Prepared for
**Nevada Environmental Response Trust**

Project Number
**21-41400A**

Prepared by
**Ramboll Environ**
**Emeryville, California**

Date
**December 15, 2017**

# HEALTH RISK ASSESSMENT FOR PARCEL F

## NEVADA ENVIRONMENTAL RESPONSE TRUST SITE HENDERSON, NEVADA

# Health Risk Assessment
# for Parcel F

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

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

Office of the Nevada Environmental Response Trust

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

not individually, but solely as Pres.

**Signature:**________________________, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

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

**Title:** Solely as President and not individually

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

**Date:** 12/13/17

# Health Risk Assessment
for Parcel F

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

**Responsible Certified Environmental Manager (CEM) for this project**

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

____________________________________ 12/15/2017

**John M. Pekala, PG** **Date**
**Senior Manager**

Certified Environmental Manager
Ramboll Environ US Corporation
CEM Certificate Number: 2347
CEM Expiration Date: September 20, 2018

The following individuals provided input to this document:

John M. Pekala, PG
Allan J. DeLorme, PE
Jessica E. Donovan, PG
Elizabeth Miesner, MS
Lynne Haroun, MPH
Christopher M. Stubbs, PhD, PE
Christopher Ritchie, PE
Kun Zhao, MS
Shuo Yu, PhD
Craig J. Knox
Yuan Zhuang, PhD
Kimberly Souder, PhD
Jonathan Hunt, PhD
Peyton Ward, MEM
Erin H. Finestone, MPH
Ruben So

Health Risk Assessment for
Parcel F
Nevada Environmental Response Trust
Henderson, Nevada

| | |
|---|---|
| Date | **December 15, 2017** |
| Prepared by | **Ramboll Environ** |
| Description | **Health Risk Assessment for Parcel F** |

Project No. **21-41400A**

Ramboll Environ
2200 Powell Street
Suite 700
Emeryville, CA 94608
USA
T +1 510 655 7400
F +1 510 655 9517
www.ramboll-environ.com

## CONTENTS

**1. INTRODUCTION** **1**
1.1 Major Revisions 1
1.2 Report Organization 3
**2. SITE BACKGROUND** **5**
2.1 Site Description 5
2.2 Climate 6
2.3 Geologic and Hydrogeological Setting 6
**3. HISTORICAL INVESTIGATIONS AND REMOVAL ACTIONS** **8**
3.1 Overview of Environmental Investigations 8
3.2 Historical Uses and Investigations of Parcel F 9
3.3 Soil Removal and Confirmation Sampling 11
3.3.1 Removal Action 12
3.3.2 Confirmation Sampling 12
**4. DATA USABILITY EVALUATION AND DATA ANALYSIS** **14**
4.1 Soil 15
4.1.1 Data Usability Evaluation 15
4.1.1.1 Soil Data Set and Data Processing 15
4.1.1.2 Criterion I – Reports to Risk Assessor 17
4.1.1.3 Criterion II – Documentation 19
4.1.1.4 Criterion III – Data Sources 19
4.1.1.5 Criterion IV – Analytical Methods and Detection Limits 20
4.1.1.6 Criterion V – Data Review 22
4.1.1.7 Criterion VI – Data Quality Indicators 23
4.1.1.8 Data Usability Conclusions 27
4.1.2 Data Analysis 27
4.1.2.1 Summary Statistics 27
4.1.2.2 Background Evaluation 27
4.1.2.3 Spatial Analysis of Chemicals in Soil 31
4.2 Soil Gas 32
4.2.1 Data Usability Evaluation 32
4.2.1.1 Soil Gas Data Set 32
4.2.1.2 Criterion I – Reports to Risk Assessor 32
4.2.1.3 Criterion II - Documentation 34
4.2.1.4 Criterion III – Data Sources 34
4.2.1.5 Criterion IV – Analytical Method and Detection Limits 35
4.2.1.6 Criterion V – Data Review 35
4.2.1.7 Criterion VI – Data Quality Indicators 36
4.2.1.8 Data Usability Conclusions 40
4.2.2 Data Analysis 40
4.2.2.1 Summary Statistics 41
4.2.2.2 Spatial Analysis of VOCs in Soil Gas 41
4.3 Groundwater 41
4.3.1 Data Usability Evaluation 41
4.3.1.1 Groundwater Data Set 42
4.3.1.2 Criterion I – Reports to Risk Assessor 43
4.3.1.3 Criterion II – Documentation 43

4.3.1.4 Criterion III – Data Sources 43
4.3.1.5 Criterion IV – Analytical Method and Detection Limits 44
4.3.1.6 Criterion V – Data Review 45
4.3.1.7 Criterion VI – Data Quality Indicators 46
4.3.1.8 Data Usability Summary 47
4.3.2 Data Analysis 48
4.3.2.1 Summary Statistics 48
4.3.2.2 Spatial Analysis of VOCs in Groundwater 48
4.3.2.3 Temporal Changes in VOC Groundwater Concentrations 48
4.4 Study Area CSM 49
**5. POST-REMEDIATION HEALTH RISK ASSESSMENT 52**
5.1 Identification of COPCs 53
5.1.1 Soil COPCs 53
5.1.1.1 Step 1 – Concentration/Toxicity Screen 53
5.1.1.2 Step 2 – Background Evaluation 55
5.1.1.3 Step 3 – Chemical-specific Evaluations 57
5.1.1.4 Summary of Soil COPCs 57
5.1.2 Soil Gas COPCs 58
5.1.3 Groundwater COPCs 58
5.2 Exposure Assessment 58
5.2.1 Conceptual Site Model and Exposure Scenarios 58
5.2.1.1 Potential Chemical Sources and Release Mechanisms 59
5.2.1.2 Potentially Exposed Human Populations and Exposure Pathways 59
5.2.2 Exposure Point Concentrations 61
5.2.2.1 Soil 62
5.2.2.2 Air: Airborne Soil/Dust Particulates 62
5.2.2.3 Indoor, Outdoor, and Trench Air: VOCs Migrating from Soil Gas, Groundwater, and Soil 64
5.2.3 Exposure Assumptions and Calculations 67
5.2.3.1 Chemicals 67
5.2.3.2 Asbestos 69
5.3 Toxicity Assessment 69
5.3.1 Chemicals 70
5.3.2 Asbestos 71
5.4 Risk Characterization 72
5.4.1 Soil 72
5.4.1.1 Cancer Risks: Chemicals 72
5.4.1.2 Non-Cancer Health Effects: Chemicals 73
5.4.1.3 Cancer Risks: Asbestos 74
5.4.2 Soil Gas VOCs 75
5.4.2.1 Assessment of Cancer Risks 75
5.4.2.2 Assessment of Noncancer Health Effects 76
5.4.3 Groundwater VOCs 77
5.4.3.1 Assessment of Cancer Risks 77
5.4.3.2 Assessment of Noncancer Health Effects 77
**6. UNCERTAINTY ANALYSIS 79**
6.1 Uncertainties Identified in the Data Usability Evaluation 79
6.1.1 Site Characterization Data 79

6.1.2 Detection Limit 80
6.1.3 Completeness 82
6.1.4 Comparability 82
6.1.5 Precision 83
6.1.6 Accuracy 84
6.1.7 Duplicate Treatment 87
6.2 Uncertainties Identified in the Risk Assessment 88
6.2.1 Identification of COPCs 88
6.2.2 Exposure Assessment 89
6.2.2.1 Exposure Scenarios 89
6.2.2.2 EPCs 90
6.2.2.3 Fate-and-Transport Modeling 91
6.2.3 Toxicity Assessment 93
6.2.4 Risk Characterization 94
**7. DATA QUALITY ASSESSMENT 97**
7.1 Soil Data 97
7.1.1 Cancer Risk 97
7.1.2 Non-Cancer HI 98
7.2 Soil Gas Data 98
7.3 Groundwater Data 99
**8. CUMULATIVE RISKS 101**
**9. SUMMARY AND CONCLUSIONS 102**
**10. REFERENCES 105**

## LIST OF TABLES

Table ES-1 Summary of Cumulative Estimated Risks for Soil and Soil Gas – Parcel F
Table 3-1 Soil Gas Samples Evaluated in the HRA – Parcel F
Table 3-2 Shallow Groundwater Locations with VOC Sampling Data Evaluated in the HRA – Parcel F
Table 3-3 Summary of Scrape Area and Soil Confirmation Sampling Information for Parcel F
Table 4-1 Evaluation of Soil Sample Quantitation Limits – Parcel F Soil
Table 4-2 Summary Statistics for Soil Data – Parcel F
Table 4-3 Soil Sampling Results for Asbestos (Long Amphibole and Chrysotile Fibers) – Parcel F
Table 4-4 Exploratory Data Analysis: Comments for Chlorine Oxyanions, Metals, Other Inorganics, and Radionuclides (0-10 ft bgs Soils – Parcel F)
Table 4-5 Exploratory Data Analysis: Comments for Dioxins/Furans, Other Organics, PAHs, Pesticides, SVOCs, and VOCs (0-10 ft bgs Soils – Parcel F)
Table 4-6 Evaluation of Sample Quantitation Limits for Soil Gas – Parcel F
Table 4-7 Summary Statistics for Soil Gas – Parcel F
Table 4-8 Evaluation of Sample Quantitation Limits for Shallow Groundwater – Parcel F
Table 4-9 Summary Statistics for Shallow Groundwater – Parcel F
Table 5-1 Concentration/Toxicity Screen – Parcel F Soil
Table 5-2 Results of the Soil Background Evaluation for Metals Carried Forward from the Concentration/Toxicity Screen
Table 5-3 Results of the Soil Background Evaluation for Radionuclides Carried Forward from the Concentration/Toxicity Screen
Table 5-4 Comparison of Cancer Risks for Radionuclides between Parcel F Soils and Background Soils
Table 5-5 Soil COPCs Identified for Parcel F (0-10 feet bgs)
Table 5-6 Soil Gas and Shallow Groundwater COPCs Identified for Parcel F
Table 5-7A Soil EPCs and EPCs of Airborne Particulates and Vapors for Parcel F (0-2 feet bgs)
Table 5-7B Soil EPCs and EPCs of Airborne Particulates and Vapors for Parcel F (0-10 feet bgs)
Table 5-8 Calculation of Particulate Emission Factors
Table 5-9 Johnson and Ettinger/Jury Modeling Parameters – Parcel F
Table 5-10 Physical and Chemical Properties for Soil Gas and Shallow Groundwater COPCs – Parcel F
Table 5-11 Soil Properties Data

Table 5-12A Transfer Factors for Volatile Compounds Migrating from Soil Gas to Indoor Air, Outdoor Air, and Trench Air – Parcel F
Table 5-12B Transfer Factors for Volatile Compounds Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air – Parcel F
Table 5-12C Transfer Factors for Vapors from Soil to Outdoor Air and Trench Air – Parcel F
Table 5-13 Air EPCs Due to Volatile Compounds Migrating from 5 ft bgs Soil Gas to Indoor Air, Outdoor Air, and Trench Air – Parcel F
Table 5-14 Air EPCs Due to Volatile Compounds Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air – Parcel F
Table 5-15 Exposure Assumptions
Table 5-16 Toxicity Criteria and Dermal Absorption Factors for Soil COPCs
Table 5-17A Chronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater COPCs – Parcel F
Table 5-17B Subchronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater COPCs – Parcel F
Table 5-18 Estimated Soil Cancer Risks and Non-Cancer Hazard Indices – Parcel F
Table 5-19 Estimated Asbestos Cancer Risks – Parcel F
Table 5-20 Estimated Soil Gas Cancer Risks and Non-Cancer Hazard Indices – Parcel F (5 ft bgs)
Table 5-21 Estimated Shallow Groundwater Cancer Risks and Non-Cancer Hazard Indices – Parcel F
Table 6-1 Uncertainty Analysis of J Qualified Soil Data
Table 6-2 Uncertainty Analysis of Soil Data with Blank Contamination
Table 7-1 Soil Data Quality Assessment – Parcel F
Table 7-2 Soil Gas Data Quality Assessment – Parcel F
Table 7-3 Shallow Groundwater Data Quality Assessment – Parcel F
Table 8-1 Summary of Cumulative Estimated Risks for Soil and Soil Gas – Parcel F

## LIST OF FIGURES

Figure 1-1 Site Location Map
Figure 1-2 Study Area and Site Features
Figure 1-3 Surrounding Facilities
Figure 2-1 Parcels, Operations Area, and LOU Map
Figure 3-1 Remediation Polygons and Soil, Groundwater, and Soil Gas Sample Locations for Parcel F
Figure 3-2 Soil Gas and Groundwater Sample Locations for Parcel F (Chloroform Plume as Depicted in 2017)

Figure 4-1 Spatial Distribution of Primary Chlorinated VOC Concentrations in 5 ft bgs Soil Gas for Parcel F
Figure 4-2 Spatial Distribution of Primary Chlorinated VOC Concentrations in Shallow Groundwater for Parcel F
Figure 4-3 Temporal Distribution of Chloroform Concentrations Shallow Groundwater for Parcel F
Figure 5-1 Soil COPC Identification Flowchart
Figure 5-2 Spatial Intensity Plot for Parcel F – Perchlorate
Figure 5-3 Spatial Intensity Plot for Parcel F – Zirconium
Figure 5-4 Spatial Intensity Plot for Parcel F – Chloride
Figure 5-5 Spatial Intensity Plot for Parcel F – Benzo(a)pyrene Equivalent
Figure 5-6 Spatial Intensity Plot for Parcel F – Aroclor 1254
Figure 5-7 Spatial Intensity Plot for Parcel F – alpha-BHC
Figure 5-8 Spatial Intensity Plot for Parcel F – Long Chrysotile Fiber
Figure 5-9 Conceptual Site Model for Potential Human Exposures
Figure 5-10 Estimated Total Cancer Risk for Future Indoor Worker for Soil Gas (5 ft bgs) – Parcel F
Figure 5-11 Estimated Total Cancer Risk for Future Indoor Worker for Shallow Groundwater – Parcel F

## APPENDICES

**Appendix A**
Response to Comment Letters
A-1 Response to Comment Letter – Responses to NDEP Comments on Soil HRA Revision 3
A-2 Response to Comment Letter – Responses to NDEP Comments on Soil Gas HRA Revision 1

**Appendix B**
2013 Soil Gas Investigation Report
  Table B-1 LOUs Within and Upgradient of Parcel F
  Table B-2 Soil Gas Probe Construction Details
  Table B-3 Soil Gas Purging and Sampling
  Table B-4 Soil Gas Probe Leak Checking
  Table B-5 2013 Soil Gas Statistics Summary
  Figure B-1 LOUs and Chloroform in Shallow Groundwater (Chloroform Plume as Depicted in 2010)
  Figure B-2 Study Area and Site Features
  Figure B-3 2008 and 2013 Soil Gas Sampling Locations (Chloroform Plume as Depicted in 2010)

Figure B-4 2008 and 2013 Soil Gas Sampling Locations (Chloroform Plume as Depicted in 2017)

**Appendix C**
Removal Action Workplan for Soil, Tronox Parcels “C”, “D”, “F”, “G”, and “H” Sites

**Appendix D**
Las Vegas Paving Scrape Clean Up Figures and Soil Disposal Manifests (CD)
D-1 Las Vegas Paving Scrape Clean Up Figures
D-2 Soil Disposal Manifests for Parcel F

**Appendix E**
Data Validation Summary Reports and Tables - Soil (CD)
Table E-1 Summary of Soil Data Samples Removed Due to Remediation
Table E-2 Summary of Soil Data Excluded from Post-Remediation Soil HRA Data Set During Data Processing
Table E-3 Summary of Parcel Rejected Soil Data
Table E-4 Summary of Qualified Soil Field Duplicates

**Appendix F**
Post Remediation Soil HRA Data Set for Parcel F (CD)
Table F-1 Post Remediation Soil HRA Data Set for Parcel F - Chemicals and Radionuclides (CD)
Table F-2 Post Remediation Soil HRA Data Set for Parcel F - Asbestos (CD)

**Appendix G**
Soil Summary Statistics for Parcel F
Table G-1 Summary Statistics for Soil Data – Parcel F

**Appendix H**
Background Soil Data Set (CD)
Figure H-1 RZ-A Soil Background Sample Locations

**Appendix I**
Background Evaluation for Metals and Radionuclides in Soil for Parcel F
Table I-1 Summary Statistics for Metals in Background (RZ-A) Soils and Parcel F Soils (0-10 feet bgs)
Table I-2 Background Comparisons for Metals in Parcel F Soils (0-10 feet bgs)
Table I-3 Summary Statistics for Radionuclides in Background (RZ-A) Soils and Parcel F Soils (0-10 feet bgs)
Table I-4 Background Comparisons for Radionuclides in Parcel F Soils (0-10 feet bgs)
Table I-5A Equivalence Test for Secular Equilibrium of the Uranium Decay Series (U-238 Chain)
Table I-5B Equivalence Test for Secular Equilibrium of the Thorium Decay Series (Th-232 Chain)
Table I-6 Correlation Matrices for the Uranium Decay Series and the Thorium Decay Series
Figures I1-1 through I1-32 – Background vs. Parcel F Boxplots (Metals)
Figures I1-33 through I1-40 – Background vs. Parcel F Boxplots (Radionuclides)

Figures I2-1 through I2-32 – Normal and Lognormal Q-Q Plots (Metals)
Figures I2-33 through I2-40 – Normal and Lognormal Q-Q Plots (Radionuclides)

**Appendix J**
Spatial Quartile Plots for Parcel F Soil Samples

**Appendix K**
Soil Gas Field Sampling Data for Parcel F (CD)

**Appendix L**
Data Validation Summary Reports and Tables - Soil Gas (CD)

**Appendix M**
Groundwater Field Sampling Data for Parcel F (CD)

**Appendix N**
Data Validation Summary Reports and Tables - Groundwater (CD)

**Appendix O**
NDEP Flowchart for Radionuclide Data Usability

**Appendix P**
ProUCL Output Files (CD)

**Appendix Q**
Risk Assessment Calculation Spreadsheets and Supporting Documentation (CD)
Q-1 Risk Assessment Calculation Spreadsheets and Supporting Documentation - Soil
Q-2 Risk Assessment Calculation Spreadsheets and Supporting Documentation - Soil Gas
Q-3 Risk Assessment Calculation Spreadsheets and Supporting Documentation - Groundwater

**Appendix R**
Soil Property Sampling Locations and Boring Logs

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ABS | soil absorption factor |
| ADD | average daily dose |
| AECOM | AECOM, Inc. |
| AP&CC | American Potash and Chemical Company |
| API | American Petroleum Institute |
| AS | analytical sensitivity |
| atm | atmosphere |
| ATSDR | Agency for Toxic Substances & Disease Registry |
| BaP | benzo(a)pyrene |
| BaPEq | benzo(a)pyrene equivalent |
| BCA | bias-corrected accelerated |
| BCL | basic comparison level |
| BEC | Basic Environmental Company |
| bgs | below ground surface |
| BHC | hexachlorocyclohexane |
| BMI | Black Mountain Industrial |
| BRC | Basic Remediation Company |
| BTEX | benzene, toluene, ethyl benzene, and total xylenes |
| Cal/EPA | California Environmental Protection Agency |
| CAS | Chemical Abstract Service |
| CFR | Code of Federal Regulations |
| CLP | Contact Laboratory Program |
| cm | centimeter |
| $cm^2$ | square centimeter |
| $cm^3$ | cubic centimeter |
| COC | chain-of-custody |
| COPC | chemical of potential concern |
| Converse | Converse Consultants |
| CSF | cancer slope factor |
| CSM | conceptual site model |
| CTE | central tendency exposure |

| | |
|---|---|
| cy | cubic yard |
| DDE | dichlorodiphenyldichloroethylene |
| DDT | dichlorodiphenyltrichloroethane |
| DNAPL | dense non-aqueous phase liquid |
| DQI | data quality indicator |
| DUE | data usability evaluation |
| DVSR | data validation summary report |
| ECA | Environmental Conditions Assessment |
| EDA | exploratory data analysis |
| EDD | electronic data deliverable |
| ENSR | ENSR Corporation |
| ENVIRON | Environ International Corporation |
| EPC | exposure point concentration |
| ERM-West | ERM-West, Inc. |
| ESA | Environmental Site Assessment |
| ETBE | ethyl tert-butyl ether |
| Exponent | Exponent, Inc. |
| f | fiber |
| ft | feet |
| g | gram |
| GC/MS | gas chromatography/mass spectroscopy |
| GISdT® | Guided Interactive Statistical Decision Tool |
| GRAS | Generally Recognized as Safe |
| HEAST | Health Effects Assessment |
| HI | hazard index |
| HQ | hazard quotient |
| HRA | health risk assessment |
| IF | intake factor |
| ILCR | incremental lifetime cancer risk |
| IQR | interquartile range |
| IRIS | Integrated Risk Information System |
| ITRC | Interstate Technology Regulatory Council |
| IUR | inhalation unit risk |

| | |
|---|---|
| IWF | interceptor well field |
| Kerr-McGee | Kerr-McGee Chemical Corporation |
| kg | kilogram |
| Kleinfelder | Kleinfelder, Inc. |
| L | liter |
| LADD | lifetime average daily dose |
| LC | laboratory control |
| LCD | laboratory control duplicate |
| LCS | laboratory control spike |
| LCSD | laboratory control spike duplicate |
| LDC | Laboratory Data Consultants, Inc. |
| LOAEL | lowest-observed-adverse-effect level |
| LOU | Letter of Understanding |
| LVP | Las Vegas Paving |
| $m^3$ | cubic meter |
| MDL | method detection limit |
| mg | milligram |
| mm Hg | millimeter of mercury |
| mol | mole |
| mph | mile per hour |
| MRL | minimal risk level |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| MTBE | methyl tert-butyl ether |
| NCP | National Contingency Plan |
| NDEP | Nevada Division of Environmental Protection |
| Neptune | Neptune and Company, Inc. |
| NERT | Nevada Environmental Response Trust |
| NFA | no further action |
| 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 |

| | |
|---|---|
| OSSM | Olin Chlor-Alkali/Stauffer/Syngenta/Montrose |
| OSWER | Office of Solid Waste and Emergency Response |
| PAH | polynuclear aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PEF | particulate emission factor |
| PPRTV | Provisional Peer Reviewed Toxicity Values |
| PQL | practical quantitation limit |
| Q-Q | quantile to quantile |
| QA/QC | quality assurance/quality control |
| Qal | quaternary alluvial deposit |
| QAPP | Quality Assurance Project Plan |
| Ra | radium |
| Ramboll Environ | Ramboll Environ US Corporation |
| RAW | Removal Action Workplan |
| RBC | risk-based concentration |
| RfC | reference concentration |
| RfD | reference dose |
| RI/FS | remedial investigation/feasibility study |
| RME | reasonable maximum exposure |
| RPD | relative percent difference |
| RSL | regional screening level |
| RZ-A | Remediation Zone A |
| SAP | sampling and analysis plan |
| SDG | sample delivery group |
| SF | risk coefficient for population of smoking females |
| SIM | selective ion monitoring |
| Site | Nevada Environmental Response Trust Site |
| SM | risk coefficient for population of smoking males |
| SOP | standard operating procedure |
| SQL | sample quantitation limit |
| SRC | site-related chemical |
| SVOC | semi-volatile organic compound |
| TAME | tert-amyl methyl ether |

| | |
|---|---|
| TEF | toxicity equivalency factor |
| TEQ | toxicity equivalent |
| Tetra Tech | Tetra Tech EM Inc. |
| Th | thorium |
| TIMET | Titanium Metals Corporation |
| TPH | total petroleum hydrocarbon |
| 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 |
| USEPA | United States Environmental Protection Agency |
| UST | underground storage tank |
| VOC | volatile organic compound |
| WBZ | Water Bearing Zone |
| WECCO | Western Electrochemical Company |
| WHO | World Health Organization |

# EXECUTIVE SUMMARY

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

This report has been prepared to address NDEP comments on the June 19, 2014 Soil HRA Report (Revision 3) and the September 23, 2016 Soil Gas HRA Report (Revision 1). Previously, a soil HRA report and a soil gas HRA report for Parcels C, D, F, G, and H were submitted separately to the NDEP. In order to streamline the No Further Action (NFA) decisions for these parcels, the Trust decided to implement a new execution strategy by combining the soil and soil gas HRAs into the following reports: Parcels C, D, and G HRA Report, Parcel F HRA Report, and Parcel H HRA Report. A post-remediation HRA report for Parcels C, D, and G (Revision 1) was submitted to NDEP on November 3, 2017 (Ramboll Environ 2017a), and a post-remediation HRA for Parcel H was submitted to NDEP on October 20, 2017 (Ramboll Environ 2017b). This report focuses on the Parcel F HRA. In addition, this report incorporates additional soil and groundwater analytical results collected within or near Parcel F in 2017, and has been further revised for consistency with recent updates to NDEP guidance.

The Site 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. Parcel F is a 6.96-acre parcel along the western boundary of the Site, and was identified for possible sale early in the environmental investigation process at the Site. Although former activities within Parcel F were not expected to have resulted in significant chemical impacts, NDEP identified four Letter of Understanding areas (LOUs) for investigation within Parcel F. The primary field investigation work for soils at Parcel F was completed in 2007, 2008, and 2017, and soil removal actions and asbestos abatement were completed in 2010. Soil gas samples were collected within Parcel F in 2008 and 2013. Shallow groundwater monitoring is ongoing.

The post-remediation HRA follows the basic procedures outlined in the United States Environmental Protection Agency (USEPA) risk assessment guidance and applicable Nevada Division of Environmental Protection (NDEP) guidance. The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] § 300) is cited as the basis for target cancer risk range by NDEP (2017a). According to the NCP, lifetime incremental cancer risks posed by a site should not exceed one in a million ($1 \times 10^{-6}$) to one hundred in a million ($1 \times 10^{-4}$). According to NCP and NDEP (2017a), non-carcinogenic 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 non-cancer hazard estimated in this HRA do not represent absolute estimates in Parcel F, 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 non-cancer 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 analytical data collected as part of initial and confirmation sampling efforts were evaluated and data representative of current conditions after the soil removel action were selected for purposes of the HRA. The soil conceptual site model (CSM), and chemicals of potential concern (COPCs), and estimated cancer risks and non-cancer HIs are summarized as follows:

- The soil removal action for Parcel F, which included the excavation and disposal of approximately 5,895 tons of soil, was completed in 2010 in accordance with the 2008 Remedial Action Workplan [RAW] (Basic Environmental Company [BEC] 2008a). Analytical results for confirmation samples collected following the soil removal action were all below the NDEP Basic Comparison Level (BCL) for commercial/industrial workers (or other NDEP-approved risk-based criteria). However, two small areas of un-remediated soil remain in Parcel F because of physical impediments, and excavation was conducted to the edge of these inaccessible areas. For these areas, qualitative considerations suggest that associated risks would be insignificant.

- Based on the CSM for Parcel F, potential exposure to soil was evaluated for future onsite indoor and outdoor commercial/industrial workers and construction workers via direct contact with soil (i.e., incidental ingestion and dermal contact) and inhalation of airborne particulates and vapors. Soil COPCs were selected according to a multi-step process, including a concentration/ toxicity screen, a background evaluation for metals and radionuclides, and chemical-specific considerations. Based on this process, ten chemicals were identified as soil COPCs, including two metals (palladium and zirconium), chloride, benzo(a)pyrene equivalent (BaPEq), Aroclor-1254, alpha- hexachlorocyclohexane (BHC), hydroxymethyl phthalimide, and asbestos (long amphibole fibers and long chrysotile fibers).

- Non-cancer HIs and excess lifetime cancer risks associated with direct contact with soil and inhalation of airborne particulates and vapors were estimated for all the soil COPCs except asbestos based on the 95% upper confidence limit (UCL) on the mean soil concentration (or the maximum detected concentration if a 95% UCL cannot be calculated due to limited detections) at the 0-2 feet (ft) depth interval and at the 0-10 ft depth interval within Parcel F. The estimated HIs and excess lifetime cancer risks were below the significant threshold of greater than one for non-cancer effects and the target cancer risk range of $10^{-6}$ to $10^{-4}$ under the conditions evaluated. The maximum HI was one for the construction worker exposed to soil at the 0-10 ft depth interval and the maximum estimated excess lifetime cancer risk was $4 \times 10^{-7}$ for the outdoor commercial/industrial worker exposed to soil at the 0-2 ft depth interval.

- With regard to asbestos (long amphibole and long chrysotile fibers), a best estimate and an upper-bound estimate of potential cancer risk via inhalation of airborne particulates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers were calculated for Parcel F. The estimated combined risks for death from lung cancer and mesothelioma associated with asbestos exposures were all less than $1 \times 10^{-6}$, except for the upper-bound risk estimate for exposure to amphibole fibers by future construction workers, which was $2 \times 10^{-6}$. However, the upper-bound estimate was based on an observed count of zero long amphibole[1] fibers in the post-abatement soil samples, considered representative of current conditions within Parcel F. Following completion of the asbestos abatement, zero fibers for long amphibole was less than the RAW specified level[2] of one (1) or more fibers. Similarly, for long chrysotile fibers, fiber counts were less than the level presented in the RAW (four or more long fibers per sample), with one exception. One sampling location – TSB-FR-04 – with counts of three and four long chrysotile fibers in the primary and field duplicate sample, respectively, was not identified for removal. The removal decision was based on the primary sample in which the count of long chrysotile fibers was less than the level identified in the RAW, not based on the field duplicate sample.

The soil gas and groundwater CSM, COPCs, and estimated cancer risks and non-cancer HIs are summarized as follows:

The soil gas data collected within Parcel F in 2008 and 2013 were evaluated in the HRA. Potential exposure to soil gas was evaluated for future onsite indoor and outdoor commercial/industrial workers and construction workers via inhalation of vapors migrating from soil gas to indoor air, outdoor air, and trench air. All VOCs detected in at least one soil gas sample were selected as soil gas COPCs. A total of 65 VOCs were identified as soil gas COPCs for Parcel F. Non-cancer HIs and excess lifetime cancer risks associated with inhalation of vapors migrating from soil gas to indoor air, outdoor air, and trench air were calculated. The results are summarized as follows:

- The estimated HIs were well below the NDEP significant threshold of greater than one for non-cancer effects (maximum HI was 0.01).

- The estimated excess lifetime cancer risks were at the lower end of the target cancer risk range of $10^{-6}$ to $10^{-4}$ for future onsite indoor and outdoor commercial/industrial workers and construction workers under the conditions evaluated. The maximum estimated excess lifetime cancer risk was $2 \times 10^{-6}$ for the indoor commercial/industrial worker. Chloroform is the primary contributor to the total estimated cancer risk for soil gas.

Shallow groundwater data was evaluated for the vapor intrusion pathway as one of the multiple lines of evidence together with the soil gas evaluation. Shallow groundwater data collected after 2005 within or near Parcel F were evaluated in the HRA. Potential exposure to groundwater was evaluated for future onsite indoor and outdoor commercial/industrial workers and construction workers via inhalation of vapors migrating from soil gas to indoor air, outdoor air, and trench air. All VOCs detected in at least one shallow groundwater sample were selected as groundwater COPCs. A total of 14 VOCs were identified as groundwater COPCs for Parcel F. Non-cancer HIs and excess lifetime cancer risks associated with inhalation of vapors migrating from shallow groundwater to indoor air, outdoor air, and trench air were estimated for identified shallow groundwater COPCs using the most recent

---

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

[2] 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 in soil samples were one (1) or more fibers and chrysotile counts were four (4) or more fibers (BEC 2008a).

two years of shallow groundwater data collected at each well. The results are summarized below:

- The estimated HIs were well below the NDEP significant threshold of greater than one for non-cancer effects (maximum HI was 0.02).
- The estimated excess lifetime cancer risks were within the target cancer risk range of $10^{-6}$ to $10^{-4}$ for future onsite indoor and outdoor commercial/industrial workers and construction workers under the conditions evaluated. The maximum estimated excess lifetime cancer risk was 6 x $10^{-6}$ for the indoor commercial/industrial workers. Chloroform is the primary contributor to the total estimated cancer risk for shallow groundwater.

The cumulative cancer risk and non-cancer HI for each receptor population were estimated by summing the estimated excess lifetime cancer risk and non-cancer HI for chemicals via direct contact with soil and VOCs via inhalation of soil gas (five ft below ground surface [bgs]) migrating to air, and are presented in Table ES-1. Only soil gas samples were collected to support evaluation of the vapor intrusion pathway. The objectives of groundwater sampling at the Site have been primarily to characterize site-related chemicals (SRCs) in groundwater near suspected source areas and plume delineation; that is, no groundwater investigation was conducted to specifically provide data to evaluate the vapor intrusion pathway. Shallow groundwater data was evaluated for the vapor intrusion pathway as one of the multiple lines of evidence together with the soil gas evaluation.

The estimated cumulative cancer risks are 2 x $10^{-6}$, 4 x $10^{-7}$, and 6 x $10^{-8}$ for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel F, respectively, which are below or within the target cancer risk range of $1\times10^{-6}$ to $1\times10^{-4}$. The cumulative HIs are 0.2, 0.3, and 1 for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel F, respectively, which are below the threshold of greater than one. The major contributor to the cumulative cancer risk for the future indoor commercial/industrial workers is the inhalation of vapors migrating from soil gas to indoor air. The major chemical contributor is chloroform. Plots of total vapor intrusion cancer risks for future indoor commercial/industrial workers in Parcel F show the only location with a total estimated vapor intrusion cancer risk greater than 1 x $10^{-6}$ (E-SG-4) is located at the northwestern corner of Parcel F where the nearby chloroform groundwater plume overlaps with Parcel F (as defined by >70 ug/L concentration of chloroform). The cancer risk and HI estimates for the onsite workers through the vapor inhalation pathways based on the shallow groundwater data in Parcel F are consistent with the cancer risk and HI estimates based on soil gas data collected in Parcel F.

# 1. INTRODUCTION

This report has been prepared by Ramboll Environ US Corporation (Ramboll Environ) on behalf of the Nevada Environmental Response Trust (NERT or the Trust) and presents the post-remediation health risk assessment (HRA) for Parcel F (also referred to as the Study Area) at the NERT site in Henderson, Nevada ("Site"). Soil removal and asbestos abatement activities completed at Parcel F are described, and the post-remediation HRA evaluating potential risks to future onsite workers from exposures to residual levels of chemicals, asbestos, and radionuclides[3] in soils is presented. The potential risks to future onsite workers associated with inhalation of volatile organic compounds (VOCs) released from soil gas and groundwater to indoor, outdoor, and trench air were evaluated. The cumulative risks associated with potential exposures to chemicals in soil and to VOCs in air are also presented.

The Site comprises approximately 346 acres located within the Black Mountain Industrial (BMI) Complex in unincorporated Clark County, Nevada; it is surrounded by the City of Henderson (Figure 1-1). Parcel F is a 6.96-acre parcel along the western boundary of the Site (Figure 1-2). Most of the parcel is vacant land, although a building foundation and a wooden pole at the edge of the foundation remain, and approximately 15 three-foot high gravel/sand piles are present. A post-remediation HRA report for Parcels C, D, and G (Revision 1) was submitted to Nevada Division of Environmental Protection (NDEP) on November 3, 2017 (Ramboll Environ 2017a), and a post-remediation HRA for Parcel H was submitted to NDEP on October 20, 2017 (Ramboll Environ 2017b). Parcel E contains a portion of the currently operating Olin Chlor Alkali/Stauffer/Syngenta/Montrose (OSSM) groundwater treatment system. No investigation or remediation on Parcel E has been performed or is planned for the foreseeable future due to the continued operation of the OSSM groundwater treatment system (NDEP 2010a). The area surrounding the Site is shown in Figure 1-3.

Environmental investigations at Parcel F have generally been conducted separately from investigations at the main area of the Site, referred to in this report as the "Operations Area". [4] The primary field investigation work for soils at Parcel F was completed in 2007, 2008, and 2017, and soil removal actions and asbestos abatement were completed in 2010. Soil gas samples were collected within Parcel F in 2008 and 2013. Shallow groundwater monitoring is ongoing.

## 1.1 Major Revisions

Previously, a soil HRA report and a soil gas HRA report for Parcels C, D, F, G, and H were submitted separately to the NDEP. Four versions of the soil HRA report have been submitted: (1) December 10, 2010 (Northgate Environmental Management, Inc. [Northgate] and Exponent, Inc. [Exponent] 2010a); (2) May 18, 2012 (Northgate 2012);

---

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

[4] The Operations Area is defined as the Site, excluding Parcels C, D, E, F, G, and H. 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 2015a).

(3) June 27, 2013 (Northgate 2013); and (4) June 19, 2014 (Northgate 2014). Two versions of the soil gas HRA report have been submitted: (1) July 25, 2013 (ENVIRON 2013a); and 2) September 23, 2016 (Ramboll Environ 2016a). NDEP commented on each submittal and each subsequent report was revised to address NDEP comments.

In order to streamline the No Further Action (NFA) decisions for these parcels, the Trust decided to implement a new execution strategy by combining the soil and soil gas HRAs into the following reports: Parcels C, D, and G HRA Report, Parcel H HRA Report, and Parcel F HRA Report. This report focuses on the Parcel F HRA.

This report has been prepared to address NDEP comments on the June 19, 2014 Soil HRA Report (Revision 3) and the September 23, 2016 Soil Gas HRA Report (Revision 1). NDEP comments and the Trust’s response to NDEP comments are included in Appendix A. In addition to combining the soil and soil gas HRAs for Parcel F as well as the revisions made to address NDEP comments, this report incorporates additional soil analytical results collected in Parcel F in 2017, and has been further revised for consistency with recent updates to NDEP guidance. The primary revisions made to this report, as compared with the previously submitted June 19, 2014 Soil HRA Report (Revision 3) and the September 23, 2016 Soil Gas HRA Report (Revision 1), are summarized below:

- **Changes in the soil HRA data set**: Additional soil samples collected within the top 10 feet (ft) below ground surface (bgs) in Parcel F during the Phase 2 Remedial Investigation (RI) in 2017 were included in the soil HRA data set.

- **Radionuclide background evaluation**: In previous versions of the soil HRA, the regional Basic Remediation Company (BRC)/Titanium Metals Corporation (TIMET) data set was used to evaluate background conditions for radionuclides. As requested by NDEP (2015a), in this evaluation the Remediation Zone A (RZ-A) background data set was used for the background evaluation for radionuclides as well as for metals. In addition, the comparison of the radionuclide data with the BRC/TIMET data set was discussed to provide perspective in the interpretation of the results relative to regional background concentrations.

- **Updated list of soil COPCs**: The approach for identifying chemicals of potential concern (COPCs) was updated and is now consistent with the NDEP-approved approach used to identify soil COPCs for the Operations Area (Ramboll Environ 2016b). Specifically, the concentration/toxicity screen was conducted first, followed by the background evaluation and chemical-specific evaluations. In addition, the screening values used for the concentration/toxicity screen were revised for consistency with the NDEP-approved screening values used in the risk assessment for the Operations Area (i.e., for most chemicals, the screening value used was 0.1 x Basic Comparison Level [BCL]). Finally, the BCLs (and toxicity values) used in the HRA have been updated to be consistent with the most recent NDEP revision (NDEP 2017a).

- **Addition of inhalation of airborne soil particulates pathway**: For consistency with the equations used to derive BCLs, risks were evaluated for the inhalation of airborne particulates pathway for all soil COPCs and all receptors.

- **Evaluation of risks for each individual parcel**: In previous versions of the soil and soil gas HRAs, the risk results were estimated for all parcels as a whole and not for each individual parcel. To help support risk management decisions, this report presents risks for Parcel F only.

- **Asbestos:** The asbestos evaluation has been updated for consistency with current NDEP guidance (Neptune and Company, Inc. [Neptune] 2015).

- **Incorporation of groundwater data in the HRA**: As presented in the 2010 HRA work plan (Northgate and Exponent 2010b), complete direct contact pathways have not been identified for groundwater, which is not used as a source of drinking water at the Site. However, inhalation of vapors migrating from shallow groundwater is a potentially complete pathway. Shallow groundwater monitoring data that were previously included in the appendices have been moved into the main text of this report for further evaluation. In addition, this report incorporates the groundwater analytical results collected within or near Parcel F during the Phase 2 RI in 2017. In addition, this report incorporates additional soil and groundwater analytical results collected within or near Parcel F in 2017.

- **Addition of a trench scenario for construction workers:** Inhalation of volatile compounds in vapors migrating from soil gas or shallow groundwater to trench air could occur for construction workers while conducting excavation activities. Therefore, a trench scenario for the construction workers was added.

- **Cumulative risks**: This report presents cumulative risks for Parcel F.

## 1.2 Report Organization

The remainder of this report is organized as follows:

- Section 2 provides background information on the Site.

- Section 3 describes former uses at Parcel F, and summarizes the results of soil, soil gas, and groundwater investigations conducted at this parcel. The soil removal actions and confirmation sampling program are also described.

- Section 4 presents the data usability evaluation (DUE), including the data analysis step of the DUE.

- Section 5 presents the methodology and results from each of the four steps of the risk assessment, i.e., 1) identification of COPCs, 2) exposure assessment, 3) toxicity assessment, and 4) risk characterization.

- Section 6 presents the uncertainty analysis, which discusses the relative impact of data uncertainties and the primary assumptions used in the HRA on the risk results.

- Section 7 provides the data quality assessment.

- Section 8 presents the cumulative cancer risks and non-cancer hazards.

- Section 9 summarizes the HRA and presents conclusions regarding current conditions within Parcel F.
- Section 10 lists the references cited in this report.

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

# 2. SITE BACKGROUND

## 2.1 Site Description

The 346-acre Site is located approximately 13 miles southeast of the city of Las Vegas in an unincorporated area of Clark County, Nevada, within Sections 1, 12, and 13 of Township 22 S, Range 62 E (Figure 1-1). The Site is located within the BMI complex, which consists of several facilities that are owned and/or operated by various chemical companies. The City of Henderson surrounds the BMI complex. Tronox, LLC (Tronox) currently leases a portion of the Site from the Trust, on which it operates a chemical manufacturing facility.

The BMI complex was first developed by the U.S. government in 1942 as a magnesium plant for World War II operations. Later, a part of the BMI complex was leased by Western Electrochemical Company (WECCO). WECCO produced manganese dioxide, sodium chlorate and sodium perchlorate, and other perchlorates. WECCO also produced ammonium perchlorate for the Navy during the early 1950s, using a plant that was constructed on the Site by the Navy. WECCO merged with American Potash and Chemical Company (AP&CC) in 1956 and continued production of ammonium perchlorate for the Navy. In 1967, AP&CC merged with Kerr-McGee Chemical Corporation (Kerr-McGee) and in the early 1970s, began producing boron chemicals (including elemental boron, boron trichloride, and boron tribromide). The production of boron tribromide was discontinued in 1994, and the production of sodium chlorate and ammonium perchlorate was discontinued in 1997 and 1998, respectively. Perchlorate was reclaimed at the Site using existing equipment until early 2002.

In 2005, Kerr-McGee Chemical LLC was renamed Tronox LLC. Tronox's Henderson facility continues to produce electrolytic manganese dioxide, used in the manufacture of alkaline batteries; elemental boron, a component of automotive airbag igniters; and boron trichloride, used in the pharmaceutical and semiconductor industries and in the manufacture of high-strength boron fibers.

During the 1970s, the United States Environmental Protection Agency (USEPA), the State of Nevada, and Clark County investigated potential environmental impacts from BMI company operations, including atmospheric emissions, groundwater and surface-water discharges, and soil impacts (Ecology and Environment 1982). From 1971 to 1976, Kerr-McGee modified its manufacturing processes and constructed lined surface impoundments to recycle and evaporate industrial wastewater. In 1976, the facility achieved zero discharge status for industrial wastewater management. In 1980, the USEPA issued Section 308 letters requesting specific information from the BMI companies regarding their manufacturing and waste management practices. In 1993, a Phase 1 Environmental Conditions Assessment (ECA) was completed for the Site and approved by NDEP (Kleinfelder, Inc. [Kleinfelder] 1993).

In 1994, NDEP issued a Letter of Understanding (LOU) to Kerr-McGee that identified 69 specific areas or items of interest at the Site and identified the level of environmental investigation required for each LOU (NDEP 1994). The LOUs for the Site are shown in Figure 2-1. In 2005, a Conceptual Site Model (CSM) Report was prepared for the Site that integrated 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 potential receptors (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, which were designed to further characterize soil, groundwater, and soil gas across the Site, as described in the Remedial Investigation and Feasibility Study Work Plan (RI/FS Work Plan) (ENVIRON 2014a). Tronox continued field investigation and remediation efforts at the Site until February 14, 2011, on which date the Trust took title to the Site and assumed responsibility for all investigation and removal activities pursuant to an Interim Consent Agreement.

## 2.2 Climate

The climate of Las Vegas Valley is arid, consisting of mild winters and dry, hot summers. Average annual precipitation as measured in Las Vegas from 1971 to 2000 was 4.49 inches. 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°F in the summer, and the average relative humidity is approximately 20%. The estimated annual mean evaporation rate from lake and reservoir surfaces at the Site is 97 inches per year.[5]

## 2.3 Geologic and Hydrogeological Setting

The Site is located within Las Vegas Valley, which occupies a topographic and structural basin trending northwest-southeast and extending approximately 55 miles from near Indian Springs on the north to Railroad Pass on the south. The valley is bounded by the Las Vegas Range, Sheep Range, and Desert Range to the north, by the Frenchman and Sunrise Mountains to the east, by the McCullough Range and River Mountains to the south and southeast, and the Spring Mountains to the west. The mountain ranges bounding the east, north, and west sides of the valley consist primarily of Paleozoic and Mesozoic sedimentary rocks (limestones, sandstones, siltstones, and fanglomerates), whereas the mountains on the south and southeast consist primarily of Tertiary volcanic rocks (basalts, rhyolites, andesites, and related rocks) that overlie Precambrian metamorphic and granitic rocks (ENSR 2007). The Site is located on Quaternary alluvial deposits (Qal) that slope north toward Las Vegas Wash. The thickness of the alluvial deposits ranges from less than one foot to more than 50 ft beneath the Site. Soil types identified in onsite soil borings include poorly sorted gravel, silty gravel, poorly sorted sand, well sorted sand, and silty sand (ENSR 2005). The Upper Muddy Creek Formation (UMCf) of Pleistocene age occurs in 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

---

[5] Ramboll Environ calculated the mean annual evaporation rate using the linear regression for Nevada Region 1 shown in Table 3 of Shevenell (1996) and a mean elevation for the Site of 1,772 ft (540 meters). The mean elevation was calculated from elevations reported in Kerr-McGee (1985) ranging from 1,675 ft (northwest) to 1,870 ft (southwest).

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) (ENSR 2005).

Depth to groundwater ranges from about 27 to 80 ft bgs across the Site and is generally deepest in the southernmost portion of the Site, becoming shallower as it approaches the Las Vegas Wash to the north. For Parcel F, groundwater depth is approximately 30 to 40 ft bgs. The groundwater flow direction at the Site is generally north to north-northwesterly, whereas north of the Site, the direction changes slightly to the north-northeast (ENVIRON 2014a).

A major feature of the alluvial deposits is the stream-deposited sands and gravels that were laid down within paleochannels that were eroded into the surface of the UMCf during infrequent flood runoff periods. These deposits are thickest within the paleochannel boundaries, which are narrow and linear and trend northeastward. The paleochannels act as preferential pathways for groundwater flow, which may significantly influence the chemical distribution in the alluvium (ENSR 2005). 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).

As shown on Figure 1-2, an extraction well field, referred to as the interceptor well field (IWF), and groundwater barrier wall are present at the Site. The groundwater barrier wall was constructed in 2001 as a physical barrier across the higher concentration portion of an existing perchlorate/chromium plume. The IWF generally captures groundwater with higher contaminant concentrations and is located downgradient of on-site source areas. The interceptor wells and barrier wall have significantly decreased chemical concentrations in the Qal downgradient of the IWF (Ramboll Environ 2016c).

# 3. HISTORICAL INVESTIGATIONS AND REMOVAL ACTIONS

## 3.1 Overview of Environmental Investigations

Parcel F was identified for possible sale early in the environmental investigation process at the Site. Although former activities within Parcel F were not expected to have resulted in significant chemical impacts, NDEP identified four LOUs for investigation within Parcel F, including LOUs 4 (Hardesty Chemical Company Site), segments of 59 (Storm Sewer System), 63 (J.S. Kelley Trucking), and 65c (Nevada Precast Concrete Products). The LOUs are shown on Figure 2-1, and brief descriptions of the LOUs are provided in Section 3.2. Also shown on Figure 2-1 is the chloroform groundwater plume in relation to the Site and Parcel F.

The primary soil investigations conducted within Parcel F are summarized below:

- **Phase 1 ECA and Environmental Site Assessments (ESAs):** In 1993, Kleinfelder completed a comprehensive ECA (Kleinfelder 1993), which included Parcel F, pursuant to a consent agreement with NDEP. In March 2007, Converse Consultants (Converse) completed a Phase 1 ESA (the “2007 Phase I ESA”) that included the areas occupied by Parcel F (Converse 2007). As part of the 2007 Phase 1 ESA, Converse conducted a site visit and reviewed historical aerial photographs dating from 1950 through 2006. In addition, an earlier Phase I was completed in 2005 by Tetra Tech EM Inc. (Tetra Tech) for Parcel F (as reported by Converse 2007).

- **Phase 2 soil investigation:** A Phase 2 sampling and analysis plan (SAP) was prepared to identify and characterize the distribution of site-related chemicals (SRCs) in soil for Parcel F (Basic Environmental Company [BEC] 2007). NDEP reviewed and approved the SAP on October 9, 2007 (NDEP 2007). The Phase 2 soil sampling in Parcel F was conducted between November 2007 and June 2008. The results were reported in the associated data validation summary report (DVSR) (ERM-West, Inc. [ERM-West] 2008) and discussed with NDEP on May 15, 2008 (NDEP 2008a).

- **Phase 2 supplemental soil investigation**: Based on the results of the Phase 2 soil investigation and discussions with NDEP, a supplemental SAP was prepared (BEC 2008b). Additional samples were collected in Parcel F in June 2008 to characterize deep soil conditions, as part of the broader investigation of the Site. The results of the supplemental investigation were reported in the associated DVSR (ERM-West 2009).

- **Phase 2 Remedial Investigation**: During sampling conducted in April 2017 as part of the Phase 2 RI, soil samples were collected at two borings within Parcel F. The results were reported in the associated DVSR submitted to NDEP on November 10, 2017 (Ramboll Environ 2017c).

The primary soil gas and groundwater investigation conducted within the Parcel F is summarized below:

- **Phase B soil gas investigation**: The Phase B soil gas investigation was conducted in 2008. Two soil gas samples were collected at approximately 5 ft bgs within Parcel

F. Details of the soil gas sampling are provided in the *Phase B Source Area Investigation Soil Gas Survey Work Plan* (the “2008 Site-Wide Soil Gas Work Plan”; ENSR 2008a). Sampling locations were based on the following: (1) results of the Phase A investigation (ENSR 2007), which identified the presence of several VOCs in soil and/or groundwater samples collected at the Site; (2) historic soil and groundwater data collected during prior investigations; and (3) an assessment of former chemical usage at the individual LOUs. Analytical results for samples collected during the soil gas survey were presented in a DVSR (ENSR 2008b) that was submitted to NDEP on October 13, 2008, and approved by NDEP on October 20, 2008.

- **2013 ENVIRON soil gas investigation**: Soil gas samples were collected in March 2013 to address some of the data gaps identified in the 2008 Phase B soil gas survey. Four additional soil gas samples including one field duplicate were collected in Parcel F at approximately five ft bgs (E-SG-4 through E-SG-6). Details of the soil gas sampling are provided in the *Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels “C”, “D”, “F”, “G”, and “H”* (ENVIRON 2013b). Analytical results for samples collected during the 2013 soil gas survey are presented in Appendix B of this report.

- **Groundwater Monitoring Wells:** Shallow groundwater was included in this HRA for the vapor intrusion pathway as one of the multiple lines of evidence together with the soil gas evaluation. For groundwater monitoring well sampling results, all shallow groundwater monitoring wells entered either into the BMI or Ramboll Environ project database and sampled for VOCs were included if they were within or adjacent to Parcel F. Data were extracted for the years 2006-2017 to determine the concentration trends, but only the last two years of data for each well were used in the risk evaluation.

The soil, soil gas, and groundwater monitoring well locations within or adjacent to Parcel F are shown on Figure 3-1. Table 3-1 lists the soil gas samples evaluated for Parcel F, and Table 3-2 summarizes the shallow groundwater monitoring wells evaluated for Parcel F. Figure 3-2 shows the soil gas and shallow groundwater sample locations in relation to the nearby chloroform groundwater plume shown on Figure 2-1 which crosses the western portion of Parcel F (Ramboll Environ 2017d).

## 3.2 Historical Uses and Investigations of Parcel F

This section describes features and historical uses of Parcel F, and summarize the results of the soil, soil gas, and groundwater investigations.

Parcel F is a 6.96-acre parcel along the western boundary of the Site (Figure 2-1). Most of the parcel is vacant land, although a building foundation and a wooden pole at the edge of the foundation remain, and approximately 15 three-foot high gravel/sand piles are present (temporary soil stockpiles from ongoing utility projects being implemented by Basic Water Company). Other features include electrical equipment and a concrete tank with a steel top that is both above and below the ground surface.

As noted previously, LOUs 4 (Hardesty Chemical Company Site), segments of 59 (Storm Sewer System), 63 (J.S. Kelley Trucking), and 65c (Nevada Precast Concrete Products) are located in Parcel F (Figure 2-1). Nevada PreCast Concrete occupied the area identified as LOU 65c. As reported by Kleinfelder (1993), the area occupied by Nevada Pre-Cast Concrete (from January 1973 to May 1978) was used only for offices; no waste streams or chemical uses were reported for LOU 65c.

From 1980 to 1986, Parcel F was leased by W.S. Hatch Company, a trucking operation. From 1986 through at least 1993, the area within Parcel F that comprises LOU 63 was leased by J.B. Kelley (also a trucking operation) (Kleinfelder 1993). J.B Kelley hauled commodities such as lime and soda ash. The specific areas of interest within LOU 63 included a 10,000-gallon fiberglass diesel underground storage tank (UST), a ceramic-lined 600-gallon waste oil UST, and a truck washing area with eight open concrete vaults that had historically served as foundations for peat storage buildings during World War II. Rinsate from truck washing was reportedly discharged to the former vault floors, metal containment tanks, a storm sewer, and/or the ground surface. Chemicals identified as being in the rinsate included lime, soda ash, barite, and magnesium chloride brine. On-site wash activities ceased in 1991. Additional fluids from truck maintenance activities, such as oil changes, were reportedly discharged to the storm sewer, which conveyed the wash water and other fluids northward to the Beta Ditch (Kleinfelder 1993). Field investigations of the diesel waste oil USTs were conducted, and both tanks, which were found to have leaked, were removed in 1991. Contaminated soil in the tank pits was reportedly excavated at the time of the tank removal (Kleinfelder 1993).

In October 2005, Tetra Tech completed a Phase I ESA for Parcel F (as reported by Converse [2007]) that identified an empty steel tank, three 55-gallon drums (no longer present), soil and gravel staining, a subsurface storm sewer system (LOU 59), and a painted surface on the interior of a building. The Phase 1 ESA review of historical aerial photographs identified a building on Parcel F in 1950 that was no longer present in 2006 (Converse 2007).

### Soil Investigations

During the Phase 2 soil investigation (ERM-West 2008), soil samples were collected from 15 locations within the current boundaries of Parcel F, at the surface and at a depth of 10 ft bgs (Figure 3-1). Both random (TSB-FR-01 to TSB-FR-05) and judgmental (TSB-FJ-01 to TSB-FJ-11) locations were sampled, with judgmental samples specifically targeting the areas of the 55-gallon drums, above ground vault, electrical equipment, debris piles, and a mobile aboveground storage tank (BEC 2007). During the Phase 2 supplemental soil investigation, samples were collected at 0, 10, 20, and 30 ft bgs at three locations (TSB-FR-02, TSB-FJ-02, and TSB-FJ-02) to characterize deep soil conditions, as part of the broader investigation of the Site. During the 2017 Phase 2 RI sampling, an additional two locations (RI-18 and RI-19) were sampled within Parcel F at depths of five and 10 ft bgs.

As described in the 2008 Remedial Action Workplan (RAW) (BEC 2008a, also included as Appendix C of this report), removal polygons were identified for asbestos at eight locations: TSB-FR-02, TSB FJ-01 through TSB FJ--03, and TSB FJ-05 through TSB FJ-08.

In addition, the following chemicals were detected at concentrations exceeding the worker BCLs in effect at that time: Aroclor 1254, benzo(a)pyrene (BaP), benzo(b)fluoranthene, and dibenz(a,h)anthracene at TSB-FR-02, and arsenic at TSB-FJ-02 (Figure 3-1).

Soil Gas Investigation

During the 2008 Phase B soil gas investigation (ENSR 2008a), two soil gas samples were collected within the current boundaries of Parcel F at a depth of five ft bgs (Figure 3-1, samples SG34 and SG74). Over 40 VOCs were detected in the two soil gas samples, generally at low concentrations. The maximum detected concentration included chloroform (640 microgram/cubic meter [$\mu g/m^3$]), tetrachloroethene (130 $\mu g/m^3$), and 1,1-dichloroethene (110 $\mu g/m^3$). All other VOCs were detected below 100 $\mu g/m^3$.

During the 2013 soil gas investigation (ENVIRON 2013b), four additional soil gas samples including one field duplicate were collected at approximately five ft bgs (Figure 3-1, E-SG-4 through E-SG-6). Over 50 VOCs were detected in the four soil gas samples, generally at low concentrations. The maximum detected concentration included n-hexane (6,100 $\mu g/m^3$), chloroform (2,800 $\mu g/m^3$, J-qualified), tetrachloroethene (120 $\mu g/m^3$), and carbon tetrachloride (110 $\mu g/m^3$). All other VOCs were detected below 100 $\mu g/m^3$.

Groundwater Investigations

As listed in Table 3-2, four shallow groundwater monitoring wells that were analyzed for VOCs and semi-volatile organic compounds (SVOCs) are located within or adjacent to Parcel F. Three of those wells (M-92, M-97, and TR-6) were sampled in March 2006 as part of the Phase A groundwater investigation. In 2009, these three wells were sampled as part of the Phase B investigation with the objective of characterizing the presence of SRCs in specific areas around the Site. Additional samples were collected by OSSM at TR-6 in 2007, 2010 and 2011, and at M-92 in 2010, 2012 and 2014. M-92, M-97, and TR-6 were sampled again in early 2015 as part of the Phase 1 portion of the remedial investigation, and in May 2017 as part of the Phase 2 RI investigation. M-93 in Parcel F needed well head repairs and was not sampled for VOCs or SVOCs in the past. M-93 was cleared and redeveloped before the 2017 RI investigation. VOC and SVOCs data were collected from this well in May 2017 as part of the RI investigation.

Over 60 VOCs were detected at least once in these wells after 2005. Chemicals detected, along with their maximum concentrations, include chloroform (3,600 microgram per liter [$\mu g/L$]), chlorobenzene (2,200 $\mu g/L$) and benzene (1,300 $\mu g/L$).

## 3.3 Soil Removal and Confirmation Sampling

In July 2008, a RAW (BEC 2008a, also included as Appendix C of this report) was prepared to address impacted soils identified in the parcel Phase 2 investigations described in Section 3.2; NDEP approved the RAW on July 2, 2008 (NDEP 2008b). The RAW identified a target cancer risk of one in a million ($1\times10^{-6}$) as a guide for remediation and for most chemicals, the NDEP commercial/industrial worker BCL (based on an incremental lifetime cancer risk [ILCR] of $1\times10^{-6}$) was used to target soils for removal. For dioxin/furans, soils with concentrations greater than 0.0010 mg/kg were identified for removal. For asbestos abatement, removal polygons were identified in the RAW for soils with the presence of amphibole (one or more long fibers) and/or chrysotile (four or more long fibers). The RAW did not include a definition of long fibers; however, current NDEP guidance (Neptune 2015) identifies fibers that should be counted for risk assessment purposes as those longer than 10 microns (µm) in length and less than 0.4 µm in width.

### 3.3.1 Removal Action

Northgate implemented the soil removal action in Parcel F in April 2010 under the oversight of NDEP. Work was performed in accordance with the approved RAW (BEC 2008a). The polygon size and shape were determined based on the Phase 2 soil sampling results and locations where chemicals were detected above levels specified in the RAW. The removal included the excavation of one foot of soil in each of the identified polygons and collection of confirmation samples (described below).

The remediation polygons for Parcel F are shown on Figure 3-1. Additional figures prepared by Las Vegas Paving (LVP) are provided in Appendix D-1 and the soil disposal manifests are provided in Appendix D-2. A total of 5,895 tons of soil in Parcel F were excavated from the soil surface and transported in covered trucks to Apex Landfill, approximately 37 miles from the Site (Northgate 2014).

Eight excavated areas were located in Parcel F (Figure 3-1 and Appendix D-1), from which a total of 3,928 cubic yards (cy) of soil was removed. The total excavation depths ranged from 0.2 to 0.9 ft below original grade (Table 3-3). Two small areas within the removal polygons were not excavated because of physical impediments: 1) an approximately 1,000 square feet section in the center portion of Fourth Street (along the western boundary of Parcel F) that is covered by asphalt, and 2) an approximately 1,955 square feet area along the railroad track at the southern boundary of Parcel F (see Appendix D-1). Excavation was conducted to the edge of these inaccessible areas. For these areas, qualitative considerations suggest that associated risks would be insignificant. Specifically, in the first area noted, the soil is in the center of Fourth Street and covered with asphalt. The second area is in close proximity to railroad tracks where individuals are not expected to spend a significant amount of time (Northgate 2014).

### 3.3.2 Confirmation Sampling

Northgate collected confirmation samples in April 2010, following the excavation of impacted soils. Field activities and sampling procedures were performed under the supervision of a Certified Environmental Manager and in accordance with the BRC Health and Safety Plan, BMI Common Areas, Clark County, Nevada (BRC and MWH 2005); the BRC Field Sampling and Standard Operating Procedures (SOP), BMI Common Areas (BRC, ERM, and MWH 2007a); and the BRC SOP-12 Surface Soil Sampling for Asbestos (BRC, ERM, and MWH 2008).

Confirmation samples were collected in a manner consistent with the approved RAW. Specifically, LVP surveyed the location of the original samples prior to the removal action and then collected the confirmation samples at the same locations; confirmation samples were then analyzed for the chemicals that had triggered the removal (i.e., analyses were conducted for those chemicals exceeding the RAW specified levels). A total of eight primary samples and three field duplicate sample were collected from the eight remediation polygons in Parcel F.

The analytical data were validated by Laboratory Data Consultants, Inc. (LDC) in accordance with procedures described in NDEP guidance Data Verification and Validation Requirements – Supplement, April 13, 2009 established for the BMI Plant Sites and Common Areas Projects (NDEP 2009a). A complete listing of the soil confirmation samples is presented in Table 1-2 of the DVSR (Northgate 2010b, see Appendix E). Final confirmation sampling results indicated that concentrations of the trigger chemicals were below the levels identified in the RAW as elevated (BEC 2008a), with one exception. One sampling location – TSB-FR-04 – with counts of three and four long chrysotile fibers in the primary and field duplicate sample, respectively, was not identified for further removal. No information was found in the administrative record as to why soils at this location were not removed. It appears that the removal decision was based on the primary sample in which the count of long chrysotile fibers was less than the level identified in the RAW[6], not based on the field duplicate sample.

Table 3-3 identifies the samples and chemicals detected above the levels specified in the RAW, and the post-removal concentrations for these chemicals.

---

[6] 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 in soil samples were one (1) or more fibers and chrysotile counts were four (4) or more fibers (BEC 2008a).

# 4. DATA USABILITY EVALUATION AND DATA ANALYSIS

This section presents the updated DUE conducted for soil and soil gas (Sections 4.1 and 4.2). These DUEs were previously included in the Soil HRA Report (Revision 3) and the Soil Gas HRA Report (Revision 1). This section also presents a DUE conducted for groundwater (Section 4.3). For each medium, the first component of the DUE focuses on the quality of each individual data point to ensure that the quality of the data is sufficient to support the HRA. The second component of the DUE, data analysis, focuses on the data set as a whole.

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

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

The second component of the DUE (data analysis) is also presented in Sections 4.1.2, 4.2.2, and 4.3.2. 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." In particular, through statistical summaries, background evaluation (for soil metals and radionuclides only), spatial plots, and other exploratory analyses, the data are reviewed relative to our current understanding of

Parcel F (as represented by the CSM) and for possible data gaps or other investigation issues. A discussion of the Study Area CSM is presented in Section 4.4.

## 4.1 Soil

### 4.1.1 Data Usability Evaluation

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

#### 4.1.1.1 Soil Data Set and Data Processing

The post-remediation soil HRA data set comprises the analytical results that are representative of current conditions within Parcel F. Specifically, the data set includes soil samples collected at 0-10 ft bgs as part of the following investigations:

- 2007-2008 Phase 2 soil investigation;
- 2008 Phase 2 supplemental soil investigation;
- 2010 confirmation sampling following soil removal; and
- 2017 Phase 2 RI.

For each soil sample collected from the above investigations, sampling locations were verified relative to current parcel and Operations Area boundaries. Samples were excluded from the post-removal soil HRA data set if 1) locations were outside the current boundaries of Parcel F; 2) the sampling depths were greater than 10 ft bgs; or 3) location and/or depth information were not available.

Only soil data representative of current conditions within Parcel F (i.e., conditions following the soil removal and asbestos abatement activities) are used for the post-remediation HRA. Specifically, the Phase 2 sampling results for surface soils (for chemicals that had triggered the 2010 soil removal) were replaced by the 2010 soil confirmation sampling results for the same chemcials at the same locations (see Table 3-3) since these earlier data represented soil that has been removed. The Phase 2 sampling results in surface soils for all the other chemicals at the same locations are retained in the post-remediation HRA data set, since soil removal was only conducted at the top few inches (at most down to one foot) and these data are still representative of the conditions of the rest of the soil column (down to 1.5 ft bgs). A summary of soil data not considered in the post-remediation HRA due to soil removal and asbestos abatement activities is presented in Appendix E, Table E-1.

The “NERT project database,” maintained by Ramboll Environ on behalf of the Trust, houses the analytical data collected during historical and ongoing investigations at NERT.[7] After identifying the preliminary set of data for the post-remediation HRA, an initial task before the DUE was to 1) identify and correct inconsistencies in data field

---

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

entries and 2) create additional fields to support data management and interpretation. The following steps of data processing were completed:

- Standardize chemical names and Chemical Abstract Service (CAS) registry numbers;
- Standardize reporting units, e.g., milligram per kilogram (mg/kg) for metals and microgram per kilogram (µg/kg) for organic compounds;
- Standardize analytical method names;
- Correct errors in data entry (e.g. typos in sample identification codes);
- Identify a unique result for use in the HRA for sample/analyte pairs for which more than one result was reported. For example, if two results were reported for naphthalene in the same sample – one by USEPA Method 8260 and the second by USEPA Method 8270 or 8270 Selective Ion Monitoring (SIM) – the result to be used in the HRA was identified as that from the 8270 or 8270 SIM analysis because naphthalene is classified as a SVOC in soil;
- Enter BCLs and confirm that BCLs correspond to the chemical form or species reported. For example, the database compared analytical results for phosphorus with the BCL for white phosphorus. There is no evidence to suggest that white phosphorus is present in parcel soils. The most abundant form of phosphorus in soil is orthophosphate. Analytical methods were reviewed to confirm that the analyses were not for white phosphorus; and
- Develop database queries and confirm that queries returned the correct output.

The above steps were necessary due to the approximately 10-year period over which the soil data was 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, 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 post-remediation HRA data set during data processing are summarized in Appendix E, Table E-2.

To ensure calculation consistency, dioxin toxicity equivalents (TEQs) were calculated (or recalculated) using the results for dioxins and furans and the World Health Organization (WHO) toxicity equivalency factors (TEFs) scheme (van den Berg et al. 2006). BaP equivalents (BaPEqs) were also calculated (or recalculated) for the seven carcinogenic polynuclear aromatic hydrocarbons (PAHs) (i.e., BaP, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene) for which USEPA has derived TEFs (USEPA 2017a). Nondetects were addressed using the Kaplan-Meier approach from USEPA's TEQ calculator.

Total petroleum hydrocarbon (TPH) data were excluded from the post-remediation soil HRA data set, consistent with NDEP guidance (NDEP 2017a). TPH was evaluated through the indicator chemicals, including benzene, toluene, ethyl benzene, and total xylenes (BTEX); methyl tert-butyl ether (MTBE); and PAHs.

For asbestos, several issues were identified in the DVSRs (Neptune 2014). A memorandum responding to the specific issues identified in the DVSRs along with the agreed data set for risk assessment purposes in the electronic data deliverable (EDD) was submitted to NDEP (ENVIRON 2014c). As further discussed in Section 6.1.6, the overall impact of asbestos data issues on the risk estimates is relatively small.

The final post-remediation soil HRA data set for Parcel F is presented in Appendix F (Table F-1 for chemicals and radionuclides, and Table F-2 for asbestos), which includes 64 samples collected at 0, 5, and 10 ft bgs from 17 sampling locations.

#### 4.1.1.2 Criterion I – Reports to Risk Assessor

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

- Parcel F is described in Section 3.2 of this report. Information on the regional and local geology and hydrogeology is provided in the RI/FS Work Plan (ENVIRON 2014a).
- The soil investigations and removal actions conducted in Parcel F are described in the following work plans:
    - *Phase 2 Sampling and Analysis Plan to Conduct Soil Characterization, Tronox Parcel "F" Site (BEC 2007, approved by NDEP on October 9, 2007);*
    - *Sampling and Analysis Plan to Conduct Supplemental Soil Characterization, Tronox Parcels "C", "D", "F", "G", and "H" (BEC 2008b, approved by NDEP on June 5, 2008);*
    - *Removal Action Workplan for Soil, Tronox Parcels "C", "D", "F", "G" and "H" Sites (BEC 2008a, approved by NDEP on July 2, 2008); and*
    - *Technical Memorandum, Remedial Investigation Data Evaluation (Proposed Phase 2 RI Data Gap Investigation is included in Section 7) (Ramboll Environ 2016d, approved by NDEP on August 23, 2016).*
- The soil analytical data are presented in the following DVSRs (included in Appendix E of this report):
    - *Data Validation Summary Report, Tronox Parcels C, D, F, and G Investigation (ERM-West 2008, approved by NDEP on April 3, 2008);*

  - *Data Validation Summary Report, Tronox Parcels C, D, F, G and H Supplemental Investigations-June-July 2008 (ERM-West 2009, approved by NDEP on January 12, 2009);*

  - *Data Validation Summary Report, Parcel “C”, “D”, “F”, “G” and “H” Soil Confirmation (Northgate 2010b, with final response to comments [Northgate 2010c], approved by NDEP on July 28, 2010);*

  - *Data Validation Summary Report for Asbestos Data Associated with the Post-Remediation Screening Health Risk Assessment Report for Parcels C, D, F, G, and H (Neptune 2014);*

  - *Response to Issues Identified in: Data Validation Summary Report for Asbestos Data Associated with the Post-Remediation Screening Health Risk Assessment Report for Parcels C, D, F, G and H (ENVIRON 2014c); and*

  - *Data Validation Summary Report, Parcel F Health Risk Assessment Soil Remedial Investigation Sampling (Ramboll Environ 2017c)*

- The laboratories provide a quality assurance/quality control (QA/QC) narrative with each analytical data package, and the data review provides a narrative of qualified analytical results. A description of the analytical methods and detection limits is included. These narratives are included as part of each DVSR.

- Method-specific QC results are provided in each laboratory report, along with the associated raw data. The laboratory reports and QC results are included as part of each DVSR.

- Data flags used by the laboratory are defined adequately and are discussed further below.

- Laboratory reports include the name and address of the laboratory, unique identification of the test report, client and project name, and dates of sample receipt and analysis. Each analytical report describes the analytical method used, the analytical results on a sample-by-sample basis, and the practical quantitation limits (PQLs). The results of the QC samples, including method blanks, laboratory control spike (LCS) samples, surrogate recoveries, internal standard recoveries, matrix spike (MS) samples, matrix spike duplicate (MSD) samples, second column confirmation, interference checks, and serial dilutions are also provided. All laboratory reports contained data equivalent to a Contract Laboratory Program (CLP) deliverable, inclusive of CLP QC summary forms where applicable, and the supporting raw data. Reported sample analysis results were imported into the NERT project database, which at the time the studies were conducted, was maintained by BEC, then by Northgate, and currently maintained by Ramboll Environ.

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

#### 4.1.1.3 Criterion II – Documentation

The objective of the documentation review is to ensure that each analytical result can be associated with a specific sampling location, and that the procedures used to collect the samples are appropriate. As part of this DUE step, Ramboll Environ completed a comprehensive review of the soil samples collected and reported in the documents listed under Criterion I and/or in the NERT project database. As discussed in Section 4.1.1.1, the geographic location of each soil sample was confirmed relative to current parcel and Operations Area boundaries. Samples with missing geographic location information (i.e., x, y coordinates and/or depth) were removed from the post-remediation soil HRA data set.

Also, as discussed in the work plans listed under Criterion I, all sample collection and handling procedures were consistent with the NDEP-approved Quality Assurance Project Plans (QAPPs; AECOM, Inc. [AECOM] and Northgate 2009, ENVIRON 2014d). Northgate and Ramboll Environ reviewed the chain-of-custody (COC) forms prepared in the field and compared them with the analytical data results provided by the laboratories to ensure completeness of the data set.

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

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

#### 4.1.1.4 Criterion III – Data Sources

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

The review of sample coverage is based on the distribution of sample locations from soil investigations listed in Section 4.1.1.1. Samples were collected in accordance with the work plans listed under Criterion I, with both judgmental and random sampling collected. As noted in Section 3.2, judgmental samples were collected at locations targeting the areas of the 55-gallon drums, above ground vault, electrical equipment, debris piles, and a mobile aboveground storage tank. Following each investigation, results were reviewed in consultation with NDEP and areas for additional sampling were identified. The vertical coverage of the soil samples ranged from surface down to 10 ft bgs. Based on the review, sample coverage from the soil investigations in Parcel F are considered adequate for purposes of the post-remediation HRA.

As part of the SAPs and the QAPPs, the use of standard USEPA analytical methods (listed under Criterion IV) were approved by NDEP. Analyses were conducted by NDEP-certified laboratories for the classes of chemical compounds identified as SRCs in Parcel F, including chlorine oxyanions (chlorate and perchlorate), metals and other inorganics, radionuclides, asbestos, dioxins/furans, organic acids, PAHs, PCBs, OCPs, SVOCs, TPHs (diesel, gasoline, and oil/grease), and VOCs. The USEPA methods are adequate for characterizing potential contaminants in soils and provide quantitative analytical results that are of adequate quality for deriving EPCs.

#### 4.1.1.5 Criterion IV – Analytical Methods and Detection Limits

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

- USEPA Method 300 or 300.1 (chlorate)
- USEPA Method 314.0 (perchlorate)
- USEPA Method 6020 or 6010 (metals)
- USEPA Method 7199 or 7196A (chromium VI)
- USEPA Method 7471 (mercury)
- USEPA Method 300 (bromide, chloride, fluoride, nitrate, nitrite, ortho-phosphate, and sulfate)
- USEPA Method 300.1 (chlorite)
- DOE EML HASL 300 (thorium [Th], uranium [U])
- USEPA Method 901.1, 903.0 or 903.1 (radium [Ra]-226)
- USEPA Method 901.1 or 904.0 (Ra-228)
- USEPA Method 540-R-97-028 (asbestos)
- USEPA Method 8290 (dioxins/furans)
- USEPA Method 8270 (organic acids)
- USEPA Method 8270, 8270 SIM or 8310 (PAHs)
- USEPA Method 8082 (PCB Aroclors)
- USEPA Method 8081 (OCPs)
- USEPA Method 8270 or 8270 SIM (SVOCs)
- USEPA Method 8015 (TPHs)
- USEPA Method 8260 (VOCs)

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

During Northgate's review of the analytical results reported in the NDEP-approved DVSRs for the initial 2008 sampling event, Northgate noted that for some samples, nondetect results were reported to the PQL rather than the SQL. Based on review of the laboratory data packages, and as discussed with the laboratory, the procedure for evaluating these results consisted of the following steps. 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 PQL. These procedures were consistent with the approved DVSR for the 2008 sampling program. In early 2011, Ramboll Environ reassessed the nondetect data according to the current NDEP guidance on the use of censoring limits (NDEP 2008c). In the soil HRA 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 was not available, the nondetect results are reported to the PQL. Based on NDEP (2008c), the uncensored data for radionulcides were used in the soil HRA, which means a detection frequency of 100%.

For analytes where the detection frequency was less than 100%, the SQLs from the soil HRA data set were compared to 0.1 times the BCL (0.1×BCL)[8] (NDEP 2017a) to confirm that they were sufficiently low for risk characterization. For chemicals where a BCL was not available, representative surrogates were identified and used for the comparison. For dioxin TEQs, the SQLs were compared to the site-specific action level of 0.0027 mg/kg, derived based on a study that evaluated the bioaccessibility of dioxins in soils collected from the NERT Site [Northgate 2010a]). Table 4-1 presents the results of SQL evaluation for Parcel F along with the screening levels.

As shown in Table 4-1, maximum SQLs in Parcel F were less than the screening levels, with the following exceptions:

- For chromium VI, only one out of 45 soil samples was detected, and the SQL exceeded 0.1xBCL in one out of 44 samples reported as nondetects.
- For dioxin TEQs, the SQLs exceeded the site-specific action level of 0.0027 mg/kg in five out of 18 soil samples reported as non-detected, while the detection frequency was 47% (16 out of 34 samples).
- For BaPEqs, only five out of 45 soil samples were detected, and the SQLs exceeded 0.1xBCL in 30 out of 40 samples reported as nondetects.
- Benzidine, hexachlorobenzene, and n-nitroso-di-n-propylamine were not detected in any soil samples; the SQLs exceeded 0.1xBCL in 100%, 100%, and 8.9% of the non-detected samples, respectively.

---

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

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

#### 4.1.1.6 Criterion V – Data Review

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

The DVSRs listed in Criterion I for soil data included in the HRA data set are provided in Appendix E, in which the names and qualifications of the reviewers, the specific data validation procedures, and the qualification findings are presented. Each DVSR (with the exception of the asbestos DVSR) includes the following tabular summaries of the data qualifications:

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

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

#### 4.1.1.7 Criterion VI – Data Quality Indicators

The project QAPPs (AECOM and Northgate 2009, ENVIRON 2014d) identified five data quality indicators (DQIs) to insure that the overall quality of the data is sufficient to support the risk assessment, as follows: completeness, comparability, representativeness, precision, and accuracy. The DQIs provide quantitative and qualitative measures for evaluating the risk assessment data as they relate to uncertainties in the selection of COPCs, characterization of EPCs, and risk descriptors used in support of the HRA. Specifically, the DQIs address field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and risk assessment.

Completeness

The completeness criterion includes evaluation of field completeness and laboratory completeness. Field completeness is defined as the percentage of samples collected versus those intended to be collected as specified in the sampling work plans. Laboratory completeness is defined as the percentage of samples reported by the laboratories versus those requested on the COCs. 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 HRA data set. A comparison of samples reported in the NERT project database with the work plans for soil investigations listed under Criterion I indicates an actual field completeness of 100% for all sampling events. In addition, all COC requests were executed by the laboratories, with minor exceptions detailed in the DVSRs. Depending on the specific DVSR, 91.41% to 99.8% laboratory completeness was archived based on validated data, with 0.2% to 8.59% of the data qualified as rejected ("R" qualified).

Rejected ("R" qualified) data associated with post-remediation soil samples at 0-10 ft bgs in Parcel F are summarized in Appendix E, Table E-3. Laboratory completeness was calculated for the post-remediation soil HRA data set (Appendix F) for Parcel F as 99.7%.

As indicated in Table E-3, among the 2010 soil confirmation results, some of the reported values for PAHs in both the primary and field duplicate sample at TSB-FR-02 were rejected due to exceedances of internal calibration limits. Another confirmation sample and field duplicate were collected on November 30, 2010 at the same location to ensure that the cleanup goals for PAHs had been achieved within the remediation polygon associated with this sample location. The results for these additional samples are provided in Appendix E. As shown in Appendix E, PAHs were not detected in either of these samples at detection limits below the BCLs. These results confirm that the remediation polygon associated with this sample location (see Figure 3-1) has been remediated. The results for these additional samples are not included in the soil HRA data set because they were not formally validated (no DVSR associated with these data).

In summary, both field and laboratory completeness meet the completeness goals of 90% established in the QAPPs. Rejected data are excluded from the post-remediation soil HRA data set, and a discussion of how these rejected data occurrences potentially affect the HRA is presented in Section 6.1.3.

Comparability

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

Soil samples identified for the post-remediation HRA 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 10 years. As discussed in Section 4.1.1.5, Ramboll Environ updated the nondetect data to be reported to the SQL whenever it is available, which maximized the comparability of reporting requirements among different investigations. However, different reporting limits for the same analyte may also impact the comparability of the data sets. The ranges of the SQLs for each analyte for which the detection frequency was less than 100% are presented in Table 4-1. As discussed in Section 4.1.1.5, for most of the analytes, the SQLs are well below 0.1xBCL (or other screening criteria); therefore, different reporting limits for the same analyte would not affect the COPC selection and risk estimates. There are a few analytes with SQLs exceeding 0.1xBCL, and their impacts on the COPC selection and risk estimates are further discussed in Section 6.1.2.

Of particular concern are possible differences between the Parcel F data set and the RZ-A background data set 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 quantile to quantile (Q-Q) plots for aluminium and titanium indicate that Parcel F concentrations are generally less than background (see Section 4.1.2.2). These observations indicate possible differences in the data sets, possibly associated with sample extraction, analytical methods, or other less-identifiable differences across the SOPs used by the different laboratories. For radionuclides, such issues were even more obvious, and may be important factors in explaining some of the radionuclide data anomalies. The Trust submitted a radionuclide data packet prepared by Ramboll Environ to NDEP via email on September 17, 2015, including a comparison of sample preparation and analytical methods between the parcel data sets and the RZ-A background data set. RZ-A background samples were collected and analyzed in 2009, while Parcel F samples were collected and analyzed between 2007 and 2017, i.e, both before and after NDEP issued guidance for evaluating radionuclide data (NDEP 2009b). Over this time period, samples were submitted for analysis to different analytical laboratories and analyzed using different preparation and analytical methods. During a meeting on October 13, 2015, NDEP, NDEP’s consultants, the Trust, and Ramboll Environ discussed the analytical issues of radionuclide data and how they would affect the results of background evaluation. These issues are further discussed in Sections 5.1.1.2 and 6.1.4.

Representativeness

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

Spatial representativeness was discussed previously under Criterion III. As noted, soil samples were collected in accordance with the NDEP-approved work plans listed under Criterion I. Both judgmental and random sampling approaches were followed, with judgmental samples collected at locations targeting the areas of the 55-gallon drums, above ground vault, electrical equipment, debris piles, and a mobile aboveground storage tank. Following each investigation, results were reviewed in consultation with NDEP and areas for additional sampling were identified. The vertical coverage of the soil samples is also adequate for Parcel F. Overall, the objectives of the investigations were met, and the placement of the sample locations is deemed representative to evaluate the Parcel F soil conditions in the context of the CSM.

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 relative percent difference (RPD) between the primary field sample and its field duplicate. Laboratory precision is quantitated for each laboratory data batch by calculating the RPD using data for the LCS/laboratory control spike duplicate (LCSD) and/or data for the MS/MSD. The field precision goal established in the QAPPs is a RPD of less than or equal to 50%, except for the case in which one (or both) of the primary or duplicate results is less than five times the reporting limit. For the latter case, the acceptance criteria is the reporting limit (i.e., the absolute value of the difference between the primary and duplicate result is less than or equal to the reporting limit). Laboratory precision goals are defined for specific analytical methods.

Field precision for the parcel samples was assessed by evaluating the field duplicate results in accordance with the Statistical Analysis Recommendations for Field Duplicates and Field Splits (NDEP 2008d), where the primary sample and field duplicate are independent samples. A total of 76 pairs of primary and field duplicate results for Parcel F were qualified due to RPD or reporting limit exceedance (see Appendix E, Table E-4). For laboratory duplicates, there were 13 data points (for Ra-226) qualified due to RPD or reporting limit exceedance (see DVSRs tables in Appendix E). In addition, six data points for zirconium and tungsten were qualified for MS/MSD RPD exceedance (see DVSR tables in Appendix E). All data with precision exceedances were qualified as

"J/Estimated" or "UJ/Estimated non-detected" and are determined to be usable for purposes of the HRA, and the effects of these qualified data on the results of conclusions of HRA are further discussed in Section 6.1.5.

Accuracy

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

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

All qualified results (i.e., U, J, J-, and J+ qualified data)[9] for the non-asbestos analytes are presented in Appendix F, Table F-1, and the reasons for these qualified results are summarized in the DVSRs (see Appendix E). 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 post-remediation HRA and are included in the HRA data set. As discussed further in Section 6.1.6, use of qualified data resulting from one or more of the above parameters is not expected to significantly impact the results and conclusions of the post-remediation HRA.

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, Ramboll Environ queried the censored data for blank contamination from the project database, and updated them from nondetected values at PQLs (U qualified) to detected values at reported concentrations (J qualified) if the PQLs were higher than the reported concentrations. Such revisions did not affect any sample in Parcel F. However, during our review, Ramboll Environ noticed that several discrepancies in the data associated with blank

---

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

contamination collected during the 2007-2008 Phase 2 soil investigation and the 2008 Phase 2 supplemental soil investigation exist between the project database and the amended tables of the DVSRs Northgate prepared in the Soil HRA Report Revision 3 (Northgate 2014), especially for the reported concentrations. Data consistent with the project database are included in this HRA, and the impacts of such discrepancies on the HRA results are further discussed in Section 6.1.6.

#### 4.1.1.8 Data Usability Conclusions

Evaluation of the soil analytical data for Parcel F in terms of usability for the risk assessment was conducted in accordance with USEPA and NDEP guidance. Based on the evaluation, the overall goals for data quality for risk assessment were achieved, and all DVSRs were reviewed and approved by NDEP (with the exception of the DVSR for Phase 2 RI in 2017, which was submitted to NDEP on November 10, 2017; NDEP provided comments on the DVSR on November 27, 2017 and the revised DVSR will be submitted to NDEP on December 27, 2017). In summary, with the exception of the rejected data discussed above, all parcel data are deemed to be usable for risk assessment purposes.

### 4.1.2 Data Analysis

Consistent with guidance (NDEP 2010b), the steps of the exploratory data analysis (EDA), as described in the following sections, include (1) preparation of summary statistics for the post-remediation soil HRA data set (Section 4.1.2.1), (2) evaluation of background conditions for metals and radionuclides (Section 4.1.2.2), and (3) preparation and review of spatial plots for detected analytes (Section 4.1.2.3).

#### 4.1.2.1 Summary Statistics

Summary statistics for analytical data collected from shallow soils (i.e., samples collected between 0 and 10 ft bgs) in Parcel F are presented in Table 4-2. Table 4-2 includes analytes detected in one or more soil samples; Appendix G 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 on Figure 3-1. In developing the summary statistics, soil samples with primary and field duplicate results were treated as independent samples. The effect of duplicate treatment on the HRA results and conclusions is further discussed in Section 6.1.7.

Table 4-3 presents the soil data summary results for asbestos (long amphibole and long chrysotile fibers). Results are reported in terms of the number of long fibers (i.e., >10 µm long and <0.4 µm wide) observed in the sample. As shown in Table 4-3, no long amphibole fibers were observed in any of the samples. Two to four long chrysotile fibers were observed in five out of 17 post-abatement samples in Parcel F.

#### 4.1.2.2 Background Evaluation

To support the EDA, a background evaluation was conducted for Parcel F. As requested by NDEP (2010d), analytical results for soil samples within RZ-A were used as the background data set for metals.[10] A detailed discussion of this data set is presented in

---

[10] 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 the NERT Site) (NDEP 2010c).

the Revised Technical Leaching Memorandum (Northgate 2010d). In summary, 31 soil samples, including three field duplicates, were collected from 14 borings[11] within RZ-A during the Phase B investigation; 16 of these samples were collected between 0 and 2 ft bgs and 15 samples were collected between 10 and 11.5 ft bgs. Consistent with the background evaluations conducted in previous versions of this HRA, a single 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 set due to elevated concentrations of boron and other metals (arsenic, chromium, cobalt, iron, molybdenum, nickel, platinum, and sodium).[12]

The RZ-A samples identified for the metals background evaluation were also used for the radionuclide background evaluation. In previous versions of Parcel Soil HRA, the BRC/TIMET background data set presented in *Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity* (BRC and TIMET 2007) was used for the radionuclide background evaluation. However, in comments on Soil HRA Report Revision 3 (NDEP 2015), NDEP clarified that the RZ-A data set (and not the BRC/TIMET data set) should also be used for the radionuclides. The data set used for the background evaluation of both metals and radionuclides and the background sample locations are included in Appendix H.

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

Box plots provide a visual comparison between Parcel F and background data. These plots are included in Appendix I. 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 parcel data indicates that the parcel data may not be significantly different from background. The whiskers demarcate one “step” above the 75th percentile and one step below the 25th percentile. One “step” is defined as 1.5 times the interquartile range (IQR, the difference between the 75th and 25th percentiles). Data points above and below the whiskers are considered potential outliers from the distribution and are shown on the plots as open circles for non-detected values and as crosses for detected values. As used here, “outliers” may indicate potential hotspots for spatial analysis.

---

[11] As shown on Figure H-1, RSAT7, RSAT8, and RSAS6 are located outside the boundaries of RZ-A and the Site. These three off-site samples are retained in the background data set.

[12] 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 ft of soil were below risk levels of concern (Northgate 2010e).

The computer statistical software program Guided Interactive Statistical Decision Tools (GiSdT®, Neptune 2007) was used to perform all statistical tests.[13] 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 2009d). These tests are described below:

**The two-sample t-test** tests for equality of the means of the parcel 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 GiSdT® version of the Gehan test uses the Mantel approach for ranking the data, which is equivalent to using the Gehan ranking system. The Gehan ranking system is used to rank non-detects with the detected concentrations (NDEP 2009d).

**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 previous versions of the parcel soil HRA (personal communication between Northgate and Neptune on October 7, 2009).

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

NDEP guidance (2008d) 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 2008d). The effect of duplicate treatment on the COPC selection and HRA results is further discussed in Section 6.1.7.

---

[13] Neptune provided Ramboll Environ with a copy of the GiSdT® program used for the statistical evaluation.

Consistent with NDEP guidance (NDEP 2009d), non-detect results were set equal to one-half the limit of detection for the parametric tests and equal to the detection limit for the non-parametric tests. Substitution is not required for the non-parametric tests, which use the Gehan ranking scheme to rank non-detects. For the t-test, the Gehan ranking scheme cannot be used; in comments on Revision 2 of the parcel soil HRA, NDEP stated that the value of one-half the detection limit for non-detects is preferred to represent the results by the most-likely actual values (NDEP 2009d).

Metals

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

- Table I-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 2008e), the median, mean, and standard deviation are calculated based on detected concentrations only. The results of the Shapiro-Wilk test are also presented.
- Table I-2 includes the calculated probability (p-values) for the four statistical tests and the overall determination as to whether soil concentrations in Parcel F 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 I1-1 through I1-32 present boxplots for metals in background soils and Parcel F soils (upper 10 ft).
- Figures I2-1 through I2-32 present normal and lognormal Q-Q plots for metals in background soils and Parcel F soils (upper 10 ft).

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

Radionuclides

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

- Table I-3 presents summary statistics for each radionuclide, including the total number of samples, number of detections, percent detections, minimum and maximum detected values, median, mean, and standard deviation. Consistent with NDEP guidance (NDEP 2008e), the median, mean, and standard deviation are calculated based on detected concentrations only. The results of the Shapiro-Wilk test are also presented.

- Table I-4 includes the p-values for the four statistical tests and the overall determination as to whether soil concentrations in Parcel F 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 I-5A and I-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 I-6 presents the correlation matrices for the uranium decay series and the thorium decay series.

- Figures I1-33 through I1-40 present the boxplots for radionuclides in background soils and Parcel F soils (upper 10 ft).

- Figures I2-33 through I2-40 present normal and lognormal Q-Q plots for radionuclides in background soils and Parcel F soils (upper 10 ft).

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

#### 4.1.2.3 Spatial Analysis of Chemicals in Soil

Spatial quartile plots (included in Appendix J) were prepared for detected chemicals in Parcel F to illustrate the spatial distribution of the data, identify potential hotspots, and compare the results to the expectations of the CSM. Each spatial quartile plot presents the following information:

- Sample locations;

- Chemical concentrations. The concentration shown at each sample location is the maximum detected concentration for all samples collected at that location for soils from 0-10 ft bgs, unless results for all samples at that location were reported as less than the detection limits; concentration bins are defined as follows:

    – *Dark green - concentrations < detection limits;*

    – *Light green - concentrations <Q1;*

    – *Yellow - concentrations within the IQR;*

    – *Orange - concentrations >Q3 and <(Q3 + 1.5×IQR); and*

    – *Red - concentrations >(Q3 + 1.5×IQR).*

Spatial quartile plots are presented for 23 detected analytes for Parcel F, as follows:

- Chloroxyanions – chlorate and perchlorate;
- Metals – all metal COPCs (identified in Section 5.1.1) and metals with concentrations greater than background (with the exception of calcium and sodium);
- Radionuclides – U-238, Th-232, and U-235 (the parent radionuclides);
- Other inorganics – only COPCs (identified in Section 5.1.1); and
- Organics - all organic COPCs (identified in Section 5.1.1) and organics with a detection frequency of 20 percent or greater (with the exception of common field/laboratory contaminants, e.g., acetone and methylene chloride). In addition, certain organics (e.g., dichlorodiphenyltrichloroethane [DDT]/ dichlorodiphenyldichloroethylene [DDE], hexachlorocyclohexanes (BHCs), and PCBs) were selected for plotting to enable spatial analysis of chemically-related contaminants.

The plots are presented in Appendix J (organized alphabetically by chemical name) and discussed in Section 4.4. The EDA (including the review of the Appendix J spatial quartile plots) is presented in Table 4-4 for chlorine oxyanions, metals, other inorganics, and radionuclides, and in Table 4-5 for dioxins/furans, other organics, PAHs, pesticides, SVOCs, and VOCs.

## 4.2 Soil Gas

### 4.2.1 Data Usability Evaluation

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

#### 4.2.1.1 Soil Gas Data Set

Soil gas samples within Parcel F are available from the following two investigations:

- 2008 Phase B investigations: soil gas samples were collected from across the Site (including Parcel F) in 2008 during the Phase B site-wide soil gas survey. Two soil gas samples (SG34 and SG74) were collected within the boundary of Parcel F. The analytical data for these two soil samples are included in Appendix K of this report.
- 2013 soil gas sampling: soil gas samples were collected in March 2013 to address some of the data gaps identified in the 2008 Phase B site-wide soil gas survey. Four soil gas samples were collected within the boundary of Parcel F at E-SG-4, E-SG-5, and E-SG-6, including one field duplicate sample at E-SG-6. The analytical data for these four soil samples are also included in Appendix K of this report.

#### 4.2.1.2 Criterion I – Reports to Risk Assessor

Criterion I requires confirmation that the reports relied upon are complete and appropriate for use in the HRA. The required information specified under this criterion was verified and is available within the following documentation associated with the Parcel F data collection efforts:

- A description of Parcels F is provided in Section 3 of this HRA. Information on the regional and local geology, hydrogeology, and historical industrial operations is provided in the Site RI/FS Work Plan (ENVIRON 2014a).

- The sampling design, rationale, and sampling procedures for the 2008 and 2013 soil gas investigations are provided in the following two work plans, respectively:

    – *Phase B Source Area Investigation Work Plan, Soil Gas Survey, Tronox LLC Facility (ENSR 2008a, approved by NDEP on March 26, 2008).*

    – *Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels “C”, “D”, “F”, “G”, and “H” (ENVIRON 2013b, approved by NDEP on April 9, 2013).*

- Soil gas sampling locations in Parcel F from the 2008 and 2013 sampling events are shown on Figures 3-1 and 3-2 of this HRA. Figure 3-2 also shows the soil gas and shallow groundwater sample locations in relation to the nearby chloroform groundwater plume which crosses the western portion of Parcel F (Ramboll Environ 2017d).

- Laboratory reports for the 2008 and 2013 soil gas data are included in the 2008 and 2013 DVSRs (Appendix L-1 and Appenix L-2). The laboratory reports include the name and address of the laboratory, a unique identifier for the test report, client and project name, and dates of sample receipt and analysis.

- The reports also identify the analytical methods and include information on sample preparation. Results are provided individually for each sample. For each analyte, method detection limits and PQLs are provided. The reports also include information on the gas chromatography/mass spectroscopy (GC/MS) tuning, initial and continuing calibrations, method and canister blanks, surrogate spike recoveries, internal standard results, laboratory control (LC) samples, field duplicate results, laboratory duplicate results, target compound identification, and dilution factors. A QA/QC narrative was included with each analytical data package, and the data review provided a narrative of qualified analytical results. These narratives are included in the Revised DVSR for the 2008 soil gas data (Appendix L-1), and the DVSR for the 2013 soil gas data (Appendix L-2).

- Data flags used by the laboratories were defined and described adequately in the 2008 and 2017 DVSR (Appendix L-1 and Appendix L-2). The qualification findings are summarized in Section 4.2.1.7.

The soil gas data from the 2008 investigation was provided in the 2008 DVSR as an Access© compatible database (ENSR 2008b, Appendix L-1), which was approved by

NDEP on October 20, 2008.[14] Soil gas data for the 2013 investigation are included in the EDD (Appendix L-2). The EDD includes an Access© compatible data file containing the analytical results. Validation of laboratory data was completed on April 24, 2013. The 2013 DVSR was prepared in accordance with NDEP guidance (NDEP 2009a) and was submitted to NDEP on September 22, 2016; NDEP provided comments on the DVSR on December 5, 2017; the revised DVSR will be submitted to NDEP on December 25, 2017. The 2008 and 2013 analytical data are provided on a per-sample basis, qualified for analytical limitations and error, and accompanied by SQLs.

The 2008 and 2013 Work Plans and associated DVSRs are considered complete for HRA purposes.

#### 4.2.1.3 Criterion II - Documentation

The objective of the documentation review is to ensure that all analytical data can be associated with a specific sample location and appropriate sample collection procedure.

All 2008 and 2013 soil gas locations were surveyed as described in the the BRC SOP-10 (ERM-West and MWH 2008) and 2013 soil gas investigation work plan (ENVIRON 2013b), respectively. Chain-of-custody forms prepared in the field were reviewed and compared to the analytical results provided by the laboratory, and all samples and results were correlated to the correct geographic location at the property. Reviewed reports provided adequate information regarding sample results relative to location, time of sampling and analysis, and sampling procedures. Figures 3-1 and 3-2 show the location of all soil gas samples included in the HRA data set; a complete set of the analytical results is summarized in Appendix K and also included in the EDD (Appendix L).

#### 4.2.1.4 Criterion III – Data Sources

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

Samples collected in accordance with the 2008 Work Plan were (1) located within LOUs where VOCs may have been used in historical operations; (2) located to evaluate soil gas concentrations associated with on-site plumes; (3) co-located with existing groundwater monitoring wells; and (4) located randomly throughout the Site (including Parcel F) to obtain spatial coverage. Samples collected in 2013 were biased in order to sample areas not previously sampled in 2008 and that overlie the highest chloroform concentrations in groundwater. The 2008 and 2013 sampling locations are shown on Figures 3-1 and 3-2. As shown on Figure 3-2, the three 2013 soil gas sample locations (E-SG-4, E-SG-5 and E-SG-6) located at the northwest half of the parcel overlap with the nearby chloroform groundwater plume (as defined by >70 ug/L concentration of chloroform). The two 2008 soil gas sample locations (SG34 and SG74) that are located near the south and the east boundaries of the parcel, respectively, are outside the

---

[14] The soil gas analytical data presented in the 2008 DVSR (ENSR 2008b) included data from samples collected across the entire Site. The 2008 data discussed in this section includes only the data from samples collected in or near Parcel F and evaluated in this HRA.

nearby chloroform groundwater plume area (as defined by >70 µg/L concentration of chloroform). Based on this review, sample coverage is considered adequate for purposes of this HRA, assuming groundwater conditions remain stable.

Analytical methods were appropriate to identify a broad spectrum of VOCs in soil gas. As identified in the approved 2008 and 2013 work plans (ENSR 2008a, ENVIRON 2013b) and approved by NDEP, the soil gas samples and QC samples collected in 2008 and 2013 were analyzed by USEPA Method TO-15, as described in *Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)* (USEPA 1999b). Analyses were conducted by NDEP-certified laboratories for VOCs in soil gas.

#### 4.2.1.5 Criterion IV – Analytical Method and Detection Limits

Under Criterion IV, the SQLs were evaluated to confirm that they were sufficient for risk characterization. Because NDEP has not derived BCLs for soil gas, risk–based concentrations (RBCs) were derived corresponding to the more stringent of (1) a cancer risk of 1 × $10^{-6}$ or (2) a noncancer hazard quotient (HQ) of 1. The RBCs were derived using the outputs from the Johnson and Ettinger (1991) model and values for exposure assumptions and toxicity criteria presented in Section 5 of this HRA. The lowest RBCs among the RBCs developed for indoor workers, outdoor workers and construction workers for 5 ft soil gas were selected in the evaluation of the SQLs of the 5 ft soil gas data set for Parcel F.

For analytes for which the detection frequency was less than 100%, the maximum SQL from the 2008 and 2013 data set for Parcel F was compared to the RBCs. Table 4-6 lists the maximum SQLs from the soil gas data set (all samples were approximately 5 ft bgs samples) and 5-ft soil gas RBCs, present the ratio of the maximum SQL to 1/10th of the RBC, and include the number of samples with SQLs greater than 1/10th of the RBC for Parcel F. For the soil gas samples collected in Parcel F, the maximum SQLs were less than 10% of the respective RBCs for all analytes (i.e. no non-detects were greater than 10% of the RBC) except that the SQL for one chemical (1,2-dibromo-3-chloropropane) in the two 2008 soil gas samples (SG34B-05 and SG74B-05) are about two folds higher than 10% of the RBC. This result is in general consistent with the QAPP goal that SQLs are less than 1/10th of the BCL, as established by NDEP for the BMI Complex and Common Areas (NDEP 2010b). The SQLs achieved were confirmed to be adequate for risk assessment. The uncertainty associated with the SQL for 1,2-dibromo-3-chloropropane for the two 2008 soil gas samples (SG34B-05 and SG74B-05) is discussed in Section 6.1.2.

#### 4.2.1.6 Criterion V – Data Review

The laboratory results of the soil gas samples for the 2008 Phase B Source Area Soil Gas Survey and the 2013 soil gas investigation were subjected to formal data validation consistent with (1) USEPA guidance on data validation (USEPA 1999a, 2001, 2008, 2009a), (2) the BMI Plant Site Specific Supplemental Guidance on Data Validation (NDEP 2009a), and (3) BRC SOP 40 and Data Review/Validation (BRC 2009). The specific data validation procedures are summarized in the following paragraphs.

The 2008 and 2013 data from the laboratory were submitted to Exponent and ENVIRON, respectively, as CLP-like data packages in PDF format and EQuIS® format EDDs. The EDDs were imported into an EQuIS® database specifically created for this project. ENSR and LDC validated the 2008 and 2013 data, respectively; all data validation qualifiers were entered into the project database. The soil gas data set from 2008 was compared to the goals established in the 2008 QAPP (ENSR 2008c) and the soil gas dataset from 2013 was compared to the goals established in the 2009 QAPP (AECOM and Northgate 2009).

As part of the 2008 and 2013 soil gas DVSRs, individual validation memoranda were developed for batches of soil gas samples (ENSR 2008b, Ramboll Environ 2016e). Exponent reviewed the 2008 soil gas DVSR; Ramboll Environ reviewed the 2013 soil gas DVSR. Both of the 2008 and 2013 soil gas DVSRs reported on the verification and examination of the following data elements:

- Data package completeness;
- Holding times;
- Initial and continuing calibrations;
- Method blanks/canister blanks;
- Surrogate spike recoveries;
- Internal standard results;
- LC sample results;
- Field duplicate results;
- Laboratory duplicate results;
- Quantitation limits and sample results; and
- Helium gas concentrations

Within Appendix L-1, the data validation memorandum summarizes the qualification findings as presented in the 2008 DVSR with regard to blank contamination, calibrations, field duplications, quantitation problems, and helium tracer results, respectively. Within Appendix L-2, the DVSR summarizes the qualification findings with regard to calibrations, field duplications, quantitation issues, and blank contamination, respectively, for the 2013 soil gas samples. These data qualifications are discussed below, as a component of Criterion VI.

#### 4.2.1.7 Criterion VI – Data Quality Indicators

The DQIs include completeness, comparability, representativeness, precision, and accuracy. The information from the DQI review supports the discussion of uncertainties in the HRA (presented in Section 6) as related to (1) selection of COPCs;

(2) characterization of exposure concentrations; and (3) the estimated cancer risks and noncancer hazards. Further, this final step of the DUE is conducted to insure that the overall quality of the data is sufficient to support the HRA and the risk management decisions that will be made for Parcel F. The specific criteria for assessing DQIs were identified in the NDEP-approved QAPPs (BRC, ERM, and MWH 2007b, ENSR 2008c, AECOM and Northgate 2009).

Completeness

The completeness criterion includes an evaluation of field completeness and laboratory completeness. Field completeness was 100% for the 2008 sampling events, exceeding the goal of greater than 90% completeness established in the QAPPs (BRC, ERM, and MWH 2007b, ENSR 2008c, AECOM and Northgate 2009). The field completeness calculation is based on the number of locations sampled and number of samples collected, as identified in the investigation work plans, as compared with the number of locations sampled and number of samples shown on the completed chain-of-custodies.

All chain-of-custody requests were executed by the laboratories, with only a few minor exceptions reported for the 2008 sampling. (Exceptions are detailed in the data validation memoranda included in Appendix L-1.) No rejected data were identified in the soil gas data set for Parcel F. Laboratory completeness achieved for each of the 2008 and 2013 data sets was 100%, based on the number of requested analyses on the chain-of-custodies as compared with the number reported by the laboratory. Overall data completeness was 99% for the 2008 data set and 100% for the 2013 data set, based on the number of validated data points, exceeding the QAPP goals of 95%.

Comparability

Comparability is a qualitative characteristic expressing the confidence with which one data set can be combined with another for purposes of estimating exposure. More specifically, comparability is a qualitative measure of confidence that two or more data sets may contribute to a common analysis. In general, comparability of data was maximized by using standard methods for sampling and analysis, data reporting, and data validation over the 2008 and 2013 sampling programs.

In both 2008 and 2013 investigations, samples were collected at approximately five ft bgs in Parcel F, and helium was used as the tracer gas for leak checking during sample collection. USEPA Method TO-15 was used for both 2008 and 2013 analytical programs. Both 2008 and 2013 sampling results were reported in $\mu g/m^3$. Additionally, the 2008 and 2013 used the same sample preservation, extraction, and preparation techniques. Finally, similar site conditions existed during the 2008 and 2013 sampling programs.

One difference between the 2008 and 2013 sampling events is that Low-Level USEPA Method TO-15 was used in 2013, as compared to the standard USEPA Method TO-15 used in 2008. For this reason, the SQLs were approximately 2- to 30-fold lower in the 2013 data set than in the 2008 data set. However, because maximum detected concentrations were used in the HRA (and SQLs were sufficiently low in all investigations, as discussed in Section 4.2.1.5), the differences in detection limits does not affect the results of the HRA.

Temporal factors were also considered in the comparability evaluation. Soil gas concentrations would be expected to follow trends in groundwater concentrations, in cases where groundwater is the source of VOCs. However, the sample location selection method for the 2008 soil gas investigation is different from the 2013 soil gas investigation; the objective of the 2013 investigation was to expand spatial coverage, particularly in areas not previously sampled in 2008 and not to evaluate concentration trends. Because no sample was co-located between the 2008 and 2013 soil gas samples, soil gas concentrations among the two investigations cannot be directly compared (this issue is discussed in Section 6.1.4, Uncertainty Analysis).

### Representativeness

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

Spatial representativeness was discussed previously in Section 4.2.1.4. Locations sampled in 2008 and/or 2013 were placed at approximately five ft bgs near or within LOUs where VOCs may have been used in past operations, or in areas overlying trespassing (western site boundary) groundwater plumes, and/or co-located with groundwater monitoring wells. For Parcel F, the three 2013 soil gas sample locations (E-SG-4, E-SG-5 and E-SG-6) are located within the nearby chloroform groundwater plume (as defined by >70 µg/L concentration of chloroform). The two 2008 soil gas sample locations (SG34 and SG74) that are located outside of the nearby chloroform groundwater plume (as defined by >70 ug/L concentration of chloroform), near the south and east boundaries of Parcel F, respectively. SG34 was also co-located with monitoring well M-92. The selection of these soil gas sample locations is consistent with the investigation objective. Collectively, the soil gas data sets are representative of potential source areas (i.e., LOUs) and areas overlying the highest VOC concentrations in groundwater within Parcel F.

The degree to which the analytical data are representative of soil gas concentrations at the locations sampled is evaluated in this section by reviewing the helium leak check data from the 2008 and 2013 investigations. Analytical precision and accuracy, also considered in the evaluation of representativeness, are discussed in Section 4.2.1.7.

Entrainment of contaminants and dilution with surface air can impact the representativeness of analytical results. Helium gas was used in the 2008 and 2013 investigations as a leak check compound during purging and sampling. For the 2008 investigation, all sample results with helium concentrations between 1% and 10% of the shroud average were qualified as estimated (J) based on possible contamination and dilution by surface air. This rule was based on a conservative interpretation of the Interstate Technology Regulatory Council (ITRC) document *Vapor Intrusion Pathway: A Practical Guideline* (ITRC 2007) and *Final Guidance for Evaluating Soil Vapor Intrusion in* *the State of New York* (New York State Department of Health 2006). None of the analytical result from the two 2008 soil gas samples collected within Parcel F was J qualified due to this criteria. No helium concentration in the 2008 soil gas samples exceeded 10% of the shroud average.

For the 2013 investigation, helium shroud concentrations ranged from 20.0% to 34.7% and averaged 28.7%. As listed in Table B-4 in Appendix B, helium was detected in E-SG-4 and E-SG-5 at concentrations less than 0.1% of the shroud concentration. One sample, E-SG-6, had a laboratory detection of helium of 2.0% (6.7% of the shroud concentration); however, a field duplicate (E-SG-6-FD) – collected simultaneously and sharing the same sampling train and shroud – contained helium at a concentration of only 0.076% (0.25% of shroud concentration). The reason for the difference between the primary and duplicate sample is not known. Because criteria for qualifying samples with helium detections was not specifically identified in the QAPP, none of the 2013 analytical results were qualified as a result of the helium detections. Section 6.1.6 discusses a sensitivity analysis conducted to evaluate the impact of the helium detections on the exposure concentrations used in the HRA.

Precision

Precision is a measure of the degree of agreement between replicate measurements of the same source (field precision) or sample (analytical precision). Precision is expressed by the RPD between replicate measurements. Replicate measurements can be made on the same sample or on two samples from the same source.

Field precision for the Parcel F samples was assessed by evaluating the field duplicate results for the 2008 and 2013 investigation, as summarized below:

- 2008 investigation: Although field duplicate samples were collected in 2008, none of the duplicate samples were collected from locations in or near Parcel F. As summarized in the 2010 Site-Wide Soil Gas HRA (Northgate and Exponent 2010c), for samples collected outside Parcel F, 84 associated field sample results in nine primary sample/field duplicate pairs were qualified estimated (J) based on RPDs that exceeded the QAPP criteria. These values were summarized from information in the 2008 DVSR.

- 2013 investigation: As specified in the 2013 work plan, one field duplicate (E-SG-6-FD) was collected in Parcel F, and 20 paired values (total of 40 sample results) were qualified based on RPDs that exceeded the QAPP criteria. These values were summarized from information in the 2013 DVSR and presented in Table L-1 in Appendix L. The uncertainties associated with each of the 2013 sample delivery groups (SDGs) are discussed further in Section 6.1.5.

Laboratory precision was quantitated for each laboratory data batch using data for the laboratory control versus the laboratory control duplicate (LC/LCD) and/or data for the MS/MSD. The laboratory duplicate precision was within the limits established in the QAAPs for the 2008 and 2013 analytical programs.

Accuracy

For this DQI, field accuracy and laboratory accuracy are evaluated. 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 QAPP, the objective for trip and equipment blanks is for no analyte to be present at levels greater than the laboratory PQL.

For the 2008 data set, two acetone results were qualified due to contamination in equipment or field blanks. A comparison of the estimated concentrations in Table L-2 with the 5 ft bgs soil gas RBCs shows that concentrations in the trip and field blanks were well below the RBCs. For the 2013 data set, no analytical results were qualified as estimated (J) due to contamination in trip or equipment blanks. All 2008 and 2013 soil gas samples were analyzed within the holding time of 30 days specified for USEPA Method TO-15, and sample preservation and sample integrity criteria were met. No deviations in sample handling were reported.

Accuracy in the laboratory analytical data is a measure of the overestimation or underestimation of reported concentrations. Accuracy is quantitated for each laboratory data batch using data for method blanks, LC samples and/or MS samples.

- Method blanks or equipment blanks. Qualifications based on contamination in method or equipment blanks were reviewed. For the 2008 soil gas data in Parcel F, two acetone results were qualified as estimated (J or J+) due to contamination in blanks associated with samples SG34 and SG74 (Table L-2). The uncertainties associated with these two acetone results are discussed in Section 6.1.
- Spike recovery. Surrogate percent recovery and LC standard percent recovery met the QAPP acceptance criteria of 70 to 130% for all 2008 and 2013 soil gas sample analyses.

#### 4.2.1.8 Data Usability Conclusions

All analytical results from the soil gas samples for Parcel F were deemed usable for conducting the HRA. As shown on Table 3-1 and Figure 3-2, The HRA soil gas data set includes two samples collected in 2008 and four samples collected in 2013, all collected at a depth of approximately five ft bgs within Parcel F.

All J-qualified data were considered usable and were retained for purposes of the HRA and are summarized in Table L-3 of Appendix L. The impact of “J” qualified data on the HRA risk results is discussed in Section 6.1 of the Uncertainty Analysis.

### 4.2.2 Data Analysis

As described by NDEP (2010c), 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 the NDEP guidance, summary statistics and spatial plots were prepared. Additionally, specific data analyses requested by NDEP were conducted, as described below.

#### 4.2.2.1 Summary Statistics

Summary statistics for the soil gas data set for Parcel F are presented in Table 4-7. For the soil gas dataset used in the Parcel F HRA, as shown in Table 4-7, 65 VOCs were detected in at least one soil gas sample, and 23 VOCs were detected in 100% of the samples collected within Parcel F. The highest detected concentrations were for n-hexane (6,100 µg/m$^3$), chloroform (2,800 µg/m$^3$), tetrachloroethene (130 µg/m$^3$), carbon tetrachloride (110 µg/m$^3$), and 1,1-dichloroethene (110 µg/m$^3$). No other VOC was detected at concentrations of over 100 µg/m$^3$, and most VOCs were detected at concentrations of less than 10 µg/m$^3$ in Parcel F. The SQLs were generally low with the maximum SQL at 2.7 µg/m$^3$ and most of the SQLs were less than 1 µg/m$^3$.

#### 4.2.2.2 Spatial Analysis of VOCs in Soil Gas

A spatial plot was prepared for carbon tetrachloride, chloroform, and tetrachloroethene based on the following criteria:

- Contribution to total cancer risk: Chloroform and carbon tetrachloride are among the highest contributors to total risk. Although 1,2-dibromo-3-dichloropropane was the second highest contributor to total risk, it was not plotted because of its relatively low detection frequency (2 out of 6 samples).

- Detection frequency and detected concentration: The detection frequency was 100 percent for carbon tetrachloride, chloroform and tetrachloroethene; the maximum detected concentrations of these three chemicals are among the highest detected VOCs in soil gas in Parcel F.

- Chemical class: carbon tetrachloride, chloroform, and tetrachloroethene were selected to examine co-location of the chlorinated VOCs.

The concentrations of the three COPCs identified for plotting in five ft bgs soil gas are presented on Figure 4-1. As shown in Figure 4-1, the three 2013 soil gas sample locations (E-SG-4, E-SG-5 and E-SG-6) located at the northwest half of the parcel are within the nearby chloroform groundwater plume (as defined by >70 ug/L concentration of chloroform). The two 2008 soil gas sample locations (SG34 and SG74) are located near the south and the east boundaries of Parcel F, respectively, outside the nearby chloroform groundwater plume (as defined by >70 ug/L concentration of chloroform). The VOC concentrations detected in the 2013 soil gas samples are a few folds higher then the two 2008 soil gas sample locations located southeast of the nearby chloroform groundwater plume.

## 4.3 Groundwater

### 4.3.1 Data Usability Evaluation

In response to NDEP comments (NDEP 2017b), groundwater data were used in this HRA to evaluate potential risks for the vapor intrusion pathway. In the previous draft HRA report for the vapor intrusion pathway (Ramboll 2016b), risks were evaluated using soil gas data, with a screening-level evaluation using groundwater data presented in an appendix. Considering USEPA's recent vapor intrusion guidance (USEPA 2015), which states that both soil gas and groundwater data should be considered in a line-of-evidence approach, risks for the vapor intrusion pathway were evaluated using both soil gas and groundwater results.

Consistent with previous USEPA guidance and NERT project work plans, only soil gas samples were collected to support evaluation of the vapor intrusion pathway. The objectives of groundwater sampling at the Site have been primarily to characterize SRCs in groundwater near suspected source areas and plume delineation; that is, no groundwater investigation was conducted to specifically provide data to evaluate the vapor intrusion pathway. Further, the majority of groundwater sampling on the Site has focused on perchlorate and hexavalent chromium, with limited sampling for VOCs and SVOCs.[15]

To provide groundwater data for this HRA, the NERT project database (discussed in Section 4.1.1.1) and the BMI database[16] were queried to identify wells within or near Parcel F and for which VOC and/or SVOC results were available for shallow groundwater. The identified wells include wells owned and sampled by NERT. The wells meeting these criteria and relevant information, including well owners and sampling dates, are listed in Table 3-2.

Considering the approach for identifying groundwater data for evaluation in the HRA, the groundwater DUE addresses those DUE elements that are relevant and practicable to evaluate. Specifically, it is not practicable to conduct a comprehensive DUE for data collected by NERT predecessors and other BMI entities that have been reported in multiple work plans and DVSRs that span a period of over 10 years. Ramboll Environ understands that groundwater data and the associated DVSRs would have been reviewed and approved by NDEP prior to entry into the NERT and BMI databases.

#### 4.3.1.1 Groundwater Data Set

As noted above, groundwater wells were identified by querying the NERT and the BMI databases. VOC results were identified from four wells within Parcel F. The x,y coordinates for each well were plotted to verify that the wells are located within or near the parcel. A complete set of the groundwater analytical results is included in Appendix M.

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

---

[15] Any chemicals labelled as SVOCs that are included in the USEPA definition of volatile compounds are also included in the vapor intrusion analysis. The volatile compounds are currently identified using the following criteria consistent with recommendation from the USEPA Regional Screening Levels Table (USEPA 2017b): 1) vapor pressure greater than 1 mm Hg or 2) Henry's Law constant greater than 0.00001 atm-$m^3$/mole.

[16] The BMI Database, or the BMI Complex, Common Areas and Vicinity Database (BMIdbase) version 2 BETA, use a database maintained by NDEP. The purpose of this site is to provide access to data from a variety of parties located within and near the BMI Complex and Common Areas in Henderson, Nevada. In addition to access to data, this site provides access to certain tools which can be used to manipulate and depict the data. http://ndep.neptuneinc.org/ndep_gisdt/home/index.xml

- Standardize chemical names and CAS registry numbers;
- Standardize analytical method names;
- Correct errors in data entry (e.g. errors in sample identification codes);
- Identify a unique result for use in the HRA for sample/analyte pairs for which more than one result was reported. For example, if two results were reported for naphthalene in the same sample – one by USEPA Method 8270 and the second by USEPA Method 8270 SIM – the result to be used in the HRA was identified as that from the 8270 SIM analysis because of the greater sensitivity (lower reporting limits) of this method.
- Develop database queries and confirm that queries returned the correct output.

The above steps were necessary due to the over 10-year period over which the groundwater data was collected and the differences in sampling, analysis, and data entry across investigations.

#### 4.3.1.2 Criterion I – Reports to Risk Assessor

Criterion I requires confirmation that the reports relied upon are complete and appropriate for use in the HRA. As noted previously, Ramboll Environ relied upon the information presented in the NERT project database and the BMI Database. Specifically, this information included location ID, x,y coordinates, sample ID, sample type, sampling date, sampling depth, analyte, analytical method, analysis date and time, result, unit, data qualifiers, dilution factor, filtered flag, reanalysis flag, source of data, and available DVSR IDs.

#### 4.3.1.3 Criterion II – Documentation

The objective of the documentation review is to ensure that all analytical data can be associated with a specific sample location and appropriate sample collection procedure.

The NERT and BMI databases provide adequate information regarding sampling results relative to sampling location, sampling date, and time and date of sample analysis. Information on sampling procedures is not available in the databases and has not been reviewed.

#### 4.3.1.4 Criterion III – Data Sources

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

For the groundwater data, the review of sample coverage included consideration of both spatial and temporal coverage. There are four shallow zone wells located within or near Parcel F (M-92, M-93, M-97, and TR-6). TR-6 was sampled in December 2006 with the highest detected chloroform concentration of 3,600 µg/L in this parcel. The northwestern portion of Parcel F overlaps with the known area of high concentrations of chloroform in groundwater (Figure 3-2). Over 60 VOCs were detected in these wells. Along with the soil gas data, these data are adequate for evaluation of the vapor intrusion pathway.

Information on analytical methods was available in the NERT and BMI databases. Standard USEPA methods were used, specifically USEPA Method SW-8260 or SW-8260 SIM for VOCs and SW-8270 or SW-8270 SIM for SVOCs.

#### 4.3.1.5 Criterion IV – Analytical Method and Detection Limits

Under Criterion IV, the SQLs were evaluated to confirm that they were sufficiently sensitive for risk characterization. Because NDEP has not derived groundwater BCLs for the vapor intrusion pathway, groundwater RBCs were derived corresponding to the more stringent of (1) a cancer risk of $1\times10^{-6}$ or (2) a noncancer HQ of 1. The RBCs were derived using outputs from the Johnson and Ettinger (1991) model and the values for exposure assumptions and toxicity criteria presented in Section 5.

For each groundwater analyte for which the detection frequency was less than 100%, the maximum SQL was compared to the RBC. Tables 4-8 lists the maximum SQL, the most stringent groundwater RBC, the ratio of the maximum SQL to 1/10th of the RBC, and the number of samples with SQLs greater than 1/10th of the RBC. For all analytes in the shallow groundwater data set for Parcel F, the maximum SQL was less than 10% of the respective RBC (i.e. no non-detects were greater than 10% of the RBC), with the following exceptions:

- For carbon tetrachloride, 26 out of 31 shallow groundwater samples were detected, and the SQL exceeded 0.1xBCL in one out of five samples reported as nondetects.
- For trichloethene, 14 out of 31 shallow groundwater samples were detected, and the SQL exceeded 0.1xBCL in 2 out of 17 samples reported as nondetects.
- For 1,2,3-trichloropropane, 10 out of 31 shallow groundwater samples were detected, and the SQL exceeded 0.1xBCL in 8 out of 21 samples reported as nondetects.
- For bromodichloromethane, 5 out of 31 shallow groundwater samples were detected, and the SQL exceeded 0.1xBCL in 2 out of 26 samples reported as nondetects.
- For 1,2-dichloroethane, 4 out of 31 shallow groundwater samples were detected, and the SQL exceeded 0.1xBCL in 2 out of 27 samples reported as nondetects.
- For 1,2-dibromo-3-chloropropane, and 1,2-dibromoethane, 2 out of 30 shallow groundwater samples were detected, and the SQL exceeded 0.1xBCL in 18 and 3 out of 28 samples as nondetects, respectively.
- For bromomethane, 1,1-dichloropropene, cis-1,3-dichloropropene, trans-1,3-dichloropropene, and hexachlorobutadiene, 2 out of 31 shallow groundwater samples were detected, and the SQL exceeded 0.1xBCL in 20, 5, 2, 2, 8, and 5 out of 29 samples as nondetects, respectively.

- Hexachlorobenzene was not detected in any shallow groundwater samples; the SQLs exceeded 0.1xBCL in 40% of the non-detected samples.

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

#### 4.3.1.6 Criterion V – Data Review

The majority of the groundwater data included in the HRA have DVSRs identified and summarized in Appendix N. The data review included evaluation of completeness, instrument calibration, laboratory precision, laboratory accuracy, blanks, adherence to method specification and QC limits, and method performance in sample matrix based on available DVSRs and the information from the NERT and BMI databases. The laboratory results of the groundwater samples included for this HRA were subjected to formal data validation consistent with (1) USEPA guidance on data validation (USEPA 1999a; 2001; 2004a; 2005a,b; 2008; 2009a), (2) the BMI Plant Site Specific Supplemental Guidance on Data Validation (NDEP 2009a), and (3) BRC SOP 40 and Data Review/Validation (BRC 2009). The specific data validation procedures are summarized in the DVSRs listed in Appendix N.

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

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

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

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

#### 4.3.1.7 Criterion VI – Data Quality Indicators

This section presents the DQI review; the specific criteria for assessing DQIs were identified in the NDEP-approved QAPPs (BRC, ERM and MWH 2007b; ENSR 2008c; AECOM and Northgate 2009).

Completeness

The completeness criterion (an evaluation of field completeness and laboratory completeness) was not evaluated for the groundwater dataset given the data selection criteria. That is, well locations for inclusion in the HRA data set were selected because relevant data were available and not specific to being part of an investigation. Completeness is typically evaluated based on a single study and not for data drawn from multiple studies.

Comparability

Comparability is a qualitative characteristic expressing the confidence with which one data set can be combined with another for purposes of estimating exposure. A limited evaluation of this DQI is presented based on the information available in the NERT and BMI databases.

The same analytical methods were used across most investigations; specifically, USEPA Method SW-8260 for VOCs and SW-8270 for SVOCs. In some investigations, the more sensitive SW-8260 SIM was used for VOCs; SW-8270 SIM was used for PAHs across all analytical programs. All groundwater sampling results were reported in µg/L.

Because maximum detected concentrations from the most recent two years' groundwater samples were used in the HRA (and SQLs were sufficiently low in those samples, as discussed in Section 4.3.1.5), the differences in detection limits does not impact the results of the HRA.

Among the three wells that were sampled over time for VOCs and/or SVOCs in Parcel F, TR-6 is the well that was sampled most frequently between 2006 and 2017 and has the highest chloromform concentrations within the parcel. Temporal analysis was performed based on the groundwater chloroform concentrations measured at this well between 2006 and 2017. As shown in Figure 4-3, chloroform was detected at higher concentrations during the earlier sampling events with the highest chloroform concentrations detected in December 2006 at 3,600 µg/L. The chloroform concentrations were detected at much lower concentrations in 2015 and 2016 (1700 µg/L and 1200 µg/L, respectively) at this well.

Representativeness

Spatial representativeness was discussed previously in Section 4.3.1.4.

Precision

Precision is a measure of the degree of agreement between replicate measurements of the same source (field precision) or sample (analytical precision). Precision is expressed by the RPD between replicate measurements. Replicate measurements can be made on the same sample or on two samples from the same source.

Field precision was assessed by evaluating the field duplicate results for the HRA groundwater data. Field precision was assessed by evaluating the field duplicate results for the HRA groundwater data. A total of four field duplicates (Table N-3) were collected for the groundwater data evaluated in the Parcel F HRA. The precision goal for field duplicates was plus or minus 50% RPD except for the case in which results are less than five times the reporting limit. For the latter case, the acceptance criteria is the reporting limit (i.e., the absolute value of the difference between the primary result and duplicate result is compared to the reporting limit). Based on this review, 49 associated field sample results in four primary sample/field duplicate pairs were qualified based on RPDs that exceeded the QAPP criteria. These values were summarized from information in Appendix N. Field duplicates were associated with each of the SDGs, as discussed further in Section 6.1.5. Table N-3 in Appendix N shows all paired results in the groundwater dataset.

Accuracy

This DQI includes an evaluation of field accuracy and laboratory accuracy. 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. The QAPP goal for the trip and equipment blanks is for no analyte to be present at levels greater than the laboratory PQL.

As shown in Table N-4, for the groundwater data set for Parcel F, three results were qualified as estimated (J) due to contamination in trip or equipment blanks in accordance with the most recent NDEP guidance (NDEP 2012).

Accuracy in the laboratory analytical data is a measure of the overestimation or underestimation of reported concentrations. Accuracy is quantitated for each laboratory data batch using data for method blanks, LC samples and/or MS samples. Qualifications based on contamination in method blanks were reviewed. For the groundwater dataset, no result was qualified as estimated (J) due to contamination in method blanks associated with the groundwater samples identified for Parcel F.

#### 4.3.1.8 Data Usability Summary

The groundwater HRA dataset includes a total of 31 samples in Parcel F. Four wells included in this HRA are located within or near the parcel boundary, with analytical results reported for VOCs and/or SVOCs. The dataset includes results for samples collected since January 2006. One R-qualified data was excluded from the dataset (Table N-1); 74 results with reanalysis data were excluded from the dataset (Table N-2). All J-qualified data were considered usable and were retained for purposes of the HRA (Table N-5); The impact of qualified data on the HRA risk results is discussed in Section 6.1.6.

### 4.3.2 Data Analysis

As described by NDEP (2010c), 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 the NDEP guidance, summary statistics and spatial plots were prepared. Additionally, specific data analyses requested by NDEP were conducted, as described below.

#### 4.3.2.1 Summary Statistics

Summary statistics for the 31 shallow groundwater samples collected after 2005 within or near Parcel F are presented in Table 4-9. As shown on Table 4-9, 66 of the 160 volatile compounds analyzed were detected in at least one sample, with detection frequencies ranging from 6.5 to 100 percent. Chloroform was detected in 100% of the samples. Chemicals detected, along with their maximum concentrations, include chloroform (3,600 µg/L), chlorobenzene (2,200 µg/L), benzene (1,300 µg/L), 1,4-dichlorobenzene (280 µg/L), 1,2-dichlorobenzene (150 µg/L), 1,1-dichloroethene (130 µg/L), n-nonyl aldehyde (120 µg/L), and carbon tetrachloride (110 µg/L). All other VOCs were detected less than 100 µg/L, and most of them are less than 10 µg/L.

#### 4.3.2.2 Spatial Analysis of VOCs in Groundwater

A spatial plot was prepared for carbon tetrachloride, chloroform, and tetrachloroethene based on the following criteria:

- Contribution to total cancer risk: Chloroform, carbon tetrachloride and tetrachloroethene are among the highest contributors to total risk.
- Detection frequency: The detection frequency was 100 percent for chloroform and tetrachloroethene, and 84% for carbon tetrachloride..
- Chemical class: carbon tetrachloride, chloroform, and tetrachloroethene were selected to examine co-location of the chlorinated VOCs.

The concentrations of the three COPCs identified for plotting in the shallow groundwater are presented on Figure 4-2. As shown in Figure 4-2, TR-6 located at the northwest half of the parcel are within the nearby chloroform groundwater plume (as defined by >70 ug/L concentration of chloroform). The other three wells (M-92, M-93, and M-97) are located to the east of TR-6 and are outside the nearby chloroform groundwater plume (as defined by >70 ug/L concentration of chloroform), with M-97 being the furthest from the plume. The VOC concentration detected at TR-6 is over 20 fold higher than the other three wells located outside of the nearby chloroform groundwater plume. The VOC concentration detected at M-97 is the lowest among the four shallow wells evaluated for Parcel F.

#### 4.3.2.3 Temporal Changes in VOC Groundwater Concentrations

In NDEP’s January 29, 2013 comment letter (NDEP 2013, Comment #9b), NDEP requested a comparison of the groundwater VOC concentrations presented in the 2010 Site-Wide Soil Gas HRA (Northgate and Exponent 2010c) with the most recent groundwater sampling results for the same wells to evaluate temporal changes in concentration.

Among the three well that were sampled over time for VOCs and/or SVOCs in Parcel F, TR-6 is the well that was sampled most frequently between 2006 and 2017 and has the highest chloromform concentrations within Parcel F. Temporal analysis was performed based on the groundwater chloroform concentrations measured at this well between 2006 and 2017. As shown in Figure 4-3, chloroform was detected at higher concentrations during the earlier sampling events with the highest chloroform concentrations detected in December 2006 at 3,600 µg/L. Chloroform was detected at much lower concentrations in 2015 and 2016 (1700 µg/L and 1200 µg/L, respectively) at this well.

## 4.4 Study Area CSM

The following presents an overall summary of the soil data in the context of our understanding of current and former land use and operations within Parcel F and the CSM (also see Tables 4-4 and 4-5).

- Chloroxyanions. Chlorate and perchlorate manufacturing operations have been conducted at the Site since approximately 1945 (Ramboll Environ 2016d), although the former manufacturing and disposal areas were not located in Parcel F. Although these compounds are detected throughout Parcel F soils (Figures J-9 and J-17), concentrations in Parcel F (<0.53 mg/kg to 310 mg/kg for chlorate and <0.0034 mg/kg to 168 mg/kg for perchlorate, see Table 4-2) are generally substantially lower than the concentrations reported in former manufacturing areas (above 1,000 mg/kg for chlorate and perchlorate).

- Metals. The 2011 NDEP Action Memorandum (NDEP 2011) identified “metals” as possible SRCs at many of the LOUs within the Operations Area, and in LOUs 4 (Hardesty Chemical Company Site), 59 (Storm Sewer System), 63 (J.S. Kelley Trucking), and 65c (Nevada Precast Concrete Products) within Parcel F. This does not mean metal contamination was known to be present, only that soil contaminated with metals were possible based on historical operations. Metals associated with LOU 59, if present, would not necessarily have been associated with operations at Parcel F, since the sewer system would have transported metals from other areas of the Site. Results of the background evaluation of metals (Appendix I) show that post-removal soil concentrations were greater than background (as compared with the RZ-A background dataset) for arsenic, barium, beryllium, calcium, chromium (total), sodium, and uranium (total) in Parcel F.

- Other Inorganics. This group of inorganic compounds includes common industrial chemicals that are used as chemical feedstocks and/or expected to be present in process waste streams. With the exception of fluoride and nitrate, all compounds were historically identified as SRCs at the Operations Area. These compounds are generally highly soluble when present as free anions or cations. Many of these compounds are physiological electrolytes and/or occur naturally in foods. 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 are not known to be associated with any of the former operations identified in Parcel F (or in the Operations Area). Although no specific source areas were identified, the parcel soil investigations included analyses for radionuclides in the U-238 and Th-232 decay series and for U-235. Although Ra-228 failed the statistical testing for background soil (Appendix I), the validity of the statistical testing is confounded by several analytical and other issues (see detailed discussion in Section 5.1.1.2).

- Dioxins/Furans. Dioxins/furans are formed during various combustion processes (in the presence of a source of hydrocarbons and chlorine) and are by-products of the production of certain chlorinated chemicals, including pesticides. Dioxins/furans are typically detected in shallow surface soils as a result of airborne deposition. They are extremely persistent in soils and over time will accumulate in the presence of a continuing source. The post-removal soil concentrations in Parcel F are below the site-specific action level of 0.0027 mg/kg.

- PAHs. PAHs are ubiquitous environmental contaminants and formed during incomplete combustion of organic materials. The detection frequencies of PAHs in Parcel F were generally very low.

- PCBs. As reported in 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 and none was associated with Parcel F. The detection frequencies of PCBs in Parcel F were very low.

- Organochlorine Pesticides. The detections of organochlorine pesticides is consistent with former site operations, including the manufacture of chlorobenzenes and DDT by Hardesty /AMECCO from 1946 to 1949 (Ramboll Environ 2016d), as well as with the manufacture of chlorinated compounds at the adjacent OSSM facility. Stauffer produced lindane at the former Lindane Plant from 1946 through 1958.

- SVOC. Nine SVOCs were detected in Parcel F with very low detection frequencies, and none was historically listed as a SRC. Bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and di-n-octylphthalate are common field/laboratory contaminants.

- VOCs. Historically, a number of individual VOCs were listed as SRCs, but VOC soil contamination was not the subject of any of the interim soil removal actions completed within Parcel F following the soil investigations. Also, NDEP identified VOCs (as a general category) as possible contaminants for LOU 4 (Hardesty Chemical Company Site) in Parcel F. However, it is noted that the initial identification of potential LOU contaminants was based on a review of historical operations and the limited sampling data available at the time of the LOU designations in 1994. Given that Parcel F is situated within the Trust’s property, as well as in the vicinity of other BMI companies, it is possible that environmental media within Parcel F could have been indirectly impacted by VOCs. At the same time, an operational history for an area that included former use of VOCs does not necessarily mean that environmental media in the area were impacted. The soil sampling results show that VOCs were detected at low frequencies and low concentrations, not indicative of a source. Several of the VOCs are common field/laboratory contaminants, including acetone, 2-butanone, 2-hexanone, methylene chloride, and toluene.

A review of the spatial quartile plots (Appendix J) did not identify a particular spatial pattern of the chemicals in soils or the presence of hot spots or potential point sources of contamination.

As part of the ongoing RI/FS, Ramboll Environ completed an extensive review of existing information and data generated previously at the Site and developed a preliminary CSM, as presented in the RI/FS Work Plan (ENVIRON 2014a). More recently, Ramboll Environ conducted a comprehensive review and analysis of historical and recently collected sampling results to assess the magnitude and extent of chloroform impacts to soil, soil gas, and groundwater at the Site, including groundwater sampling results within the Parcel F (Ramboll Environ 2015b, 2016a). The conclusions of the review considering the RI data gap investigation results are presented below.

- Chloroform impacts to shallow groundwater, both on-Site and in the downgradient plume area to the north, appear related in part to historical wastewater discharges to the former Beta Ditch. The highest concentrations of chloroform found in shallow groundwater at the Site have consistently been associated with the area where the former Beta Ditch extended across the property.

- Chloroform is migrating onto the Site from the adjacent OSSM site located to the west. Chloroform in the dissolved phase is present in shallow groundwater beneath the western portion of Parcel F. In the deeper Middle Water Bearing Zone (WBZ), Montrose is investigating a lobe of dense non-aqueous phase liquid (DNAPL) that originates at the OSSM site and extends into the western portion of the NERT Site. However, the DNAPL in the Middle WBZ has not been found beneath Parcel F.

- As shown on Figure 3-2, the northwestern portion of Parcel F overlaps with the nearby chloroform groundwater plume (as defined by <70 ug/L chloroform concentration) and the VOC concentrations in soil, soil gas, and groundwater are generally low, no additional investigation is necessary in Parcel F.

There is no evidence to suggest that soils within Parcel F are acting as a source of groundwater VOC contamination; further, concentrations in soil are not indicative of historic releases of chloroform to soils.

# 5. POST-REMEDIATION HEALTH RISK ASSESSMENT

This section presents the post-remediation HRA, which includes the following elements:

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

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

- Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A) (USEPA 1989);
- Guidelines for Exposure Assessment (USEPA 1992c);
- Exposure Factors Handbook (USEPA 2011);
- Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA 2004b);
- Soil Screening Guidance: Technical Background Document (USEPA 1996);
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002b);
- Soil Screening Guidance for Radionuclides (USEPA 2000);
- Technical Support Document for a Protocol to Assess Asbestos-Related Risk, Final Draft (USEPA 2003);
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA 2009b);
- Office of Solid Waste and Emergency Response (OSWER) Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) (USEPA 2002c);
- User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings (USEPA 2004c);
- OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (USEPA 2015);
- Technical and Regulatory Guidance, Vapor Intrusion Pathway: A Practical Guideline (ITRC 2007); and

- Soil Physical and Chemical Property Measurement and Calculation Guidance, BMI Plant Sites and Common Areas Projects, Henderson, Nevada (NDEP 2010d).

## 5.1 Identification of COPCs

### 5.1.1 Soil COPCs

Soil COPCs for quantitative evaluation in the post-remediation HRA were identified from the risk assessment data set discussed in Section 4 for Parcel F based on the following three-step approach:

1. Concentration/toxicity screen;

2. Background evaluation for metals and radionuclides; and

3. Chemical-specific considerations.

The chemicals that "fail" these steps are retained as COPCs and those that "pass" are excluded as COPCs[17], as described in Sections 5.1.1.1 through 5.1.1.3 and shown on Figure 5-1.

#### 5.1.1.1 Step 1 – Concentration/Toxicity Screen

The concentration/toxicity screen is conducted to identify those chemicals that could contribute significantly to the cancer risk and/or non-cancer hazard estimate (i.e., the hazard index [HI]). The screen considers the maximum detected concentration in soils in Parcel F 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 0.1 times the BCL (0.1×BCL). Chemicals that pass this screen are eliminated as COPCs. Chemicals that fail this screen (i.e., are present at concentrations greater than or equal to 0.1×BCL) are further screened under Step 2 and/or Step 3.

The post-remediation soil HRA data set identified in Section 4 is the starting point for the concentration/toxicity screen. This data set includes the results for all analytes detected in one or more samples from the 0 to 10 ft depth interval[18], with the exception of the analytical results excluded based on the DUE, as discussed in Section 4. For most analytes, the BCL used for the concentration/toxicity screen is the minimum of the indoor and outdoor commercial/industrial worker BCL (NDEP 2017a). Because BCLs have not been established for all analytes in Parcel F soils, surrogate values were identified where possible. Surrogates and other chemical-specific exceptions as well as the results of the screen are presented in Table 5-1 and discussed in the following sections.

---

[17] The three screening steps are consistent with the COPC identification steps outlined in the Baseline Health Risk Assessment Work Plan for Operations Area (ENVIRON 2014b). However, as agreed upon by NDEP (Ramboll Environ 2015c), the order of the steps has been changed.

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

### 5.1.1.1.1 Surrogates

The concentration/toxicity screen can be implemented only for chemicals for which a BCL or appropriate surrogate is available. Surrogates were identified as follows:

| **Analyte** | **Surrogate** |
|---|---|
| Acenaphthylene | Acenaphthene |
| Chromium (total) | Chromium III |
| 2,4'-DDE | 4,4'-DDE |
| Endrin aldehyde | Endrin |
| N-Nonyl aldehyde | Acetaldehyde |
| Phosphorus (total) | Phosphoric acid |
| ortho-Phosphate | Phosphoric acid |

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

### 5.1.1.1.2 Chemicals with Non-Health Based BCLs

NDEP has established a non-health based upper-limit soil concentration or a “not-to-exceed” concentration of 100,000 mg/kg for metals and for inorganic and organic compounds with low toxicity. That is, if the calculated health-based BCL is greater than 100,000 mg/kg, a limit value of 100,000 mg/kg is listed in the BCL table. For all detected analytes with a NDEP-established upper limit BCL, the maximum concentration is less than 100,000 mg/kg (see Table 5-1). Thus, these compounds were not identified as COPCs based on concentration considerations.

For health-based considerations (i.e., COPC identification), it is appropriate to use the NDEP-calculated health-based BCL (and not the concentration-limit value of 100,000 mg/kg). The health-based BCLs were taken from the BCL calculation tables (NDEP 2017a). Due to the very low toxicity, the calculated health-based BCL for some chemicals is greater than one million parts per million. The chemicals for which health-based BCLs are used in place of non-health based BCLs are identified in Table 5-1.

### 5.1.1.1.3 Arsenic, Dioxin TEQs, and Lead

As presented in the HRA work plan (Northgate and Exponent 2010b), site-specific screening values are used for arsenic and dioxin TEQs:

- For arsenic, the maximum detected concentration is compared to the site-specific remediation goal of 7.2 mg/kg (NDEP 2010e), which is the maximum arsenic concentration reported for the BRC/TIMET background data set (BRC and TIMET 2007); arsenic is eliminated as a COPC if the maximum concentration is less than this screening value. This screening value has been used as the soil remediation goal in removal actions completed at the Site (BEC 2008a).

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

USEPA has not established toxicity values (i.e., a cancer slope factor [CSF] or reference dose [RfD]) for lead (USEPA 2017a). 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 a cancer risk or non-cancer HI, the maximum detected concentration is compared directly to the commercial/industrial worker BCL of 800 mg/kg, and not to 0.1×BCL.

##### 5.1.1.1.4 Asbestos

BCLs have not been established for asbestos (long amphibole and long chrysotile fibers). Exposure and risk assessments for asbestos are highly dependent on sample size (see discussion in Section 6.2.2.2). Even for the case where fibers are not identified (i.e., zero fibers), upper-bound cancer risk estimates can be greater than $1\times10^{-6}$, depending on sample size. In the 17 post-abatement samples collected in Parcel F, two long chrysotile fibers were observed in two samples; three long chrysotile fibers were observed in two samples; and four long chrysotile fibers were observed in one sample. Therefore, long chrysotile fiber was identified as a COPC. Although not observed in any of the samples analyzed for asbestos, long amphibole fiber was also included as a COPC per NDEP guidance (Neptune 2015).

##### 5.1.1.1.5 Results of Concentration/Toxicity Screen

The concentration/toxicity screen is presented in Table 5-1 for Parcel F. 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.

Of the 97 analytes listed in Table 5-1, 75 chemicals passed, 14 chemicals failed based on the BCL (or other screening criteria) comparison, and eight chemicals (calcium, palladium, potassium, silicon, sodium, sulfate, sulfur, and hydroxymethyl phthalimide) 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.

#### 5.1.1.2 Step 2 – Background Evaluation

The background evaluation step is consistent with USEPA (1989) and NDEP (2009d) 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 are not available are then further screened under Step 3.

The metals and radionuclides that either failed the concentration/toxicity screen or for which a BCL was not available for screening are listed in Tables 5-2 and 5-3, respectively. The results of the background evaluation presented in Section 4.1.2.2 and Appendix I are also included.

Of the seven metals carried forward from Step 1, potassium[19] was present at concentrations consistent with background and is eliminated as a COPC. Calcium and sodium were present at concentrations greater than background, and background data were not available for four metals (palladium, silicon, sulfur, and zirconium). Of the eight radionuclides carried forward from Step 1, Ra-228 failed the statistical testing for background consistency, while activities of all the other radionuclides were consistent with background.

For radionuclides, as presented in the NDEP flowchart (Appendix O), 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; 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, those radionuclides that fail the background evaluation would be carried forward in the risk assessment. As indicated in Table 5-3, secular equilibrium is exhibited in all the decay chains. However, it is unexpected that radionuclides in the Th-232 decay series both passed and failed the background comparisons. Similar issues have previously been identified by NDEP in the radionuclide analytical data sets for soil samples collected across the BMI Complex (NDEP 2009b).

Sample preparation and analytical methods were important factors in explaining some of the radionuclide data anomalies. The Trust submitted a radionuclide data packet prepared by Ramboll Environ to NDEP via email on September 17, 2015, including a comparison of sample preparation and analytical methods between the parcel data sets and the RZ-A background data set. RZ-A background samples were collected and analyzed in 2009, while the Parcel F samples were collected and analyzed between 2007 and 2017, i.e, both before and after NDEP issued guidance for evaluating radionuclide data (NDEP 2009b). Over this time period, samples were submitted for analysis to different analytical laboratories and analyzed using different preparation and analytical methods. For example, the analytical methods for Ra-228 included beta spectroscopy and gamma spectroscopy, depending on the laboratory, which may be the reason for the lack of correlation with Ra-228 in the Th-232 decay chain (Table I-6). It is also an unexpected finding that for the RZ-A background data set, the Th-232 decay chain was not in secular equilibrium (Table I-5B).

Given that the validity of the statistical testing is confounded by several issues identified above, it is difficult to interpret the results of background evaluation for radionuclides and consider them as a reliable basis for the COPC selection. In order to provide a point of comparison from a health risk perspective between radionuclides in Parcel F soils and in site and regional background soils, the total estimated cancers risks from all the radionuclides were calculated by taking the ratio of soil activities to the commercial/industrial worker BCLs corresponding to a cancer risk of $10^{-6}$. The 95% upper confidence limit (UCL) on the mean soil activity, calculated by the ProUCL software (Version 5.1), was used in the cancer risk calculation for Parcel F, RZ-A background, and BRC/TIMET regional background.[20] The results of radionuclide cancer risks are presented in Table 5-4, and the ProUCL output files are included in Appendix P. As indicated in Table 5-4, the total radionuclide cancer risk for

---

[19] NDEP (2017a) notes that calcium, potassium, and sodium are essential nutrients and do not need to be evaluated in a HRA.

[20] The radionuclide data used in the 95% UCL calculation were not censored based on NDEP guidance (NDEP 2008c).

Parcel F was 2 x $10^{-4}$; the total radionuclide cancer risks for RZ-A background and BRC/TIMET regional background were also 2 x $10^{-4}$. Although the total radionuclide cancer risk for Parcel F was slightly above the target cancer risk range of $10^{-6}$ to $10^{-4}$, it is consistent with background in the area. Radionuclides are not known to be associated with any of the former operations within Parcel F. Based on the above discussion, radionuclides were not identified as COPCs. The impact of excluding radionuclides as COPCs on the HRA results and conclusions is further discussed in the uncertainties in Section 6.2.1.

#### 5.1.1.3 Step 3 – Chemical-specific Evaluations

For the final step of COPC identification, chemicals commonly recognized as having low toxicity and for which a BCL was not available (such that a concentration/toxicity screen could not be conducted) were further reviewed. These chemicals include macronutrients or essential micronutrients and/or are listed on the Generally Recognized as Safe (GRAS) list developed by the U.S. Food and Drug Administration[21]:

- **Calcium and Sodium** (essential macronutrients, required in large quantities; high consumption from foods; GRAS); NDEP (2017a) identifies calcium and sodium as elements that typically do not need to be included in a risk assessment because of their low toxicity;

- **Silicon** (essential nutrient; present in foods, with a typical dietary intake of over 20 mg/day in adults); and

- **Sulfur, Sulfate** (essential macronutrients, required in large quantities; high consumption from foods; GRAS).

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

#### 5.1.1.4 Summary of Soil COPCs

The COPCs identified for soils in Parcel F are listed in Table 5-5. The ten COPCs identified for Parcel F include perchlorate, two metals (palladium and zirconium), chloride, BaPEq, Aroclor-1254, alpha-BHC, hydroxymethyl phthalimide, and asbestos (long amphibole and long chrysotile fibers).

BCLs (and associated toxicity values) are not available for palladium and hydroxymethyl phthalimide; in absence of toxicity values, these COPCs were evaluated qualitatively in Section 6.2.4. Also, RZ-A background data are not available for palladium and zirconium and therefore a background evaluation cannot be conducted. The parcel data for these two metals were compared to BRC/TIMET regional background data in Section 6.2.4.

Spatial intensity plots were developed for perchlorate, zirconium, chloride, BaPEq, Aroclor 1254, alpha BHC, and long chrysotile fibers (Figures 5-2 through 5-8).[22] Since BCLs are not

---

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

[22] In addition to the spatial quartile plots discussed in Section 4.1.2.3 (and included in Appendix J) as part of Data Analysis, additional spatial intensity plots were developed for all major COPCs. The two sets of plots differ in the concentration bins used for plotting. The concentration bins used for the Appendix J plots are based on quartiles

available for hydroxymethyl phthalimide and palladium, no spatial intensity plots were prepared for these COPCs and their spatial distributions are presented in the spatial quartile plots (Figures J-14 and J-16). No spatial intensity plot was prepared for long amphibole fiber since it was not observed in any soil sample collected in Parcel F.

Each COPC spatial intensity plot presents the following information:

- Sample locations;
- COPC concentrations. The concentration shown at each sample location is the maximum detected concentration for all samples collected at that location for soils from 0-10 ft bgs, unless results for all samples at that location were reported as less than the detection limits; concentrations are binned relative to BCLs, as shown on the individual plots. Results for samples reported as less than the detection limit are colored dark green.

As indicated in the spatial intensity plots, possible “hot spots”[23] or other spatial patterns were not identified.

### 5.1.2 Soil Gas COPCs

All chemicals detected in one or more validated soil gas sample were selected as COPCs, as recommended by NDEP in their April 9, 2013 comment letter (NDEP 2013, Comment #3). Using this selection criterion, 65 VOCs[24] were identified as COPCs in soil gas for Parcel F (Table 5-6).

### 5.1.3 Groundwater COPCs

All VOCs detected in one or more validated groundwater samples from the most recent two years at each well were selected as COPCs (USEPA 2015). Using this selection criterion, 14 VOCs were identified as COPCs in shallow groundwater for Parcel F (Table 5-6).

## 5.2 Exposure Assessment

### 5.2.1 Conceptual Site Model and Exposure Scenarios

To evaluate the human health risks posed by a site, it is necessary to identify the populations that may potentially be exposed to the chemicals present and to determine the pathways by which these exposures may occur. A CSM was developed in order to characterize exposure potential in Parcel F. The CSM outlines information relevant to conducting the exposure assessment for Parcel F by (1) evaluating potential chemical sources and releases, (2) identifying populations that could potentially be exposed to chemicals present in Parcel F, and (3) identifying exposure pathways and routes through

---

of the distribution of detected concentrations. The concentration bins used for the COPC plots are based on the BCLs or other screening criteria.

[23] “Hotspot” refers to a localized area in which concentrations tend to be at the upper end of the distribution. These areas are identified based on review of the spatial intensity plots; a statistical hotspot analysis has not been conducted.

[24] Any chemicals labelled as SVOCs that are included in the USEPA definition of volatile compounds are also included in the vapor intrusion analysis. The volatile compounds are currently identified using the following criteria consistent with recommendation from the USEPA Regional Screening Levels Table (USEPA 2017b): 1) vapor pressure greater than 1 mm Hg or 2) Henry's Law constant greater than 0.00001 atm-$m^3$/mole.

which human exposure might occur. The CSM can be an important tool in guiding site characterization, evaluating data quality in the context of potential risks to exposure populations, and developing exposure scenarios. The CSM for Parcel F is presented in Figure 5-9, and its elements are discussed below.

#### 5.2.1.1 Potential Chemical Sources and Release Mechanisms

Historically, NDEP concurred with a list of SRCs that had been identified based on a review of historical site operations and practices, as well as those at neighboring facilities. Based on the CSM, many of the SRCs identified for the Site as a whole were not related to the more limited operations in Parcel F and were therefore not expected to be detected in Parcel F soils. Specifically, as summarized in Section 3.1, much of the parcel property has never been developed, and a few LOUs were identified in Parcel F. However, as a conservative investigation approach, samples collected in Parcel F were analyzed for the same chemicals identified for analysis in samples collected within the Operations Area, including chlorine oxyanions (chlorate and perchlorate), metals and other inorganics, radionuclides, asbestos, dioxins/furans, organic acids, PAHs, PCBs, OCPs, SVOCs, and VOCs.

As discussed previously in Section 3.2, soil samples were collected at both random and judgmental locations, with the latter targeting possible source areas or potentially-impacted areas within Parcel F.

As indicated in the CSM (Figure 5-9), SRCs were released from potential on-site/off-site sources to surface soils and groundwater through several primary release mechanisms, such as spills and leaks/infiltration, water level fluctuation, and groundwater transport. In addition to the potential primary release mechanisms, secondary/tertiary release mechanisms included resuspension of SRCs in surface soils into ambient air, migration of VOCs present in subsurface media through the soil column to indoor air, outdoor air, or trench air, and leaching of SRCs in soils to groundwater.

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

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

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

As noted previously, the land within Parcel F is mostly vacant. Future land use will be restricted to industrial and/or commercial purposes through a land-use covenant. Accordingly, future on-site receptors identified for the post-remediation HRA were long-term indoor industrial/ commercial workers, long-term industrial/ commercial outdoor workers, and short-term construction workers, consistent with USEPA guidance (2002b). Other potential on-site receptors, such as visitors or trespassers, do not warrant 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.

In accordance with the NDEP-approved HRA Work Plan (Northgate and Exponent 2010b, ENVIRON 2013b), off-site receptors were not quantitatively evaluated in the HRA. Current and future off-site receptors include indoor and outdoor commercial/industrial workers and residents located outside the Site boundaries who could be exposed to airborne chemicals (vapors and particulates) emitted during, e.g., routine operations or construction projects (USEPA 2002b). The Site is located within the BMI complex, surrounding by several industrial facilities. For Parcel F, there are Tronox and Tronox sub-tenant workers to the east and south, TIMET to the north, Lhoist to the east, and OSSM to the west. The nearest residents are located approximately 3,500 ft south of Parcel F. A qualitative discussion of the potential risks to off-site populations is presented in Section 6.2.2.1.

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

- Indoor commercial/industrial workers[25]
    - *Incidental soil ingestion*[26]
    - *Inhalation of airborne dust particulates*[26,27]
    - *External exposure from soil*[28]
    - *Inhalation of vapors migrating from soil gas/groundwater to indoor air*
- Outdoor commercial/industrial workers
    - *Incidental soil ingestion*[26]

---

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

[26] Includes radionuclide exposures; however, as noted in Section 5.1.1.4, radionuclides were not selected as soil COPCs for Parcel F.

[27] Includes asbestos exposures.

[28] Only radionuclide exposures; however, as noted in Section 5.1.1.4, radionuclides were not selected as soil COPCs for Parcel F.

  - *Dermal contact with soil*
  - *Inhalation of airborne soil particulates*[26,27]
  - *External exposure from soil*[28]
  - *Inhalation of vapors migrating from soil gas/groundwater to outdoor air*
- Construction workers
  - *Incidental soil ingestion*[26]
  - *Dermal contact with soil*
  - *Inhalation of airborne soil particulates*[26,27]
  - *External exposure from soil*[28]
  - *Inhalation of vapors migrating from soil gas/groundwater to trench air*

Future commercial/industrial workers were assumed to have direct contact with shallow soils (0–2 ft bgs) when minimum soil excavation occurs that could bring subsurface soil to the surface, or with surface and subsurface soils (0–10 ft bgs) when soils from depths of up to 10 ft 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 ft bgs) during excavation or other activities.

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

Exposure via domestic use of groundwater was not evaluated because Site groundwater is not used as a domestic water supply. Incidental ingestion of groundwater and dermal contact with groundwater during short-term construction activities were not considered complete exposures pathways due to the groundwater depth being greater than 10 ft bgs.

### 5.2.2 Exposure Point Concentrations

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

#### 5.2.2.1 Soil

Soil EPCs were used to estimate direct-contact soil exposures (i.e., incidental ingestion and dermal contact) for future on-site indoor and outdoor commercial/industrial workers and construction workers. The soil EPCs were also used to derive airborne particulate and vapor concentrations for the COPCs, as presented in Section 5.2.2.2.

The soil EPC was calculated as the 95% UCL on the mean soil concentration of all soil samples collected at 0-2 ft depth interval and all soil samples collected at 0-10 ft depth interval within Parcel F, which is representative for a reasonable maximum exposure (RME) estimate. The bias-corrected accelerated bootstrap method (BCA UCL) by the ProUCL software (Version 5.1) was used to calculate the UCLs, since it is generally robust regardless of data distribution. The ProUCL output files are included in Appendix P. For Aroclor-1254, the maximum detected concentrations were used as soil EPCs, because 95% UCLs cannot be calculated due to limited detection. The soil EPCs for Parcel F are presented in Tables 5-7A and 5-7B.

#### 5.2.2.2 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 the areal extent of site surface contamination, which is assumed to be equivalent to the area of Parcel F.

For long-term commercial/industrial indoor and outdoor workers, the PEF is estimated based on emissions from wind erosion of surface soils and was calculated using the equations presented by Neptune (2015). The PEF for short-term construction workers includes two components: (1) emissions from unpaved roads and (2) emissions from wind erosion, excavation, dozing, grading, and tilling (USEPA 2002b). These two components were calculated and then combined into a single PEF using the equations presented in Neptune (2015). The parameters used to estimate the PEFs are presented in Table 5-8.

Air EPCs for Chemicals

The air EPCs for chemical COPCs 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 (µg/m$^3$)
$EPC_{soil}$ = Soil Exposure Point Concentration (mg/kg)
$CF_1$ = Conversion Factor (1000 µg/mg)
PEF = Particulate Emission Factor (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 (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 [f]/g)
f = Number of long fibers observed in soil samples (unitless)
AS = Analytical Sensitivity (f/g) [29]
n = Sample Size

Two types of the asbestos soil concentrations were estimated, i.e., a best estimate and an upper-bound estimate, as defined in USEPA (2003) and Neptune (2015). The best-estimate concentration is similar to a central-tendency exposure (CTE) estimate, whereas the upper-bound concentration is comparable to a 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 analytical sensitivity (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$^3$)

---

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

$C_{soil}$ = Soil Concentration (f/g)
PEF = Particulate Emission Factor ($m^3/kg$)

The air EPCs for particulates are presented in Tables 5-7A and 5-7B. For asbestos, the soil concentrations and air concentrations (and associated health risks) were calculated using NDEP's "asbestos guidance riskcalcs.xls" spreadsheet, and are presented in Appendix Q-1.

#### 5.2.2.3 Indoor, Outdoor, and Trench Air: VOCs Migrating from Soil Gas, Groundwater, and Soil

The following subsections describe the derivation of the exposure concentrations and includes descriptions of the source terms and the fate and transport modeling conducted to estimate the exposure concentrations.

Source Terms

Chemicals detected in soil gas (sourcing from groundwater and/or soil) can potentially migrate through the unsaturated zone to ambient or indoor air (USEPA 2004c). For this evaluation, the groundwater, soil, and soil gas data are used as the source term to model the indoor and outdoor concentrations (i.e., the exposure concentrations in the exposure medium or air). For all volatile COPCs evaluated for Parcel F, the exposure concentrations in air used in risk characterization for vapors migrating from soil gas, soil, and groundwater are conservatively modeled using the maximum concentrations detected in soil gas, soil, or in the most recent two years of groundwater, respectively, within Parcel F.

Fate and Transport Modeling

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

For the receptors evaluated in this HRA (future onsite workers), transfer factors for vapors of volatile compounds migrating to indoor air, outdoor air, and trench air were derived based on migration of groundwater vapors from the shallow groundwater table or soil gas from 5 ft bgs to a commercial slab-on-grade building, outdoor air, and trench air, respectively. The transfer factors were estimated using the screening-level model described by Johnson and Ettinger (1991); this model was developed to predict vapor migration into buildings using a combination of diffusion and advection. Specifically, Version 3.1 of the spreadsheet implementation developed by the USEPA was used (USEPA 2004c). Additional transfer factors for volatile compounds in soil migrating to outdoor and trench air were derived based the Jury model as described in the Soil Screening Users Guidance (USEPA 2002b). The parcel-specific input parameters are listed in Table 5-9.

The COPC physical/chemical properties are presented in Table 5-10. The source of all physical/chemical properties is noted in the table. In general, priority is given to the most recent physical/chemical data as well as the most relevant for a site located in Nevada. As such, the hierarchy for selecting physical/chemical properties was: 1) NDEP values from BCL tables (NDEP 2017); 2) USEPA values from RSLs (USEPA 2017); 3) USEPA values from the original Johnson and Ettinger model (USEPA 2004); 4) USEPA values from EPISuite (2012) combined with using surrogate chemicals for chemical diffusivities.

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

- Soil gas from five ft bgs migrating to indoor air in a commercial building and outdoor air at Parcel F;
- Soil gas migrating from one centimeter (cm) below the base of a 10 foot construction trench in Parcel F;
- Groundwater from 30 ft bgs migrating to commercial indoor air, outdoor air, or a 10 foot construction trench from Parcel F;
- Soil from ground surface to outdoor air or a 10 foot construction trench in Parcel F.

As reported in the 2010 Site-Wide Soil Gas HRA (Northgate and Exponent 2010c), soil samples were collected to determine site-specific soil properties representative of the unsaturated zone. Samples were collected at 16 locations at depths of 9 to 15 ft bgs (mostly at 10 ft) across the Site (sampling locations and boring logs in included in Appendix R) to determine volumetric water content, total porosity, dry bulk density, and grain density in accordance with NDEP guidance (NDEP 2010d). The soil property results (shown in Table 5-11) were used for modeling purposes and are the average of 15 site-specific values measured from 9-10 ft bgs. One sample collected at a depth of 15 ft bgs was not included as it represents wetter than average conditions at the site. A map showing the location of these samples is shown in Appendix R.

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

Depth to groundwater for Parcel F was determined by evaluating both current and historic groundwater elevations for non-artisanal wells within the parcel. The depth to groundwater was selected to be a conservative estimate given both current and recent historic measurements.

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

A conservative default building (with building characteristics shown on Table 5-9), was assumed for modeling. The default building size of 100 meters by 100 meters (USEPA 2004c) was selected. The default building has an assumed vapor flow rate of 5 liters/minute into the building (USEPA 2004c). California's default air exchange rate of one air change per hour (California Environmental Protection Agency [Cal/EPA] 2011) was used in the absence of a default rate from NDEP or USEPA. A conservative building height of 10 ft was assumed.

When modeling the above-ground outdoor air scenarios, the Q/C model described in the Soil Screening Users Guidance (USEPA 2002b) was used with parcel-specific site area. For construction trench scenarios, a box model was used to simulate dispersion. Construction trench dimensions of 10 ft deep, 20 ft long, and 5 ft wide were assumed. Although we are comparing to shallower soil gas samples in Parcel F, we still assumed the construction trench would be 10 feet deep to ensure we considered a conservative enough scenario with low dispersion. 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 ft bgs. Additionally, soil gas samples were assumed to be within one cm of the base of the construction trench and VOCs were emitted from all the construction trench walls in addition to the base of the construction trench. These assumptions allow us to conservatively evaluate the 5 foot soil gas samples using the 10-ft trench model.

Benzene is well known to degrade naturally due to aerobic respiration at many sites. Measured concentrations of benzene at shallow depths are consistently lower than would be predicted from deeper sources (soil gas and groundwater) using typical diffusion modeling with no biodegradation providing evidence for biodegradation at the Site. To account for this, the software bioVapor (American Petroleum Institute [API] 2012) was used to calculate the relative impact of biodegradation between the samples collected at depth and the surface for all soil gas and groundwater scenarios. The input parameters for this calculation are also presented in Table 5-9 and were consistent with the input parameters for the rest of the modelling.

Table 5-12A summarizes the transfer factors from soil gas to indoor air, outdoor air and trench air for Parcel F. Table 5-12B summarizes the transfer factors from groundwater to indoor air, outdoor air and trench air for Parcel F. Table 5-12C summarizes the transfer factors from soil to outdoor air and trench air for Parcel F. The conservative nature of the model input parameters and modeling uncertainties are discussed in Section 6.2.2.3.

### Exposure Point Concentrations

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

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

where:

$EPC_{air}$ = Air Exposure Point Concentration ($\mu g/m^3$)
$EPC_{S/SG/GW}$ = Exposure Point Concentration ($\mu g/kg$ for soil, $\mu g/m^3$ for soil gas, $\mu g/L$ for groundwater)
TF = Transfer Factor ($\mu g/m^3$ per $\mu g/kg$ for soil, $\mu g/m^3$ per $\mu g/m^3$ for soil gas, $\mu g/m^3$ per $\mu g/L$ for groundwater)

Tables 5-7A and 5-7B present the source term concentrations in soil, which are the maximum detected concentrations at 0-2 ft and 0-10 depth interval for Aroclor-1254 in Parcel F, and calculated vapor EPCs in outdoor air and trench air. Table 5-13 presents the source term concentrations in soil gas, calculated EPCs in indoor air, outdoor air and trench air based on the maximum detected concentration in Parcel F. Table 5-14 presents the source term concentrations in shallow groundwater, the calculated EPCs in indoor air, outdoor air and trench air based on the maximum detected concentration in groundwater for Parcel F in the most recent two years groundwater data.

### 5.2.3 Exposure Assumptions and Calculations

The magnitude of exposure for any given receptor is a function of the amount of chemical in the exposure medium, 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 could be 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 non-carcinogens, 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.

#### 5.2.3.1 Chemicals

As shown in Table 5-15, 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 (USEPA 2017a) were used for soil ingestion, dermal contact, and particulate inhalation pathways, except that a construction trench scenario was also evaluated for the construction workers assuming that they could be exposed to volatile compounds migrating from subsurface soil, soil gas, and groundwater to air in a 10-ft deep construction trench. The construction workers are assumed to be conducting excavation activities for four hours per day, 30 days per year for one year based on approach recommended by the Virginia Department of Environmental Quality (VDEQ) for evaluating the construction trench scenario (VDEQ 2016) and NDEP's recommendation (NDEP 2017b, General Comment #3 and Specific Comment #3)[30].

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 2004b):

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

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 = Conversion Factor (kg of soil/mg of soil)

Inhalation of Airborne Soil Particulate or Vapor Migrating from Soil, Soil Gas, or Groundwater to Air

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

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

---

[30] In the evaluation of the construction workers exposed to volatile compounds migrating from subsurface soil, soil gas, and groundwater to air in a construction trench, the exposure frequency is assumed to be 30 days based on NDEP's recommendation (NDEP 2017b, General Comment #3); the exposure time of 4 hours per day and the exposure duration of one year are both based on VDEQ's recommendations (VDEQ 2016) per NDEP's comment (NDEP 2017b, Specific Comment #3).

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)

#### 5.2.3.2 Asbestos

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

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

where:

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

## 5.3 Toxicity Assessment

The purpose of 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 the rat, mouse, rabbit, guinea pig, hamster, dog, or monkey.

Chemicals are usually evaluated for their potential health effects in two categories, carcinogenic and non-carcinogenic. Different methods are used to estimate the potential for carcinogenic and non-carcinogenic health effects to occur. Several chemicals produce non-carcinogenic effects at sufficiently high doses but only some chemicals are associated with carcinogenic effects. Most regulatory agencies consider carcinogens to pose a risk for cancer at all exposure levels (i.e., a "no-threshold" assumption); that is, any increase in dose is associated with an increase in the probability of developing cancer. In contrast, 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-day)$^{-1}$, and inhalation unit risks (IURs), which are expressed in units of (µg/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 CSFs and IURs are defined as upper-bound estimates of the probability of an individual developing cancer per unit intake of a potential carcinogen over a lifetime. With CSFs and IURs, a higher value implies a more potent carcinogenic potential.

Non-cancer oral RfDs, which are expressed in units of mg/kg-day, and inhalation reference concentrations (RfCs), which are expressed in units of µg/m$^{3}$, are experimentally derived "no-effect" levels that are used to quantify the extent of toxic effects other than cancer due to exposure to chemicals. The RfDs and RfCs 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.

### 5.3.1 Chemicals

For COPCs, 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, were selected over the IRIS values. Also, for chemicals not included in IRIS, NDEP relied on other sources for toxicity values. Ramboll Environ 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 the USEPA RSL table (USEPA 2017b) were used for PAHs.

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

For construction workers who were assumed to be present at Parcel F for one year, subchronic toxicity values were used whenever available for the evaluation of adverse non-cancer effects in accordance with recommendations by USEPA (USEPA 2017a). The general hierarchy of sources used for the subchronic toxicity values are as below:

- USEPA Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV) (USEPA 2017c);

- Agency for Toxic Substances & Disease Registry (ATSDR). Minimal Risk Levels (MRLs) (ATSDR 2017); and

- USEPA's Health Effects Assessment (HEAST) Summary Tables (USEPA 1997).

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.

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

The toxicity values are presented in Table 5-16 for soil COPCs. Tables 5-17A and 5-17B present chronic and subchronic toxicity values for all COPCs identified in the soil gas and shallow groundwater data included in the risk evaluation for Parcel F, respectively. The uncertainties in the selection of toxicity values are further discussed in Section 6.2.3.

### 5.3.2 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):

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

where:

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

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

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

where:

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

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

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

## 5.4 Risk Characterization

Risk characterization represents the final step in the risk assessment process. In this step, the results of exposure and toxicity assessments are integrated into quantitative or qualitative estimates of potential health risks. In each environmental medium (i.e., soil, soil gas, groundwater), potential excess lifetime cancer risks and non-cancer adverse health effects for each COPC were characterized separately. In addition, potential cancer risks associated with exposure to asbestos in soil are characterized separately from other carcinogenic soil COPCs.

The National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] § 300) is cited as the basis for target risk range by NDEP (2017a). According to the NCP, lifetime incremental cancer risks posed by a site should not exceed 1 x 10$^{-6}$ to one hundred in a million (1 x 10$^{-4}$)[31]. According to NCP and NDEP (2017a), non-carcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., a HI greater than one).

It should be noted that the cancer risk and non-cancer hazard estimated in this HRA do not represent absolute estimates in Parcel F, 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 non-cancer 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.

### 5.4.1 Soil

#### 5.4.1.1 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:

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

where:

---

[31] 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.

$EPC_{soil}$ = 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)
$CSF_{oral}$ = Oral Cancer Slope Factor (mg/kg body weight-day)$^{-1}$
IUR = Inhalation Unit Risk (µg/m$^3$)$^{-1}$

The equation used to calculate cancer risk for outdoor commercial/industrial workers and construction workers due to exposure via incidental soil ingestion, dermal contact, and inhalation of airborne soil particulates and vapor is as follows:

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

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)
ABS = Soil Absorption Factor (unitless)
$CSF_{oral}$ = Oral Cancer Slope Factor (mg/kg body weight-day)$^{-1}$
IUR = Inhalation Unit Risk (µg/m$^3$)$^{-1}$

Soil absorption factors (ABS) used in the risk calculation are presented in Table 5-16.

The detailed calculation of cancer risks for each receptor population is presented in Appendix Q-1. The estimated excess lifetime cancer risk for each COPC was conservatively summed, regardless of the type of cancer, to estimate the total cancer risk from soil COPCs for an exposed individual. The cancer risk results for Parcel F are summarized in Table 5-18. The excess lifetime cancer risks due to exposure to chemicals in soil in Parcel F were $2\times10^{-7}$ (both 0-2 ft bgs and 0-10 ft bgs) for future indoor commercial/industrial workers, $4\times10^{-7}$ (0-2 ft bgs) and $3\times10^{-7}$ (0-10 ft bgs) for future outdoor commercial/industrial workers, and $4\times10^{-8}$ (0-10 ft bgs) for future construction workers, which were below the lower end of the target cancer risk range of $10^{-6}$ to $10^{-4}$. Therefore, potential exposure to COPCs in soil in Parcel F is not expected to pose an unacceptable carcinogenic health risk under the conditions evaluated.

#### 5.4.1.2 Non-Cancer Health Effects: Chemicals

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

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

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)
$RfD_{oral}$ = Oral Reference Dose (mg/kg body weight-day)
$RfC_{inh}$ = Inhalation Reference Concentration (µg/m$^3$)

The equation used to calculate non-cancer HQ for outdoor commercial/industrial workers and construction workers due to exposure via incidental soil ingestion, dermal contact, and inhalation of airborne soil particulates and vapor is as follows:

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

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)
$IF_{soil.derm}$ = 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 non-cancer HQs for each receptor population is presented in Appendix Q-1. The estimated non-cancer HQs for each COPC were conservatively summed, regardless of the target organ, to estimate the total non-cancer HI from soil COPCs for the exposed individual. The non-cancer HI results for Parcel F are summarized in Table 5-18. The estimated non-cancer HIs due to exposure to chemicals in soil in Parcel F were 0.2 (both 0-2 ft bgs and 0-10 ft bgs) for future indoor commercial/industrial workers, 0.3 (both 0-2 ft bgs and 0-10 ft bgs) for future outdoor commercial/industrial workers, and 1 (0-10 ft bgs) for future construction workers, which were below the NDEP significant threshold of greater than one. Therefore, potential exposure to COPCs in soil in Parcel F is not expected to pose an unacceptable non-carcinogenic health effect under the conditions evaluated.

### 5.4.1.3 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 the NDEP's "asbestos guidance riskcalcs.xls" spreadsheet, and are presented in Appendix Q-1. The best estimate and upper-bound estimate of asbestos cancer risks for Parcel F are summarized in Table 5-19. The best estimates and upper-bound estimates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers from potential inhalation exposure to chrysotile long fibers were all less than $1\times10^{-6}$ in Parcel F, which were below the lower end of the target cancer risk range of $10^{-6}$ to $10^{-4}$. For amphibole long fibers, the best estimate was zero. The upper-bound estimates for indoor and outdoor commercial/industrial workers were less than $1\times10^{-6}$, and was $2\times10^{-6}$ for construction workers. It should be noted that the upper-bound risk estimates for long amphibole fibers were based on an observed count of zero fibers in 17 post-abatement soil samples in Parcel F.[32] Overall, potential exposure to asbestos in soil in Parcel F is not expected to pose an unacceptable carcinogenic health risk under the conditions evaluated. Uncertainties in the risk estimates for asbestos, including the impact of sample size, are discussed in Section 6.2.2.2.

## 5.4.2 Soil Gas VOCs

### 5.4.2.1 Assessment of Cancer Risks

Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the Parcel F COPCs. The following equations were used to calculate chemical-specific risk and total risk:

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

where:

$EPC_{air}$ = exposure concentration in air $(\mu g/m^3)$
$IF_{inh}$ = inhalation intake factor (unitless)
UR = unit risk $(\mu g/m^3)^{-1}$

and

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

The cancer risk estimates were calculated for Parcel F based on maximum chemical concentrations detected in the approximately 5 ft bgs soil gas samples, regardless of whether they were co-located.

---

[32] 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 95% UCL, which for a fiber count of zero in soil samples, yields a value of three fibers per gram of soil (also see the discussion in Section 6.2.2.2).

The estimated excess lifetime cancer risks associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from approximately 5 ft soil gas to indoor and outdoor air in Parcel F are summarized in Table 5-20. The associated maximum parcel-specific excess lifetime cancer risks for all COPCs detected in approximately 5 ft soil gas samples are presented in Appendix Q-2 (Tables Q-2-1). As shown in Table 5-20, the total excess lifetime cancer risks estimated for Parcel F are $2 \times 10^{-6}$ for an indoor commercial/industrial worker, $3 \times 10^{-8}$ for an outdoor commercial/industrial worker, and $2 \times 10^{-8}$ for a construction worker. Chloroform is the primary contributor to the total estimated cancer risks for all onsite worker populations for soil gas.

Figure 5-10 plots the estimated excess lifetime cancer risk results at each soil gas sampling location and shows the relation to the nearby chloroform groundwater plume in shallow groundwater (as defined by <70 ug/L chloroform concentration). As shown in Figure 5-10, there is only one location (E-SG-4) located within the plume at the northwestern portion of Parcel F with a total estimated excess lifetime cancer risk slightly greater than $1 \times 10^{-6}$ (i.e. $2 \times 10^{-6}$). The estimated excess lifetime cancer risks for all the other four soil gas sampling locations are below or at $1 \times 10^{-6}$.

Therefore, the potential exposure to COPCs in soil gas in Parcel F is not expected to pose an unacceptable carcinogenic health risk under the conditions evaluated.

#### 5.4.2.2 Assessment of Noncancer Health Effects

For each COPC, the potential for noncancer adverse health effects was estimated as follows:

$$Hazard\ Quotient_{inhalation} = \frac{EC \times IFinh}{RfC}$$

where:

EC = exposure concentration (µg/m$^3$)
$IF_{inh}$ = inhalation intake factor (unitless)
RfC = reference concentration (µg/m$^3$)

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

$$Hazard\ Index = \sum Hazard\ Quotients$$

The estimated total HIs associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from 5 ft soil gas to indoor and outdoor air in Parcel F are summarized in Tables 5-20. The associated maximum HQs for all COPCs detected in 5 ft soil gas in Parcel F are presented in Appendix Q-2 (Tables Q-2-1 through Q-2-3). As shown in Table 5-20, the total HIs estimated for Parcel F are 0.01 for an indoor commercial/industrial worker, 0.0002 for an outdoor commercial/industrial worker, and 0.0005 for a construction worker. Therefore, the potential exposure to COPCs in soil gas in Parcel F is not expected to pose an unacceptable non-carcinogenic health effect under the conditions evaluated.

### 5.4.3 Groundwater VOCs

#### 5.4.3.1 Assessment of Cancer Risks

Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the Parcel F COPCs. The following equations were used to calculate chemical-specific risk and total risk:

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

where:

$EPC_{air}$ = exposure concentration in air ($\mu g/m^3$)
$IF_{inh}$ = inhalation intake factor (unitless)
UR = unit risk ($(\mu g/m^3)^{-1}$)

and

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

The cancer risk estimates were calculated based on maximum chemical concentrations detected in the shallow groundwater in Parcel F, regardless of whether they were co-located.

The estimated excess lifetime cancer risks associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from shallow groundwater to indoor and outdoor air in Parcel F are summarized in Table 5-21. The associated maximum excess lifetime cancer risks for all COPCs detected in shallow groundwater for Parcel F are presented in Appendix Q-3 (Tables Q-3-1 through Q-3-3). As shown in Table 5-21, the excess lifetime cancer risks estimated for Parcel F are $6 \times 10^{-6}$ for an indoor commercial/industrial worker, $9 \times 10^{-8}$ for an outdoor commercial/industrial worker, and $4 \times 10^{-10}$ for a construction worker. Chloroform is the primary contributor to the total estimated cancer risks for all onsite worker populations for shallow groundwater.

Figure 5-11 plots the estimated excess lifetime cancer risk results at each shallow groundwater well and shows the relation to the nearby chloroform groundwater plume in shallow groundwater (as defined by <70 ug/L chloroform concentration). As shown in Figure 5-11, there is only one location (TR-6) located within the plume at the northwestern portion of Parcel F with a total estimated excess lifetime cancer risk greater than $1 \times 10^{-6}$ (i.e. $6 \times 10^{-6}$). The estimated excess lifetime cancer risks for all the other four soil gas sampling locations are below or at $1 \times 10^{-6}$.

Therefore, the potential exposure to COPCs in shallow groundwater in Parcel F is not expected to pose an unacceptable carcinogenic health risk under the conditions evaluated. The cancer risk estimates for the onsite workers through the vapor inhalation pathways based on the shallow groundwater data in Parcel F are consistent with the cancer risk estimates based on soil gas data collected in Parcel F.

#### 5.4.3.2 Assessment of Noncancer Health Effects

For each COPC, the potential for noncancer adverse health effects was estimated as follows:

$$Hazard\ Quotient_{inhalation} = \frac{EC \times IFinh}{RfC}$$

where:

EC = exposure concentration (µg/m$^3$)
IF$_{inh}$ = inhalation intake factor (unitless)
RfC = reference concentration (µg/m$^3$)

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

$$Hazard\ Index = \sum Hazard\ Quotients$$

The estimated total HIs associated with exposures of indoor, outdoor commercial/industrial workers, and construction workers to COPCs migrating from groundwater to indoor and outdoor air for Parcel F are summarized in Table 5-21. The associated maximum HQs for all COPCs detected in shallow groundwater are presented in Appendix Q-3 (Tables Q-3-1 through Q-3-3). As shown in Table 5-21, the total HIs estimated for Parcel F are 0.02 for an indoor commercial/industrial worker, 0.0003 for an outdoor commercial/industrial worker, and 0.00003 for a construction worker. Therefore, potential exposure to COPCs in shallow groundwater in Parcel F is not expected to pose an unacceptable non-carcinogenic health effect under the conditions evaluated. The HI estimates for the onsite workers through the vapor inhalation pathways based on the shallow groundwater data in Parcel F are consistent with the HI estimates based on soil gas data collected in Parcel F.

# 6. UNCERTAINTY ANALYSIS

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

## 6.1 Uncertainties Identified in the Data Usability Evaluation

### 6.1.1 Site Characterization Data

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

Soil data used in the post-remediation HRA came from investigations following both judgmental and random sampling approaches, with judgmental samples collected at locations targeting the areas of the 55-gallon drums, above ground vault, electrical equipment, debris piles, and a mobile aboveground storage tank in Parcel F. Soil samples collected from these locations were analyzed for the full suite of SRC chemicals. Also, adequate soil samples were collected at 0-10 ft bgs. Overall, the placement of the soil sample locations was deemed representative to evaluate the soil conditions of Parcel F in the context of the CSM, and the relative uncertainty in the Site characterization data was considered to be low.

Soil gas samples collected in 2008 (five ft bgs samples from two locations) and 2013 (five ft bgs samples from three locations) within Parcel F were used to estimate cancer risks and noncancer hazards in the HRA. The 2008 Site-Wide Soil Gas Work Plan (ENSR 2008a) states that the majority of sampling locations were selected to (1) sample near or within one of the 18 LOUs identified as being a potential source of VOCs; (2) co-locate with groundwater wells; and/or (3) sample areas where VOCs had been detected in soil or groundwater. This sample placement is consistent with the CSM in which groundwater is identified as the primary source of VOCs in soil gas. The soil gas samples were analyzed for the full suite of VOCs using USEPA Method TO-15, as proposed in the soil gas investigation work plans (ENSR 2008a). The 2013 soil gas samples were collected in March 2013 to address some of the data gaps identified in the 2008 Phase B site-wide soil gas survey. The selection of these soil gas sample locations is consistent with the investigation objective. Collectively, the soil gas data sets are representative of potential source areas (i.e., LOUs) and areas overlying the highest VOC concentrations in groundwater within Parcel F. Further, the analyses included both (1) VOCs associated with historical operations and (2) those VOCs that had been detected in soil or groundwater. Given that (1) in the absence of a building footprint, risks associated with the vapor intrusion pathway are typically evaluated for each individual sampling location (i.e., statistical averages are not estimated); and (2) chloroform concentrations in the underlying groundwater plume were used to inform selection of the soil gas sampling locations, the available samples are considered adequate to characterize soil gas concentrations in Parcel F.

The DVSRs for the 2008 and 2013 soil gas analytical data are included in Appendix L. As noted in Section 4.2 and discuss in more detail in Section 6.1.2 through 6.1.7, three data points were qualified based on minor method blank, and quantitation issues, but were deemed acceptable and were not biased low. All soil gas data were deemed usable for risk assessment. Discussions of the impact on the risk results from helium detections in the sampling train and the findings for blank contamination and precision are provided in Section 6.1.6.

Consistent with previous USEPA guidance and NERT project work plans, only soil gas samples were collected to support evaluation of the vapor intrusion pathway. The objectives of groundwater sampling at the Site have been primarily to characterize SRCs in groundwater near suspected source areas and plume delineation; that is, no groundwater investigation was conducted to specifically provide data to evaluate the vapor intrusion pathway. Further, the majority of groundwater sampling on the Site has focused on perchlorate and hexavalent chromium, with limited sampling for VOCs and SVOCs. In response to NDEP comments (NDEP 2017b), groundwater data was also incorporated in this HRA to evaluate potential risks for the vapor intrusion pathway to provide additional line of evidence for the analysis. To provide groundwater data for this HRA, the NERT project database (discussed in Section 4.1.1.1) and the BMI database were queried to identify wells within or near Parcel F and for which VOC and/or SVOC results were available for shallow groundwater. The identified wells to include in the Parcel F HRA are all owned and sampled by NERT on the Site (Table 3-2). The findings of the review of sample coverage included consideration of both spatial and temporal coverage and are summarized as follows. There are four wells in Parcel F. The northwestern portion of Parcel F overlaps with the nearby chloroform groundwater plume (Figure 3-2). Over 60 VOCs were detected in these wells from 2006 to 2017. TR-6 was sampled in December 2006 with the highest detected chloroform concentration of 3,600 µg/L in this parcel. Along with the soil gas data, these data are adequate for evaluation of the vapor intrusion pathway.

### 6.1.2 Detection Limit

For soil analytes for which the detection frequency was less than 100%, the SQLs from the soil HRA data set were compared to 0.1xBCL (or other screening criteria) to confirm that they were sufficiently low for risk characterization (see Section 4.1.1.5). As presented in Table 4-1, most of the SQLs in Parcel F were less than the screening levels, with a few exceptions. The impacts of elevated SQLs on the soil COPC selection and risk estimates are discussed below.

- Chromium VI: The SQLs exceeded 0.1xBCL in one out of 44 samples reported as nondetects, with a maximum SQL of 3.2 mg/kg. Chromium VI was not identified as a soil COPC for Parcel F. The estimated cancer risk associated with the maximum SQL would be 5 x $10^{-7}$, which is below the target cancer risk range of $10^{-6}$ to $10^{-4}$. Therefore, even if chromium VI was identified as a soil COPC for Parcel F, it would have little impact on the overall risk evaluation.

- Dioxin TEQ: The SQLs exceeded the site-specific action level of 0.0027 mg/kg in five out of 18 samples reported as nondetects, with a maximum SQL of 0.0056 mg/kg. Dioxin TEQ was not identified as a soil COPC for Parcel F based on a maximum detected concentration of 0.0013 mg/kg. Even if the dioxin TEQ was identified as a soil COPC for

Parcel F, the soil EPC (0.00020 mg/kg, calculated as 95% UCL using both detected and nondetected data) would correspond to cancer risks below or near the low end of the the target cancer risk range of $10^{-6}$ to $10^{-4}$. Therefore, elevated SQLs for dioxin TEQs would have little impact on the overall risk evaluation.

- BaPEqs: The SQLs exceeded 0.1xBCL in 30 out of 40 samples reported as nondetects, with a maximum SQL of 0.039 mg/kg. BaPEq was identified as a soil COPC for Parcel F, and the 95% UCLs calculated using both detected and nondetected data (0.085 mg/kg for 0-2 ft bgs and 0.044 mg/kg for 0-10 ft bgs) were used as the soil EPCs in the risk calculation. Therefore, elevated SQLs for BaPEqs do not have any impact on the risk evaluation for Parcel F.

- Benzidine, hexachlorobenzene, and n-nitroso-di-n-propylamine: These three chemicals were not detected in any samples; the SQLs exceeded 0.1xBCL in 100%, 100%, and 8.9% of the non-detected samples, respectively. The maximum SQL of benzidine would correspond to an estimated cancer risk of 7 x $10^{-5}$ for a commercial/industrial scenario, which is within the target cancer risk range of $10^{-6}$ to $10^{-4}$. Therefore, if benzidine was identified as a soil COPC for Parcel F, there would be moderate impact on the overall risk evaluation. The maximum SQLs of hexachlorobenzene and n-nitroso-di-n-propylamine would correspond to estimated cancer risks of 6 x $10^{-8}$ and 2 x $10^{-7}$, respectively for a commercial/industrial scenario, which are below the target cancer risk range of $10^{-6}$ to $10^{-4}$. Therefore, if hexachlrobenzene and n-nitroso-di-n-propylamine were identified as soil COPCs for Parcel F, there would be little impact on the overall risk evaluation.

For soil gas analytes for which the detection frequency was less than 100%, the SQLs for the soil gas dataset included in this HRA were compared to 10% of the RBC to confirm that they were sufficiently low for risk characterization (see Section 4.2.1.5). As presented in Table 4-6, the maximum SQLs were all less than 10% of the respective RBCs for all analytes except for one analyte (1,2-Dibromo-3-chloropropane) in two soil gas samples collected at SB 34 and SB74 in 2008. The SQLs for 1,2-Dibromo-3-chloropropane for these two samples were approximately two fold higher than 10% of the RBC. This result is in general consistent with the QAPP goal that SQLs are less than 1/10th of the screening level, as established by NDEP for the BMI Complex and Common Areas (NDEP 2010b). The SQLs achieved were confirmed to be adequate for risk assessment, and the uncertainty associated with the detection limits for the soil gas dataset is considered low.

For each groundwater analyte for which the detection frequency was less than 100%, the maximum SQL was compared to the RBC. Table 4-8 lists the maximum SQL, the most stringent groundwater RBC, the ratio of the maximum SQL to 1/10th of the RBC, and the number of samples with SQLs greater than 1/10th of the RBC. For all analytes, the maximum SQL was less than 10% of the respective RBC (i.e. no non-detects were greater than 10% of the RBC) with some exceptions as summarized in Section 4.3. Because maximum detected concentrations from the most recent two years' groundwater samples were used in the HRA, and the SQLs for all the recent groundwater samples collected in 2015 and 2017 are below 10% of their RBCs, this result is generally consistent with the QAPP goal that SQLs are less than 1/10th of the screening level, as established by NDEP for the BMI Complex and Common Areas (NDEP 2010b). The SQLs achieved were confirmed to be adequate for risk assessment for the 2015 and 2017 groundwater data used in the risk calculations for Parcel F, and the uncertainty associated with the detection limits for the groundwater dataset used in the risk evaluations for groundwater in Parcel F is considered low.

### 6.1.3 Completeness

The rejected (“R” qualified) data associated with post-remediation soil samples at 0-10 ft bgs in Parcel F are summarized in Appendix E, Table E-3. The percent completeness for the soil HRA data set is 99.7%. Given the small percentage of rejected data and that there is no apparent spatial grouping of rejected data, these rejected data have little impact on the spatial coverage of the soil HRA data set. Additionally, none of the rejected data were above 0.1xBCL. Therefore, the rejected data do not significantly impact the overall risk evaluation.

As discussed in Section 4.1.1.7, additional primary and field duplicate confirmation samples for PAHs (Q3-PF-3-1-0.0 and Q3-PF-3-1-0.0 FD) were collected at TSB-FR-02 (see Appendix E), which are not included in the soil HRA data set because they were not formally validated (no DVSR associated with these data). PAHs were not detected in either of these samples at detection limits below the BCLs. Therefore, even if these additional PAH data are included in the soil HRA data set, the BaPEqs in these two samples would be below the maximum detected concentration (0.41 mg/kg) used in the COPC selction and the EPCs (0.085 mg/kg at 0-2 ft bgs and 0.044 mg/kg at 0-10 ft bgs) used in the risk calculation. Excluding these data does not significantly impact the overall risk evaluation.

There are no rejected (“R” qualified) data associated with soil gas samples in Parcel F.

Benzidine from a 2007 groundwater sample collected at TR-6 is the only rejected (“R” qualified) data associated with shallow groundwater samples in Parcel F, as shown in Table N-1 in Appendix N. The percent completeness for the groundwater dataset included for Parcel F is over 99%. Given the small percentage of rejected data and that there is no apparent spatial grouping of rejected data, these rejected data have little impact on the spatial coverage of the groundwater HRA data set. The rejected data was from one of the older samples that are not used in the groundwater risk evaluation. Additionally, benzidine was not detected in this sample and the detection limit was below 0.1xRBC. Therefore, the impact of the rejected data on the risk evaluation for Parcel F is considered low.

### 6.1.4 Comparability

As discussed in Section 4.1.1.7, different reporting limits for the same analyte in soil may impact the comparability of the data sets. The ranges of the SQLs for each soil analyte for which the detection frequency was less than 100% are presented in Table 4-1. For most of the soil analytes, the SQLs are well below 0.1xBCL (or other screening criteria); there are a few soil analytes with SQLs exceeding 0.1xBCL (or other screening criteria), and their impacts on the COPC selection and risk estimates are discussed in Section 6.1.2. In summary, different reporting limits for the same soil analyte would not affect the overall risk evaluation.

Also, differences in sample preparation and analytical methods exist between the Parcel F data set and the RZ-A background data set for both metals and radionuclides, which may affect the statistical testing results of background evaluation. However, as discussed in Section 5.1.1, no metal or radionuclide was identified or eliminated as a soil COPC based solely on the statistical testing results of background evaluation. Therefore, potential changes of statistical testing results of background evaluation due to the incomparability issues of analytical methods would not have any impact on the overall risk calculation.

The sample location selection method for the 2008 soil gas investigation is different from the 2013 soil gas investigation; the objective of the 2013 investigation was to expand spatial coverage, particularly in areas not previously sampled in 2008 and not to evaluate concentration trends. Because no sample was co-located between the 2008 and 2013 soil gas samples, the temporal comparability evaluation was not performed for the soil gas data. Spatial representativeness was discussed previously in Section 4.2.1.4. Locations sampled in the 2008 and 2013 soil gas surveys were placed at five ft bgs near or within LOUs where VOCs may have been used in past operations; in areas overlying the nearby chloroform groundwater plume (defined by <70 ug/L chloroform concentration) at the northwestern site half of Parcel F; and/or co-located with groundwater monitoring wells. Addtionally, the maximum soil gas COPC concentrations across Parcel F were conservatively used in the risk evaluation, and the maximum concentration of chloroform, the primary risk driver in soil gas at Parcel F, is from one of the more recent 2013 soil gas samples ( at E-SG-4) that was collected from the location within the plume. Collectively, the soil gas data set provides adequate coverage of Parcel F, and the use of the maximum detected concentrations for the exposure estimates is considered conservative.

For the groundwater data used in the HRA, as discussed in Section 4.3, a limited evaluation of this DQI is presented based on the information available in the NERT and BMI databases.

The same analytical methods were used across most investigations; specifically, USEPA Method SW-8260 for VOCs and SW-8270 for SVOCs. In some investigations, the more sensitive SW-8260 SIM was used for VOCs; SW-8270 SIM was used for PAHs across all analytical programs. All groundwater sampling results were reported in µg/L.

Because maximum detected concentrations from the most recent two years of groundwater data were used in the HRA (and SQLs were sufficiently low in the most recent investigation in 2017, as discussed in Section 4.3.1.5), the differences in detection limits does not impact the results of the HRA.

Three out of the four wells have been sampled over time in at least four investigations for VOCs and/or SVOCs except for M-93. In general, the detected concentrations were found to be lower in the more recent sampling events between 2015 and 2017 in Parcel F.

### 6.1.5 Precision

Precision is a measure of the degree of agreement between replicate measurements of the same source (field precision) or sample (analytical precision). Precision is expressed by the RPD between replicate measurements. Replicate measurements can be made on the same sample or on two samples from the same source.

As presented in Table E-4, in the soil HRA data set, a total of 76 pairs of primary and field duplicate results were qualified due to RPD or reporting limit exceedance. Soil samples with qualified primary and field duplicate results were treated as independent samples in the HRA. Except for perchlorate and chloride, none of the soil analytes qualified due to RPD or reporting limit exceedance was identified as a soil COPC. For chloride, the maximum detected concentration used in the COPC selection (see Table 5-1) was greater than the duplicate results qualified due to RPD or reporting limit exceedance (see Table E-4), and the non-cancer HQs associated with chloride were well below the significant threshold (see Appendix Q-1). For perchlorate, the two samples with concentrations exceeding 0.1xBCL (107 mg/kg in TSB-FJ-02-0 and 168 mg/kg in TSB-FJ-06-0) were both qualified due to RPD exceedance, and the concentrations in their field duplicate samples were well below 0.1xBCL (3 mg/kg in TSB-FJ-02-0 FD and 9.99 mg/kg in TSB-FJ-06-0). If average concentrations between primary and field duplicate samples were used in the toxicity screening, perchlorate would not be identified as a soil COPC for Parcel F. However, even if perchlorate was identified as a soil COPC for Parcel F based on the maximum detected concentrations qualified due to RPD exceedance, the non-cancer HQs associated with perchlorate were well below the significant threshold (see Appendix Q-1). Therefore, the precision issues for the duplicate samples do not significant impact on the overall risk calculation.

For the soil gas and shallow groundwater dataset used in the HRA, field precision for the samples was assessed by evaluating the field duplicate results.

<u>2008 soil gas investigation:</u> None of the duplicate samples were collected from locations in or near Parcel F.

<u>2013 soil gas investigation</u>: One field duplicate (E-SG-6) was collected in Parcel F, 17 paired values (total of 34 sample results) were qualified based on RPDs that exceeded the QAPP criteria. These values are summarized in Table L-1 in Appendix L. Results for the primary contributor to the total estimated risk (i.e., chloroform) for soil gas was within the RPD acceptance criteria. In addition, the maximum chloroform concentration is not from this pair of soil gas samples. Therefore, the J-qualified samples due to RPDs exceeding the QAPP criteria in Parcel F did not impact the risk results for the primary risk drivers.

For the shallow groundwater dataset used in the HRA, as presented in Table N-3, field precision for the samples collected in Parcel F was assessed by evaluating the field duplicate results for the HRA groundwater data. A total of four field duplicates (Table N-3) were collected for the shallow groundwater data set for Parcel F. The precision goal for field duplicates was plus or minus 50% RPD except for the case in which results are less than five times the reporting limit. For the latter case, the acceptance criteria is the reporting limit (i.e., the absolute value of the difference between the primary result and duplicate result is compared to the reporting limit). Based on this review, 49 associated field sample results in one primary sample/field duplicate pair were qualified based on RPDs that exceeded the QAPP criteria. These values were summarized in Table N-3. This primary sample/field duplicate pair were older samples collected at TR-6 in April 2007. The results from these samples were not used in the shallow groundwater risk evaluation and therefore did not impact the shallow groundwater risk results.

### 6.1.6 Accuracy

The soil analytical data were evaluated in DVSRs presented in Appendix E, 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 (984 out of 10,609 data points, see Table F-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 HRA results was evaluated:

- J and J+ Qualified Data: A review of the J and J+ qualified data indicated that the estimated results were either below 0.1xBCL (or other screening criteria) or below/equal to the maximum detected concentration used in the COPC selection (Table 6-1). Only Aroclor 1254 and perchlorate were identified as COPCs based on the maximum detected concentrations with J/J+ qualifiers. The cancer risks and non-cancer HQs associated with Aroclor 1254 and the non-cancer HQs associated with perchlorate were below the significant thresholds (see Appendix Q-1). Therefore, the J and J+ qualified data do not have any impact on the overall risk evaluation.

- J- Qualified Data: A review of the J- qualified data indicated that the results estimated with low bias were either significantly below 0.1xBCL or below/equal to the maximum detected concentration used in the COPC selection (Table 6-1). Therefore, correction for the low bias would not change the selection of COPCs. Only zirconium and hydroxymethyl phthalimide were identified as COPCs based on maximum detected concentrations with a J- qualifier. No toxicity value is available for hydroxymethyl phthalimide, and this chemical is qualitatively discussed in Section 6.2.4. The non-cancer HQs associated with zirconium were below the significant threshold of greater than one (see Appendix Q-1). Correction for the low bias of this chemical may slightly increase the estimated non-cancer HQs, but it would likely still be below the significant threshold. Therefore, the J- qualified data have little impact on the overall risk evaluation.

As discussed in Section 4.1.1.7, Ramboll Environ noticed that several discrepancies in the data associated with blank contamination exist between the project database and the amended tables of the DVSRs Northgate prepared in the Soil HRA Report Revision 3 (Northgate 2014), especially for the reported concentrations. Data consistent with the project database are included in this HRA, and the impacts of such discrepancies on the soil results were evaluated (Table 6-2). Except for zirconium, the reported concentrations associated with blank contamination were all below 0.1xBCL. Zirconium was identified as a soil COPC for Parcel F, and the maximum detected concentration (36 mg/kg, Table 5-1) used in the COPC selection and the soil EPCs (22 mg/kg at 0-2 ft bgs and 21 mg/kg at 10 ft bgs) used in the risk estimate were greater than or similar to the maximum reported concentration associated with blank contamination (22 mg/kg, Table 6-2). In addition, the data associated with blank contamination may result in the selection of additional metals (e.g., antimony, boron, cadmium, mercury, molybdenum, thallium, tin, and tungsten) as being above background; however, these metals all passed the concentration/toxicity screen, and would not be identified as soil COPCs. Therefore, the data associated with blank contamination do not have any impact on the overall risk evaluation.

For asbestos, several data quality issues were identified in the DVSRs (Neptune 2014), ranging from unsigned chain of custody forms to inability to verify fiber counts on the bench sheet data reports due to poor legibility. A memorandum responding to the specific issues identified in the DVSRs along with the agreed data set for risk assessment purposes in the EDD was submitted to NDEP (ENVIRON 2014c). In the case of illegible bench sheet data, information (fiber counts and AS) presented in the laboratory reports was used. It is anticipated that the information in the laboratory reports would have been correct, or would not have deviated from the bench data sheet reports by more than one or two fiber counts. Further, bench data sheets were illegible for only two samples. Therefore, the overall impact of asbestos data quality issues on the risk estimates is relatively small.

The soil gas dataset, as presented in Appendix L, has a subset of the data qualified with a J qualifier (J) based on method blank, field duplicate, and/or other quantitation issues (130 out of 402 data points, see Table L-1); that is, the reported value was estimated, with no (J)bias. The potential impact of the J qualified data on the HRA results was evaluated. The maximum detected concentrations for each COPC in Parcel F were used in the risk evaluations. A review of the J qualified soil gas data indicated that some of the maximum detected concentrations for the primary contributors to the total estimated risk (i.e., chloroform, and 1,2-dibromo-3-chloropropane) were based on the estimated results, but with no bias (J) for Parcel F. Therefore, the J qualified data are not expected to have any significant impact on the overall risk evaluation.

Also, as noted in Section 4.2.1.7, helium gas was used as part of the leak-check procedure for the 2008 soil gas sampling events. The primary advantage of using helium as a gaseous tracer is that leakage can be readily quantified by comparing laboratory results for helium with concentrations measured within the sampling shroud. Laboratory results are used because field results are less reliable at the low end of the concentration range. The field measurements are used to allow personnel to take corrective action in the field in response to potential leaks. Helium was not detected in any of the 2008 soil gas samples. One sample, E-SG-6, had a laboratory detection of helium of 2.0% (6.7% of shroud concentration); however, a field duplicate was collected simultaneously with this sample. The field duplicate, which shared the same sampling train and shroud, contained helium at a concentration of only 0.076% (0.25% of shroud concentration). The reason for the difference between the primary and duplicate sample is not known. To evaluate the impact of leakage on the risk estimates, VOC results were adjusted assuming a 6.7% leak (these calculations are not shown.) The adjusted VOC results did not result in any material changes to the risk estimates or conclusions in the HRA.

The groundwater analytical data were evaluated in DVSRs presented in Appendix N, with a subset of the data qualified with a J qualifier (J, or J-) based on method blank, field duplicate, and/or other quantitation issues (18 out of 747 data points used in the groundwater risk evaluations, see Table N-3); that is, the reported value was estimated, with no (J), or low (J-) bias. The potential impact of the J qualified data on the HRA results was evaluated.

- The maximum detected concentrations for each COPC in Parcel F were used in the risk evaluation. A review of the J qualified groundwater data indicated that the maximum detected concentration used in the groundwater risk estimations for Parcel F for the primary contributor to the total estimated risk (i.e., chloroform) was not based on the estimated results. Therefore the impact of the estimated results with no bias (J) or low (J-) bias are considered low in the groundwater risk evaluations for Parcel F.

### 6.1.7 Duplicate Treatment

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

- Only perchlorate was identified as a soil COPC based on the maximum concentration detected in a sample with a duplicate. The detected concentration in the primary sample (168 mg/kg in TSB-FJ-06-0) was above 0.1xBCL, while the detected concentration in the field duplicate sample (9.99 mg/kg in TSB-FJ-06-0 FD) was below 0.1xBCL. If the average concentration between primary and field duplicate samples (89 mg/kg) was used in the toxicity screening, perchlorate would not be identified as a soil COPC for Parcel F. However, even if perchlorate was conservatively identified as a soil COPC for Parcel F based on the detected concentration in the primary sample, the non-cancer HQs associated with perchlorate were well below the significant threshold (see Appendix Q-1).

- Although the treatment of duplicate samples may affect the results of background evaluation, no metals or radionuclides were identified as soil COPCs based solely on the background evaluation.

- The treatment of duplicate samples may affect the soil EPCs calculated as the 95% UCLs on the mean concentrations within Parcel F. However, as indicated in Table 5-18, the estimated excess lifetime cancer risks were below the target cancer risk range of $10^{-6}$ to $10^{-4}$, and the non-cancer HIs were below the significant threshold of greater than one. The non-cancer HI for a future construction worker was one, and the driver chemical was zirconium. The detected concentrations in the field duplicate samples (TSB-FR-02-02-10-FD, TSB-FJ-06-0 FD, and TSB-FR-04-0 FD) were comparable to both the concentrations detected in the primary samples and the soil EPCs used in the risk calculation. Therefore, the treatment of duplicate samples does not have much effect on the HQs associated with zirconium.

- The asbestos risk calculations employed both original and field duplicate samples, resulting in an increase of sample size and decrease of pooled AS. As indicated in Appendix Q-1, Parcel F contained two field duplicate samples. Excluding these field duplicate samples would slightly increase the calculated cancer risks from long amphibole fibers, and slightly decrease the calculated cancer risks from long chrysotile fibers. However, the best estimates and upper-bound estimates would still be less than $1\times10^{-6}$ for all the receptor populations in Parcel F, except for the upper-bound estimates for construction workers due to zero fibers and sample size issues (see discussion in Section 6.2.2.2).

In summary, there is little impact of duplicate treatment on the overall soil risk evaluation.

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

One field duplicate sample was collected at E-SG-6 within Parcel F during the 2013 investigation (Table L-1). The soil gas HRA included both the parent sample and field duplicate sample, resulting in increase of sample size. However, the maximum detected concentration of the risk driver, chloroform, is not from this location. Therefore, excluding the field duplicate sample is expected to have negligible impact on the calculated risk estimates for soil gas.

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

A total of four field duplicates (Table N-3) were collected for the shallow groundwater data set in Parcel F. For shallow groundwater, the HRA included both the parent samples and field duplicate samples, resulting in an increase of sample size. The maximum detected concentration of the risk driver, chloroform, is identical between the parent sample and the field duplicate collected in May 2017 at TR-6 (both are 1200 µg/L). Therefore, excluding the field duplicate samples are expected to have negligible impact on the calculated risk estimates for shallow groundwater.

Therefore the field duplicates do not have any impact on the soil gas and groundwater risk evaluations for Parcel F.

## 6.2 Uncertainties Identified in the Risk Assessment

### 6.2.1 Identification of COPCs

Chemicals detected in at least one soil sample were included in the COPC selection process. Nine out of 97 detected chemicals in Parcel F 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; therefore, exclusion of these chemicals from the quantitative risk assessment may slightly underestimate the potential health risks posed by Parcel F, but to such a small degree as to be inconsequential to the overall results of the HRA. It should be noted that, for a few chemicals, the SQLs were higher than the screening levels in a few soil samples (see Table 4-1). The impacts of elevated SQLs on the risk evaluation are discussed in Section 6.1.2.

Surrogate BCLs were used for the toxicity screen and COPC selection for acenaphthylene, chromium (total), 2,4’-DDE, endrin aldehyde, 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, 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 surrogates were identified for palladium and hydroxymethyl phthalimide. These chemicals were identified as soil COPCs, and are discussed qualitatively in Section 6.2.4.

Based on comparison to RZ-A background, some metals were identified as being above background, while for others, there are insufficient detections in the background and/or Parcel F soil data sets to make a determination (see Appendix I). However, except for palladium and zirconium for which RZ-A background data are not available, no metal was identified as a soil COPC. That is because most metals passed the concentration/toxicity screen and some metals are essential nutrients. Also, for the majority of metals, there is no reason to believe they are related to historical parcel activities, based on the CSM. Therefore, although there were some uncertainties with the background evaluation for metals, such uncertainties do not have any impact on the selection of soil COPCs and overall risk evaluation.

One radionuclide (Ra-228) failed the statistical testing of background consistency, but given that the validity of the statistical testing is confounded by several issues (see discussion in Section 5.1.1.2), all radionuclides were excluded as soil COPCs based on a comparison of cancer risks between Parcel F soils and site/regional background soils. As indicated in Table 5-4, although the radionuclide cancer risk for Parcel F was slightly above the target cancer risk range of $10^{-6}$ to $10^{-4}$, it was consistent with the cancer risks in both the RZ-A background soil and the BRC/TIMET regional background soil. Excluding radionuclides as soil COPCs has only marginal impact on the overall risk evaluation.

A total of over 60 VOCs and volatile SVOCs were detected in soil gas or groundwater dataset selected for the risk evaluations, 65 were detected in at least one soil gas sample, and 14 were detected in at least one groundwater sample in the most recent two years groundwater data at each well. As a conservative approach, all detected analytes were identified as COPCs (Table 5-6). For the chemicals reported as “not detected” in all samples, the SQLs were less than their respective RBCs (Tables 4-6, and 4-8). Thus, it is unlikely the risks estimated in the HRA were underestimated as a result of the COPC selection process.

### 6.2.2 Exposure Assessment

#### 6.2.2.1 Exposure Scenarios

The exposure assessment in this HRA is based on a RME scenario, which is defined by USEPA as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site (USEPA 1989). To achieve this goal, the RME scenario uses highly conservative exposure assumptions. For example, this HRA assumes that an on-site outdoor commercial/industrial worker incidentally ingests 100 mg of parcel 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 Parcel F.

Other potential receptors that were not quantitatively evaluated in the HRA include off-site indoor and outdoor commercial/industrial workers, off-site residents, and visitors and trespassers. The uncertainty associated with the exclusion of these receptors from the quantitative HRA is discussed below.

In accordance with the NDEP-approved *Health Risk Assessment Work Plan* (Northgate and Exponent 2010b), off-site receptors were not quantitatively evaluated in the HRA. Off-site receptors could be exposed to airborne chemicals (vapors and particulates) emitted during onsite activities, e.g., routine operations or construction projects (USEPA 2002b).

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

Tables 5-13 and 5-14 present the estimated exposure point concentrations for air based on the maximum concentrations detected in soil gas at approximately five ft bgs and shallow groundwater, respectively. For Parcel F, the predicted outdoor concentration for chloroform, the major chemical contributor to the soil gas and groundwater risks, is 0.051 µg/m3 based on shallow groundwater, and 0.015 µg/$m^3$ based on soil gas (five ft bgs). All concentrations are below the commercial RSL for air of 0.53 µg/$m^3$ or the residential RSL for air of 0.12 µg/$m^3$.

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

#### 6.2.2.2 EPCs

The soil EPCs for non-asbestos soil COPCs were calculated as the 95% UCL on the mean soil concentration at 0-2 ft depth interval and 0-10 ft depth interval within Parcel F (unless a 95% UCL cannot 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 parcel soils at concentrations higher than the 95% UCLs over an extended period of time.

Consistent with NDEP guidance (Neptune 2015), asbestos EPCs are 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 5.2.2.2, the soil concentration used to estimate asbestos air EPC is equal to the number of long fibers detected multiplied by the pooled AS. For the best estimate, the number of long fibers observed in the soil samples collected in Parcel F is used in the calculation. For the upper bound estimate, the 95% UCL on the number of long fibers observed in the soil samples collected in Parcel F assuming a Poisson distribution is used in the calculation. Pooled AS, which was used in both calculations, is a function of sample size. Specifically, pooled AS decreases with increasing sample size (the equation for calculating pooled AS is presented in Section 5.2.2.2), 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 Parcel F, the best estimate risk was zero (i.e., amphibole long fibers were not detected in any sample, so that both the soil concentration and air EPC were zero); while for the upper-bound estimate, the 95% UCL of the Poisson distribution for the case in which no fibers were detected was three fibers, and the risk is a function of sample size. As shown in Table 5-19, although amphibole long fibers were not detected in any sample in Parcel F, the estimated risk to construction workers was 2 x $10^{-6}$ with a sample size of 17.

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

#### 6.2.2.3 Fate-and-Transport Modeling

The fate-and-transport modeling for soil is limited to estimating PEFs of airborne particulates 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 non-asbestos soil COPCs, inhalation of airborne particulates did not contribute significantly to the overall risk estimates, because exposures via incidental ingestion were much higher (see Appendix Q-1); therefore, the uncertainty in the PEFs does not affect the conclusions of the HRA. However, for asbestos, which was evaluated as a carcinogen only for the inhalation route of exposure, the potential uncertainty in the PEFs could contribute substantially to the overall risk estimates. This is particularly important for the construction worker scenario because the estimated PEF was large relative to the commercial/industrial scenario (see Table 5-8). 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. In this case, the majority of the input parameters were based on default values recommended by USEPA (2002b). USEPA provides the basis for most of these default values, except the average weight of the vehicle (eight tonnes) 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 Parcel F is unknown; however, it is believed that, in combination, these assumptions are more likely to overestimate than underestimate potential health risks, potentially to a significant degree, especially when dust control measures will be implemented during construction.

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

The soil properties used for the Johnson and Ettinger model and Jury model were conservatively selected assuming that the entire unsaturated zone in Parcel F is Qal. This is a conservative assumption in that for areas where the UMCf is part of the unsaturated zone, the finer-grained UMCf would act to reduce vapor transport of COPCs. Further, the site-specific soil properties used in the model (Table 5-11) were based on samples collected in the Qal. Additionally, to be conservative the one sample collected from below 10 ft bgs was not used in our evaluation due to extraordinarily wet soil properties measured at that location.

If default soil properties were used in the evaluation of the 5 ft bgs samples, the results would increase by approximately a factor of 2. Currently, the estimated excess lifetime cancer risk is 2 x $10^{-6}$. The use of default soil properties would raise this to 4 x $10^{-6}$, still within the target cancer risk range of $10^{-6}$ to $10^{-4}$.

Soil gas sampling depths are based on site-specific values for evaluating indoor and outdoor above-ground commercial scenarios. When evaluating construction trench scenarios, we conservatively assumed that the construction trench would be located only one cm above the soil gas sample, allowing for maximum potential exposure. We also conservatively assumed that air containing VOCs would be migrating from the walls of the construction trench in addition to the base to maximize exposure potential. Depth to groundwater was site-specific and selected to be conservative considering both current and historical data for the parcel. 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 entire vadose zone is filled with soil at the maximum detected concentration.

A conservative default building (with building characteristics shown on Table 5-9), was assumed for modeling. The default building size was selected although many commercial buildings are larger. However, larger buildings are often partitioned into smaller areas or offices that represents an exposure zone. A conservative height of 10 ft was assumed, although many commercial buildings have higher first floor ceilings.

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

### 6.2.3 Toxicity Assessment

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

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

Chemical-specific uncertainties in toxicity criteria are provided below for zirconium and asbestos in soil, followed by a discussion regarding soil gas and groundwater COPCs for which surrogate criteria were used.

Zirconium

The oral RfD for zirconium is a screening toxicity value taken from an appendix of a PPRTV assessment, which was based on two drinking water and feed studies over lifetime to rats and mice (USEPA 2012). The critical effect considered in the derivation of oral RfD is 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-adverse-effect level (LOAEL) 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 LOAEL 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.

Asbestos

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

VOCs

As identified in Tables 5-17A and 5-17B, surrogate toxicity criteria were used to estimate HQs (for the noncancer endpoint) for 16 of the 68 soil gas and shallow groundwater COPCs. Of these, nine surrogates are those identified by NDEP BCLs Table (NDEP 2017c) and as identified in Appendix B of the Users' Guide for BCLs (NDEP 2017a). Freon 113 was specified by NDEP as a surrogate for 1,2-dichloro-1,1,2,2-tetrafluoroethane (Freion 114) in its response to the *Revised Technical Memorandum: Screening-Level Indoor Air Health Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation* (NDEP 2010f). The surrogates used for the six remaining COPCs are as follows: for 1,3,5-trimethylbenzene, the RfC for 1,2,4-trimethylbenzene is used as a surrogate; for cis-1,3-dichloropropene and trans-1,3-dichloropropene, the RfC for 1,3-dichloropropene is used as a surrogate; for n-nonyl aldehyde, the RfC for acetaldehyde is used as a surrogate; and for t-amyl methyl ether and ethyl tert-butyl ether, the RfC for methyl tertbutyl ether is used as a surrogate.

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

### 6.2.4 Risk Characterization

The uncertainties associated with risk characterization are generally the result of combined uncertainties in the site characterization data, COPC selection, exposure assessment, and toxicity assessment. In addition, risks cannot be quantitatively characterized for chemicals for which toxicity criteria have not been established. In this HRA, potential health risks were quantified for future on-site indoor and outdoor commercial/industrial workers and construction workers associated with direct contact with soil, inhalation of airborne particulates, and inhalation of vapors migrating from soil, soil gas, or groundwater to indoor, outdoor, or trench air. Given the highly conservative nature of the exposure parameters used to characterize these pathways, especially for the RME scenario, it is highly unlikely that the same receptor would be exposed at that level over the entire duration of exposure. These conservative estimates of exposure were then combined with even more conservative estimates of toxicity values to estimate the magnitude (non-cancer) or likelihood (cancer) of potential effects. This methodology is believed to not underestimate the true risk, but could overestimate the true risk by a considerable degree, and the true risk could be as low as zero.

One source of uncertainty that is unique to risk characterization is the assumption that the total risk associated with exposure to multiple chemicals is equal to the sum of the individual risks for each chemical (i.e., the risks are additive). Other possible interactions include synergism, where the total risk is higher than the sum of the individual risks, and antagonism, where the total risk is lower than the sum of the individual risks. Relatively few data are available regarding potential chemical interactions following environmental exposure to chemical mixtures. Some studies have been carried out in rodents that were given simultaneous doses of multiple chemicals. The results of these studies indicated that no interactive effects were observed for mixtures of chemicals that affect different target organs (i.e., each chemical acted independently), whereas antagonism was observed for mixtures of chemicals that affect the same target organ, but by different mechanisms (Risk Commission 1997). While there are no data on chemical interactions in humans exposed to chemical mixtures at the dose levels typically observed in environmental exposures, animal studies suggest that synergistic effects will not occur at levels of exposure below their individual effect levels (Seed et al. 1995). As exposure levels approach the individual effect levels, a variety of interactions may occur, including additive, synergistic, and antagonistic interactions (Seed et al. 1995).

USEPA guidance for risk assessment of chemical mixtures (USEPA 1986) recommends assuming an additive effect following exposure to multiple chemicals. Subsequent recommendations by other parties, such as the National Research Council (NRC 1988) and the Presidential/Congressional Commission on Risk Assessment and Risk Management (Risk Commission 1997), have also advocated a default assumption of additivity. As currently practiced in this HRA, risk assessments of chemical mixtures summed cancer risks regardless of tumor type, and summed non-cancer HIs regardless of toxic endpoint or mode of action. Given the available experimental data, this approach likely overestimates potential risks associated with simultaneous exposure to multiple chemicals. Asbestos risks were evaluated separately from other chemical risks, consistent with approach outlined in the HRA Work Plan (Northgate and Exponent 2010b). 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 hydroxymethyl phthalimide), toxicity values are not available; in absence of toxicity values, these soil COPCs were not evaluated quantitatively. Palladium was 100% detected in Parcel F; however, RZ-A background data are not available for this soil COPC. When compared to BRC/TIMET regional background data (ranging from 0.14 mg/kg to 1.5 mg/kg), palladium in 40 out of 41 soil samples was detected at concentrations lower than 0.9 mg/kg, and only the concentration in one sample (2.1 mg/kg) fell outside the range of regional background concentrations. Therefore, palladium concentrations in Parcel F were generally consistent with regional background, and the exclusion of this soil COPC from quantitative risk assessment is not expected to impact the risk estimates or overall conclusions of the HRA. Hydroxymethyl phthalimide was detected in only two out of 41 samples in Parcel F, respectively. Considering the low detection frequencies, the exclusion of this soil COPC from quantitative risk assessment is not expected to impact the risk estimates or overall conclusions of the HRA.

Although zirconium was identified as a soil COPC for Parcel F, RZ-A background data are not available for this soil COPC. When compared to BRC/TIMET regional background data (ranging from 60 mg/kg to 180 mg/kg), the maximum detected concentration of zirconium in Parcel F (35.7 mg/kg) fell below the lower end of the range of regional background concentrations. Therefore, zirconium concentrations in Parcel F 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 6.2.1, radionuclides were excluded as soil COPCs in the quantitative risk evaluation due to consistency with background and minimal risk reduction for remediation. 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 5-4, the cancer risk for Ra-226 in Parcel F was consistent with the site and regional background; therefore, activities of Ra-226 are not considered elevated in soils beneath a building in Parcel F, and the risk associated with inhalation of radon-222 within a commercial building should not be a concern. Overall, excluding radionuclides as soil COPCs only have little impact on the overall risk evaluation.

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

# 7. DATA QUALITY ASSESSMENT

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

## 7.1 Soil Data

For soil, the evaluation of the cancer risk or non-cancer HI was based on the 95% UCL which is a measure of mean concentration, when the 95% UCL can be calculated. If the 95% UCL cannot be calculated due to limited detections, the evaluation of the cancer risk or non-cancer HI was based the maximum detected concentration. Specifically, the evaluation for the cancer risk driver, Aroclor 1254, was based on the maximum detected concentrations, while the evaluation for the non-cancer HI driver, zirconium, was based the 95% UCLs.

### 7.1.1 Cancer Risk

For cancer risk, the data quality assessment was conceptualized as a statistical test of the proportion of the soil samples that are associated with an unacceptable risk. As summarized in Table 5-18, the cancer risk estimates are all below the target cancer risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$; therefore, the proportion of samples with an unacceptable risk is zero out of the total number of samples, or 0%. The sample size for the cancer risk driver, Aroclor 1254, is 16 at a depth interval of 0 to 2 ft bgs and 20 at a depth interval of 0 to 10 ft bgs (Table 7-1).

In a hypothesis testing framework, a binomial test of proportions was used to evaluate the possibility that there is a greater-than-zero proportion of samples with an unacceptable cancer risk. The null hypothesis is that the proportion of samples with an unacceptable cancer risk is 0 ($P_1=0$). The alternative hypothesis is that the proportion samples with an unacceptable cancer risk is greater than $P_2$, which is $P_1$ plus an appropriate effect size (i.e., population proportion) that the test should be able to detect.

For the purposes of evaluating if a sufficient number of samples were collected to support the assessment of cancer risk, the number of samples required for each scenario (each combination of depth interval and effect size) was determined using the Exact – Generic Binomial Test in the software program G*Power version 3.1.9 (Faul et al. 2009). A null hypothesis with a $P_1$ of 0 indicates that the false rejection error rate ($\alpha$) is 0 and independent of the sample size and other parameters. Thus, the number of samples required depends on false acceptance rate ($\beta$), $P_1$, and $P_2$. The number of samples required with $\beta$ at 15%, 20% to 25% for each scenario was tested.

As a starting point, an effect size of one sample over the total number of samples was considered, which would be equivalent to one sample having an unacceptable cancer risk. Under this assumption, the null hypothesis would be rejected if one or more samples with an unacceptable cancer risk were observed. As shown in Table 7-1, the number of samples required are larger than the number of samples collected, and the null hypothesis that no soil samples would have an unacceptable cancer risk is rejected with $\beta$ as large as 25%. Therefore, the current sample size is not sufficient to guarantee that no sample over the entire Parcel F would have an unacceptable cancer risk.

Further, an effect size of two samples over the total number of samples was considered, which would be equivalent to two samples having an unacceptable cancer risk. Under this assumption, the null hypothesis would be rejected if two or more samples with an unacceptable cancer risk were observed. As shown in Table 7-1, the number of samples required are smaller than the number of samples collected, and the null hypothesis that no soil samples would have an unacceptable cancer risk is accepted with β as small as 15%. Therefore, the current sample size is sufficient to guarantee that no more than one sample over the entire Parcel F would have an unacceptable cancer risk.

### 7.1.2 Non-Cancer HI

For non-cancer HI, the data quality assessment was conceptualized as a statistical test of comparing the mean of population non-cancer HI with the target non-cancer HI. In a hypothesis testing framework, a t-test can be used to evaluate the possibility that the mean of population non-cancer HI is greater than the target non-cancer HI. The null hypothesis is that the mean of the population non-cancer HI is the same as the non-cancer HI based on the 95% UCL of sample results ($Mean_0$). The alternative hypothesis is that the mean of the population non-cancer HI is greater than the target non-cancer HI ($Mean_1$).

As summarized in Table 5-18, the non-cancer HIs based on 95% UCLs for all of the receptor populations at both 0-2 and 0-10 ft bgs depth intervals were below the target HI of greater than one. For each depth interval, the data for the receptor population with the maximum non-cancer HI was used in our calculation. The sample size of the chemical as the non-cancer HI driver (zirconium) for each depth interval 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 assessment of non-cancer HI depends on false rejection error rate (α), false acceptance rate (β), $Mean_0$, $Mean_1$, and standard deviation of non-cancer HQ from the driver chemical. A value of 5% was used for both α and β. $Mean_0$ was defined as the non-cancer HI based on the 95% UCL of sample results in the corresponding scenario. In the G*Power program, the target HQ ($Mean_1$) was set to 1.49 which can be rounded to 1.

As shown in Table 7-1, the number of soil samples required to support the assessment of non-cancer HI are smaller than the number of samples collected in Parcel F. With α and β equal to 5%, the null hypothesis that the mean of population non-cancer HI is the same as the non-cancer HI based on 95% UCL of sample results is not rejected. Since the non-cancer HIs based on the 95% UCL of sample results were below the target threshold, the mean of population non-cancer HI is also expected to be below the target threshold. Based on this analysis, the number of soil samples collected in Parcel F during the soil investigations is sufficient for the purpose of non-cancer HI characterization.

## 7.2 Soil Gas Data

The evaluation of the risk of vapor intrusion was based on maximum detected soil gas concentrations, rather than on a measure of mean concentrations. For the purposes of the data quality assessment, the risk evaluation was conceptualized as a statistical test of the proportion of the soil gas samples that are associated with an unacceptable risk of vapor intrusion. As summarized in Table 5-20, the maximum cumulative cancer risk estimates for each exposed population are all below the upper limit of the target cancer risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$, and the noncancer hazard does not exceed the noncancer threshold of greater than 1. The number of samples for most chemicals of concern is 6. Because the estimated risks and hazards at all the sampling locations did not exceed their respective thresholds, the proportion of samples with unacceptable risk is 0 out of the total number of samples, or 0%.

In a hypothesis testing framework, a binomial test of proportions was used to evaluate the possibility that there is a greater-than-zero proportion of samples with unacceptable risk. The null hypothesis is that the proportion of samples with an unacceptable risk is 0 ($P_1=0$). The alternative hypothesis is that the proportion is greater than $P_2$, which is $P_1$ plus an appropriate effect size (i.e., population proportion) that the test should be able to detect.

For the purposes of evaluating if a sufficient number of samples were collected to support the risk assessment, the number of samples required was determined using the Exact – Generic binomial test in the software program G*Power version 3.1.9 (Faul et al. 2009). In the HRA, a null hypothesis with a proportion of 0 indicates that the false rejection error rate ($\alpha$) is 0 and independent of the sample size and other parameters. Thus, the number of samples required depends on false acceptance rate ($\beta$), $P_1$, and $P_2$. The number of samples required for $\beta$ at 15%, 20% to 25% was tested.

As a starting point, an effect size of one over the number of samples was considered, which would be equivalent to one sample having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if one or more samples with unacceptable risk were observed. As shown in Table 7-2, the number of samples required are larger than the number of samples collected. The null hypothesis that no soil gas samples would have unacceptable risk is rejected with effect size of one sample over number of samples and $\beta$ smaller than 25%. Therefore, the current sample size is not sufficient to guarantee that no sample over the entire Parcel F would have an unacceptable cancer risk.

Given the null hypothesis is rejected with effect size of one sample over number of samples, an effect size of two over the number of samples was considered, which would be equivalent to two samples having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if two or more samples with unacceptable risk were observed. As shown in Table 7-3, the number of samples required are smaller than the number of samples collected. With effect size of two samples over number of samples and $\beta$ smaller than 25%, the null hypothesis that no soil gas samples would have unacceptable risk is not rejected, and the alternative hypothesis that two or more than two samples having unacceptable risk is rejected. Therefore, the current sample size is sufficient to guarantee that no more than one sample over the entire Parcel F would have an unacceptable cancer risk.

## 7.3 Groundwater Data

The evaluation of the risk of vapor intrusion was based on maximum detected groundwater concentrations, rather than on a measure of mean concentrations. For the purposes of the data quality assessment, the risk evaluation was conceptualized as a statistical test of the proportion of the groundwater samples that are associated with an unacceptable risk of vapor intrusion. As summarized in Table 5-21, the total cancer risk estimates for all groundwater samples included in the risk evaluation are below the upper limit of the target cancer risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$, and the total noncancer hazard for these groundwater samples did not exceed the noncancer threshold of greater than 1. The number of samples for most chemicals of concern is 5. Because the estimated risks and hazards at all the samples are within the target risk range, the proportion of samples with unacceptable risk is 0 out of the total number of samples, or 0%.

In a hypothesis testing framework, a binomial test of proportions was used to evaluate the possibility that there is a greater-than-zero proportion of samples with unacceptable risk. The null hypothesis is that the proportion of samples with an unacceptable risk is 0 ($P_1=0$). The alternative hypothesis is that the proportion is greater than $P_2$, which is $P_1$ plus an appropriate effect size (i.e., population proportion) that the test should be able to detect.

For the purposes of evaluating if a sufficient number of samples were collected to support the risk assessment, the number of samples required was determined using the Exact – Generic binomial test in the software program G*Power version 3.1.9 (Faul et al. 2009). In the HRA, a null hypothesis with a proportion of 0 indicates that the false rejection error rate ($\alpha$) is 0 and independent of the sample size and other parameters. Thus, the number of samples required depends on false acceptance rate ($\beta$), $P_1$, and $P_2$. We tested the number of samples required for $\beta$ at 15%, 20%, and 25%.

As a starting point, an effect size of one over the number of samples was considered, which would be equivalent to one sample having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if one or more samples with unacceptable risk were observed. As shown in Table 7-3, the number of samples required are larger than the number of samples collected. The null hypothesis that no groundwater samples would have unacceptable risk is rejected with effect size of one sample over number of samples and $\beta$ smaller than 25%. Therefore, the current sample size is not sufficient to guarantee that no sample over the entire Parcel F would have an unacceptable cancer risk.

Given the null hypothesis is rejected with effect size of one sample over the total number of samples evaluated, an effect size of two over the number of samples was considered, which would be equivalent to two samples having unacceptable risk. When employing this hypothesis test, the null hypothesis would be rejected if two or more samples with unacceptable risk were observed. As shown in Table 7-3, the number of samples required are smaller than the number of samples collected. With effect size of two samples over number of samples and $\beta$ smaller than 25%, the null hypothesis that no groundwater samples would have unacceptable risk is not rejected, and the alternative hypothesis that two or more than two samples having unacceptable risk is rejected. Therefore, the current sample size is sufficient to guarantee that no more than one sample over the entire Parcel F would have an unacceptable cancer risk.

# 8. CUMULATIVE RISKS

The cumulative cancer risk and non-cancer HI for each receptor population were estimated by summing the estimated excess lifetime cancer risk and non-cancer HI for chemicals from Table 5-18 via direct contact with soil and VOCs from Table 5-20 via inhalation of soil gas (5 ft bgs) migrating to air. Only soil gas samples were collected to support evaluation of the vapor intrusion pathway. The objectives of groundwater sampling at the Site have been primarily to characterize SRCs in groundwater near suspected source areas and plume delineation; that is, no groundwater investigation was conducted to specifically provide data to evaluate the vapor intrusion pathway. Shallow groundwater data was evaluated for the vapor intrusion pathway as one of the multiple lines of evidence together with the soil gas evaluation.

The estimated cumulative cancer risks are $2 \times 10^{-6}$, $4 \times 10^{-7}$, and $6 \times 10^{-8}$ for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel F, respectively, which are below or within the target cancer risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The cumulative HIs are 0.2, 0.3, and 1 for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel F, respectively, which are below the threshold of greater than one. The major contributor to the cumulative cancer risk for the future indoor commercial/industrial workers is the inhalation of vapors migrating from soil gas to indoor air. The major chemical contributor is chloroform. Plots of total vapor intrusion cancer risks for future indoor commercial/industrial workers in Parcel F show the only location with a total estimated vapor intrusion cancer risk greater than $1 \times 10^{-6}$ (E-SG-4) is located at the northwestern corner of Parcel F where the nearby chloroform groundwater plume overlaps with Parcel F (as defined by >70 ug/L concentration of chloroform). The cancer risk and HI estimates for the onsite workers through the vapor inhalation pathways based on the shallow groundwater data in Parcel F are consistent with the cancer risk and HI estimates based on soil gas data collected in Parcel F.

# 9. SUMMARY AND CONCLUSIONS

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

The NCP (40 CFR § 300) is cited as the basis for target cancer risk range 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 $10^{-4}$. According to NCP and NDEP (2017a), non-carcinogenic chemicals should not be present at levels expected to cause adverse health effects (i.e., a HI greater than one). It should be noted that the cancer risk and non-cancer hazard estimated in this HRA do not represent absolute estimates in Parcel F, 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 non-cancer 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 analytical data collected as part of initial and confirmation sampling efforts were evaluated and data representative of current conditions after the soil removel action were selected for purposes of the HRA. The soil CSM, COPCs, and estimated cancer risks and non-cancer HIs are summarized as follows:

- The soil removal action for Parcel F, which included the excavation and disposal of approximately 5,895 tons of soil, was completed in 2010 in accordance with the 2008 RAW (BEC 2008a). Analytical results for confirmation samples collected following the soil removal action were all below the NDEP BCL for commercial/industrial workers (or other NDEP-approved risk-based criteria). However, two small areas of un-remediated soil remain in Parcel F because of physical impediments, and excavation was conducted to the edge of these inaccessible areas. For these areas, qualitative considerations suggest that associated risks would be insignificant.

- Based on the CSM for Parcel F, potential exposure to soil was evaluated for future onsite indoor and outdoor commercial/industrial workers and construction workers via direct contact with soil (i.e., incidental ingestion and dermal contact) and inhalation of airborne particulates and vapors. Soil COPCs were selected according to a multi-step process, including a concentration/ toxicity screen, a background evaluation for metals and radionuclides, and chemical-specific considerations. Based on this process, ten chemicals were identified as soil COPCs, including two metals (palladium and zirconium), chloride, BaPEq, Aroclor-1254, alpha-BHC, hydroxymethyl phthalimide, and asbestos (long amphibole fibers and long chrysotile fibers).

- Non-cancer HIs and excess lifetime cancer risks associated with direct contact with soil and inhalation of airborne particulates and vapors were estimated for all the soil COPCs except asbestos based on the 95% UCL on the mean soil concentration (or the maximum detected concentration if a 95% UCL cannot be calculated due to limited detections) at the 0-2 ft depth interval and at the 0-10 ft depth interval within Parcel F. The estimated HIs and excess lifetime cancer risks were below the significant threshold of greater than one for non-cancer effects and the target cancer risk range of $10^{-6}$ to $10^{-4}$ under the conditions evaluated. The maximum HI was one for the construction worker exposed to soil at the 0-10 ft depth interval and the maximum estimated excess lifetime cancer risk was 4 x $10^{-7}$ for the outdoor commercial/industrial worker exposed to soil at the 0-2 ft depth interval.

- With regard to asbestos (long amphibole and long chrysotile fibers), a best estimate and an upper-bound estimate of potential cancer risk via inhalation of airborne particulates for indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers were calculated for Parcel F. The estimated combined risks for death from lung cancer and mesothelioma associated with asbestos exposures were all less than $1\times10^{-6}$, except for the upper-bound risk estimate for exposure to amphibole fibers by future construction workers, which was $2 \times 10^{-6}$. However, the upper-bound estimate was based on an observed count of zero long amphibole[33] fiber in the post-abatement soil samples, considered representative of current conditions within Parcel F. Following completion of the asbestos abatement, zero fiber for long amphibole was less than the RAW specified level[34] of one (1) or more fibers. Similarly, for long chrysotile fibers, fiber counts were less than the level presented in the RAW (four or more long fibers per sample), with one exception. One sampling location – TSB-FR-04 – with counts of three and four long chrysotile fibers in the primary and field duplicate sample, respectively, was not identified for removal. The removal decision was based on the primary sample in which the count of long chrysotile fibers was less than the level identified in the RAW, not based on the field duplicate sample.

The soil gas and groundwater CSM, COPCs, and estimated cancer risks and non-cancer HIs are summarized as follows:

- The soil gas data collected within Parcel F were evaluated in the HRA. Potential exposure to soil gas was evaluated for future onsite indoor and outdoor commercial/industrial workers and construction workers via inhalation of vapors migrating from soil gas to indoor air, outdoor air, and trench air. All VOCs detected in at least one soil gas sample were selected as soil gas COPCs. A total of 65 VOCs were identified as soil gas COPCs for Parcel F. Non-cancer HIs and excess lifetime cancer risks were quantified for inhalation of vapors migrating from soil gas to indoor air, outdoor air, and trench air. The estimated HIs were well below the significant threshold of greater than one for non-cancer effects (maximum HI was 0.01), and the estimated excess lifetime cancer risks were below or at the lower end of target cancer risk range of $10^{-6}$ to $10^{-4}$ (maximum estimated excess lifetime cancer risk was

---

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

[34] 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 in soil samples were one (1) or more fibers and chrysotile counts were four (4) or more fibers (BEC 2008a).

$2 \times 10^{-6}$ for future onsite indoor commercial/industrial workers) under the conditions evaluated.

- Shallow groundwater data was evaluated for the vapor intrusion pathway as one of the multiple lines of evidence together with the soil gas evaluation. Shallow groundwater data collected after January 2006 within Parcel F were evaluated in the HRA. Potential exposure to groundwater was evaluated for future onsite indoor and outdoor commercial/industrial workers and construction workers via inhalation of vapors migrating from shallow groundwater to indoor air, outdoor air, and trench air. All VOCs and volatile SVOCs detected in at least one shallow groundwater sample were selected as groundwater COPCs. A total of 14 VOCs were identified as groundwater COPCs for Parcel F. The estimated HIs based on maximum chemical concentrations detected in the most recent two years of groundwater data for each well were below the NDEP significant threshold of greater than one for non-cancer effects (the maximum HI was 0.02). The estimated excess lifetime cancer risks were below or within the target cancer risk range of $10^{-6}$ to $10^{-4}$ for future onsite indoor and outdoor commercial/industrial workers and construction workers under the conditions evaluated (the maximum estimated excess lifetime cancer risk was $6 \times 10^{-6}$ for a future onsite indoor commercial/industrial worker). The cancer risk and HI estimates for the onsite workers through the vapor inhalation pathways based on the shallow groundwater data in Parcel F are consistent with the cancer risk and HI estimates based on soil gas data collected in Parcel F.

The cumulative cancer risk and non-cancer HI for each receptor population were estimated by summing the estimated excess lifetime cancer risk and non-cancer HI for chemicals via direct contact with soil and VOCs via inhalation of soil gas (five ft bgs) migrating to air. Only soil gas samples were collected to support evaluation of the vapor intrusion pathway. The objectives of groundwater sampling at the Site have been primarily to characterize SRCs in groundwater near suspected source areas and plume delineation; that is, no groundwater investigation was conducted to specifically provide data to evaluate the vapor intrusion pathway. Shallow groundwater data was evaluated for the vapor intrusion pathway as one of the multiple lines of evidence together with the soil gas evaluation.

The estimated cumulative cancer risks are $2 \times 10^{-6}$, $4 \times 10^{-7}$, and $6 \times 10^{-8}$ for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel F, respectively, which are below or within the target cancer risk range of $1 \times 10^{-6}$ to $1 \times 10^{-4}$. The cumulative HIs are 0.2, 0.3, and 1 for future indoor commercial/industrial workers, outdoor commercial/industrial workers, and construction workers in Parcel F, respectively, which are below the threshold of greater than one. The major contributor to the cumulative cancer risk for the future indoor commercial/industrial workers is the inhalation of vapors migrating from soil gas to indoor air. The major chemical contributor is chloroform. Plots of total vapor intrusion cancer risks for future indoor commercial/industrial workers in Parcel F show the only location with a total estimated vapor intrusion cancer risk greater than $1 \times 10^{-6}$ (E-SG-4) is located at the northwestern corner of Parcel F where the nearby chloroform groundwater plume overlaps with Parcel F (as defined by >70 ug/L concentration of chloroform).

# 10. REFERENCES

AECOM, Inc. (AECOM) and Northgate Environmental Management, Inc (Northgate). 2009. Revised Phase B Quality Assurance Project Plan, Tronox LLC Facility, Henderson, Nevada. July 20, 2009. (Includes Errata). NDEP approved July 27, 2009.

Agency for Toxic Substances & Disease Registry (ATSDR). 2017. Minimal Risk Levels (MRLs). June.

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

Basic Environmental Company (BEC). 2007. Phase 2 Sampling and Analysis Plan to Conduct Soil Characterization, Tronox Parcel "F" Site, Henderson, Nevada. September 19. NDEP approved October 9, 2007.

BEC. 2008a. Removal Action Workplan for Soil, Tronox Parcels “C”, “D”, “F”, “G” and “H” Sites, Henderson Nevada. July 1. NDEP approved July 2, 2008.

BEC. 2008b. Sampling and Analysis Plan to Conduct Supplemental Soil Characterization, Tronox Parcels "C", "D", "F", "G", and "H", Henderson, Nevada. May 28. NDEP approved June 5, 2008.

Basic Remediation Company (BRC) and MWH. 2005. Health and Safety Plan, BMI Common Areas, Clark County, Nevada. October. Not reviewed by NDEP.

BRC, ERM, and MWH. 2007a. Field Sampling and Standard Operating Procedures (SOP), BMI Common Areas, Clark County, Nevada. August.

BRC, ERM, and MWH. 2007b. BRC Quality Assurance Project Plan. BMI Common Areas, Clark County, Nevada. August.

BRC, ERM, and MWH. 2008. Field Sampling and Standard Operating Procedures (SOP), BMI Common Areas, Clark County, Nevada. December.

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

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

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

California Environmental Protection Agency (Cal/EPA). 2011. Guidance for the Evaluation and Mitigationof Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance). Final. October.

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

Converse Consultants (Converse). 2007. Phase I Environmental Site Assessment [ESA], Approximately 182 Acres, APNs 178-13-601-002,-002, 178-12-101-002, -003, 178-12-201-005, 178-12-601-005, 178-01-401-001, 178-11-501-007, and Portions of 178-12-401-009 & 178-13-101-002, Henderson, Nevada. March. NDEP commented May 11, 2007.

Ecology and Environment. 1982. Summary and Interpretation of Environmental Quality Data, BMI Industrial Complex, Henderson Nevada, November.

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

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

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

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

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

ENVIRON. 2013a. Soil Gas Investigation Report and Human Health Risk Assessment for Parcels C, D, F, G, and H, Revision 0, Nevada Environmental Response Trust Site, Henderson, Nevada. July 25.

ENVIRON. 2013b. Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels C, D, F, G, and H, Nevada Environmental Response Trust Site, Henderson, Nevada. March 18. NDEP approved April 9, 2013.

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

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

RON. 2014c. Response to Issues Identified in: Data Validation Summary Report for Asbestos Data Associated with the Post-Remediation Screening Health Risk Assessment Report for

Parcels C, D, F, G and H, Nevada Environmental Response Trust (NERT), by Neptune and Company, Inc. dated February 10, 2014. June 19.

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

ERM-West, Inc. (ERM-West). 2008. Data Validation Summary Report, Tronox Parcels C, D, F, and G Investigation, November 2007, BMI Industrial Complex, Clark County, Nevada. February. NDEP approved April 3, 2008.

ERM-West. 2009. Data Validation Summary Report, Tronox Parcels C, D, F, G and H Supplemental Investigations-June-July 2008, BMI Industrial Complex, Clark County, Nevada. January 7. NDEP approved January 12, 2009.

ERM-West and MWH. 2008. Basic Remediation Company (BRC) SOP-10.

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

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

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

Kerr McGee Chemical Corporation. 1985. Hydrogeological Investigation. Prepared by Bert J. Smith, Hydrology Department. July.

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

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

Neptune and Company, Inc (Neptune). 2007. Guided Interactive Statistical Decision Tools (GISdT).

Neptune. 2014. Data Validation Summary Report for Asbestos Data Associated with the Post-Remediation Screening Health Risk Assessment Report for Parcels C, D, F, G, and H, Nevada Environmental Response Trust (NERT). February 10.

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

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

NDEP. 2007. Nevada Division of Environmental Protection Response to: Phase 2 Sampling and Analysis Plan to Conduct Soil Characterization, Tronox Parcel “F” Site, Henderson, Nevada, Revision 1 (dated September 19, 2007). October 9.

NDEP. 2008a. Meeting Minutes: May 15, 2008 NDEP-TRONOX discussion on investigation results for Parcels C, D, F, G, and H.

NDEP. 2008b. Letter to Ms. Susan Crowley, Tronox LLC, from Ms. Shannon Harbour, regarding NDEP Response to Removal Action Workplan for Soil, Tronox Parcels “C”, “D”, “F,” “G” and “H” Sites, Henderson, Nevada, dated July 1, 2008. July 2.

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

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

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

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

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

NDEP. 2009c. Guidance for Evaluating Secular Equilibrium at the BMI Complex and Common Areas. Henderson, Nevada. February 6, 2009.

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

NDEP. 2010a. Letter to Tronox LLC re: TRX Sale Parcels A through K, Tronox LLC. January 7.

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

NDEP. 2010c. NDEP Response to Background Issues and Determination of Background Dataset for TRX, Tronox LLC. August 17.

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

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

NDEP. 2010f. NDEP Response to Revised Technical Memorandum: Screening-Level Indoor Air Health Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Tronox LLC, Henderson, Nevada, Dated: June 29, 2010. August 31.

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

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

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

NDEP. 2015. Nevada Division of Environmental Protection (NDEP) Response to: Post-Remediation Screening Health Risk Assessment Report for Parcels C, D, F, G and H, Revision 3, Dated June 19, 2014 and the Letter Response on NDEP Draft Comments on Post-remediation Screening Health Risk Assessment Report for Parcels C, D, F, G and H, Revision 3, Dated April 29, 2015. Dated May 6, 2015.

NDEP. 2017a. 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 2017.

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

NDEP. 2017c. NDEP Basic Comparison Levels (BCLs) Table. July 2017.

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

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

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

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

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

Northgate. 2010b. Data Validation Summary Report, Parcel "C", "D", "F", "G" and "H" Soil Confirmation, Tronox LLC, Henderson Nevada. June 15. NDEP approved July 28, 2010.

Northgate. 2010c. Response to Nevada Division of Environmental Protection's July 6, 2010 Comments on Data Validation Summary Report, Parcel "C", "D", "F", "G", and "H" Soil Confirmation, Tronox LLC, Henderson, Nevada, dated June 15, 2010. July 21. NDEP approved July 28, 2010.

Northgate. 2010d. Revised Technical Memorandum: Calculation of Leaching-Based, Site-Specific Levels (LSSLs) for the Soil-to-Groundwater Pathway Using NDEP Guidance, Tronox LLC, Henderson, Nevada. November 18. NDEP responded January 13, 2011.

Northgate. 2010e. Revised Human Health Risk Assessment for Remediation Zone A, Tronox LLC, Henderson, Nevada. July 23. NDEP approved August 20, 2010.

Northgate. 2012. Revised Closure and Post-remediation Screening Health Risk Assessment Report for Parcels C, D, F, G, and H, Henderson, Nevada. May 18. NDEP Commented on August 7 and 10, 2012.

Northgate. 2013. Post-remediation Screening Health Risk Assessment Report for Parcels C, D, F, G, and H, Henderson, Nevada, Revision 2, June 27. NDEP Commented on September 30, 2013 and April 1, 2014.

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

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

Ramboll Environ. 2015b. Technical Memorandum: Preliminary Evaluation of Chloroform Sampling Data, Nevada Environmental Response Trust Site, Henderson, dated June 30.

Ramboll Environ. 2015c. July 15, 2015. Meeting Summary and BHRA Path Forward. Letter from Ramboll Environ to the Nevada Environmental Response Trust Site, dated August 29, 2015. Nevada Environmental Response Trust Site, Henderson, Nevada.

Ramboll Environ. 2016a. Soil Gas Investigation and Health Risk Assessment for Parcels C, D, F, G and H, Revision 1. Nevada Environmental Response Trust Site, Henderson, Nevada. Dated September 23, 2016.

Ramboll Environ. 2016b. Interim Report, Identification of COPCs and Exposure Units for Soils, Nevada Environmental Response Trust Site, Henderson, Nevada. Dated August 26, 2016.

Ramboll Environ. 2016c. Annual Remedial Performance Report for Chromium and Perchlorate, Nevada Environmental Response Trust Site, Henderson, Nevada. Dated October 31, 2016.

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

Ramboll Environ. 2016e. Data Validation Summary Report: March 2013 Soil Gas Sampling, Nevada Environmental Response Trust Site, Henderson, Nevada. Dated September 22, 2016.

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

Ramboll Environ. 2017b. Health Risk Assessment for Parcel H. Nevada Environmental Response Trust, Henderson, Nevada, October 20. Under NDEP review.

Ramboll Environ. 2017c. Data Validation Summary Report, Parcel F Health Risk Assessment Soil Remedial Investigation Sampling, April 2017, Nevada Environmental Response Trust, Henderson, Nevada. November 10. NDEP commented November 27, 2017.

Ramboll Environ. 2017d. Annual Remedial Performance Report for Chromium and Perchlorate, Nevada Environmental Response Trust Site; Henderson, Nevada; July 2016 – June 2017. November 30.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

USEPA. 2012. Provisional Peer-Reviewed Toxicity Values for Soluble Zirconium Compounds. December.

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

USEPA. 2017a. Regional Screening Levels User’s Guide. June.

USEPA. 2017b. Regional Screening Levels. June.

USEPA. 2017c. Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV). Available online at https://hhpprtv.ornl.gov/. Accessed on May 5, 2017.

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

Virginia Department of Environmental Quality (VDEQ). 2016. Virginia Unified Risk Assessment Model – VURAM User’s Guide for Risk Assessors.

# TABLES

# TABLE ES-1. Summary of Cumulative Estimated Risks for Soil and Soil Gas – Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Parcel | Exposure [1] | Indoor Commercial/Industrial Worker | | Outdoor Commercial/Industrial Worker | | Construction Worker | |
|---|---|---|---|---|---|---|---|
| | | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI |
| F | Cumulative Risk for Soil (0-2 ft) and Soil Gas (5 ft) | 2E-06 | 0.2 | 4E-07 | 0.3 | -- | -- |
| | Cumulative Risk for Soil (0-10 ft) and Soil Gas (5 ft) | 2E-06 | 0.2 | 4E-07 | 0.3 | 6E-08 | 1 |
| | Asbestos - Best Estimate | 4E-09 | -- | 9E-09 | -- | 1E-07 | -- |
| | Asbestos - Upper-Bound Estimate | 1E-07 | -- | 2E-07 | -- | 2E-06 | -- |

**Notes:**

-- = Not applicable

ft = feet

HI = Hazard index

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

## TABLE 3-1. Soil Gas Samples Evaluated in the HRA – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Parcel | Sample ID | Investigation | Depth (feet bgs) | Sample Location | |
|---|---|---|---|---|---|
| | | | | Within Parcel | Near Parcel |
| **Parcel F** | E-SG-4-031313 | ENVIRON 2013 | 5 | X | |
| | E-SG-5-031313 | ENVIRON 2013 | 5 | X | |
| | E-SG-6-030813 | ENVIRON 2013 | 5 | X | |
| | E-SG-6-030813-FD | ENVIRON 2013 | 5 | X | |
| | SG34B-05 | ENSR 2008 | 5 | X | |
| | SG74B-05 | ENSR 2008 | 5.5 | X | |

**Note:**

bgs = below ground surface

FD = field duplicate

**References:**

ENSR Corporation (ENSR). 2008. Phase B Source Area Investigation Work Plan, Soil Gas Survey, Tronox LLC Facility, Henderson, Nevada, March.

ENVIRON International Corporation (ENVIRON). 2013. Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels C, D, F, G, and H, Nevada Environmental Response Trust Site, Henderson, Nevada. March 18.

## TABLE 3-2. Shallow Groundwater Wells with VOC Sampling Data Evaluated in the HRA – Parcel F

### Nevada Environmental Response Trust Site
### Henderson, Nevada

| Parcel | Well ID | Depth to Groundwater (feet bgs) [1] | Water-Bearing Zone [1] | Dates Sampled for VOCs after 2005 | Well Owner |
|---|---|---|---|---|---|
| Parcel F | M-92 | 31.48 - 37.38 | Shallow | November 2006, July 2009, May 2010, May 2012, June 2014, January 2015, April 2015, May 2017 | NERT |
| | M-93 | 33.44 - 39.95 | Shallow | May 2017 | NERT |
| | M-97 [2] | 37-94 - 41 | Shallow | November 2006, July 2009, January 2015, May 2017 | NERT |
| | TR-6 | 34.02 - 38.11 | Shallow | December 2006, January 2007, March 2007, April 2007, July 2007, April 2008, October 2008, July 2009, November 2009, May 2010, July 2010, April 2011, January 2015, May 2017 | NERT |

**Notes:**

bgs = below ground surface

NERT = Nevada Environmental Response Trust

VOC = volatile organic compound

[1] Wells with sampling results from the shallow or middle portion of the aquifer were evaluated because the shallow and middle aquifer (in contrast to deeper aquifers) would be the primary source of VOCs in soil gas.

[2] Located near the parcel boundary and included in parcel assessment.

**References:**

Nevada Division of Environmental Protection (NDEP). 2017. BMI Complex, Common Areas, and Vicinity Database (BMIdbase) version 2 BETA. Accessed August 1, 2017.

Ramboll. 2017. Analytical Database.

# TABLE 3-3. Summary of Scrape Area and Soil Confirmation Sampling Information-Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Parcel | Sample Location Identified for Remediation | Analyte Detected Above Level Specifed in RAW | Confirmation Sample Identifier | Scrape Depth (feet) | Net Tonnage of Soil Removed (disposed weight) |
|---|---|---|---|---|---|
| F | TSB-FJ-01 | Long Chrysotile = 15 fibers | P2-P2-1-1-0.0 | 0.7 | 5,895.02 |
|  | TSB-FJ-02 | Long Chrysotile = 20 fibers | P3-PF-2-1-0.0 | 0.3 |  |
|  |  | Arsenic = 11.3 mg/kg |  |  |  |
|  | TSB-FJ-03 | Long Chrysotile = 8 fibers | P4-PF-1-1-0.0 | 0.6 |  |
|  | TSB-FJ-05 | Long Amphibole = 1 fiber | Q3-PF-2-1-0.0 | 0.6 |  |
|  | TSB-FJ-06 | Long Amphibole = 1 fiber | Q3-PF-1-1-0.0 | 0.9 |  |
|  | TSB-FJ-07 | Long Amphibole = 4 fibers | Q2-PF-1-1-0.0 | 0.2 |  |
|  | TSB-FJ-08 | Long Amphibole = 3 fibers | P3-PF-1-1-0.0 | 0.9 |  |
|  | TSB-FR-02 | Long Chrysotile = 7 fibers | Q3-PF-3-1-0.0 | 0.7 |  |
|  |  | Aroclor 1254 = 0.76 mg/kg |  |  |  |
|  |  | Benzo(a)pyrene = 0.85 mg/kg |  |  |  |
|  |  | Benzo(b)fluoranthene = 3.3 mg/kg |  |  |  |
|  |  | Dibenzo(a,h)anthracene = 0.57 mg/kg |  |  |  |

**Notes:**

mg/kg = milligram per kilogram

RAW = Removal Action Workplan

## TABLE 4-1. Evaluation of Soil Sample Quantitation Limits - Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Screening Level [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% of Screen | |
| Chlorine Oxyanions | Chlorate | 38,900 | mg/kg | 45 | 32 | 71 | 0.53 | 1.0 | 0 | 0 | -- |
| | Perchlorate | 908 | mg/kg | 45 | 42 | 93 | 0.0034 | 0.0034 | 0 | 0 | -- |
| Metals | Antimony | 519 | mg/kg | 45 | 34 | 76 | 0.063 | 0.54 | 0 | 0 | -- |
| | Boron | 259,000 | mg/kg | 45 | 17 | 38 | 1.4 | 3.3 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | Cadmium | 1,260 | mg/kg | 45 | 14 | 31 | 0.0050 | 0.28 | 0 | 0 | -- |
| | Chromium VI | 7.0 | mg/kg | 45 | 1 | 2.2 | 0.16 | 3.2 | 0 | 1 | -- |
| | Lithium | 2,600 | mg/kg | 41 | 38 | 93 | 0.66 | 0.73 | 0 | 0 | -- |
| | Mercury | 389 | mg/kg | 45 | 16 | 36 | 0.0067 | 0.013 | 0 | 0 | mercury compounds BCL is used |
| | Molybdenum | 6,490 | mg/kg | 45 | 25 | 56 | 0.052 | 1.1 | 0 | 0 | -- |
| | Niobium | 130 | mg/kg | 43 | 2 | 4.7 | 0.76 | 3.2 | 0 | 0 | -- |
| | Platinum | 649 | mg/kg | 41 | 7 | 17 | 0.010 | 0.024 | 0 | 0 | -- |
| | Selenium | 6,490 | mg/kg | 41 | 0 | 0 | 0.16 | 0.16 | 0 | 0 | -- |
| | Silver | 6,490 | mg/kg | 45 | 41 | 91 | 0.80 | 0.82 | 0 | 0 | -- |
| | Sulfur | N/A | mg/kg | 41 | 24 | 59 | 210 | 210 | N/A | N/A | -- |
| | Thallium | 13 | mg/kg | 45 | 1 | 2.2 | 0.10 | 0.54 | 0 | 0 | -- |
| | Tin | 779,000 | mg/kg | 41 | 38 | 93 | 0.026 | 0.026 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | Tungsten | 1,040 | mg/kg | 43 | 3 | 7.0 | 0.10 | 2.8 | 0 | 0 | -- |
| | Zirconium | 104 | mg/kg | 45 | 33 | 73 | 0.25 | 5.4 | 0 | 0 | -- |
| Other Inorganics | Bromide | 441,000 | mg/kg | 41 | 5 | 12 | 0.063 | 0.25 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | Chlorite | 38,900 | mg/kg | 38 | 0 | 0 | 0.040 | 0.80 | 0 | 0 | -- |
| | Fluoride | 51,900 | mg/kg | 41 | 20 | 49 | 0.10 | 0.25 | 0 | 0 | -- |
| | Nitrite | 130,000 | mg/kg | 21 | 2 | 10 | 0.020 | 1.2 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | ortho-Phosphate | 30,400,000 | mg/kg | 41 | 3 | 7.3 | 0.50 | 1.6 | 0 | 0 | Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit |
| Dioxin/Furans | 2,3,7,8-TCDD TEQ* | 0.0027 | mg/kg | 34 | 16 | 47 | 0.0000011 | 0.0056 | 5 | -- | Site-specific action level |
| Other Organics | Phthalic acid | 1,830,000 | mg/kg | 41 | 2 | 4.9 | 0.25 | 0.25 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| PAHs | Acenaphthene | 118 | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.033 | 0 | 0 | -- |
| | Acenaphthylene | 118 | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.033 | 0 | 0 | Use acenaphthene as a surrogate |
| | Anthracene | 4.3 | mg/kg | 45 | 0 | 0 | 0.00067 | 0.033 | 0 | 0 | -- |
| | BaPEq* | 0.32 | mg/kg | 45 | 5 | 11 | 0.0012 | 0.039 | 0 | 30 | -- |
| | Benzo(g,h,i)perylene | 25,300 | mg/kg | 43 | 0 | 0 | 0.0043 | 0.033 | 0 | 0 | -- |
| | Fluoranthene | 33,700 | mg/kg | 45 | 5 | 11 | 0.0043 | 0.041 | 0 | 0 | -- |
| | Fluorene | 93 | mg/kg | 45 | 0 | 0 | 0.0043 | 0.033 | 0 | 0 | -- |
| | 1-Methylnaphthalene | 81 | mg/kg | 4 | 0 | 0 | 0.16 | 0.16 | 0 | 0 | -- |
| | 2-Methylnaphthalene | 368 | mg/kg | 45 | 0 | 0 | 0.020 | 0.076 | 0 | 0 | -- |
| | Naphthalene | 18 | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.035 | 0 | 0 | -- |
| | Phenanthrene | 25 | mg/kg | 45 | 4 | 8.9 | 0.0017 | 0.033 | 0 | 0 | -- |
| | Pyrene | 44 | mg/kg | 45 | 5 | 11 | 0.0030 | 0.033 | 0 | 0 | -- |

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

| Chemical Group | Analyte | Screening Level [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% of Screen | |
| PCBs | Aroclor-1016 | 33 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | 0 | 0 | -- |
| | Aroclor-1221 | 1.1 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | 0 | 0 | -- |
| | Aroclor-1232 | 1.1 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | 0 | 0 | -- |
| | Aroclor-1242 | 1.1 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | 0 | 0 | -- |
| | Aroclor-1248 | 1.1 | mg/kg | 20 | 1 | 5.0 | 0.0049 | 0.033 | 0 | 0 | -- |
| | Aroclor-1254 | 1.1 | mg/kg | 20 | 1 | 5.0 | 0.0027 | 0.033 | 0 | 0 | -- |
| | Aroclor-1260 | 1.1 | mg/kg | 24 | 0 | 0 | 0.0027 | 0.033 | 0 | 0 | -- |
| Pesticides - OCPs | Aldrin | 0.21 | mg/kg | 45 | 0 | 0 | 0.000088 | 0.0017 | 0 | 0 | -- |
| | alpha-BHC | 0.49 | mg/kg | 45 | 6 | 13 | 0.000096 | 0.0017 | 0 | 0 | -- |
| | beta-BHC | 1.7 | mg/kg | 45 | 16 | 36 | 0.00019 | 0.0017 | 0 | 0 | -- |
| | delta-BHC | 334 | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | 0 | 0 | -- |
| | gamma-BHC | 2.8 | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | 0 | 0 | -- |
| | Chlordane (total) | 7.3 | mg/kg | 41 | 0 | 0 | 0.0023 | 0.0023 | 0 | 0 | -- |
| | alpha-Chlordane | 7.3 | mg/kg | 45 | 0 | 0 | 0.00010 | 0.0022 | 0 | 0 | Use chlordane as a surrogate |
| | gamma-Chlordane | 7.3 | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | 0 | 0 | Use chlordane as a surrogate |
| | 2,4'-DDD | 15 | mg/kg | 41 | 0 | 0 | 0.00011 | 0.00031 | 0 | 0 | Use 4,4'-DDD as a surrogate |
| | 4,4'-DDD | 15 | mg/kg | 45 | 1 | 2.2 | 0.000089 | 0.0017 | 0 | 0 | -- |
| | 2,4'-DDE | 9.5 | mg/kg | 45 | 5 | 11 | 0.000089 | 0.0017 | 0 | 0 | Use 4,4'-DDE as a surrogate |
| | 4,4'-DDE | 9.5 | mg/kg | 45 | 10 | 22 | 0.00019 | 0.0017 | 0 | 0 | -- |
| | 4,4'-DDT | 7.5 | mg/kg | 45 | 8 | 18 | 0.00020 | 0.0017 | 0 | 0 | -- |
| | Dieldrin | 0.16 | mg/kg | 45 | 0 | 0 | 0.000073 | 0.0017 | 0 | 0 | -- |
| | Endosulfan I | 5,500 | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | 0 | 0 | Use endosulfan as a surrogate |
| | Endosulfan II | 5,500 | mg/kg | 45 | 0 | 0 | 0.000093 | 0.0017 | 0 | 0 | Use endosulfan as a surrogate |
| | Endosulfan sulfate | 5,500 | mg/kg | 45 | 0 | 0 | 0.00012 | 0.0022 | 0 | 0 | Use endosulfan as a surrogate |
| | Endrin | 30 | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | 0 | 0 | -- |
| | Endrin aldehyde | 30 | mg/kg | 45 | 2 | 4.4 | 0.00011 | 0.0017 | 0 | 0 | Use endrin as a surrogate |
| | Endrin ketone | 30 | mg/kg | 45 | 0 | 0 | 0.00016 | 0.0022 | 0 | 0 | Use endrin as a surrogate |
| | Heptachlor | 0.81 | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0022 | 0 | 0 | -- |
| | Heptachlor epoxide | 0.40 | mg/kg | 45 | 0 | 0 | 0.00012 | 0.0022 | 0 | 0 | -- |
| | Hexachlorobenzene | 0.23 | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | 0 | 45 | -- |
| | Methoxychlor | 4,580 | mg/kg | 45 | 0 | 0 | 0.00032 | 0.0017 | 0 | 0 | -- |
| | Toxaphene | 2.3 | mg/kg | 45 | 0 | 0 | 0.0058 | 0.056 | 0 | 0 | -- |
| SVOCs | Acetophenone | 2,520 | mg/kg | 41 | 2 | 4.9 | 0.033 | 0.033 | 0 | 0 | -- |
| | Aniline | 450 | mg/kg | 45 | 0 | 0 | 0.033 | 0.093 | 0 | 0 | -- |
| | Azobenzene | 33 | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | 0 | 0 | -- |
| | Benzenethiol | 1,260 | mg/kg | 41 | 0 | 0 | 0.12 | 0.12 | 0 | 0 | -- |
| | Benzidine | 0.011 | mg/kg | 4 | 0 | 0 | 0.71 | 0.72 | 4 | 4 | -- |
| | Benzoic acid | 3,670,000 | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.37 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | Benzyl alcohol | 91,600 | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.16 | 0 | 0 | -- |
| | bis(2-Chloro-1-methylethyl) ether | 1,020 | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | 0 | 0 | -- |
| | bis(2-Chloroethoxy)methane | 2,750 | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | 0 | 0 | -- |
| | bis(2-Chloroethyl) ether | 1.3 | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | 0 | 0 | -- |

## TABLE 4-1. Evaluation of Soil Sample Quantitation Limits - Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Screening Level [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% of Screen | |
| SVOCs | bis(2-Ethylhexyl)phthalate | 183 | mg/kg | 45 | 4 | 8.9 | 0.033 | 0.098 | 0 | 0 | -- |
| | bis(4-Chlorophenyl) disulfide | N/A | mg/kg | 41 | 0 | 0 | 0.20 | 0.20 | N/A | N/A | -- |
| | bis(4-Chlorophenyl) sulfone | 733 | mg/kg | 41 | 0 | 0 | 0.33 | 0.33 | 0 | 0 | -- |
| | 4-Bromophenyl-phenyl ether | N/A | mg/kg | 45 | 0 | 0 | 0.033 | 0.082 | N/A | N/A | -- |
| | Butylbenzylphthalate | 1,350 | mg/kg | 45 | 0 | 0 | 0.033 | 0.087 | 0 | 0 | -- |
| | Carbazole | 128 | mg/kg | 41 | 1 | 2.4 | 0.033 | 0.033 | 0 | 0 | -- |
| | 4-Chloro-3-methylphenol | 91,600 | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | 0 | 0 | -- |
| | 4-Chloroaniline | 18 | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | 0 | 0 | -- |
| | 2-Chloronaphthalene | 175 | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | 0 | 0 | -- |
| | 2-Chlorophenol | 6,490 | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | 0 | 0 | -- |
| | 4-Chlorophenyl-phenyl ether | N/A | mg/kg | 45 | 0 | 0 | 0.033 | 0.093 | N/A | N/A | -- |
| | 4-Chlorothioanisole | N/A | mg/kg | 41 | 0 | 0 | 0.0076 | 0.0076 | N/A | N/A | -- |
| | 4-Chlorothiophenol | N/A | mg/kg | 41 | 0 | 0 | 0.19 | 0.19 | N/A | N/A | -- |
| | Di-n-butylphthalate | 91,600 | mg/kg | 45 | 4 | 8.9 | 0.033 | 0.098 | 0 | 0 | -- |
| | Di-n-octylphthalate | 9,160 | mg/kg | 45 | 2 | 4.4 | 0.015 | 0.098 | 0 | 0 | -- |
| | Dibenzofuran | 171 | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | 0 | 0 | -- |
| | 3,3'-Dichlorobenzidine | 5.7 | mg/kg | 45 | 0 | 0 | 0.033 | 0.16 | 0 | 0 | -- |
| | 2,2'-/4,4'-Dichlorobenzil | 389 | mg/kg | 41 | 0 | 0 | 0.070 | 4.2 | 0 | 0 | Use 4,4-dichlorobenzil as a surrogate |
| | 1,2-Diphenylhydrazine | 3.2 | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | 0 | 0 | -- |
| | 2,4-Dichlorophenol | 3,220 | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | 0 | 0 | -- |
| | Diethylphthalate | 733,000 | mg/kg | 45 | 0 | 0 | 0.033 | 0.10 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | 2,4-Dimethylphenol | 18,300 | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | 0 | 0 | -- |
| | Dimethylphthalate | 9,160,000 | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | 2,4-Dinitrophenol | 1,830 | mg/kg | 45 | 0 | 0 | 0.33 | 0.36 | 0 | 0 | -- |
| | 2,4-Dinitrotoluene | 8.3 | mg/kg | 45 | 0 | 0 | 0.033 | 0.087 | 0 | 0 | -- |
| | 2,6-Dinitrotoluene | 2.4 | mg/kg | 45 | 0 | 0 | 0.033 | 0.10 | 0 | 0 | -- |
| | 1,4-Dioxane | 36 | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | 0 | 0 | -- |
| | Diphenyl disulfide | N/A | mg/kg | 41 | 0 | 0 | 0.029 | 0.029 | N/A | N/A | -- |
| | Diphenyl sulfide | N/A | mg/kg | 41 | 0 | 0 | 0.0035 | 0.0035 | N/A | N/A | -- |
| | Diphenyl sulfone | 733 | mg/kg | 41 | 0 | 0 | 0.0067 | 0.0067 | 0 | 0 | -- |
| | Hexachlorobutadiene | 6.1 | mg/kg | 45 | 0 | 0 | 0.00099 | 0.033 | 0 | 0 | -- |
| | Hexachlorocyclopentadiene | 8.2 | mg/kg | 45 | 0 | 0 | 0.14 | 0.33 | 0 | 0 | -- |
| | Hexachloroethane | 9.3 | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | 0 | 0 | -- |
| | Hydroxymethyl phthalimide | N/A | mg/kg | 41 | 2 | 4.9 | 0.043 | 0.043 | N/A | N/A | -- |
| | Isophorone | 2,700 | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | 0 | 0 | -- |
| | 2-Methylphenol | 45,800 | mg/kg | 45 | 0 | 0 | 0.086 | 0.12 | 0 | 0 | -- |
| | 4-Methylphenol | 91,600 | mg/kg | 4 | 0 | 0 | 0.14 | 0.14 | 0 | 0 | -- |
| | 3&4-Methylphenol | 45,800 | mg/kg | 41 | 0 | 0 | 0.067 | 0.067 | 0 | 0 | minimum BCL of 4-methylphenol and 3-methylphenol |
| | 2-Nitroaniline | 8,880 | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | 0 | 0 | -- |
| | 3-Nitroaniline | 3,660 | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | 0 | 0 | Use 4-nitroaniline as a surrogate (noncancer endpoint) |
| | 4-Nitroaniline | 128 | mg/kg | 45 | 0 | 0 | 0.14 | 0.33 | 0 | 0 | -- |

## TABLE 4-1. Evaluation of Soil Sample Quantitation Limits - Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Screening Level [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% of Screen | |
| SVOCs | Nitrobenzene | 25 | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | 0 | 0 | -- |
| | 2-Nitrophenol | 7,330 | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | 0 | 0 | Use 4-nitrophenol as a surrogate |
| | 4-Nitrophenol | 7,330 | mg/kg | 45 | 0 | 0 | 0.15 | 0.33 | 0 | 0 | -- |
| | n-Nitroso-di-n-propylamine | 0.37 | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | 0 | 4 | -- |
| | n-Nitrosodiphenylamine | 524 | mg/kg | 45 | 0 | 0 | 0.033 | 0.087 | 0 | 0 | -- |
| | Octachlorostyrene | N/A | mg/kg | 45 | 0 | 0 | 0.033 | 2.5 | N/A | N/A | -- |
| | Pentachlorobenzene | 19 | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | 0 | 0 | -- |
| | 1,2,4,5-Tetrachlorobenzene | 8.0 | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | 0 | 0 | -- |
| | 2,4,5-Trichlorophenol | 91,600 | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | 0 | 0 | -- |
| | 2,4,6-Trichlorophenol | 233 | mg/kg | 45 | 0 | 0 | 0.033 | 0.082 | 0 | 0 | -- |
| VOCs | Acetone | 1,040,000 | mg/kg | 45 | 12 | 27 | 0.0017 | 0.0086 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | Acetonitrile | 3,750 | mg/kg | 41 | 0 | 0 | 0.0020 | 0.0054 | 0 | 0 | -- |
| | t-Amyl methyl ether | 70,900 | mg/kg | 4 | 0 | 0 | 0.00099 | 0.0011 | 0 | 0 | Use methyl tert-butyl ether as a surrogate (noncancer endpoint) |
| | Benzene | 5.8 | mg/kg | 45 | 0 | 0 | 0.000087 | 0.00053 | 0 | 0 | -- |
| | Bromobenzene | 679 | mg/kg | 45 | 0 | 0 | 0.00012 | 0.0011 | 0 | 0 | -- |
| | Bromochloromethane | 692 | mg/kg | 45 | 0 | 0 | 0.00023 | 0.0011 | 0 | 0 | -- |
| | Bromodichloromethane | 1.4 | mg/kg | 45 | 0 | 0 | 0.00021 | 0.00053 | 0 | 0 | -- |
| | Bromoform | 104 | mg/kg | 45 | 0 | 0 | 0.000059 | 0.0011 | 0 | 0 | -- |
| | Bromomethane | 33 | mg/kg | 45 | 0 | 0 | 0.00013 | 0.0011 | 0 | 0 | -- |
| | 2-Butanone | 28,400 | mg/kg | 45 | 3 | 6.7 | 0.00087 | 0.0053 | 0 | 0 | -- |
| | tert Butyl alcohol | 21,300 | mg/kg | 4 | 0 | 0 | 0.0099 | 0.011 | 0 | 0 | -- |
| | n-Butylbenzene | 108 | mg/kg | 45 | 0 | 0 | 0.00018 | 0.0011 | 0 | 0 | -- |
| | sec-Butylbenzene | 145 | mg/kg | 45 | 0 | 0 | 0.00011 | 0.0011 | 0 | 0 | -- |
| | tert-Butylbenzene | 183 | mg/kg | 45 | 0 | 0 | 0.00010 | 0.0011 | 0 | 0 | -- |
| | Carbon disulfide | 735 | mg/kg | 41 | 0 | 0 | 0.00012 | 0.00055 | 0 | 0 | -- |
| | Carbon tetrachloride | 3.2 | mg/kg | 45 | 0 | 0 | 0.00021 | 0.00090 | 0 | 0 | -- |
| | Chlorobenzene | 18,300 | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | 0 | 0 | -- |
| | Chloroethane | 2,110 | mg/kg | 45 | 0 | 0 | 0.00035 | 0.0011 | 0 | 0 | -- |
| | Chloroform | 1.5 | mg/kg | 45 | 1 | 2.2 | 0.00010 | 0.00053 | 0 | 0 | -- |
| | Chloromethane | 510 | mg/kg | 45 | 0 | 0 | 0.00027 | 0.0011 | 0 | 0 | -- |
| | 2-Chlorotoluene | 907 | mg/kg | 45 | 0 | 0 | 0.00025 | 0.0011 | 0 | 0 | -- |
| | 4-Chlorotoluene | 18,300 | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0011 | 0 | 0 | -- |
| | Cumene | 91,600 | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00053 | 0 | 0 | -- |
| | p-Cymene | 647 | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00053 | 0 | 0 | -- |
| | 1,2-Dibromo-3-chloropropane | 0.071 | mg/kg | 45 | 0 | 0 | 0.00021 | 0.0021 | 0 | 0 | -- |
| | Dibromochloromethane | 43 | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00053 | 0 | 0 | -- |
| | 1,2-Dibromoethane | 0.18 | mg/kg | 4 | 0 | 0 | 0.00049 | 0.00053 | 0 | 0 | -- |
| | Dibromomethane | 21,000,000 | mg/kg | 45 | 0 | 0 | 0.00017 | 0.00053 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | 1,2-Dichlorobenzene | 376 | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00053 | 0 | 0 | -- |
| | 1,3-Dichlorobenzene | 373 | mg/kg | 45 | 0 | 0 | 0.00013 | 0.00053 | 0 | 0 | -- |
| | 1,4-Dichlorobenzene | 475 | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | 0 | 0 | -- |
| | Dichlorodifluoromethane | 403 | mg/kg | 45 | 0 | 0 | 0.00029 | 0.0011 | 0 | 0 | -- |

## TABLE 4-1. Evaluation of Soil Sample Quantitation Limits - Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Screening Level [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% of Screen | |
| VOCs | 1,1-Dichloroethane | 17 | mg/kg | 45 | 0 | 0 | 0.000070 | 0.00095 | 0 | 0 | -- |
| | 1,2-Dichloroethane | 2.3 | mg/kg | 45 | 0 | 0 | 0.000066 | 0.00053 | 0 | 0 | -- |
| | 1,1-Dichloroethene | 1,100 | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00055 | 0 | 0 | -- |
| | 1,2-Dichloroethene | 2,360 | mg/kg | 41 | 0 | 0 | 0.00011 | 0.00054 | 0 | 0 | minimum BCL of trans-1,2-Dichloroethene and cis-1,2-Dichloroethene |
| | cis-1,2-Dichloroethene | 2,360 | mg/kg | 45 | 0 | 0 | 0.000054 | 0.00053 | 0 | 0 | -- |
| | trans-1,2-Dichloroethene | 18,300 | mg/kg | 45 | 0 | 0 | 0.000090 | 0.00053 | 0 | 0 | -- |
| | 1,2-Dichloropropane | 5.0 | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | 0 | 0 | -- |
| | 1,3-Dichloropropane | 18,300 | mg/kg | 45 | 0 | 0 | 0.000051 | 0.00053 | 0 | 0 | -- |
| | cis-1,3-Dichloropropene | 26 | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00073 | 0 | 0 | Use 1,3-dichloropropene as a surrogate |
| | trans-1,3-Dichloropropene | 26 | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00053 | 0 | 0 | Use 1,3-dichloropropene as a surrogate |
| | 2,2-Dichloropropane | 73 | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0011 | 0 | 0 | Use 1,2-dichloropropane as a surrogate (noncancer endpoint) |
| | 1,1-Dichloropropene | 27,500 | mg/kg | 45 | 0 | 0 | 0.000087 | 0.00053 | 0 | 0 | Use 1,3-dichloropropene as a surrogate (noncancer endpoint) |
| | Diisopropyl ether | 2,260 | mg/kg | 4 | 0 | 0 | 0.00099 | 0.0011 | 0 | 0 | -- |
| | Dimethyl disulfide | N/A | mg/kg | 41 | 0 | 0 | 0.00018 | 0.00021 | N/A | N/A | -- |
| | 2,2-Dimethylpentane | N/A | mg/kg | 41 | 0 | 0 | 0.00028 | 0.00028 | N/A | N/A | -- |
| | 2,3-Dimethylpentane | N/A | mg/kg | 41 | 0 | 0 | 0.00022 | 0.00022 | N/A | N/A | -- |
| | 2,4-Dimethylpentane | N/A | mg/kg | 41 | 0 | 0 | 0.00019 | 0.00019 | N/A | N/A | -- |
| | 3,3-Dimethylpentane | N/A | mg/kg | 41 | 0 | 0 | 0.00020 | 0.00020 | N/A | N/A | -- |
| | Ethanol | 15,100,000 | mg/kg | 41 | 0 | 0 | 0.047 | 0.19 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | Ethyl benzene | 233 | mg/kg | 45 | 2 | 4.4 | 0.000058 | 0.00053 | 0 | 0 | -- |
| | Ethyl tert-butyl ether | 70,900 | mg/kg | 4 | 0 | 0 | 0.00099 | 0.0011 | 0 | 0 | Use methyl tert-butyl ether as a surrogate (noncancer endpoint) |
| | 3-Ethylpentane | N/A | mg/kg | 41 | 0 | 0 | 0.00021 | 0.00021 | N/A | N/A | -- |
| | n-Heptane | 220 | mg/kg | 41 | 0 | 0 | 0.00016 | 0.00016 | 0 | 0 | -- |
| | 2-Hexanone | 1,650 | mg/kg | 45 | 2 | 4.4 | 0.00024 | 0.0053 | 0 | 0 | -- |
| | Iodomethane | 1,510 | mg/kg | 41 | 0 | 0 | 0.00012 | 0.00026 | 0 | 0 | -- |
| | Methyl tert-butyl ether | 238 | mg/kg | 45 | 0 | 0 | 0.000089 | 0.0011 | 0 | 0 | -- |
| | 4-Methyl-2-pentanone | 3,360 | mg/kg | 45 | 0 | 0 | 0.00029 | 0.0027 | 0 | 0 | -- |
| | Methylene Chloride | 1,550 | mg/kg | 45 | 16 | 36 | 0.00069 | 0.0053 | 0 | 0 | -- |
| | 2-Methylhexane | N/A | mg/kg | 41 | 0 | 0 | 0.00020 | 0.00020 | N/A | N/A | -- |
| | 3-Methylhexane | N/A | mg/kg | 41 | 0 | 0 | 0.00014 | 0.00014 | N/A | N/A | -- |
| | 2-Nitropropane | 0.066 | mg/kg | 41 | 0 | 0 | 0.00060 | 0.0017 | 0 | 0 | -- |
| | n-Nonyl aldehyde | 380 | mg/kg | 41 | 1 | 2.4 | 0.00047 | 0.00088 | 0 | 0 | Use acetaldehyde as a surrogate (noncancer endpoint) |
| | Pentachlorophenol | 4.5 | mg/kg | 45 | 0 | 0 | 0.33 | 0.37 | 0 | 0 | -- |
| | Phenol | 275,000 | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.098 | 0 | 0 | Use health-based BCL instead of non-health based upper-limit |
| | n-Propylbenzene | 264 | mg/kg | 45 | 1 | 2.2 | 0.00011 | 0.00095 | 0 | 0 | -- |
| | Pyridine | 1,300 | mg/kg | 45 | 0 | 0 | 0.033 | 0.16 | 0 | 0 | -- |
| | Styrene | 867 | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0012 | 0 | 0 | -- |
| | 1,1,1,2-Tetrachloroethane | 10 | mg/kg | 45 | 0 | 0 | 0.00018 | 0.0011 | 0 | 0 | -- |
| | 1,1,2,2-Tetrachloroethane | 3.2 | mg/kg | 45 | 0 | 0 | 0.000078 | 0.0011 | 0 | 0 | -- |
| | Tetrachloroethene | 117 | mg/kg | 45 | 0 | 0 | 0.000087 | 0.00053 | 0 | 0 | -- |
| | Toluene | 817 | mg/kg | 45 | 1 | 2.2 | 0.00013 | 0.00053 | 0 | 0 | -- |
| | 1,1,2-Trichloro-1,2,2-trifluoroethane | 900 | mg/kg | 41 | 0 | 0 | 0.00015 | 0.00054 | 0 | 0 | -- |

## TABLE 4-1. Evaluation of Soil Sample Quantitation Limits - Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Screening Level [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% of Screen | |
| VOCs | 1,2,3-Trichlorobenzene | 151 | mg/kg | 45 | 0 | 0 | 0.00039 | 0.0011 | 0 | 0 | -- |
| | 1,2,4-Trichlorobenzene | 125 | mg/kg | 45 | 0 | 0 | 0.00033 | 0.0011 | 0 | 0 | -- |
| | 1,3,5-Trichlorobenzene | 285 | mg/kg | 41 | 0 | 0 | 0.00037 | 0.00068 | 0 | 0 | Use 1,2,4-trichlorobenzene as a surrogate (noncancer endpoint) |
| | 1,1,1-Trichloroethane | 638 | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | 0 | 0 | -- |
| | 1,1,2-Trichloroethane | 5.8 | mg/kg | 45 | 0 | 0 | 0.000067 | 0.00053 | 0 | 0 | -- |
| | Trichloroethene | 6.9 | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00053 | 0 | 0 | -- |
| | Trichlorofluoromethane | 1,210 | mg/kg | 45 | 0 | 0 | 0.00022 | 0.0011 | 0 | 0 | -- |
| | 1,2,3-Trichloropropane | 0.12 | mg/kg | 45 | 0 | 0 | 0.00025 | 0.0011 | 0 | 0 | -- |
| | 1,2,4-Trimethylbenzene | 218 | mg/kg | 45 | 7 | 16 | 0.00013 | 0.0011 | 0 | 0 | -- |
| | 1,3,5-Trimethylbenzene | 182 | mg/kg | 45 | 3 | 6.7 | 0.000097 | 0.0011 | 0 | 0 | -- |
| | 2,2,3-Trimethylbutane | N/A | mg/kg | 41 | 0 | 0 | 0.00021 | 0.00021 | N/A | N/A | -- |
| | Vinyl acetate | 2,750 | mg/kg | 41 | 0 | 0 | 0.00018 | 0.00024 | 0 | 0 | -- |
| | Vinyl chloride | 2.2 | mg/kg | 45 | 0 | 0 | 0.00011 | 0.0011 | 0 | 0 | -- |
| | m,p-Xylene | 387 | mg/kg | 45 | 3 | 6.7 | 0.00017 | 0.0011 | 0 | 0 | minimum BCL of m-xylene and p-xylene |
| | o-Xylene | 434 | mg/kg | 45 | 2 | 4.4 | 0.000076 | 0.00053 | 0 | 0 | -- |
| | Xylenes (total) | 259 | mg/kg | 41 | 2 | 4.9 | 0.00023 | 0.00086 | 0 | 0 | -- |

**Notes:**

-- = Not applicable

mg/kg = milligram per kilogram

BaPEq = Benzo(a)pyrene equivalent

BCL = Basic Comparison Level

BHC = Hexachlorocyclohexane

DDD = Dichlorodiphenyldichloroethane

DDE = Dichlorodiphenyldichloroethylene

DDT = Dichlorodiphenyltrichloroethane

N/A = BCL (other screening value) not available for screen

NDEP = Neveda Department of Environmental Protection

OCP = Organochlorine pesticide

PAH = Polycyclic aromatic hydrocarbon

PCB = Polychlorinated biphenyl

SQL = Sample quantitation limit

SVOC = Semivolatile organic compound

TCDD = Tetrachlorodibenzo-p-dioxin

TEQ = Toxicity equivalent

VOC = Volatile organic compound

* Methodology for equivalent calculations explained in text

[1] Screening levels are the lowest level among the indoor worker and outdoor worker BCLs (NDEP 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 4-2. Summary Statistics for Soil Data - Parcel F

**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 | 45 | 32 | 71 | 0.53 | 1.0 | 1.2 | 310 | 12 | 45 | 71 | 1.6 | TSB-FR-02-02 |
| | Perchlorate | mg/kg | 45 | 42 | 93 | 0.0034 | 0.0034 | 0.020 | 168 | 2.8 | 15 | 33 | 2.1 | TSB-FJ-06 |
| Metals | Aluminum | mg/kg | 41 | 41 | 100 | -- | -- | 4,700 | 12,000 | 7,300 | 7,400 | 1,300 | 0.18 | TSB-FR-01 |
| | Antimony | mg/kg | 45 | 34 | 76 | 0.063 | 0.54 | 0.14 | 0.32 | 0.18 | 0.19 | 0.051 | 0.27 | TSB-FJ-06 |
| | Arsenic | mg/kg | 44 | 44 | 100 | -- | -- | 2.4 | 6.9 | 3.6 | 3.9 | 1.1 | 0.29 | TSB-FJ-06 |
| | Barium | mg/kg | 45 | 45 | 100 | -- | -- | 67 | 1,400 | 150 | 220 | 230 | 1.0 | TSB-FJ-06-02 |
| | Beryllium | mg/kg | 41 | 41 | 100 | -- | -- | 0.39 | 0.84 | 0.52 | 0.53 | 0.079 | 0.15 | TSB-FR-01 |
| | Boron | mg/kg | 45 | 17 | 38 | 1.4 | 3.3 | 5.8 | 14 | 11 | 11 | 2.6 | 0.24 | RI-19 |
| | Cadmium | mg/kg | 45 | 14 | 31 | 0.0050 | 0.28 | 0.068 | 0.42 | 0.12 | 0.16 | 0.097 | 0.60 | TSB-FR-02-02 |
| | Calcium | mg/kg | 41 | 41 | 100 | -- | -- | 4,200 | 97,000 | 28,000 | 31,000 | 17,000 | 0.54 | TSB-FR-02 |
| | Chromium (total) | mg/kg | 45 | 45 | 100 | -- | -- | 5.2 | 19 | 10 | 12 | 3.7 | 0.32 | TSB-FR-01 |
| | Chromium VI | mg/kg | 45 | 1 | 2.2 | 0.16 | 3.2 | 0.55 | 0.55 | 0.55 | 0.55 | -- | -- | TSB-FJ-06-02 |
| | Cobalt | mg/kg | 45 | 45 | 100 | -- | -- | 4.7 | 11 | 6.9 | 7.0 | 1.4 | 0.21 | TSB-FR-01 |
| | Copper | mg/kg | 45 | 45 | 100 | -- | -- | 10 | 25 | 14 | 16 | 3.7 | 0.24 | TSB-FJ-06 |
| | Iron | mg/kg | 45 | 45 | 100 | -- | -- | 8,600 | 23,000 | 13,000 | 13,000 | 3,500 | 0.26 | RI-19 |
| | Lead | mg/kg | 45 | 45 | 100 | -- | -- | 5.1 | 140 | 8.5 | 14 | 21 | 1.4 | TSB-FR-02-02 |
| | Lithium | mg/kg | 41 | 38 | 93 | 0.66 | 0.73 | 5.7 | 23 | 13 | 14 | 4.4 | 0.31 | TSB-FR-02-02 |
| | Magnesium | mg/kg | 45 | 45 | 100 | -- | -- | 5,900 | 19,000 | 9,600 | 10,000 | 2,800 | 0.27 | TSB-FR-02-02 |
| | Manganese | mg/kg | 45 | 45 | 100 | -- | -- | 150 | 920 | 330 | 360 | 170 | 0.46 | TSB-FR-02-02 |
| | Mercury | mg/kg | 45 | 16 | 36 | 0.0067 | 0.013 | 0.0088 | 1.0 | 0.015 | 0.083 | 0.24 | 3.0 | RI-19 |
| | Molybdenum | mg/kg | 45 | 25 | 56 | 0.052 | 1.1 | 0.29 | 1.5 | 0.55 | 0.67 | 0.30 | 0.44 | TSB-FR-02-02 |
| | Nickel | mg/kg | 45 | 45 | 100 | -- | -- | 8.1 | 23 | 14 | 14 | 2.6 | 0.18 | TSB-FR-01 |
| | Niobium | mg/kg | 43 | 2 | 4.7 | 0.76 | 3.2 | 9.0 | 9.9 | 9.4 | 9.4 | 0.64 | 0.067 | TSB-FR-01 |
| | Palladium | mg/kg | 41 | 41 | 100 | -- | -- | 0.17 | 2.1 | 0.34 | 0.40 | 0.30 | 0.76 | TSB-FJ-02-02 |
| | Phosphorus (total) | mg/kg | 45 | 45 | 100 | -- | -- | 650 | 1,400 | 920 | 960 | 190 | 0.20 | TSB-FR-01 |
| | Platinum | mg/kg | 41 | 7 | 17 | 0.010 | 0.024 | 0.021 | 2.4 | 0.11 | 0.41 | 0.88 | 2.1 | TSB-FJ-02-02 |
| | Potassium | mg/kg | 41 | 41 | 100 | -- | -- | 1,200 | 3,900 | 1,700 | 1,800 | 510 | 0.28 | TSB-FR-01 |
| | Silicon | mg/kg | 41 | 41 | 100 | -- | -- | 93 | 1,000 | 160 | 230 | 170 | 0.76 | TSB-FJ-02-02 |
| | Silver | mg/kg | 45 | 41 | 91 | 0.80 | 0.82 | 0.052 | 0.21 | 0.089 | 0.10 | 0.041 | 0.40 | TSB-FR-02-02 |
| | Sodium | mg/kg | 41 | 41 | 100 | -- | -- | 170 | 2,900 | 810 | 910 | 590 | 0.64 | TSB-FJ-02 |
| | Strontium | mg/kg | 45 | 45 | 100 | -- | -- | 120 | 360 | 210 | 220 | 65 | 0.30 | TSB-FJ-06-02 |
| | Sulfur | mg/kg | 41 | 24 | 59 | 210 | 210 | 460 | 1,300 | 540 | 660 | 240 | 0.36 | TSB-FJ-06-02 |
| | Thallium | mg/kg | 45 | 1 | 2.2 | 0.10 | 0.54 | 0.43 | 0.43 | 0.43 | 0.43 | -- | -- | TSB-FR-02-02 |
| | Tin | mg/kg | 41 | 38 | 93 | 0.026 | 0.026 | 0.41 | 1.1 | 0.55 | 0.60 | 0.19 | 0.31 | TSB-FJ-06 |
| | Titanium | mg/kg | 41 | 41 | 100 | -- | -- | 340 | 1,000 | 500 | 540 | 130 | 0.24 | TSB-FR-01 |
| | Tungsten | mg/kg | 43 | 3 | 7.0 | 0.10 | 2.8 | 1.1 | 9.0 | 1.2 | 3.8 | 4.5 | 1.2 | TSB-FJ-02-02 |
| | Uranium (total) | mg/kg | 41 | 41 | 100 | -- | -- | 0.58 | 3.2 | 1.2 | 1.3 | 0.55 | 0.42 | TSB-FR-01 |
| | Vanadium | mg/kg | 41 | 41 | 100 | -- | -- | 27 | 72 | 40 | 43 | 11 | 0.26 | RI-19 |

## TABLE 4-2. Summary Statistics for Soil Data - Parcel F
**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 | Zinc | mg/kg | 41 | 41 | 100 | -- | -- | 24 | 67 | 30 | 33 | 9.9 | 0.30 | TSB-FJ-06 |
| | Zirconium | mg/kg | 45 | 33 | 73 | 0.25 | 5.4 | 8.8 | 36 | 22 | 22 | 5.2 | 0.23 | TSB-FR-01 |
| Other Inorganics | Bromide | mg/kg | 41 | 5 | 12 | 0.063 | 0.25 | 3.9 | 10 | 5.4 | 5.9 | 2.5 | 0.42 | TSB-FJ-10 |
| | Chloride | mg/kg | 41 | 41 | 100 | -- | -- | 1.9 | 18,000 | 670 | 1,900 | 3,200 | 1.7 | TSB-FR-02-02 |
| | Fluoride | mg/kg | 41 | 20 | 49 | 0.10 | 0.25 | 0.42 | 3.0 | 1.1 | 1.2 | 0.74 | 0.60 | TSB-FR-02-02 |
| | Nitrate | mg/kg | 45 | 45 | 100 | -- | -- | 0.41 | 350 | 11 | 35 | 63 | 1.8 | TSB-FR-02-02 |
| | Nitrate/Nitrite | mg/kg | 4 | 4 | 100 | -- | -- | 1.2 | 24 | 4.3 | 8.5 | 10 | 1.2 | RI-19 |
| | Nitrite | mg/kg | 21 | 2 | 10 | 0.020 | 1.2 | 0.79 | 11 | 5.6 | 5.6 | 6.9 | 1.2 | TSB-FR-01 |
| | Sulfate | mg/kg | 41 | 41 | 100 | -- | -- | 15 | 2,300 | 180 | 300 | 380 | 1.3 | TSB-FJ-08 |
| | ortho-Phosphate | mg/kg | 41 | 3 | 7.3 | 0.50 | 1.6 | 1.3 | 6.3 | 6.0 | 4.5 | 2.8 | 0.62 | TSB-FR-01 |
| Radionuclides | Radium-226 | pCi/g | 45 | 45 | 100 | -- | -- | 0.41 | 2.3 | 0.97 | 0.99 | 0.27 | 0.27 | TSB-FR-02-02 |
| | Radium-228 | pCi/g | 45 | 45 | 100 | -- | -- | 0.44 | 14 | 1.7 | 2.1 | 2.1 | 0.99 | TSB-FR-02-02 |
| | Thorium-228 | pCi/g | 45 | 45 | 100 | -- | -- | 1.2 | 2.2 | 1.6 | 1.6 | 0.24 | 0.15 | RI-19 |
| | Thorium-230 | pCi/g | 45 | 45 | 100 | -- | -- | 0.79 | 1.7 | 1.1 | 1.2 | 0.21 | 0.18 | TSB-FR-01 |
| | Thorium-232 | pCi/g | 45 | 45 | 100 | -- | -- | 1.1 | 2.0 | 1.5 | 1.5 | 0.24 | 0.16 | RI-19 |
| | Uranium-234 | pCi/g | 38 | 38 | 100 | -- | -- | 0.73 | 2.6 | 1.1 | 1.2 | 0.38 | 0.33 | TSB-FJ-06 |
| | Uranium-235 | pCi/g | 38 | 38 | 100 | -- | -- | -0.018 | 0.11 | 0.039 | 0.043 | 0.025 | 0.58 | TSB-FJ-06-02 |
| | Uranium-238 | pCi/g | 38 | 38 | 100 | -- | -- | 0.64 | 1.8 | 1.0 | 1.0 | 0.28 | 0.27 | TSB-FJ-06 |
| Dioxin/Furans | 2,3,7,8-TCDD TEQ* | mg/kg | 34 | 16 | 47 | 0.0000011 | 0.0056 | 0.00000016 | 0.0013 | 0.000048 | 0.00017 | 0.00036 | 2.2 | TSB-FR-02 |
| Other Organics | Phthalic acid | mg/kg | 41 | 2 | 4.9 | 0.25 | 0.25 | 0.29 | 0.76 | 0.53 | 0.53 | 0.33 | 0.63 | TSB-FJ-06-02 |
| PAHs | Acenaphthene | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.033 | 0.23 | 0.23 | 0.23 | 0.23 | -- | -- | TSB-FJ-06-02 |
| | Acenaphthylene | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.033 | 0.10 | 0.10 | 0.10 | 0.10 | -- | -- | TSB-FJ-06-02 |
| | BaPEq* | mg/kg | 45 | 5 | 11 | 0.0012 | 0.039 | 0.012 | 0.41 | 0.039 | 0.11 | 0.17 | 1.5 | TSB-FJ-06-02 |
| | Fluoranthene | mg/kg | 45 | 5 | 11 | 0.0043 | 0.041 | 0.041 | 0.097 | 0.049 | 0.059 | 0.023 | 0.38 | TSB-FR-04 |
| | Naphthalene | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.035 | 0.010 | 0.010 | 0.010 | 0.010 | -- | -- | RI-19 |
| | Phenanthrene | mg/kg | 45 | 4 | 8.9 | 0.0017 | 0.033 | 0.018 | 0.96 | 0.068 | 0.28 | 0.46 | 1.6 | TSB-FR-04 |
| | Pyrene | mg/kg | 45 | 5 | 11 | 0.0030 | 0.033 | 0.015 | 0.30 | 0.040 | 0.10 | 0.12 | 1.2 | TSB-FR-04 |
| PCBs | Aroclor-1248 | mg/kg | 20 | 1 | 5.0 | 0.0049 | 0.033 | 0.074 | 0.074 | 0.074 | 0.074 | -- | -- | TSB-FJ-03 |
| | Aroclor-1254 | mg/kg | 20 | 1 | 5.0 | 0.0027 | 0.033 | 0.29 | 0.29 | 0.29 | 0.29 | -- | -- | TSB-FJ-06-02 |
| Pesticides - OCPs | alpha-BHC | mg/kg | 45 | 6 | 13 | 0.000096 | 0.0017 | 0.0020 | 0.059 | 0.0043 | 0.014 | 0.022 | 1.6 | TSB-FR-02 |
| | beta-BHC | mg/kg | 45 | 16 | 36 | 0.00019 | 0.0017 | 0.0018 | 0.14 | 0.037 | 0.048 | 0.046 | 0.96 | TSB-FR-02 |
| | 4,4'-DDD | mg/kg | 45 | 1 | 2.2 | 0.000089 | 0.0017 | 0.013 | 0.013 | 0.013 | 0.013 | -- | -- | TSB-FR-02-02 |
| | 2,4'-DDE | mg/kg | 45 | 5 | 11 | 0.000089 | 0.0017 | 0.0019 | 0.020 | 0.015 | 0.013 | 0.0077 | 0.60 | TSB-FJ-06-02 |
| | 4,4'-DDE | mg/kg | 45 | 10 | 22 | 0.00019 | 0.0017 | 0.0019 | 0.18 | 0.022 | 0.043 | 0.055 | 1.3 | TSB-FR-02-02 |
| | 4,4'-DDT | mg/kg | 45 | 8 | 18 | 0.00020 | 0.0017 | 0.0019 | 0.26 | 0.013 | 0.05 | 0.089 | 1.8 | TSB-FR-02-02 |
| | Endrin aldehyde | mg/kg | 45 | 2 | 4.4 | 0.00011 | 0.0017 | 0.0068 | 0.020 | 0.013 | 0.013 | 0.0093 | 0.70 | TSB-FJ-06 |
| SVOCs | Acetophenone | mg/kg | 41 | 2 | 4.9 | 0.033 | 0.033 | 0.046 | 0.062 | 0.054 | 0.054 | 0.011 | 0.21 | TSB-FJ-06 |
| | Benzoic acid | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.37 | 0.23 | 0.32 | 0.28 | 0.28 | 0.064 | 0.23 | TSB-FR-02 |

## TABLE 4-2. Summary Statistics for Soil Data - Parcel F

**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 | Benzyl alcohol | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.16 | 0.094 | 0.34 | 0.22 | 0.22 | 0.17 | 0.80 | TSB-FJ-06 |
| | bis(2-Ethylhexyl)phthalate | mg/kg | 45 | 4 | 8.9 | 0.033 | 0.098 | 0.048 | 1.4 | 0.12 | 0.42 | 0.65 | 1.6 | TSB-FJ-09 |
| | Carbazole | mg/kg | 41 | 1 | 2.4 | 0.033 | 0.033 | 0.068 | 0.068 | 0.068 | 0.068 | -- | -- | TSB-FR-02 |
| | Di-n-butylphthalate | mg/kg | 45 | 4 | 8.9 | 0.033 | 0.098 | 0.047 | 5.2 | 2.4 | 2.5 | 2.8 | 1.1 | TSB-FJ-06-02 |
| | Di-n-octylphthalate | mg/kg | 45 | 2 | 4.4 | 0.015 | 0.098 | 0.21 | 0.28 | 0.24 | 0.24 | 0.049 | 0.20 | TSB-FJ-06 |
| | Hydroxymethyl phthalimide | mg/kg | 41 | 2 | 4.9 | 0.043 | 0.043 | 0.12 | 0.15 | 0.14 | 0.14 | 0.021 | 0.16 | TSB-FJ-06-02 |
| VOCs | Acetone | mg/kg | 45 | 12 | 27 | 0.0017 | 0.0086 | 0.0056 | 1.9 | 0.015 | 0.23 | 0.54 | 2.4 | TSB-FJ-10 |
| | 2-Butanone | mg/kg | 45 | 3 | 6.7 | 0.00087 | 0.0053 | 0.0045 | 0.013 | 0.0060 | 0.0078 | 0.0045 | 0.58 | TSB-FJ-10 |
| | Chloroform | mg/kg | 45 | 1 | 2.2 | 0.00010 | 0.00053 | 0.00065 | 0.00065 | 0.00065 | 0.00065 | -- | -- | RI-18 |
| | Ethyl benzene | mg/kg | 45 | 2 | 4.4 | 0.000058 | 0.00053 | 0.00041 | 0.00048 | 0.00044 | 0.00044 | 0.000049 | 0.11 | TSB-FJ-10 |
| | 2-Hexanone | mg/kg | 45 | 2 | 4.4 | 0.00024 | 0.0053 | 0.0022 | 0.0071 | 0.0047 | 0.0047 | 0.0035 | 0.75 | TSB-FJ-06 |
| | Methylene Chloride | mg/kg | 45 | 16 | 36 | 0.00069 | 0.0053 | 0.0063 | 0.021 | 0.0074 | 0.0090 | 0.0043 | 0.48 | TSB-FJ-02-02 |
| | n-Nonyl aldehyde | mg/kg | 41 | 1 | 2.4 | 0.00047 | 0.00088 | 0.0033 | 0.0033 | 0.0033 | 0.0033 | -- | -- | TSB-FJ-07 |
| | Phenol | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.098 | 0.13 | 0.44 | 0.29 | 0.29 | 0.22 | 0.77 | TSB-FJ-06 |
| | n-Propylbenzene | mg/kg | 45 | 1 | 2.2 | 0.00011 | 0.00095 | 0.0014 | 0.0014 | 0.0014 | 0.0014 | -- | -- | TSB-FJ-10 |
| | Toluene | mg/kg | 45 | 1 | 2.2 | 0.00013 | 0.00053 | 0.00047 | 0.00047 | 0.00047 | 0.00047 | -- | -- | TSB-FJ-06 |
| | 1,2,4-Trimethylbenzene | mg/kg | 45 | 7 | 16 | 0.00013 | 0.0011 | 0.00041 | 0.0086 | 0.00068 | 0.0022 | 0.0030 | 1.3 | TSB-FJ-10 |
| | 1,3,5-Trimethylbenzene | mg/kg | 45 | 3 | 6.7 | 0.000097 | 0.0011 | 0.00061 | 0.0038 | 0.0011 | 0.0018 | 0.0017 | 0.94 | TSB-FJ-10 |
| | m,p-Xylene | mg/kg | 45 | 3 | 6.7 | 0.00017 | 0.0011 | 0.0012 | 0.0026 | 0.0020 | 0.0019 | 0.00070 | 0.36 | TSB-FJ-10 |
| | o-Xylene | mg/kg | 45 | 2 | 4.4 | 0.000076 | 0.00053 | 0.00083 | 0.00083 | 0.00083 | 0.00083 | 0 | 0 | TSB-FJ-06 |
| | Xylenes (total) | mg/kg | 41 | 2 | 4.9 | 0.00023 | 0.00086 | 0.0028 | 0.0034 | 0.0031 | 0.0031 | 0.00042 | 0.14 | TSB-FJ-10 |

**Notes:**

-- = No value
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BaPEq = Benzo(a)pyrene equivalent
BHC = Hexachlorocyclohexane
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane

OCP = Organochlorine 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 4-3. Soil Sampling Results for Asbestos (Long Amphibole and Chrysotile Fibers) – Parcel F
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Parcel | Sample ID | Sample Type | Sample Date | Start Depth (ft bgs) | Long Amphibole Count (s/sample) | Long Chrysotile Count (s/sample) | Analytical Sensitivity (s/gPM10) |
|---|---|---|---|---|---|---|---|
| F | P2-P2-1-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 2960000 |
| F | P3-PF-2-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 3000000 |
| F | P4-PF-1-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 2960000 |
| F | TSB-FJ-04-0_11/2/2007 | N | 11/2/2007 | 0 | 0 | 2 | 2955627 |
| F | Q3-PF-2-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 2990000 |
| F | Q3-PF-1-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 2990000 |
| F | Q3-PF-1-1-0.0 FD | FD | 4/6/2010 | 0 | 0 | 0 | 2970000 |
| F | Q2-PF-1-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 2990000 |
| F | P3-PF-1-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 2960000 |
| F | TSB-FJ-09-0_11/15/2007 | N | 11/15/2007 | 0 | 0 | 3 | 2998000 |
| F | TSB-FJ-10-0_11/2/2007 | N | 11/2/2007 | 0 | 0 | 2 | 2946804 |
| F | TSB-FR-01-0_11/2/2007 | N | 11/2/2007 | 0 | 0 | 0 | 2954448 |
| F | Q3-PF-3-1-0.0 | N | 4/6/2010 | 0 | 0 | 0 | 3000000 |
| F | TSB-FR-03-0_11/2/2007 | N | 11/2/2007 | 0 | 0 | 0 | 2986626 |
| F | TSB-FR-04-0_11/2/2007 | N | 11/2/2007 | 0 | 0 | 3 | 2986626 |
| F | TSB-FR-04-0 FD_11/2/2007 | FD | 11/2/2007 | 0 | 0 | 4 | 2954448 |
| F | TSB-FR-05-0_11/2/2007 | N | 11/2/2007 | 0 | 0 | 0 | 2978516 |

**Notes:**

bgs = below ground surface

ft = feet

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

s/sample = fiber per sample

FD = Field Duplicate

N = Normal Sample

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

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

| Chemical Group | Analyte | No. of Samples | No. of Detects | Maximum Detected Conc[1] | 2005 CSM SRC? [2] | Background Evaluation | | | Spatial Plot | Comment [3] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fails Statistical Testing for Background? | Table | Figure | | |
| Chlorine Oxyanions | Chlorate | 45 | 32 | 310 | Yes | NA | NA | NA | J-9 | Manufactured at the Site Operations Area from approximately 1945-1998; chlorate and perchlorate are frequently co-located. No manufacturing or disposal areas were located in Parcel F. Parcel F soil concentrations (<0.53 mg/kg to 310 mg/kg for chlorate and <0.0034 mg/kg to 168 mg/kg for perchlorate) are substantially lower than the concentrations reported in former manufacturing areas (above 1,000 mg/kg for chlorate and perchlorate). |
| | Perchlorate | 45 | 42 | 168 | Yes | NA | NA | NA | 5-2, J-17 | |
| Metals | Aluminum | 41 | 41 | 11,600 | Yes | No | I2 | I1-1, I2-1 | NA | Although historically listed as a SRC, NDEP did not identify aluminum as a specific contaminant for Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Antimony | 45 | 34 | 0.32 | Yes | LDF | I2 | I1-2, I2-2 | NA | Although historically listed as a SRC, NDEP did not identify antimony as a specific contaminant for Parcel F. Concentrations are <0.1xBCL. |
| | Arsenic | 44 | 44 | 6.9 | Yes | Yes | I2 | I1-3, I2-3 | J-3 | Hardesty/AMECCO (LOU4) manufactured sodium arsenite solution. NDEP identified arsenic as a potential contaminant for LOU4 in Parcel F. Arsenic concentrations are greater than background in Parcel F, with elevated concentrations detected at scattered locations. Concentrations are below the NDEP-approved remediation goal of 7.2 mg/kg. |
| | Barium | 45 | 45 | 1,420 | Yes | Yes | I2 | I1-4, I2-4 | J-5 | NDEP identified barium as a potential contaminant at several LOUs, including the Storm Sewer System (#59); Kelley Trucking (#63); and Nevada Precast Concrete (#65) in Parcel F. Concentrations are greater than background but <0.1xBCL. |
| | Beryllium | 41 | 41 | 0.84 | Yes | Yes | I2 | I1-5, I2-5 | J-6 | Although historically listed as a SRC, NDEP did not identify beryllium as a specific contaminant for Parcel F. Concentrations are greater than background but <0.1xBCL. |
| | Boron | 45 | 17 | 14 | Yes | LDF | I2 | I1-6, I2-6 | NA | Kerr-McGee manufactured boron at the Site beginning in approximately 1994, and Tronox continues to operate a boron plant. No boron manufacturing or disposal areas have been located in Parcel F. The low detection frequency and a review of box plots and the Q-Q plots suggest that parcel concentrations are consistent with background. Concentrations are <0.1xBCL. |
| | Cadmium | 45 | 14 | 0.42 | Yes | No | I2 | I1-7, I2-7 | NA | Although historically listed as a SRC, NDEP did not identify cadmium as a specific contaminant for Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Calcium | 41 | 41 | 97,000 | Yes | Yes | I2 | I1-8, I2-8 | NA | Used extensively or formed as a waste product (e.g., calcium is a process waste from chlorate and manganese production) at the Operations Area. However, not known to be associated with activities at Parcel F. Concentrations are greater than background. |
| | Chromium (total) | 45 | 45 | 19 | Yes | Yes | I2 | I1-9, I2-9 | J-11 | Although historically listed as a SRC, NDEP did not identify chromium as a specific contaminant for Parcel F. Concentrations are greater than background but <0.1xBCL. |
| | Chromium VI | 45 | 1 | 0.55 | Yes | LDF | | | NA | 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 within the Operations Area, but there were no manufacturing activity located in Parcel F. The maximum concentrations are <0.1xBCL. Low detection frequency. |
| | Cobalt | 45 | 45 | 11 | Yes | No | I2 | I1-11, I2-11 | NA | Cobalt may be a by-product of manganese production and within the Operations Area, cobalt was generally found to co-locate with manganese. Cobalt is not known to have been used at Parcel F. The parcel concentrations are consistent than background and <0.1xBCL. |
| | Copper | 45 | 45 | 25 | Yes | No | I2 | I1-12, I2-12 | NA | Although historically listed as a SRC, NDEP did not identify copper as a specific contaminant for Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Iron | 45 | 45 | 23,000 | Yes | No | I2 | I1-13, I2-13 | NA | NDEP identified iron as a potential contaminant at multiple LOUs within the Operations Area but did not identify iron as a specific contaminant for Parcel F. Concentrations are consistent with background < 0.1xBCL. |
| | Lead | 45 | 45 | 136 | Yes | No | I2 | I1-14, I2-14 | NA | NDEP identified lead as a potential contaminant at several LOUs, including the Storm Sewer System (LOU59) in Parcel F. Concentrations are consistent with background and less than the lead BCL. |
| Metals | Lithium | 41 | 38 | 23 | No | NA | NA | NA | NA | Not historically identified as a SRC. RZ-A background data are not available. |

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

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | No. of Samples | No. of Detects | Maximum Detected Conc[1] | 2005 CSM SRC? [2] | Background Evaluation | | | Spatial Plot | Comment [3] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fails Statistical Testing for Background? | Table | Figure | | |
| | Magnesium | 45 | 45 | 18,900 | Yes | No | I2 | I1-15, I2-15 | NA | Produced at the Site from approximately 1942 to 1944. NDEP identified magnesium as a potential contaminant associated with numerous LOUs within the Operations Area, but did not identify magnesium as a specific contaminant for Parcel F. Concentrations are consistent with background levels and <0.1xBCL. |
| | Manganese | 45 | 45 | 917 | Yes | No | I2 | I1-16, I2-16 | NA | Produced at the Site since 1951; ongoing production by Tronox. Concentrations are consistent with background and <0.1xBCL. |
| | Mercury | 45 | 16 | 1.0 | Yes | No | I2 | I1-17, I2-17 | NA | Although historically identified as a SRC, NDEP did not identify mercury as a specific contaminant at Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Molybdenum | 45 | 25 | 1.5 | Yes | No | I2 | I1-18, I2-18 | NA | Concentrations are consistent with background and <0.1xBCL. |
| | Nickel | 45 | 45 | 23 | Yes | No | I2 | I1-19, I2-19 | NA | Although historically identified as a SRC, NDEP did not identify nickel as a specific contaminant at Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Niobium | 43 | 2 | 9.9 | No | NA | NA | NA | NA | Not historically identified as a SRC. Low detection frequency. RZ-A background data are not available. |
| | Palladium | 41 | 41 | 2.1 | No | NA | NA | NA | J-16 | Not historically identified as a SRC. RZ-A background data are not available. |
| | Phosphorus (total) | 45 | 45 | 1,440 | Yes | NA | NA | NA | NA | Although historically identified as a SRC, NDEP did not identify phosphorus as a specific contaminant in Parcel F. RZ-A background data are not available. *See related discussion for "phosphates."* |
| | Platinum | 41 | 7 | 2.4 | Yes | LDF | I2 | I1-20, I2-20 | NA | Platinum was not identified as a potential contaminant for Parcel F. Concentrations < 0.1xBCL. |
| | Potassium | 41 | 41 | 3,930 | Yes | No | I2 | I1-21, I2-21 | NA | Although historically listed as a SRC, NDEP did not identify potassium as associated with contamination in Parcel F. Concentrations are consistent with background. |
| | Silicon | 41 | 41 | 1,020 | Yes | NA | NA | NA | NA | Although historically listed as a SRC, NDEP did not identify silicon as specific contaminant in Parcel F. RZ-A background data are not available. |
| | Silver | 45 | 41 | 0.21 | Yes | LDF | I2 | I1-23, I2-23 | NA | Although historically identified as a SRC, NDEP did not identify silver as a specific contaminant in Parcel F. Concentrations are <0.1xBCL. |
| | Sodium | 41 | 41 | 2,910 | Yes | Yes | I2 | I1-24, I2-24 | NA | NDEP identified sodium as a potential contaminant at multiple LOUs, but not in Parcel F. Concentrations are greater than background. |
| | Strontium | 45 | 45 | 355 | Yes | No | I2 | I1-25, I2-25 | NA | Although historically listed as a SRC, NDEP did not identify strontium as a specific contaminant in Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Sulfur | 41 | 24 | 1,310 | Yes | NA | NA | NA | NA | *See discussion for "Other Inorganics."* |
| | Thallium | 45 | 1 | 0.43 | Yes | LDF | I2 | I1-26, I2-26 | NA | Although historically listed as a SRC, NDEP did not identify thallium as a specific contaminant in Parcel F. Concentrations are <0.1xBCL. Low detection frequency. |
| | Tin | 41 | 38 | 1.1 | Yes | LDF | I2 | I1-27, I2-27 | NA | Although historically listed as a SRC, NDEP did not identify tin as a specific contaminant in Parcel F. Concentrations are <0.1xBCL. |
| | Titanium | 41 | 41 | 1,010 | Yes | No | I2 | I1-28, I2-28 | NA | NDEP identified titanium as a potential contaminant at the former J.B Kelley Trucking (LOU 63) and Nevada Precast Concrete (LOU 65) in Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Tungsten | 43 | 3 | 9.0 | Yes | LDF | I2 | I1-29, I2-29 | NA | Low detection frequency. Concentrations are < 0.1xBCL. |
| | Uranium (total) | 41 | 41 | 3.2 | Yes | Yes | I2 | I1-30, I2-30 | J-20 | Although historically identified as a SRC, NDEP did not identify uranium as a specific contaminant in Parcel F. Concentrations are greater than background but <0.1xBCL. |
| | Vanadium | 41 | 41 | 72 | Yes | No | I2 | I1-31, I2-31 | NA | Although historically identified as a SRC, NDEP did not identify vanadium as a specific contaminant in Parcel F. Concentrations are consistent with background and <0.1xBCL. |
| | Zinc | 41 | 41 | 67 | Yes | No | I2 | I1-32, I2-32 | NA | NDEP identified zinc as a potential contaminant within the Storm Sewer System (LOU59) in Parcel F. Soil concentrations are consistent with background and <0.1xBCL. |
| | Zirconium | 45 | 33 | 36 | No | NA | NA | NA | 5-3, J-23 | Not historically listed as a SRC. RZ-A background data are not available. |

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

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

| Chemical Group | Analyte | No. of Samples | No. of Detects | Maximum Detected Conc[1] | 2005 CSM SRC? [2] | Background Evaluation | | | Spatial Plot | Comment [3] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Fails Statistical Testing for Background? | Table | Figure | | |
| Other Inorganics | Bromide | 41 | 5 | 10 | Yes | NA | NA | NA | NA | This group of inorganic compounds includes common industrial chemicals that are used as chemical feedstocks and/or expected to be present in process waste streams. With the exception of fluoride and nitrate, all compounds were historically identified as SRCs at the Operations Area. These compounds are generally highly soluble when present as free anions or cations. Many of these compounds are physiological electrolytes and/or occur naturally in foods.<br>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. |
| | Chloride | 41 | 41 | 18,300 | Yes | NA | NA | NA | 5-4, J-10 | |
| | Fluoride | 41 | 20 | 3.0 | No | NA | NA | NA | NA | |
| | Nitrate | 45 | 45 | 349 | Yes | NA | NA | NA | NA | |
| | Nitrate/Nitrite | 4 | 4 | 24 | Yes | NA | NA | NA | NA | |
| | Nitrite | 21 | 2 | 11 | No | NA | NA | NA | NA | |
| | Sulfate | 41 | 41 | 2,270 | Yes | NA | NA | NA | NA | |
| | ortho-Phosphate | 41 | 3 | 6.3 | Yes | NA | NA | NA | NA | |
| Radio-nuclides | Uranium-238 | 38 | 38 | 1.8 | Yes | No | I-4 | I1-33, I2-33 | J-22 | Although historically listed as SRCs, radionuclides are not known to be associated with any of the former/current operations at the Site. Although radium-228 failed the statistical testing for background consistency, the validity of the statistical testing is confounded by several analytical and other issues. |
| | Uranium-234 | 38 | 38 | 2.6 | Yes | No | I-4 | I1-34, I2-34 | NA | |
| | Thorium-230 | 45 | 45 | 1.7 | Yes | No | I-4 | I1-35, I2-35 | NA | |
| | Radium-226 | 45 | 45 | 2.3 | Yes | No | I-4 | I1-36, I2-36 | NA | |
| | Thorium-232 | 45 | 45 | 2.0 | Yes | No | I-4 | I1-37, I2-37 | J-19 | |
| | Thorium-228 | 45 | 45 | 2.2 | Yes | No | I-4 | I1-39, I2-39 | NA | |
| | Radium-228 | 45 | 45 | 14 | Yes | Yes | I-4 | I1-38, I2-38 | NA | |
| | Uranium-235 | 38 | 38 | 0.11 | No | No | I-4 | I1-40, I2-40 | J-21 | |

**Notes:**

bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BCL = Basic comparison level
CSM = Conceptual site model
LDF = Low detection frequency (<25%) in either site or background datasets. Background comparison results may not be applicable.
LOU = Letter of Understanding
NA = Not applicable
NDEP = Nevada Division of Environmental Protection
SRC = Site related chemical, as identified in the Conceptual Site Model (ENSR 2005)

Listed analytes are those detected in one or more soil samples in Parcel F.

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

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

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

**Sources:**

ENSR. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada. February. NDEP requested response to comments during the next monthly meeting October 22.
ENVIRON. 2011. Phase I Environmental Site Assessment of Tronox LLC, Clark County, Nevada. January.
NDEP. 2011. Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada. July.
Ramboll Environ. 2016. Technical Memorandum, Remedial Investigation Data Evaluation, Nevada Environmental Response Trust Site, Henderson, Nevada, dated May 2.

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

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

| Chemical Group | Analyte | No. of Samples | No. of Detects | Maximum Detected Concentration (mg/kg) | 2005 CSM SRC? [1] | Spatial Plot | Comment [2] |
|---|---|---|---|---|---|---|---|
| Dioxins/ Furans | 2,3,7,8-TCDD TEQ* | 34 | 16 | 0.0013 | Yes | J-18 | Unintentional by-product of high-temperature processes, e.g., incomplete combustion and pesticide production (a source of chlorine is required). Highly persistent. Soil concentrations are below the NDEP-approved action level of 0.0027 mg/kg. |
| Organics | Phthalic acid | 41 | 2 | 0.76 | No | NA | Low detection frequency. Concentrations <0.1xBCL. |
| PAHs | Acenaphthene | 45 | 1 | 0.23 | Yes | NA | Expected to co-locate with BaPEqs. Low detection frequency. Concentration <0.1xBCL. |
| | Acenaphthylene | 45 | 1 | 0.10 | Yes | NA | |
| | BaPEq* | 45 | 5 | 0.41 | Yes | 5-5, J-4 | PAHs are ubiquitous environmental contaminants, formed during incomplete combustion of organic materials. |
| | Fluoranthene | 45 | 5 | 0.097 | Yes | NA | Expected to co-locate with BaPEqs. Low detection frequency. Concentration <0.1xBCL. |
| | Naphthalene | 45 | 1 | 0.010 | Yes | NA | |
| | Phenanthrene | 45 | 4 | 0.96 | Yes | NA | |
| | Pyrene | 45 | 5 | 0.30 | Yes | NA | |
| PCBs | Aroclor-1248 | 20 | 1 | 0.074 | Yes | J-1 | 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 and none was associated with Parcel F. Low detection frequency. |
| | Aroclor-1254 | 20 | 1 | 0.29 | Yes | 5-6, J-2 | |
| Pesticides OCPs | alpha-BHC | 45 | 6 | 0.059 | No | 5-7, J-7 | Not listed historically as a SRC. However, the former Stauffer facility (to the west) produced gamma BHC (lindane) from 1946 through 1958; the alpha and beta isomers are by-products of lindane production. |
| | beta-BHC | 45 | 16 | 0.14 | No | J-8 | |
| | 4,4'-DDD | 45 | 1 | 0.013 | Yes | NA | Historical information indicates that Hardesty/AMECCO (1946-1949, LOU 4) listed DDT for production. The detected concentrations of DDT and related compounds in Parcel F are relatively low and < 0.1xBCL. 4,4'-DDT and 4,4'-DDE are mostly co-located. |
| | 2,4'-DDE | 45 | 5 | 0.020 | Yes | NA | |
| | 4,4'-DDE | 45 | 10 | 0.18 | Yes | J-12 | |
| | 4,4'-DDT | 45 | 8 | 0.26 | Yes | J-13 | |
| | Endrin aldehyde | 45 | 2 | 0.020 | No | NA | Although OCPs were historically listed as SRCs, NDEP did not identify endrin aldehyde as a specific contaminant at an LOU. Very persistent in soils. Compounds were detected at a low detection frequency (<5%) and post-removal concentrations are <0.1xBCL. |
| SVOCs | Acetophenone | 41 | 2 | 0.062 | No | NA | Not listed historically as a SRC. Low detection frequency. Concentrations < 0.1xBCL. |
| | Benzoic acid | 45 | 2 | 0.32 | No | NA | |
| | Benzyl alcohol | 45 | 2 | 0.34 | No | NA | |
| | bis(2-Ethylhexyl)phthalate | 45 | 4 | 1.4 | No | NA | A common field/laboratory contaminant. Concentrations < 0.1xBCL. |
| | Carbazole | 41 | 1 | 0.068 | No | NA | Not listed historically as a SRC. Low detection frequency. Concentrations < 0.1xBCL. |
| | Di-n-butylphthalate | 45 | 4 | 5.2 | No | NA | A common field/laboratory contaminant. Concentrations < 0.1xBCL. |
| | Di-n-octylphthalate | 45 | 2 | 0.28 | No | NA | |
| | Hydroxymethyl phthalimide | 41 | 2 | 0.15 | No | J-14 | Not listed historically as a SRC. Low detection frequency. |
| | Phenol | 45 | 2 | 0.44 | No | NA | Not listed historically as a SRC. Low detection frequency. Concentrations < 0.1xBCL. |
| VOCs | Acetone | 45 | 12 | 1.9 | Yes | NA | *See VOC comments below.* |
| | 2-Butanone | 45 | 3 | 0.013 | Yes | NA | |
| | Chloroform | 45 | 1 | 0.00065 | Yes | NA | 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 in Parcel F are very low and not indicative of a potential source area. |

## TABLE 4-5. Exploratory Data Analysis: Comments for Dioxins/Furans, Other Organics, PAHs, Pesticides, SVOCs, and VOCs (0-10 ft bgs Soil – Parcel F)
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical Group | Analyte | No. of Samples | No. of Detects | Maximum Detected Concentration (mg/kg) | 2005 CSM SRC? [1] | Spatial Plot | Comment [2] |
|---|---|---|---|---|---|---|---|
| VOCs | Ethyl benzene | 45 | 2 | 0.00048 | Yes | NA | Historically, a number of individual VOCs were listed as SRCs, but VOC soil contamination was not the subject of any of the interim soil removal actions completed within Parcel F following the soil investigations. Also, NDEP identified VOCs (as a general category) as possible contaminants for LOU 4 (Hardesty Chemical Company Site) in Parcel F. However, it is noted that the initial identification of potential LOU contaminants was based on a review of historical operations and the limited sampling data available at the time of the LOU designations in 1994. Given that Parcel F is situated within the Trust's property, as well as in the vicinity of other BMI companies, it is possible that environmental media within Parcel F could have been indirectly impacted by VOCs. At the same time, an operational history for an area that included former use of VOCs does not necessarily mean that environmental media in the area were impacted. The soil sampling results show that VOCs were detected at low frequencies and low concentrations, not indicative of a source.<br>Several of the VOCs are common field/laboratory contaminants, for example, acetone, 2-butanone, 2-hexanone, methylene chloride, and toluene. |
| | 2-Hexanone | 45 | 2 | 0.0071 | Yes | NA | |
| | Methylene chloride | 45 | 16 | 0.021 | Yes | NA | |
| | n-Nonyl aldehyde | 41 | 1 | 0.0033 | No | J-14 | |
| | n-Propylbenzene | 45 | 1 | 0.0014 | No | NA | |
| | Toluene | 45 | 1 | 0.00047 | Yes | NA | |
| | 1,2,4-Trimethylbenzene | 45 | 7 | 0.0086 | No | NA | |
| | 1,3,5-Trimethylbenzene | 45 | 3 | 0.0038 | No | NA | |
| | m,p-Xylene | 45 | 3 | 0.0026 | Yes | NA | |
| | o-Xylene | 45 | 2 | 0.00083 | Yes | NA | |
| | Xylenes (total) | 41 | 2 | 0.0034 | Yes | NA | |

**Notes:**

bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic comparison level
BHC = Hexachlorocyclohexane
CSM = Conceptual site model
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
LOU = Letter of Understanding
NA = Not applicable
NDEP = Nevada Division of Environmental Protection
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
SRC = Site-related chemical
SVOC = Semivolatile organic compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent
VOC = Volatile organic compound
* Methodology for equivalent calculations explained in text

Listed analytes include only those detected in one or more soil samples in Parcel F.

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

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

**Sources:**

ENSR. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada. February. NDEP requested response to comments during the next monthly meeting October 22.
ENVIRON. 2011. Phase I Environmental Site Assessment of Tronox LLC, Clark County, Nevada. January.
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.
Ramboll Environ. 2016. Technical Memorandum, Remedial Investigation Data Evaluation, Nevada Environmental Response Trust Site, Henderson, Nevada, dated May 2.

# TABLE 4-6. Evaluation of Sample Quantitation Limits for Soil Gas – Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | % Above 10% of RBC |
| Acetone | 4.1E+08 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Acrylonitrile | 6.0E+02 | μg/m$^3$ | 6 | 0 | 0 | 0.10 | 1.7 | 0 |
| t-Amyl methyl ether | 6.5E+07 | μg/m$^3$ | 6 | 1 | 17 | 0.076 | 1.7 | 0 |
| Benzene | 2.9E+14 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Benzyl chloride | 1.2E+03 | μg/m$^3$ | 6 | 2 | 33 | 0.068 | 0.34 | 0 |
| Bromodichloromethane | 3.2E+03 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Bromoform | 9.0E+04 | μg/m$^3$ | 6 | 0 | 0 | 1.5 | 2.7 | 0 |
| Bromomethane | 9.9E+01 | μg/m$^3$ | 6 | 2 | 33 | 0.20 | 0.34 | 0 |
| 1,3-Butadiene | 1.5E+03 | μg/m$^3$ | 4 | 0 | 0 | 0.28 | 0.34 | 0 |
| 2-Butanone | 8.2E+07 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| n-Butylbenzene | 7.7E+06 | μg/m$^3$ | 2 | 2 | 100 | -- | -- | -- |
| sec-Butylbenzene | 7.7E+06 | μg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | 0 |
| tert-Butylbenzene | 7.7E+06 | μg/m$^3$ | 2 | 0 | 0 | 0.59 | 0.68 | 0 |
| Carbon disulfide | 1.1E+07 | μg/m$^3$ | 6 | 2 | 33 | 0.042 | 0.051 | 0 |
| Carbon tetrachloride | 8.7E+03 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| 3-Chloro-1-propene | 7.6E+03 | μg/m$^3$ | 2 | 0 | 0 | 0.30 | 0.34 | 0 |
| Chlorobenzene | 9.8E+05 | μg/m$^3$ | 6 | 3 | 50 | 0.070 | 0.34 | 0 |
| Chloroethane | 1.5E+08 | μg/m$^3$ | 6 | 1 | 17 | 0.076 | 0.34 | 0 |
| Chloroform | 1.8E+03 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Chloromethane | 1.3E+06 | μg/m$^3$ | 6 | 0 | 0 | 0.022 | 0.34 | 0 |
| Cumene | 7.7E+06 | μg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | 0 |
| Cyclohexane | 1.1E+08 | μg/m$^3$ | 4 | 2 | 50 | 0.18 | 0.18 | 0 |
| p-Cymene | 7.7E+06 | μg/m$^3$ | 2 | 1 | 50 | 1.7 | 1.7 | 0 |
| 1,2-Dibromo-3-chloropropane | 8.5E+00 | μg/m$^3$ | 6 | 2 | 33 | 0.20 | 1.7 | 50 |
| Dibromochloromethane | -- | μg/m$^3$ | 6 | 1 | 17 | 0.11 | 0.34 | -- |
| 1,2-Dibromoethane | 9.1E+01 | μg/m$^3$ | 6 | 1 | 17 | 0.096 | 0.34 | 0 |
| 1,2-Dichlorobenzene | 4.1E+06 | μg/m$^3$ | 6 | 3 | 50 | 0.15 | 0.34 | 0 |
| 1,3-Dichlorobenzene | 4.1E+06 | μg/m$^3$ | 6 | 1 | 17 | 0.10 | 0.34 | 0 |
| 1,4-Dichlorobenzene | 5.2E+03 | μg/m$^3$ | 6 | 4 | 67 | 0.18 | 0.18 | 0 |
| Dichlorodifluoromethane | 1.8E+06 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| 1,1-Dichloroethane | 3.4E+04 | μg/m$^3$ | 6 | 3 | 50 | 0.34 | 0.82 | 0 |

## TABLE 4-6. Evaluation of Sample Quantitation Limits for Soil Gas – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | % Above 10% of RBC |
| 1,2-Dichloroethane | 1.6E+03 | μg/m$^3$ | 6 | 3 | 50 | 0.090 | 0.34 | 0 |
| 1,1-Dichloroethene | 3.4E+06 | μg/m$^3$ | 6 | 2 | 33 | 0.040 | 0.048 | 0 |
| cis-1,2-Dichloroethene | -- | μg/m$^3$ | 6 | 1 | 17 | 0.068 | 0.34 | -- |
| trans-1,2-Dichloroethene | -- | μg/m$^3$ | 6 | 2 | 33 | 0.064 | 0.34 | -- |
| 1,2-Dichloropropane | 5.2E+03 | μg/m$^3$ | 6 | 3 | 50 | 0.11 | 0.34 | 0 |
| cis-1,3-Dichloropropene | 1.6E+04 | μg/m$^3$ | 6 | 1 | 17 | 0.080 | 1.7 | 0 |
| trans-1,3-Dichloropropene | 1.6E+04 | μg/m$^3$ | 6 | 1 | 17 | 0.24 | 1.7 | 0 |
| 1,4-Dioxane | 8.5E+03 | μg/m$^3$ | 6 | 1 | 17 | 0.096 | 1.7 | 0 |
| Ethanol | 1.2E+09 | μg/m$^3$ | 2 | 2 | 100 | -- | -- | -- |
| Ethyl benzene | 2.2E+04 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Ethyl acetate | 1.4E+06 | μg/m$^3$ | 4 | 4 | 100 | -- | -- | -- |
| 4-Ethyltoluene | 7.7E+06 | μg/m$^3$ | 6 | 3 | 50 | 1.0 | 1.2 | 0 |
| Freon 114 | 5.6E+08 | μg/m$^3$ | 6 | 2 | 33 | 0.16 | 1.7 | 0 |
| n-Heptane | 1.6E+08 | μg/m$^3$ | 6 | 4 | 67 | 1.5 | 1.7 | 0 |
| Hexachlorobutadiene | 5.9E+03 | μg/m$^3$ | 6 | 2 | 33 | 0.14 | 0.34 | 0 |
| n-Hexane | 7.0E+06 | μg/m$^3$ | 4 | 4 | 100 | -- | -- | -- |
| 2-Hexanone | 6.1E+05 | μg/m$^3$ | 6 | 5 | 83 | 0.22 | 0.22 | 0 |
| Methyl tert-butyl ether | 2.0E+05 | μg/m$^3$ | 6 | 1 | 17 | 0.096 | 0.89 | 0 |
| 4-Methyl-2-pentanone | 5.8E+07 | μg/m$^3$ | 6 | 5 | 83 | 1.7 | 1.7 | 0 |
| Methylene Chloride | 4.3E+06 | μg/m$^3$ | 6 | 3 | 50 | 0.078 | 0.70 | 0 |
| Methylmethacrylate | 1.3E+07 | μg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | 0 |
| Naphthalene | 1.9E+03 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| n-Octane | -- | μg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | -- |
| Diisopropyl ether | 1.5E+07 | μg/m$^3$ | 6 | 0 | 0 | 0.058 | 1.7 | 0 |
| n-Propylbenzene | 1.9E+07 | μg/m$^3$ | 2 | 2 | 100 | -- | -- | -- |
| Styrene | 2.0E+07 | μg/m$^3$ | 6 | 1 | 17 | 0.050 | 1.7 | 0 |
| 1,1,1,2-Tetrachloroethane | 7.6E+03 | μg/m$^3$ | 4 | 1 | 25 | 0.15 | 0.15 | 0 |
| 1,1,2,2-Tetrachloroethane | 9.7E+02 | μg/m$^3$ | 6 | 2 | 33 | 0.072 | 0.34 | 0 |
| Tetrachloroethene | 2.1E+05 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Tetrahydrofuran | 3.1E+07 | μg/m$^3$ | 4 | 0 | 0 | 1.2 | 1.4 | 0 |
| Toluene | 8.6E+07 | μg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |

## TABLE 4-6. Evaluation of Sample Quantitation Limits for Soil Gas – Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | % Above 10% of RBC |
| 1,2,4-Trichlorobenzene | 8.3E+04 | µg/m$^3$ | 6 | 4 | 67 | 0.22 | 0.22 | 0 |
| 1,1,1-Trichloroethane | 9.4E+07 | µg/m$^3$ | 6 | 2 | 33 | 0.092 | 0.34 | 0 |
| 1,1,2-Trichloroethane | 3.3E+03 | µg/m$^3$ | 6 | 3 | 50 | 0.10 | 0.34 | 0 |
| Trichloroethene | 1.3E+04 | µg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Trichlorofluoromethane | 1.2E+07 | µg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| 1,2,4-Trimethylbenzene | 1.2E+06 | µg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| 1,3,5-Trimethylbenzene | 1.2E+06 | µg/m$^3$ | 6 | 4 | 67 | 0.15 | 1.7 | 0 |
| Vinyl acetate | 3.5E+06 | µg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| Vinyl chloride | 9.5E+03 | µg/m$^3$ | 6 | 1 | 17 | 0.12 | 0.34 | 0 |
| o-Xylene | 1.7E+06 | µg/m$^3$ | 2 | 2 | 100 | -- | -- | -- |
| m,p-Xylene | -- | µg/m$^3$ | 2 | 2 | 100 | -- | -- | -- |
| Xylenes (total) | 2.0E+06 | µg/m$^3$ | 4 | 3 | 75 | 2.6 | 2.6 | 0 |
| Ethyl tert-butyl ether | 6.5E+07 | µg/m$^3$ | 6 | 1 | 17 | 0.084 | 1.7 | 0 |
| alpha-Methylstyrene | 2.0E+07 | µg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | 0 |
| tert Butyl alcohol | 4.7E+08 | µg/m$^3$ | 6 | 6 | 100 | -- | -- | -- |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.3E+09 | µg/m$^3$ | 6 | 2 | 33 | 1.6 | 1.9 | 0 |

**Notes:**

-- = not available

RBC = Risk-Based Concentration

SQL = sample quantitation limit

µg/m$^3$ = microgram per cubic meter

[1] Risk-Based Concentrations (RBCs) used in this evaluation are the lowest among the 5 ft bgs soil gas RBCs for indoor workers, outdoor workers and construction workers.

## TABLE 4-7. Summary Statistics for Soil Gas – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| Acetone | μg/m$^3$ | 6 | 6 | 100 | -- | -- | 9.4 | 67 | 19 | 26 | 21 | 0.80 | E-SG-6 |
| Acrylonitrile | μg/m$^3$ | 6 | 0 | 0 | 0.10 | 1.7 | -- | -- | -- | -- | -- | -- | -- |
| t-Amyl methyl ether | μg/m$^3$ | 6 | 1 | 17 | 0.076 | 1.7 | 0.78 | 0.78 | 0.78 | 0.78 | -- | -- | E-SG-6 |
| Benzene | μg/m$^3$ | 6 | 6 | 100 | -- | -- | 1.5 | 3.0 | 2.5 | 2.3 | 0.52 | 0.22 | SG34 |
| Benzyl chloride | μg/m$^3$ | 6 | 2 | 33 | 0.068 | 0.34 | 0.14 | 0.43 | 0.29 | 0.29 | 0.21 | 0.72 | E-SG-6 |
| Bromodichloromethane | μg/m$^3$ | 6 | 6 | 100 | -- | -- | 0.38 | 1.8 | 1.2 | 1.1 | 0.59 | 0.52 | SG34 |
| Bromoform | μg/m$^3$ | 6 | 0 | 0 | 1.5 | 2.7 | -- | -- | -- | -- | -- | -- | -- |
| Bromomethane | μg/m$^3$ | 6 | 2 | 33 | 0.20 | 0.34 | 0.33 | 0.84 | 0.58 | 0.58 | 0.36 | 0.62 | E-SG-6 |
| 1,3-Butadiene | μg/m$^3$ | 4 | 0 | 0 | 0.28 | 0.34 | -- | -- | -- | -- | -- | -- | -- |
| 2-Butanone | μg/m$^3$ | 6 | 6 | 100 | -- | -- | 4.9 | 11 | 7.4 | 7.8 | 2.4 | 0.31 | SG74 |
| n-Butylbenzene | μg/m$^3$ | 2 | 2 | 100 | -- | -- | 0.39 | 0.70 | 0.54 | 0.54 | 0.22 | 0.40 | SG34 |
| sec-Butylbenzene | μg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | -- | -- | -- | -- | -- | -- | -- |
| tert-Butylbenzene | μg/m$^3$ | 2 | 0 | 0 | 0.59 | 0.68 | -- | -- | -- | -- | -- | -- | -- |
| Carbon disulfide | μg/m$^3$ | 6 | 2 | 33 | 0.042 | 0.051 | 0.75 | 1.1 | 0.93 | 0.93 | 0.25 | 0.27 | SG74 |
| Carbon tetrachloride | μg/m$^3$ | 6 | 6 | 100 | -- | -- | 3.0 | 110 | 16 | 40 | 47 | 1.2 | E-SG-4 |
| 3-Chloro-1-propene | μg/m$^3$ | 2 | 0 | 0 | 0.30 | 0.34 | -- | -- | -- | -- | -- | -- | -- |
| Chlorobenzene | μg/m$^3$ | 6 | 3 | 50 | 0.070 | 0.34 | 0.29 | 2.3 | 1.3 | 1.3 | 1.0 | 0.78 | E-SG-6 |
| Chloroethane | μg/m$^3$ | 6 | 1 | 17 | 0.076 | 0.34 | 0.43 | 0.43 | 0.43 | 0.43 | -- | -- | SG34 |
| Chloroform | μg/m$^3$ | 6 | 6 | 100 | -- | -- | 180 | 2800 | 780 | 1,200 | 1,000 | 0.83 | E-SG-4 |
| Chloromethane | μg/m$^3$ | 6 | 0 | 0 | 0.022 | 0.34 | -- | -- | -- | -- | -- | -- | -- |
| Cumene | μg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | -- | -- | -- | -- | -- | -- | -- |
| Cyclohexane | μg/m$^3$ | 4 | 2 | 50 | 0.18 | 0.18 | 0.60 | 4.7 | 2.6 | 2.6 | 2.9 | 1.1 | E-SG-6 |
| p-Cymene | μg/m$^3$ | 2 | 1 | 50 | 1.7 | 1.7 | 0.29 | 0.29 | 0.29 | 0.29 | -- | -- | SG34 |
| 1,2-Dibromo-3-chloropropane | μg/m$^3$ | 6 | 2 | 33 | 0.20 | 1.7 | 0.41 | 1.7 | 1.1 | 1.1 | 0.91 | 0.86 | E-SG-6 |
| Dibromochloromethane | μg/m$^3$ | 6 | 1 | 17 | 0.11 | 0.34 | 1.2 | 1.2 | 1.2 | 1.2 | -- | -- | E-SG-6 |
| 1,2-Dibromoethane | μg/m$^3$ | 6 | 1 | 17 | 0.096 | 0.34 | 1.4 | 1.4 | 1.4 | 1.4 | -- | -- | E-SG-6 |
| 1,2-Dichlorobenzene | μg/m$^3$ | 6 | 3 | 50 | 0.15 | 0.34 | 0.29 | 1.8 | 1.5 | 1.2 | 0.80 | 0.67 | E-SG-6 |
| 1,3-Dichlorobenzene | μg/m$^3$ | 6 | 1 | 17 | 0.10 | 0.34 | 0.26 | 0.26 | 0.26 | 0.26 | -- | -- | SG34 |
| 1,4-Dichlorobenzene | μg/m$^3$ | 6 | 4 | 67 | 0.18 | 0.18 | 1.3 | 80 | 16 | 28 | 37 | 1.3 | SG34 |
| Dichlorodifluoromethane | μg/m$^3$ | 6 | 6 | 100 | -- | -- | 1.5 | 2.5 | 2.0 | 2.1 | 0.33 | 0.16 | E-SG-5 |
| 1,1-Dichloroethane | μg/m$^3$ | 6 | 3 | 50 | 0.34 | 0.82 | 0.35 | 1.3 | 1.0 | 0.88 | 0.49 | 0.55 | E-SG-6 |
| 1,2-Dichloroethane | μg/m$^3$ | 6 | 3 | 50 | 0.090 | 0.34 | 0.11 | 0.87 | 0.25 | 0.41 | 0.4 | 0.99 | E-SG-6 |
| 1,1-Dichloroethene | μg/m$^3$ | 6 | 2 | 33 | 0.040 | 0.048 | 36 | 110 | 73 | 73 | 52 | 0.72 | SG74 |
| cis-1,2-Dichloroethene | μg/m$^3$ | 6 | 1 | 17 | 0.068 | 0.34 | 0.89 | 0.89 | 0.89 | 0.89 | -- | -- | E-SG-6 |
| trans-1,2-Dichloroethene | μg/m$^3$ | 6 | 2 | 33 | 0.064 | 0.34 | 0.069 | 0.94 | 0.50 | 0.50 | 0.62 | 1.2 | E-SG-6 |
| 1,2-Dichloropropane | μg/m$^3$ | 6 | 3 | 50 | 0.11 | 0.34 | 0.12 | 1.2 | 1.0 | 0.77 | 0.57 | 0.74 | SG34 |
| cis-1,3-Dichloropropene | μg/m$^3$ | 6 | 1 | 17 | 0.080 | 1.7 | 0.75 | 0.75 | 0.75 | 0.75 | -- | -- | E-SG-6 |
| trans-1,3-Dichloropropene | μg/m$^3$ | 6 | 1 | 17 | 0.24 | 1.7 | 0.68 | 0.68 | 0.68 | 0.68 | -- | -- | E-SG-6 |

## TABLE 4-7. Summary Statistics for Soil Gas – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| 1,4-Dioxane | µg/m$^3$ | 6 | 1 | 17 | 0.096 | 1.7 | 0.64 | 0.64 | 0.64 | 0.64 | -- | -- | E-SG-6 |
| Ethanol | µg/m$^3$ | 2 | 2 | 100 | -- | -- | 5.8 | 7.4 | 6.6 | 6.6 | 1.1 | 0.17 | SG74 |
| Ethyl benzene | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 0.46 | 4.4 | 0.58 | 1.3 | 1.6 | 1.2 | E-SG-4 |
| Ethyl acetate | µg/m$^3$ | 4 | 4 | 100 | -- | -- | 1.8 | 9.9 | 2.9 | 4.4 | 3.8 | 0.87 | E-SG-5 |
| 4-Ethyltoluene | µg/m$^3$ | 6 | 3 | 50 | 1.0 | 1.2 | 0.32 | 3.1 | 0.53 | 1.3 | 1.5 | 1.2 | E-SG-4 |
| Freon 114 | µg/m$^3$ | 6 | 2 | 33 | 0.16 | 1.7 | 0.25 | 1.4 | 0.82 | 0.82 | 0.81 | 0.99 | E-SG-6 |
| n-Heptane | µg/m$^3$ | 6 | 4 | 67 | 1.5 | 1.7 | 0.91 | 2.4 | 1.3 | 1.5 | 0.64 | 0.43 | E-SG-6 |
| Hexachlorobutadiene | µg/m$^3$ | 6 | 2 | 33 | 0.14 | 0.34 | 0.33 | 1.1 | 0.72 | 0.72 | 0.54 | 0.76 | E-SG-6 |
| n-Hexane | µg/m$^3$ | 4 | 4 | 100 | -- | -- | 1.5 | 6100 | 4.1 | 1,500 | 3,000 | 2.0 | E-SG-6 |
| 2-Hexanone | µg/m$^3$ | 6 | 5 | 83 | 0.22 | 0.22 | 0.50 | 2.3 | 0.70 | 1.0 | 0.75 | 0.74 | E-SG-6 |
| Methyl tert-butyl ether | µg/m$^3$ | 6 | 1 | 17 | 0.096 | 0.89 | 0.47 | 0.47 | 0.47 | 0.47 | -- | -- | SG34 |
| 4-Methyl-2-pentanone | µg/m$^3$ | 6 | 5 | 83 | 1.7 | 1.7 | 0.31 | 2.8 | 1.2 | 1.4 | 0.92 | 0.67 | E-SG-6 |
| Methylene Chloride | µg/m$^3$ | 6 | 3 | 50 | 0.078 | 0.70 | 0.24 | 2.9 | 2.9 | 2.0 | 1.5 | 0.76 | E-SG-6 |
| Methylmethacrylate | µg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | -- | -- | -- | -- | -- | -- | -- |
| Naphthalene | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 0.96 | 5.2 | 2.1 | 2.3 | 1.5 | 0.65 | E-SG-6 |
| n-Octane | µg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | -- | -- | -- | -- | -- | -- | -- |
| Diisopropyl ether | µg/m$^3$ | 6 | 0 | 0 | 0.058 | 1.7 | -- | -- | -- | -- | -- | -- | -- |
| n-Propylbenzene | µg/m$^3$ | 2 | 2 | 100 | -- | -- | 0.32 | 0.37 | 0.34 | 0.34 | 0.035 | 0.10 | SG34 |
| Styrene | µg/m$^3$ | 6 | 1 | 17 | 0.050 | 1.7 | 0.74 | 0.74 | 0.74 | 0.74 | -- | -- | E-SG-6 |
| 1,1,1,2-Tetrachloroethane | µg/m$^3$ | 4 | 1 | 25 | 0.15 | 0.15 | 1.1 | 1.1 | 1.1 | 1.1 | -- | -- | E-SG-6 |
| 1,1,2,2-Tetrachloroethane | µg/m$^3$ | 6 | 2 | 33 | 0.072 | 0.34 | 0.14 | 1.1 | 0.62 | 0.62 | 0.68 | 1.1 | E-SG-6 |
| Tetrachloroethene | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 7.5 | 130 | 18 | 51 | 58 | 1.1 | SG74 |
| Tetrahydrofuran | µg/m$^3$ | 4 | 0 | 0 | 1.2 | 1.4 | -- | -- | -- | -- | -- | -- | -- |
| Toluene | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 1.3 | 11 | 6.0 | 6.0 | 4.1 | 0.69 | E-SG-4 |
| 1,2,4-Trichlorobenzene | µg/m$^3$ | 6 | 4 | 67 | 0.22 | 0.22 | 0.47 | 21 | 3.8 | 7.2 | 9.5 | 1.3 | SG34 |
| 1,1,1-Trichloroethane | µg/m$^3$ | 6 | 2 | 33 | 0.092 | 0.34 | 0.12 | 1.0 | 0.56 | 0.56 | 0.62 | 1.1 | E-SG-6 |
| 1,1,2-Trichloroethane | µg/m$^3$ | 6 | 3 | 50 | 0.10 | 0.34 | 0.18 | 1.1 | 0.19 | 0.49 | 0.53 | 1.1 | E-SG-6 |
| Trichloroethene | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 0.98 | 8.3 | 3.2 | 3.6 | 2.5 | 0.69 | SG34 |
| Trichlorofluoromethane | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 1.1 | 48 | 1.9 | 9.6 | 19 | 2.0 | E-SG-4 |
| 1,2,4-Trimethylbenzene | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 0.59 | 3.2 | 1.2 | 1.4 | 0.99 | 0.71 | E-SG-4 |
| 1,3,5-Trimethylbenzene | µg/m$^3$ | 6 | 4 | 67 | 0.15 | 1.7 | 0.30 | 1.2 | 0.73 | 0.74 | 0.48 | 0.64 | E-SG-6 |
| Vinyl acetate | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 2.3 | 10 | 3.1 | 4.3 | 2.9 | 0.68 | E-SG-6 |
| Vinyl chloride | µg/m$^3$ | 6 | 1 | 17 | 0.12 | 0.34 | 0.40 | 0.40 | 0.40 | 0.40 | -- | -- | E-SG-6 |
| o-Xylene | µg/m$^3$ | 2 | 2 | 100 | -- | -- | 0.93 | 1.3 | 1.1 | 1.1 | 0.26 | 0.23 | SG34 |
| m,p-Xylene | µg/m$^3$ | 2 | 2 | 100 | -- | -- | 1.5 | 2.8 | 2.1 | 2.1 | 0.92 | 0.43 | SG34 |
| Xylenes (total) | µg/m$^3$ | 4 | 3 | 75 | 2.6 | 2.6 | 2.9 | 21 | 6.2 | 10 | 9.6 | 0.96 | E-SG-4 |
| Ethyl tert-butyl ether | µg/m$^3$ | 6 | 1 | 17 | 0.084 | 1.7 | 0.82 | 0.82 | 0.82 | 0.82 | -- | -- | E-SG-6 |
| alpha-Methylstyrene | µg/m$^3$ | 2 | 0 | 0 | 1.5 | 1.7 | -- | -- | -- | -- | -- | -- | -- |

## TABLE 4-7. Summary Statistics for Soil Gas – Parcel F
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| tert Butyl alcohol | µg/m$^3$ | 6 | 6 | 100 | -- | -- | 0.53 | 4.8 | 2.0 | 2.1 | 1.6 | 0.77 | E-SG-6 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | µg/m$^3$ | 6 | 2 | 33 | 1.6 | 1.9 | 0.45 | 0.54 | 0.49 | 0.49 | 0.064 | 0.13 | SG34 |

**Notes:**

-- = not available

µg/m$^3$ = microgram per cubic meter

SQL = sample quantitation limit

## TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater – Parcel F
### Nevada Environmental Response Trust Site
### Henderson, Nevada

| Chemical Group | Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Minimum SQL | Maximum SQL | % Above 10% of Screen |
| SVOCs | Acenaphthene | 1.8E+05 | µg/L | 15 | 0 | 0 | 0.19 | 10 | 0 |
| | Acenaphthylene | 2.1E+05 | µg/L | 15 | 0 | 0 | 0.19 | 10 | 0 |
| | Aniline | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Anthracene | 2.6E+05 | µg/L | 15 | 0 | 0 | 0.19 | 10 | 0 |
| | Azobenzene | 5.8E+04 | µg/L | 10 | 0 | 0 | 19 | 19 | 0 |
| | Diphenyl sulfone | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | Diphenyl sulfide | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | Benzidine | -- | µg/L | 5 | 0 | 0 | 19 | 19 | -- |
| | Benzo(a)anthracene | 2.3E+04 | µg/L | 15 | 0 | 0 | 0.19 | 10 | 0 |
| | Benzo(a)pyrene | -- | µg/L | 14 | 0 | 0 | 0.19 | 10 | -- |
| | Benzo(b)fluoranthene | -- | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- |
| | Benzo(g,h,i)perylene | -- | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- |
| | Benzo(k)fluoranthene | -- | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- |
| | Benzoic acid | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | Benzyl alcohol | -- | µg/L | 10 | 1 | 10 | 19 | 19 | -- |
| | bis(2-Ethylhexyl)phthalate | -- | µg/L | 15 | 3 | 20 | 4.7 | 49 | -- |
| | bis(2-Chloroethoxy)methane | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | bis(2-Chloroethyl) ether | 3.9E+03 | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | 0 |
| | 4-Bromophenyl-phenyl ether | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Butylbenzylphthalate | -- | µg/L | 15 | 0 | 0 | 4.7 | 19 | -- |
| | 4-Chloro-3-methylphenol | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | 4-Chloroaniline | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | 2-Chloronaphthalene | 3.4E+04 | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | 0 |
| | 2-Chlorophenol | 2.5E+05 | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | 0 |
| | 4-Chlorophenyl methyl sulfone | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | 4-Chlorophenyl-phenyl ether | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | 4-Chlorothioanisole | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | 4-Chlorothiophenol | -- | µg/L | 4 | 0 | 0 | 190 | 190 | -- |
| | Chrysene | -- | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- |
| | Diphenyl disulfide | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | Di-n-butylphthalate | -- | µg/L | 15 | 0 | 0 | 4.7 | 19 | -- |
| | Di-n-octylphthalate | -- | µg/L | 15 | 0 | 0 | 4.7 | 19 | -- |
| | Dibenz(a,h)anthracene | -- | µg/L | 15 | 0 | 0 | 0.19 | 19 | -- |
| | Dibenzofuran | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | 3,3'-Dichlorobenzidine | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |

**TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater – Parcel F**

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Minimum SQL | Maximum SQL | % Above 10% of Screen |
| SVOCs | 2,2'-/4,4'-Dichlorobenzil | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | 4,4'-Dichlorobenzophenone | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | 2,4-Dichlorophenol | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Diethylphthalate | -- | µg/L | 15 | 0 | 0 | 4.7 | 10 | -- |
| | 2,4-Dimethylphenol | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | Dimethylphthalate | -- | µg/L | 15 | 0 | 0 | 4.7 | 10 | -- |
| | 4,6-Dinitro-2-methylphenol | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | 2,4-Dinitrophenol | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | 2,4-Dinitrotoluene | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | 2,6-Dinitrotoluene | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Fluoranthene | -- | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- |
| | Fluorene | 2.5E+05 | µg/L | 15 | 0 | 0 | 0.19 | 10 | 0 |
| | Hexachlorobenzene | 7.9E+01 | µg/L | 5 | 0 | 0 | 0.19 | 10 | 40 |
| | Hexachlorobutadiene | 4.6E+02 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 17 |
| | Hexachloroethane | 1.7E+03 | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | 0 |
| | Hydroxymethyl phthalimide | -- | µg/L | 4 | 0 | 0 | 190 | 190 | -- |
| | Indeno(1,2,3-cd)pyrene | -- | µg/L | 15 | 0 | 0 | 0.19 | 19 | -- |
| | Isophorone | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Benzophenone | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | 2-Methylnaphthalene | -- | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- |
| | 2-Methylphenol | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | 4-Methylphenol | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Naphthalene | 2.1E+03 | µg/L | 31 | 2 | 6.5 | 0.19 | 25 | 0 |
| | 2-Nitroaniline | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | 3-Nitroaniline | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | 4-Nitroaniline | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | Nitrobenzene | 2.2E+04 | µg/L | 15 | 0 | 0 | 0.19 | 19 | 0 |
| | 2-Nitrophenol | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | 4-Nitrophenol | -- | µg/L | 10 | 0 | 0 | 19 | 19 | -- |
| | n-Nitrosodimethylamine | 2.5E+02 | µg/L | 4 | 0 | 0 | 19 | 19 | 0 |
| | n-Nitrosodiphenylamine | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | n-Nitroso-di-n-propylamine | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Octachlorostyrene | -- | µg/L | 9 | 0 | 0 | 0.19 | 19 | -- |
| | Pentachlorobenzene | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| SVOCs | Phenanthrene | -- | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- |

## TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater – Parcel F

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

| Chemical Group | Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Minimum SQL | Maximum SQL | % Above 10% of Screen |
| | Phenol | -- | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- |
| | Pyrene | 3.1E+06 | µg/L | 15 | 0 | 0 | 0.19 | 10 | 0 |
| | Pyridine | 3.6E+07 | µg/L | 9 | 0 | 0 | 1.9 | 20 | 0 |
| | bis(4-Chlorophenyl) sulfone | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | 1,2,4,5-Tetrachlorobenzene | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | bis(4-Chlorophenyl) disulfide | -- | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- |
| | bis(2-Chloro-1-methylethyl) ether | 1.4E+04 | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | 0 |
| VOCs | Acetaldehyde | 4.6E+04 | µg/L | 1 | 0 | 0 | 30 | 30 | 0 |
| | Acetone | 1.7E+09 | µg/L | 8 | 2 | 25 | 9.5 | 500 | 0 |
| | t-Amyl methyl ether | 1.8E+07 | µg/L | 5 | 0 | 0 | 1.0 | 5.0 | 0 |
| | Benzene | 1.0E+14 | µg/L | 31 | 12 | 39 | 0.25 | 100 | 0 |
| | Bromobenzene | 1.3E+05 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | Bromochloromethane | 1.7E+05 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | Bromodichloromethane | 6.3E+02 | µg/L | 31 | 5 | 16 | 0.25 | 100 | 8.0 |
| | Bromoform | 8.0E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | Bromomethane | 8.2E+00 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 69 |
| | 2-Butanone | 9.6E+08 | µg/L | 17 | 0 | 0 | 2.5 | 500 | 0 |
| | n-Butylbenzene | 4.3E+05 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | sec-Butylbenzene | 1.6E+07 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | tert-Butylbenzene | 2.6E+05 | µg/L | 31 | 2 | 6.5 | 0.22 | 250 | 0 |
| | Carbon tetrachloride | 1.8E+02 | µg/L | 31 | 26 | 84 | 0.25 | 250 | 20 |
| | Chlorobenzene | 1.6E+05 | µg/L | 31 | 13 | 42 | 0.25 | 100 | 0 |
| | Chloroethane | 7.0E+06 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | Chloroform | 1.9E+02 | µg/L | 31 | 31 | 100 | -- | -- | -- |
| | Chloromethane | 2.7E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 2-Chlorotoluene | 1.1E+05 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 4-Chlorotoluene | 1.0E+05 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | Cumene | 5.0E+03 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | p-Cymene | 2.8E+03 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | 2,3-Dimethylpentane | 5.6E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | 2,4-Dimethylpentane | 5.1E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | Dimethyl disulfide | -- | µg/L | 16 | 2 | 12 | 0.50 | 100 | -- |
| | 1,2-Dibromo-3-chloropropane | 1.5E+01 | µg/L | 30 | 2 | 6.7 | 0.0050 | 250 | 64 |
| VOCs | Dibromochloromethane | -- | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | -- |
| | 1,2-Dibromoethane | 1.2E+02 | µg/L | 30 | 2 | 6.7 | 0.010 | 100 | 11 |

## TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater – Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Minimum SQL | Maximum SQL | % Above 10% of Screen |
| | Dibromomethane | 3.9E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | 1,2-Dichlorobenzene | 1.3E+06 | µg/L | 31 | 11 | 35 | 0.25 | 100 | 0 |
| | 1,3-Dichlorobenzene | 1.3E+06 | µg/L | 31 | 7 | 23 | 0.25 | 100 | 0 |
| | 1,4-Dichlorobenzene | 1.3E+03 | µg/L | 31 | 12 | 39 | 0.25 | 100 | 0 |
| | Dichlorodifluoromethane | 1.1E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 1,1-Dichloroethane | 3.4E+03 | µg/L | 31 | 9 | 29 | 0.25 | 100 | 0 |
| | 1,2-Dichloroethane | 7.6E+02 | µg/L | 31 | 4 | 13 | 0.25 | 100 | 7.0 |
| | 1,1-Dichloroethene | 7.1E+04 | µg/L | 31 | 15 | 48 | 0.84 | 250 | 0 |
| | cis-1,2-Dichloroethene | -- | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | -- |
| | trans-1,2-Dichloroethene | -- | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | -- |
| | 1,2-Dichloropropane | 1.0E+03 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | 1,3-Dichloropropane | 1.0E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 2,2-Dichloropropane | 2.0E+03 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | 1,1-Dichloropropene | 1.4E+02 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 17 |
| | cis-1,3-Dichloropropene | 5.8E+02 | µg/L | 31 | 2 | 6.5 | 0.22 | 100 | 7.0 |
| | trans-1,3-Dichloropropene | 5.8E+02 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 7.0 |
| | 2,2-Dimethylpentane | 3.1E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | 3,3-Dimethylpentane | 5.3E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | 1,4-Dioxane | 3.7E+05 | µg/L | 15 | 8 | 53 | 0.50 | 10 | 0 |
| | Ethanol | 4.6E+10 | µg/L | 1 | 0 | 0 | 500 | 500 | 0 |
| | Ethyl benzene | 1.8E+03 | µg/L | 30 | 2 | 6.7 | 0.25 | 100 | 0 |
| | 3-Ethylpentane | 4.3E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | Formaldehyde | 3.9E+05 | µg/L | 1 | 1 | 100 | -- | -- | -- |
| | n-Heptane | 3.6E+04 | µg/L | 2 | 0 | 0 | 100 | 250 | 0 |
| | 2-Hexanone | 1.6E+06 | µg/L | 8 | 0 | 0 | 8.5 | 500 | 0 |
| | 3-Methylhexane | 4.1E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | Methyl tert-butyl ether | 1.4E+05 | µg/L | 7 | 0 | 0 | 1.0 | 250 | 0 |
| | 4-Methyl-2-pentanone | 1.6E+08 | µg/L | 8 | 0 | 0 | 4.9 | 500 | 0 |
| | Methylene Chloride | 9.3E+05 | µg/L | 31 | 5 | 16 | 0.88 | 250 | 0 |
| | 2-Methylhexane | 2.0E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | n-Nonyl aldehyde | 7.9E+04 | µg/L | 2 | 1 | 50 | 250 | 250 | 0 |
| | Diisopropyl ether | 2.3E+06 | µg/L | 5 | 0 | 0 | 1.0 | 5.0 | 0 |
| VOCs | n-Propylbenzene | 1.0E+06 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | Styrene | 4.4E+06 | µg/L | 31 | 2 | 6.5 | 0.20 | 100 | 0 |
| | 2,2,3-Trimethylbutane | 4.3E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |

## TABLE 4-8. Evaluation of Sample Quantitation Limits for Shallow Groundwater – Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Risk-Based Concentration [1] | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Minimum SQL | Maximum SQL | % Above 10% of Screen |
| | 1,1,1,2-Tetrachloroethane | 1.0E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 1,1,2,2-Tetrachloroethane | 1.3E+03 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | Tetrachloroethene | 7.7E+03 | µg/L | 31 | 10 | 32 | 0.25 | 100 | 0 |
| | Toluene | 7.8E+06 | µg/L | 31 | 5 | 16 | 0.25 | 100 | 0 |
| | 1,2,3-Trichlorobenzene | 1.9E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 1,2,4-Trichlorobenzene | 3.5E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 1,3,5-Trichlorobenzene | 7.8E+03 | µg/L | 2 | 0 | 0 | 40 | 100 | 0 |
| | 1,1,1-Trichloroethane | 3.3E+06 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | 1,1,2-Trichloroethane | 1.7E+03 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | Trichloroethene | 7.5E+02 | µg/L | 31 | 14 | 45 | 0.52 | 100 | 12 |
| | Trichlorofluoromethane | 6.9E+04 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0 |
| | 1,2,3-Trichloropropane | 1.6E+02 | µg/L | 31 | 10 | 32 | 0.0025 | 500 | 38 |
| | 1,2,4-Trimethylbenzene | 1.4E+05 | µg/L | 31 | 2 | 6.5 | 0.23 | 100 | 0 |
| | 1,3,5-Trimethylbenzene | 1.1E+05 | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0 |
| | Vinyl chloride | 1.8E+02 | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 28 |
| | o-Xylene | 2.0E+05 | µg/L | 29 | 2 | 6.9 | 0.25 | 100 | 0 |
| | m,p-Xylene | -- | µg/L | 29 | 2 | 6.9 | 0.50 | 100 | -- |
| | Xylenes (total) | 1.8E+05 | µg/L | 2 | 0 | 0 | 10 | 10 | 0 |
| | Ethyl tert-butyl ether | 1.5E+07 | µg/L | 14 | 0 | 0 | 0.25 | 6.3 | 0 |
| | tert Butyl alcohol | 1.1E+10 | µg/L | 5 | 0 | 0 | 5.0 | 100 | 0 |

**Notes:**

-- = not available

µg/L = microgram per liter

RBC = Risk-Based Concentration

SQL = sample quantitation limit

SVOC = Semivolatile organic compound

VOC = Volatile organic compound

[1] Risk-Based Concentrations (RBCs) used in this evaluation are the lowest groundwater RBCs based on vapor migration from groundwater to air for indoor workers, outdoor workers and construction workers for Parcel F.

### TABLE 4-9. Summary Statistics for Shallow Groundwater – Parcel F
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| SVOCs | Acenaphthene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Acenaphthylene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Aniline | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Anthracene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Azobenzene | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Diphenyl sulfone | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | Diphenyl sulfide | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | Benzidine | µg/L | 5 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Benzo(a)anthracene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Benzo(a)pyrene | µg/L | 14 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Benzo(b)fluoranthene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Benzo(g,h,i)perylene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Benzo(k)fluoranthene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Benzoic acid | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Benzyl alcohol | µg/L | 10 | 1 | 10 | 19 | 19 | 7.1 | 7.1 | 7.1 | 7.1 | -- | -- | TR-6 |
| | bis(2-Ethylhexyl)phthalate | µg/L | 15 | 3 | 20 | 4.7 | 49 | 0.24 | 3.2 | 1.5 | 1.6 | 1.5 | 0.90 | M-92 |
| | bis(2-Chloroethoxy)methane | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | bis(2-Chloroethyl) ether | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Bromophenyl-phenyl ether | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Butylbenzylphthalate | µg/L | 15 | 0 | 0 | 4.7 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chloro-3-methylphenol | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chloroaniline | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Chloronaphthalene | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Chlorophenol | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorophenyl methyl sulfone | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorophenyl-phenyl ether | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorothioanisole | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorothiophenol | µg/L | 4 | 0 | 0 | 190 | 190 | -- | -- | -- | -- | -- | -- | -- |
| | Chrysene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Diphenyl disulfide | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | Di-n-butylphthalate | µg/L | 15 | 0 | 0 | 4.7 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Di-n-octylphthalate | µg/L | 15 | 0 | 0 | 4.7 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Dibenz(a,h)anthracene | µg/L | 15 | 0 | 0 | 0.19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Dibenzofuran | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 3,3'-Dichlorobenzidine | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 2,2'-/4,4'-Dichlorobenzil | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | 4,4'-Dichlorobenzophenone | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dichlorophenol | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Diethylphthalate | µg/L | 15 | 0 | 0 | 4.7 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dimethylphenol | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |

## TABLE 4-9. Summary Statistics for Shallow Groundwater – Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| SVOCs | Dimethylphthalate | µg/L | 15 | 0 | 0 | 4.7 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | 4,6-Dinitro-2-methylphenol | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dinitrophenol | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dinitrotoluene | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 2,6-Dinitrotoluene | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Fluoranthene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Fluorene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Hexachlorobenzene | µg/L | 5 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Hexachlorobutadiene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.38 | 1.9 | 1.1 | 1.1 | 1.1 | 0.94 | TR-6 |
| | Hexachloroethane | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Hydroxymethyl phthalimide | µg/L | 4 | 0 | 0 | 190 | 190 | -- | -- | -- | -- | -- | -- | -- |
| | Indeno(1,2,3-cd)pyrene | µg/L | 15 | 0 | 0 | 0.19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Isophorone | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Benzophenone | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Methylnaphthalene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Methylphenol | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Methylphenol | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Naphthalene | µg/L | 31 | 2 | 6.5 | 0.19 | 25 | 0.41 | 2.0 | 1.2 | 1.2 | 1.1 | 0.93 | TR-6 |
| | 2-Nitroaniline | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 3-Nitroaniline | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Nitroaniline | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Nitrobenzene | µg/L | 15 | 0 | 0 | 0.19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Nitrophenol | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Nitrophenol | µg/L | 10 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | n-Nitrosodimethylamine | µg/L | 4 | 0 | 0 | 19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | n-Nitrosodiphenylamine | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | n-Nitroso-di-n-propylamine | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Octachlorostyrene | µg/L | 9 | 0 | 0 | 0.19 | 19 | -- | -- | -- | -- | -- | -- | -- |
| | Pentachlorobenzene | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | Phenanthrene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Phenol | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| | Pyrene | µg/L | 15 | 0 | 0 | 0.19 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Pyridine | µg/L | 9 | 0 | 0 | 1.9 | 20 | -- | -- | -- | -- | -- | -- | -- |
| | bis(4-Chlorophenyl) sulfone | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2,4,5-Tetrachlorobenzene | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | bis(4-Chlorophenyl) disulfide | µg/L | 4 | 0 | 0 | 9.4 | 9.5 | -- | -- | -- | -- | -- | -- | -- |
| | bis(2-Chloro-1-methylethyl) ether | µg/L | 10 | 0 | 0 | 9.4 | 9.7 | -- | -- | -- | -- | -- | -- | -- |
| VOCs | Acetaldehyde | µg/L | 1 | 0 | 0 | 30 | 30 | -- | -- | -- | -- | -- | -- | -- |
| | Acetone | µg/L | 8 | 2 | 25 | 9.5 | 500 | 1.9 | 6.2 | 4.0 | 4.0 | 3.0 | 0.75 | M-92 |

## TABLE 4-9. Summary Statistics for Shallow Groundwater – Parcel F
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| VOCs | t-Amyl methyl ether | µg/L | 5 | 0 | 0 | 1.0 | 5.0 | -- | -- | -- | -- | -- | -- | -- |
| | Benzene | µg/L | 31 | 12 | 39 | 0.25 | 100 | 0.28 | 1300 | 70 | 230 | 380 | 1.7 | TR-6 |
| | Bromobenzene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.27 | 1.4 | 0.83 | 0.83 | 0.80 | 0.96 | TR-6 |
| | Bromochloromethane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.40 | 2.0 | 1.2 | 1.2 | 1.1 | 0.94 | TR-6 |
| | Bromodichloromethane | µg/L | 31 | 5 | 16 | 0.25 | 100 | 0.28 | 1.5 | 0.32 | 0.59 | 0.52 | 0.89 | TR-6 |
| | Bromoform | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.40 | 2.0 | 1.2 | 1.2 | 1.1 | 0.94 | TR-6 |
| | Bromomethane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.42 | 2.1 | 1.3 | 1.3 | 1.2 | 0.94 | TR-6 |
| | 2-Butanone | µg/L | 17 | 0 | 0 | 2.5 | 500 | -- | -- | -- | -- | -- | -- | -- |
| | n-Butylbenzene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.37 | 1.8 | 1.1 | 1.1 | 1.0 | 0.93 | TR-6 |
| | sec-Butylbenzene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.25 | 1.2 | 0.72 | 0.72 | 0.67 | 0.93 | TR-6 |
| | tert-Butylbenzene | µg/L | 31 | 2 | 6.5 | 0.22 | 250 | 0.22 | 1.1 | 0.66 | 0.66 | 0.62 | 0.94 | TR-6 |
| | Carbon tetrachloride | µg/L | 31 | 26 | 84 | 0.25 | 250 | 0.29 | 110 | 30 | 31 | 33 | 1.0 | TR-6 |
| | Chlorobenzene | µg/L | 31 | 13 | 42 | 0.25 | 100 | 0.36 | 2200 | 100 | 380 | 620 | 1.6 | TR-6 |
| | Chloroethane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.40 | 2.0 | 1.2 | 1.2 | 1.1 | 0.94 | TR-6 |
| | Chloroform | µg/L | 31 | 31 | 100 | -- | -- | 5.9 | 3600 | 1,200 | 1,300 | 1,300 | 0.98 | TR-6 |
| | Chloromethane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.40 | 2.0 | 1.2 | 1.2 | 1.1 | 0.94 | TR-6 |
| | 2-Chlorotoluene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.28 | 1.4 | 0.84 | 0.84 | 0.79 | 0.94 | TR-6 |
| | 4-Chlorotoluene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.29 | 1.4 | 0.84 | 0.84 | 0.78 | 0.93 | TR-6 |
| | Cumene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.25 | 1.2 | 0.72 | 0.72 | 0.67 | 0.93 | TR-6 |
| | p-Cymene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.28 | 1.4 | 0.84 | 0.84 | 0.79 | 0.94 | TR-6 |
| | 2,3-Dimethylpentane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dimethylpentane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | Dimethyl disulfide | µg/L | 16 | 2 | 12 | 0.50 | 100 | 0.50 | 2.5 | 1.5 | 1.5 | 1.4 | 0.94 | TR-6 |
| | 1,2-Dibromo-3-chloropropane | µg/L | 30 | 2 | 6.7 | 0.0050 | 250 | 0.97 | 4.8 | 2.9 | 2.9 | 2.7 | 0.94 | TR-6 |
| | Dibromochloromethane | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.40 | 2.0 | 1.2 | 1.2 | 1.1 | 0.94 | TR-6 |
| | 1,2-Dibromoethane | µg/L | 30 | 2 | 6.7 | 0.010 | 100 | 0.40 | 2.0 | 1.2 | 1.2 | 1.1 | 0.94 | TR-6 |
| | Dibromomethane | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.36 | 1.8 | 1.1 | 1.1 | 1.0 | 0.94 | TR-6 |
| | 1,2-Dichlorobenzene | µg/L | 31 | 11 | 35 | 0.25 | 100 | 0.32 | 150 | 23 | 43 | 45 | 1.0 | TR-6 |
| | 1,3-Dichlorobenzene | µg/L | 31 | 7 | 23 | 0.25 | 100 | 0.35 | 9.6 | 1.9 | 3.5 | 3.7 | 1.1 | TR-6 |
| | 1,4-Dichlorobenzene | µg/L | 31 | 12 | 39 | 0.25 | 100 | 0.37 | 280 | 44 | 79 | 86 | 1.1 | TR-6 |
| | Dichlorodifluoromethane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.26 | 1.3 | 0.78 | 0.78 | 0.74 | 0.94 | TR-6 |
| | 1,1-Dichloroethane | µg/L | 31 | 9 | 29 | 0.25 | 100 | 0.25 | 2.0 | 0.30 | 0.56 | 0.56 | 1.0 | TR-6 |
| | 1,2-Dichloroethane | µg/L | 31 | 4 | 13 | 0.25 | 100 | 0.27 | 1.4 | 0.29 | 0.56 | 0.56 | 1.0 | TR-6 |
| | 1,1-Dichloroethene | µg/L | 31 | 15 | 48 | 0.84 | 250 | 2.1 | 130 | 9.0 | 29 | 42 | 1.5 | M-97 |
| | cis-1,2-Dichloroethene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.32 | 1.6 | 0.96 | 0.96 | 0.91 | 0.94 | TR-6 |
| | trans-1,2-Dichloroethene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.30 | 1.5 | 0.90 | 0.90 | 0.85 | 0.94 | TR-6 |
| | 1,2-Dichloropropane | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.35 | 1.8 | 1.1 | 1.1 | 1.0 | 0.95 | TR-6 |
| | 1,3-Dichloropropane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.32 | 1.6 | 0.96 | 0.96 | 0.91 | 0.94 | TR-6 |
| | 2,2-Dichloropropane | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.34 | 1.7 | 1.0 | 1.0 | 0.96 | 0.94 | TR-6 |
| | 1,1-Dichloropropene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.28 | 1.4 | 0.84 | 0.84 | 0.79 | 0.94 | TR-6 |

**TABLE 4-9. Summary Statistics for Shallow Groundwater – Parcel F**
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| VOCs | cis-1,3-Dichloropropene | µg/L | 31 | 2 | 6.5 | 0.22 | 100 | 0.22 | 1.1 | 0.66 | 0.66 | 0.62 | 0.94 | TR-6 |
| | trans-1,3-Dichloropropene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.32 | 1.6 | 0.96 | 0.96 | 0.91 | 0.94 | TR-6 |
| | 2,2-Dimethylpentane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | 3,3-Dimethylpentane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | 1,4-Dioxane | µg/L | 15 | 8 | 53 | 0.50 | 10 | 0.37 | 5.9 | 2.9 | 3.0 | 1.9 | 0.66 | M-97 |
| | Ethanol | µg/L | 1 | 0 | 0 | 500 | 500 | -- | -- | -- | -- | -- | -- | -- |
| | Ethyl benzene | µg/L | 30 | 2 | 6.7 | 0.25 | 100 | 0.25 | 1.2 | 0.72 | 0.72 | 0.67 | 0.93 | TR-6 |
| | 3-Ethylpentane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | Formaldehyde | µg/L | 1 | 1 | 100 | -- | -- | 60 | 60 | 60 | 60 | -- | -- | TR-6 |
| | n-Heptane | µg/L | 2 | 0 | 0 | 100 | 250 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Hexanone | µg/L | 8 | 0 | 0 | 8.5 | 500 | -- | -- | -- | -- | -- | -- | -- |
| | 3-Methylhexane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | Methyl tert-butyl ether | µg/L | 7 | 0 | 0 | 1.0 | 250 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Methyl-2-pentanone | µg/L | 8 | 0 | 0 | 4.9 | 500 | -- | -- | -- | -- | -- | -- | -- |
| | Methylene Chloride | µg/L | 31 | 5 | 16 | 0.88 | 250 | 0.85 | 22 | 1.8 | 6.1 | 9.0 | 1.5 | TR-6 |
| | 2-Methylhexane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | n-Nonyl aldehyde | µg/L | 2 | 1 | 50 | 250 | 250 | 120 | 120 | 120 | 120 | -- | -- | TR-6 |
| | Diisopropyl ether | µg/L | 5 | 0 | 0 | 1.0 | 5.0 | -- | -- | -- | -- | -- | -- | -- |
| | n-Propylbenzene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.27 | 1.4 | 0.83 | 0.83 | 0.80 | 0.96 | TR-6 |
| | Styrene | µg/L | 31 | 2 | 6.5 | 0.20 | 100 | 0.20 | 1.0 | 0.60 | 0.60 | 0.57 | 0.94 | TR-6 |
| | 2,2,3-Trimethylbutane | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1,1,2-Tetrachloroethane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.27 | 1.4 | 0.83 | 0.83 | 0.80 | 0.96 | TR-6 |
| | 1,1,2,2-Tetrachloroethane | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.30 | 1.5 | 0.90 | 0.90 | 0.85 | 0.94 | TR-6 |
| | Tetrachloroethene | µg/L | 31 | 10 | 32 | 0.25 | 100 | 0.32 | 9.5 | 3.3 | 4.1 | 2.8 | 0.69 | TR-6 |
| | Toluene | µg/L | 31 | 5 | 16 | 0.25 | 100 | 0.36 | 5.0 | 0.76 | 1.7 | 1.9 | 1.1 | M-92 |
| | 1,2,3-Trichlorobenzene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.30 | 1.5 | 0.90 | 0.90 | 0.85 | 0.94 | TR-6 |
| | 1,2,4-Trichlorobenzene | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.48 | 2.4 | 1.4 | 1.4 | 1.4 | 0.94 | TR-6 |
| | 1,3,5-Trichlorobenzene | µg/L | 2 | 0 | 0 | 40 | 100 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1,1-Trichloroethane | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.30 | 1.5 | 0.90 | 0.90 | 0.85 | 0.94 | TR-6 |
| | 1,1,2-Trichloroethane | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.30 | 1.5 | 0.90 | 0.90 | 0.85 | 0.94 | TR-6 |
| | Trichloroethene | µg/L | 31 | 14 | 45 | 0.52 | 100 | 1.3 | 18 | 4.2 | 6.3 | 5.1 | 0.82 | M-97 |
| | Trichlorofluoromethane | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.34 | 1.7 | 1.0 | 1.0 | 0.96 | 0.94 | TR-6 |
| | 1,2,3-Trichloropropane | µg/L | 31 | 10 | 32 | 0.0025 | 500 | 0.0027 | 2.0 | 0.27 | 0.42 | 0.57 | 1.4 | TR-6 |
| | 1,2,4-Trimethylbenzene | µg/L | 31 | 2 | 6.5 | 0.23 | 100 | 0.23 | 1.2 | 0.71 | 0.71 | 0.69 | 0.96 | TR-6 |
| | 1,3,5-Trimethylbenzene | µg/L | 31 | 2 | 6.5 | 0.25 | 100 | 0.26 | 1.3 | 0.78 | 0.78 | 0.74 | 0.94 | TR-6 |
| | Vinyl chloride | µg/L | 31 | 2 | 6.5 | 0.25 | 250 | 0.40 | 2.0 | 1.2 | 1.2 | 1.1 | 0.94 | TR-6 |

## TABLE 4-9. Summary Statistics for Shallow Groundwater – Parcel F

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

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum SQL | Maximum SQL | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum Detect |
| VOCs | o-Xylene | µg/L | 29 | 2 | 6.9 | 0.25 | 100 | 0.30 | 1.5 | 0.90 | 0.90 | 0.85 | 0.94 | TR-6 |
| | m,p-Xylene | µg/L | 29 | 2 | 6.9 | 0.50 | 100 | 0.60 | 3.0 | 1.8 | 1.8 | 1.7 | 0.94 | TR-6 |
| | Xylenes (total) | µg/L | 2 | 0 | 0 | 10 | 10 | -- | -- | -- | -- | -- | -- | -- |
| | Ethyl tert-butyl ether | µg/L | 14 | 0 | 0 | 0.25 | 6.3 | -- | -- | -- | -- | -- | -- | -- |
| | tert Butyl alcohol | µg/L | 5 | 0 | 0 | 5.0 | 100 | -- | -- | -- | -- | -- | -- | -- |

**Notes:**

-- = not available

µg/L = microgram per liter

SQL = sample quantitation limit

SVOC = Semivolatile organic compound

VOC = Volatile organic compound

## TABLE 5-1. Concentration/Toxicity Screen – Parcel F Soil

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Detects | | Screening Level [1] | Screening Level Note | No. of Samples > 0.1 x Screening Level | Cocentration/ Toxicity Screen Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Maximum | Location of Maximum | | | | |
| Chlorine Oxyanions | Chlorate | mg/kg | 45 | 32 | 71 | 310 | TSB-FR-02-02 | 38,900 | -- | 0 | Pass |
| | Perchlorate | mg/kg | 45 | 42 | 93 | 168 | TSB-FJ-06 | 908 | -- | 2 | Fail |
| Metals | Aluminum | mg/kg | 41 | 41 | 100 | 12,000 | TSB-FR-01 | 1,240,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Antimony | mg/kg | 45 | 34 | 76 | 0.32 | TSB-FJ-06 | 519 | -- | 0 | Pass |
| | Arsenic | mg/kg | 44 | 44 | 100 | 6.9 | TSB-FJ-06 | 7.2 | maximum BRC/TIMET background | -- | Pass |
| | Barium | mg/kg | 45 | 45 | 100 | 1,400 | TSB-FJ-06-02 | 238,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Beryllium | mg/kg | 41 | 41 | 100 | 0.84 | TSB-FR-01 | 2,540 | -- | 0 | Pass |
| | Boron | mg/kg | 45 | 17 | 38 | 14 | RI-19 | 259,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Cadmium | mg/kg | 45 | 14 | 31 | 0.42 | TSB-FR-02-02 | 1,260 | -- | 0 | Pass |
| | Calcium | mg/kg | 41 | 41 | 100 | 97,000 | TSB-FR-02 | N/A | -- | N/A | N/A |
| | Chromium (total) | mg/kg | 45 | 45 | 100 | 19 | TSB-FR-01 | 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 | 45 | 1 | 2.2 | 0.55 | TSB-FJ-06-02 | 7.0 | -- | 0 | Pass |
| | Cobalt | mg/kg | 45 | 45 | 100 | 11 | TSB-FR-01 | 385 | -- | 0 | Pass |
| | Copper | mg/kg | 45 | 45 | 100 | 25 | TSB-FJ-06 | 36,700 | -- | 0 | Pass |
| | Iron | mg/kg | 45 | 45 | 100 | 23,000 | RI-19 | 908,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Lead | mg/kg | 45 | 45 | 100 | 140 | TSB-FR-02-02 | 800 | -- | -- | Pass |
| | Lithium | mg/kg | 41 | 38 | 93 | 23 | TSB-FR-02-02 | 2,600 | -- | 0 | Pass |
| | Magnesium | mg/kg | 45 | 45 | 100 | 19,000 | TSB-FR-02-02 | 5,200,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Manganese | mg/kg | 45 | 45 | 100 | 920 | TSB-FR-02-02 | 28,100 | -- | 0 | Pass |
| | Mercury | mg/kg | 45 | 16 | 36 | 1.0 | RI-19 | 389 | mercury compounds BCL is used | 0 | Pass |
| | Molybdenum | mg/kg | 45 | 25 | 56 | 1.5 | TSB-FR-02-02 | 6,490 | -- | 0 | Pass |
| | Nickel | mg/kg | 45 | 45 | 100 | 23 | TSB-FR-01 | 24,700 | -- | 0 | Pass |
| | Niobium | mg/kg | 43 | 2 | 4.7 | 9.9 | TSB-FR-01 | 130 | -- | 0 | Pass |
| | Palladium | mg/kg | 41 | 41 | 100 | 2.1 | TSB-FJ-02-02 | N/A | -- | N/A | N/A |
| | Phosphorus (total) | mg/kg | 45 | 45 | 100 | 1,400 | TSB-FR-01 | 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 | 41 | 7 | 17 | 2.4 | TSB-FJ-02-02 | 649 | -- | 0 | Pass |
| | Potassium | mg/kg | 41 | 41 | 100 | 3,900 | TSB-FR-01 | N/A | -- | N/A | N/A |
| | Silicon | mg/kg | 41 | 41 | 100 | 1,000 | TSB-FJ-02-02 | N/A | -- | N/A | N/A |
| | Silver | mg/kg | 45 | 41 | 91 | 0.21 | TSB-FR-02-02 | 6,490 | -- | 0 | Pass |
| | Sodium | mg/kg | 41 | 41 | 100 | 2,900 | TSB-FJ-02 | N/A | -- | N/A | N/A |
| | Strontium | mg/kg | 45 | 45 | 100 | 360 | TSB-FJ-06-02 | 779,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Sulfur | mg/kg | 41 | 24 | 59 | 1,300 | TSB-FJ-06-02 | N/A | -- | N/A | N/A |
| | Thallium | mg/kg | 45 | 1 | 2.2 | 0.43 | TSB-FR-02-02 | 13 | -- | 0 | Pass |
| | Tin | mg/kg | 41 | 38 | 93 | 1.1 | TSB-FJ-06 | 779,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Titanium | mg/kg | 41 | 41 | 100 | 1,000 | TSB-FR-01 | 5,190,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Tungsten | mg/kg | 43 | 3 | 7.0 | 9.0 | TSB-FJ-02-02 | 1,040 | -- | 0 | Pass |
| | Uranium (total) | mg/kg | 41 | 41 | 100 | 3.2 | TSB-FR-01 | 3,830 | -- | 0 | Pass |
| | Vanadium | mg/kg | 41 | 41 | 100 | 72 | RI-19 | 6,420 | -- | 0 | Pass |
| | Zinc | mg/kg | 41 | 41 | 100 | 67 | TSB-FJ-06 | 389,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Zirconium | mg/kg | 45 | 33 | 73 | 36 | TSB-FR-01 | 104 | -- | 32 | Fail |
| Other Inorganics | Bromide | mg/kg | 41 | 5 | 12 | 10 | TSB-FJ-10 | 441,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Chloride | mg/kg | 41 | 41 | 100 | 18,000 | TSB-FR-02-02 | 113,000 | Use health-based BCL instead of non-health based upper-limit (consider chloride as non-volatile) | 1 | Fail |
| | Fluoride | mg/kg | 41 | 20 | 49 | 3.0 | TSB-FR-02-02 | 51,900 | -- | 0 | Pass |
| | Nitrate | mg/kg | 45 | 45 | 100 | 350 | TSB-FR-02-02 | 2,080,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |

## TABLE 5-1. Concentration/Toxicity Screen – Parcel F Soil

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Detects | | Screening Level [1] | Screening Level Note | No. of Samples > 0.1 x Screening Level | Cocentration/ Toxicity Screen Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Maximum | Location of Maximum | | | | |
| Other Inorganics | Nitrate/Nitrite | mg/kg | 4 | 4 | 100 | 24 | RI-19 | 130,000 | minimum BCL of nitrate and nitrite, use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Nitrite | mg/kg | 21 | 2 | 9.5 | 11 | TSB-FR-01 | 130,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Sulfate | mg/kg | 41 | 41 | 100 | 2,300 | TSB-FJ-08 | N/A | -- | N/A | N/A |
| | ortho-Phosphate | mg/kg | 41 | 3 | 7.3 | 6.3 | TSB-FR-01 | 30,400,000 | Use phosphoric acid as a surrogate, use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| Radionuclides | Radium-226 | pCi/g | 45 | 45 | 100 | 2.3 | TSB-FR-02-02 | 0.023 | -- | 45 | Fail |
| | Radium-228 | pCi/g | 45 | 45 | 100 | 14 | TSB-FR-02-02 | 0.041 | -- | 45 | Fail |
| | Thorium-228 | pCi/g | 45 | 45 | 100 | 2.2 | RI-19 | 0.025 | -- | 45 | Fail |
| | Thorium-230 | pCi/g | 45 | 45 | 100 | 1.7 | TSB-FR-01 | 8.4 | -- | 44 | Fail |
| | Thorium-232 | pCi/g | 45 | 45 | 100 | 2.0 | RI-19 | 7.4 | -- | 45 | Fail |
| | Uranium-234 | pCi/g | 38 | 38 | 100 | 2.6 | TSB-FJ-06 | 11 | -- | 18 | Fail |
| | Uranium-235 | pCi/g | 38 | 38 | 100 | 0.11 | TSB-FJ-06-02 | 0.35 | -- | 24 | Fail |
| | Uranium-238 | pCi/g | 38 | 38 | 100 | 1.8 | TSB-FJ-06 | 1.4 | -- | 38 | Fail |
| Dioxin/Furans | 2,3,7,8-TCDD TEQ* | mg/kg | 34 | 16 | 47 | 0.0013 | TSB-FR-02 | 0.0027 | Site-specific action level | -- | Pass |
| Other Organics | Phthalic acid | mg/kg | 41 | 2 | 4.9 | 0.76 | TSB-FJ-06-02 | 1,830,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| PAHs | Acenaphthene | mg/kg | 45 | 1 | 2.2 | 0.23 | TSB-FJ-06-02 | 118 | -- | 0 | Pass |
| | Acenaphthylene | mg/kg | 45 | 1 | 2.2 | 0.10 | TSB-FJ-06-02 | 118 | Use acenaphthene as a surrogate | 0 | Pass |
| | BaPEq* | mg/kg | 45 | 5 | 11 | 0.41 | TSB-FJ-06-02 | 0.32 | -- | 4 | Fail |
| | Fluoranthene | mg/kg | 45 | 5 | 11 | 0.097 | TSB-FR-04 | 33,700 | -- | 0 | Pass |
| | Naphthalene | mg/kg | 45 | 1 | 2.2 | 0.010 | RI-19 | 18 | -- | 0 | Pass |
| | Phenanthrene | mg/kg | 45 | 4 | 8.9 | 0.96 | TSB-FR-04 | 25 | -- | 0 | Pass |
| | Pyrene | mg/kg | 45 | 5 | 11 | 0.30 | TSB-FR-04 | 44 | -- | 0 | Pass |
| PCBs | Aroclor-1248 | mg/kg | 20 | 1 | 5.0 | 0.074 | TSB-FJ-03 | 1.1 | -- | 0 | Pass |
| | Aroclor-1254 | mg/kg | 20 | 1 | 5.0 | 0.29 | TSB-FJ-06-02 | 1.1 | -- | 1 | Fail |
| Pesticides - OCPs | alpha-BHC | mg/kg | 45 | 6 | 13 | 0.059 | TSB-FR-02 | 0.49 | -- | 1 | Fail |
| | beta-BHC | mg/kg | 45 | 16 | 36 | 0.14 | TSB-FR-02 | 1.7 | -- | 0 | Pass |
| | 4,4'-DDD | mg/kg | 45 | 1 | 2.2 | 0.013 | TSB-FR-02-02 | 15 | -- | 0 | Pass |
| | 2,4'-DDE | mg/kg | 45 | 5 | 11 | 0.020 | TSB-FJ-06-02 | 9.5 | Use 4,4'-DDE as a surrogate | 0 | Pass |
| | 4,4'-DDE | mg/kg | 45 | 10 | 22 | 0.18 | TSB-FR-02-02 | 9.5 | -- | 0 | Pass |
| | 4,4'-DDT | mg/kg | 45 | 8 | 18 | 0.26 | TSB-FR-02-02 | 7.5 | -- | 0 | Pass |
| | Endrin aldehyde | mg/kg | 45 | 2 | 4.4 | 0.020 | TSB-FJ-06 | 30 | Use endrin as a surrogate | 0 | Pass |
| SVOCs | Acetophenone | mg/kg | 41 | 2 | 4.9 | 0.062 | TSB-FJ-06 | 2,520 | -- | 0 | Pass |
| | Benzoic acid | mg/kg | 45 | 2 | 4.4 | 0.32 | TSB-FR-02 | 3,670,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | Benzyl alcohol | mg/kg | 45 | 2 | 4.4 | 0.34 | TSB-FJ-06 | 91,600 | -- | 0 | Pass |
| | bis(2-Ethylhexyl)phthalate | mg/kg | 45 | 4 | 8.9 | 1.4 | TSB-FJ-09 | 183 | -- | 0 | Pass |
| | Carbazole | mg/kg | 41 | 1 | 2.4 | 0.068 | TSB-FR-02 | 128 | -- | 0 | Pass |
| | Di-n-butylphthalate | mg/kg | 45 | 4 | 8.9 | 5.2 | TSB-FJ-06-02 | 91,600 | -- | 0 | Pass |
| | Di-n-octylphthalate | mg/kg | 45 | 2 | 4.4 | 0.28 | TSB-FJ-06 | 9,160 | -- | 0 | Pass |
| | Hydroxymethyl phthalimide | mg/kg | 41 | 2 | 4.9 | 0.15 | TSB-FJ-06-02 | N/A | -- | N/A | N/A |
| VOCs | Acetone | mg/kg | 45 | 12 | 27 | 1.9 | TSB-FJ-10 | 1,040,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | 2-Butanone | mg/kg | 45 | 3 | 6.7 | 0.013 | TSB-FJ-10 | 28,400 | -- | 0 | Pass |
| | Chloroform | mg/kg | 45 | 1 | 2.2 | 0.00065 | RI-18 | 1.5 | -- | 0 | Pass |
| | Ethyl benzene | mg/kg | 45 | 2 | 4.4 | 0.00048 | TSB-FJ-10 | 233 | -- | 0 | Pass |
| | 2-Hexanone | mg/kg | 45 | 2 | 4.4 | 0.0071 | TSB-FJ-06 | 1,650 | -- | 0 | Pass |
| | Methylene Chloride | mg/kg | 45 | 16 | 36 | 0.021 | TSB-FJ-02-02 | 1,550 | -- | 0 | Pass |

## TABLE 5-1. Concentration/Toxicity Screen – Parcel F Soil
### Nevada Environmental Response Trust Site
### Henderson, Nevada

| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Detects | | Screening Level [1] | Screening Level Note | No. of Samples > 0.1 x Screening Level | Cocentration/ Toxicity Screen Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Maximum | Location of Maximum | | | | |
| VOCs | n-Nonyl aldehyde | mg/kg | 41 | 1 | 2.4 | 0.0033 | TSB-FJ-07 | 380 | Use acetaldehyde as a surrogate (noncancer endpoint) | 0 | Pass |
| | Phenol | mg/kg | 45 | 2 | 4.4 | 0.44 | TSB-FJ-06 | 275,000 | Use health-based BCL instead of non-health based upper-limit | 0 | Pass |
| | n-Propylbenzene | mg/kg | 45 | 1 | 2.2 | 0.0014 | TSB-FJ-10 | 264 | -- | 0 | Pass |
| | Toluene | mg/kg | 45 | 1 | 2.2 | 0.00047 | TSB-FJ-06 | 817 | -- | 0 | Pass |
| | 1,2,4-Trimethylbenzene | mg/kg | 45 | 7 | 16 | 0.0086 | TSB-FJ-10 | 218 | -- | 0 | Pass |
| | 1,3,5-Trimethylbenzene | mg/kg | 45 | 3 | 6.7 | 0.0038 | TSB-FJ-10 | 182 | -- | 0 | Pass |
| | m,p-Xylene | mg/kg | 45 | 3 | 6.7 | 0.0026 | TSB-FJ-10 | 387 | minimum BCL of m-xylene and p-xylene | 0 | Pass |
| | o-Xylene | mg/kg | 45 | 2 | 4.4 | 0.00083 | TSB-FJ-06 | 434 | -- | 0 | Pass |
| | Xylenes (total) | mg/kg | 41 | 2 | 4.9 | 0.0034 | TSB-FJ-10 | 259 | -- | 0 | Pass |

**Notes:**

-- = Not applicable
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
BHC = Hexachlorocyclohexane
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
N/A = BCL (other screening value) not available for screen

NDEP = Neveda Department of Environmental Protection
OCP = Organochlorine 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
[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 0.1x screening level. If the maximum detected concentration is greater than or equal to the 0.1 x screening level, the analyte “fails” and is carried forward to Step 2. If less than the 0.1 x screening level, the analyte “passes” and is eliminated as a COPC. By default, analytes for which screening levels are not available are retained for Step 2 (metals) and Step 3 (organics).

**Source:**

NDEP. 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 Soil Background Evaluation for Metals Carried Forward from the Concentration/Toxicity Screen

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Parcel | Chemical Name | Fail Statistical Testing for Background Consistency?[1] |
|---|---|---|
| F | Calcium | Yes |
| | Palladium | NA |
| | Potassium | No |
| | Silicon | NA |
| | Sodium | Yes |
| | Sulfur | NA |
| | Zirconium | NA |

**Notes:**

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 I.

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

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Parcel | Chain | Secular Equilibrium? | Radionuclide | Fail Statistical Testing for Background Consistency?[1] | Hydrofluoric Acid Digestion? |
|---|---|---|---|---|---|
| F | Uranium-238 | in Secular Equilibrium | Uranium-238 | No | Yes |
| | | | Uranium-234 | No | |
| | | | Thorium-230 | No | |
| | | | Radium-226 | No | |
| | Thorium-232 | In Secular Equilibrium | Thorium-232 | No | Yes |
| | | | Radium-228 | Yes | |
| | | | Thorium-228 | No | |
| | Uranium-235 | -- | Uranium-235 | No | Yes |

**Notes:**

-- = Not evaluated

🟦 radionuclide is present at concentrations greater than background.

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

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

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Chain | Radionuclide | Commercial/Industrial BCL (pCi/g) | Parcel F | | RZ-A Background | | BRC/TIMET Background | |
|---|---|---|---|---|---|---|---|---|
| | | | 95% UCL (pCi/g) | Cancer Risk | 95% UCL (pCi/g) | Cancer Risk | 95% UCL (pCi/g) | Cancer Risk |
| Uranium-238 | Uranium-238 | 1.4 | 1.1 | 8.0E-07 | 1.1 | 7.8E-07 | 1.1 | 8.2E-07 |
| | Uranium-234 | 11 | 1.3 | 1.2E-07 | 1.2 | 1.0E-07 | 1.2 | 1.1E-07 |
| | Thorium-230 | 8.4 | 1.2 | 1.5E-07 | 1.2 | 1.4E-07 | 1.3 | 1.6E-07 |
| | Radium-226 | 0.023 | 1.1 | 4.7E-05 | 1.1 | 4.6E-05 | 1.2 | 5.1E-05 |
| Thorium-232 | Thorium-232 | 7.4 | 1.6 | 2.1E-07 | 1.6 | 2.1E-07 | 1.7 | 2.2E-07 |
| | Radium-228 | 0.041 | 3.0 | 7.3E-05 | 1.4 | 3.5E-05 | 2.0 | 4.9E-05 |
| | Thorium-228 | 0.025 | 1.7 | 6.8E-05 | 1.8 | 7.3E-05 | 1.7 | 6.9E-05 |
| Uranium-235 | Uranium-235 | 0.35 | 0.050 | 1.4E-07 | 0.065 | 1.9E-07 | 0.072 | 2.1E-07 |
| | | **Total Cancer Risk** | **--** | **2E-04** | **--** | **2E-04** | **--** | **2E-04** |

**Notes:**

-- = Not applicable

pCi/g = picocurie per gram

BCL = Basic Comparison Level

UCL = Upper Confidence Limit

# TABLE 5-5. Soil COPCs Identified for Parcel F (0-10 feet bgs)

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Chemical Group | COPC | Parcel F |
|---|---|---|
| Chlorine Oxyanions | Perchlorate | X |
| Metals | Palladium [1] [2] | X |
| | Zirconium [2] | X |
| Other Inorganics | Chloride | X |
| PAHs | BaPEq | X |
| PCBs | Aroclor-1254 | X |
| Pesticides - OCPs | alpha-BHC | X |
| SVOCs | Hydroxymethyl phthalimide [1] | X |
| Asbestos | Long amphibole fibers | X |
| | Long chrysotile fibers | X |

**Notes:**

BaPEq = Benzo(a)pyrene equivalent
BCL = Basic Comparison Level
bgs = below ground surface
BHC = Hexachlorocyclohexane
COPC = Chemical of Potential Concern
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
OCP = Organochlorine pesticide
SVOC = Semivolatile organic compound

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

[2] RZ-A background data are not available for this chemical. The Parcel F data are compared to BRC/TIMET regional background data in the uncertainty section.

# TABLE 5-6. Soil Gas and Shallow Groundwater COPCs Identified for Parcel F
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Chemical Group | Chemical Name [1] | Soil Gas [2] | Shallow Groundwater | Volatile Compounds? [3] |
|---|---|---|---|---|
| VOCs | Acetone | X | X | V |
| VOCs | Amyl methyl ether t- | X |  | V |
| VOCs | Benzene | X |  | V |
| VOCs | Benzyl chloride | X |  | V |
| VOCs | Bromodichloromethane | X |  | V |
| VOCs | Bromomethane | X |  | V |
| VOCs | Butanone 2 | X |  | V |
| VOCs | Butylbenzene n | X |  | V |
| VOCs | Carbon Disulfide | X |  | V |
| VOCs | Carbon Tetrachloride | X | X | V |
| VOCs | Chlorobenzene | X |  | V |
| VOCs | Chloroethane | X |  | V |
| VOCs | Chloroform | X | X | V |
| VOCs | Cyclohexane | X |  | V |
| VOCs | Cymene, p | X |  | V |
| VOCs | Dibromo-3-chloropropane, 1,2- | X |  | V |
| VOCs | Dibromochloromethane | X |  | V |
| VOCs | Dibromoethane 1,2 | X |  | V |
| VOCs | Dichlorobenzene 1,2 | X |  | V |
| VOCs | Dichlorobenzene 1,3 | X |  | V |
| VOCs | Dichlorobenzene 1,4 | X |  | V |
| VOCs | Dichlorodifluoromethane | X |  | V |
| VOCs | Dichloroethane 1,1 | X | X | V |
| VOCs | Dichloroethane 1,2 | X |  | V |
| VOCs | Dichloroethene 1,1 | X | X | V |
| VOCs | Dichloroethene 1,2 cis | X |  | V |
| VOCs | Dichloroethene 1,2 trans | X |  | V |
| VOCs | Dichloropropane 1,2 | X |  | V |
| VOCs | Dichloropropene 1,3 cis | X |  | V |
| VOCs | Dichloropropene 1,3 trans | X |  | V |
| VOCs | Dioxane 1,4 | X | X | V |
| VOCs | Disulfide, dimethyl |  | X | V |
| VOCs | Ethanol | X |  | V |
| VOCs | ether Ethyl tert-butyl | X |  | V |
| VOCs | Ethyl acetate | X |  | V |
| VOCs | Ethyl Benzene | X |  | V |
| VOCs | Ethyltoluene, 4- | X |  | V |
| VOCs | Formaldehyde |  | X | V |
| VOCs | Freon 114 | X |  | V |
| VOCs | Heptane n | X |  | V |
| VOCs | Hexane n | X |  | V |
| VOCs | Hexanone 2 | X |  | V |
| VOCs | Methyl tert butyl ether | X |  | V |
| VOCs | Methyl-2-pentanone 4 | X |  | V |
| VOCs | Methylene Chloride | X | X | V |
| VOCs | Nonyl Aldehyde n- |  | X | V |
| VOCs | Propylbenzene n | X |  | V |

# TABLE 5-6. Soil Gas and Shallow Groundwater COPCs Identified for Parcel F
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Chemical Group | Chemical Name [1] | Soil Gas [2] | Shallow Groundwater | Volatile Compounds? [3] |
|---|---|---|---|---|
| VOCs | Styrene | X | | V |
| VOCs | tert Butyl alcohol | X | | V |
| VOCs | Tetrachloroethane 1,1,1,2 | X | | V |
| VOCs | Tetrachloroethane 1,1,2,2 | X | | V |
| VOCs | Tetrachloroethene | X | X | V |
| VOCs | Toluene | X | X | V |
| VOCs | Trichlorobenzene 1,2,4 | X | | V |
| VOCs | Trichloroethane 1,1,1 | X | | V |
| VOCs | Trichloroethane 1,1,2 | X | | V |
| VOCs | Trichloroethene | X | X | V |
| VOCs | Trichlorofluoromethane | X | | V |
| VOCs | Trichloropropane 1,2,3 | | X | V |
| VOCs | trifluoroethane 1,1,2-Trichloro-1,2,2- | X | | V |
| VOCs | Trimethylbenzene 1,2,4 | X | | V |
| VOCs | Trimethylbenzene 1,3,5 | X | | V |
| VOCs | Vinyl Acetate | X | | V |
| VOCs | Vinyl Chloride | X | | V |
| VOCs | Xylene ortho | X | | V |
| VOCs | Xylene, m,p | X | | V |
| VOCs | Xylenes (total) | X | | V |
| SVOCs | Bis(2-Ethylhexyl)phthalate | | X | |
| SVOCs | Hexachlorobutadiene | X | | V |
| SVOCs | Naphthalene | X | | V |

**Notes:**

X = Indicates a constituent was detected in a specific medium.
atm = atmosphere
COPC = chemical of potential concern
$m^3$ = cubic meter
mm Hg = millimeter mercury
SVOC = Semivolatile organic compound
VOC = Volatile organic compound
USEPA = United States Environmental Protection Agency

[1] Based on detected constituents in soil gas and the most recent two years of groundwater sampling data collected within or near Parcel F after January 1, 2006.

[2] Only 5 feet soil gas samples were collected within Parcel F.

[3] The volatile compounds were identified using the following criteria consistent with recommendation from the USEPA Regional Screening Levels Table (USEPA 2017): 1) vapor pressure greater than 1 mm Hg or 2) Henry's Law constant greater than 0.00001 atm or $m^3$/mole.

**Source:**

USEPA. 2017. Regional Screening Levels. June.

# TABLE 5-7A. Soil EPCs and EPCs of Airborne Particulates and Vapors for Parcel F (0-2 feet bgs)

## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Parcel | 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 |
| F | Chlorine Oxyanions | Perchlorate | 47 | 0.000040 | 0.0098 | -- | -- |
| | Metal | Palladium | 0.62 | 0.00000054 | 0.00013 | -- | -- |
| | Metal | Zirconium | 22 | 0.000019 | 0.0045 | -- | -- |
| | Other Inorganics | Chloride | 4,949 | 0.0043 | 1.0 | -- | -- |
| | PAHs | BaPEq | 0.085 | 0.000000073 | 0.000018 | -- | -- |
| | PCBs | Aroclor-1254 | 0.29 | 0.00000025 | 0.000061 | 0.0014 | 0.011 |
| | Pesticides - OCPs | alpha-BHC | 0.012 | 0.000000011 | 0.0000026 | -- | -- |
| | SVOCs | Hydroxymethyl phthalimide | 0.065 | 0.000000056 | 0.000014 | -- | -- |

**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 = Constituent of potential concern

EPC = Exposure point concentration

OCP = Organochlorine pesticide

PAH = Polycyclic aromatic hydrocarbon

PCB = Polychlorinated biphenyl

SVOC = Semivolatile organic compound

UCL = Upper confidence limit

[1] The 95% UCL on the mean concentration over 0-2 feet bgs was used as the EPC. For Aroclor-1254, the maximum detected concentration was used as the soil EPC, because 95% UCLs cannot be calculated due to limited detections.

## TABLE 5-7B. Soil EPCs and EPCs of Airborne Particulates and Vapors for Parcel F (0-10 feet bgs)

### Nevada Environmental Response Trust Site
### Henderson, Nevada

| Parcel | Chemical Group | COPC | Soil EPC [1] (mg/kg) | Airborne Particulate EPC [1] (µg/m³) | | Vapor EPC [1] (µg/m³) | |
|---|---|---|---|---|---|---|---|
| | | | | Indoor and Outdoor Commercial/ Industrial Worker | Construction Worker | Indoor and Outdoor Commercial/ Industrial Worker | Construction Worker |
| F | Chlorine Oxyanions | Perchlorate | 26 | 0.000022 | 0.0054 | -- | -- |
| | Metal | Palladium | 0.54 | 0.00000046 | 0.00011 | -- | -- |
| | Metal | Zirconium | 21 | 0.000018 | 0.0045 | -- | -- |
| | Other Inorganics | Chloride | 3,062 | 0.0026 | 0.64 | -- | -- |
| | PAHs | BaPEq | 0.044 | 0.000000037 | 0.0000091 | -- | -- |
| | PCBs | Aroclor-1254 | 0.29 | 0.00000025 | 0.000061 | 0.0014 | 0.011 |
| | Pesticides - OCPs | alpha-BHC | 0.0064 | 0.0000000055 | 0.0000013 | -- | -- |
| | SVOCs | Hydroxymethyl phthalimide | 0.047 | 0.000000041 | 0.0000099 | -- | -- |

**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 = Constituent of potential concern
EPC = Exposure point concentration
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
SVOC = Semivolatile organic compound
UCL = Upper confidence limit

[1] The 95% UCL on the mean concentration over 0-10 feet bgs was used as the EPC. For Aroclor-1254, the maximum detected concentration was used as the soil EPC, because 95% UCLs cannot be calculated due to limited detection.

# TABLE 5-8. Calculation of Particulate Emission Factors
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Parameter | Symbol | Value | Unit | Reference |
|---|---|---|---|---|
| | | Parcel F | | |
| **Indoor and Outdoor Commercial/Industrial Worker** | | | | |
| Fraction of vegetative cover | V | 0.5 | unitless | USEPA 2002 |
| Mean annual wind speed | $U_m$ | 4.1 | m/s | [1] |
| Equivalent threshold value of wind speed | $U_t$ | 11.32 | m/s | USEPA 2002 |
| Function dependent on $U/U_t$ | F(x) | 0.19 | unitless | USEPA 2002 |
| Air dispersion factor for area source (calculated) | $Q/C_{wind}$ | 44.24 | $g/m^2$-s per $kg/m^3$ | USEPA 2002 |
| Dispersion factor for area source - Constant A (Las Vegas, NV) | A | 13.31 | unitless | USEPA 2002 |
| Dispersion factor for area source - Constant B (Las Vegas, NV) | B | 19.84 | unitless | USEPA 2002 |
| Dispersion factor for area source - Constant C (Las Vegas, NV) | C | 230.17 | unitless | USEPA 2002 |
| Areal extent of site surface contamination | $A_{surf}$ | 6.96 | acre | Area of parcel |
| **Particulate emission factor (calculated)** | **PEF** | **1.2E+09** | **$m^3/kg$** | **Neptune 2015** |
| **Construction Worker** | | | | |
| Fraction of vegetative cover | V | 0 | unitless | USEPA 2002 |
| Mean annual wind speed | $U_m$ | 4.1 | m/s | [1] |
| Equivalent threshold value of wind speed | $U_t$ | 11.32 | m/s | USEPA 2002 |
| Function dependent on $U/U_t$ | F(x) | 0.19 | unitless | USEPA 2002 |
| Areal extent of site surface contamination | $A_{surf}$ | 24.8 | acre | Area of parcel |
| Wet soil bulk density | $r_{soil}$ | 1.87 | $g/cm^3$ | [2] |
| Percent of soil moisture content | M | 14.8 | % | [2] |
| Areal extent of site excavation | $A_{excav}$ | 5,633 | $m^2$ | [3] |
| Depth of site excavation | $d_{excav}$ | 1.0 | m | USEPA 2002 |
| Number of times soil is dumped | $N_A$ | 2 | unitless | USEPA 2002 |
| Percent of soil silt content | s | 10 | % | [4] |
| Average dozing speed | $S_{doz}$ | 11.4 | km/hr | USEPA 2002 |
| Number of times area is dozed | $N_{doze}$ | 3 | unitless | USEPA 2002 |
| Length of dozer blade | $B_d$ | 2.44 | m | USEPA 2002 |
| Average grading speed | $S_{grade}$ | 11.4 | km/hr | USEPA 2002 |
| Number of times area is graded | $N_{grade}$ | 3 | unitless | USEPA 2002 |
| Length of dozer blade | $B_g$ | 2.44 | m | USEPA 2002 |
| Areal extent of site tilling | $A_{till}$ | 1.39 | acre | [3] |
| Number of times soil is tilled | $N_A$ | 2 | unitless | USEPA 2002 |
| Subchronic dispersion factor for area source-Constant A | A | 2.45 | unitless | USEPA 2002 |
| Subchronic dispersion factor for area source-Constant B | B | 17.57 | unitless | USEPA 2002 |
| Subchronic dispersion factor for area source-Constant C | C | 189.04 | unitless | USEPA 2002 |
| Length of road segment | $L_R$ | 167.83 | m | [5] |
| Width of road segment | $W_R$ | 6.1 | m | USEPA 2002 |
| Mean vehicle weight | W | 8.0 | ton | USEPA 2002 |
| Percent of moisture in dry road surface | $M_{dry}$ | 0.20 | % | USEPA 2002 |
| Number of days/year with at least 0.01 inches of precipitation | p | 27 | day | Neptune 2015 |
| Number of vehicles for duration of construction | $N_V$ | 30 | unitless | USEPA 2002 |
| Length of road traveled per day | $L_D$ | 167.83 | m/day | [5] |
| Subchronic dispersion factor for road segment-Constant A | A | 12.94 | unitless | USEPA 2002 |
| Subchronic dispersion factor for road segment-Constant B | B | 5.74 | unitless | USEPA 2002 |

# TABLE 5-8. Calculation of Particulate Emission Factors
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Parameter | Symbol | Value | Unit | Reference |
|---|---|---|---|---|
| | | Parcel F | | |
| Subchronic dispersion factor for road segment-Constant C | C | 71.77 | unitless | USEPA 2002 |
| **Particulate emission factor (calculated)** | **PEF** | **4.8E+06** | **$m^3$/kg** | **Neptune 2015** |

**Notes:**

g/$cm^3$ = gram per cubic centimeter

g/$m^2$-s per kg/$m^3$ = (gram per square meter per second) per (koligram 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

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 parcel 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 parcel 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. 2010. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada. November.

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 5-9. Johnson and Ettinger Modeling Parameters – Parcel F

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

| Parameter | Value | Units | Notes |
|---|---|---|---|
| ***Source/Receptor Parameters - Indoor and Outdoor Scenarios*** | | | |
| Depth to groundwater: Parcel F | 30 | feet | Site-specific estimate |
| Soil gas sampling depth (shallow) | 5 | feet | Site-specific estimated based on sampling depth |
| Depth to top of soil contamination | 1 | cm | Conservative estimate |
| Depth to base of soil contamination | 30 | ft | Conservative estimate that assumes VOCs in soil extend until the water table depth. |
| 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 |
| ***Parameters used for benzene degradation*** | | | |
| Fraction organic carbon | 0.006 | unitless | Default value (USEPA 2002) |
| Minimum oxygen content for aerobic respiration | 1 | percentage | Default value (API 2012) |
| First order biodegradation rate for benzene | 0.79 | 1/hr | Default value (API 2012) |
| ***Building Foundation Parameters*** | | | |
| Depth to Bottom of Foundation, Slab-on-grade | 15 | cm | Default value (Cal/EPA 2011) |
| Foundation crack ratio | 0.005 | unitless | Default value (Cal/EPA 2011) |
| Average vapor flow rate into building | 5 | $L/min/m^2$ | Default value (USEPA 2004) |
| Foundation thickness | 10 | cm | Default value (Cal/EPA 2011) |
| Mixing height of building, Slab-on-grade | 244 | cm | Residential default value (Cal/EPA 2011) |
| **Commercial Indoor Air Scenarios** | | | |
| Air exchange rate | 1 | 1/hour | Default value for commercial buildings (Cal/EPA 2011) |
| Length of building | 1000 | cm | Default value for commercial buildings (USEPA 2004) |
| Width of building | 1000 | cm | Default value for commercial buildings (USEPA 2004) |
| Mixing height of building, Slab-on-grade | 305 | cm | Engineering estimate. |
| ***Air Dispersion Parameters* - Outdoor Scenario** | | | |
| **Commercial Outdoor Air Scenarios** | | | |
| Site specific dispersion factor (Q/C): Parcel F | 54 | $g/m^2$-s per $kg/m^3$ | Site-specific estimate based on parcel area of 24.81 acres. |
| ***Source/Receptor Parameters -10 foot Construction Trench Scenario*** | | | |
| Depth to groundwater: Parcel F | 20 | feet | Site-specific estimate |
| Soil gas sampling depth | 1 | cm | Site-specific estimate for depth between trench and soil gas sample |
| 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 | 0.41 | m/s | Conservative Estimate (1/10 of site-specific windspeed) |
| Site specific dispersion factor ($Q/C_{vol}$) | 34.17 | $g/m^2$-s per $kg/m^3$ | Site-specific estimate based on box model. |

**Notes:**

-- =Not applicable
cm = centimeter
$g/cm^3$ = gram per cubic centimeter
$L/min/m^2$ = liter per minute per 100 square meter
Cal/EPA = California Environmental Protection Agency
USDA = United States Department of Agriculture
USEPA = United States Environmental Protection Agency

**Sources:**

California Environmental Protection Agency (Cal/EPA). 2005. Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil. January.

California Environmental Protection Agency (CalEPA). 2011. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance). Final. Department of Toxic Substances Control. October.

United States Environmental Protection Agency (USEPA). 2004. User's Guide for Evaluating Subsurface Vapor Intrusion Into Buildings Office of Emergency and

United States Environmental Protection Agency (USEPA). 2002. Supplemental Guidance for Developing. Soil Screening Levels for Superfund Sites. December

American Petroleum Institute (API) 2012. BIOVAPOR – A 1-D Vapor Intrusion Model with Oxygen-Limited Aerobic Biodegradation. Version 2.1. November.

## TABLE 5-10. Physical and Chemical Properties for Soil Gas and Shallow Groundwater COPCs – Parcel F

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

| Chemical Group | Constituent [1] | Molecular Weight | Organic Carbon Partition Coefficient | Diffusivity in Air | Diffusivity in Water | Pure Component Water Solubility | Henry's Law Constant at 25° C | Normal Boiling Point | Critical Temperature | Enthalpy of Vaporization at the Normal Boiling Point | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MW | $K_{oc}$ | $D_a$ | $D_w$ | S | H | $T_B$ | $T_C$ | ΔHv,b | |
| | | (g/mol) | ($cm^3$/g) | ($cm^2$/s) | ($cm^2$/s) | (mg/L) | (atm-$m^3$/mol) | (°K) | (°K) | (cal/mol) | |
| VOCs | Acetone | 5.80E+01 | 5.75E-01 | 1.24E-01 | 1.14E-05 | 1.00E+06 | 3.88E-05 | 3.29E+02 | 5.08E+02 | 6.96E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | t-Amyl methyl ether | 1.02E+02 | 2.27E+01 | 6.50E-02 | 7.80E-06 | 2.64E+03 | 1.32E-03 | NA | NA | NA | EPISUITE + diisopropyl ether for diffusivities |
| VOCs | Benzene | 7.81E+01 | 6.20E+01 | 8.80E-02 | 9.80E-06 | 1.75E+03 | 5.55E-03 | 3.53E+02 | 5.62E+02 | 7.34E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Benzyl chloride | 1.27E+02 | 5.00E+01 | 6.66E-02 | 7.80E-06 | 3.30E+03 | 5.06E-05 | NA | NA | NA | NDEP |
| VOCs | Bromodichloromethane | 1.64E+02 | 1.00E+02 | 2.98E-02 | 1.06E-05 | 6.74E+03 | 1.60E-03 | 3.63E+02 | 5.86E+02 | 7.80E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Bromomethane | 9.50E+01 | 9.00E+00 | 7.28E-02 | 1.21E-05 | 1.52E+04 | 6.24E-03 | 2.77E+02 | 4.67E+02 | 5.71E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 2-Butanone | 7.20E+01 | 4.50E+00 | 8.95E-02 | 9.80E-06 | 2.68E+05 | 2.74E-05 | 3.53E+02 | 5.37E+02 | 7.48E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | n-Butylbenzene | 1.34E+02 | 2.83E+03 | 7.50E-02 | 7.80E-06 | 1.38E+01 | 1.31E-02 | 4.56E+02 | 6.61E+02 | 9.29E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Carbon disulfide | 7.60E+01 | 4.57E+01 | 1.04E-01 | 1.00E-05 | 1.19E+03 | 3.03E-02 | 3.19E+02 | 5.52E+02 | 6.39E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Carbon tetrachloride | 1.54E+02 | 1.52E+02 | 7.80E-02 | 8.80E-06 | 7.93E+02 | 3.04E-02 | 3.50E+02 | 5.57E+02 | 7.13E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Chlorobenzene | 1.13E+02 | 2.24E+02 | 7.30E-02 | 8.70E-06 | 4.72E+02 | 3.70E-03 | 4.05E+02 | 6.32E+02 | 8.41E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Chloroethane | 6.50E+01 | 1.47E+01 | 1.04E-01 | 1.15E-05 | 5.70E+03 | 1.10E-02 | 2.85E+02 | 4.60E+02 | 5.88E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Chloroform | 1.19E+02 | 5.30E+01 | 1.04E-01 | 1.00E-05 | 7.92E+03 | 3.67E-03 | 3.34E+02 | 5.36E+02 | 6.99E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Cyclohexane | 8.40E+01 | 1.60E+02 | 8.00E-02 | 9.00E-06 | 5.50E+01 | 1.98E-01 | NA | NA | NA | NDEP |
| VOCs | p-Cymene | 1.34E+02 | 2.20E+02 | 7.50E-02 | 7.10E-06 | 6.10E+01 | 1.20E+00 | NA | NA | NA | NDEP |
| VOCs | 1,2-Dibromo-3-chloropropane | 2.36E+02 | 1.70E+02 | 8.00E-02 | 8.00E-06 | 1.23E+03 | 1.50E-04 | NA | NA | NA | RSL |
| VOCs | Dibromochloromethane | 2.08E+02 | 6.31E+01 | 1.96E-02 | 1.05E-05 | 2.70E+03 | 8.50E-04 | 4.16E+02 | 6.78E+02 | 5.90E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,2-Dibromoethane | 1.88E+02 | 2.81E+01 | 7.33E-02 | 8.06E-06 | 3.40E+03 | 3.20E-04 | 4.05E+02 | 5.83E+02 | 8.31E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,2-Dichlorobenzene | 1.47E+02 | 3.79E+02 | 6.90E-02 | 7.90E-06 | 1.56E+02 | 1.90E-03 | 4.54E+02 | 7.05E+02 | 9.70E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,3-Dichlorobenzene | 1.47E+02 | 3.79E+02 | 6.90E-02 | 7.90E-06 | 1.56E+02 | 1.90E-03 | 4.46E+02 | 6.84E+02 | 9.23E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,4-Dichlorobenzene | 1.47E+02 | 6.16E+02 | 6.90E-02 | 7.90E-06 | 7.38E+01 | 2.43E-03 | 4.47E+02 | 6.85E+02 | 9.27E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Dichlorodifluoromethane | 1.21E+02 | 5.80E+01 | 8.00E-02 | 1.05E-05 | 2.80E+02 | 1.00E-01 | 2.43E+02 | 3.85E+02 | 9.42E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,1-Dichloroethane | 9.90E+01 | 5.30E+01 | 7.42E-02 | 1.05E-05 | 5.06E+03 | 5.62E-03 | 3.31E+02 | 5.23E+02 | 6.90E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,2-Dichloroethane | 9.90E+01 | 3.80E+01 | 1.04E-01 | 9.90E-06 | 8.52E+03 | 9.79E-04 | 3.57E+02 | 5.61E+02 | 7.64E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,1-Dichloroethene | 9.70E+01 | 6.50E+01 | 9.00E-02 | 1.04E-05 | 2.25E+03 | 2.61E-02 | 3.05E+02 | 5.76E+02 | 6.25E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | cis-1,2-Dichloroethene | 9.70E+01 | 3.55E+01 | 7.36E-02 | 1.13E-05 | 3.50E+03 | 4.08E-03 | 3.34E+02 | 5.44E+02 | 7.19E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | trans-1,2-Dichloroethene | 9.70E+01 | 3.80E+01 | 7.07E-02 | 1.19E-05 | 6.30E+03 | 9.38E-03 | 3.21E+02 | 5.17E+02 | 6.72E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,2-Dichloropropane | 1.13E+02 | 4.70E+01 | 7.82E-02 | 8.73E-06 | 2.80E+03 | 2.80E-03 | 3.70E+02 | 5.72E+02 | 7.59E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | cis-1,3-Dichloropropene | 1.11E+02 | 4.57E+01 | 6.26E-02 | 1.00E-05 | 2.80E+03 | 1.77E-02 | 3.81E+02 | 5.87E+02 | 7.90E+03 | 1,3-Dichloropropene (total) used as surrogate for all properties |
| VOCs | trans-1,3-Dichloropropene | 1.11E+02 | 4.57E+01 | 6.26E-02 | 1.00E-05 | 2.80E+03 | 1.77E-02 | 3.81E+02 | 5.87E+02 | 7.90E+03 | 1,3-Dichloropropene (total) used as surrogate for all properties |
| VOCs | 1,4-Dioxane | 8.81E+01 | 2.63E+00 | 8.74E-02 | 1.05E-05 | 1.00E+06 | 4.80E-06 | NA | NA | NA | RSL |
| VOCs | Dimethyl disulfide | 9.42E+01 | 3.96E+01 | 8.00E-02 | 1.00E-05 | 3.00E+03 | 1.21E-03 | NA | NA | NA | EPISUITE + Methyl tert-butyl ether for diffusivities |
| VOCs | Ethanol | 4.60E+01 | 1.00E+00 | 1.24E-01 | 1.37E-05 | 1.00E+06 | 5.00E-06 | NA | NA | NA | NDEP |
| VOCs | Ethyl tert-butyl ether | 1.02E+02 | 2.11E+01 | 6.50E-02 | 7.80E-06 | 2.64E+03 | 1.64E-03 | NA | NA | NA | EPISUITE + diisopropyl ether for diffusivities |
| VOCs | Ethyl acetate | 8.80E+01 | 5.94E+01 | 7.32E-02 | 9.66E-06 | 8.00E+04 | 1.40E-04 | NA | NA | NA | NDEP |
| VOCs | Ethyl benzene | 1.06E+02 | 2.04E+02 | 7.50E-02 | 7.80E-06 | 1.69E+02 | 7.88E-03 | 4.09E+02 | 6.17E+02 | 8.50E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 4-Ethyltoluene | 1.20E+02 | 2.20E+02 | 7.50E-02 | 7.10E-06 | 6.10E+01 | 1.20E+00 | NA | NA | NA | NDEP |
| VOCs | Formaldehyde | 3.00E+01 | 3.63E+00 | 1.80E-01 | 2.00E-05 | 5.50E+05 | 3.40E-07 | NA | NA | NA | NDEP |
| VOCs | Freon 114 | 1.71E+02 | 1.97E+02 | 7.80E-02 | 8.20E-06 | 4.31E+01 | 1.51E+00 | NA | NA | NA | EPISUITE + 1,1,2-Trichloro-1,2,2-trifluoroethane for diffusivities |
| VOCs | n-Heptane | 1.00E+02 | 8.20E+03 | 6.16E-02 | 6.45E-06 | 3.40E+00 | 2.00E+00 | NA | NA | NA | NDEP |
| VOCs | n-Hexane | 8.60E+01 | 8.90E+02 | 2.00E-01 | 7.77E-06 | 1.80E+01 | 1.22E-01 | 3.42E+02 | 5.08E+02 | 6.90E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 2-Hexanone | 1.00E+02 | 1.50E+01 | 7.00E-02 | 8.40E-06 | 1.72E+04 | 9.32E-05 | NA | NA | NA | NDEP |
| VOCs | Methyl tert-butyl ether | 8.50E+01 | 6.00E+00 | 8.00E-02 | 1.00E-05 | 1.50E+05 | 5.90E-04 | 3.28E+02 | 4.97E+02 | 6.68E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 4-Methyl-2-pentanone | 1.00E+02 | 1.34E+02 | 7.50E-02 | 7.80E-06 | 1.90E+04 | 1.40E-04 | 3.90E+02 | 5.71E+02 | 8.24E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Methylene Chloride | 8.50E+01 | 1.00E+01 | 1.01E-01 | 1.17E-05 | 1.32E+04 | 2.19E-03 | 3.13E+02 | 5.10E+02 | 6.71E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | n-Nonyl aldehyde | 1.42E+02 | 3.61E+01 | 7.50E-02 | 7.80E-06 | 9.60E+01 | 7.34E-04 | | | | EPISUITE + n-Butylbenzene for diffusivities |
| VOCs | n-Propylbenzene | 1.20E+02 | 2.83E+03 | 7.50E-02 | 7.80E-06 | 1.38E+01 | 1.31E-02 | 4.32E+02 | 6.30E+02 | 9.12E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Styrene | 1.04E+02 | 9.12E+02 | 7.10E-02 | 8.00E-06 | 3.10E+02 | 2.75E-03 | 4.18E+02 | 6.36E+02 | 8.74E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | tert Butyl alcohol | 7.41E+01 | 2.92E+00 | 9.00E-02 | 1.00E-05 | 1.81E+05 | 9.05E-06 | | | | NDEP |
| VOCs | 1,1,1,2-Tetrachloroethane | 1.68E+02 | 7.90E+01 | 7.10E-02 | 7.90E-06 | 2.97E+03 | 3.45E-04 | 4.04E+02 | 6.24E+02 | 9.77E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |

## TABLE 5-10. Physical and Chemical Properties for Soil Gas and Shallow Groundwater COPCs – Parcel F

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

| Chemical Group | Constituent [1] | Molecular Weight | Organic Carbon Partition Coefficient | Diffusivity in Air | Diffusivity in Water | Pure Component Water Solubility | Henry's Law Constant at 25° C | Normal Boiling Point | Critical Temperature | Enthalpy of Vaporization at the Normal Boiling Point | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MW | $K_{oc}$ | $D_a$ | $D_w$ | S | H | $T_B$ | $T_C$ | ΔHv,b | |
| | | (g/mol) | ($cm^3/g$) | ($cm^2/s$) | ($cm^2/s$) | (mg/L) | (atm-$m^3$/mol) | ($^oK$) | ($^oK$) | (cal/mol) | |
| VOCs | 1,1,2,2-Tetrachloroethane | 1.68E+02 | 7.90E+01 | 7.10E-02 | 7.90E-06 | 2.97E+03 | 3.45E-04 | 4.20E+02 | 6.61E+02 | 9.00E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Tetrachloroethene | 1.66E+02 | 2.65E+02 | 7.20E-02 | 8.20E-06 | 2.00E+02 | 1.84E-02 | 3.94E+02 | 6.20E+02 | 8.29E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Toluene | 9.20E+01 | 1.40E+02 | 8.70E-02 | 8.60E-06 | 5.26E+02 | 6.64E-03 | 3.84E+02 | 5.92E+02 | 7.93E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,2,4-Trichlorobenzene | 1.81E+02 | 1.66E+03 | 3.00E-02 | 8.23E-06 | 3.00E+02 | 1.42E-03 | 4.86E+02 | 7.25E+02 | 1.05E+04 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,1,1-Trichloroethane | 1.33E+02 | 1.35E+02 | 7.80E-02 | 8.80E-06 | 1.33E+03 | 1.72E-02 | 3.47E+02 | 5.45E+02 | 7.14E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,1,2-Trichloroethane | 1.33E+02 | 7.50E+01 | 7.80E-02 | 8.80E-06 | 4.42E+03 | 9.13E-04 | 3.86E+02 | 6.02E+02 | 8.32E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Trichloroethene | 1.31E+02 | 9.43E+01 | 7.90E-02 | 9.10E-06 | 1.10E+03 | 1.03E-02 | 3.60E+02 | 5.44E+02 | 7.51E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Trichlorofluoromethane | 1.37E+02 | 1.60E+02 | 8.70E-02 | 1.30E-05 | 1.10E+03 | 9.70E-02 | 2.97E+02 | 4.71E+02 | 6.00E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,2,3-Trichloropropane | 1.47E+02 | 5.10E+01 | 7.10E-02 | 7.90E-06 | 2.70E+03 | 2.80E-02 | 4.30E+02 | 6.52E+02 | 9.17E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.87E+02 | 1.60E+02 | 2.88E-02 | 8.07E-06 | 1.10E+03 | 5.21E-01 | 3.21E+02 | 4.87E+02 | 6.46E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,2,4-Trimethylbenzene | 1.20E+02 | 3.72E+03 | 7.50E-02 | 7.10E-06 | 2.55E-01 | 5.70E-03 | 4.42E+02 | 6.49E+02 | 9.37E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | 1,3,5-Trimethylbenzene | 1.20E+02 | 8.19E+02 | 7.50E-02 | 7.10E-06 | 5.00E+01 | 7.71E-03 | 4.38E+02 | 6.37E+02 | 9.32E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Vinyl acetate | 8.60E+01 | 5.25E+00 | 8.50E-02 | 9.20E-06 | 2.00E+04 | 5.11E-04 | 3.46E+02 | 5.19E+02 | 7.80E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Vinyl chloride | 6.30E+01 | 1.86E+01 | 1.06E-01 | 1.23E-06 | 2.76E+03 | 2.70E-02 | 2.59E+02 | 4.32E+02 | 5.25E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | o-Xylene | 1.06E+02 | 2.41E+02 | 8.70E-02 | 1.00E-05 | 1.78E+02 | 5.19E-03 | 4.18E+02 | 6.30E+02 | 8.66E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| VOCs | Xylenes (total) | 1.06E+02 | 1.96E+02 | 7.00E-02 | 7.80E-06 | 1.61E+02 | 7.34E-03 | 4.12E+02 | 6.16E+02 | 8.53E+03 | NDEP + USEPA 2004 for Tb, Tc, ΔH |
| SVOCs | Hexachlorobutadiene | 2.61E+02 | 8.45E+02 | 2.67E-02 | 7.03E-06 | 3.20E+00 | 1.03E-02 | 4.86E+02 | 7.38E+02 | 1.02E+04 | RSL + USEPA 2004 for Tb, Tc, and ΔH |
| SVOCs | Naphthalene | 1.28E+02 | 1.19E+03 | 5.90E-02 | 7.50E-06 | 3.10E+01 | 4.83E-04 | 4.91E+02 | 7.48E+02 | 1.04E+04 | NDEP + USEPA 2004 for Tb, Tc, ΔH |

**Notes:**

NA = Not available
atm-$m^3$/mol = atmosphere-cubic meter per mole
cal/mol = calorie per mole
$cm^3$/g = cubic centimeter per gram
$cm^2$/s = square centimeter per second
g/mol = gram per mole
$^oK$ = degrees Kelvin
mg/L = milligram per liter
PCDD/F = Polychlorinated dibenzo dioxin and furan
SVOC = Semivolatile organic compound
USEPA = United States Environmental Protection Agency
VOC = Volatile organic compound

[1] Volatile compounds defined by USEPA (2016) as constituents with vapor pressure greater than 1 millimeter (mm) Hg or Henry's Law constant greater than 0.00001 atm-$m^3$/mole.

**Sources:**

United States Environmental Protection Agency (USEPA). 2004. User’s Guide for Evaluating Subsurface Vapor Intrusion Into Buildings Office of Emergency and Remedial Response. February.
EPISUITE: United States Environmental Protection Agency (USEPA). 2012. Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11. Washington, DC, USA.
Nevada Division of Environmental Protection (NDEP). 2017. Basic Screening Levels (BCLs) Version 1.0. July.
RSL: United States Environmental Protection Agency (USEPA). 2017. Regional Screening Level (RSL) Table. June.

# TABLE 5-11. Soil Properties Data [1]

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

| Sample ID | Depth (ft) | Volumetric Water Content [2] | Dry Bulk Density [3] (g/cm$^3$) | Grain Density [4] (g/cm$^3$) | Soil Total Porosity [5] (g/cm$^3$) | 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 |
| Mininum | 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:**

NA = not applicable

g/cm$^3$ = grams per cubic centimeter

[1] The soil properties were reported in Northgate (2010). Soil type is discussed in the main text in both section 2.3 and section 5.2.2.3.

[2] As measured according to ASTM D 2216 and adjusted to convert 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 evaluation.

**Reference:**

Northgate Environmental Management, Inc. (Northgate), 2010. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada. November 22.

# TABLE 5-12A. Transfer Factors for Volatile Compounds Migrating from Soil Gas to Indoor Air, Outdoor Air, and Trench Air – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Chemical Group | Constituent | TF for Soil Gas Migrating to Indoor Air (µg/m$^3$ per µg/m$^3$) | TF for Soil Gas Migrating to Outdoor Air (µg/m$^3$ per µg/m$^3$) | TF for Soil Gas Migrating to Construction Trench Air (µg/m$^3$ per µg/m$^3$) |
|---|---|---|---|---|
| | | 5 ft bgs | 5 ft bgs | |
| VOCs | Acetone | 3.3E-04 | 6.7E-06 | 1.6E-03 |
| VOCs | t-Amyl methyl ether | 2.0E-04 | 4.2E-06 | 8.2E-04 |
| VOCs | Benzene | 5.5E-15 | 9.9E-17 | 1.1E-03 |
| VOCs | Benzyl chloride | 2.1E-04 | 4.4E-06 | 8.6E-04 |
| VOCs | Bromodichloromethane | 1.0E-04 | 1.9E-06 | 3.8E-04 |
| VOCs | Bromomethane | 2.2E-04 | 4.7E-06 | 9.2E-04 |
| VOCs | 2-Butanone | 2.7E-04 | 4.9E-06 | 1.2E-03 |
| VOCs | n-Butylbenzene | 2.3E-04 | 4.0E-06 | 9.5E-04 |
| VOCs | Carbon disulfide | 2.9E-04 | 5.5E-06 | 1.3E-03 |
| VOCs | Carbon tetrachloride | 2.3E-04 | 4.1E-06 | 9.9E-04 |
| VOCs | Chlorobenzene | 2.2E-04 | 4.7E-06 | 9.2E-04 |
| VOCs | Chloroethane | 2.9E-04 | 5.5E-06 | 1.3E-03 |
| VOCs | Chloroform | 2.9E-04 | 5.5E-06 | 1.3E-03 |
| VOCs | Cyclohexane | 2.4E-04 | 5.2E-06 | 1.0E-03 |
| VOCs | p-Cymene | 2.3E-04 | 4.0E-06 | 9.5E-04 |
| VOCs | 1,2-Dibromo-3-chloropropane | 2.4E-04 | 5.2E-06 | 1.0E-03 |
| VOCs | Dibromochloromethane | 7.2E-05 | 1.3E-06 | 2.5E-04 |
| VOCs | 1,2-Dibromoethane | 2.2E-04 | 4.7E-06 | 9.3E-04 |
| VOCs | 1,2-Dichlorobenzene | 2.1E-04 | 4.4E-06 | 8.7E-04 |
| VOCs | 1,3-Dichlorobenzene | 2.1E-04 | 4.4E-06 | 8.7E-04 |
| VOCs | 1,4-Dichlorobenzene | 2.1E-04 | 3.6E-06 | 8.7E-04 |
| VOCs | Dichlorodifluoromethane | 2.4E-04 | 4.2E-06 | 1.0E-03 |
| VOCs | 1,1-Dichloroethane | 2.3E-04 | 4.8E-06 | 9.4E-04 |
| VOCs | 1,2-Dichloroethane | 2.9E-04 | 6.7E-06 | 1.3E-03 |
| VOCs | 1,1-Dichloroethene | 2.6E-04 | 5.8E-06 | 1.1E-03 |
| VOCs | cis-1,2-Dichloroethene | 2.2E-04 | 4.7E-06 | 9.3E-04 |
| VOCs | trans-1,2-Dichloroethene | 2.2E-04 | 4.6E-06 | 8.9E-04 |
| VOCs | 1,2-Dichloropropane | 2.3E-04 | 5.0E-06 | 9.9E-04 |
| VOCs | cis-1,3-Dichloropropene | 2.0E-04 | 4.0E-06 | 7.9E-04 |
| VOCs | trans-1,3-Dichloropropene | 2.0E-04 | 4.0E-06 | 7.9E-04 |
| VOCs | 1,4-Dioxane | 2.9E-04 | 5.5E-06 | 1.3E-03 |
| VOCs | Ethanol | 3.6E-04 | 7.6E-06 | 1.8E-03 |
| VOCs | Ethyl tert-butyl ether | 2.0E-04 | 4.2E-06 | 8.2E-04 |
| VOCs | Ethyl acetate | 2.2E-04 | 4.7E-06 | 9.3E-04 |
| VOCs | Ethyl benzene | 2.3E-04 | 4.0E-06 | 9.5E-04 |
| VOCs | 4-Ethyltoluene | 2.3E-04 | 4.0E-06 | 9.5E-04 |
| VOCs | Freon 114 | 2.3E-04 | 4.1E-06 | 9.9E-04 |
| VOCs | n-Heptane | 1.9E-04 | 3.3E-06 | 7.8E-04 |
| VOCs | n-Hexane | 4.4E-04 | 1.3E-05 | 2.5E-03 |
| VOCs | 2-Hexanone | 2.2E-04 | 3.7E-06 | 8.9E-04 |
| VOCs | Methyl tert-butyl ether | 2.4E-04 | 5.2E-06 | 1.0E-03 |
| VOCs | 4-Methyl-2-pentanone | 2.3E-04 | 4.0E-06 | 9.6E-04 |
| VOCs | Methylene Chloride | 2.8E-04 | 5.3E-06 | 1.3E-03 |
| VOCs | n-Propylbenzene | 2.3E-04 | 4.0E-06 | 9.5E-04 |
| VOCs | Styrene | 2.2E-04 | 3.8E-06 | 9.0E-04 |
| VOCs | tert Butyl alcohol | 2.8E-04 | 5.2E-06 | 1.2E-03 |
| VOCs | 1,1,1,2-Tetrachloroethane | 2.2E-04 | 4.6E-06 | 9.0E-04 |
| VOCs | 1,1,2,2-Tetrachloroethane | 2.2E-04 | 3.8E-06 | 9.0E-04 |
| VOCs | Tetrachloroethene | 2.2E-04 | 3.8E-06 | 9.1E-04 |

# TABLE 5-12A. Transfer Factors for Volatile Compounds Migrating from Soil Gas to Indoor Air, Outdoor Air, and Trench Air – Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Chemical Group | Constituent | TF for Soil Gas Migrating to Indoor Air ($\mu g/m^3$ per $\mu g/m^3$) | TF for Soil Gas Migrating to Outdoor Air ($\mu g/m^3$ per $\mu g/m^3$) | TF for Soil Gas Migrating to Construction Trench Air ($\mu g/m^3$ per $\mu g/m^3$) |
|---|---|---|---|---|
| | | 5 ft bgs | 5 ft bgs | |
| VOCs | Toluene | 2.5E-04 | 4.6E-06 | 1.1E-03 |
| VOCs | 1,2,4-Trichlorobenzene | 1.1E-04 | 1.6E-06 | 3.8E-04 |
| VOCs | 1,1,1-Trichloroethane | 2.3E-04 | 5.0E-06 | 9.9E-04 |
| VOCs | 1,1,2-Trichloroethane | 2.3E-04 | 5.0E-06 | 9.9E-04 |
| VOCs | Trichloroethene | 2.4E-04 | 4.2E-06 | 1.0E-03 |
| VOCs | Trichlorofluoromethane | 2.5E-04 | 4.6E-06 | 1.1E-03 |
| VOCs | 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.0E-04 | 1.5E-06 | 3.6E-04 |
| VOCs | 1,2,4-Trimethylbenzene | 2.3E-04 | 4.0E-06 | 9.5E-04 |
| VOCs | 1,3,5-Trimethylbenzene | 2.3E-04 | 4.0E-06 | 9.5E-04 |
| VOCs | Vinyl acetate | 2.5E-04 | 4.5E-06 | 1.1E-03 |
| VOCs | Vinyl chloride | 2.9E-04 | 6.8E-06 | 1.3E-03 |
| VOCs | o-Xylene | 2.5E-04 | 4.6E-06 | 1.1E-03 |
| VOCs | Xylenes (total) | 2.2E-04 | 4.5E-06 | 8.8E-04 |
| SVOCs | Hexachlorobutadiene | 9.5E-05 | 1.7E-06 | 3.4E-04 |
| SVOCs | Naphthalene | 1.9E-04 | 3.1E-06 | 7.5E-04 |

**Notes:**

ft = feet

bgs = below ground surface

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

TF = Transfer Factor

SVOC = Semi-Volatile Organic Compound

VOC = Volatile Organic Compound

# TABLE 5-12B. Transfer Factors for Volatile Compounds Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air – Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Constituent | TF for Groundwater Migrating to Indoor Air (µg/m$^3$ per µg/L) | TF for Groundwater Migrating to Outdoor Air (µg/m$^3$ per µg/L) | TF for Groundwater Migrating to Construction Trench Air (µg/m$^3$ per µg/L) |
|---|---|---|---|---|
| VOCs | Acetone | 7.8E-05 | 1.2E-06 | 2.8E-06 |
| VOCs | Carbon tetrachloride | 1.2E-02 | 2.1E-04 | 3.0E-04 |
| VOCs | Chloroform | 2.8E-03 | 4.2E-05 | 7.7E-05 |
| VOCs | 1,1-Dichloroethane | 2.3E-03 | 4.2E-05 | 6.0E-05 |
| VOCs | 1,1-Dichloroethene | 1.2E-02 | 2.3E-04 | 3.2E-04 |
| VOCs | 1,4-Dioxane | 6.6E-06 | 1.2E-07 | 1.9E-07 |
| VOCs | Dimethyl disulfide | 8.4E-04 | 1.5E-05 | 2.3E-05 |
| VOCs | Formaldehyde | 2.4E-06 | 5.2E-08 | 8.2E-08 |
| VOCs | Methylene Chloride | 1.3E-03 | 2.4E-05 | 3.5E-05 |
| VOCs | n-Nonyl aldehyde | 5.0E-04 | 9.2E-06 | 1.4E-05 |
| VOCs | Tetrachloroethene | 6.1E-03 | 1.1E-04 | 1.6E-04 |
| VOCs | Toluene | 2.8E-03 | 5.1E-05 | 7.4E-05 |
| VOCs | Trichloroethene | 4.0E-03 | 7.3E-05 | 1.0E-04 |
| VOCs | 1,2,3-Trichloropropane | 8.5E-03 | 1.5E-04 | 2.2E-04 |

**Notes:**

µg/L = microgram per liter

µg/m$^3$ = microgram per cubic meter

TF = Transfer Factor

SVOC = Semivolatile organic compound

VOC = Volatile Organic Compound

# TABLE 5-12C. Transfer Factors for Vapors from Soil to Outdoor Air and Trench Air - Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Chemical Group | Chemical | TF for Soil Migrating to Outdoor Air ($\mu g/m^3$ per µg/kg) | TF for Soil Migrating to Trench Air ($\mu g/m^3$ per µg/kg) |
|---|---|---|---|
| PCBs | Aroclor-1254 | 4.7E-06 | 3.7E-05 |

**Notes:**

µg/kg = microgram per kilogram

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

PCB = Polychlorinated biphenyl

TF = Transfer Factor

# TABLE 5-13. Air EPCs Due to Volatile Compounds Migrating from 5 ft bgs Soil Gas to Indoor Air, Outdoor Air, and Trench Air – Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Chemical Group | Constituent | 5 ft bgs Maximum Soil Gas Concentration | Predicted Indoor Air Concentration | Predicted Outdoor Air Concentration | Predicted Trench Air Concentration |
|---|---|---|---|---|---|
| | | (µg/m$^3$) | | | |
| VOCs | Acetone | 6.7E+01 | 2.2E-02 | 4.5E-04 | 1.1E-01 |
| VOCs | t-Amyl methyl ether | 7.8E-01 | 1.6E-04 | 3.3E-06 | 6.4E-04 |
| VOCs | Benzene | 3.0E+00 | 1.6E-14 | 3.0E-16 | 3.2E-03 |
| VOCs | Benzyl chloride | 4.3E-01 | 9.0E-05 | 1.9E-06 | 3.7E-04 |
| VOCs | Bromodichloromethane | 1.8E+00 | 1.9E-04 | 3.5E-06 | 6.8E-04 |
| VOCs | Bromomethane | 8.4E-01 | 1.9E-04 | 3.9E-06 | 7.7E-04 |
| VOCs | 2-Butanone | 1.1E+01 | 2.9E-03 | 5.4E-05 | 1.3E-02 |
| VOCs | n-Butylbenzene | 7.0E-01 | 1.6E-04 | 2.8E-06 | 6.6E-04 |
| VOCs | Carbon disulfide | 1.1E+00 | 3.2E-04 | 6.0E-06 | 1.4E-03 |
| VOCs | Carbon tetrachloride | 1.1E+02 | 2.6E-02 | 4.5E-04 | 1.1E-01 |
| VOCs | Chlorobenzene | 2.3E+00 | 5.1E-04 | 1.1E-05 | 2.1E-03 |
| VOCs | Chloroethane | 4.3E-01 | 1.2E-04 | 2.4E-06 | 5.7E-04 |
| VOCs | Chloroform | 2.8E+03 | 8.1E-01 | 1.5E-02 | 3.7E+00 |
| VOCs | Cyclohexane | 4.7E+00 | 1.1E-03 | 2.4E-05 | 4.8E-03 |
| VOCs | p-Cymene | 2.9E-01 | 6.6E-05 | 1.1E-06 | 2.7E-04 |
| VOCs | 1,2-Dibromo-3-chloropropane | 1.7E+00 | 4.1E-04 | 8.8E-06 | 1.7E-03 |
| VOCs | Dibromochloromethane | 1.2E+00 | 8.6E-05 | 1.5E-06 | 3.0E-04 |
| VOCs | 1,2-Dibromoethane | 1.4E+00 | 3.1E-04 | 6.6E-06 | 1.3E-03 |
| VOCs | 1,2-Dichlorobenzene | 1.8E+00 | 3.8E-04 | 8.0E-06 | 1.6E-03 |
| VOCs | 1,3-Dichlorobenzene | 2.6E-01 | 5.5E-05 | 1.2E-06 | 2.3E-04 |
| VOCs | 1,4-Dichlorobenzene | 8.0E+01 | 1.7E-02 | 2.9E-04 | 7.0E-02 |
| VOCs | Dichlorodifluoromethane | 2.5E+00 | 6.0E-04 | 1.1E-05 | 2.5E-03 |
| VOCs | 1,1-Dichloroethane | 1.3E+00 | 2.9E-04 | 6.2E-06 | 1.2E-03 |
| VOCs | 1,2-Dichloroethane | 8.7E-01 | 2.5E-04 | 5.8E-06 | 1.1E-03 |
| VOCs | 1,1-Dichloroethene | 1.1E+02 | 2.9E-02 | 6.4E-04 | 1.3E-01 |
| VOCs | cis-1,2-Dichloroethene | 8.9E-01 | 2.0E-04 | 4.2E-06 | 8.3E-04 |
| VOCs | trans-1,2-Dichloroethene | 9.4E-01 | 2.0E-04 | 4.3E-06 | 8.4E-04 |
| VOCs | 1,2-Dichloropropane | 1.2E+00 | 2.8E-04 | 6.0E-06 | 1.2E-03 |
| VOCs | cis-1,3-Dichloropropene | 7.5E-01 | 1.5E-04 | 3.0E-06 | 5.9E-04 |
| VOCs | trans-1,3-Dichloropropene | 6.8E-01 | 1.3E-04 | 2.7E-06 | 5.4E-04 |
| VOCs | 1,4-Dioxane | 6.4E-01 | 1.8E-04 | 3.5E-06 | 8.4E-04 |
| VOCs | Ethanol | 7.4E+00 | 2.7E-03 | 5.6E-05 | 1.3E-02 |
| VOCs | Ethyl tert-butyl ether | 8.2E-01 | 1.7E-04 | 3.4E-06 | 6.7E-04 |
| VOCs | Ethyl acetate | 9.9E+00 | 2.2E-03 | 4.7E-05 | 9.2E-03 |
| VOCs | Ethyl benzene | 4.4E+00 | 1.0E-03 | 1.7E-05 | 4.2E-03 |
| VOCs | 4-Ethyltoluene | 3.1E+00 | 7.0E-04 | 1.2E-05 | 2.9E-03 |
| VOCs | Freon 114 | 1.4E+00 | 3.3E-04 | 5.8E-06 | 1.4E-03 |
| VOCs | n-Heptane | 2.4E+00 | 4.7E-04 | 7.8E-06 | 1.9E-03 |
| VOCs | n-Hexane | 6.1E+03 | 2.7E+00 | 7.9E-02 | 1.5E+01 |
| VOCs | 2-Hexanone | 2.3E+00 | 5.0E-04 | 8.6E-06 | 2.1E-03 |

## TABLE 5-13. Air EPCs Due to Volatile Compounds Migrating from 5 ft bgs Soil Gas to Indoor Air, Outdoor Air, and Trench Air – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Chemical Group | Constituent | 5 ft bgs Maximum Soil Gas Concentration | Predicted Indoor Air Concentration | Predicted Outdoor Air Concentration | Predicted Trench Air Concentration |
|---|---|---|---|---|---|
| | | ($\mu g/m^3$) | | | |
| VOCs | Methyl tert-butyl ether | 4.7E-01 | 1.1E-04 | 2.4E-06 | 4.8E-04 |
| VOCs | 4-Methyl-2-pentanone | 2.8E+00 | 6.4E-04 | 1.1E-05 | 2.7E-03 |
| VOCs | Methylene Chloride | 2.9E+00 | 8.2E-04 | 1.5E-05 | 3.7E-03 |
| VOCs | n-Propylbenzene | 3.7E-01 | 8.4E-05 | 1.5E-06 | 3.5E-04 |
| VOCs | Styrene | 7.4E-01 | 1.6E-04 | 2.8E-06 | 6.6E-04 |
| VOCs | tert Butyl alcohol | 4.8E+00 | 1.3E-03 | 2.5E-05 | 6.0E-03 |
| VOCs | 1,1,1,2-Tetrachloroethane | 1.1E+00 | 2.4E-04 | 5.0E-06 | 9.9E-04 |
| VOCs | 1,1,2,2-Tetrachloroethane | 1.1E+00 | 2.4E-04 | 4.1E-06 | 9.9E-04 |
| VOCs | Tetrachloroethene | 1.3E+02 | 2.9E-02 | 4.9E-04 | 1.2E-01 |
| VOCs | Toluene | 1.1E+01 | 2.8E-03 | 5.1E-05 | 1.2E-02 |
| VOCs | 1,2,4-Trichlorobenzene | 2.1E+01 | 2.2E-03 | 3.3E-05 | 8.0E-03 |
| VOCs | 1,1,1-Trichloroethane | 1.0E+00 | 2.3E-04 | 5.0E-06 | 9.9E-04 |
| VOCs | 1,1,2-Trichloroethane | 1.1E+00 | 2.6E-04 | 5.5E-06 | 1.1E-03 |
| VOCs | Trichloroethene | 8.3E+00 | 2.0E-03 | 3.5E-05 | 8.3E-03 |
| VOCs | Trichlorofluoromethane | 4.8E+01 | 1.2E-02 | 2.2E-04 | 5.3E-02 |
| VOCs | 1,1,2-Trichloro-1,2,2-trifluoroethane | 5.4E-01 | 5.5E-05 | 8.2E-07 | 2.0E-04 |
| VOCs | 1,2,4-Trimethylbenzene | 3.2E+00 | 7.3E-04 | 1.3E-05 | 3.0E-03 |
| VOCs | 1,3,5-Trimethylbenzene | 1.2E+00 | 2.7E-04 | 4.8E-06 | 1.1E-03 |
| VOCs | Vinyl acetate | 1.0E+01 | 2.5E-03 | 4.5E-05 | 1.1E-02 |
| VOCs | Vinyl chloride | 4.0E-01 | 1.2E-04 | 2.7E-06 | 5.4E-04 |
| VOCs | o-Xylene | 1.3E+00 | 3.3E-04 | 6.0E-06 | 1.4E-03 |
| VOCs | Xylenes (total) | 2.1E+01 | 4.5E-03 | 9.5E-05 | 1.9E-02 |
| SVOCs | Hexachlorobutadiene | 1.1E+00 | 1.0E-04 | 1.9E-06 | 3.7E-04 |
| SVOCs | Naphthalene | 5.2E+00 | 9.8E-04 | 1.6E-05 | 3.9E-03 |

**Notes:**

| | |
|---|---|
| bgs = below ground surface | $\mu g/m^3$ = microgram per cubic meter |
| EPC = Exposure Point Concentration | SVOC = Semi-Volatile Organic Compound |
| ft = feet | VOC = Volatile Organic Compound |

## TABLE 5-14. Air EPCs Due to Volatile Compounds Migrating from Shallow Groundwater to Indoor Air, Outdoor Air, and Trench Air – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Chemical Group | Constituent | Maximum Shallow Groundwater Concentration (µg/L) [1] | Predicted Indoor Air Concentration (µg/m$^3$ ) | Predicted Outdoor Air Concentration (µg/m$^3$) | Predicted Trench Air Concentration (µg/m$^3$) |
|---|---|---|---|---|---|
| VOCs | Acetone | 6.2E+00 | 4.8E-04 | 7.6E-06 | 1.7E-05 |
| VOCs | Carbon tetrachloride | 3.0E+01 | 3.5E-01 | 6.4E-03 | 9.1E-03 |
| VOCs | Chloroform | 1.2E+03 | 3.3E+00 | 5.1E-02 | 9.2E-02 |
| VOCs | 1,1-Dichloroethane | 2.7E-01 | 6.1E-04 | 1.1E-05 | 1.6E-05 |
| VOCs | 1,1-Dichloroethene | 6.3E+01 | 7.8E-01 | 1.4E-02 | 2.0E-02 |
| VOCs | 1,4-Dioxane | 5.9E+00 | 3.9E-05 | 7.2E-07 | 1.1E-06 |
| VOCs | Dimethyl disulfide | 2.5E+00 | 2.1E-03 | 3.9E-05 | 5.6E-05 |
| VOCs | Formaldehyde | 6.0E+01 | 1.4E-04 | 3.1E-06 | 4.9E-06 |
| VOCs | Methylene Chloride | 2.2E+01 | 2.9E-02 | 5.3E-04 | 7.7E-04 |
| VOCs | n-Nonyl aldehyde | 1.2E+02 | 6.0E-02 | 1.1E-03 | 1.6E-03 |
| VOCs | Tetrachloroethene | 9.5E+00 | 5.8E-02 | 1.1E-03 | 1.5E-03 |
| VOCs | Toluene | 7.6E-01 | 2.1E-03 | 3.9E-05 | 5.6E-05 |
| VOCs | Trichloroethene | 1.8E+01 | 7.2E-02 | 1.3E-03 | 1.9E-03 |
| VOCs | 1,2,3-Trichloropropane | 3.1E-01 | 2.6E-03 | 4.8E-05 | 6.8E-05 |

**Notes:**
µg/L = microgram per liter
µg/m$^3$ = microgram per cubic meter
-- = not calculated
EPC = Exposure Point Concentration
VOC = Volatile Organic Compound

[1] maximum chemical concentrations from the most recent two years of groundwater data at each well.

# TABLE 5-15. Exposure Assumptions

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

| Exposure Factors | Units | Symbol | Indoor Commercial/ Industrial Worker | | Outdoor Commercial/ Industrial Worker | | Construction Worker | |
|---|---|---|---|---|---|---|---|---|
| | | | Value | Source | Value | Source | Value | Source |
| **Population-Specific Exposure Assumptions** | | | | | | | | |
| Exposure Time | hours/day | ET | 8 | NDEP 2017a | 8 | NDEP 2017a | 8 | USEPA 2017 |
| Exposure Time_Trench | hours/day | ET | -- | -- | -- | -- | 4 | VDEQ 2016 |
| Exposure Frequency | days/year | EF | 250 | NDEP 2017a | 225 | NDEP 2017a | 250 | USEPA 2017 |
| Exposure Frequency_Trench | days/year | EF | -- | -- | -- | -- | 30 | [1] |
| Exposure Duration | years | ED | 25 | NDEP 2017a | 25 | NDEP 2017a | 1 | USEPA 2017 |
| Body Weight | $kg_{BW}$ | BW | 80 | NDEP 2017a | 80 | NDEP 2017a | 80 | USEPA 2017 |
| Averaging Time for Cancinogens | days | $AT_c$ | 25,550 | NDEP 2017a | 25,550 | NDEP 2017a | 25,550 | USEPA 2017 |
| Averaging Time for Noncarcinogens | days | $AT_{nc}$ | 9,125 | NDEP 2017a | 9,125 | NDEP 2017a | 365 | USEPA 2017 |
| **Soil Ingestion** | | | | | | | | |
| Soil Ingestion Rate | $mg_{soil}$/day | $IR_s$ | 50 | NDEP 2017a | 100 | NDEP 2017a | 330 | USEPA 2017 |
| Conversion Factor | $kg_{soil}/mg_{soil}$ | CF | 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 |
| 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 |
| **Soil Dermal Contact** | | | | | | | | |
| Skin Surface Area for Soil Contact | $cm^2$/day | SAs | -- | -- | 3,527 | USEPA 2017 | 3,527 | USEPA 2017 |
| Adherence Factor | $mg_{soil}/cm^2$ | AF | -- | -- | 0.12 | NDEP 2017a | 0.3 | USEPA 2017 |
| Conversion Factor | $kg_{soil}/mg_{soil}$ | CF | -- | -- | 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 |
| 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 |
| **Inhalation of Airborne Particulates** | | | | | | | | |
| Conversion Factor | hour/day | CF | 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 |
| 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 |
| **Inhalation of Vapor Migrating from Soil, Soil Gas, or Groundwater to Air** | | | | | | | | |
| Conversion Factor | hour/day | CF | 24 | -- | 24 | -- | 24 | -- |
| Intake Factor for Vapor Inhalation, cancer | unitless | $IF_{vapor.inh\_c}$ | 8.2E-02 | USEPA 2009 | 7.3E-02 | USEPA 2009 | 2.0E-04 | USEPA 2009 |
| Intake Factor for Vapor Inhalation, noncancer | unitless | $IF_{vapor.inh\_nc}$ | 2.3E-01 | USEPA 2009 | 2.1E-01 | USEPA 2009 | 1.4E-02 | USEPA 2009 |

**Notes:**

-- = Not applicable
$cm^2$/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
NDEP = Nevada Divisoin 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 Docuentation for the Nevada Divisoin 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. 2016. Virginia Unified Risk Assessment Model - VURAM User's Guide. Appendix 3.

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. 2017. User’s Guide for Regional Screening Levels for Chemical Contaminants at Superfund Sites. June.

## TABLE 5-16. 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$^3$) | | Soil Dermal Absorption Factor ABS$_{soil}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chlorine Oxyanions | Perchlorate | -- | -- | -- | -- | -- | 0.0007 | IRIS | -- | -- | 0.0007 | IRIS [1] | -- | -- | -- | -- |
| Metal | Palladium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Metal | Zirconium | -- | -- | -- | -- | -- | 0.00008 | PPRTV Appendix | -- | -- | 0.00008 | PPRTV Appendix [1] | -- | -- | -- | -- |
| Other Inorganics | Chloride | -- | -- | -- | -- | -- | 0.1 | IRIS | 0.15 | ATSDR | 0.1 | IRIS [1] | 5.8 | ATSDR | -- | -- |
| PAHs | BaPEq | 1 | IRIS | 0.0006 | IRIS | B2 | 0.0003 | IRIS | 0.002 | IRIS | 0.0003 | IRIS [1] | 0.002 | IRIS [1] | 0.13 | NDEP 2017 |
| PCBs | Aroclor-1254 | 2 | IRIS | 0.00057 | IRIS | B2 | 0.00002 | IRIS | -- | -- | 0.00003 | ATSDR | -- | -- | 0.14 | NDEP 2017 |
| Pesticides - OCPs | alpha-BHC | 6.3 | IRIS | 0.0018 | IRIS | B2 | 0.0003 | NDEP 2017 | -- | -- | 0.0003 | NDEP 2017 [1] | -- | -- | 0.04 | NDEP 2017 |
| SVOCs | Hydroxymethyl phthalimide | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

**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 (ATSDR 2017)
B2 = Probable carcinogen, sufficient evidence in animals (USEPA 2014)
BaPEq = Benzo(a)pyrene equivalent
BHC = Hexachlorocyclohexane
COPC = Chemical of potential concern
IRIS = Integrated Risk Information System (USEPA 2017a)
NDEP = Neveda Department of Environmental Protection
OCP = Organochlorine pesticide
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
PPRTV = Provisional Peer Reviewed Toxicity Values for Superfund (USEPA 2017b)
RfD = Reference dose
RfC = Reference concentration
SVOC = Semivolatile organic compound
USEPA = United States Environmental Protection Agency
[1] Use chronic value as surrogate

**Sources:**

ATSDR. 2017. Minimal Risk Levels. June.
NDEP. 2017. Basic Comparison Level (BCL) Table. July.
USEPA. 2014. Prioritized Chronic Dose-Response Values. May.
USEPA. 2017a. Integreated Risk Information System (IRIS). Available online at https://www.epa.gov/iris. Accessed on October 23, 2017.
USEPA. 2017b. Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV). Available online at https://hhpprtv.ornl.gov/. Accessed on October 23, 2017.

## TABLE 5-17A. Chronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater COPCs – Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Chemical Group | Constituent | Inhalation Unit Risk (µg/m$^3$)$^{-1}$ | | Inhalation RfC (µg/m$^3$) | |
|---|---|---|---|---|---|
| VOCs | Acetone | -- | -- | 31000 | ATSDR 2016 |
| VOCs | t-Amyl methyl ether | -- | -- | 3000 | IRIS 2017, Sur [1] |
| VOCs | Benzene | 0.0000078 | IRIS 2017 | 30 | IRIS 2017 |
| VOCs | Benzyl chloride | 0.000049 | Cal/EPA 2017 | 1 | PPRTV 2017 |
| VOCs | Bromodichloromethane | 0.000037 | Cal/EPA 2017 | 1000 | NDEP 2017b, Sur |
| VOCs | Bromomethane | -- | -- | 0.0050 | IRIS 2017 |
| VOCs | 2-Butanone | -- | -- | 5000 | IRIS 2017 |
| VOCs | n-Butylbenzene | -- | -- | 400 | NDEP 2017b, Sur |
| VOCs | Carbon disulfide | -- | -- | 700 | IRIS 2017 |
| VOCs | Carbon tetrachloride | 0.000006 | IRIS 2017 | 100 | IRIS 2017 |
| VOCs | Chlorobenzene | -- | -- | 50 | PPRTV 2017 |
| VOCs | Chloroethane | -- | -- | 10000 | IRIS 2017 |
| VOCs | Chloroform | 0.000023 | IRIS 2017 | 98 | ATSDR 2016 |
| VOCs | Cyclohexane | -- | -- | 6000 | IRIS 2017 |
| VOCs | p-Cymene | -- | -- | 400 | NDEP 2017b, Sur |
| VOCs | 1,2-Dibromo-3-chloropropane | 0.006 | PPRTV 2017 | 0.2 | IRIS 2017 |
| VOCs | Dibromochloromethane | -- | -- | -- | -- |
| VOCs | 1,2-Dibromoethane | 0.0006 | IRIS 2017 | 9 | IRIS 2017 |
| VOCs | 1,2-Dichlorobenzene | -- | -- | 200 | HEAST 1997 |
| VOCs | 1,3-Dichlorobenzene | -- | -- | 200 | NEDP 2017b, Sur |
| VOCs | 1,4-Dichlorobenzene | 0.000011 | Cal/EPA 2017 | 800 | IRIS 2017 |
| VOCs | Dichlorodifluoromethane | -- | -- | 100 | PPRTV Apendix |
| VOCs | 1,1-Dichloroethane | 0.0000016 | Cal/EPA 2017 | -- | -- |
| VOCs | 1,2-Dichloroethane | 0.000026 | IRIS 2017 | 7 | PPRTV 2017 |
| VOCs | 1,1-Dichloroethene | -- | -- | 200 | IRIS 2017 |
| VOCs | cis-1,2-Dichloroethene | -- | -- | -- | -- |
| VOCs | trans-1,2-Dichloroethene | -- | -- | -- | -- |
| VOCs | 1,2-Dichloropropane | 0.00001 | Cal/EPA 2017 | 4.0 | IRIS 2017 |
| VOCs | cis-1,3-Dichloropropene | 0.000004 | IRIS 2017, Sur [2] | 20 | IRIS 2017, Sur [2] |
| VOCs | trans-1,3-Dichloropropene | 0.000004 | IRIS 2017, Sur [2] | 20 | IRIS 2017, Sur [2] |
| VOCs | 1,4-Dioxane | 0.000005 | IRIS 2017 | 30 | IRIS 2017 |
| VOCs | Dimethyl disulfide | -- | -- | -- | -- |
| VOCs | Ethanol | -- | -- | 100000 | NDEP 2017a, Sur |
| VOCs | Ethyl tert-butyl ether | -- | -- | 3000 | IRIS 2017, Sur [1] |
| VOCs | Ethyl acetate | -- | -- | 70 | PPRTV 2017 |
| VOCs | Ethyl benzene | 0.0000025 | Cal/EPA 2017 | 1000 | IRIS 2017 |
| VOCs | 4-Ethyltoluene | -- | -- | 400 | NDEP 2017a, Sur |
| VOCs | Formaldehyde | 0.000013 | IRIS 2017 | 9.8 | ATSDR 2016 |
| VOCs | Freon 114 | -- | -- | 30000 | HEAST 1997, Sur [3] |
| VOCs | n-Heptane | -- | -- | 7000 | NDEP 2017a, Sur |
| VOCs | n-Hexane | -- | -- | 700 | IRIS 2017 |
| VOCs | 2-Hexanone | -- | -- | 30 | IRIS 2017 |
| VOCs | Methyl tert-butyl ether | 0.00000026 | Cal/EPA 2017 | 3000 | IRIS 2017 |
| VOCs | 4-Methyl-2-pentanone | -- | -- | 3000 | IRIS 2017 |
| VOCs | Methylene Chloride | 0.00000001 | IRIS 2017 | 600 | IRIS 2017 |
| VOCs | n-Nonyl aldehyde | -- | -- | 9.0 | IRIS 2017, Sur, [4] |
| VOCs | n-Propylbenzene | -- | -- | 1000 | PPRTV Apendix |
| VOCs | Styrene | -- | -- | 1000 | IRIS 2017 |
| VOCs | tert Butyl alcohol | -- | -- | 30000 | NDEP 2017a, Sur |
| VOCs | 1,1,1,2-Tetrachloroethane | 0.0000074 | IRIS 2017 | -- | -- |
| VOCs | 1,1,2,2-Tetrachloroethane | 0.000058 | Cal/EPA 2017 | -- | -- |
| VOCs | Tetrachloroethene | 0.00000026 | IRIS 2017 | 40 | IRIS 2017 |
| VOCs | Toluene | -- | -- | 5000 | IRIS 2017 |
| VOCs | 1,2,4-Trichlorobenzene | -- | -- | 2.0 | PPRTV 2017 |

# TABLE 5-17A. Chronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater COPCs – Parcel F

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Group | Constituent | Inhalation Unit Risk (µg/m$^3$)$^{-1}$ | | Inhalation RfC (µg/m$^3$) | |
|---|---|---|---|---|---|
| VOCs | 1,1,1-Trichloroethane | -- | -- | 5000 | IRIS 2017 |
| VOCs | 1,1,2-Trichloroethane | 0.000016 | IRIS 2017 | 0.20 | PPRTV Apendix |
| VOCs | Trichloroethene | 0.0000041 | IRIS 2017 | 2.0 | IRIS 2017 |
| VOCs | Trichlorofluoromethane | -- | -- | 700 | HEAST 1997 |
| VOCs | 1,2,3-Trichloropropane | -- | -- | 0.30 | IRIS 2017 |
| VOCs | 1,1,2-Trichloro-1,2,2-trifluoroethane | -- | -- | 30000 | HEAST 1997 |
| VOCs | 1,2,4-Trimethylbenzene | -- | -- | 60 | IRIS 2017 |
| VOCs | 1,3,5-Trimethylbenzene | -- | -- | 60 | IRIS 2017, Sur [5] |
| VOCs | Vinyl acetate | -- | -- | 200 | IRIS 2017 |
| VOCs | Vinyl chloride | 0.0000044 | IRIS 2017 | 100 | IRIS 2017 |
| VOCs | o-Xylene | -- | -- | 100 | NDEP 2017a, Sur |
| VOCs | Xylenes (total) | -- | -- | 100 | IRIS 2017 |
| SVOCs | Hexachlorobutadiene | 0.000022 | IRIS 2017 | -- | -- |
| SVOCs | Naphthalene | 0.000034 | Cal/EPA 2017 | 3.0 | IRIS 2017 |

**Notes:**

-- = Not available
µg/m$^3$ = microgram per cubic meter
ATSDR = Agency for Toxic Substances and Disease Registry
Cal/EPA = California Environmental Protection Agency
HEAST = Health Effects Summary Tables
IRIS = Integrated Risk Information System
NDEP = Nevada Division of Environmental Protection
PPRTV = Provisional Peer Reviewed Toxicity Values for Superfund
SVOC = Semivolatile Organic Compound
RfC = Reference Concentration
Sur = Surrogate
USEPA = United States Environmental Protection Agency
VOC = Volatile Organic Compound

[1] Used toxicity value for methyl tertbutyl ether as surrogate.
[2] Used toxicity value for 1,3-dichloropropene as surrogate.
[3] Used toxicity value for Freon 113 as surrogate.
[4] Used toxicity value for acetaldehyde as surrogate.
[5] Used the toxicity value for 1,2,4-trimethylbenzene as surrogate.

**Sources:**

ATSDR. 2016. Minimal Risk Levels. March.

Cal/EPA. 2017. Office of Environmental Health Hazard Assessment (OEHHA). OEHHA Chemical Database Meta Data. Accessed in August 2017.

Health Effects Assessment Summary Tables (HEAST). 1997.

Integrated Risk Information System (IRIS). 2017. Online database Maintained by the USEPA. Accessed in August, 2017.

Nevada Division of Environmental Protection (NDEP) 2017a. Basic Comparison Levels Table. July.

Nevada Division of Environmental Protection (NDEP) 2017b. User's Guide and Technical Document for Basic Comparison Levels. Appendix B. July.

Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV). 2017. Available online at https://hhpprtv.ornl.gov/. Accessed in May 2017.

USEPA. 2017. User’s Guide for Regional Screening Levels (RSLs)for Chemical Contaminants at Superfund Sites. June.

# TABLE 5-17B. Subchronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater COPCs – Parcel F

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

| Chemical Group | Constituent | Subchronic Inhalation RfC (µg/m$^3$) | |
|---|---|---|---|
| VOCs | Acetone | 30882 | ATSDR 2017 |
| VOCs | t-Amyl methyl ether | 2524 | ATSDR 2017, Sur [2] |
| VOCs | Benzene | 80 | PPRTV |
| VOCs | Benzyl chloride | 4 | PPRTV |
| VOCs | Bromodichloromethane | 20 | PPRTV |
| VOCs | Bromomethane | 100 | PPRTV |
| VOCs | 2-Butanone | 5000 | IRIS [1] |
| VOCs | n-Butylbenzene | 400 | NEDP 2015, Sur [1] |
| VOCs | Carbon disulfide | 700 | HEAST 1997 |
| VOCs | Carbon tetrachloride | 189 | ATSDR 2017 |
| VOCs | Chlorobenzene | 2302 | PPRTV |
| VOCs | Chloroethane | 4000 | PPRTV |
| VOCs | Chloroform | 244 | ATSDR 2017 |
| VOCs | Cyclohexane | 18000 | PPRTV |
| VOCs | p-Cymene | 400 | NDEP 2017b, Sur [1] |
| VOCs | 1,2-Dibromo-3-chloropropane | 2 | PPRTV |
| VOCs | Dibromochloromethane | -- | -- |
| VOCs | 1,2-Dibromoethane | 9 | IRIS [1] |
| VOCs | 1,2-Dichlorobenzene | 2000 | HEAST 1997 |
| VOCs | 1,3-Dichlorobenzene | 200 | NEDP 2017b, Sur [1] |
| VOCs | 1,4-Dichlorobenzene | 1202 | ATSDR 2017 |
| VOCs | Dichlorodifluoromethane | 1000 | PPRTV |
| VOCs | 1,1-Dichloroethane | 5000 | HEAST 1997 |
| VOCs | 1,2-Dichloroethane | 70 | PPRTV |
| VOCs | 1,1-Dichloroethene | 79 | IRIS [1] |
| VOCs | cis-1,2-Dichloroethene | 793 | ATSDR 2017, Sur [1], [3] |
| VOCs | trans-1,2-Dichloroethene | 793 | ATSDR 2017 |
| VOCs | 1,2-Dichloropropane | 4 | PPRTV |
| VOCs | cis-1,3-Dichloropropene | 20 | IRIS 2017, Sur [1], [4] |
| VOCs | trans-1,3-Dichloropropene | 20 | IRIS 2017, Sur [1], [4] |
| VOCs | 1,4-Dioxane | 721 | ATSDR 2017 |
| VOCs | Dimethyl disulfide | -- | -- |
| VOCs | Ethanol | 100000 | NDEP 2015, Sur [1] |
| VOCs | Ethyl tert-butyl ether | 2524 | ATSDR 2017, Sur [2] |
| VOCs | Ethyl acetate | 700 | PPRTV |
| VOCs | Ethyl benzene | 9000 | PPRTV |
| VOCs | 4-Ethyltoluene | 400 | NDEP 2017a, Sur [1] |
| VOCs | Formaldehyde | 37 | ATSDR 2017 |
| VOCs | Freon 114 | 30000 | HEAST 1997, Sur [1], [5] |
| VOCs | n-Heptane | 4000 | PPRTV |
| VOCs | n-Hexane | 2000 | PPRTV |
| VOCs | 2-Hexanone | 30 | IRIS [1] |
| VOCs | Methyl tert-butyl ether | 2524 | ATSDR 2017 |
| VOCs | 4-Methyl-2-pentanone | 3000 | IRIS [1] |
| VOCs | Methylene Chloride | 1042 | ATSDR 2017 |
| VOCs | n-Nonyl aldehyde | 9 | IRIS 2017, Sur [1], [6] |
| VOCs | n-Propylbenzene | 1000 | PPRTV |
| VOCs | Styrene | 3000 | HEAST 1997 |
| VOCs | tert Butyl alcohol | 30000 | NDEP 2017a, Sur [1], [2] |
| VOCs | 1,1,1,2-Tetrachloroethane | -- | -- |
| VOCs | 1,1,2,2-Tetrachloroethane | -- | -- |
| VOCs | Tetrachloroethene | 41 | ATSDR 2017 |
| VOCs | Toluene | 5000 | PPRTV |
| VOCs | 1,2,4-Trichlorobenzene | 2 | PPRTV 2017 [1] |
| VOCs | 1,1,1-Trichloroethane | 3820 | ATSDR 2017 |
| VOCs | 1,1,2-Trichloroethane | 2.0 | PPRTV |
| VOCs | Trichloroethene | 2.1 | ATSDR 2017 |
| VOCs | Trichlorofluoromethane | 1000 | PPRTV |
| VOCs | 1,2,3-Trichloropropane | 0.30 | IRIS [1] |
| VOCs | 1,1,2-Trichloro-1,2,2-trifluoroethane | 50000 | PPRTV |
| VOCs | 1,2,4-Trimethylbenzene | 60 | PPRTV |
| VOCs | 1,3,5-Trimethylbenzene | 60 | PPRTV |
| VOCs | Vinyl acetate | 35 | ATSDR 2017 |
| VOCs | Vinyl chloride | 77 | ATSDR 2017 |
| VOCs | o-Xylene | 400 | PPRTV 2017, sur [7] |
| VOCs | Xylenes (total) | 400 | PPRTV |
| SVOCs | Hexachlorobutadiene | 4 | Cal/EPA 2017 [1] |
| SVOCs | Naphthalene | 3 | IRIS [1] |

## TABLE 5-17B. Subchronic Inhalation Toxicity Criteria for Soil Gas and Shallow Groundwater COPCs – Parcel F

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

**Notes:**

-- = Not available
µg/m$^3$ = microgram per cubic meter
ATSDR = Agency for Toxic Substances and Disease Registry
HEAST = Health Effects Summary Tables
IRIS = Integrated Risk Information System
NDEP = Nevada Division of Environmental Protection
PPRTV = Provisional Peer Reviewed Toxicity Values for Superfund
RfC = Reference Concentration
Sur = Surrogate
SVOC = Semi-Volatile Organic Compound
VOC = Volatile Organic Compound

[1] Chornic toxicity values were used when subchronic toxicity values were not available.
[2] Used toxicity value for methyl tertbutyl ether as surrogate.
[3] Used toxicity value for trans-1,2-dichloroethene as surrogate.
[4] Used toxicity value for 1,3-dichloropropene as surrogate.
[5] Used toxicity value for Freon 113 as surrogate.
[6] Used toxicity value for acetaldehyde as surrogate.
[7] Used the toxicity value for xylenes(total) as surrogate.

**Sources:**

ATSDR. 2017. Minimal Risk Levels. June.
Cal/EPA. 2017. Human and Ecological Risk Office (HERO) Human Health Risk assessment (HHRA) Note 3 - DTSC-Modified Screening Levels (DTSC-SLs). August.

Health Effects Assessment Summary Tables (HEAST). 1997.
Integrated Risk Information System (IRIS). 2017. Online database Maintained by the USEPA. Accessed May 10, 2017.
Nevada Division of Environmental Protection (NDEP) 2015. Basic Comparison Levels. February.
Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV). 2017. Available online at https://hhpprtv.ornl.gov/. Accessed on August 2017.

# TABLE 5-18. Estimated Soil Cancer Risks and Non-Cancer Hazard Indices – Parcel F
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Parcel | 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) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI |
| H | 2E-07 | 0.2 | 2E-07 | 0.2 | 4E-07 | 0.3 | 3E-07 | 0.3 | 4E-08 | 1 |

**Notes:**
bgs = below ground surface
HI = Hazard index

## TABLE 5-19. Estimated Asbestos Cancer Risks– Parcel F

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Parcel | Risk Type | Indoor Commercial/Industrial Worker | | | Outdoor Commercial/Industrial Worker | | | Construction Worker | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Amphibole Risk | Chrysotile Risk | Total Asbestos Risk | Amphibole Risk | Chrysotile Risk | Total Asbestos Risk | Amphibole Risk | Chrysotile Risk | Total Asbestos Risk |
| F | Best Estimate | 0E+00 | 4E-09 | 4E-09 | 0E+00 | 9E-09 | 9E-09 | 0E+00 | 1E-07 | 1E-07 |
| | Upper-Bound Estimate | 9E-08 | 6E-09 | 1E-07 | 2E-07 | 1E-08 | 2E-07 | 2E-06 | 1E-07 | 2E-06 |

**Notes:**

Best Estimate = Calculated based on the number of long fibers observed in soil samples.

Upper-Bound Estimate = Calculated based on the 95% upper confidence limit (UCL) of the number of long fibers observed in soil samples from a Poisson distribution.

## TABLE 5-20. Estimated Soil Gas Cancer Risks and Non-Cancer Hazard Indices – Parcel F

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

| Population | Soil Gas (< 5 ft bgs) | |
|---|---|---|
| | Cancer Risk | HI |
| Indoor Worker | 2E-06 | 0.01 |
| Outdoor Worker | 3E-08 | 0.0002 |
| Construction Worker (Trench Scenario) | 2E-08 | 0.0005 |

**Notes:**
bgs = below ground surface
ft = feet
HI = Hazard Index

# TABLE 5-21. Estimated Shallow Groundwater Cancer Risks and Non-Cancer Hazard Indices – Parcel F

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

| Population | Groundwater | |
|---|---|---|
| | Cancer Risk | HI |
| Indoor Worker | 6E-06 | 0.02 |
| Outdoor Worker | 9E-08 | 0.0003 |
| Construction Worker (Trench Scenario) | 4E-10 | 0.00003 |

**Note:**
HI = Hazard Index

# TABLE 6-1. Uncertainty Analysis of J Qualified Soil Data

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

| Parcel | Analyte | Maximum Concentration of Qualified Data | Qualifier | Maximum Detected Concentration in Soil HRA Data Set | Screening Level | Unit |
|---|---|---|---|---|---|---|
| F | Iron | 23,000 | J | 23,000 | 908,000 | mg/kg |
| F | Nitrate/Nitrite | 1.2 | J | 24 | 130,000 | mg/kg |
| F | Chromium (total) | 12 | J | 19 | 1,950,000 | mg/kg |
| F | Chromium VI | 0.55 | J | 0.55 | 7.0 | mg/kg |
| F | Cobalt | 9.0 | J | 11 | 385 | mg/kg |
| F | Di-n-butylphthalate | 4.7 | J | 5.2 | 91,600 | mg/kg |
| F | Di-n-octylphthalate | 0.28 | J | 0.28 | 9,160 | mg/kg |
| F | Endrin aldehyde | 0.020 | J | 0.020 | 30 | mg/kg |
| F | Ethyl benzene | 0.00048 | J | 0.00048 | 233 | mg/kg |
| F | Fluoranthene | 0.097 | J | 0.097 | 33,700 | mg/kg |
| F | Chloride | 604 | J | 18,000 | 113,000 | mg/kg |
| F | Hydroxymethyl phthalimide | 0.12 | J | 0.15 | NA | mg/kg |
| F | Chlorate | 310 | J | 310 | 38,900 | mg/kg |
| F | Lead | 19 | J | 140 | 800 | mg/kg |
| F | Lithium | 23 | J | 23 | 2,600 | mg/kg |
| F | m,p-Xylene | 0.0026 | J | 0.0026 | 387 | mg/kg |
| F | 1,2,4-Trimethylbenzene | 0.0032 | J | 0.0086 | 218 | mg/kg |
| F | Magnesium | 16,000 | J | 19,000 | 5,200,000 | mg/kg |
| F | Mercury | 0.033 | J | 1.0 | 389 | mg/kg |
| F | Methylene Chloride | 0.011 | J | 0.021 | 1,550 | mg/kg |
| F | Molybdenum | 0.92 | J | 1.5 | 6,490 | mg/kg |
| F | Naphthalene | 0.010 | J | 0.010 | 18 | mg/kg |
| F | Nitrate | 7.9 | J | 350 | 2,080,000 | mg/kg |
| F | Fluoride | 3.0 | J | 3.0 | 51,900 | mg/kg |
| F | Barium | 859 | J | 1,400 | 238,000 | mg/kg |
| F | 1,3,5-Trimethylbenzene | 0.0038 | J | 0.0038 | 182 | mg/kg |
| F | 2,3,7,8-TCDD TEQ | 0.0013 | J | 0.0013 | 0.0027 | mg/kg |
| F | 2,4'-DDE | 0.019 | J | 0.020 | 9.5 | mg/kg |
| F | 2-Butanone | 0.013 | J | 0.013 | 28,400 | mg/kg |
| F | 2-Hexanone | 0.0071 | J | 0.0071 | 1,650 | mg/kg |
| F | 4,4'-DDE | 0.073 | J | 0.18 | 9.5 | mg/kg |
| F | 4,4'-DDT | 0.089 | J | 0.26 | 7.5 | mg/kg |
| F | Acetone | 1.9 | J | 1.9 | 1,040,000 | mg/kg |
| F | Acetophenone | 0.062 | J | 0.062 | 2,520 | mg/kg |
| F | Chloroform | 0.00065 | J | 0.00065 | 1.5 | mg/kg |
| F | Aroclor-1248 | 0.074 | J | 0.074 | 1.1 | mg/kg |
| F | Manganese | 514 | J | 920 | 28,100 | mg/kg |
| F | Benzoic acid | 0.32 | J | 0.32 | 3,670,000 | mg/kg |
| F | Benzyl alcohol | 0.094 | J | 0.34 | 91,600 | mg/kg |
| F | Beryllium | 0.63 | J | 0.84 | 2,540 | mg/kg |
| F | beta-BHC | 0.12 | J | 0.14 | 1.7 | mg/kg |
| F | bis(2-Ethylhexyl)phthalate | 0.14 | J | 1.4 | 183 | mg/kg |
| F | Boron | 13 | J | 14 | 259,000 | mg/kg |
| F | Bromide | 4.3 | J | 10 | 441,000 | mg/kg |
| F | Cadmium | 0.10 | J | 0.42 | 1,260 | mg/kg |
| F | Calcium | 66,200 | J | 97,000 | NA | mg/kg |
| F | Carbazole | 0.068 | J | 0.068 | 128 | mg/kg |
| F | Aluminum | 8,940 | J | 12,000 | 1,240,000 | mg/kg |
| F | Titanium | 893 | J | 1,000 | 5,190,000 | mg/kg |
| F | Pyrene | 0.30 | J | 0.30 | 44 | mg/kg |
| F | Radium-226 | 2.3 | J | 2.3 | 0.023 | pCi/g |
| F | Radium-228 | 1.7 | J | 14 | 0.041 | pCi/g |
| F | Silicon | 426 | J | 1,000 | NA | mg/kg |
| F | Sodium | 2,900 | J | 2,900 | NA | mg/kg |
| F | Strontium | 340 | J | 360 | 779,000 | mg/kg |
| F | Sulfate | 553 | J | 2,300 | NA | mg/kg |

# TABLE 6-1. Uncertainty Analysis of J Qualified Soil Data
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| Parcel | Analyte | Maximum Concentration of Qualified Data | Qualifier | Maximum Detected Concentration in Soil HRA Data Set | Screening Level | Unit |
|---|---|---|---|---|---|---|
| F | Sulfur | 913 | J | 1,300 | NA | mg/kg |
| F | Potassium | 2,900 | J | 3,900 | NA | mg/kg |
| F | Tin | 0.41 | J | 1.1 | 779,000 | mg/kg |
| F | Silver | 0.21 | J | 0.21 | 6,490 | mg/kg |
| F | Toluene | 0.00047 | J | 0.00047 | 817 | mg/kg |
| F | Uranium-234 | 0.96 | J | 2.6 | 11 | pCi/g |
| F | Uranium-235 | 0.079 | J | 0.11 | 0.35 | pCi/g |
| F | Uranium-238 | 1.7 | J | 1.8 | 1.4 | pCi/g |
| F | Vanadium | 72 | J | 72 | 6,420 | mg/kg |
| F | Xylenes (total) | 0.0034 | J | 0.0034 | 259 | mg/kg |
| F | Zinc | 62 | J | 67 | 389,000 | mg/kg |
| F | Zirconium | 21 | J | 36 | 104 | mg/kg |
| F | Thallium | 0.43 | J | 0.43 | 13 | mg/kg |
| F | Perchlorate | 168 | J | 168 | 908 | mg/kg |
| F | n-Nonyl aldehyde | 0.0033 | J | 0.0033 | 380 | mg/kg |
| F | n-Propylbenzene | 0.0014 | J | 0.0014 | 264 | mg/kg |
| F | ortho-Phosphate | 1.3 | J | 6.3 | 30,400,000 | mg/kg |
| F | o-Xylene | 0.00083 | J | 0.00083 | 434 | mg/kg |
| F | Palladium | 0.21 | J | 2.1 | NA | mg/kg |
| F | Platinum | 0.15 | J | 2.4 | 649 | mg/kg |
| F | Phenanthrene | 0.96 | J | 0.96 | 25 | mg/kg |
| F | Phenol | 0.13 | J | 0.44 | 275,000 | mg/kg |
| F | Phosphorus (total) | 1,270 | J | 1,400 | 9,630,000 | mg/kg |
| F | Phthalic acid | 0.76 | J | 0.76 | 1,830,000 | mg/kg |
| F | Cobalt | 11 | J- | 11 | 385 | mg/kg |
| F | Potassium | 3,900 | J- | 3,900 | NA | mg/kg |
| F | Acetone | 0.0062 | J- | 1.9 | 1,040,000 | mg/kg |
| F | Nickel | 23 | J- | 23 | 24,700 | mg/kg |
| F | Tungsten | 9.0 | J- | 9.0 | 1,040 | mg/kg |
| F | Vanadium | 37 | J- | 72 | 6,420 | mg/kg |
| F | Silicon | 309 | J- | 1,000 | NA | mg/kg |
| F | Zirconium | 36 | J- | 36 | 104 | mg/kg |
| F | Barium | 1,400 | J- | 1,400 | 238,000 | mg/kg |
| F | Sodium | 1,330 | J- | 2,900 | NA | mg/kg |
| F | 4,4'-DDE | 0.0032 | J- | 0.18 | 9.5 | mg/kg |
| F | Copper | 25 | J- | 25 | 36,700 | mg/kg |
| F | Antimony | 0.32 | J- | 0.32 | 519 | mg/kg |
| F | Sulfur | 1,300 | J- | 1,300 | NA | mg/kg |
| F | beta-BHC | 0.10 | J- | 0.14 | 1.7 | mg/kg |
| F | Nitrite | 0.79 | J- | 11 | 130,000 | mg/kg |
| F | Sulfate | 904 | J- | 2,300 | NA | mg/kg |
| F | Hydroxymethyl phthalimide | 0.15 | J- | 0.15 | NA | mg/kg |
| F | Chromium (total) | 19 | J- | 19 | 1,950,000 | mg/kg |
| F | Magnesium | 18,900 | J- | 19,000 | 5,200,000 | mg/kg |
| F | Phosphorus (total) | 1,400 | J- | 1,400 | 9,630,000 | mg/kg |
| F | Zinc | 67 | J- | 67 | 389,000 | mg/kg |
| F | 2,4'-DDE | 0.020 | J+ | 0.020 | 9.5 | mg/kg |
| F | 4,4'-DDD | 0.013 | J+ | 0.013 | 15 | mg/kg |
| F | Nitrate | 110 | J+ | 350 | 2,080,000 | mg/kg |
| F | Niobium | 9.9 | J+ | 9.9 | 130 | mg/kg |
| F | 4,4'-DDE | 0.026 | J+ | 0.18 | 9.5 | mg/kg |
| F | Endrin aldehyde | 0.0068 | J+ | 0.020 | 30 | mg/kg |
| F | alpha-BHC | 0.0020 | J+ | 0.059 | 0.49 | mg/kg |
| F | Barium | 200 | J+ | 1,400 | 238,000 | mg/kg |
| F | Aroclor-1254 | 0.29 | J+ | 0.29 | 1.1 | mg/kg |
| F | Sulfur | 919 | J+ | 1,300 | NA | mg/kg |

# TABLE 6-1. Uncertainty Analysis of J Qualified Soil Data
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Parcel | Analyte | Maximum Concentration of Qualified Data | Qualifier | Maximum Detected Concentration in Soil HRA Data Set | Screening Level | Unit |
|---|---|---|---|---|---|---|
| F | Phosphorus (total) | 1,250 | J+ | 1,400 | 9,630,000 | mg/kg |
| F | Sulfate | 573 | J+ | 2,300 | NA | mg/kg |
| F | Nitrate/Nitrite | 24 | J+ | 24 | 130,000 | mg/kg |
| F | Silicon | 300 | J+ | 1,000 | NA | mg/kg |
| F | Fluoride | 2.4 | J+ | 3.0 | 51,900 | mg/kg |

**Notes:**
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BHC = Hexachlorocyclohexane
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
HRA = Health risk assessment
J = Estimated value
J- = Estimate value, biased low
J+ = Estimate value, biased high
NA = Not available
TCDD = Tetrachlorodibenzo-p-dioxin
TEQ = Toxicity equivalent

# TABLE 6-2. Uncertainty Analysis of Soil Data with Blank Contamination

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Parcel | Analyte | Maximum Reported Concentration in 2012 Blank Contamination Amended Table (Northgate 2014) mg/kg | Maximum Detected Concentration in Soil HRA Data Set mg/kg | Screening Level mg/kg |
|---|---|---|---|---|
| F | Acetone | 0.40 | 1.9 | 1,040,000 |
| F | Antimony | 0.22 | 0.32 | 519 |
| F | Boron | 12 | 14 | 259,000 |
| F | 2-Butanone | 0.015 | 0.013 | 28,431 |
| F | Cadmium | 0.10 | 0.42 | 1,260 |
| F | Chloroform | 0.00053 | 0.00065 | 1.5 |
| F | Fluoride | 2.4 | 3.0 | 51,900 |
| F | 2-Hexanone | 0.24 | 0.0071 | 1,653 |
| F | Lithium | 7.8 | 23 | 2,600 |
| F | Mercury | 0.029 | 1.0 | 389 |
| F | Methylene Chloride | 0.096 | 0.021 | 1,554 |
| F | Molybdenum | 0.97 | 1.5 | 6,490 |
| F | Niobium | 4.3 | 9.9 | 130 |
| F | Perchlorate | 0.038 | 168 | 908 |
| F | Tetrachloroethylene | 0.0016 | ND | 117 |
| F | Thallium | 0.43 | 0.43 | 13 |
| F | Tin | 0.40 | 1.1 | 779,000 |
| F | Toluene | 0.0017 | 0.00047 | 817 |
| F | Tungsten | 0.97 | 9.0 | 1,040 |
| F | Zirconium | 22 | 36 | 104 |

**Notes:**

mg/kg = milligram per kilogram

HRA = Health risk assessment

ND = Not detected

**Source:**

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

# TABLE 7-1. Soil Data Quality Assessment – Parcel F
## Nevada Environmental Response Trust Site
## Henderson, Nevada

| **Cancer Risk** | | | | | |
|---|---|---|---|---|---|
| **Depth Interval** | | 0-10 ft bgs | | 0-2 ft bgs | |
| **Cancer Risk Driver** [1] | | Aroclor 1254 | | Aroclor 1254 | |
| **Sample Size** | | 20 | | 16 | |
| **$P_1$** [2] | | 0 | 0 | 0 | 0 |
| **Sample count for effect size** | | 1 | 2 | 1 | 2 |
| **Effect size** [3] | | 0.050 | 0.10 | 0.063 | 0.13 |
| **$P_2$** [4] | | 0.050 | 0.10 | 0.063 | 0.13 |
| **Number of samples required** [1] | β=15% | 37 | 19 | 30 | 15 |
| | β=20% | 32 | 16 | 25 | 13 |
| | β=25% | 28 | 14 | 22 | 11 |

| **Non-Cancer HQ** | | |
|---|---|---|
| **Depth Interval** | 0-10 ft bgs | 0-2 ft bgs |
| **Population with Maximum Non-Cancer HI** | Construction Worker | Outdoor Commercial/ Industrial Worker |
| **Non-Cancer HI Driver** [5] | Zirconium | Zirconium |
| **Sample Size** | 45 | 22 |
| **Target HQ** [6] | 1.49 | 1.49 |
| **Non-Cancer HI Based on 95% UCL**[7] | 1 | 0.3 |
| **95% UCL of Driver Chemical Concentration (mg/kg)** | 21 | 22 |
| **Non-Cancer HQ Based on 95%UCL of Driver Chemical** | 0.8 | 0.2 |
| **SD of Driver Chemical Concentration (mg/kg)**[8] | 11 | 11 |
| **SD of HQ from Driver Chemical**[9] | 0.4 | 0.1 |
| **Number of Sample Required**[5] | 9 | 2 |

**Notes:**

bgs = below ground surface
ft = feet
mg/kg = milligram per kilogram
HQ = Hazard quotient
HI = Hazard index
EPC = Exposure point concentration
SD = Standard deviation
UCL = Upper confidence limit

[1] The soil EPC used for the cancer risk driver is the maximum detected concentration. Analysis for cancer risk was conducted using the Exact – Generic Binomial Test in the software program G*Power.

[2] $P_1$ is the theoretical proportion of samples exceeding a threshold as specified in the null hypothesis. Input 0.000001 in G*Power, because the minimum input is 0.000001 in G*Power.

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

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

[5] The soil EPC used for the non-cancer HI driver is 95% UCL over the mean concentration. Analysis for non-cancer HQ was conducted using the t tests - Means: difference from constant (one sample case) in the software program G*Power.

[6] Target HQ is set as 1.49, which can be rounded to 1. This value was input as $\text{Mean}_1$ in G*Power, indicating an alternative hypothesis that the mean of population HQ is greater than the target HQ .

[7] The values were input as $\text{Mean}_0$ in G*Power, indicating a null hypothesis that the mean of population HI is the same as the HI based on the 95% UCL of sample results.

[8] SD of driver chemical concentration was calculated using Kaplan–Meier method in ProUCL.

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

# TABLE 7-2. Soil Gas Data Quality Assessment – Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| **Medium** | **Soil Gas (0-5 ft bgs)** | |
|---|---|---|
| **Parcel** | **F** | |
| **Number of Samples** | 6 | |
| **$P_1$ [1]** | 0 | |
| **Sample count for effect size** | 1 | 2 |
| **Effect size [2]** | 0.167 | 0.333 |
| **$P_2$ [3]** | 0.167 | 0.333 |
| | **Number of samples required [4]** | |
| **β=15%** | 11 | 5 |
| **β=20%** | 9 | 4 |
| **β=25%** | 8 | 4 |

**Notes:**

bgs = below ground surface

ft = feet

[1] $P_1$ is the theoretical proportion of concentrations exceeding a threshold as specified in the null hypothesis. Input 0.000001 in G*Power, because the minimum input is 0.000001 in Gpower.

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

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

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

# TABLE 7-3. Shallow Groundwater Data Quality Assessment – Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| **Medium** | **Groundwater** | |
|---|---|---|
| **Parcel** | **F** | |
| **Number of Samples** | 5 | |
| **$P_1$ [1]** | 0 | 0 |
| **Sample count for effect size** | 1 | 2 |
| **Effect size [2]** | 0.200 | 0.400 |
| **$P_2$ [3]** | 0.200 | 0.400 |
| | **Number of samples required [4]** | |
| **β=15%** | 9 | 4 |
| **β=20%** | 8 | 4 |
| **β=25%** | 7 | 3 |

**Notes:**

[1] $P_1$ is the theoretical proportion of concentrations exceeding a threshold as specified in the null hypothesis. Input 0.000001 in G*Power, because the minimum input is 0.000001 in Gpower.

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

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

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

# TABLE 8-1. Summary of Cumulative Estimated Risks for Soil and Soil Gas – Parcel F

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Parcel | Exposure [1] | Indoor Commercial/Industrial Worker | | Outdoor Commercial/Industrial Worker | | Construction Worker | |
|---|---|---|---|---|---|---|---|
| | | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI | Cancer Risk | Non-Cancer HI |
| F | Cumulative Risk for Soil (0-2 ft) and Soil Gas (5 ft) | 2E-06 | 0.2 | 4E-07 | 0.3 | -- | -- |
| | Cumulative Risk for Soil (0-10 ft) and Soil Gas (5 ft) | 2E-06 | 0.2 | 4E-07 | 0.3 | 6E-08 | 1 |
| | Asbestos - Best Estimate | 4E-09 | -- | 9E-09 | -- | 1E-07 | -- |
| | Asbestos - Upper-Bound Estimate | 1E-07 | -- | 2E-07 | -- | 2E-06 | -- |

**Notes:**

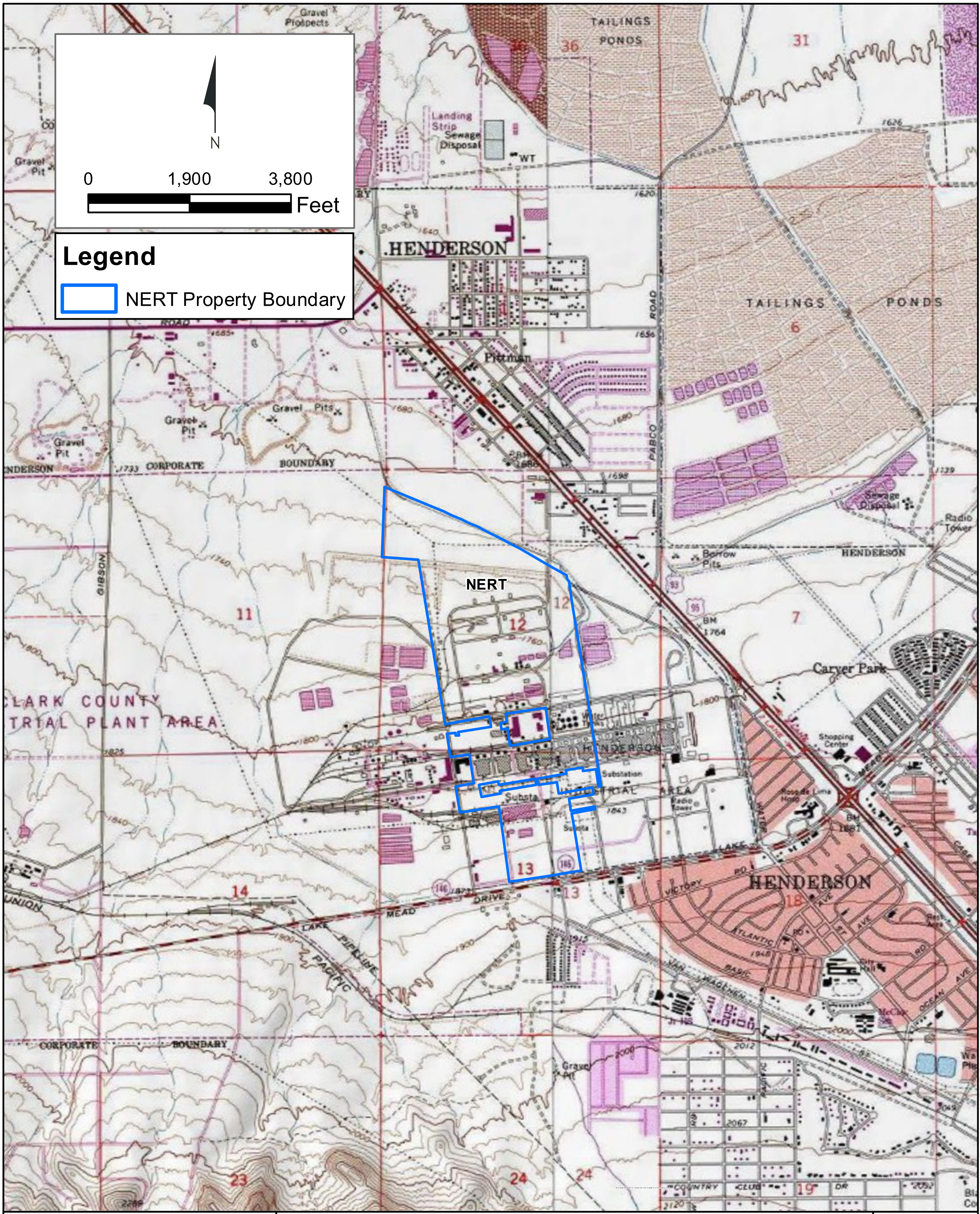
-- = Not applicable

ft = feet

HI = Hazard index

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

# FIGURES



Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Maps\Figure 1-1_sml.mxd

RAMBOLL ENVIRON

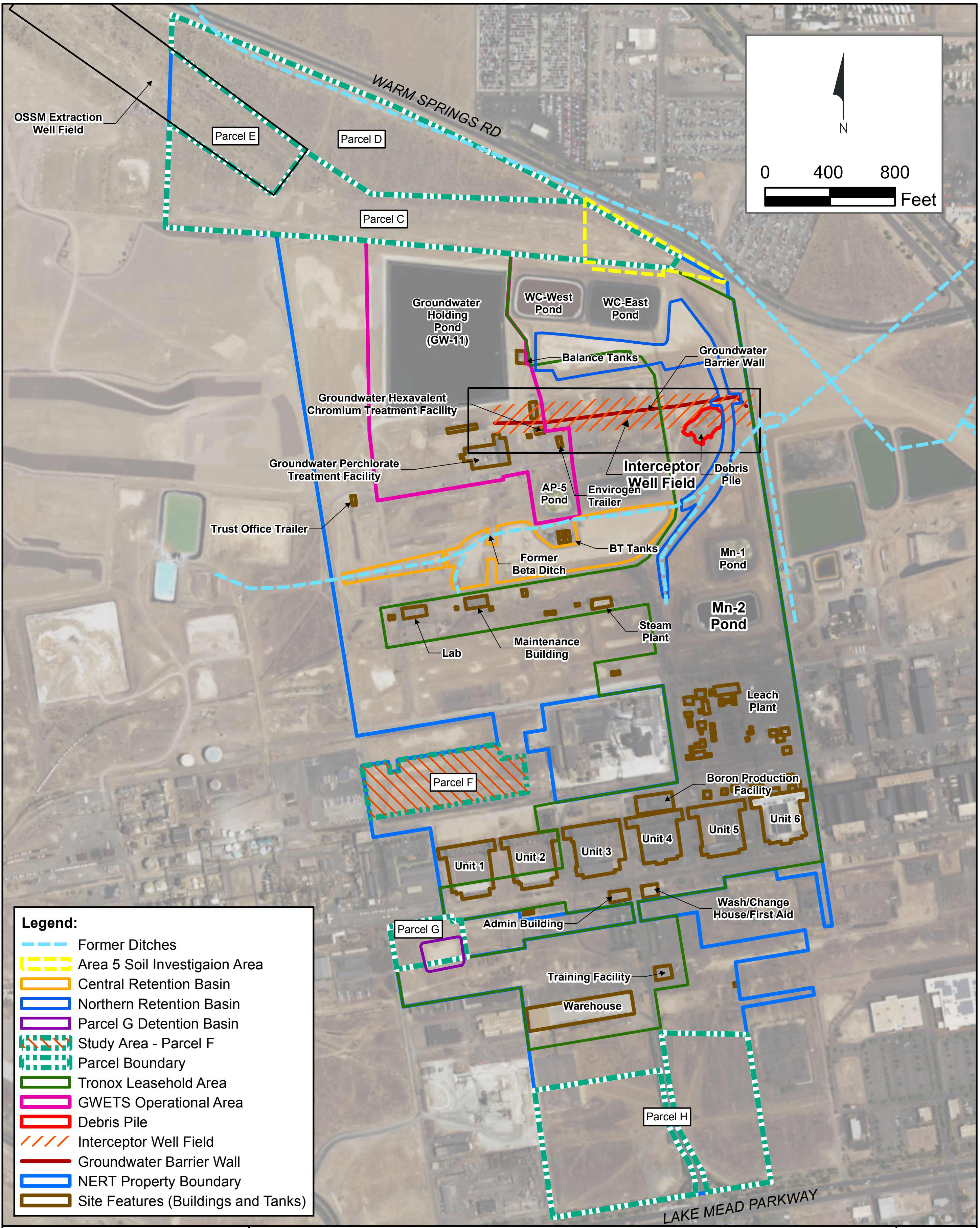
## Site Location Map

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**1-1**

| Drafter: EF | Date: 7/13/2017 | Contract Number: 21-41400A | Approved by: | Revised: |
|---|---|---|---|---|



Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Maps\Figure 1-2_Parcel F.mxd

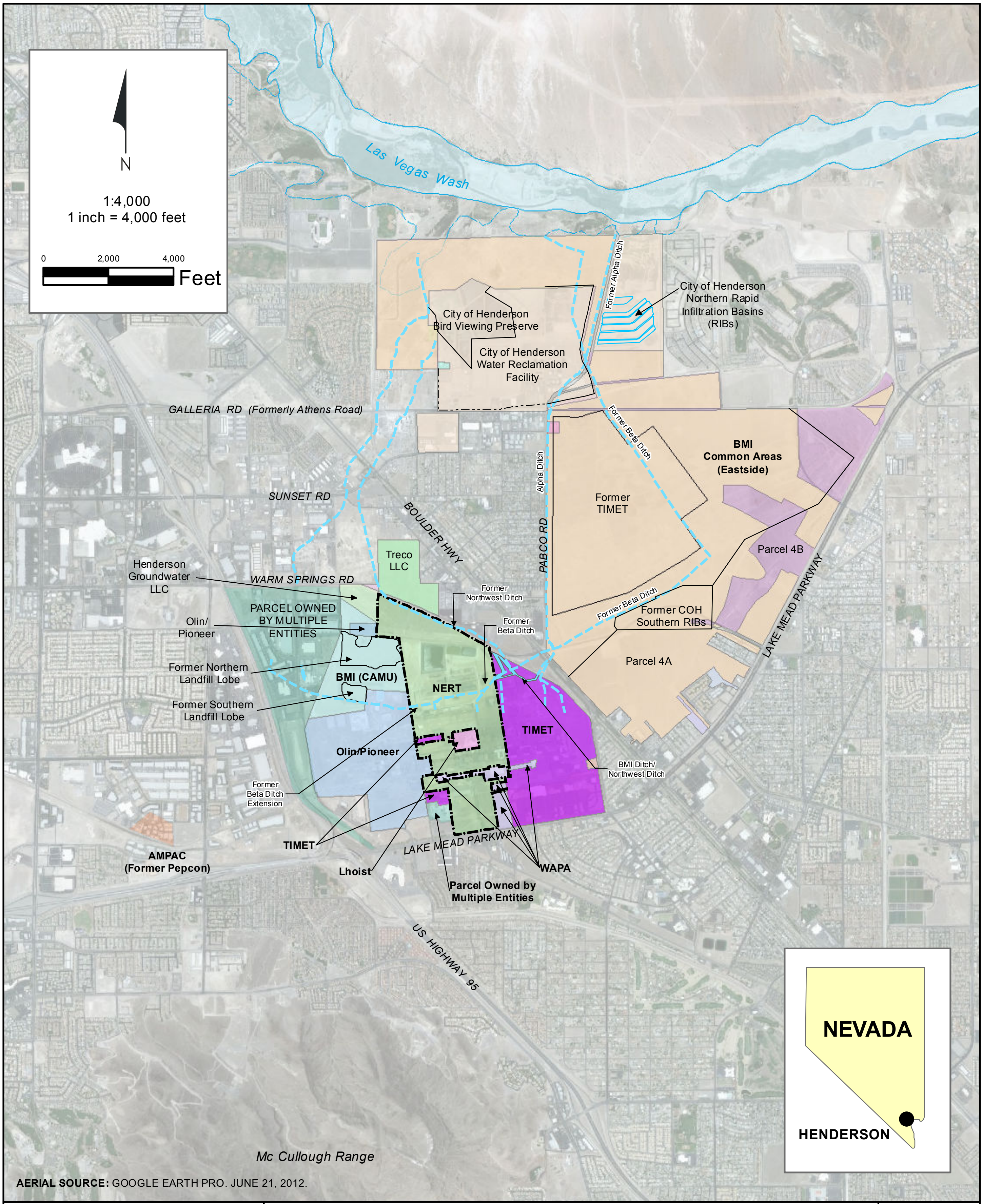
RAMBOLL ENVIRON

# Study Area and Site Features

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**1-2**

Drafter: RS/EF Date: 10/13/2017 Contract Number: 21-41400A Approved by: Revised:



**AERIAL SOURCE:** GOOGLE EARTH PRO. JUNE 21, 2012.

Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Maps\Figure 1-3.mxd

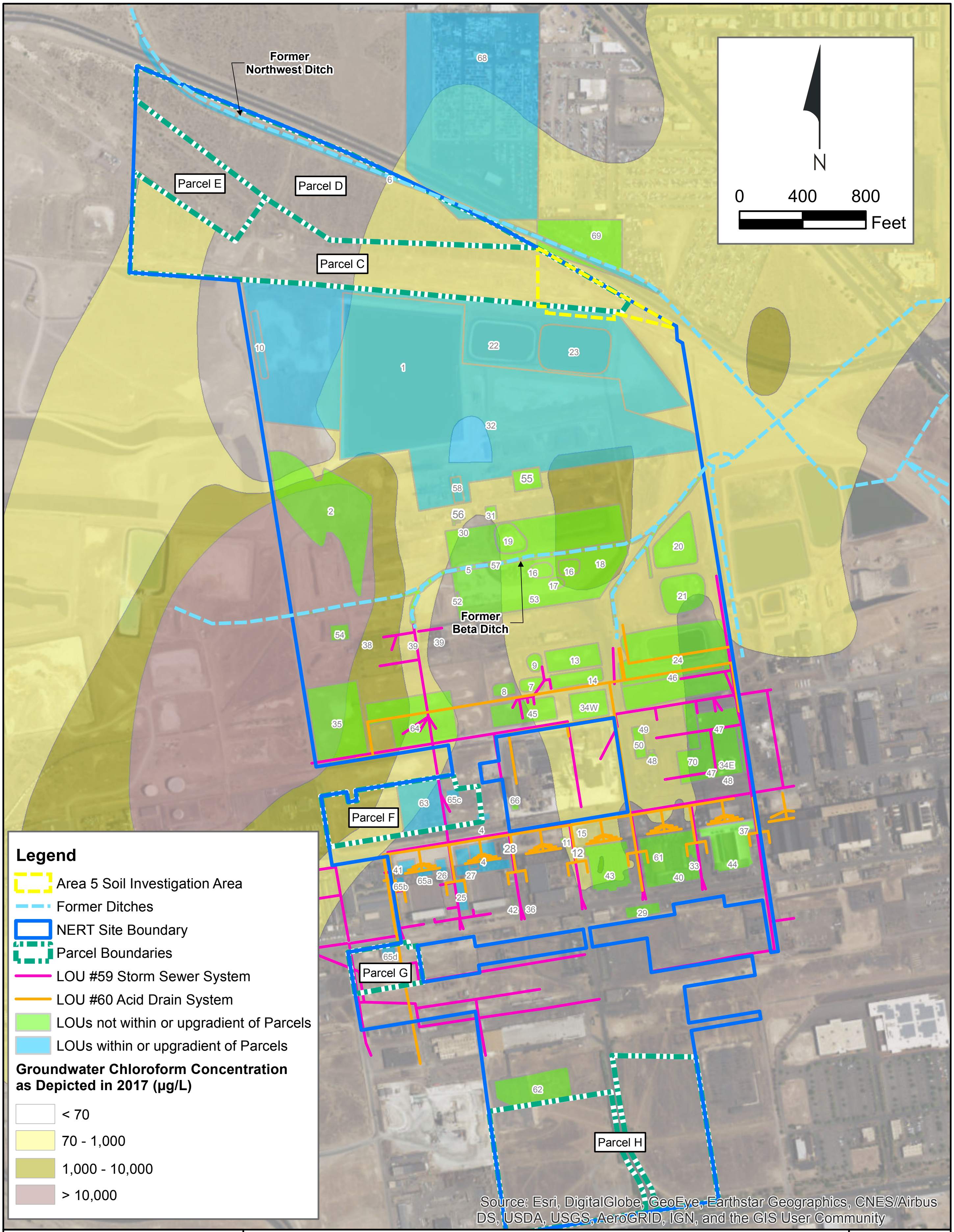
RAMBOLL ENVIRON

## Surrounding Facilities

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
1-3

Drafter: EF Date: 6/29/2017 Contract Number: 21-41400A Approved by: Revised:



**Legend**

- Area 5 Soil Investigation Area
- Former Ditches
- NERT Site Boundary
- Parcel Boundaries
- LOU #59 Storm Sewer System
- LOU #60 Acid Drain System
- 🟩 LOUs not within or upgradient of Parcels
- 🟦 LOUs within or upgradient of Parcels

**Groundwater Chloroform Concentration as Depicted in 2017 (µg/L)**

- ☐ < 70
- 🟨 70 - 1,000
- 🟫 1,000 - 10,000
- 🟥 > 10,000

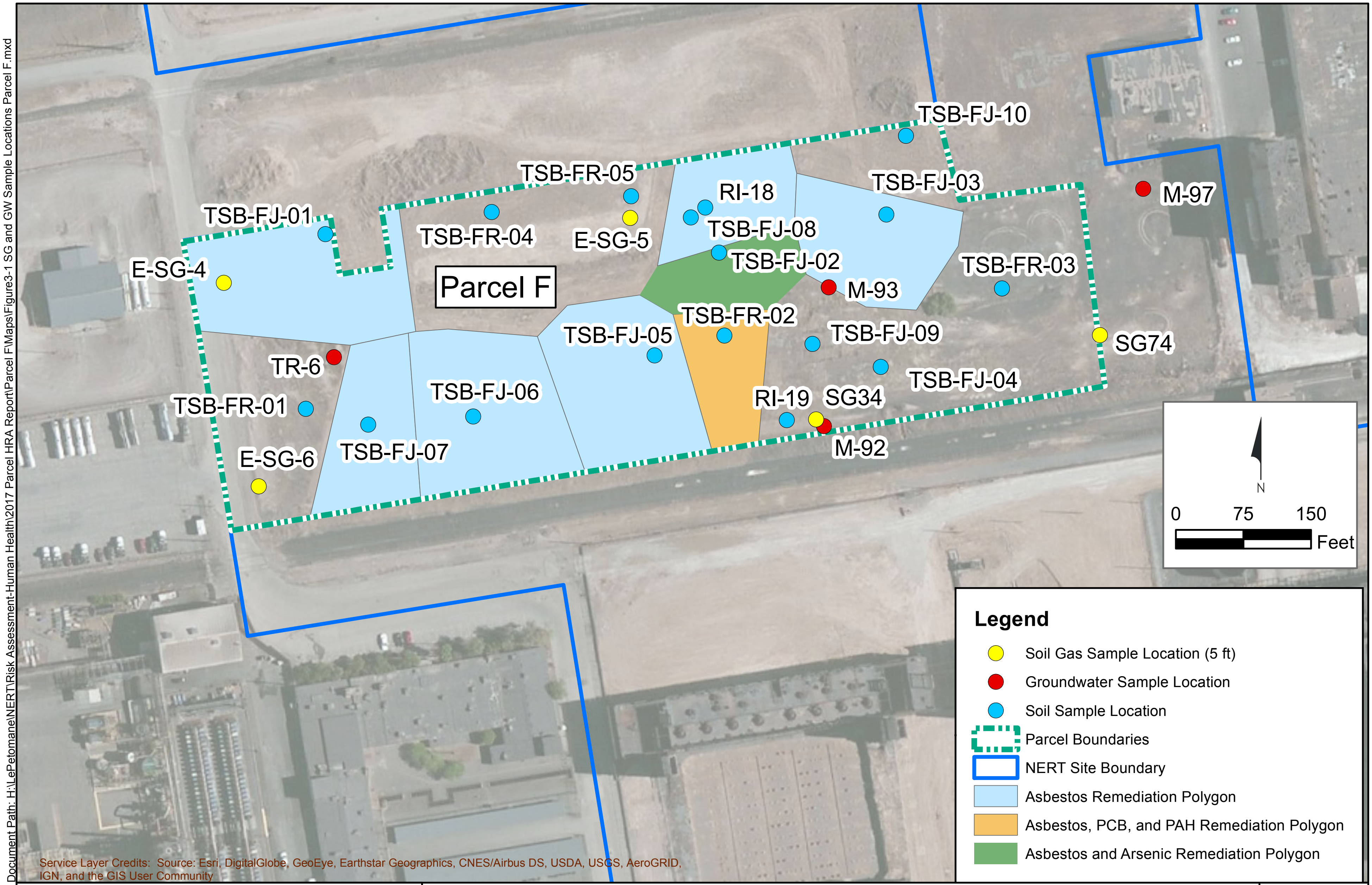
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

RAMBOLL ENVIRON

**Parcels, Operations Area, and LOU Map (Chloroform Plume as Depicted in 2017)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**2-1**

Drafter: EF Date: 11/28/2017 Contract Number: 21-41400A Approved by: Revised:



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

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Parcel F\Maps\Figure3-1 SG and GW Sample Locations Parcel F.mxd

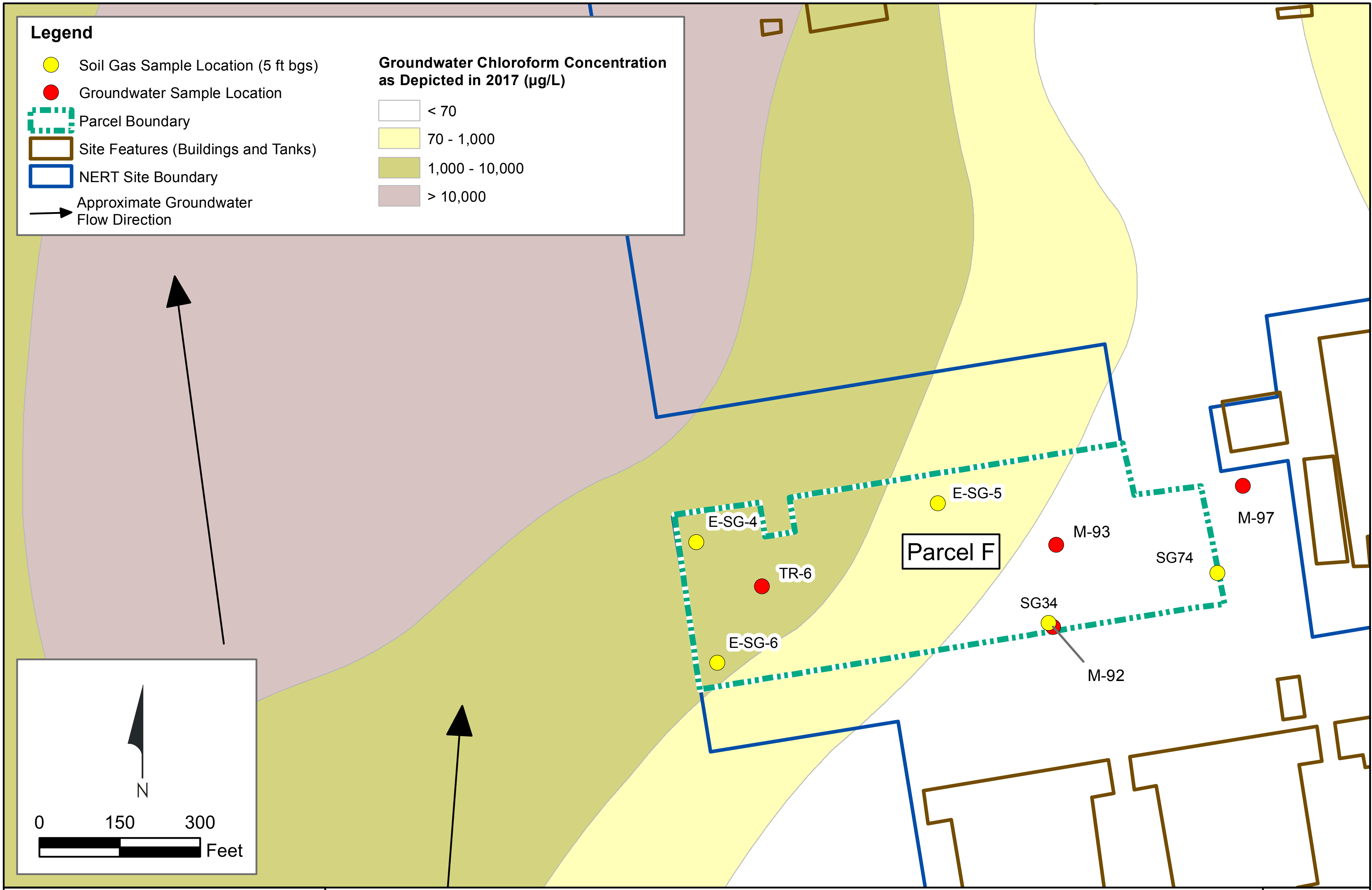
RAMBOLL ENVIRON

## Remediation Polygon and Soil, Groundwater, and Soil Gas Sample Locations for Parcel F

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**3-1**

Drafter: RS Date: 11/8/2017 Contract Number: 21-41400A Approved by: Revised:



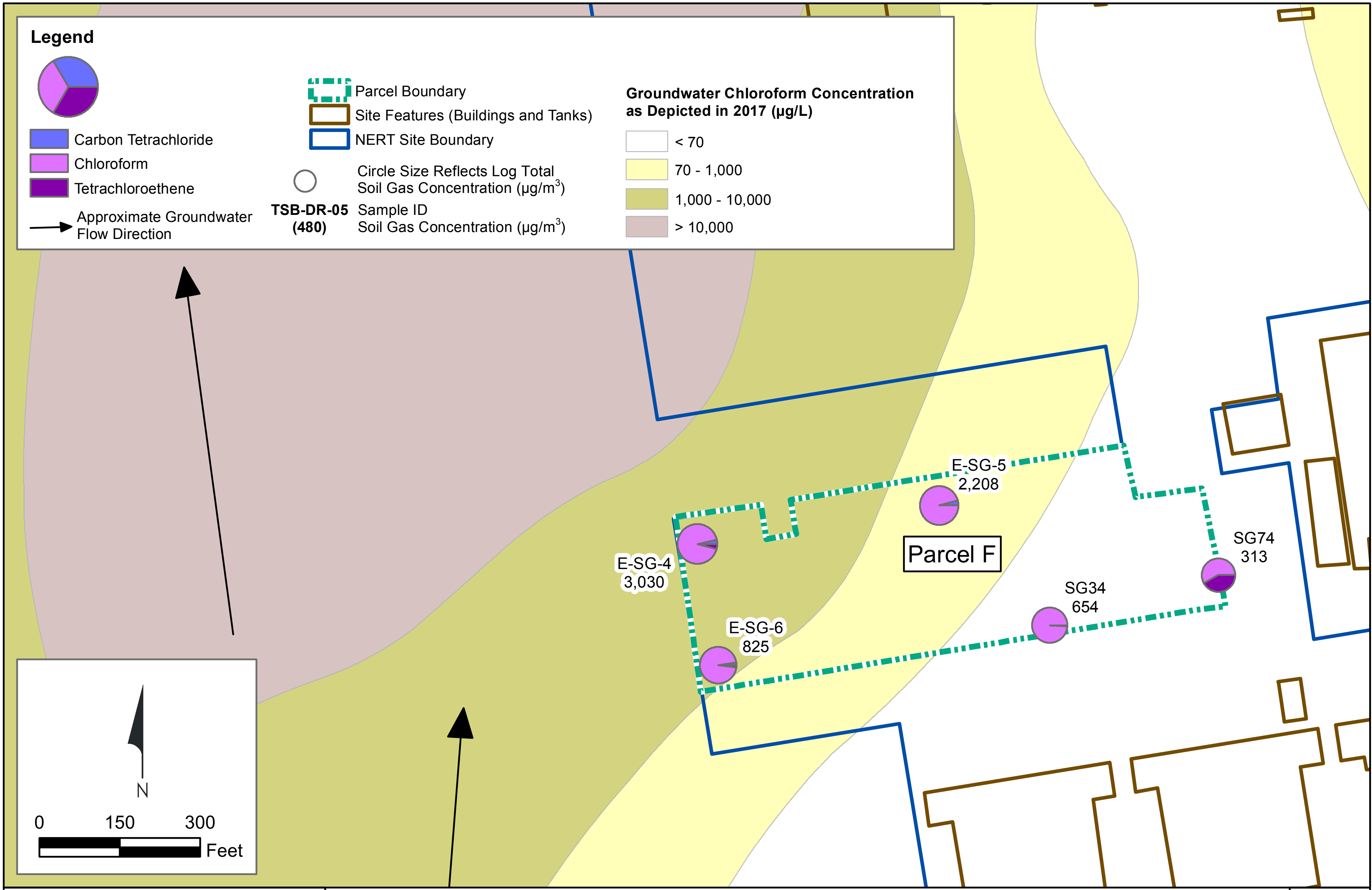
Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Parcel F\Maps\Figure 3-2 Sample Locations on Plume.mxd

RAMBOLL ENVIRON

**Soil Gas and Groundwater Sample Locations for Parcel F**
**(Chloroform Plume as Depicted in 2017)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**3-2**

Drafter: RS/EF Date: 11/15/2017 Contract Number: 21-41400A Approved by: Revised:



Path: \\wcevlfps1\ENG\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Parcel F\Maps\Figure 4-1 Spatial Distribution SG.mxd

RAMBOLL ENVIRON

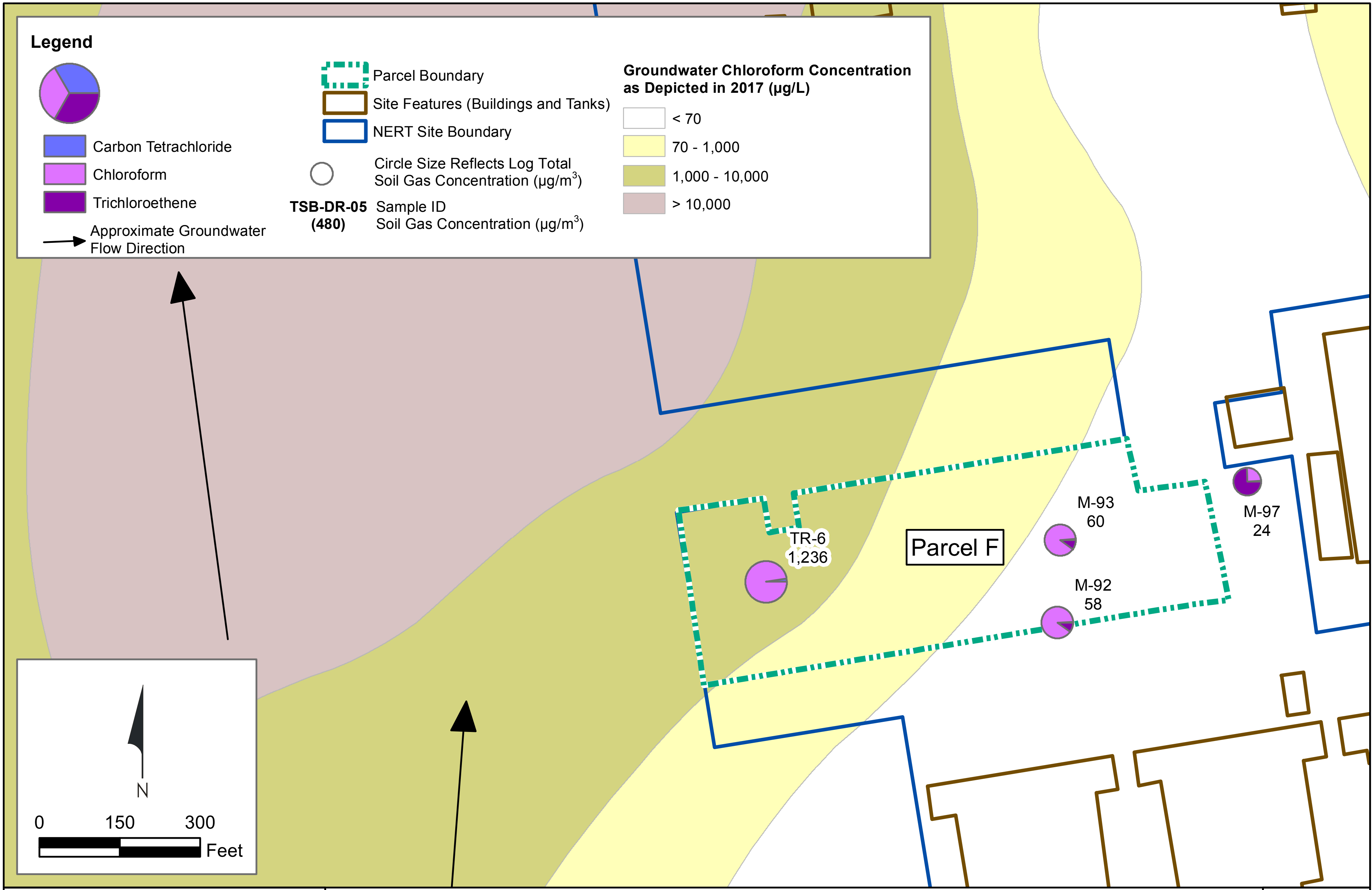
**Spatial Distribution of Primary Chlorinated VOC Concentrations in 5 ft bgs Soil Gas for Parcel F (Chloroform Plume as Depicted in 2017)**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**4-1**

Drafter: RS/EF Date: 11/21/2017 Contract Number: 21-41400A Approved by: Revised:



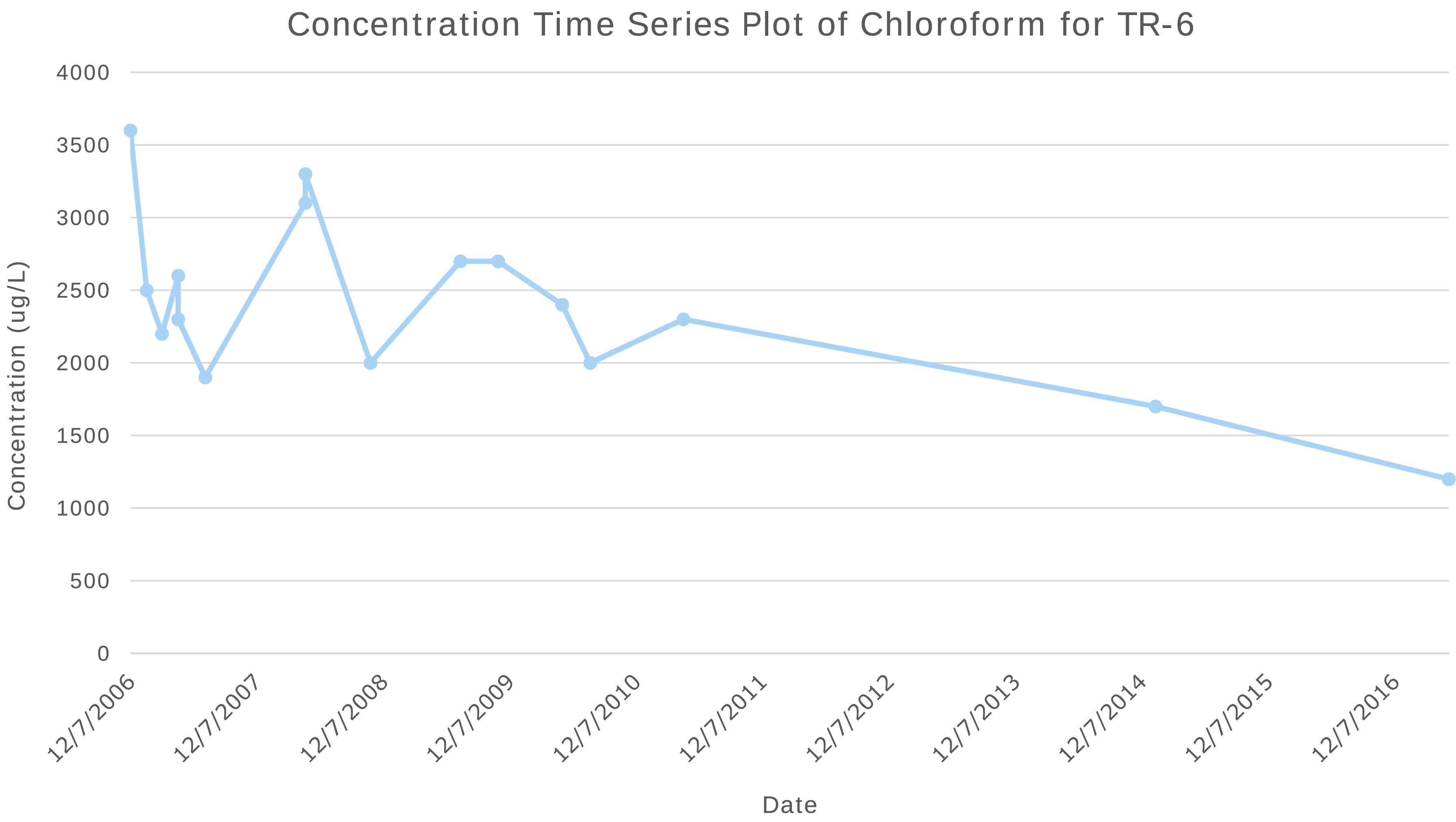
Path: \\wcevlfps1\ENG\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Parcel F\Maps\Figure 4-2 Spatial Distribution GW.mxd

**Spatial Distribution of Primary Chlorinated VOC Concentrations in Shallow Groundwater for Parcel F (Chloroform Plume as Depicted in 2017)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**4-2**

Drafter: RS/EF
Date: 11/16/2017
Contract Number: 21-41400A
Approved by:
Revised:



RAMBOLL ENVIRON

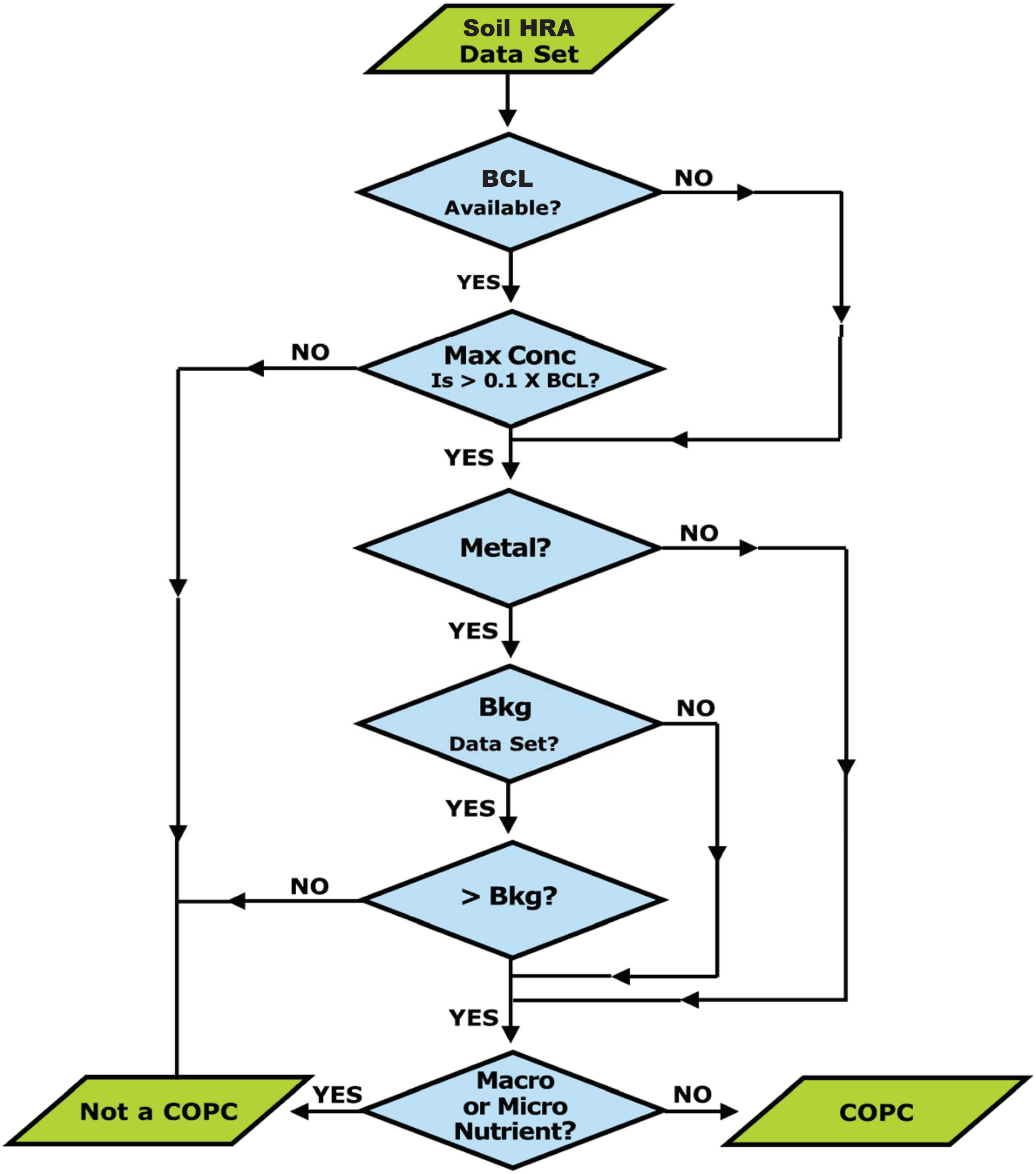
# Temporal Trend of Chloroform in Groundwater

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

Drafter: PW
Date: 11/16/2017
Contract Number: 21-41400A

**Figure**

**4-3**



RAMBOLL ENVIRON

DRAFTED BY: RS

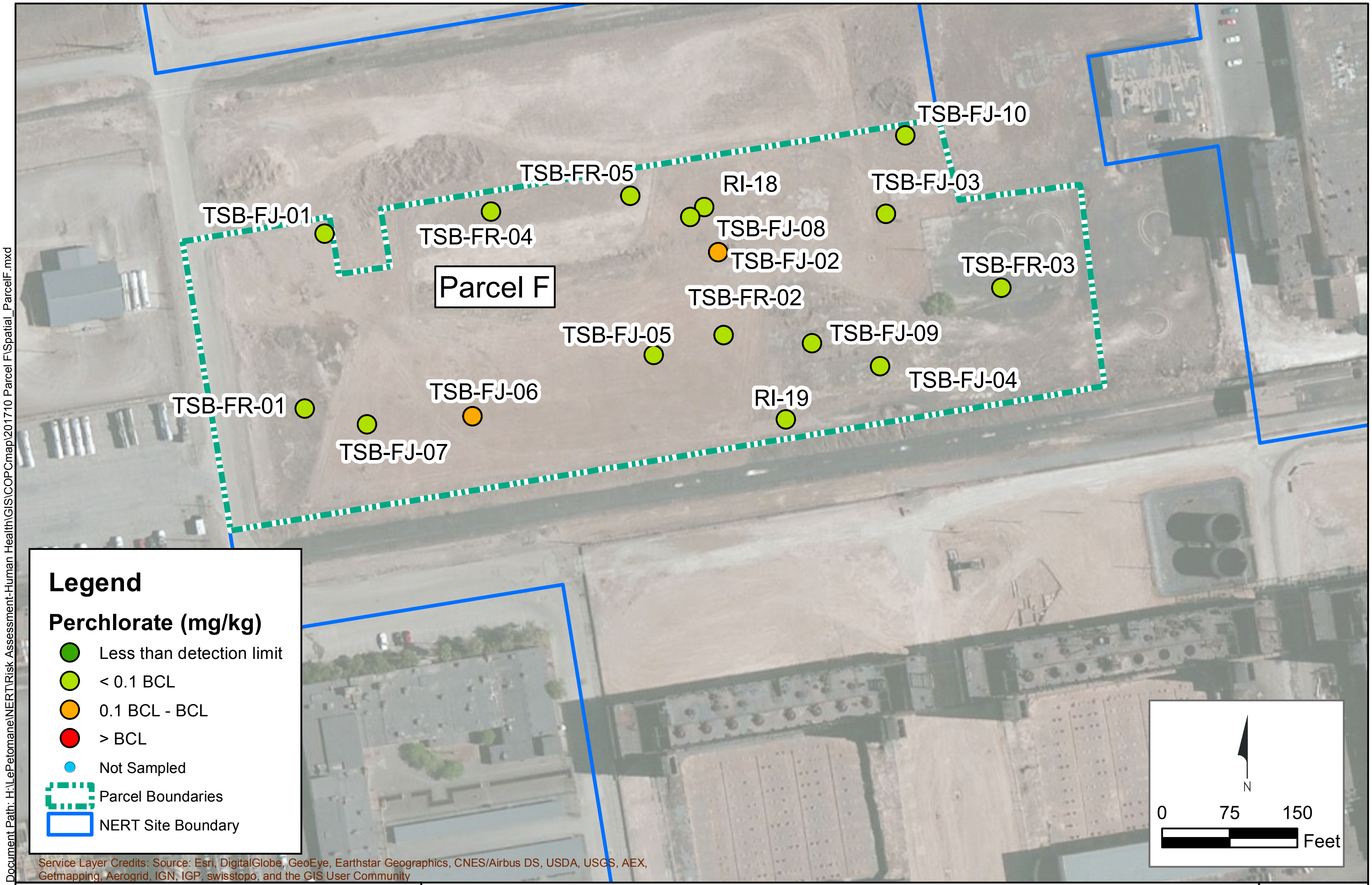
DATE: 8/19/16

**Soil COPC Identification Flowchart**

FIGURE

**5-1**

Q:\DRAWINGS\NERT



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Intensity Plot for Parcel F - Perchlorate**

**[BCL = 908 mg/kg]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**5-2**

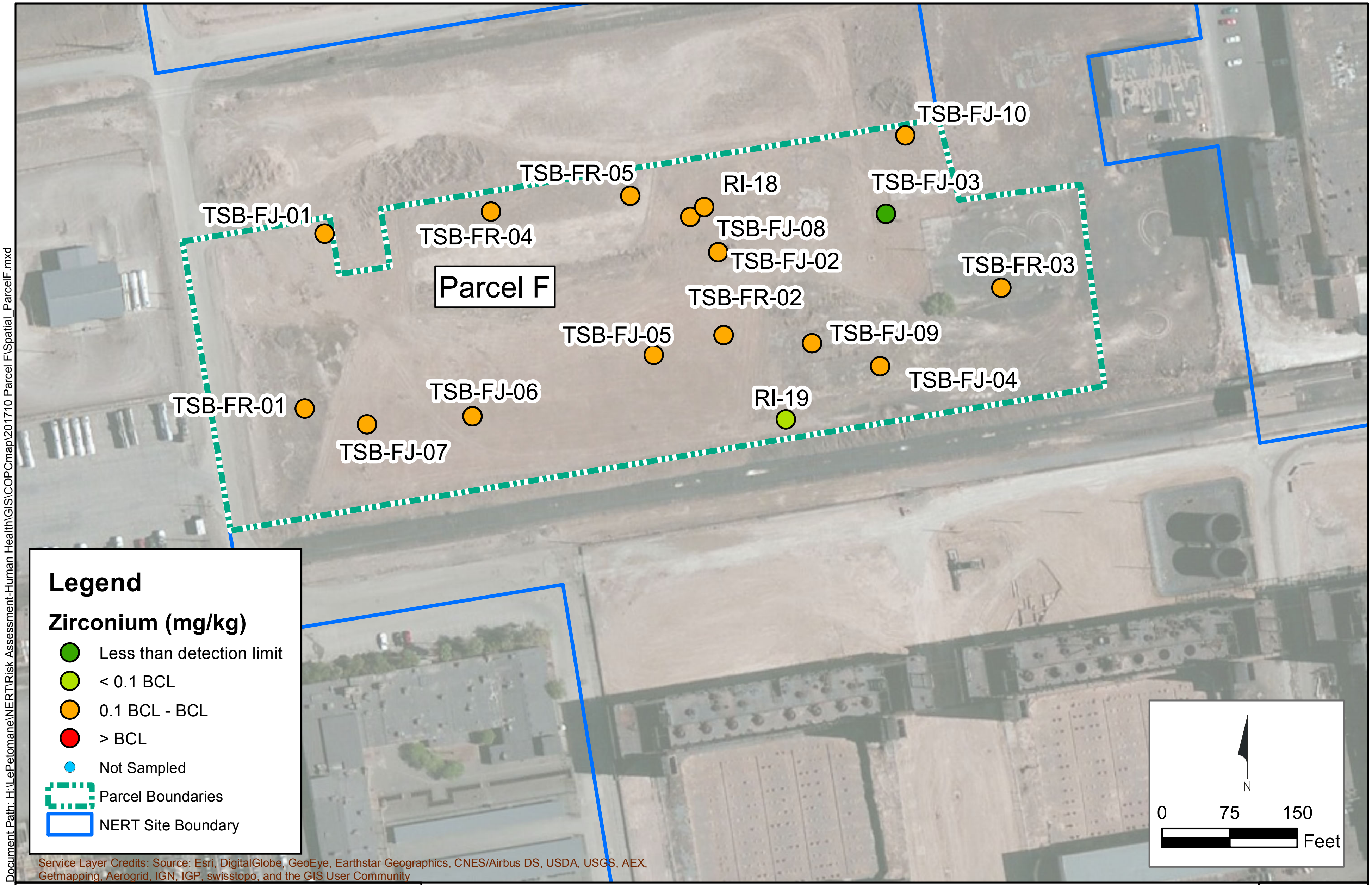
Drafter: RS

Date: 10/24/2017

Contract Number: 21-41400A

Approved by:

Revised:



Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

RAMBOLL ENVIRON

**Spatial Intensity Plot for Parcel F - Zirconium**

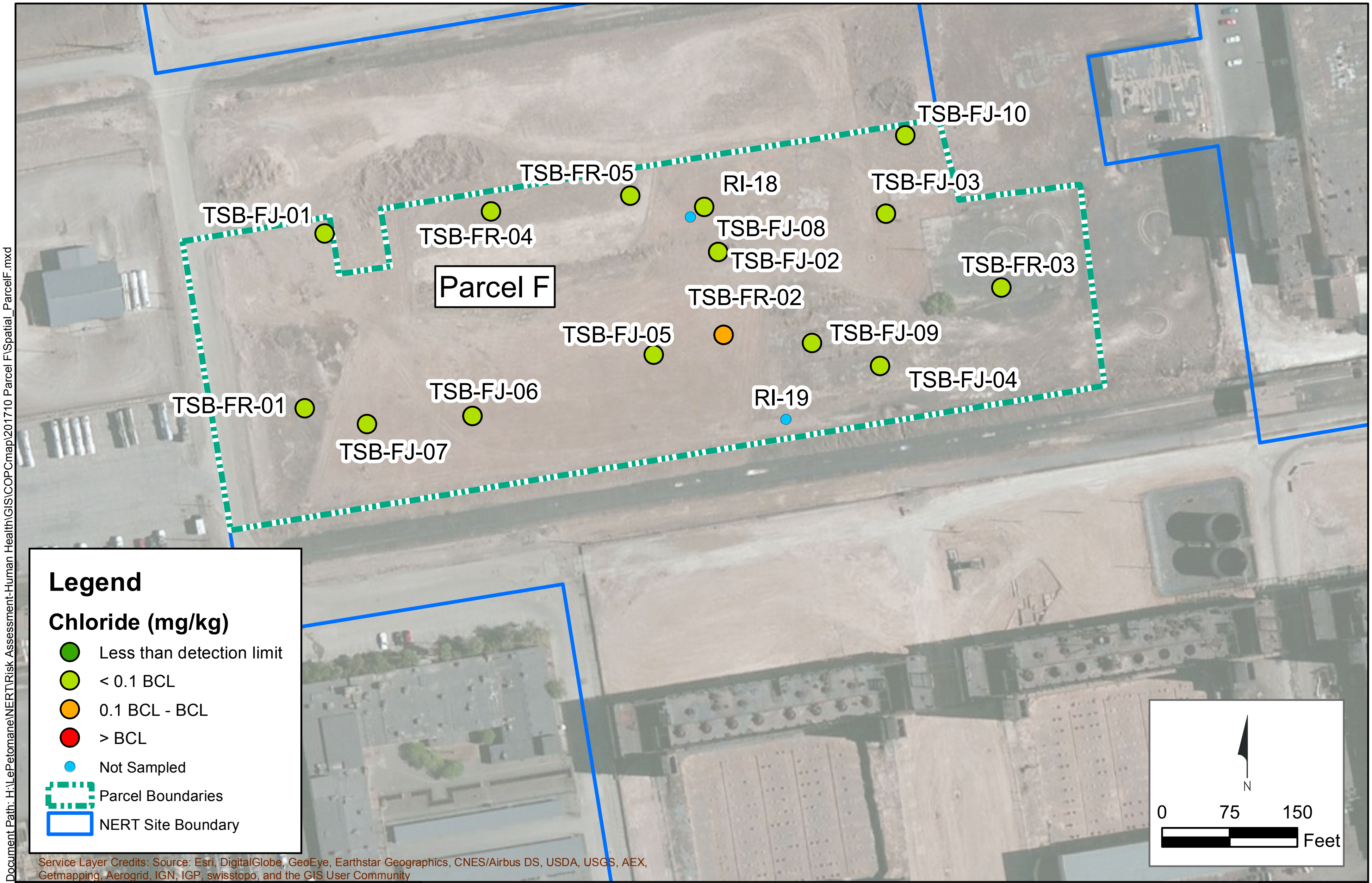
**[BCL = 104 mg/kg]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**5-3**

Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

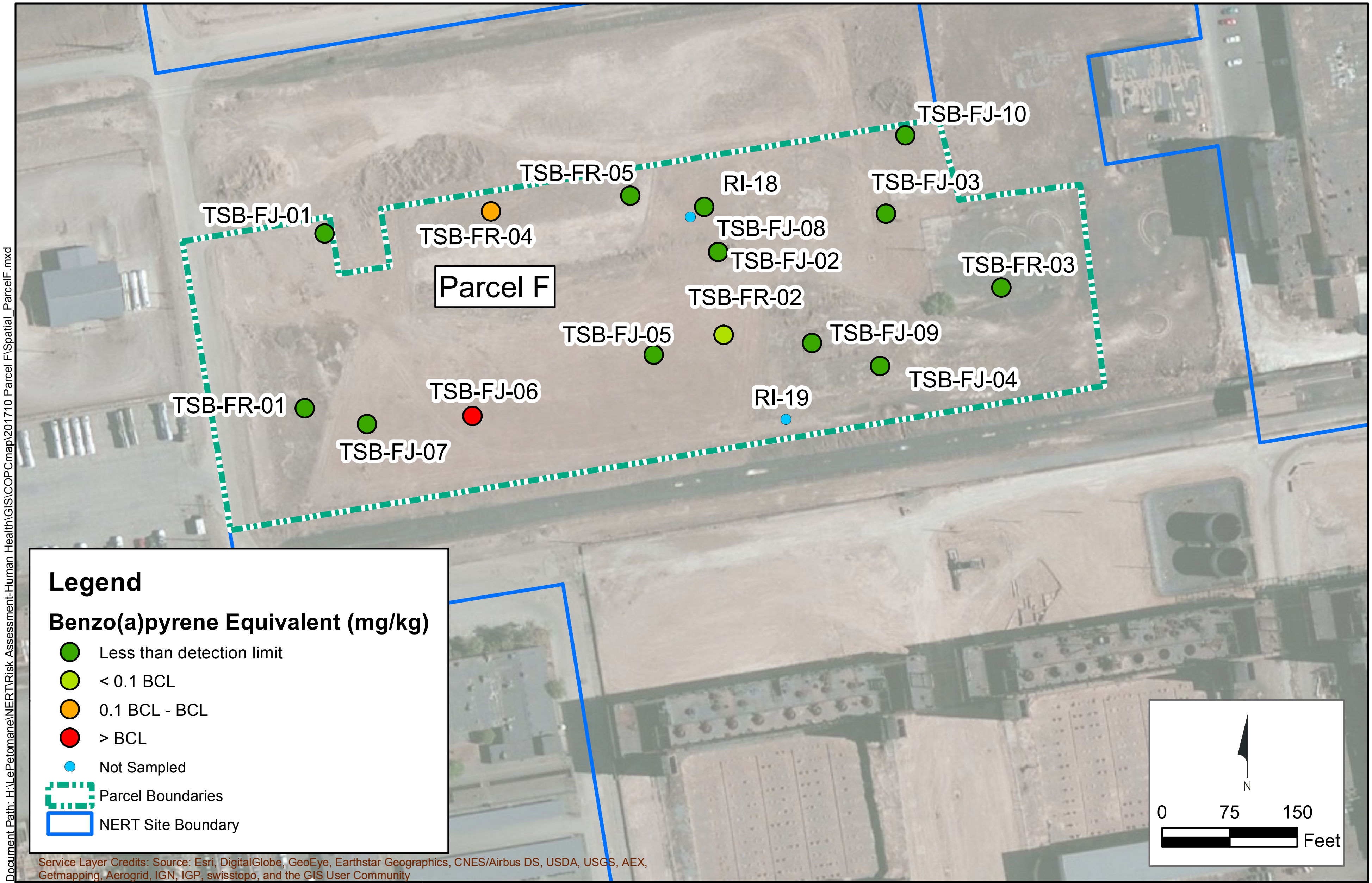
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Intensity Plot for Parcel F - Chloride**
**[BCL = 113,032 mg/kg]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**5-4**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Intensity Plot for Parcel F - Benzo(a)pyrene Equivalent [BCL = 0.32 mg/kg]**

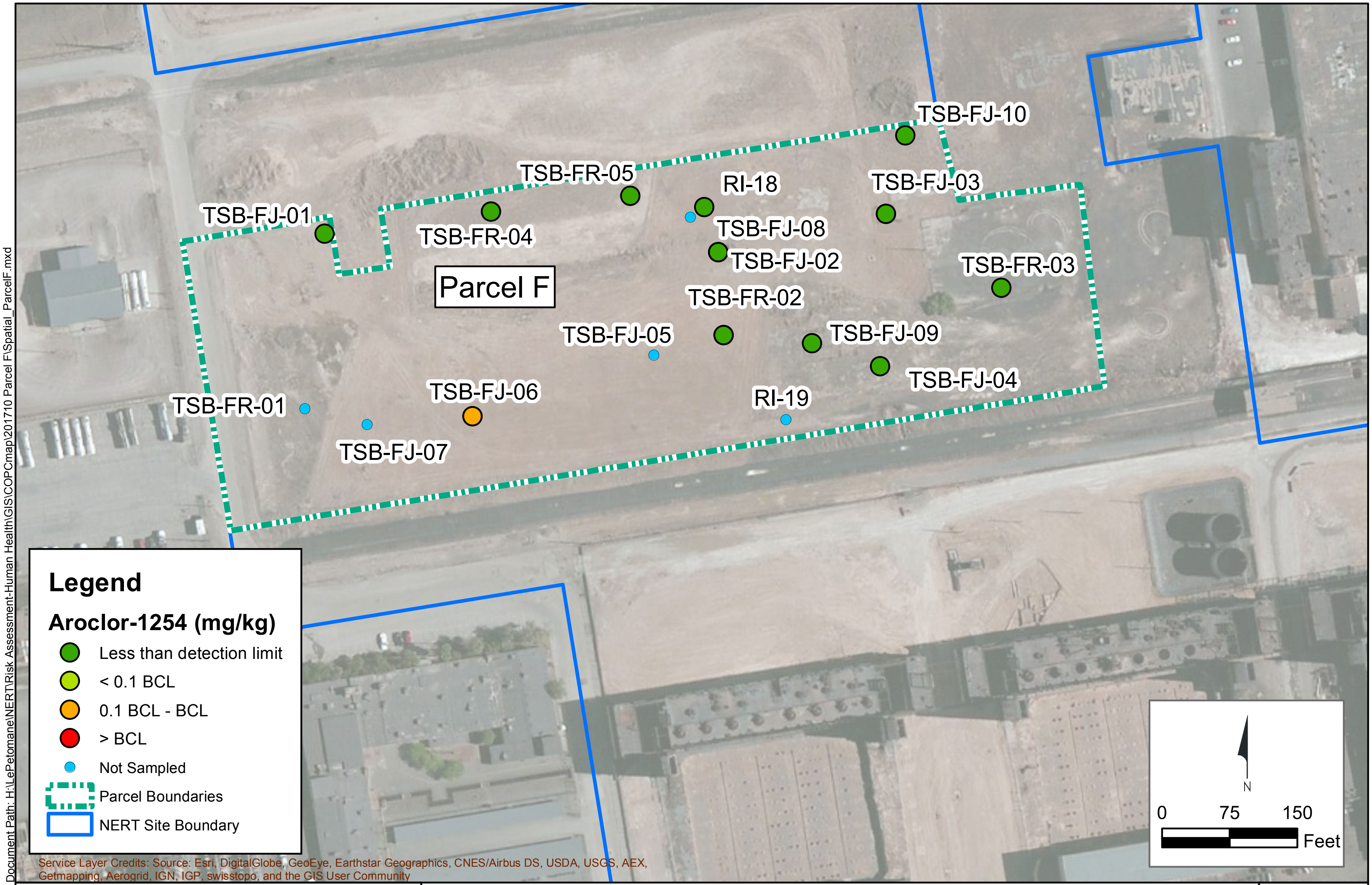
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**5-5**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

RAMBOLL ENVIRON

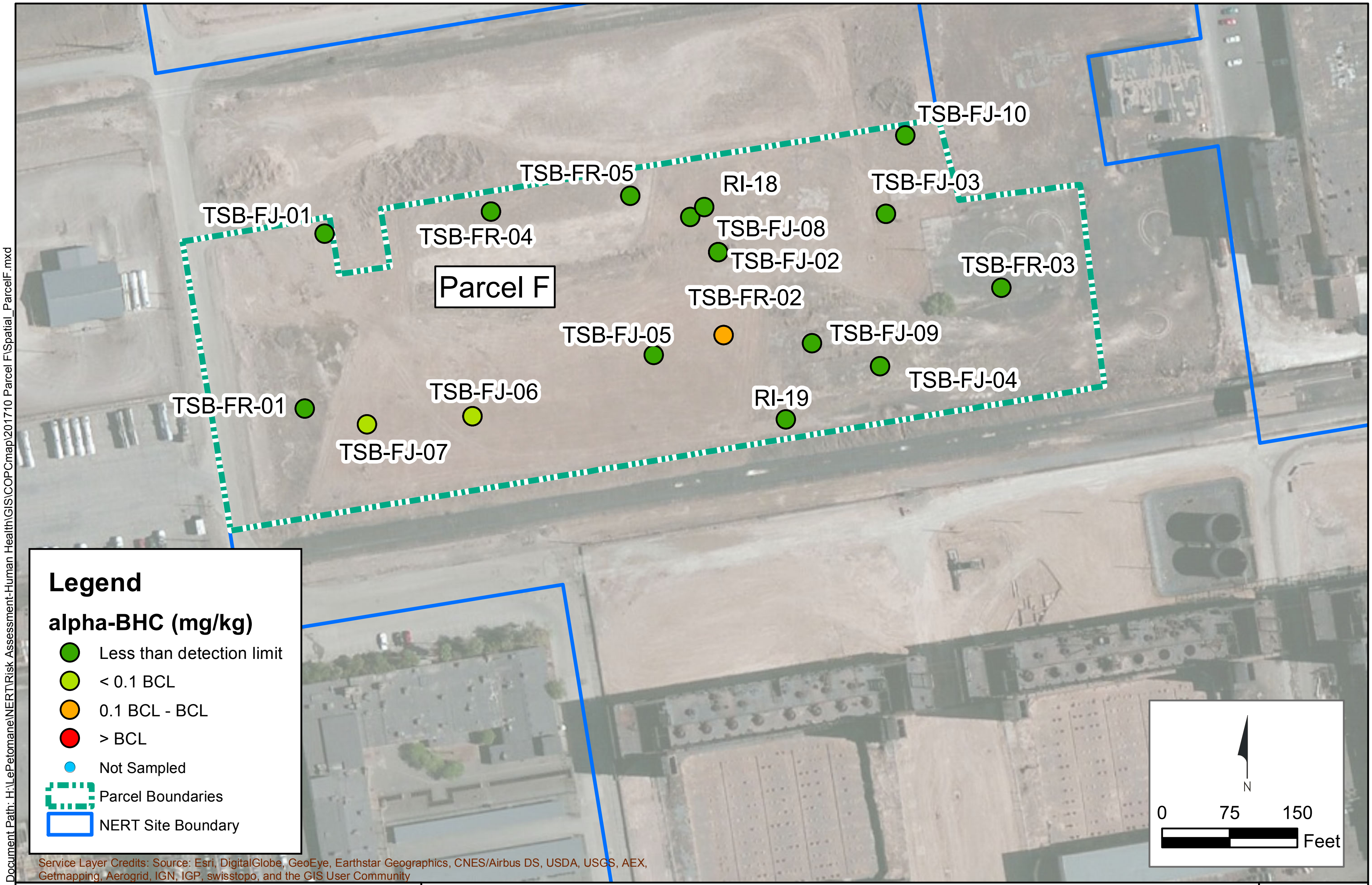
## Spatial Intensity Plot for Parcel F - Aroclor-1254 [BCL = 1.1 mg/kg]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**5-6**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

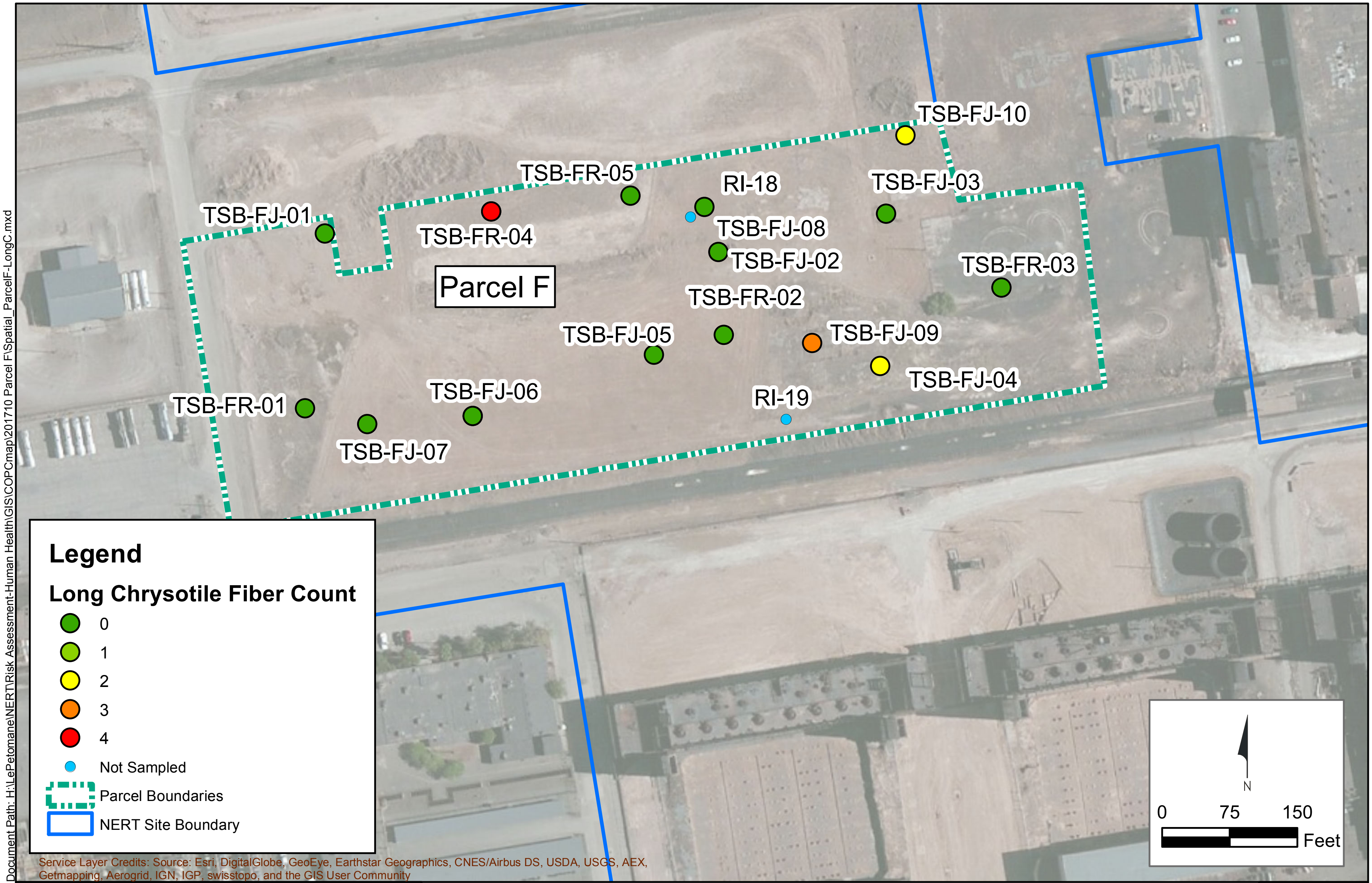
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Intensity Plot for Parcel F - alpha-BHC**
**[BCL = 0.49 mg/kg]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**5-7**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF-LongC.mxd

RAMBOLL ENVIRON

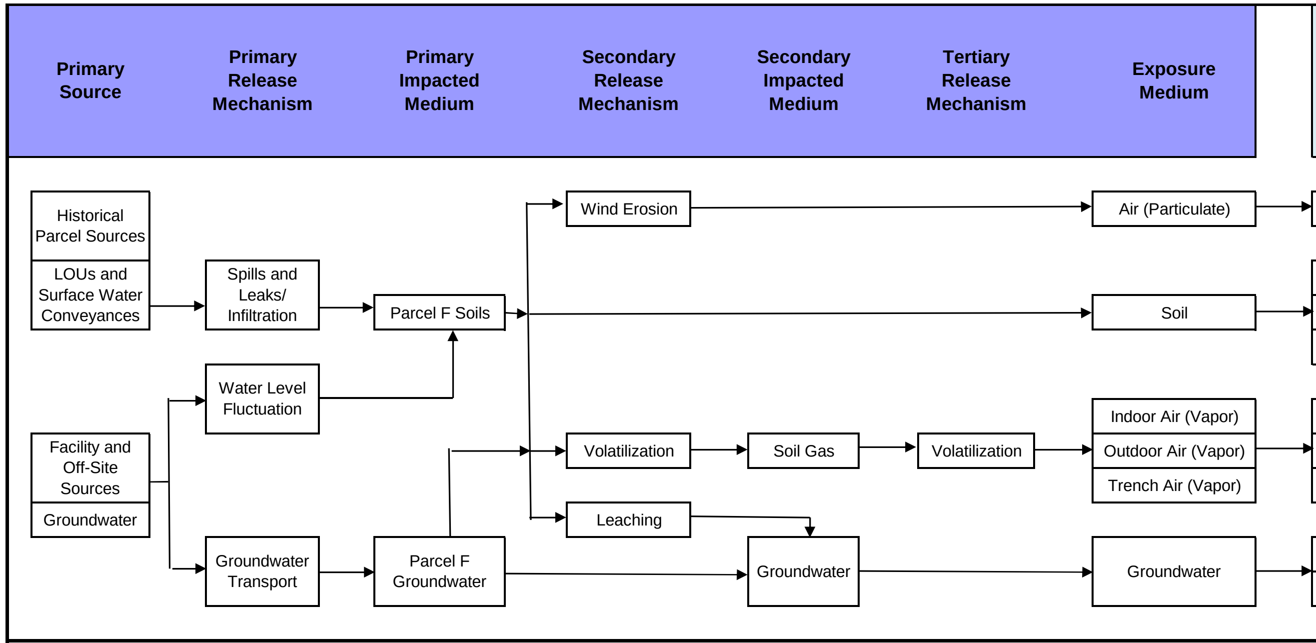
## Spatial Intensity Plot for Parcel F – Long Chrysotile Fiber

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**5-8**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



| Exposure Route | Current/Future Receptor | | | | | | |
|---|---|---|---|---|---|---|---|
| | On-Parcel | | | | Off-Site | | |
| | Construction Worker | Indoor Commercial/ Industrial Worker | Outdoor Commercial/ Industrial Worker | Visitor and Trespasser | Indoor Commercial/ Industrial Worker | Outdoor Commercial/ Industrial Worker | Resident |
| Inhalation [1], [2] | X | X | X | O [9] | O [10] | O [10] | O [10] |
| Ingestion [1] | X | X | X | O [9] | -- | -- | -- |
| Dermal Contact | X | -- | X | O [9] | -- | -- | -- |
| External [3] | X | X | X | O [9] | -- | -- | -- |
| Inhalation | -- | X | -- | -- | O [11] | -- | O [11] |
| Inhalation | O [4] | O [7] | X | O [9] | O [11] | O [11] | O [11] |
| Inhalation | X [5] | -- | -- | -- | -- | -- | -- |
| Ingestion | -- [6] | -- [8] | -- [8] | -- [8] | -- [8] | -- [8] | -- [8] |
| Dermal Contact | -- [6] | -- [8] | -- [8] | -- [8] | -- [8] | -- [8] | -- [8] |

**Notes:**

X = Complete or potentially complete exposure pathway
O = Complete, but negligible exposure pathway; discussed qualitatively
-- = Incomplete exposure pathway
EPC = Exposure point concentration
LOU = Letter of Understanding
PEF = Particulate emission factor
VOC = Volatile organic compound

[1] Includes radionuclide exposures, if applicable.
[2] Includes asbestos exposures.
[3] Only radionuclide exposures, if applicable.
[4] The exposure to VOCs in outdoor air is not quantitatively evaluated for construction workers because it is expected to be much lower than the exposure to VOCs in trench air.
[5] To be conservative, construction workers are assumed to be exposed to vapors migrating from soil gas/groundwater while standing in a 10-foot trench in the unsaturated zone, placing them closer to the potential sources.
[6] Incidental ingestion and dermal contact with groundwater by construction workers are not considered complete exposure pathways because depth to groundwater is greater than 10 feet below ground surface.
[7] The exposure to VOCs in outdoor air is not quantitatively evaluated for indoor commercial/industrial workers because it is expected to be much lower than the exposure to VOCs in indoor air.
[8] Exposure via domestic use of groundwater is not evaluated because Site groundwater is not used as a domestic water supply.
[9] Visitors and trespassers are not quantitatively evaluated because 1) public access is generally restricted at industrial sites, and 2) while the public may have access to commercial sites, on-site workers have a much higher exposure potential because they spend substantially more time at the site.
[10] For inhalation of soil particulates, the PEF for on-site construction workers is much higher than the PEF during construction for off-site receptors (see discussion in text Section 6.2.2.1). Therefore, as compared with other exposure factors that may be higher for the off-site receptors, the exposures through inhalation of soil particulates by off-site receptors are expected to be lower than the exposures by on-site construction workers, and are not quantitatively evaluated.
[11] For inhalation of vapors migrating from soil gas or groundwater, the EPCs in air for off-site receptors are expected to be much lower than those for on-site receptors due to air dispersion given the distances to parcel boundaries (see discussion in text Section 6.2.2.1). Therefore, the off-site receptors are not quantitatively evaluated.

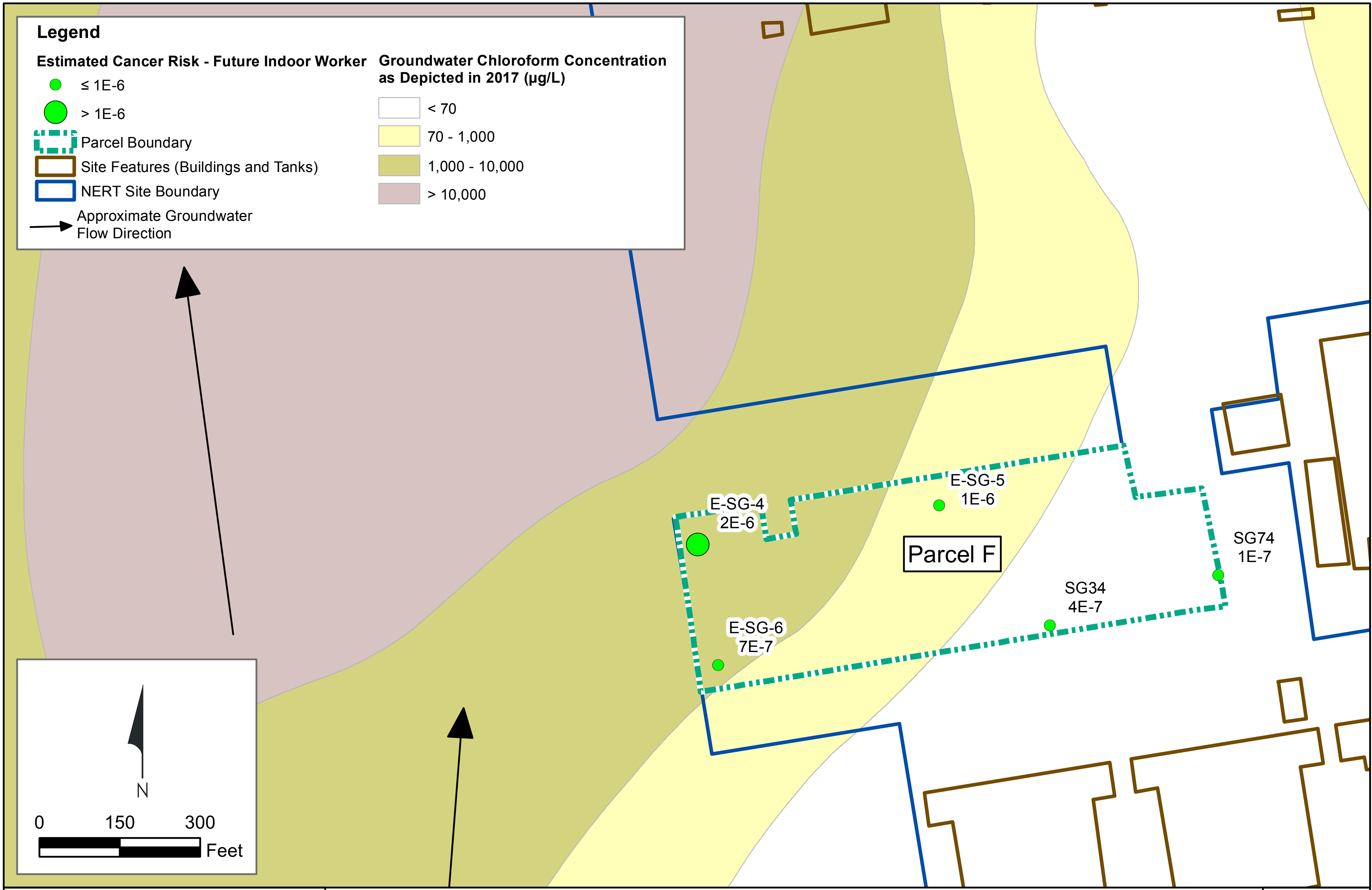
RAMBOLL ENVIRON

**Conceptual Site Model for Potential Human Exposures**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**5-9**

Drafter:
Date: 6/29/2017
Contract Number: 21-41400A
Approved by:
Revised:



Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Parcel F\Maps\Figure 5-10 Total Cancer Risk SG.mxd

RAMBOLL ENVIRON

**Estimated Total Cancer Risk for Future Indoor Worker for Soil Gas (5 ft bgs) - Parcel F (Chloroform Plume as Depicted in 2017)**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**5-10**

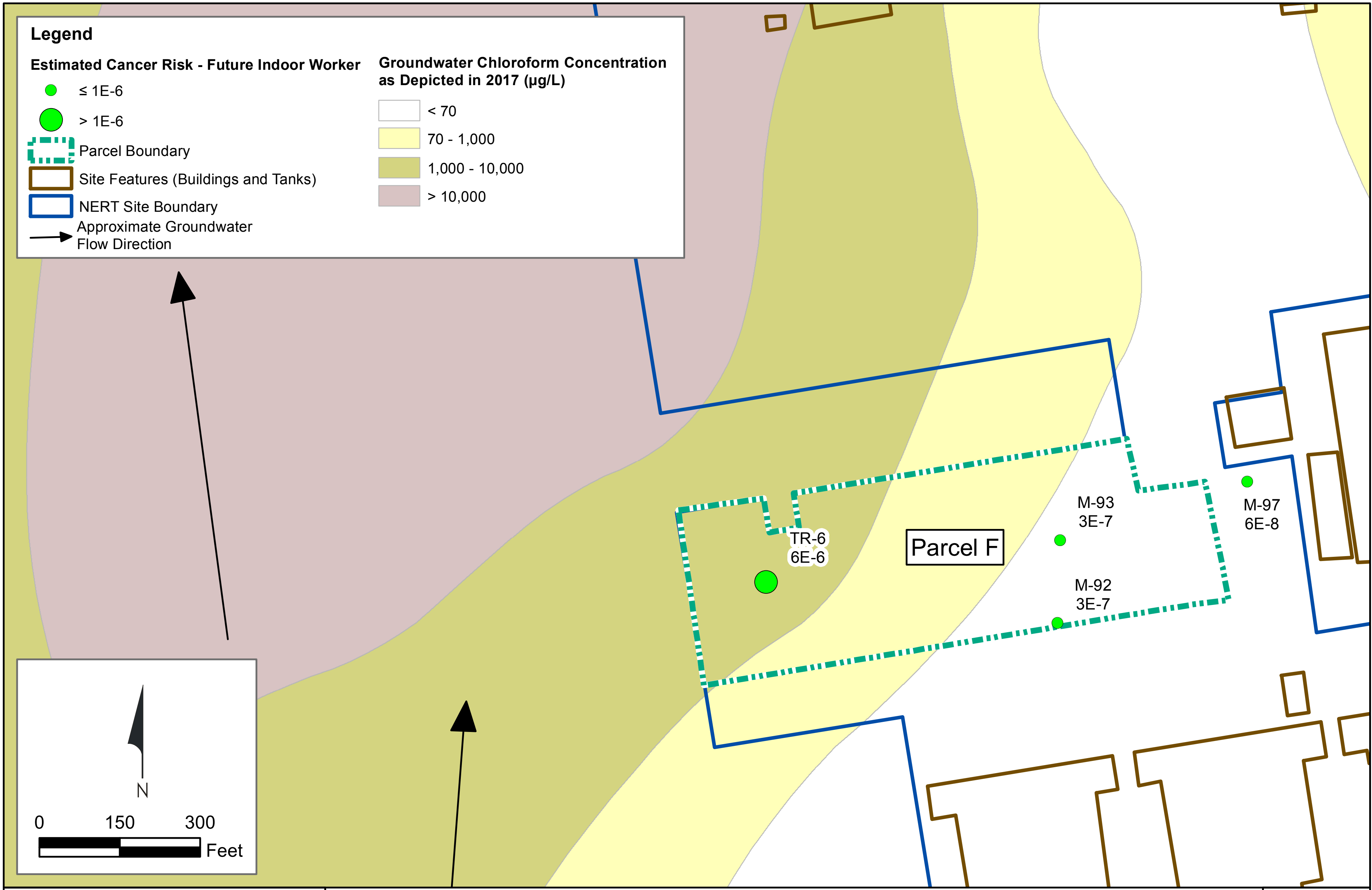
Drafter: RS/EF

Date: 11/21/2017

Contract Number: 21-41400A

Approved by:

Revised:



Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Parcel F\Maps\Figure 5-11 Total Cancer Risk GW.mxd

RAMBOLL ENVIRON

**Estimated Total Cancer Risk for Future Indoor Worker for Shallow Groundwater - Parcel F (Chloroform Plume as Depicted in 2017)**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**5-11**

Drafter: RS/EF Date: 11/15/2017 Contract Number: 21-41400A Approved by: Revised:

# APPENDIX A
# RESPONSE TO COMMENT LETTERS

# APPENDIX A-1

# RESPONSE TO COMMENT LETTER – RESPONSES TO NDEP COMMENTS ON SOIL HRA REVISION 3

# Appendix A-1

**Explanatory Note:**
**The following are the list of comments received from NDEP on May 6, 2015 on the Post-remediation Screening Health Risk Assessment Report for Parcels C, D, F, G and H, Revision 3 (dated June 19, 2014).**

## General Comments

### General Comment 1: Background for radionuclides.

Background comparisons for metals were performed using the RZ-A data for background, per NDEP recommendations and previous comparisons of site data with background. This is because of the difference between the BRC/TIMET background concentrations and the RZ-A concentrations; the latter exhibit lower mean concentrations, and the differences are often statistically significant. Hence, RZ-A was used as a more local background dataset than the BRC/TIMET BMI Complex-side background data.

However, the BRC/TIMET background data have been used for radionuclides. An initial and cursory review of the BRC/TIMET background and RZ-A concentration data for radionuclides also indicates that the RZ-A mean concentrations are less than the BRC/TIMET mean concentrations. For at least five of the radionuclides under consideration the differences are statistically significant. This suggests that the RZ-A data should be used as background for radionuclides as well as for metals.

An obvious conclusion is that RZ-A represents a (slightly) different geology than the locations for the BRC/TIMET data. However, both datasets of interest are ostensibly taken from McCullough range derived soils. It is possible that there are other issues at play, but this is difficult to determine based on the presentation. For example, perhaps there are analytical issues. It is not unusual for different labs to report slightly different concentrations. A possible course of action would be to investigate lab reports more closely. Also note that the Ra-228 concentrations appear to be quite low in RZ-A, compared to the BC/TIMET data and compared to data from other RZs (or Parcels). This is perhaps an indication of analytical issues.

It is also possible that acid-solvent leaching of the soil matrix with subsequent transport to groundwater has occurred in this area, and this is cause for somewhat decreased concentrations of some metals and radionuclides in relatively near surface soils. Possible courses of action to further investigate this possibility might include evaluation of redox potential of these soils, and spatial comparison to groundwater concentrations for some metals (e.g., arsenic, uranium).

**Response**:

Northgate and Ramboll Environ had understood that the RZ-A background data set should be used for chemical analytes, but that the BRC/TIMET BMI Complex background data set should be used for radionuclides. We note that the BRC/TIMET background data set was used for the radionuclide background analysis presented in the June 27, 2012 HRArev2 report (Section 5.2.1) and that NDEP did not comment on that analysis; Northgate therefore used the same data set (i.e., the BRC/TIMET data set) in the HRArev3 report.

As agreed during the October 13, 2015 and January 28, 2016 meeting with

NDEP and NDEP consultants to discuss the radionuclide background analysis (Ramboll Environ 2015), the radionuclide background analysis and discussion were revised as follows:

- The background evaluation for radionuclides was based on the comparison with the RZ-A data set for COPC selection.
- An expanded discussion of analytical and other issues associated with the data sets for the radionuclides are included in Section 5.1.1.2.
- Through the comparison of preliminary cancer risks calculated for the parcel data set and background data set (both RZ-A background and BRC/TIMET background), radionuclides are considered as consistent with background and not identified as COPCs.

**General Comment 2: Spatial plots**.

A request was made for spatial plots, and some have been provided. Chemicals included in spatial plots are those that are identified as COPCs. However, spatial plots of some other chemicals would be useful to understand and contribute to the CSM. This is perhaps more important here at this site because of the concentrations that are lower than BRC/TIMET background in RZ-A.

Of further note is that the spatial plots are not as useful as plots that use a continuous scale across concentrations (while perhaps using different symbols for non-detects). Splitting data by the mean concentration does not provide a general picture of concentration patterns, and does not allow easy comparison of chemicals for similar spatial patterns. Also, use of large and small circles for shallow and deeper samples does not make it easy to discern differences or patterns. Continuous concentration plots and separate plots for surface and deeper samples would be more helpful.

Also, there does not appear to be much discussion of the results of the spatial plots, perhaps because it is not easy to see effects or patterns given the types of plots provided. There is a discussion in Section 4.5 of why some chemicals were chosen for plotting, but there is no discussion of the results.

**Response**:

Spatial quartile plots for selected detected analytes and spatial intensity plots for all COPCs are provided in the revised report. In the spatial quartile plots, the concentrations bins are tied to those used for the box plots (i.e., <Q1, Q1-Q3, Q3 + [1.5 x IQR] and > Q3 + [1.5 x IQR]). In the spatial intensity plots, the concentrations bins are tied to BCLs or other screening criteria. Discussion of the spatial plots are provided in the report text. Although Neptune did not like the spatial quartile plots or the spatial intensity plots, Ramboll Environ found the spatial plots to be helpful from a risk perspective. Through agreement between Ramboll Environ and Neptune, Neptune would develop their own plots using the data provided in this report by Ramboll Environ.

**General Comment 3: Radionuclide risk**.

Certain radionuclides were identified as COPCs in Revision 3 of the Parcels C – H HRA Report pursuant to comments on Revision 2 of the HRA Report indicating that radionuclide concentrations appeared elevated relative to background. Because a radionuclide risk assessment has not previously been presented the assessment in Revision 3 was reviewed:

a. Particulate inhalation exposure pathway; indoor worker. The exposure assessment for radionuclides (Section 5.3.2.3) includes a reference to the BCL User's Guide (NDEP 2008-rev 2013) for methodology and equations. Although NDEP (2008-rev 2013) does not differentiate indoor and outdoor workers for radionuclide BCLs, separate calculations for radionuclide risk were performed in Revision 3 of the Parcels C – H HRA Report consistent with the exposure assessment for chemicals. Inhalation of particulates in indoor air, using an attenuation factor applied to ambient air concentrations, is identified as a potentially complete exposure pathway for chemicals in NDEP (2008-rev 2013). In Section 5.1.3, the rationale provided for excluding this pathway for the indoor worker in Revision 3 of the Parcels C – H HRA Report is a reference to a supplemental soil screening levels guidance (EPA 2002a). The fact that particulate inhalation was not identified as a recommended chemical exposure pathway for indoor workers in EPA (2002a) is not justification for excluding this pathway from the radionuclide risk assessment. EPA (2002a) was among the references evaluated during development of the BCLs for the BMI Complex and Common Areas, yet inhalation of particulates in indoor air was retained as a potentially complete exposure pathway for BCL calculations. An attenuation factor for indoor air particulate concentrations may be applied in the inhalation pathway risk calculation for indoor workers to refine this calculation. In fact, a dilution factor for outdoor to indoor air is listed among the parameters shown in Table 7 of the Parcels C – H HRA Report. Please provide rationale for not quantifying indoor worker inhalation risk for radionuclides.

   We note that practically, the particulate inhalation pathway will make a negligible contribution to total radionuclide risks. But this should be demonstrated / explained to justify not evaluating it. An option might be to consider pathway contributions for the BCL calculations.

   **Response:**

   Radionuclides are not identified as COPCs, and therefore are not carried forward into the risk calculation.

b. Particulate emission factor value. Revision 3 of the Parcels C – H HRA Report presents a screening-level calculation of risk using the maximum concentration for each COPC from all Parcels. The values for industrial/commercial and construction PEF are not stated in the report. Instead, tables are referenced that show Parcel-specific PEF values. The radionuclide risk calculation workbook was reviewed to determine that the Parcel G PEF values were applied in the calculations. The Parcel G PEF values are the largest among all Parcels, and particulate loading in air (and hence cancer risk) is inversely proportional to the magnitude of the PEF value. The selection of the Parcel G PEF values for a screening calculation should be explained since the most-protective value would more commonly be applied during screening.

   **Response:**

   The soil HRA has been revised to include a separate evaluation of risks for each individual parcel. Parcel-specific PEFs were used for each individual parcel.

c. Tables 7 and 8. The inhalation rate values used for the radionuclide risk calculations should be added to these tables.

**Response:**

Radionuclides are not identified as COPCs, and therefore are not carried forward into the risk calculation.

d. Section 5.5.4. The use of maximum detected background concentrations as a point of comparison to the screening-level risk assessment results for each scenario is inappropriate and should be removed from this discussion. An estimate of average background radionuclide concentrations may be employed in the risk assessment calculations for the purpose of providing a point of comparison to Site risks and estimating incremental cancer risks. If the protectively biased screening-level risk assessment results using the maxima from all Parcels is inadequate to support risk management decisions a baseline risk assessment for each Parcel using Parcel-specific concentrations should be prepared. Comparison of maxima is completely inappropriate. Maxima are, by their very nature, highly uncertain with values that are greatly affected by sample size. In this case the sample size used for background is 95, which is much greater than the site sample size for any single parcel. Not only is this approach statistical indefensible, but it is made worse by the background sample size used. This is notwithstanding the issue in General Comment #1 above, which requires use of the RZA data to represent background for radionuclides.

**Response:**

The soil HRA has been revised to include a separate evaluation of risks for each individual parcel. All discussion comparing risks to maxima background radionuclide concentrations were deleted. As noted, discussion comparing parcel risks with risks associated with both the RZ-A and the BRC/TIMET background data set based on 95% UCL over the mean soil activities are included in the revised HRA.

e. Section 5.6, Uncertainty Analysis. A subsection should be added to the Uncertainty Analysis focusing on the radionuclide risk assessment. The current Uncertainty Analysis focuses primarily on the results of the chemical risk assessment. Various aspects of this discussion are not applicable to the radionuclide risk assessment and key uncertainties related to the radiation risk assessment (such as the radon-222 pathway) are not presently addressed.

**Response:**

A discussion of uncertainties in the radionuclide risk assessment is presented in Section 6.2.4, including uncertainties with excluding radionuclides from the risk calculation and inhalation risk of radon gas (radon-222) within a commercial building.

f. Radon-222 risk. As discussed in Appendix E-4 of the BCL User's Guide (NDEP 2008-rev 2013) inhalation of radon gas within a building is potentially of greater concern than other exposure pathways related to radium-226. At a minimum, a discussion of potential radon-222 inhalation risks should be added to Section 5.5.4.1 and to the new radionuclide risk assessment subsection of the Uncertainty Analysis.

**Response:**

A discussion of the inhalation risks from radon in indoor air is presented in Section 6.2.4.

**General Comment 4: Asbestos data.**

ENVIRON noted in their comment responses to Neptune DVSR comments as follows: DVSR Comment d on Table D-10 of the HRA. The comment response indicates that sample Q3-PF-1-1-0.0 was adjusted in Table D-10 to show an analytical sensitivity of 2.99E+06 structures/g PM10. In asbestos workbook Parcel F_asbestos_riskcalcrev.xlsx the analytical sensitivity for this sample is instead 2.96E+06 structures/g PM10. Please clarify.

**Response:**

The analytical sensitivity listed in asbestos workbook Parcel F_asbestos_riskcalcrev.xlsx for sample Q3-PF-1-1-0.0 was replaced with the value of 2.99E+06.

**General Comment 5: Asbestos risk calculation workbooks.**

a. The asbestos risk assessment calculations employ both original and field duplicate samples. This increases the sample size by treating these quality control samples as independent samples, resulting in lower values of pooled analytical sensitivity. If field duplicate samples are to be treated as independent samples the magnitude and variability of results for the field duplicate pairs must be compared with that of primary samples to demonstrate that field duplicate results are independent of primary sample results, otherwise the asbestos risk can be under-estimated.

**Response:**

We note that both original and field duplicate samples were used in the analysis presented in the HRA rev2 report and that NDEP did not comment on the analysis; Northgate therefore used the same approach in the HRArev3 analysis.

The asbestos cancer risks based on the primary and field duplicate samples are presented in the risk characterization section, and the asbestos cancer risks based on the primary samples only are presented in Section 6.1.7. Results indicate that excluding the field duplicate samples would not change the conclusion.

b. References for site-specific values used in the PEF calculations should be provided in the workbooks. These include site surface area, in situ wet bulk soil density, gravimetric soil moisture content, soil silt content, and road surface soil silt content. The references were discovered in Table 6 of the HRA Report. Please provide the appropriate reference in appropriate asbestos sections of the report.

**Response:**

References for site-specific values used in the PEF calculations are provided in Table 5-8.

**Attachment A-1**

**RTC Comment 1**. Section 4.2. The section notes that MS/MSD recoveries were outside of control limits in 570 instances and that holding-time exceedances in 75 instances. This potential effect on the risk assessment should be discussed in the uncertainty analysis.

**Response:**

The discussion of the potential effect on the risk assessment of the qualified data is provided in Section 6.1.6.

**New Comment 1a.** The revised text of Section 5.6 discusses the potential impacts of J-qualified data on the risk assessment results and concludes that J and J- data would not impact COPC selection or identification of maximum concentrations. In particular, the text states, "COPC selection was based on the maximum detected concentration; for analytes not selected as COPCs, the J-qualified results were significantly below BCLs such that even if corrected for the low bias, the analyte would not have been identified as a COPC." This statement should be supported by analysis showing estimated bias-corrected values compared to BCLs.

**Response:**

A summary of the comparison of J-qualified data to BCLs is provided in Table 6-1.

**New Comment 1b.** In Section 4.2 it is stated that 444 field duplicate results, and one MS/MSD pair, were qualified for excessively large relative percent difference values. Table C-1 however shows only 304 results qualified due to reason code 17 (Field duplicates did not meet the 50% RPD control criterion). The previous report version stated that there were 570 instances where MS/MSD recovery was outside of control limits, but Table C-1 shows 1,281 results qualified due to reason code 4 (The MS/MSD recovery was outside of control limits). The previous report also noted 75 instances of holding time exceedances. Section 4.2 does not specifically discuss holding time exceedance in the current version, but Table C-1 indicates that 1,164 results were qualified due to reason code 1 (The sample preparation and/or analytical holding time was exceeded). Please explain these discrepancies and revise Section 4.2 to provide a complete summarization of data validation results.

**Response:**

All qualified results (i.e., U, J, J-, and J+ qualified data) for the non-asbestos analytes are presented in Appendix F, Table F-1, and the reasons for these qualified results are summarized in the DVSRs (see Appendix E). The data qualified due to precision exceedance are summarized in Table E-4, and discussed in Section 4.1.1.7.

**RTC Comment 2**. Section 4.2. Identify rejected data and discuss implications for the risk assessment.

**Response:**

The discussion of the potential effect of the rejected data on the risk assessment is presented in Section 6.1.3.

**RTC Comment 3**. Table 5. Please update using the latest BCL table and guidance (August, 2013).

**Response:**

The report was updated using the BCL tables and guidance issued in July 2017.

**RTC Comment 4**. Table 9. The Deliverable should rely upon the latest toxicity criteria for each of the COPCs (listed in Table 9). The NDEP (2013) reference necessarily documents toxicity criteria current when this reference was prepared, but these criteria are subject to revision over time. The authors should review the federal and state agency references where relevant toxicity criteria are published to identify current toxicity criteria. (The values in Table 9 were checked and are current with present-day values published by federal and state agencies – this clarification pertains to methodology and future assessments).

**Response:**

Comment acknowledged; the referenced federal and state agency sources for the toxicity values were reviewed to confirm that the most current values are being used at the time the report is submitted.

**RTC Comment 5**. Editorial change. Please change “contaminate” to “contaminant” in footnote #5.

**Response:**

This comment was addressed.

**Attachment A-2**

**RTC Comment 1. Section 5.2.1.** The reasoning by which all radionuclides were dismissed as COPCs appears flawed. In the case of Parcel H, not just one but all four radionuclides in the uranium series were clearly elevated with respect to background.

**Response:**

In this report, the background evaluation for radionuclides was based on the comparison with the RZ-A data set for COPC selection. An expanded discussion of analytical and other issues associated with the data sets for the radionuclides are included in Section 5.1.1.2. Through the comparison of preliminary cancer risks calculated for the parcel data set and background data set (both RZ-A background and BRC/TIMET background), radionuclides are considered as consistent with background and not identified as COPCs.

**New Comment 1a.** Section 5.2.1, 3rd paragraph, 1st sentence. The text indicates that the “potential comparability issues identified for metals data were not observed” for radionuclides. Our review of radionuclide summary statistics for the RZ-A site background and BRC/TIMET (2007) background data sets suggests that, as for metals, RZ-A site background for radionuclides may also be lower than regional background for radionuclides. Data analysis must be provided to support the statement that radionuclides are not affected by the comparability issues and justify the use of the BRC/TIMET (2007) background data set for radionuclides.

**Response:**

Please see response to General Comment #1.

**New Comment 1b.** Section 5.2.1, last paragraph. A review of Table F-4 does not support the identification as COPCs of only the uranium-238 decay series radionuclides (U-238, U-234, Th-230, Ra-226) in Parcel H. Thorium-232 and radium-228 are also indicated as being present in Parcel H soils at concentrations elevated above background, indicating that the thorium-232 decay series (Th-232, Ra-228, Th-228) should be retained as COPCs.

**Response:**

In this report, the background evaluation for radionuclides was based on the comparison with the RZ-A data set for COPC selection. An expanded discussion of analytical and other issues associated with the data sets for the radionuclides are included in Section 5.1.1.2. Through the comparison of preliminary cancer risks calculated for the parcel data set and background data set (both RZ-A background and BRC/TIMET background), radionuclides are considered as consistent with background and not identified as COPCs.

**RTC Comment 2.** Spatial intensity plots showing the spatial distribution of analytes are needed to evaluate the implicit assumption that there is no spatial structure to the soil samples and therefore it is appropriate to pool samples.

**Response:**

Please see response to General Comment #2.

**New Comment 2a.** Spatial intensity plots should be provided for all chemicals rather than a subset. The purpose of such plots is to investigate possible spatial patterns that can inform the conceptual site model, provide a basis for evaluating data adequacy, and finally support data aggregation for exposure assessment. Also, identifying chemical collocation is facilitated by review of these plots. Producing plots for all analytes should not require substantially more effort than for a subset, and in fact may ultimately be more efficient since there is then no need to provide rationale for omitting a subset of chemicals based on documentation of the reviews described in the response.

**Response:**

Please see response to General Comment #2.

**New Comment 2b.** The spatial plots provided in Figures 7 through 17 are inadequate to allow review of spatial patterns of contamination. The plots should provide a continuous scale, using color or bubble size. Distinguishing concentrations at different locations as either greater or less than the mean as the current plots are configured is of limited value for identifying the location of anomalously high values. In addition, it would be more helpful to have separate plots for the two different depth layers – these could be presented side-by-side.

**Response:**

Please see response to General Comment #2.

**RTC Comment 3**. Executive Summary. Please revise the paragraph related to asbestos risks to correct the reference to constant lifetime exposure for construction worker amphibole upper-bound cancer risk results in the risk assessment.

**Response:**

The paragraph has been revised.

**New Comment 3a.** Footnote 2 clarifies that the fiber counts referenced to the Removal Action Workplan are not remediation goals. Explain the relevance of the cited Removal Action Workplan fiber counts or remove these sentences from the paragraph.

**Response:**

The language in the report has been revised to delete any suggestion that the number of fiber counts is a remediation goal.

**New Comment 3b.** In both Executive Summary and Section 5.5.3 there are statements that the upper-bound risk estimates are based on an observed count of zero long amphibole structures in the 75 remaining (post-abatement) samples from the Parcels. These statements are incorrect and misleading, and conflict with the request for clarification of this issue in Comment 19. Asbestos UCLs and related risk estimates were not calculated with 75 samples but rather with the number of post-abatement samples collected in each individual parcel, which range from 6 samples (Parcel G; 6E-06 cancer risk) to 23 samples (Parcel H; 2E-06 cancer risk). Please revise the text in this paragraph and Section 5.5.3.

**Response:**

The text in Section 6.2.2.2 has been revised to reflect the number of samples in Parcel F, as appropriate to the discussion.

**RTC Comment 4.** Section 2.2; last paragraph. Asbestos remediation goals are stated in this paragraph without reference. The basis for the chrysotile and amphibole asbestos counts referenced to the Removal Action Workplan is not described in the post-remediation risk assessment and it is inappropriate to infer that these fiber counts somehow define acceptable post-remediation levels of asbestos in soil. Fiber counts in a sample are not meaningful without an associated analytical sensitivity, so while these counts may have significance for delineating target areas for soil remediation in the workplan context they have no particular significance in a risk assessment context. More specifically, it is the pooled analytical sensitivity based on multiple samples that is relevant for estimating asbestos soil concentrations and this is a function of the number of samples as well as sample-specific analytical sensitivity. Explain the relevance of the cited Removal Action Workplan fiber counts or remove this language.

**Response:**

The language in the report has been revised to delete any suggestion that the number of fiber counts is a remediation goal.

**RTC Comment 5**. Section 3.1. Appendix C contains data files for samples with qualified results only. The text of Section 3.1 states, “A complete listing of the Parcel Soil Confirmation samples and SDGs is presented in Table 1-2 of the Northgate (2010a) Data Validation Summary Report for the Parcels, which is discussed later in this report and provided in Appendix C.” Please briefly describe the three Excel workbooks also provided in Appendix C.

**Response:**

All the data summary tables and documents related to the soil DUE are presented in Appendices E and F. Appendix E includes four Excel workbooks for data not considered due to soil removal and asbestos abatement activities, data excluded during data processing, rejected data, and qualified field duplicate, in addition to a folder with data validation summary reports. Appendix F includes post remediation soil HRA data set for chemicals and radionuclides (including all U- and J-qualified data) and the post remediation soil HRA data set for asbestos.

**RTC Comment 6**. Section 3.7. Please define a “trigger sample” as referenced in the sentence describing how “…the trigger sample point was surveyed and marked by LVP.”

**Response:**

This was clarified in the text of Section 3.3.1.2.

**RTC Comment 7**. Section 4.2. Data validation methods and results for asbestos should be discussed.

**Response:**

Neptune validated the asbestos results in accordance with NDEP guidance (Neptune 2014), and a memorandum responding to the specific issues identified in the DVSRs along with the agreed data set for risk assessment purposes in the EDD was submitted to NDEP (ENVIRON 2014). The final asbestos data set used in this post-remediation soil HRA is presented in Table F-2.

**RTC Comment 8**. Section 4.2. Add a discussion of laboratory accreditation / certification under Criterion III.

**Response:**

The text in Section 4.1.1.4 was amended indicating that analyses were conducted by NDEP-certified laboratories.

**RTC Comment 9**. Section 4.2. Provide more details about detection limits above BCLs for benzo(a)pyrene and dibenz(a,h)anthracene. Table 5 indicates that detection frequencies for detected PAHs are relatively low, being in all cases less than 5%. This provides evidence that PAHs are not a widespread soil contaminant and support a conclusion that detection limit issues for benzo(a)pyrene and dibenz(a,h)anthracene are not a significant concern. Please add a discussion of this line of evidence to the text of the report.

**Response:**

A discussion of the impacts of elevated SQLs on the soil COPC selection and risk estimates is presented in Section 6.1.2.

**RTC Comment 10**. Section 4.2. More information needs to be provided about the RPD exceedances. This information should be summarized in a table.

**Response:**

The data qualified due to precision exceedance are summarized in Table E-4, and discussed in Section 4.1.1.7.

**New Comment 10a.** The summary of the assessment of precision in the revised text (444 field duplicate results, and one MS/MSD pair, were qualified for excessively large relative percent difference values) appears inconsistent with the earlier text (570 instances where MS/MSD recovery was outside of control limits). Please explain this discrepancy.

**Response:**

The summary of data qualified due to precision exceedance was reorganized, and was checked against the DVSRs for consistency.

**New Comment 10b.** Vinyl acetate is identified as the only analyte for which an MS/MSD sample exceeded the RPD criterion. This result was qualified with the statement that vinyl acetate "is not a compound that is included in the HRA data set (Appendix D)." Section 4.4 states that all confirmation data are included in Appendix D. Please identify any other analytes that have been excluded, explain the basis for which an analyte such as vinyl acetate would have been excluded from the assessment data set, and provide this information in the risk assessment report.

**Response:**

Vinyl acetate was not excluded from the soil HRA data set (see Table F-1), and no data point for vinyl acetate was qualified for MS/MSD RPD exceedance. No analyte was excluded from the soil HRA data set due to precision exceedance.

**RTC Comment 11**. Section 4.2. Provide the total number of results evaluated and results rejected to calculate percent completeness.

**Response:**

The rejected data are summarized in Table E-3, and the calculated completeness for Parcel F is presented in Section 4.1.1.7.

**RTC Comment 12**. Section 4.2 and Appendix C. Section 4.2 and Table C-1 do not provide enough information about the data qualifications made. All data qualifications, not just J-, should be discussed. Additionally, Table C-1 needs to provide: limits and recoveries, definition of reason codes, holding time vs exceeded time, LCS/LCSD issues, and an explanation of the yellow highlight. The text on page 21 (570 MS/MSD exceedances and 75 holding time exceedances) does not accord with the numbers of exceedances for these endpoints in Table C-1.

**Response:**

All qualified results (i.e., U, J, J-, and J+ qualified data) for the non-asbestos analytes are presented in Table F-1, and the reasons for these qualified results, including details of the exceedances and deficiencies, are summarized in the DVSRs (see Appendix E).

**New Comment.** The summary bullets related to J-qualified data in the Data Quality Indicators discussion were deleted in this revision of the risk assessment. A summary table with information for each analytical suite was introduced for the data completeness endpoint, but summary information related to data qualifiers for precision and accuracy is now missing. Summary tables for precision and accuracy parameters should be added to Section 4.2. These summaries, and reference to Table C-1 as appropriate, should be used as the basis for the discussion of the effect of uncertainty in data usability/data evaluation (Section 5.6) on risk assessment results and conclusions. Table C-1 should be referenced for data qualification details, but this table has >8400 rows and requires summarization in the main report. See also clarification for Attachment A-1, Comment 1, for specific examples of discrepancies between Table C-1 and Section 4.2.

**Response:**

The Data Quality Indicators discussion was reorganized in Section 4.1.1.7 of this report. All the data summary tables and documents related to the soil DUE are presented in Appendices E and F. Appendix E includes four Excel workbooks for data not considered due to soil removal and asbestos abatement activities, data excluded during data processing, rejected data, and qualified field duplicate, in addition to a folder with data validation summary reports. Appendix F includes post remediation soil HRA data set for chemicals and radionuclides (including all U- and J-qualified data) and post remediation soil HRA data set for asbestos. This information was used as the basis for the discussion of the effect of uncertainty in data usability/data evaluation on risk assessment results and conclusions (see Section 6.1).

**RTC Comment 13**. Section 4.2. There needs to be more information about how blank contamination was handled for DVSRs. Blank contamination is one of the parameters that should be summarized in Section 4.2 and discussed in relation to the effect of uncertainty in data usability/data evaluation (Section 5.6) on risk assessment results and conclusions. Although the impact of blank contamination is discussed in Section 5.6 a summary of the sample results affected by blank contamination should be provided in Section 4.2. Information summarizing the levels of contamination found in blank samples should be added to the discussion in Section 4.2. See also the clarification for Comment 12.

**Response:**

As requested by NDEP and in accordance with the most recent guidance (NDEP 2012) for evaluating data associated with blank contamination, Ramboll Environ queried the censored data for blank contamination from the project database, and changed them from nondetected values at PQLs (U qualified) to detected values at reported concentrations (J qualified) if the PQLs were higher than the reported concentrations. Such revisions did not affect any sample in Parcel F. However, during our review, Ramboll Environ noticed that several discrepancies in the data associated with blank contamination exist between the project database and the amended tables of the DVSRs Northgate prepared in the Soil HRA Report Revision 3 (Northgate 2014), especially for the reported concentrations. Data consistent with the project database are included in this soil HRA, and the impacts of such discrepancies on the soil HRA results are further discussed in Section 6.1.6. Also, please see our response to NDEP comment on Attachment A-2, Comment #12.

**RTC Comment 14**. Section 5.2.1. Please clarify why data from two different locations are used as background. Analysis must be provided to support this statement and justify the use of the BRA and TIMET (2007) background data set for radionuclides. As noted in the New Comment for RTC Comment 1, our cursory review of radionuclide summary statistics for the RZ-A site background and BRA and TIMET (2007) background data sets suggests that, as for metals, RZ-A site background for radionuclides may also be lower than regional background for radionuclides. Geologic differences are cited in Section 5.2.1 and in this comment response as one possible explanation of the discrepancy between Site and background concentrations for analytes in the metals analytical suite, and such differences could also affect radionuclide concentrations.

**Response:**

See response to General Comment #1.

**RTC Comment 15**. Section 5.2.1. The reason for using different substitution values for non-detects for parametric and non-parametric tests should be discussed. Section 5 .2.1 was revised to cite NDEP guidance for the substitution values, but the rationale for the use of different values for parametric and non-parametric tests was not provided as the response indicated it would be. Please provide a brief summary of the rationale, which pertains to the difference between representing results by ranked value (non-parametric tests) versus representing results by the most-likely actual value (parametric tests).

> **Response:**
>
> The text in Section 4.1.2.2 was expanded accordingly.

**RTC Comment 16**. Section 5.2.1. Discuss issues related to the use of PQLs in the data analyses in lieu of SQLs. The analytes affected by this issue are not specified nor is the direction or degree of potential bias clearly explained for data analyses affected by this issue. Tables including affected analytes would be helpful, including a comparison of the non-detect limits with the detected data, and some discussion of how this affects conclusions. Table 3 contains some of this information. For example, the non-detect (presumably PQLs) for antimony appear to range from 1 – 5.4 ppm, but the detected data range from 0.088 to 0.32 ppm. The same basic issues arise for all metals that have non-detects reported (e.g., boron, cadmium, chromium VI, mercury, thallium, tin, tungsten). Some of these metals failed background comparisons, however, the impact of the PQLs on these background comparisons is not clear. For example, boron and thallium failed background comparisons – was this because of the high PQLs?

> **Response:**
>
> As discussed in Section 4.1.1.5, the issue of reporting nondetect results to PQL instead of SQL no longer exists in the current soil HRA data set. After taking the responsibility for maintaining the project database on behalf of the Trust in early 2011, Ramboll Environ reassessed the nondetect data according to the current NDEP guidance on the use of censoring limits (NDEP 2008). In the soil HRA 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 SQL or MDL is not available, the nondetect results are reported to the PQL.

**RTC Comment 17**. Section 5.2.2. Reconcile presentation of amphibole risks with amphibole not being identified as a COPC. Consistent with the April 1, 2014 NDEP response to the NERT response to Comment 17, amphibole was retained as a COPC. Table 5 indicates amphibole was identified as a COPC based on NDEP (2011), but no NDEP (2011) reference is included in the risk assessment references (Section 7). Please provide the reference.

> **Response:**
>
> Long amphibole fiber was included as a COPC per NDEP guidance (Neptune 2015).

**RTC Comment 18**. Section 5.5.3. Revise paragraph to accurately describe bias related to the asbestos URF used in the risk assessment. The Comment 3 is also applied to this comment.

**Response:**

The uncertainty of asbestos toxicity value is discussed in Section 6.2.3. Also, see response to Attachment A-2, Comment 3.

**RTC Comment 19**. Section 5.6. Add a discussion explaining the relationship between sample size and pooled analytical sensitivity to provide context for upper-bound asbestos risk estimates. This discussion provides a good summary of the relationship between sample size, fiber count, and the 95UCL for asbestos. This should be referenced in addressing New Comment for RTC Comment 3 and RTC Comment 18.

**Response:**

The discussion of uncertainty in asbestos exposure point concentrations is presented in Section 6.2.2.2, in response to NDEP Attachment A-2 RTC Comment 3 and RTC Comment 18.

**RTC Comment 20**. Section 5.2.1. The rationale and distinction between parcel level comparisons and site wide comparisons should be more fully discussed in the main report. The following new text was added to Section 5.2.1: "The background evaluation was performed for each Parcel individually and is presented for both the combined Parcels and individual Parcels. The Parcels were evaluated individually because potential sources of chemicals could exist only in certain Parcels." Please revise the second sentence as follows: "The Parcels were evaluated individually because they had different operational histories and previous soil investigations identified different potential contaminants among the different Parcels (see Section 2.0)"

**Response:**

The soil HRA has been revised to include a separate evaluation of risks for each individual parcel, so the background evaluation will only be performed for each parcel individually. The referenced sentence was revised as suggested in Section 4.1.2.2.

**RTC Comment 21**. Tables F5A and F5B. Explain what is meant by the "Number Missing" column.

**Response:**

The missing number is the count of sampling locations for which one or more results are unavailable. A footnote has been added to Tables I-5A and I-5B.

**RTC Comment 22**. Section 5.5.3. The variation in the asbestos upper-bound risk estimates is a function of differences in sample size and should be explained in that context.

**Response:**

See response to Attachment A-2 RTC Comment 19.

**RTC Comment 23**. Table 5. Add a footnote explaining blue shading.

**Response:**

A footnote was added to Table 5-1 explaining that blue shading indicates analyte is carried forward to COPC identification Step 2.

**RTC Comment 24**. Appendix F boxplots. The points outside of the 1.5x interquartile range are not necessarily outliers.

**Response:**

The term “outlier” was deleted from all boxplots in Appendix I.

# APPENDIX A-2

# RESPONSE TO COMMENT LETTER – RESPONSES TO NDEP COMMENTS ON SOIL GAS HRA REVISION 1

## Appendix A-2

**Explanatory Note:**
**The following are the list of comments received from NDEP on January 12, 2017 on the Soil Gas Investigation and Health Risk Assessment for Parcels C, D, F, G, and H, Revision 1 (dated September 23, 2016).**

**General Comment:**

1. Run the J&E model for the soils at the depth of 5 ft. and 10 ft., and the groundwater with the data available, respectively;
2. The input data for the J&E model must use the site specific data. If the site specific data is not available, NERT should choose using the default values of the dominant soil classifications for corresponding soil horizons at the site or collecting new data for the depth of 5 ft. and 10 ft.;
3. Do a 30-day exposure frequency for trench model analysis.

**Specific Comment #1 - March 18, 2013 NERT HRA Work Plan, on page 2, Section 1.1 Overview, footnote #4 and Section 5.4.3**
This section states: "Potential risks associated with soils within the Study Area are currently being evaluated. The current draft of the soil HRA was submitted to NDEP on May 18, 2012 (Northgate 2012) and NDEP provided comments on the draft HRA on August 7, 2012. Responses to NDEP comments and revisions to the draft HRA are in preparation. Results from the final (NDEP-approved) HRA will be combined with the risk results for the vapor intrusion pathway to evaluate cumulative risk."

The current version of the report only addresses the vapor intrusion pathway and makes no statement with regard to next steps/path forward. It is understood that the path forward is dependent upon risk management decisions among stakeholders, however, the current report does not address the cumulative risk.

> **Response:** Reporting of cumulative risk (soil + soil gas) was discussed on pages 2, 3-4, and 49 of the Rev1 report. As noted on those pages, the original plan was for the cumulative cancer risks and HIs for inhalation of VOCs (as evaluated in the Soil Gas HRA) and for soil-related pathways (for all soil chemicals of potential concern) to be presented in the final version of the Soil Gas HRA or in the final version of the soil HRA. The current version of this report now addresses soil, soil gas and groundwater for Parcel F.

**Specific Comment #2 - March 18, 2013 NERT HRA Work Plan, Figure 5**
Figure 5, the CSM, indicates that the downgradient receptor pathways for Indoor Worker and Resident are complete. Further, page 35, Section 5.2.l Conceptual Site Model, last paragraph states:

> "In accordance with the 2010 and 2013 risk assessment work plans (Northgate and Exponent 2010a; ENVIRON 2013a), off-site receptors, visitors, and trespassers were not quantitatively evaluated in the HRA. The rationale for excluding these receptors and a qualitative in the HRA. The rationale for excluding these receptors and a qualitative discussion of their potential risks is presented in Section 6.4.

And on Page 47, Section 6.4, Exposure Assessment, fourth paragraph states:

> "In accordance with the NDEP-approved Health Risk Assessment Work Plan (Northgate and Exponent 2010a), off-site receptors were not quantitatively evaluated in the HRA. Inhalation of VOCs by on-site outdoor

> commercial/industrial workers serves as an upper-bound estimate of the potential exposures to VOCs by off-site receptors, ..."

For reference and clarity of the administrative record, the Health Risk Assessment Work Plan (Northgate and Exponent 2010a) specifically states on page 8:

> "...off-Site receptors will not be quantitatively evaluated in post-remediation risk assessments and a discussion will be included to provide rationale for this decision, and the associated uncertainties will be included in the uncertainty assessment."

The report lacks transparency as regards rationale and justification for not evaluating off- Site receptors as this justification is not brought forward into the HRA report. It should also be noted this plan states, "Based on the relative differences in the on-Site receptor particulate emission factor .... and the off-Site receptor particulate emission factor during construction, ... versus other exposure factors that may be higher for the off-site receptor, the on-Site construction exposure will be greater than that of the off-Site receptors." Underline added for emphasis to draw attention to lack of technical justification for not evaluating the off-Site receptor. Recommend revision to this section to provide clear justification and technical rationale for why off-Site receptors are protected.

**Response:** Discussion was added to clarify this point in Section 6.2.2.

**Specific Comment #3 - Executive Summary**

The construction worker receptor should be evaluated using a model accounting for vapor intrusion into a utility trench such as that from the Virginia Department of Environmental Quality (2016).[1]

**Response:** A utility trench was not included in the approved work plan. At the request of NDEP a utility trench scenario has been added to the Parcel C, D, and G HRA Report, the Parcel H HRA Report, and the Parcel F HRA Report.

**Specific Comment #4 - Section 1. Introduction, page 3.**

The text states that "In addition, based on a review of figures showing a chloroform plume in shallow groundwater, NDEP noted that the 2008 Phase B investigation soil gas samples were collected from locations where VOC results would likely be biased low. Finally, NDEP commented that it may be reasonable to use the site-wide soil gas data reported in the 2010 Site-Wide Soil Gas HRA in conjunction with groundwater data to evaluate potential risks for the vapor intrusion pathway."

Section 1. Introduction, page 5. The text states that "Since completion of the soil gas sampling and Revision 0 of this HRA, USEPA issued the final version of its guidance Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (USEPA 2015a). Ramboll Environ has reviewed the guidance and found that the completed field work and HRA are generally consistent with the current guidance."

USEPA (2015) referenced herein states that "Modeling results for idealized scenarios

---

[1] http://www.deg.virginia.gov/Programs/LandProtectionRevitalization/RemediationProgrARn/Voluntai:yRemediationPr ogram/VRPRiskAssessmentGuidance /Guidance.aspx

show that, in homogeneous soil, soil gas concentrations tend to be greater beneath the building than at the same depth in adjacent open areas when the vapor source is underneath the building, even if the source is laterally extensive relative to the building footprint (e.g., broad plume of contaminated groundwater) (USEPA 2012b). Given these predictions and supporting field evidence (USEPA 2012a, see Figure 6; Luo et al. 2009; Patterson and Davis 2009, see Figure 1), individual exterior soil gas samples cannot generally be expected to accurately estimate sub-slab or indoor air concentrations. This potential limitation may be particularly valid for shallow soil gas samples collected exterior or adjacent to a building footprint...Deeper soil gas samples collected in the vadose zone immediately above the source of vapor contamination (i.e., 'near-source' soil gas samples; see Section 6.3.1) can reasonably be expected to be less susceptible to the diluting effects of ambient air, compared to shallow soil gas samples. On this basis, deeper soil gas samples collected in the vadose zone immediately above the source of vapor contamination will tend to be more suitable than will be shallow soil gas samples for assessing vapor concentrations that may be in contact with the building's sub-slab." The USEPA (2015) as referenced in the Deliverable does not appear to support the use of shallow soil gas sample on open areas.

> **Response:** Groundwater modelling results were included in the previous report in Appendix I. As discussed with NDEP, the groundwater results have been updated and moved into the main text as an additional line of evidence. In addition, soil gas samples collected in 2007 within Parcels C and D at a depth of 10 ft bgs have been identified and included in the Parcel C, D and G HRA Report.

**Specific Comment #5 - Section 2.1.5 Parcel H, First Line, page 14**

The text indicates the size of Parcel H is 24.5 acres. However, the J&E modeling done used a parcel size of 26.3. Please reconcile and correct J&E modeling accordingly (Table 12).

> **Response:** This was corrected in the Parcel H HRA Report.

**Specific Comment #6 - Section 4.1.1Soil Gas Data Set, Second Paragraph, page 22**

The text indicates that there are 12 sampling locations from the 2008 investigation ...shown on Figures 5 and 6. Consistent with the RTCs, for Parcel H, why not include the soil gas data from sample locations SG47, SG66 and SG67?

> **Response:** Samples SG47, SG66, and SG67 are to the north of Parcel H. For the few cases in which samples exterior to a parcel boundary were included in the HRA data set, the samples were located downgradient (not updgradient) of a parcel.

**Specific Comment #7 - Section 4.2.2.2 Parcels F, G, and H), page 32.**

1. The text states that "However, as previously described (Section 2.3), chloroform was not detected in the 0 and 10 ft soil samples collected within Parcel F (7 of which were located within LOU 63, although downgradient of SG34), but was detected at concentrations of 200 and 410 µg/kg in two of the 20 and 30 ft soil samples collected within Parcel F, suggesting a groundwater source." Please show this data in graphic and/or tabular form.
2. The text states that "For the outlier pair, for which the soil gas concentration was higher than predicted, available shallow soil samples (at 0 and 10 ft bgs) did not provide evidence of a surface source, with chloroform detected only in deep soil samples at 20 and 30 ft bgs." The correlation shown in Figure 8 does not support the predicted concentration assumed herein. Given that USEPA (2015) referenced in the states that "Modeling results for idealized scenarios show that, in homogeneous soil, soil gas concentrations tend to be greater beneath the building than at the same depth in adjacent open areas...individual exterior soil gas samples cannot generally be

expected to accurately estimate sub-slab or indoor air concentrations ... This potential limitation may be particularly valid for shallow soil gas samples collected exterior or adjacent to a building footprint..."Please explain the apparent low bias in shallow soil gas as shown in these two paragraphs in Section 4.2.2.2.

**Response:** As agreed with NDEP, the groundwater/soil gas comparison has been removed from the report. Groundwater modelling results were included in the previous report in Appendix I. As discussed with NDEP, the groundwater results have been updated and moved into the main text as an additional line of evidence.

**Specific Comment #8 - Section 4.2.3 Spatial Analysis of VOCs in Soil Gas, page 32**
In general, it appears that this exercise also supports the tenet of groundwater as the source yet several exceptions are noted. For example, no discussion is offered concerning significant contribution of carbon tetrachloride in Parcel G soil gas samples E-SG-8 and SG47. However, shallow groundwater data (Table 8) in Parcel G monitoring well TR-8 reports nondetect or very low estimated concentrations. Please update this section to provide a more robust interpretation of the data.

**Response:** During our meeting, NDEP agreed to remove this comment.

**Specific Comment #9 - Section 5.2.3.2 Fate and Transport Modeling, page 36.**
The text states that "For the receptors evaluated in this HRA (future on-site workers), transfer factors for soil gas to indoor air and outdoor air were derived based on migration of soil gas from 5 ft bgs into a commercial slab-on-grade building and into ambient air." The J&E model documentation states that the advective zone of influence for soil gas flow is limited to soil immediately adjacent to the building foundation. The foundation acts as a barrier to atmospheric cycles resulting in higher sub-foundation soil gas concentrations than measured in the absence of a building. Computer simulations by Massmann and Farrier (1992) supports the concept that "fresh air may migrate several meters into the subsurface during a barometric pressure cycle." Three-dimensional modeling by Abreu, et.al. (2008) indicated that for shallow sources on undeveloped land the best sampling depth was between 4 to 5 meters of depth and for deep sources samples should be collected from a maximum depth of 5.5 meters.

Reference to Table 12 and Table 14. The J&E soil gas model was for shallow 5-foot deep soil gas samples; however, the soil physical properties were for soil samples from 9 to 15 feet deep with an average of 10 feet deep. The mean volumetric water content was 0.154 (unitless) and the total porosity was 0.366 (unitless). If comparable shallow soil samples are not available on the NERT site then J&E default values for loamy sand (volumetric water content 0.076 and total porosity was 0.39) should be used in the model.

**Response:** Groundwater modelling results were included in the previous report in Appendix I. As discussed with NDEP, the groundwater results will be updated and moved into the main text as an additional line of evidence.

In addition, soil gas samples collected from Parcels C and D at a depth of 10 feet bgs have been identified and included in the Parcel C, D, and G HRA Report. The 10 foot soil properties were used for all soil gas modelling but the use of more conservative default soil properties is discussed in the uncertainties section (Section 6.2.2.3).

The site-specific soil properties were used in the modelling of both the 5 and 10 foot soil gas samples. After reviewing site boring logs and lithology, the site-specific soil properties were used with the removal of the one sample collected at 15 feet. Reviewing both the boring logs in the parcels and the boring logs where the samples were collected did not reveal any systematic increase in “wetness” between 5 and 10 feet throughout the site. While a few locations did note wetter conditions at 10 feet, a few locations also noted wetter conditions at 5 feet as well. Additionally, there is very little variability among the soil properties measured from the 9 and 10 feet samples. The exception to that is the one sample collected at a depth of 15 feet that did note wetter conditions than typical and also had the highest water filled porosity measured at the site. It was decided to remove the 15 foot sample from the evaluation and modify the site-specific soil properties to include only the samples from 9 and 10 feet. We also reviewed the stratigraphy from the site and in all of the parcel areas, both 5 and 10 feet should be located in the same stratigraphic unit (the alluvium) and are expected to have very similar conditions. The upper muddy creek formation, which should have wetter soil properties, does not appear stratigraphically until significantly deeper than 10 feet in all three parcels.

Use of conservative default values in the place of site-specific soil properties has been addressed in the uncertainty section (Section 6.2.2.3).

**Specific Comment #10 - Section 6.3, page 46**

The report states "California's default air exchange rate of 1 air change per hour (Cal/EPA 2011) was used in the absence of a default rate from USEPA. A conservative height of 10 ft was assumed, although many commercial buildings have higher first floor ceilings." The CalEPA default commercial building height (8 feet) should be used.

**Response:** The height was proposed and agreed upon in the Work Plan.

**Specific Comment #11 - Section 6.3 Exposure Concentrations, page 50.**

The text states that "Lastly, it is expected that the soil gas samples will provide a more accurate risk characterization because soil gas samples are collected closer to the point of exposure." It is accurate to say that the shallow soil gas sample is closer to the point of exposure; however, it is inaccurate to say that a shallow soil gas sample is equivalent to a sub-slab or deep soil gas sample. Shallow soil gas samples over undeveloped land are not equivalent to either sub-slab soil gas (USEPA, 2015; USEPA, 2004) or soil gas samples from undeveloped land (Massmann and Farrier, 1992; Abreu, et.al., 2008). Given the probable low bias from shallow soil gas in undeveloped (open) as cited here and in previous comments, it is recommended that shallow soil gas samples be used as only one line of evidence. Furthermore, it is recommended that the groundwater COPCs be modeled using the J&E Groundwater Model.

**Response:** Groundwater modelling results were included in the previous report in Appendix I. As discussed with NDEP, the groundwater results were updated and moved into the main text as an additional line of evidence. In addition, soil gas samples collected in 2007 within Parcels C and D at a depth of 10 ft bgs have been identified and included in the Parcel C, D and G HRA Report.

**Specific Comment #12 – Table 1 LOUs Within and Directly Upgradient of the Study Area Parcels**

Parcel C does not list LOU #58 yet Figure 4 indicates it is within or directly upgradient. Please correct accordingly.

**Response:** For this report, the table has been removed but the figure retained (now Figure 2-1). As shown in the figure, LOU #58 is not within or directly upgradient of

Parcel C.

**Specific Comment #13 - Table 3**
Please provide the equation(s) used to derive the risk-based concentrations (RBCs).

**Response:** Page 32 of the report states that "The RBCs were derived using the inputs to the Johnson and Ettinger (1991) model and values for exposure assumptions and toxicity criteria presented in Section 5 of this HRA." Equations for deriving RBCs were added in the Section 5 of the report.

**Specific Comment #14 - Table 4 Field Duplicate Qualifications**
Please verify the calculation for sample pairs E-SG-6-030813 1,2 Dibromoethane, E-SG-6- 030813 cis-1,3 Dichloropropene, E-SG-6-0308131 1,1,1,2-Tetrachloroethane as they do not appear to be correct.

**Response:** Soil gas sample E-SG-6-030813 collected in 2013 is located in Parcel F. The calculations for field duplicates for this sample are updated and included in the Parcel F HRA Report.

**Specific Comment #15 - Table 7 Soil Gas Summary Statistics -Combined 2008 and 2013 Data**

Several chemicals were which were detected in 2008 were not analyzed in 2013 yet the report does not provide rationale for elimination of these chemicals from the suite. The chemicals are noted as follows:

- N-Butylbenzene @ 100% detection frequency
- Ethanol @ 92% detection frequency
- N-Octane @ 50% detection frequency
- N-Propylbenzene @ 75% detection frequency

Please provide some discussion on the subject.

**Response:** Although both investigations used analytical method TO-15, the laboratories reported a different set of chemicals. As shown in Appendix Q, Table Q-2-4, all chemicals listed above were evaluated for noncarcinogenic effects in the soil gas HRA and none contributed significantly to the estimated HIs for any parcels or exposure populations.

**Specific Comment #16 - Table 8**
Please expand this table to include all groundwater COPCs listed in Table 9.

**Response:** Groundwater tables were revised and now include all groundwater COPCs.

**Specific Comment #17 - Table 11**
Was vapor intrusion modeling and associated risk calculations conducted for chloroform for Parcel E? If not, because Figure 4 and Figure 5 show elevated chloroform concentrations in groundwater immediately south/southwest (upgradient) of Parcel E, it is recommended that a groundwater-based vapor intrusion model be used to quantify the potential future risk associated with chloroform in groundwater given the expectation that this chloroform will soon migrate beneath this parcel.

**Response:** Parcel E is not included in this report.

**Specific Comment #18 - Table 12 and Table 14**

Are there any data soil properties data available for samples collected at depths less than or equal to 5 feet? If so, they should be used. The default saturation (ratio of water-filled porosity to porosity) for a loamy sand is approximately 19% whereas the value used in the model (0.154 / 0.366) equates to approximately 42%. The values listed in the table are associated with samples collected from depths ranging between 9 and 15 feet. Please provide justification for using these samples for vapor intrusion model simulations based on a source depth of only 5 feet, especially given the moist/wet conditions noted on some of the boring logs included in Appendix F in the 9- to 15-foot depth interval in which the soil properties samples were collected. The potential for lower moisture conditions in the depth interval ranging between 0 and 5 feet, and associated higher risk values, should be discussed.

**Response:** See response to Specific Comment #9.

**Specific Comment #19** - Table 13 and 'VLOOKUP' Table

Many of the chemical property values in these tables are outdated in comparison to those more recently published by the USEPA. It is recommended that the updated USEPA values be used. For example, the reference concentration for TCE – which is a COPC as listed in Table 9 - has been revised downward from 0.04 mg/m$^3$ to 0.002 mg/m$^3$.

**Response:** The chemical property values were updated.

**Specific Comment #20 - Table 14**

Footnote b of this table states that the volumetric moisture content is "As measured per ASTM D 2216". This is incorrect as ASTM D 2216 measures moisture content on a mass basis (e.g., grams of water per gram of soil). Mass basis moisture values should be adjusted using dry bulk density and water density values as described in NDEP (2010) *Soil Physical and Chemical Property Measurement and Calculation Guidance.*

**Response:** The values presented in the table are already corrected using that methodology. The footnote in the table has been revised for clarity.

**Specific Comment #21 - Figure 4, Figure 5, and Figure 6**

Please add a groundwater flow direction arrow (or arrows) to these figures. Further, Figure 5 indicates the Primary Source of Groundwater VOC is from Off-Site sources. As new field data is collected the validity of this assumption is called into question, specifically as regards Units 4 and 5 investigations. Revision to this figure is recommended.

**Response:** A revised figure (Figure 3-2) was made to incorporate the changes. Previous Figures 5 and 6 are now incorporated in Appendix B as Figure B-4, and groundwater flow direction arrows have been added on this Figure. Figure B-4 now shows the chloroform groundwater plume as it was depicted in 2017.

**Specific Comment #22 - Figures**

The figure suggests that there are chloroform data are from 2008 and 2013. Are there more recent chloroform soil gas data?

**Response:** No.

**Specific Comment #23 - Figure 6**

Comparison to Figure 5 shows the chloroform in groundwater plume is migrating to the northeast. A discussion regarding the potential for soil gas concentrations to increase or decrease at the various parcels in the future as the chloroform in groundwater plume continues to migrate should be included. API Publication Number 4741 (2005) notes that for deeper sources (i.e., greater than 10 meters [30 feet] – which is in reasonable agreement with the 35-foot depth modeled in this report), vertical vapor-phase travel times can be on the order of years to decades.

**Response:** Discussion has been added in Section 5.4.3.1.

**Specific Comment #24 - Figure 7 and Figure 8**
Are there contemporaneous groundwater and soil gas data? From what year? Are there co-located (in plan-view) groundwater and soil gas data?

**Response:** Per NDEP's comment, the scatter plots of co-located groundwater and soil gas data were removed.

**Specific Comment #25 - Appendix H, J&E, Groundwater Advanced and Soil Gas Advanced Models.**
Please provide the rationale and reference for adding the Reference Concentration on the Chemical Properties sheet for both models.

**Response:** It was added for convenience but has been removed from the printouts in this report. Examples of the soil gas and groundwater J&E models are included in Appendix Q.

**Specific Comment #26 - Appendix I, Shallow Groundwater Evaluation, Section 1.5, page 1-4.**
The text states that "It is expected that the soil gas sampling will provide a more accurate risk characterization because the samples are collected closer to the receptor. In general, the closer the sampled medium is to the receptor, the more relevant the data are for estimating exposure and greater its weight of evidence (California Environmental Protection Agency [Cal/EPA] 2011)." Please refer to Comment # 10 above.

**Response:** Groundwater modelling results were included in the previous report in Appendix I. As discussed with NDEP, the groundwater results have been updated and moved into the main text as an additional line of evidence. In addition, soil gas samples collected in 2007 within Parcels C and D at a depth of 10 ft bgs have been identified and included in the Parcel C, D and G HRA Report.

**Editorial Comments**

**Specific Comment No. #27 - Page 7, Section 1.4 Geologic and Hydrogeologic Setting**
This section states:

> "Soil types identified in the on-site soil borings include poorly sorted gravel, silty gravel, poorly sorted sand, well sorted sand, and silty sand (ENSR 2005)"

This discussion should tie back to the loamy sand parameter on Table 12. Suggest footnote.

**Response:** Footnote has been added to refer to the text for further discussion of the soil type selection.

**Specific Comment #28 - Page 8, Section 1.4 Geologic and Hydrogeologic Setting, last paragraph, last sentence.**
This statement is not support without reference to technical report. Suggest adding reference.

**Response:** Reference was added.

**Specific Comment #29 – Page 16, Section 2.3 Study Area CSM, third bullet**
This bullet states: "Additional investigation is necessary at the Unit 4 and 5 Buildings to better understand the distribution of chloroform in this area. This work was begun in early 2016 and will continue into 2017."

Yet, on the following page and paragraph the Deliverable states,

> "...nor is there evidence of significant on-Site sources of groundwater contamination." ...."There is no evidence to suggest that soils at the Study Area are acting as a source of groundwater VOC contamination; further, concentrations in soil are not indicative of historic releases of chloroform to soils"

Suggest deleting these statements as there is insufficient data until the site investigation is complete.

**Response:** The Study Area refers to the Parcels, not the Operations area which includes the Unit 4 and 5 Buildings. The text has been changed to clarify this.

**Specific Comment #30 - Page 30, Section 4.2.2 Scatterplots for Co-located Soil Gas and Groundwater Samples**
Although classified as "shallow" groundwater monitoring wells, TR-6 is screened from 60 - 80 ft bgs in the UMCf and TR-8 is screened from 63-93 ft bgs UMCf as compared to M-92 Parcel F) which is screened from 39 - 49 ft bgs. Perhaps this should be noted/considered in discussions correlating groundwater data to soil gas data.

**Response:** As mentioned in response to comment #7, as agreed with NDEP, the groundwater/soil gas comparison has been removed from the report. However, this will be noted in the general discussion.

**Specific Comment #31 - Page 35, Section 5.2.1 Conceptual Site Model**
It should be noted that the nearest resident north - northwest is only 1550 ft away from Parcel D and the nearest resident south is only 500 ft from parcel H.

**Response:** Noted and added to the text.

**Specific Comment #32 - Figure 10 Explanation b**
Please correct the sentence for Explanation b.

**Response:** Corrected the sentence.

**Specific Comment #34 -** Table 10 References
USEPA, 2002. Should be revised to USEPA, 2002b.

**Response:** References have been updated.

## References

Abreu, L., Johnson, P., and McAlary, T. 2006. 3D Model Simulations and Implications to Near Building Sampling. USEPA VI Workshop, AEHS Conference, San Diego, CA. March.

Massmann, J., and D. F. Farrier. 1992. Effects of Atmospheric Pressures on Gas Transport in the Vadose Zone. Water Resources Research, v. 28, n. 3, p. 777 -791.

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

USEPA, 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. Office of Solid Waste and Emergency Response. Publication 9285.7-081. May.

USEPA, 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February.

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

# APPENDIX B
# 2013 SOIL GAS INVESTIGATION REPORT

## CONTENTS

**1. 2013 SOIL GAS FIELD SAMPLING INVESTIGATION 1**
- 1.1 Sampling Locations 1
- 1.2 Sampling Methodology 2
- 1.3 Sample Handling and Chain-of-Custody 2
- 1.4 Analytical Testing 3
- 1.5 Equipment Decontamination 3
- 1.6 Management of Investigation-Derived Waste 3

**2. REFERENCES 4**

## LIST OF TABLES

Table B-1 LOUs Within and Immediately Upgradient of the Study Area Parcels
Table B-2 Soil Gas Probe Construction Details
Table B-3 Summary of Soil Gas Purging and Sampling
Table B-4 Summary of Soil Gas Probe Leak Check
Table B-5 Summary Statistics for 2013 Soil Gas

## LIST OF FIGURES

Figure B-1 LOUs and Chloroform in Shallow Groundwater (2006-2009 Data)
Figure B-2 Study Area and Site Features
Figure B-3 2008 and 2013 Soil Gas Sampling Locations (Chloroform as Depicted in 2010)
Figure B-4 2008 and 2013 Soil Gas Sampling Locations (Chloroform as Depicted in 2015)

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| bgs | below ground surface |
| ENVIRON | ENVIRON International Corporation |
| Exponent | Exponent, Inc. |
| ft | foot, feet |
| HQ | hazard quotient |
| IDW | investigation-derived waste |
| LOU | Letter of Understanding |
| NDEP | Nevada Division of Environmental Protection |
| Northgate | Northgate Environmental Management, Inc. |
| PQL | practical quantitation limit |
| QC | quality control |
| RBC | risk-based concentration |
| SQL | sample quantitation limit |
| USEPA | U.S. Environmental Protection Agency |
| VOC | volatile organic compound |

# 1. 2013 SOIL GAS FIELD SAMPLING INVESTIGATION

This section summarizes the soil gas sampling investigation conducted by ENVIRON International Corporation (ENVIRON) in March 2013; no additional soil gas samples have been collected in the Study Area since that time.

## 1.1 Sampling Locations

The October 2012 draft soil gas investigation work plan (ENVIRON 2012) identified eight locations for collection of 5 feet below ground surface (ft bgs) soil gas samples, as follows: 2 in Parcel C, 1 in Parcel D, 3 in Parcel F, 2 in Parcel G, and none in Parcel H. Factors considered in identifying the sampling locations included: (1) the 2008 soil gas sampling locations within and downgradient of the parcels[1], (2) available analytical results for chloroform concentrations in shallow groundwater beneath and upgradient of the Study Area, (3) direction of groundwater flow, (4) Letters of Understanding (LOUs) at which volatile organic compounds (VOCs) may have been used (Table B-1 and Figure B-1), and (5) VOC results for soil samples collected within the Study Area. The locations of paleochannels, the Olin extraction well field, and the interceptor well field were also considered (Figures B-2, B-3, and B-4). Additionally, samples were located near groundwater wells (Figures B-3 and B-4) that had been analyzed for VOCs during the Phase B investigation or as part of investigations conducted by BMI facilities to the west of the Site. The purpose of locating soil gas samples near groundwater monitoring wells was to provide additional paired results for investigation of the correlation between soil gas and the underlying groundwater concentrations, as initially proposed by Northgate and Exponent (2010) in the 2010 site-wide soil gas Health Risk Assessment.

On January 29, 2013, Nevada Division of Environmental Protection (NDEP) approved the field work and sampling portions of the work plan and recommended collection of one additional sample near M-23 located in Parcel D (NDEP 2013a). This location (E-SG-9, shown on Figures B-3 and B-4) was added to the sampling program and the approved field work was implemented the week of March 4, 2013.

Subsequent to completion of the field work, ENVIRON submitted an expanded work plan to NDEP that included a newly added section describing the risk assessment methodology (ENVIRON 2013). The previously submitted sections of the work plan had been updated to address NDEP's January 29, 2013, comments. NDEP provided comments on the expanded work plan on April 9, 2013, including additional comments on the previously-approved field work (NDEP 2013b). Specifically, NDEP requested sampling at an additional four locations (one in each of Parcels C, F, G, and H). Because the field work had been completed at the time this request was made, these additional samples were not collected. Uncertainty in the soil gas characterization data set is discussed in the main text.

---

[1] The chloroform plume and paleochannels shown on Figures B-1 and B-3 were taken from Northgate 2010. The 2010 depiction of the plume was used to inform selection of sample locations in 2013 since no additional on-site data were available for groundwater VOCs. In 2016, Ramboll ENVIRON updated the chloroform contours considering chloroform groundwater data from the Ramboll Environ 2015 sampling event. Figure B-4 presents the 2008 and 2013 sampling locations overlying the updated chloroform contours.

## 1.2 Sampling Methodology

Nine soil gas samples (E-SG-1 through E-SG-9) were collected at the locations shown on Figures B-3 and B-4. All probes were installed at a depth of 5 ft bgs, using new materials as specified in the March 2013 Work Plan (ENVIRON 2013) and shown in Tables B-2 and B-3. Probes were installed using direct-push tooling as described in the March 2013 Work Plan and no adjustments of probe depth were required during installation. Sampling was conducted in accordance with the March 2013 Work Plan.

Prior to sampling and as part of the leak-check procedure, a shut-in test was performed at each location to confirm the air-tightness of the sampling train. All shut-in tests were completed successfully. In addition, helium gas was used as a leak check compound during purging and sampling. Shroud concentrations ranged from 20.0% to 34.7% and averaged 28.7%. Helium was not detected in the probes with the exception of probe E-SG-1 (2.85%) and E-SG-3 (0.5%); however, the laboratory detections for these samples were 0.0067% and 0.0082%, respectively, indicating that the field detections had not impacted the samples. Helium detections are shown in Table B-4. Once connections were checked, soil gas was withdrawn from the Teflon® tubing using an evacuated purge Summa™ canister connected via a shut-off valve. The first three dead volumes of soil gas were discarded to purge the sample tubing, sand pack, and void space of the dry bentonite in the annular space.

After purging, the soil gas sample was collected in a 1-liter Summa™ canister while monitoring the fill time and the in-line vacuum gauge. The sample fill time and initial and final vacuums were recorded in the field notes. Following sampling, the tubing was pulled from the ground and the surface patched to match surroundings.

ENVIRON was present during drilling and maintained a log of the borings, made observations of the work area conditions, conducted health and safety monitoring of possible organic vapors encountered during drilling, screened and logged soil cores, directed the installation of the soil probes, performed leak testing, and collected and maintained custody of soil gas and field quality control (QC) samples. Field QC samples for this investigation consisted of one duplicate soil gas sample collected at the same time as the primary sample using a T-fitting, and one trip blank sample per sample shipment to the laboratory. Replicate sampling was not performed.

## 1.3 Sample Handling and Chain-of-Custody

Each lot of sampling containers was certified as contaminant-free by the laboratory. Samples were collected, handled, and stored in such a manner that they were representative of their original condition and chemical composition. Summa™ canisters and sample trains identified as having leaks or being incapable of holding a vacuum were not used during sampling and were returned to the laboratory and identified as unused due to leaks.

Identification of samples and maintenance of custody are important elements and were utilized to ensure that samples would be representative of site conditions. All samples were properly identified and maintained under chain-of-custody protocol to protect sample integrity as described in the October 2012 Work Plan.

As samples were shipped to the laboratory, the original chain-of-custody relinquishing the samples was sealed inside a plastic bag within the shipping box and the box was sealed by the last person listed on the chain-of-custody. United States Department of Transportation shipping requirements were followed and the sample shipping receipt was retained in the project files as part of the permanent chain-of-custody document. The shipping company (Federal Express) did not sign the chain-of-custody forms as a receiver; instead the laboratory signed as a receiver when the samples were received.

## 1.4 Analytical Testing

The soil gas and associated QC samples were submitted to McCampbell Analytical, Inc., a qualified licensed analytical laboratory, under chain-of-custody protocol for analysis of VOCs by United States Environmental Protection Agency (USEPA) Method TO-15 and helium on a standard 5-day turn-around time. The laboratory's ability to achieve practical quantitation limits (PQLs) below risk-based concentrations (RBCs) corresponding to either a cancer risk of $1 \times 10^{-6}$ for carcinogens or a hazard quotient (HQ) of 1 for non-carcinogens was confirmed prior to sampling. As part of the data usability evaluation (DUE), the sample quantitation limits (SQLs) for analytes reported as not detected in one or more samples were compared to the RBCs (see Section 4 of the main report).  Table B-5 presents the summary statistics for the 2013 soil gas results.

## 1.5 Equipment Decontamination

Prior to mobilizing the direct-push rig to the Study Area, the rig and all associated equipment were cleaned with a high-pressure, steam washer to remove any oil, grease, mud, tar, and/or other foreign matter. To minimize the potential for cross-contamination, equipment used during the field investigation (including all non-dedicated sampling equipment) was decontaminated after use at each sampling location. Decontamination consisted of a detergent wash (Alconox) followed by a clean water wash, and finally a clean water rinse.

Sample containers, soil gas manifolds, and critical orifice flow controllers with integral particulate filters are dedicated sampling equipment and were received as certified-clean from the laboratory. Materials used for probe construction (tubing, filters, and fittings) were purchased new and not reused.

## 1.6 Management of Investigation-Derived Waste

Solid investigation-derived waste (IDW) was collected in a 5-gallon bucket that was labeled and sealed following completion of field activities. Liquid waste created during decontamination was collected in a 5-gallon bucket and was drained into the GW-11 pond for treatment. Each container was marked with water-proof labels and water-proof markers. Following characterization, each container of material was disposed of as appropriate per federal, state, and local requirements.

# 2. REFERENCES

ENVIRON International Corporation (ENVIRON), 2012. Draft Soil Gas Investigation Work Plan for Parcels C, D, F, G, and H, Nevada Environmental Response Trust Site, Henderson, Nevada. October. NDEP commented January 29, 2013, and approved the field work and sampling.

ENVIRON, 2013. Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels C, D, F, G, and H, Nevada Environmental Response Trust Site, Henderson, Nevada. March 18. NDEP approved April 9, 2013.

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

NDEP, 2013b. NDEP Response to: Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels C, D, F, G, and H, dated March 18, 2013. April 9.

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

## Table B-1. LOUs Within and Directly Upgradient of the Study Area Parcels

Nevada Environmental Response Trust Site
Henderson, Nevada

| Parcel | LOU | | | VOCs Identified as Potential Contaminants?[a] |
|---|---|---|---|---|
| | # | Name | Location | |
| **Parcel C** | 1 | Trade Effluent Settling Ponds | upgradient | VOCs (benzene derivatives) |
| | 10 | On-Site Hazardous Waste Landfill | upgradient | *not identified* |
| | 22 | Pond WC-West and Associated Piping | upgradient | *not identified* |
| | 23 | Pond WC-East and Associated Piping | upgradient | *not identified* |
| | 32 | Groundwater Remediation Unit | upgradient | *not identified* |
| **Parcel D** | 6 | Unnamed Drainage Ditch Segment (BMI Landfill) | within | *not identified* |
| | 68 | Southern Nevada Auto Parts Site (Kerr-McGee tenant) | within | VOCs |
| **Parcel F** | 4 | Former Hardesty Chemical Company Site | upgradient | VOCs (benzene derivatives) |
| | 26 | Trash Storage Area | upgradient | *not identified* |
| | 41 | Unit 1 Tenants - Stains | upgradient | VOCs |
| | 59 | Storm Sewer System | within | *not identified* |
| | 60 | Acid Drain System | upgradient | VOCs |
| | 63 | J.B. Kelley Trucking Inc. Site | within | VOCs |
| | 65(a) | Ebony Construction Sites | upgradient | VOCs |
| | 65(b) | Buckles Construction Company | upgradient | VOCs |
| | 65(c) | Nevada Precast Concrete Products (Kerr-McGee tenant) | within | *not identified*[b] |
| **Parcel G** | 59 | Storm Sewer System | within | *not identified* |
| | 60 | Acid Drain System | within | VOCs |
| | 65(d) | Green Ventures International (Kerr-McGee tenant) | within | *not identified*[b] |
| **Parcel H** | -- | -- | -- | -- |

**Notes:**

-- = No LOU is within or upgradient of the parcel
LOU = Letter of Understanding
VOC = Volatile organic compound

[a] As identified by (1) ENSR and AECOM (2008) based on a review of historical sources and/or (2) NDEP in 2011 (NDEP 2011).

[b] NDEP (2011) lists VOCs as potential contaminants in LOU 65. However, Kleinfelder (1993) reported that LOU 65c and LOU 65d were used only for offices.

**References:**

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

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

Kleinfelder, 1993. Environmental Conditions Assessment, Kerr-McGee Chemical Corporation, Henderson, Nevada. April.

Nevada Division of Environmental Protection (NDEP), 2011. Action Memorandum: Removal Actions, Nevada Environmental Response Trust Site, Clark County, Nevada. July 21.

## TABLE B-2. Soil Gas Probe Construction Details

Nevada Environmental Response Trust Site
Henderson, Nevada

| Location ID | Date Installed | Borehole Diameter (inches) | Total Depth of Boring (feet bgs) | Proposed Probe Depth (feet bgs) | Installed Probe Depth (feet bgs) | Sand Pack Interval (feet bgs) |
|---|---|---|---|---|---|---|
| E-SG-1 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-2 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-3 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-4 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-5 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-6 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-7 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-8 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |
| E-SG-9 | 3/7/2013 | 2.25 | 5.5 | 5.0 | 5.0 | 4.5 - 5.5 |

**Notes:**

ID = identification

feet bgs = feet below ground surface

1/4" outer diameter Teflon-lined tubing with 1" stainless steel sintered filter used in all probe construction.

Cemex Lapis Lustre #3 Monterey sand used for filter pack with hydrated Cetco #8 crumbles used for seal.

## TABLE B-3. Summary of Soil Gas Purging and Sampling

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Location ID | Date Installed | Sample Date | Targeted Probe Depths | Installed Probe Depths | Total Tubing | Stick-Up | Filter Pack Volume[a] | 3X Purge Volume | Volume Purged[b] | PVs | Purge Rate[c] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (feet bgs) | (feet bgs) | (feet) | (feet) | (ml) | (ml) | (ml) | | (ml/min) |
| E-SG-1 | 3/7/2013 | 3/8/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 150 |
| E-SG-2 | 3/7/2013 | 3/7/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 200 |
| E-SG-3 | 3/7/2013 | 3/7/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 200 |
| E-SG-4 | 3/7/2013 | 3/13/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 150 |
| E-SG-5 | 3/7/2013 | 3/13/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 150 |
| E-SG-6 | 3/7/2013 | 3/8/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 200 |
| E-SG-7 | 3/7/2013 | 3/8/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 150 |
| E-SG-8 | 3/7/2013 | 3/13/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 150 |
| E-SG-9 | 3/7/2013 | 3/8/2013 | 5.0 | 5.0 | 7.0 | 2.0 | 273 | 989 | 1000 | 3.0 | 150 |

**Notes:**

ID = identification

feet bgs = feet below ground surface

ml= milliliter

ml/min = milliliter per minute

PV = purge volume

[a] Filter pack volume includes dry bentonite above sand pack. Thirty percent porosity assumed.

[b] All samples were purged with Summa™ purge can.

[c] Critical orifice supplied from the lab rated to between 150-200 ml/min. A rotameter attached to the purge can was used to measure the actual purge rate.

## TABLE B-4: Summary of Soil Gas Probe Leak Checking[a]
**Nevada Environmental Response Trust Site**
**Henderson, Nevada**

| Location ID | Sample Date | Shut-in Test | Helium Concentration in Shroud | | | Helium Concentration in Probe | | | Lab Detection | % of Shroud Concentration[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Pre-Sampling | Post-Sampling | Average | Pre-Sampling | Post-Sampling | Average | | |
| E-SG-1 | 3/8/2013 | PASSED | 35.0 | 20.0 | 27.5 | 3.3 | 2.4 | 2.85 | 0.0067 | 0.024 |
| E-SG-2 | 3/7/2013 | PASSED | 21.8 | 27.2 | 24.5 | ND<0.1 | ND<0.1 | ND<0.1 | 0.0081 | 0.033 |
| E-SG-3 | 3/7/2013 | PASSED | 30.0 | 30.0 | 30.0 | 0.1 | ND<0.1 | 0.5 | 0.0082 | 0.027 |
| E-SG-4 | 3/13/2013 | PASSED | 30.5 | 38.9 | 34.7 | ND<0.1 | ND<0.1 | ND<0.1 | 0.010 | 0.029 |
| E-SG-5 | 3/13/2013 | PASSED | 28.1 | 33.2 | 30.7 | ND<0.1 | ND<0.1 | ND<0.1 | 0.0071 | 0.023 |
| E-SG-6 | 3/8/2013 | PASSED | 29.6 | 30.3 | 30.0 | ND<0.1 | ND<0.1 | ND<0.1 | 2.0 | 6.7 |
| E-SG-6-FD | 3/8/2013 | PASSED | 29.6 | 30.3 | 30.0 | ND<0.1 | ND<0.1 | ND<0.1 | 0.076 | 0.25 |
| E-SG-7 | 3/8/2013 | PASSED | 24.4 | 18.3 | 21.4 | ND<0.1 | ND<0.1 | ND<0.1 | ND<0.005 | 0.023 |
| E-SG-8 | 3/13/2013 | PASSED | 31.6 | 31.5 | 31.6 | ND<0.1 | ND<0.1 | ND<0.1 | 0.012 | 0.038 |
| E-SG-9 | 3/8/2013 | PASSED | 31.0 | 21.9 | 26.5 | ND<0.1 | ND<0.1 | ND<0.1 | ND<0.005 | 0.019 |

**Notes:**

ID = identification

FD = field duplicate

ND = not detected above sample quantitation limit

[a] All values are reported in %.

[b] The sample quantitation limit (SQL) was used for samples that were not detected in the lab.

### TABLE B-5. Summary Statistics for 2013 Soil Gas

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| Acetone | μg/m$^3$ | 11 | 11 | 100 | -- | -- | 6.2 | 67 | 13 | 18 | 18 | 0.96 | E-SG-6 |
| Acrylonitrile | μg/m$^3$ | 11 | 0 | 0 | 0.1 | 0.12 | -- | -- | -- | -- | -- | -- | -- |
| t-Amyl methyl ether | μg/m$^3$ | 11 | 1 | 9.09 | 0.076 | 0.08 | 0.78 | 0.78 | 0.78 | 0.78 | -- | -- | E-SG-6 |
| Benzene | μg/m$^3$ | 11 | 11 | 100 | -- | -- | 1.4 | 12 | 2 | 3.5 | 3.8 | 1.1 | E-SG-2 |
| Benzyl chloride | μg/m$^3$ | 11 | 2 | 18.18 | 0.068 | 0.071 | 0.14 | 0.43 | 0.29 | 0.29 | 0.21 | 0.72 | E-SG-6 |
| Bromodichloromethane | μg/m$^3$ | 11 | 7 | 63.64 | 0.1 | 0.1 | 0.3 | 1.7 | 1.2 | 1 | 0.49 | 0.48 | E-SG-6 |
| Bromoform | μg/m$^3$ | 11 | 0 | 0 | 2.2 | 2.7 | -- | -- | -- | -- | -- | -- | -- |
| Bromomethane | μg/m$^3$ | 11 | 4 | 36.36 | 0.2 | 0.21 | 0.33 | 0.84 | 0.36 | 0.47 | 0.25 | 0.52 | E-SG-6 |
| 1,3-Butadiene | μg/m$^3$ | 11 | 0 | 0 | 0.28 | 0.44 | -- | -- | -- | -- | -- | -- | -- |
| 2-Butanone | μg/m$^3$ | 11 | 11 | 100 | -- | -- | 3.2 | 9.9 | 4.9 | 5.5 | 2.2 | 0.39 | E-SG-6 |
| Carbon disulfide | μg/m$^3$ | 11 | 0 | 0 | 0.042 | 0.051 | -- | -- | -- | -- | -- | -- | -- |
| Carbon tetrachloride | μg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.3 | 110 | 18 | 32 | 39 | 1.2 | E-SG-4 |
| Chlorobenzene | μg/m$^3$ | 11 | 8 | 72.73 | 0.07 | 0.07 | 0.12 | 17 | 0.86 | 3.7 | 6 | 1.6 | E-SG-2 |
| Chloroethane | μg/m$^3$ | 11 | 2 | 18.18 | 0.076 | 0.092 | 100 | 140 | 120 | 120 | 28 | 0.24 | E-SG-3 |
| Chloroform | μg/m$^3$ | 11 | 11 | 100 | -- | -- | 2.2 | 2,900 | 460 | 921 | 1,130 | 1.2 | E-SG-3 |
| Chloromethane | μg/m$^3$ | 11 | 0 | 0 | 0.022 | 0.027 | -- | -- | -- | -- | -- | -- | -- |
| Cyclohexane | μg/m$^3$ | 11 | 4 | 36.36 | 0.18 | 73 | 0.6 | 4.9 | 4.8 | 3.8 | 2.1 | 0.56 | E-SG-1 |
| 1,2-Dibromo-3-chloropropane | μg/m$^3$ | 11 | 2 | 18.18 | 0.2 | 0.21 | 0.41 | 1.7 | 1.1 | 1.1 | 0.91 | 0.86 | E-SG-6 |
| Dibromochloromethane | μg/m$^3$ | 11 | 1 | 9.09 | 0.11 | 0.11 | 1.2 | 1.2 | 1.2 | 1.2 | -- | -- | E-SG-6 |
| 1,2-Dibromoethane | μg/m$^3$ | 11 | 1 | 9.09 | 0.096 | 0.1 | 1.4 | 1.4 | 1.4 | 1.4 | -- | -- | E-SG-6 |
| 1,2-Dichlorobenzene | μg/m$^3$ | 11 | 5 | 45.45 | 0.15 | 0.15 | 1.5 | 6.1 | 2.7 | 3.1 | 1.8 | 0.59 | E-SG-2 |
| 1,3-Dichlorobenzene | μg/m$^3$ | 11 | 3 | 27.27 | 0.1 | 0.13 | 0.12 | 38 | 13 | 17 | 19 | 1.1 | E-SG-2 |
| 1,4-Dichlorobenzene | μg/m$^3$ | 11 | 5 | 45.45 | 0.18 | 0.18 | 0.94 | 10 | 1.3 | 3.6 | 3.8 | 1.1 | E-SG-2 |
| Dichlorodifluoromethane | μg/m$^3$ | 11 | 11 | 100 | -- | -- | 1.5 | 2.6 | 2.1 | 2 | 0.4 | 0.2 | E-SG-3 |
| 1,1-Dichloroethane | μg/m$^3$ | 11 | 4 | 36.36 | 0.82 | 0.82 | 1 | 330 | 150 | 160 | 179 | 1.2 | E-SG-2 |
| 1,2-Dichloroethane | μg/m$^3$ | 11 | 6 | 54.55 | 0.09 | 0.09 | 0.11 | 33 | 0.51 | 10 | 15 | 1.5 | E-SG-3 |
| 1,1-Dichloroethene | μg/m$^3$ | 11 | 2 | 18.18 | 0.04 | 0.048 | 13 | 33 | 23 | 23 | 14 | 0.61 | E-SG-2 |
| cis-1,2-Dichloroethene | μg/m$^3$ | 11 | 3 | 27.27 | 0.068 | 0.068 | 0.32 | 2.3 | 0.89 | 1.2 | 1 | 0.87 | E-SG-2 |
| trans-1,2-Dichloroethene | μg/m$^3$ | 11 | 4 | 36.36 | 0.064 | 0.064 | 0.069 | 2.2 | 1.5 | 1.3 | 1 | 0.76 | E-SG-3 |
| 1,2-Dichloropropane | μg/m$^3$ | 11 | 3 | 27.27 | 0.11 | 0.12 | 0.12 | 1.4 | 1 | 0.84 | 0.65 | 0.78 | E-SG-3 |
| cis-1,3-Dichloropropene | μg/m$^3$ | 11 | 1 | 9.09 | 0.08 | 0.084 | 0.75 | 0.75 | 0.75 | 0.75 | -- | -- | E-SG-6 |
| trans-1,3-Dichloropropene | μg/m$^3$ | 11 | 1 | 9.09 | 0.24 | 0.25 | 0.68 | 0.68 | 0.68 | 0.68 | -- | -- | E-SG-6 |
| Diisopropyl ether | μg/m$^3$ | 11 | 0 | 0 | 0.058 | 0.07 | -- | -- | -- | -- | -- | -- | -- |
| 1,4-Dioxane | μg/m$^3$ | 11 | 1 | 9.09 | 0.096 | 0.1 | 0.64 | 0.64 | 0.64 | 0.64 | -- | -- | E-SG-6 |
| Ethyl benzene | μg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.5 | 4.4 | 0.79 | 1.2 | 1.1 | 0.92 | E-SG-4 |

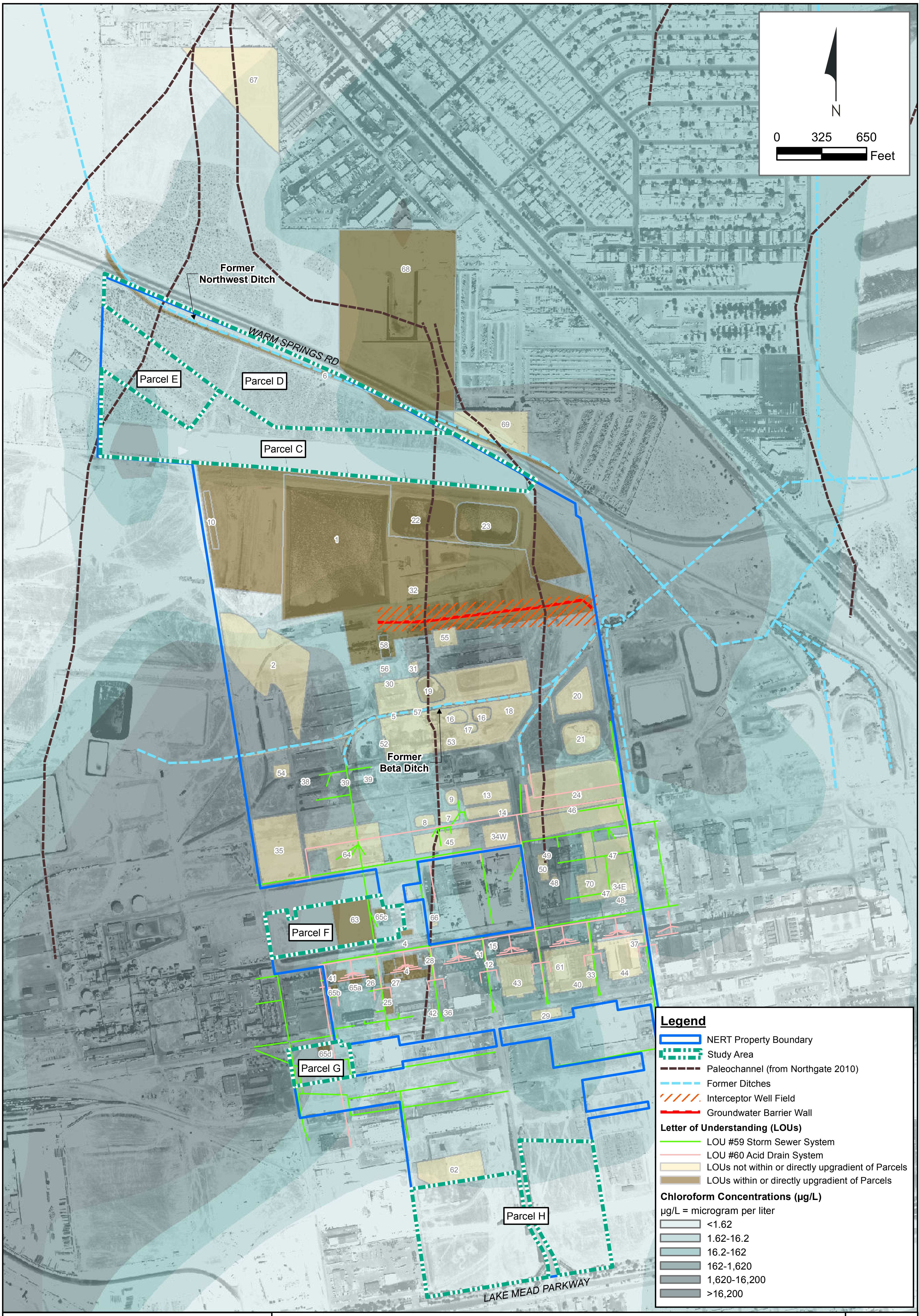
## TABLE B-5. Summary Statistics for 2013 Soil Gas
### Nevada Environmental Response Trust Site
### Henderson, Nevada

| Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| Ethyl acetate | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.75 | 14 | 2.5 | 5 | 5 | 1 | E-SG-1 |
| 4-Ethyltoluene | µg/m$^3$ | 11 | 2 | 18.18 | 1 | 1.2 | 1.2 | 3.1 | 2.1 | 2.1 | 1.3 | 0.62 | E-SG-4 |
| Freon 114 | µg/m$^3$ | 11 | 2 | 18.18 | 0.16 | 0.16 | 0.25 | 1.4 | 0.82 | 0.82 | 0.81 | 0.99 | E-SG-6 |
| n-Heptane | µg/m$^3$ | 11 | 9 | 81.82 | 0.074 | 0.077 | 0.91 | 2.4 | 1.7 | 1.7 | 0.63 | 0.37 | E-SG-3 |
| Hexachlorobutadiene | µg/m$^3$ | 11 | 5 | 45.45 | 0.14 | 0.14 | 0.33 | 7.1 | 2.1 | 2.9 | 2.7 | 0.93 | E-SG-9 |
| n-Hexane | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.95 | 6100 | 2.3 | 557 | 1840 | 3.3 | E-SG-6 |
| 2-Hexanone | µg/m$^3$ | 11 | 7 | 63.64 | 0.22 | 0.23 | 0.52 | 2.3 | 0.7 | 0.97 | 0.64 | 0.66 | E-SG-6 |
| Methyl tert-butyl ether | µg/m$^3$ | 11 | 0 | 0 | 0.096 | 0.89 | -- | -- | -- | -- | -- | -- | -- |
| 4-Methyl-2-pentanone | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.77 | 7.2 | 1.9 | 2.3 | 1.9 | 0.82 | E-SG-2 |
| Methylene Chloride | µg/m$^3$ | 11 | 3 | 27.27 | 0.078 | 0.7 | 2.9 | 19 | 14 | 12 | 8.2 | 0.69 | E-SG-2 |
| Naphthalene | µg/m$^3$ | 11 | 10 | 90.91 | 0.42 | 0.42 | 0.89 | 5.2 | 1.3 | 1.8 | 1.3 | 0.73 | E-SG-6 |
| Styrene | µg/m$^3$ | 11 | 4 | 36.36 | 0.05 | 0.052 | 0.098 | 0.74 | 0.26 | 0.34 | 0.28 | 0.82 | E-SG-6 |
| 1,1,1,2-Tetrachloroethane | µg/m$^3$ | 11 | 1 | 9.09 | 0.15 | 0.16 | 1.1 | 1.1 | 1.1 | 1.1 | -- | -- | E-SG-6 |
| 1,1,2,2-Tetrachloroethane | µg/m$^3$ | 11 | 2 | 18.18 | 0.072 | 0.075 | 0.14 | 1.1 | 0.62 | 0.62 | 0.68 | 1.1 | E-SG-6 |
| Tetrachloroethene | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 1.2 | 1,100 | 15 | 155 | 337 | 2.2 | E-SG-3 |
| Tetrahydrofuran | µg/m$^3$ | 11 | 0 | 0 | 1.2 | 1.4 | -- | -- | -- | -- | -- | -- | -- |
| Toluene | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.77 | 15 | 5.7 | 6.7 | 5.2 | 0.78 | E-SG-1 |
| 1,2,4-Trichlorobenzene | µg/m$^3$ | 11 | 4 | 36.36 | 0.22 | 0.22 | 0.47 | 79 | 5.5 | 23 | 38 | 1.7 | E-SG-2 |
| 1,1,1-Trichloroethane | µg/m$^3$ | 11 | 2 | 18.18 | 0.092 | 0.096 | 0.12 | 1 | 0.56 | 0.56 | 0.62 | 1.1 | E-SG-6 |
| 1,1,2-Trichloroethane | µg/m$^3$ | 11 | 4 | 36.36 | 0.1 | 0.1 | 0.19 | 21 | 4.6 | 7.6 | 9.6 | 1.3 | E-SG-3 |
| Trichloroethene | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.34 | 570 | 3.5 | 81 | 173 | 2.1 | E-SG-2 |
| Trichlorofluoromethane | µg/m$^3$ | 11 | 7 | 63.64 | 1.1 | 1.2 | 1.2 | 48 | 1.7 | 8.5 | 17 | 2 | E-SG-4 |
| 1,2,4-Trimethylbenzene | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.44 | 3.2 | 0.68 | 1.1 | 0.91 | 0.8 | E-SG-4 |
| 1,3,5-Trimethylbenzene | µg/m$^3$ | 11 | 4 | 36.36 | 0.15 | 0.16 | 0.3 | 1.2 | 0.89 | 0.82 | 0.41 | 0.51 | E-SG-6 |
| Vinyl acetate | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 1.8 | 10 | 3 | 3.9 | 2.5 | 0.63 | E-SG-6 |
| Vinyl chloride | µg/m$^3$ | 11 | 3 | 27.27 | 0.12 | 0.12 | 0.4 | 4.4 | 2.3 | 2.4 | 2 | 0.85 | E-SG-2 |
| Xylenes (total) | µg/m$^3$ | 11 | 10 | 90.91 | 2.6 | 2.6 | 2.9 | 21 | 3.7 | 5.6 | 5.5 | 0.98 | E-SG-4 |
| Ethyl tert-butyl ether | µg/m$^3$ | 11 | 1 | 9.09 | 0.084 | 0.088 | 0.82 | 0.82 | 0.82 | 0.82 | -- | -- | E-SG-6 |
| tert Butyl alcohol | µg/m$^3$ | 11 | 11 | 100 | -- | -- | 0.92 | 4.8 | 2 | 2.3 | 1.1 | 0.47 | E-SG-6 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | µg/m$^3$ | 11 | 0 | 0 | 1.6 | 1.9 | -- | -- | -- | -- | -- | -- | -- |

**Notes:**

-- = not available

µg/m$^3$ = microgram per cubic meter



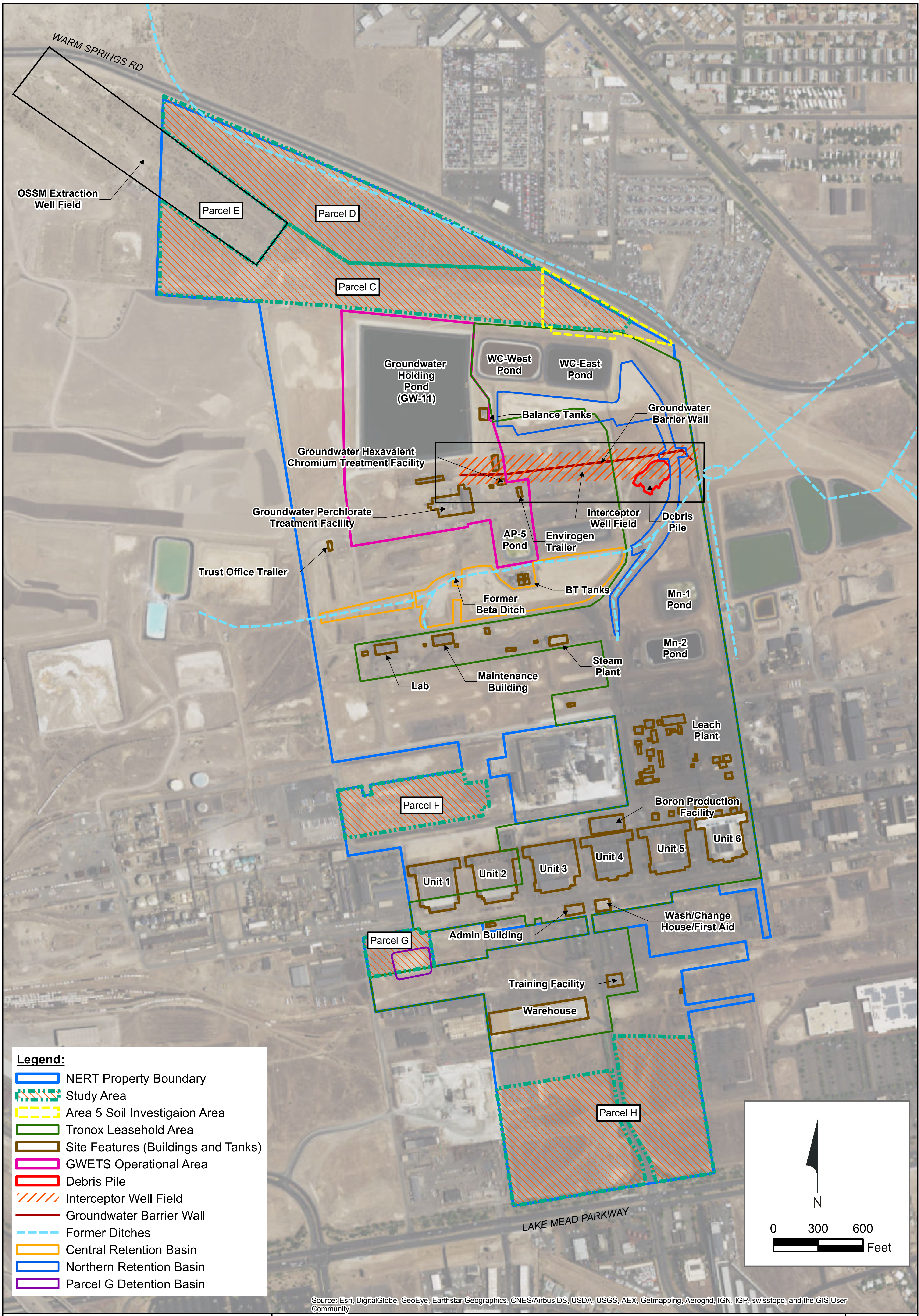
Path: H:\LePetomane\NERT\Leasehold_Offsite Operations\GIS\G01_LOUs_ParcelsC-H.mxd

RAMBOLL ENVIRON

**LOUs and Chloroform in Shallow Groundwater**
**(Chloroform Plume as Depicted in 2010)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**B-1**

Drafter: EA/RS Date: 9/21/2016 Contract Number: 21-41400A Approved by: Revised:



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Path: H:\LePetomane\NERT\Leasehold_Offsite Operations\GIS\G01_Fig2_SiteFeatures-2.mxd

RAMBOLL ENVIRON

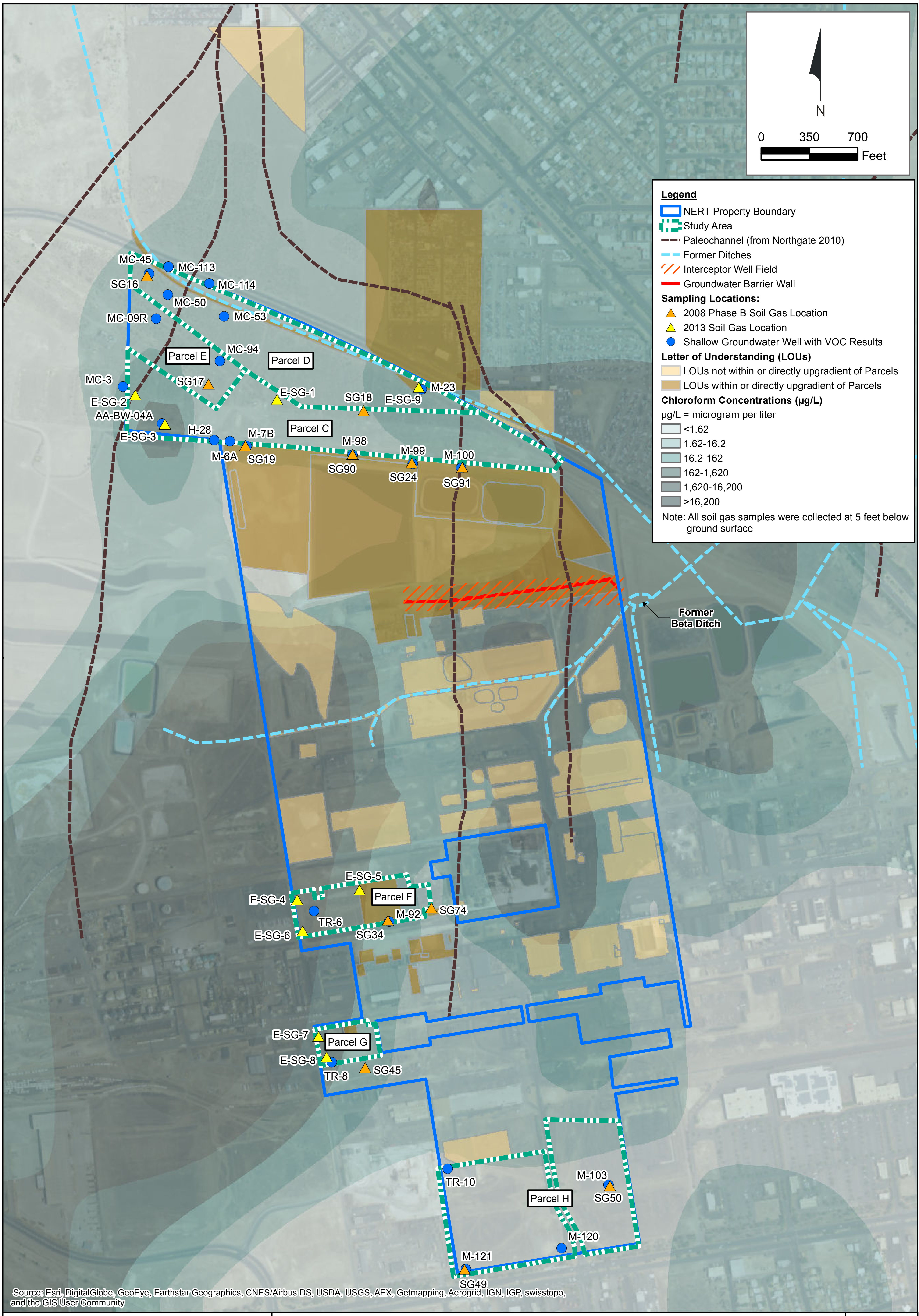
**Study Area and Site Features**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**B-2**

Drafter: EA/RS Date: 9/19/2016 Contract Number: 21-41400A Approved by: Revised:



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

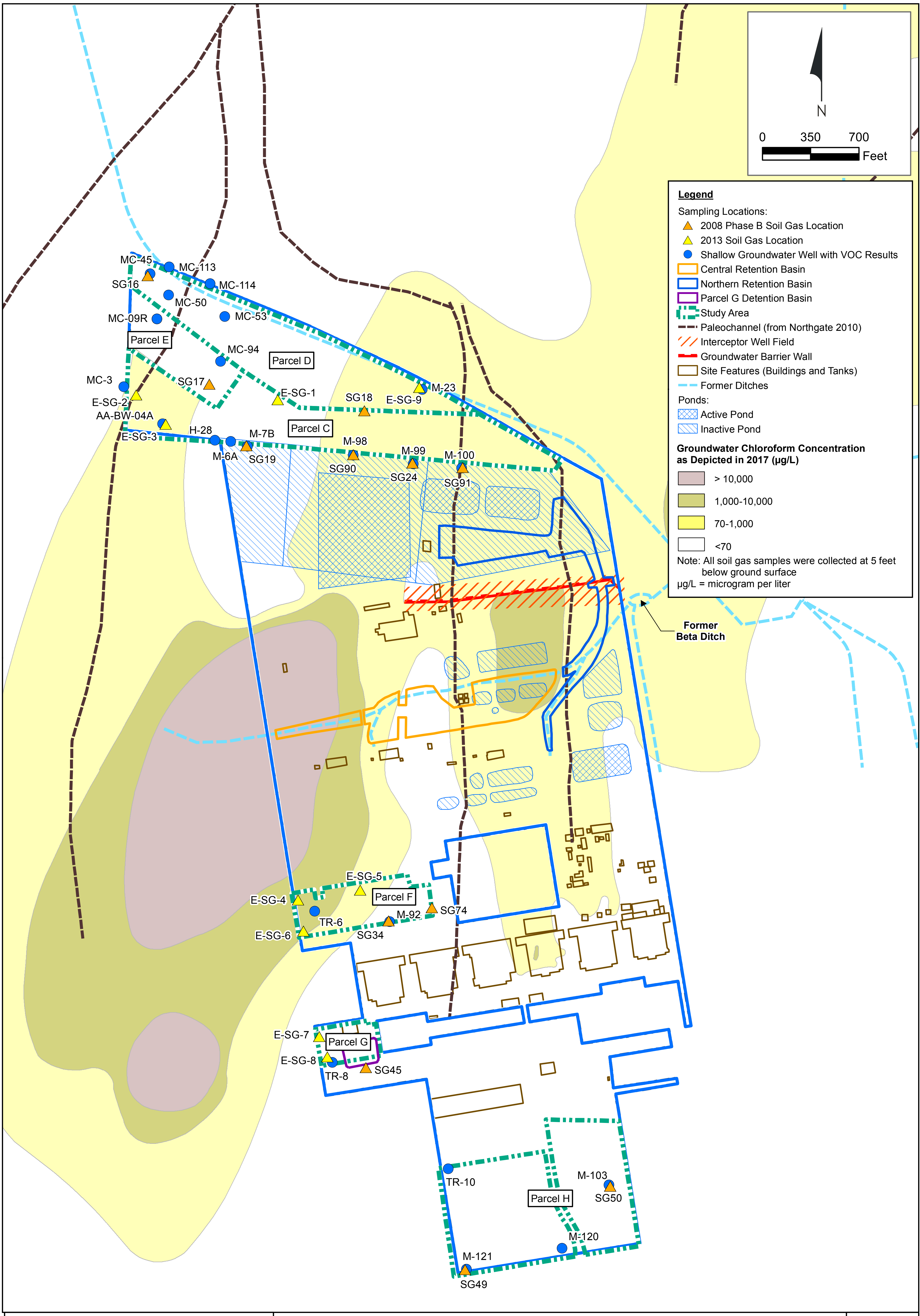
Path: H:\LePetomane\NERT\Leasehold_Offsite Operations\GIS\G01_Parcel_C-H_Samploc-HRA1.mxd

RAMBOLL ENVIRON

**2008 and 2013 Soil Gas Sampling Locations**
**(Chloroform Plume as Depicted in 2010)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**B-3**

Drafter: RS Date: 9/19/2016 Contract Number: 21-41400A Approved by: Revised:



Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Parcel F\Appendices\App B 2013 SG Investigation\FigureB-4.mxd

RAMBOLL ENVIRON

**2008 and 2013 Soil Gas Sampling Locations (Chloroform Plume as Depicted in 2017)**
Nevada Environmental Response Trust Site, Henderson, Nevada

Drafter: RS Date: 11/21/2017 Contract Number: 21-38800A Approved by: Revised:

Figure
**B-4**

# APPENDIX C
# REMOVAL ACTION WORKPLAN FOR SOIL, TRONOX PARCELS "C", "D", "F", "G", AND "H" SITES

Basic Environmental
COMPANY

July 1, 2008

Ms. Shannon Harbour, P.E.
Nevada Division of Environmental Protection
Bureau of Corrective Actions
2030 E. Flamingo Road, Suite 230
Las Vegas, Nevada 89119-0818

**Subject: Removal Action Workplan for Soil, Tronox Parcels “C”, “D”, “F”, “G” and “H” Sites, Henderson, Nevada**

Dear Shannon:

On behalf of Tronox, Basic Environmental Company (BEC) appreciates the opportunity to submit this Removal Action Workplan (RAW) to address the remediation of impacted soil at the Tronox Parcels “C”, “D”, “F”, “G” and “H”. These Sites are located within the Tronox facility, north of Lake Mead Parkway, one mile west of the intersection with Boulder Highway, in Henderson, Nevada. Figure 1 illustrates the location of the subject Sites within the Tronox property.

The conclusion that remediation of soil at each of the Sites is needed is based on the findings of the field investigations carried out in accordance to each of the NDEP-approved Phase 2 Sampling and Analysis Plans. The overall goal of this RAW is to present a cleanup strategy for each of the Sites that effectively reduces, to the extent feasible, the human health risks associated with the identified soil in the impacted areas of each Site. . As with prior work on Parcels A and B, NDEP has indicated that a target risk of one in a million excess cancers will be utilized to guide remediation. Preliminary risk summary tables for each of the Parcels were presented and discussed with NDEP, Tronox and AIG in a meeting at the NDEP offices May 15, 2008. All proposed remediation work will be completed under the direction of a State of Nevada Certified Environmental Manager. Discussion on the proposed remediation at each of the Sites is presented below.

## **Parcels C and D**

Results of the Phase 2 field investigation indicate the presence of amphibole (one or more long fibers) and/or chrysotile (four or more long fibers) at four locations within Parcels C and D, as well as elevated levels of dioxins/furans (above the Agency for Toxic Substances and Disease Registry [ATSDR] action level of 1.0 parts per billion) at one location. Based on the sample locations across the Site, a Thiessen or Voronoi map was overlaid across the Site.

Voronoi maps are constructed from a series of polygons formed around each sample location. Voronoi polygons are created so that every location within a polygon is closer to the sample location in that polygon than any other sample location. These polygons do not take into account the respective concentrations at each sample location.

These polygons were used as the basis for the areal extent of remediation for each of the locations with elevated asbestos levels. Those polygons associated with elevated asbestos levels proposed for remediation are shown on Figure 2. At two sample locations, the size of the remediation polygon area is large. This area could be reduced by the placement of two additional sample locations (shown on Figure 2) and it is our intent to collect these additional samples. If these sample locations are clean, then the reduced polygon shown on Figure 2 would be the remediation area. However, if one or both have elevated levels of asbestos, then the areal extent for remediation would be the original polygon(s) size.

One exception to the use of these polygons for the extent of asbestos remediation is the sample location in Parcel D, TSB-DR-04, which is situated within a drainage ditch. Two supplemental samples were collected approximately 100 feet to either side of this sample, along the ditch. Results of these sample locations were considered clean, therefore, the extent of the proposed remediation for sample location TSB-DR-04 is half the distance to each of these two supplemental samples, and bounded by the extent of the ditch in the other two directions.

Because the extent of impact associated with the sample location with elevated dioxins/furans is likely to be small, the remediation area is based on a 50-foot square area around this sample location (TSB-CR-07). The total areal extent of remediation at Parcels C and D ranges from 2.6 to 3.7 acres, depending on whether the additional samples are collected, and their results.

## Parcel F

Results of the Phase 2 field investigation indicate the presence of amphibole (one or more long fibers) and/or chrysotile (four or more long fibers) at eight locations within Parcel F, as well as several other chemicals at three of these locations. Based on the sample locations across the Site, a Thiessen or Voronoi map was overlaid across the Site. These polygons were used as the basis for the areal extent of remediation for each of the locations with elevated asbestos levels. Those polygons associated with elevated contaminant levels in surface soil (results for deep soil samples are pending) proposed for remediation are shown on Figure 3. The total areal extent of remediation at Parcel F is 3.8 acres.

## Parcel G

Results of the Phase 2 field investigation indicate the presence of amphibole (one or more long fibers) at two locations within Parcel G, as well as elevated levels of benzo(a)pyrene (above the USEPA Region 6 MSSL) at one location.. Based on the sample locations across the Site, a Thiessen or Voronoi map was overlaid across the Site. These polygons were used as the basis for the areal extent of remediation for each of the locations with elevated asbestos and benzo(a)pyrene levels. Those polygons associated with elevated levels in surface soil (results for deep soil samples are pending) proposed for remediation are shown on Figure 4. The total areal extent of remediation at Parcel G is 1.3 acres.

## Parcel H

Results of the Phase 2 field investigation indicate the presence of amphibole (one or more long fibers) and/or chrysotile (four or more long fibers) at two locations within Parcel H. Based on the sample locations across the Site, a Thiessen or Voronoi map was overlaid across the Site. These polygons were used as the basis for the areal extent of remediation for each of the locations with elevated asbestos levels. Those polygons associated with elevated asbestos levels proposed for remediation are shown on Figure 5. At one sample location, the size of the remediation polygon area is large. This area could be reduced by the placement of two additional sample locations (shown on Figure 5) and it is our intent to collect these additional samples. If these sample locations are clean, then the reduced polygon shown on Figure 5 would be the remediation area. However, if one or both have elevated levels of asbestos, then the areal extent for remediation would be increased appropriately. The total areal extent of remediation at Parcel H ranges from 0.55 to 2.1 acres, depending on whether the additional samples are collected, and their results.

## Confirmation Sampling

Following remediation confirmation sampling will be conducted at each of the original sample locations. Field activities will be conducted in accordance with applicable standard operating procedures (SOPs; BRC, ERM and MWH 2007). The BRC Quality Assurance Project Plan (QAPP; BRC and ERM 2008) and Health and Safety Plan (HASP; BRC and MWH 2005) prepared for the BMI Common Areas will be used for confirmation soil sampling.

For each location, the proposed analyte list is composed of those chemicals that triggered the remediation at that location. Collectively, the analytes set includes; polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dioxins/furans, metals and asbestos.

Following collection and analysis of confirmation soil samples, the data will be discussed with the NDEP. If results are considered acceptable, a risk assessment will be conducted to evaluate the potential risks to future on-site human receptors at each Site. The receptors identified to be evaluated in the risk assessment will be consistent with the proposed development of each Site.

## Schedule

Once final approval of the RAW is received from NDEP, field implementation activities can commence within one week. BEC will provide NDEP with at least two days notice prior to the initiation of field activities at the Site. It is anticipated that this work can be completed within one week, depending on field conditions. The confirmation soil samples will be submitted to the laboratories and placed on a standard turn around time. A report will be completed within three weeks after the final data are received from the laboratory and validated.

## Closing Remarks

See attached for appropriate certification language and signature. Please direct any remaining questions or comments you may have to me at 626-382-0001.

Sincerely,

Basic Environmental Company

Ranajit Sahu

Ranajit Sahu, CEM
Project Manager

cc: Brian Rakvica, NDEP, BCA, Las Vegas, NV 89119
Jim Najima, NDEP, BCA, Carson City, NV 89701

Attachments: Figure 1 – Tronox/BEC Parcel Map with Tronox Source Areas
Figure 2 – Remediation Areas – Parcels “C” and “D”
Figure 3 – Remediation Areas – Parcel “F”
Figure 4 – Remediation Areas – Parcel “G”
Figure 5 – Remediation Areas – Parcel “H”

## References

Basic Remediation Company (BRC) and MWH. 2005. BRC Health and Safety Plan, BMI Common Areas, Clark County, Nevada. October.

Basic Remediation Company (BRC), ERM, and MWH. 2007. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. August.

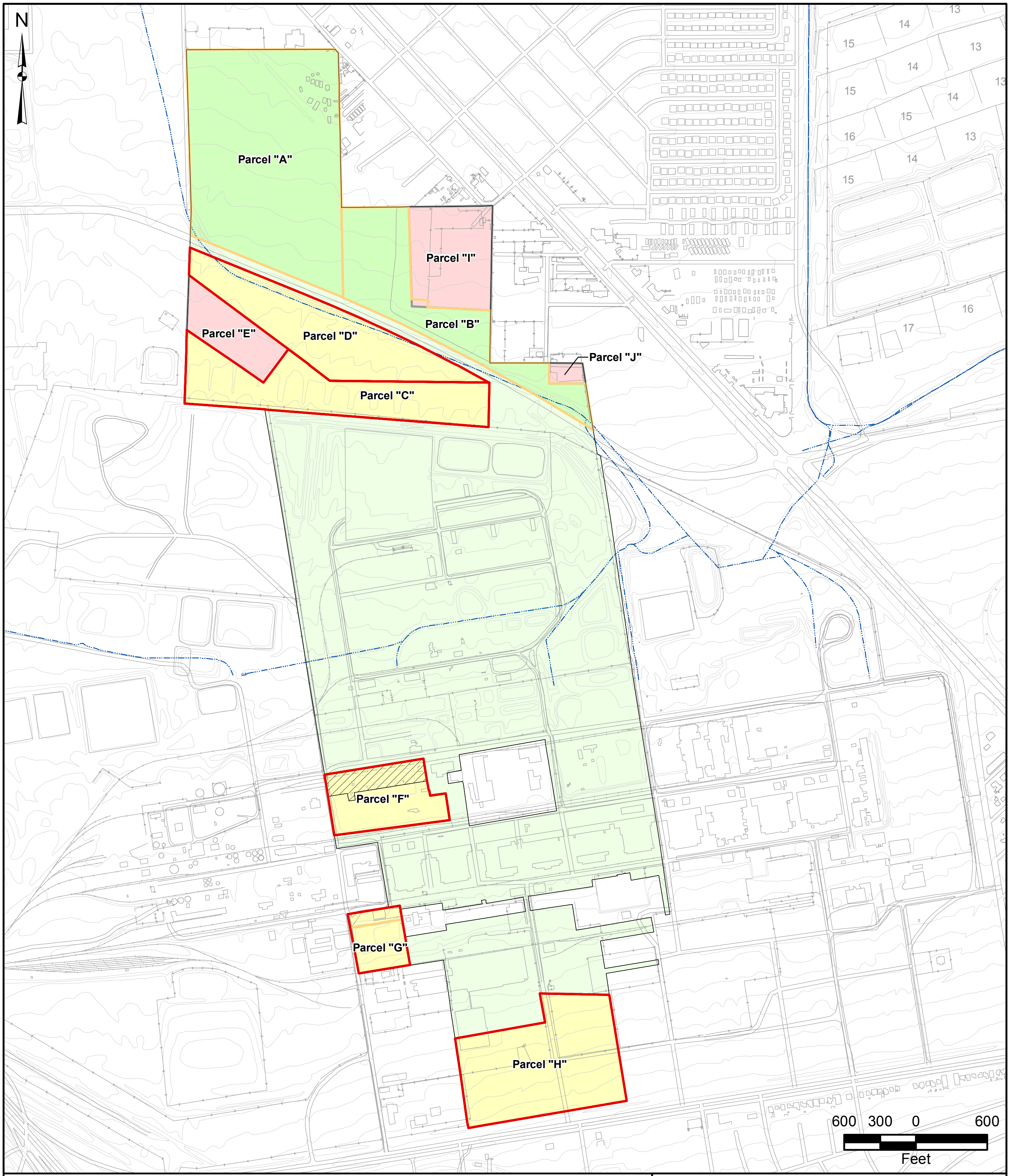
Basic Remediation Company (BRC) and ERM. 2008. BRC Quality Assurance Project Plan. BMI Common Areas, Clark County, Nevada. April.

---

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. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

Ranajit Sahu July 1, 2008

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2009) Date
BRC Project Manager



🟩 Tronox Property

Historical Ditches

**Tronox/BEC Parcels**

23

🟨 Parcels included in this RAW

24

🟩 NFA previously obtained

🟥 NFA to be obtained later

▨ TIMET NFA Area

Removal Action Workplan for Soil
Tronox Parcels "C", "D", "F", "G" and "H"

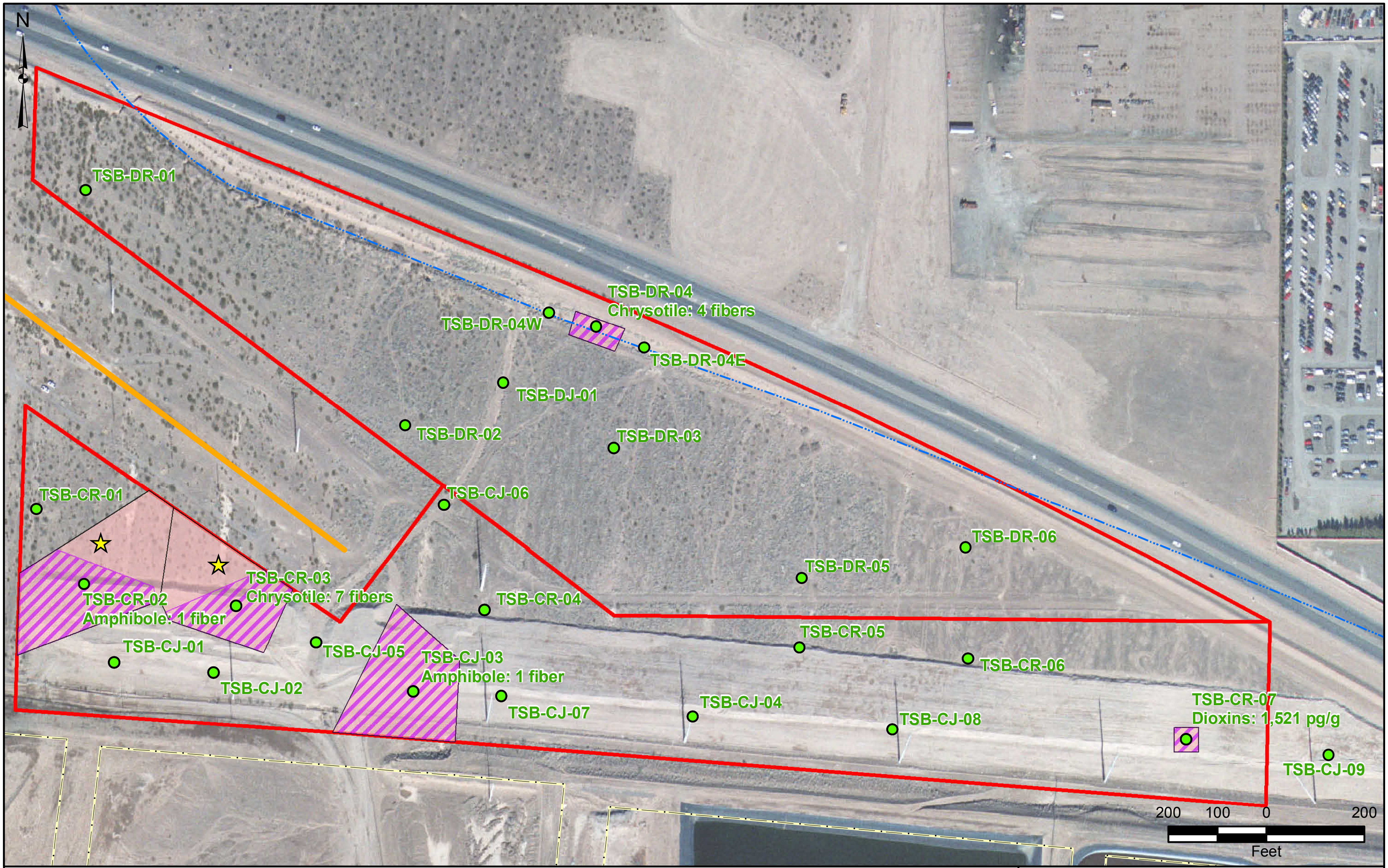
FIGURE 1

TRONOX/BEC
PARCEL MAP

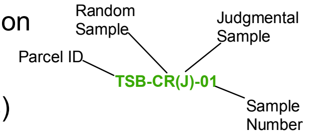
Basic Environmental
COMPANY

ERM

| Prepared by: | Date | JOB No. 0069073 |
|---|---|---|
| MKJ | 07/01/08 | FILE: GIS/BEC/TRONOX/FIGURE_1.MXD |



- 🟥 Parcel Boundaries
- ▭ Historical Effluent Ponds
- ━ Pioneer/Montrose GW Treatment System
- ‐·‐ Historical Northwestern Ditch
- ☆ Additional Asbestos Sample Location
- ● Sampling Location
- ■ Proposed Scrape Areas (3.7 Acres)
- ▨ Scrape Area with 2 Extra Pts (2.6 Acres)



January 2008 Aerial from AeroTech Mapping.

Removal Action Workplan for Soil
Tronox Parcels “C”, “D”, “F”, “G” and “H”

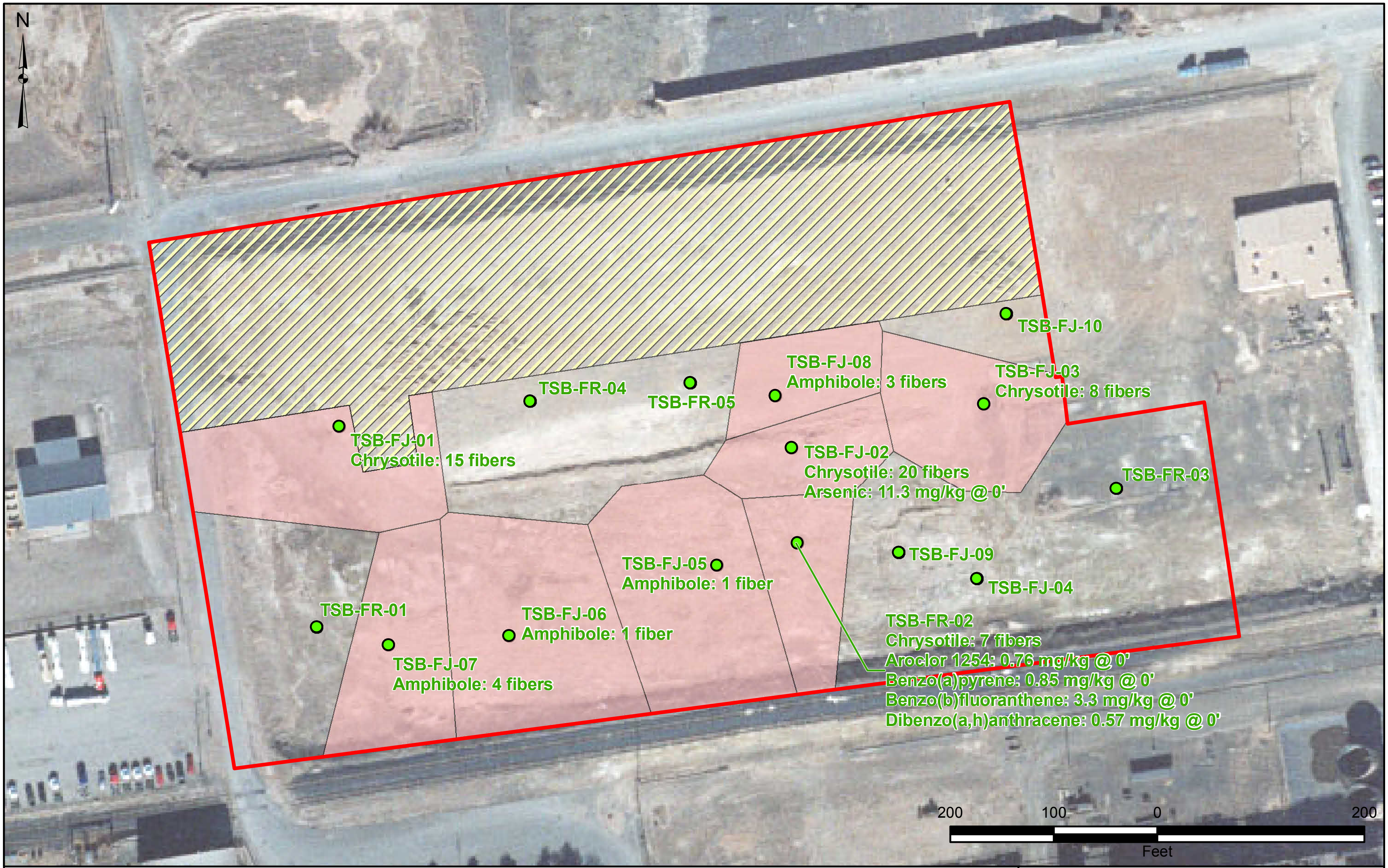
## FIGURE 2

## REMEDIATION AREAS
## PARCELS "C" AND "D"

Basic Environmental
COMPANY

ERM

| Prepared by: | Date | |
|---|---|---|
| MKJ | 07/01/08 | JOB No. 0069073<br>FILE: GIS/BEC/TRONOX/FIGURE_2.MXD |



| | | | |
|---|---|---|---|
| ☐ | Parcel F Boundary | ● | Sampling Location |
| ▨ | TIMET NFA Area | 🟥 | Proposed Scrape Areas (3.8 Acres) |

Random Sample
Judgmental Sample
Parcel ID
TSB-FR(J)-01
Sample Number

January 2008 Aerial from AeroTech Mapping.

Removal Action Workplan for Soil
Tronox Parcels "C", "D", "F", "G" and "H"

FIGURE 3

REMEDIATION AREAS
PARCEL "F"

Basic Environmental
COMPANY

ERM

Prepared by: MKJ
Date 07/01/08
JOB No. 0069073
FILE: GIS/BEC/TRONOX/FIGURE_3.MXD

● Sampling Location

🟥 Parcel G Boundary

🟥 Proposed Scrape Areas (1.3 Acres)

Random Sample
Judgmental Sample
Parcel ID
TSB-GR(J)-01
Sample Number

January 2008 Aerial from AeroTech Mapping.

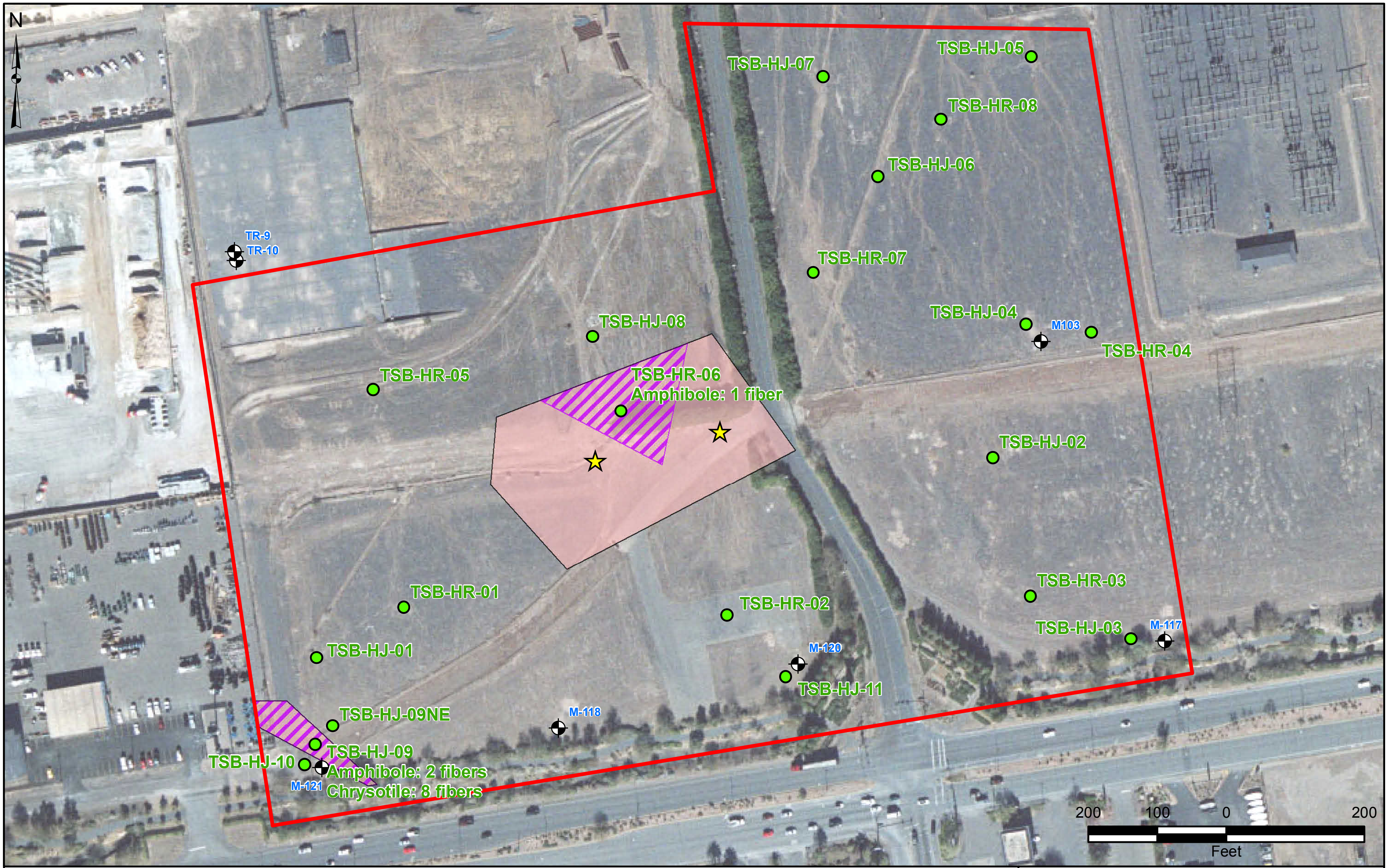
Removal Action Workplan for Soil
Tronox Parcels “C”, “D”, “F”, “G” and “H”

## FIGURE 4

## REMEDIATION AREAS
## PARCEL "G"

Basic Environmental
COMPANY

Prepared by: MKJ
Date 07/01/08
JOB No. 0069073
FILE: GIS/BEC/TRONOX/FIGURE_4.MXD



▭ Parcel H Boundary

★ Additional Asbestos Sample Location

● Sampling Location

■ Proposed Scrape Areas (2.1 Acres)

▨ Scrape Area with 2 Extra Pts (0.55 Acres)

Sample ID Nomenclature:

TSB-HR(J)-01

Parcel ID

Random Sample

Judgmental Sample

Sample Number

January 2008 Aerial from AeroTech Mapping.

Removal Action Workplan for Soil
Tronox Parcels “C”, “D”, “F”, “G” and “H”

# FIGURE 5

# REMEDIATION AREAS PARCEL "H"

Basic Environmental
COMPANY

| Prepared by: | Date | |
|---|---|---|
| MKJ | 07/01/08 | JOB No. 0069073<br>FILE: GIS/BEC/TRONOX/FIGURE_5.MXD |

# APPENDIX D

# LAS VEGAS PAVING SCRAPE CLEAN UP FIGURES AND SOIL DISPOSAL MANIFESTS (CD)

# APPENDIX D-1
# LAS VEGAS PAVING SCRAPE CLEAN UP FIGURES

# APPENDIX D-2
# SOIL DISPOSAL MANIFESTS FOR PARCEL F

# APPENDIX E
# DATA VALIDATION SUMMARY REPORTS AND TABLES – SOIL (CD)

# APPENDIX F
# POST REMEDIATION SOIL HRA DATA SET FOR PARCEL F (CD)

# APPENDIX F-1

# POST REMEDIATION SOIL HRA DATA SET FOR PARCEL F - CHEMICALS AND RADIONUCLIDES (CD)

# APPENDIX F-2
# POST REMEDIATION SOIL HRA DATA SET FOR PARCEL F – ASBESTOS (CD)

# APPENDIX G
# SOIL SUMMARY STATISTICS FOR PARCEL F

## TABLE G-1. Summary Statistics for Soil Data - Parcel F

**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 | 45 | 32 | 71 | 0.53 | 1.0 | 1.2 | 310 | 12 | 45 | 71 | 1.6 | TSB-FR-02-02 |
| | Perchlorate | mg/kg | 45 | 42 | 93 | 0.0034 | 0.0034 | 0.020 | 168 | 2.8 | 15 | 33 | 2.1 | TSB-FJ-06 |
| Metals | Aluminum | mg/kg | 41 | 41 | 100 | -- | -- | 4,700 | 12,000 | 7,300 | 7,400 | 1,300 | 0.18 | TSB-FR-01 |
| | Antimony | mg/kg | 45 | 34 | 76 | 0.063 | 0.54 | 0.14 | 0.32 | 0.18 | 0.19 | 0.051 | 0.27 | TSB-FJ-06 |
| | Arsenic | mg/kg | 44 | 44 | 100 | -- | -- | 2.4 | 6.9 | 3.6 | 3.9 | 1.1 | 0.29 | TSB-FJ-06 |
| | Barium | mg/kg | 45 | 45 | 100 | -- | -- | 67 | 1,400 | 150 | 220 | 230 | 1.0 | TSB-FJ-06-02 |
| | Beryllium | mg/kg | 41 | 41 | 100 | -- | -- | 0.39 | 0.84 | 0.52 | 0.53 | 0.079 | 0.15 | TSB-FR-01 |
| | Boron | mg/kg | 45 | 17 | 38 | 1.4 | 3.3 | 5.8 | 14 | 11 | 11 | 2.6 | 0.24 | RI-19 |
| | Cadmium | mg/kg | 45 | 14 | 31 | 0.0050 | 0.28 | 0.068 | 0.42 | 0.12 | 0.16 | 0.097 | 0.60 | TSB-FR-02-02 |
| | Calcium | mg/kg | 41 | 41 | 100 | -- | -- | 4,200 | 97,000 | 28,000 | 31,000 | 17,000 | 0.54 | TSB-FR-02 |
| | Chromium (total) | mg/kg | 45 | 45 | 100 | -- | -- | 5.2 | 19 | 10 | 12 | 3.7 | 0.32 | TSB-FR-01 |
| | Chromium VI | mg/kg | 45 | 1 | 2.2 | 0.16 | 3.2 | 0.55 | 0.55 | 0.55 | 0.55 | -- | -- | TSB-FJ-06-02 |
| | Cobalt | mg/kg | 45 | 45 | 100 | -- | -- | 4.7 | 11 | 6.9 | 7.0 | 1.4 | 0.21 | TSB-FR-01 |
| | Copper | mg/kg | 45 | 45 | 100 | -- | -- | 10 | 25 | 14 | 16 | 3.7 | 0.24 | TSB-FJ-06 |
| | Iron | mg/kg | 45 | 45 | 100 | -- | -- | 8,600 | 23,000 | 13,000 | 13,000 | 3,500 | 0.26 | RI-19 |
| | Lead | mg/kg | 45 | 45 | 100 | -- | -- | 5.1 | 140 | 8.5 | 14 | 21 | 1.4 | TSB-FR-02-02 |
| | Lithium | mg/kg | 41 | 38 | 93 | 0.66 | 0.73 | 5.7 | 23 | 13 | 14 | 4.4 | 0.31 | TSB-FR-02-02 |
| | Magnesium | mg/kg | 45 | 45 | 100 | -- | -- | 5,900 | 19,000 | 9,600 | 10,000 | 2,800 | 0.27 | TSB-FR-02-02 |
| | Manganese | mg/kg | 45 | 45 | 100 | -- | -- | 150 | 920 | 330 | 360 | 170 | 0.46 | TSB-FR-02-02 |
| | Mercury | mg/kg | 45 | 16 | 36 | 0.0067 | 0.013 | 0.0088 | 1.0 | 0.015 | 0.083 | 0.24 | 3.0 | RI-19 |
| | Molybdenum | mg/kg | 45 | 25 | 56 | 0.052 | 1.1 | 0.29 | 1.5 | 0.55 | 0.67 | 0.30 | 0.44 | TSB-FR-02-02 |
| | Nickel | mg/kg | 45 | 45 | 100 | -- | -- | 8.1 | 23 | 14 | 14 | 2.6 | 0.18 | TSB-FR-01 |
| | Niobium | mg/kg | 43 | 2 | 4.7 | 0.76 | 3.2 | 9.0 | 9.9 | 9.4 | 9.4 | 0.64 | 0.067 | TSB-FR-01 |
| | Palladium | mg/kg | 41 | 41 | 100 | -- | -- | 0.17 | 2.1 | 0.34 | 0.40 | 0.30 | 0.76 | TSB-FJ-02-02 |
| | Phosphorus (total) | mg/kg | 45 | 45 | 100 | -- | -- | 650 | 1,400 | 920 | 960 | 190 | 0.20 | TSB-FR-01 |
| | Platinum | mg/kg | 41 | 7 | 17 | 0.010 | 0.024 | 0.021 | 2.4 | 0.11 | 0.41 | 0.88 | 2.1 | TSB-FJ-02-02 |
| | Potassium | mg/kg | 41 | 41 | 100 | -- | -- | 1,200 | 3,900 | 1,700 | 1,800 | 510 | 0.28 | TSB-FR-01 |
| | Selenium | mg/kg | 41 | 0 | 0 | 0.16 | 0.16 | -- | -- | -- | -- | -- | -- | -- |
| | Silicon | mg/kg | 41 | 41 | 100 | -- | -- | 93 | 1,000 | 160 | 230 | 170 | 0.76 | TSB-FJ-02-02 |
| | Silver | mg/kg | 45 | 41 | 91 | 0.80 | 0.82 | 0.052 | 0.21 | 0.089 | 0.10 | 0.041 | 0.40 | TSB-FR-02-02 |
| | Sodium | mg/kg | 41 | 41 | 100 | -- | -- | 170 | 2,900 | 810 | 910 | 590 | 0.64 | TSB-FJ-02 |
| | Strontium | mg/kg | 45 | 45 | 100 | -- | -- | 120 | 360 | 210 | 220 | 65 | 0.30 | TSB-FJ-06-02 |
| | Sulfur | mg/kg | 41 | 24 | 59 | 210 | 210 | 460 | 1,300 | 540 | 660 | 240 | 0.36 | TSB-FJ-06-02 |
| | Thallium | mg/kg | 45 | 1 | 2.2 | 0.10 | 0.54 | 0.43 | 0.43 | 0.43 | 0.43 | -- | -- | TSB-FR-02-02 |
| | Tin | mg/kg | 41 | 38 | 93 | 0.026 | 0.026 | 0.41 | 1.1 | 0.55 | 0.60 | 0.19 | 0.31 | TSB-FJ-06 |
| | Titanium | mg/kg | 41 | 41 | 100 | -- | -- | 340 | 1,000 | 500 | 540 | 130 | 0.24 | TSB-FR-01 |
| | Tungsten | mg/kg | 43 | 3 | 7.0 | 0.10 | 2.8 | 1.1 | 9.0 | 1.2 | 3.8 | 4.5 | 1.2 | TSB-FJ-02-02 |
| | Uranium (total) | mg/kg | 41 | 41 | 100 | -- | -- | 0.58 | 3.2 | 1.2 | 1.3 | 0.55 | 0.42 | TSB-FR-01 |

**TABLE G-1. Summary Statistics for Soil Data - Parcel F**
**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 | 41 | 41 | 100 | -- | -- | 27 | 72 | 40 | 43 | 11 | 0.26 | RI-19 |
| | Zinc | mg/kg | 41 | 41 | 100 | -- | -- | 24 | 67 | 30 | 33 | 9.9 | 0.30 | TSB-FJ-06 |
| | Zirconium | mg/kg | 45 | 33 | 73 | 0.25 | 5.4 | 8.8 | 36 | 22 | 22 | 5.2 | 0.23 | TSB-FR-01 |
| Other Inorganics | Bromide | mg/kg | 41 | 5 | 12 | 0.063 | 0.25 | 3.9 | 10 | 5.4 | 5.9 | 2.5 | 0.42 | TSB-FJ-10 |
| | Chloride | mg/kg | 41 | 41 | 100 | -- | -- | 1.9 | 18,000 | 670 | 1,900 | 3,200 | 1.7 | TSB-FR-02-02 |
| | Chlorite | mg/kg | 38 | 0 | 0 | 0.040 | 0.80 | -- | -- | -- | -- | -- | -- | -- |
| | Fluoride | mg/kg | 41 | 20 | 49 | 0.10 | 0.25 | 0.42 | 3.0 | 1.1 | 1.2 | 0.74 | 0.60 | TSB-FR-02-02 |
| | Nitrate | mg/kg | 45 | 45 | 100 | -- | -- | 0.41 | 350 | 11 | 35 | 63 | 1.8 | TSB-FR-02-02 |
| | Nitrate/Nitrite | mg/kg | 4 | 4 | 100 | -- | -- | 1.2 | 24 | 4.3 | 8.5 | 10 | 1.2 | RI-19 |
| | Nitrite | mg/kg | 21 | 2 | 10 | 0.020 | 1.2 | 0.79 | 11 | 5.6 | 5.6 | 6.9 | 1.2 | TSB-FR-01 |
| | Sulfate | mg/kg | 41 | 41 | 100 | -- | -- | 15 | 2,300 | 180 | 300 | 380 | 1.3 | TSB-FJ-08 |
| | ortho-Phosphate | mg/kg | 41 | 3 | 7.3 | 0.50 | 1.6 | 1.3 | 6.3 | 6.0 | 4.5 | 2.8 | 0.62 | TSB-FR-01 |
| Radionuclides | Radium-226 | pCi/g | 45 | 45 | 100 | -- | -- | 0.41 | 2.3 | 0.97 | 0.99 | 0.27 | 0.27 | TSB-FR-02-02 |
| | Radium-228 | pCi/g | 45 | 45 | 100 | -- | -- | 0.44 | 14 | 1.7 | 2.1 | 2.1 | 0.99 | TSB-FR-02-02 |
| | Thorium-228 | pCi/g | 45 | 45 | 100 | -- | -- | 1.2 | 2.2 | 1.6 | 1.6 | 0.24 | 0.15 | RI-19 |
| | Thorium-230 | pCi/g | 45 | 45 | 100 | -- | -- | 0.79 | 1.7 | 1.1 | 1.2 | 0.21 | 0.18 | TSB-FR-01 |
| | Thorium-232 | pCi/g | 45 | 45 | 100 | -- | -- | 1.1 | 2.0 | 1.5 | 1.5 | 0.24 | 0.16 | RI-19 |
| | Uranium-234 | pCi/g | 38 | 38 | 100 | -- | -- | 0.73 | 2.6 | 1.1 | 1.2 | 0.38 | 0.33 | TSB-FJ-06 |
| | Uranium-235 | pCi/g | 38 | 38 | 100 | -- | -- | -0.018 | 0.11 | 0.039 | 0.043 | 0.025 | 0.58 | TSB-FJ-06-02 |
| | Uranium-238 | pCi/g | 38 | 38 | 100 | -- | -- | 0.64 | 1.8 | 1.0 | 1.0 | 0.28 | 0.27 | TSB-FJ-06 |
| Dioxin/Furans | 2,3,7,8-TCDD TEQ* | mg/kg | 34 | 16 | 47 | 0.0000011 | 0.0056 | 0.00000016 | 0.0013 | 0.000048 | 0.00017 | 0.00036 | 2.2 | TSB-FR-02 |
| Other Organics | Phthalic acid | mg/kg | 41 | 2 | 4.9 | 0.25 | 0.25 | 0.29 | 0.76 | 0.53 | 0.53 | 0.33 | 0.63 | TSB-FJ-06-02 |
| PAHs | Acenaphthene | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.033 | 0.23 | 0.23 | 0.23 | 0.23 | -- | -- | TSB-FJ-06-02 |
| | Acenaphthylene | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.033 | 0.10 | 0.10 | 0.10 | 0.10 | -- | -- | TSB-FJ-06-02 |
| | Anthracene | mg/kg | 45 | 0 | 0 | 0.00067 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | BaPEq* | mg/kg | 45 | 5 | 11 | 0.0012 | 0.039 | 0.012 | 0.41 | 0.039 | 0.11 | 0.17 | 1.5 | TSB-FJ-06-02 |
| | Benzo(g,h,i)perylene | mg/kg | 43 | 0 | 0 | 0.0043 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | Fluoranthene | mg/kg | 45 | 5 | 11 | 0.0043 | 0.041 | 0.041 | 0.097 | 0.049 | 0.059 | 0.023 | 0.38 | TSB-FR-04 |
| | Fluorene | mg/kg | 45 | 0 | 0 | 0.0043 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | 1-Methylnaphthalene | mg/kg | 4 | 0 | 0 | 0.16 | 0.16 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Methylnaphthalene | mg/kg | 45 | 0 | 0 | 0.020 | 0.076 | -- | -- | -- | -- | -- | -- | -- |
| | Naphthalene | mg/kg | 45 | 1 | 2.2 | 0.0043 | 0.035 | 0.010 | 0.010 | 0.010 | 0.010 | -- | -- | RI-19 |
| | Phenanthrene | mg/kg | 45 | 4 | 8.9 | 0.0017 | 0.033 | 0.018 | 0.96 | 0.068 | 0.28 | 0.46 | 1.6 | TSB-FR-04 |
| | Pyrene | mg/kg | 45 | 5 | 11 | 0.0030 | 0.033 | 0.015 | 0.30 | 0.040 | 0.10 | 0.12 | 1.2 | TSB-FR-04 |
| PCBs | Aroclor-1016 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | Aroclor-1221 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | Aroclor-1232 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | Aroclor-1242 | mg/kg | 20 | 0 | 0 | 0.0049 | 0.033 | -- | -- | -- | -- | -- | -- | -- |

## TABLE G-1. Summary Statistics for Soil Data - Parcel F
**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 |
| PCBs | Aroclor-1248 | mg/kg | 20 | 1 | 5.0 | 0.0049 | 0.033 | 0.074 | 0.074 | 0.074 | 0.074 | -- | -- | TSB-FJ-03 |
| | Aroclor-1254 | mg/kg | 20 | 1 | 5.0 | 0.0027 | 0.033 | 0.29 | 0.29 | 0.29 | 0.29 | -- | -- | TSB-FJ-06-02 |
| | Aroclor-1260 | mg/kg | 24 | 0 | 0 | 0.0027 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| Pesticides - OCPs | Aldrin | mg/kg | 45 | 0 | 0 | 0.000088 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | alpha-BHC | mg/kg | 45 | 6 | 13 | 0.000096 | 0.0017 | 0.0020 | 0.059 | 0.0043 | 0.014 | 0.022 | 1.6 | TSB-FR-02 |
| | beta-BHC | mg/kg | 45 | 16 | 36 | 0.00019 | 0.0017 | 0.0018 | 0.14 | 0.037 | 0.048 | 0.046 | 0.96 | TSB-FR-02 |
| | delta-BHC | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | gamma-BHC | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | Chlordane (total) | mg/kg | 41 | 0 | 0 | 0.0023 | 0.0023 | -- | -- | -- | -- | -- | -- | -- |
| | alpha-Chlordane | mg/kg | 45 | 0 | 0 | 0.00010 | 0.0022 | -- | -- | -- | -- | -- | -- | -- |
| | gamma-Chlordane | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4'-DDD | mg/kg | 41 | 0 | 0 | 0.00011 | 0.00031 | -- | -- | -- | -- | -- | -- | -- |
| | 4,4'-DDD | mg/kg | 45 | 1 | 2.2 | 0.000089 | 0.0017 | 0.013 | 0.013 | 0.013 | 0.013 | -- | -- | TSB-FR-02-02 |
| | 2,4'-DDE | mg/kg | 45 | 5 | 11 | 0.000089 | 0.0017 | 0.0019 | 0.020 | 0.015 | 0.013 | 0.0077 | 0.60 | TSB-FJ-06-02 |
| | 4,4'-DDE | mg/kg | 45 | 10 | 22 | 0.00019 | 0.0017 | 0.0019 | 0.18 | 0.022 | 0.043 | 0.055 | 1.3 | TSB-FR-02-02 |
| | 4,4'-DDT | mg/kg | 45 | 8 | 18 | 0.00020 | 0.0017 | 0.0019 | 0.26 | 0.013 | 0.05 | 0.089 | 1.8 | TSB-FR-02-02 |
| | Dieldrin | mg/kg | 45 | 0 | 0 | 0.000073 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | Endosulfan I | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | Endosulfan II | mg/kg | 45 | 0 | 0 | 0.000093 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | Endosulfan sulfate | mg/kg | 45 | 0 | 0 | 0.00012 | 0.0022 | -- | -- | -- | -- | -- | -- | -- |
| | Endrin | mg/kg | 45 | 0 | 0 | 0.000083 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | Endrin aldehyde | mg/kg | 45 | 2 | 4.4 | 0.00011 | 0.0017 | 0.0068 | 0.020 | 0.013 | 0.013 | 0.0093 | 0.70 | TSB-FJ-06 |
| | Endrin ketone | mg/kg | 45 | 0 | 0 | 0.00016 | 0.0022 | -- | -- | -- | -- | -- | -- | -- |
| | Heptachlor | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0022 | -- | -- | -- | -- | -- | -- | -- |
| | Heptachlor epoxide | mg/kg | 45 | 0 | 0 | 0.00012 | 0.0022 | -- | -- | -- | -- | -- | -- | -- |
| | Hexachlorobenzene | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | -- | -- | -- | -- | -- | -- | -- |
| | Methoxychlor | mg/kg | 45 | 0 | 0 | 0.00032 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | Toxaphene | mg/kg | 45 | 0 | 0 | 0.0058 | 0.056 | -- | -- | -- | -- | -- | -- | -- |
| SVOCs | Acetophenone | mg/kg | 41 | 2 | 4.9 | 0.033 | 0.033 | 0.046 | 0.062 | 0.054 | 0.054 | 0.011 | 0.21 | TSB-FJ-06 |
| | Aniline | mg/kg | 45 | 0 | 0 | 0.033 | 0.093 | -- | -- | -- | -- | -- | -- | -- |
| | Azobenzene | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | Benzenethiol | mg/kg | 41 | 0 | 0 | 0.12 | 0.12 | -- | -- | -- | -- | -- | -- | -- |
| | Benzidine | mg/kg | 4 | 0 | 0 | 0.71 | 0.72 | -- | -- | -- | -- | -- | -- | -- |
| | Benzoic acid | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.37 | 0.23 | 0.32 | 0.28 | 0.28 | 0.064 | 0.23 | TSB-FR-02 |
| | Benzyl alcohol | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.16 | 0.094 | 0.34 | 0.22 | 0.22 | 0.17 | 0.80 | TSB-FJ-06 |
| | bis(2-Chloro-1-methylethyl) ether | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | bis(2-Chloroethoxy)methane | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | bis(2-Chloroethyl) ether | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | -- | -- | -- | -- | -- | -- | -- |
| | bis(2-Ethylhexyl)phthalate | mg/kg | 45 | 4 | 8.9 | 0.033 | 0.098 | 0.048 | 1.4 | 0.12 | 0.42 | 0.65 | 1.6 | TSB-FJ-09 |

**TABLE G-1. Summary Statistics for Soil Data - Parcel F**
**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 | bis(4-Chlorophenyl) disulfide | mg/kg | 41 | 0 | 0 | 0.20 | 0.20 | -- | -- | -- | -- | -- | -- | -- |
| | bis(4-Chlorophenyl) sulfone | mg/kg | 41 | 0 | 0 | 0.33 | 0.33 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Bromophenyl-phenyl ether | mg/kg | 45 | 0 | 0 | 0.033 | 0.082 | -- | -- | -- | -- | -- | -- | -- |
| | Butylbenzylphthalate | mg/kg | 45 | 0 | 0 | 0.033 | 0.087 | -- | -- | -- | -- | -- | -- | -- |
| | Carbazole | mg/kg | 41 | 1 | 2.4 | 0.033 | 0.033 | 0.068 | 0.068 | 0.068 | 0.068 | -- | -- | TSB-FR-02 |
| | 4-Chloro-3-methylphenol | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chloroaniline | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Chloronaphthalene | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Chlorophenol | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorophenyl-phenyl ether | mg/kg | 45 | 0 | 0 | 0.033 | 0.093 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorothioanisole | mg/kg | 41 | 0 | 0 | 0.0076 | 0.0076 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorothiophenol | mg/kg | 41 | 0 | 0 | 0.19 | 0.19 | -- | -- | -- | -- | -- | -- | -- |
| | Di-n-butylphthalate | mg/kg | 45 | 4 | 8.9 | 0.033 | 0.098 | 0.047 | 5.2 | 2.4 | 2.5 | 2.8 | 1.1 | TSB-FJ-06-02 |
| | Di-n-octylphthalate | mg/kg | 45 | 2 | 4.4 | 0.015 | 0.098 | 0.21 | 0.28 | 0.24 | 0.24 | 0.049 | 0.20 | TSB-FJ-06 |
| | Dibenzofuran | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | -- | -- | -- | -- | -- | -- | -- |
| | 3,3'-Dichlorobenzidine | mg/kg | 45 | 0 | 0 | 0.033 | 0.16 | -- | -- | -- | -- | -- | -- | -- |
| | 2,2'-/4,4'-Dichlorobenzil | mg/kg | 41 | 0 | 0 | 0.070 | 4.2 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2-Diphenylhydrazine | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dichlorophenol | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | -- | -- | -- | -- | -- | -- | -- |
| | Diethylphthalate | mg/kg | 45 | 0 | 0 | 0.033 | 0.10 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dimethylphenol | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | Dimethylphthalate | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dinitrophenol | mg/kg | 45 | 0 | 0 | 0.33 | 0.36 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dinitrotoluene | mg/kg | 45 | 0 | 0 | 0.033 | 0.087 | -- | -- | -- | -- | -- | -- | -- |
| | 2,6-Dinitrotoluene | mg/kg | 45 | 0 | 0 | 0.033 | 0.10 | -- | -- | -- | -- | -- | -- | -- |
| | 1,4-Dioxane | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | Diphenyl disulfide | mg/kg | 41 | 0 | 0 | 0.029 | 0.029 | -- | -- | -- | -- | -- | -- | -- |
| | Diphenyl sulfide | mg/kg | 41 | 0 | 0 | 0.0035 | 0.0035 | -- | -- | -- | -- | -- | -- | -- |
| | Diphenyl sulfone | mg/kg | 41 | 0 | 0 | 0.0067 | 0.0067 | -- | -- | -- | -- | -- | -- | -- |
| | Hexachlorobutadiene | mg/kg | 45 | 0 | 0 | 0.00099 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | Hexachlorocyclopentadiene | mg/kg | 45 | 0 | 0 | 0.14 | 0.33 | -- | -- | -- | -- | -- | -- | -- |
| | Hexachloroethane | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | Hydroxymethyl phthalimide | mg/kg | 41 | 2 | 4.9 | 0.043 | 0.043 | 0.12 | 0.15 | 0.14 | 0.14 | 0.021 | 0.16 | TSB-FJ-06-02 |
| | Isophorone | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Methylphenol | mg/kg | 45 | 0 | 0 | 0.086 | 0.12 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Methylphenol | mg/kg | 4 | 0 | 0 | 0.14 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | 3&4-Methylphenol | mg/kg | 41 | 0 | 0 | 0.067 | 0.067 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Nitroaniline | mg/kg | 45 | 0 | 0 | 0.033 | 0.073 | -- | -- | -- | -- | -- | -- | -- |

## TABLE G-1. Summary Statistics for Soil Data - Parcel F

**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 | 3-Nitroaniline | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Nitroaniline | mg/kg | 45 | 0 | 0 | 0.14 | 0.33 | -- | -- | -- | -- | -- | -- | -- |
| | Nitrobenzene | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Nitrophenol | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Nitrophenol | mg/kg | 45 | 0 | 0 | 0.15 | 0.33 | -- | -- | -- | -- | -- | -- | -- |
| | n-Nitroso-di-n-propylamine | mg/kg | 45 | 0 | 0 | 0.033 | 0.076 | -- | -- | -- | -- | -- | -- | -- |
| | n-Nitrosodiphenylamine | mg/kg | 45 | 0 | 0 | 0.033 | 0.087 | -- | -- | -- | -- | -- | -- | -- |
| | Octachlorostyrene | mg/kg | 45 | 0 | 0 | 0.033 | 2.5 | -- | -- | -- | -- | -- | -- | -- |
| | Pentachlorobenzene | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2,4,5-Tetrachlorobenzene | mg/kg | 41 | 0 | 0 | 0.033 | 0.033 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4,5-Trichlorophenol | mg/kg | 45 | 0 | 0 | 0.033 | 0.14 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4,6-Trichlorophenol | mg/kg | 45 | 0 | 0 | 0.033 | 0.082 | -- | -- | -- | -- | -- | -- | -- |
| VOCs | Acetone | mg/kg | 45 | 12 | 27 | 0.0017 | 0.0086 | 0.0056 | 1.9 | 0.015 | 0.23 | 0.54 | 2.4 | TSB-FJ-10 |
| | Acetonitrile | mg/kg | 41 | 0 | 0 | 0.0020 | 0.0054 | -- | -- | -- | -- | -- | -- | -- |
| | t-Amyl methyl ether | mg/kg | 4 | 0 | 0 | 0.00099 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Benzene | mg/kg | 45 | 0 | 0 | 0.000087 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Bromobenzene | mg/kg | 45 | 0 | 0 | 0.00012 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Bromochloromethane | mg/kg | 45 | 0 | 0 | 0.00023 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Bromodichloromethane | mg/kg | 45 | 0 | 0 | 0.00021 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Bromoform | mg/kg | 45 | 0 | 0 | 0.000059 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Bromomethane | mg/kg | 45 | 0 | 0 | 0.00013 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Butanone | mg/kg | 45 | 3 | 6.7 | 0.00087 | 0.0053 | 0.0045 | 0.013 | 0.0060 | 0.0078 | 0.0045 | 0.58 | TSB-FJ-10 |
| | tert Butyl alcohol | mg/kg | 4 | 0 | 0 | 0.0099 | 0.011 | -- | -- | -- | -- | -- | -- | -- |
| | n-Butylbenzene | mg/kg | 45 | 0 | 0 | 0.00018 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | sec-Butylbenzene | mg/kg | 45 | 0 | 0 | 0.00011 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | tert-Butylbenzene | mg/kg | 45 | 0 | 0 | 0.00010 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Carbon disulfide | mg/kg | 41 | 0 | 0 | 0.00012 | 0.00055 | -- | -- | -- | -- | -- | -- | -- |
| | Carbon tetrachloride | mg/kg | 45 | 0 | 0 | 0.00021 | 0.00090 | -- | -- | -- | -- | -- | -- | -- |
| | Chlorobenzene | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Chloroethane | mg/kg | 45 | 0 | 0 | 0.00035 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Chloroform | mg/kg | 45 | 1 | 2.2 | 0.00010 | 0.00053 | 0.00065 | 0.00065 | 0.00065 | 0.00065 | -- | -- | RI-18 |
| | Chloromethane | mg/kg | 45 | 0 | 0 | 0.00027 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Chlorotoluene | mg/kg | 45 | 0 | 0 | 0.00025 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Chlorotoluene | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Cumene | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | p-Cymene | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2-Dibromo-3-chloropropane | mg/kg | 45 | 0 | 0 | 0.00021 | 0.0021 | -- | -- | -- | -- | -- | -- | -- |
| | Dibromochloromethane | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2-Dibromoethane | mg/kg | 4 | 0 | 0 | 0.00049 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |

## TABLE G-1. Summary Statistics for Soil Data - Parcel F
### 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 | Dibromomethane | mg/kg | 45 | 0 | 0 | 0.00017 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2-Dichlorobenzene | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,3-Dichlorobenzene | mg/kg | 45 | 0 | 0 | 0.00013 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,4-Dichlorobenzene | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Dichlorodifluoromethane | mg/kg | 45 | 0 | 0 | 0.00029 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1-Dichloroethane | mg/kg | 45 | 0 | 0 | 0.000070 | 0.00095 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2-Dichloroethane | mg/kg | 45 | 0 | 0 | 0.000066 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1-Dichloroethene | mg/kg | 45 | 0 | 0 | 0.00012 | 0.00055 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2-Dichloroethene | mg/kg | 41 | 0 | 0 | 0.00011 | 0.00054 | -- | -- | -- | -- | -- | -- | -- |
| | cis-1,2-Dichloroethene | mg/kg | 45 | 0 | 0 | 0.000054 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | trans-1,2-Dichloroethene | mg/kg | 45 | 0 | 0 | 0.000090 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2-Dichloropropane | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,3-Dichloropropane | mg/kg | 45 | 0 | 0 | 0.000051 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | cis-1,3-Dichloropropene | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00073 | -- | -- | -- | -- | -- | -- | -- |
| | trans-1,3-Dichloropropene | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 2,2-Dichloropropane | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1-Dichloropropene | mg/kg | 45 | 0 | 0 | 0.000087 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Diisopropyl ether | mg/kg | 4 | 0 | 0 | 0.00099 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Dimethyl disulfide | mg/kg | 41 | 0 | 0 | 0.00018 | 0.00021 | -- | -- | -- | -- | -- | -- | -- |
| | 2,2-Dimethylpentane | mg/kg | 41 | 0 | 0 | 0.00028 | 0.00028 | -- | -- | -- | -- | -- | -- | -- |
| | 2,3-Dimethylpentane | mg/kg | 41 | 0 | 0 | 0.00022 | 0.00022 | -- | -- | -- | -- | -- | -- | -- |
| | 2,4-Dimethylpentane | mg/kg | 41 | 0 | 0 | 0.00019 | 0.00019 | -- | -- | -- | -- | -- | -- | -- |
| | 3,3-Dimethylpentane | mg/kg | 41 | 0 | 0 | 0.00020 | 0.00020 | -- | -- | -- | -- | -- | -- | -- |
| | Ethanol | mg/kg | 41 | 0 | 0 | 0.047 | 0.19 | -- | -- | -- | -- | -- | -- | -- |
| | Ethyl benzene | mg/kg | 45 | 2 | 4.4 | 0.000058 | 0.00053 | 0.00041 | 0.00048 | 0.00044 | 0.00044 | 0.000049 | 0.11 | TSB-FJ-10 |
| | Ethyl tert-butyl ether | mg/kg | 4 | 0 | 0 | 0.00099 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 3-Ethylpentane | mg/kg | 41 | 0 | 0 | 0.00021 | 0.00021 | -- | -- | -- | -- | -- | -- | -- |
| | n-Heptane | mg/kg | 41 | 0 | 0 | 0.00016 | 0.00016 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Hexanone | mg/kg | 45 | 2 | 4.4 | 0.00024 | 0.0053 | 0.0022 | 0.0071 | 0.0047 | 0.0047 | 0.0035 | 0.75 | TSB-FJ-06 |
| | Iodomethane | mg/kg | 41 | 0 | 0 | 0.00012 | 0.00026 | -- | -- | -- | -- | -- | -- | -- |
| | Methyl tert-butyl ether | mg/kg | 45 | 0 | 0 | 0.000089 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 4-Methyl-2-pentanone | mg/kg | 45 | 0 | 0 | 0.00029 | 0.0027 | -- | -- | -- | -- | -- | -- | -- |
| | Methylene Chloride | mg/kg | 45 | 16 | 36 | 0.00069 | 0.0053 | 0.0063 | 0.021 | 0.0074 | 0.0090 | 0.0043 | 0.48 | TSB-FJ-02-02 |
| | 2-Methylhexane | mg/kg | 41 | 0 | 0 | 0.00020 | 0.00020 | -- | -- | -- | -- | -- | -- | -- |
| | 3-Methylhexane | mg/kg | 41 | 0 | 0 | 0.00014 | 0.00014 | -- | -- | -- | -- | -- | -- | -- |
| | 2-Nitropropane | mg/kg | 41 | 0 | 0 | 0.00060 | 0.0017 | -- | -- | -- | -- | -- | -- | -- |
| | n-Nonyl aldehyde | mg/kg | 41 | 1 | 2.4 | 0.00047 | 0.00088 | 0.0033 | 0.0033 | 0.0033 | 0.0033 | -- | -- | TSB-FJ-07 |
| | Pentachlorophenol | mg/kg | 45 | 0 | 0 | 0.33 | 0.37 | -- | -- | -- | -- | -- | -- | -- |
| | Phenol | mg/kg | 45 | 2 | 4.4 | 0.033 | 0.098 | 0.13 | 0.44 | 0.29 | 0.29 | 0.22 | 0.77 | TSB-FJ-06 |

## TABLE G-1. Summary Statistics for Soil Data - Parcel F

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

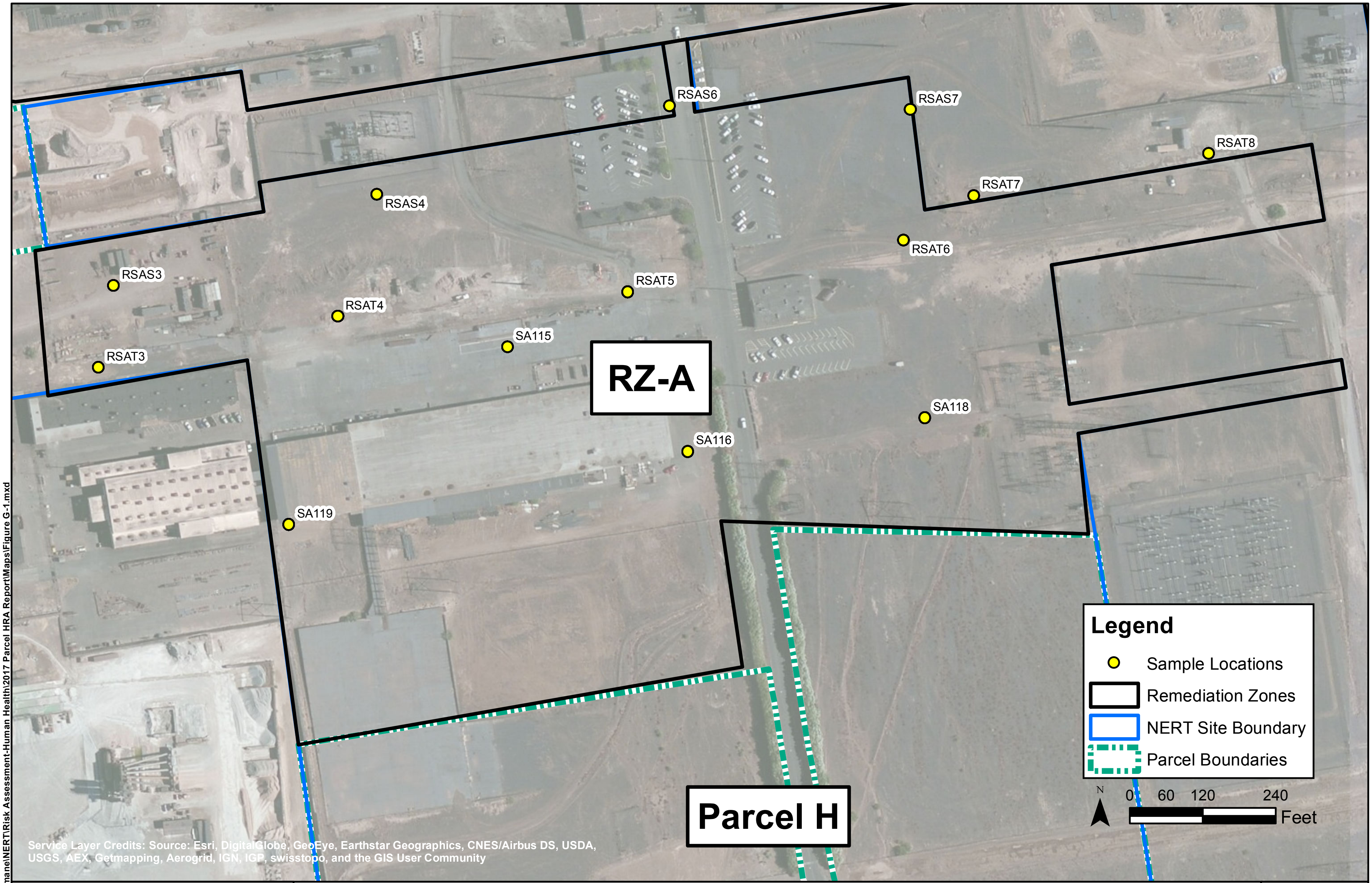
| Chemical Group | Analyte | Unit | No. of Samples | No. of Detects | % Detects | Nondetects | | Detects | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum | Maximum | Minimum | Maximum | Median | Mean | Standard Deviation | Coefficient of Variation | Location of Maximum |
| VOCs | n-Propylbenzene | mg/kg | 45 | 1 | 2.2 | 0.00011 | 0.00095 | 0.0014 | 0.0014 | 0.0014 | 0.0014 | -- | -- | TSB-FJ-10 |
| | Pyridine | mg/kg | 45 | 0 | 0 | 0.033 | 0.16 | -- | -- | -- | -- | -- | -- | -- |
| | Styrene | mg/kg | 45 | 0 | 0 | 0.00017 | 0.0012 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1,1,2-Tetrachloroethane | mg/kg | 45 | 0 | 0 | 0.00018 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1,2,2-Tetrachloroethane | mg/kg | 45 | 0 | 0 | 0.000078 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | Tetrachloroethene | mg/kg | 45 | 0 | 0 | 0.000087 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Toluene | mg/kg | 45 | 1 | 2.2 | 0.00013 | 0.00053 | 0.00047 | 0.00047 | 0.00047 | 0.00047 | -- | -- | TSB-FJ-06 |
| | 1,1,2-Trichloro-1,2,2-trifluoroethane | mg/kg | 41 | 0 | 0 | 0.00015 | 0.00054 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2,3-Trichlorobenzene | mg/kg | 45 | 0 | 0 | 0.00039 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2,4-Trichlorobenzene | mg/kg | 45 | 0 | 0 | 0.00033 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 1,3,5-Trichlorobenzene | mg/kg | 41 | 0 | 0 | 0.00037 | 0.00068 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1,1-Trichloroethane | mg/kg | 45 | 0 | 0 | 0.00011 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | 1,1,2-Trichloroethane | mg/kg | 45 | 0 | 0 | 0.000067 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Trichloroethene | mg/kg | 45 | 0 | 0 | 0.00010 | 0.00053 | -- | -- | -- | -- | -- | -- | -- |
| | Trichlorofluoromethane | mg/kg | 45 | 0 | 0 | 0.00022 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2,3-Trichloropropane | mg/kg | 45 | 0 | 0 | 0.00025 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | 1,2,4-Trimethylbenzene | mg/kg | 45 | 7 | 16 | 0.00013 | 0.0011 | 0.00041 | 0.0086 | 0.00068 | 0.0022 | 0.0030 | 1.3 | TSB-FJ-10 |
| | 1,3,5-Trimethylbenzene | mg/kg | 45 | 3 | 6.7 | 0.000097 | 0.0011 | 0.00061 | 0.0038 | 0.0011 | 0.0018 | 0.0017 | 0.94 | TSB-FJ-10 |
| | 2,2,3-Trimethylbutane | mg/kg | 41 | 0 | 0 | 0.00021 | 0.00021 | -- | -- | -- | -- | -- | -- | -- |
| | Vinyl acetate | mg/kg | 41 | 0 | 0 | 0.00018 | 0.00024 | -- | -- | -- | -- | -- | -- | -- |
| | Vinyl chloride | mg/kg | 45 | 0 | 0 | 0.00011 | 0.0011 | -- | -- | -- | -- | -- | -- | -- |
| | m,p-Xylene | mg/kg | 45 | 3 | 6.7 | 0.00017 | 0.0011 | 0.0012 | 0.0026 | 0.0020 | 0.0019 | 0.00070 | 0.36 | TSB-FJ-10 |
| | o-Xylene | mg/kg | 45 | 2 | 4.4 | 0.000076 | 0.00053 | 0.00083 | 0.00083 | 0.00083 | 0.00083 | 0 | 0 | TSB-FJ-06 |
| | Xylenes (total) | mg/kg | 41 | 2 | 4.9 | 0.00023 | 0.00086 | 0.0028 | 0.0034 | 0.0031 | 0.0031 | 0.00042 | 0.14 | TSB-FJ-10 |

**Notes:**

-- = No value
mg/kg = milligram per kilogram
pCi/g = picocurie per gram
BaPEq = Benzo(a)pyrene equivalent
BHC = Hexachlorocyclohexane
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane

OCP = Organochlorine 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

# APPENDIX H
# BACKGROUND SOIL DATA SET (CD)



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

RAMBOLL ENVIRON

## RZ-A Soil Background Sample Locations

Nevada Environmental Response Trust Site, Henderson, Nevada

Drafter: EF Date: 4/13/2017 Contract Number: 21-41400A Approved by: Revised:

Figure

**H-1**

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\2017 Parcel HRA Report\Maps\Figure G-1.mxd

# APPENDIX I

# BACKGROUND EVALUATION FOR METALS AND RADIONUCLIDES IN SOIL FOR PARCEL F

## TABLE I-1. Summary Statistics for Metals in Background (RZ-A) Soils and Parcel F Soils (0-10 feet bgs)

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Name | Location | No. of Samples | No. of Detects | % Detects | Non-Detects (mg/kg) | | Detects (mg/kg) | | | | | Shapiro-Wilk Test | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimun | Maximum | Minimum | Median | Mean | Maximum | Standard Deviation | Normal (*p*-value) | Lognormal (*p*-value) |
| Aluminum | Background | 31 | 31 | 100% | NA | NA | 7,340 | 8,970 | 9,020 | 11,400 | 890 | 0.6 | 0.9 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 4,650 | 7,260 | 7,420 | 11,600 | 1,340 | 0.05 | 0.5 |
| Antimony | Background | 31 | 3 | 9.7% | 2.0 | 2.2 | 0.60 | 0.90 | 1.6 | 3.4 | 1.5 | *<0.001* | *<0.001* |
| | Parcel F | 45 | 34 | 76% | 0.063 | 0.54 | 0.14 | 0.18 | 0.19 | 0.32 | 0.051 | *0.003* | *<0.001* |
| Arsenic | Background | 31 | 31 | 100% | NA | NA | 1.6 | 2.4 | 2.4 | 4.3 | 0.54 | 0.02 | 0.5 |
| | Parcel F | 44 | 44 | 100% | NA | NA | 2.4 | 3.6 | 3.9 | 6.9 | 1.1 | *0.005* | 0.3 |
| Barium | Background | 31 | 31 | 100% | NA | NA | 111 | 162 | 166 | 213 | 23 | 0.6 | 0.4 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 67 | 153 | 222 | 1,420 | 230 | *<0.001* | *<0.001* |
| Beryllium | Background | 31 | 31 | 100% | NA | NA | 0.36 | 0.46 | 0.46 | 0.59 | 0.048 | 0.6 | 0.7 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 0.39 | 0.52 | 0.53 | 0.84 | 0.079 | *0.003* | 0.2 |
| Boron | Background | 31 | 7 | 23% | 10 | 11 | 3.6 | 6.2 | 6.7 | 12 | 2.7 | *<0.001* | *<0.001* |
| | Parcel F | 45 | 17 | 38% | 1.4 | 3.3 | 5.8 | 11 | 11 | 14 | 2.6 | *<0.001* | *<0.001* |
| Cadmium | Background | 31 | 25 | 81% | 0.10 | 0.11 | 0.11 | 0.19 | 0.20 | 0.48 | 0.085 | *0.003* | 0.02 |
| | Parcel F | 45 | 14 | 31% | 0.0050 | 0.28 | 0.068 | 0.12 | 0.16 | 0.42 | 0.097 | *<0.001* | *<0.001* |
| Calcium | Background | 31 | 31 | 100% | NA | NA | 19,200 | 28,200 | 29,000 | 43,300 | 6,580 | 0.2 | 0.6 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 4,160 | 28,300 | 31,400 | 97,000 | 17,100 | *<0.001* | *0.008* |
| Chromium (total) | Background | 31 | 31 | 100% | NA | NA | 5.6 | 7.5 | 7.7 | 11 | 1.2 | 0.4 | 0.7 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 5.2 | 10 | 12 | 19 | 3.7 | *<0.001* | *0.005* |
| Chromium VI | Background | 31 | 1 | 3.2% | 0.41 | 0.43 | 0.29 | 0.29 | 0.29 | 0.29 | NA | *<0.001* | *<0.001* |
| | Parcel F | 45 | 1 | 2.2% | 0.16 | 3.2 | 0.55 | 0.55 | 0.55 | 0.55 | NA | *<0.001* | *<0.001* |
| Cobalt | Background | 31 | 31 | 100% | NA | NA | 5.4 | 7.3 | 7.3 | 9.1 | 0.76 | 0.5 | 0.4 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 4.7 | 6.9 | 7.0 | 11 | 1.4 | 0.02 | 0.5 |
| Copper | Background | 31 | 31 | 100% | NA | NA | 16 | 19 | 23 | 140 | 22 | *<0.001* | *<0.001* |
| | Parcel F | 45 | 45 | 100% | NA | NA | 10 | 15 | 16 | 25 | 3.7 | *<0.001* | *0.005* |
| Iron | Background | 31 | 31 | 100% | NA | NA | 11,300 | 15,700 | 15,500 | 20,600 | 2,140 | 0.5 | 0.3 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 8,620 | 12,500 | 13,300 | 23,000 | 3,490 | *<0.001* | *<0.001* |
| Lead | Background | 31 | 31 | 100% | NA | NA | 7.1 | 8.9 | 11 | 73 | 12 | *<0.001* | *<0.001* |
| | Parcel F | 45 | 45 | 100% | NA | NA | 5.1 | 8.5 | 14 | 136 | 21 | *<0.001* | *<0.001* |
| Magnesium | Background | 31 | 31 | 100% | NA | NA | 7,700 | 9,810 | 9,990 | 13,000 | 1,320 | 0.8 | 1 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 5,910 | 9,550 | 10,000 | 18,900 | 2,750 | *0.002* | 0.09 |
| Manganese | Background | 31 | 31 | 100% | NA | NA | 262 | 360 | 366 | 537 | 61 | 0.03 | 0.4 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 154 | 327 | 363 | 917 | 166 | *<0.001* | 0.01 |
| Mercury | Background | 31 | 27 | 87% | 0.017 | 0.019 | 0.0060 | 0.016 | 0.036 | 0.36 | 0.069 | *<0.001* | *<0.001* |
| | Parcel F | 45 | 16 | 36% | 0.0067 | 0.013 | 0.0088 | 0.015 | 0.083 | 1.0 | 0.24 | *<0.001* | *<0.001* |
| Molybdenum | Background | 31 | 30 | 97% | 0.31 | 0.31 | 0.31 | 0.49 | 1.7 | 33 | 5.9 | *<0.001* | *<0.001* |
| | Parcel F | 45 | 25 | 56% | 0.052 | 1.1 | 0.29 | 0.55 | 0.67 | 1.5 | 0.30 | *<0.001* | *<0.001* |
| Nickel | Background | 31 | 31 | 100% | NA | NA | 13 | 16 | 16 | 21 | 1.8 | 0.08 | 0.5 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 8.1 | 14 | 14 | 23 | 2.6 | 0.09 | 0.4 |
| Platinum | Background | 31 | 19 | 61% | 0.10 | 0.11 | 0.0060 | 0.010 | 0.012 | 0.046 | 0.0085 | *<0.001* | *<0.001* |
| | Parcel F | 41 | 7 | 17% | 0.010 | 0.024 | 0.021 | 0.11 | 0.41 | 2.4 | 0.88 | *<0.001* | *<0.001* |

## TABLE I-1. Summary Statistics for Metals in Background (RZ-A) Soils and Parcel F Soils (0-10 feet bgs)

**Nevada Environmental Response Trust Site**

**Henderson, Nevada**

| Chemical Name | Location | No. of Samples | No. of Detects | % Detects | Non-Detects (mg/kg) | | Detects (mg/kg) | | | | | Shapiro-Wilk Test | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Minimun | Maximum | Minimum | Median | Mean | Maximum | Standard Deviation | Normal (*p* -value) | Lognormal (*p* -value) |
| Potassium | Background | 31 | 31 | 100% | NA | NA | 1,450 | 2,080 | 2,180 | 4,210 | 658 | *<0.001* | 0.02 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 1,190 | 1,710 | 1,820 | 3,930 | 510 | *<0.001* | *0.007* |
| Selenium | Background | 31 | 3 | 9.7% | 4.1 | 4.4 | 0.80 | 0.80 | 0.83 | 0.90 | 0.058 | *<0.001* | *<0.001* |
| | Parcel F | 41 | 0 | 0% | 0.16 | 0.16 | NA | NA | NA | NA | NA | NA | NA |
| Silver | Background | 31 | 0 | 0% | 0.50 | 0.50 | NA | NA | NA | NA | NA | NA | NA |
| | Parcel F | 45 | 41 | 91% | 0.80 | 0.82 | 0.052 | 0.089 | 0.10 | 0.21 | 0.041 | *<0.001* | *<0.001* |
| Sodium | Background | 31 | 31 | 100% | NA | NA | 307 | 630 | 621 | 1,050 | 194 | 0.3 | 0.3 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 169 | 806 | 913 | 2,910 | 585 | *<0.001* | 0.2 |
| Strontium | Background | 31 | 31 | 100% | NA | NA | 129 | 214 | 222 | 339 | 57 | 0.4 | 0.3 |
| | Parcel F | 45 | 45 | 100% | NA | NA | 117 | 213 | 216 | 355 | 65 | 0.02 | 0.1 |
| Thallium | Background | 31 | 31 | 100% | NA | NA | 0.071 | 0.092 | 0.11 | 0.19 | 0.033 | *<0.001* | *0.003* |
| | Parcel F | 45 | 1 | 2.2% | 0.10 | 0.54 | 0.43 | 0.43 | 0.43 | 0.43 | NA | *<0.001* | *<0.001* |
| Tin | Background | 31 | 0 | 0% | 10 | 11 | NA | NA | NA | NA | NA | 0.4 | 0.4 |
| | Parcel F | 41 | 38 | 93% | 0.026 | 0.026 | 0.41 | 0.55 | 0.60 | 1.1 | 0.19 | *<0.001* | *<0.001* |
| Titanium | Background | 31 | 31 | 100% | NA | NA | 480 | 829 | 793 | 1,080 | 162 | 0.2 | 0.04 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 343 | 504 | 535 | 1,010 | 130 | *<0.001* | 0.1 |
| Tungsten | Background | 31 | 30 | 97% | 0.11 | 0.11 | 0.12 | 0.17 | 0.21 | 0.62 | 0.11 | *<0.001* | 0.04 |
| | Parcel F | 43 | 3 | 7.0% | 0.10 | 2.8 | 1.1 | 1.2 | 3.8 | 9.0 | 4.5 | *<0.001* | *<0.001* |
| Uranium (total) | Background | 31 | 31 | 100% | NA | NA | 0.66 | 0.98 | 1.1 | 1.9 | 0.36 | *0.002* | 0.05 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 0.58 | 1.2 | 1.3 | 3.2 | 0.55 | *<0.001* | 0.2 |
| Vanadium | Background | 31 | 31 | 100% | NA | NA | 28 | 46 | 44 | 55 | 7.6 | 0.08 | 0.02 |
| | Parcel F | 41 | 41 | 100% | NA | NA | 27 | 40 | 43 | 72 | 11 | *<0.001* | *0.004* |
| Zinc | Background | 31 | 31 | 100% | NA | NA | 26 | 33 | 40 | 254 | 40 | *<0.001* | *<0.001* |
| | Parcel F | 41 | 41 | 100% | NA | NA | 24 | 30 | 33 | 67 | 9.9 | *<0.001* | *<0.001* |

**Notes:**

bgs = below ground surface

mg/kg = milligram per kilogram

NA = value not available

*p-* values < 0.01 are shown in italic.

Background dataset is from RZ-A, excluding the six borings in LOU 62.

Shapiro Wilk tests use 1/2 the detection limit (DL) for non-detects.

## TABLE I-2. Background Comparisons for Metals in Parcel F Soils (0-10 feet bgs)

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

| Chemical Name | Distribution | *t*-test | *t*-test (logged data) | Gehan Test | Quantile Test (0.8) | Slippage Test | Fail Statistical Testing for Background Consistency? |
|---|---|---|---|---|---|---|---|
| | | (*p*-value) | (*p*-value) | (*p*-value) | (*p*-value) | (*p*-value) | |
| Aluminum | N, LN | 1 | 1 | 1 | 1 | 0.6 | No |
| Antimony | NP | 1 | 1 | 1 | 0.09 | 1 | LDF |
| Arsenic | LN | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | Yes |
| Barium | NP | 0.06 | 0.2 | 0.7 | *0.01* | *0.002* | Yes |
| Beryllium | LN | *<0.001* | *<0.001* | *<0.001* | *0.002* | *0.02* | Yes |
| Boron | NP | 0.9 | 1 | 1 | *0.01* | *0.02* | LDF |
| Cadmium | NP | 1 | 1 | 1 | 1 | 1 | No |
| Calcium | NP | 0.2 | 0.6 | 0.7 | 0.5 | *0.02* | Yes |
| Chromium (total) | NP | *<0.001* | *<0.001* | *<0.001* | *<0.001* | *<0.001* | Yes |
| Chromium VI | NP | 1 | 1 | 1 | 0.6 | 1 | LDF |
| Cobalt | N, LN | 0.9 | 1 | 1 | 0.6 | 0.1 | No |
| Copper | NP | 1 | 1 | 1 | 0.8 | 1 | No |
| Iron | NP | 1 | 1 | 1 | 1 | 0.1 | No |
| Lead | NP | 0.2 | 0.3 | 0.7 | 0.2 | 0.6 | No |
| Magnesium | LN | 0.5 | 0.7 | 0.7 | 0.06 | 0.2 | No |
| Manganese | LN | 0.5 | 0.9 | 1 | 0.6 | 0.07 | No |
| Mercury | NP | 0.5 | 1 | 1 | 0.8 | 0.6 | No |
| Molybdenum | NP | 0.9 | 1 | 0.9 | 0.8 | 1 | No |
| Nickel | N, LN | 1 | 1 | 1 | 1 | 0.6 | No |
| Platinum | NP | 0.2 | 1 | 0.9 | 0.9 | 0.1 | LDF |
| Potassium | NP | 1 | 1 | 1 | 1 | 1 | No |
| Selenium | N, LN | 1 | 1 | 1 | 1 | 1 | LDF |
| Silver | NP | 1 | 1 | 1 | *<0.001* | NA | LDF |
| Sodium | LN | *0.002* | *0.008* | *0.006* | *0.001* | *0.002* | Yes |

# TABLE I-2. Background Comparisons for Metals in Parcel F Soils (0-10 feet bgs)

## Nevada Environmental Response Trust Site

## Henderson, Nevada

| Chemical Name | Distribution | *t*-test | *t*-test (logged data) | Gehan Test | Quantile Test (0.8) | Slippage Test | Fail Statistical Testing for Background Consistency? |
|---|---|---|---|---|---|---|---|
| | | (*p*-value) | (*p*-value) | (*p*-value) | (*p*-value) | (*p*-value) | |
| Strontium | N, LN | 0.6 | 0.7 | 0.7 | 0.6 | 0.2 | No |
| Thallium | NP | 1 | 1 | *0.001* | 1 | 0.6 | LDF |
| Tin | NP | 1 | 1 | 1 | *<0.001* | NA | LDF |
| Titanium | LN | 1 | 1 | 1 | 1 | 1 | No |
| Tungsten | NP | 0.2 | 1 | 1 | 1 | 0.2 | LDF |
| Uranium (total) | LN | *0.02* | *0.02* | *0.02* | 0.1 | 0.05 | Yes |
| Vanadium | NP | 0.7 | 0.8 | 1 | 1 | 0.05 | No |
| Zinc | NP | 0.8 | 0.9 | 1 | 0.9 | 1 | No |

**Notes:**

bgs = below ground surface

NA = value not available

LDF = Low detection frequency (<25%) in either site or background datasets. Background comparison results may not be applicable.

*p-* values in italics indicate $p < 0.025$

Background comparison tests use 1/2 the detection limit (DL) for non-detects in the parametric test (t-test) and the DL for non-parametric tests (Gehan test, quantile test, and slippage test).

Background dataset is from RZ-A, excluding the six borings in LOU 62.

Distibution:

N = Study area data and background data consistent with normal distribution

LN = Study area data and background data consistent with log-normal distribution

NP = Study area data or background data is not consistent with both normal distribution and log-normal distribution.

# TABLE I-3. Summary Statistics for Radionuclides in Background (RZ-A) Soils and Parcel F Soils (0-10 feet bgs)

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

| Chain | Chemical Name | Location | No. of Samples | No. of Detects | % Detects | Detects (pCi/g) | | | | | Shapiro-Wilk Test | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Minimum | Median | Mean | Maximum | Standard Deviation | Normal (*p*-value) | Lognormal (*p*-value) |
| Uranium-238 | Uranium-238 | Background | 31 | 31 | 100% | 0.36 | 1.0 | 1.0 | 1.6 | 0.21 | *0.004* | *<0.001* |
| | | Parcel F | 38 | 38 | 100% | 0.64 | 1.0 | 1.0 | 1.8 | 0.28 | *0.002* | 0.20 |
| | Uranium-234 | Background | 31 | 31 | 100% | 0.39 | 1.0 | 1.1 | 1.7 | 0.30 | 0.09 | 0.04 |
| | | Parcel F | 38 | 38 | 100% | 0.73 | 1.1 | 1.2 | 2.6 | 0.38 | *<0.001* | *0.005* |
| | Thorium-230 | Background | 31 | 31 | 100% | 0.51 | 1.1 | 1.1 | 1.7 | 0.28 | 0.7 | 0.7 |
| | | Parcel F | 45 | 45 | 100% | 0.79 | 1.1 | 1.2 | 1.7 | 0.21 | 0.1 | 0.6 |
| | Radium-226 | Background | 31 | 31 | 100% | 0.047 | 0.89 | 0.95 | 1.7 | 0.35 | 0.4 | *<0.001* |
| | | Parcel F | 45 | 45 | 100% | 0.41 | 0.97 | 0.99 | 2.3 | 0.27 | *<0.001* | *<0.001* |
| Thorium-232 | Thorium-232 | Background | 31 | 31 | 100% | 1.0 | 1.5 | 1.5 | 2.1 | 0.24 | 1 | 1 |
| | | Parcel F | 45 | 45 | 100% | 1.1 | 1.5 | 1.5 | 2.0 | 0.24 | 0.2 | 0.1 |
| | Radium-228 | Background | 31 | 31 | 100% | 0.46 | 1.2 | 1.3 | 2.5 | 0.54 | 0.3 | 0.8 |
| | | Parcel F | 45 | 45 | 100% | 0.44 | 1.7 | 2.1 | 14 | 2.1 | *<0.001* | *<0.001* |
| | Thorium-228 | Background | 31 | 31 | 100% | 1.2 | 1.7 | 1.7 | 2.9 | 0.36 | 0.03 | 0.5 |
| | | Parcel F | 45 | 45 | 100% | 1.2 | 1.6 | 1.6 | 2.2 | 0.24 | 0.6 | 0.6 |
| Uranium-235 | Uranium-235 | Background | 31 | 31 | 100% | -0.077 | 0.049 | 0.051 | 0.20 | 0.044 | *0.003* | NA |
| | | Parcel F | 38 | 38 | 100% | -0.018 | 0.039 | 0.043 | 0.11 | 0.025 | 0.3 | NA |

**Notes:**

bgs = below ground surface

pCi/g = picocurie per gram

NA = value not available

*p*- values < 0.01 are shown in italic.

Background dataset is from RZ-A, excluding the six borings in LOU 62.

Shapiro Wilk tests use 1/2 the detection limit (DL) for non-detects.

## TABLE I-4. Background Comparisons for Radionuclides in Parcel F Soils (0-10 feet bgs)

### Nevada Environmental Response Trust Site

### Henderson, Nevada

| Chain | Chemical Name | Distribution | *t* -test | *t* -test (logged data) | Gehan Test | Quantile Test (0.8) | Slippage Test | Fail Statistical Testing for Background Consistency? |
|---|---|---|---|---|---|---|---|---|
| | | | (*p* -value) | (*p* -value) | (*p* -value) | (*p* -value) | (*p* -value) | |
| Uranium-238 | Uranium-238 | LN | 0.5 | 0.5 | 0.7 | 0.6 | 0.2 | No |
| | Uranium-234 | NP | 0.1 | 0.1 | 0.1 | 0.8 | 0.2 | No |
| | Thorium-230 | N, LN | 0.08 | 0.05 | 0.07 | 0.4 | 1 | No |
| | Radium-226 | NP | 0.3 | 0.1 | 0.1 | 1 | 0.6 | No |
| Thorium-232 | Thorium-232 | N, LN | 0.4 | 0.4 | 0.5 | 0.2 | 1 | No |
| | Radium-228 | NP | *0.007* | *<0.001* | *<0.001* | 0.6 | 0.2 | Yes |
| | Thorium-228 | N, LN | 0.7 | 0.7 | 0.6 | 1 | 1 | No |
| Uranium-235 | Uranium-235 | N, LN | 0.8 | 0.8 | 0.9 | 0.8 | 1 | No |

**Notes:**

bgs = below ground surface

*p-* values in italics indicate $p < 0.025$

Background comparison tests use 1/2 the detection limit (DL) for non-detects in the parametric test (t-test) and the DL for non-parametric tests (Gehan test, quantile test, and slippage test).

Background dataset is from RZ-A, excluding the six borings in LOU 62.

Distibution:

- N = Study area data and background data consistent with normal distribution
- LN = Study area data and background data consistent with log-normal distribution
- NP = Study area data or background data is not consistent with both normal distribution and log-normal distribution.

# Table I-5A. Equivalence Test for Secular Equilibrium of Uranium Decay Series (U-238 Chain)[1]
## Nevada Environmental Response Trust Remediation Project Site
## Henderson, Nevada

| Location | p-value | Conclusion[2] | Delta | Sample Size[3] | Number Missing[4] | Analyte | Mean Proportions of Radioactivity | 95% Confid. Intervals | | Shifts[5] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper | |
| All | <0.0001 | in Secular Equilibrium | 0.1 | 69 | 7 | Ra-226 | 0.2318 | 0.2104 | 0.2532 | 0 |
| | | | | | | Th-230 | 0.2629 | 0.2448 | 0.2810 | 0 |
| | | | | | | U-234 | 0.2611 | 0.2443 | 0.2779 | 0 |
| | | | | | | U-238 | 0.2442 | 0.2297 | 0.2588 | 0 |
| Background | <0.0001 | in Secular Equilibrium | 0.1 | 31 | 0 | Ra-226 | 0.2267 | 0.1909 | 0.2625 | 0 |
| | | | | | | Th-230 | 0.2626 | 0.2314 | 0.2939 | 0 |
| | | | | | | U-234 | 0.2572 | 0.2283 | 0.2861 | 0 |
| | | | | | | U-238 | 0.2534 | 0.2276 | 0.2793 | 0 |
| Parcel F | <0.0001 | in Secular Equilibrium | 0.1 | 38 | 7 | Ra-226 | 0.2360 | 0.2070 | 0.2649 | 0 |
| | | | | | | Th-230 | 0.2631 | 0.2393 | 0.2869 | 0 |
| | | | | | | U-234 | 0.2642 | 0.2422 | 0.2863 | 0 |
| | | | | | | U-238 | 0.2367 | 0.2192 | 0.2542 | 0 |

**Notes:**

1. Analyzed in top 10 feet bgs using the EnviroGISdT software tool from Neptune & Company, Inc.
2. Tool states "in Secular Equilibrium" if the computed *p* -value is less than a standard significance level of 0.05.
3. Sample dataset includes field duplicates
4. Count of samples for which one or more results are unavailable. These samples are not counted in the sample size and are not included in the secular equilibrium calculation.
5. Data Shift - Lists the values of the data shift utililzed by the tool in case of negative radioactivity measurements. All measurements values for that radioisotope are shifted upwards by the shift value so that all values are non-negative. A zero shift value indicates lack of negative measurements.

# Table I-5B. Equivalence Test for Secular Equilibrium of Thorium Decay Series (Th-232 Chain)[1]

## Nevada Environmental Response Trust Remediation Project Site

## Henderson, Nevada

| Location | p-value | Conclusion[2] | Delta | Sample Size[3] | Number Missing[4] | Analyte | Mean Proportions of Radioactivity | 95% Confid. Intervals | | Shifts[5] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper | |
| All | <0.0001 | in Secular Equilibrium | 0.1 | 76 | 0 | Ra-228 | 0.3285 | 0.2949 | 0.3622 | 0 |
| | | | | | | Th-228 | 0.3524 | 0.3323 | 0.3724 | 0 |
| | | | | | | Th-232 | 0.3191 | 0.3014 | 0.3368 | 0 |
| Background | 0.164 | Not in Secular Equilibrium | 0.1 | 31 | 0 | Ra-228 | 0.2779 | 0.2341 | 0.3218 | 0 |
| | | | | | | Th-228 | 0.3808 | 0.3557 | 0.4060 | 0 |
| | | | | | | Th-232 | 0.3413 | 0.3141 | 0.3684 | 0 |
| Parcel F | <0.0001 | in Secular Equilibrium | 0.1 | 45 | 0 | Ra-228 | 0.3634 | 0.3187 | 0.4081 | 0 |
| | | | | | | Th-228 | 0.3327 | 0.3052 | 0.3602 | 0 |
| | | | | | | Th-232 | 0.3038 | 0.2812 | 0.3265 | 0 |

**Note:**

1. Analyzed in top 10 feet bgs using the EnviroGISdT software tool from Neptune & Company, Inc.

2. Tool states "in Secular Equilibrium" if the computed *p* -value is less than a standard significance level of 0.05.

3. Sample dataset includes field duplicates

4. Count of samples for which one or more results are unavailable. These samples are not counted in the sample size and are not included in the secular equilibrium calculation.

5. Data Shift - Lists the values of the data shift utililzed by the tool in case of negative radioactivity measurements. All measurements values for that radioisotope are shifted upwards by the shift value so that all values are non-negative. A zero shift value indicates lack of negative measurements.

## Table I-6. Correlation Matrices for the Uranium Decay Series and the Thorium Decay Series

### Nevada Environmental Response Trust Remediation Project Site

### Henderson, Nevada

### i) Parcels F (0-10 ft bgs)

| Uranium Decay Chain | | | | |
|---|---|---|---|---|
| Correl. | Ra-226 | Th-230 | U-234 | U-238 |
| Ra-226 | 1 | -0.274 | 0.010 | -0.030 |
| Th-230 | -0.274 | 1 | 0.292 | 0.305 |
| U-234 | 0.010 | 0.292 | 1 | 0.840 |
| U-238 | -0.030 | 0.305 | 0.840 | 1 |

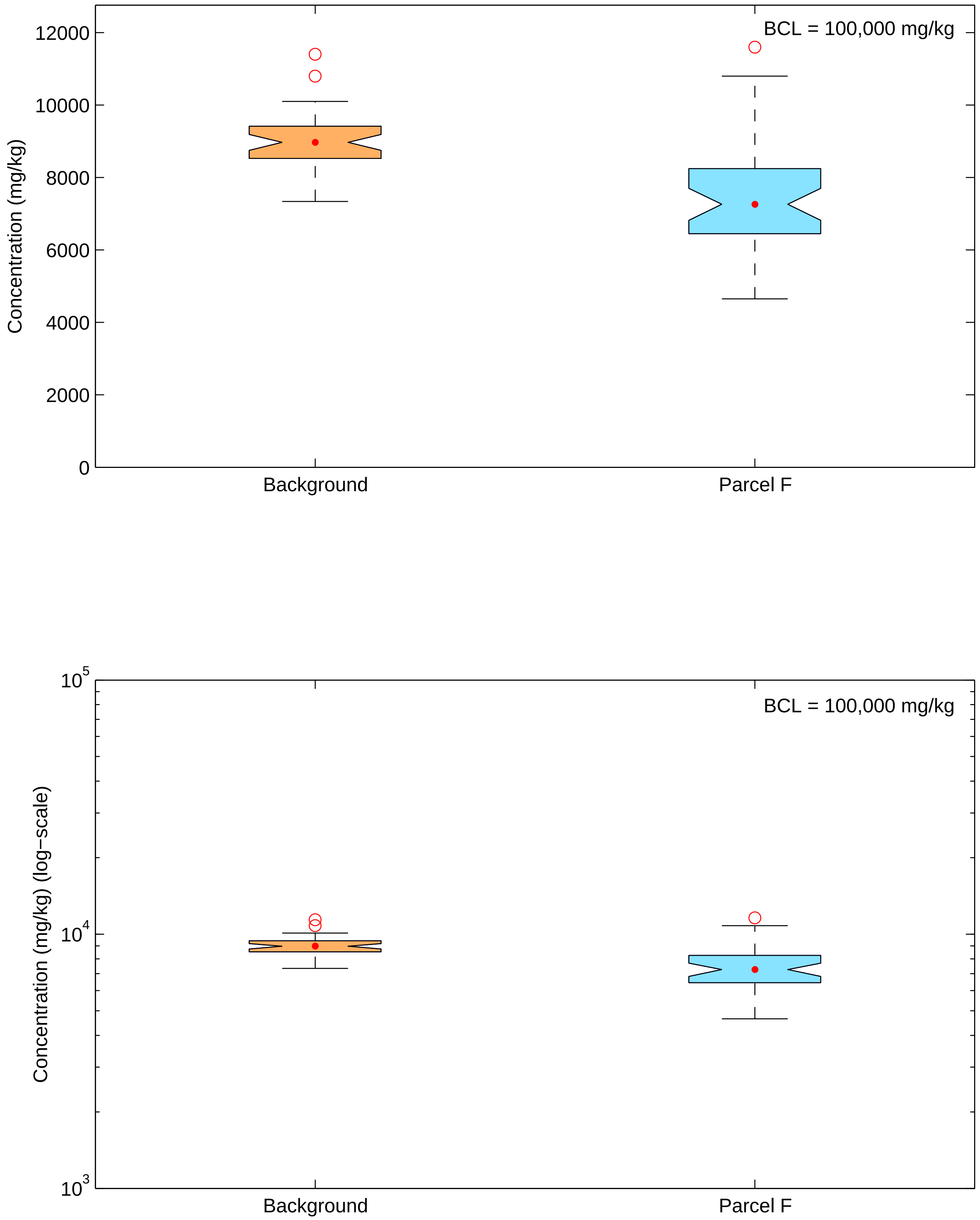
| Thorium Decay Chain | | | |
|---|---|---|---|
| Correl. | Ra-228 | Th-228 | Th-232 |
| Ra-228 | 1 | 0.080 | 0.152 |
| Th-228 | 0.080 | 1 | 0.470 |
| Th-232 | 0.152 | 0.470 | 1 |

### ii) Background (RZ-A) Soils

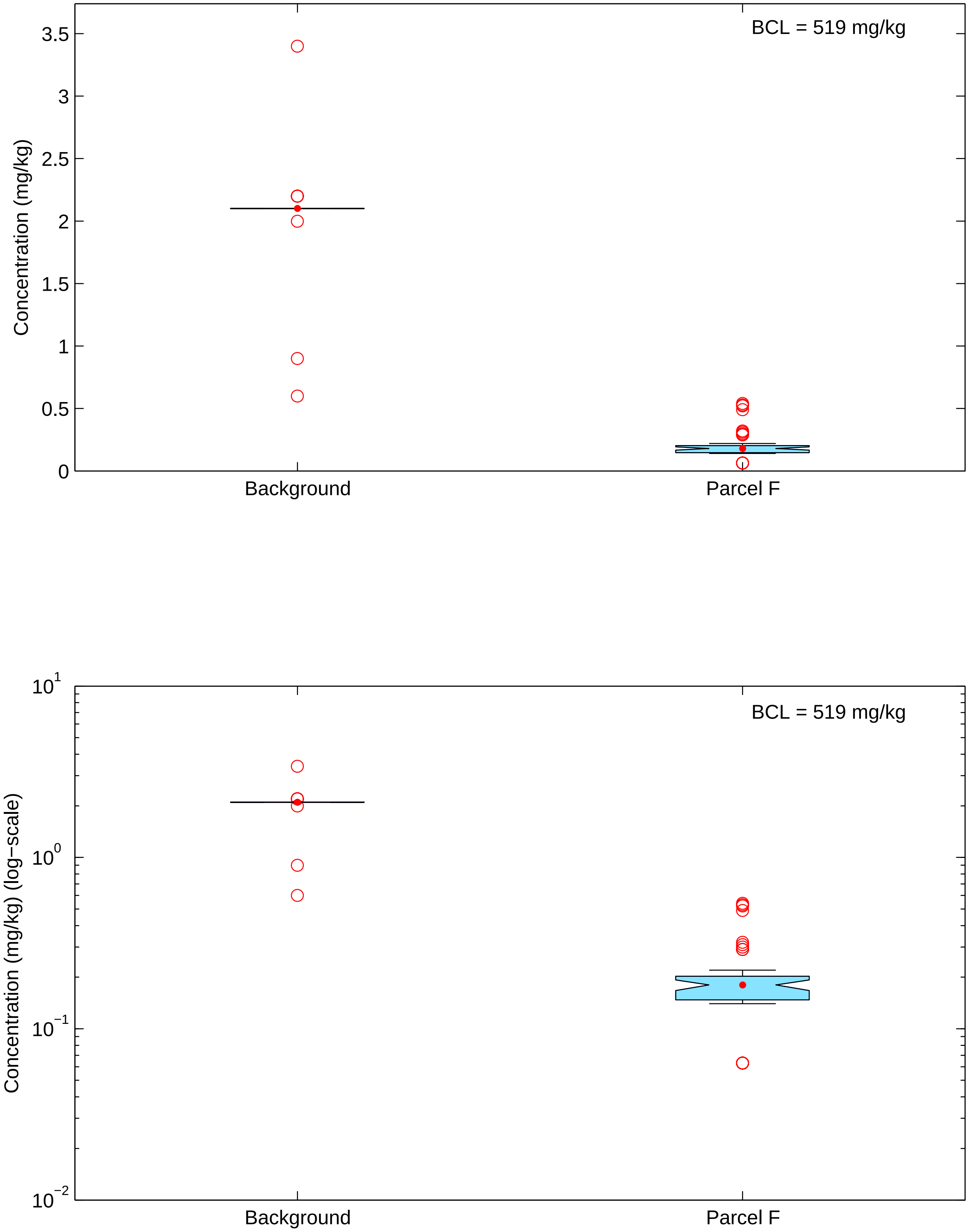
| Uranium Decay Chain | | | | |
|---|---|---|---|---|
| Correl. | Ra-226 | Th-230 | U-234 | U-238 |
| Ra-226 | 1 | 0.680 | 0.313 | 0.321 |
| Th-230 | 0.680 | 1 | 0.351 | 0.271 |
| U-234 | 0.313 | 0.351 | 1 | 0.886 |
| U-238 | 0.321 | 0.271 | 0.886 | 1 |

| Thorium Decay Chain | | | |
|---|---|---|---|
| Correl. | Ra-228 | Th-228 | Th-232 |
| Ra-228 | 1 | 0.297 | 0.119 |
| Th-228 | 0.297 | 1 | 0.627 |
| Th-232 | 0.119 | 0.627 | 1 |

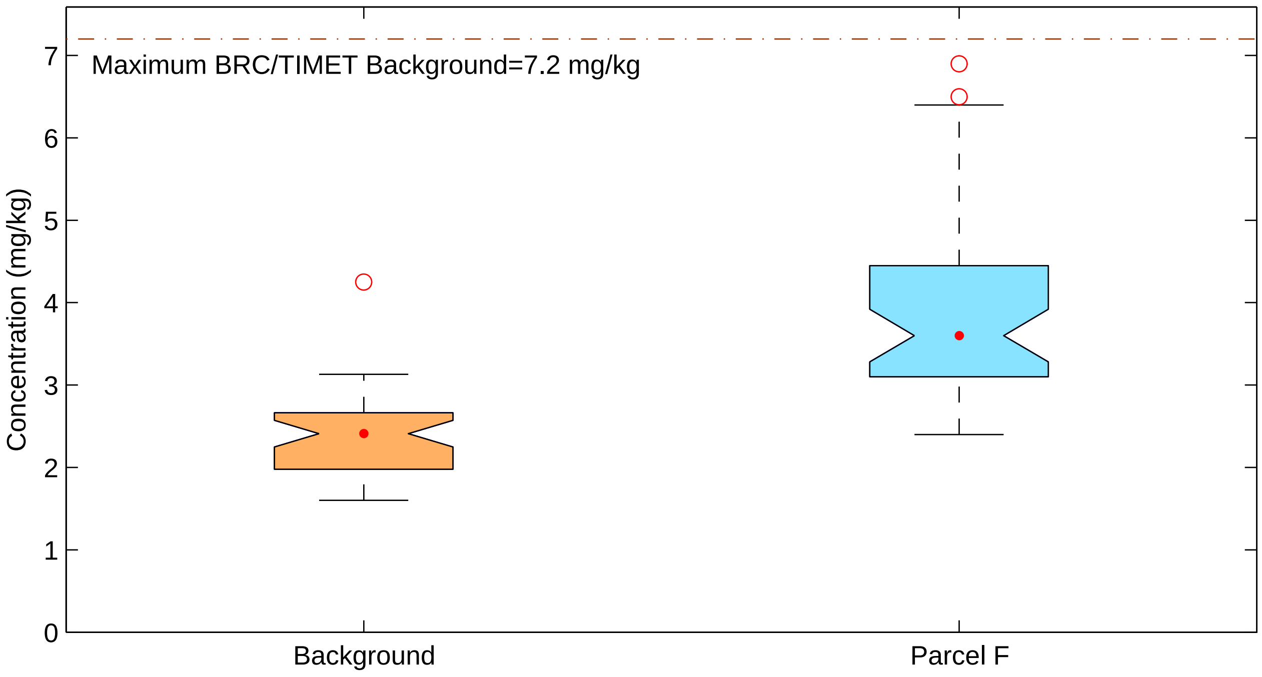
# Figure I1−1. Background vs. Parcel F Boxplots
# Aluminum

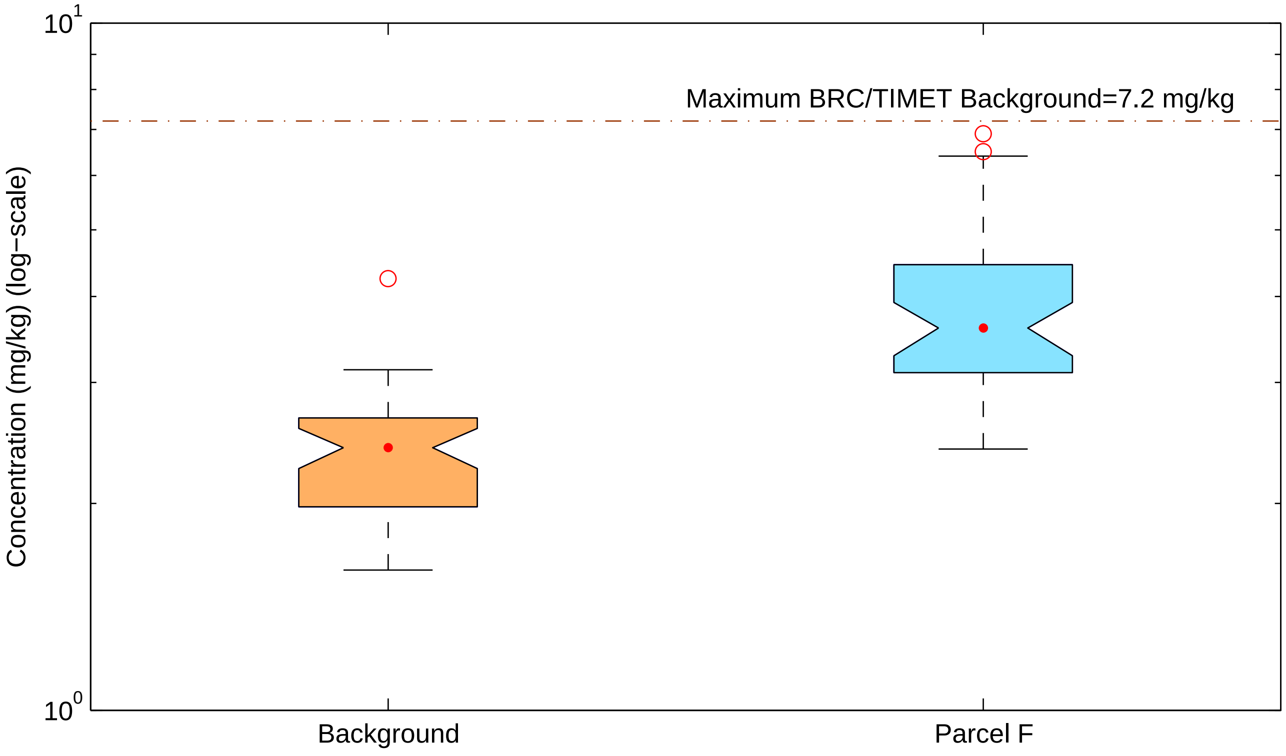


# Figure I1−2. Background vs. Parcel F Boxplots
# Antimony



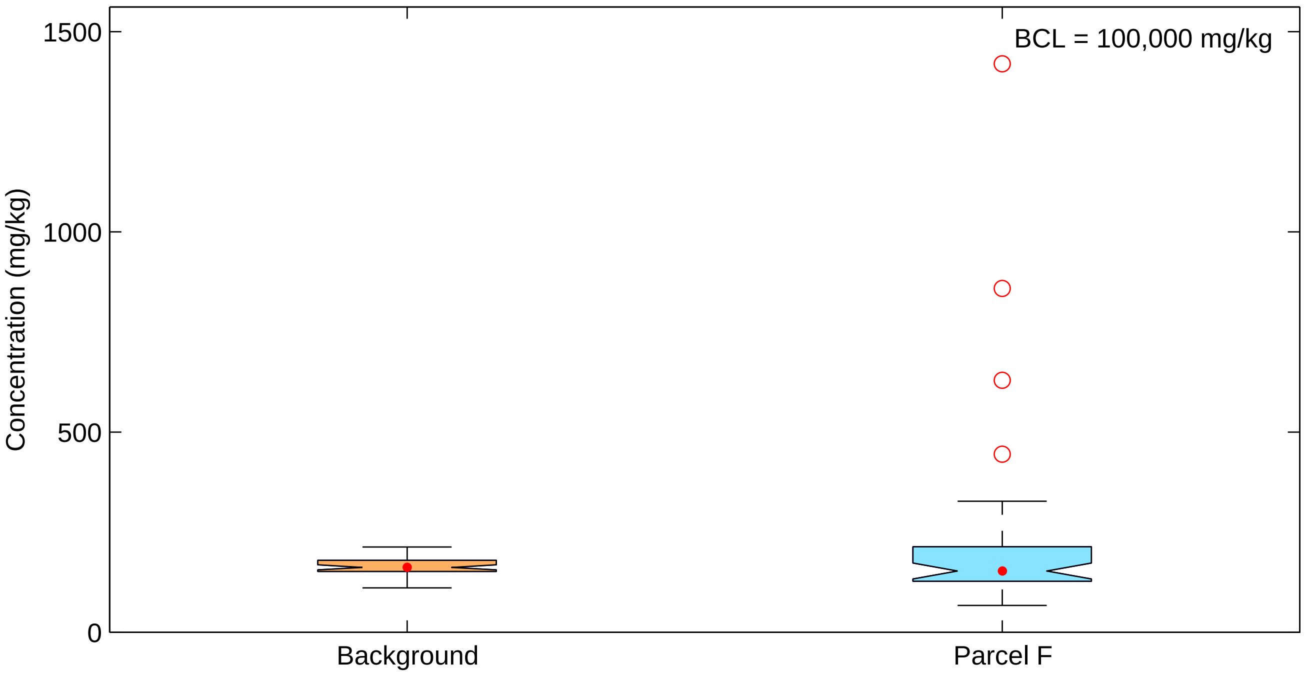
# Figure I1−3. Background vs. Parcel F Boxplots
# Arsenic

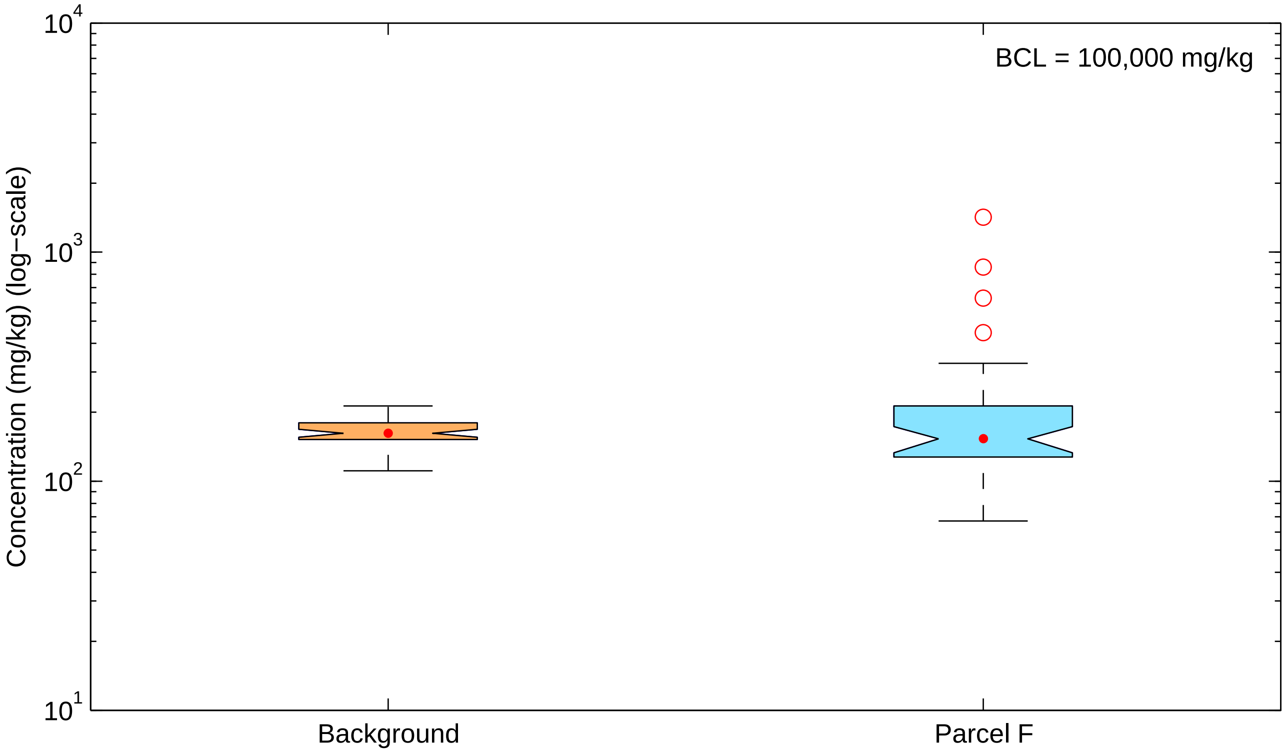




**Ramboll Environ**

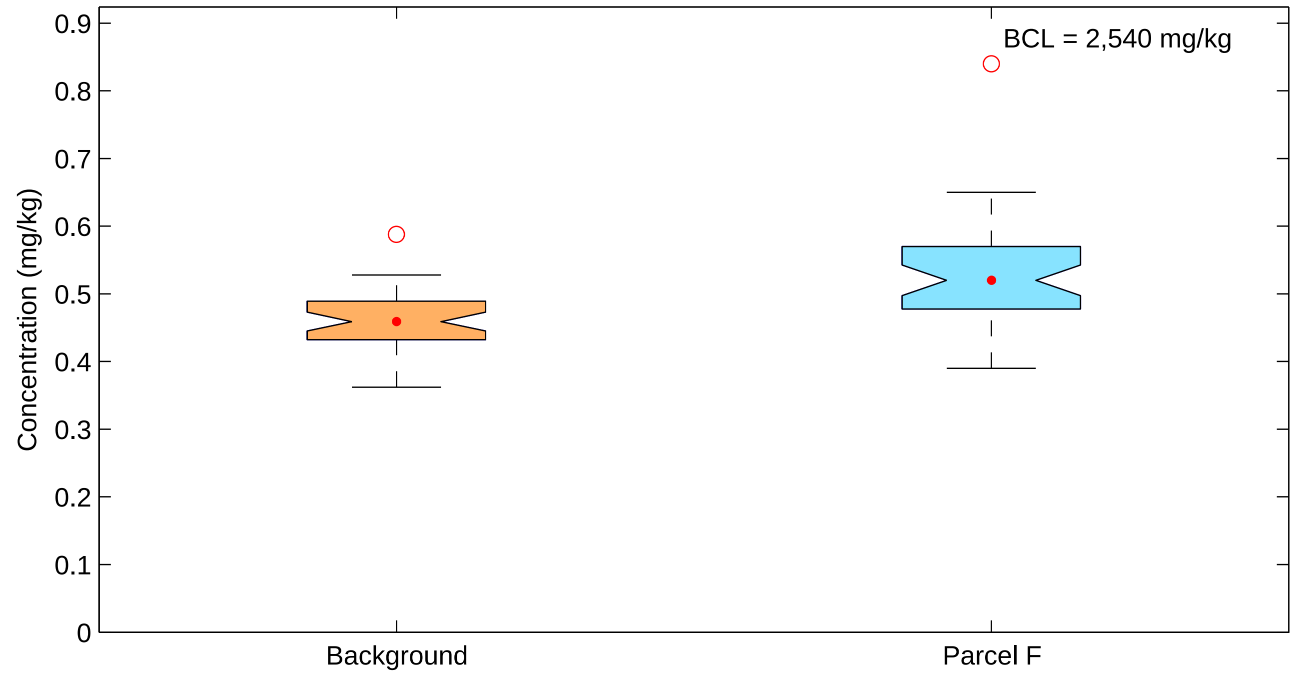
# Figure I1−4. Background vs. Parcel F Boxplots
## Barium

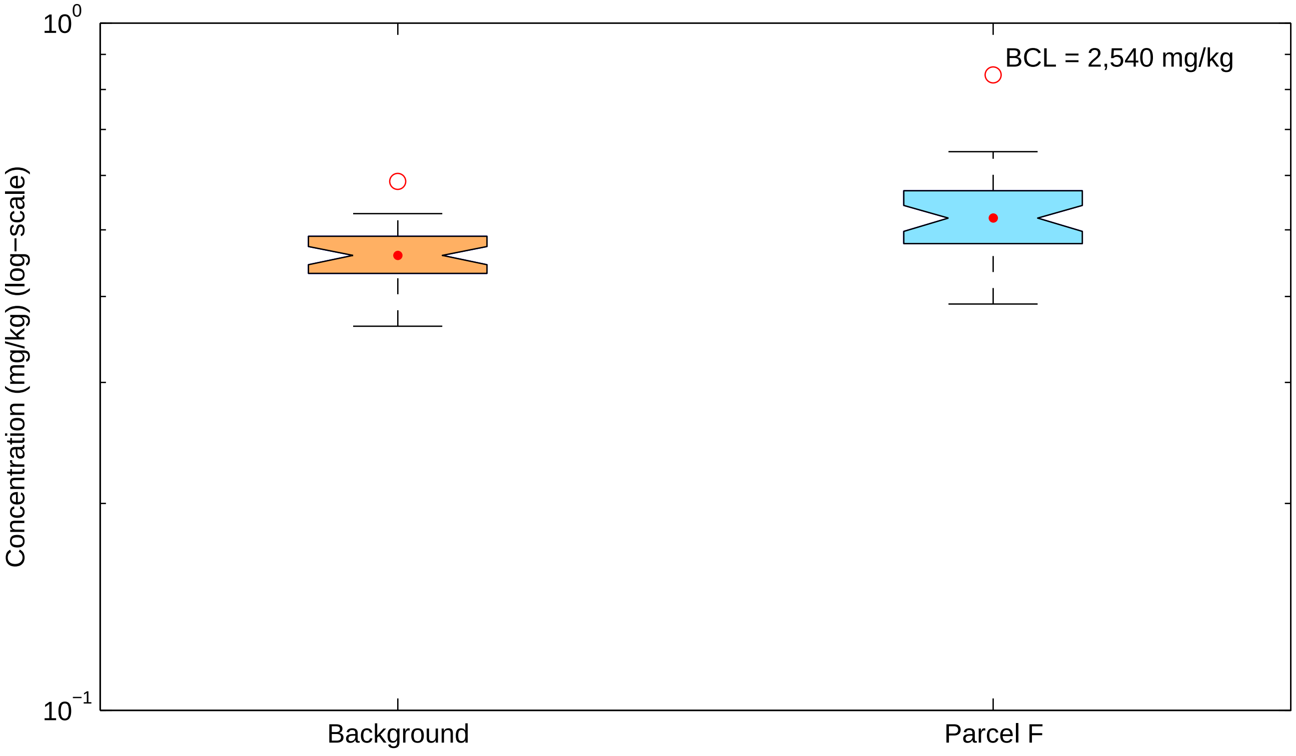




**Ramboll Environ**

# Figure I1−5. Background vs. Parcel F Boxplots
# Beryllium





# Figure I1−6. Background vs. Parcel F Boxplots
## Boron

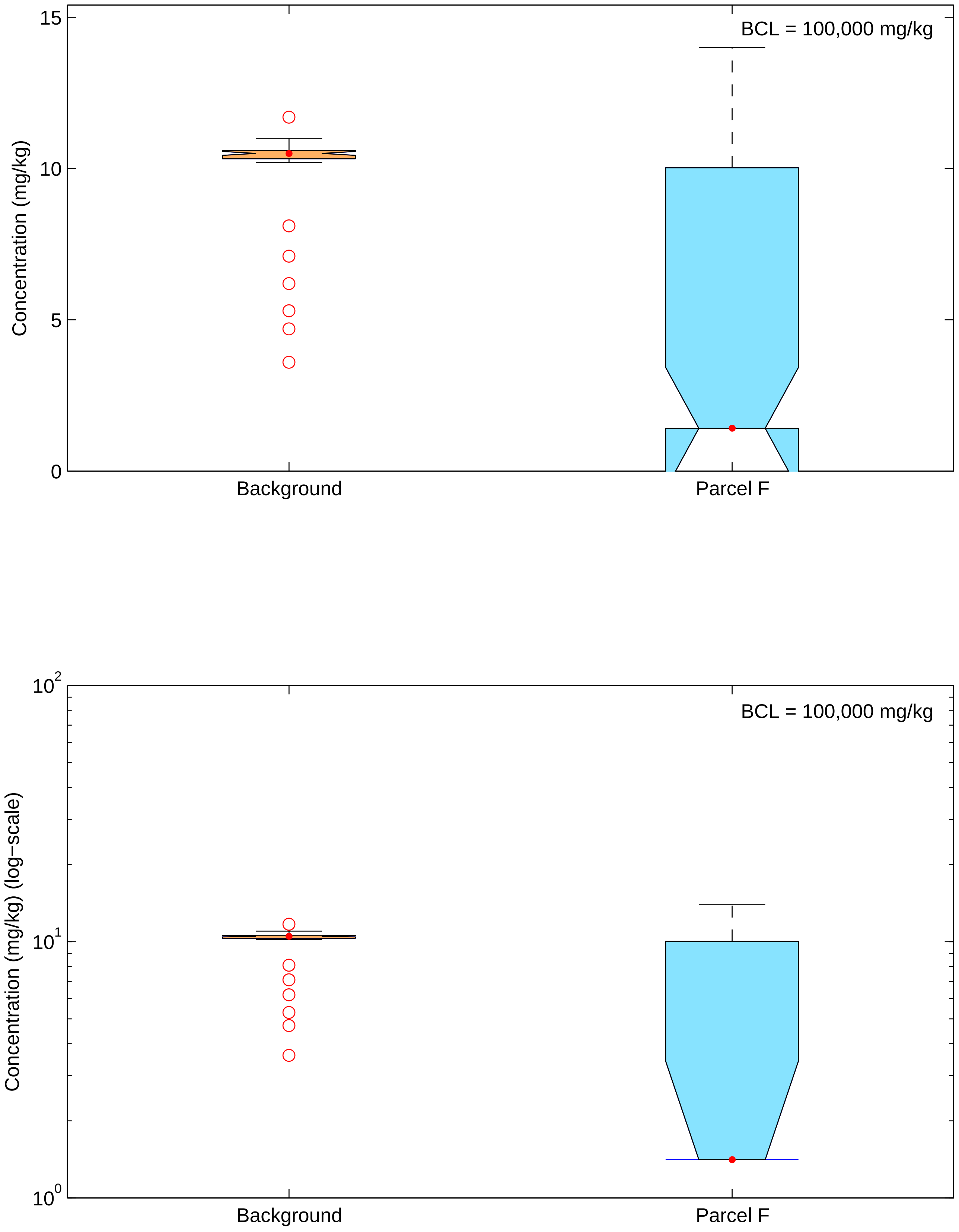


Figure I1−7. Background vs. Parcel F Boxplots
Cadmium

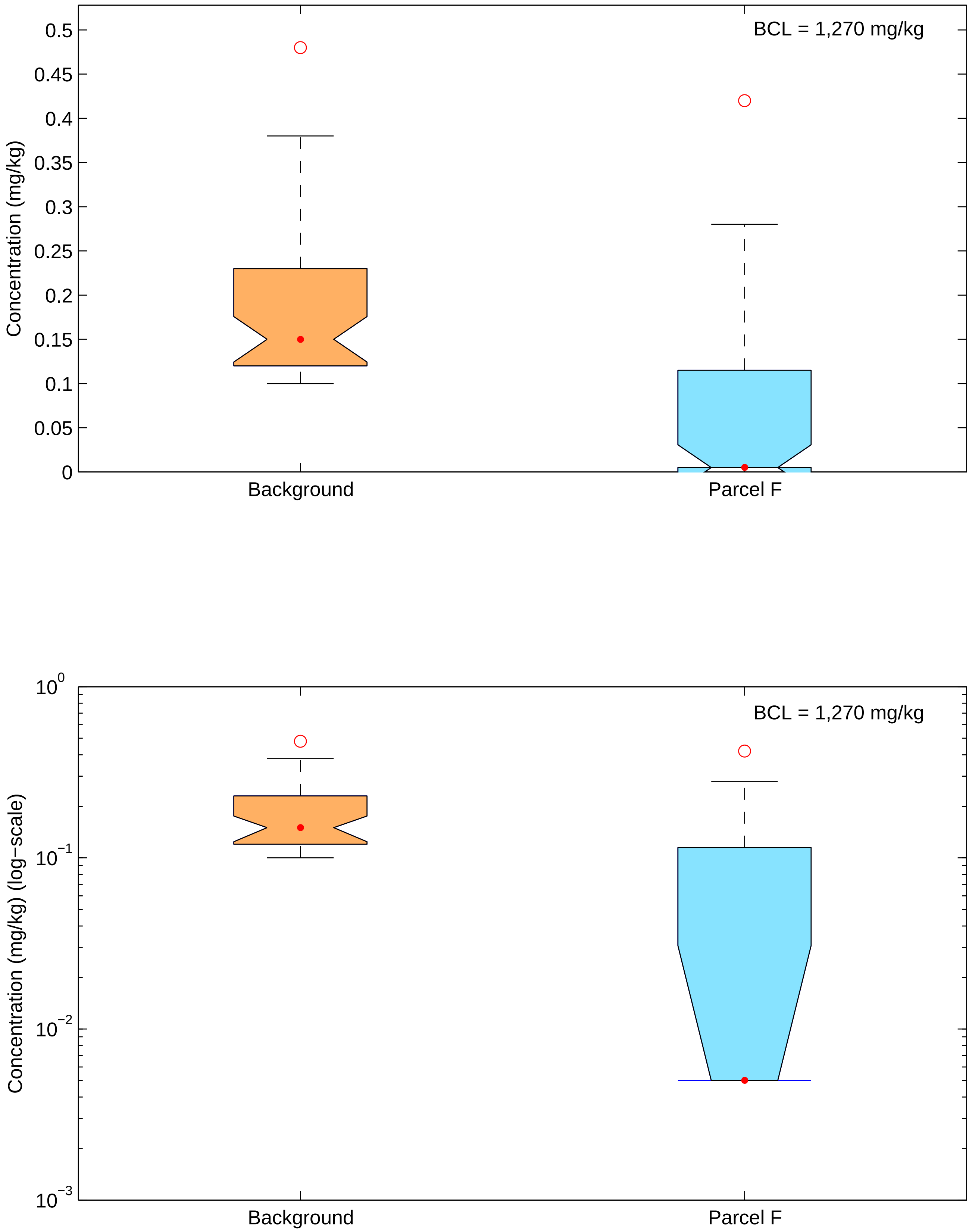
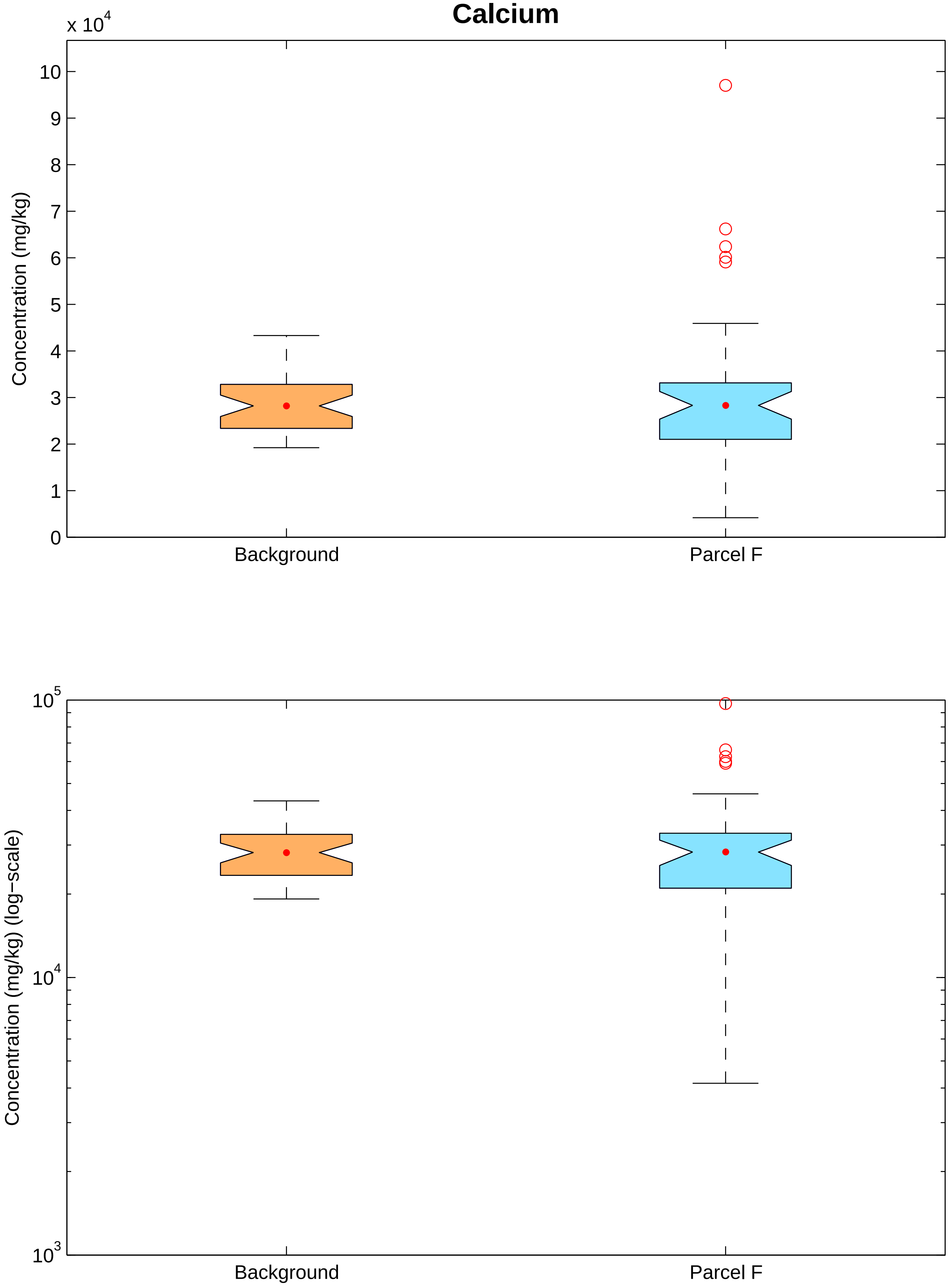
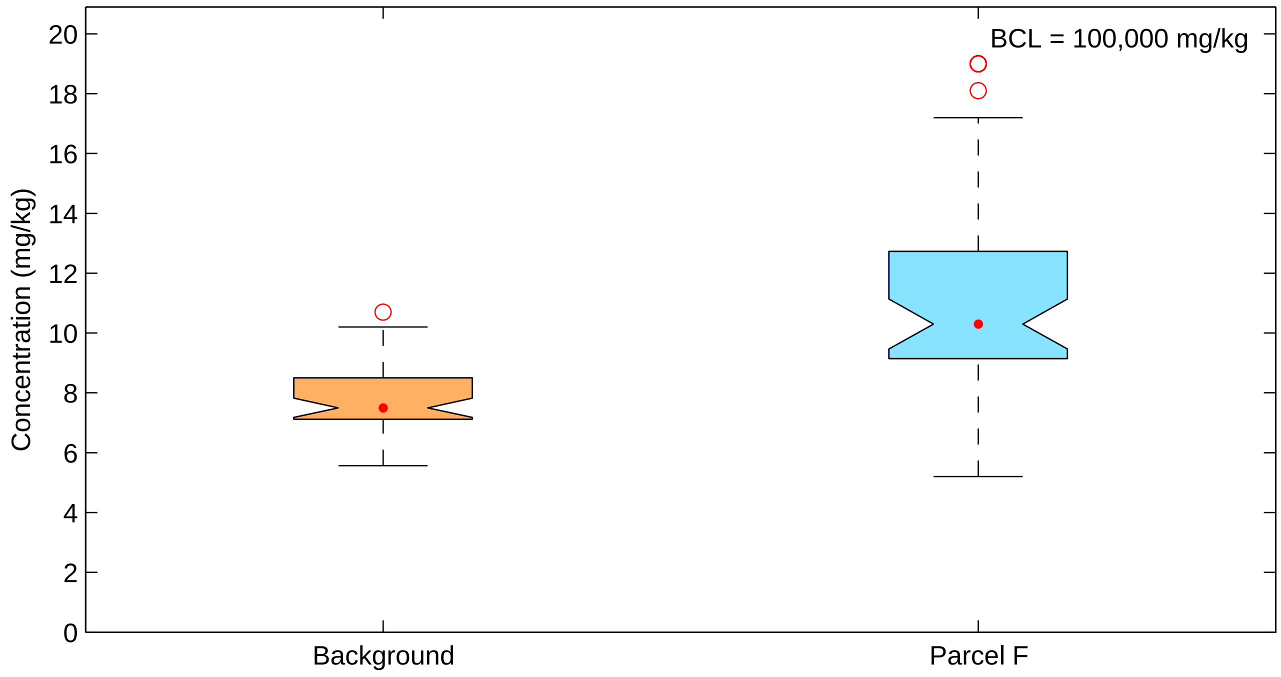
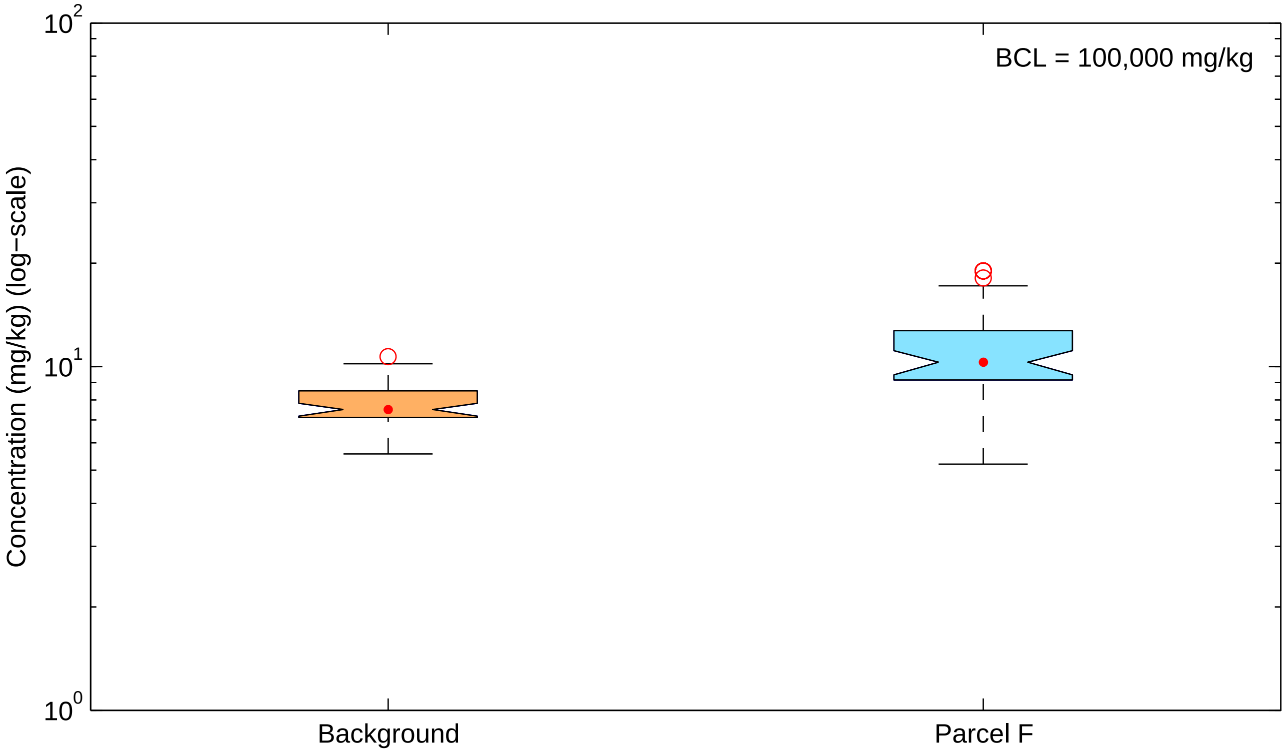


**Figure I1−8. Background vs. Parcel F Boxplots**
**Calcium**

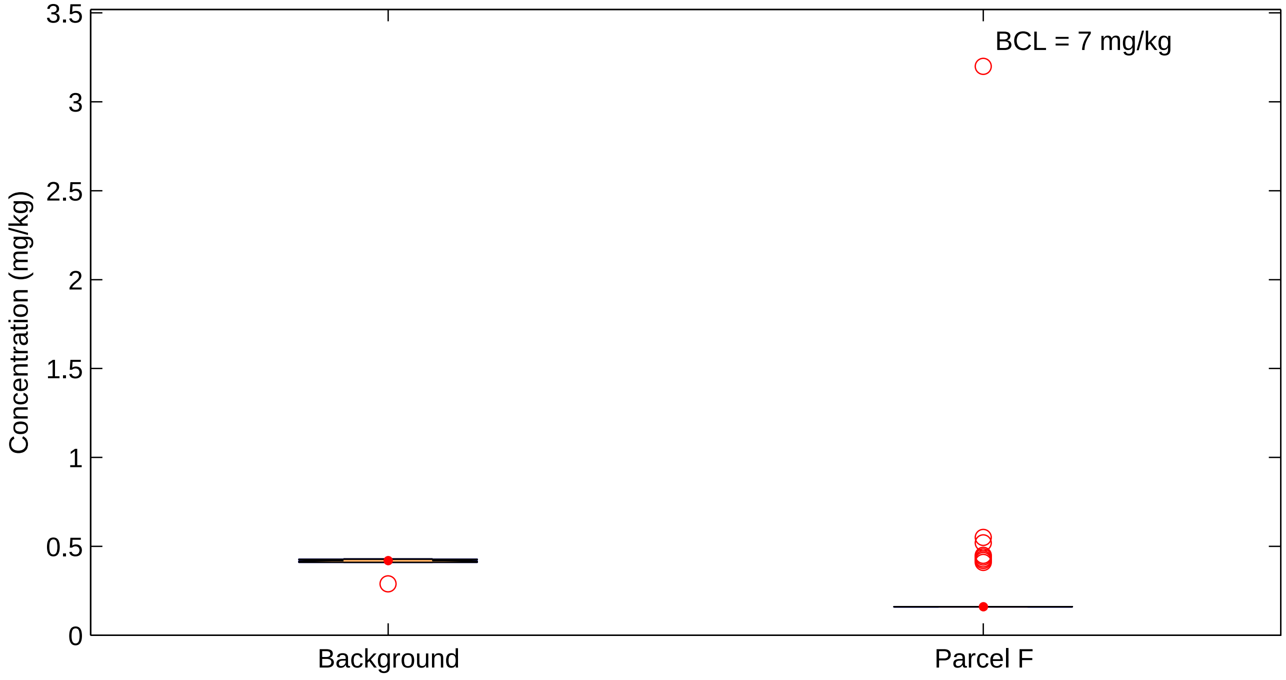


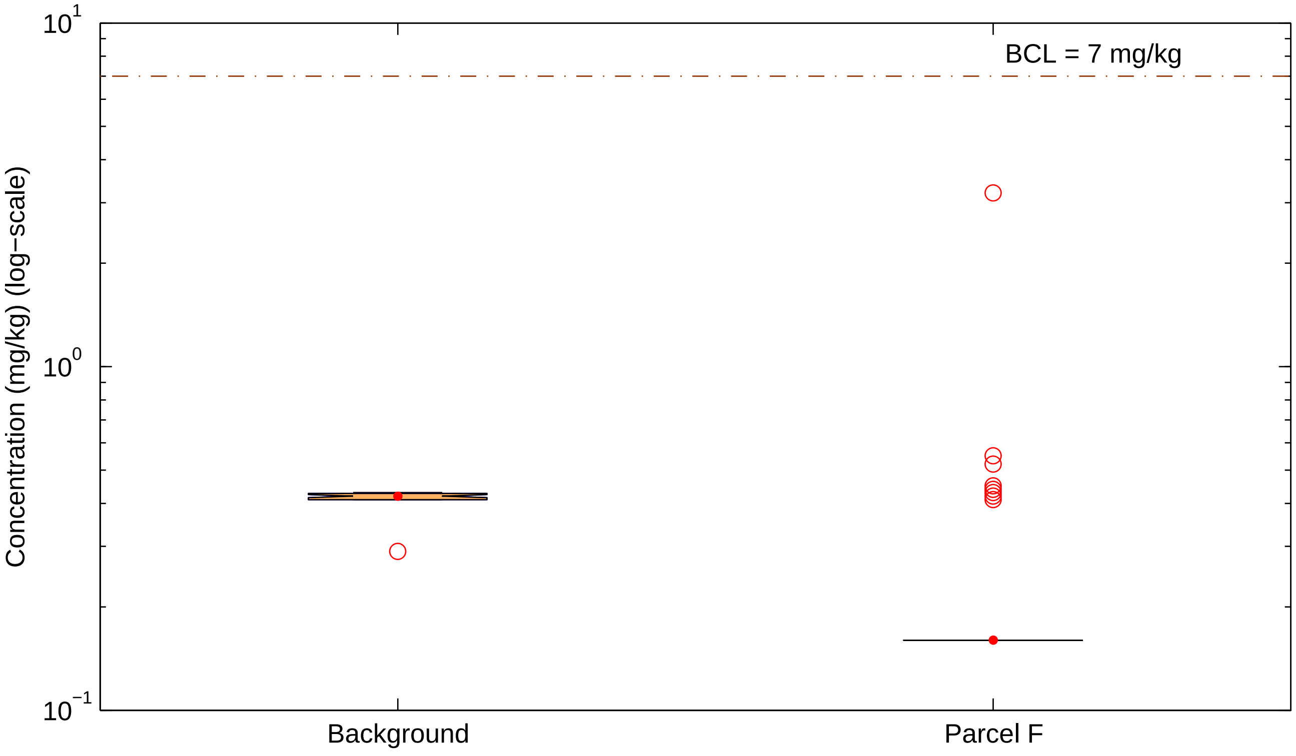
# Figure I1−9. Background vs. Parcel F Boxplots
# Chromium (total)





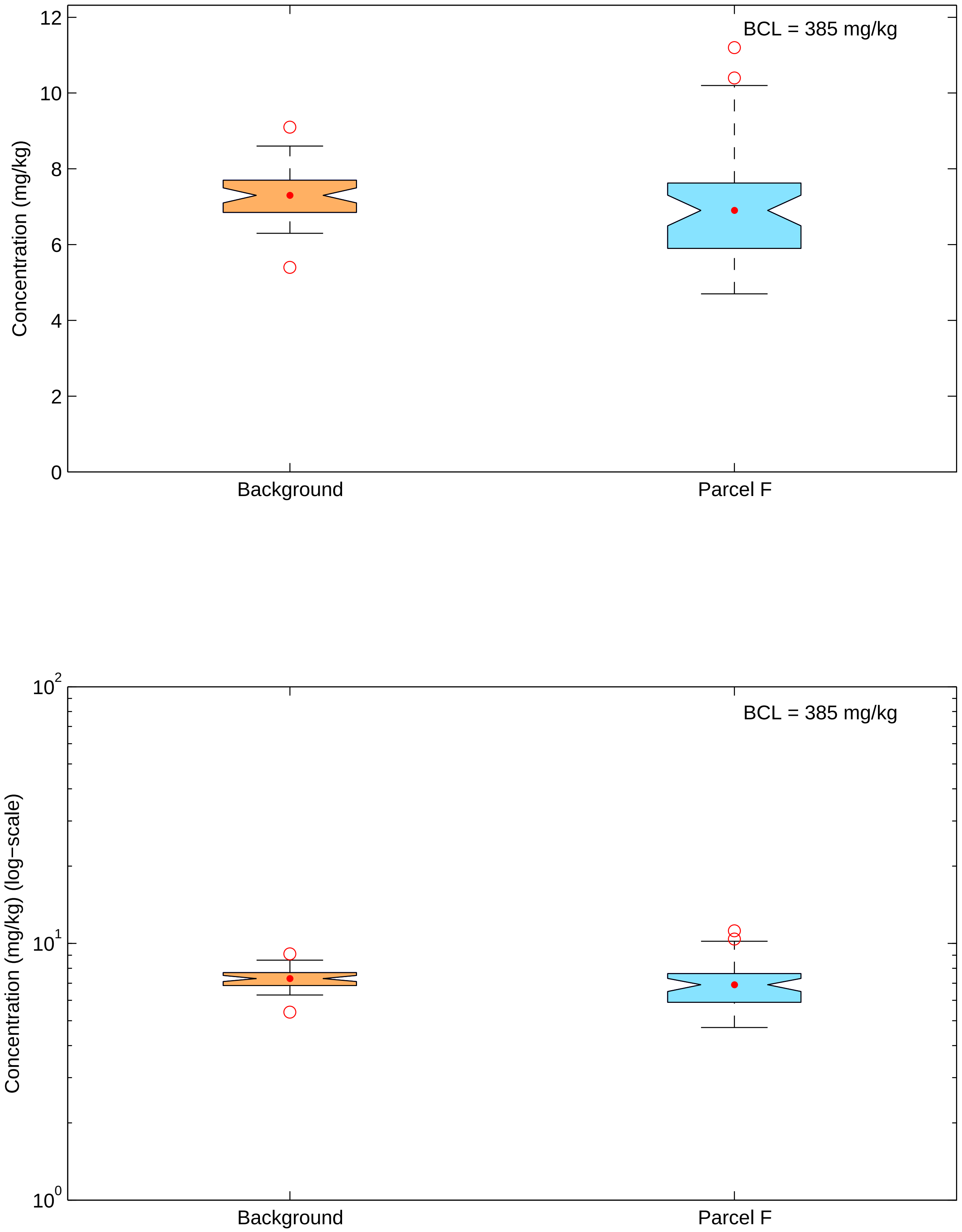
# Figure I1−10. Background vs. Parcel F Boxplots
# Chromium VI





**Ramboll Environ**

# Figure I1−11. Background vs. Parcel F Boxplots
# Cobalt



# Figure I1−12. Background vs. Parcel F Boxplots
# Copper

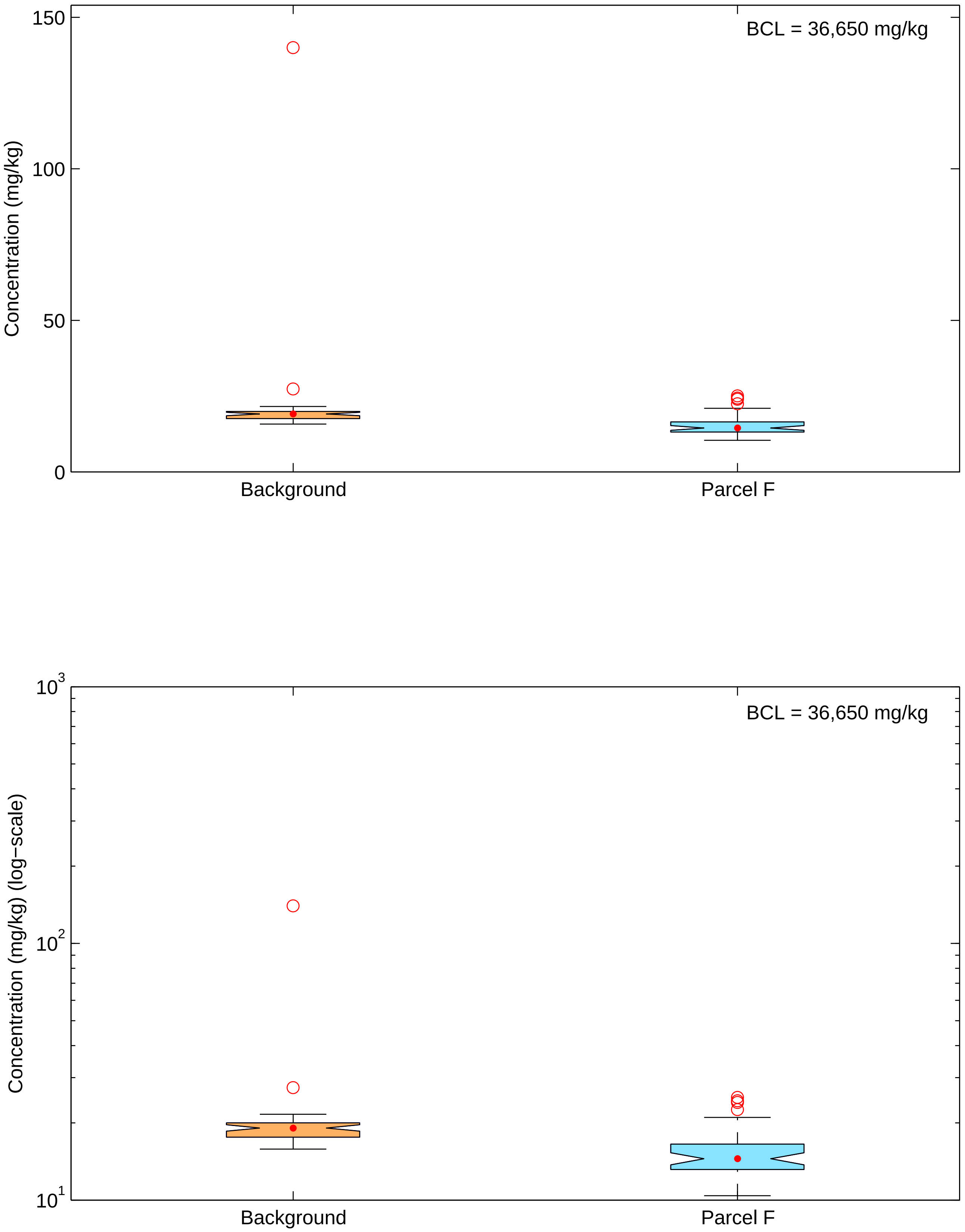
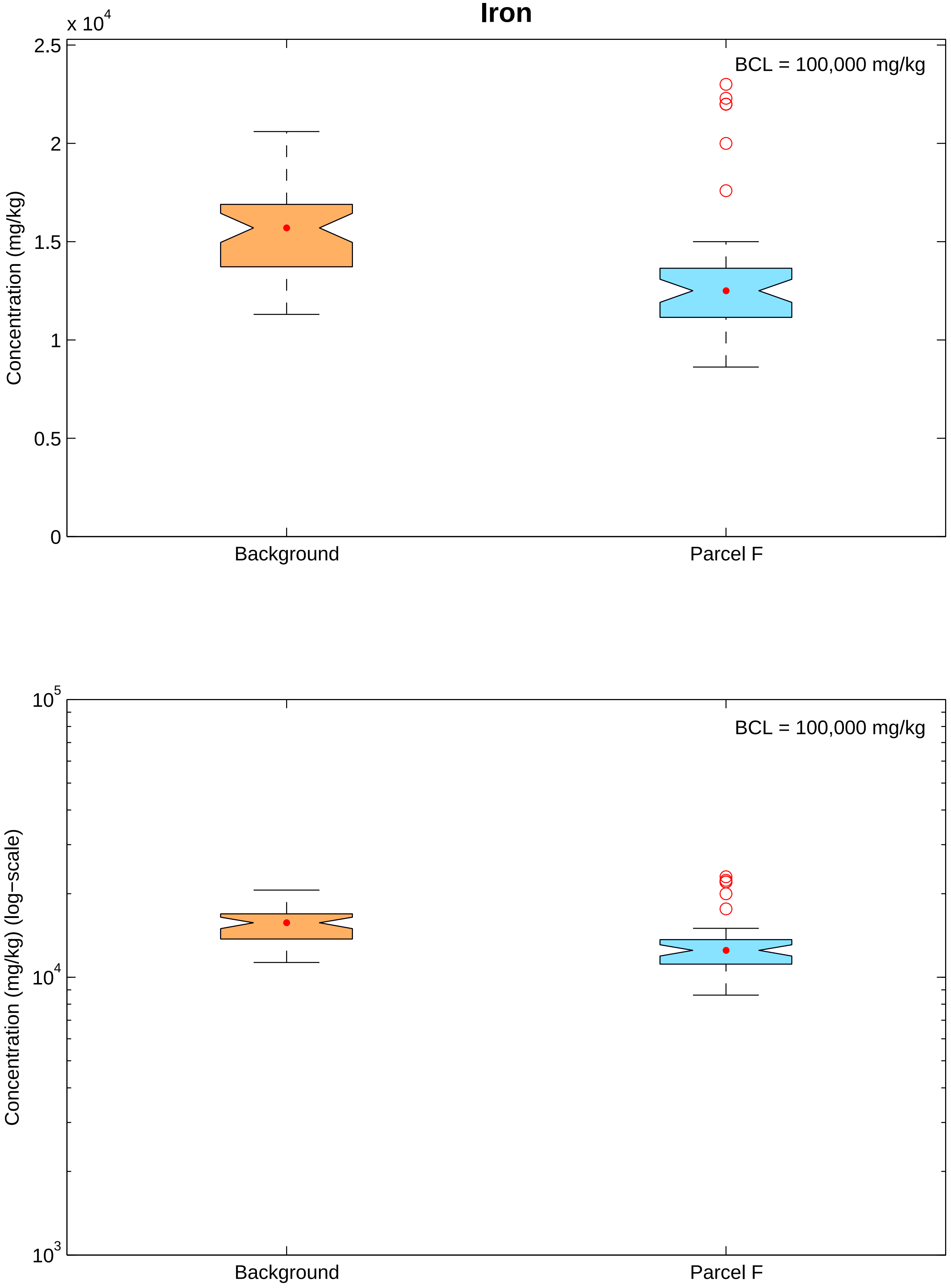
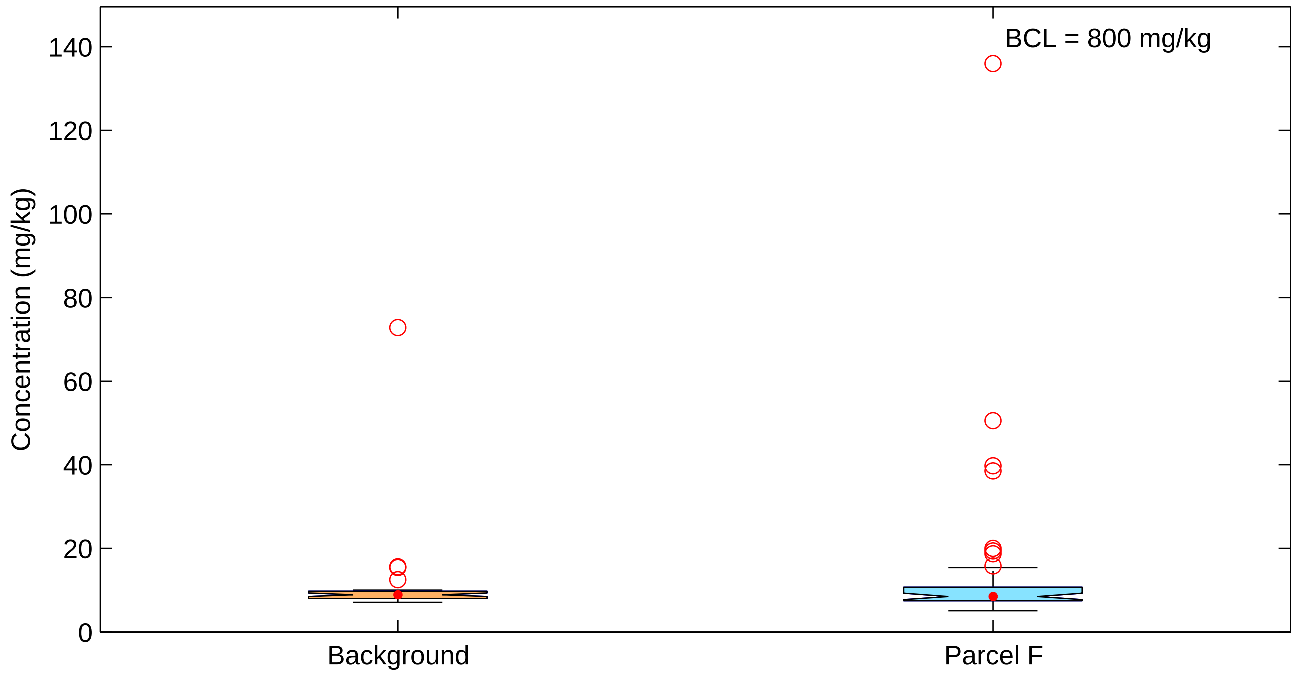
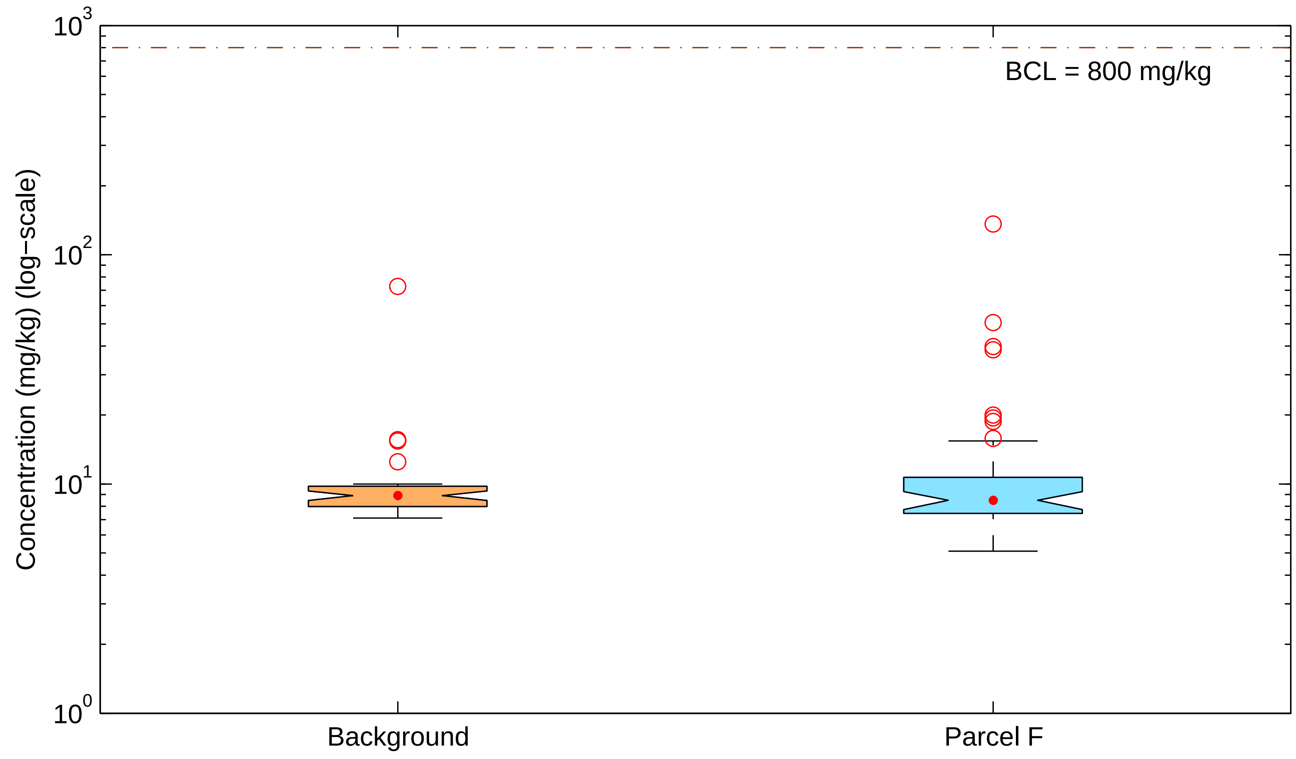


**Figure I1−13. Background vs. Parcel F Boxplots**
**Iron**



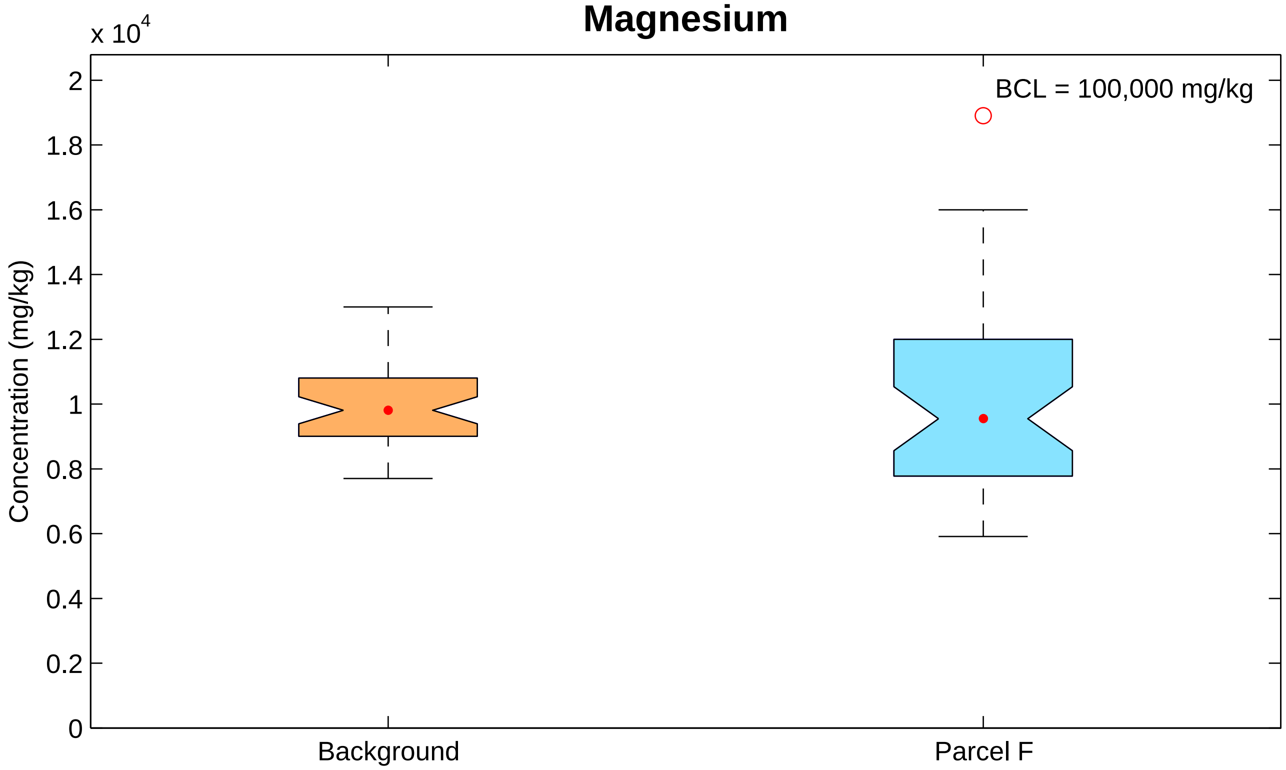
# Figure I1−14. Background vs. Parcel F Boxplots
# Lead

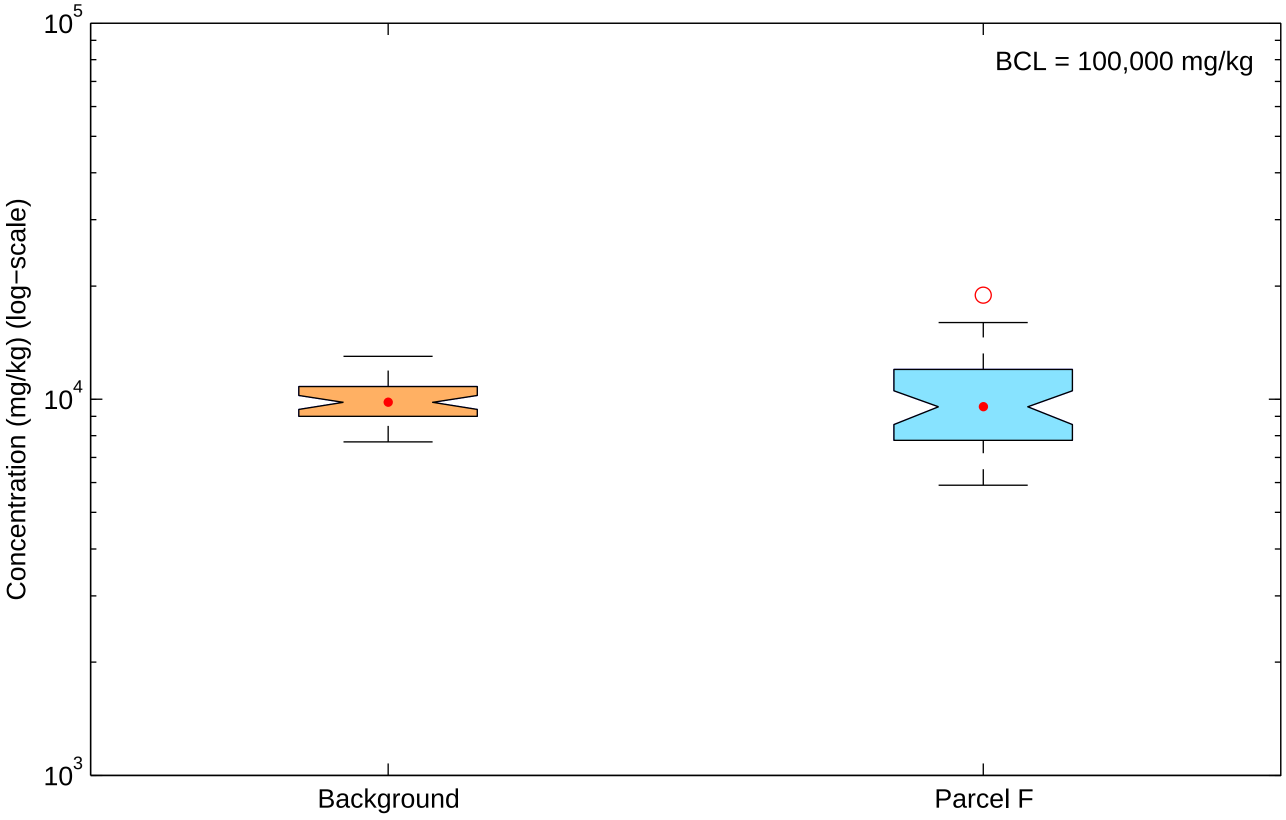




**Ramboll Environ**

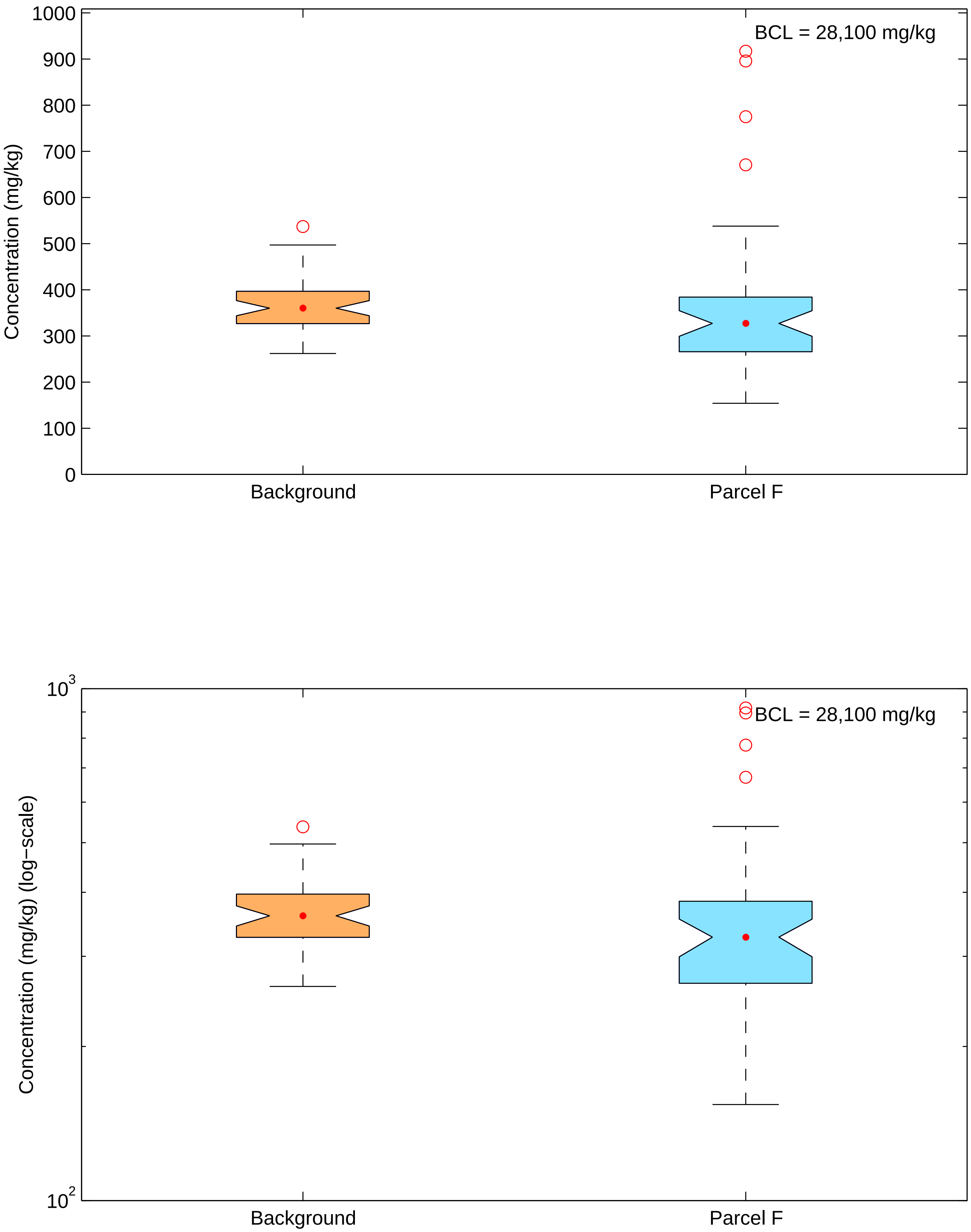
# Figure I1−15. Background vs. Parcel F Boxplots
# Magnesium





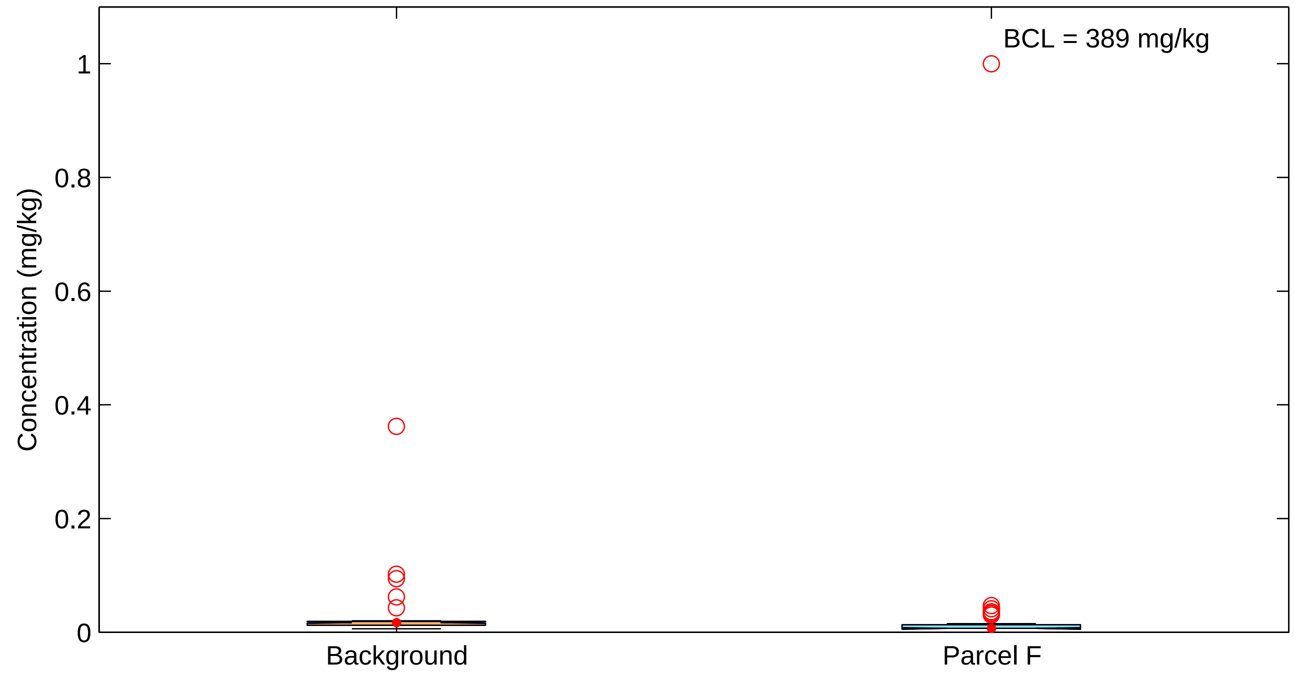
**Ramboll Environ**

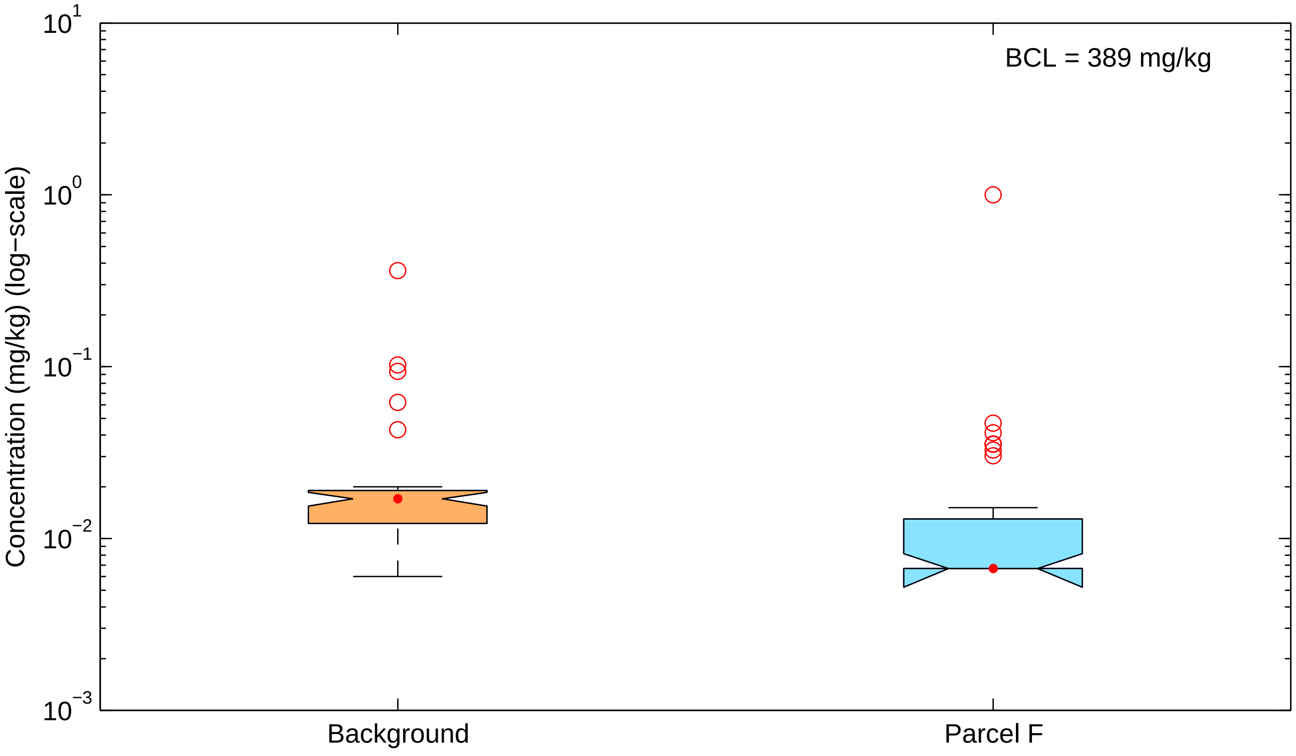
# Figure I1−16. Background vs. Parcel F Boxplots
# Manganese



**Ramboll Environ**

# Figure I1−17. Background vs. Parcel F Boxplots
# Mercury





**Ramboll Environ**

# Figure I1−18. Background vs. Parcel F Boxplots
## Molybdenum

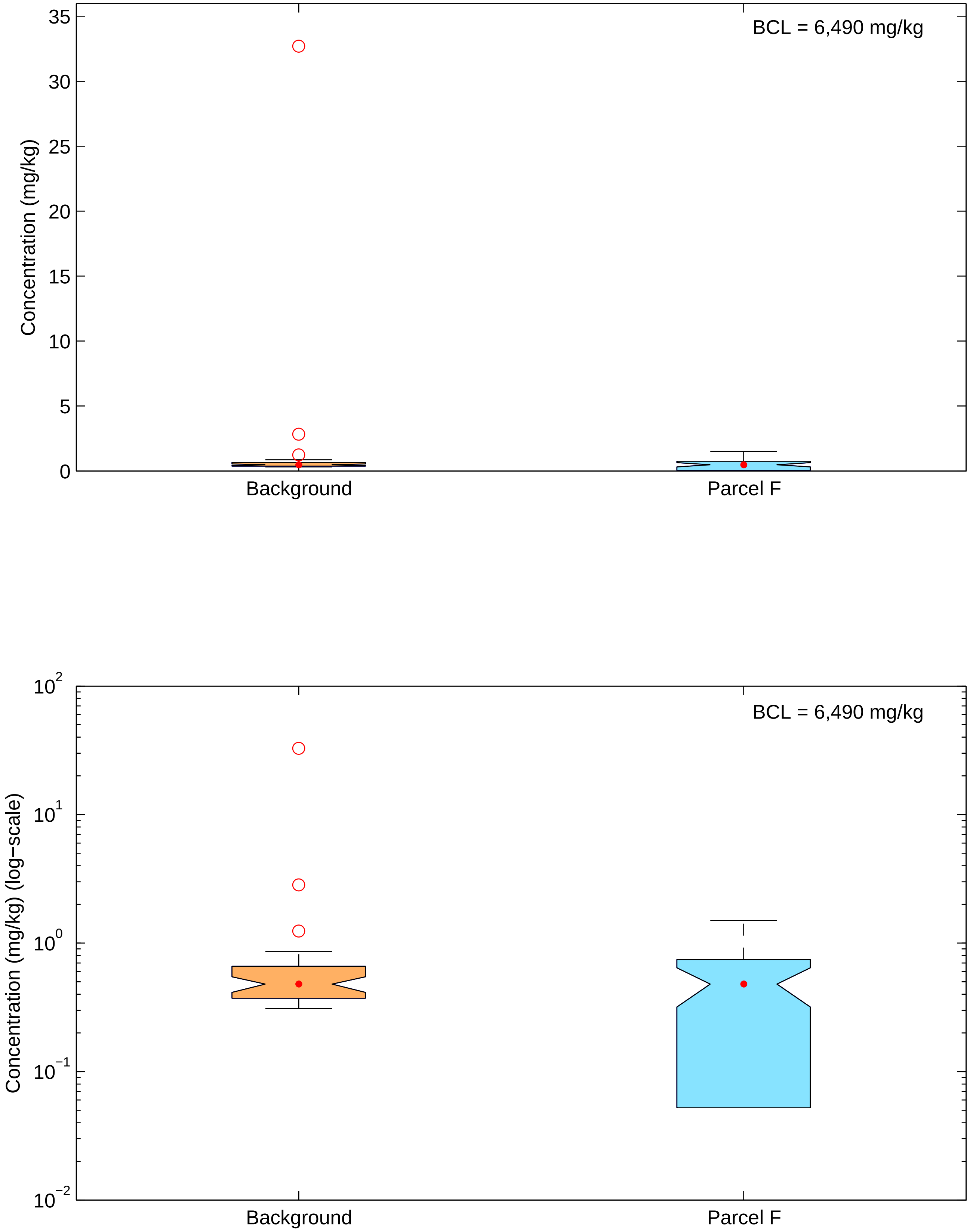
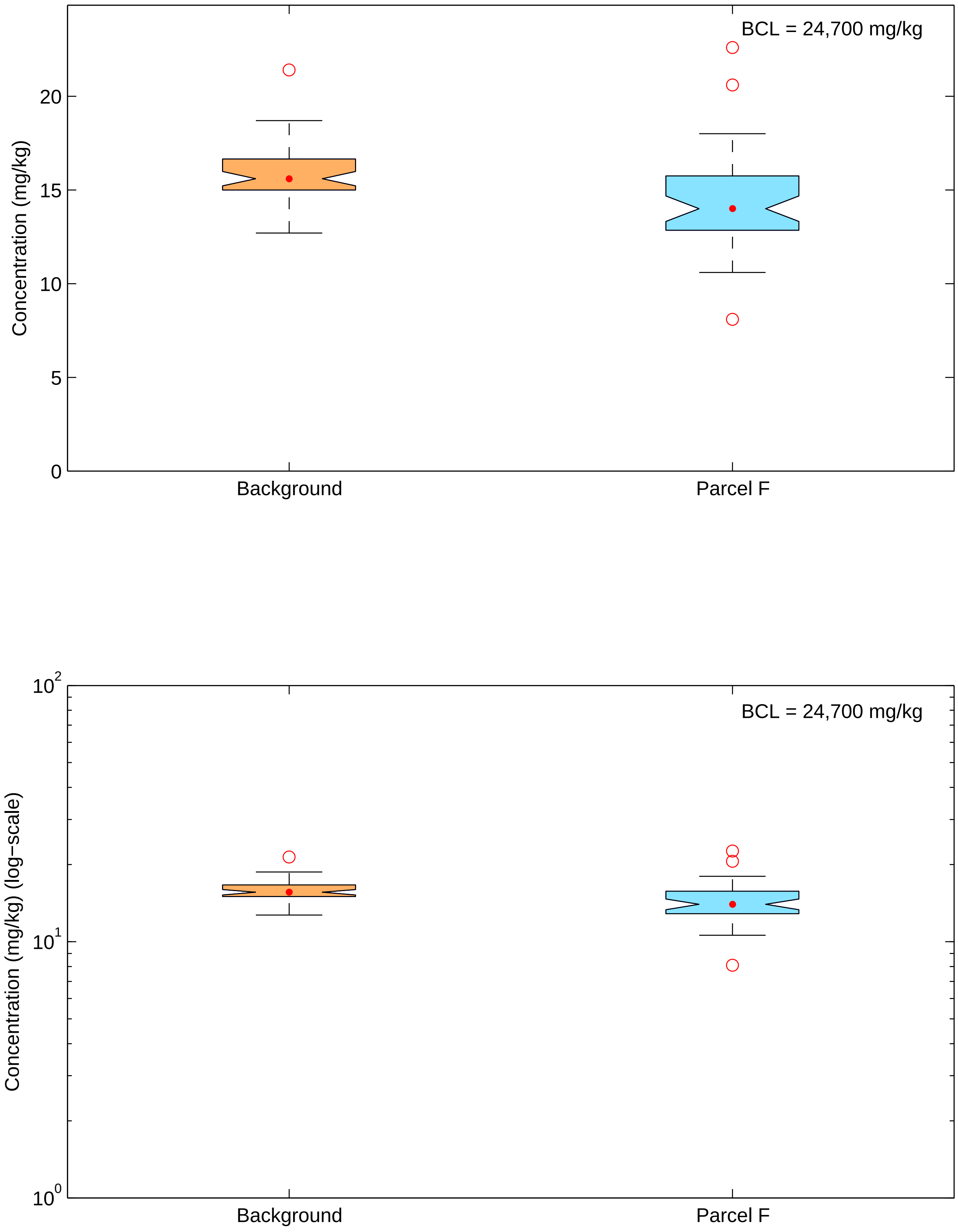
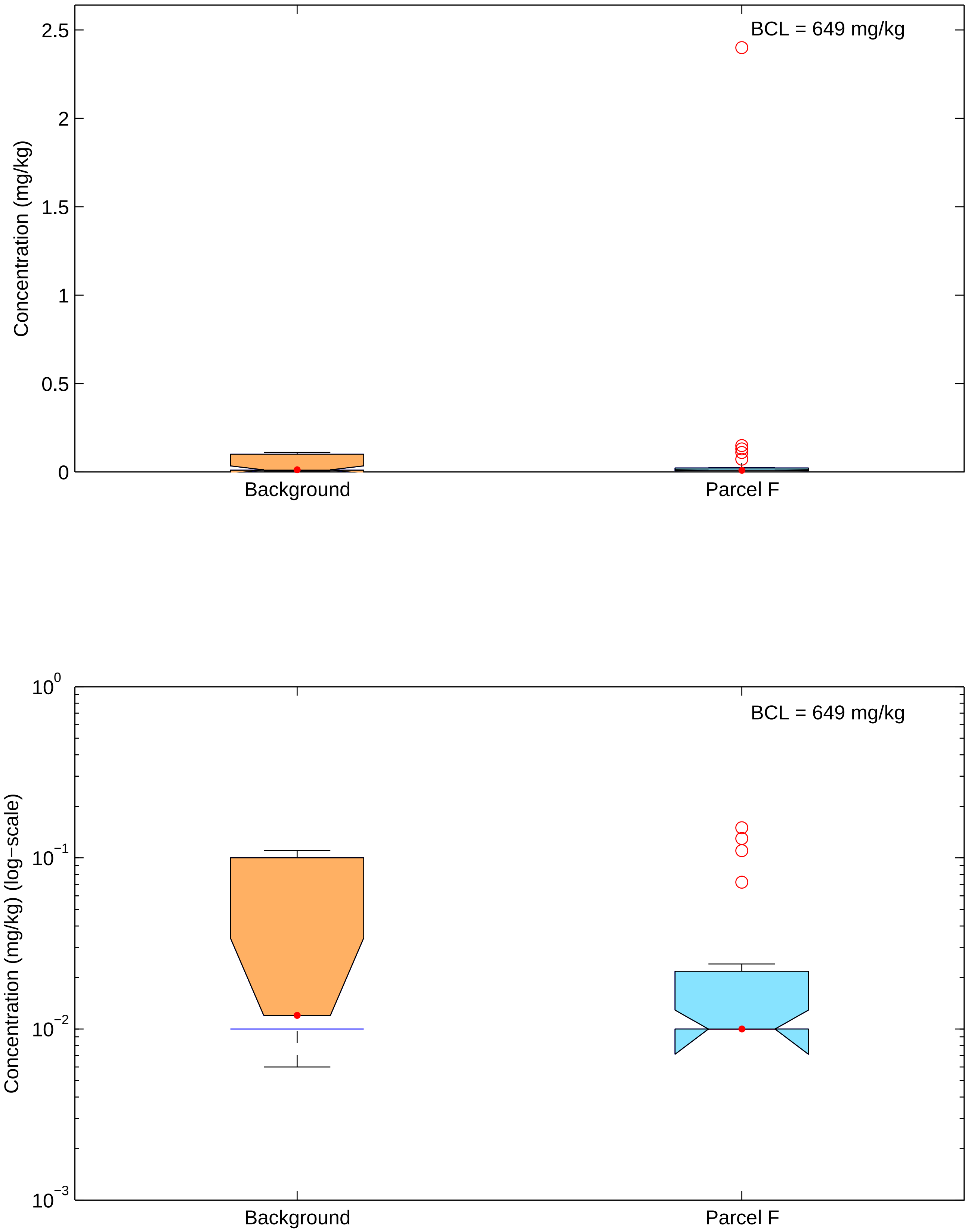


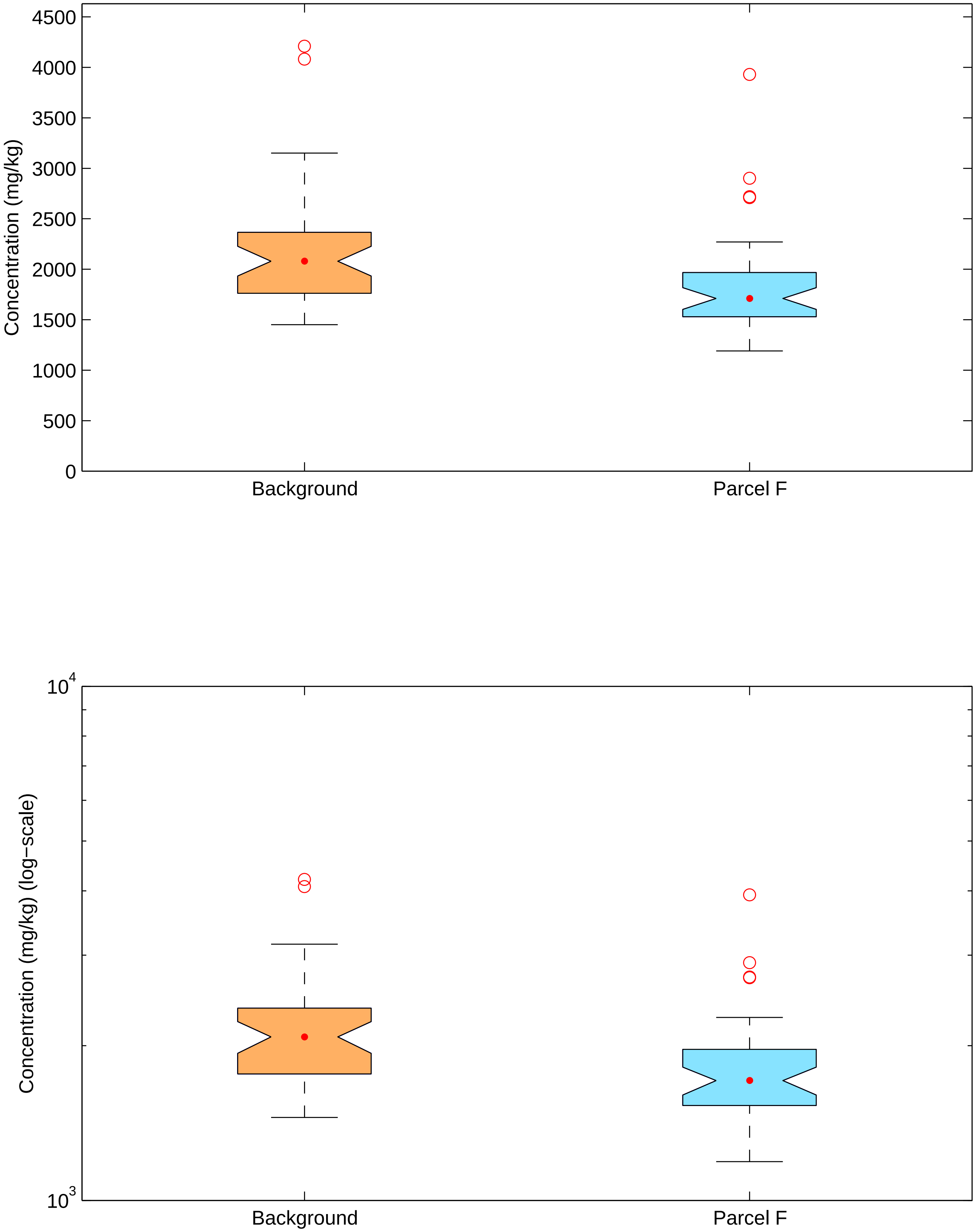
**Figure I1−19. Background vs. Parcel F Boxplots**
**Nickel**



## Figure I1−20. Background vs. Parcel F Boxplots
## Platinum

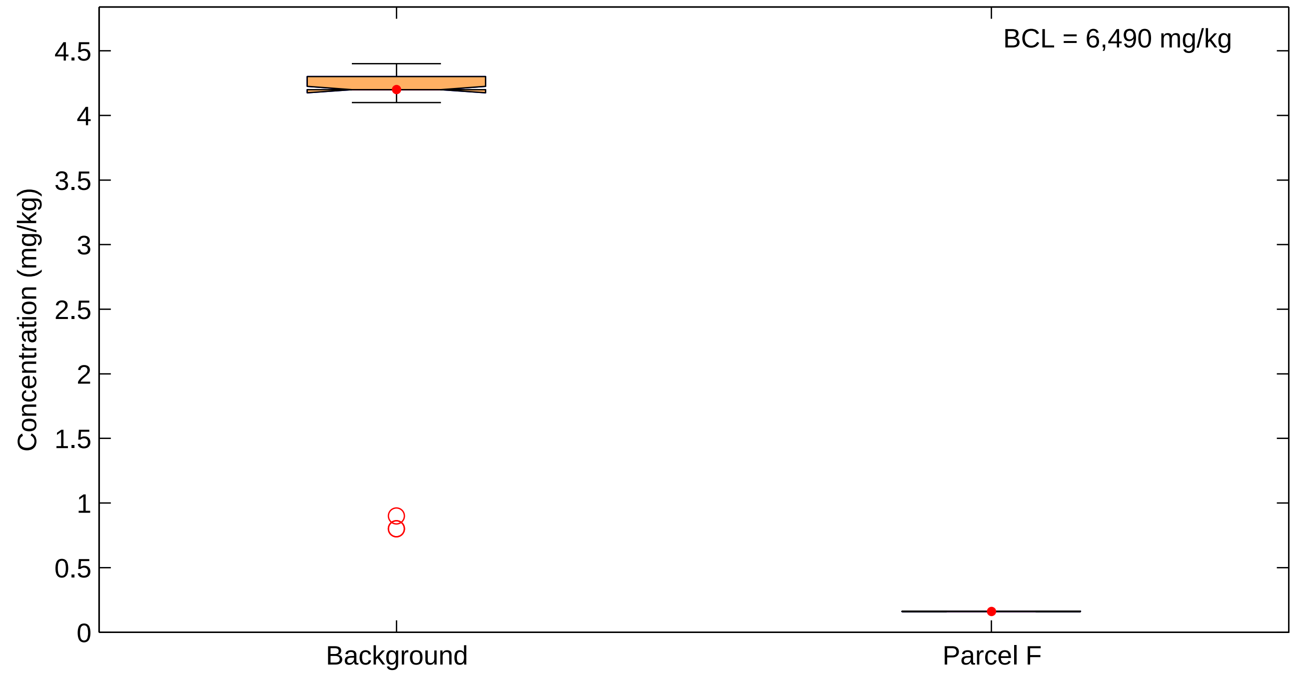


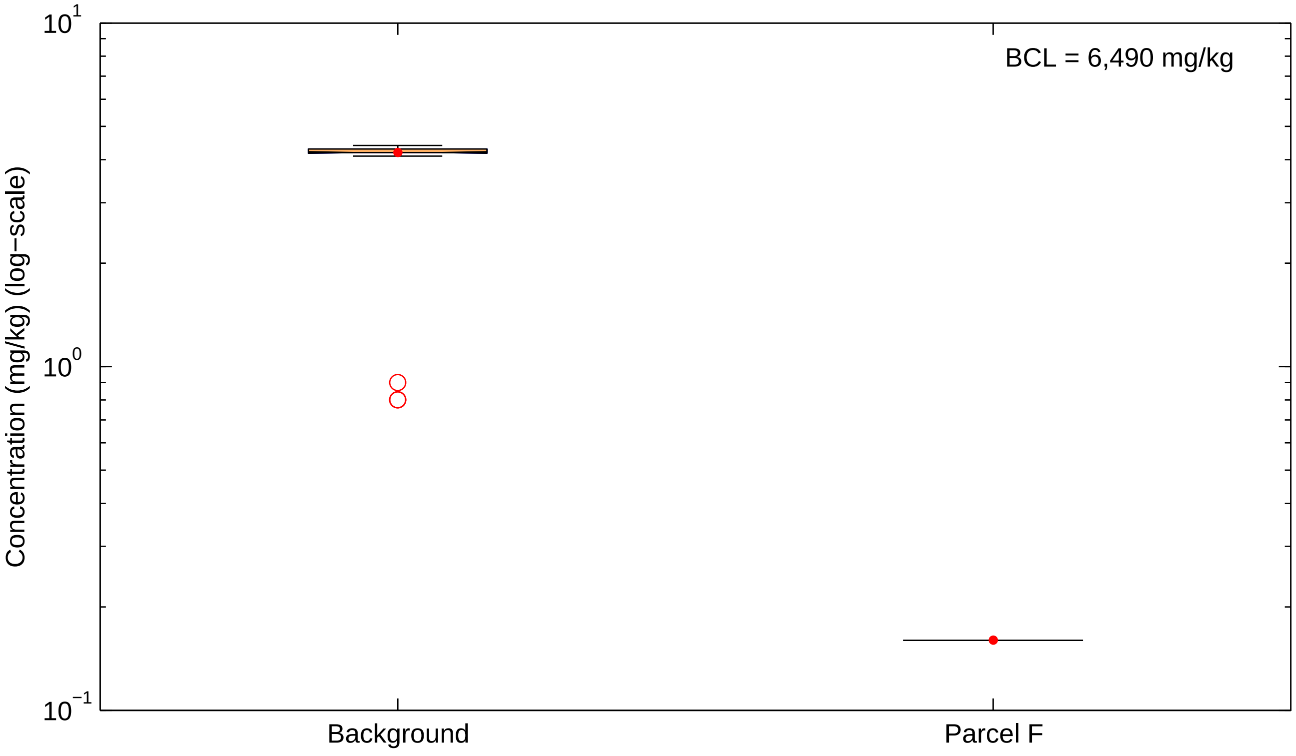
# Figure I1−21. Background vs. Parcel F Boxplots
# Potassium



**Ramboll Environ**

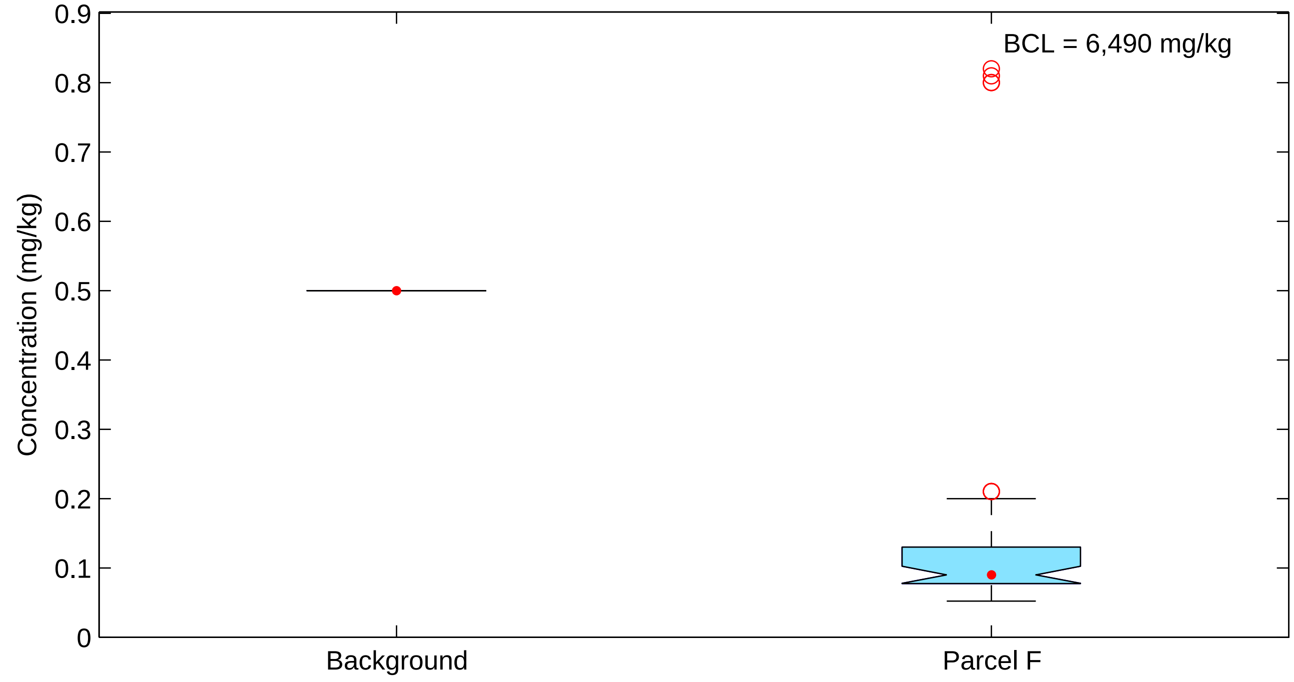
# Figure I1−22. Background vs. Parcel F Boxplots
# Selenium

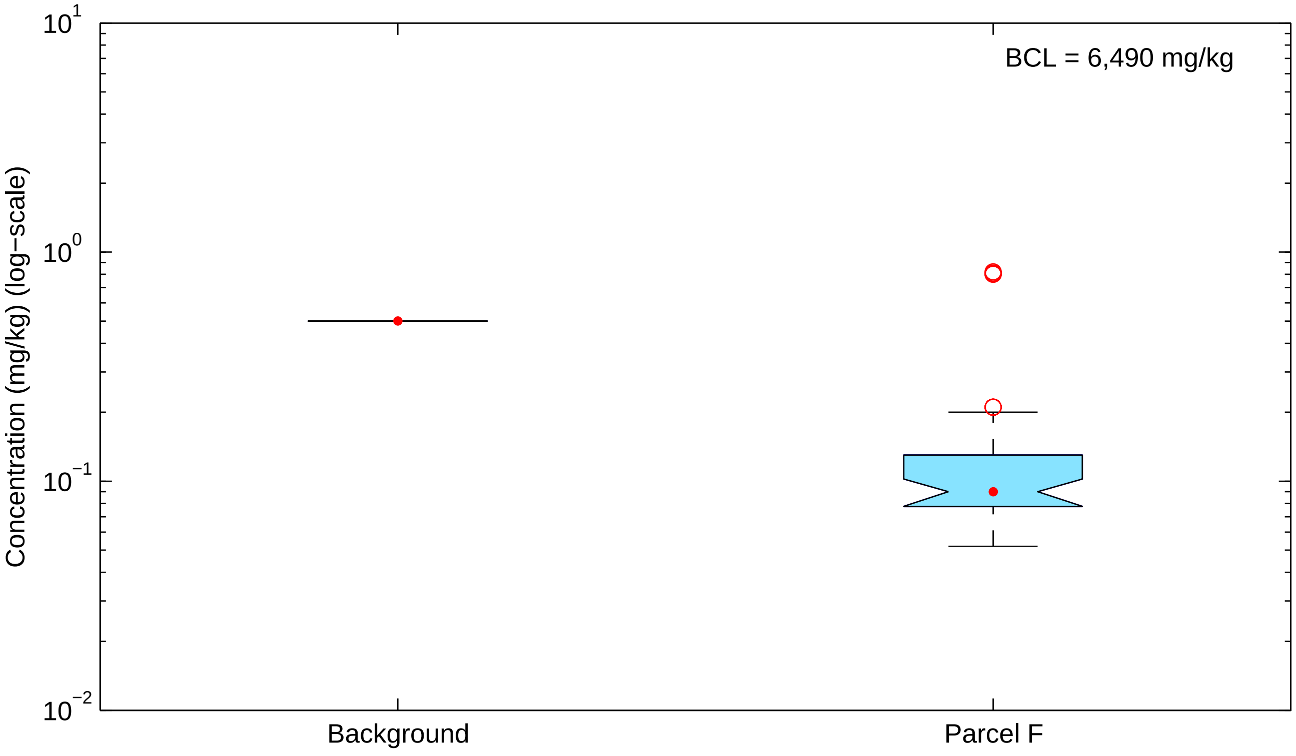




**Ramboll Environ**

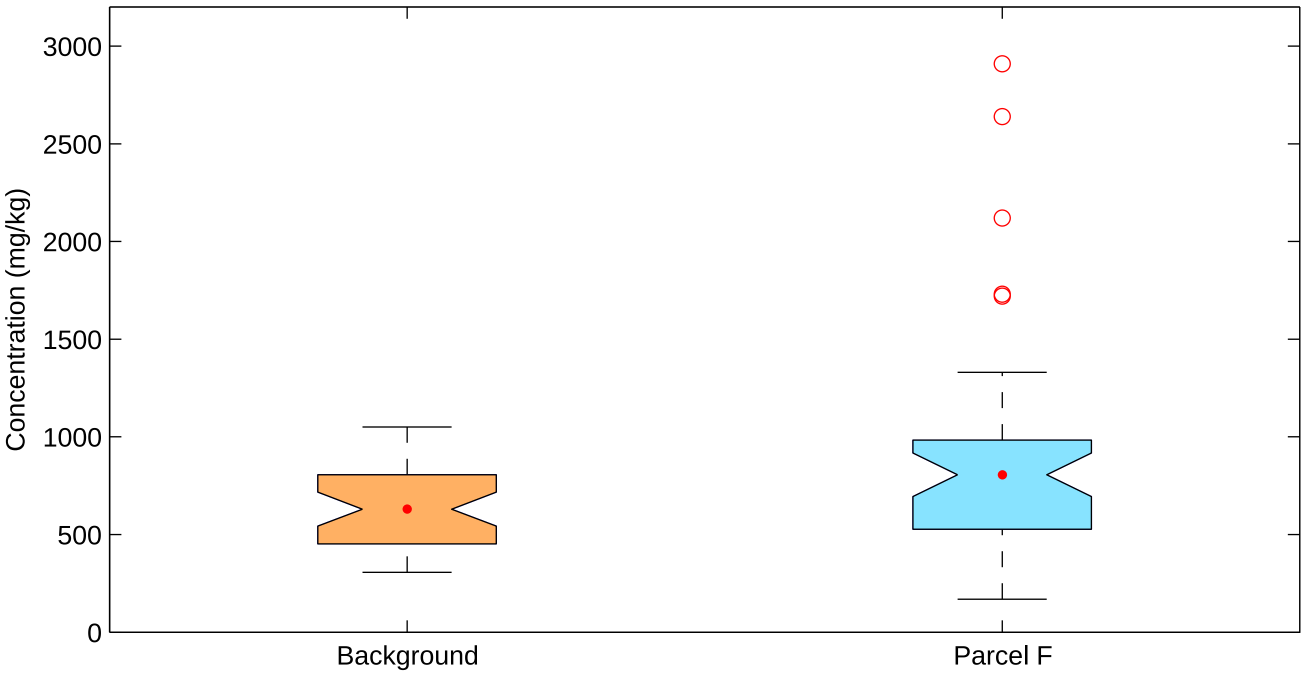
# Figure I1−23. Background vs. Parcel F Boxplots
## Silver

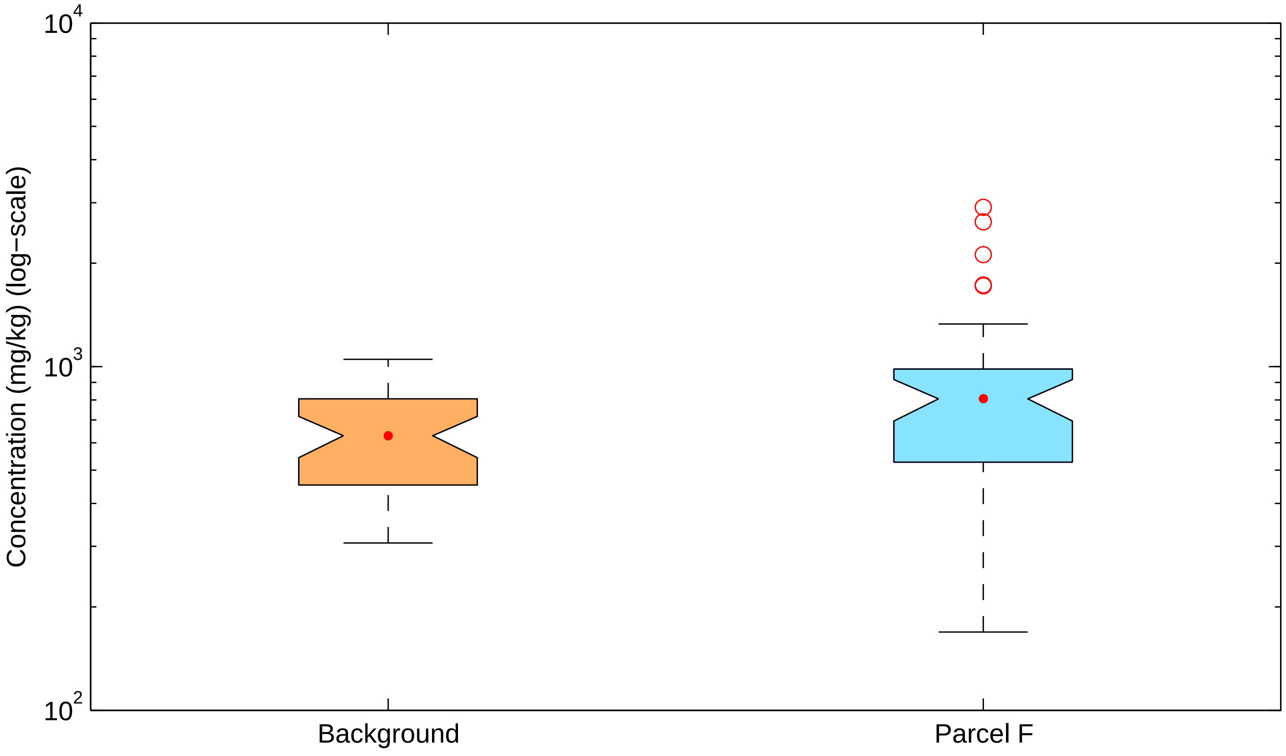




**Ramboll Environ**

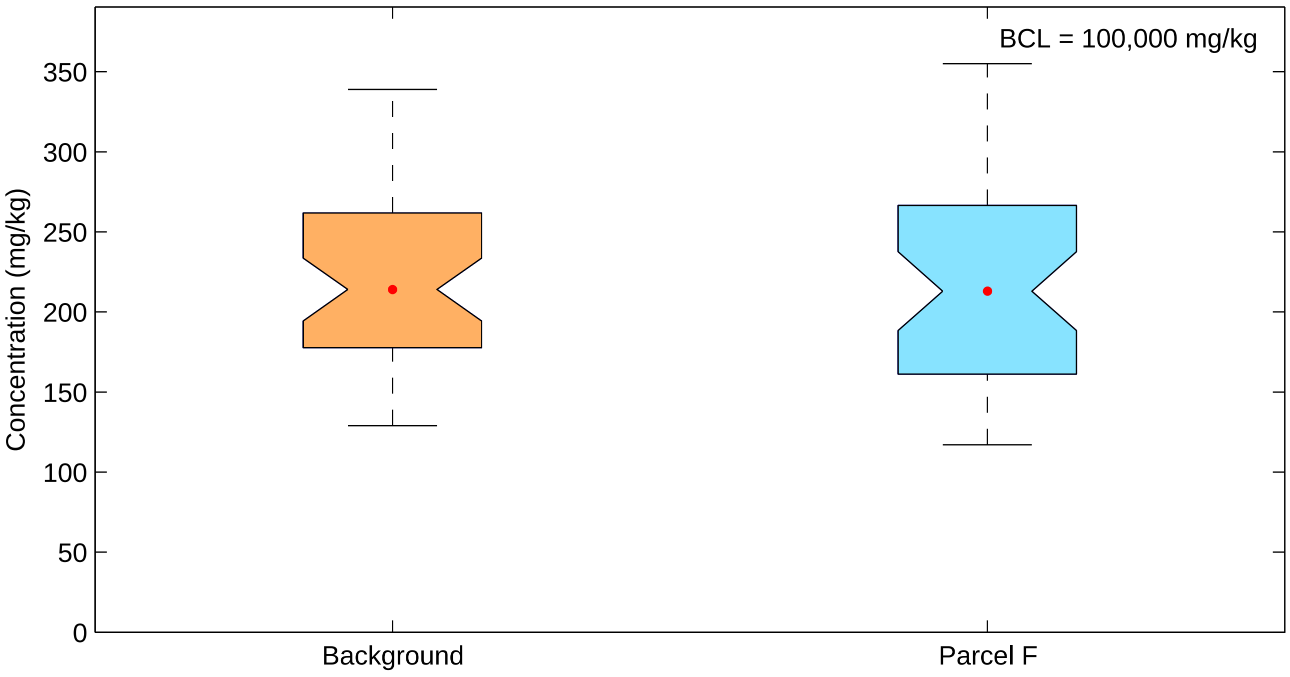
# Figure I1−24. Background vs. Parcel F Boxplots
## Sodium

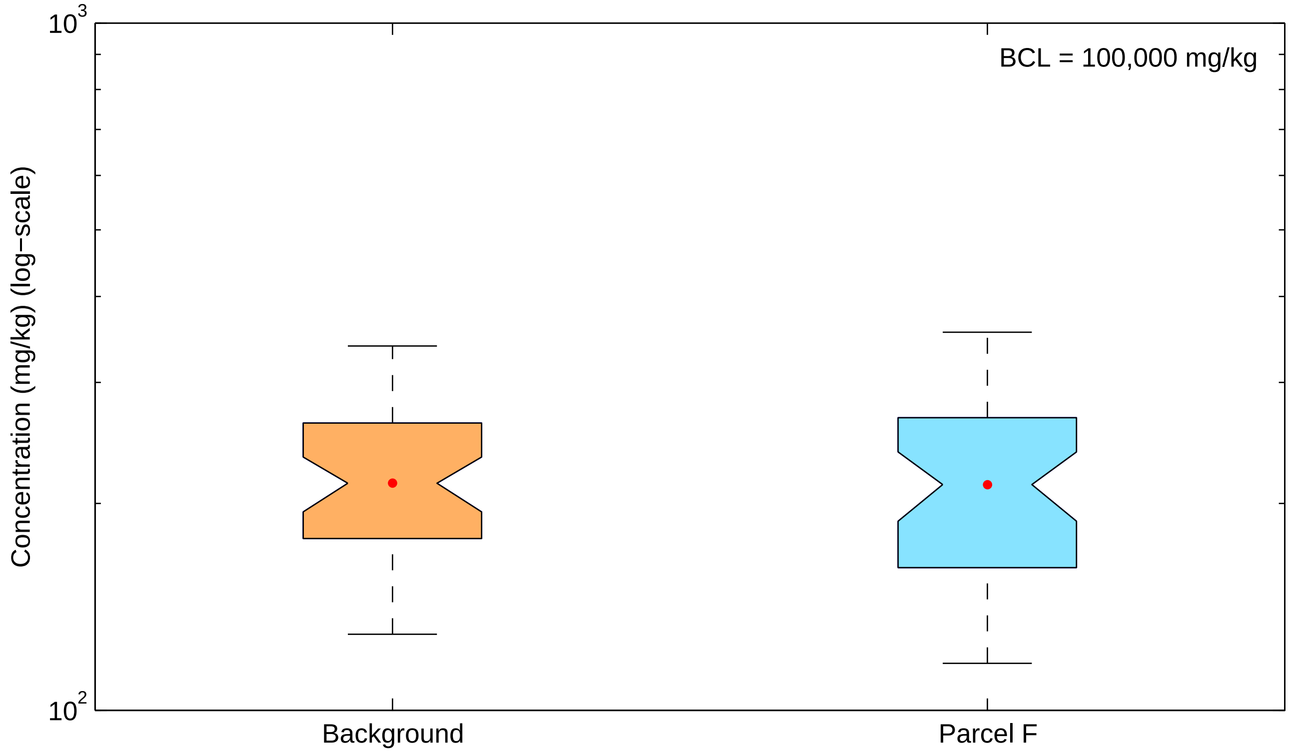




**Ramboll Environ**

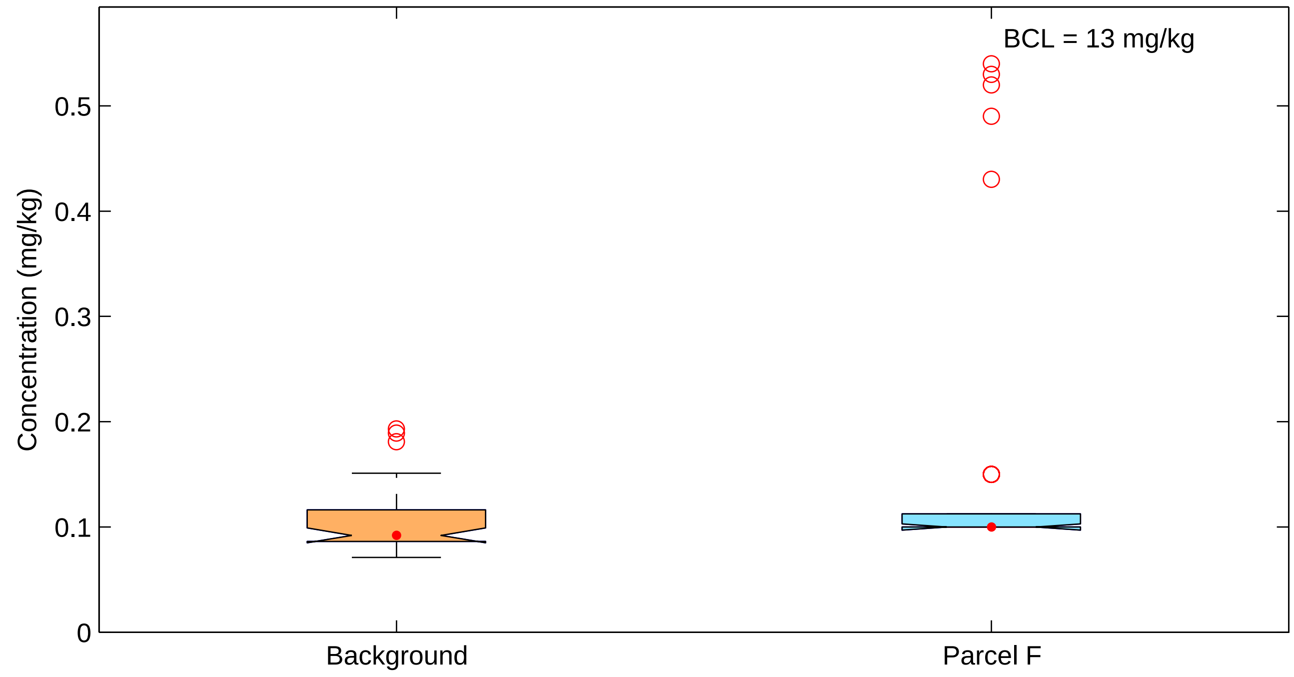
# Figure I1−25. Background vs. Parcel F Boxplots
# Strontium

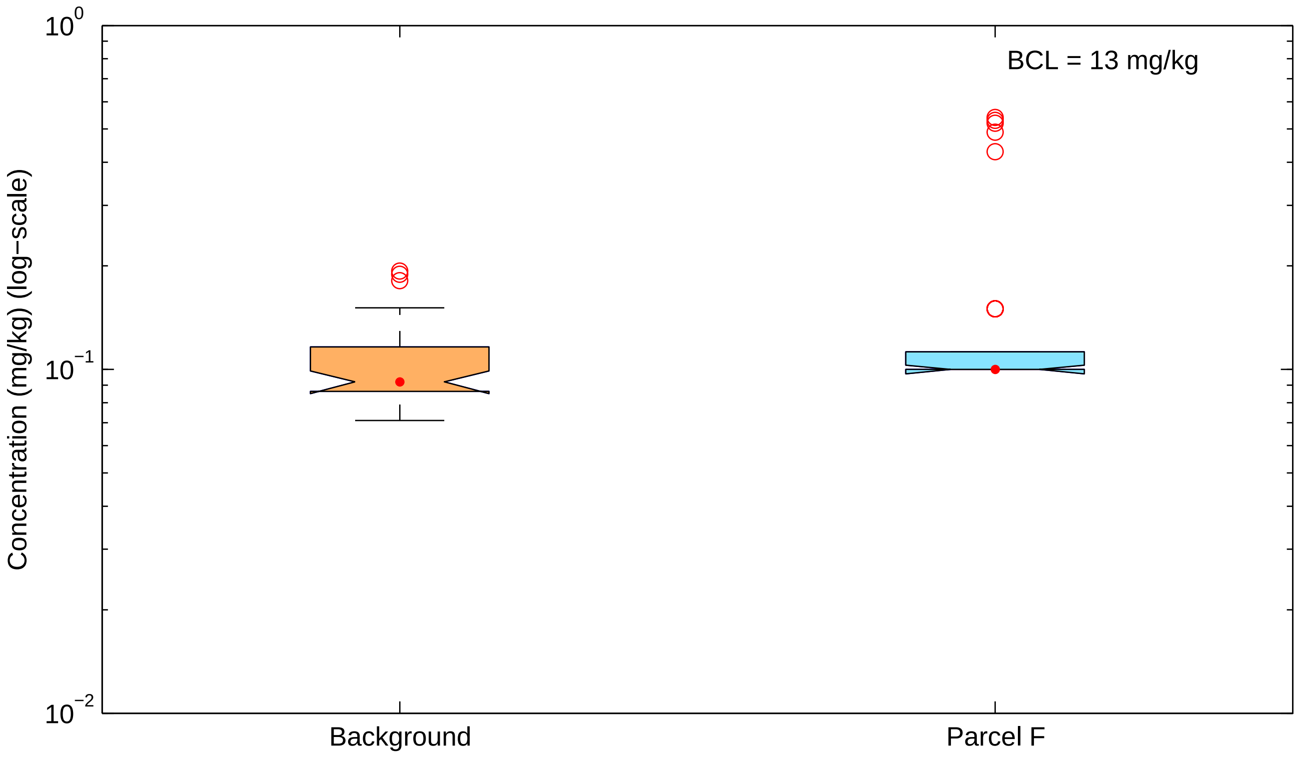




**Ramboll Environ**

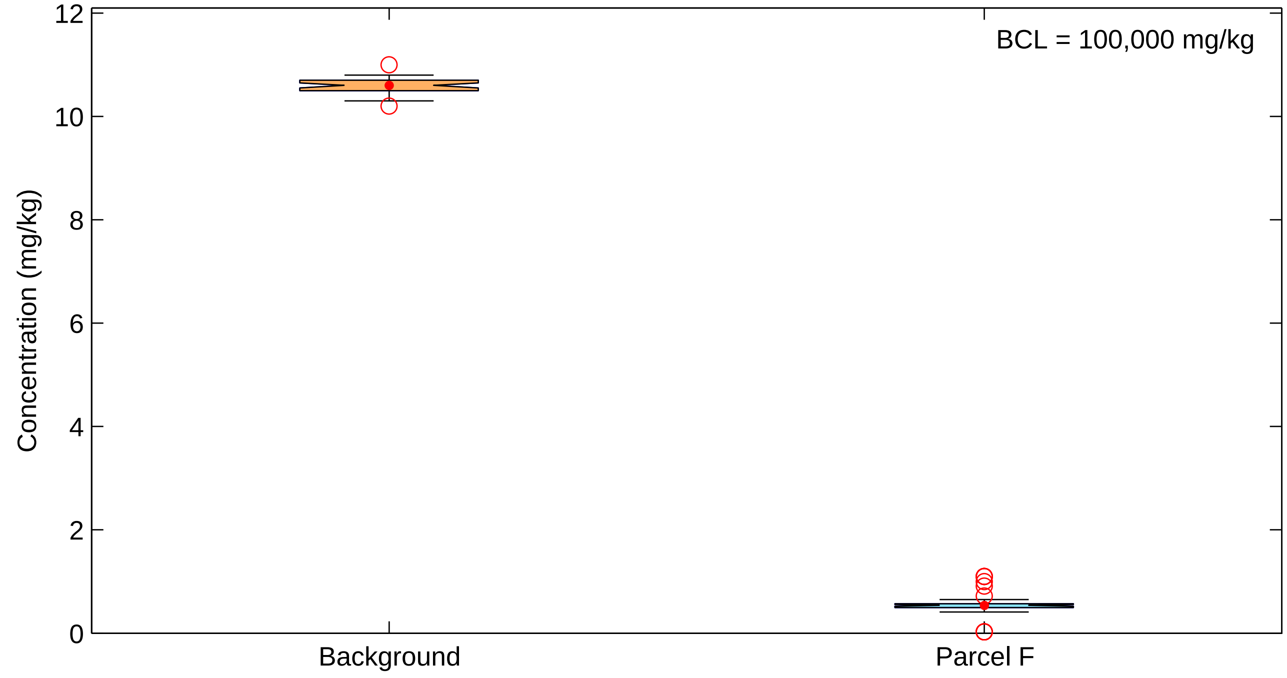
# Figure I1−26. Background vs. Parcel F Boxplots
# Thallium

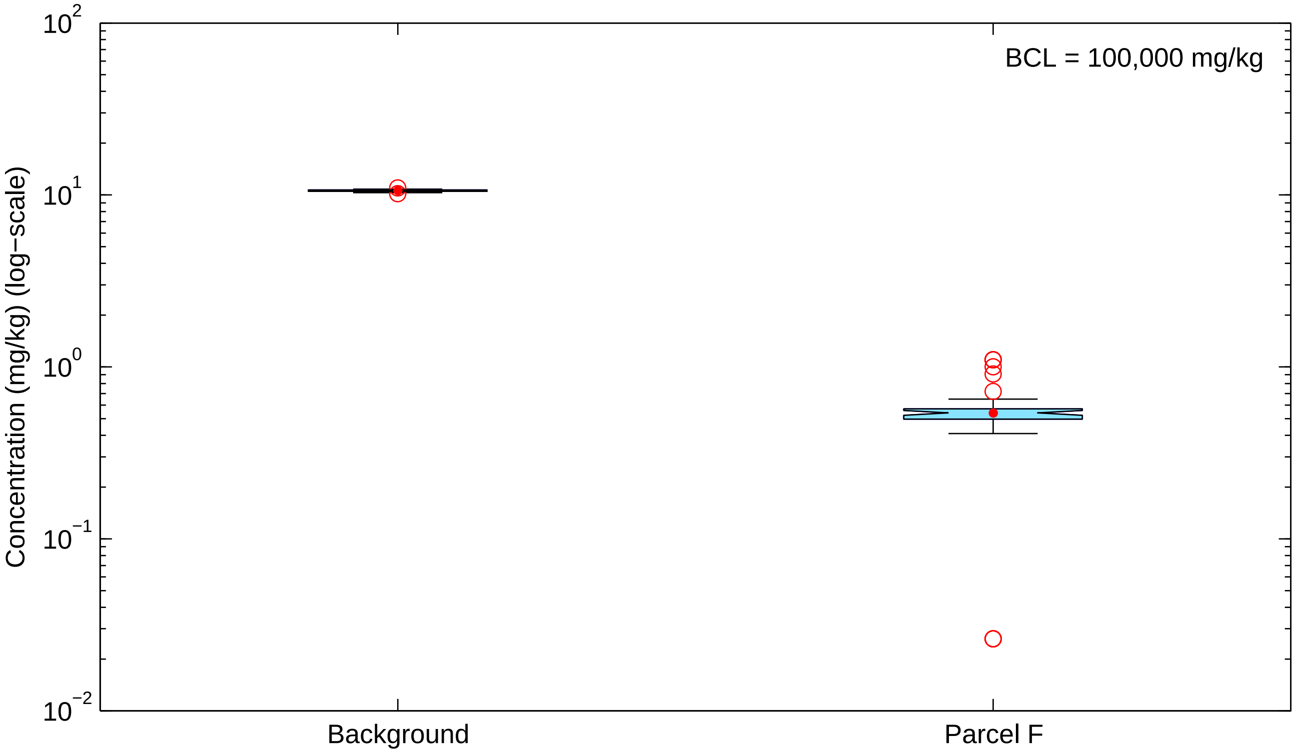




**Ramboll Environ**

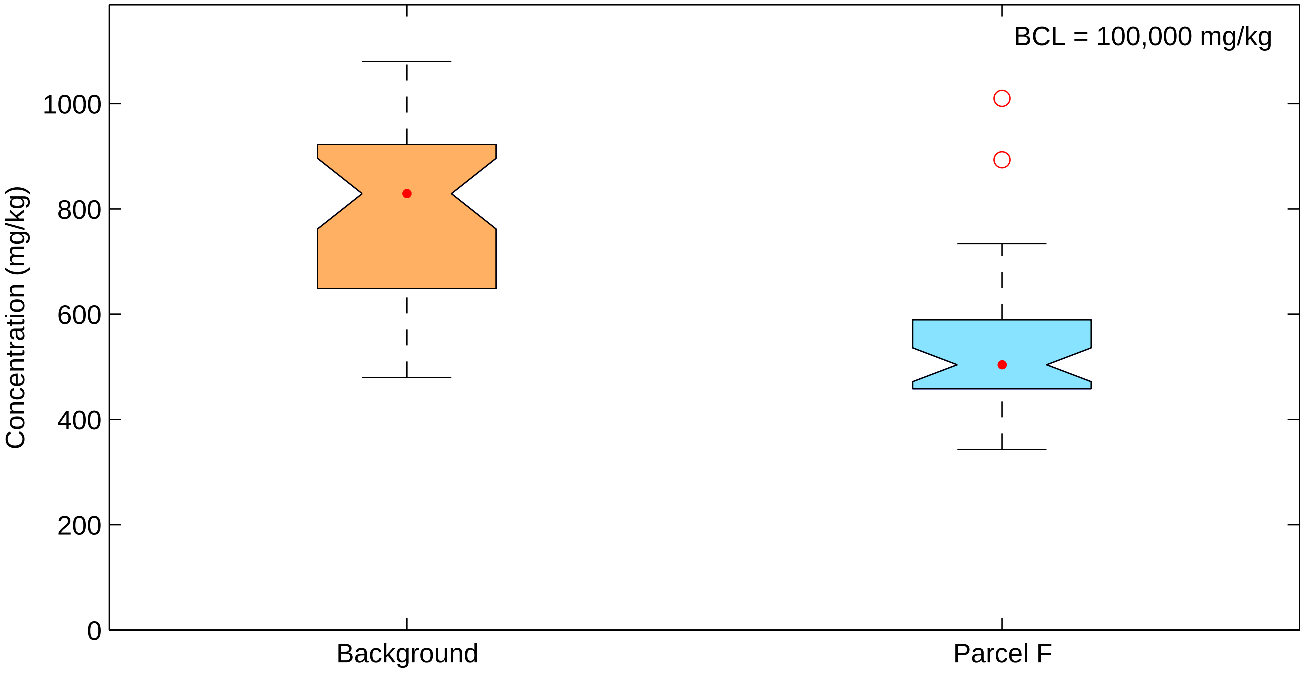
# Figure I1−27. Background vs. Parcel F Boxplots
# Tin

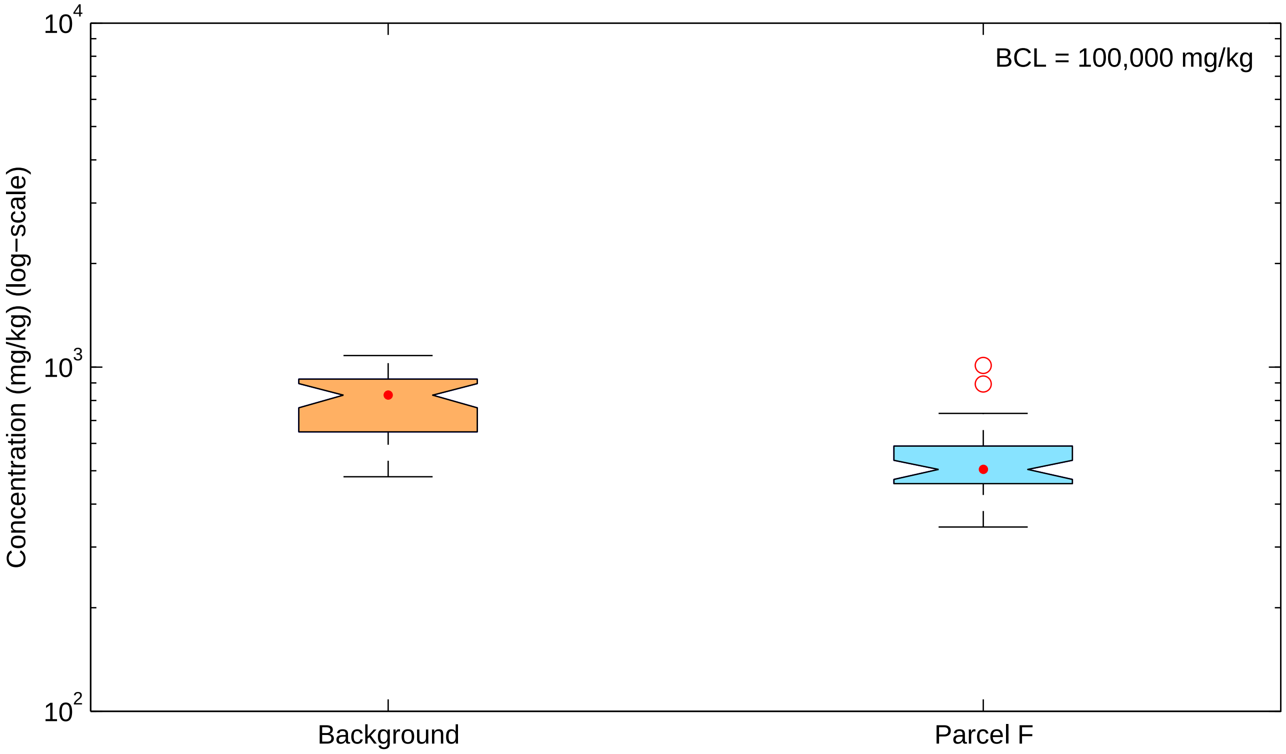




**Ramboll Environ**

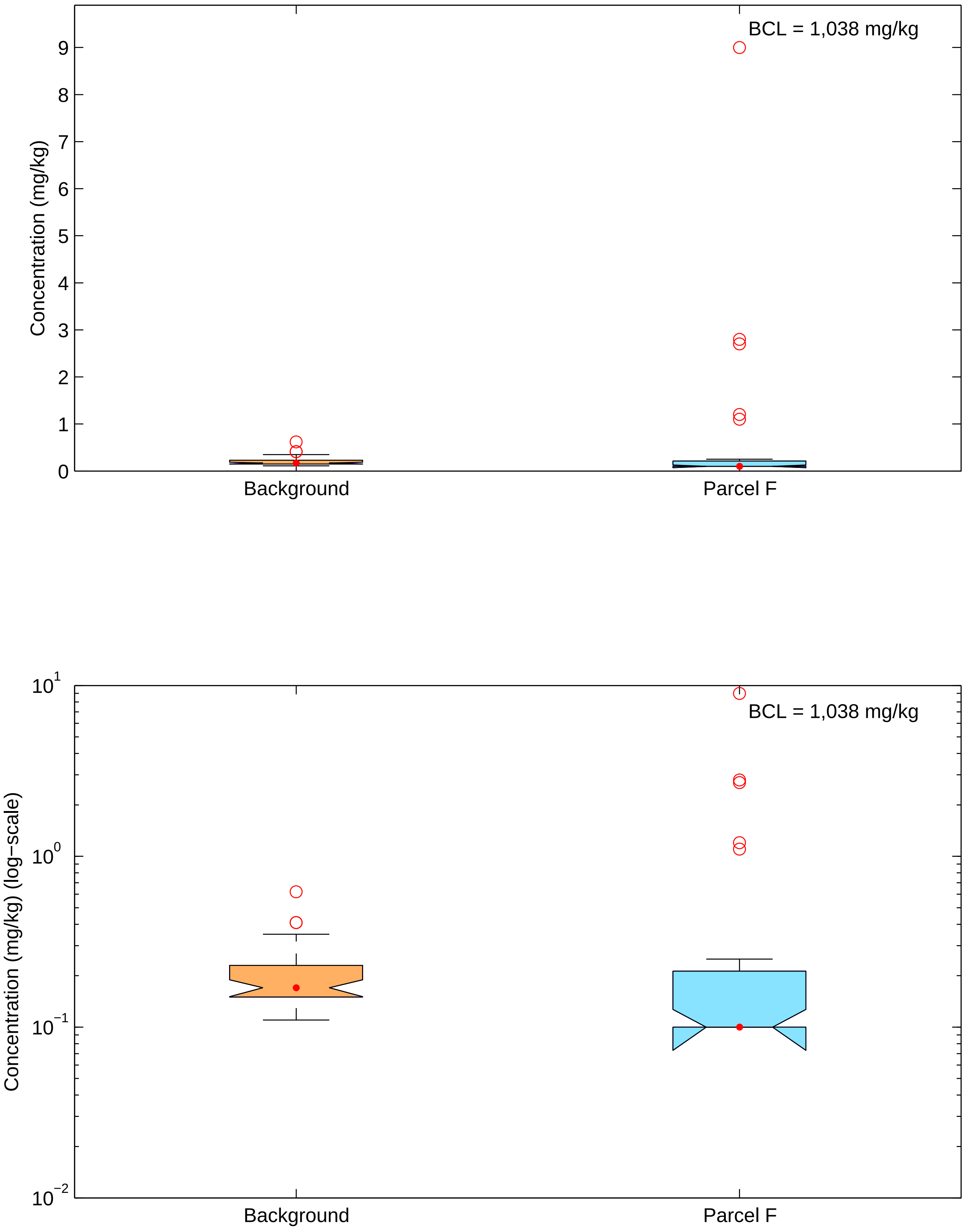
# Figure I1−28. Background vs. Parcel F Boxplots
# Titanium





**Ramboll Environ**

# Figure I1−29. Background vs. Parcel F Boxplots
# Tungsten



**Ramboll Environ**

# Figure I1−30. Background vs. Parcel F Boxplots
# Uranium (total)

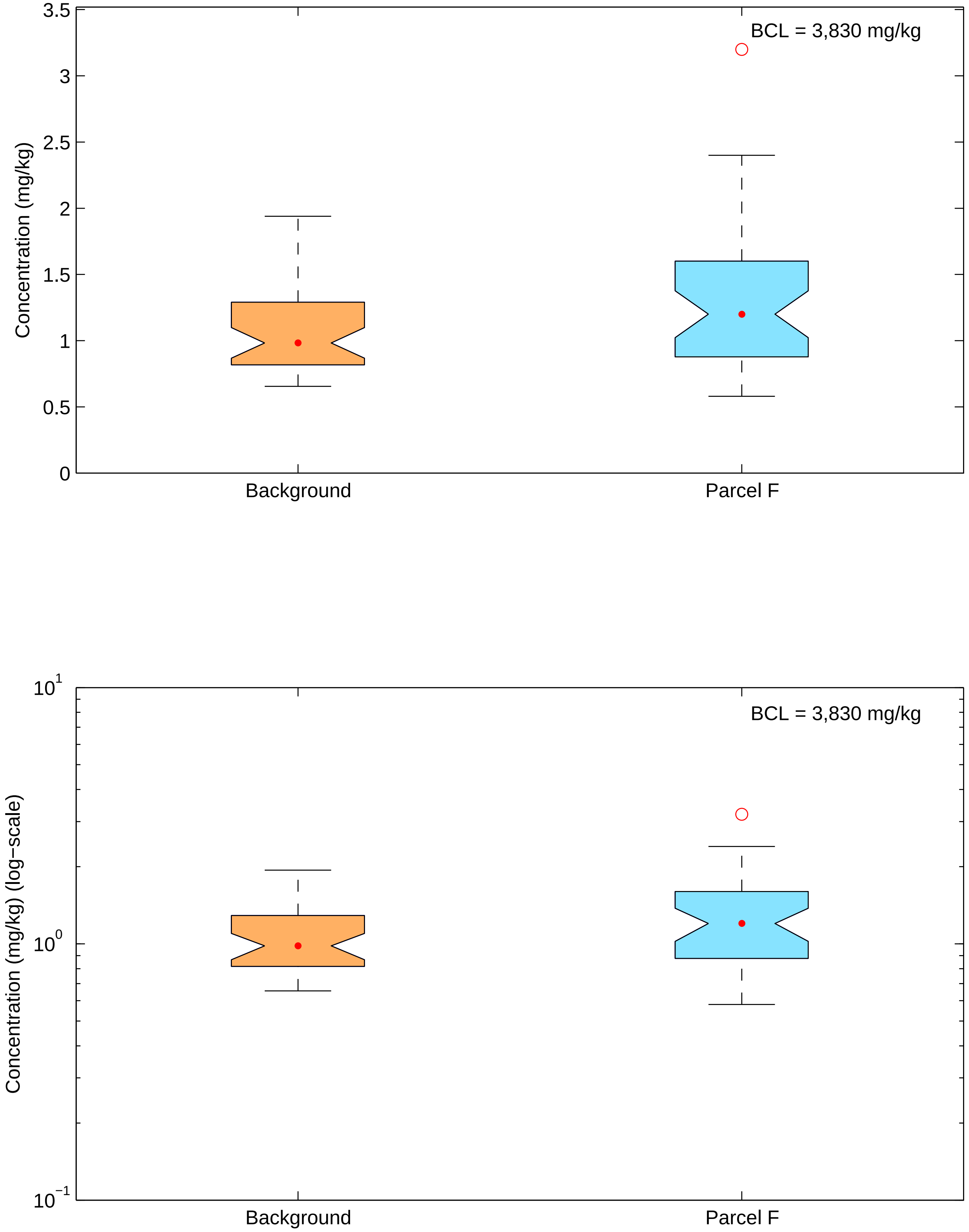


Figure I1−31. Background vs. Parcel F Boxplots
Vanadium

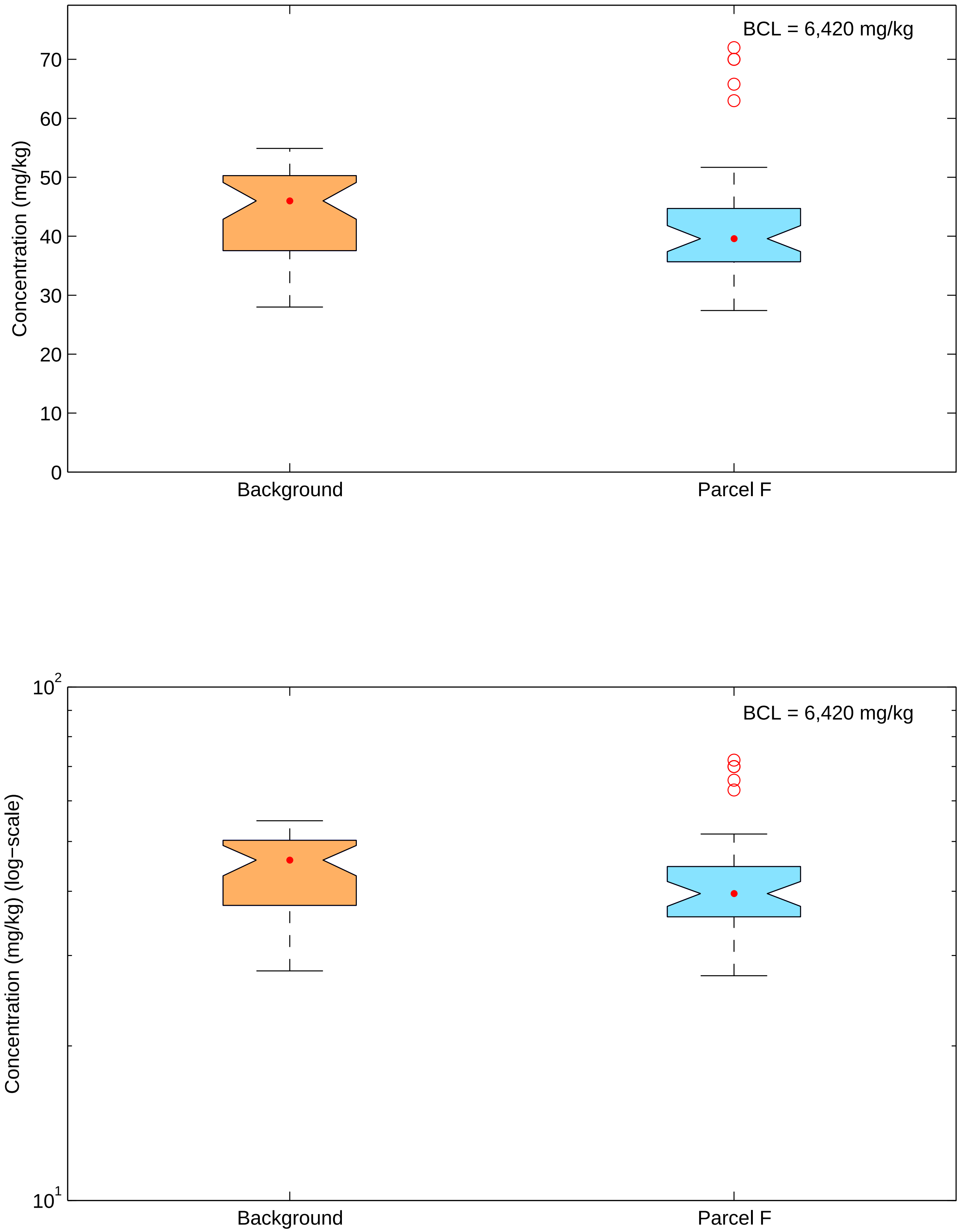
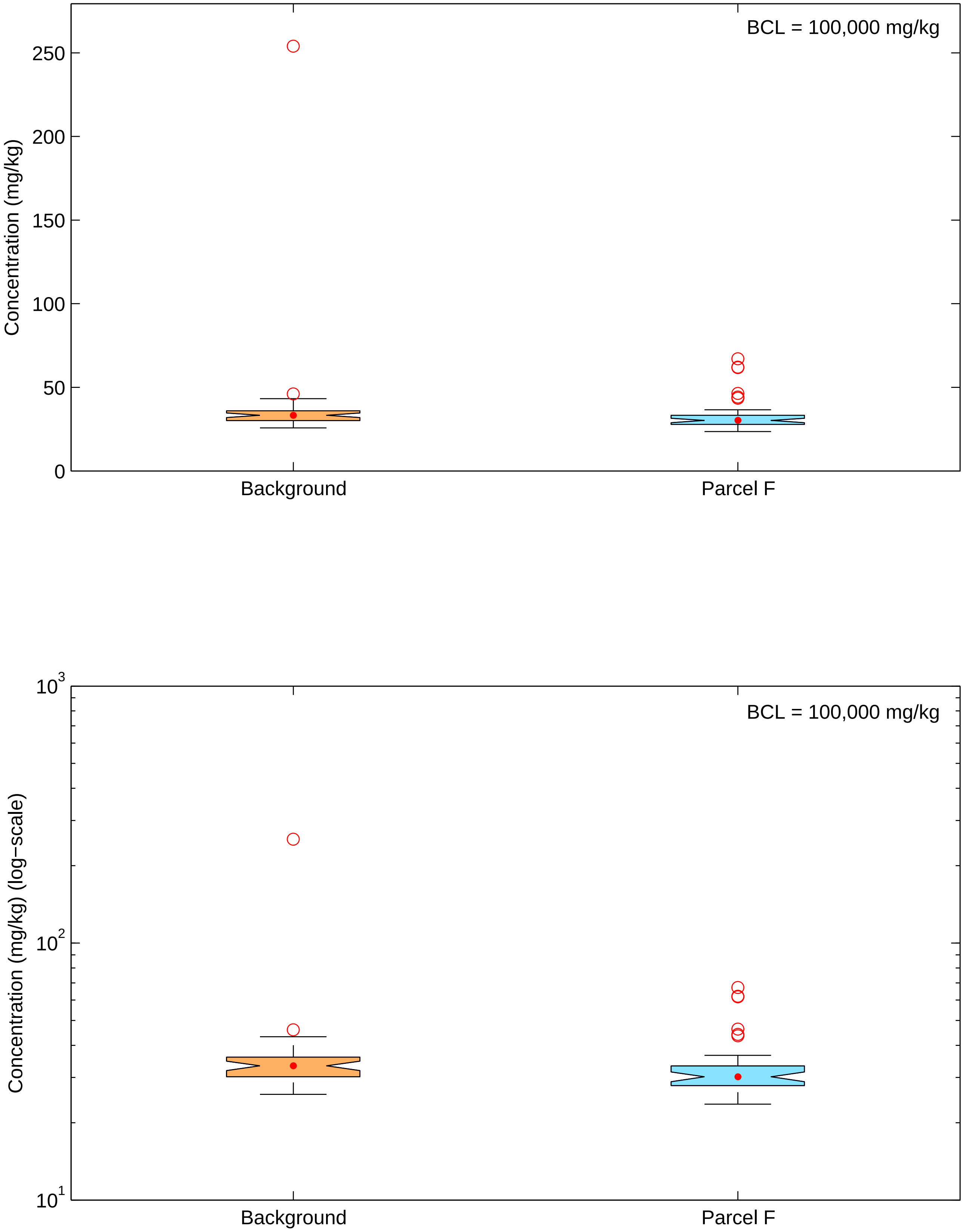
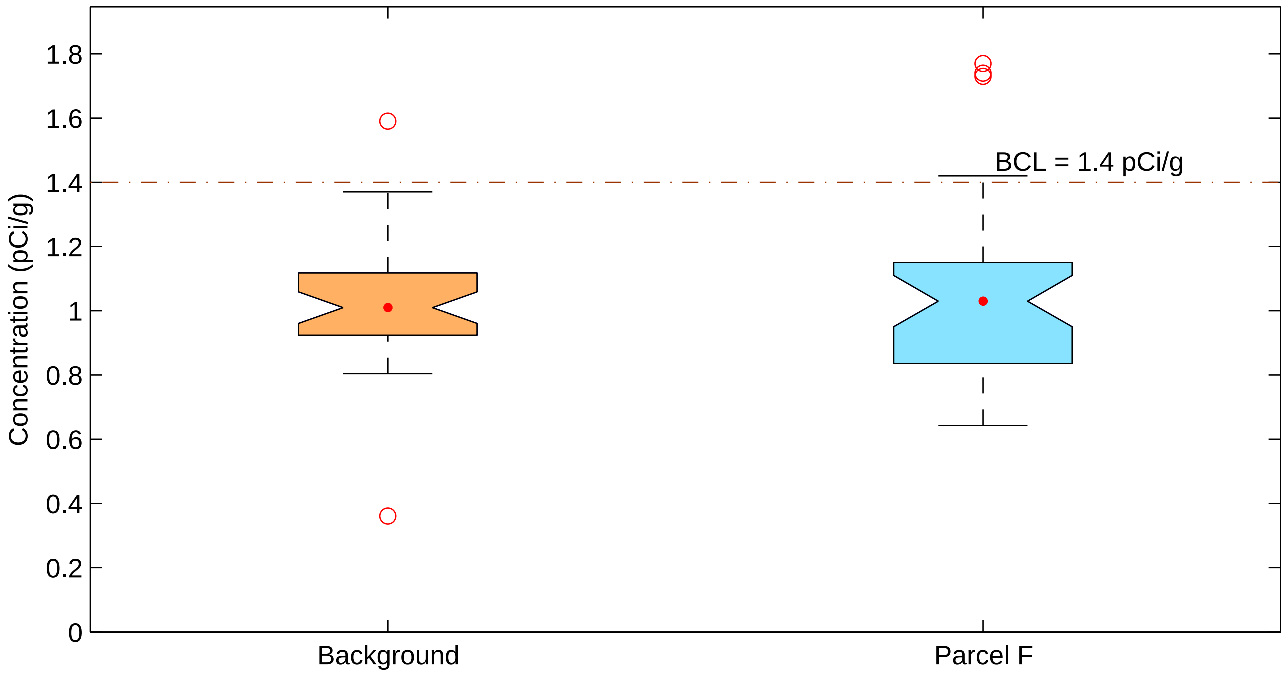
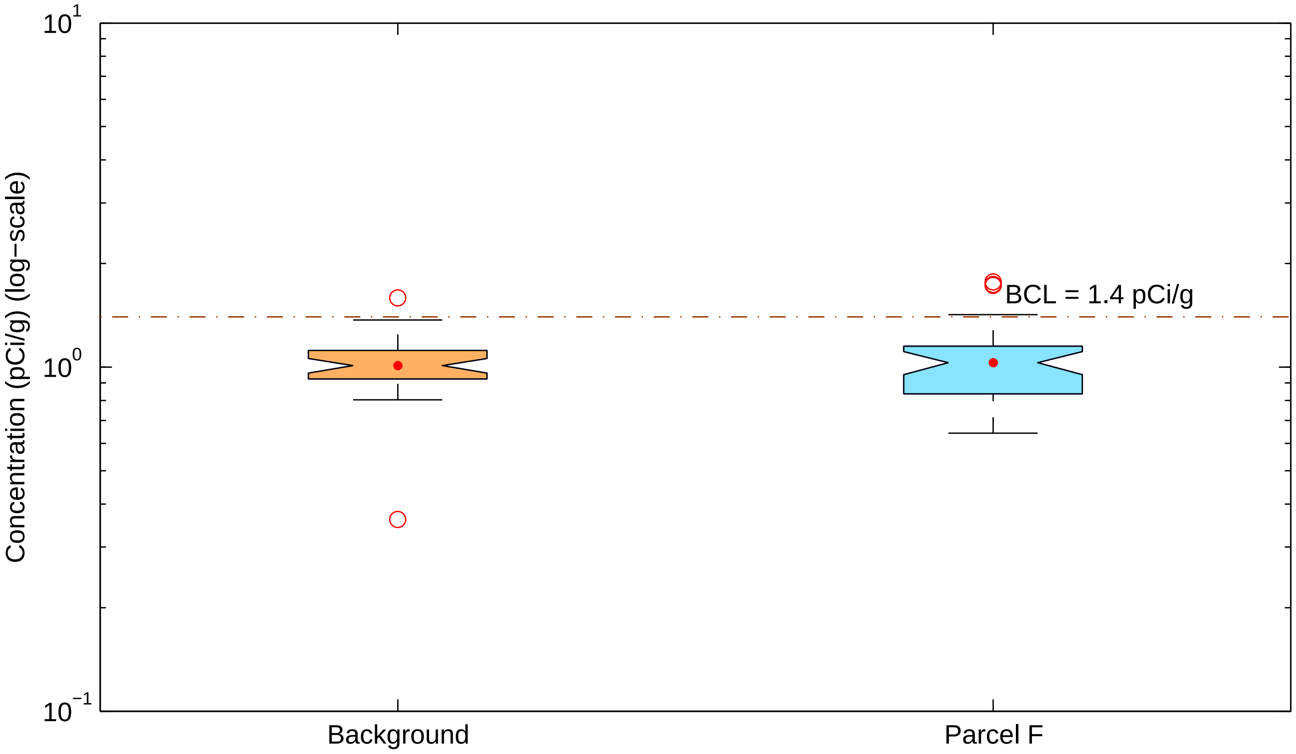


Figure I1−32. Background vs. Parcel F Boxplots
Zinc



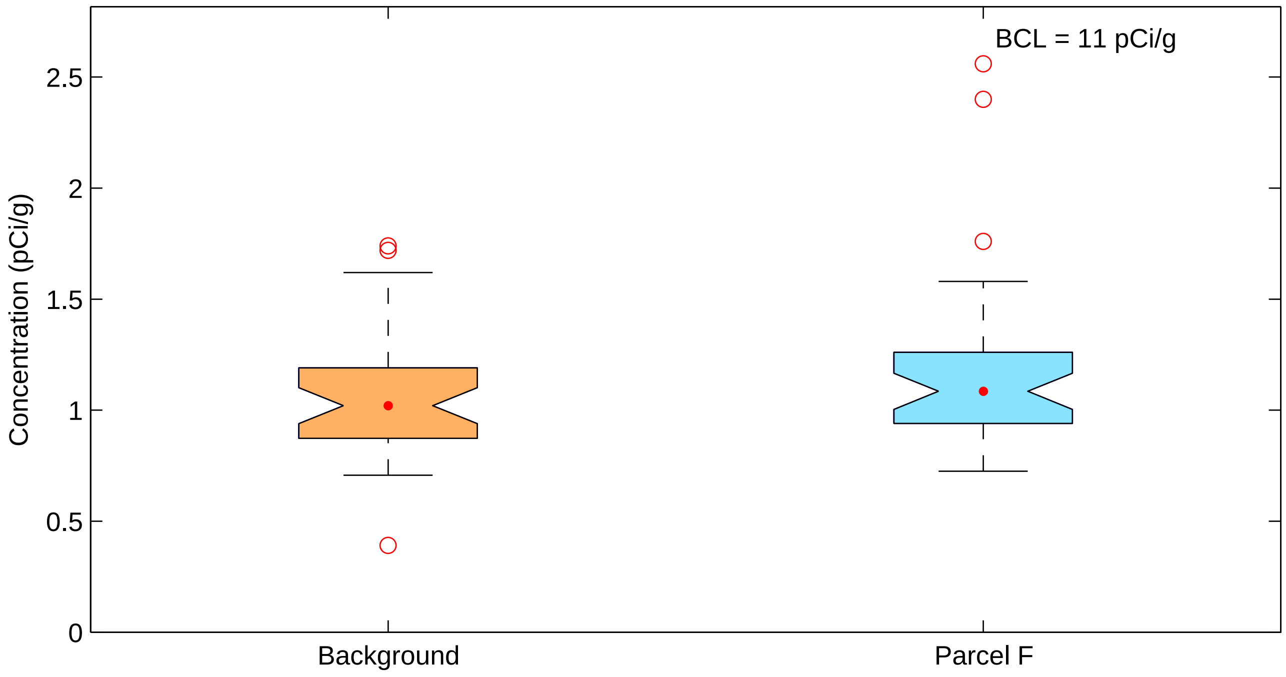
# Figure I1−33. Background vs. Parcel F Boxplots
## Uranium−238

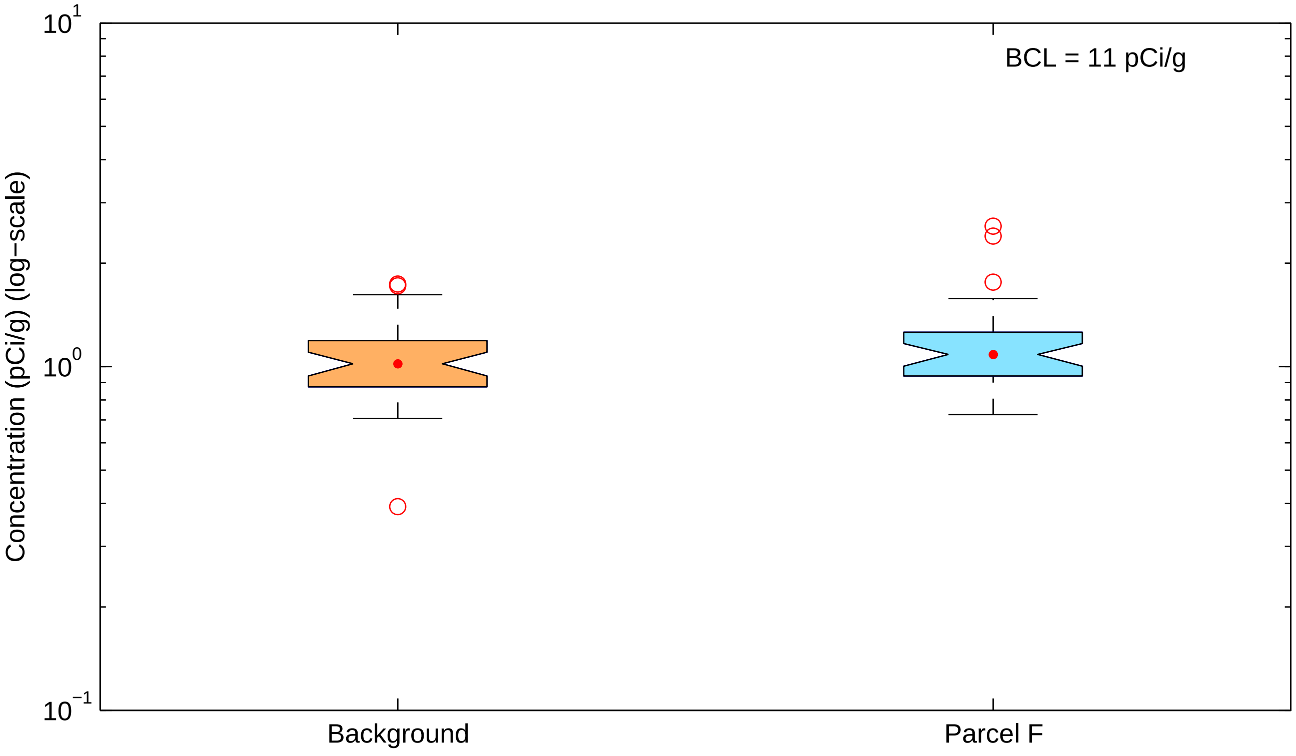




**Ramboll Environ**

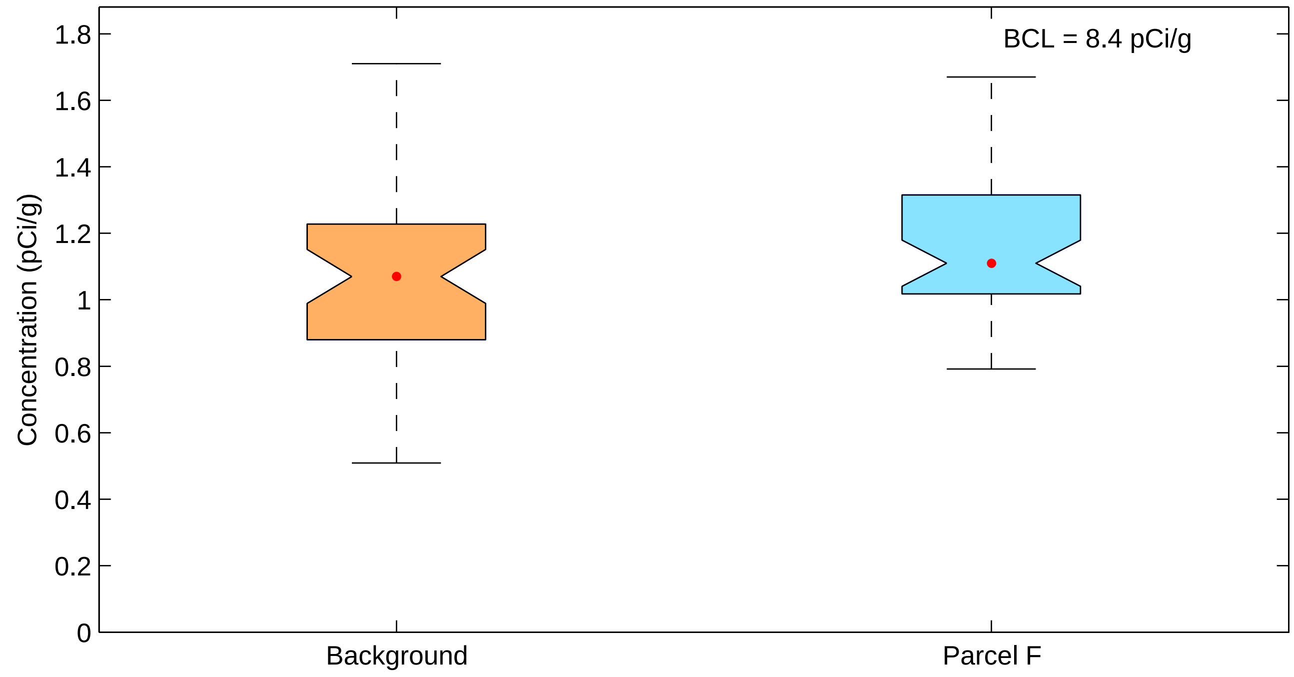
# Figure I1−34. Background vs. Parcel F Boxplots
# Uranium−234

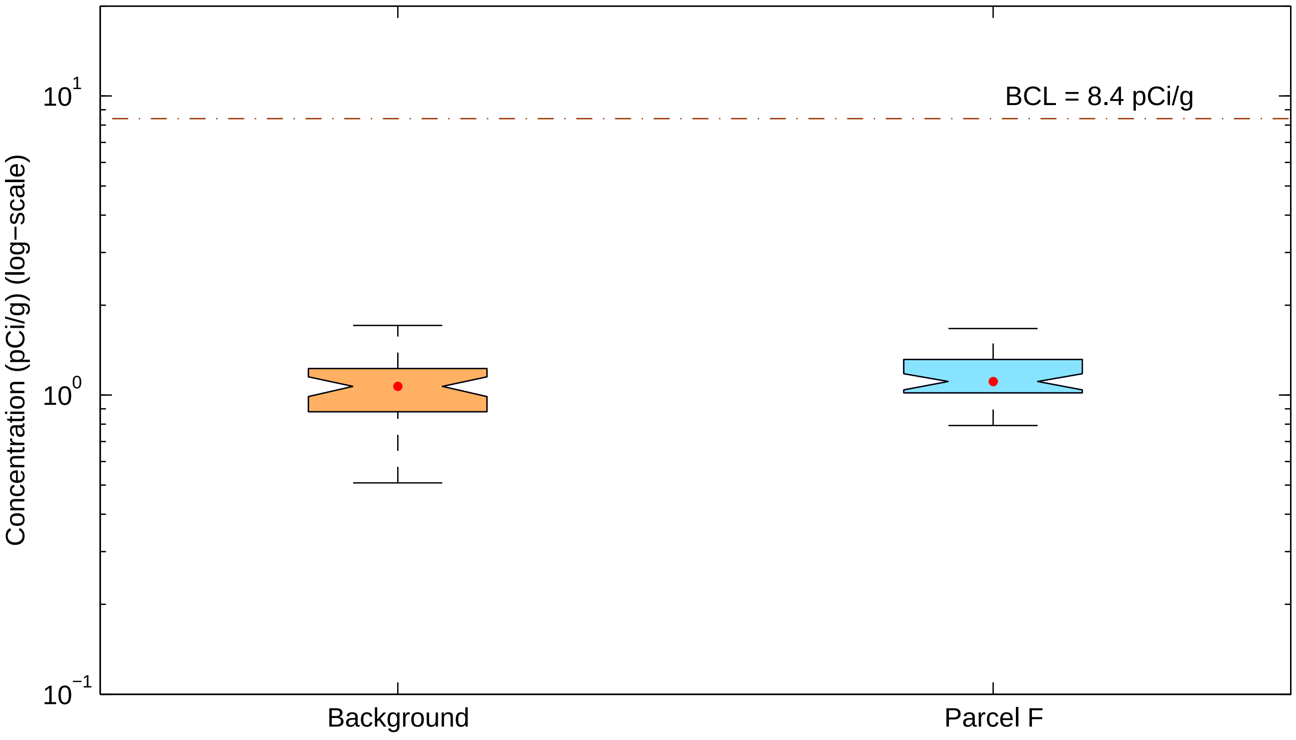




**Ramboll Environ**

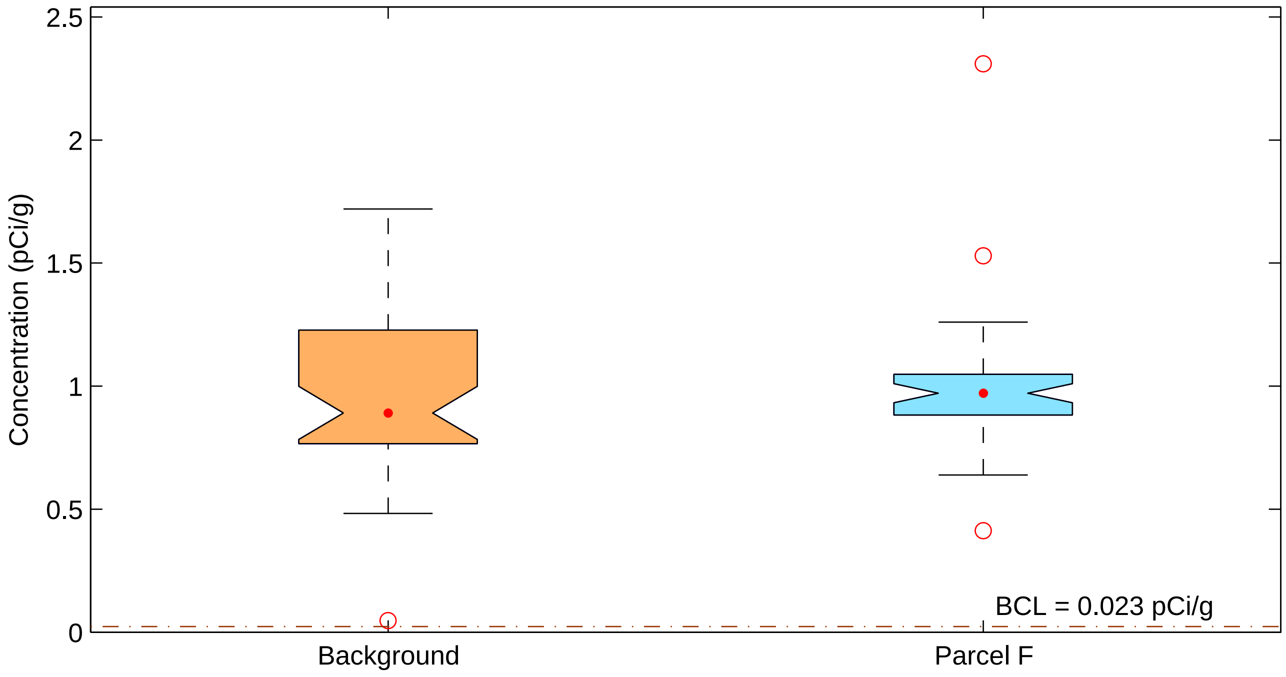
# Figure I1−35. Background vs. Parcel F Boxplots
# Thorium−230

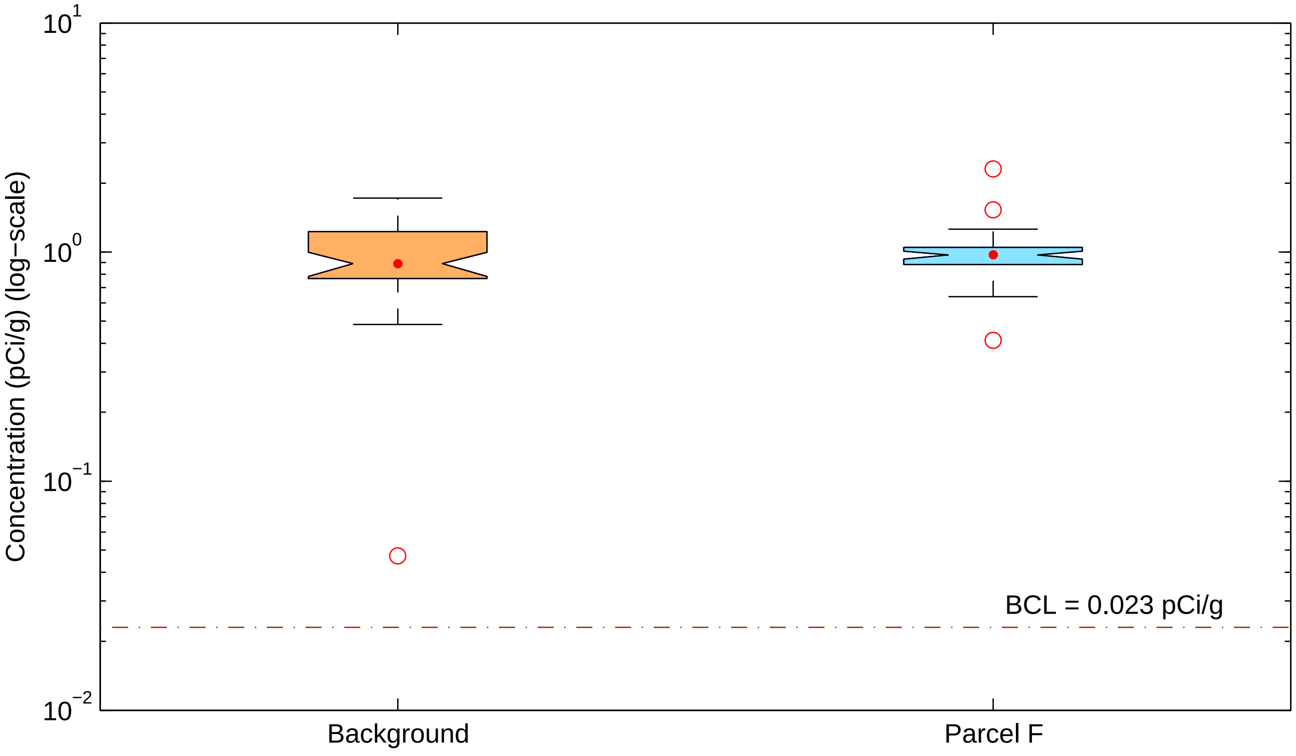




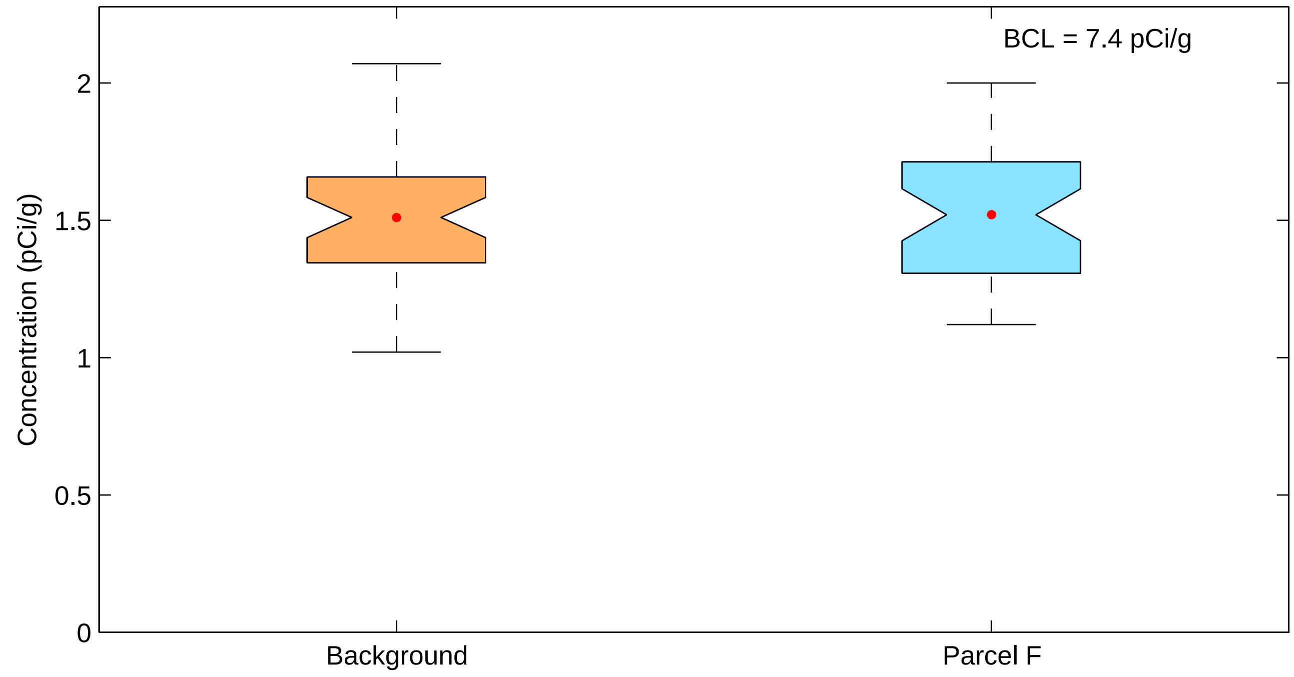
**Ramboll Environ**

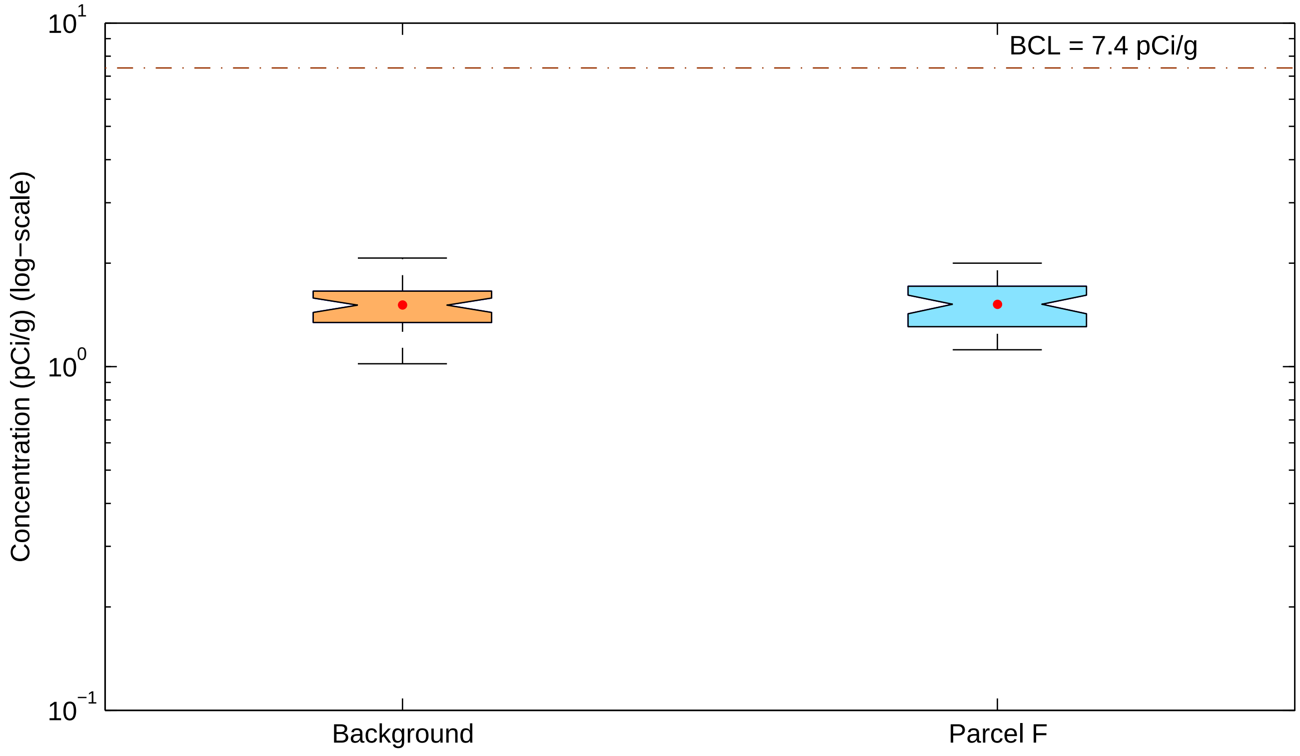
# Figure I1−36. Background vs. Parcel F Boxplots
## Radium−226



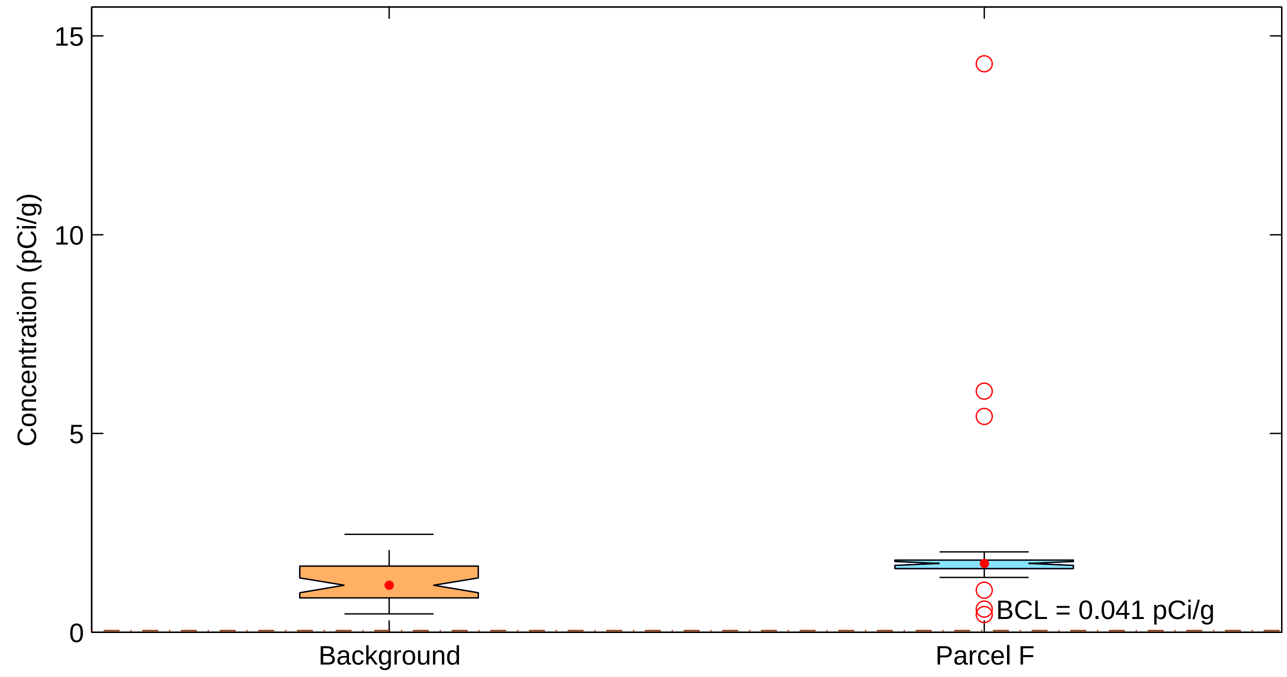


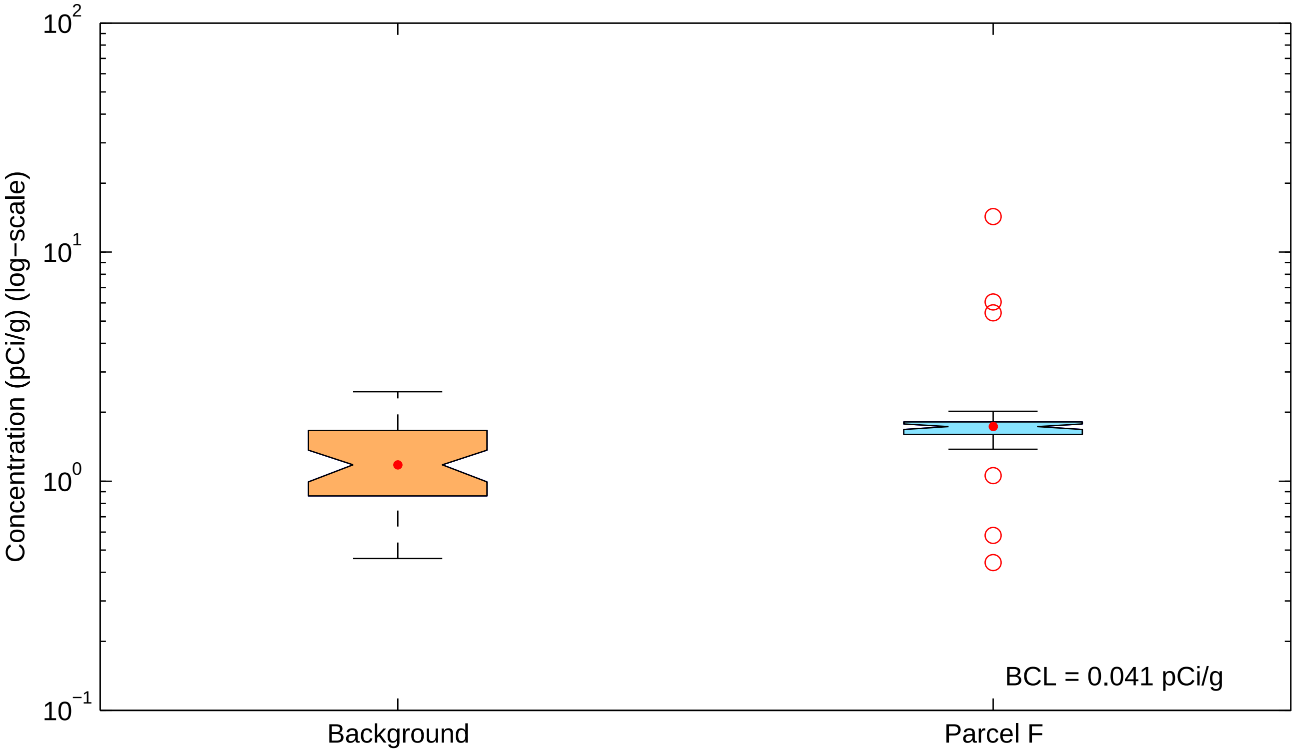
# Figure I1−37. Background vs. Parcel F Boxplots
# Thorium−232





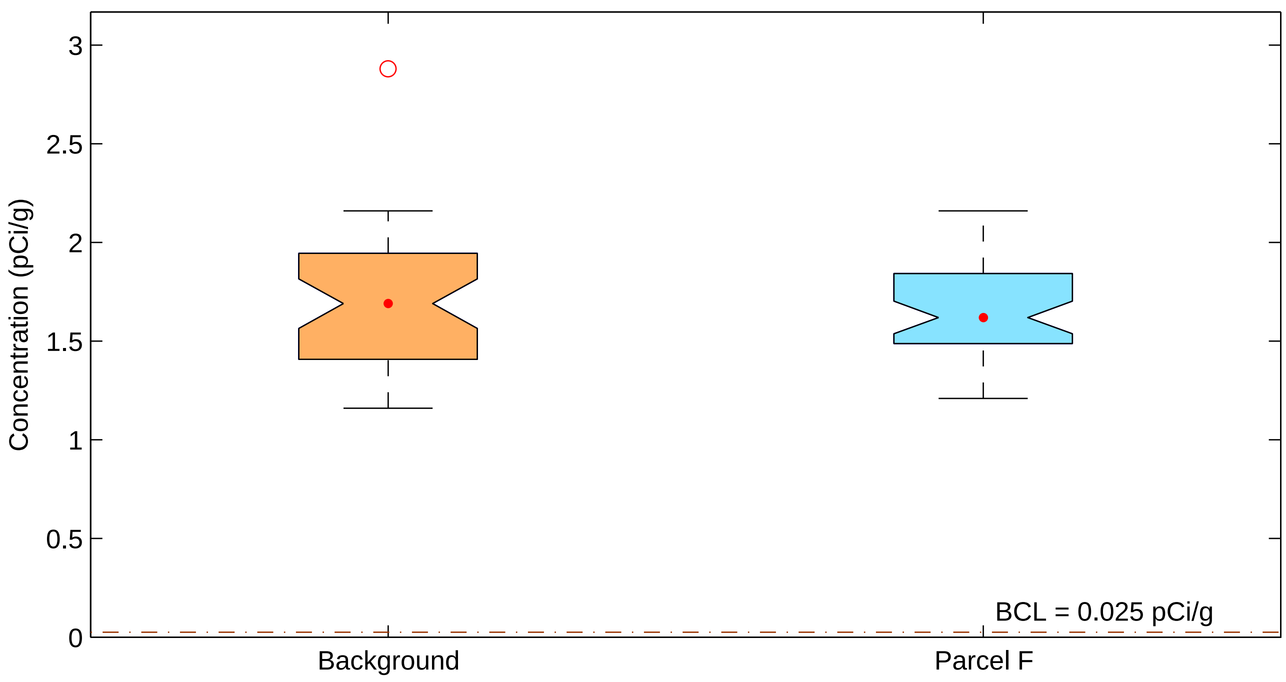
# Figure I1−38. Background vs. Parcel F Boxplots
# Radium−228

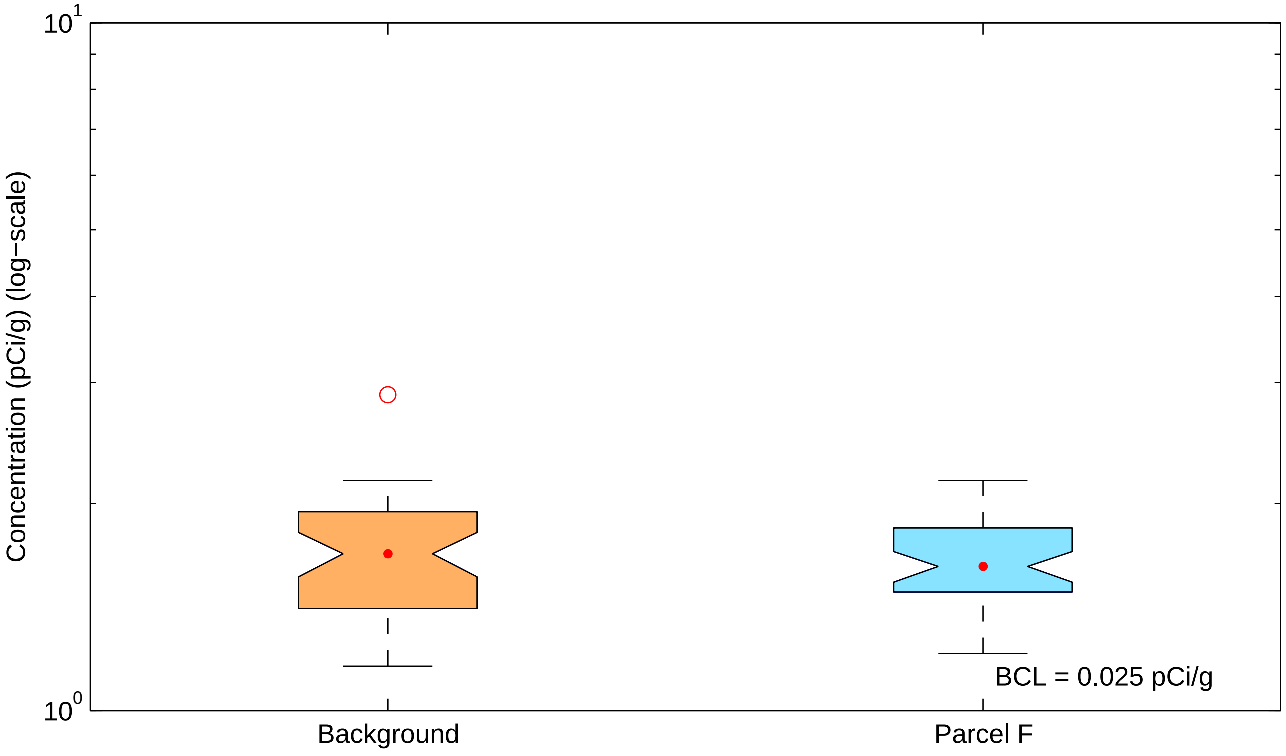




**Ramboll Environ**

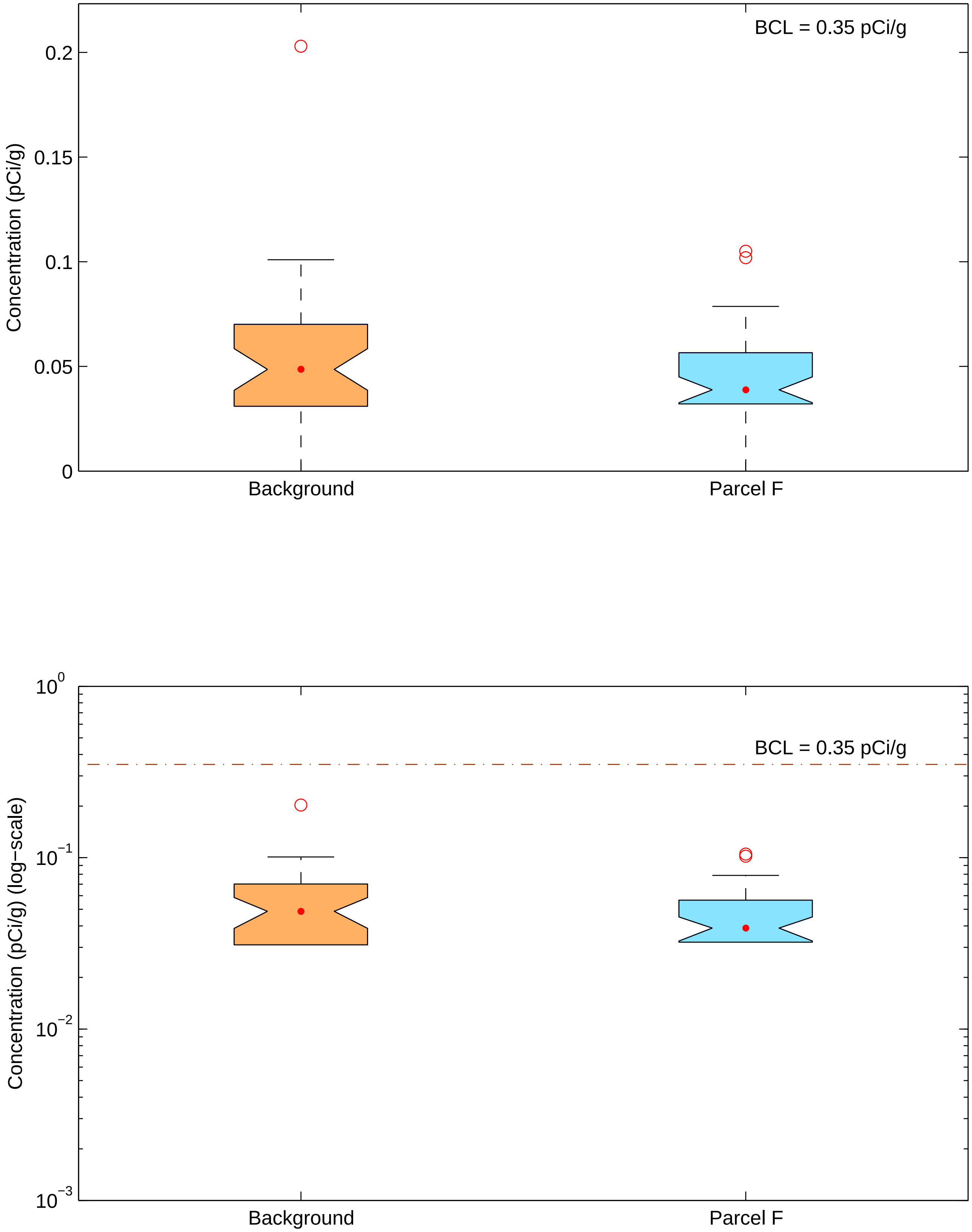
## Figure I1−39. Background vs. Parcel F Boxplots
## Thorium−228





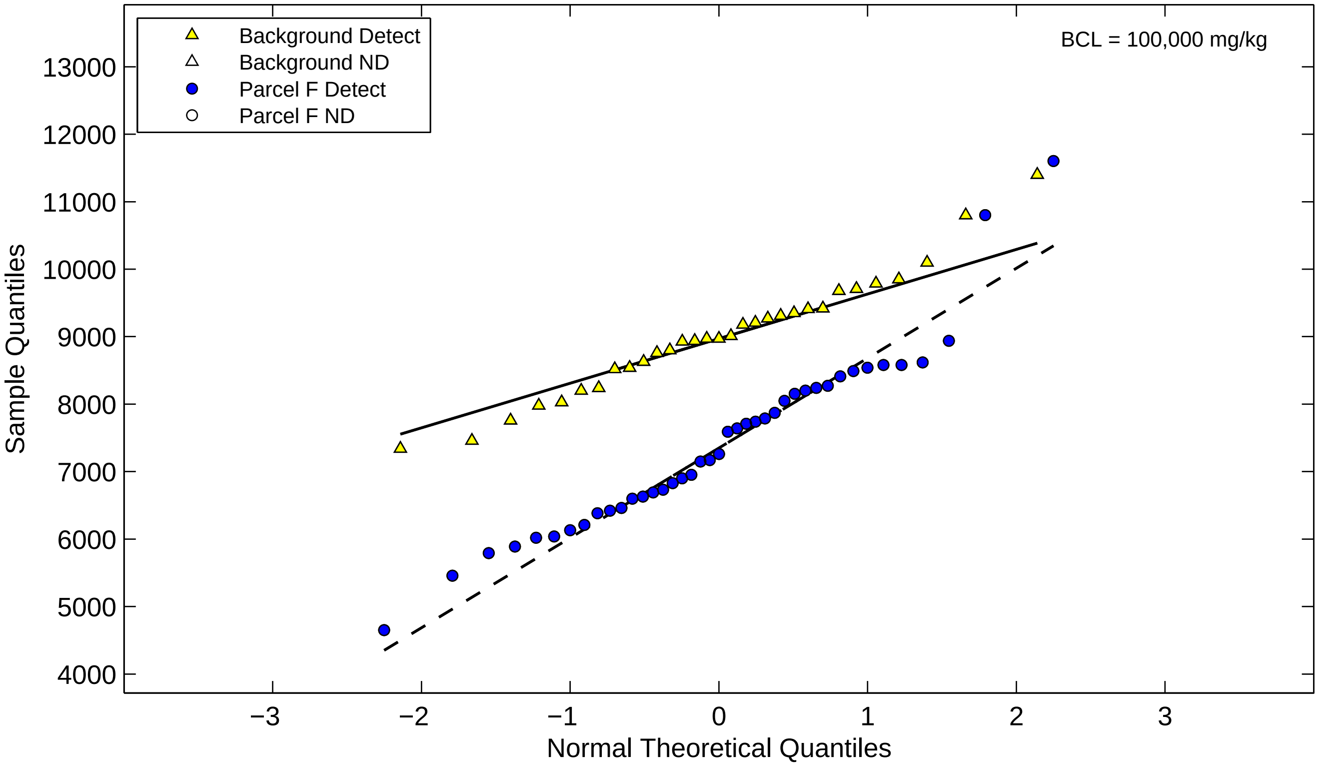
**Ramboll Environ**

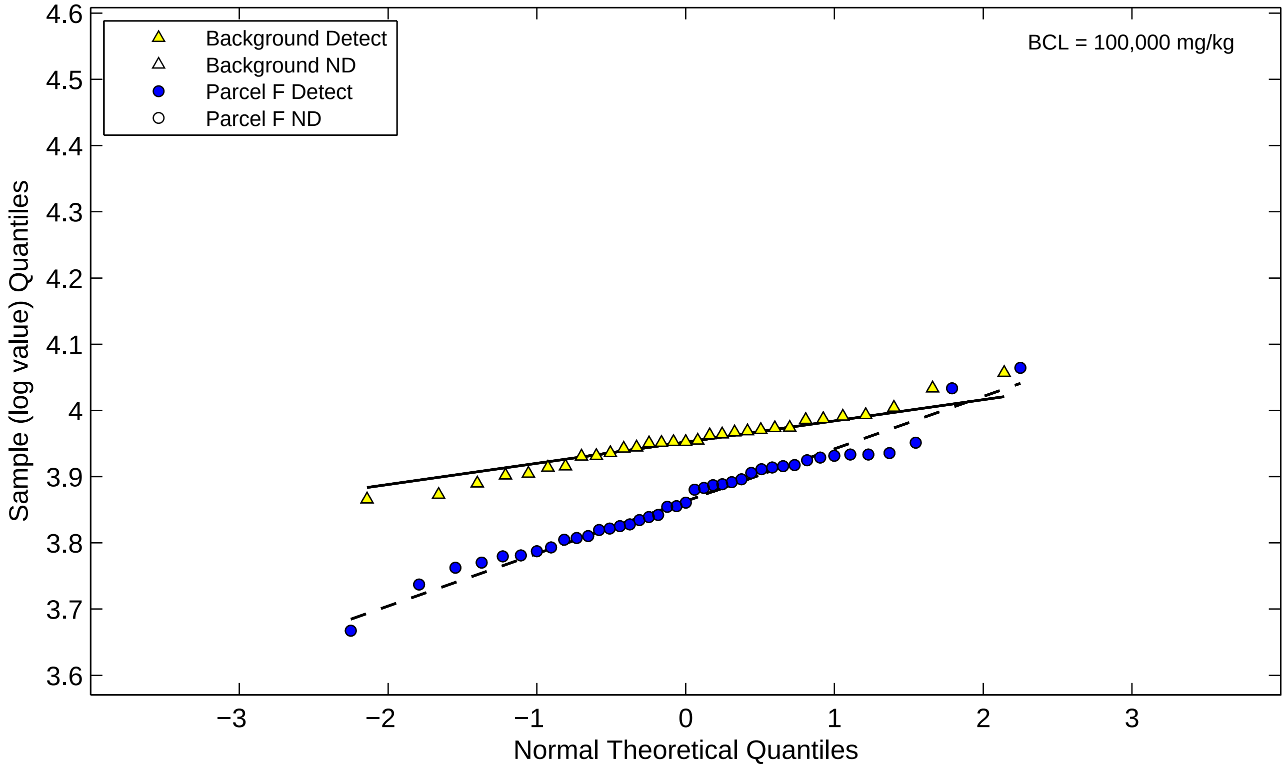
# Figure I1−40. Background vs. Parcel F Boxplots
# Uranium−235



**Ramboll Environ**

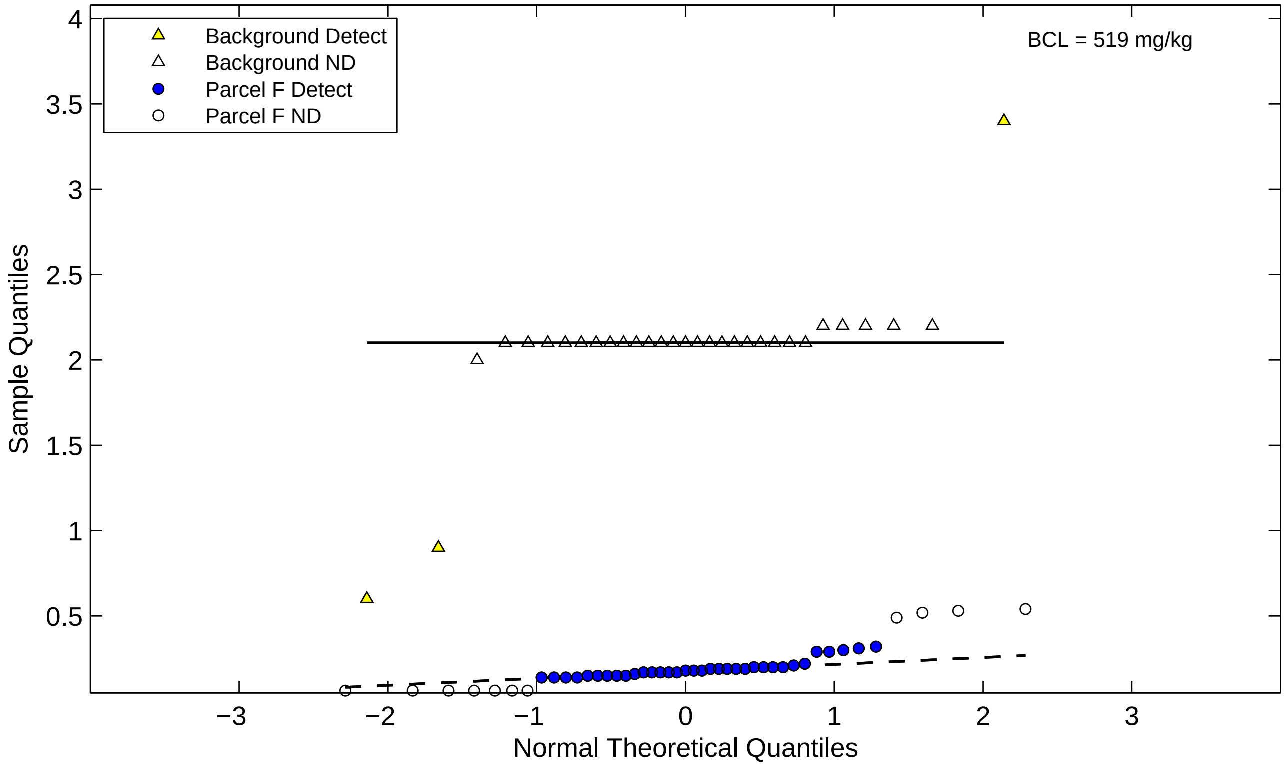
# Figure I2−1. Normal and Lognormal Q−Q Plots
# Aluminum

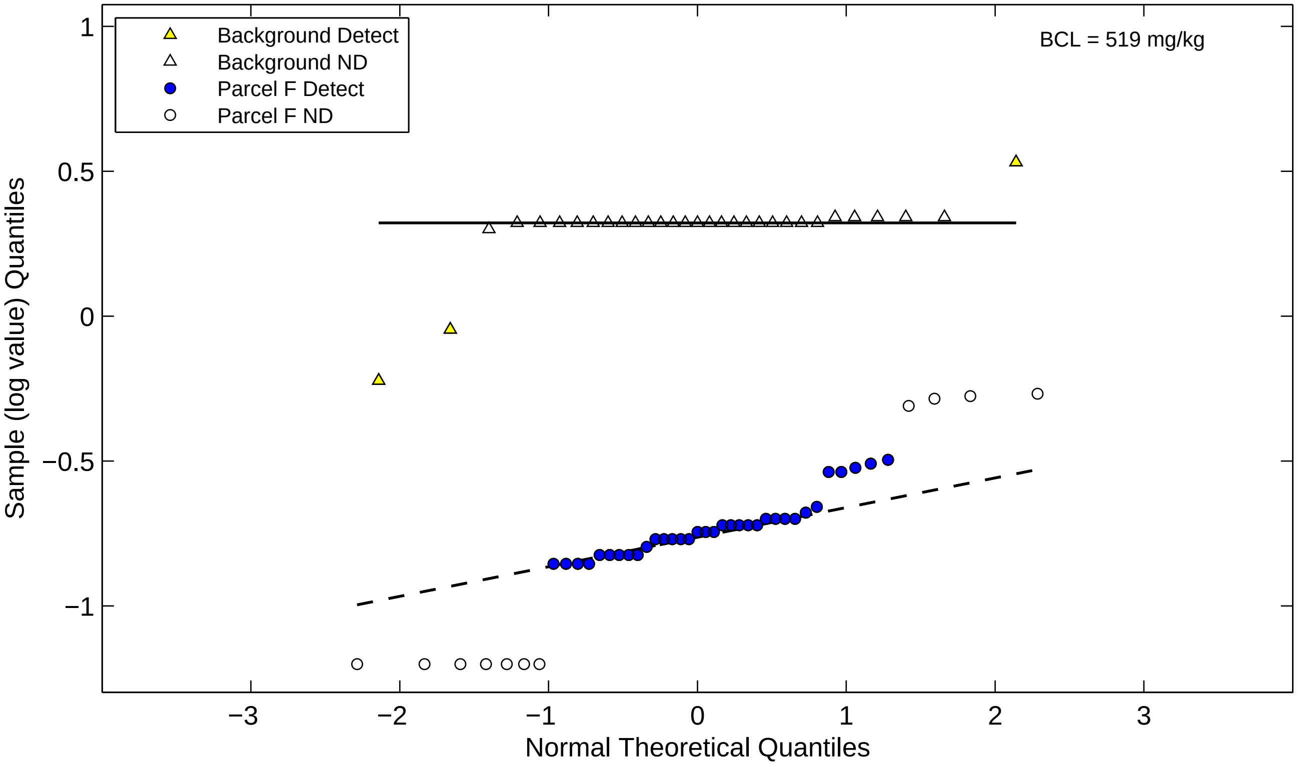




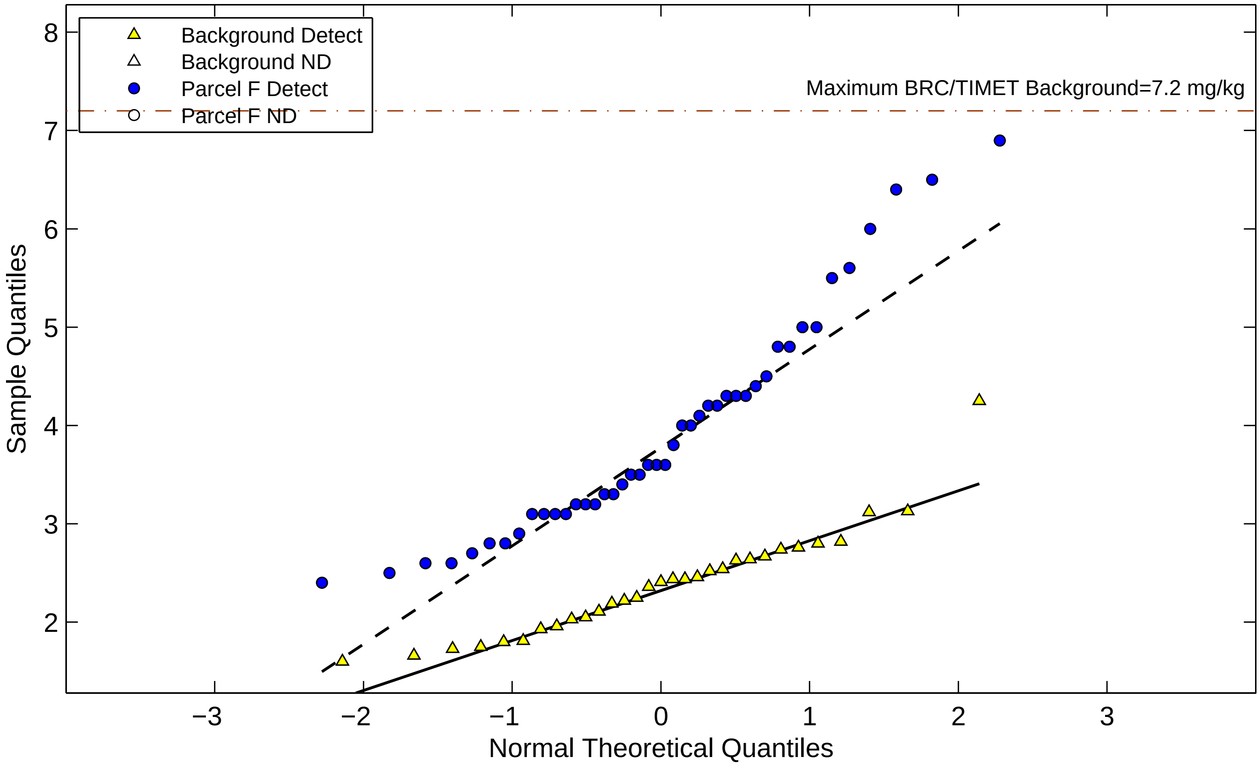
**Ramboll Environ**

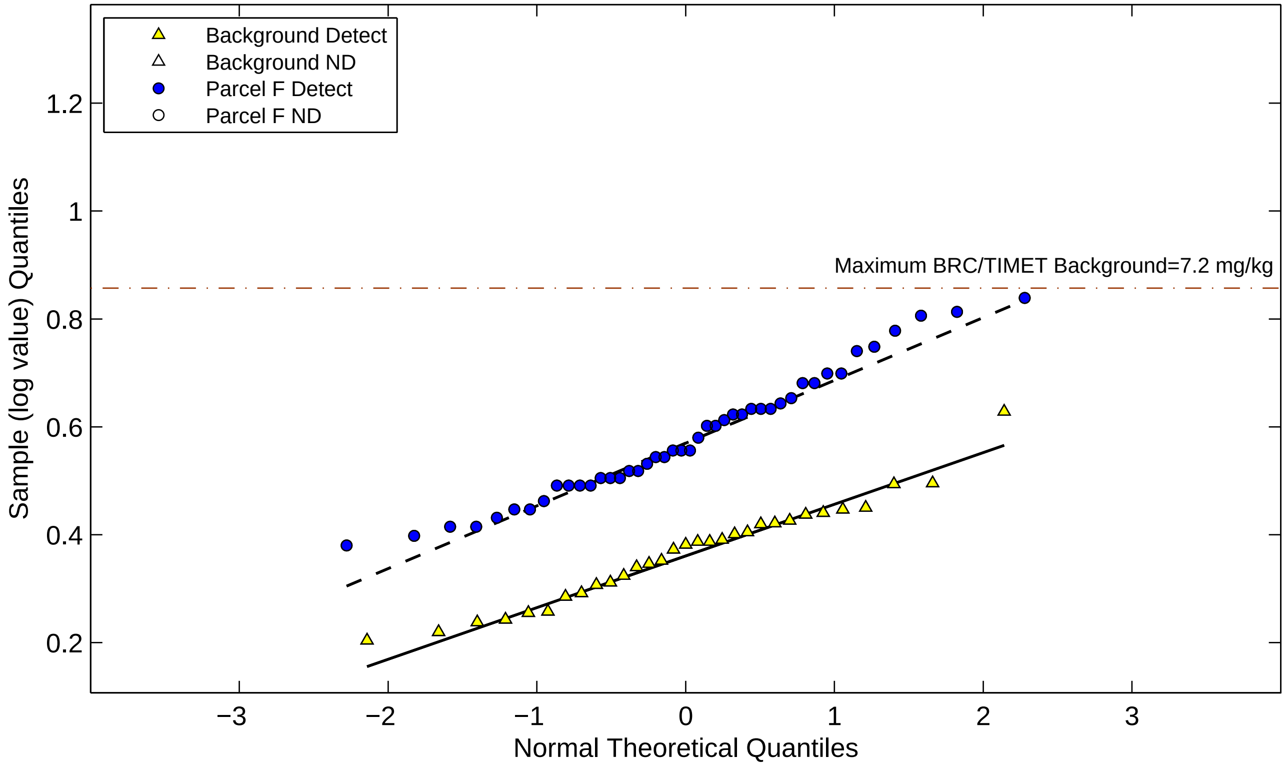
# Figure I2−2. Normal and Lognormal Q−Q Plots
## Antimony





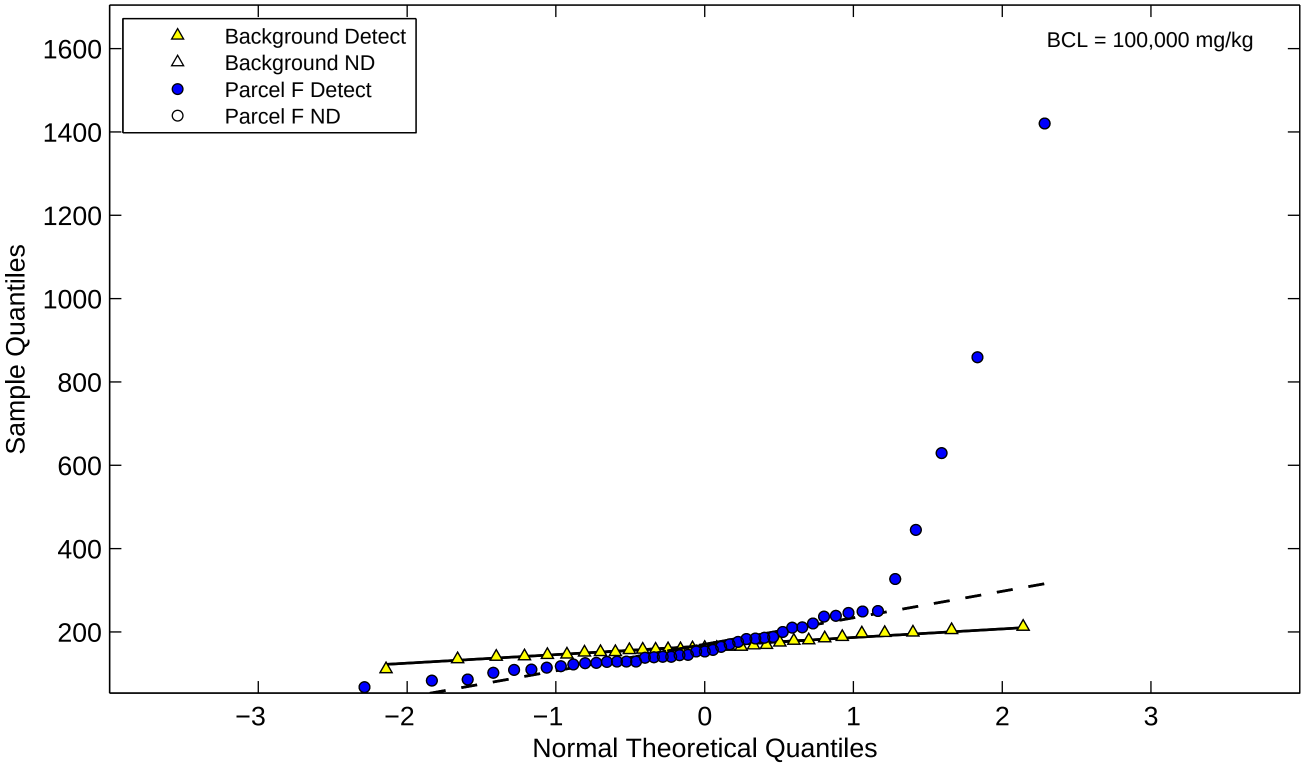
# Figure I2−3. Normal and Lognormal Q−Q Plots
# Arsenic

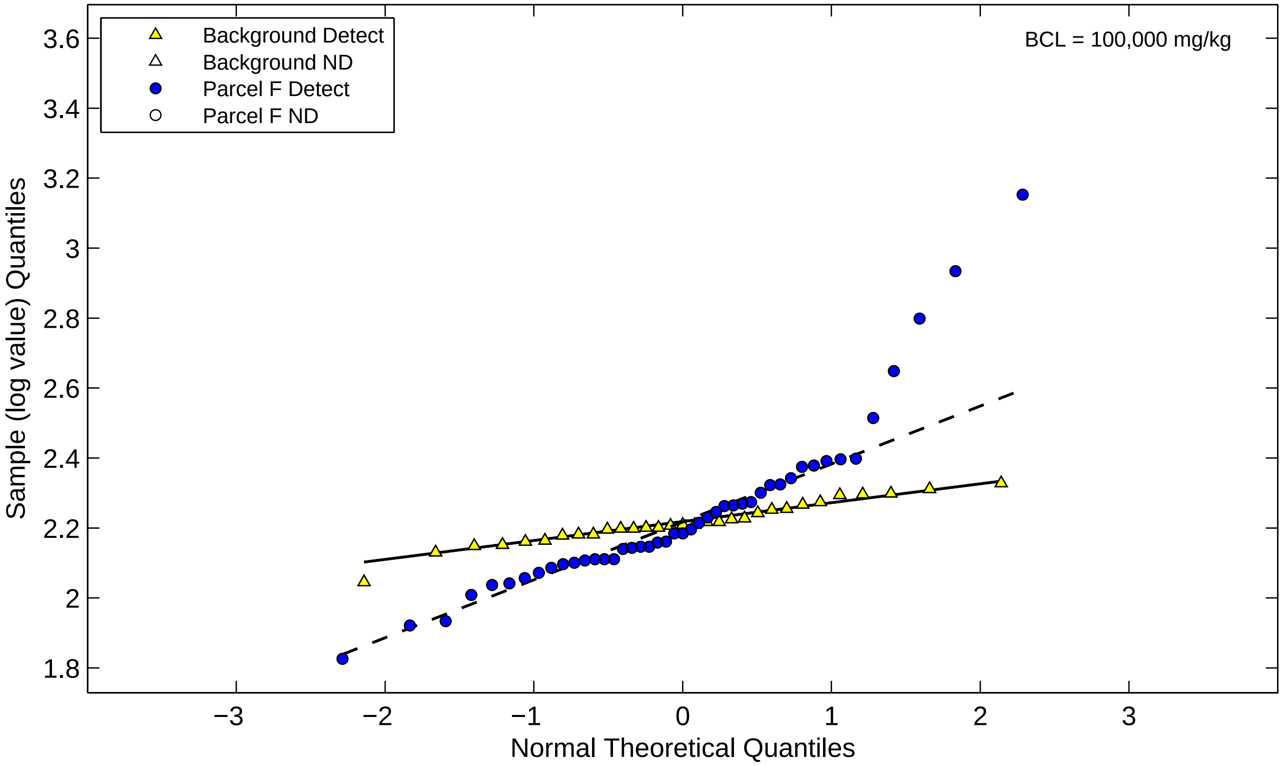




**Ramboll Environ**

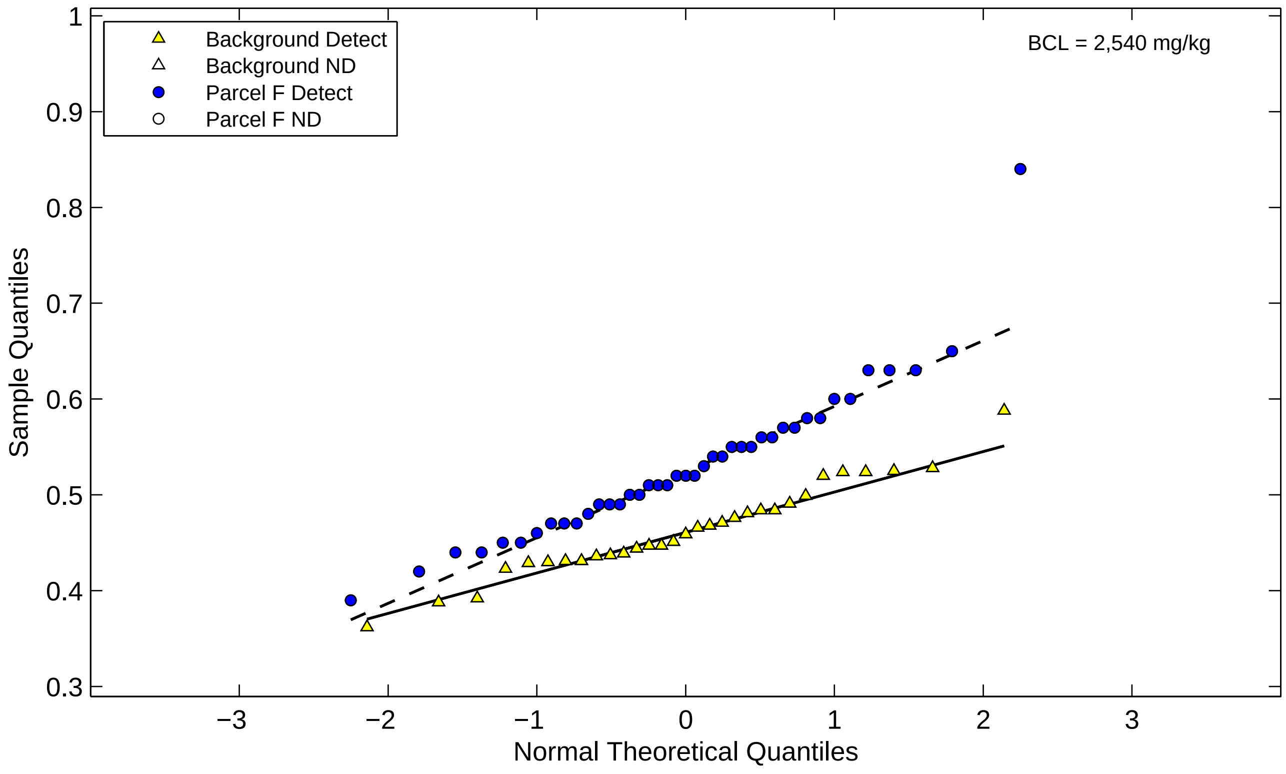
# Figure I2−4. Normal and Lognormal Q−Q Plots
## Barium

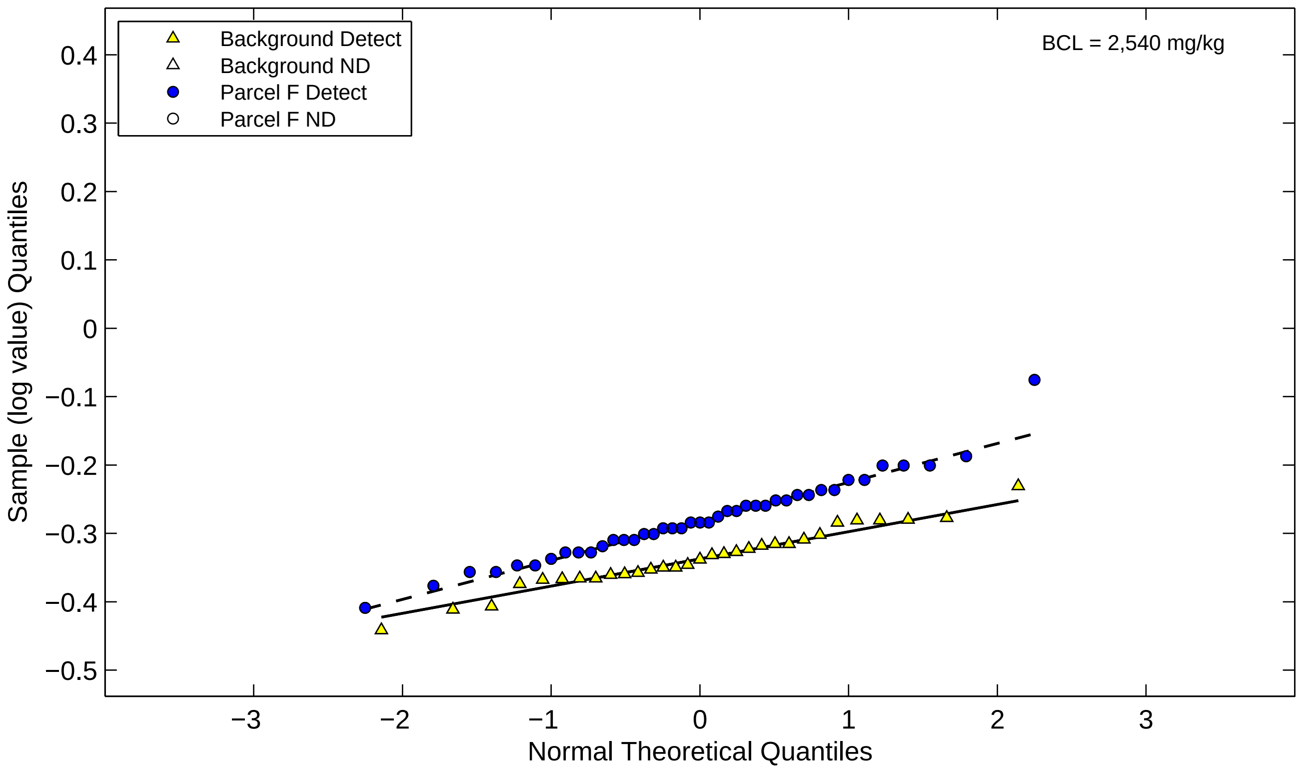




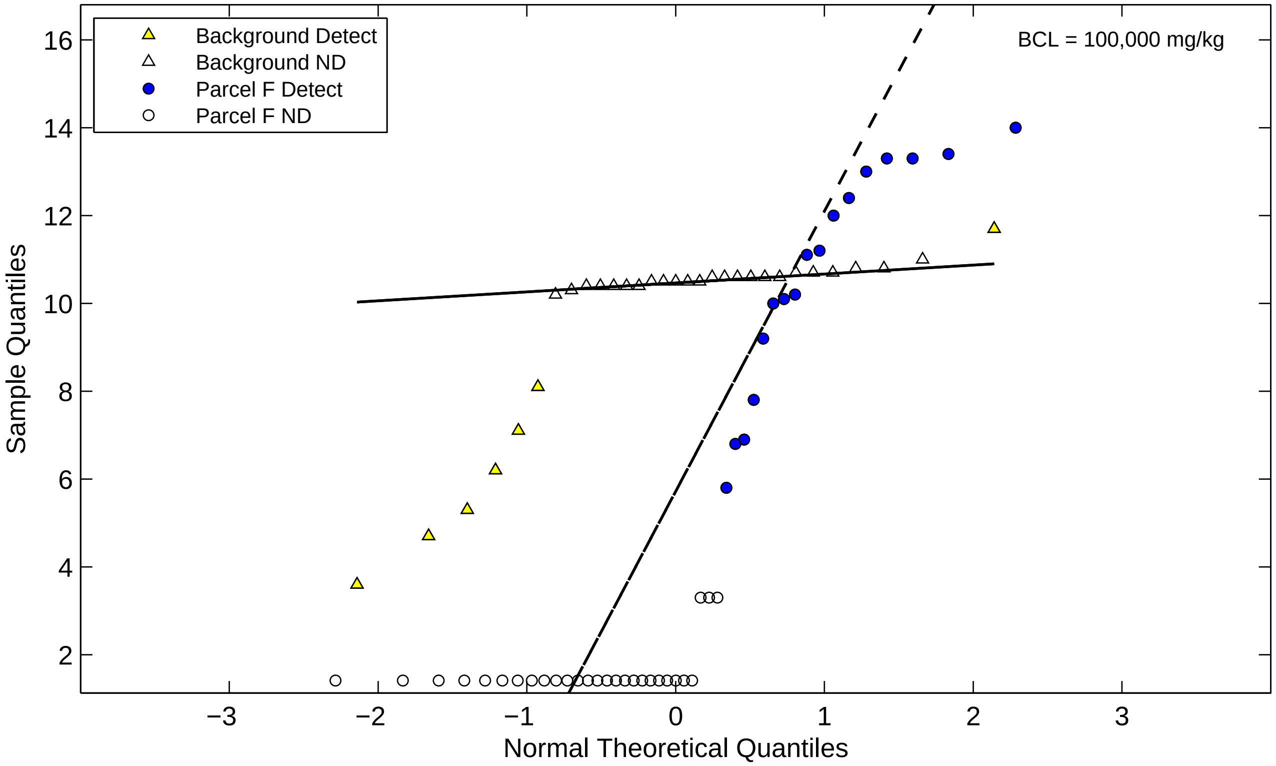
**Ramboll Environ**

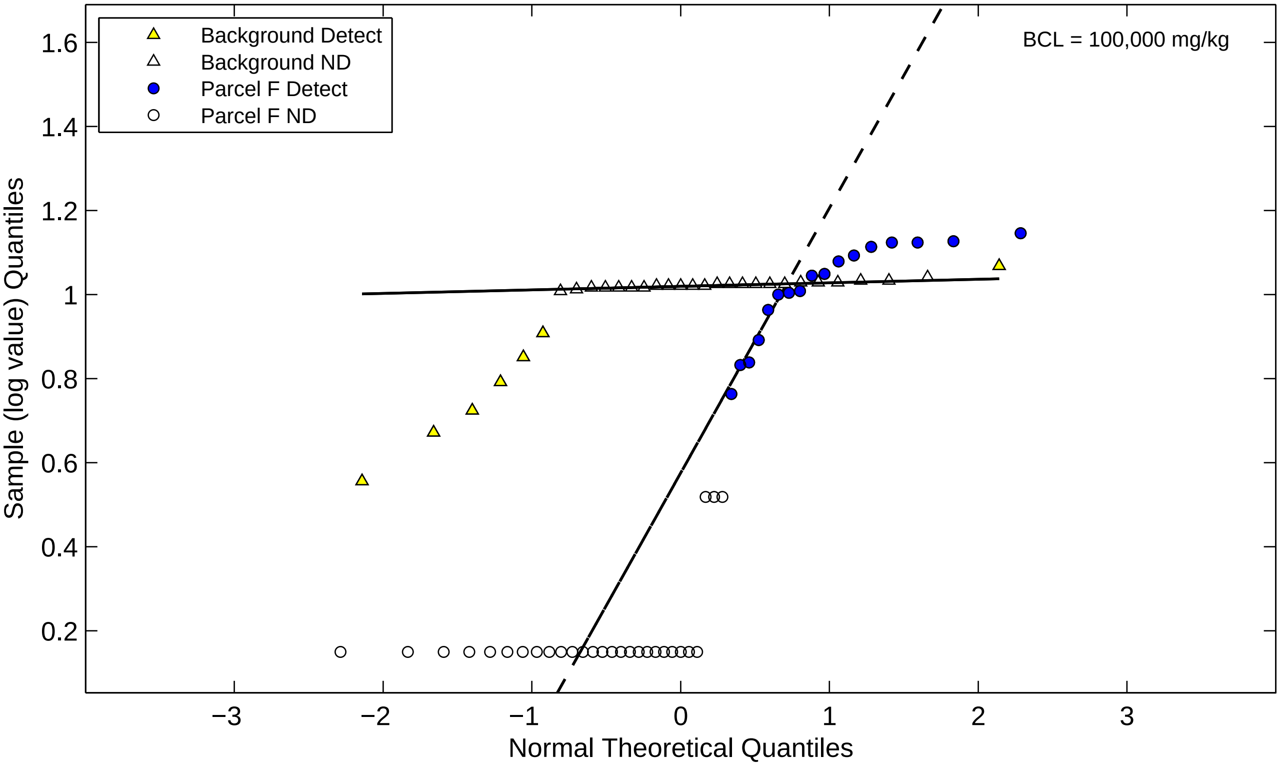
# Figure I2−5. Normal and Lognormal Q−Q Plots
# Beryllium





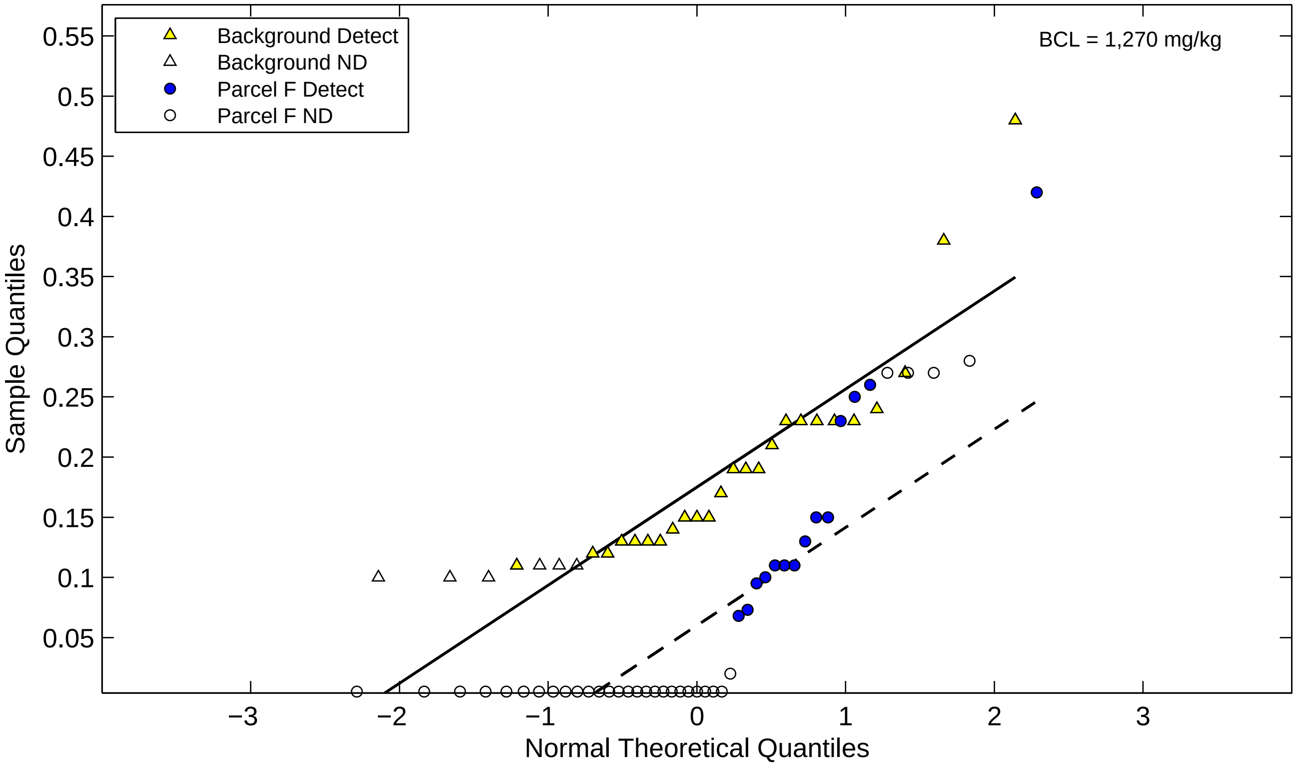
# Figure I2−6. Normal and Lognormal Q−Q Plots
# Boron

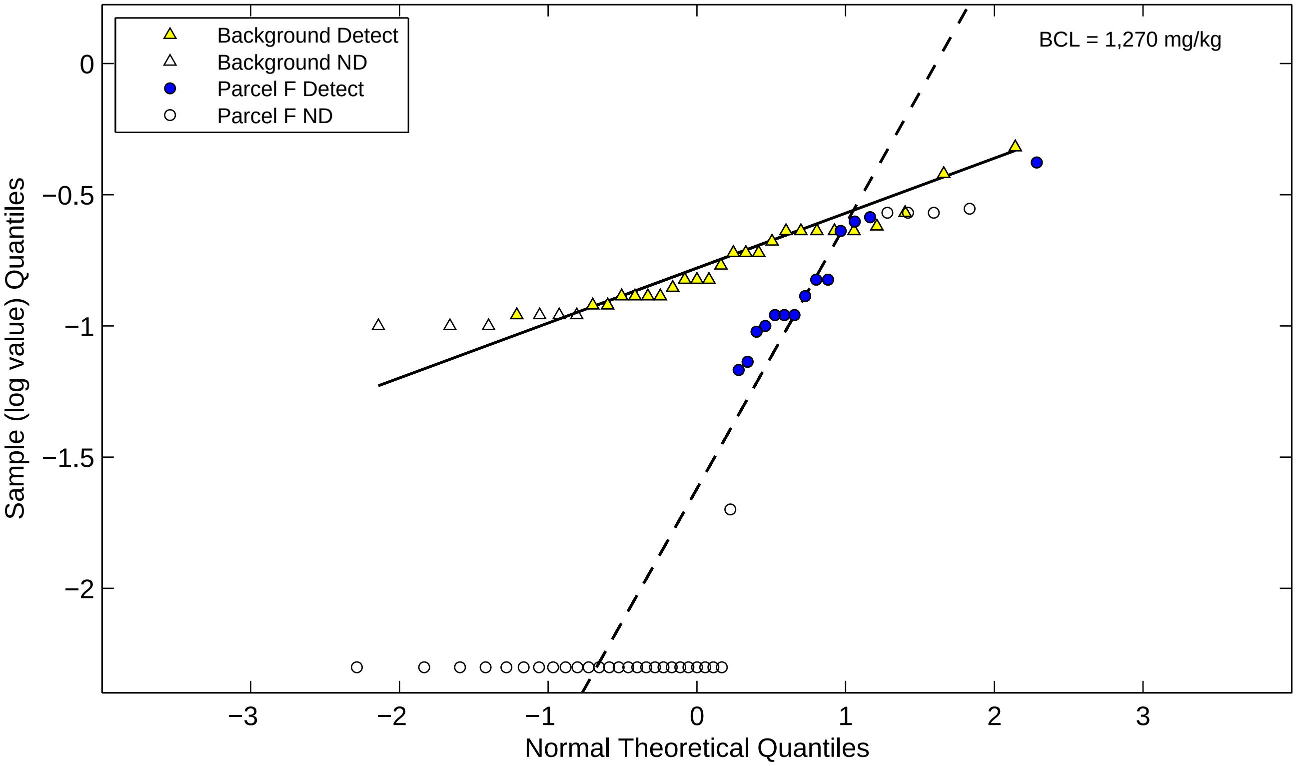




**Ramboll Environ**

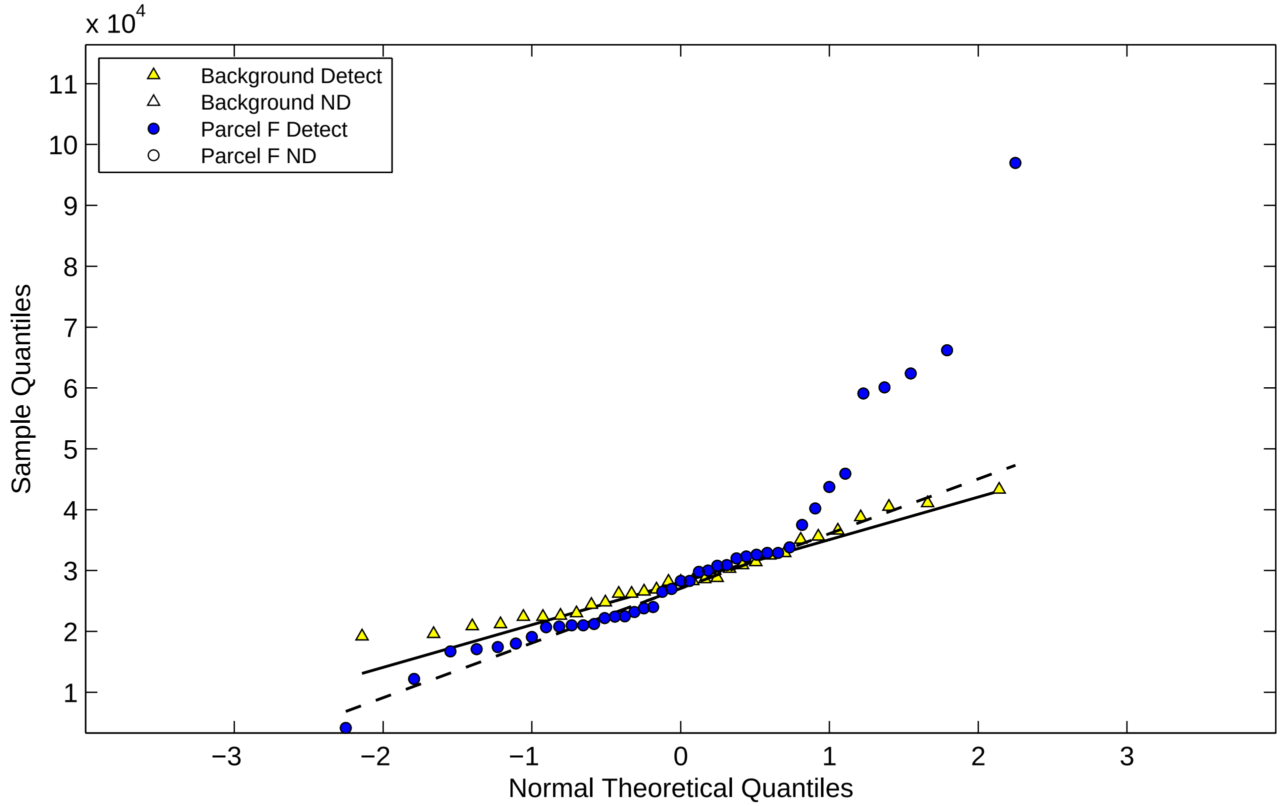
# Figure I2−7. Normal and Lognormal Q−Q Plots
# Cadmium

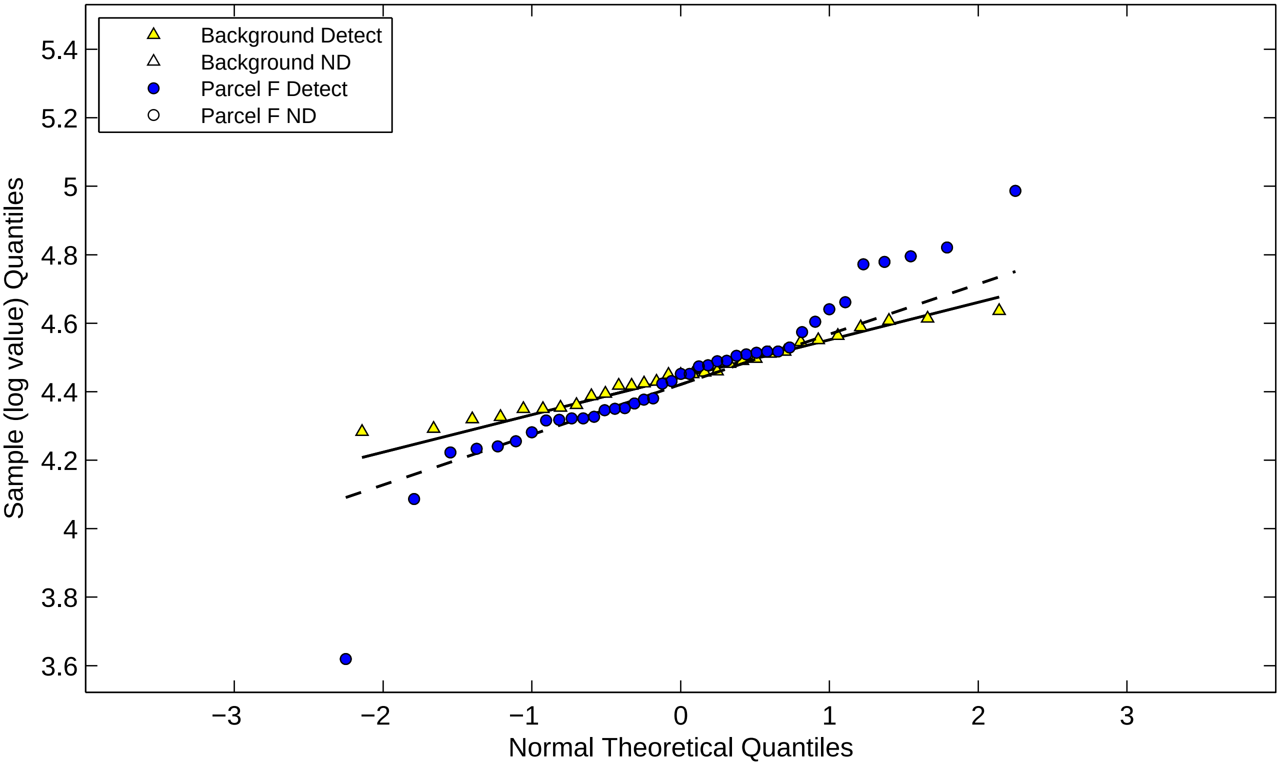




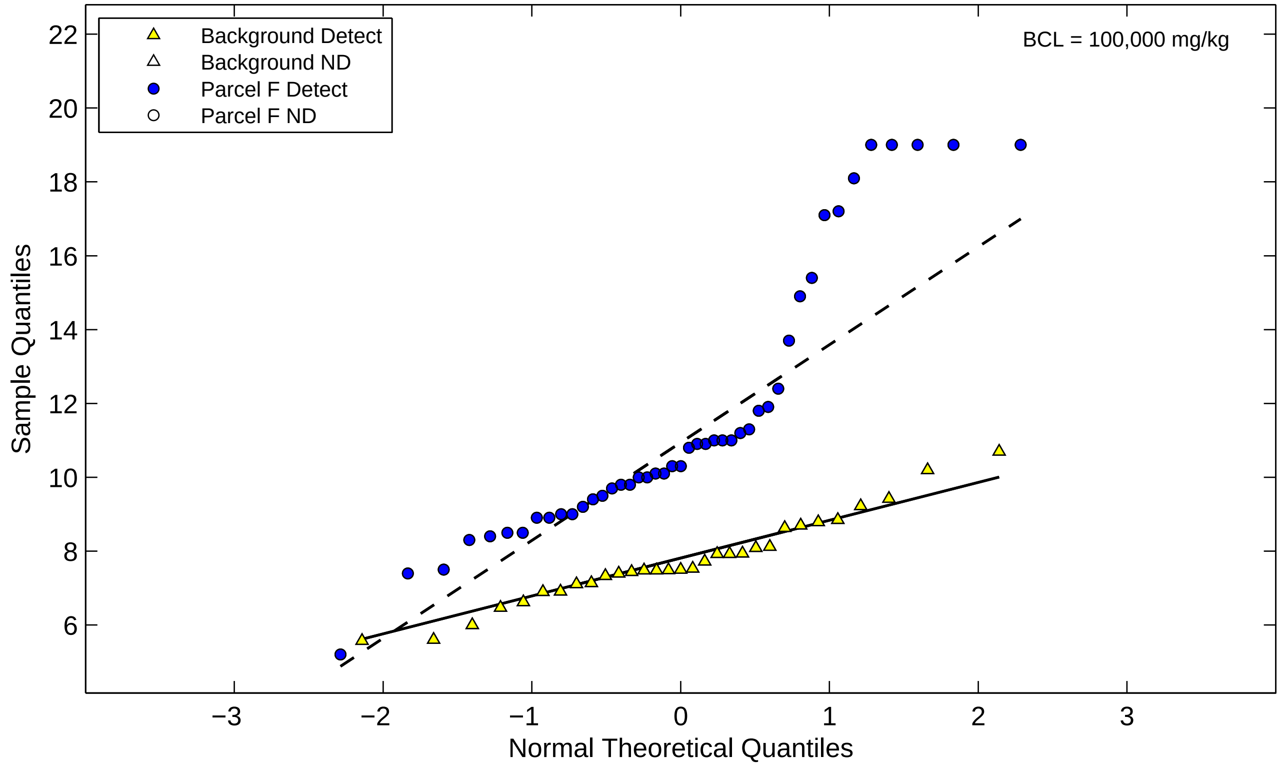
**Ramboll Environ**

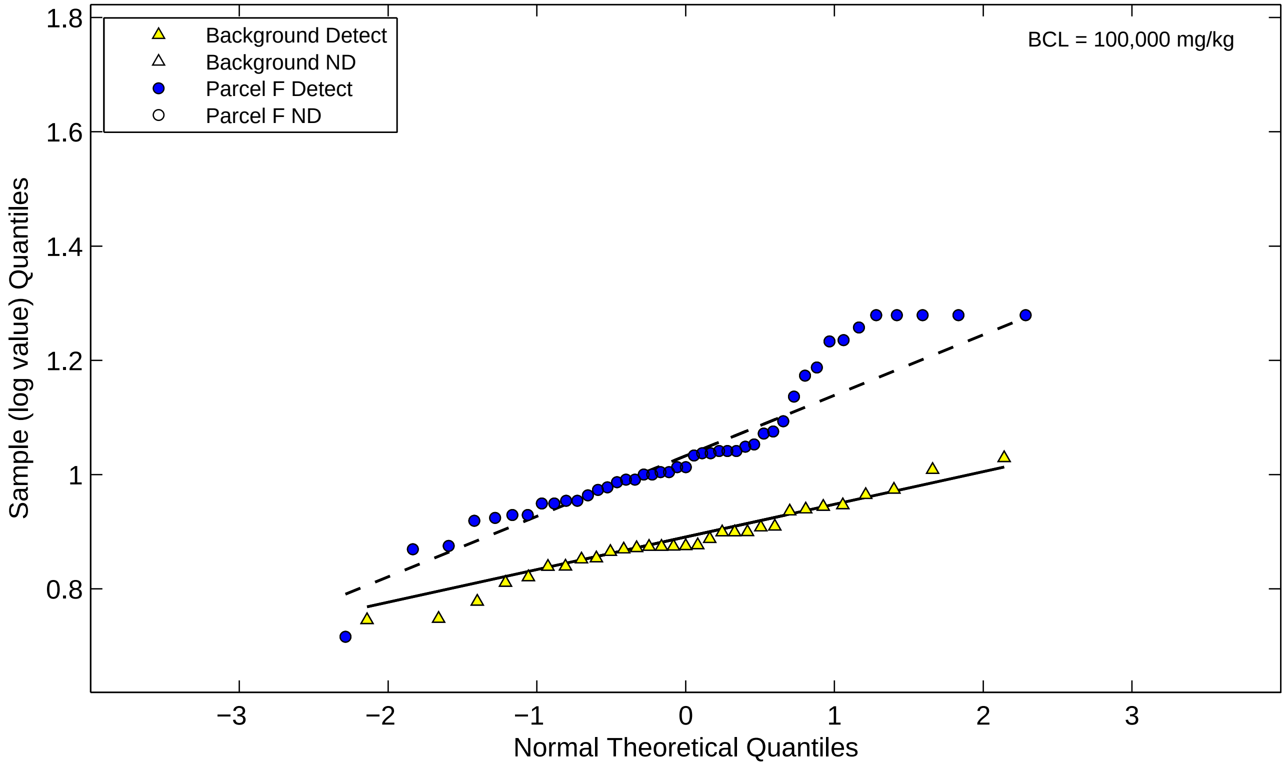
# Figure I2−8. Normal and Lognormal Q−Q Plots
# Calcium



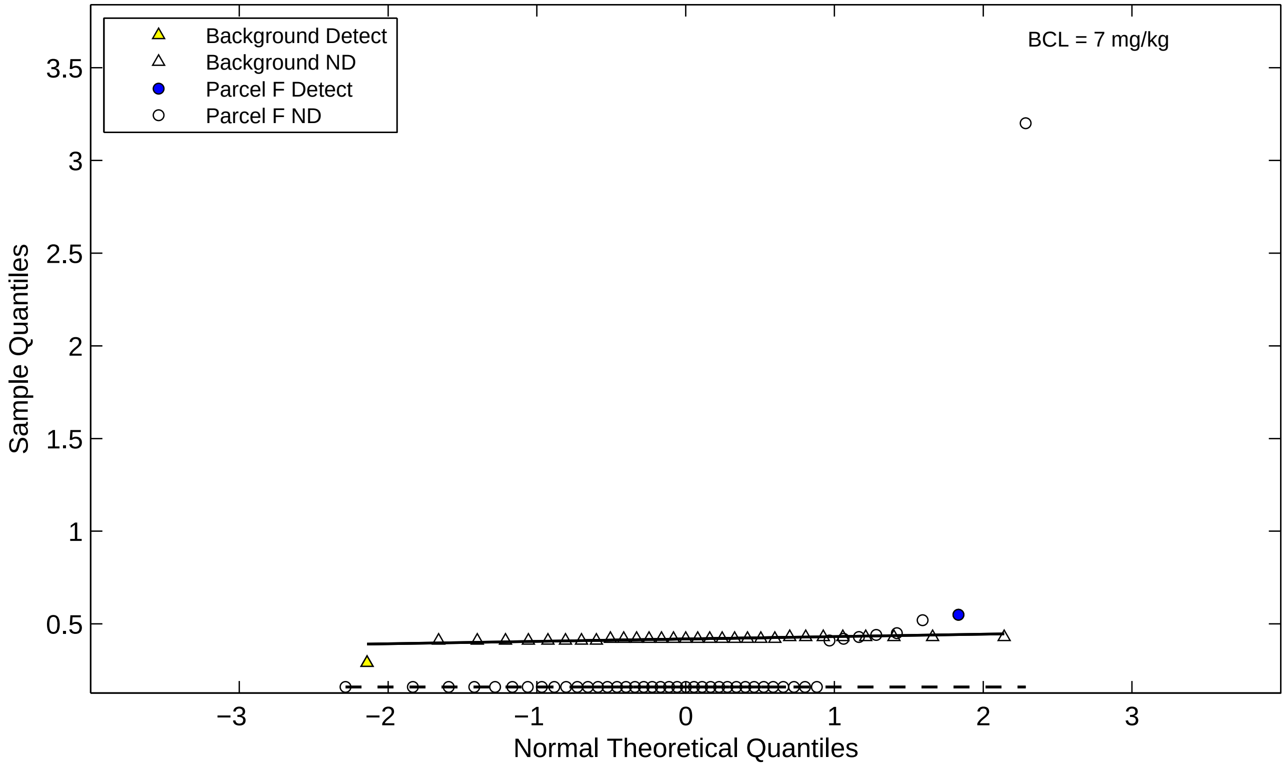


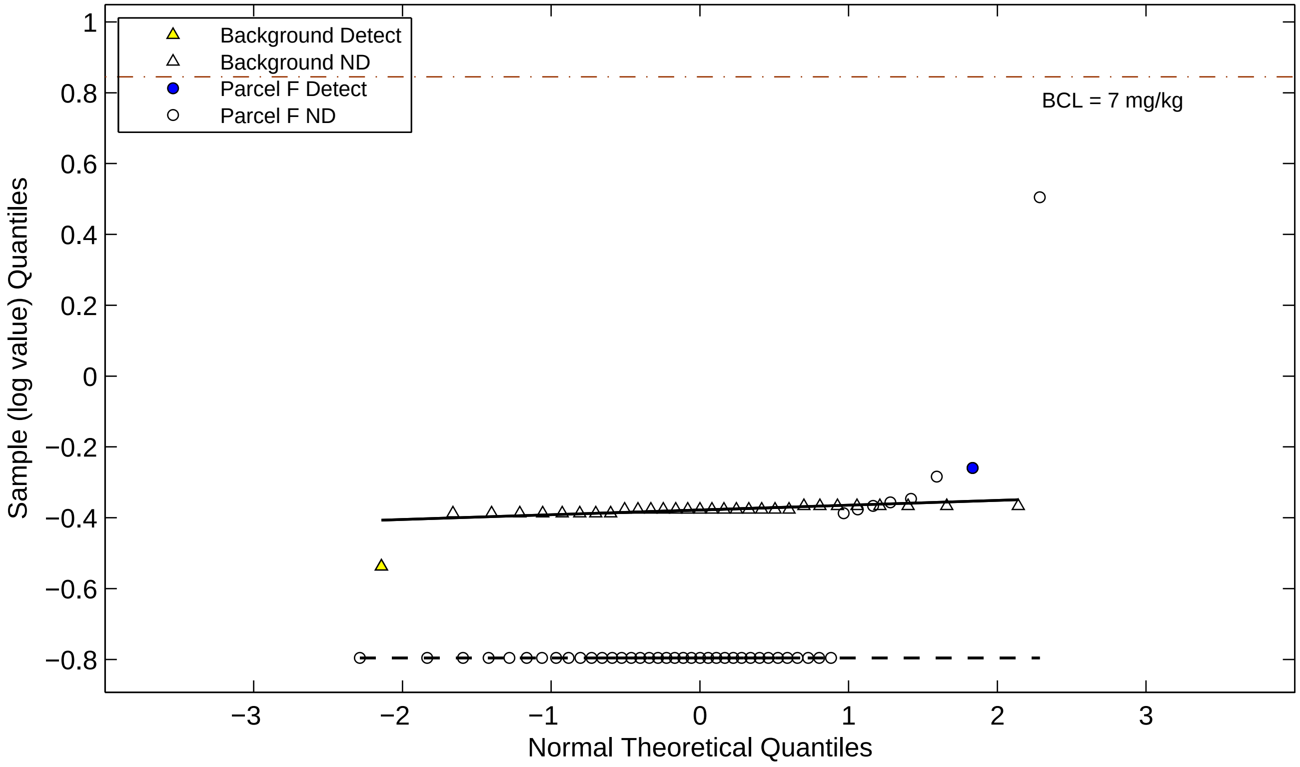
# Figure I2−9. Normal and Lognormal Q−Q Plots
## Chromium (total)





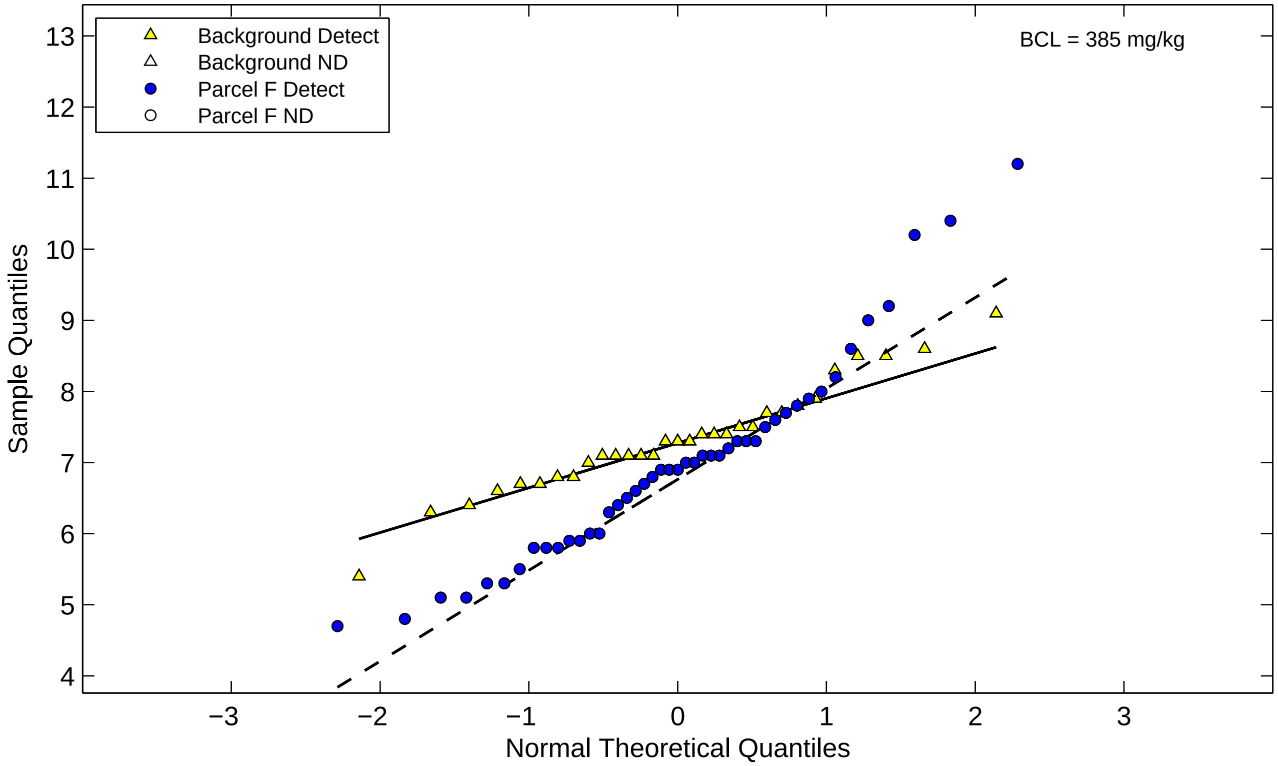
# Figure I2−10. Normal and Lognormal Q−Q Plots
# Chromium VI

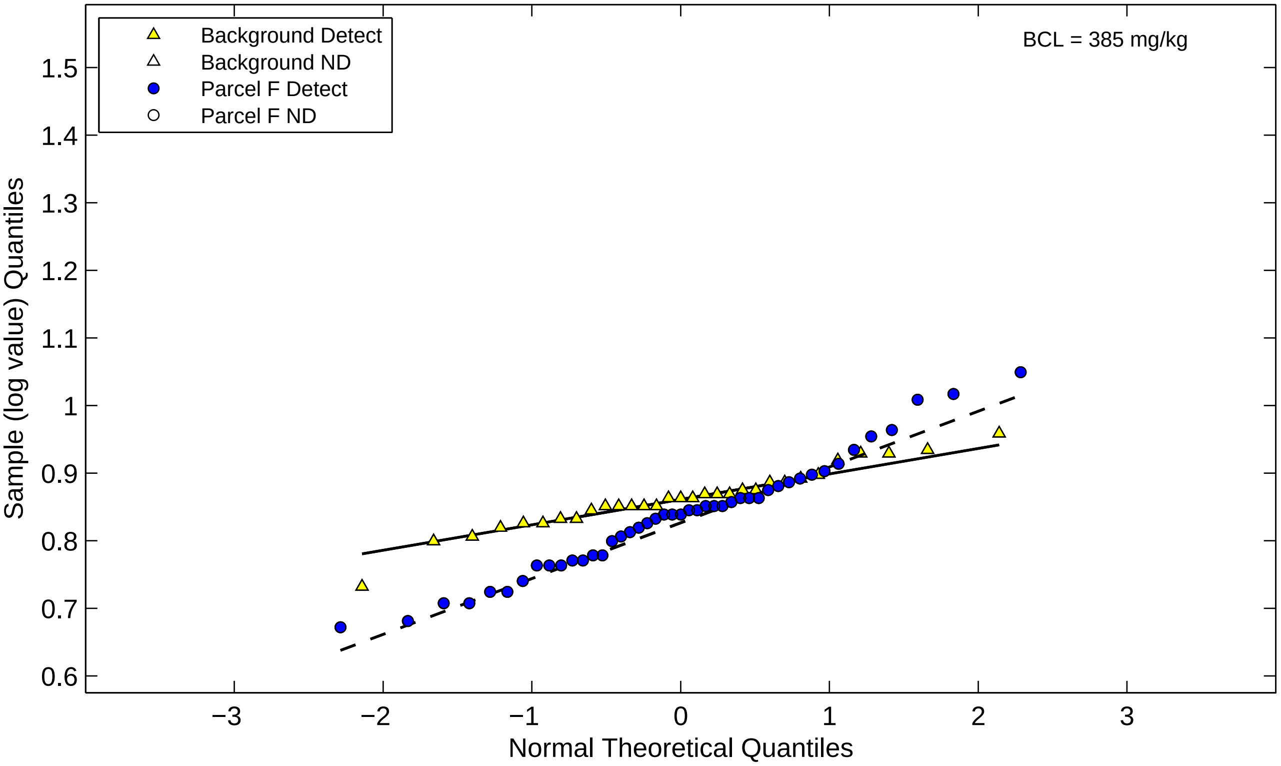




**Ramboll Environ**

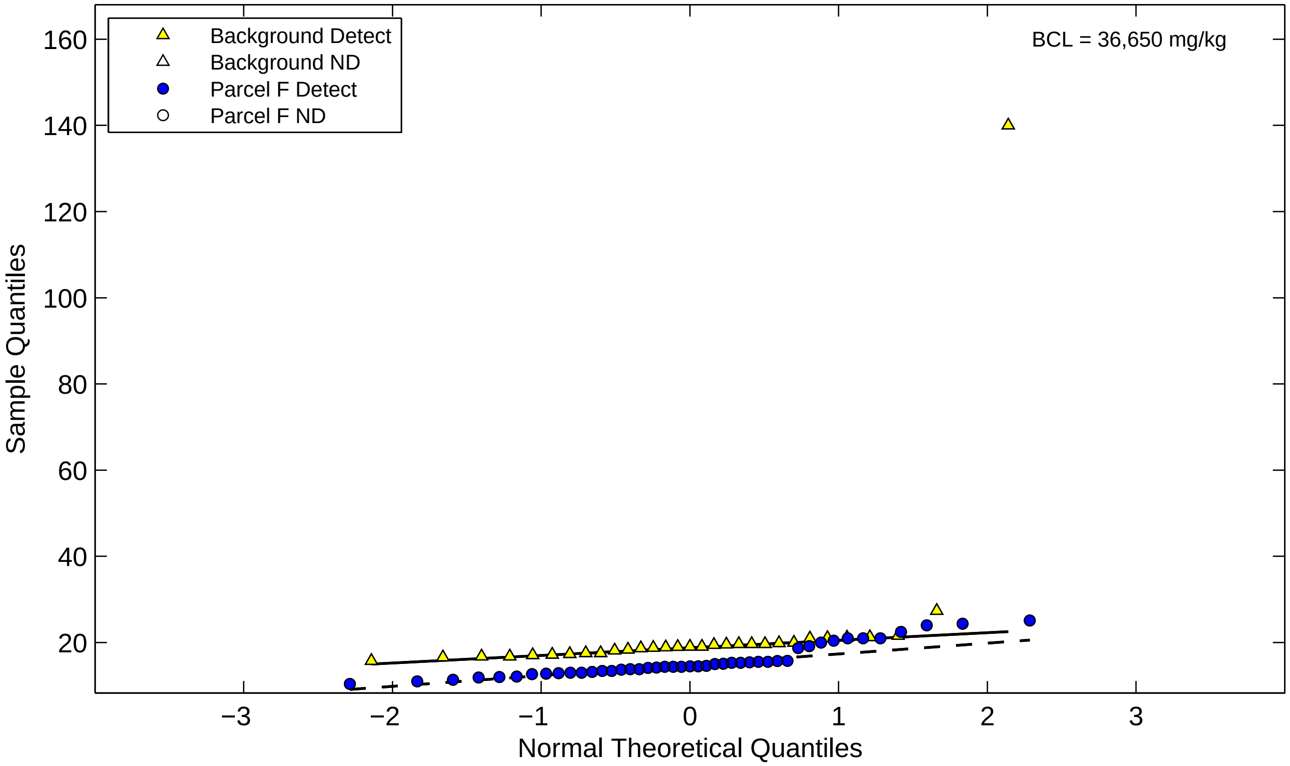
# Figure I2−11. Normal and Lognormal Q−Q Plots
# Cobalt

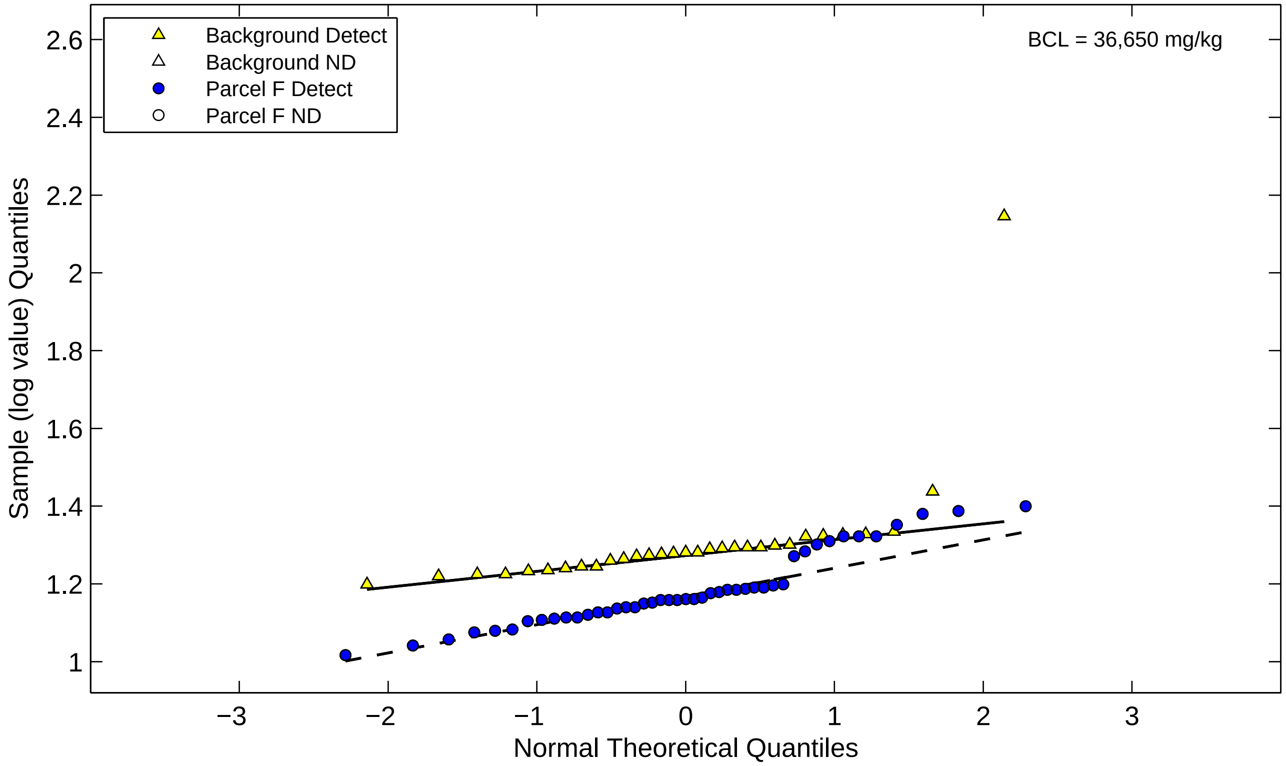




**Ramboll Environ**

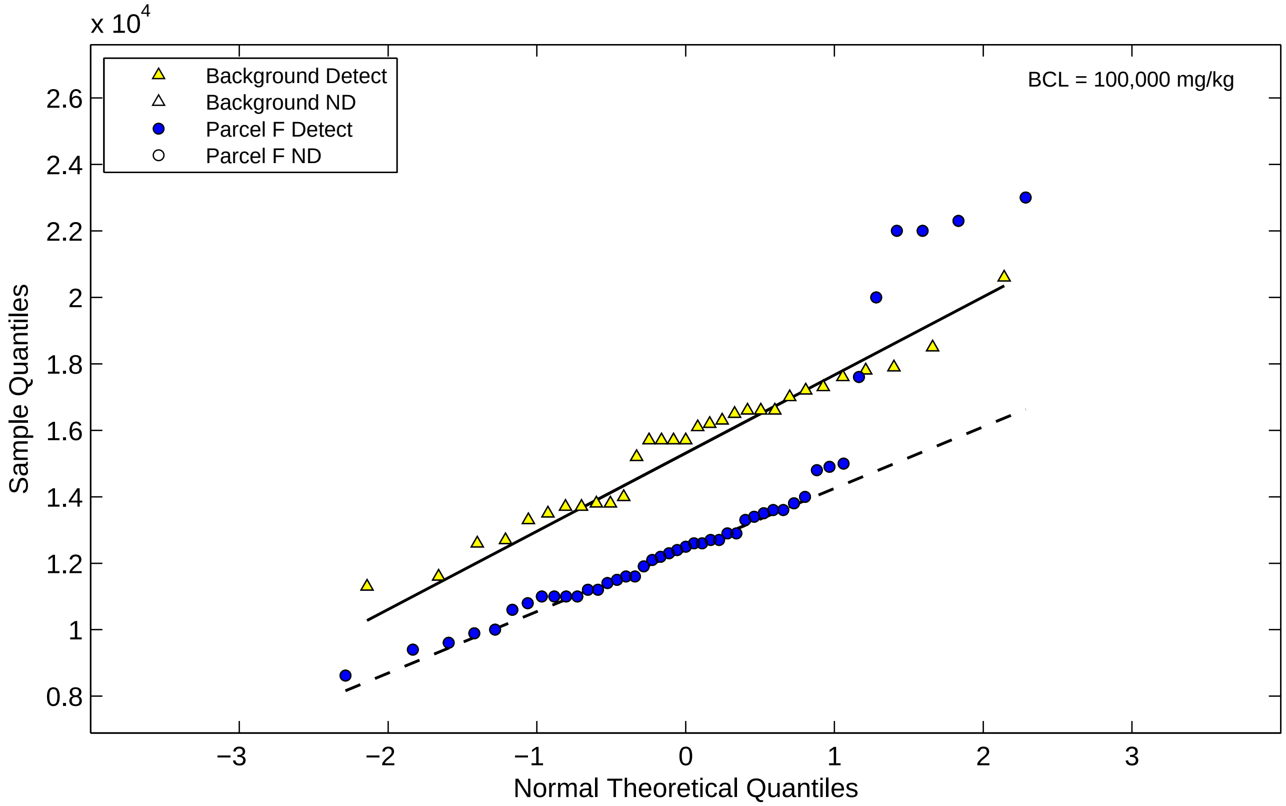
# Figure I2−12. Normal and Lognormal Q−Q Plots
# Copper

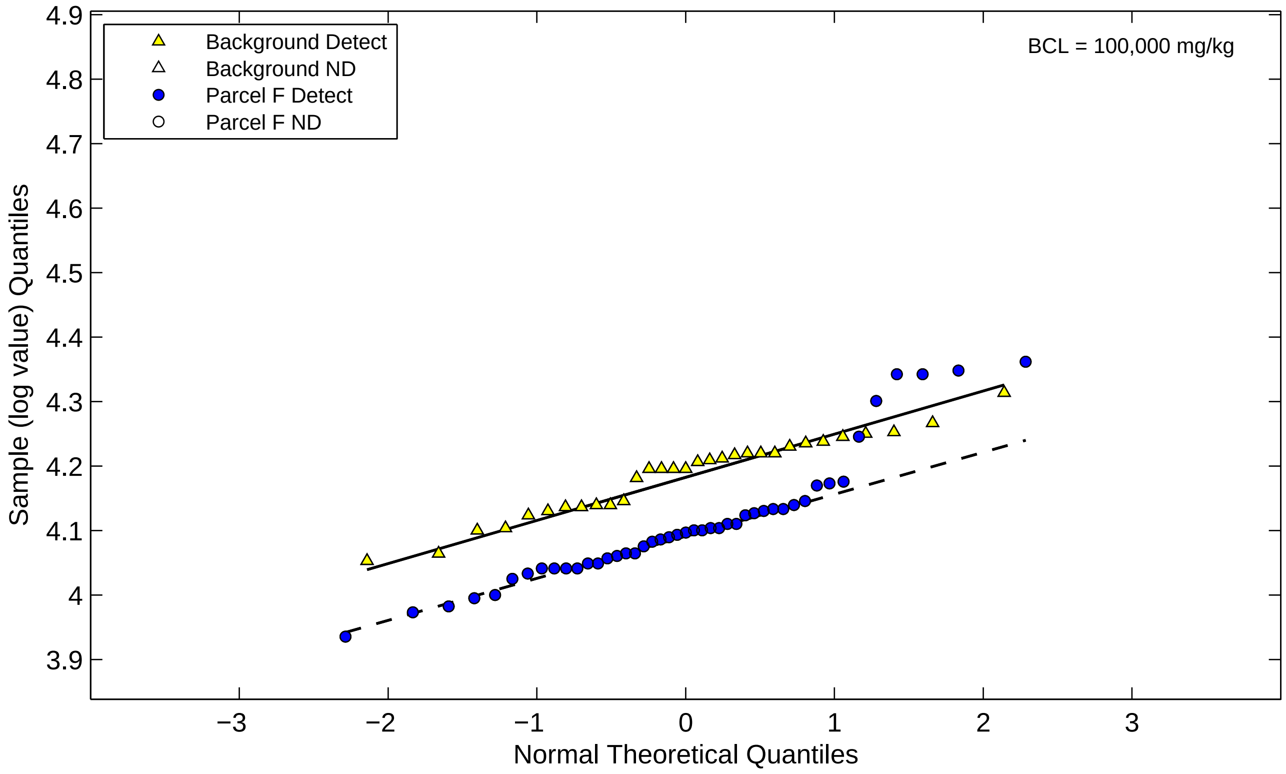




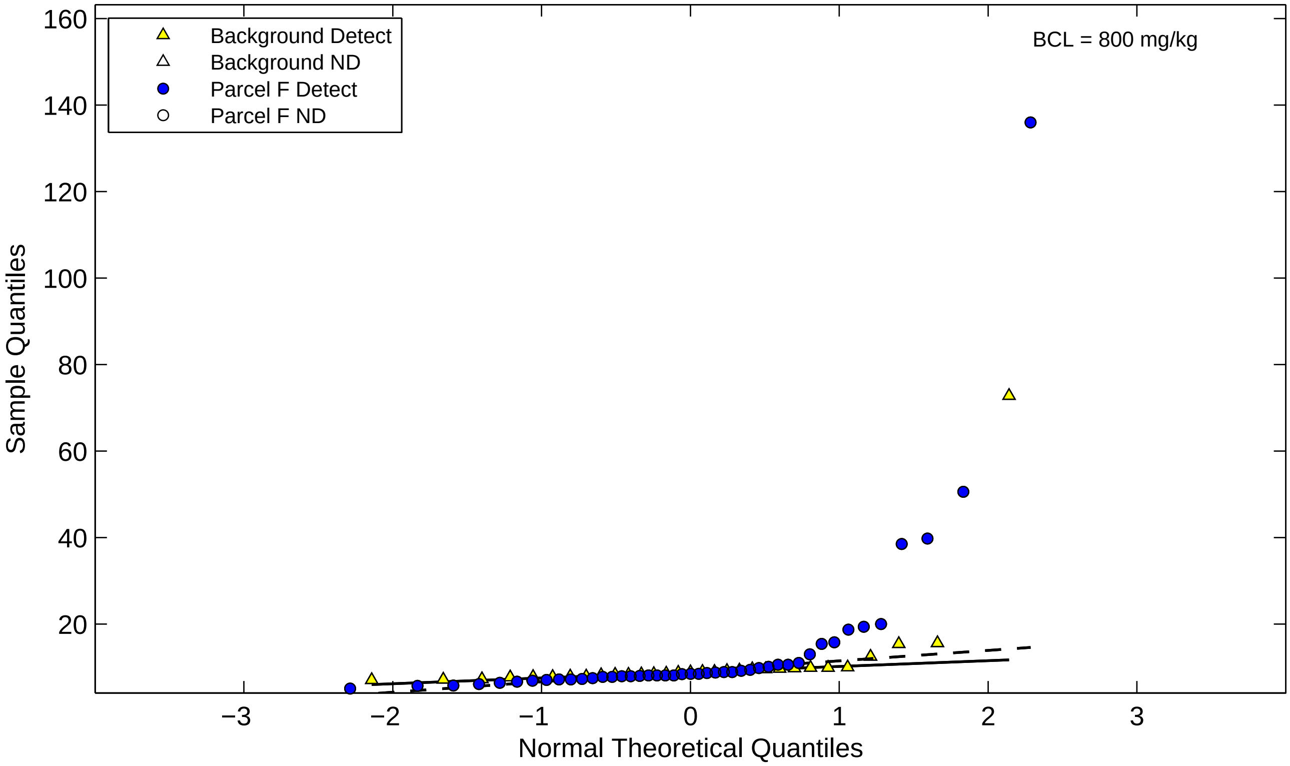
**Ramboll Environ**

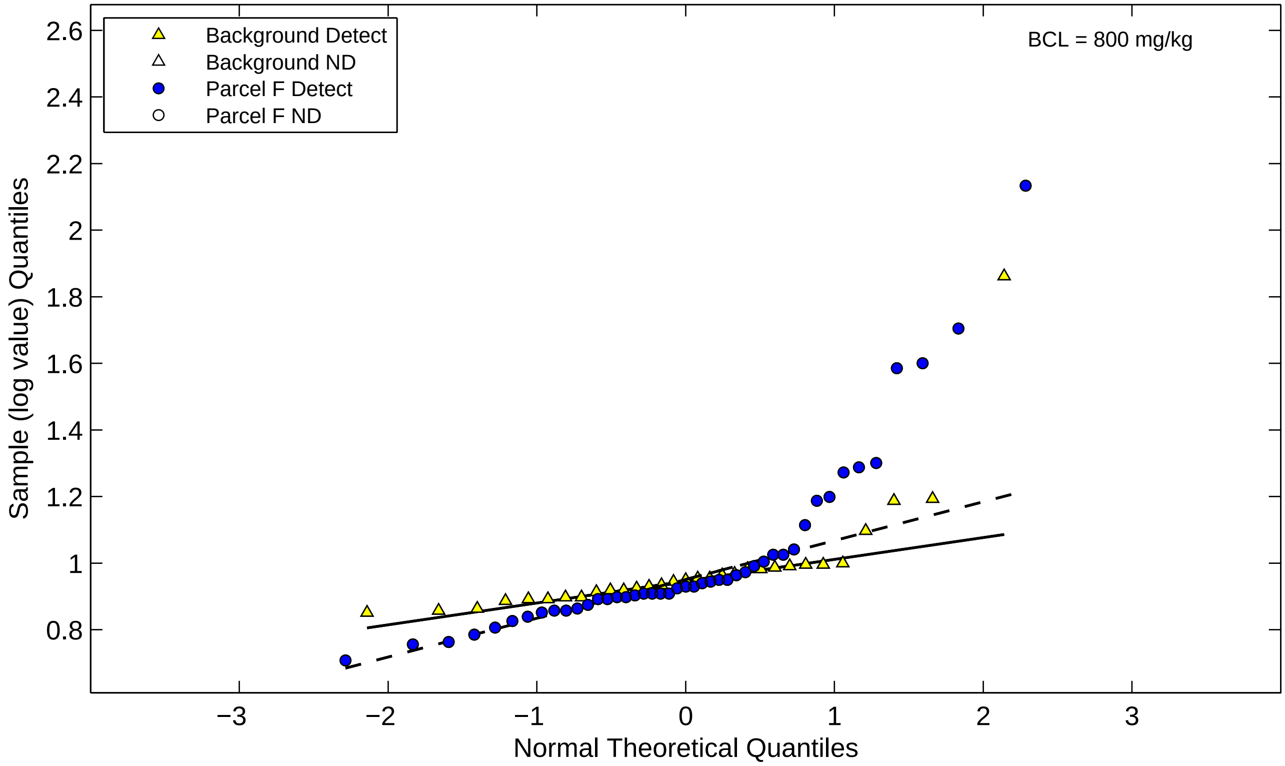
# Figure I2−13. Normal and Lognormal Q−Q Plots
# Iron



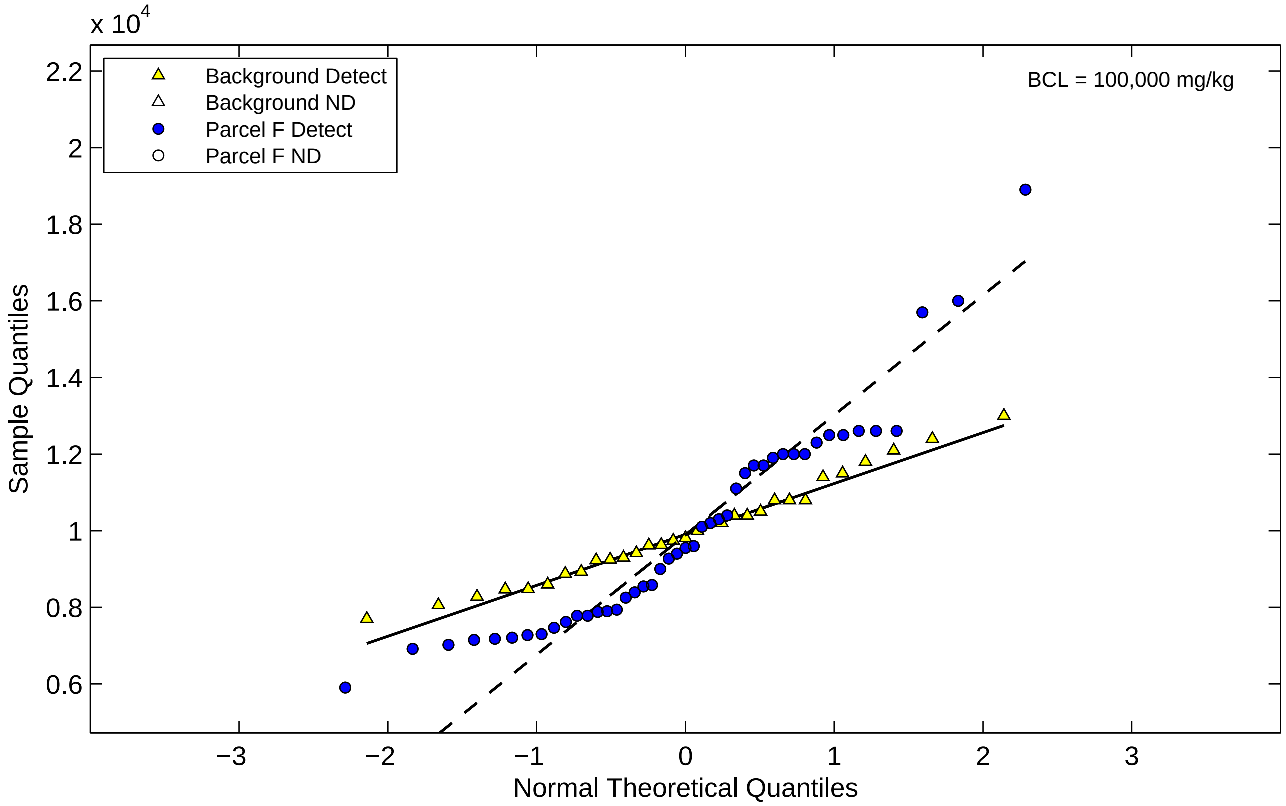


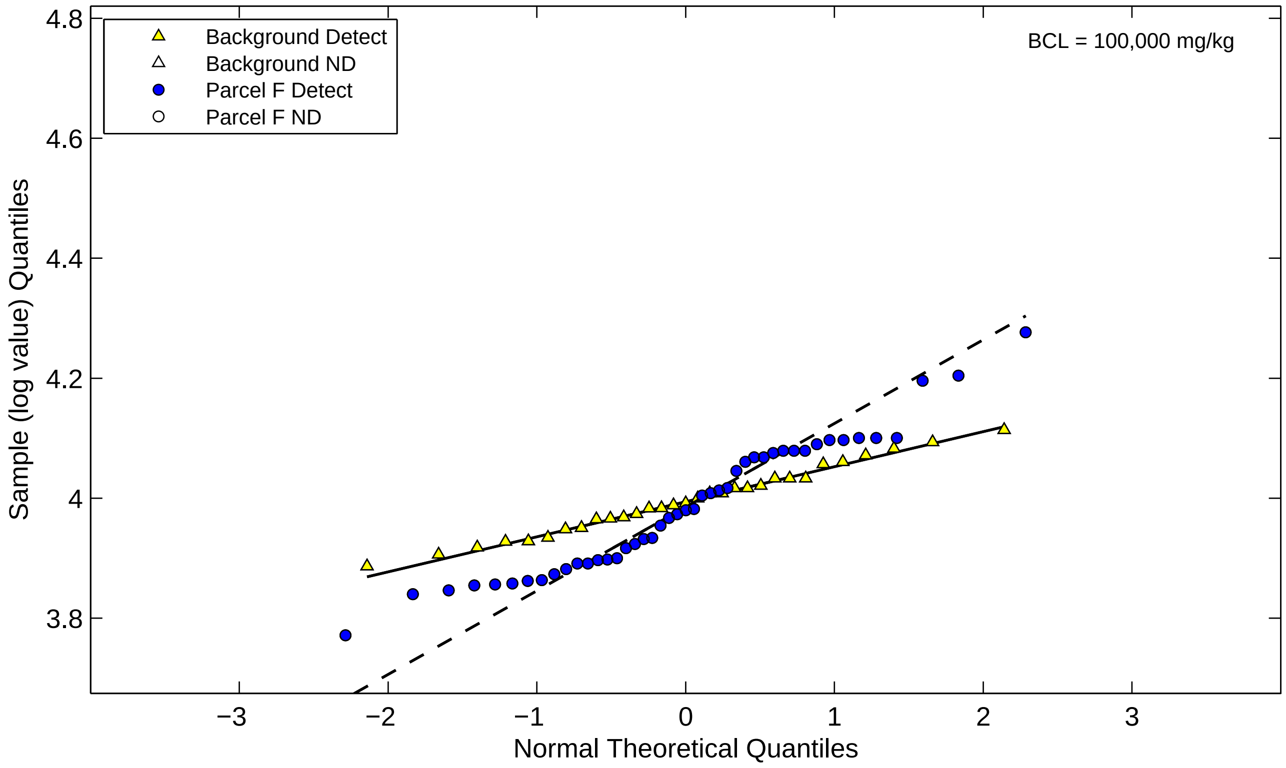
# Figure I2−14. Normal and Lognormal Q−Q Plots
# Lead





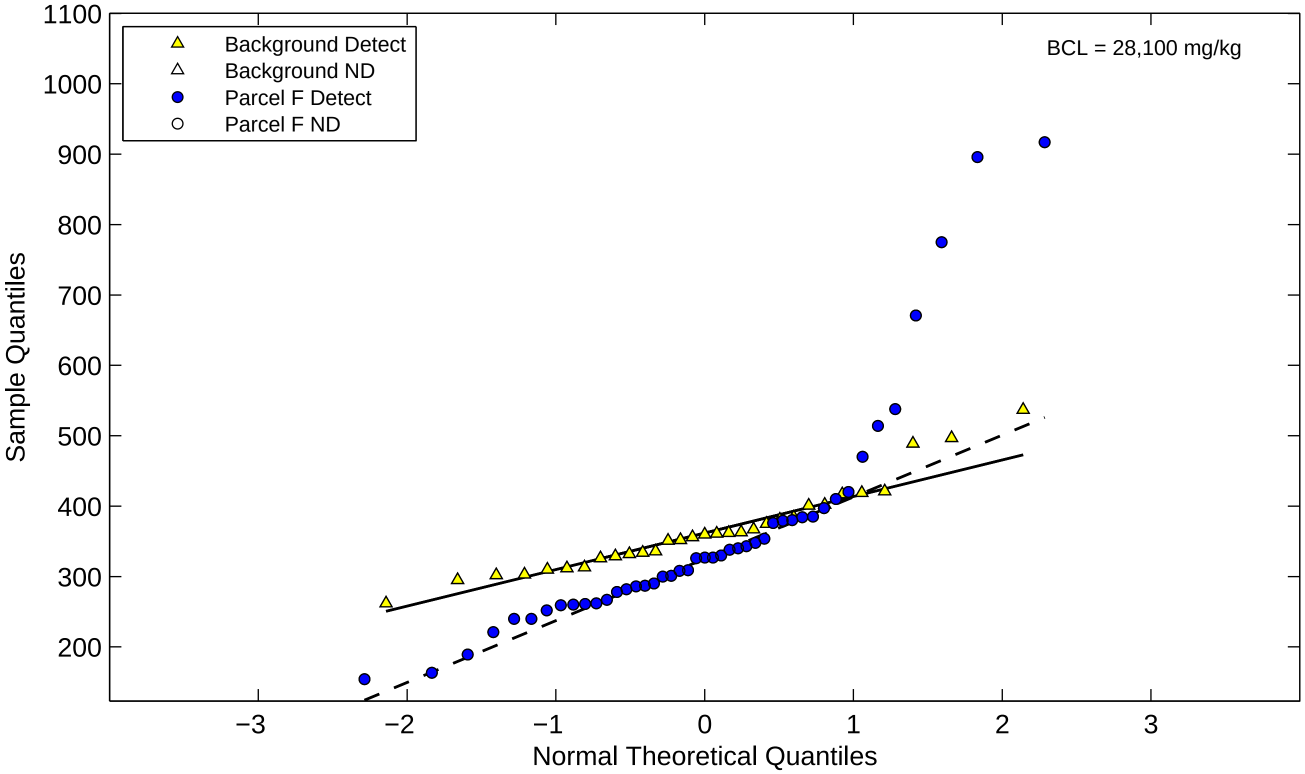
# Figure I2−15. Normal and Lognormal Q−Q Plots
## Magnesium

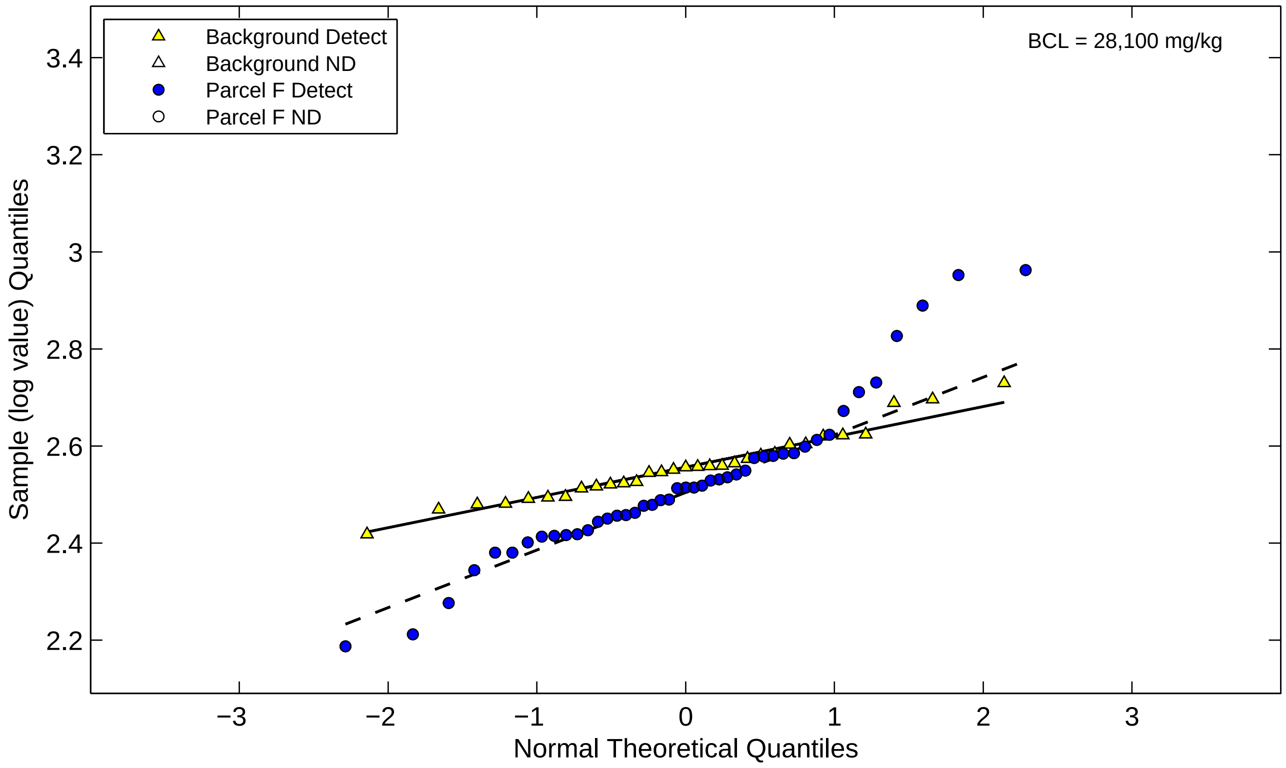




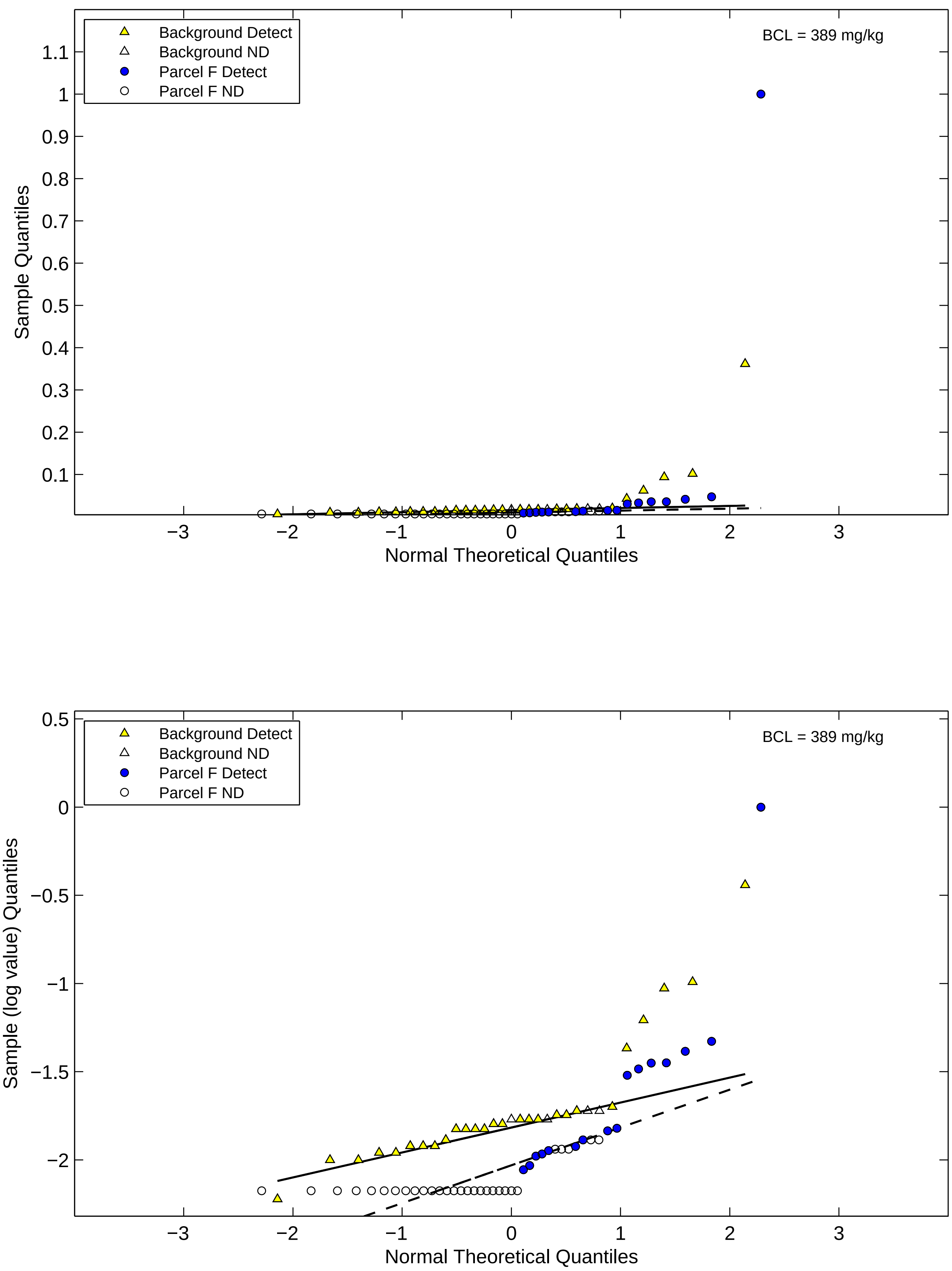
**Ramboll Environ**

# Figure I2−16. Normal and Lognormal Q−Q Plots
## Manganese



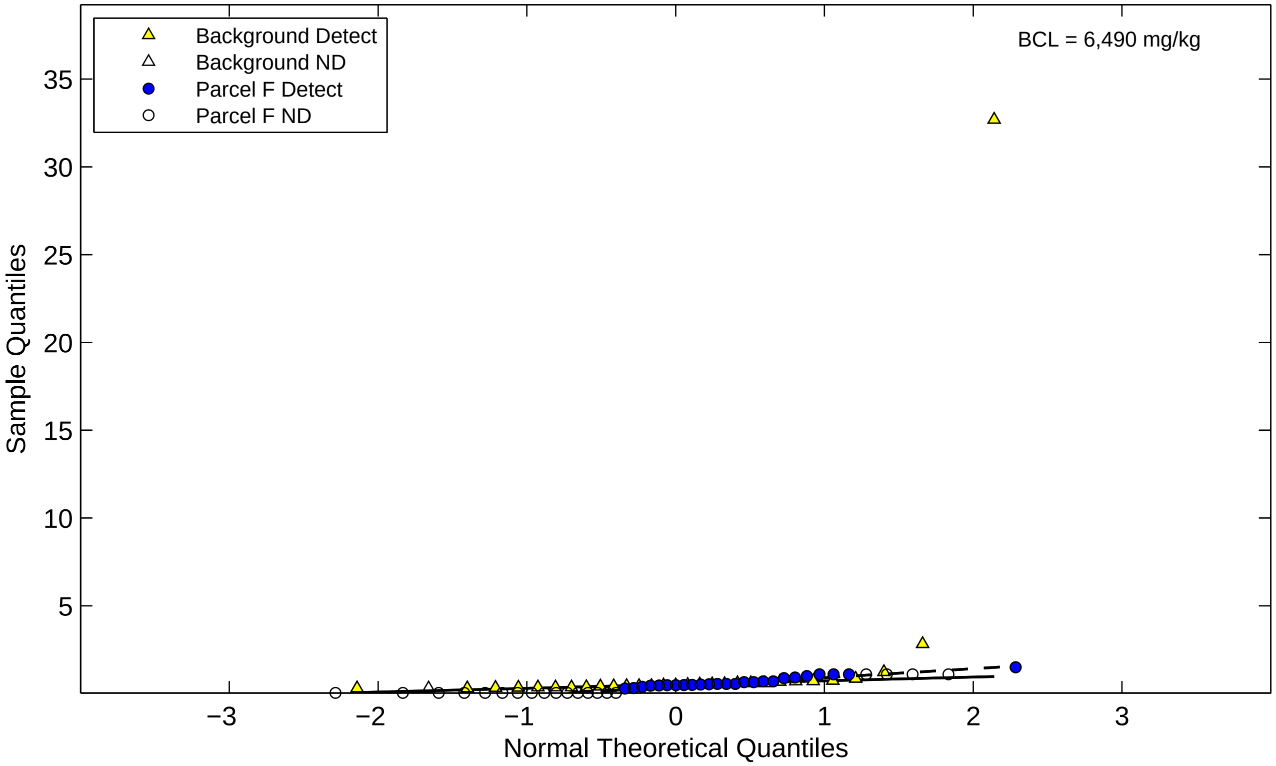


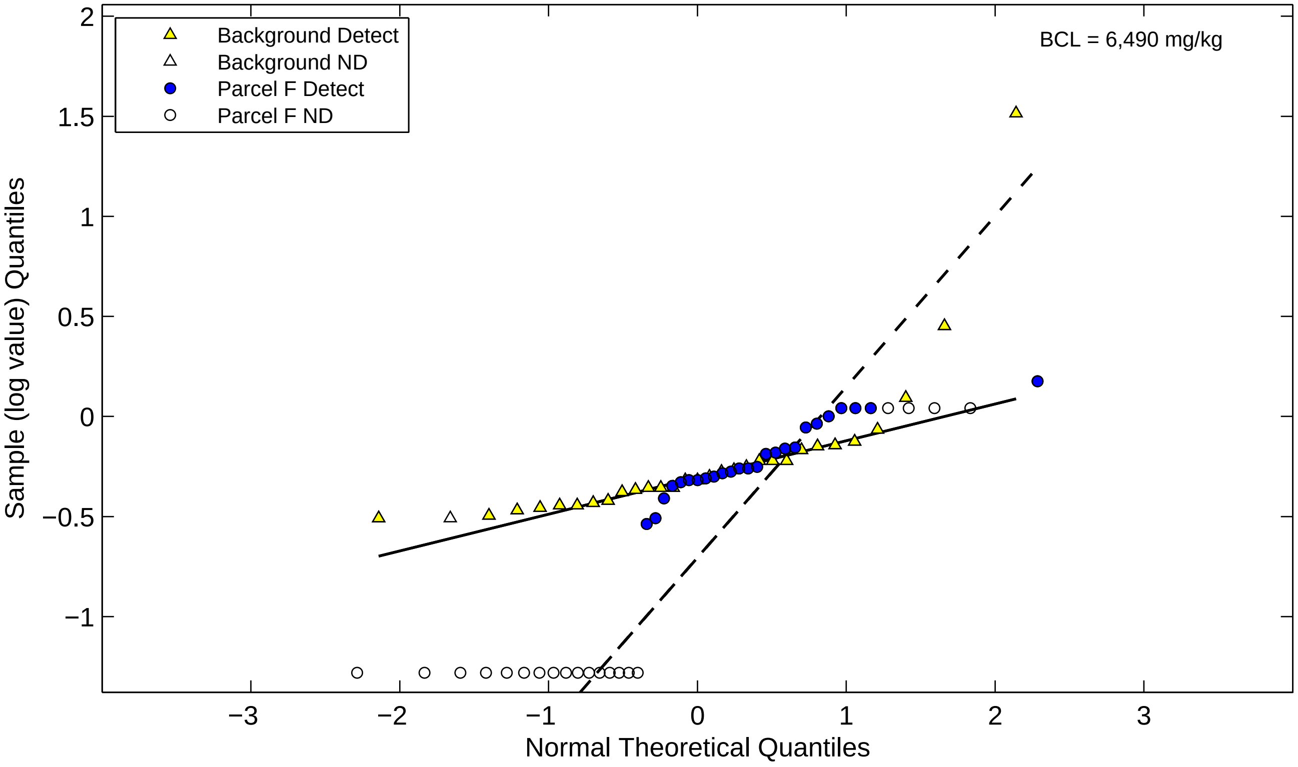
# Figure I2−17. Normal and Lognormal Q−Q Plots
# Mercury



**Ramboll Environ**

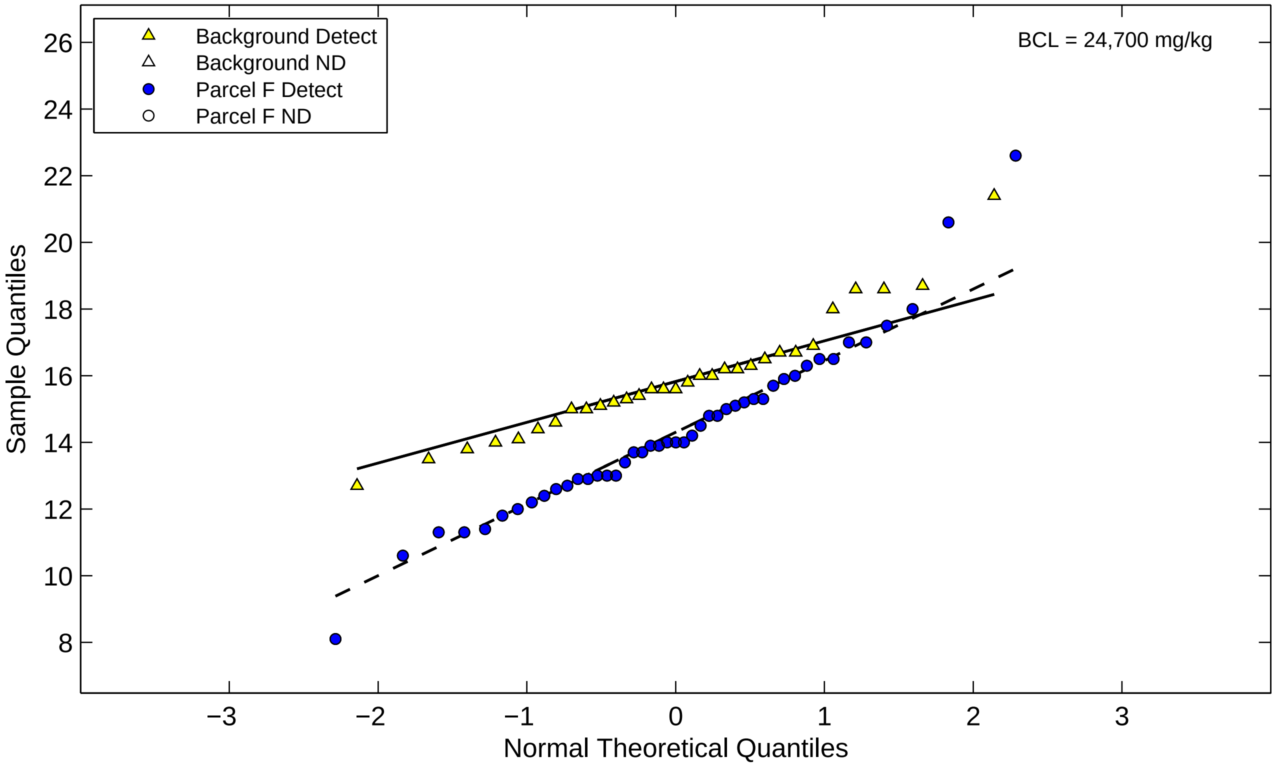
# Figure I2−18. Normal and Lognormal Q−Q Plots
# Molybdenum

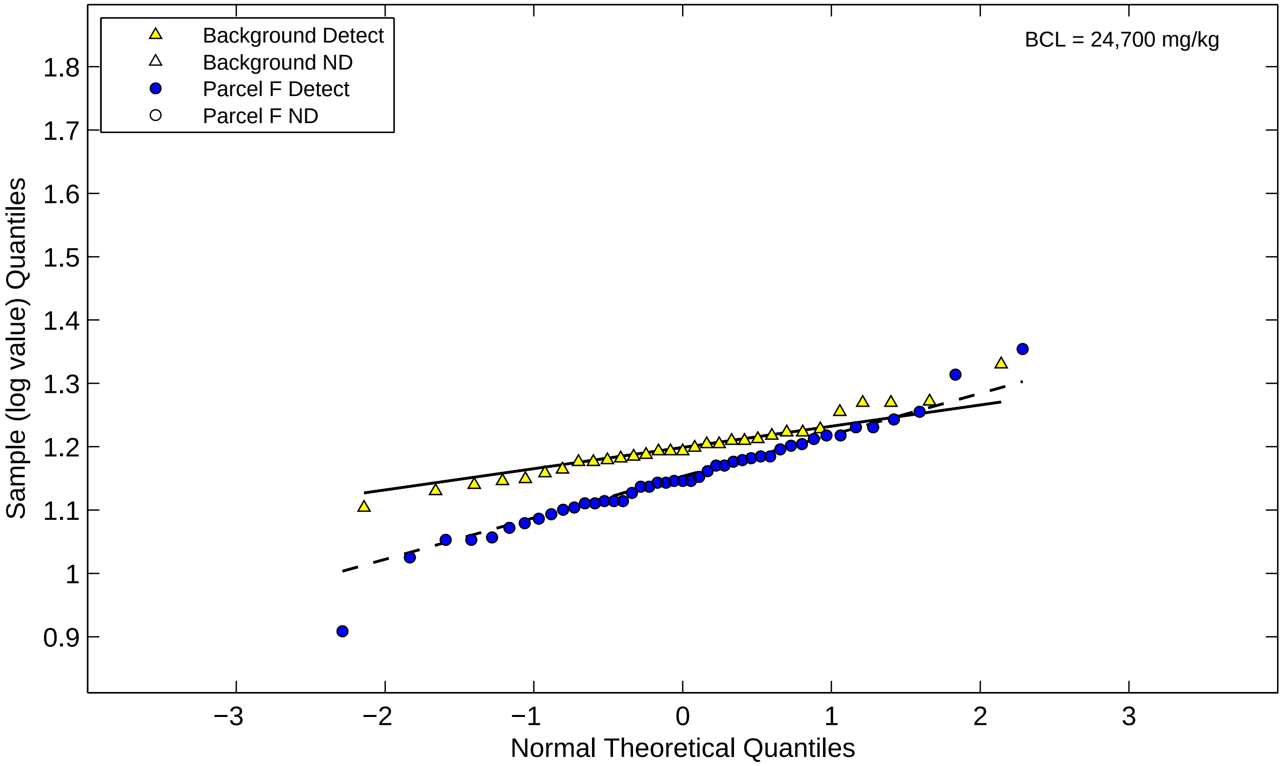




**Ramboll Environ**

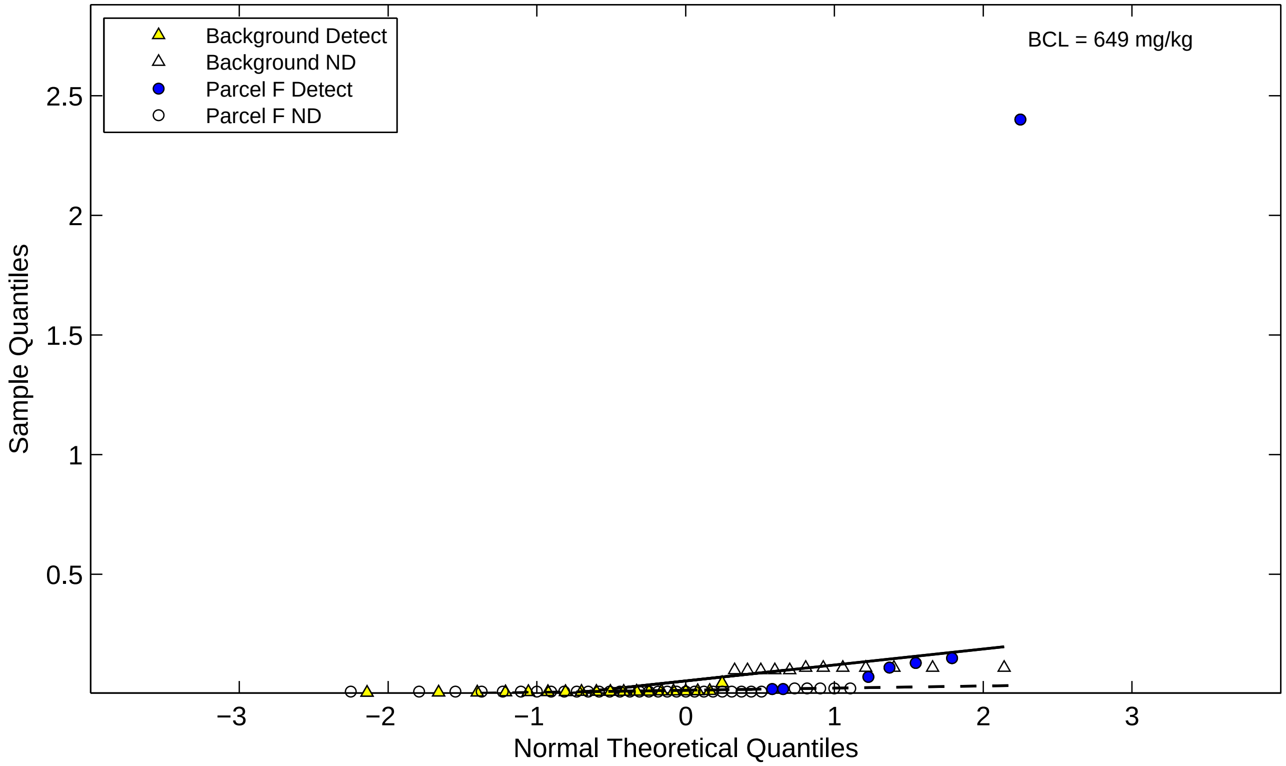
# Figure I2−19. Normal and Lognormal Q−Q Plots
## Nickel

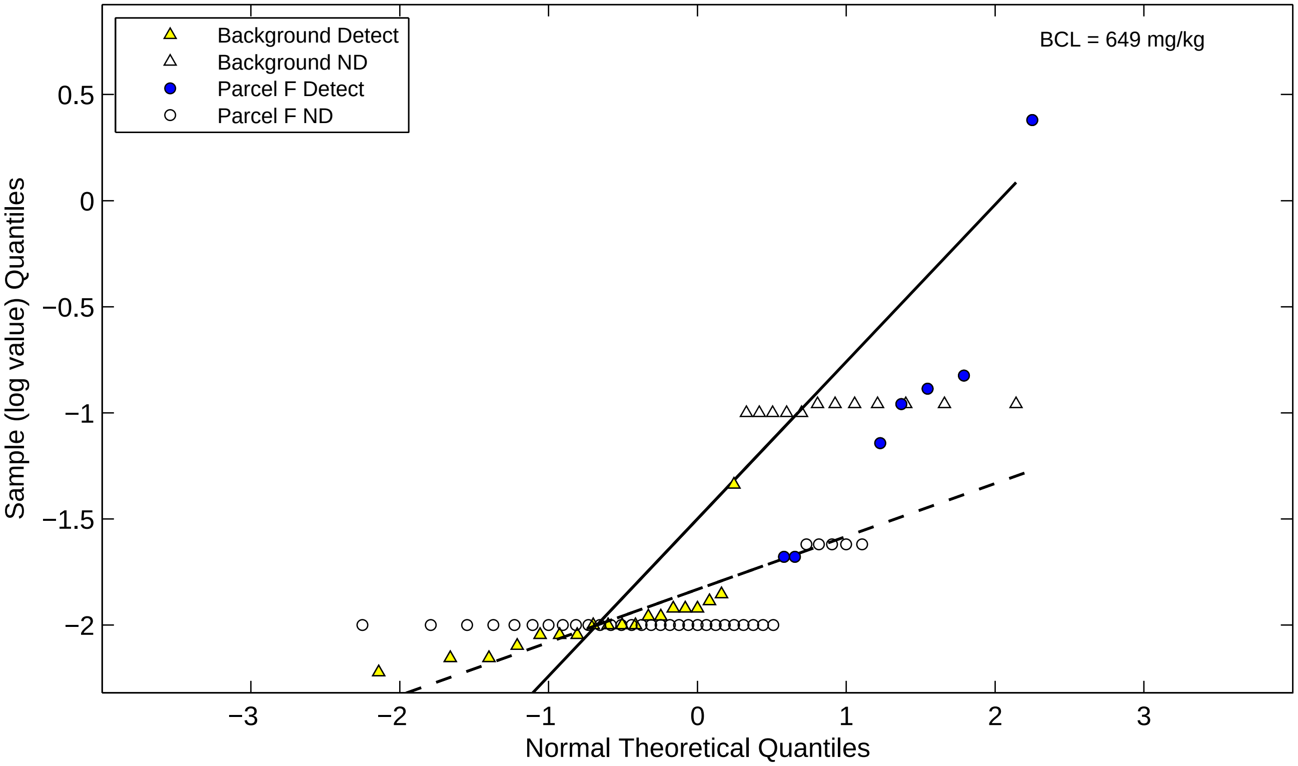




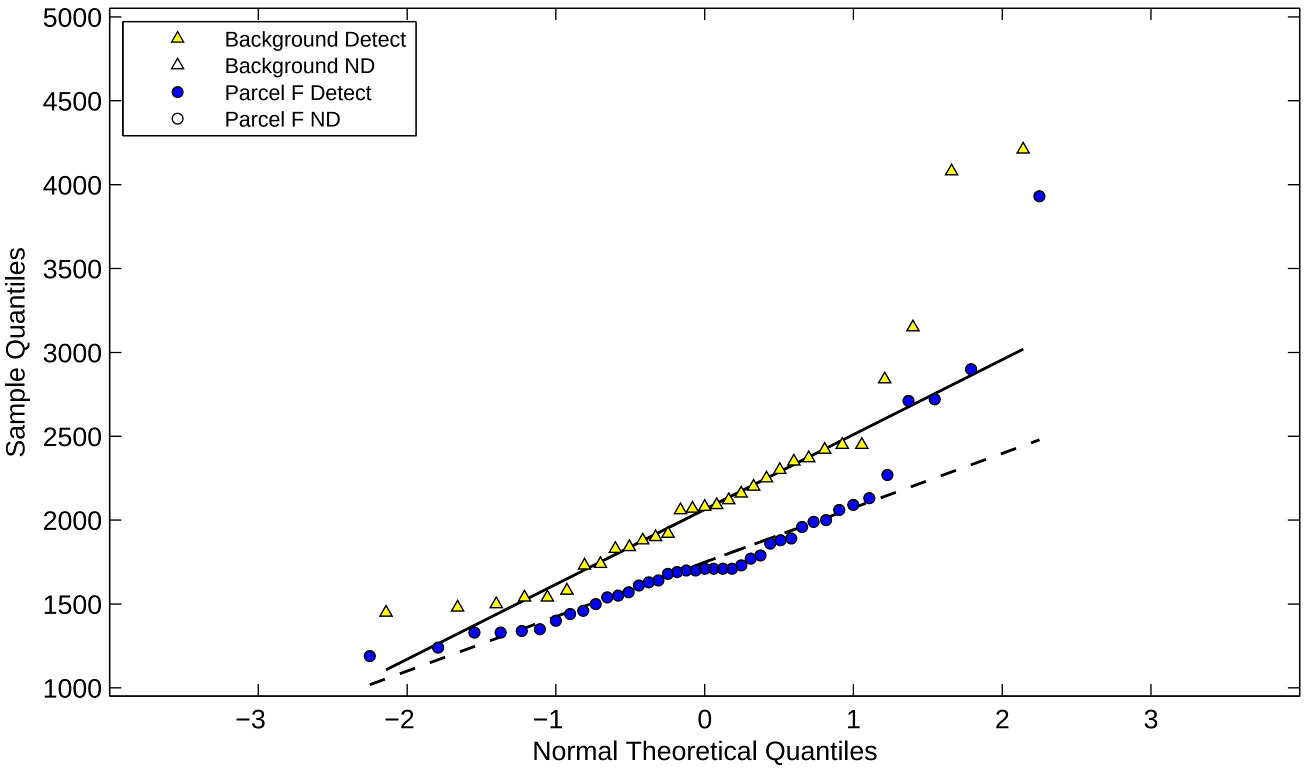
**Ramboll Environ**

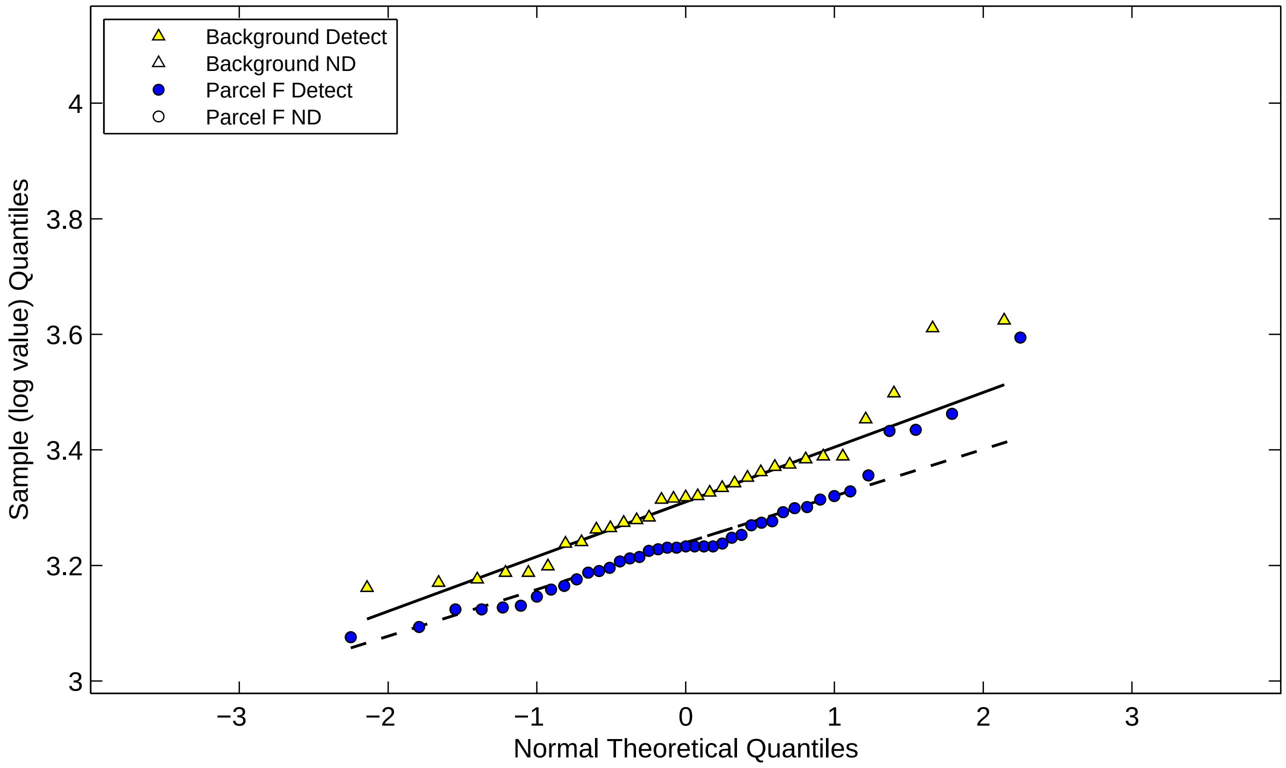
# Figure I2−20. Normal and Lognormal Q−Q Plots
## Platinum





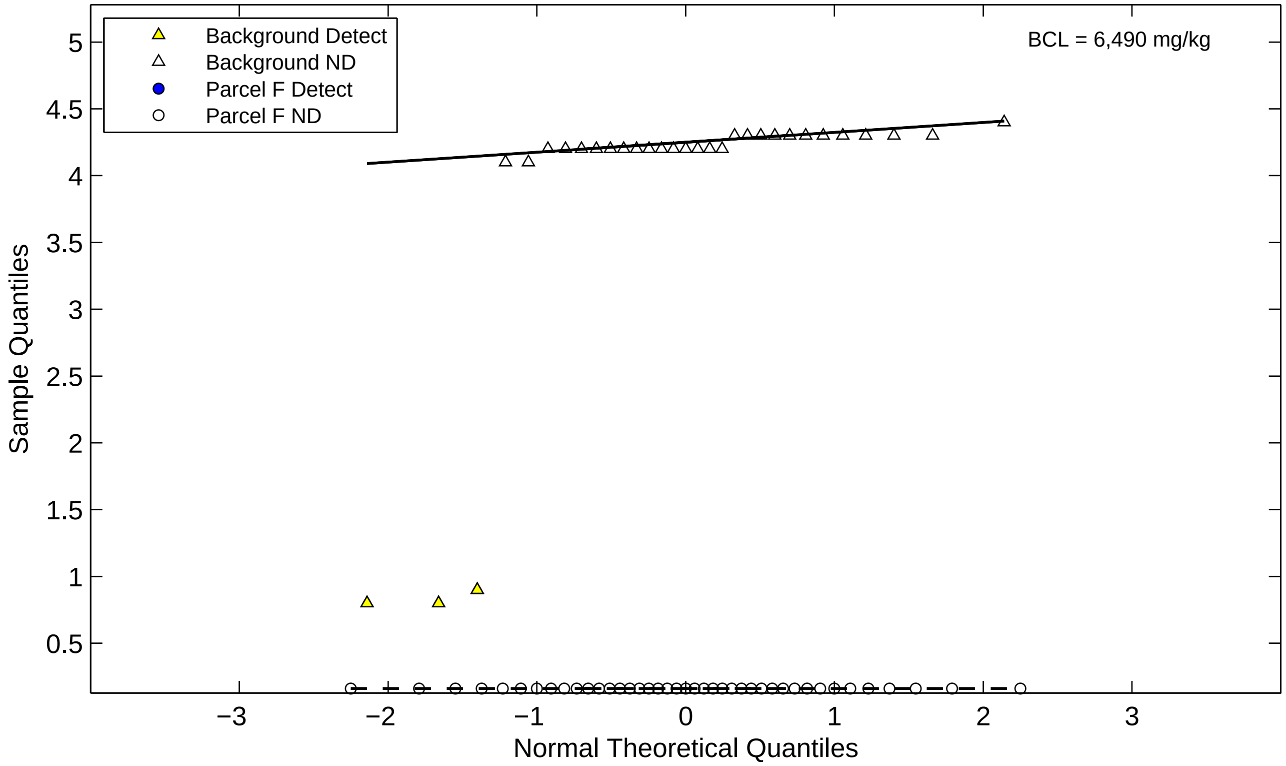
# Figure I2−21. Normal and Lognormal Q−Q Plots
# Potassium

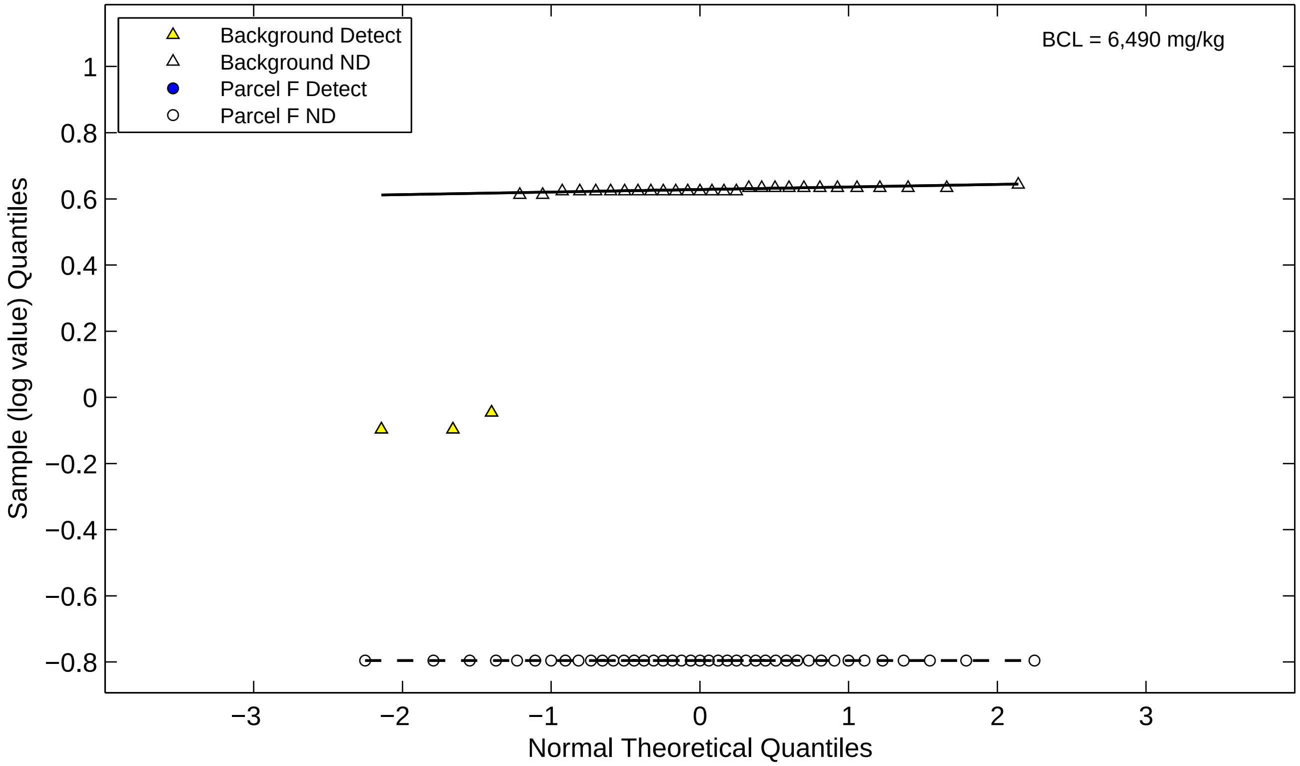




**Ramboll Environ**

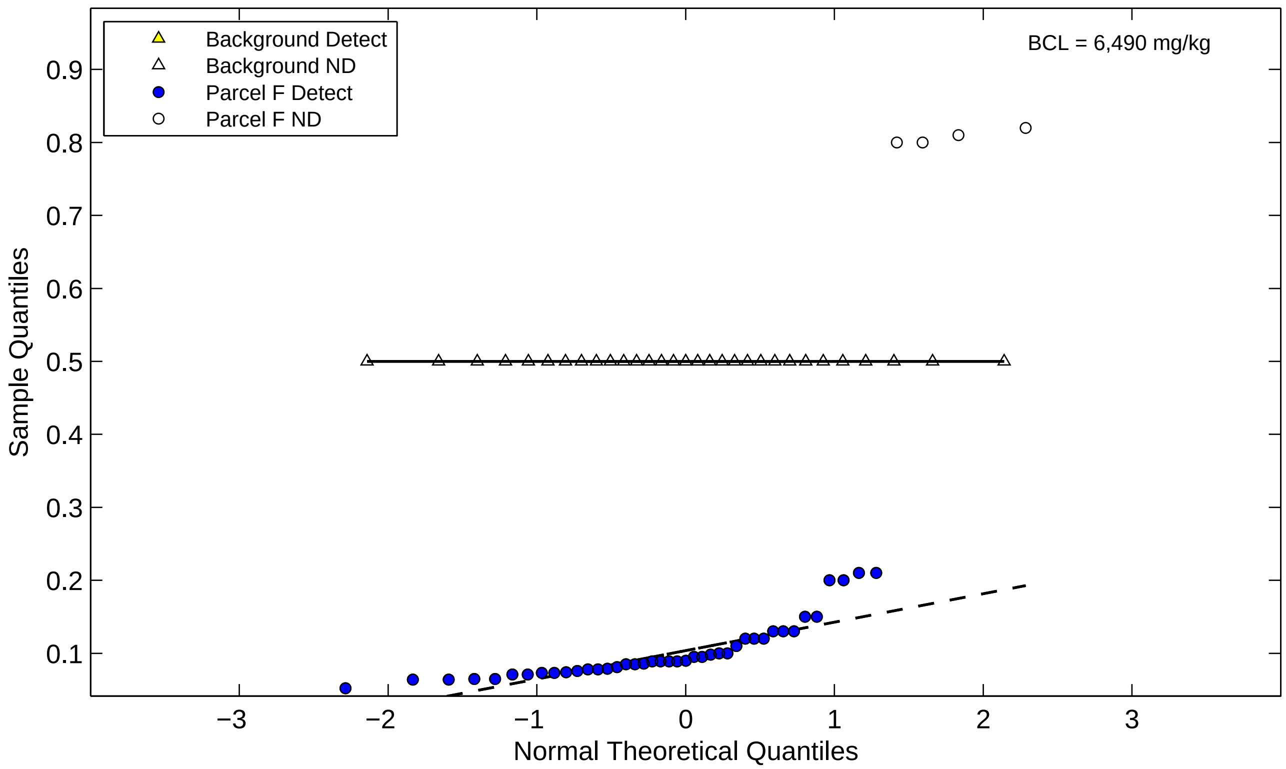
# Figure I2−22. Normal and Lognormal Q−Q Plots
# Selenium

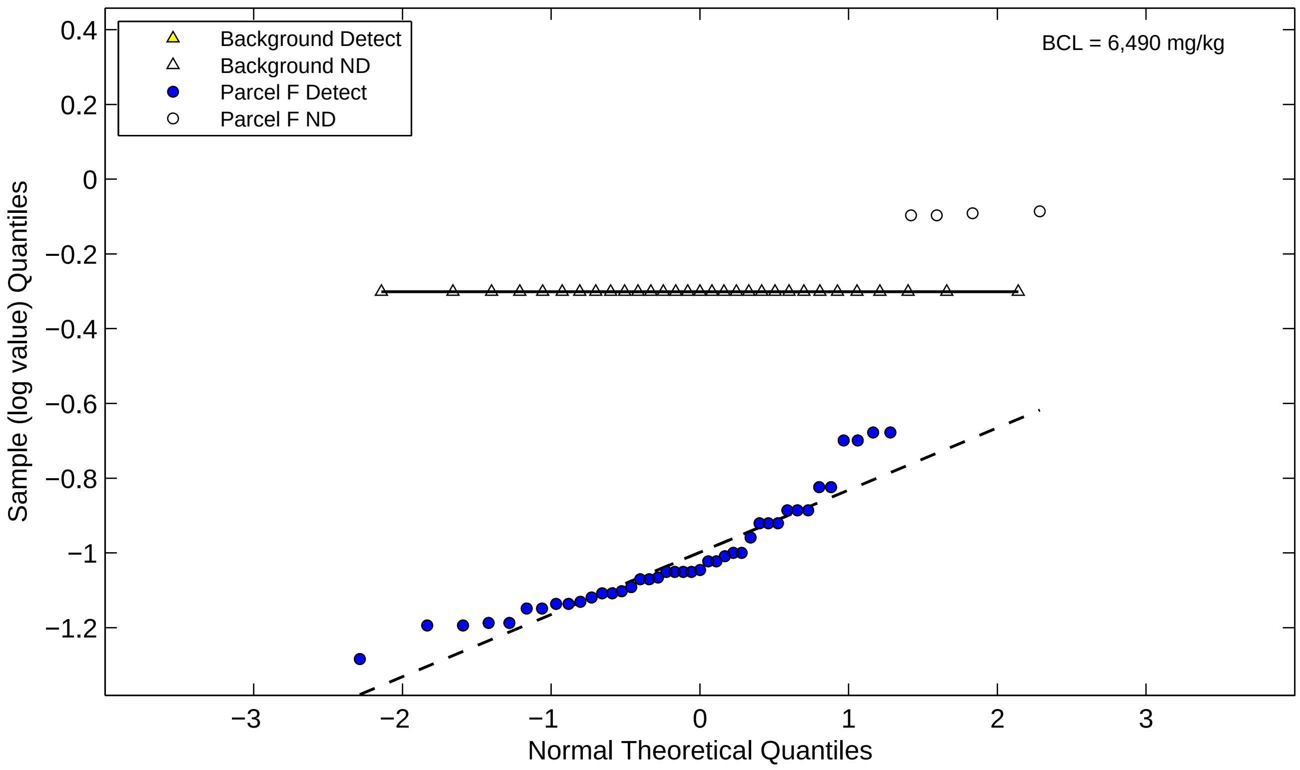




**Ramboll Environ**

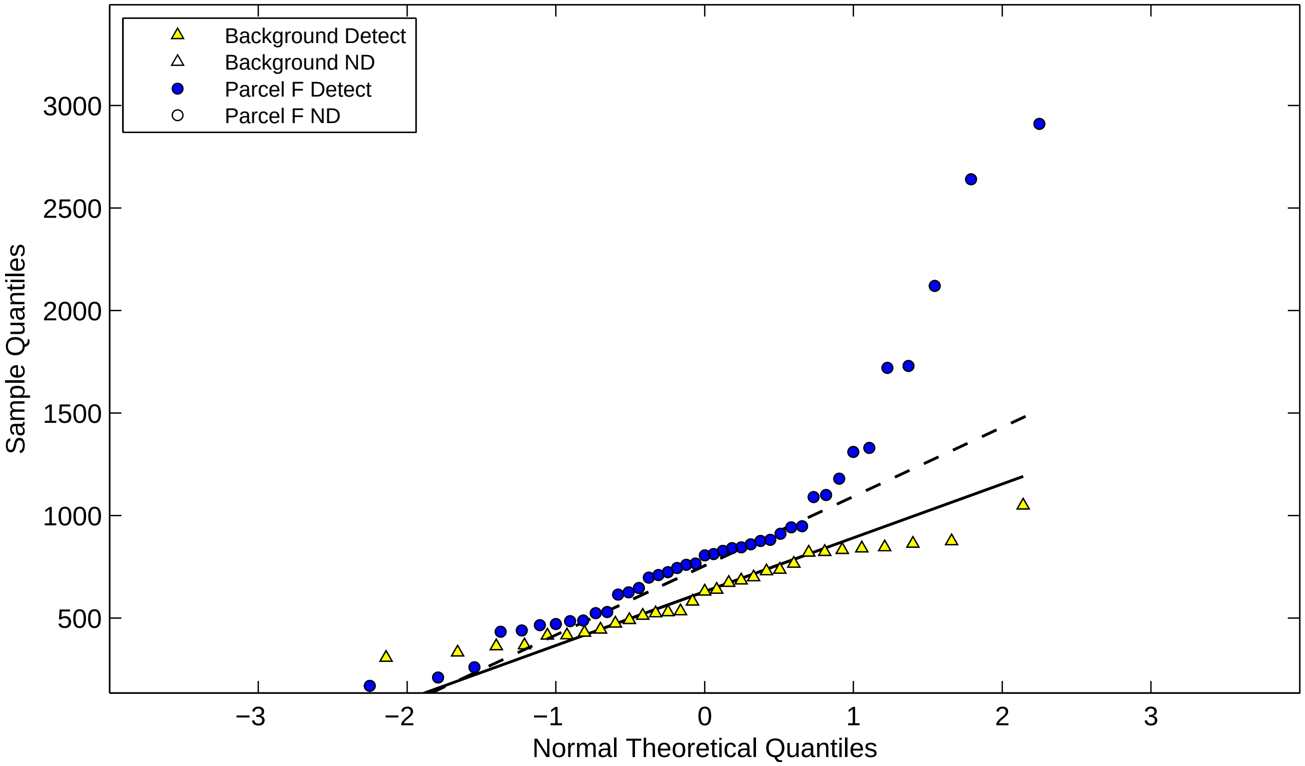
# Figure I2−23. Normal and Lognormal Q−Q Plots
# Silver

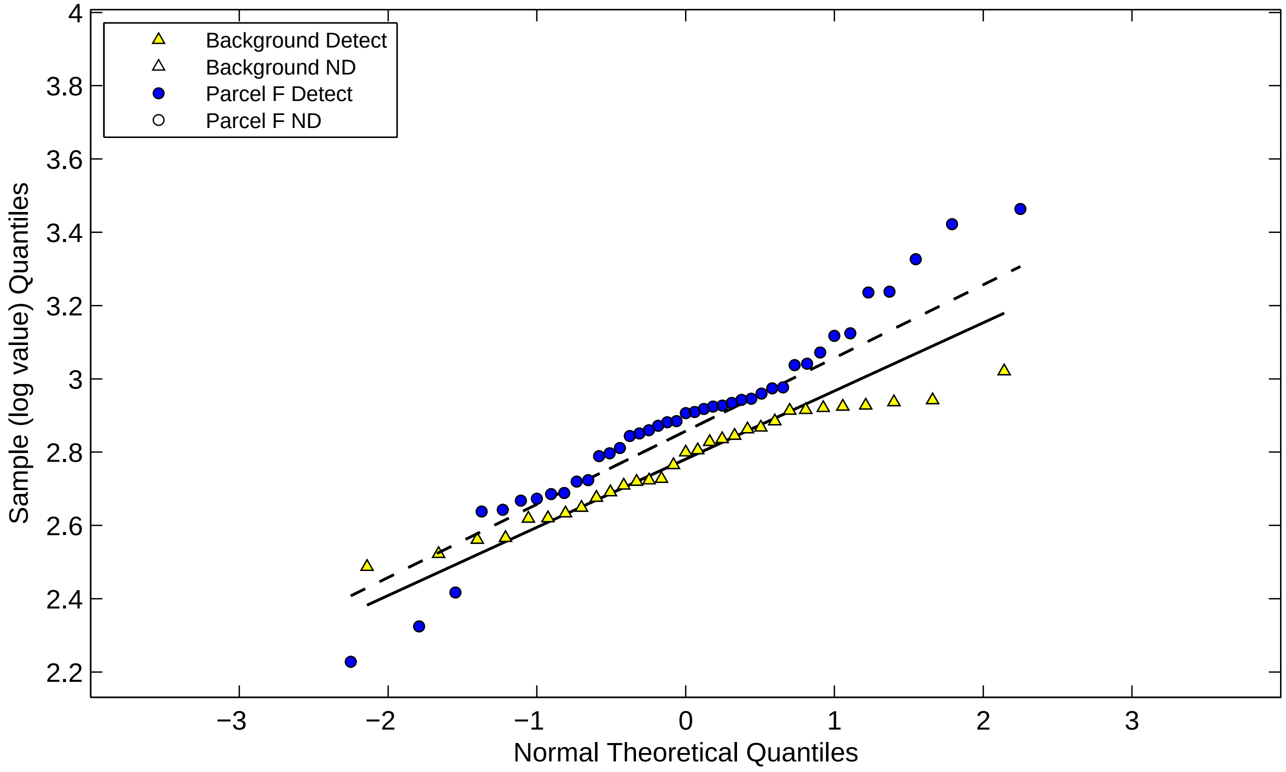




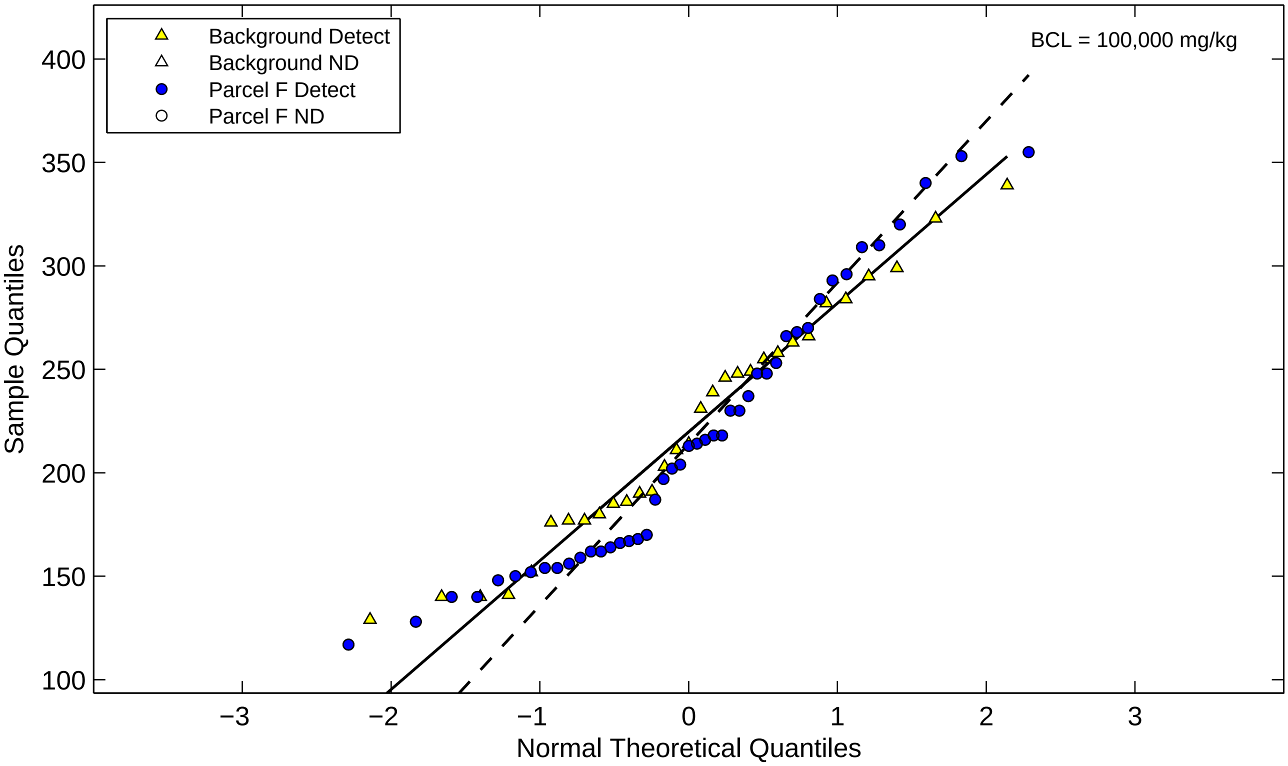
**Ramboll Environ**

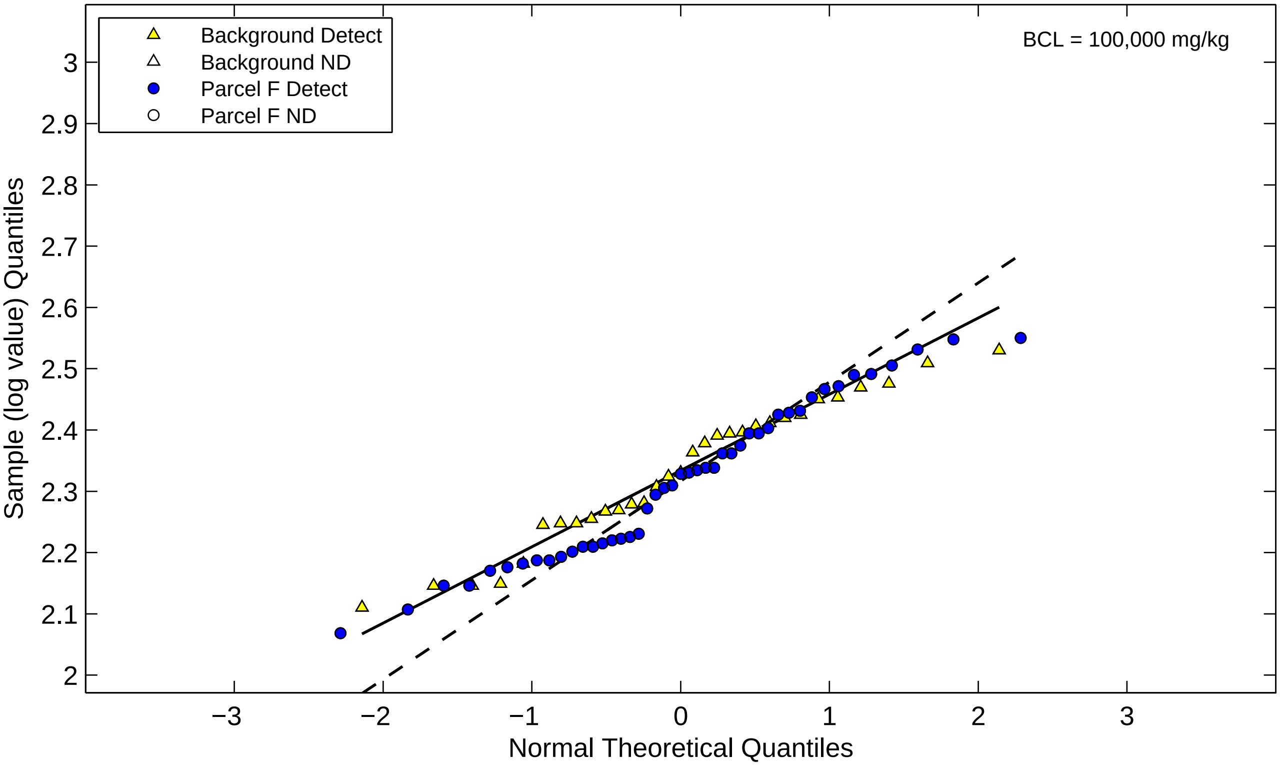
# Figure I2−24. Normal and Lognormal Q−Q Plots
# Sodium



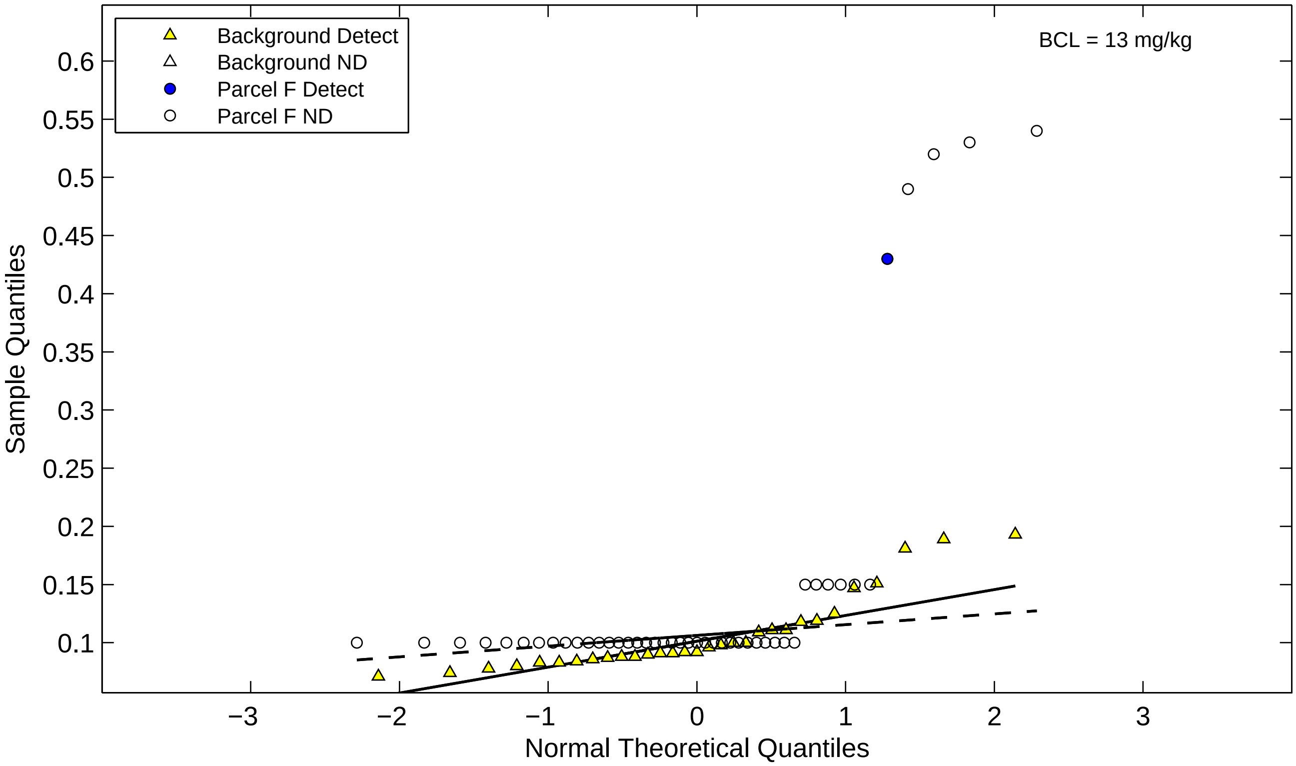


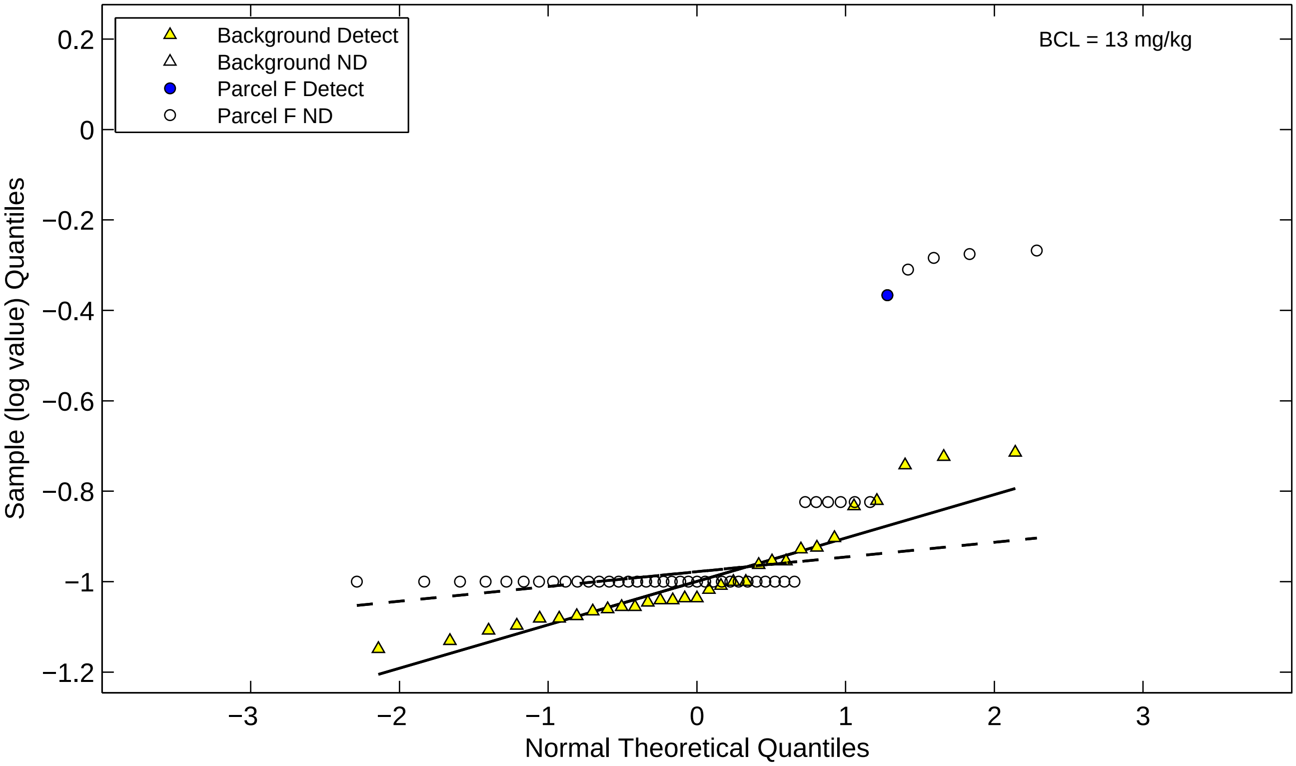
# Figure I2−25. Normal and Lognormal Q−Q Plots
## Strontium





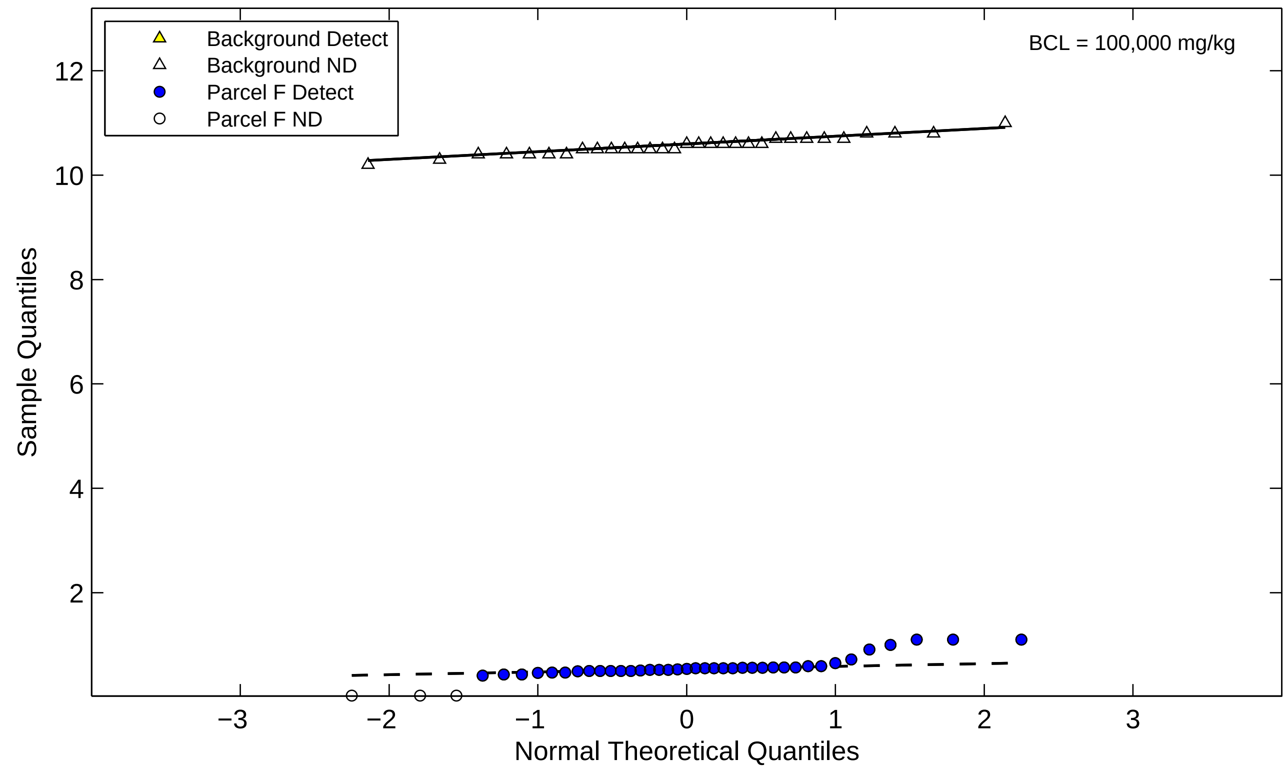
# Figure I2−26. Normal and Lognormal Q−Q Plots
# Thallium

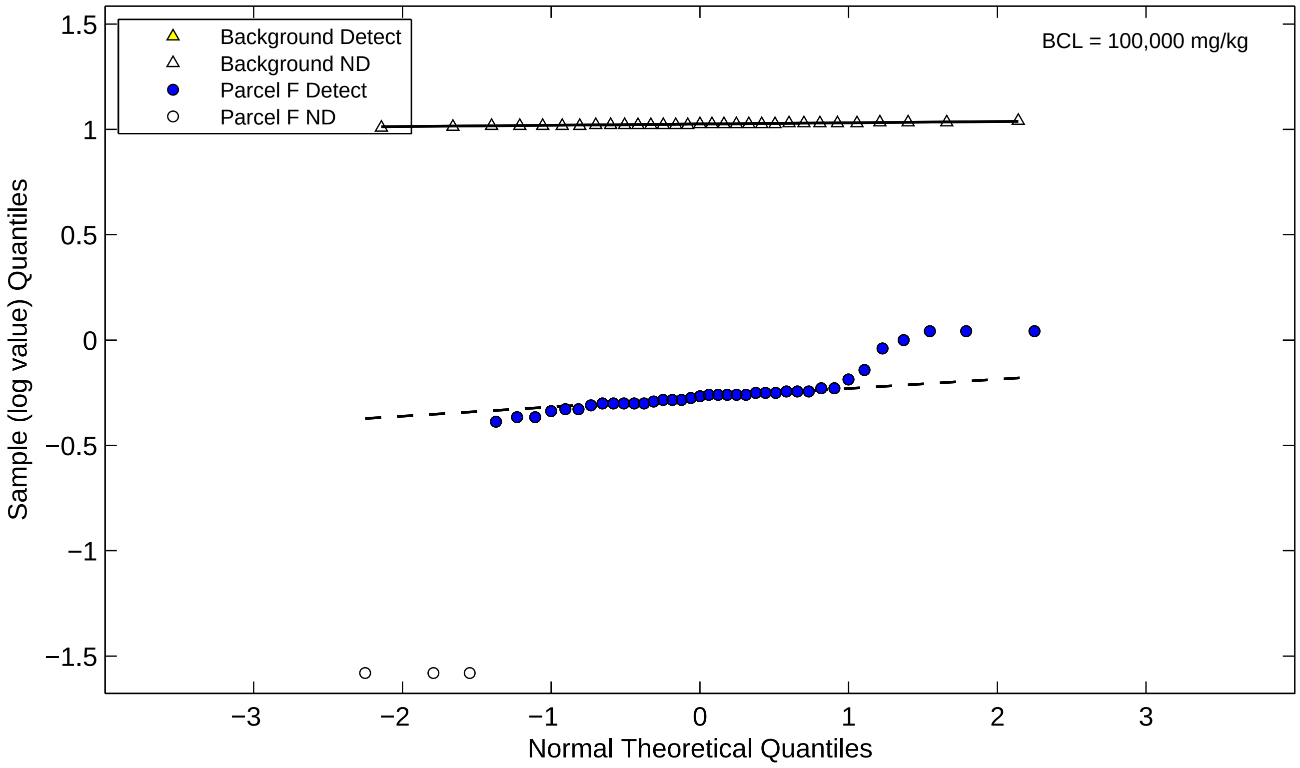




**Ramboll Environ**

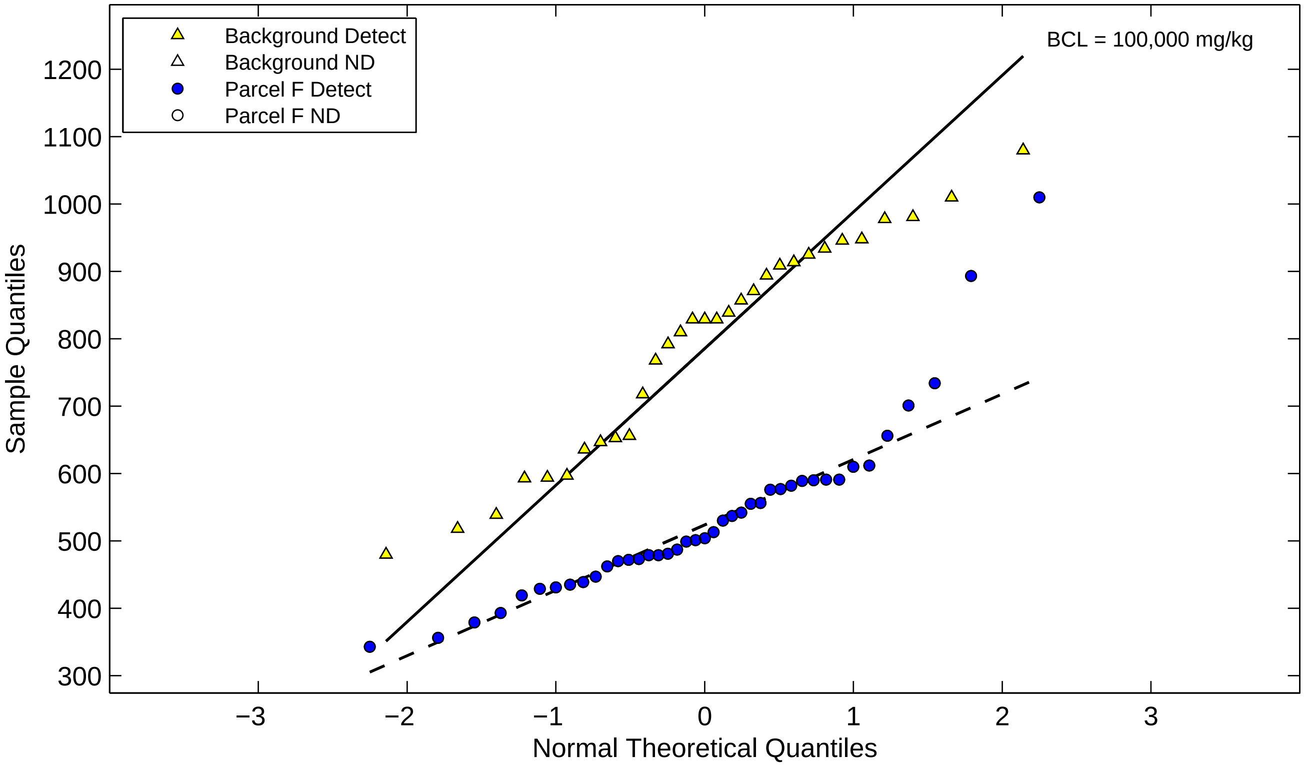
# Figure I2−27. Normal and Lognormal Q−Q Plots
# Tin

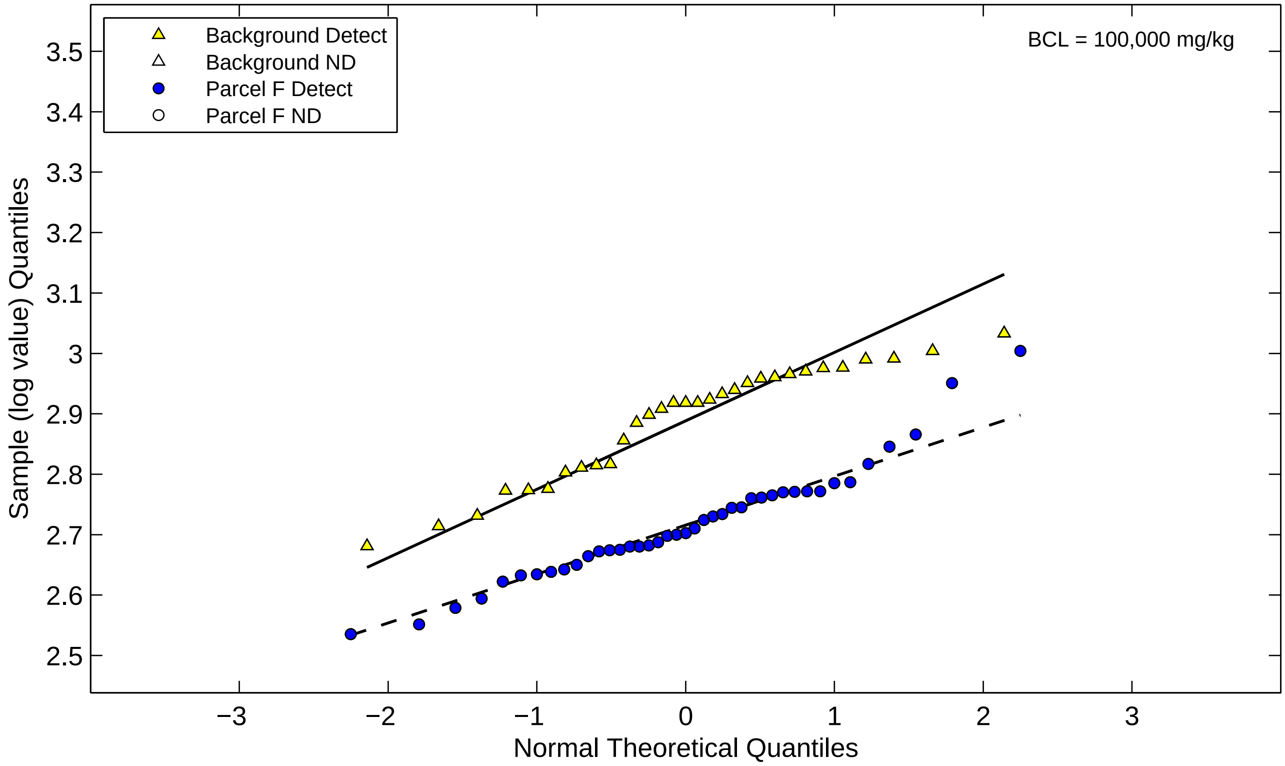




**Ramboll Environ**

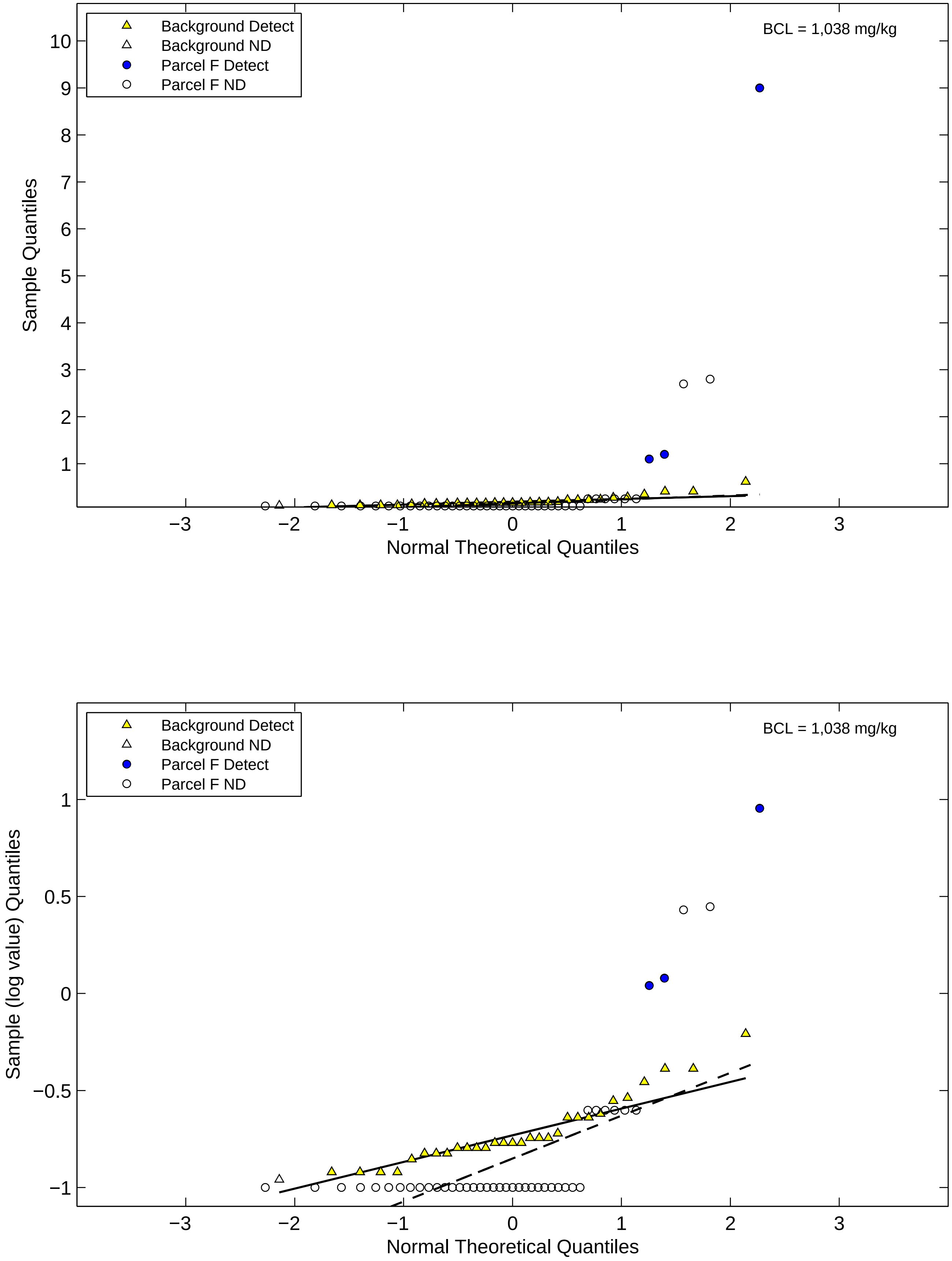
# Figure I2−28. Normal and Lognormal Q−Q Plots
# Titanium



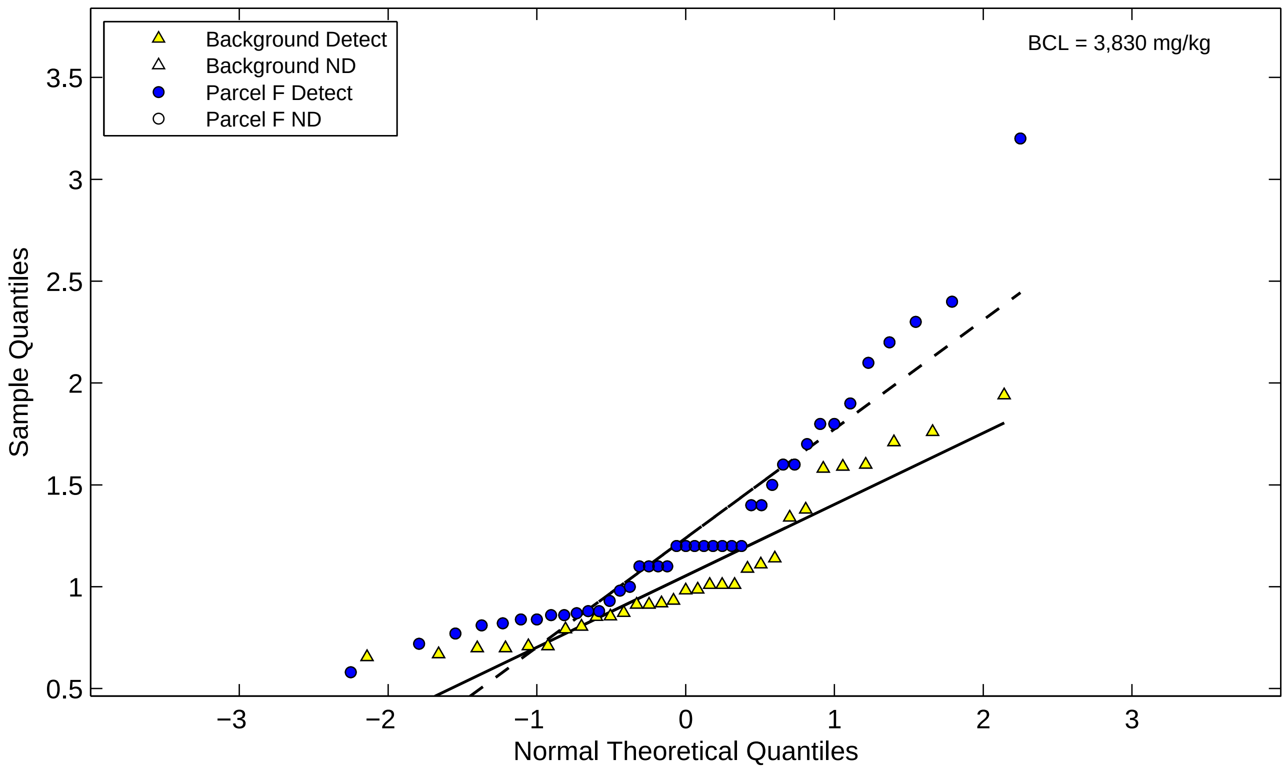


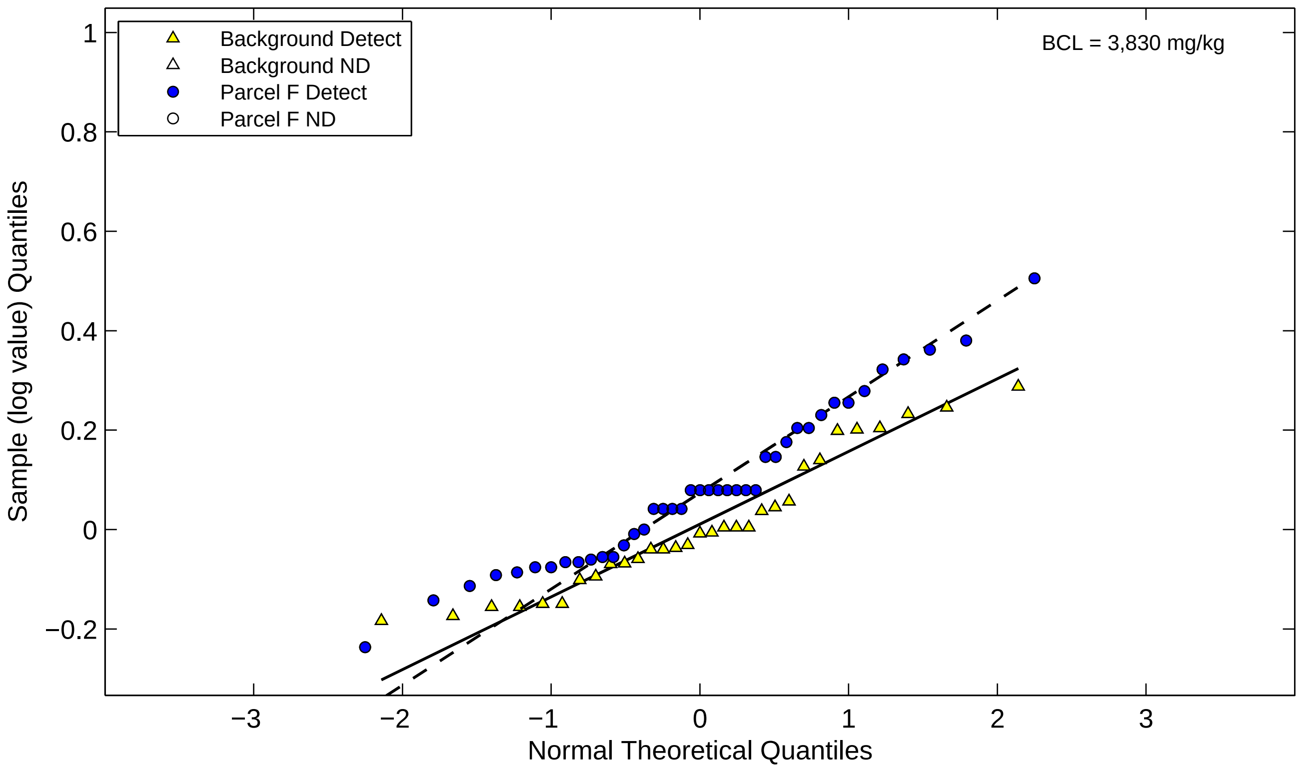
**Ramboll Environ**

# Figure I2−29. Normal and Lognormal Q−Q Plots
# Tungsten



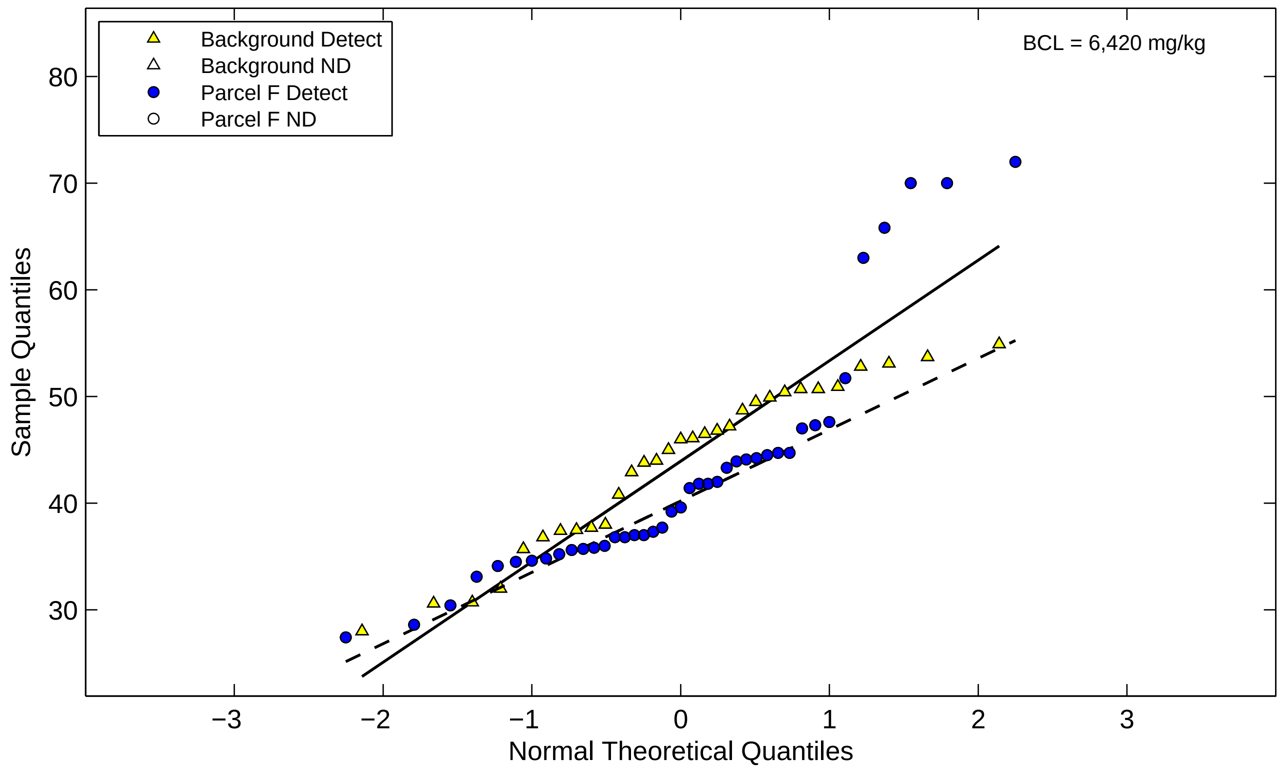
# Figure I2−30. Normal and Lognormal Q−Q Plots
## Uranium (total)

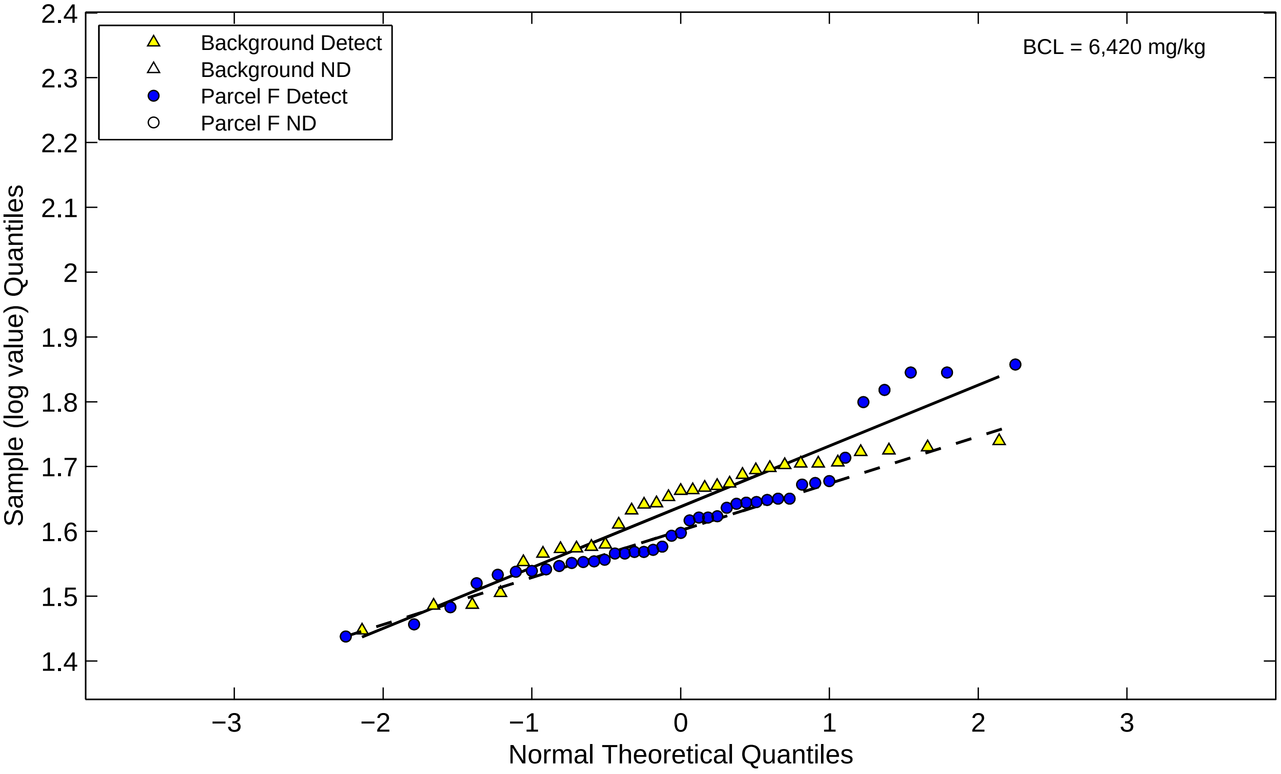




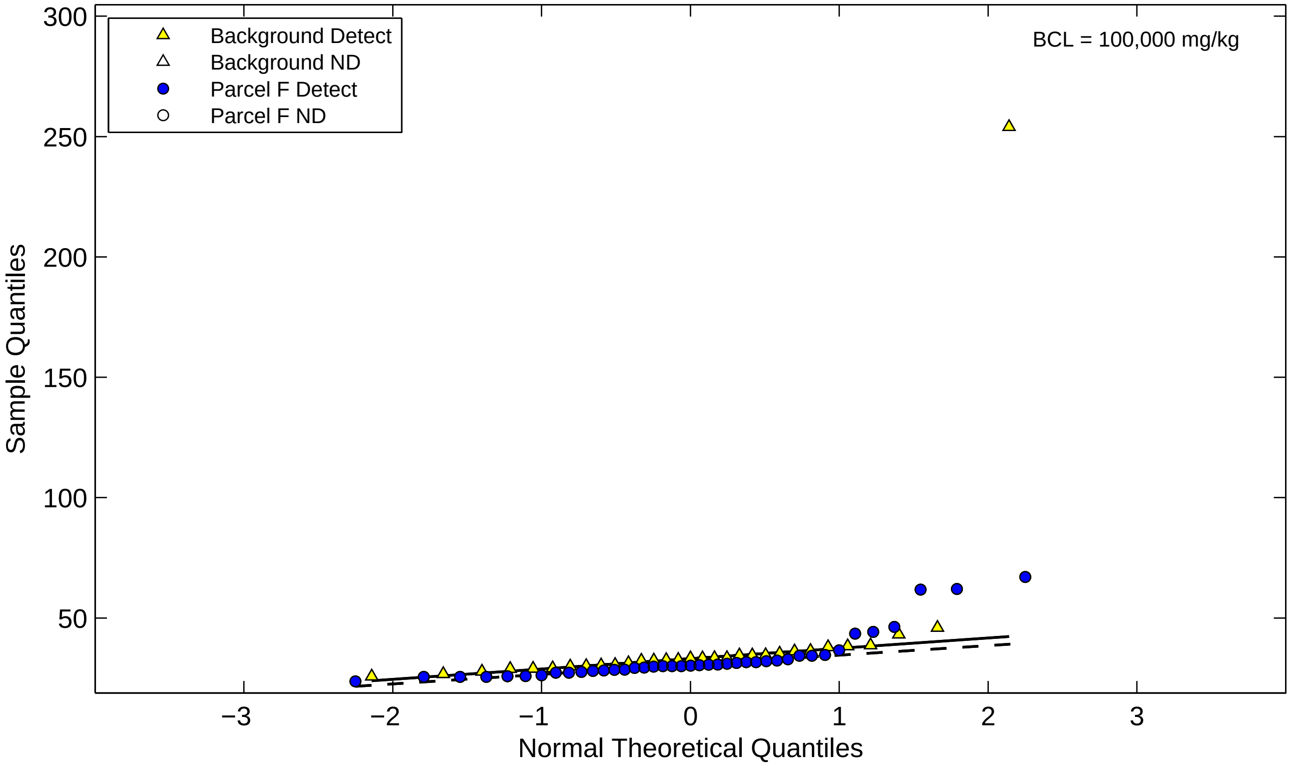
**Ramboll Environ**

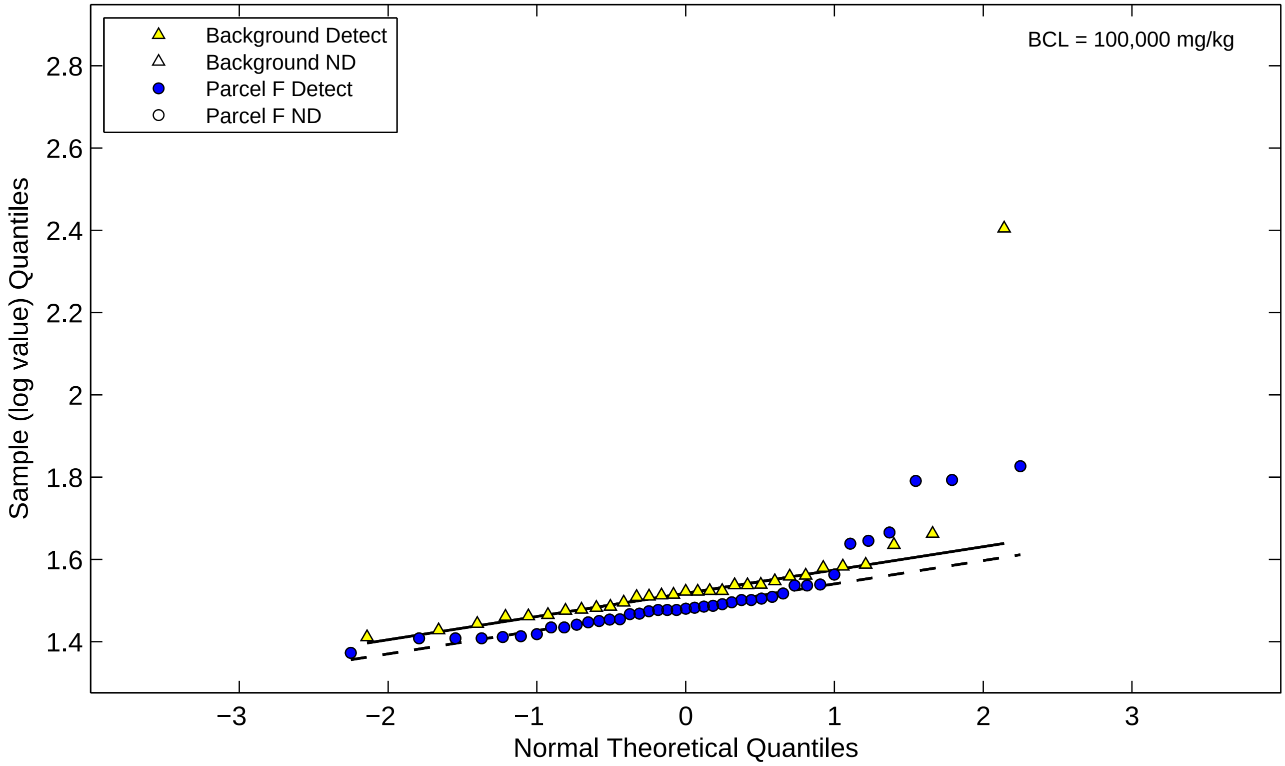
# Figure I2−31. Normal and Lognormal Q−Q Plots
# Vanadium



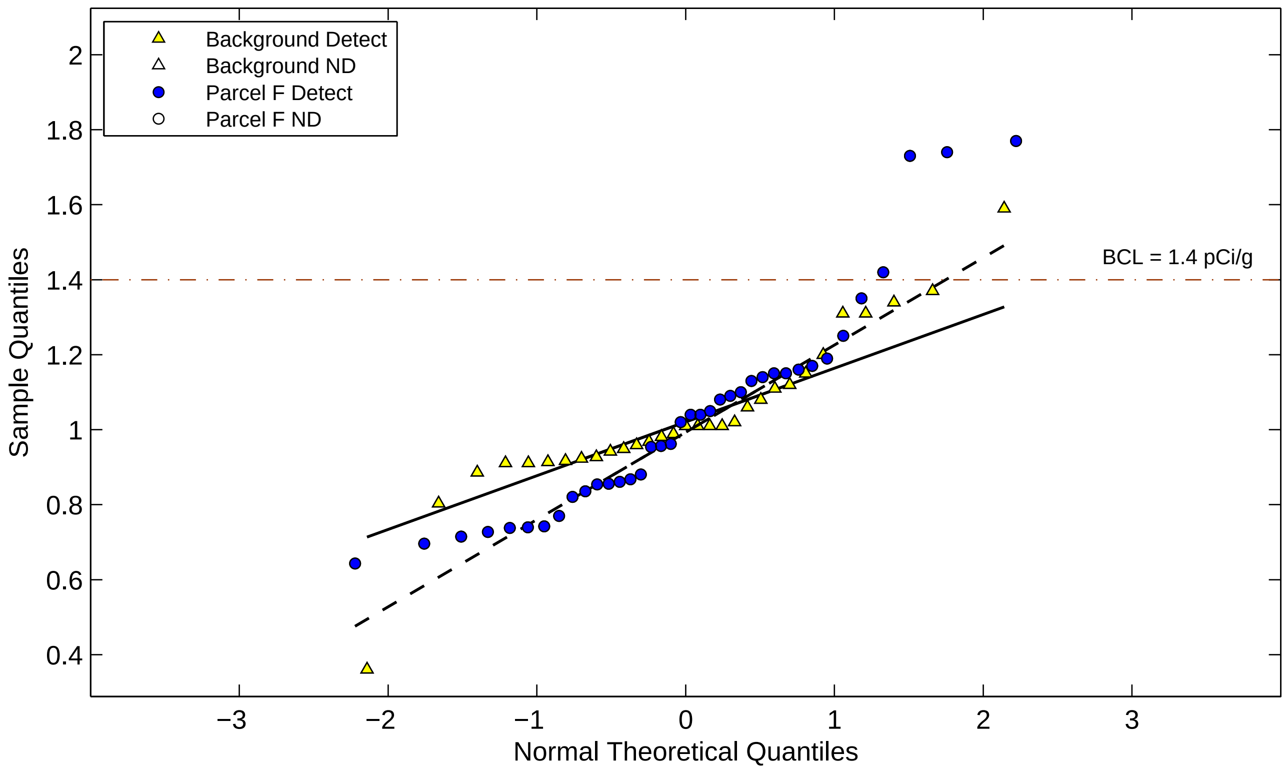


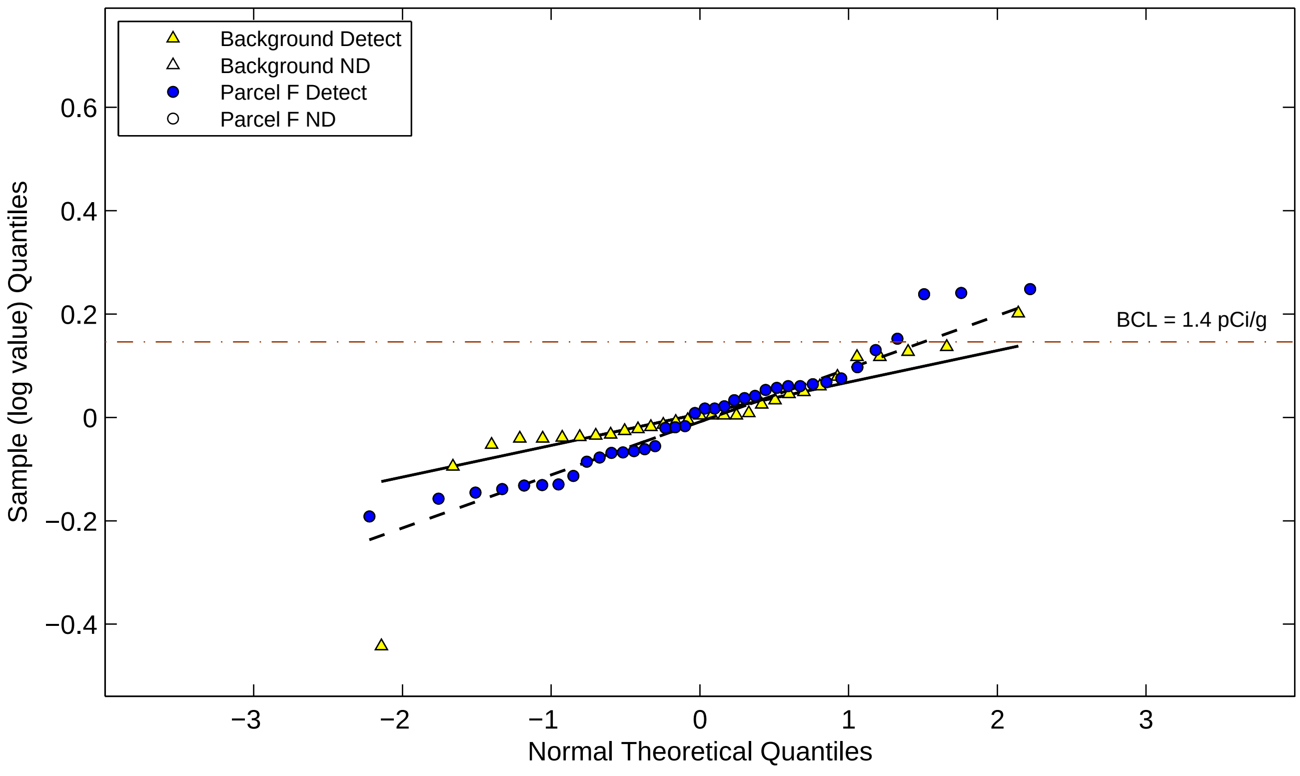
# Figure I2−32. Normal and Lognormal Q−Q Plots
# Zinc





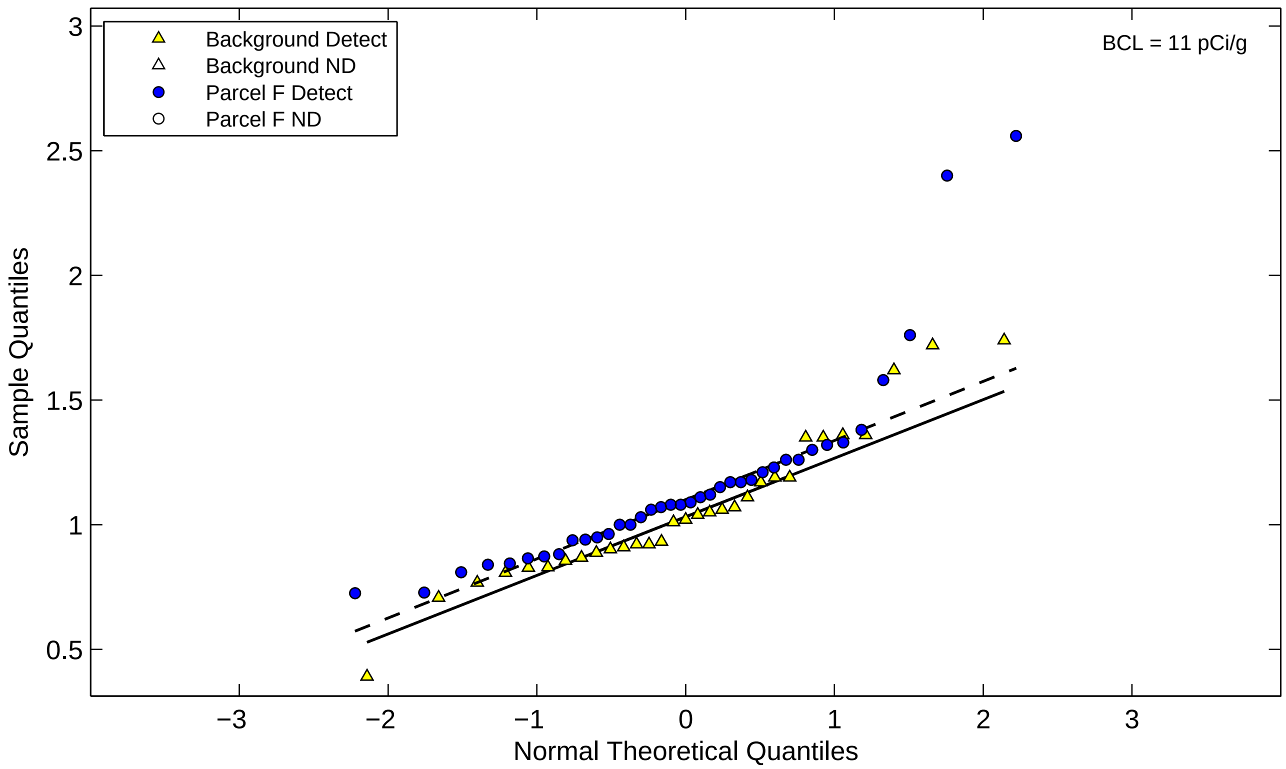
# Figure I2−33. Normal and Lognormal Q−Q Plots
## Uranium−238

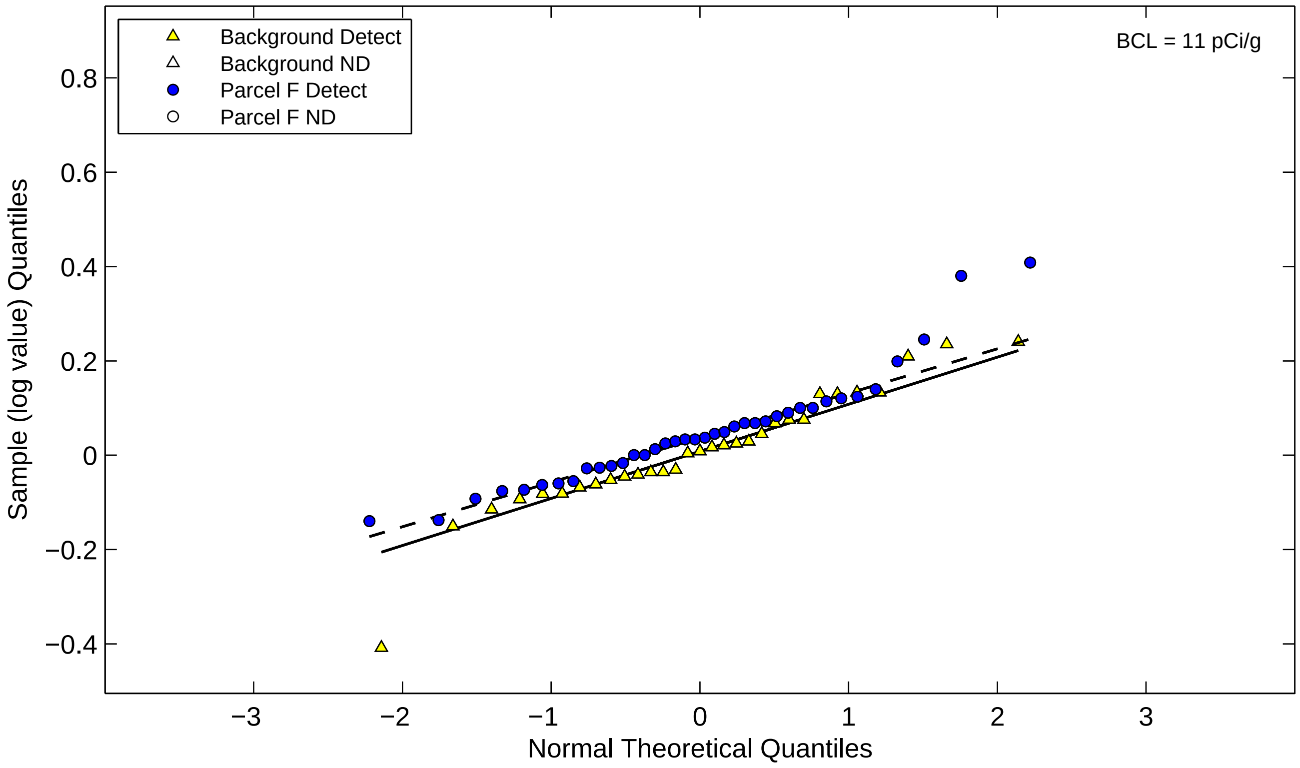




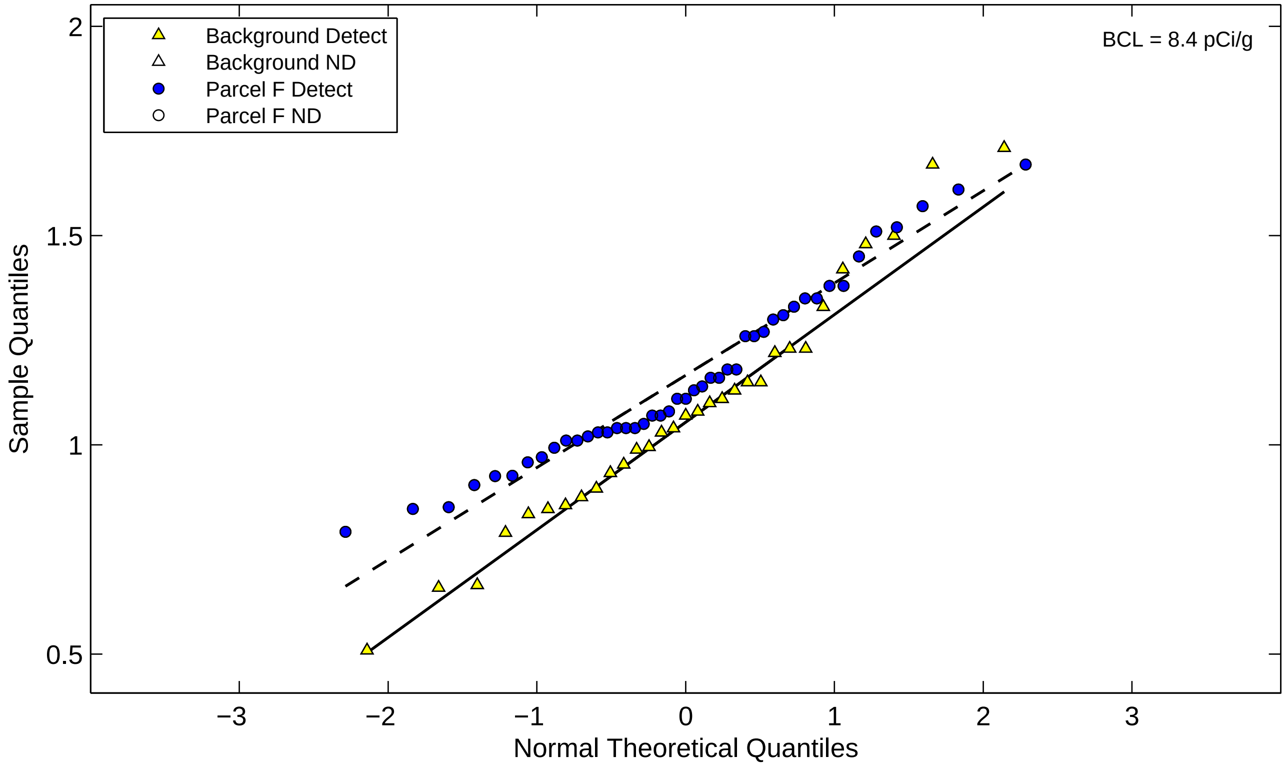
**Ramboll Environ**

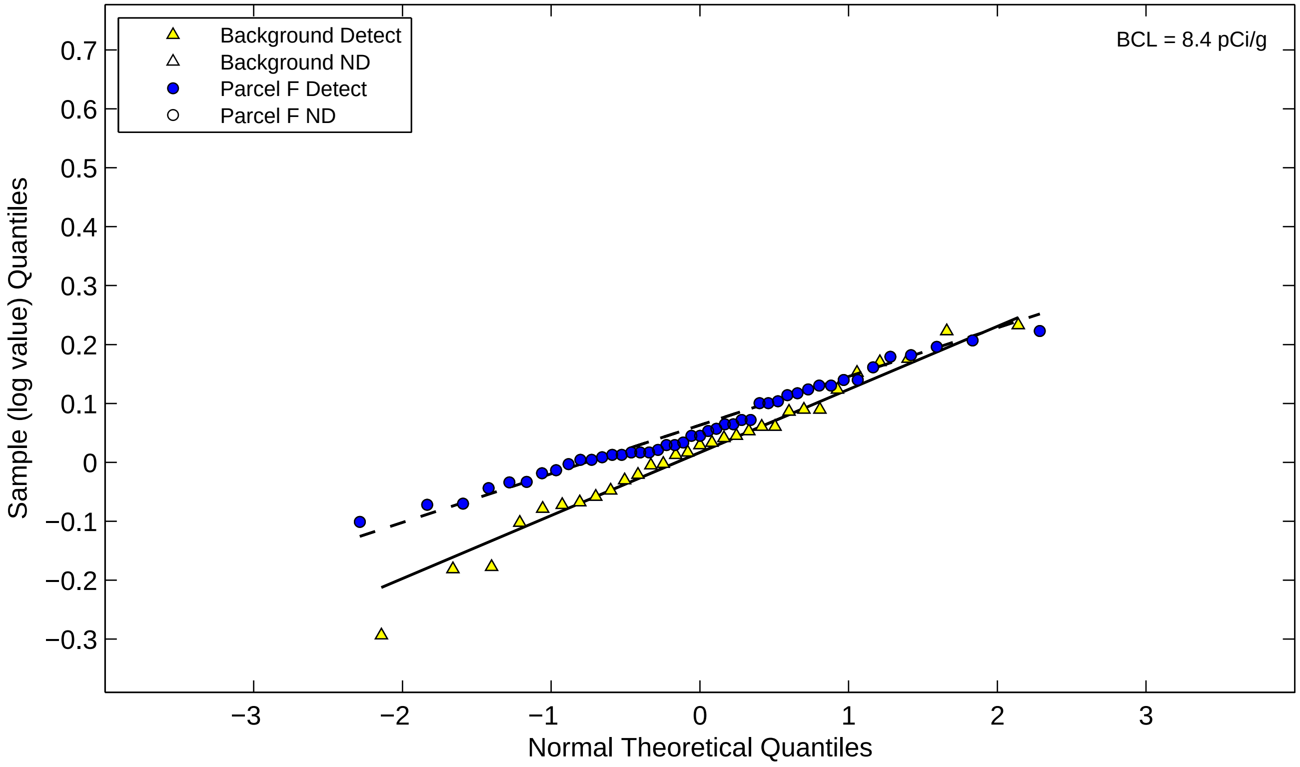
# Figure I2−34. Normal and Lognormal Q−Q Plots
## Uranium−234



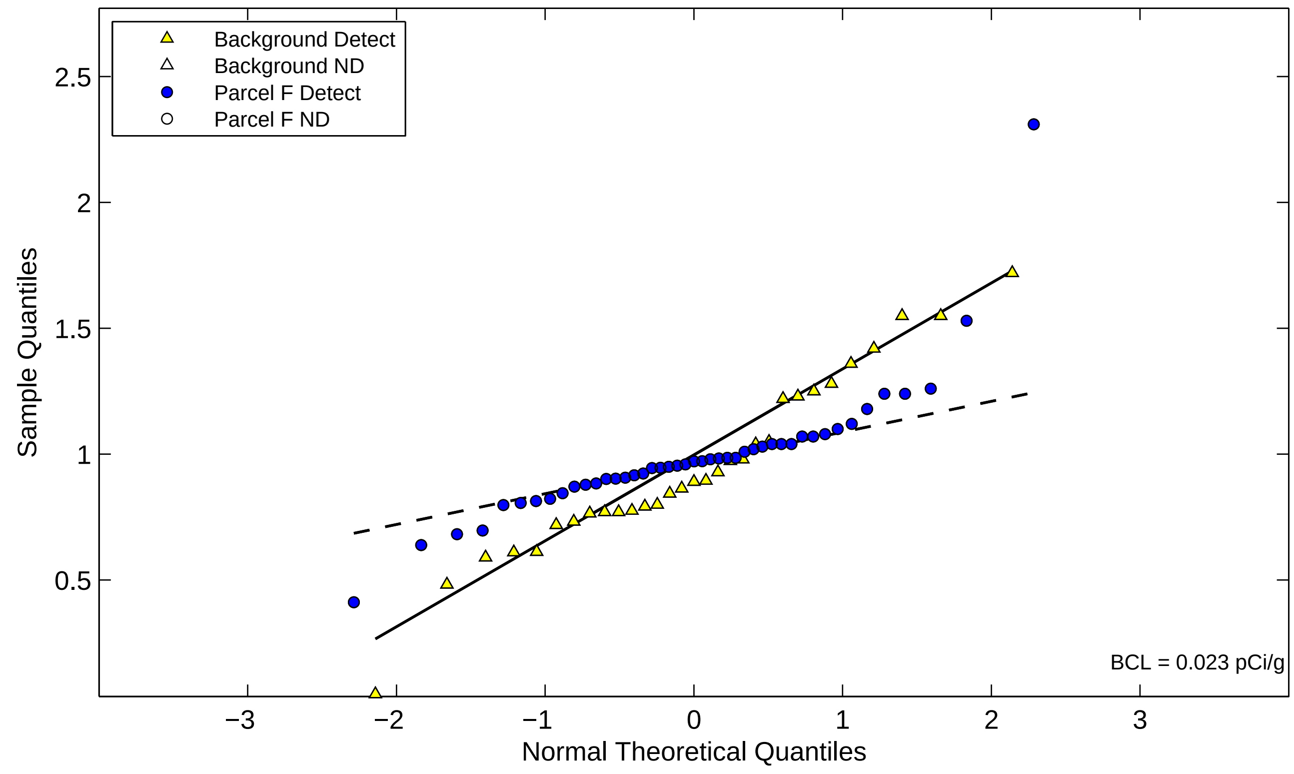


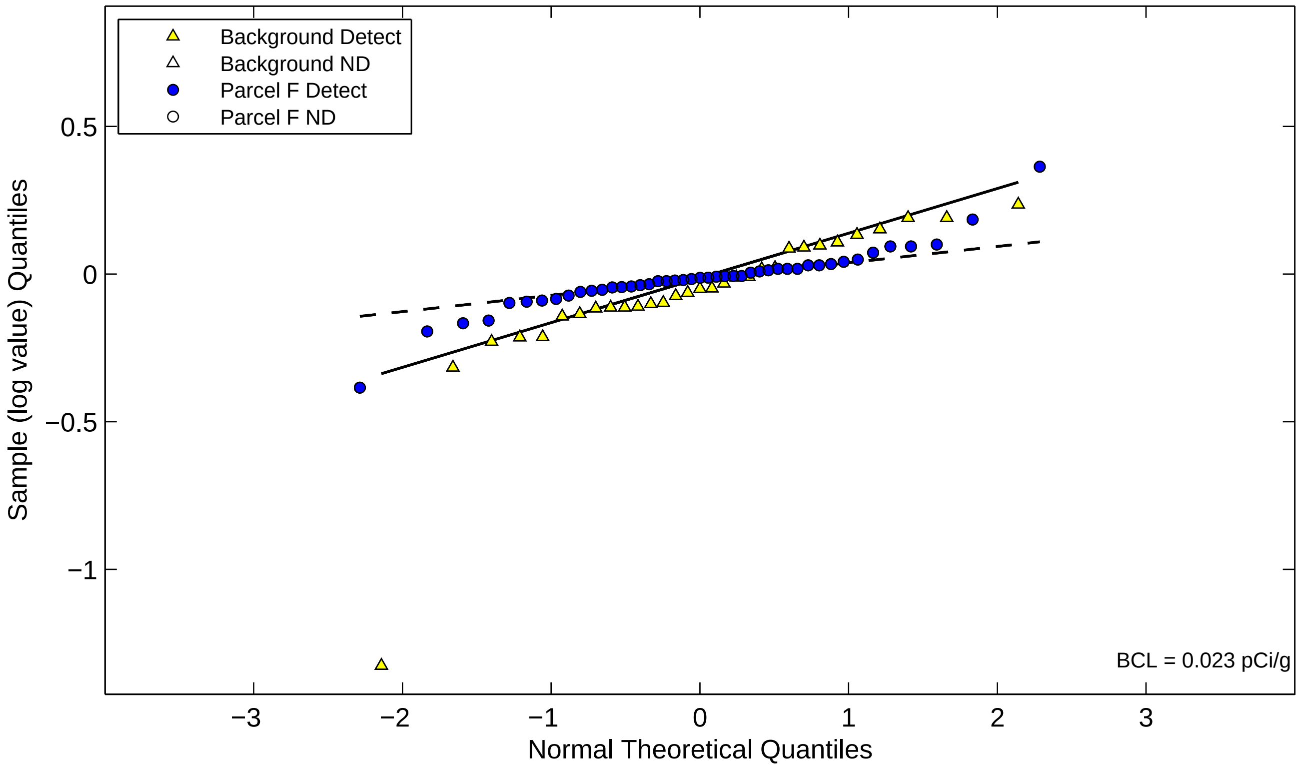
# Figure I2−35. Normal and Lognormal Q−Q Plots
# Thorium−230



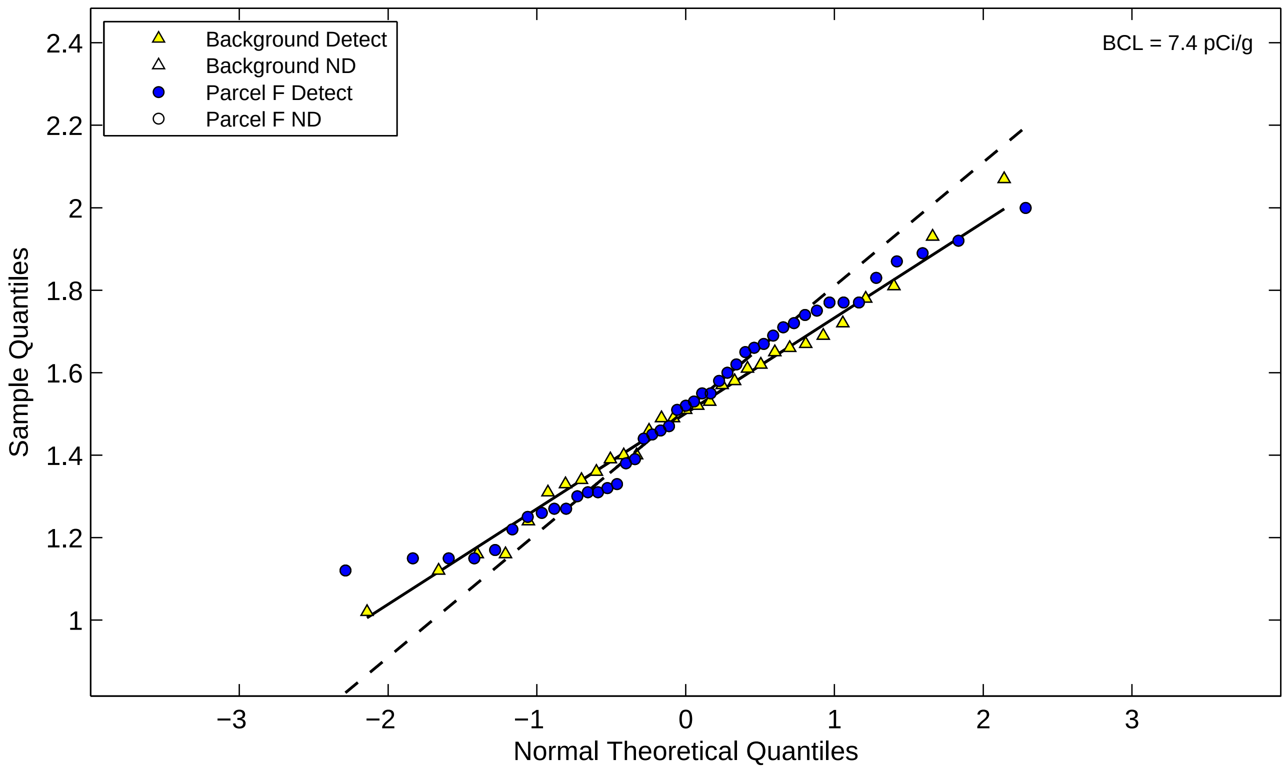


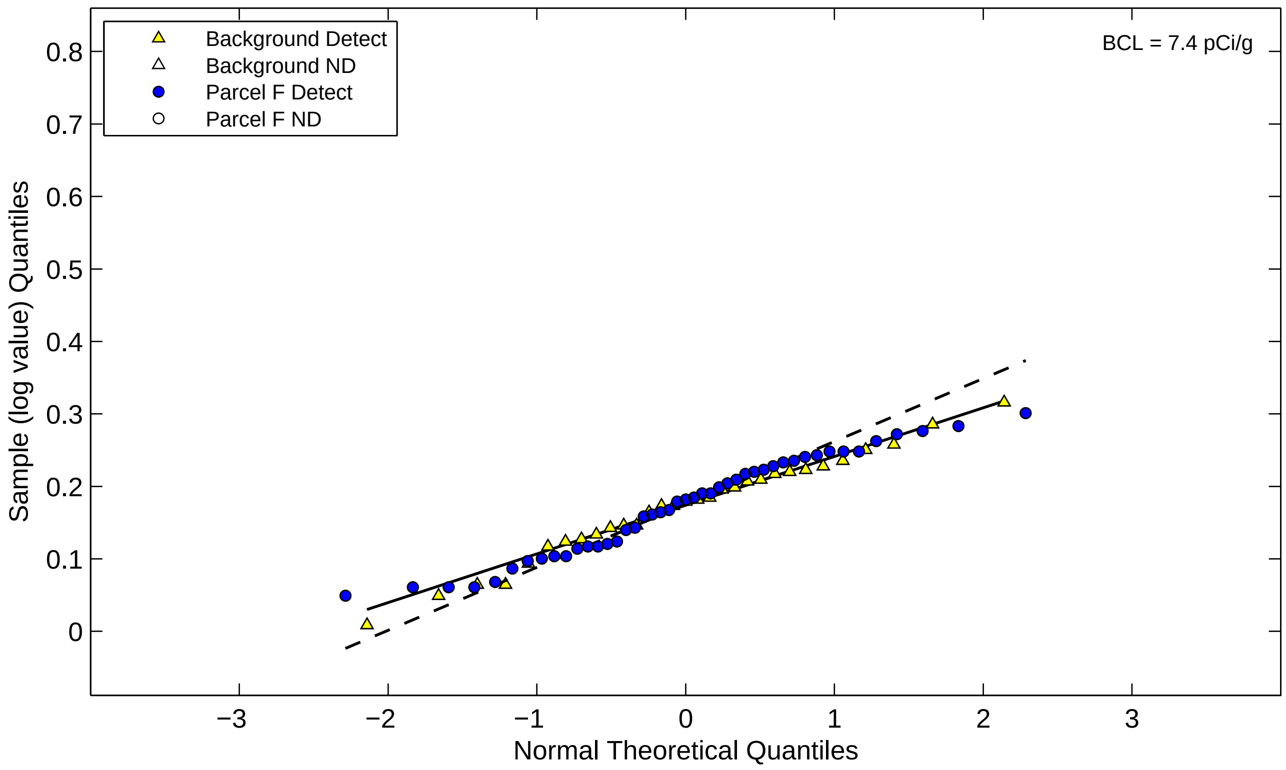
# Figure I2−36. Normal and Lognormal Q−Q Plots
## Radium−226





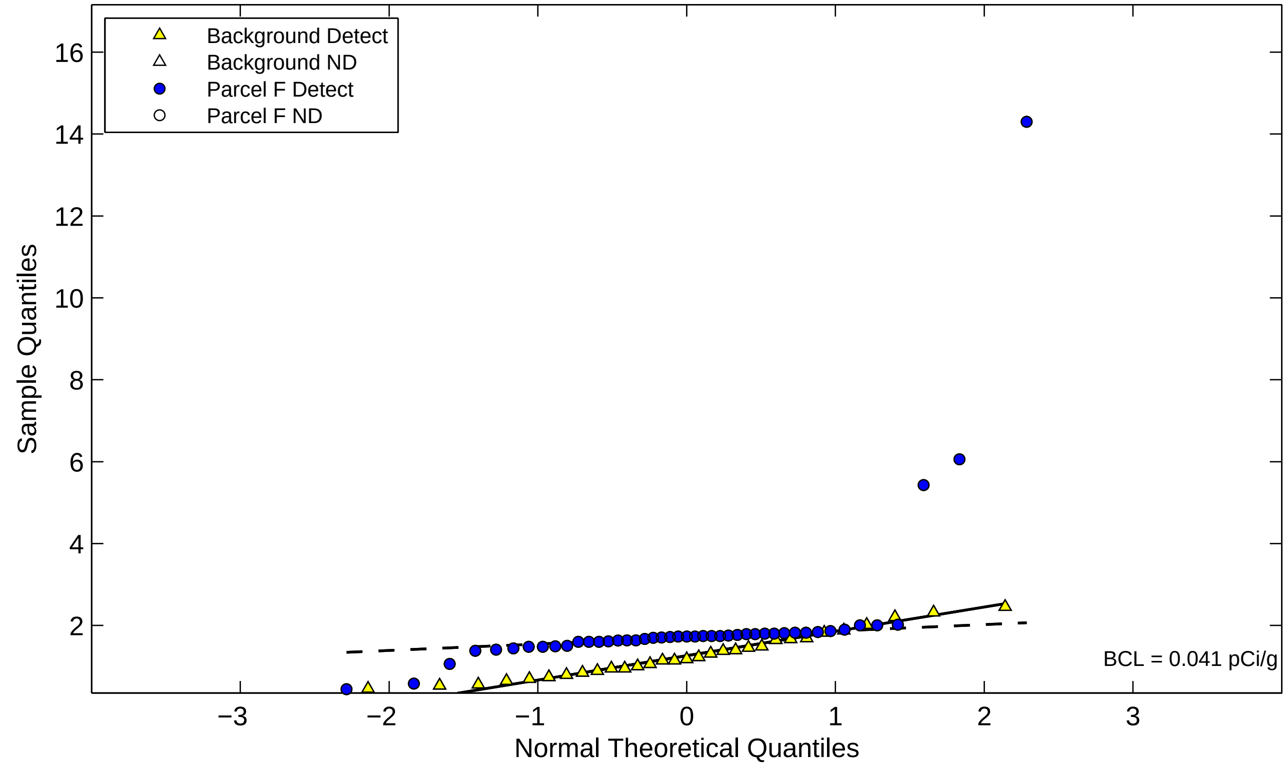
# Figure I2−37. Normal and Lognormal Q−Q Plots
# Thorium−232

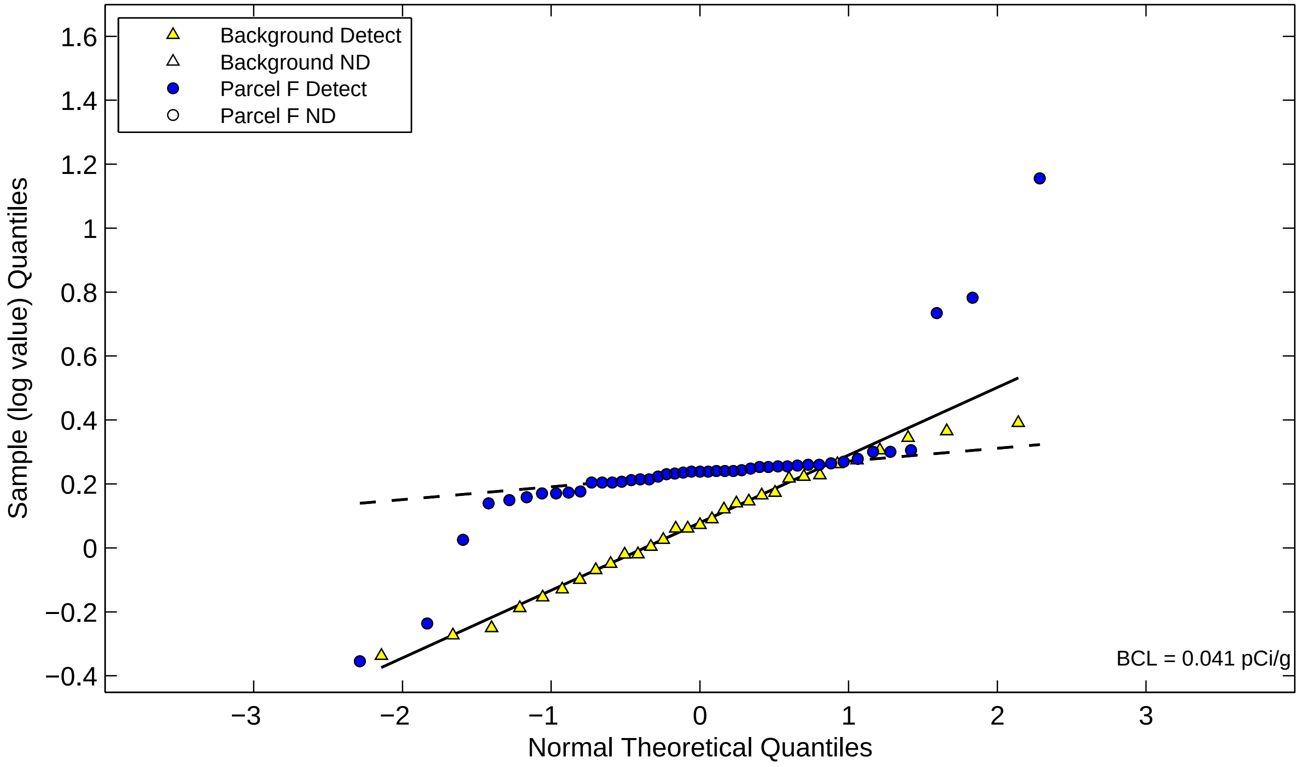




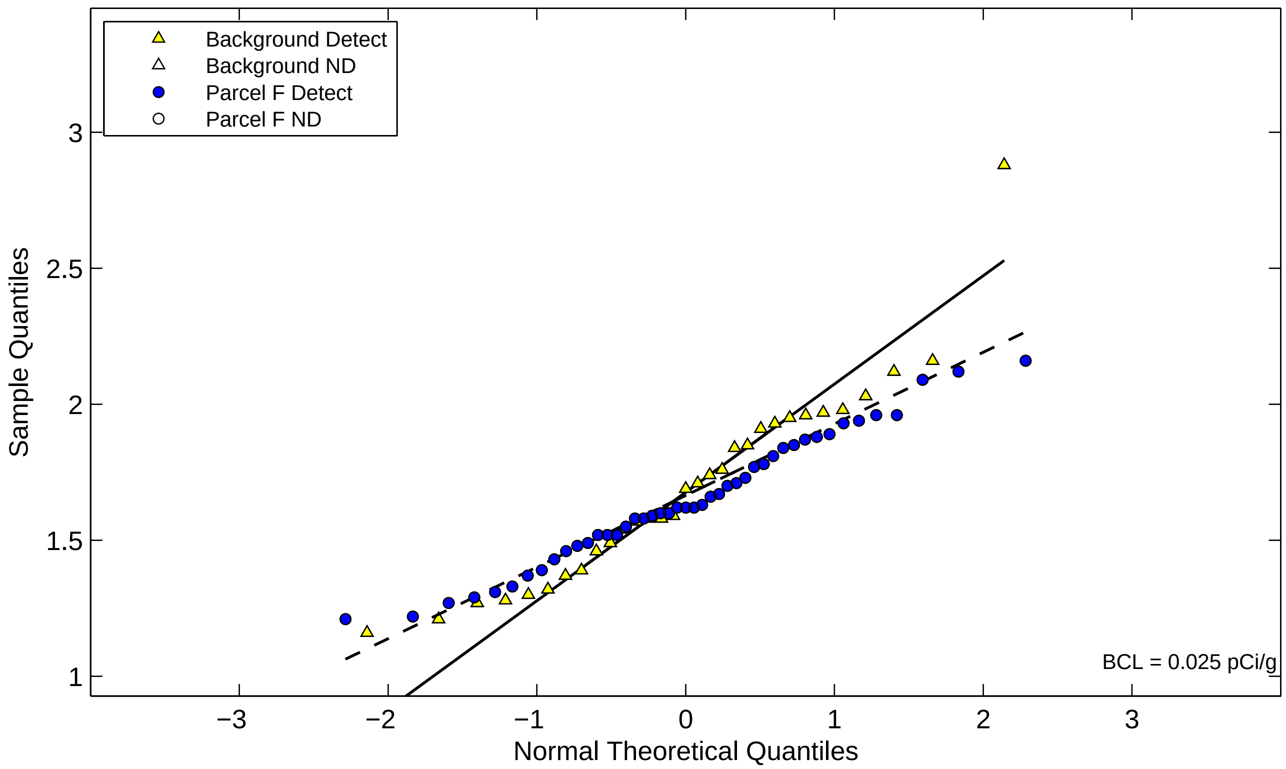
**Ramboll Environ**

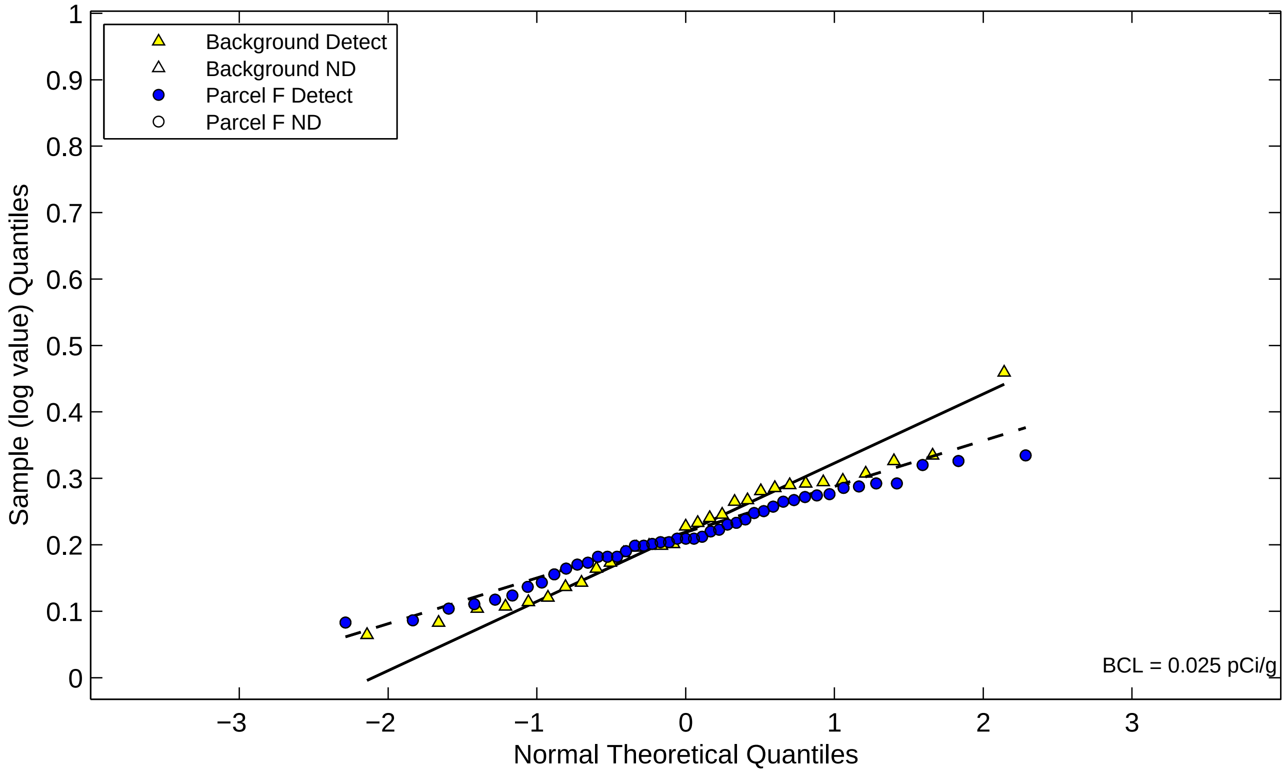
# Figure I2−38. Normal and Lognormal Q−Q Plots
## Radium−228





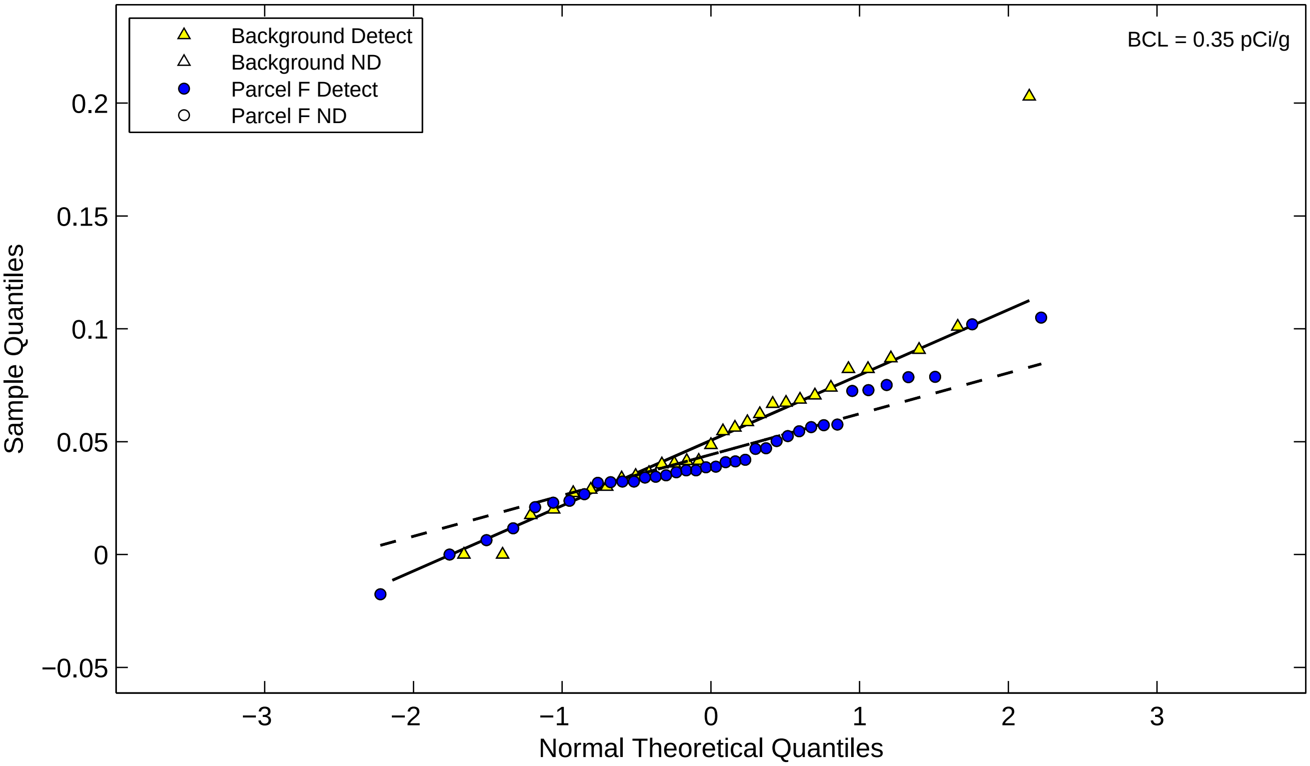
# Figure I2−39. Normal and Lognormal Q−Q Plots
# Thorium−228

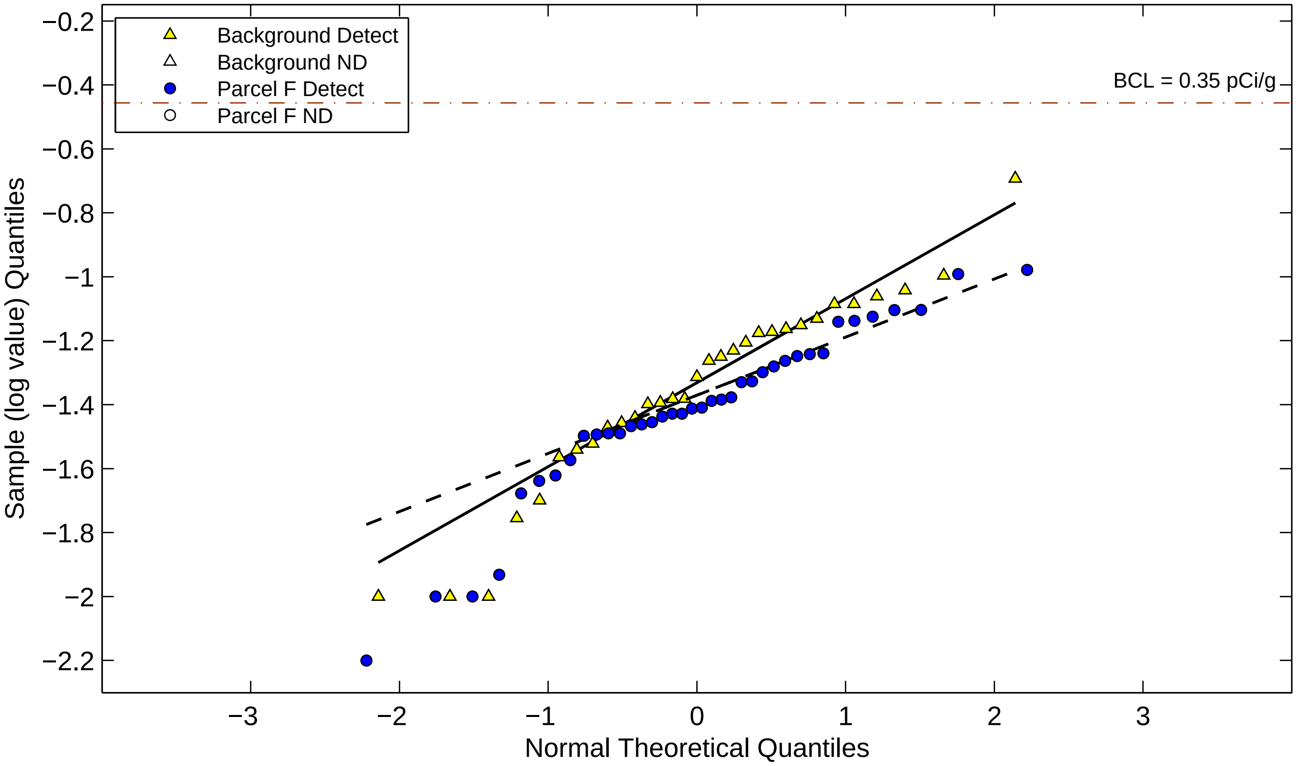




**Ramboll Environ**

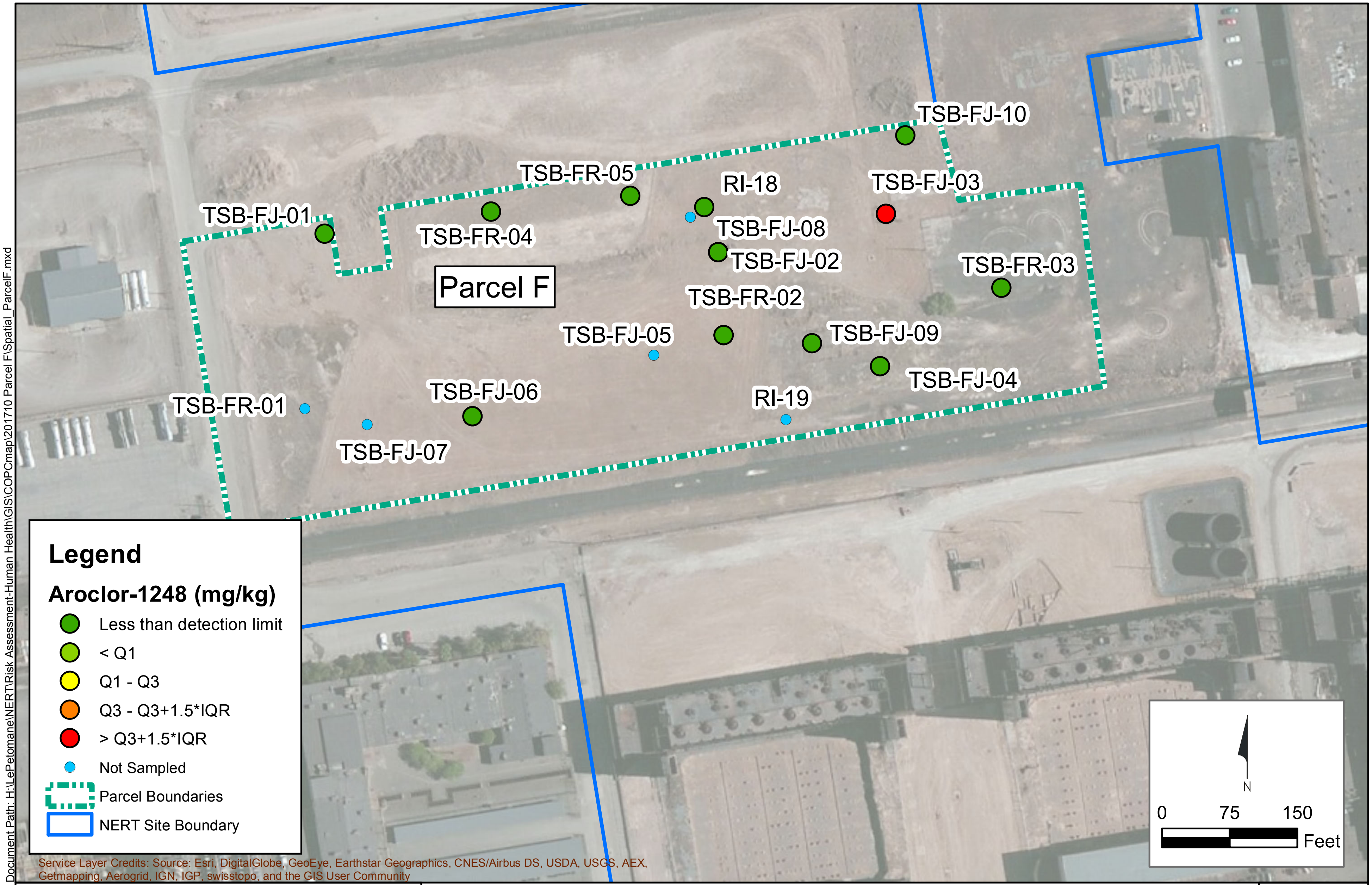
# Figure I2−40. Normal and Lognormal Q−Q Plots
## Uranium−235





**Ramboll Environ**

# APPENDIX J
# SPATIAL QUARTILE PLOTS FOR PARCEL F SOIL SAMPLES



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

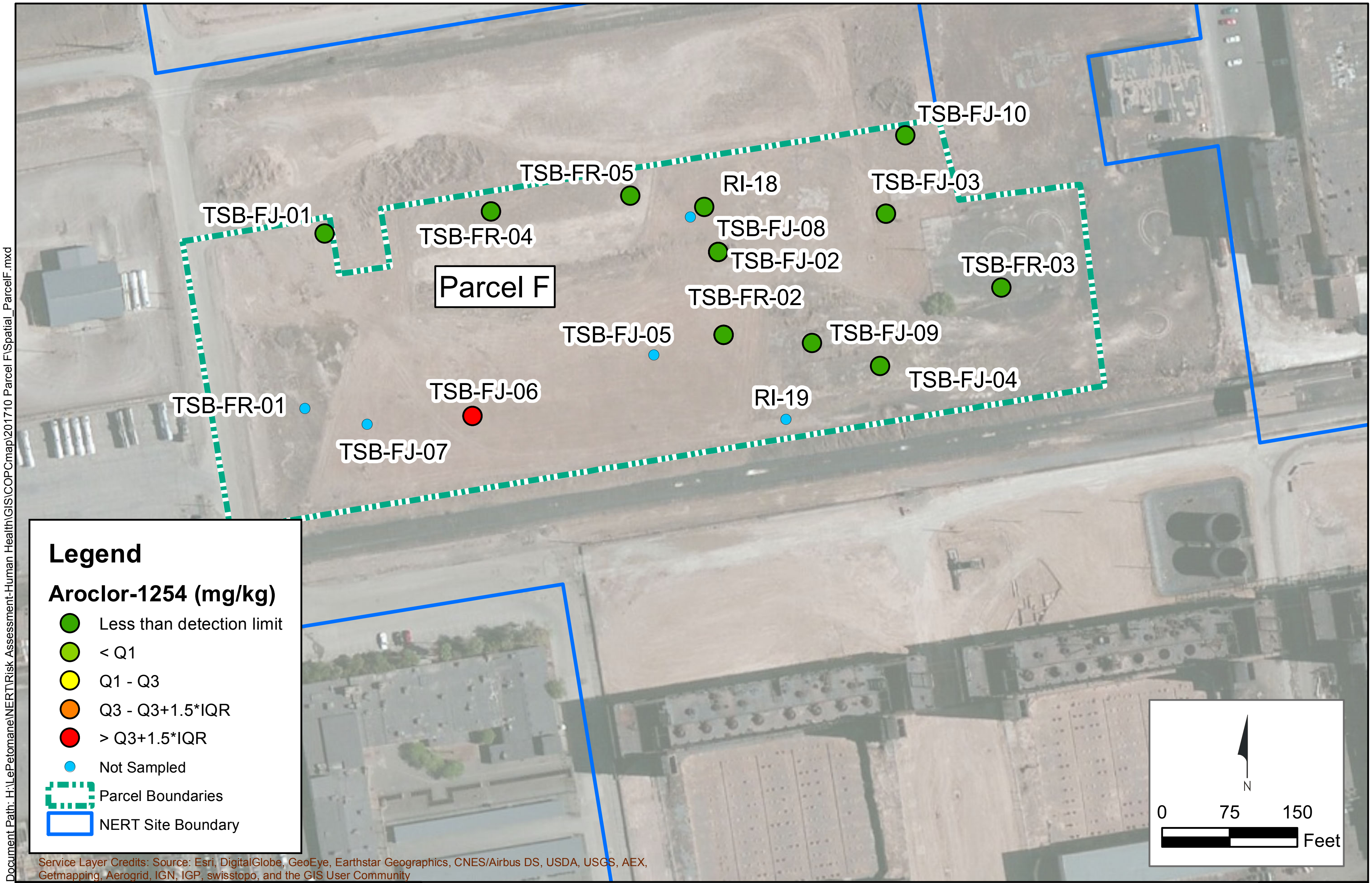
RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Aroclor-1248 (mg/kg)**
**[Q1 = 0.0049, Q3 = 0.006, Q3+1.5*IQR = 0.00765]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-1**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

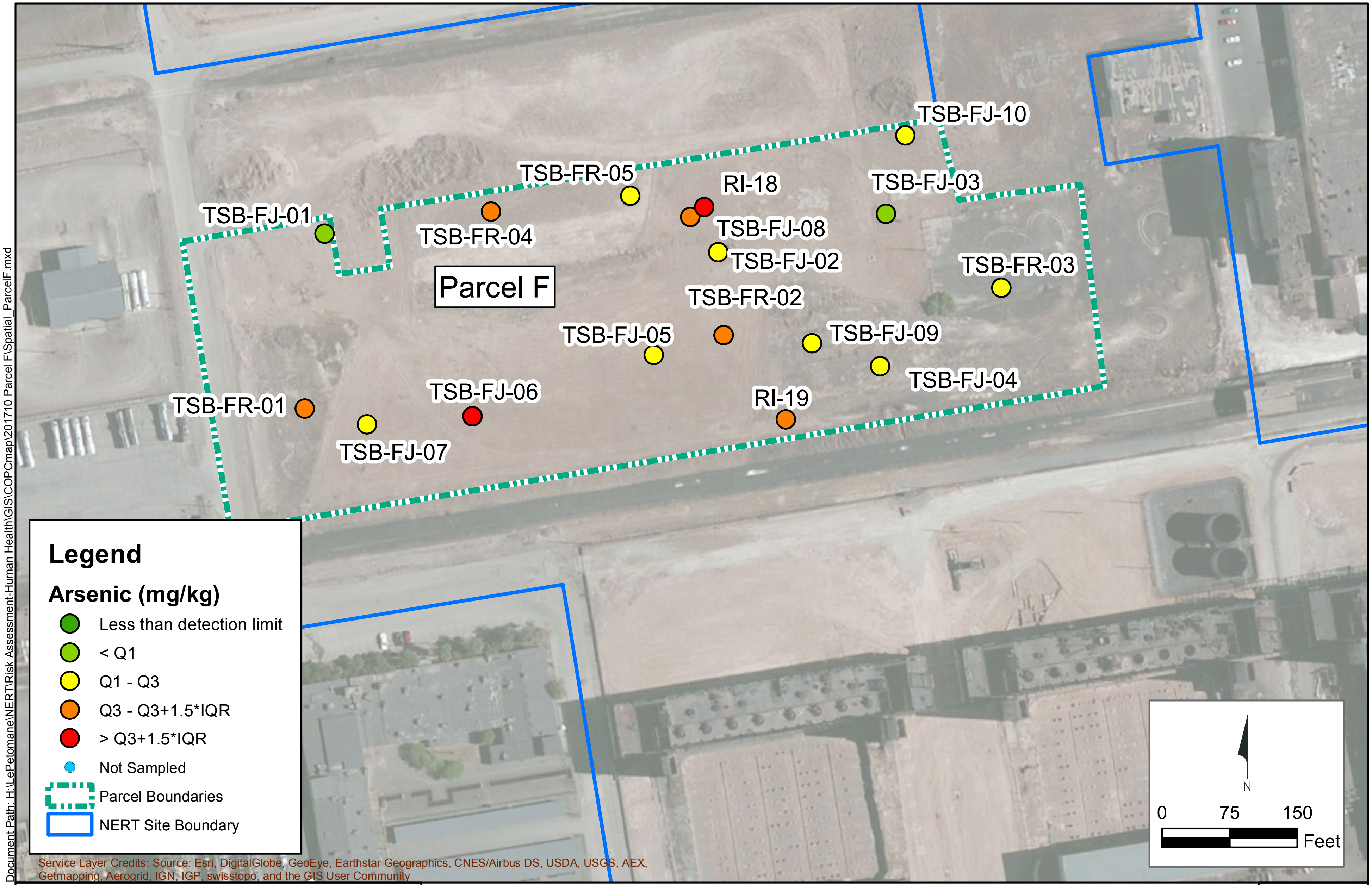
RAMBOLL ENVIRON

## Spatial Quartile Plot for Parcel F - Aroclor-1254 (mg/kg)
**[Q1 = 0.0056, Q3 = 0.00658, Q3+1.5*IQR = 0.00804]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-2**

Drafter: RS
Date: 10/24/2017
Contract Number: 21-41400A
Approved by:
Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

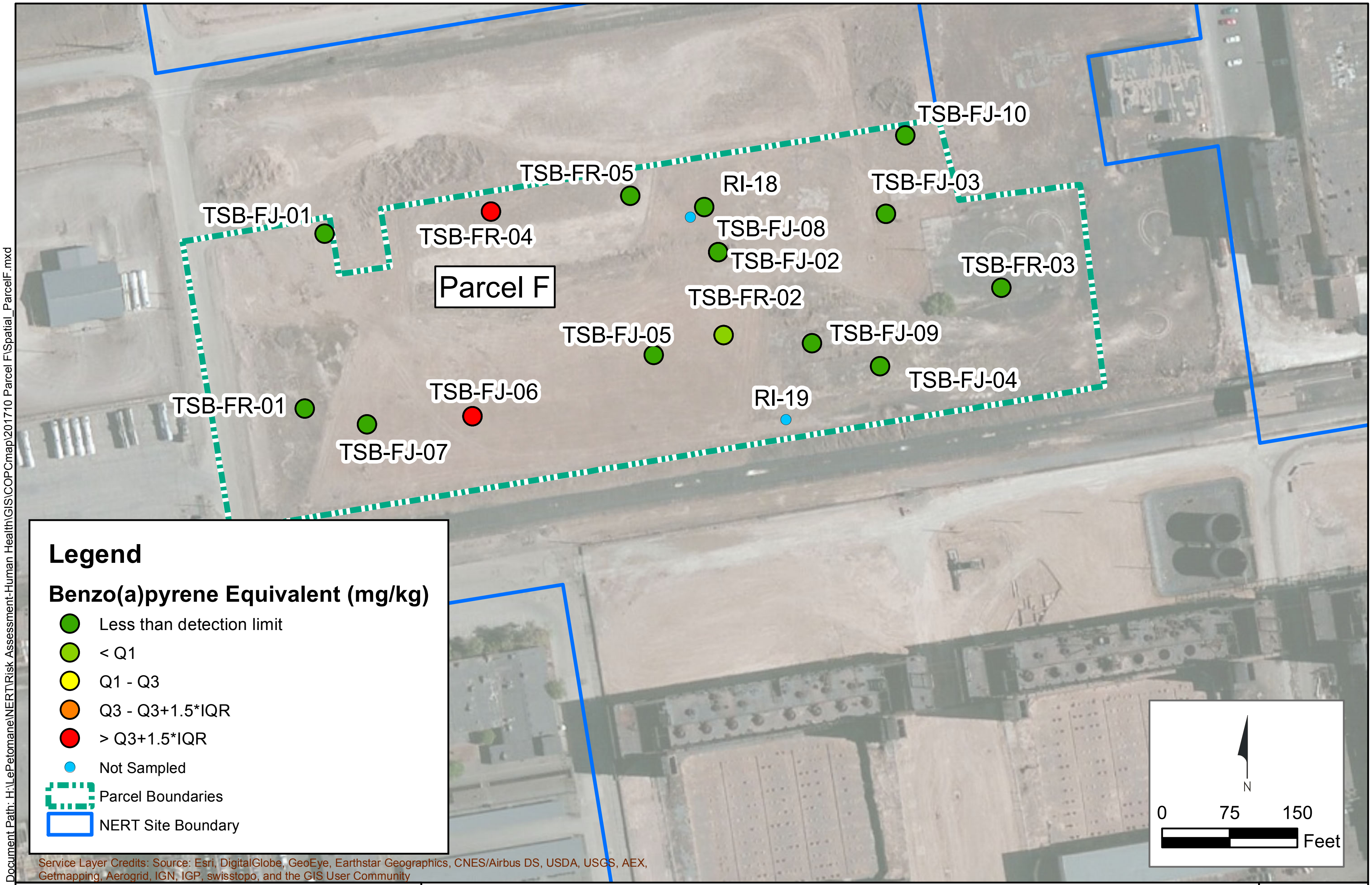
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Arsenic (mg/kg)**
**[Q1 = 3.1, Q3 = 4.42, Q3+1.5*IQR = 6.41]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-3**

| | | | | |
|---|---|---|---|---|
| Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised: |



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Benzo(a)pyrene Equivalent (mg/kg)**

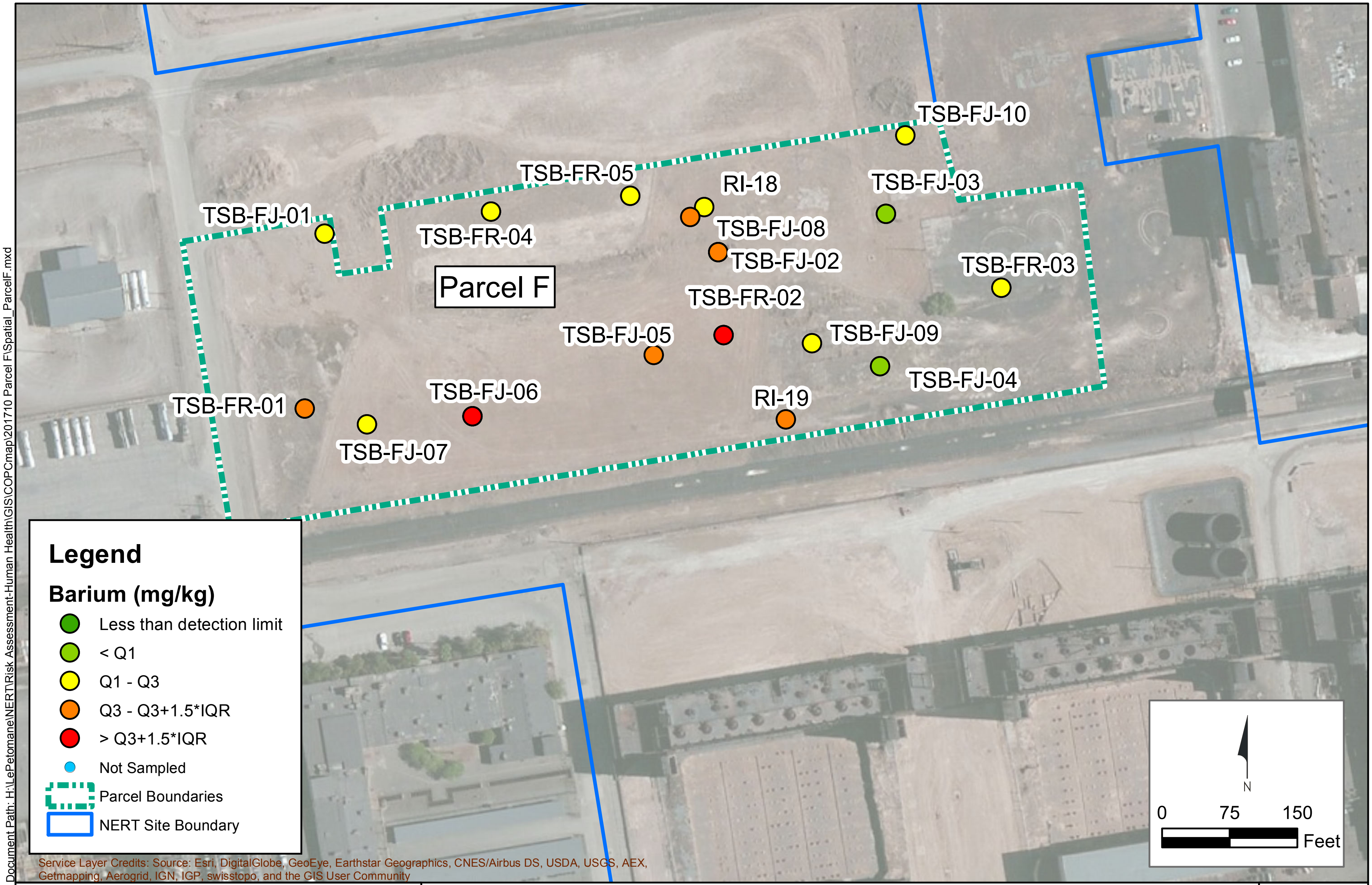
**[Q1 = 0.0385, Q3 = 0.0385, Q3+1.5*IQR = 0.0385]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**J-4**

Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

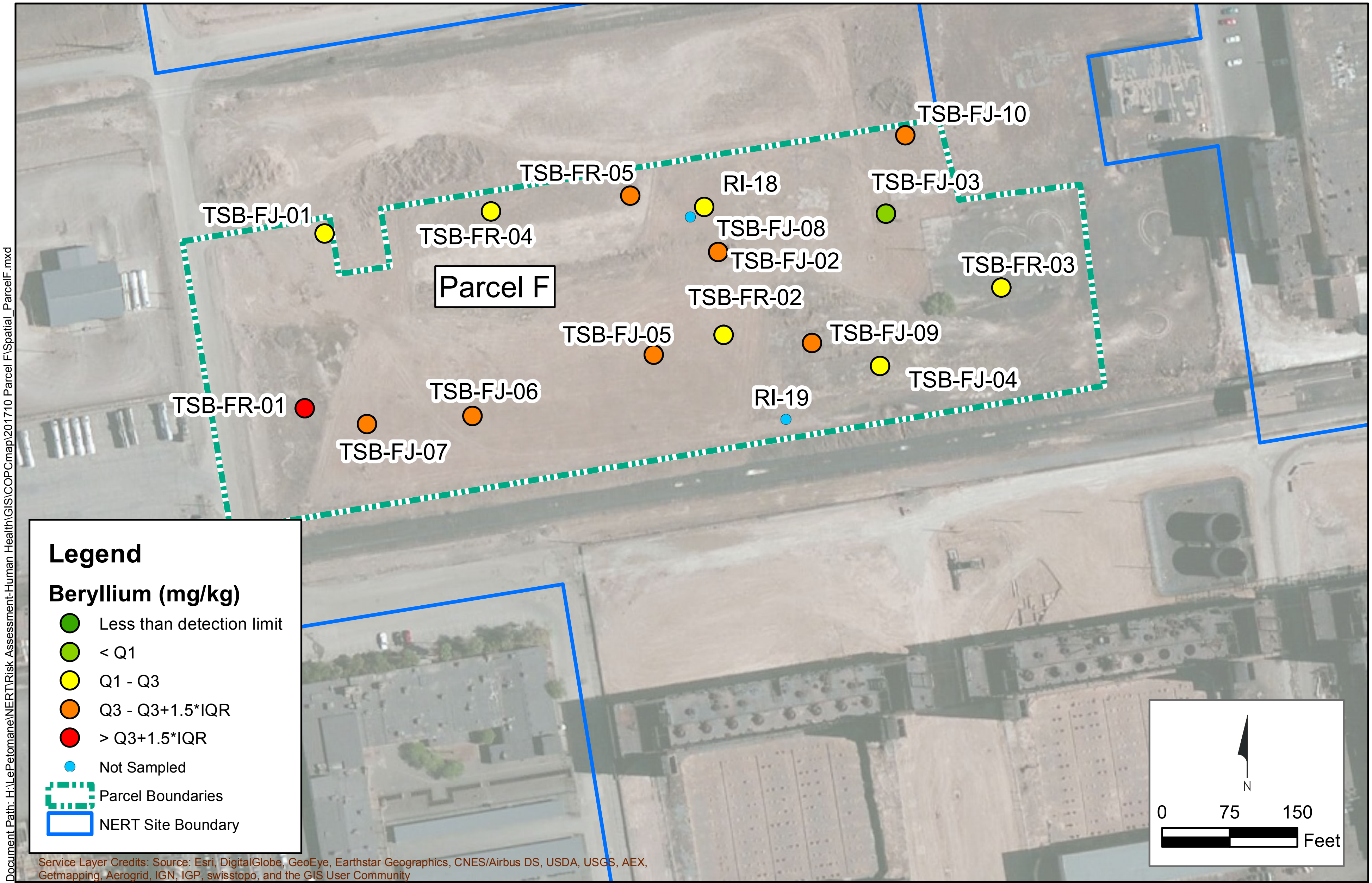
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Barium (mg/kg)**
**[Q1 = 128, Q3 = 211, Q3+1.5*IQR = 336]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-5**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

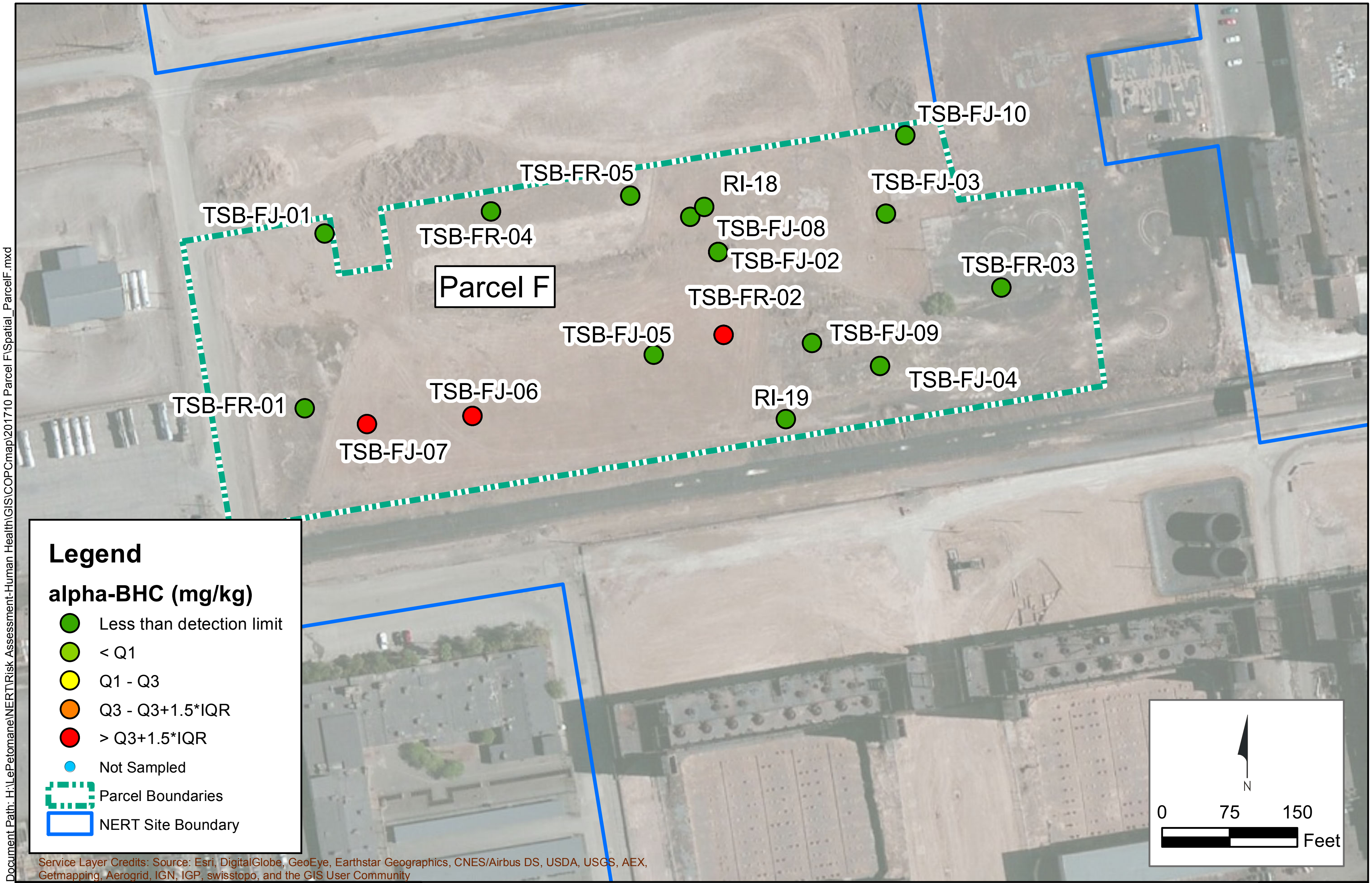
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Beryllium (mg/kg)**
**[Q1 = 0.48, Q3 = 0.57, Q3+1.5*IQR = 0.705]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-6**

Drafter: RS
Date: 10/24/2017
Contract Number: 21-41400A
Approved by:
Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - alpha-BHC (mg/kg)**

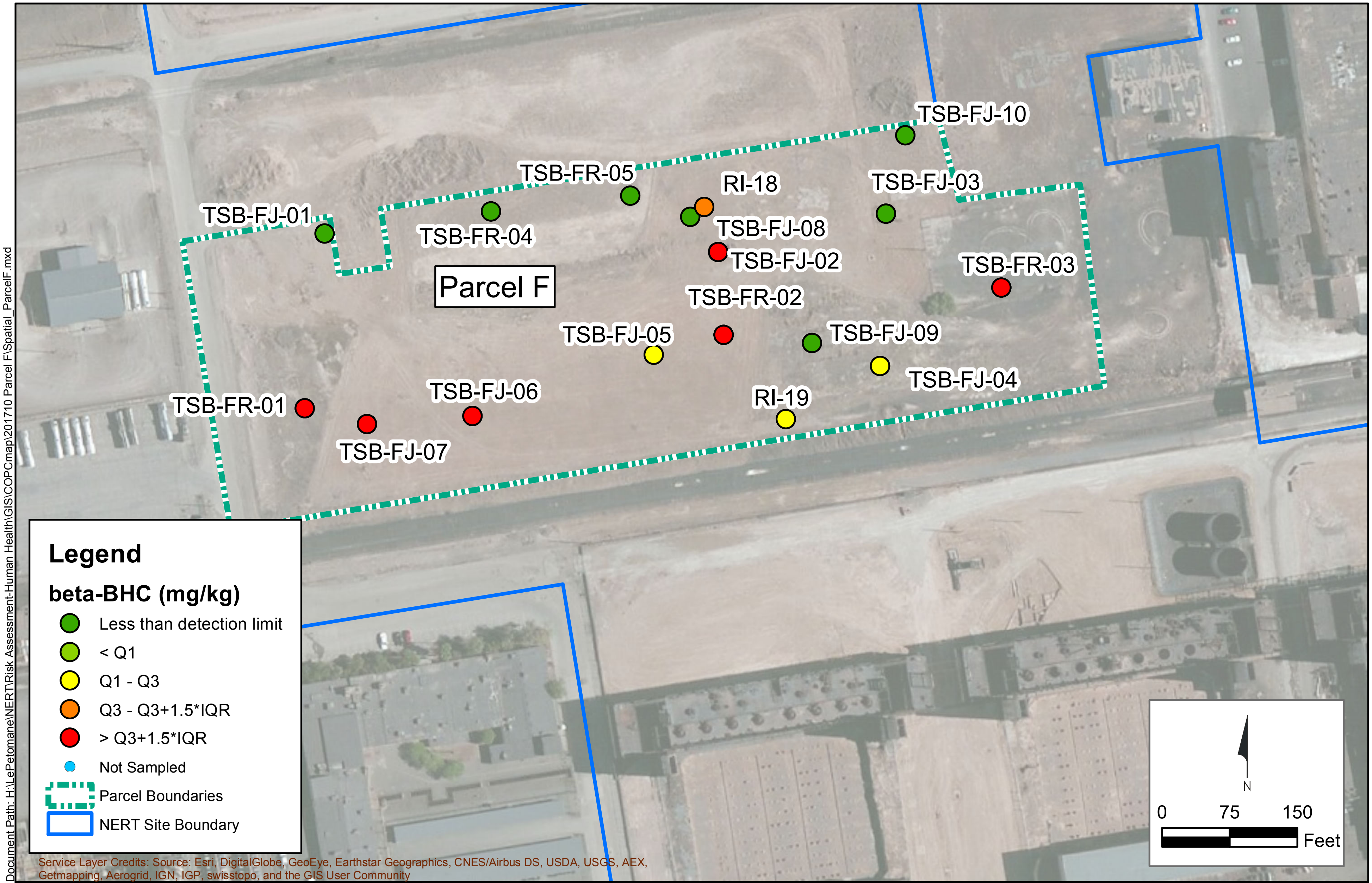
**[Q1 = 0.0000962, Q3 = 0.000282, Q3+1.5*IQR = 0.000561]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**J-7**

Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

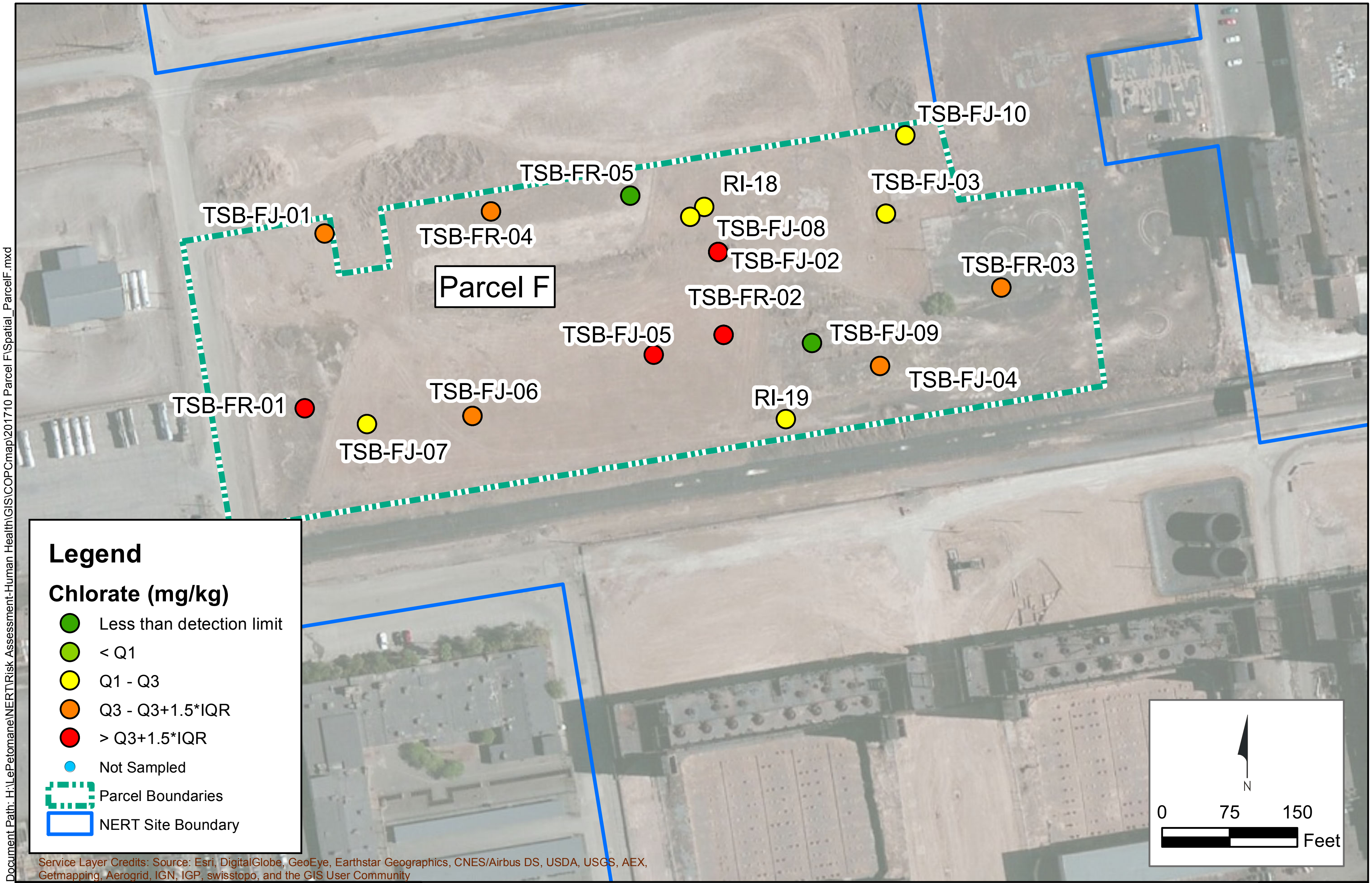
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - beta-BHC (mg/kg)**
**[Q1 = 0.000345, Q3 = 0.0078, Q3+1.5*IQR = 0.019]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-8**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

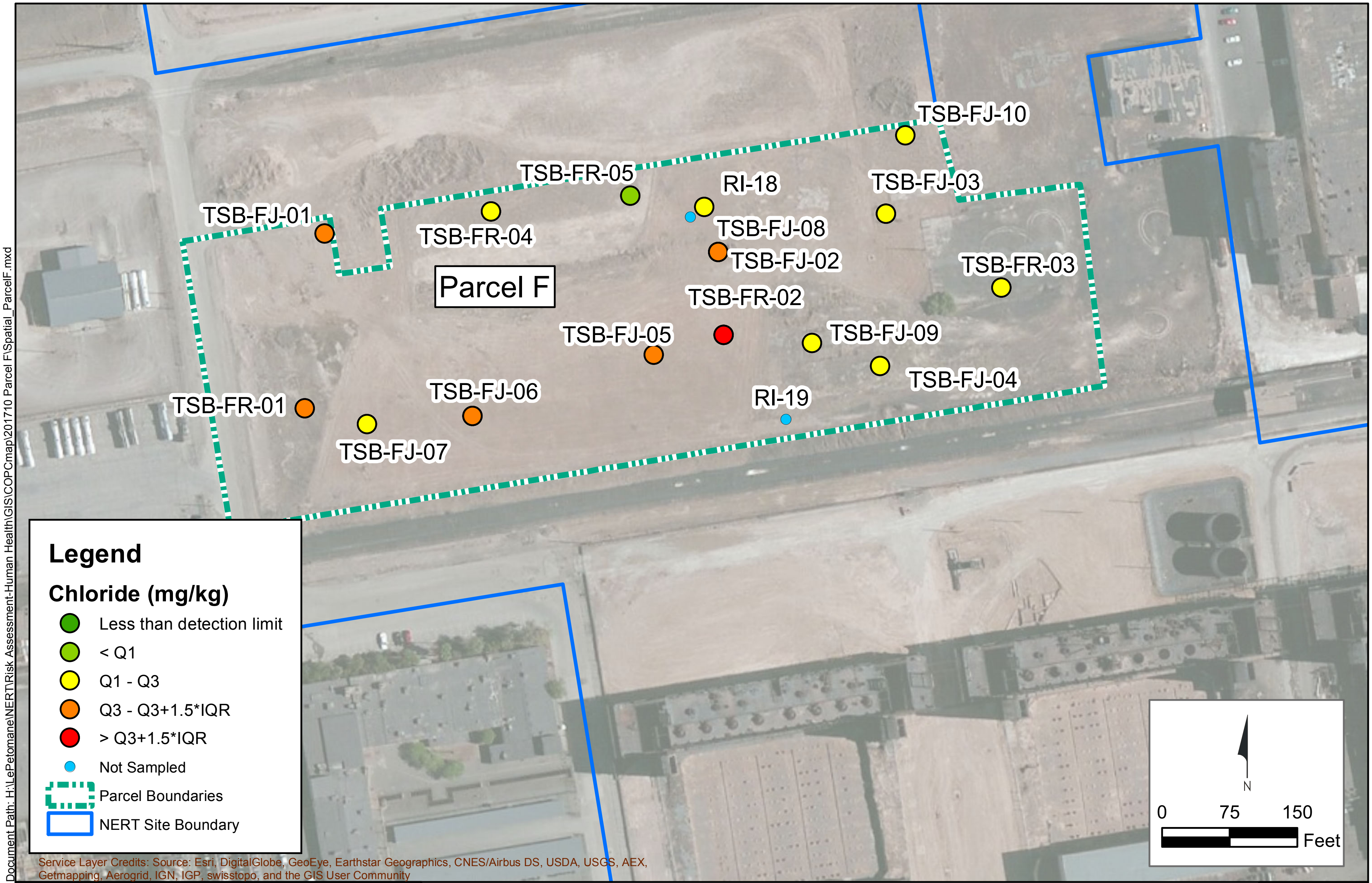
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Chlorate (mg/kg)**
**[Q1 = 1, Q3 = 32.3, Q3+1.5*IQR = 79.2]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-9**

| Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised: |
|---|---|---|---|---|



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

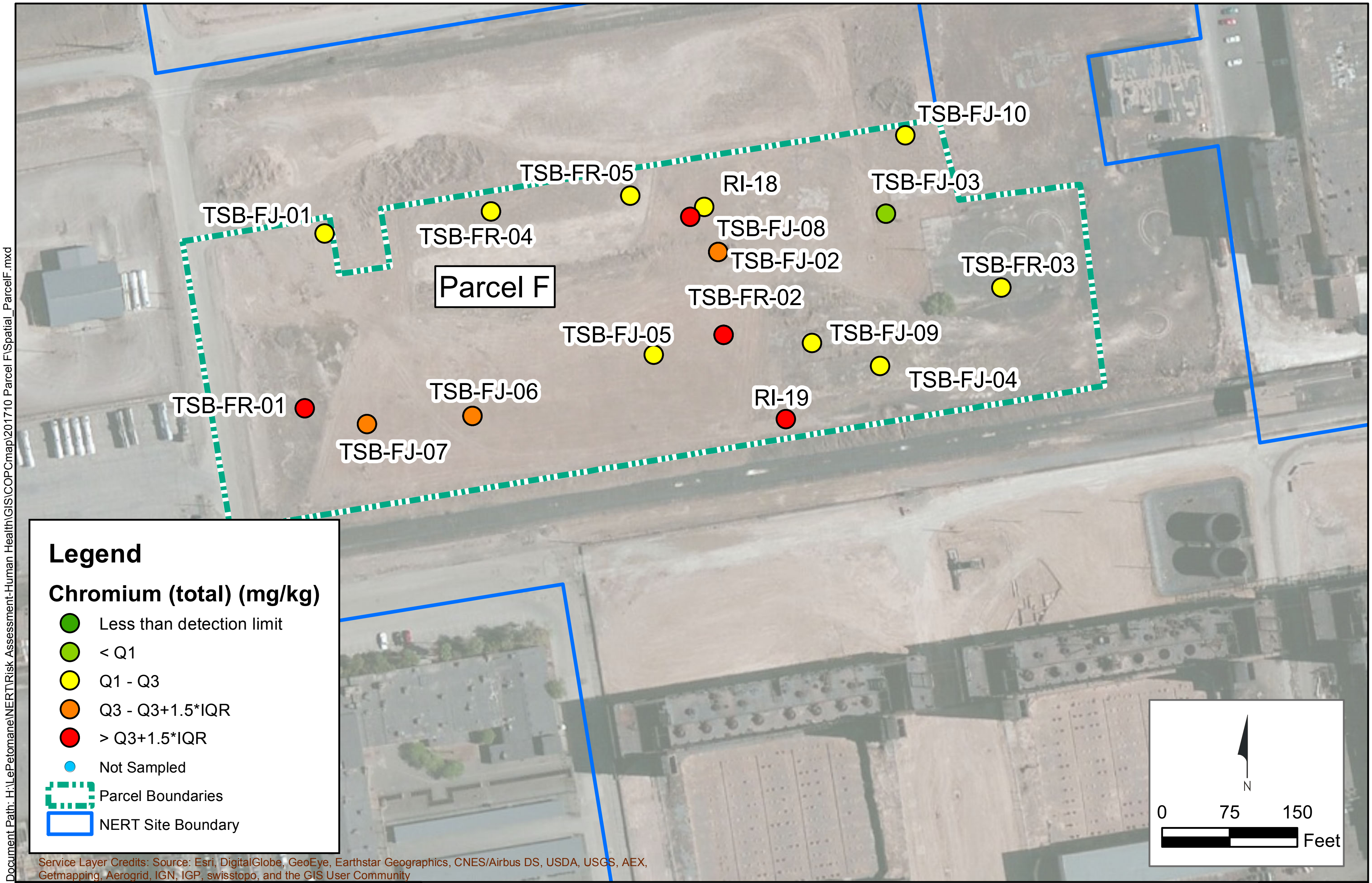
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Chloride (mg/kg)**
**[Q1 = 135, Q3 = 2850, Q3+1.5*IQR = 6920]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-10**

Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

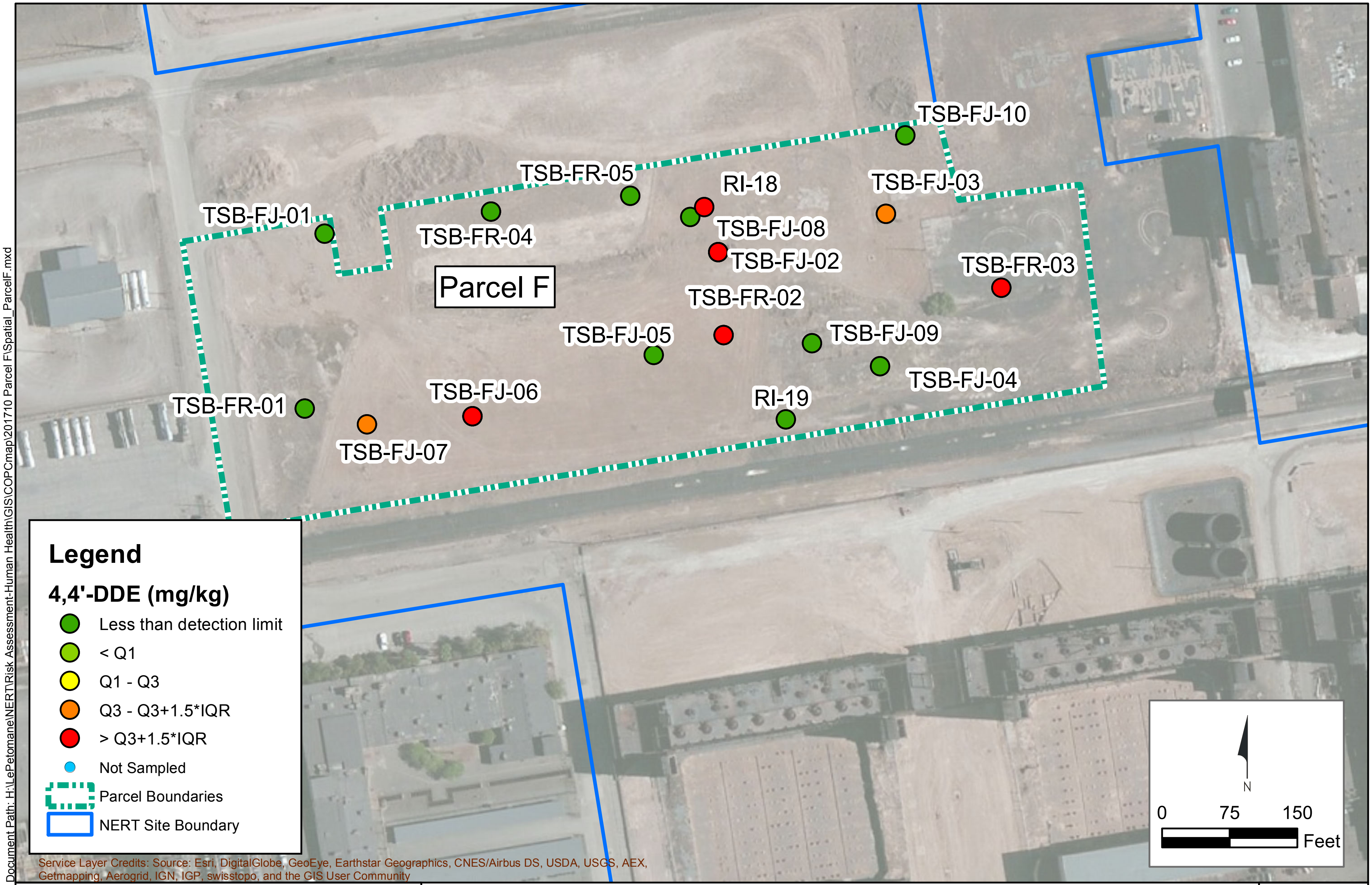
RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Chromium (total) (mg/kg)**
**[Q1 = 9.2, Q3 = 12.4, Q3+1.5*IQR = 17.2]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-11**

Drafter: RS
Date: 10/24/2017
Contract Number: 21-41400A
Approved by:
Revised:

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - 4,4'-DDE (mg/kg)**

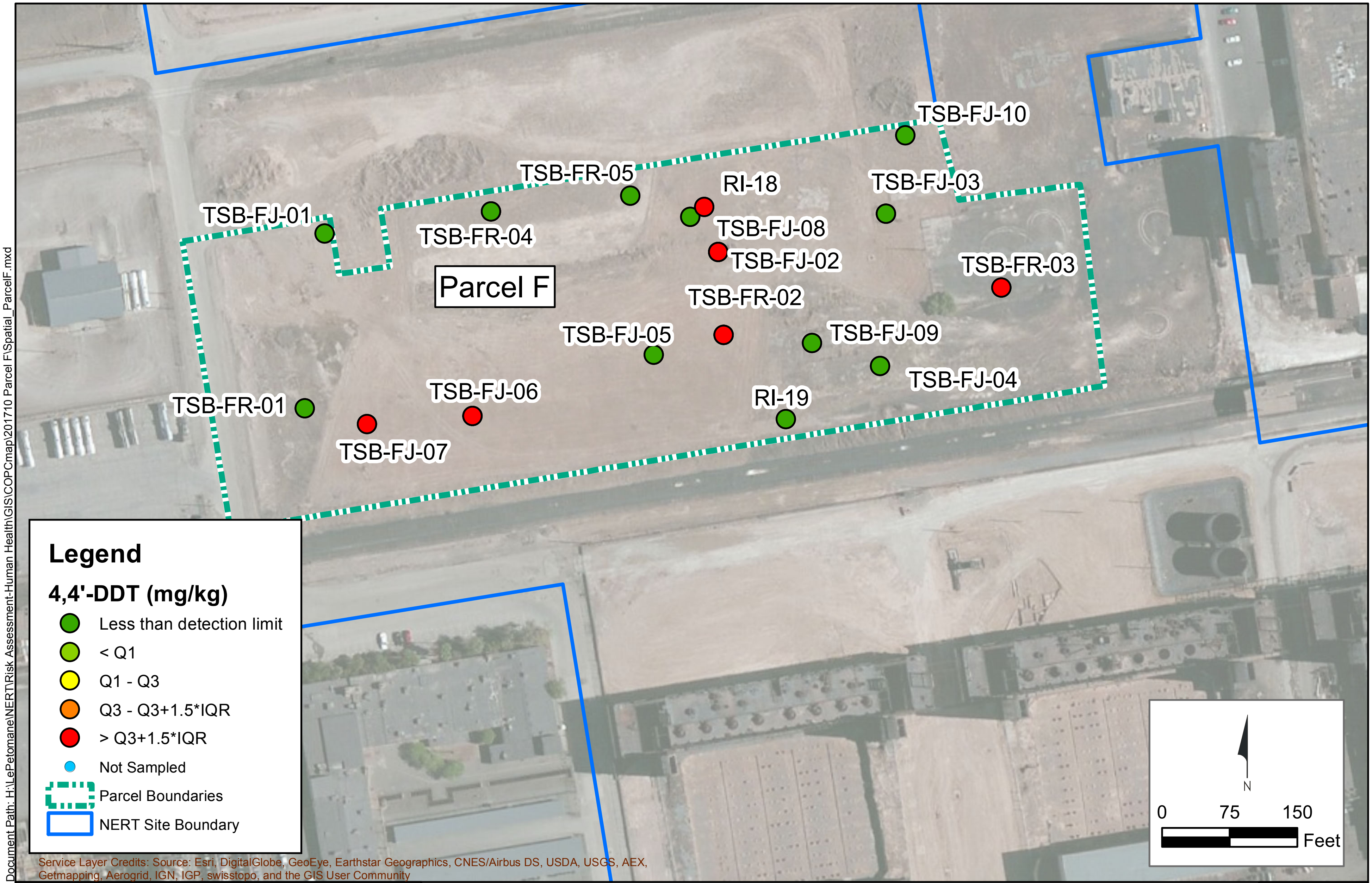
**[Q1 = 0.000252, Q3 = 0.0016, Q3+1.5*IQR = 0.00362]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**J-12**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - 4,4'-DDT (mg/kg)**

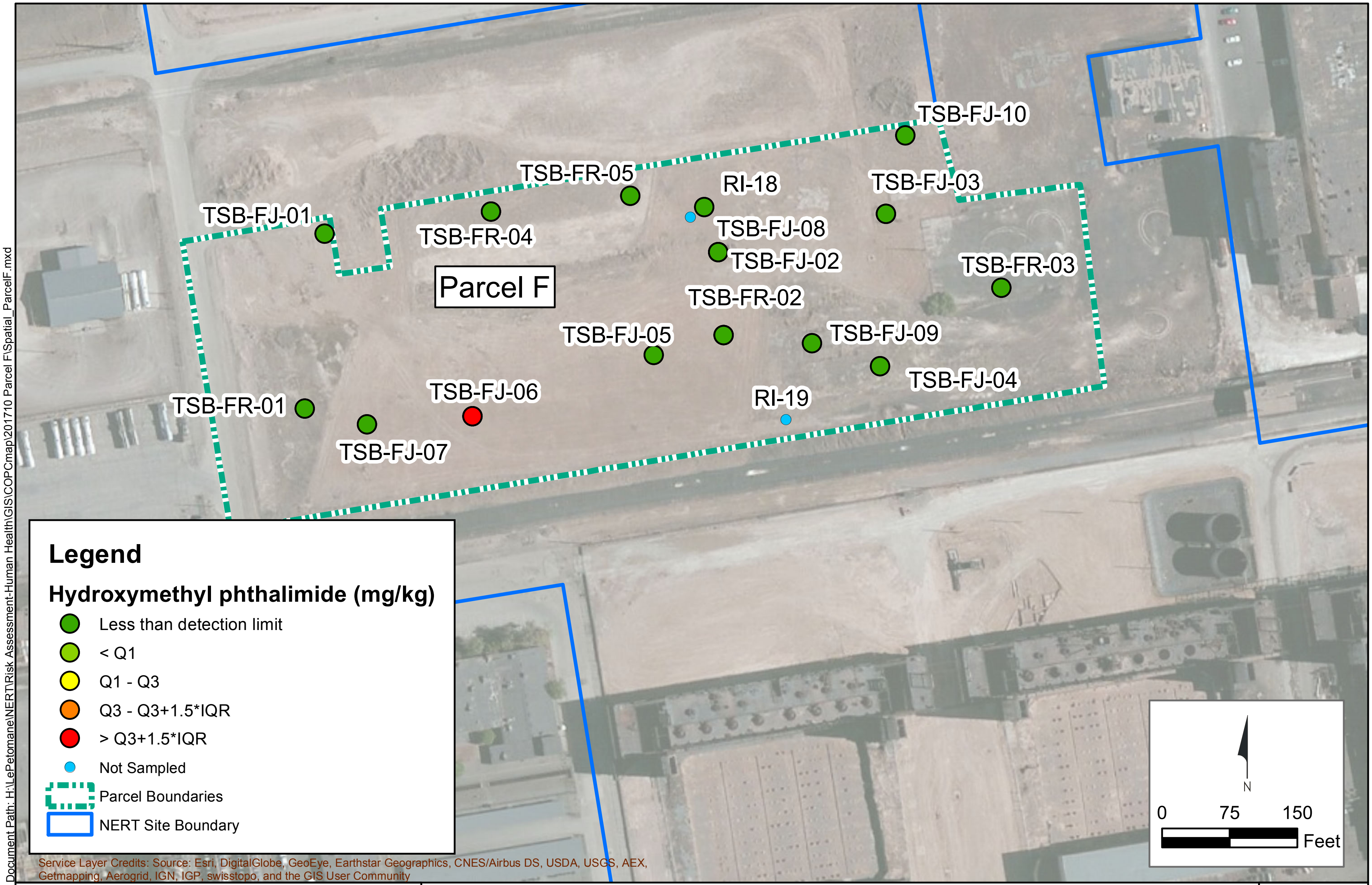
**[Q1 = 0.000427, Q3 = 0.00079, Q3+1.5*IQR = 0.00133]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**J-13**

| Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised: |
|---|---|---|---|---|



**Legend**

**Hydroxymethyl phthalimide (mg/kg)**

- 🟢 Less than detection limit
- 🟢 < Q1
- 🟡 Q1 - Q3
- 🟠 Q3 - Q3+1.5*IQR
- 🔴 > Q3+1.5*IQR
- ● Not Sampled
- ▭ Parcel Boundaries
- ▭ NERT Site Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

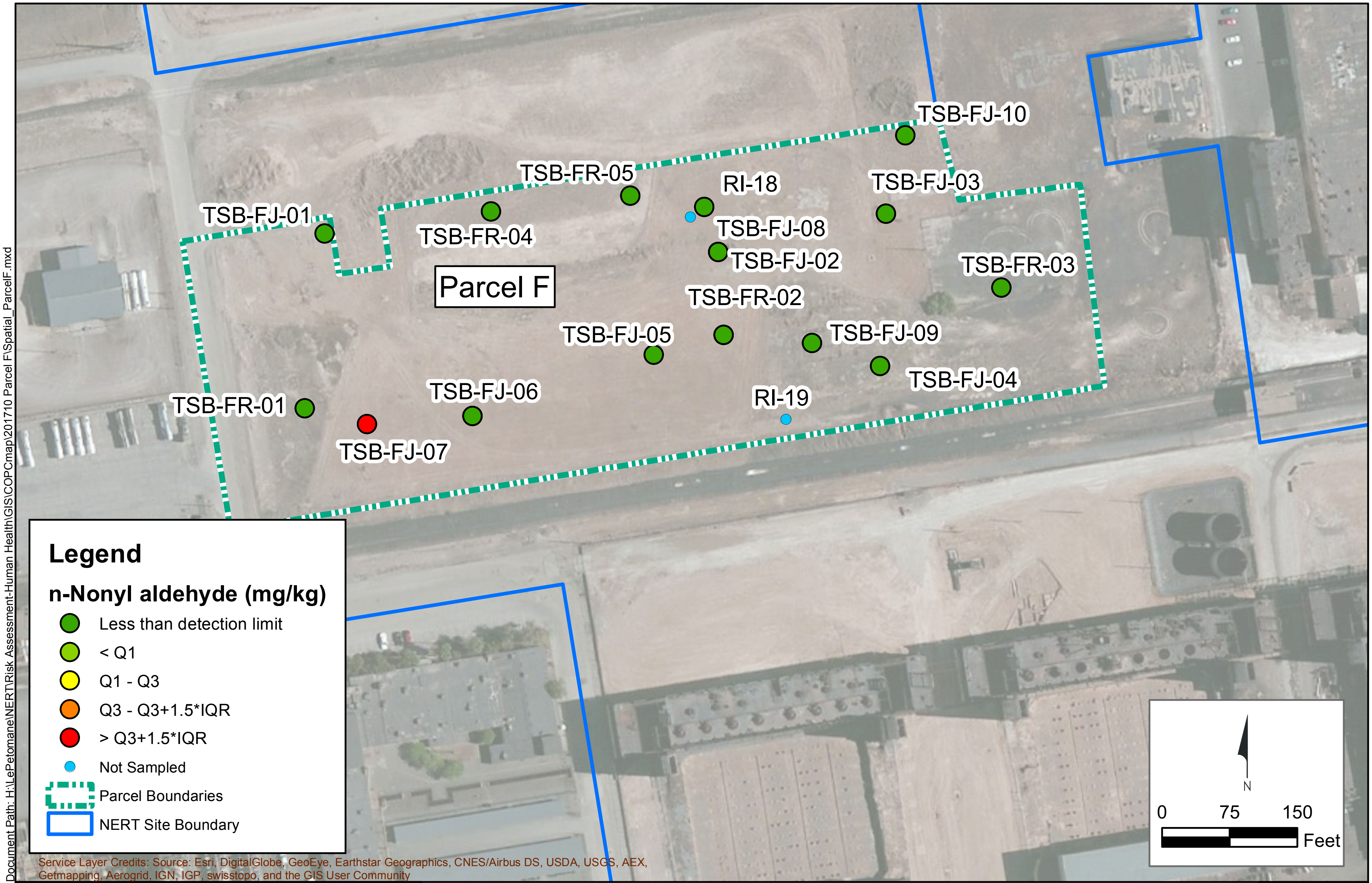
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Hydroxymethyl phthalimide (mg/kg)**
**[Q1 = 0.0434, Q3 = 0.0434, Q3+1.5*IQR = 0.0434]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-14**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



**Legend**

**n-Nonyl aldehyde (mg/kg)**

- ● Less than detection limit
- ● < Q1
- ● Q1 - Q3
- ● Q3 - Q3+1.5*IQR
- ● > Q3+1.5*IQR
- ● Not Sampled
- ▭ Parcel Boundaries
- ▭ NERT Site Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

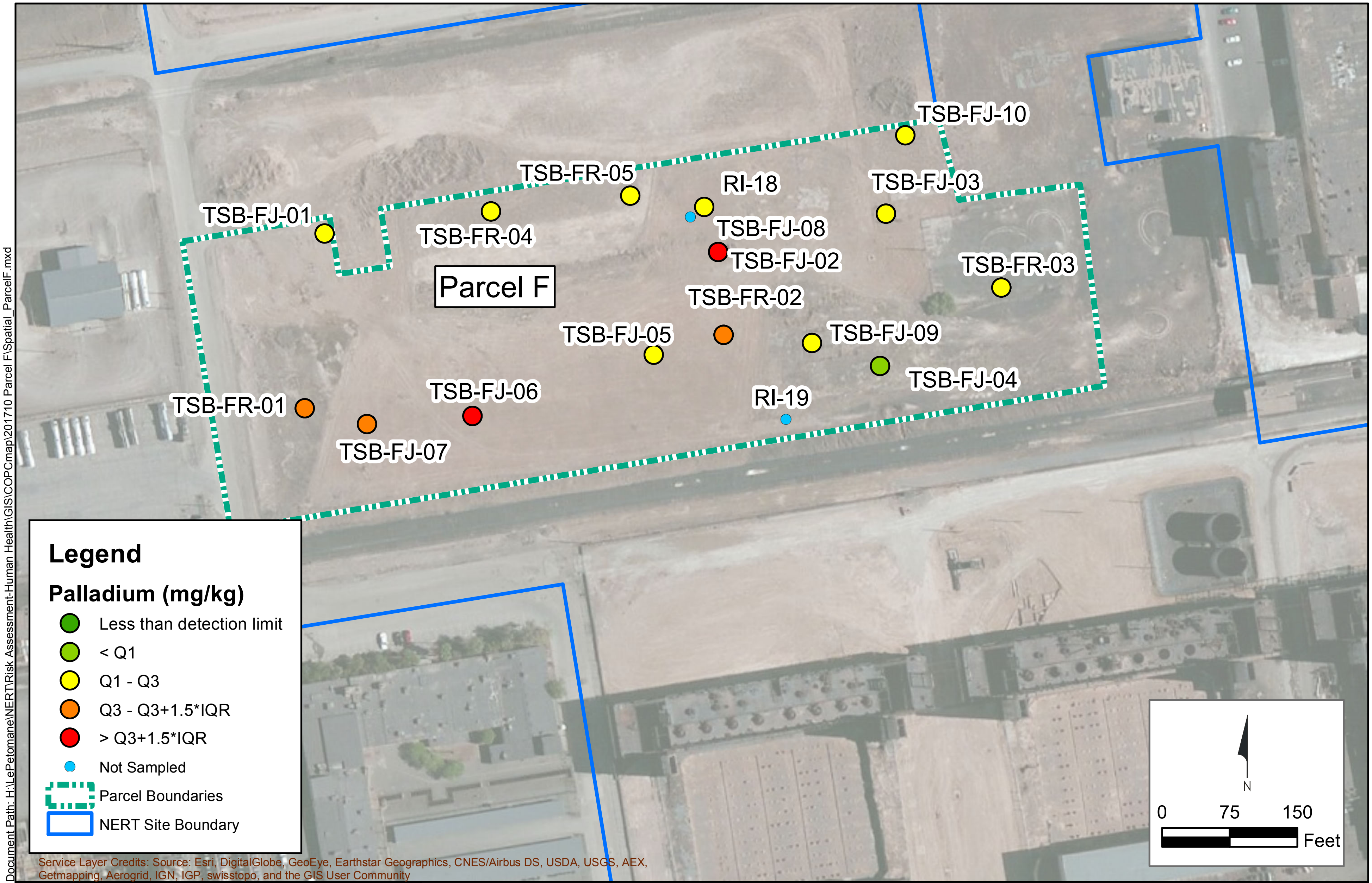
RAMBOLL ENVIRON

## Spatial Quartile Plot for Parcel F - n-Nonyl aldehyde (mg/kg)
## [Q1 = 0.00088, Q3 = 0.00088, Q3+1.5*IQR = 0.00088]

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-15**

Drafter: RS    Date: 10/24/2017    Contract Number: 21-41400A    Approved by:    Revised:



Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

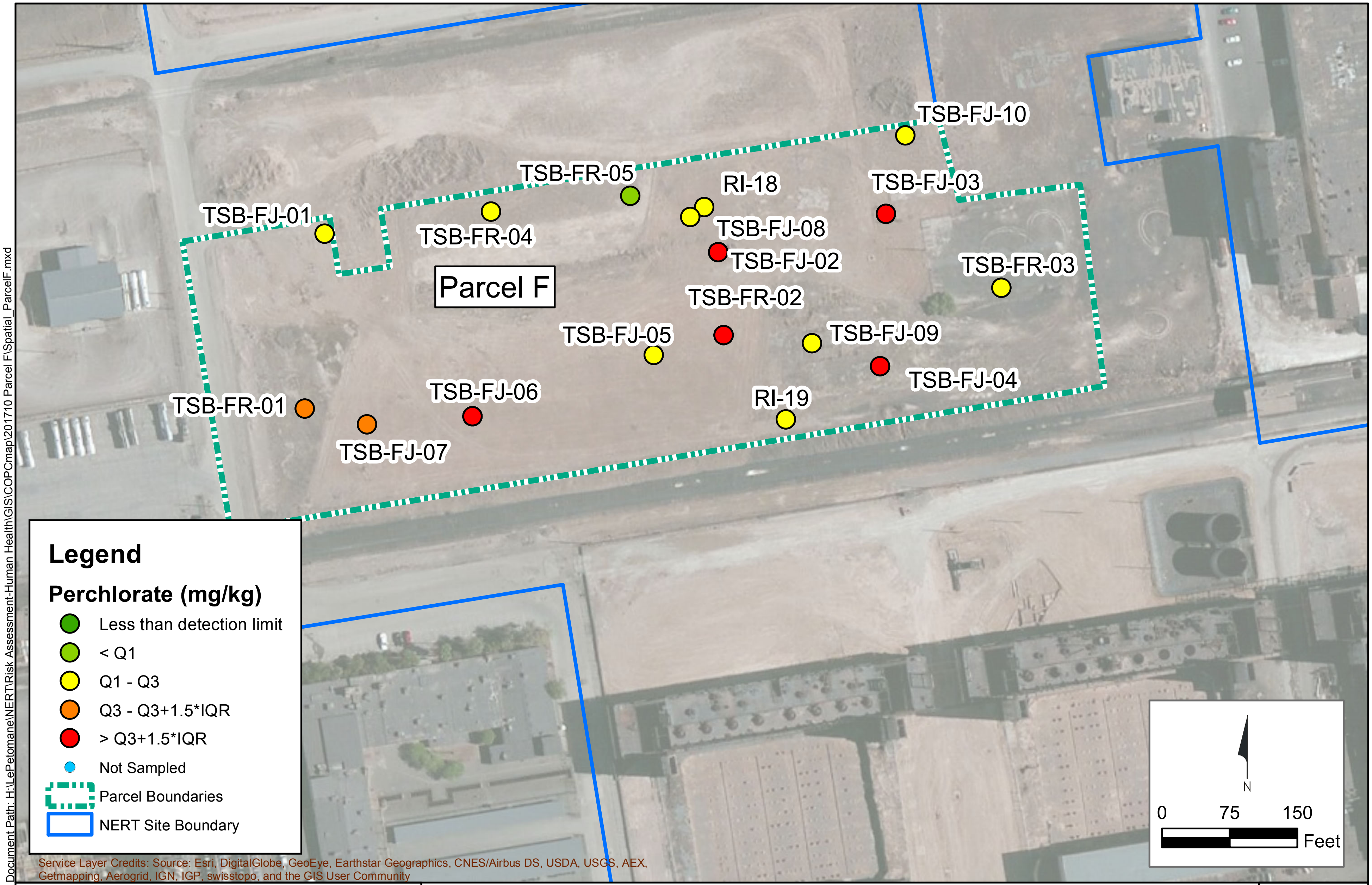
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Palladium (mg/kg)**
**[Q1 = 0.26, Q3 = 0.43, Q3+1.5*IQR = 0.685]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-16**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

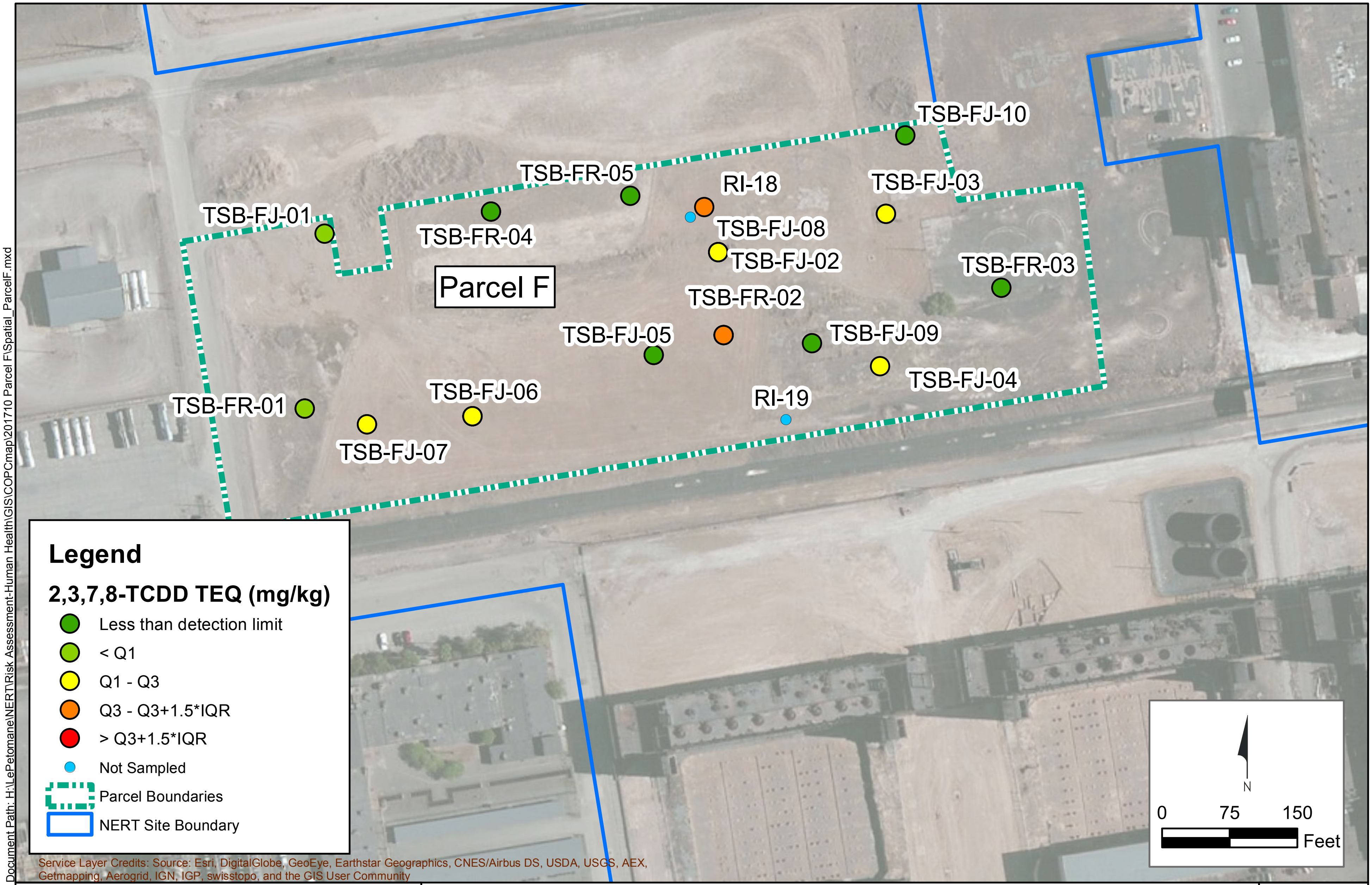
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Perchlorate (mg/kg)**
**[Q1 = 0.226, Q3 = 9.5, Q3+1.5*IQR = 23.4]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-17**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

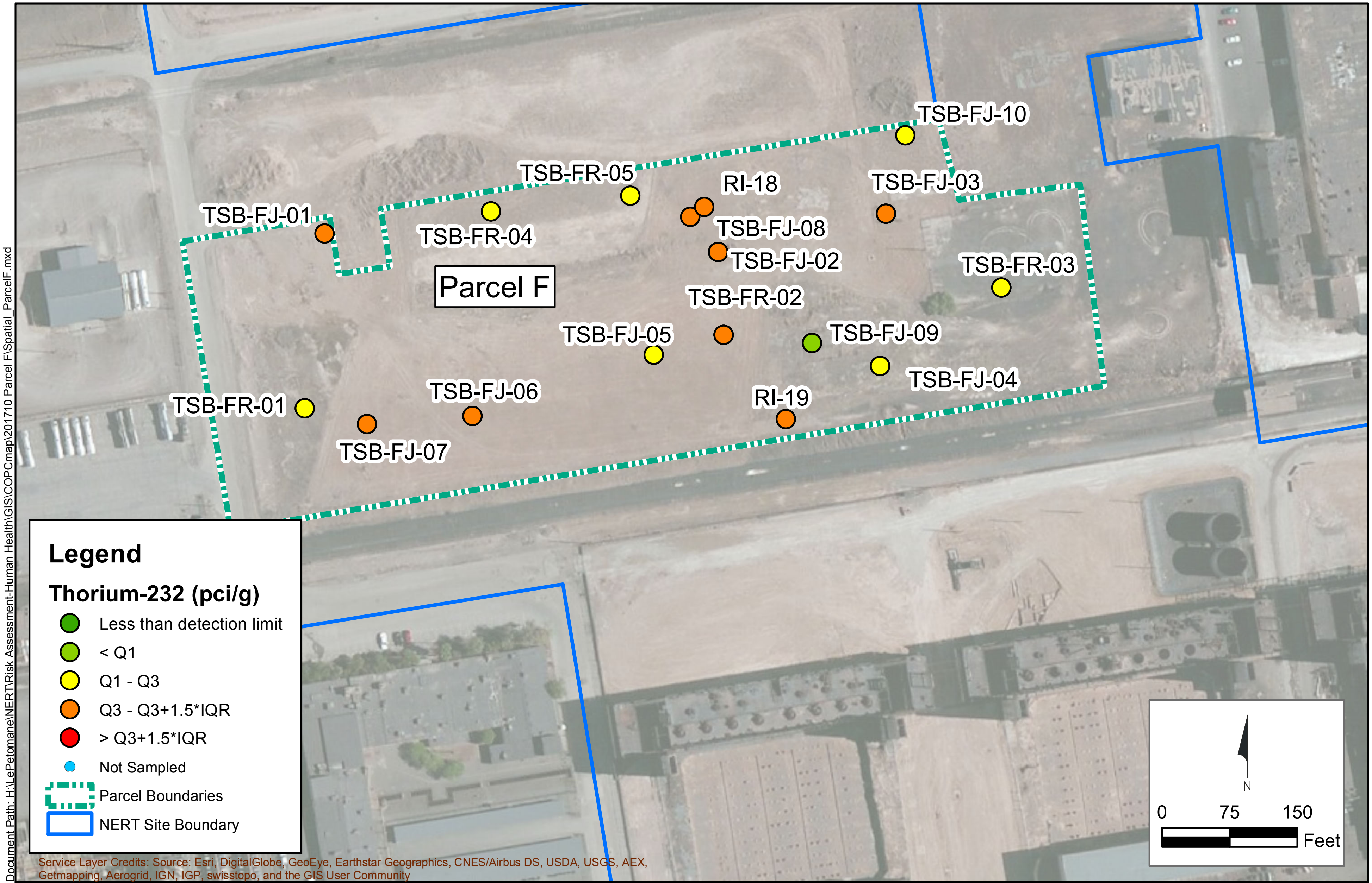
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - 2,3,7,8-TCDD TEQ (mg/kg)**
**[Q1 = 0.0000153, Q3 = 0.000731, Q3+1.5*IQR = 0.00181]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-18**

| Drafter: RS | Date: 10/24/2017 | Contract Number: 21-41400A | Approved by: | Revised: |
|---|---|---|---|---|



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

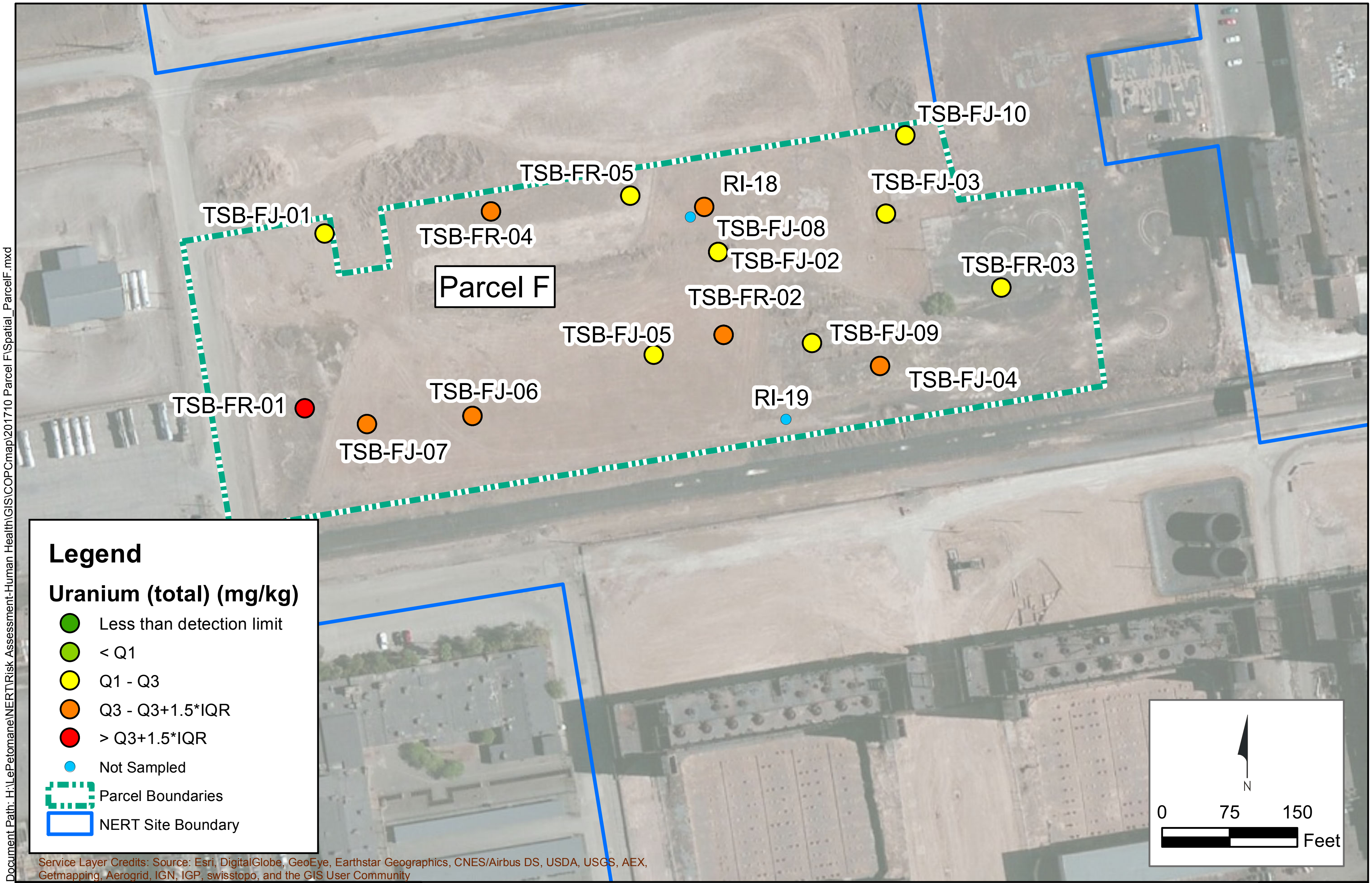
Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Thorium-232 (pci/g)**
**[Q1 = 1.31, Q3 = 1.71, Q3+1.5*IQR = 2]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-19**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

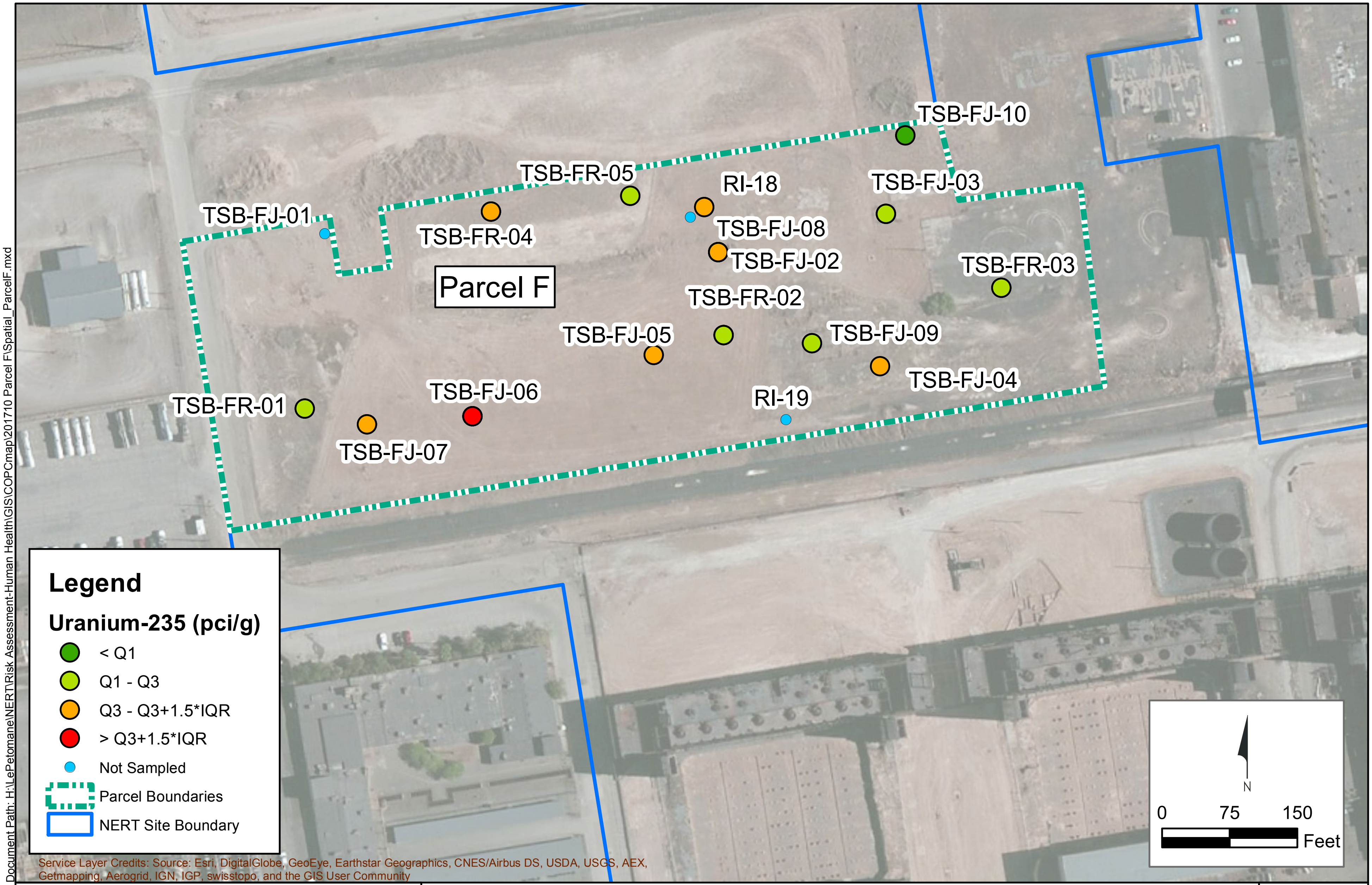
RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Uranium (total) (mg/kg)**
**[Q1 = 0.88, Q3 = 1.6, Q3+1.5*IQR = 2.68]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-20**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Uranium-235 (pci/g)**

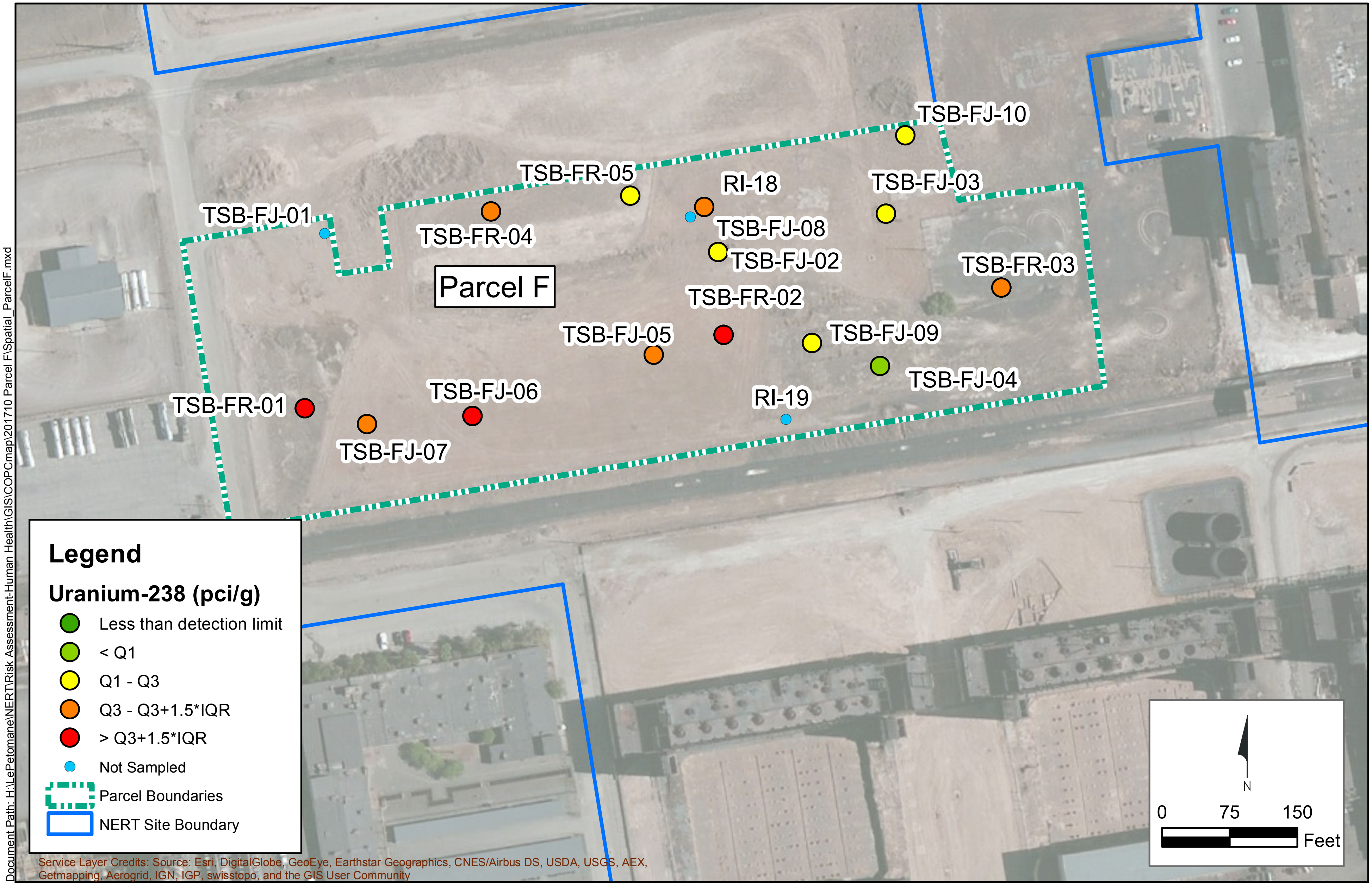
**[Q1 = 0.0322, Q3 = 0.056, Q3+1.5*IQR = 0.0918]**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**J-21**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:



**Legend**

**Uranium-238 (pci/g)**

- ● Less than detection limit
- ● < Q1
- ● Q1 - Q3
- ● Q3 - Q3+1.5*IQR
- ● > Q3+1.5*IQR
- ● Not Sampled
- ▭ Parcel Boundaries
- ▭ NERT Site Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd

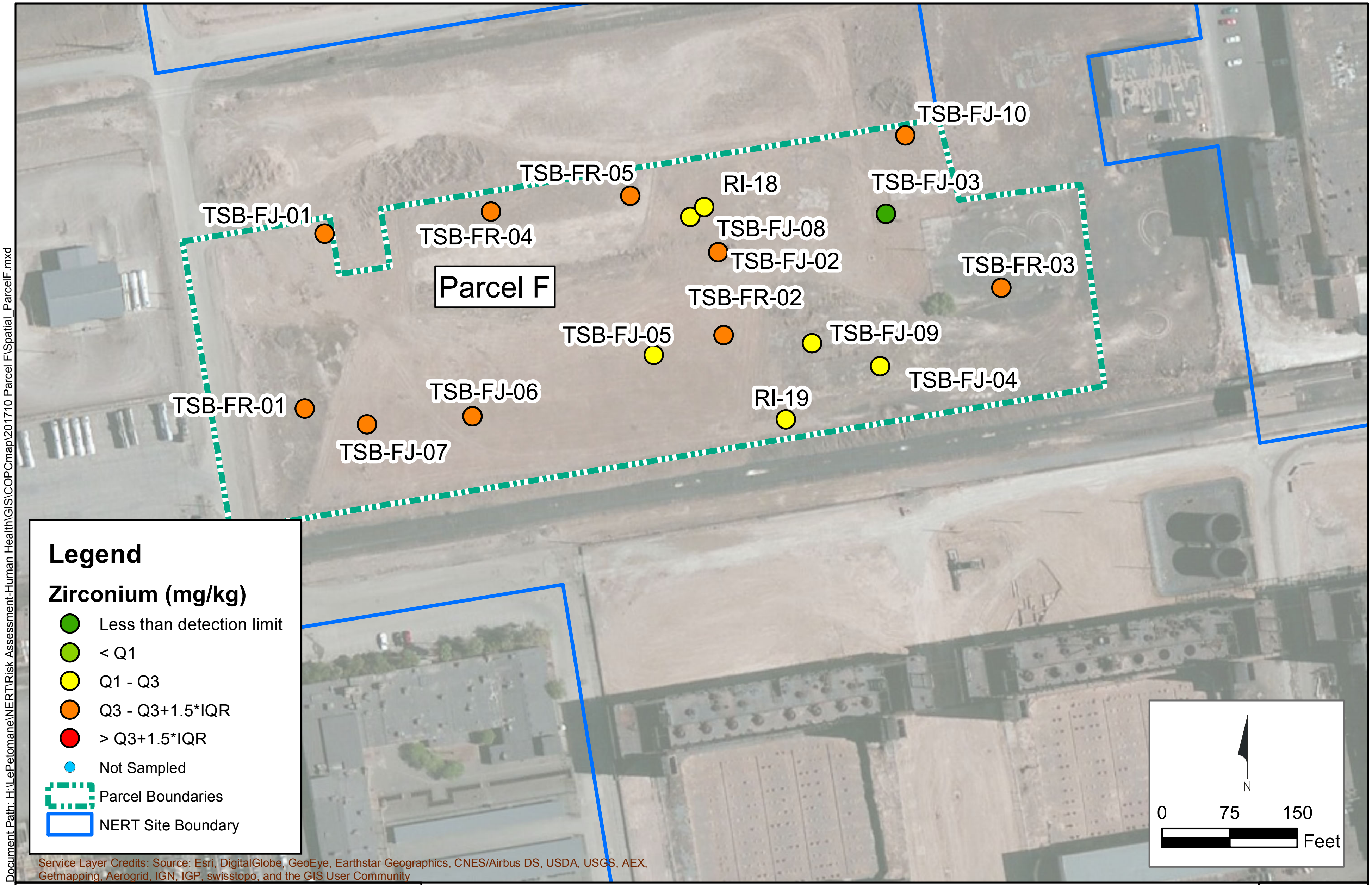
RAMBOLL ENVIRON

**Spatial Quartile Plot for Parcel F - Uranium-238 (pci/g)**
**[Q1 = 0.84, Q3 = 1.15, Q3+1.5*IQR = 1.61]**
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-22**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:

Document Path: H:\LePetomane\NERT\Risk Assessment-Human Health\GIS\COPCmap\201710 Parcel F\Spatial_ParcelF.mxd



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

RAMBOLL ENVIRON

## Spatial Quartile Plot for Parcel F - Zirconium (mg/kg)
## [Q1 = 5.4, Q3 = 23.6, Q3+1.5*IQR = 35.7]
Nevada Environmental Response Trust Site, Henderson, Nevada

Figure
**J-23**

Drafter: RS Date: 10/24/2017 Contract Number: 21-41400A Approved by: Revised:

# APPENDIX K
# SOIL GAS FIELD SAMPLING DATA FOR PARCEL F (CD)

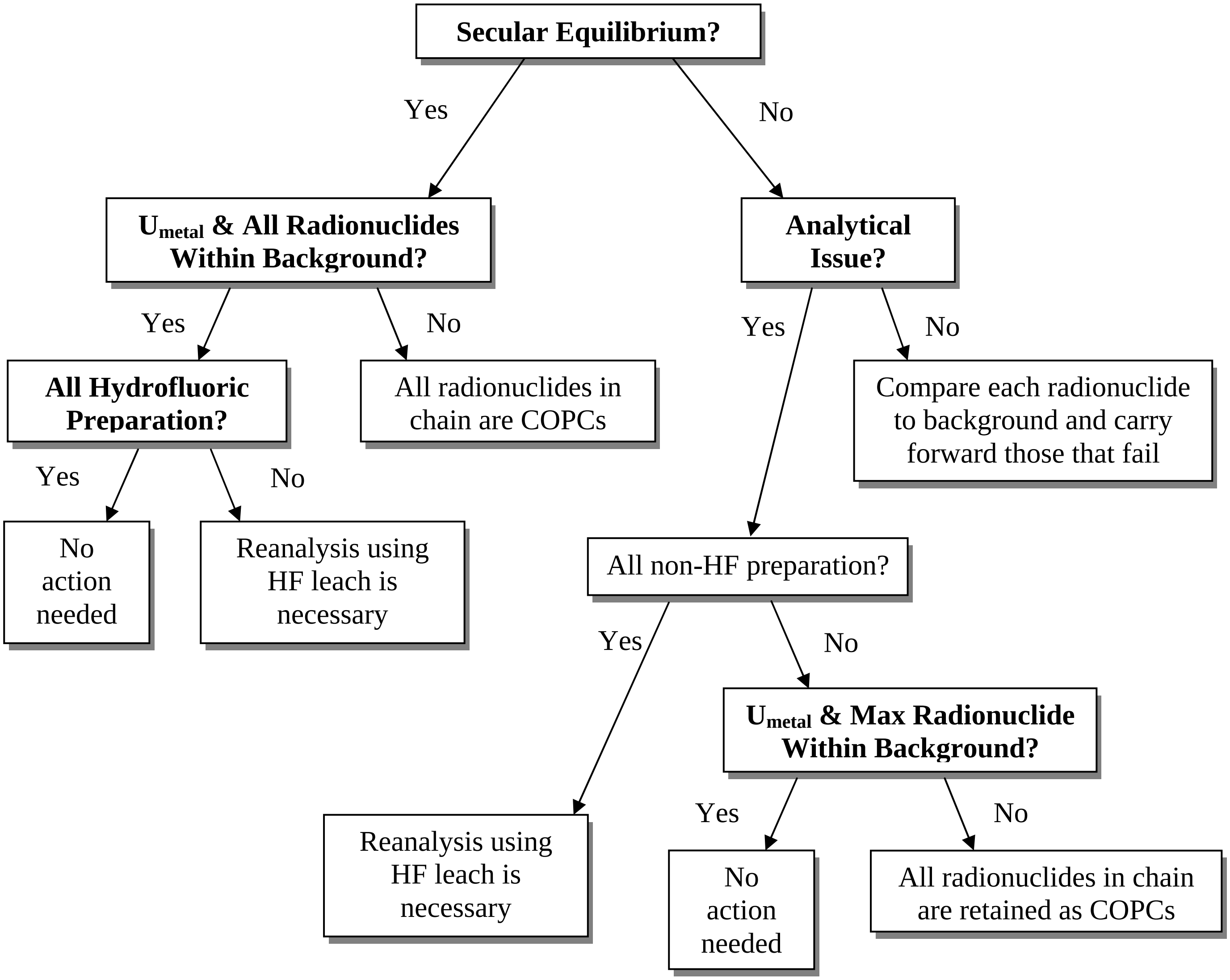
# APPENDIX L
# DATA VALIDATION SUMMARY REPORTS AND TABLES - SOIL GAS (CD)

# APPENDIX M

# GROUNDWATER FIELD SAMPLING DATA FOR PARCEL F (CD)

# APPENDIX N
# DATA VALIDATION SUMMARY REPORTS AND TABLES – GROUNDWATER (CD)

# APPENDIX O
# NDEP FLOWCHART FOR RADIONUCLIDE DATA USABILITY



COPCs indicates “chemicals of potential concern”.
$U_{metal}$ denotes metallic uranium.

**Figure 1. Flowchart describing the decision framework for radionuclide historical dataset usability for Sites within the BMI Complex and Common Areas, Henderson, NV.**

# APPENDIX P
# PROUCL OUTPUT FILES (CD)

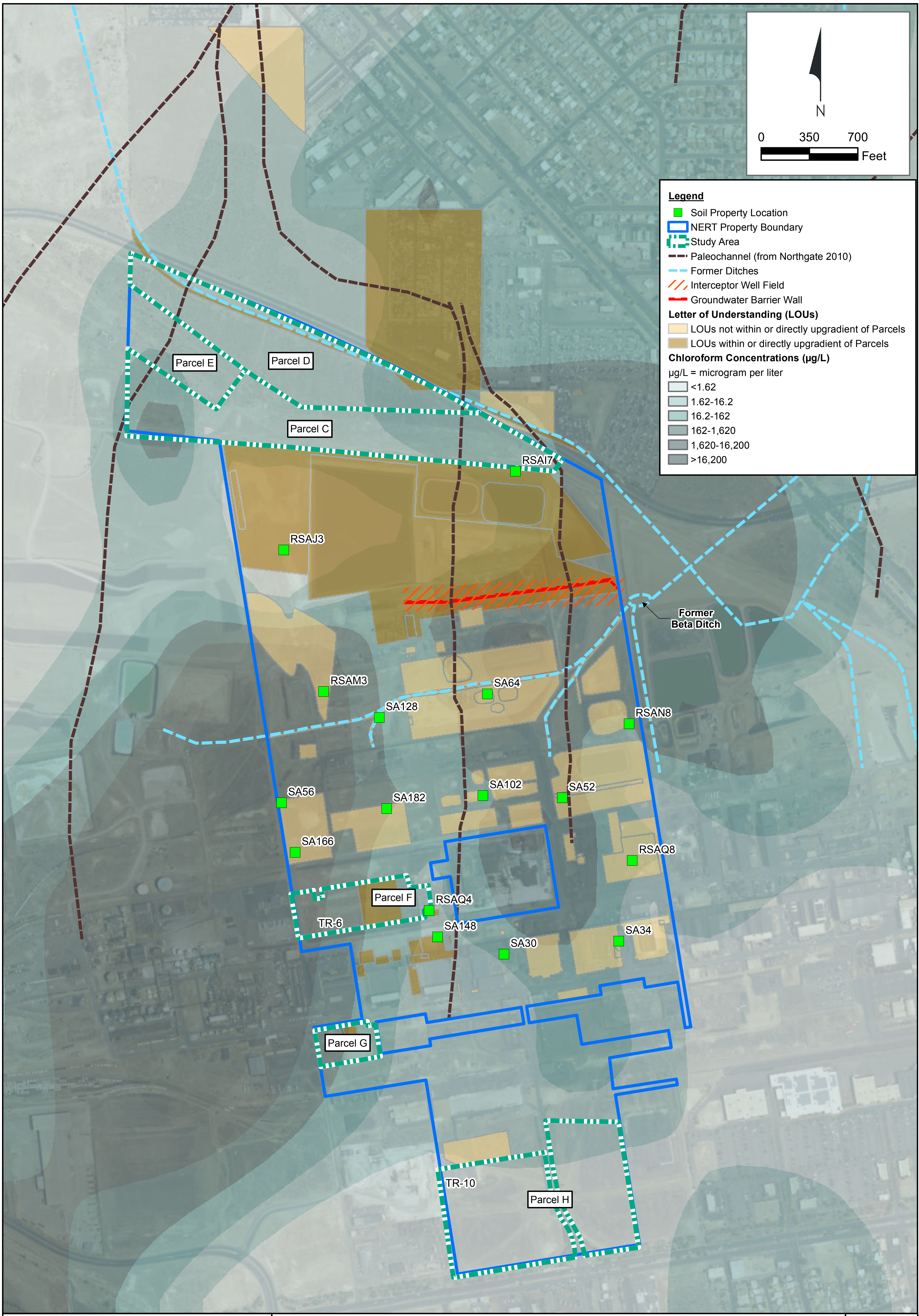
# APPENDIX Q
# RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION (CD)

# APPENDIX Q-1
# RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION – SOIL (CD)

# APPENDIX Q-2
# RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION - SOIL GAS (CD)

# APPENDIX Q-3
# RISK ASSESSMENT CALCULATION SPREADSHEETS AND SUPPORTING DOCUMENTATION – GROUNDWATER (CD)

# APPENDIX R
# SOIL PROPERTY SAMPLING LOCATIONS AND BORING LOGS



Path: H:\LePetomane\NERT\Leasehold_Offsite Operations\GIS\FigureG-1_SampLoc.mxd

RAMBOLL ENVIRON

**Soil Property Sampling Locations**

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure

**R-1**

Drafter: RS | Date: 9/19/2016 | Contract Number: 21-38800A | Approved by: | Revised:

Geraghty & Miller, Inc.

## WELL LOG

Well No.: H-23

Project: Stauffer Chemical Company

Date Completed: 1/31/80

Location: Henderson, Nevada

| Description | Depth Below Land Surface (feet) |
|---|---|
| Sand, silty to clayey, grayish-brown very fine to very coarse (poorly sorted), and gravel, pebbles, cobbles and boulders, rounded to subangular; also with layers of caliche and caliche-cemented sand and gravel<br>Notes: layers of cemented sand and gravel 27'-29', 31'-34', 40'-41'; organic odor in mud at 37' | 0 - 42½ |
| Clay, silty, to silt, clayey, light brown with traces of sand and gravel in matrix; also, with occasional thin layers of sand, reworked caliche, and caliche (Muddy Creek Formation)<br>Notes: thin layers of white silt and clay (reworked caliche) at 54'-55', 87', 96'. | 42½ - 101 |

# LITHOLOGY LOG FOR HENDERSON WELL NO. H-28

| Description | Depth Below Land Surface (feet) |
|---|---|
| Sand, silty to clayey, grayish-brown very fine to very coarse (poorly sorted), and gravel, pebbles, cobbles and boulders, rounded to subangular; also with layers of caliche and caliche-cemented sand and gravel | 0 - 44½ |
| Clay, silty, to silt, clayey, light brown with traces of sand and gravel in matrix; also, with occasional thin layers of sand, reworked caliche, and caliche (Muddy Creek Formation) | 44½ - 51 |

Data from Geraghty and Miller, Inc., October, 1980.

**SOIL BORING LOG** KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMC LLC | LOCATION<br>HENDERSON NV | BORING NUMBER M 106 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 0-4 Gravel, sdy, lt brn (5YR5/4). interbeds of sdy gravel and gravelly sd Sd 40-60%, vf-vcg, A-SR, Gravel 40-60, pea size to 1/2", volc, com caliche rinds on clasts. Sl. calcareous | | GP<br>SW | | | | | | | |
| 9 | 4-9 SAND, gravelly, lt brn, com calichification vf-vc, A-SR, w/ 10-20% volc pea gravel. | | | | | | | | | |
| 15<br>20 | 9'-20' SAND, gravelly & silty, lt brn. 10-20% silt in matrix, sd, vf-vc, A-SR, 25-35% pea gravel, volc, up to 2". Mod-com caliche rinds | | GM | | | | | | | DAMP @ 15' |
| 25<br>28 | 20-28 SILT, lt brn (5YR5/4) w/ minor lt gry oran (10YR 8/4). Non-calcareous. Tr. vf-fg sd. 5-10% clay in matrix | | ML | | | | | | | |
| 30 | 28-30 SILT, calcareous, lt brn. com. v. thin parallel calcareous laminae | | ML | | | | | | | |
| 35<br>38 | 30-38 SILT, sdy and SAND, silty, interbedded, lt brn. SLT:SD = 70:30. vfg, A-SA sd, 20%, in SILT 30-40% SILT in sd | | ML/SM | | | | | | | WET @ 30' |
| | 38-42 SAND, silty lt brn, vfg w/ 30-40% silt | | SM | | | | | | | |

EXPLANATION

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▮ AUGER
▮ ROCK CORE
■ THIN-WALLED TUBE
▮ CONTINUOUS SAMPLER
◸ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

GRAPHIC LOG LEGEND

▧ CLAY
▥ SILT
▒ SAND
⁘ GRAVEL
▧ SILTY CLAY
▥ CLAYEY SILT
▩ DEBRIS FILL
☰ HIGHLY ORGANIC (PEAT)
▧ SANDY CLAY
▧ CLAYEY SAND
☐ ______
☐ ______

| | |
|---|---|
| DATE DRILLED<br>2-2-01 | PAGE<br>1 of 2 |
| DRILLING METHOD<br>PERCUSSION | |
| DRILLED BY<br>LAYNE | |
| LOGGED BY<br>ED KRISH | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

# SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMC LLC | LOCATION<br>Henderson NV | BORING NUMBER M-106 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 42 | sl. calcareous | | SM | | | | | | | |
| 45<br>50 | 42-52 SILT, lt brn. w/ 10.% clay and 10% vfg sd<br>42-47 mod calcareous lt. gry oran (10YR 8/4) | | ML | | | | ☒ | 50-51.5 | 100% | |
| 55 | 52-55 SILT, sdy, lt brn, 20-30% vfg sd. | | ML | | | | | | | |
| 60<br>64 | 55'-64' SAND, slty. lt brn and paleoran (10YR7/2) where calcareous. vfg, A-SA w/ 30-40% silt & 5-10% clay<br>58-62 calcareous | | SM | | | | | | | |
| 70<br>75 | 64-75 SILT, sdy, lt brn, sl. calcareous. 20-25% vfg sd, 10% clay | | ML | | | | ☒ | 70-71.5 | 100% | |
| 78 | 75-78 SILT, sdy, 20% vfg, mottled v. pale oran (10YR8/2) & yell gry (5Y8/1) com. calc. nodules, tr. gyp. 10-15% clay in matrix | | ML | | | | | | | TD @ 78' |

EXPLANATION

▼ Water Table (24 Hour)

▽ Water Table (Time of Boring)

PID Photoionization Detection (ppm)

NO. Identifies Sample by Number

TYPE Sample Collection Method

| | | |
|---|---|---|
| ☒ SPLIT-BARREL | AUGER | ROCK CORE |
| THIN-WALLED TUBE | CONTINUOUS SAMPLER | NO RECOVERY |

DEPTH Depth Top and Bottom of Sample

REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | DEBRIS FILL |
| SILT | HIGHLY ORGANIC (PEAT) |
| SAND | SANDY CLAY |
| GRAVEL | CLAYEY SAND |
| SILTY CLAY | ☐ _______ |
| CLAYEY SILT | ☐ _______ |

| | |
|---|---|
| DATE DRILLED<br>2-2-01 | PAGE<br>2 of 2 |

DRILLING METHOD
Percussion

DRILLED BY
LAYNE

LOGGED BY
Ed Krish

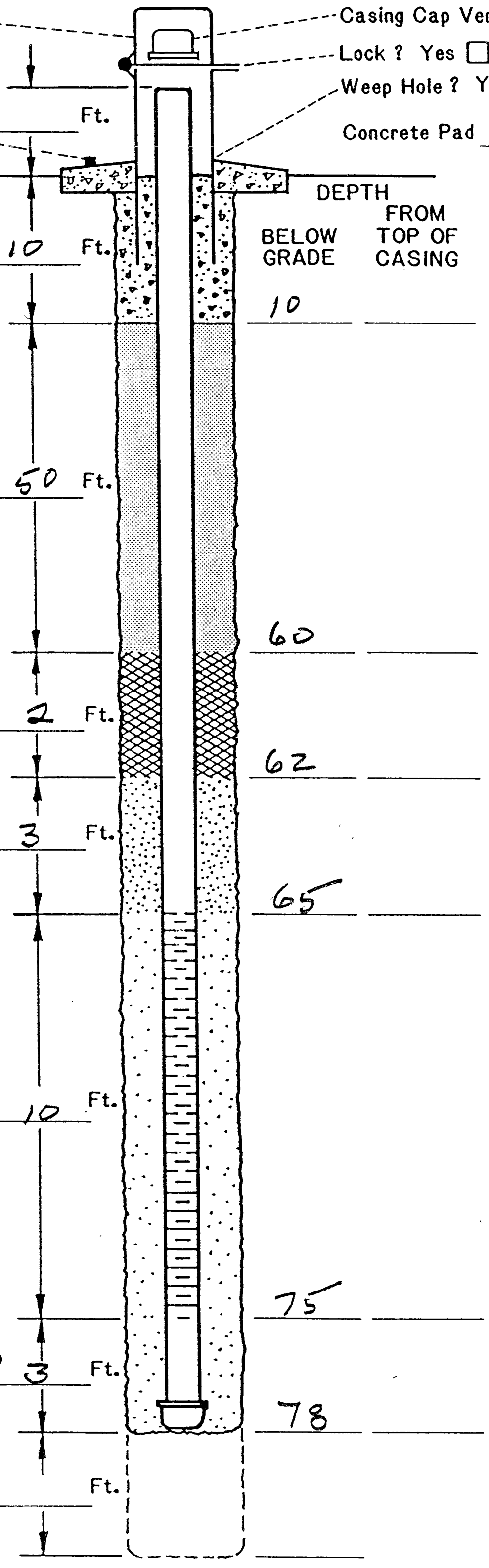
EXISTING GRADE ELEVATION (FT. AMSL)

LOCATION OR GRID COORDINATES

# KERR-McGEE CORPORATION
# HYDROLOGY DEPARTMENT
## *MONITORING WELL INSTALLATION DIAGRAM*

Protective Pipe
Yes ☒ No ☐
Steel ☒ PVC ☐
_______ Ft.
Surveying Pin ?
Yes ☐ No ☒

Casing Cap Vent ? Yes ☒ No ☐
Lock ? Yes ☐ No ☒
Weep Hole ? Yes ☐ No ☒
Concrete Pad _______ Ft. x _______ Ft. x _______ Inches



Concrete 10 Ft.

Cement/Bentonite Grout Mix
Yes ☒ No ☐
5.5 Gallons Water to 94Lb. Bag Cement & 3-5 Lb. Bentonite Powder 50 Ft.
Other: _______

Bentonite Seal 2 Ft.
Pellets ☒ Slurry ☐

Filter Pack Above Screen 3 Ft.

FILTER PACK MATERIAL
Silica Sand ☐
Washed Sand ☒ 10 Ft.
Pea Gravel ☐
Other: _______
Sand Size 3-12

Dense Phase Sampling Cup 3 Ft.
Bottom Plug
Yes ☒ No ☐

Overdrilled Material Backfill _______ Ft.
Grout ☐ Sand ☒
Caved Material ☐
Other: _______

| DEPTH BELOW GRADE | DEPTH FROM TOP OF CASING |
|---|---|
| 10 | |
| 60 | |
| 62 | |
| 65 | |
| 75 | |
| 78 | |
| | |

### *DRILLING INFORMATION:*

1. Borehole Diameter= 9 Inches.
2. Were Drilling Additives Used ? Yes ☐ No ☒
   Revert ☐ Bentonite ☐ Water ☐
   Solid Auger ☐ Hollow Stem Auger ☐
3. Was Outer Steel Casing Used ? Yes ☐ No ☒
   Depth= _______ to _______ Feet.
4. Borehole Diameter for Outer Casing _______ Inches.

### *WELL CONSTRUCTION INFORMATION:*

1. Type of Casing: PVC ☒ Galvanized ☐ Teflon ☐
   Stainless ☐ Other _______
2. Type of Casing Joints: Screw-Couple ☒ Glue-Couple ☐ Other _______
3. Type of Well Screen: PVC ☒ Galvanized ☐
   Stainless ☐ Teflon ☐ Other _______
4. Diameter of Casing and Well Screen:
   Casing 2 Inches, Screen 2 Inches.
5. Slot Size of Screen: 0.020
6. Type of Screen Perforation: Factory Slotted ☒
   Hacksaw ☐ Drilled ☐ Other _______
7. Installed Protector Pipe w/Lock: Yes ☒ No ☐

### *WELL DEVELOPMENT INFORMATION:*

1. How was Well Developed ? Bailing ☐ Pumping ☒
   Air Surging (Air or Nitrogen) ☐ Other _______
2. Time Spent on Well Development ?
   _______ / _______ Minutes/Hours
3. Approximate Water Volume Removed ? _______ Gallons
4. Water Clarity Before Development ? Clear ☐
   Turbid ☐ Opaque ☐
5. Water Clarity After Development ? Clear ☐
   Turbid ☐ Opaque ☐
6. Did Water have Odor ? Yes ☐ No ☐
   If Yes, Describe _______
7. Did Water have any Color ? Yes ☐ No ☐
   If Yes , Describe _______

### *WATER LEVEL INFORMATION:*

Water Level Summary (From Top of Casing)
During Drilling 20 Ft. Date 2-2-01
Before Development _______ Ft. Date _______
After Development _______ Ft. Date _______

Driller/Firm LAYNE
Drill Rig Type AP-1000
Date Installed 2-2-01
Drill Crew PERRY
Well No. M-106
Kerr-McGee Hydrologist Ed Krish

## SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMC LLC | LOCATION<br>HENDERSON, NV | BORING NUMBER M107 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | TD 57'<br>M107 is 10' S of M106. SEE M106 lith log for description | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▮ AUGER
▮ ROCK CORE
■ THIN-WALLED TUBE
▮ CONTINUOUS SAMPLER
⧄ NO RECOVERY

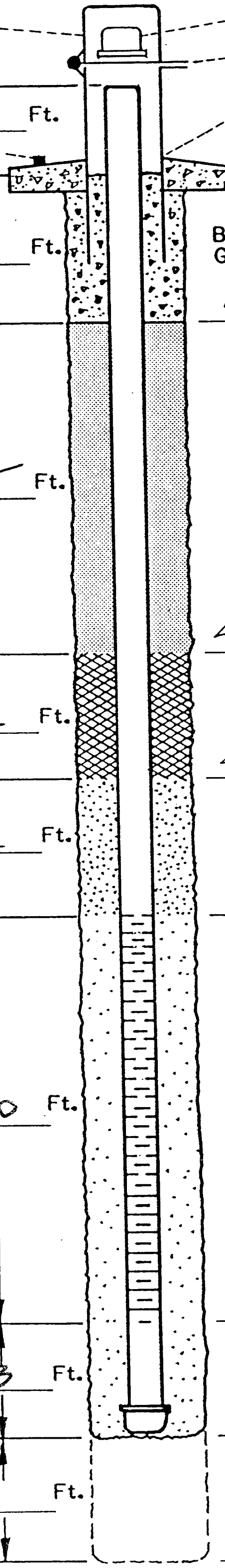
DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ☐ HIGHLY ORGANIC (PEAT) |
| ▒ SAND | ▨ SANDY CLAY |
| ⁘ GRAVEL | ▨ CLAYEY SAND |
| ▨ SILTY CLAY | ☐ ________ |
| ▨ CLAYEY SILT | ☐ ________ |

| | |
|---|---|
| DATE DRILLED<br>2-2-01 | PAGE<br>1 of 1 |
| DRILLING METHOD<br>PERCUSSION | |
| DRILLED BY<br>LAYNE | |
| LOGGED BY<br>Ed Krish | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

# KERR-McGEE CORPORATION
# HYDROLOGY DEPARTMENT
## *MONITORING WELL INSTALLATION DIAGRAM*



Casing Cap Vent ? Yes ☒ No ☐

Lock ? Yes ☒ No ☐

Weep Hole ? Yes ☐ No ☒

Concrete Pad ______ Ft. x ______ Ft. x ______ Inches

Protective Pipe

Yes ☒ No ☐

Steel ☒ PVC ☐

______ Ft.

Surveying Pin ?

Yes ☐ No ☒

Concrete ______ Ft.

Cement/Bentonite Grout Mix

Yes ☒ No ☐

5.5 Gallons Water to 94Lb. Bag Cement & 3-5 Lb. Bentonite Powder

35 Ft.

Other: ______

Bentonite Seal 2 Ft.

Pellets ☒ Slurry ☐

Filter Pack Above Screen 2 Ft.

FILTER PACK MATERIAL

Silica Sand ☐

Washed Sand ☒ 10 Ft.

Pea Gravel ☐

Other: ______

Sand Size 3-12

Dense Phase Sampling Cup 3 Ft.

Bottom Plug

Yes ☒ No ☐

Overdrilled Material Backfill ______ Ft.

Grout ☐ Sand ☒

Caved Material ☐

Other: ______

| DEPTH BELOW GRADE | DEPTH FROM TOP OF CASING |
|---|---|
| 5 | |
| 40 | |
| 42 | |
| 44 | |
| 54 | |
| 57 | |
| | |

### *DRILLING INFORMATION:*

1. Borehole Diameter= 9 Inches.
2. Were Drilling Additives Used ? Yes ☐ No ☒
   Revert ☐ Bentonite ☐ Water ☐
   Solid Auger ☐ Hollow Stem Auger ☐
3. Was Outer Steel Casing Used ? Yes ☐ No ☒
   Depth= ______ to ______ Feet.
4. Borehole Diameter for Outer Casing ______ Inches.

### *WELL CONSTRUCTION INFORMATION:*

1. Type of Casing: PVC ☒ Galvanized ☐ Teflon ☐
   Stainless ☐ Other ______
2. Type of Casing Joints: Screw—Couple ☒ Glue—Couple ☐ Other ______
3. Type of Well Screen: PVC ☒ Galvanized ☐
   Stainless ☐ Teflon ☐ Other ______
4. Diameter of Casing and Well Screen:
   Casing 2 Inches, Screen 2 Inches.
5. Slot Size of Screen: 0.020
6. Type of Screen Perforation: Factory Slotted ☒
   Hacksaw ☐ Drilled ☐ Other ______
7. Installed Protector Pipe w/Lock: Yes ☒ No ☐

### *WELL DEVELOPMENT INFORMATION:*

1. How was Well Developed ? Bailing ☐ Pumping ☒
   Air Surging (Air or Nitrogen) ☐ Other ______
2. Time Spent on Well Development ?
   ______/______ Minutes/Hours
3. Approximate Water Volume Removed ? ______ Gallons
4. Water Clarity Before Development ? Clear ☐
   Turbid ☐ Opaque ☐
5. Water Clarity After Development ? Clear ☐
   Turbid ☐ Opaque ☐
6. Did Water have Odor ? Yes ☐ No ☐
   If Yes, Describe ______
7. Did Water have any Color ? Yes ☐ No ☐
   If Yes, Describe ______

### *WATER LEVEL INFORMATION:*

Water Level Summary (From Top of Casing)

During Drilling 20 Ft. Date 2-2-01

Before Development 19.47 Ft. Date 2-3-01

After Development ______ Ft. Date ______

Driller/Firm LAYNE

Drill Rig Type AP-1000

Date Installed 2-2-01

Drill Crew Perry

Well No. M-107

Kerr-McGee Hydrologist Ed Krish

**ENSR**

1220 Avenida Acaso
Camarillo, California 93012
(805) 388-3775

## Boring No. M-117

| | | | |
|---|---|---|---|
| *Client:* Tronox LLC | | | |
| *Project Number:* 04020-023-151 | | | |
| *Site Location:* Henderson, NV | | | |
| *Coordinates:* 26715198.289 N , 828917.057 E NAD83 | *Elevation:* 1877.98 ft, msl | | *Sheet:* 1 of 2 |
| *Drilling Method:* Sonic - Continuous Core | | | *Monitoring Well Installed:* Yes |
| *Sample Type(s):* Split Spoon/Core | *Boring Diameter:* 7-inch | | *Screened Interval:* 130-150 feet |
| *Weather:* Cold, cloudy, 30s to 40s | *Logged By:* Ed Krish | *Date/Time Started:* 3/11/06 7:30 a | *Depth of Boring:* 157 feet |
| *Drilling Contractor:* Prosonic | *Ground Elevation:* | *Date/Time Finished:* 3/11/06 | *Water Level:* 79.4 feet |

| Depth (ft) | Sample ID | Sample Depth (ft) | Blows per 6" | Recovery (feet) | Headspace (ppm) | U.S.C.S | MATERIAL IDENTIFICATION, color, description of fine grained material (silt and clay) description of coarse grained material (sand and gravel), structural or mineralogical features, density or stiffness, moisture content, odors or staining. | Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|
| | M-117-0.5 | ☒ | | 10 | | SM (GM) | **ALLUVIUM:** SILTY/GRAVELY SAND, with silty gravel lenses present, pale yellow brown (10YR 6/4), 10-20% silt with trace clay, 60 to 80% sand (very fine- to very coarse-grained, angular to subrounded), 10 to 30% gravel to 2" maximum, (commonly 1/8" to 3/4", subangular to angular, volcanic to basaltic, well graded), dry, no unusual odor or staining. | |
| | M-117-5 | ☒ | | | 0.0 | | | |
| 10 | M-117-10 | ☒ | | 10 | 0.0 | | | |
| 20 | M-117-20<br>M-117-20D | ☒ | | 10 | 0.0 | | | |
| | | | | | | | From 27 to 40 ft: brown (5YR 5/4). | |
| 30 | M-117-30 | ☒ | | 10 | 0.0 | | | |
| 40 | M-117-40 | ☒ | | 10 | 0.0 | | | 40 ft |
| | | | | | | GM | **ALLUVIUM:** SANDY SILTY GRAVEL, brown (5YR 5/4), 25% silt with trace clay, 35% sand (very fine- to very coarse-grained, angular to subrounded), 40% gravel to 2 1/2" maximum (commonly 1/8" to 1", angular to subangular), dry, no unusual odor or staining.<br>From 46 to 47 ft: caliche zone at contact with Muddy Creek Fm - First coarse-grained facies at 47'. | 47 ft |
| 50 | M-117-50 | ☒ | | 10 | 0.0 | SM (GM) | **MUDDY CREEK FORMATION - FIRST COARSE-GRAINED FACIES:** SILTY SAND and GRAVELLY SAND, with silty gravel lenses present, brown (5YR 5/4 & 5/6), 20 to 45% silt with trace clay, 50 to 70% sand (very fine- to very coarse-grained, angular to subrounded), 0 to 20% gravel to 1" maximum (commonly 1/8" to 3/4", angular to subangular), dry, no unusual odors or staining. | |
| 60 | M-117-60 | ☒ | | 20 | 0.0 | | | |
| 70 | M-117-70 | ☒ | | | 0.0 | | Damp at 70'<br>From 72 to 74 ft: caliche zone, nodular. | |
| 80 | M-117-80<br>M-117-80D | ☒ | | 17 | 0.0 | | From 79 to 85 ft: common caliche nodules to 1/2".<br>Wet at 80' | ▼ |
| | | | | | | | From 85 to 100 ft: Sp. (?) caliche nodules to 1/2". | |
| 90 | | | | | | | | |
| | | | | 20 | | | | |
| 100 | | | | | | | | |

Notes:

Checked by SWB Date: 8/10/06

**ENSR**

1220 Avenida Acaso
Camarillo, California 93012
(805) 388-3775

| | | | |
|---|---|---|---|
| *Client:* Tronox LLC | | | **Boring No. M-118** |
| *Project Number:* 04020-023-151 | | | |
| *Site Location:* Henderson, NV | | | |
| *Coordinates:* 26715068.012 N , 828036.397 E ; NAD 83 | *Elevation:* 1874.53 feet | | *Sheet:* 1 of 2 |
| *Drilling Method:* Sonic - Continuous Core | | | *Monitoring Well Installed:* Yes |
| *Sample Type(s):* Split Spoon/Core | *Boring Diameter:* 7-inch | | *Screened Interval:* 138-158 feet |
| *Weather:* Sunny, windy, 50s F | *Logged By:* Ed Krish | *Date/Time Started:* 3/8/06 11:45 am | *Depth of Boring:* 163 feet |
| *Drilling Contractor:* Prosonic | *Ground Elevation:* | *Date/Time Finished:* 3/8/06 5:05 pm | *Water Level:* |

| Depth (ft) | Sample ID | Sample Depth (ft) | Blows per 6" | Recovery (feet) | Headspace (ppm) | U.S.C.S | MATERIAL IDENTIFICATION, color, description of fine grained material (silt and clay) description of coarse grained material (sand and gravel), structural or mineralogical features, density or stiffness, moisture content, odors or staining. | Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|
| | M-118-0.5 | ☒ | | 10 | | SM (GM) | **ALLUVIUM:** SILTY SAND and GRAVELY SAND, with silty gravel lenses present, brown (5YR 5/5), 15 to 20% silt, 65 to 70% sand (very fine- to very-coarse-grained, angular to subangular), 10 to 20% volcanic gravel to 4" maximum (commonly granule to pea gravel, 18" to 1/4", angular to subangular), dry, no unusual odor or staining. | |
| | M-118-5 | ☒ | | | 2.4 | | | |
| 10 | M-118-10 | ☒ | | 10 | 12.8 | | | |
| 20 | M-118-20<br>M-118-20D | ☒ | | 10 | 5.1 | | | |
| 30 | M-118-30 | ☒ | | 10 | 2.9 | | | |
| 40 | M-118-40 | ☒ | | 10 | 4.7 | | From 40 to 51 ft: very pale orange (10YR 8/2) with common caliche nodules and soft cement in sand matrix, nodules to 2 1/2". | |
| 50 | M-118-50 | ☒ | | 10 | | | From 51 to 52 ft: Silty Sand, very fine- to fine-grained, common caliche nodules, possibly reworked Muddy Creek Fm. | 52 ft |
| | | | | | | SM (GM) | **MUDDY CREEK FM - FIRST COARSE-GRAINED FACIES:** SILTY SAND and SILTY/GRAVELY SAND, with silty gravel lenses present, brown (5YR 5/5), 10 to 35% silt, 60 to 80% sand (very fine- to very coarse-grained, angular to subrounded), 0 to 15% granules and pea gravel (1/8" to 3/8", angular to subangular), interbedded, dry, no unusual odors or staining.<br>From 52 to 62 ft: Local zones with caliche nodules (1/8" to 1" diameter). | |
| 60 | M-118-60 | ☒ | | 7 | 0.4 | | | |
| | | | | 13 | | | | |
| 70 | | | | | | | Damp at 75' | |
| | | | | | | | From 77 to 80 ft: Local zones with caliche nodules (1/8" to 1" diameter). | |
| 80 | M-118-80 | ☒ | | 7 | | | Wet from 80' | |
| | | | | | | | From 83 to 87 ft: Local zones with caliche nodules (1/8" to 1" diameter). | |
| | | | | 13 | | | | |
| 90 | | | | | | | From 92 to 102 ft: Local zones with caliche nodules (1/8" to 1" diameter). | |
| | | | | 13 | | | | |
| 100 | | | | | 3.4 | | | |

**Notes:**

Checked by SWB Date: 8/10/06

| | | | |
|---|---|---|---|
| **ENSR**<br>1220 Avenida Acaso<br>Camarillo, California 93012<br>(805) 388-3775 | *Client:* Tronox LLC<br>*Project Number:* 04020-023-151<br>*Site Location:* Henderson, NV | | **Boring No. M-120** |
| | *Coordinates:* 26715162.900 N, 828387.792 E, NAD 83 | *Elevation:* 1875.81 ft, msl | *Sheet: 1 of 2* |
| | *Drilling Method:* Sonic - Continuous Core | | *Monitoring Well Installed:* Yes |
| | *Sample Type(s):* Split Spoon/Core | *Boring Diameter:* 7-inch | *Screened Interval:* 80-100 feet |
| *Weather:* Windy, 40s to 58s F | *Logged By:* Ed Krish | *Date/Time Started:* 3/8/06 9:00 am | *Depth of Boring:* 107 feet |
| *Drilling Contractor:* Prosonic | *Ground Elevation:* | *Date/Time Finished:* 3/8/06 | *Water Level:* 79.47 |

| Depth (ft) | Sample ID | Sample Depth (ft) | Blows per 6" | Recovery (feet) | Headspace (ppm) | U.S.C.S | MATERIAL IDENTIFICATION, color, description of fine grained material (silt and clay) description of coarse grained material (sand and gravel), structural or mineralogical features, density or stiffness, moisture content, odors or staining. | Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|
| | M-120-0.5 | ☒ | | 7 | | SW/SP | **ALLUVIUM:** SAND, brown (5YR 5/4), 20% silt and clay, 60% sand (very fine- to fine-grained with common medium- to very coarse-grained sand, angular to subangular), 20% granules and gravel (fine-grained to 1/2", angular to subangular), gravelly, dry, no unusual odors or staining. | |
| | M-120-5 | ☒ | | 3 | 0.0 | | | |
| 10 | M-120-10 | ☒ | | 12 | 1.0 | | | |
| 20 | M-120-20 | ☒ | | 10 | 1.8 | | | 21 ft |
| | | | | | | GM | **ALLUVIUM:** SANDY GRAVEL, brown (5YR 5/4), 20% silt and clay, 30% sand (very fine- to very coarse-grained, angular to subangular), 50% gravel to 3 1/2" (mostly 1/8" to 1 1/2", angular to subangular, basaltic), dry. | 26 ft |
| | | | | 3 | | SM | **ALLUVIUM:** SILTY SAND, brown (5YR 5/4), 25 to 35% silt, 75% sand (very fine- to fine-grained with minor medium to coarse-grained sand, angular to subangular), 0 to 5% granules and gravel (fine gravel to 1/4"), dry, no unusual odors or staining. | |
| 30 | M-120-30 | ☒ | | | 0.8 | | | |
| | | | | 11 | | | From 31 to 41 ft: moderate calcite cement. | |
| 40 | M-120-40<br>M-120-40D | ☒ | | 12 | 2.2 | | | |
| | | | | | | | From 48 to 49 ft: caliche zone with nodules to 3 1/2". | |
| | | | | 12 | 1.6 | | Contact with Muddy Creek Fm at 49 ft | 49 ft |
| 50 | M-120-50 | ☒ | | | | SC/SM<br>(GM) | **MUDDY CREEK FM - FIRST COARSE-GRAINED FACIES:** SAND, with silty gravel lenses present, silty gravel lenses present and varying amounts of silt, clay and/or gravel, brown (5YR 5/4), 0 to 20% clay, 10 to 50% silt, 50 to 70% sand (very fine- to fine-grained, with medium- to very coarse-grained sand, angular to subangular), 0 to 15% gravel (granules to fine gravel to 1", angular to subangular), dry. | |
| 60 | M-120-60 | ☒ | | | 0.8 | | From 49 to 57 ft: sand, silty or clayey. | |
| | | | | 7 | | | From 57 to 83 ft: sand, gravelly ± silt. | |
| | | | | 15 | | | | |
| 70 | | | | | | | | |
| 80 | M-120-80 | ☒ | | 7 | 1.8 | | Damp at 80' | ▼ |
| | | | | | | | From 83 to 102 ft: sand, silty. | |
| | | | | | | | Wet at 85' | |
| 90 | | | | 15 | | | | |
| 100 | | | | 8 | | | | |

**Notes:**

Checked by SWB Date: 8/10/06

**ENSR**

1220 Avenida Acaso
Camarillo, California 93012
(805) 388-3775

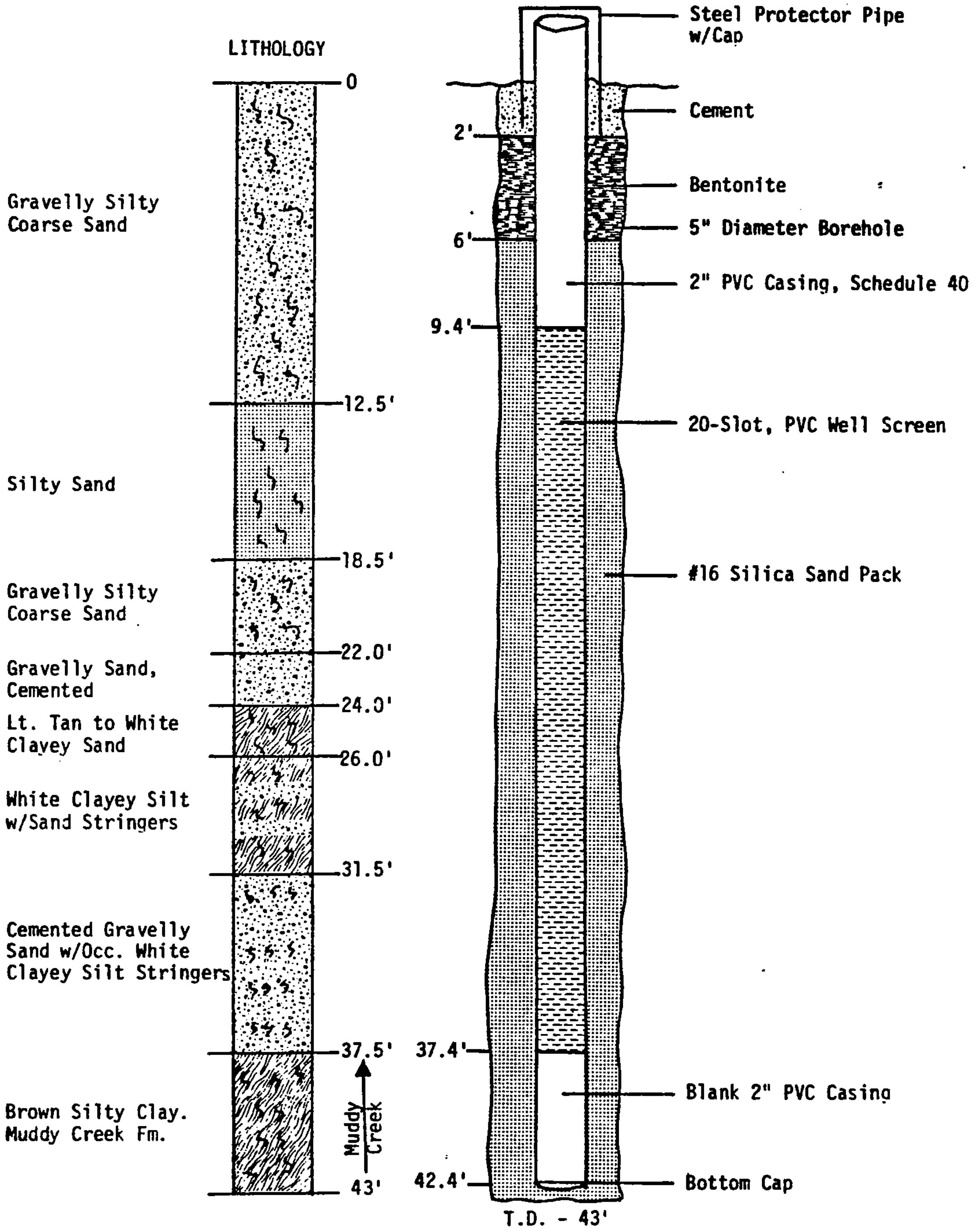
| | | | | | |
|---|---|---|---|---|---|
| *Client:* | Tronox LLC | | | **Boring No. M-121** | |
| *Project Number:* | 04020-023-151 | | | | |
| *Site Location:* | Henderson, NV | | | | |
| *Coordinates:* | 26715001.237 N, 827694.571 E, NAD 83 | *Elevation:* | 1872.90 ft, msl | *Sheet:* 1 of 2 | |
| *Drilling Method:* | Sonic | | | *Monitoring Well Installed:* | Yes |
| *Sample Type(s):* | Split Spoon/Core | *Boring Diameter:* | 7-inch | *Screened Interval:* | 77-97 feet |
| *Weather:* Windy, cold, 30s F | *Logged By:* Ed Krish | *Date/Time Started:* | 3/10/06 7:30 am | *Depth of Boring:* | 107 feet |
| *Drilling Contractor:* Prosonic | *Ground Elevation:* | *Date/Time Finished:* | 3/10/06 1:00 pm | *Water Level:* | 76.1 |

| Depth (ft) | Sample ID | Sample Depth (ft) | Blows per 6" | Recovery (feet) | Headspace (ppm) | U.S.C.S | MATERIAL IDENTIFICATION, color, description of fine grained material (silt and clay) description of coarse grained material (sand and gravel), structural or mineralogical features, density or stiffness, moisture content, odors or staining. | Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|
| | M-121-0.5 | ☒ | | 10 | | SM/GM | **ALLUVIUM:** SILTY/GRAVELLY SAND, brown (5YR 5/4), 15% silt with trace clay, 60% sand (very fine- to fine-grained, angular to subangular), 25% volcanic gravel (commonly 1/8" to 3/4", angular to subangular), dry, no unusual odors or staining. | |
| | M-121-5 | ☒ | | | 0.0 | | | |
| | M-121-5D | | | | | | | |
| 10 | M-121-10 | ☒ | | 10 | 0.0 | | | |
| 20 | M-121-20 | ☒ | | 10 | 17.2 | | | |
| 30 | M-121-30 | ☒ | | 10 | 2.0 | | | |
| 40 | M-121-40 | ☒ | | 6 | 0.8 | | From 44 to 45ft: Silty Sand, 75% sand (very fine-grained sand with medium- to coarse-grained sand, angular to subangular), caliche zone with nodules to 4 1/2". | 45 ft |
| | | | | 4 | | | | |
| | | | | 10 | 3.3 | SM (GM) | **MUDDY CREEK FM - FIRST COARSE-GRAINED FACIES:** SILTY SAND and GRAVELLY SAND, with silty gravel lenses present, brown (5YR 5/5), locally very silty to 40% silt with trace clay, gravely zones with 5 to 15% gravel (granules and fine gravel to 1", commonly 1/8" to 1/4", angular to subangular), no unusual odors or staining. | |
| 50 | M-121-50 | ☒ | | | | | From 45 to 52 ft: with 5% granules to 1/4". | |
| 60 | M-121-60 | ☒ | | 10 | 89.6 | | | |
| | | | | | | | From 63 to 67 ft: with 10% granules to 1/4". | |
| 70 | | | | | 104.0 | | | |
| | | | | 13 | | | From 71 to 72 ft: with 5% granules to 1/8".<br>Damp at 71' | |
| | | | | | | | From 77 to 79 ft: with 5% granules to 1/8". | ▼ |
| 80 | M-121-80 | ☒ | | 17 | 0.0 | | From 80 to 82 ft: with 15% granules, fine gravel to 1".<br>From 82 to 89 ft: with 5% granules to 1/8".<br>Wet at 80' | |
| 90 | | | | | | | From 89 to 92 ft: with 10% granules to 1/4". | |
| | | | | 10 | | | From 97 to 102 ft: with 5% granules to 1/8". | |
| 100 | | | | | | | | |

Notes:

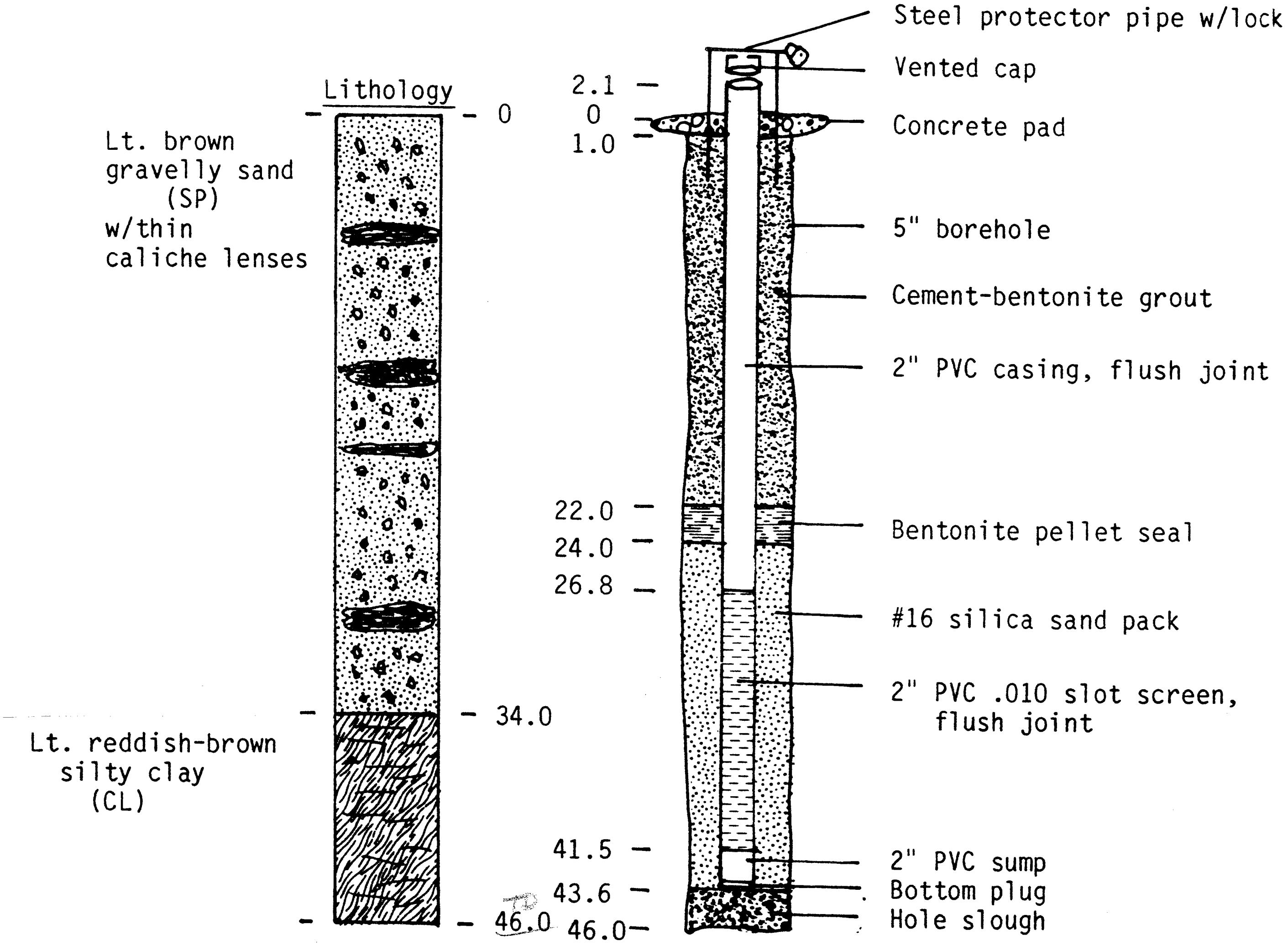
Checked by SWB Date: 8/10/09

# WELL CONSTRUCTION DIAGRAM
## MONITOR WELL M-23
## HENDERSON FACILITY



Note: Drilled 8-11-83

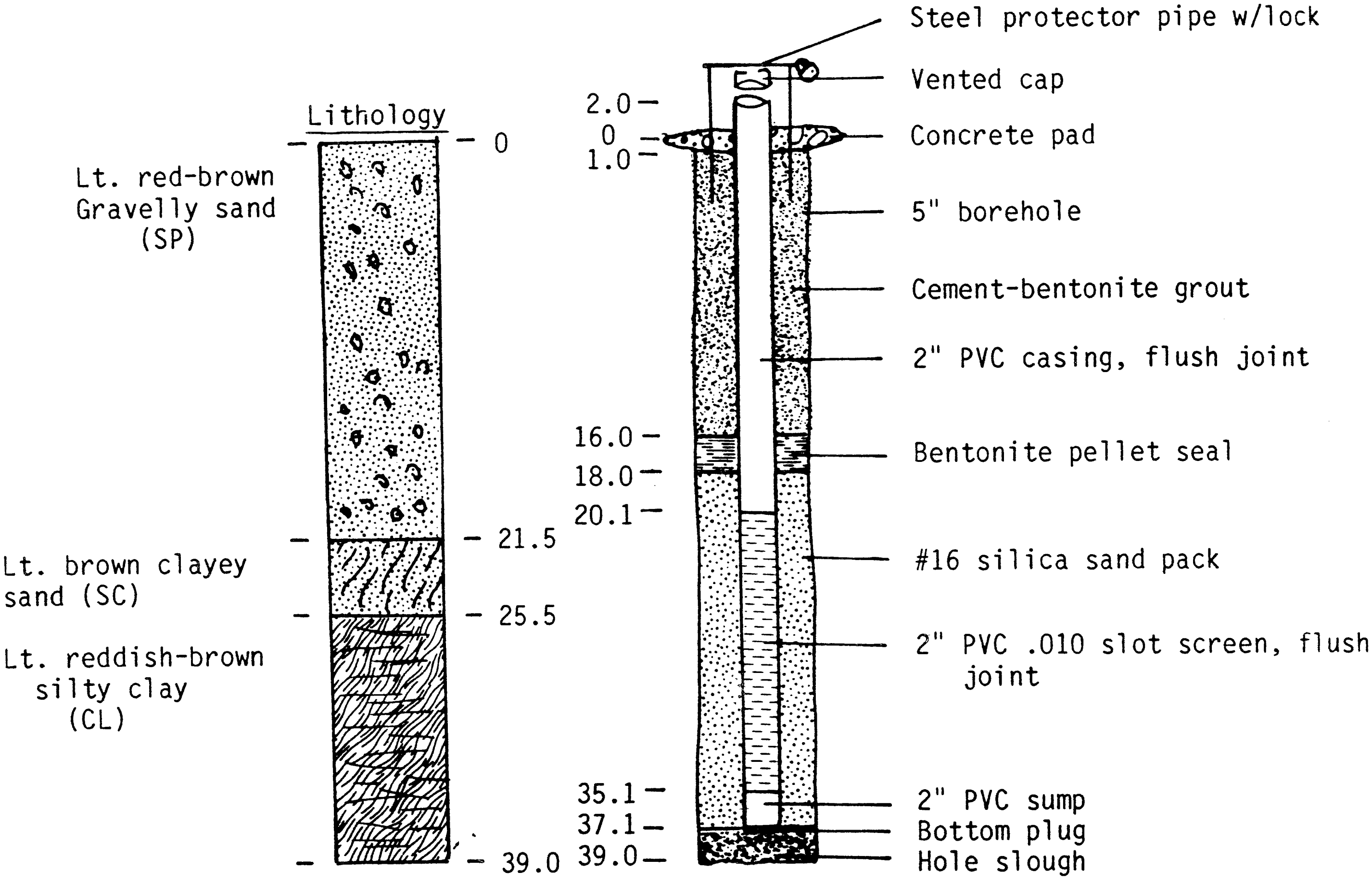
# WELL CONSTRUCTION DIAGRAM
## WELL M-6A
## HENDERSON, NV



Date Drilled: 12-18-86
Drilled By: Mooney Drilling
Drilling Method: Rotary Wash
Logged By: W. M. Goodman, KM

# WELL CONSTRUCTION DIAGRAM
## WELL M-7A
## HENDERSON, NV

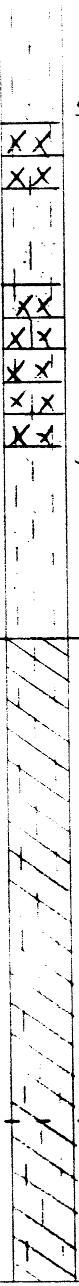
P - A



Date Drilled: 12-18-86
Drilled By: Mooney Drilling
Drilling Method: Rotory Wash, Bentonite
Logged By: W. M. Goodman, KM

## SOIL BORING LOG KM–5655-A

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. Engineering Services | KM SUBSIDIARY<br>CHEMICAL | LOCATION<br>HENDERSON, NV. | BORING NUMBER M-92 |



| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | UNIFIED SOIL FIELD CLASS. | BLOWS PER FOOT | PID (ppm) | SOIL SAMPLE NO | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|
| | SILTY SAND, LT-MEDIUM BROWN, WELL GRADED, DRY TO SLIGHTLY MOIST | SM | | | | | | | |
| 5 | CALICHE-CEMENTED GRAVEL ZONE @ 4-6' | | | | | | | | |
| 10 | SILTY SAND; FINE-COARSE GRAINED, CALICHE CEMENTED GRAVELLY ZONE @ 9-14' | SM | | | | | | | EARTHY OR MUSTY ODOR NOTED DURING DRILLING |
| 15 | SILTY SAND AS ABOVE, BECOMING MODERATELY MOIST @ 18' | | | | | | | | |
| 20 | SILTY CLAY, LT. BROWN, SLI. TO MODERATELY MOIST, STIFF, OCC. FINE TO MED SAND GRAINS | CL | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | SILTY CLAY AS ABOVE; SATURATED, MOD. PLASTIC | ▽ | | | | | | | |
| 40 | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

| | | |
|---|---|---|
| ☐ SPLIT-BARREL | ▮ AUGER | ▮ ROCK CORE |
| ▩ THIN-WALLED TUBE | ▮ CONTINUOUS SAMPLER | ☐ NO RECOVERY |

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ≈ HIGHLY ORGANIC PEAT |
| ░ SAND | ▨ SANDY CLAY |
| ⁘ GRAVEL | ☐ CLAYEY SAND |
| ▨ SILTY CLAY | X CALICHE |
| ▨ CLAYEY SILT | ☐ |

| | |
|---|---|
| DATE DRILLED<br>5/4-5/93 | PAGE<br>1 of 2 |

DRILLING METHOD
HOLLOW STEM AUGER

DRILLED BY
WESTERN TECH.

LOGGED BY
— REED

EXISTING GRADE ELEVATION (FT AMSL)
~ 1800'

LOCATION OR GRID COORDINATES

## SOIL BORING LOG KM–5655-A

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. Engineering Services | KM SUBSIDIARY<br>CHEMICAL | LOCATION<br>HENDERSON, NV. | BORING NUMBER M-93 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | UNIFIED SOIL FIELD CLASS. | BLOWS PER FOOT | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|
| | GRAVEL FILL | | | | | | | | |
| 1 | SILTY SAND, LT TO MED. BROWN, DRY, AND GRAVEL 1-6' | SM | | 0<br>0 | | | | | |
| 5 | SILTY SAND AS ABOVE, GRAVEL AND COBBLES COMMON FROM 6-10' | | | 0<br>0<br>0 | | | | | NO HYDROCARBON ODOR |
| 10 | SILTY SAND AS ABOVE, BECOMING SLI. MOIST; CALICHE-CEMENTED GRAVELLY ZONE FROM 14-15' | | | 0<br>0 | | | | | |
| 15 | | SM | | 0<br>0<br>0 | | | | | |
| 20 | | | | 0<br>0 | | | | | |
| 23.5 | SILTY CLAY, LT. BROWN, SLI. MOIST, STIFF, SAND GRAINS COMMON | | | 0<br>0 | | | | | |
| 25 | | CL | | 0<br>0<br>0 | | | | | |
| 30 | SILTY CLAY SATURATED @ 33' | | | 0<br>0<br>0 | | | | | NO HYDROCARBON ODOR |
| 33 | | ▽ | | 0 | | | | | |
| 35 | | | | 0<br>0<br>0<br>0 | | | | | |
| 40 | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▮ AUGER
▮ ROCK CORE
■ THIN-WALLED TUBE
◧ CONTINUOUS SAMPLER
◻ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | ▦ DEBRIS FILL |
| ▥ SILT | ☰ HIGHLY ORGANIC (PEAT) |
| ▩ SAND | ▧ SANDY CLAY |
| ⁞ GRAVEL | ▧ CLAYEY SAND |
| ▧ SILTY CLAY | ☒ CALICHE |
| ▧ CLAYEY SILT | ☐ ______ |

| | |
|---|---|
| DATE DRILLED<br>5/5/93 | PAGE<br>1 of 2 |
| DRILLING METHOD<br>HOLLOW STEM AUGER | |
| DRILLED BY<br>WESTERN TECH. | |
| LOGGED BY<br>T. REED | |
| EXISTING GRADE ELEVATION FT AMSL<br>~1798' | |
| LOCATION OR GRID COORDINATES | |

P:A 6/03

# SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMC LLC | LOCATION<br>HENDERSON, NV | BORING NUMBER PC 102 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6' | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 0-8 GRAVEL, gry brn, sl. sdy (10-15) m-vc & sl slty (10%). Grav. up to 4", ave 1/2" | | GP | | | | | | | start 11AM. finish 11:30 am<br>wet @ 0'<br>WTR @ 2' |
| 14 | 8-14 slty SAND & slty sdy GRAVEL, interbedded<br>8-9 brn, slty (40%) vf-f sd<br>9-11 brn slty sdy gravel, 30% silt, 20% f-c sd, 50% pea gravel to 1"<br>11-14 brn, slty vf-f sd | | SM/GM | | | | | | | dry 8-9'<br>wet @ 9' |
| 19 | 14-19 sdy SILT and slty SAND, interbedded, brn to ltgrnish brn. vf-f sd | | ML/SM | | | | | | | |
| 22 | 19-22 sdy GRAVEL, gry brn, 30-40% vf-vc, A-SR sd in gran./pea gravel, SR-R, to 1/2" (volc) | | GW | | | | | | | |
| 24 | 22-24 slty SAND, brn 30% silt in vf-fg sd | | SM | | | | | | | |
| 28 | 24-28 slty sdy GRAVEL, dec silt from 30% @ 24 to 15% @ 28'. brn, f-m w/ cg SR sd in pea grav/gran to 1/2-3/4" | | GM/SM | | | | | | | |
| 36 | 28-36 sdy GRAVEL, gry brn & whtish. Contains abu ls. gravels. 20-30% f-vc; SR sd in gran/peagravel ave 1" w/ up to 6" locally | | GW | | | | | | | |
| 39 | | | GM/SM | | | | | | | |
| | | | GW | | | | | | | |

## EXPLANATION

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▯ AUGER
▯ ROCK CORE
■ THIN-WALLED TUBE
▯ CONTINUOUS SAMPLER
⧄ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

## GRAPHIC LOG LEGEND

▨ CLAY
▥ SILT
▒ SAND
⁘ GRAVEL
▩ SILTY CLAY
▩ CLAYEY SILT
▩ DEBRIS FILL
≈ HIGHLY ORGANIC (PEAT)
▨ SANDY CLAY
▨ CLAYEY SAND
☐ ______
☐ ______

| | |
|---|---|
| DATE DRILLED 8-17-00 | PAGE 1 of 2 |
| DRILLING METHOD PERCUSSION | |
| DRILLED BY LAYNE | |
| LOGGED BY ED KRISH | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

## SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCC | LOCATION<br>Henderson, NV | BORING NUMBER<br>PC 36 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|
| 5<br>10<br>12.5 | SAND, gravelly, f-m w/c-vc<br>0-12.5' mod yell brn (10YR5/4) f-m sd (w/minor c-vc) and minor gravel (10-20% of 1/4"-1 1/4"). Dry. Contains 10-15% silt. Minor caliche cement @12.5 damp | SW/GW | | | | ▮ | | | |
| 15 | SAND, silty & gravelly, f-m w/c-vc<br>12.5'-15' 15-20% 1/4"-1/2" grav and 25-30% silt. | GM | | | | ▮ | | | wet @ 15' ▽ |
| 20<br>25<br>27 | SAND, silty, mod yell brn, SA-SR, 30% silt, no gravel f-m w/c grained | SM | | | | ▮ | | | Water sample taken when hole 30' deep |
| 30.5 | SAND, mod yell brn, vf-f w/m, compact, w/20% silt | SP/SM | | | | ☒ | 29-30 | 100 | |
| 35 | SAND, silty, gravelly, f-m w/c-vc and 10-15% 1/4" gravel. 25-30% silt. Minor caliche cement | SM | | | | ▮ | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▮ AUGER
▮ ROCK CORE
■ THIN-WALLED TUBE
▮ CONTINUOUS SAMPLER
⧄ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | | | |
|---|---|---|---|
| ▨ | CLAY | ▩ | DEBRIS FILL |
| ▥ | SILT | ☐ | HIGHLY ORGANIC (PEAT) |
| ▦ | SAND | ▧ | SANDY CLAY |
| ⁘ | GRAVEL | ▧ | CLAYEY SAND |
| ▨ | SILTY CLAY | ☐ | _____ |
| ▥ | CLAYEY SILT | ☐ | _____ |

| | |
|---|---|
| DATE DRILLED<br>4-27-98 | PAGE<br>1 of 2 |
| DRILLING METHOD<br>Auger | |
| DRILLED BY<br>Weber | |
| LOGGED BY<br>E. J. Krish | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

## SOIL BORING LOG KM-5655-B

| KERR-McGEE CORPORATION<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY | LOCATION | BORING NUMBER |
|---|---|---|---|
| | KMCLLC | HENDERSON, NV. | PC-37 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAND / SILTY SAND; OCC. GRAVEL; LT. TAN-BROWN; WELL-GRADED; GRAVEL ZONE @ 3-4' | | | | | | | | | |
| 5 | | | SM | | | | | | | |
| 10 | SAND AS ABOVE; GRAVEL ZONE @ 12-13' | | | | | | | | | |
| 15 | | | ▽ | | | | | | | |
| 20 | SAND AS ABOVE; GRAY-BROWN; GRAVEL ZONE @ 22' | | | | | | | | | |
| 25 | | | | | | | | | | |
| 27 | SANDY SILT; OCC. GRAVEL; LT. GRAY-BROWN; SATURATED | | | | | | | | | |
| 30 | | | ML | | | | | | | |
| 35 | | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
◧ AUGER
◨ ROCK CORE
■ THIN-WALLED TUBE
◧ CONTINUOUS SAMPLER
◹ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ☐ HIGHLY ORGANIC (PEAT) |
| ▦ SAND | ▧ SANDY CLAY |
| ⁘ GRAVEL | ▧ CLAYEY SAND |
| ▨ SILTY CLAY | ☐ ______ |
| ▥ CLAYEY SILT | ☐ ______ |

| | |
|---|---|
| DATE DRILLED 4/27/98 | PAGE 1 of 2 |
| DRILLING METHOD HSA | |
| DRILLED BY WEBER DRLG. | |
| LOGGED BY T. REED | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

# SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCC | LOCATION<br>Henderson, NV | BORING NUMBER PC38 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAND, gravelly, lt brn 0-40', f-m w/ c-vc sd and 30-35% 1/4-3/4" grav. (Minor 3/4"-2" grav). Slight silty 5-10%. Minor caliche cement throughout | | SW | | | | | | | |
| 5 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | 20'-40' 20% silt, lt brn sd and grav as above | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | DAMP @ 33'<br>▽ |
| 35 | | | | | | | | | | |
| | | | | | | | | | | MOIST-WET @ 40' |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
AUGER
ROCK CORE
THIN-WALLED TUBE
CONTINUOUS SAMPLER
NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

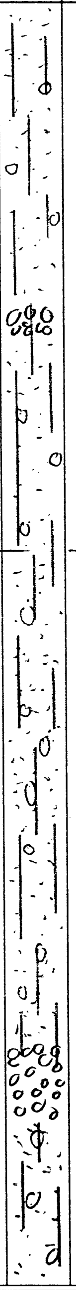
**GRAPHIC LOG LEGEND**

CLAY
DEBRIS FILL
SILT
HIGHLY ORGANIC (PEAT)
SAND
SANDY CLAY
GRAVEL
CLAYEY SAND
SILTY CLAY
☐ ______
CLAYEY SILT
☐ ______

| | |
|---|---|
| DATE DRILLED<br>4-27-98 | PAGE<br>1 of 2 |
| DRILLING METHOD<br>AUGER | |
| DRILLED BY<br>WEBER | |
| LOGGED BY<br>EJ Krish | |
| EXISTING GRADE ELEVATION (FT AMSL) | |
| LOCATION OR GRID COORDINATES | |

## SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCLLC | LOCATION<br>HENDERSON, NV | BORING NUMBER PC-39 |



| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|
| | SAND/SILTY SAND; LT. TAN-BROWN; OCC. GRAVEL; SLI. MOIST; WELL-GRADED | | | | | | | | |
| 5 | | | | | | | | | |
| | | SM | | | | | | | |
| 10 | SAND AS ABOVE; GRAVEL ZONE @ 10' | | | | | | | | |
| 15 | | | | | | | | | |
| 17 | | ∇ | | | | | | | |
| 20 | | | | | | | | | |
| 25 | | | | | | | | | |
| | | SM | | | | | | | |
| 30 | | | | | | | | | |
| | GRAVEL ZONE @ 33-35' | | | | | | | | |
| 35 | | | | | | | | | |
| 40 | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
∇ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
◧ AUGER
◧ ROCK CORE
■ THIN-WALLED TUBE
◧ CONTINUOUS SAMPLER
◩ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

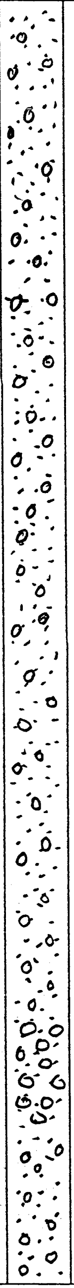
**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ☐ HIGHLY ORGANIC (PEAT) |
| ▦ SAND | ▨ SANDY CLAY |
| ⁞ GRAVEL | ▨ CLAYEY SAND |
| ▨ SILTY CLAY | ☐ ______ |
| ▨ CLAYEY SILT | ☐ ______ |

| | |
|---|---|
| DATE DRILLED<br>4/27/98 | PAGE<br>1 of 2 |
| DRILLING METHOD<br>HSA | |
| DRILLED BY<br>WEBER DRLG. | |
| LOGGED BY<br>T. REED | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

## SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCC | LOCATION<br>HENDERSON, NV | BORING NUMBER PC 40 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAND, gravelly, mod yell brn (10YR 5/4). Contains 20-30% 1/4"-3/4" gravel. |  | | | | | | | | |
| 5 | Slightly silty (5%). | | | | | | | | | |
| | 0'-10' w/ minor cobbles - 3/4" - 3" | | | | | | | | | |
| 10 | minor caliche cement throughout | | | | | | | | | |
| | 0'-43' sand is f-m w/ minor c-vc | | | | | | | | | |
| 15 | | | | | | | | | | |
| | | | SW | | | | | | | @ 18' damp |
| 20 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | ▽ | @ 30' moist-wet |
| | 32'-35' cobbles w/ caliche cement | | | | | | | | | |
| 35 | | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
◧ AUGER
◫ ROCK CORE
■ THIN-WALLED TUBE
◧ CONTINUOUS SAMPLER
◪ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ☐ HIGHLY ORGANIC (PEAT) |
| ▦ SAND | ▨ SANDY CLAY |
| ⁘ GRAVEL | ▨ CLAYEY SAND |
| ▨ SILTY CLAY | ☐ ______ |
| ▨ CLAYEY SILT | ☐ ______ |

| | |
|---|---|
| DATE DRILLED 4-27/28-98 | PAGE 1 of 2 |
| DRILLING METHOD AUGER | |
| DRILLED BY WEBER | |
| LOGGED BY E. J. Krish | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

## SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCC | LOCATION<br>HENDERSON, NV | BORING NUMBER PC 42 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAND, gravelly, lt brn (5YR 6/4). poorly sorted, SA-SR, f-vc w/ 20-30% 1/4"-3/4" gravel. Weak caliche cement throughout | | | | | | | | | |
| 5 | | | | | | | | | | |
| 10 | 0'-41' sparse silt (5-10%) | | | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | | | SW | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | 31'-41' Calichefied sand and gravel, slow drilling, poor returns | | | | | | | | | 31-41' hard drilling - sample off auger flites |
| 35 | | | | | | | | | | |

### EXPLANATION

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

⊠ SPLIT-BARREL
▐ AUGER
▮ ROCK CORE
■ THIN-WALLED TUBE
▌ CONTINUOUS SAMPLER
⧄ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

### GRAPHIC LOG LEGEND

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ≋ HIGHLY ORGANIC (PEAT) |
| ▒ SAND | ▧ SANDY CLAY |
| ⁘ GRAVEL | ▧ CLAYEY SAND |
| ▨ SILTY CLAY | ☐ ______ |
| ▥ CLAYEY SILT | ☐ ______ |

| | |
|---|---|
| DATE DRILLED<br>4-28/29-98 | PAGE<br>1 of 2 |
| DRILLING METHOD<br>AUGER | |
| DRILLED BY<br>WEBER | |
| LOGGED BY<br>E. J Krish | |
| EXISTING GRADE ELEVATION (FT. AMSL) | |
| LOCATION OR GRID COORDINATES | |

**SOIL BORING LOG** KM—5655-A

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. Engineering Services | KM SUBSIDIARY<br>Chemical | LOCATION<br>Henderson, NV | BORING NUMBER PC-71 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | UNIFIED SOIL FIELD CLASS. | BLOWS PER FOOT | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|
| 0–17.5 (5, 10, 15) | Tan to reddish brown silty sand with variable small to medium gravel in thin layers. Alluvial Sequence | GM | | | | | | | |
| | White and Gray Sand | SP | | | | ☒ | 17.5-18 | 0.5 | 1035 |
| 20 | Hard red clay | CL | | | | ☒ | 20-21 | 1' | 1045 |
| 25 | reddish-brown silty clay | CL | | | | ☒ | 24.5-26 | 1,5 | 1055 |
| | Reddish-brown clay, blocky, dry-Muddy Creek<br>TD 33 Ft | CL | | | | ☒ | 27-28 | 1' | 1110 |
| 30 | | | | | | ☒ | 30-31 | 1' | 1130 |
| 35 | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▮ AUGER
▮ ROCK CORE
■ THIN-WALLED TUBE
▮ CONTINUOUS SAMPLER
⧄ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ≈ HIGHLY ORGANIC (PEAT) |
| ▦ SAND | ▨ SANDY CLAY |
| ⁘ GRAVEL | ▨ CLAYEY SAND |
| ▨ SILTY CLAY | ☐ ______ |
| ▥ CLAYEY SILT | ☐ ______ |

DATE DRILLED 11-30-98
PAGE 1 of 1
DRILLING METHOD Hollow Stem Auger
DRILLED BY Compliance Drilling
LOGGED BY Steve Lower
EXISTING GRADE ELEVATION (FT. AMSL)
LOCATION OR GRID COORDINATES

**SOIL BORING LOG** KM–5655-A

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. Engineering Services | KM SUBSIDIARY<br>Chemical | LOCATION<br>Henderson, NV | BORING NUMBER PC-72 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | UNIFIED SOIL FIELD CLASS. | BLOWS PER FOOT | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|
| 5<br>10<br>15<br>20 | Tan to reddish brown silty sand with variable small to medium gravel<br>Alluvial Sequence | GM | | | | | | | |
| 25 | | | | | | ☒ | 245-25 | 0.5 | 1515 |
| 30 | Sequence of caliche and gray coarse sand | SP | | | | | | | |
| 35 | Reddish-brown clay, firm, blocky - Muddy Creek | CL | | | | ☒ | 345-35 | 0.5 | 1600 |
| | | | | | | ☒ | 35-36 | 1' | 0750 |
| | | | | | | ☒ | 37-38 | 1' | 0810 |
| 40 | TD 38 ft | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)

▽ Water Table (Time of Boring)

PID Photoionization Detection (ppm)

NO. Identifies Sample by Number

TYPE Sample Collection Method

☒ SPLIT-BARREL ◨ AUGER ◫ ROCK CORE

■ THIN-WALLED TUBE ◨ CONTINUOUS SAMPLER ⧄ NO RECOVERY

DEPTH Depth Top and Bottom of Sample

REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

▨ CLAY ▦ DEBRIS FILL

▥ SILT ☐ HIGHLY ORGANIC (PEAT)

▩ SAND ▨ SANDY CLAY

⁘ GRAVEL ▨ CLAYEY SAND

▨ SILTY CLAY ☐ ______

▨ CLAYEY SILT ☐ ______

DATE DRILLED 12-1-98

PAGE 1 of 1

DRILLING METHOD Hollow Stem Auger

DRILLED BY Compliance Drilling

LOGGED BY Steve Lower

EXISTING GRADE ELEVATION (FT. AMSL)

LOCATION OR GRID COORDINATES

## SOIL BORING LOG KM—5655-A

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. Engineering Services | KM SUBSIDIARY<br>Chemical | LOCATION<br>Henderson, NV | BORING NUMBER PC-73 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER FOOT | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tan to reddish brown silty sand with variable small to medium gravel in thin layers | | | | | | | | | |
| 5 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 15 | | | GM | | | | | | | |
| 20 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | Gray silty sand with small gravel | | | | | | | | | |
| 35 | | | Gm | | | | | | | |
| 40 | | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)

▽ Water Table (Time of Boring)

PID Photoionization Detection (ppm)

NO. Identifies Sample by Number

TYPE Sample Collection Method

☒ SPLIT-BARREL

AUGER

ROCK CORE

THIN-WALLED TUBE

CONTINUOUS SAMPLER

NO RECOVERY

DEPTH Depth Top and Bottom of Sample

REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | |
|---|---|
| ▨ CLAY | DEBRIS FILL |
| SILT | HIGHLY ORGANIC (PEAT) |
| SAND | SANDY CLAY |
| GRAVEL | CLAYEY SAND |
| SILTY CLAY | ☐ ______ |
| CLAYEY SILT | ☐ ______ |

| | |
|---|---|
| DATE DRILLED<br>12-1-98 | PAGE<br>1 of 2 |

DRILLING METHOD Hollow Stem Auger

DRILLED BY Compliance Drilling

LOGGED BY Steve Lower

EXISTING GRADE ELEVATION (FT. AMSL)

LOCATION OR GRID COORDINATES

SOIL BORING LOG KM-5655-B

| KERR-McGEE CORPORATION<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMC LLC | LOCATION<br>HENDERSON, NV | BORING NUMBER TR 11 |
|---|---|---|---|

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | TYPE | DEPTH | REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 - 4 GRAVEL, sdy, mod yell brn (10YR 5/4), sd vf-vc, gravel up to 1" diam. A-SR, com caliche cement | | GW | | | | | | | |
| 5 | 4-8 sand, vf-vc, A-SA<br>7-8 hard caliche | | SW | | | | | | | |
| 10 | 8-28 SAND, gravelly, gry oran (10YR7/4) to mod yell brn (10YR 5/4). vf-vc, A-SA, gravel to to 1" diam<br>Com. caliche cement | | SP | | | | | | | |
| 15 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 25 | 24-28 lg cobbles w/ com caliche, hard | | GP | | | | | | | |
| 30 | 28-32 SAND, w/ minor caliche and granules vf-vc | | SW | | | | | | | |
| 35 | 32-50 GRAVEL, hard, cemented, fractured. Com caliche cement. Minor sd interbeds and in matrix<br>Gry oran and dusky yell brn | | GW | | | | | | | |

EXPLANATION

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▯ AUGER
▯ ROCK CORE
■ THIN-WALLED TUBE
▯ CONTINUOUS SAMPLER
◻ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

GRAPHIC LOG LEGEND

▨ CLAY
▨ DEBRIS FILL
▥ SILT
▨ HIGHLY ORGANIC (PEAT)
▩ SAND
▨ SANDY CLAY
⁘ GRAVEL
▨ CLAYEY SAND
▨ SILTY CLAY
☐ ______
▨ CLAYEY SILT
☐ ______

DATE DRILLED 10-10-99
PAGE 1 of 7
DRILLING METHOD ARCH
DRILLED BY BEYLIK
LOGGED BY Ed Krish
EXISTING GRADE ELEVATION (FT AMSL)
LOCATION OR GRID COORDINATES

## SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMC LLC | LOCATION<br>HENDERSON | BORING NUMBER TR-12 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 0-5 GRAVEL w/slty sd in matrix. Com caliche coatings. .Sized up to 2', volcanics | | GM | | | | | | | |
| 10 | 5-10 SAND, slty w/ mod cobble-size volc gravel, Com caliche coatings.. Sd vf-vc, A-SR | | SW | | | | | | | |
| 15<br>19 | 10-19 Gravel, boulders, w/com. caliche coatings. Mod vf-vc slty sand matrix dk yell brn (10YR 2/2) and gry oran (10YR 7/4) | | GW | | | | | - | | |
| 21 | 19-21 SAND, slty w/mod pea gravel, volc. | | SW | | | | | | | |
| 27 | 21-27 Gravel, boulders w/ mod slty sd matrix. dk yell brn + gry oran. Sd vf-vc. Mod cemented Com caliche coatings | | GW | | | | | | | |
| 30<br>36 | 27-36 GRAVEL, up to bouldersize w/ minor vf-vc sd matrix. HARD well cemented w/ caliche | | GP | | | | | | | - - |
| 38 | 36-38 SAND, HARD, well cemented (caliche). vf-vc | | SP | | | | | | | |
| 39 | 38-39 SAND + GRAVEL, as above, uncemented | | GW<br>SP | | | | | | | |

EXPLANATION

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
◧ AUGER
◫ ROCK CORE
▩ THIN-WALLED TUBE
◧ CONTINUOUS SAMPLER
◺ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

▧ CLAY
▥ SILT
▒ SAND
⁘ GRAVEL
▧ SILTY CLAY
▥ CLAYEY SILT
▦ DEBRIS FILL
☐ HIGHLY ORGANIC (PEAT)
▧ SANDY CLAY
▧ CLAYEY SAND
☐ ______
☐ ______

| | |
|---|---|
| DATE DRILLED 10-16-99 | PAGE 1 of 8 |
| DRILLING METHOD ARCH | |
| DRILLED BY BEYLIK | |
| LOGGED BY Ed Krish | |
| EXISTING GRADE ELEVATION (FT AMSL) | |
| LOCATION OR GRID COORDINATES | |

**SOIL BORING LOG** KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCLLC | LOCATION<br>HENDERSON | BORING NUMBER<br>TR-5 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–5 | SANDY GRAVEL w/ SILT; SLI. MOIST; GRAYISH-ORANGE PINK 5YR 7/2 | | GW | | | | | | | |
| 5–10 | SAND (VF-MED.) WITH SILT AND GRAVEL; SLI. MOIST; 5YR 7/2 | | SW | | | | | | | |
| 10–20 | SANDY GRAVEL, SLI. MOIST; SOME SILT; GRAYISH-ORANGE PINK 5YR 7/2 | | GW | | | | | | | |
| 20–25 | SAND; VF-F GRAINED; MED-COARSE SAND OCC. TO COMMON; SLI.-MOD. MOIST; LT. BROWN 5YR 6/4 | | SW | | | | | | | |
| 25–37 | GRAVELLY SAND; VF-COARSE; MOD. MOIST; LT. BROWN; 5YR 6/4 | | SW | | | | | | | Qal |
| 37–40 | 37-62 SILT w/thin sdy zones, mod yell brn (10YR5/4) calcareous | | ML | | | | | | | MC fg |

EXPLANATION

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
◨ AUGER
◫ ROCK CORE
■ THIN-WALLED TUBE
◨ CONTINUOUS SAMPLER
⧄ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | | | |
|---|---|---|---|
| ▨ | CLAY | ▩ | DEBRIS FILL |
| ▥ | SILT | ☐ | HIGHLY ORGANIC (PEAT) |
| ▦ | SAND | ▨ | SANDY CLAY |
| ⁘ | GRAVEL | ▨ | CLAYEY SAND |
| ▨ | SILTY CLAY | ☐ | ______ |
| ▨ | CLAYEY SILT | ☐ | ______ |

DATE DRILLED 9/16-9/22/99
PAGE 1 of 7
DRILLING METHOD ARCH
DRILLED BY BEYLIK
LOGGED BY T. REED
EXISTING GRADE ELEVATION (FT AMSL)
LOCATION OR GRID COORDINATES

# SOIL BORING LOG KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCC | LOCATION<br>HENDERSON | BORING NUMBER TR 6 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE | | | | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NO. | TYPE | DEPTH | REC. | |
| | TD 80'<br>15' North of TR 5<br>see TR 5 lith log for lithology | | | | | | | | | |

EXPLANATION

▼ Water Table (24 Hour)

▽ Water Table (Time of Boring)

PID Photoionization Detection (ppm)

NO. Identifies Sample by Number

TYPE Sample Collection Method

☒ SPLIT-BARREL

▮ AUGER

▮ ROCK CORE

■ THIN-WALLED TUBE

▮ CONTINUOUS SAMPLER

◿ NO RECOVERY

DEPTH Depth Top and Bottom of Sample

REC. Actual Length of Recovered Sample in Feet

GRAPHIC LOG LEGEND

| | |
|---|---|
| ▨ CLAY | ▩ DEBRIS FILL |
| ▥ SILT | ☐ HIGHLY ORGANIC (PEAT) |
| ▦ SAND | ▧ SANDY CLAY |
| ⁙ GRAVEL | ▧ CLAYEY SAND |
| ▧ SILTY CLAY | ☐ ______ |
| ▥ CLAYEY SILT | ☐ ______ |

| | |
|---|---|
| DATE DRILLED<br>9-24-99 | PAGE<br>1 of 1 |
| DRILLING METHOD<br>ARCH | |
| DRILLED BY<br>BEYLIK | |
| LOGGED BY<br>E. KRISH | |
| EXISTING GRADE ELEVATION (FT AMSL) | |
| LOCATION OR GRID COORDINATES | |

**SOIL BORING LOG** KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCC | LOCATION<br>HENDERSON | BORING NUMBER TR7 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| 5<br>10<br>12 | 0-12 GRAVEL, sdy, gry oran (10YR7/4) and mod yell brn (10YR 5/4). 60-70% gravel up to 1" diam in sd (f-vc) matrix. Mod. calcite cement. Mod calichification | | GW | | | | | | | |
| 15<br>20 | 12-20 SAND, gravelly, as above w/ 30-40% 1" diam volc gravel | | SW | | | | | | | |
| 26 | 20-26 SAND, silty gry oran (10YR 7/4) vf-vc w/ 20% silt in matrix | | SM | | | | | | | |
| 30<br>35 | 26-43 SAND, gry orange (10YR 7/4) vf-m w/ minor vc, A-SA, calcareous w/ sp-sd-size caliche nodules | | SW | | | | | | | damp @ 28' |

EXPLANATION

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
▮ AUGER
▮ ROCK CORE
■ THIN-WALLED TUBE
▮ CONTINUOUS SAMPLER
⧄ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | | | |
|---|---|---|---|
| ▨ | CLAY | ▩ | DEBRIS FILL |
| ▥ | SILT | ☐ | HIGHLY ORGANIC (PEAT) |
| ▦ | SAND | ▨ | SANDY CLAY |
| ⁙ | GRAVEL | ▨ | CLAYEY SAND |
| ▨ | SILTY CLAY | ☐ | ______ |
| ▥ | CLAYEY SILT | ☐ | ______ |

| | |
|---|---|
| DATE DRILLED 9/25-9/26/99 | PAGE 1 of 8 |
| DRILLING METHOD ARCH | |
| DRILLED BY BEYLIK | |
| LOGGED BY E KRISH | |
| EXISTING GRADE ELEVATION (FT AMSL) | |
| LOCATION OR GRID COORDINATES | |

**SOIL BORING LOG** KM-5655-B

| | | | |
|---|---|---|---|
| **KERR-McGEE CORPORATION**<br>Hydrology Dept. - S&EA Division | KM SUBSIDIARY<br>KMCC | LOCATION<br>HENDERSON | BORING NUMBER TR8 |

| DEPTH IN FEET | LITHOLOGIC DESCRIPTION | GRAPHIC LOG | UNIFIED SOIL FIELD CLASS. | BLOWS PER 6" | PID (ppm) | SOIL SAMPLE NO. | SOIL SAMPLE TYPE | SOIL SAMPLE DEPTH | SOIL SAMPLE REC. | REMARKS OR FIELD OBSERVATIONS |
|---|---|---|---|---|---|---|---|---|---|---|
| | HOLE LOCATED 12 ft South of TR7 - see TR7 for Lithology<br>TD 98'<br>NOTE:<br>IN TR8 first MC gravel started @ 62' and ended at 93 ft. | | | | | | | | | |

**EXPLANATION**

▼ Water Table (24 Hour)
▽ Water Table (Time of Boring)
PID Photoionization Detection (ppm)
NO. Identifies Sample by Number
TYPE Sample Collection Method

☒ SPLIT-BARREL
◧ AUGER
◨ ROCK CORE
■ THIN-WALLED TUBE
◧ CONTINUOUS SAMPLER
⧅ NO RECOVERY

DEPTH Depth Top and Bottom of Sample
REC. Actual Length of Recovered Sample in Feet

**GRAPHIC LOG LEGEND**

| | | | |
|---|---|---|---|
| ▨ | CLAY | ▩ | DEBRIS FILL |
| ▥ | SILT | ☐ | HIGHLY ORGANIC (PEAT) |
| ▦ | SAND | ▨ | SANDY CLAY |
| ⁙ | GRAVEL | ▨ | CLAYEY SAND |
| ▨ | SILTY CLAY | ☐ | ______ |
| ▥ | CLAYEY SILT | ☐ | ______ |

| | |
|---|---|
| DATE DRILLED<br>9/30/99 | PAGE<br>1 of 1 |
| DRILLING METHOD<br>ARCH | |
| DRILLED BY<br>BEYLIK | |
| LOGGED BY<br>E. KRISH | |
| EXISTING GRADE ELEVATION (FT AMSL) | |
| LOCATION OR GRID COORDINATES | |