E-06	0.3	9E-07	0.5	1E-10	0.000002	9E-07	0.5	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	3E-06	0.2	1E-04	0.1	1E-04	0.3	8E-06	0.4	5E-09	0.000008	8E-06	0.4	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	3E-06	0.1	1E-04	0.1	1E-04	0.2	7E-06	0.3	5E-09	0.000008	7E-06	0.3	9E-07	0.5	1E-09	0.00002	9E-07	0.5	--	--	--	--	--	--
	Asbestos - Best Estimate	2E-09	--	--	--	2E-09	--	4E-09	--	--	--	4E-09	--	4E-08	--	--	--	4E-08	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	6E-08	--	--	--	6E-08	--	1E-07	--	--	--	1E-07	--	1E-06	--	--	--	1E-06	--	--	--	--	--	--	--
EU-3	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	1E-05	0.3	4E-07	0.001	1E-05	0.3	3E-05	0.8	2E-09	0.000003	3E-05	0.8	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	5E-06	0.2	4E-07	0.001	6E-06	0.2	1E-05	0.4	2E-09	0.000003	1E-05	0.4	2E-06	0.6	2E-12	0.00000004	2E-06	0.6	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	1E-05	0.3	4E-08	0.00008	1E-05	0.3	3E-05	0.8	5E-09	0.000008	3E-05	0.8	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	5E-06	0.2	4E-08	0.00008	5E-06	0.2	1E-05	0.4	5E-09	0.000008	1E-05	0.4	2E-06	0.6	5E-13	0.00000001	2E-06	0.6	--	--	--	--	--	--
	Asbestos - Best Estimate	9E-08	--	--	--	9E-08	--	2E-07	--	--	--	2E-07	--	2E-06	--	--	--	2E-06	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	2E-07	--	--	--	2E-07	--	5E-07	--	--	--	5E-07	--	5E-06	--	--	--	5E-06	--	--	--	--	--	--	--
EU-4	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs) [3]	2E-07	0.6	3E-07	0.0004	5E-07	0.6	3E-07	1.0	2E-09	0.000003	3E-07	1	--	--	--	--	--	--	2E-08	0.05	3E-12	0.00000002	2E-08	0.05
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	4E-07	0.4	3E-07	0.0004	7E-07	0.4	7E-07	0.6	2E-09	0.000003	7E-07	0.6	1E-07	2.4	1E-12	0.00000002	1E-07	2	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs) [3]	2E-07	0.6	9E-07	0.002	1E-06	0.6	3E-07	1.0	5E-09	0.000008	3E-07	1	--	--	--	--	--	--	2E-08	0.05	7E-12	0.00000005	2E-08	0.05
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	4E-07	0.4	9E-07	0.002	1E-06	0.4	7E-07	0.6	5E-09	0.000008	7E-07	0.6	1E-07	2.4	1E-11	0.0000002	1E-07	2	--	--	--	--	--	--
	Asbestos - Best Estimate	2E-09	--	--	--	2E-09	--	6E-09	--	--	--	6E-09	--	6E-08	--	--	--	6E-08	--	7E-12	--	--	--	7E-12	--
	Asbestos - Upper-Bound Estimate	8E-07	--	--	--	8E-07	--	2E-06	--	--	--	2E-06	--	2E-05	--	--	--	2E-05	--	2E-09	--	--	--	2E-09	--

TABLE 12-1. Summary of Cumulative Estimated Risks for OU-1 Soil and Soil Gas
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Exposure [1],[2]	Indoor Commercial/Industrial Worker						Outdoor Commercial/Industrial Worker						Construction Worker						Outdoor Utility/Maintenance Worker in EU-4					
		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk	
		Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
EU-5	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.1	5E-07	0.0006	6E-07	0.1	2E-07	0.2	2E-09	0.000003	2E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.1	5E-07	0.0006	6E-07	0.1	1E-07	0.2	2E-09	0.000003	1E-07	0.2	2E-07	2.8	2E-12	0.00000003	2E-07	3	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.1	4E-07	0.0007	6E-07	0.1	2E-07	0.2	5E-09	0.000008	2E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.1	4E-07	0.0007	5E-07	0.1	1E-07	0.2	5E-09	0.000008	1E-07	0.2	2E-07	2.8	6E-12	0.0000003	2E-07	3	--	--	--	--	--	--
	Asbestos - Best Estimate	0E+00	--	--	--	0E+00	--	0E+00	--	--	--	0E+00	--	0E+00	--	--	--	0E+00	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	1E-07	--	--	--	1E-07	--	3E-07	--	--	--	3E-07	--	3E-06	--	--	--	3E-06	--	--	--	--	--	--	--
EU-6	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	2E-07	0.09	9E-06	0.01	9E-06	0.1	3E-07	0.2	2E-09	0.000003	3E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	1E-07	0.05	9E-06	0.01	9E-06	0.07	2E-07	0.09	2E-09	0.000003	2E-07	0.09	5E-08	2.1	4E-11	0.0000005	5E-08	2	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	2E-07	0.09	1E-05	0.01	1E-05	0.1	3E-07	0.2	5E-09	0.000008	3E-07	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	1E-07	0.05	1E-05	0.01	1E-05	0.07	2E-07	0.09	5E-09	0.000008	2E-07	0.09	5E-08	2.1	1E-10	0.000002	5E-08	2	--	--	--	--	--	--
	Asbestos - Best Estimate	4E-10	--	--	--	4E-10	--	1E-09	--	--	--	1E-09	--	1E-08	--	--	--	1E-08	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	1E-07	--	--	--	1E-07	--	3E-07	--	--	--	3E-07	--	3E-06	--	--	--	3E-06	--	--	--	--	--	--	--
EU-7	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	1E-06	0.08	1E-06	0.002	2E-06	0.08	2E-06	0.1	2E-09	0.000003	2E-06	0.1	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	2E-06	0.3	1E-06	0.002	4E-06	0.3	4E-06	0.5	2E-09	0.000003	4E-06	0.5	2E-06	1.9	6E-12	0.00000008	2E-06	2	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	1E-06	0.08	1E-06	0.002	2E-06	0.08	2E-06	0.1	5E-09	0.000008	2E-06	0.1	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	2E-06	0.3	1E-06	0.002	4E-06	0.3	4E-06	0.5	5E-09	0.000008	4E-06	0.5	2E-06	1.9	2E-11	0.0000003	2E-06	2	--	--	--	--	--	--
	Asbestos - Best Estimate	6E-10	--	--	--	6E-10	--	1E-09	--	--	--	1E-09	--	2E-08	--	--	--	2E-08	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	2E-07	--	--	--	2E-07	--	5E-07	--	--	--	5E-07	--	5E-06	--	--	--	5E-06	--	--	--	--	--	--	--
EU-8	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)[4]	2E-07	0.007	7E-08	0.0004	2E-07	0.008	4E-07	0.01	2E-09	0.000003	4E-07	0.01	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)[4]	1E-07	1.1	7E-08	0.0004	2E-07	1	3E-07	2	2E-09	0.000003	3E-07	2	4E-08	7.3	3E-13	0.00000004	4E-08	7	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)[5]	2E-07	0.007	1E-07	0.03	3E-07	0.03	4E-07	0.01	5E-09	0.000008	4E-07	0.01	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)[5]	1E-07	1.1	1E-07	0.03	2E-07	1	3E-07	2	5E-09	0.000008	3E-07	2	4E-08	7.3	7E-11	0.0004	4E-08	7	--	--	--	--	--	--
	Asbestos - Best Estimate	5E-09	--	--	--	5E-09	--	1E-08	--	--	--	1E-08	--	1E-07	--	--	--	1E-07	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	3E-07	--	--	--	3E-07	--	7E-07	--	--	--	7E-07	--	7E-06	--	--	--	7E-06	--	--	--	--	--	--	--

TABLE 12-1. Summary of Cumulative Estimated Risks for OU-1 Soil and Soil Gas
Nevada Environmental Response Trust Site
Henderson, Nevada

EU	Exposure [1],[2]	Indoor Commercial/Industrial Worker						Outdoor Commercial/Industrial Worker						Construction Worker						Outdoor Utility/Maintenance Worker in EU-4					
		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk		Risk from Soil Direct Contact		Risk from Vapor Intrusion		Cumulative Risk	
		Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI	Cancer Risk	Noncancer HI
EU-9	Soil (0-2 ft bgs) and Soil Gas (5 ft bgs)	5E-07	0.1	4E-06	0.01	4E-06	0.1	1E-06	0.2	2E-09	0.000003	1E-06	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (5 ft bgs)	6E-06	0.3	4E-06	0.01	1E-05	0.3	2E-05	0.7	2E-09	0.000003	2E-05	0.7	2E-06	0.8	2E-11	0.0000005	2E-06	0.8	--	--	--	--	--	--
	Soil (0-2 ft bgs) and Soil Gas (15 ft bgs)	5E-07	0.1	6E-07	0.001	1E-06	0.1	1E-06	0.2	5E-09	0.000008	1E-06	0.2	--	--	--	--	--	--	--	--	--	--	--	--
	Soil (0-10 ft bgs) and Soil Gas (15 ft bgs)	6E-06	0.3	6E-07	0.001	7E-06	0.3	2E-05	0.7	5E-09	0.000008	2E-05	0.7	2E-06	0.8	8E-12	0.0000002	2E-06	0.8	--	--	--	--	--	--
	Asbestos - Best Estimate	6E-08	--	--	--	6E-08	--	1E-07	--	--	--	1E-07	--	1E-06	--	--	--	1E-06	--	--	--	--	--	--	--
	Asbestos - Upper-Bound Estimate	2E-07	--	--	--	2E-07	--	3E-07	--	--	--	3E-07	--	3E-06	--	--	--	3E-06	--	--	--	--	--	--	--

Notes:

-- = Not applicable

bgs = below ground surface

ft = feet

BHRA = Baseline health risk assessment

EU = Exposure unit

HI = Hazard index

OU = Operable unit

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

[2] Unless noted, the cancer risks and noncancer HIs in soil gas for indoor commercial/industrial workers and construction workers were the maximum results in each EU among the soil gas sample locations collected during the Remedial Investigation. The cancer risks and noncancer HIs in soil gas for outdoor commercial/industrial workers were the same in all the EUs, which were calculated based on the 95% upper confidence limits (UCLs) on the mean concentrations over the entire Operations Area. These risk results are presented in the OU-1 Soil Gas and Groundwater BHRA Report (Ramboll 2021).

[3] The cancer risks and noncancer HIs in soil gas for outdoor utility/maintenance workers in EU-4 were calculated based on the risk results for outdoor commercial/industrial workers scaled by exposure parameters presented in Table 7-7.

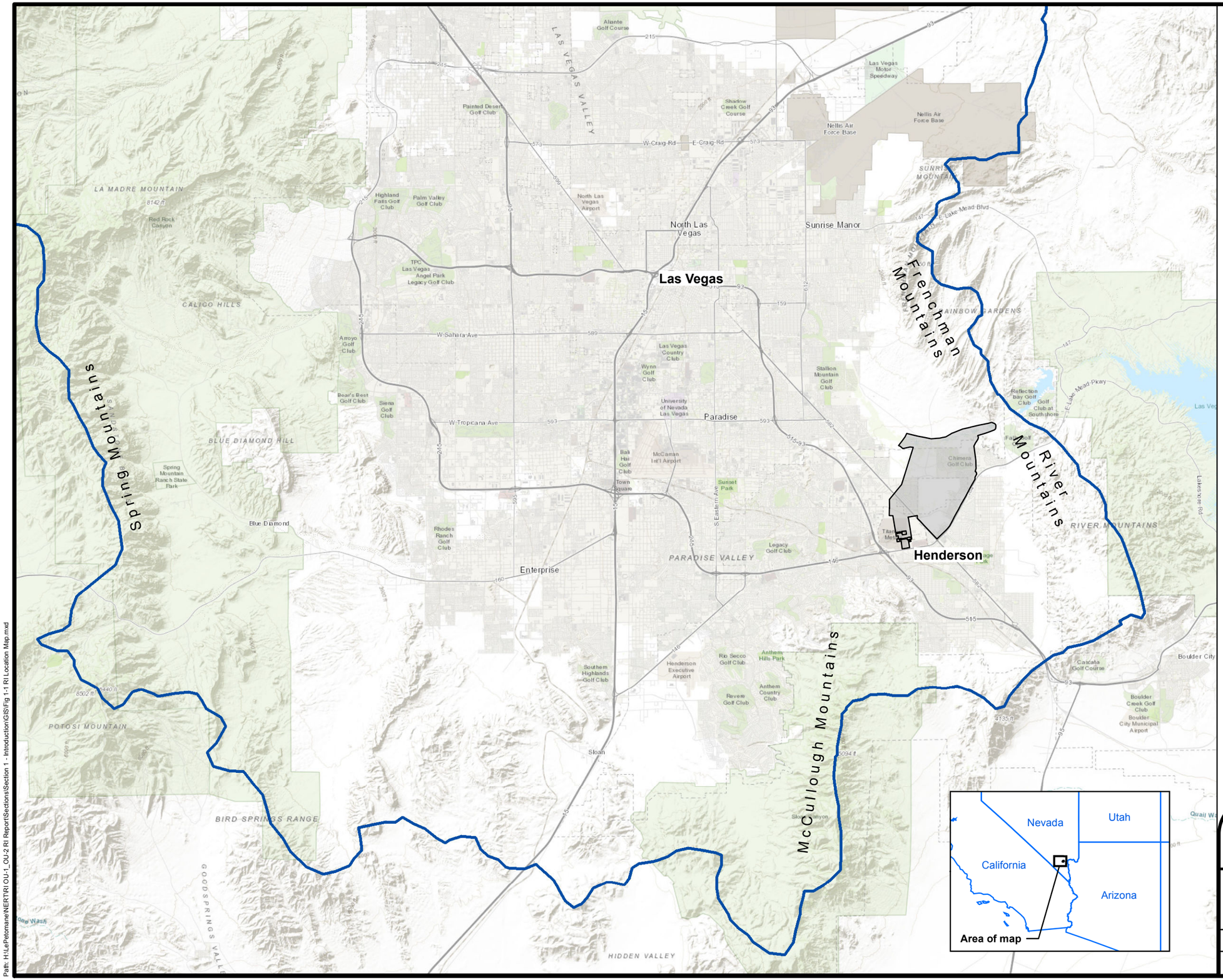
[4] The cancer risks and noncancer HIs in soil gas at 5 ft bgs for indoor commercial/industrial workers and construction workers in EU-8 were the risk results at SG74 collected during the Phase B Soil Gas Investigation since no soil gas samples were collected during the Remedial Investigation in this EU.

[5] The cancer risks and noncancer HIs at shallow groundwater well location M-97 were used as a surrogate for soil gas risk results at 15 ft bgs for indoor commercial/industrial workers and construction workers in EU-8, since no soil gas samples at a deep depth closer to groundwater were collected in this EU.

Source:

Ramboll. 2021. Baseline Health Risk Assessment Report for OU-1 Soil Gas and Groundwater, Nevada Environmental Response Trust Site, Henderson, Nevada. September 13. Under NDEP review.

FIGURES



LEGEND:

- Las Vegas Valley Hydrologic Basin
- NERT RI Study Area

Note:
See Figure 1-2 for NERT RI Study Area details.

N

0 2.5 5 Miles

RAMBOLL

NERT RI Study Area Location Map

Nevada Environmental Response Trust Site
Henderson, Nevada

Date:	Contract Number:		Figure
3/1/2022	1690025040-003		ES-1
Drafter: RS	Approved:	Revised:	

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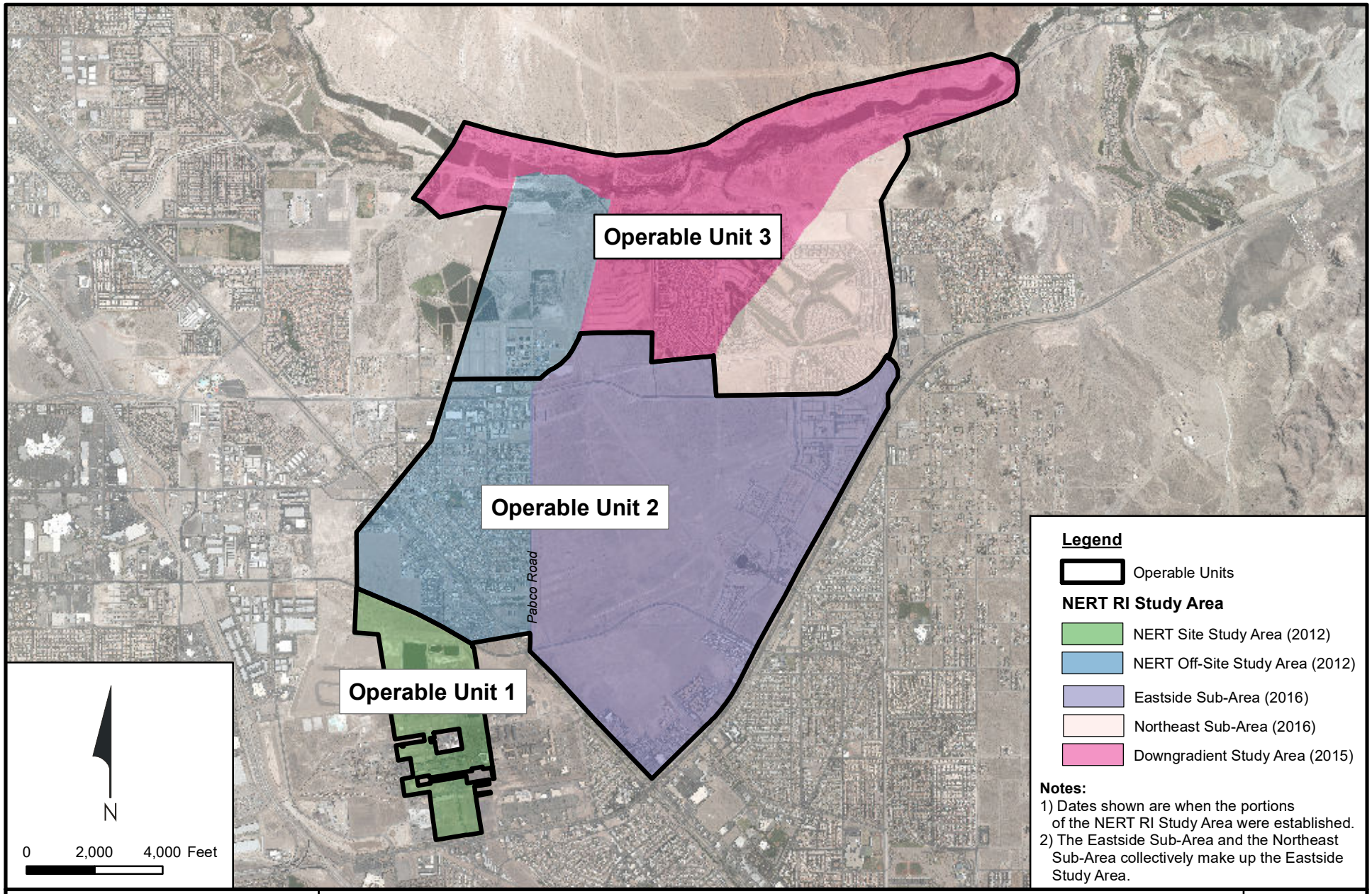

RAMBOLL

NERT RI Study Area Operable Units
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
ES-2

Drafter: RS Date: 3/1/2022 Contract Number: 1690025040-003 Approved: Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Fig 1-2 RI Study Area Operable Units.mxd

WARM SPRINGS RD

Parcel E

Former Parcels C & D

L'hoist

Parcel F

Parcel G

Former Parcel H

Former Parcel H

LAKE MEAD PARKWAY

Legend

- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Operations Area
- EMD (former Tronox) Leasehold Area

N

0 250 500

Feet

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\MXD\Fig1_BHRAFacilityArea-TronoxLeasehold_BoundaryUpdate.mxd

RAMBOLL

Layout of Operable Unit 1
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
ES-3

Drafter: RS	Date: 3/1/2022	Contract Number: 1690025040-003	Approved by:	Revised:

Parcel E

Former Parcels C & D

N

0 200 400

Feet

L'hoist

Parcel F

Parcel G

RZ-A

Former Parcel H

Former Parcel H

Legend

- Sale Parcel Boundary
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Excavation Control Area (ECA)
- Remediation Zone A
- BHRA Study Area

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

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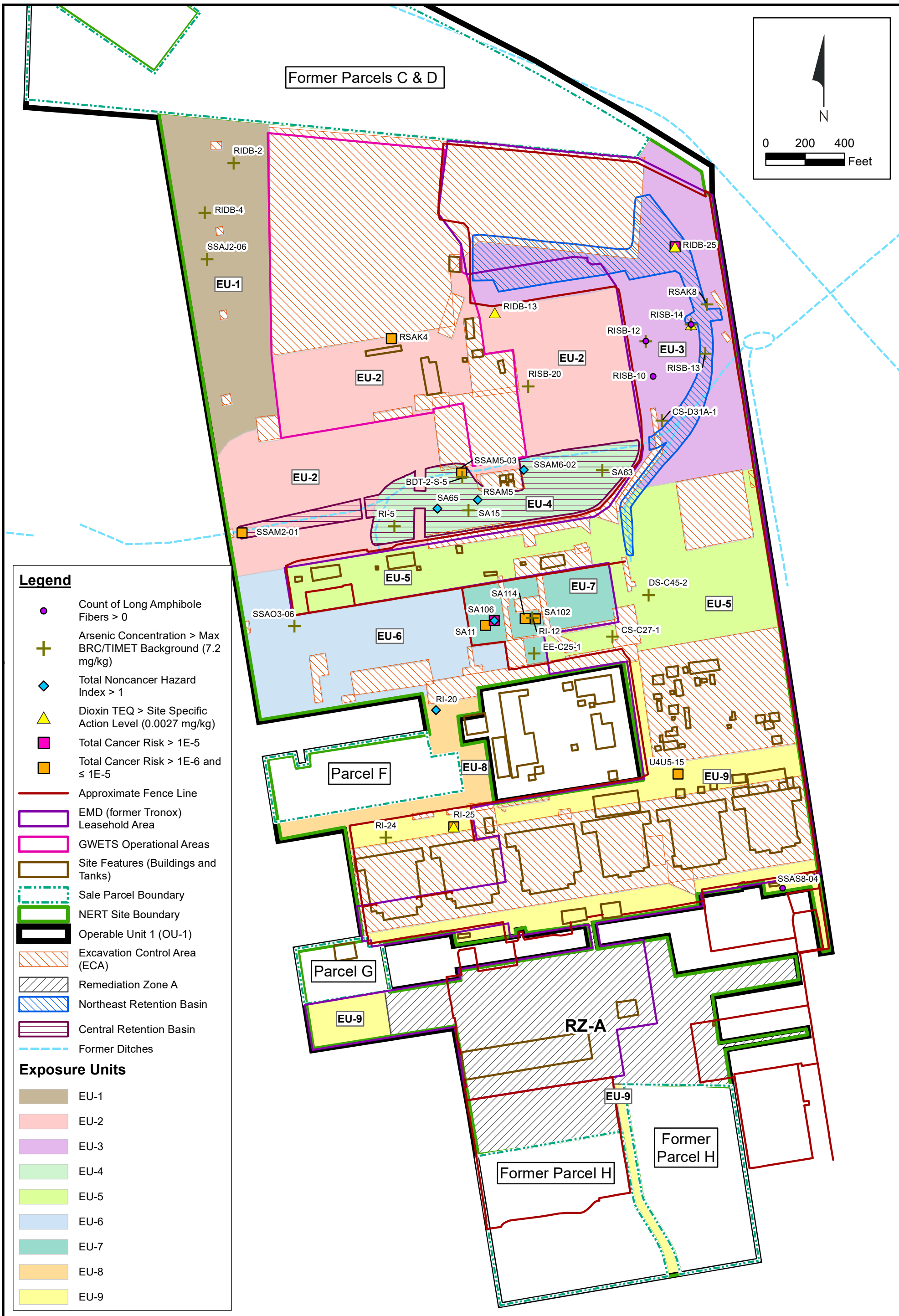
RAMBOLL

BHRA Study Area
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
ES-4

Drafter: RZ | Date: 3/1/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:



RAMBOLL

Exposure Units for OU-1 Soil BHRA
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
ES-5

Drafter: RS/YZ Date: 3/1/2022 Contract Number: 1690025040-003 Approved by: Revised:

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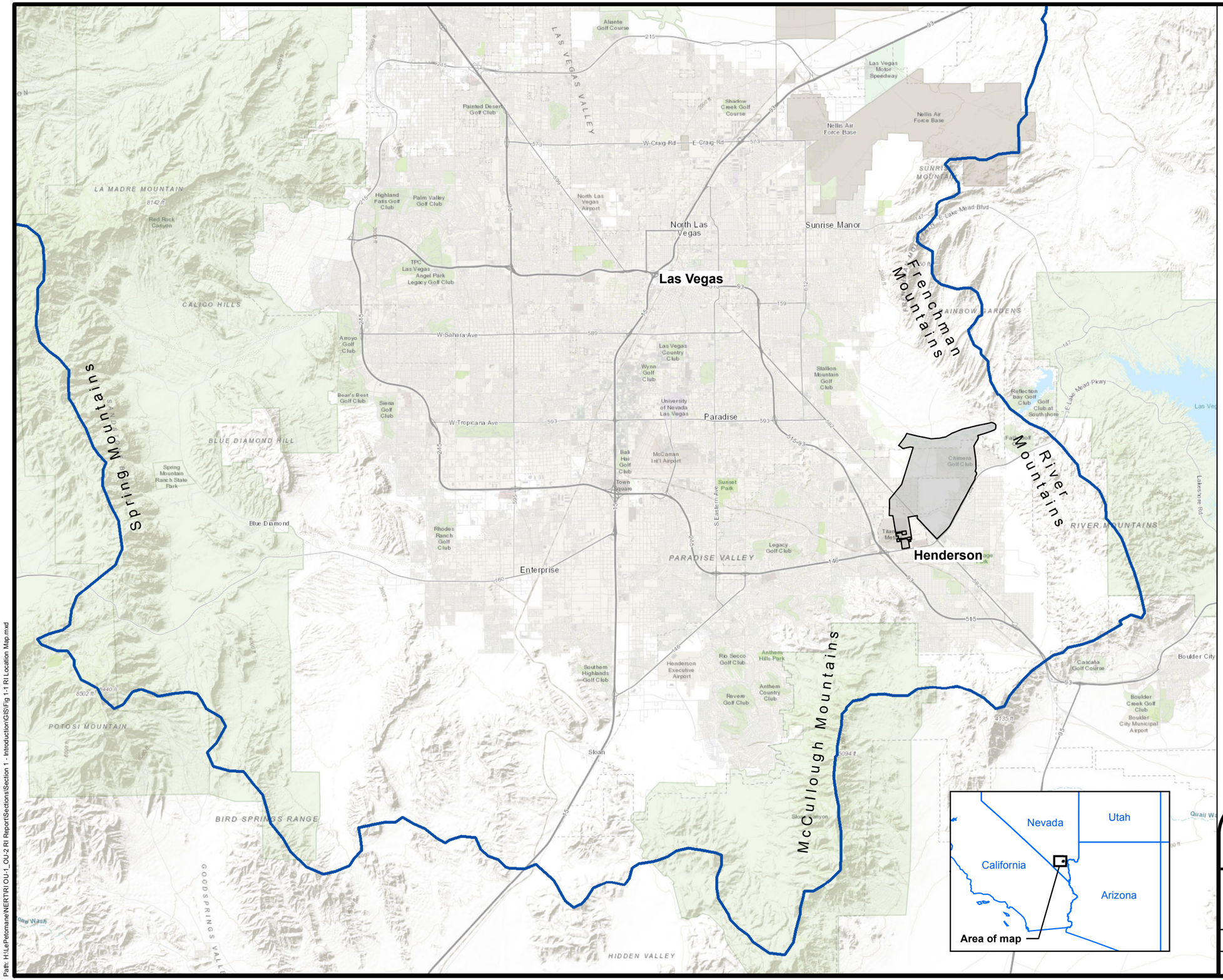

LEGEND:

- Las Vegas Valley Hydrologic Basin
- NERT RI Study Area

Note:
See Figure 1-2 for NERT RI Study Area details.

N

0 2.5 5 Miles

RAMBOLL

NERT RI Study Area Location Map

Nevada Environmental Response Trust Site
Henderson, Nevada

Date:	Contract Number:		Figure
3/1/2022	1690025040-003		1-1
Drafter: RS	Approved:	Revised:	

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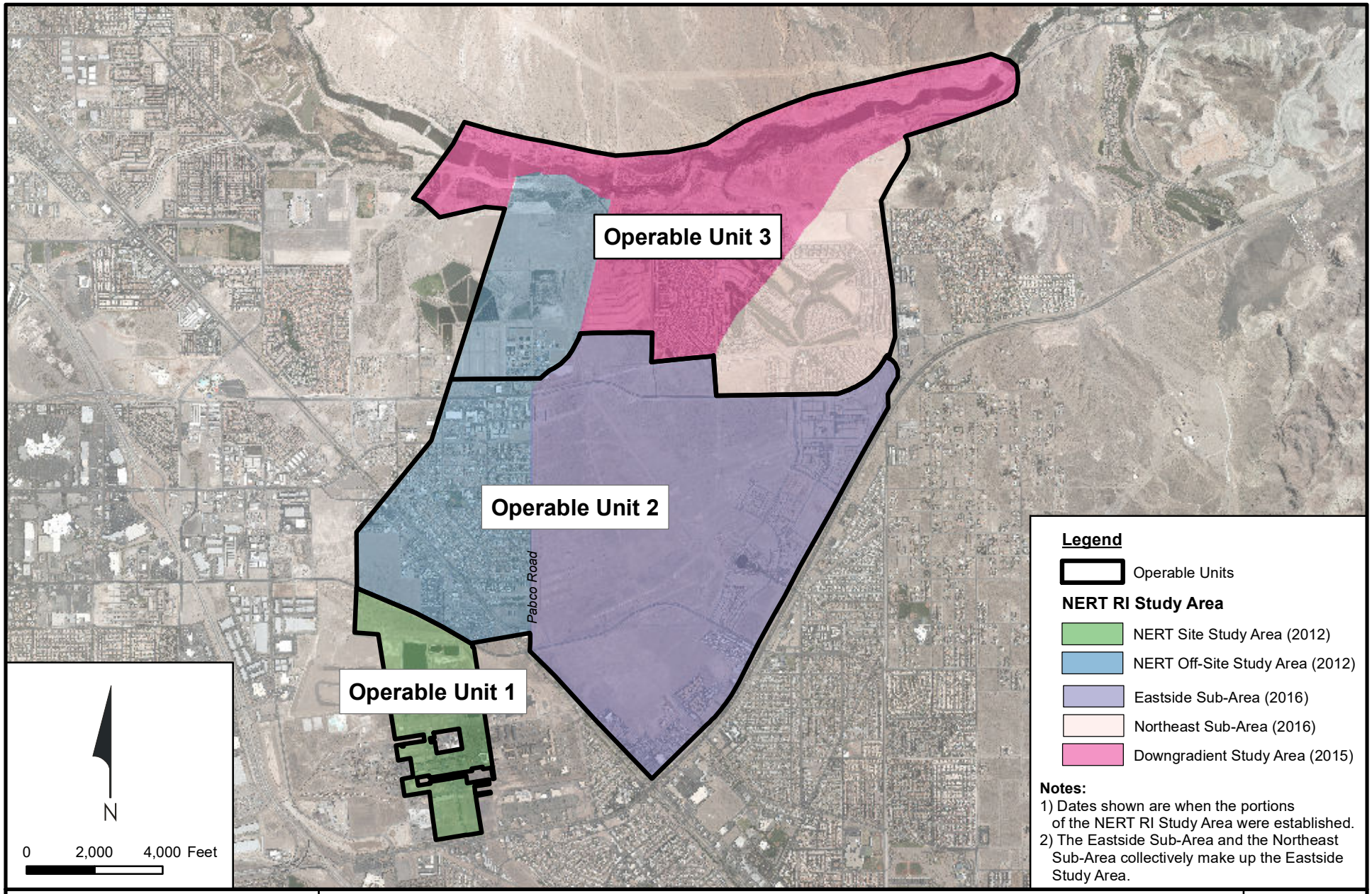


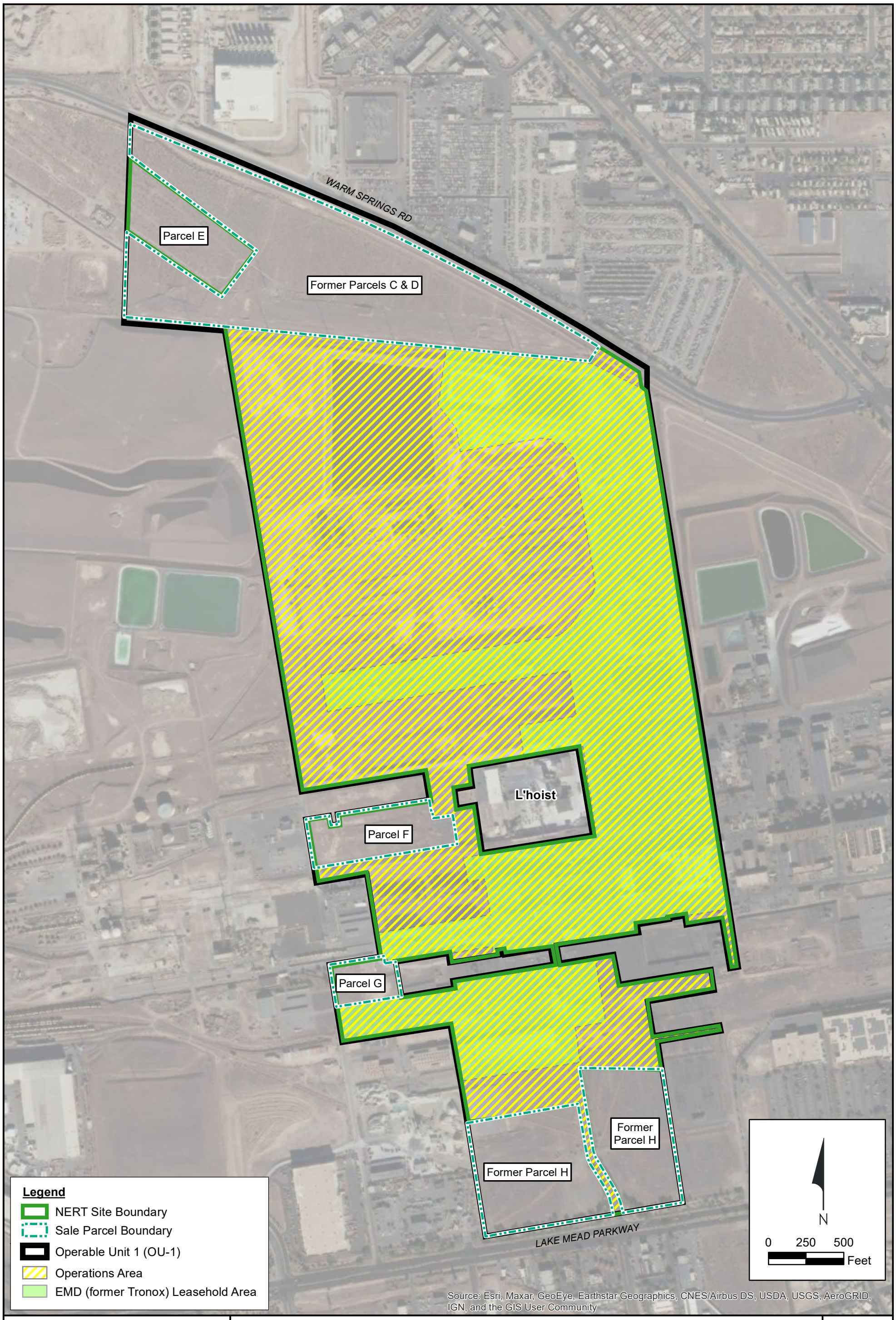
RAMBOLL

NERT RI Study Area Operable Units
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
1-2

Drafter: RS Date: 3/1/2022 Contract Number: 1690025040-003 Approved: Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Fig 1-2 RI Study Area Operable Units.mxd



RAMBOLL

Layout of Operable Unit 1
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
1-3

Drafter: RS | Date: 3/1/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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Parcel E
Former Parcels C & D
Warm Springs Rd
OU-2
WC-West Pond
WC-East Pond
Groundwater Holding Pond (GW-11)
BMI (CAMU)
Equalization Area
Groundwater Barrier Wall
Groundwater Treatment Plant (GWTP) (treats Hexavalent Chromium)
Interceptor Well Field (IWF) Area
Leasehold Debris Pile
AP-5 Process Tanks
Envirogen
Fluidized Bed Reactors (FBRs) (treats Perchlorate)
AP-6 Pond
Trust Office Trailer
Former AP-5 Pond (closed in 2019)
Former Beta Ditch
BT Tanks
Mn-1 Pond
Lab
Maintenance Building
Steam Plant
Mn-2 Pond
OU-1
Former Manganese Tailings Pile Area
Leach Plant
TIMET
Lhoist
Parcel F
Boron Production Facility
Unit 6
Unit 5
Unit 4
Unit 3
Unit 2
Unit 1
Wash/Change House/First Aid
Admin Building
WAPA
Parcel G
Training Facility
Warehouse
Industrial Supply
Former Parcel H
Former Parcel H
EMD Main Entrance
W Lake Mead Pkwy
N
0 250 500 Feet

Legend

- Operable Units
- NERT Site
- Former NERT-owned Property
- EMD (former Tronox) Leasehold Area
- Operations Area
- NERT Sale Parcels
- Leasehold Debris Pile
- Buildings, Ponds, and Tanks
- GWETS Operational Area
- Interceptor Well Field
- Groundwater Barrier Wall
- Former Ditches
- Former BMI Siphon Pipe
- Central Retention Basin
- Northern Retention Basin

Other Site Occupants

- Envirogen
- Industrial Supply

AERIAL SOURCE: SNWA, 2020.

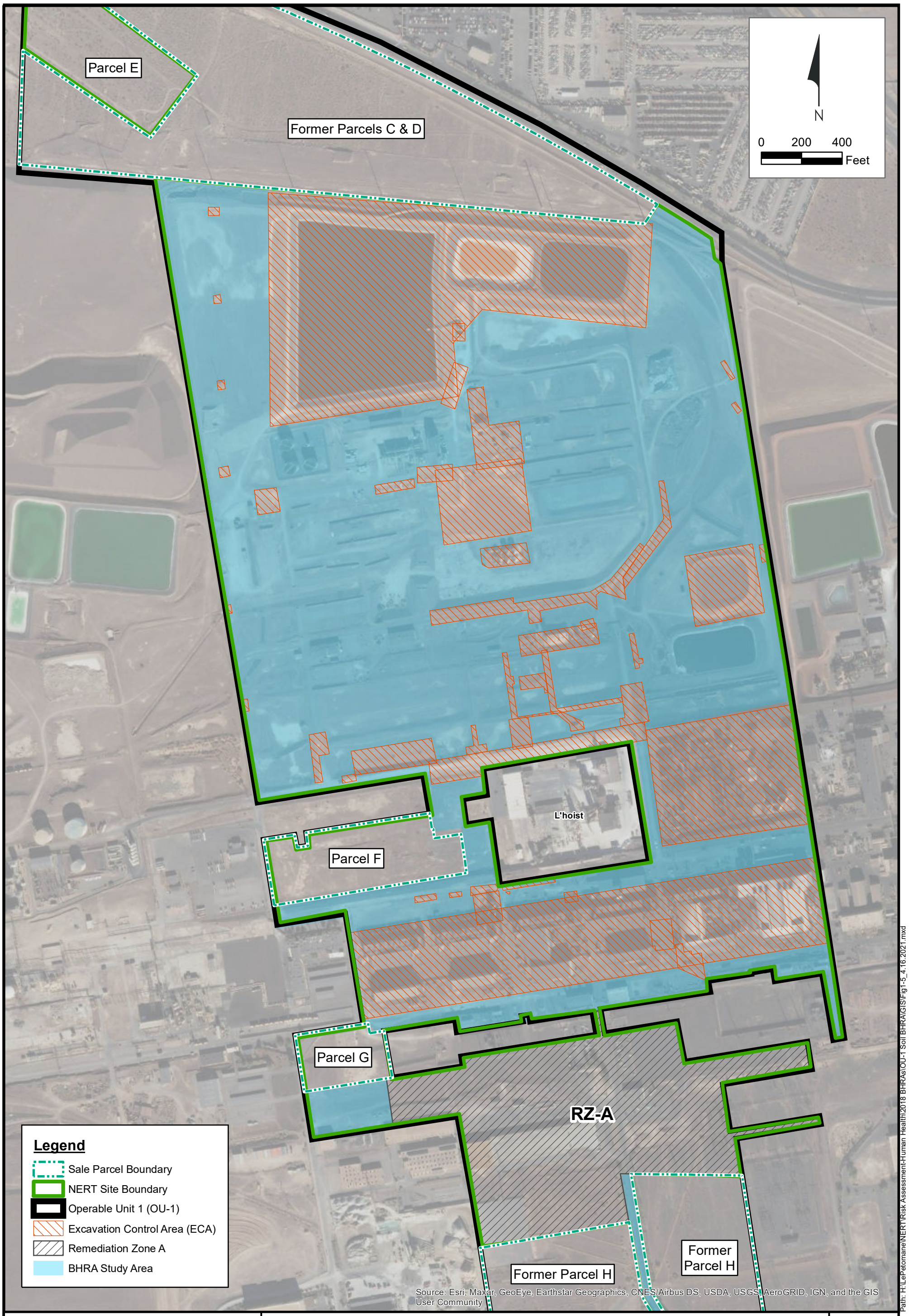
Path: \\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil Gas and Groundwater BHRA\GIS\Fig 1-4 Site Features.mxd

RAMBOLL

Operations Area Features
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
1-4

Drafter: RS/JC | Date: 3/1/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:



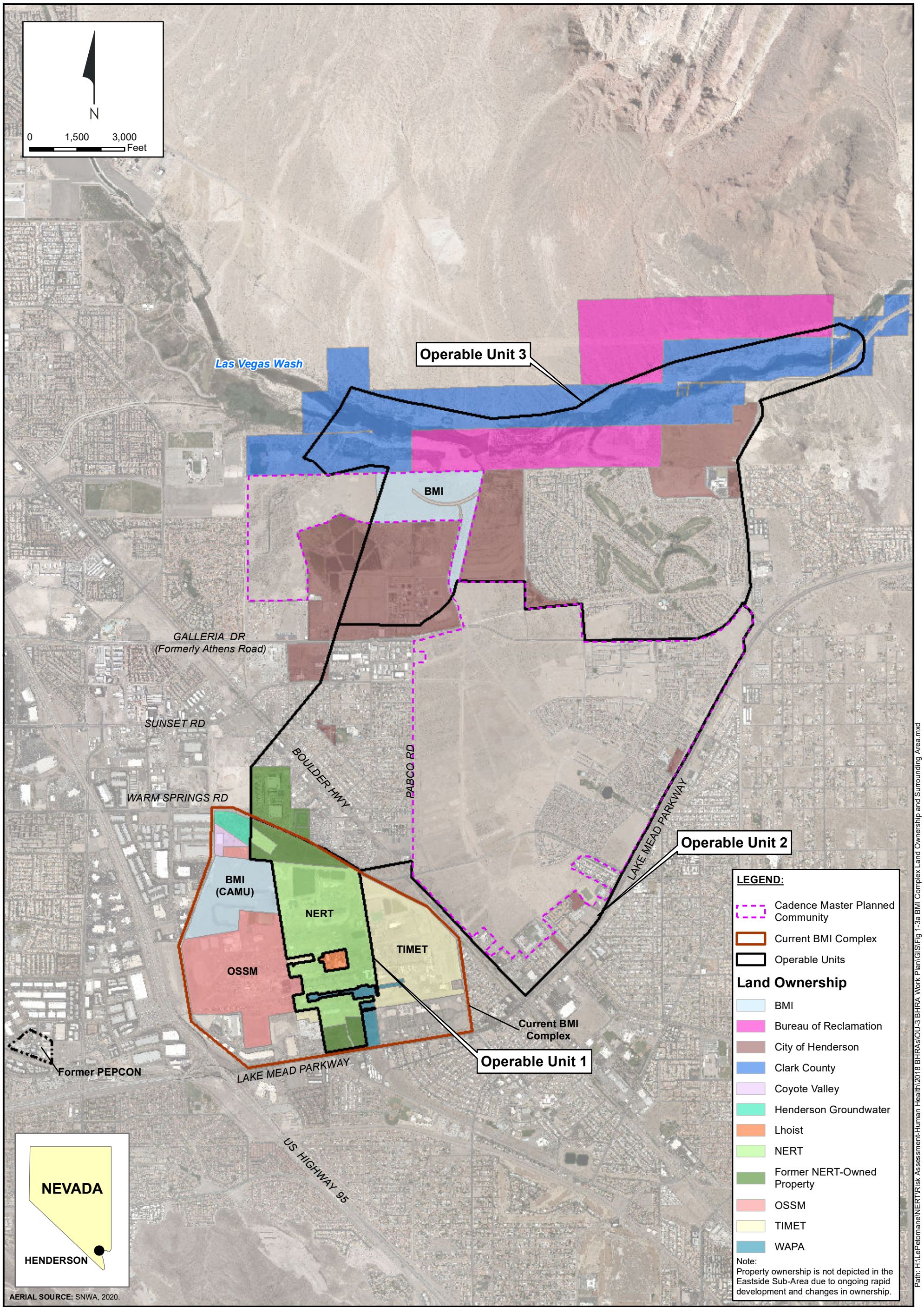
RAMBOLL

BHRA Study Area, Excavation Control Areas (ECAs), and Remediation Zone A (RZ-A)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
1-5

Drafter: RZ | Date: 3/1/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Fig1-5_4.16.2021.mxd

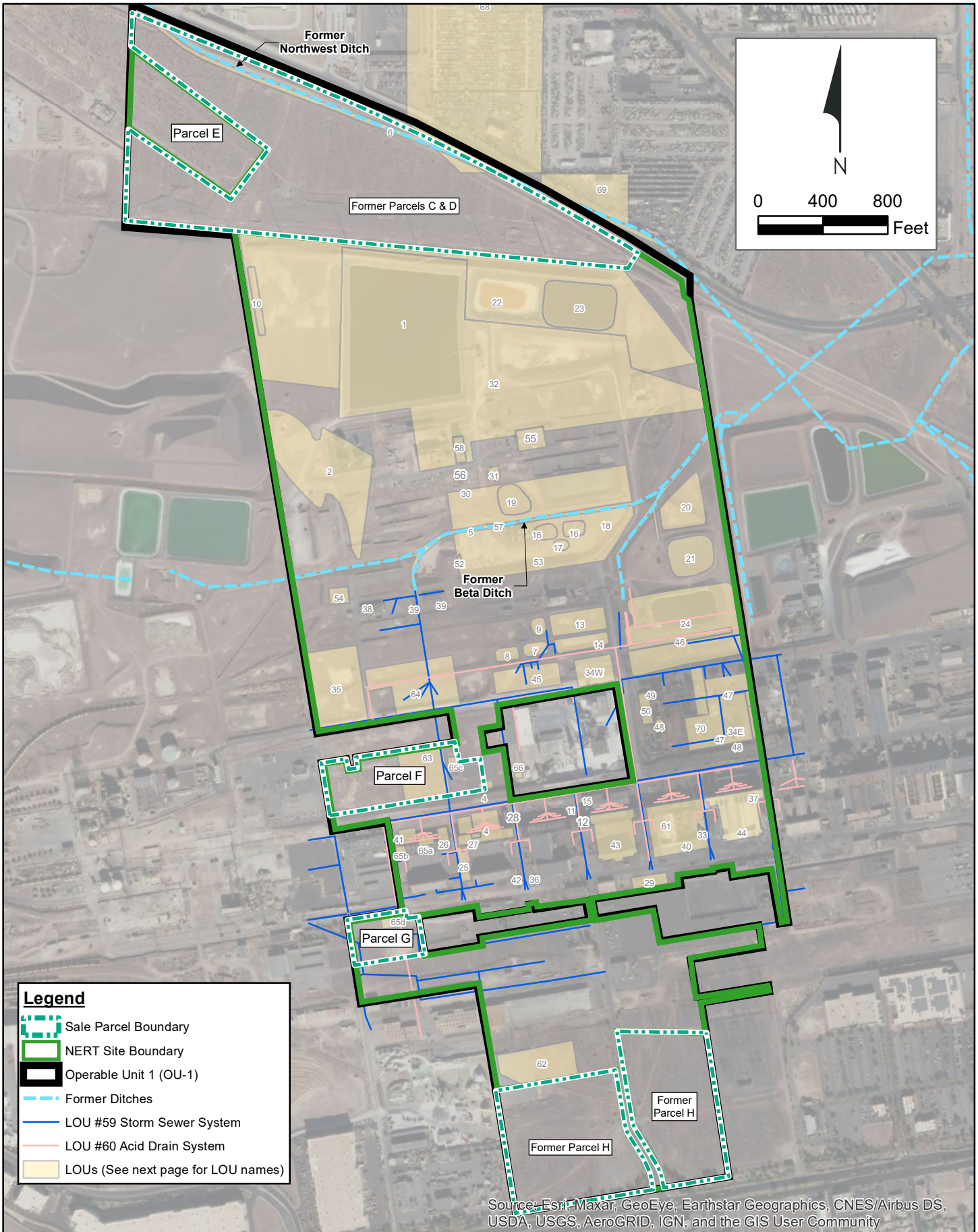


RAMBOLL

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

Figure
2-1

Drafter: RS/JC	Date: 02/25/2022	Contract Number: 1690025040-003	Approved by:	Revised:



Path: \\WCEVLFPS1\eng\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil Gas and Groundwater BHRA\GIS\Figure 2-2.mxd

RAMBOLL

Letter of Understanding (LOU) Map
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **2-2**

Drafter: RS | Date: 3/1/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

LOU Identification

LOU #	Name	LOU #	Name
1	Trade Effluent Settling Ponds	36	Former satellite accumulation point - Maintenance Shop
2	Open area south of Trade Effluent Settling Ponds area	37	Former satellite accumulation point - Unit 6 Maintenance Shop
3	Air emissions associated with industrial processes	38	Former satellite accumulation point - AP Change House & Laboratory
4	Hardesty Chemical Company Site	39	Satellite accumulation point - AP maintenance shop
5	On-Site portion of Beta Ditch + diversion ditch north of Pond C-1	40	PCB transformer spill
6	Unnamed drainage ditch segment	41	Unit 1 tenant stains
7	Old Pond P-2 and associated conveyance facilities	42	Unit 2 salt conveyor
8	Old P-3 Pond and associated conveyance facilities	43	Unit 4 and old Sodium Chlorate Plant decommissioning
9	New P-2 and associated piping	44	Unit 6 basement
10	On-Site Hazardous Waste Landfill	45	Diesel storage tanks
11	Sodium chlorate filter cake holding area	46	Former old main cooling tower and recirculation lines
12	Hazardous Waste Storage Area	47	Leach Plant area Mn ore piles (current & historic)
13	Pond S-1	48	Leach Plant analyte tanks
14	Pond P-1 and associated conveyance piping	49	Leach Plant area sulfuric acid storage tanks
15	Platinum drying unit	50	Leach Plant area leach lines
16/17	Ponds AP-1, AP-2, and AP-3 and associated transfer lines	51	Leach Plant area transfer lines
18	Pond AP-4	52	AP Plant area Screening Building, Dryer Building, and associated sump
19	Ponds AP-5 & AP-6	53	AP Plant area Tank Farm
20	Pond C-1 and associated piping	54	AP Plant area Change House / laboratory septic tank
21	Pond Mn-1 and associated piping	55	Area affected by July 1990 fire
22	Pond WC-W and associated piping	56	AP Plant area old building D-1 washdown
23	Pond WC-E and associated piping	57	AP Plant area transfer lines to sodium chlorate process
24	Leach beds, associated conveyance facilities and Mn tailings area	58	AP Plant area New D-1 Building washdown
25	Process hardware storage area	59	Storm sewer system
26	Trash storage area	60	Acid drain system
27	PCB storage area	61	Unit 5 basement & old Sodium Chlorate Plant decommission
28	Hazardous Waste Storage Area	62	State Industries, Inc site
29	Solid waste dumpsters	63	J.B. Kelley Trucking Inc. site
30	AP Plant area - Pad 35	64	Koch Materials Company site
31	Drum recycling area	65	Nevada precast concrete products, Green Ventures International, Buckles Construction Company, and Ebony Construction sites
32	Groundwater remediation unit	66	Above-ground diesel storage tank leased by Flintkote Company on Chemstar property
33	Sodium perchlorate platinum by-product filter	67	Delbert Madsen and estate of Delbert Madsen site
34	Former Mn tailings area	68	Southern Nevada Auto Parts site
35	Truck emptying/dumping site	69	Dillon Potter site
36	Former satellite accumulation point - Maintenance Shop	70	US Vanadium Leasehold

RAMBOLL

Letter of Understanding (LOU) Map

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **2-2**

Drafter: Date: 3/1/2022 Contract Number: 1690025040-003 Approved by: Revised:

Parcel E

Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Former Parcel H

Legend

- OU-1 Soil Sample Locations
- Sale Parcel Boundary
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRA\GIS\OU-1 Soil BHRA\GIS\Fig4-1_4.16.2021.mxd

RAMBOLL

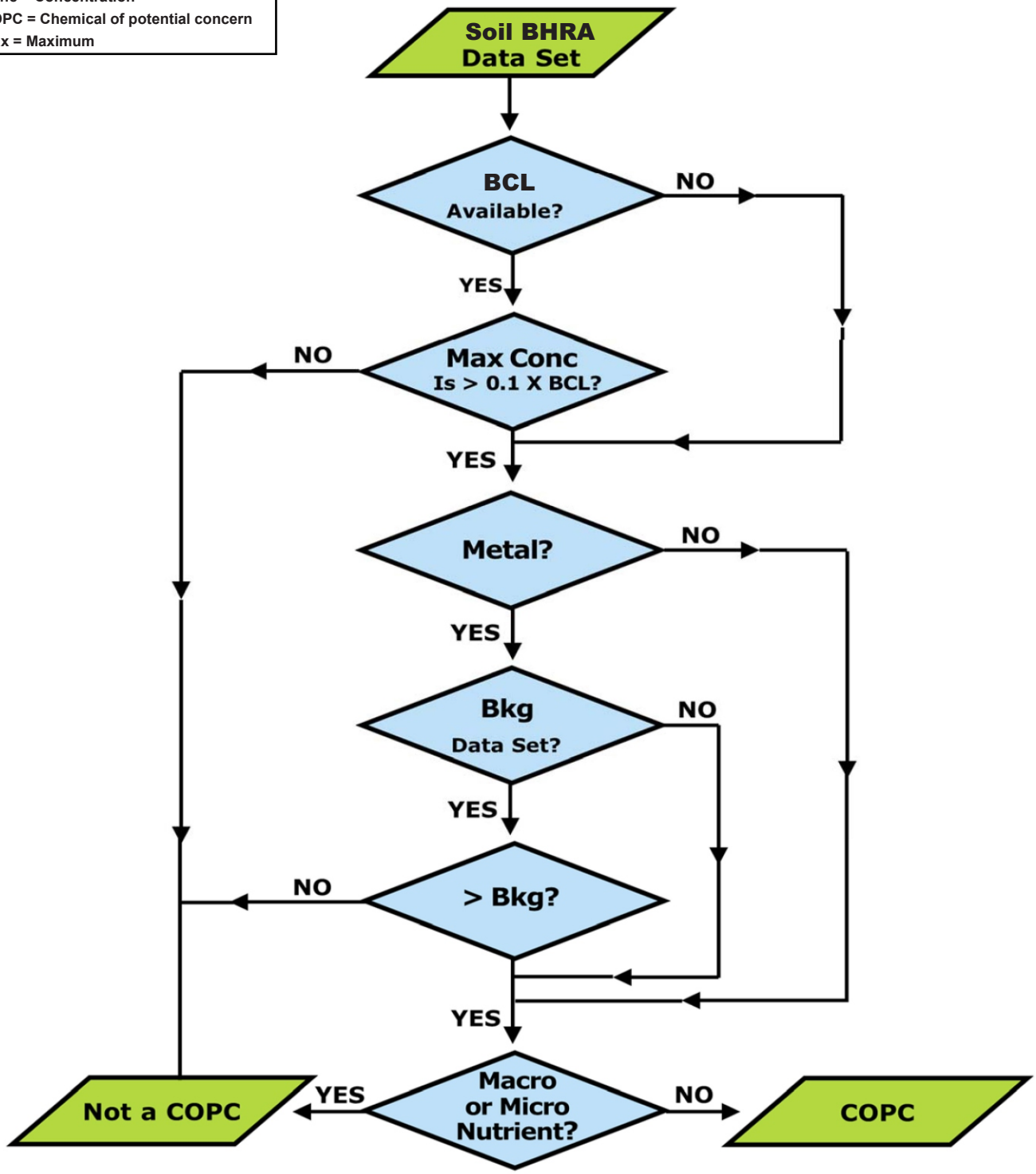
Soil Sampling Locations Included in the BHRA
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
4-1

Drafter: RC | Date: 3/1/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

Acronym

BCL = Basic comparison level
BHRA = Baseline health risk assessment
Bkg = Background
Conc = Concentration
COPC = Chemical of potential concern
Max = Maximum



Q:\DRAWINGS\NERT

RAMBOLL

DRAFTED BY: RS

DATE: 3/29/2022

Soil COPC Identification Flowchart

FIGURE
5-1

Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations
- Perchlorate less than detection limit
- Perchlorate < 0.1 BCL
- Perchlorate 0.1 BCL - BCL
- Perchlorate > BCL
- Chlorate less than detection limit
- Chlorate < 0.1 BCL
- Chlorate 0.1 BCL - BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Chlorate and Perchlorate

[Chlorate BCL = 38,900 mg/kg, Perchlorate BCL = 908 mg/kg]

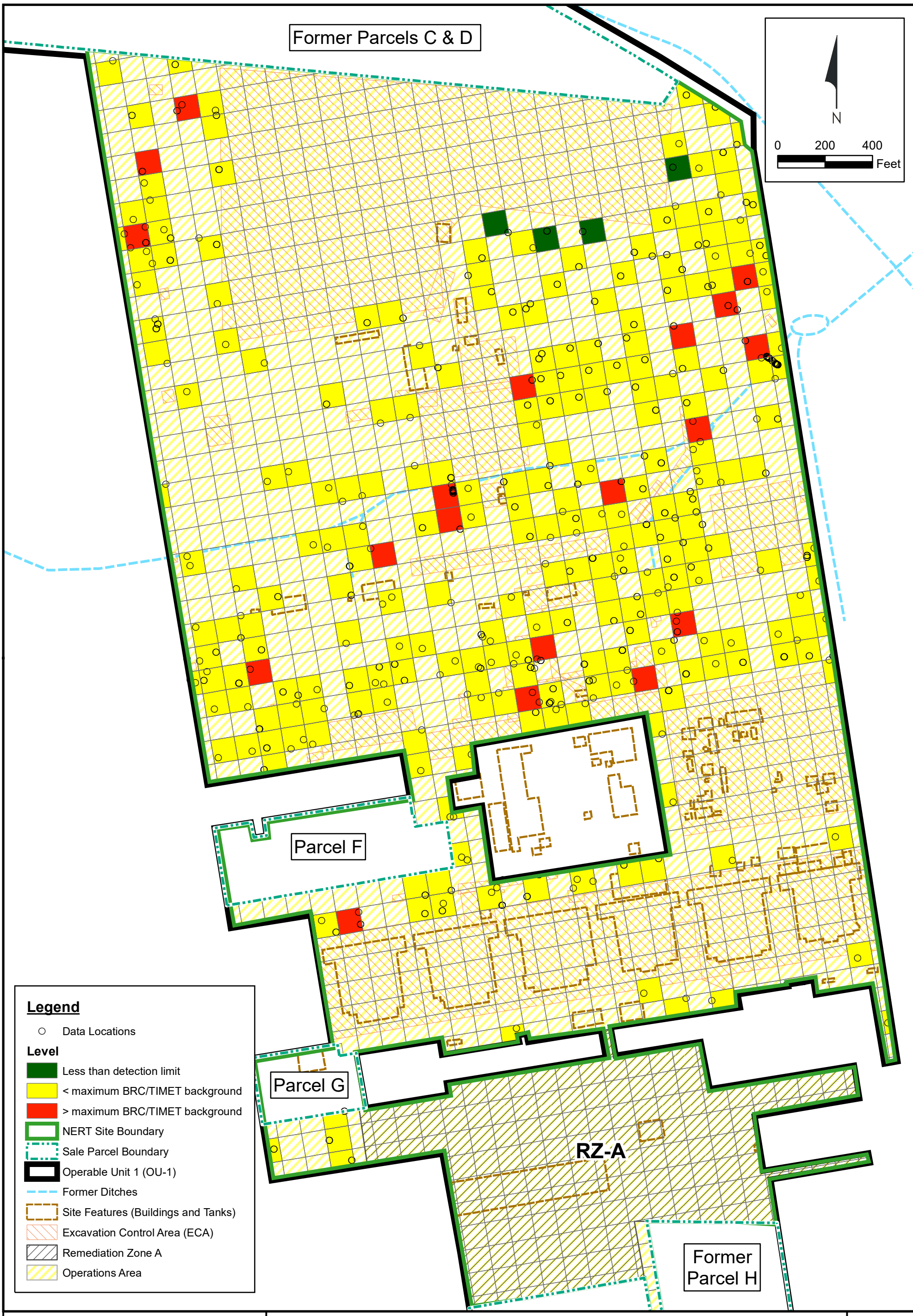
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-2

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\202104 OU-1\GIS\GIS 202104\OU-1_COPC_intensity202104-Perchlorate.mxd



RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Arsenic

[maximum BRC/TIMET background = 7.2 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-3**

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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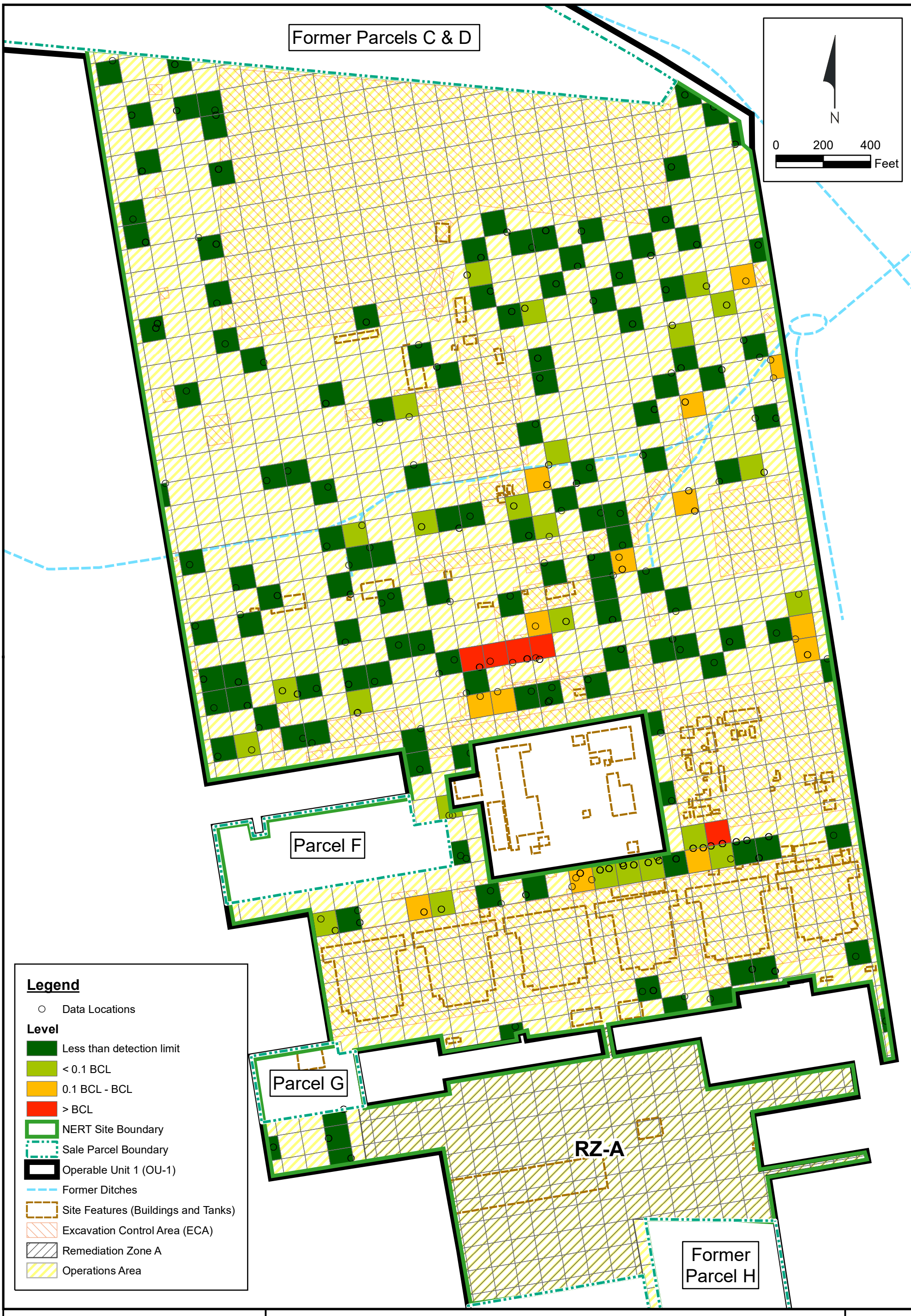

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Chromium VI

[BCL = 7 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-4**

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < 0.1 BCL
- 0.1 BCL - BCL
- > BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Cobalt

[BCL = 385 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-5

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < 0.1 BCL
- 0.1 BCL - BCL
- > BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Manganese

[BCL = 28,100 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-6

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

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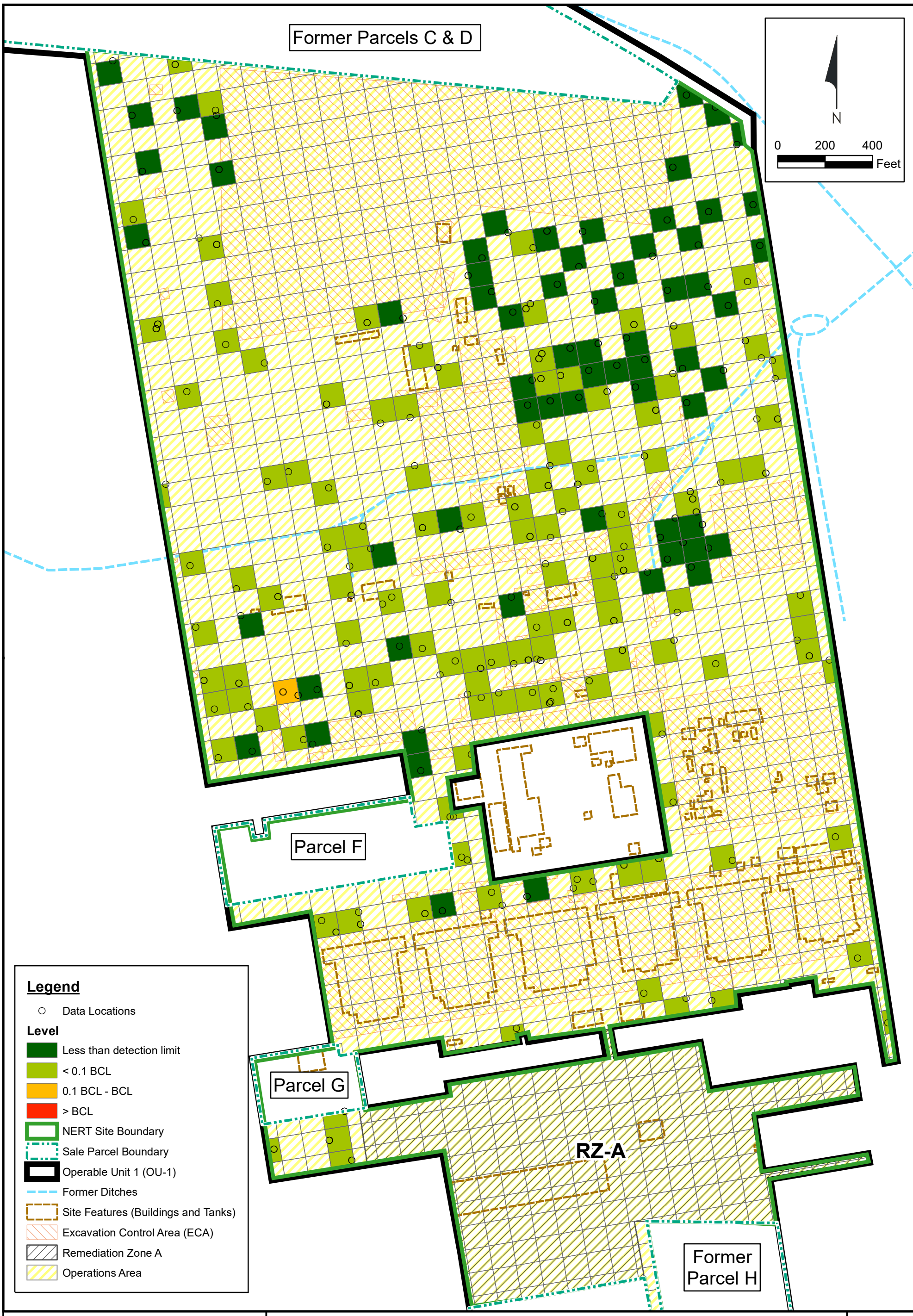

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Thallium

[BCL = 13 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-7**

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < 0.1 BCL
- 0.1 BCL - BCL
- > BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Zirconium

[BCL = 104 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-8

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < 0.1 BCL
- 0.1 BCL - BCL
- > BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Ammonia

[BCL = 6,140 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-9

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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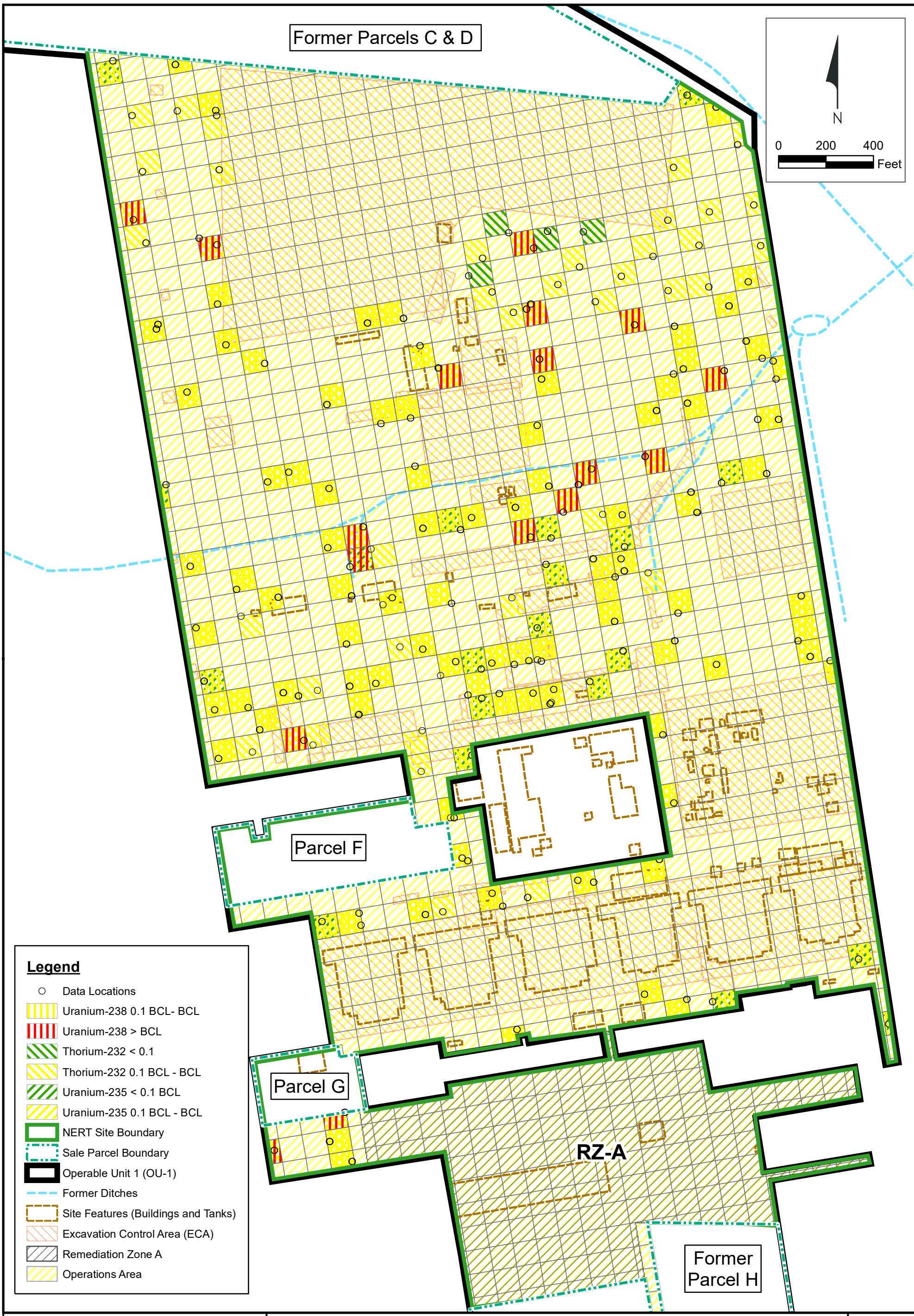

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Uranium-238 [BCL = 1.4 pCi/g], Thorium-232 [BCL = 7.4 pCi/g], and Uranium-235 [BCL = 0.35 pCi/g]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-10**

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < action level
- > action level
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Dioxin TEQs

[action level = 0.0027 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-11

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < 0.1 BCL
- 0.1 BCL - BCL
- > BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Benzo(a)pyrene Equivalents (BaPEqs)

[BCL = 0.32 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-12

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < 0.1 BCL
- 0.1 BCL - BCL
- > BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Naphthalene

[BCL = 18 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-13

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations
- 4,4'-DDT less than detection limit
- 4,4'-DDT < 0.1 BCL
- 4,4'-DDT 0.1 BCL - BCL
- 4,4'-DDE less than detection limit
- 4,4'-DDE < 0.1 BCL
- 4,4'-DDE 0.1 BCL - BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): 4,4'-DDE and 4,4'-DDT

[4,4'-DDE BCL = 9.5 mg/kg, 4,4'-DDT BCL = 7.5 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-14

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\202104 OU-1\GIS\GIS 202104\OU-1_COPC_intensity202104-DDT.mxd

Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations
- beta-BHC less than detection limit
- beta-BHC < 0.1 BCL
- beta-BHC 0.1 BCL - BCL
- Dieldrin less than detection limit
- Dieldrin < 0.1 BCL
- Dieldrin 0.1 BCL - BCL
- Toxaphene less than detection limit
- Toxaphene < 0.1 BCL
- Toxaphene 0.1 BCL - BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): beta-BHC [BCL = 1.7 mg/kg], Dieldrin [BCL= 0.16 mg/kg], and Toxaphene [BCL = 2.3 mg/kg]

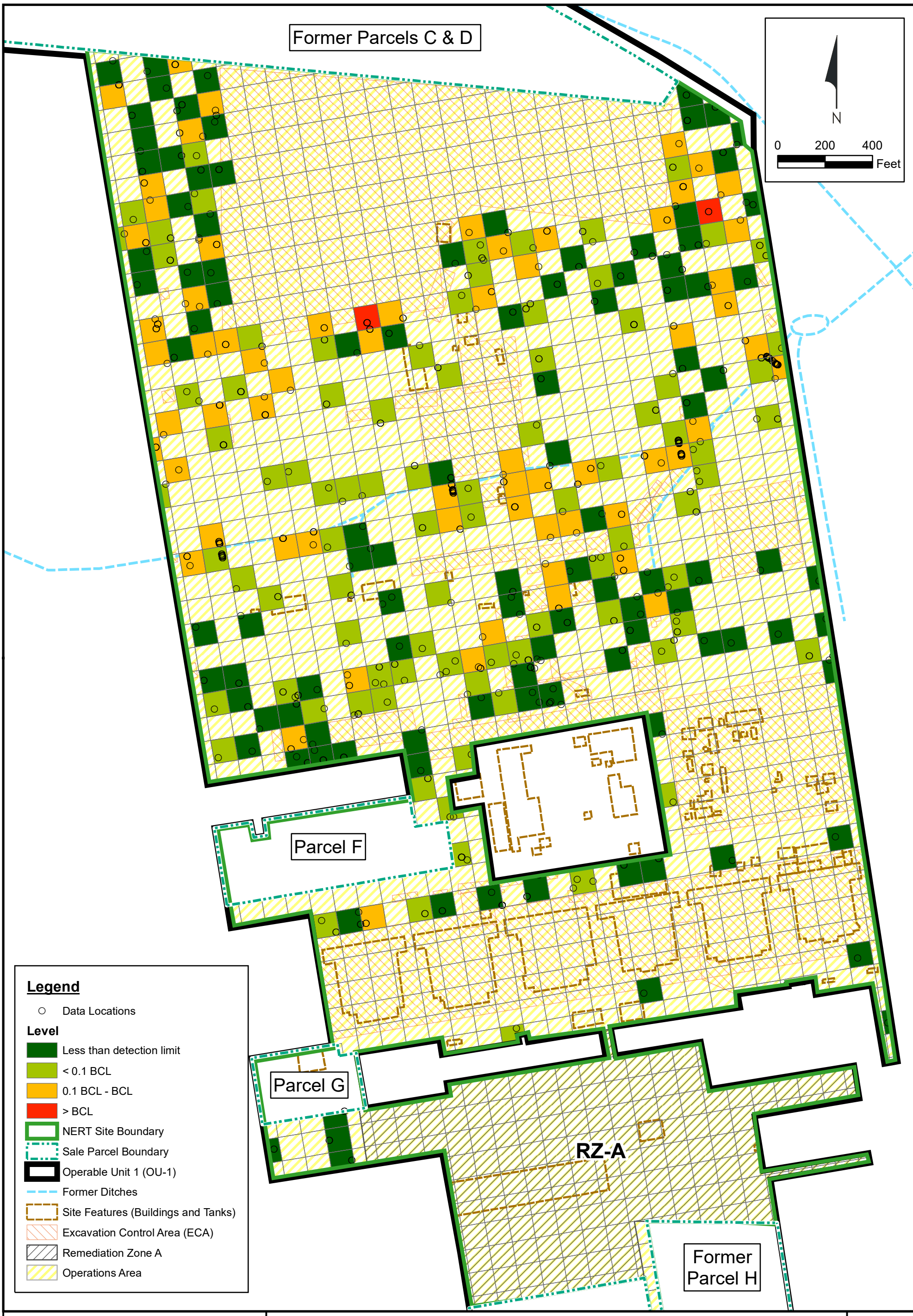
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-15

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\202104 OU-1\GIS\GIS 202104\OU-1_COPC_intensity202104-Dieldrin.mxd



RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Hexachlorobenzene

[BCL = 1.3 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **5-16**

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

- Data Locations

Level

- Less than detection limit
- < 0.1 BCL
- 0.1 BCL - BCL
- > BCL
- NERT Site Boundary
- Sale Parcel Boundary
- Operable Unit 1 (OU-1)
- Former Ditches
- Site Features (Buildings and Tanks)
- Excavation Control Area (ECA)
- Remediation Zone A
- Operations Area

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Bis(2-Ethylhexyl)phthalate

[BCL = 183 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-17

Drafter: YZ | Date: 4/4/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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Former Parcels C & D

N

0 200 400

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

Data Locations

Long Amphibole Fiber Count

0

1

2

3

Long Chrysotile Fiber Count

0

1

2

3

NERT Site Boundary

Sale Parcel Boundary

Operable Unit 1 (OU-1)

Former Ditches

Site Features (Buildings and Tanks)

Excavation Control Area (ECA)

Remediation Zone A

Operations Area

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\202104 OU-1\GIS\GIS 202104\OU-1_COPC_intensity202104-Fiber.mxd

RAMBOLL

Spatial Intensity Plot for BHRA Study Area Soils (0-10 ft bgs): Asbestos (Long Amphibole and Long Chrysotile Fibers)

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

5-18

Drafter: YZ Date: 4/4/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

RIDB-25 (0.025)

RIDB-13 (0.0046)

RISB-14 (0.0047)

RI-25 (0.011)

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

Dioxin TEQ (mg/kg)

- ≤ Site Specific Action Level (0.0027 mg/kg)
- > Site Specific Action Level (0.0027 mg/kg)
- Former Ditches
- Site Features (Buildings and Tanks)
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Sale Parcel Boundary
- Excavation Control Area (ECA)
- Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-1a_DioxinTEQ_0-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Dioxin TEQs
(Soil Samples 0-10 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-1a**

Drafter: SS Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

RIDB-25 (0.025)

RISB-14 (0.0047)

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

Dioxin TEQ (mg/kg)

- ≤ Site Specific Action Level (0.0027 mg/kg)
- > Site Specific Action Level (0.0027 mg/kg)
- Former Ditches
- Site Features (Buildings and Tanks)
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Sale Parcel Boundary
- Excavation Control Area (ECA)
- Remediation Zone A

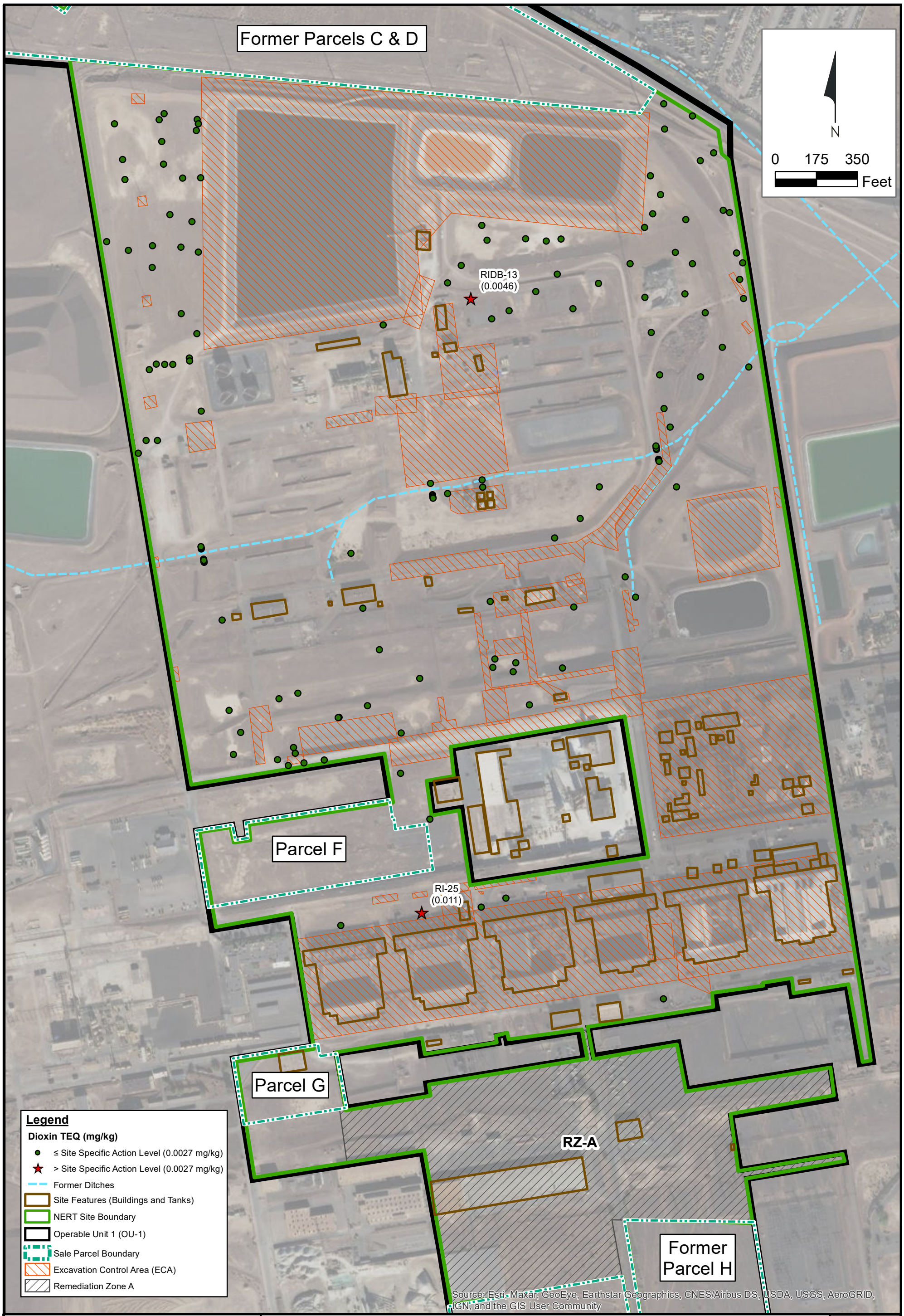
Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-1b_DioxinTEQ_0-2.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Dioxin TEQs
(Soil Samples 0-2 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-1b**

Drafter: SS | Date: 3/29/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:



Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-1c_DioxinTEQ_2-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Dioxin TEQs
(Soil Samples 2-10 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
6-1c

Drafter: SS | Date: 3/29/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

Former Parcels C & D

RIDB-2 (11)
RIDB-4 (15)
SSAJ2-06 (19)
RSAK8 (12)
RISB-12 (9.8)
RISB-14 (9.0)
RISB-13 (9.0)
RISB-20 (8.6)
CS-D31A-1 (8.1)
BDT-2-S-5 (10)
SA63 (7.5)
RI-5 (15)
SA15 (11)
DS-C45-2 (12)
RI-12 (7.4)
SSAO3-06 (16)
CS-C27-1 (11)
EE-C25-1 (34)
RI-24 (8.6)

Parcel F
Parcel G
RZ-A
Former Parcel H

N
0 175 350
Feet

Legend

Arsenic (mg/kg)

- ≤ Max BRC/TIMET Background (7.2 mg/kg)
- > Max BRC/TIMET Background (7.2 mg/kg)
- Former Ditches
- Site Features (Buildings and Tanks)
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Sale Parcel Boundary
- Excavation Control Area (ECA)
- Remediation Zone A

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-2a_Arsenic_0-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Arsenic
(Soil Samples 0-10 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
6-2a

Drafter: SS Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

RISB-14 (9.0)

RISB-12 (9.8)

RISB-20 (8.6)

BDT-2-S-5 (10)

DS-C45-2 (12)

Parcel F

RI-24 (8.6)

Parcel G

RZ-A

Former Parcel H

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

Legend

Arsenic (mg/kg)

- ≤ Max BRC/TIMET Background (7.2 mg/kg)
- > Max BRC/TIMET Background (7.2 mg/kg)
- Former Ditches
- Site Features (Buildings and Tanks)
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Sale Parcel Boundary
- Excavation Control Area (ECA)
- Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-2b_Arsenic_0-2.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Arsenic
(Soil Samples 0-2 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
6-2b

Drafter: SS Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

RIDB-2 (11)

RIDB-4 (15)

SSAJ2-06 (19)

RSAK8 (12)

RISB-12 (9.6)

RISB-13 (9.0)

CS-D31A-1 (8.1)

SA63 (7.5)

BDT-2-S-5 (9.0)

SA15 (11)

RI-5 (15)

RI-12 (7.4)

CS-C27-1 (11)

SSAO3-06 (16)

EE-C25-1 (34)

Parcel F

Parcel G

RZ-A

Former Parcel H

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

Legend

Arsenic (mg/kg)

- ≤ Max BRC/TIMET Background (7.2 mg/kg)
- > Max BRC/TIMET Background (7.2 mg/kg)
- Former Ditches
- Site Features (Buildings and Tanks)
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Sale Parcel Boundary
- Excavation Control Area (ECA)
- Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-2c_Arsenic_2-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Arsenic
(Soil Samples 2-10 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
6-2c

Drafter: SS Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

RIDB-25 (2E-5)

RSAK4 (2E-6)

SSAM5-03 (2E-6)

SSAM2-01 (2E-6)

SA106 (2E-5)

SA102 (3E-6)

SA11 (2E-6)

SA114 (9E-6)

U4U5-15 (2E-6)

RI-25 (6E-6)

Parcel F

Parcel G

RZ-A

Former Parcel H

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

Legend

Cancer Risk

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4

Former Ditches

Site Features (Buildings and Tanks)

NERT Site Boundary

Operable Unit 1 (OU-1)

Sale Parcel Boundary

Excavation Control Area (ECA)

Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-3a_Cancer_0-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Cancer Risk
(Soil Samples 0-10 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-3a**

Drafter: JA Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

RIDB-25
(2E-5)

RSAK4
(2E-6)

SA102
(3E-6)

Parcel F

Parcel G

RZ-A

Former
Parcel H

Legend

Cancer Risk

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- Former Ditches
- Site Features (Buildings and Tanks)
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Sale Parcel Boundary
- Excavation Control Area (ECA)
- Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-3b_Cancer_0-2.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Cancer Risk
(Soil Samples 0-2 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
6-3b

Drafter: JA Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

SSAM5-03
(2E-6)

SSAM2-01
(2E-6)

SA106
(2E-5)

SA114
(9E-6)

SA11
(2E-6)

U4U5-15
(2E-6)

RI-25
(6E-6)

Parcel F

Parcel G

RZ-A

Former
Parcel H

Legend

Cancer Risk

- ≤ 1E-6
- > 1E-6 and ≤ 1E-5
- > 1E-5 and ≤ 1E-4
- Former Ditches
- Site Features (Buildings and Tanks)
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Sale Parcel Boundary
- Excavation Control Area (ECA)
- Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-3c_Cancer_2-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Cancer Risk
(Soil Samples 2-10 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
6-3c

Drafter: JA Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

SSAM6-02
(2)

RSAM5
(3)

SA65
(2)

SA106
(2)

RI-20
(3)

Parcel F

Parcel G

RZ-A

Former
Parcel H

Legend

Noncancer Hazard Index

- ≤ 1
- > 1

Former Ditches

Site Features (Buildings and Tanks)

NERT Site Boundary

Operable Unit 1 (OU-1)

Sale Parcel Boundary

Excavation Control Area (ECA)

Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-4a_Noncancer_0-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Noncancer Hazard Indices (Soil Samples 0-10 ft bgs)

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-4a**

Drafter: RC Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

SSAM6-02
(2)

RSAM5
(3)

SA65
(2)

Parcel F

Parcel G

RZ-A

Former
Parcel H

Legend

Noncancer Hazard Index

- ≤ 1
- > 1

Former Ditches

Site Features (Buildings and Tanks)

NERT Site Boundary

Operable Unit 1 (OU-1)

Sale Parcel Boundary

Excavation Control Area (ECA)

Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-4b_Noncancer_0-2.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Noncancer Hazard Indices (Soil Samples 0-2 ft bgs)

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-4b**

Drafter: RC Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

SSAM6-02
(2)

SA106
(2)

RI-20
(3)

Parcel F

Parcel G

RZ-A

Former
Parcel H

Legend

Noncancer Hazard Index

- ≤ 1
- > 1

Former Ditches

Site Features (Buildings and Tanks)

NERT Site Boundary

Operable Unit 1 (OU-1)

Sale Parcel Boundary

Excavation Control Area (ECA)

Remediation Zone A

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-4c_Noncancer_2-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Noncancer Hazard Indices (Soil Samples 2-10 ft bgs)

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-4c**

Drafter: RC Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

Radionuclide Cancer Risk

- ≤ 1E-4
- 2E-4

Former Ditches

Site Features (Buildings and Tanks)

Sale Parcel Boundary

NERT Site Boundary

Operable Unit 1 (OU-1)

Excavation Control Area (ECA)

Remediation Zone A

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-5a_Radio_0-10.mxd

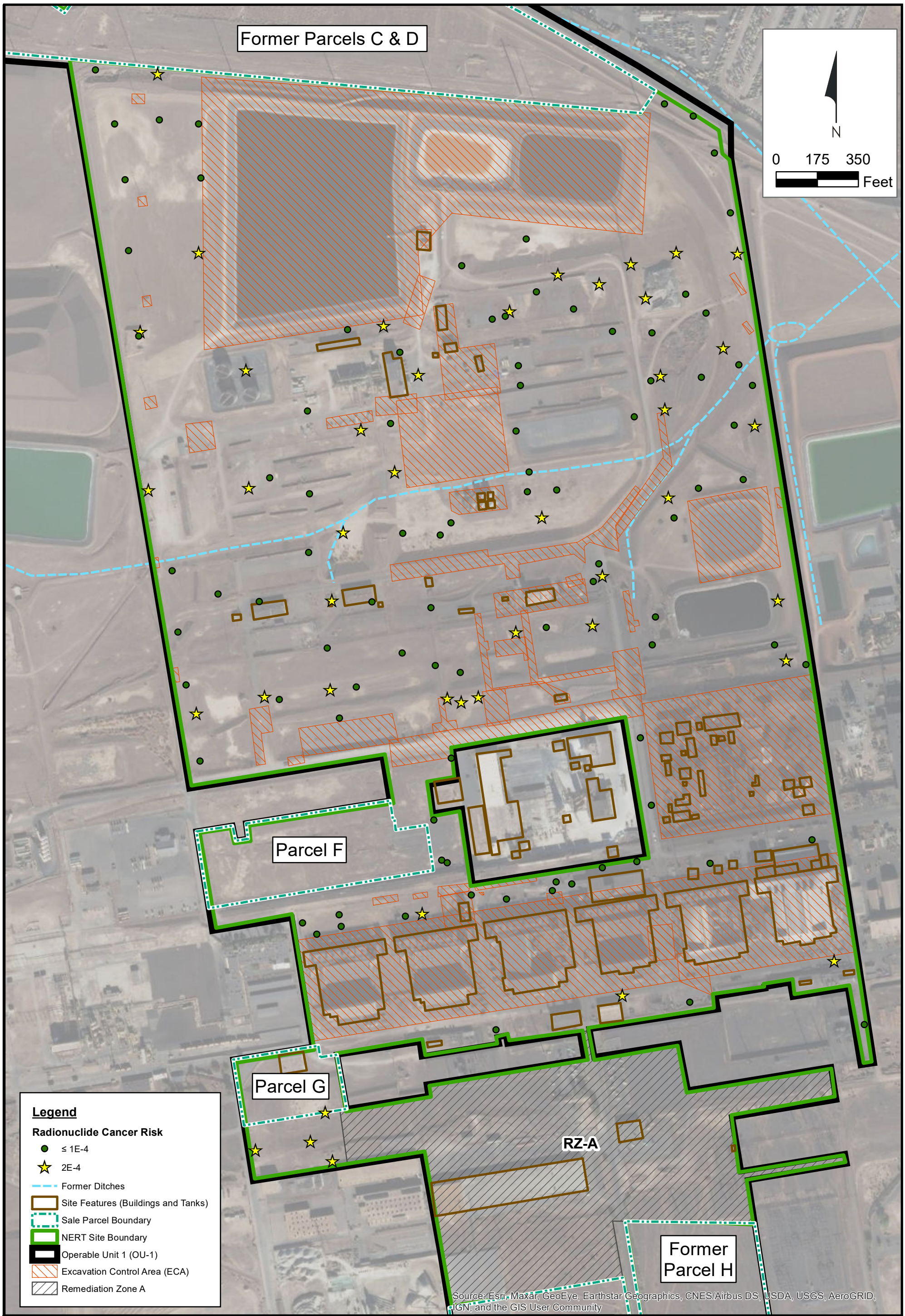
RAMBOLL

Spatial Concentration/Risk Plot for Radionuclide Cancer Risk (Soil Samples 0-10 ft bgs)

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-5a**

Drafter: RC Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:



Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-5b_Radio_0-2.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Radionuclide Cancer Risk (Soil Samples 0-2 ft bgs)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-5b**

Drafter: RC | Date: 3/29/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

Former Parcels C & D

N

0 175 350

Feet

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

Radionuclide Cancer Risk

- ≤ 1E-4
- 2E-4

Former Ditches

Site Features (Buildings and Tanks)

Sale Parcel Boundary

NERT Site Boundary

Operable Unit 1 (OU-1)

Excavation Control Area (ECA)

Remediation Zone A

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-5c_Radio_2-10.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Radionuclide Cancer Risk (Soil Samples 2-10 ft bgs)

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-5c**

Drafter: RC Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 175 350

Feet

RISB-14 (1)

RISB-12 (1)

RISB-10 (1)

SSAS8-04 (3)

Parcel F

Parcel G

RZ-A

Former Parcel H

Legend

Count of Long Amphibole Fibers

- 0
- 1 - 3

Former Ditches

Site Features (Buildings and Tanks)

Sale Parcel Boundary

NERT Site Boundary

Operable Unit 1 (OU-1)

Excavation Control Area (ECA)

Remediation Zone A

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-6_Amphibole.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Long Amphibole Fibers (Surface Soil Samples)

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-6**

Drafter: RC Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

RSAH3 (1)

SA18 (2)

RSAK4 (1)

RSAL5 (1)

RISB-12 (2)

SSAL3-03 (3)

SA123 (3)

SSAM7-08 (1)

SSAL2-03 (3)

SA64 (1)

SSAN4-01 (2)

SA85 (1)

SSAN6-05 (1)

SA185 (1)

RSAP5 (2)

SA103 (2)

SA08 (2)

SA07 (1)

Parcel F

SSAQ4-01 (3)

SA212 (1)

SA121 (3)

SSAQ3-04 (2)

SA122 (2)

RSAS5 (1)

SSAS8-02 (1)

Parcel G

TSB-GJ-02 (1)

TSB-GR-02 (1)

RZ-A

Former Parcel H

N

0 175 350

Feet

Legend

Count of Long Chrysotile Fibers

- 0
- 1 - 3
- Former Ditches
- Site Features (Buildings and Tanks)
- Sale Parcel Boundary
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Excavation Control Area (ECA)
- Remediation Zone A

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 6-7_Chrysotile.mxd

RAMBOLL

Spatial Concentration/Risk Plot for Long Chrysotile Fibers (Surface Soil Samples)
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **6-7**

Drafter: RC Date: 3/29/2022 Contract Number: 1690025040-003 Approved by: Revised:

Former Parcels C & D

N

0 200 400

Feet

RIDB-2
RIDB-4
SSAJ2-06
EU-1
RIDB-25
RSAK8
RIDB-13
RISB-14
RISB-12
RSAK4
EU-3
EU-2
EU-2
RISB-13
RISB-20
RISB-10
CS-D31A-1
SSAM5-03
SSAM6-02
SA63
EU-2
BDT-2-S-5
RSAM5
SA65
EU-4
SA15
RI-5
SSAM2-01
EU-5
EU-7
DS-C45-2
SA114
EU-5
SA106
SA102
SSAO3-06
SA11
RI-12
CS-C27-1
EU-6
EE-C25-1
RI-20
Parcel F
EU-8
U4U5-15
EU-9
RI-25
RI-24
SSAS8-04
Parcel G
EU-9
RZ-A
EU-9
Former Parcel H
Former Parcel H

Legend

- Count of Long Amphibole Fibers > 0
- Arsenic Concentration > Max BRC/TIMET Background (7.2 mg/kg)
- Total Noncancer Hazard Index > 1
- Dioxin TEQ > Site Specific Action Level (0.0027 mg/kg)
- Total Cancer Risk > 1E-5
- Total Cancer Risk > 1E-6 and ≤ 1E-5
- Approximate Fence Line
- EMD (former Tronox) Leasehold Area
- GWETS Operational Areas
- Site Features (Buildings and Tanks)
- Sale Parcel Boundary
- NERT Site Boundary
- Operable Unit 1 (OU-1)
- Excavation Control Area (ECA)
- Remediation Zone A
- Northeast Retention Basin
- Central Retention Basin
- Former Ditches

Exposure Units

- EU-1
- EU-2
- EU-3
- EU-4
- EU-5
- EU-6
- EU-7
- EU-8
- EU-9

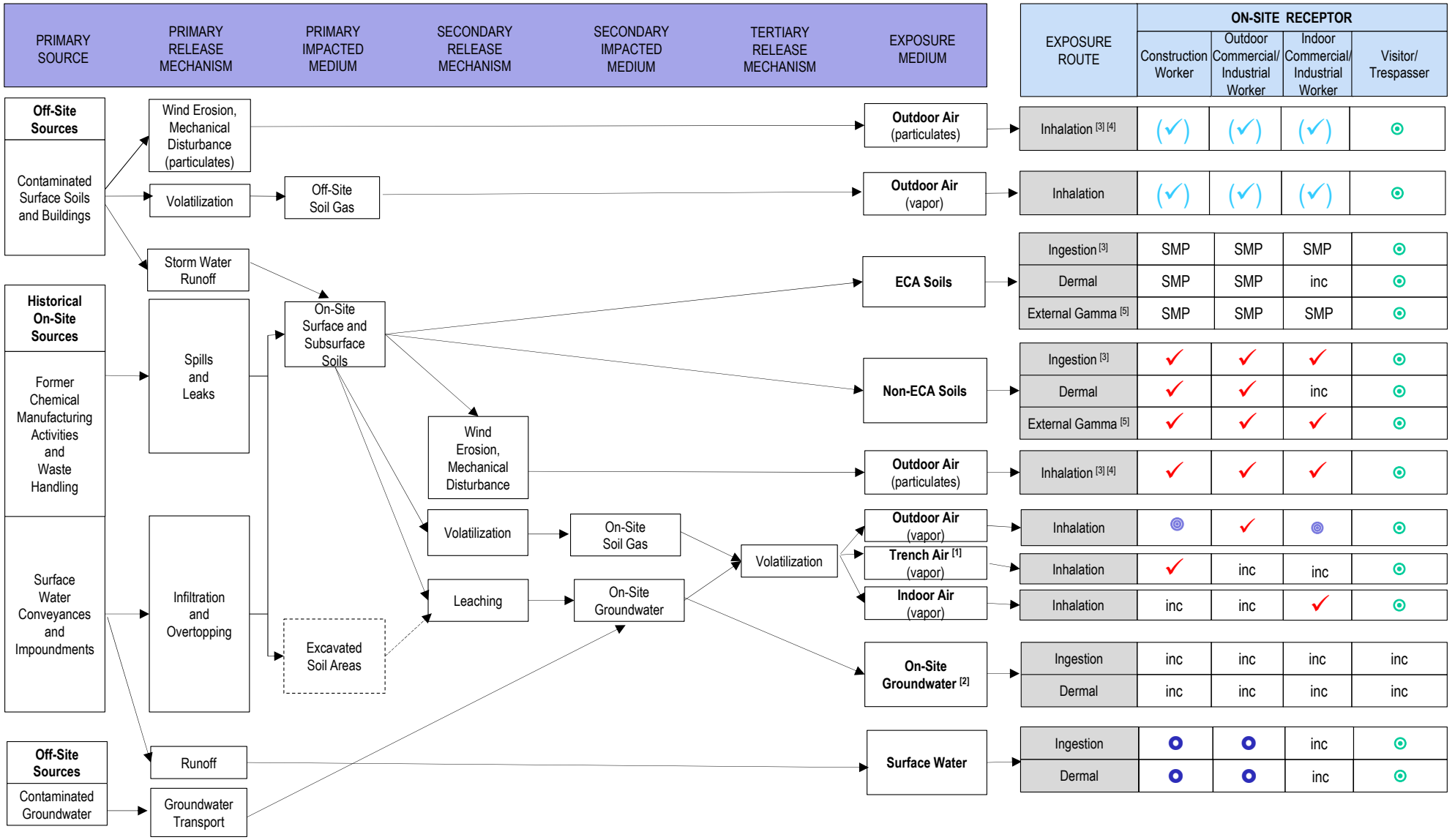
RAMBOLL

Exposure Units for OU-1 Soil BHRA
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
6-8

Drafter: RS/YZ Date: 3/1/2022 Contract Number: 1690025040-003 Approved by: Revised:

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\C



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RAMBOLL

Conceptual Site Model for OU-1 Operations Area
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **7-1**

Drafter: EL Date: 3/1/2022 Contract Number: 1690025040-003 Approved by: Revised:

Notes:

BHRA	Baseline health risk assessment
ECA	Excavation control area
NDEP	Nevada Division of Environmental Protection
OSHA	Occupational Safety and Health Administration
OU	Operable unit
VOC	Volatile organic compound
[1]	To be conservative, construction workers are assumed to be exposed to vapors migrating from soil/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 on-site groundwater is not and will not be used as a source of drinking water. Incidental ingestion of and dermal contact with groundwater by on-site construction workers are considered to be incomplete exposure pathways because depth to groundwater is >10 feet below ground surface.
[3]	Includes radionuclide exposures, if applicable.
[4]	Includes asbestos exposures.
[5]	Only radionuclide exposures, if applicable.

Key:

inc	Incomplete exposure pathway
SMP	Site Management Plan -- potential exposures via direct-contact pathways are managed through the SMP.
✓	Complete exposure pathway; evaluated quantitatively in the BHRA.
(✓)	Complete exposure pathway. Ramboll understands that exposures of on-site receptors to airborne releases from neighboring properties would be evaluated in the risk assessments being prepared for those properties, under the oversight of NDEP. The results of these off-site risk assessments are discussed quantitatively in the BHRA.
◎	The exposure to VOCs in outdoor air is not quantitatively evaluated for construction workers and indoor commercial/industrial workers because it is expected to be much lower than the exposure to VOCs in trench air and indoor air.
◉	Potentially complete, but insignificant exposure pathway; not evaluated quantitatively because such exposures would be intermittent and of short duration or regulated under OSHA.
◉	Potentially complete exposure pathway; not evaluated quantitatively because public access is generally restricted at industrial sites and potential exposures of a visitor/trespasser would be less than exposures of an on-site worker; the visitor/trespasser is discussed qualitatively.

H:\LePetomane\NERT\BHRA\Report\Figures

RAMBOLL

Conceptual Site Model for OU-1 Operations Area
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
7-1

Drafter: EL Date: 3/1/2022 Contract Number: 1690025040-003 Approved by: Revised:

N

0 50 100

Feet

VMW-01D

VER-01D

VER-01I

VMW-02D

Envirogen

Vacuum Enhanced Recovery Treatability

AP Area Treatability

E2-1

Former AP-5 Pond (closed in 2019)

AP-6 Pond

Soil Flushing Treatability

DFSB-16/DFCB-16 (3)

CTMW-05D

CTMW-06D (4)

CTMW-04D (2)

CTMW-03D (2)

TT-TP4-B2

TT-TP4-L2

TT-TP4-B1

TT-TP3-B2

TT-TP3-L2

TT-TP3-B1

TT-TP2-B2 (2)

TT-TP2-B1 (22)

TT-TP1-B2

TT-TP1-B1

TT-TP1-L2

TT-TP1-B4

TT-TP1-B3

TT-TP2-B4 (31)

TT-TP2-B3 (10)

TT-TP2-L2 (2)

TT-TP3-B3

TT-TP3-B4

TT-TP4-B4

TT-TP4-B3

CTMW-01D

CTIW-01D (2)

CTIW-03D

CTMW-02D

CTIW-02D

In Situ Chromium Biological Reduction

Legend

Noncancer Hazard Index

- ≤ 1
- > 1

Site Features (Buildings and Tanks)

AP Ponds

Treatability Study Area

Central Retention Basin

Northern Retention Basin

GWETS Operational Areas

Debris Pile

Interceptor Well Field

Groundwater Barrier Wall

Former Ditches

Other Site Occupant

Envirogen

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

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2018 BHRAs\OU-1 Soil BHRA\GIS\Figure 10-1 Noncancer Hazard Indices for Commercial Industrial Workers Treatability Studies.mxd

RAMBOLL

Estimated Noncancer Hazard Indices for Commercial/Industrial Workers – Baseline Soil Data (0-10 ft bgs) from Treatability Studies

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **10-1**

Drafter: SS | Date: 3/1/2022 | Contract Number: 1690025040-003 | Approved by: | Revised:

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