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Soil Gas Investigation Work Plan for Parcels C, D, F, G, and H

Nevada Environmental Response Trust Site; Henderson, Nevada

Prepared for:
Nevada Environmental Response Trust

Prepared by:
ENVIRON International Corporation
Emeryville, California
Chicago, Illinois

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ENVIRON

Soil Gas Investigation Work Plan for Parcels C, D, F, G, and H

Nevada Environmental Response Trust
(Former Tronox LLC Site)
Clark County, Nevada

Nevada Environmental Response Trust (NERT) Representative Certification

I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of 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 prepared 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.

Signature: _____

Name: _____

Title: _____

Company: _____

Date: _____

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Nevada Environmental Response Trust
(Former Tronox LLC Site)
Clark County, 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. I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

_____ _____

John M. Pekala, PG Date

Certified Environmental Manager
ENVIRON International Corporation
EM Certificate Number: 2347
EM Expiration Date: September 20, 2014

The following individuals provided input to this document:

John M. Pekala, PG
Allan J. DeLorme, PE
Mark Travers, PG
Jessica E. Donovan, PG
Lynne Haroun, MPH
Christopher J. Ritchie, PE
Emily Lisker
Kimberly Souder
Elysha Anderson
Ruben So

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1.0 Introduction

This Soil Gas Sampling Work Plan (Work Plan) has been prepared on behalf of the Nevada Environmental Response Trust (the Trust) for Parcels C, D, F, G, and H (the Parcels) at the Nevada Environmental Response Trust Site (the Site) located in Henderson, Nevada. The Work Plan is being submitted to the Nevada Division of Environmental Protection (NDEP) as part of the Parcels Vapor Intrusion Sampling and Health Risk Assessment (HRA).

1.1 Work Plan Objectives

In a letter to the Trust dated August 7, 2012 (NDEP 2012a), NDEP commented on the *Revised Closure and Post-Remediation Screening HRA Report for Parcels C, D, F, G, and H*, prepared by Northgate Environmental Management, Inc. (Northgate) and dated May 18, 2012. In comment #12, NDEP stated that the soil gas sampling data collected for the *Site-Wide Soil Gas Human Health Risk Assessment* (Northgate 2010b) were not adequate to characterize risk when the Parcels were evaluated individually. In addition, based on a review of figures showing the chloroform plume in shallow groundwater, NDEP noted that soil gas samples from the Phase B investigation were collected from locations where results for volatile organic compounds (VOCs) would likely be biased low. Finally, NDEP commented that it may be reasonable to use site-wide soil gas data in conjunction with groundwater data to develop a parcel-specific HRA. This Work Plan has been prepared in response to NDEP's comments, as well as additional comments provided in an August 30, 2012 call between ENVIRON and NDEP. The Work Plan presents a soil gas sampling and analysis plan to address data gaps in the available soil gas data for the Parcels with the objective of providing additional analytical data needed to characterize risk to human health. The work is being conducted under the oversight of NDEP.

The analytical results will be used with previously collected data (Northgate 2010a, 2010b) to support a screening-level HRA for the vapor intrusion pathway. The Parcels will be evaluated either as a single exposure unit, using the maximum detected concentrations across all Parcels for analytes identified as chemicals of potential concern (COPCs) in the HRA, or as individual Parcels, using maximum detected concentrations within each individual Parcel. The specific approach will be determined following a review of the results of the additional soil gas sampling.

As discussed with NDEP, this sampling plan is being submitted as an interim deliverable to allow for an expedited review of the proposed sampling locations and analytes such that field work can be scheduled following NDEP concurrence on the sampling locations and analytes. The work plan for conducting the HRA is currently in preparation and will be submitted to NDEP for review. A Data Validation Summary Report (DVSR) for the soil gas sampling analytical results will be submitted following completion of soil gas sampling and data validation activities, and the HRA for the vapor intrusion pathway will be prepared.

1.2 Work Plan Organization

The organization of this Work Plan follows:

- The remainder of Section 1.0 presents information on Site history and background, including a discussion of site geology and hydrogeology as well as previous soil gas and groundwater investigations of VOCs.
- Section 2.0 identifies pre-sampling activities, health and safety requirements, and soil gas sample locations and provides information on probe construction. In addition, analytical methods, equipment decontamination, and management of investigation-derived waste are discussed.
- Sections 3.0, 4.0, and 5.0 identify the steps for evaluation, interpretation, and reporting of sample results, the sampling activities schedule, and references for documents cited in this Work Plan.

1.3 Site Background

The approximately 416-acre Site, of which the Parcels constitute approximately 83.8 acres, is located approximately 13 miles southeast of the city of Las Vegas in an unincorporated area of Clark County, Nevada, and lies in Sections 1, 12, and 13 of Township 22 S, Range 62 E, (Figure 1). The Site is located within the Black Mountain Industrial (BMI) complex, which consists of several facilities owned and/or operated by chemical companies. One such facility is leased and operated by Tronox, LLC (Tronox) on land owned by the Trust.

The Site has been the subject of extensive environmental investigations since the 1970s. In 1994, NDEP identified 69 Letter of Understanding Potential Source Areas (NDEP 1994) (referred to in this and other reports as LOUs). Subsequent to the identification of the LOUs, an additional potential source area, the former U.S. Vanadium site, was identified during planning for the 2008 Phase B investigation (NDEP 2011). A detailed discussion of the specific areas or items of interest identified in the LOUs, lists of the products made, years of production, approximate waste volumes for various former operators at the Site (Western Electrochemical Company, American Potash & Chemical Company, and Tronox), and actions taken for each LOU study item is presented in the Conceptual Site Model (CSM) Report for the Site (ENSR 2005).

No LOUs are located in Parcels C or H. Two LOUs, 63 and 65c, are located in Parcel F, LOU 65d is located in Parcel G, and a small portion of LOU 68 is located along the northeast border of Parcel D.

1.4 Geologic and Hydrogeological Setting

The Parcels are located within the 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 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 Parcels are located on Quaternary alluvial (Qal) deposits that slope north toward Las Vegas Wash. The thickness of the alluvial deposits ranges from less than 1 feet to more than 50 feet 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 Pleistocene Muddy Creek Formation (UMCf) 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 Parcels, the Muddy Creek Formation is composed of at least two thicker units of fine-grained sediments of clay and silt (the first and second fine-grained facies, respectively) interbedded with at least two thinner units of coarse-grained sediments of sand, silt, and gravel (the first and second coarse-grained facies, respectively) (ENSR 2005).

Depth to groundwater ranges from about 27 to 80 feet below ground surface (bgs) and is generally deepest in the southernmost portion of the Site, becoming shallower as it approaches the Las Vegas Wash to the north. The groundwater flow direction at the Site is generally north to north-northwesterly, whereas north of the facility the direction changes slightly to the north-northeast (ENSR 2005).

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 Muddy Creek formation during infrequent flood runoff periods. These deposits are thickest within the paleochannel boundaries, which are narrow and linear and trend northeastward. The paleochannels (shown on Figure 2) act as preferred pathways for groundwater flow, which may contribute significantly to chemical distribution in the Shallow Zone (ENSR 2005).

An on-site Interceptor Well Field (IWF) and groundwater barrier wall is shown on Figure 2. The groundwater barrier wall was constructed as a physical barrier across the higher concentration portion of the perchlorate/chromium plume on the Site in 2001. The IWF captures the highest concentrations of the groundwater plume located downgradient of the on-site source areas. The interceptor wells may have a significant influence on the chemical distribution in the Shallow Zone.

1.5 Previous Soil Gas Investigations

Previous soil gas investigations were conducted at the Site as part of the Phase B investigation. At the request of NDEP (Kerr-McGee Chemical Corporation [KMCC] 2005), a “Site-wide” investigation was conducted for the entire Site, including the Parcels.

The Phase B soil gas investigation involved collection of 95 soil gas samples at the Site in May 2008. The details of the soil gas sampling are presented in the *Phase B Source Area*

Investigation Soil Gas Survey Work Plan (2008 Soil Gas Work Plan; ENSR 2008, approved by NDEP in March 2008) and summarized in the *Site-Wide Soil Gas Health Risk Assessment* (2010 Soil Gas HRA) (Northgate 2010b). Soil gas sample locations were based on the 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, as well as on historic soil and groundwater data collected during prior investigations. In addition, groundwater studies performed subsequent to the Phase A investigation by Hargis + Associates (2011) as part of their work for companies located west of the Site were considered.

As presented in the 2008 Soil Gas Work Plan, six soil gas samples were collected in the Parcels (one each in Parcels C, D, F, and G; and two in Parcel H). An additional 26 samples were collected near each of the Parcels (six near Parcel C, seven near Parcel D, six near Parcel F, two near Parcel G, and five near Parcel H). All samples were collected at 5 feet bgs. These samples, as well as additional samples identified for collection in this Work Plan) are listed in Table 1.

Using the results of the soil gas data collected as part of the Phase B sampling, an HRA was prepared to characterize potential risks to indoor workers. The most current draft was submitted to NDEP in 2010 (Northgate 2010b). COPCs were selected according to a multi-step process, including a toxicity screen and frequency of detection screen, and considering the conceptual site model. Based on this process, eight chemicals (benzene, bromodichloromethane, carbon tetrachloride, chloroform, hexachlorobutadiene, naphthalene, tetrachloroethene, and trichloroethene) were identified as COPCs for evaluation.

The 2010 Soil Gas HRA reported cancer risk estimates at or below 1×10^{-6} and hazard indices well below one (1) for worker exposure to COPCs for the vapor intrusion pathway. In comments on the draft submittal of the post-remediation screening HRA conducted for soil in Parcels C, D, F, G, and H, NDEP stated that the available soil gas data used in the 2010 Soil Gas HRA were not sufficient to characterize risk at the Parcels. This Work Plan was prepared in response to this comment.

1.6 Previous Groundwater Investigations

The Phase B Groundwater Investigation was initiated in 2008 by ENSR/AECOM and finalized by Northgate in 2009. Northgate prepared a DVSR to assess the validity and usability of the Phase B sampling data (Northgate 2010a), which was approved by NDEP on April 14, 2010.

As reported in the 2010 Soil Gas HRA (Northgate 2010b), shallow groundwater is believed to represent the primary source of chemicals detected in soil gas. Shallow groundwater contours for chloroform suggest the existence of an off-site chloroform plume extending onto the Site from the west, in the area between Parcels C and F, and an on-site plume east of Parcels F and G (Figure 2). Other VOCs have very similar distribution patterns.

As shown in Table 2, 11 groundwater wells located in the Parcels within the shallow portion of the aquifer were sampled for VOCs (four in Parcel C, four in Parcel D, two in Parcel F, one in Parcel H, none in Parcel G) and may be used to provide additional information about chemical distributions in the Parcels. An additional 12 shallow groundwater wells were sampled for VOCs

near the Parcels (four near Parcel C, three near Parcel D, two near Parcel F, and three near Parcel H). These samples, along with the soil gas samples previously discussed in Section 1.5, can be used to better characterize contaminant distributions in the Parcels.

2.0 Soil Gas Sampling and Analysis

To meet the soil gas investigation objectives, a total of eight soil gas samples will be collected. Figure 2 identifies the shallow groundwater wells that were sampled for VOCs in and nearby the Parcels, the soil gas locations that were sampled as part of the 2008 Soil Gas Work Plan (ENSR 2008), and the soil gas locations that will be sampled to further investigate VOCs in soil gas. Additionally, Figure 2 shows the concentrations of chloroform in shallow groundwater based on the Phase A and B Groundwater Investigations as well as data obtained from NDEP's regional database (as cited by Northgate 2010b).

2.1 Pre-Sampling Activities

Prior to initiating the field work, ENVIRON will prepare a health and safety plan and coordinate and schedule utility locating, drilling, analytical laboratory, and other subcontractors as necessary. Sample locations will be cleared by an independent utility locator under the supervision of an ENVIRON engineer or geologist and notification will be made to Underground Service Alert at least three business days prior to starting drilling activities.

2.2 Health and Safety

All personnel performing work at the Site with the potential for exposure to hazardous substances or health hazards are required to be 40-hour Occupational Safety Health Administration (OSHA) trained in accordance with CFR 1910.120 and will meet the personnel training requirements in accordance with 29 CFR 1910.120(e). It is required that Level D personal protection equipment (PPE) be worn by all personnel working at the Site. It is not anticipated that an upgrade to Level C or higher PPE will be necessary, however, all on-site ENVIRON personnel and drillers working at the Site will be trained in the use and limitations of, and be qualitatively fit tested, for half-face respirators in accordance with 29 CFR 1910.134. Prior to conducting sampling activities, a health and safety meeting will be directed by an ENVIRON representative and attended by the sampling team.

2.3 Sample Locations

The soil gas sample locations are selected to provide coverage for each Parcel based upon the occurrence of VOCs identified in the 2010 Soil Gas HRA (Northgate 2010b) and in the Phase B groundwater sampling (Northgate 2010a). ENVIRON will collect a total of eight soil gas samples (two in Parcel C, one in Parcel D, three in Parcel F, and two in Parcel G) (Figure 2). The soil gas samples will be collected from 5 feet bgs.

Criteria for selecting sample locations included: location of previous soil gas samples, location of shallow groundwater samples, interpolated shallow groundwater concentrations, and direction of groundwater flow. Information presented in Northgate (2010c) on paleochannels and interceptor wells was also considered. Additionally, some soil gas locations are located near wells that were sampled and analyzed for VOCs during the Phase B investigation. The purpose of collocating soil gas borings with Phase B borings and/or groundwater monitoring wells is to

facilitate comparison of the data in soil gas and groundwater, as recommended by NDEP (NDEP 2012a). The soil gas sample locations are described in the Sections 2.3.1 through 2.3.5).

ENVIRON proposes relying on the previous soil property data collected for the Site as part of the 2010 Soil Gas HRA (Northgate 2010b) and will not collect soil samples for evaluation of soil properties. The soil property data will be used for modeling purposes in the soil gas HRA.

2.3.1 Parcel C

One soil gas sample (SG18) was collected in Parcel C as part of the 2010 sampling (Northgate 2010b) and four shallow groundwater samples (AA-BW-04A, H-28A, M-6A, and M-7B) were collected as part of the Phase B sampling (Northgate 2010a). An additional six soil gas samples (SG13, SG17, SG19, SG24, SG90, and SG91) and four groundwater samples (AA-BW-05A, M-23, MC-3, and MC97) were collected near Parcel C and can be used to provide additional information about chemical distributions in Parcel C. ENVIRON will collect two additional samples (E-SG-2 and E-SG-3) inside Parcel C and one additional sample (E-SG-1, as discussed below) located in Parcel D near the border of Parcel C (Figure 2). Sample E-SG-2 was selected to be in a region of higher measured benzene concentrations in shallow groundwater, near groundwater well MC-3, and near potential paleochannels leading from the chloroform and benzene groundwater plumes up into Parcel C. E-SG-3 was selected to be in a region of higher measured chloroform concentrations in shallow groundwater, near groundwater well AA-BW-04A, and near potential paleochannels leading from the chloroform groundwater plume up into Parcel C. With these additional samples, there will be four paired soil gas and groundwater samples, four samples collected near potential paleochannels, and samples collected near predicted maximum concentrations of chloroform and benzene as measured and interpolated in shallow groundwater.

2.3.2 Parcel D

One soil gas sample (SG16) was collected in Parcel D as part of the 2010 sampling (Northgate 2010b) and four shallow groundwater samples (M-23, MC45, MC53, and MC94) were collected as part of the Phase B sampling (Northgate 2010a). An additional seven soil gas samples (SG06, SG11, SG12, SG13, SG14, SG17, and SG18) and three groundwater samples (M-48, MC97, and PC37) were collected near Parcel D and can be used to provide additional information about chemical distributions in the Parcel. ENVIRON will collect one additional sample (E-SG-1) as shown on Figure 2, located in Parcel D near the border of Parcel C. This additional sample can be used to better characterize contaminant distributions along the southern portion of Parcel D and the northern portion of Parcel C. For both Parcels, this location is in a region without nearby soil gas or groundwater samples. The remainder of Parcel D has adequate soil gas sampling either inside the Parcel, or nearby and upgradient of the Parcel. With this additional sample, there will be four paired soil gas and groundwater samples, one sample collected in the path of potential paleochannels, and samples collected near predicted maximum concentrations of chloroform as interpolated in shallow groundwater.

2.3.3 Parcel F

One soil gas sample (SG34) was collected in Parcel F as part of the 2010 sampling (Northgate 2010b) and two shallow groundwater samples (TR-6 and M92) were collected as part of the Phase B sampling (Northgate 2010a). An additional six soil gas samples (SG63, SG33, SG74, SG73, SG72, and SG88) and two groundwater samples (M97 and M124) were collected near Parcel F and can be used to provide additional information about chemical distributions in the Parcel. ENVIRON will collect three additional samples (E-SG-4, E-SG-5, and E-SG-6) inside the Parcel, as shown on Figure 2. E-SG-4 and E-SG-5 were selected to be in the western portion of the site, near higher predicted chloroform concentrations in shallow groundwater. However, two samples are required to adequately characterize both the southwestern and the northwestern portions of Parcel F. Sample E-SG-6 is also recommended to better characterize the northern portion of the Parcel as sampling north of Parcel F indicates there may be rapid changes in chloroform concentrations over relatively small distances in this region. With these additional samples, there will be two paired soil gas and groundwater samples, and samples collected near predicted maximum concentrations of chloroform as interpolated in shallow groundwater.

2.3.4 Parcel G

One soil gas sample (SG45) was collected in Parcel G as part of the 2010 sampling (Northgate 2010b). An additional two soil gas samples (SG44 and SG64) were collected near Parcel G and can be used to provide additional information about chemical distributions in the Parcel. No shallow groundwater samples were collected as part of the Phase B sampling that are in or near Parcel G (Northgate 2010a). ENVIRON will collect two additional samples (E-SG-7 and E-SG-8) inside the Parcel, as shown on Figure 2. E-SG-7 and E-SG-8 were selected to be in the western portion of the Parcel, near higher predicted chloroform concentrations in shallow groundwater. The two samples are required to adequately characterize both the southwestern and the northwestern portions of Parcel G. Parcel G is relatively small, and the eastern portion of the Parcel is well characterized by soil gas samples in or near the Parcel.

2.3.5 Parcel H

Two soil gas samples (SG49 and SG50) were collected in Parcel H as part of the 2010 sampling (Northgate 2010b), and one shallow groundwater sample (M-103) was collected as part of the Phase B sampling (Northgate 2010a). An additional five soil gas samples (SG47, SG66, SG67, SG68, and SG48) and three groundwater samples (M10, M137, and M138) were collected near Parcel H and can be used to provide additional information about chemical distributions in the Parcel. Parcel H appears to be upgradient of potential chemical plumes and is characterized by soil gas samples on the southwestern, northern, and eastern portions of the Parcel. As such, ENVIRON concludes that adequate soil gas and groundwater samples exist to characterize the contaminant distribution in Parcel H, and no additional samples are recommended.

2.4 Sampling Methodology

The eight soil gas sampling locations (E-SG-1 through E-SG-8) proposed by ENVIRON are shown on Figure 2. Based on utility clearing, access limitations, and other field observations, the

actual soil gas sample locations and depths may deviate from those proposed herein. In general, the planned depth for the temporary probes is five feet bgs.

To install the soil gas probes, borings will be advanced using direct-push tooling consisting of one to two-inch diameter drive rods. All borings will be continuously-cored to avoid compressing the surrounding formation. The soil cores will be collected in acetate sleeves to observe the soil conditions and adjust the soil gas probe depth as necessary. Limited access to some of the inside locations may necessitate drilling by hand auger rather than by direct push.

Each semi-permanent soil gas probe will be constructed by placing a new half-inch sintered stainless steel filter at the target depth. New 0.25-inch outside diameter (0.187-inch inside diameter) Teflon® tubing will be attached to the filter, and will extend in one piece to above the ground surface. The filter will be emplaced within approximately one foot of sand pack comprised of clean, kiln-dried Monterrey 30-mesh sand. Approximately two inches of dry granular bentonite will be emplaced on top of the sand pack to ensure that the sand pack will not be plugged when the remaining borehole is sealed with hydrated granular bentonite. The tubing will be labeled at the surface for the location and depth. A gas-tight Swagelok® fitting will cap the sampling tube and allow the direct attachment of the sampling train. As necessary, the surface of the temporary soil gas probes will be completed to allow coiling of the tubing for storage and a protective flush-mount cap.

Soil gas probes installed using direct-push tooling will be allowed to equilibrate a minimum of 30 minutes before sampling. Following equilibration, a laboratory-supplied 1-liter Summa™ canister will be attached to the tubing via quarter-inch Swagelok fittings. A laboratory-supplied critical orifice flow controller (calibrated to 100-200 milliliters per minute, ml/min) with integral particulate filter will be installed immediately upstream of the Summa™ canister. The sample connections will then be tested using a shut-in test to confirm the integrity of the sample connections. Once connections are checked, soil gas will be withdrawn from the Teflon® tubing using a small calibrated syringe or an evacuated purge Summa™ canister connected via a shut-off valve. The first three dead volumes of soil gas will be discarded to purge the sample tubing. The syringe will be filled at a rate not to exceed 200 milliliters (ml) per minute (generally a 15-second fill time for a 50-ml syringe). After purging, the soil gas sample will be 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 will be recorded in the field notes. Following sampling or at a later date, the tubing will be pulled from the ground and the surface patched to match surroundings. During sampling, a tracer gas atmosphere will be generated, maintained, and monitored around the top of the soil vapor probe where the tubing exits the ground and around sample connections. It is anticipated that helium will be used as a tracer gas for this scope of work, but other leak check compounds may be used as long as the compound can be analyzed in the collected soil gas samples. A plastic shroud (i.e., a transparent Tupperware® container or similar) with pliable weather stripping along its base will be used to maintain the tracer gas atmosphere around the top of the probe.

ENVIRON will be present during drilling to maintain a log of the borings, make observations of the work area conditions, conduct health and safety monitoring of possible organic vapors

encountered during drilling, screen and log soil cores, direct the installation of the soil probes, perform leak testing, and collect and maintain custody of soil gas and field quality control (QC) samples. Field QC samples for this investigation will consist of one duplicate soil gas sample and one trip blank sample.

2.5 Sample Handling and Chain-of-Custody

Each lot of sampling containers will be certified as contaminant-free by the laboratory. Samples will be collected, handled, and stored in such a manner that they are representative of their original condition and chemical composition. For soil gas samples collected in Summa™ canisters, this generally means that the containers are free of leaks before, during, and after sampling. The occurrence of leaks will be mitigated through the use of proper tools and tightening canister fittings according to manufacture specifications. Leaks will be identified through the use of vacuum checks before and after sampling as well as before and after transport to the laboratory.

Identification of samples and maintenance of custody are important elements that must also be utilized to ensure samples characterize site conditions. All samples will be properly identified and maintained under chain-of-custody protocol to protect sample integrity. Sample chain-of-custody procedures will be used to maintain and document sample integrity during collection, transportation, storage, and analysis. A sample is considered to be under the control of, and in the custody of, the responsible person if the samples are in their physical possession, locked or sealed in a tamper-proof container, or stored in a secure area.

The Chain-of-Custody form provides an accurate written record that traces the possession of individual samples from the time of collection in the field until they are accepted at the analytical laboratory. The Chain-of-Custody form also documents the samples collected and the analyses requested. The field sampler will sign the Chain-of-Custody and will record the time and date at the time of transfer to the laboratory or an intermediate person. A set of signatures is required for each relinquished/received transfer, including internal transfer. The original imprint of the Chain-of-Custody will accompany the sample containers and a duplicate copy will be kept in the project file.

If the samples are to be shipped to the laboratory, the original Chain-of-Custody relinquishing the samples will be sealed inside a plastic bag within the shipping box and the box will be sealed with custody tape that has been signed and dated by the last person listed on the Chain-of-Custody. U.S. Department of Transportation shipping requirements will be followed and the sample shipping receipt will be retained in the project files as part of the permanent Chain-of-Custody document. The shipping company (e.g., Federal Express, UPS) will not sign the Chain-of-Custody forms as a receiver; instead the laboratory will sign as a receiver when the samples are received.

2.6 Analytical Testing

Soil gas samples and QC samples will be submitted to a qualified licensed analytical laboratory under chain-of-custody protocol for analysis of the entire suite of compounds by USEPA Method

TO-15 on a standard 10-day turn-around time. The reporting limits will be presented in the Quality Assurance Project Plan.

2.7 Equipment Decontamination

Prior to mobilizing the sampling rigs to the Site, the rig and all associated equipment will be cleaned with a high-pressure, steam washer to remove any oil, grease, mud, tar, and other foreign matter. In order to minimize the potential for cross-contamination, equipment used during the field investigation (including all non-dedicated sampling equipment) will be decontaminated between uses at each sampling location. Decontamination will consist of a detergent wash (Alconox or equivalent) followed by a clean water wash, and finally a clean water rinse; or alternatively, using high pressure steam washer.

Sample containers, soil gas manifolds, critical orifice flow controllers with integral particulate filters are dedicated sampling equipment and will come certified-clean from the laboratory. Materials used for probe construction (tubing, filters, and fittings) will be purchased new and not reused.

2.8 Management of Investigation-Derived Waste

Investigation derived waste (IDW) will be collected in 5-gallon buckets or 55-gallon drums that will be labeled and sealed following completion of field activities. Each container will be marked with water-proof labels and water-proof markers. Each container will receive a unique identification number and will be cataloged for waste containment documentation purposes. Following characterization, each container of material will be disposed of as appropriate per federal, state and local requirements.

3.0 Evaluation, Interpretation, and Reporting of Results

Upon receipt of all field and analytical data, a DVSR and Vapor Intrusion HRA will be prepared. The DVSR will be developed in accordance with NDEP Guidance (NDEP 2009, 2012b). The Vapor Intrusion HRA will include the following elements:

- A description of the field methods employed, analytical methods, analytical results, data evaluation methods and data validation results;
- Laboratory analysis results presented in tabulated form;
- A scale map(s) containing the locations of the soil gas borings;
- A scale map(s) presenting the concentrations of contaminants of concern at each investigative location;
- Laboratory-certified analytical reports provided in Adobe Acrobat (.PDF) electronic form on a compact disc (CD) in an appendix;
- A human health risk assessment for the vapor intrusion pathway, including evaluation of the soil gas data using the USEPA version of the Johnson and Ettinger vapor intrusion model (USEPA, 2004a,b) as well as correlation of collocated soil gas and groundwater samples; and,
- Jurat provided by a Nevada-Certified Environmental Manager on the report.

4.0 Schedule

A schedule for implementation of the sampling activities described herein was prepared and submitted to the NDEP on September 28, 2012. As described in the schedule, ENVIRON can immediately begin preparations for the field investigation upon approval of this Work Plan. The field preparation time will be contingent on subcontractor availability, site access, weather, and other potential factors; however, in ENVIRON's experience, a field investigation of this size and type can usually be commenced within three weeks of approval of the Work Plan. It is anticipated that the pre-sampling site visit and soil gas sampling will take approximately three days to complete. However, if soil gas probes need to be installed using hand auger, an additional field day will be required to allow for the 48-hour equilibration time prior to sampling.

Within six weeks of receiving the validated analytical results, ENVIRON will submit the DVSR to the Trust. Within three weeks of receipt of the validated soil gas sampling analytical results, ENVIRON will submit the draft vapor intrusion HRA report to the Trust for review.

5.0 References

ENSR, 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada, February.

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

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

Hargis + Associates (2011). 2011 Comprehensive Groundwater Data Evaluation Report, Former Montrose and Stauffer Facilities and Current Olin Facility, Henderson, Nevada. August 18.

Kerr-McGee Chemical Corporation (KMCC), 2005. Kerr-McGee Henderson Source Area, Workplan Conceptual Approach. September 30.

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

NDEP, 2009. BMI Plant Sites and Common Areas Projects, Henderson, Nevada Supplemental Guidance on Data Validation. April 13.

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

NDEP, 2012a. NDEP Response to: Revised Closure and Post-Remediation Screening Health Risk Assessment Report for Parcels C, D, F. G, and H. Nevada Environmental Response Trust Site, Henderson, Nevada, Dated: May 18, 2012. August 7.

NDEP, 2012b. BMI Plant Sites and Common Areas Projects, Henderson, Nevada, Guidance on Unified Chemical Electronic Data Deliverable Format. March 5.

Northgate Environmental Management, Inc. (Northgate), 2010a. Revised Data Validation Summary Report, Phase B Investigation Groundwater, Tronox LLC, Henderson, Nevada. April 7.

Northgate, 2010b. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada. November 22.

Northgate, 2010c. Capture Zone Evaluation Report, Tronox LLC, Henderson, Nevada. December 10.

Tables

TABLE 1
Proposed and Existing Soil Gas Sampling Locations[a]

Parcel[b]	Sample ID Number	
Parcel C	E-SG-1	ENVIRON (proposed)
	E-SG-2	ENVIRON (proposed)
	E-SG-3	ENVIRON (proposed)
	SG13	Phase B
	SG17	Phase B
	SG18	Phase B
	SG19	Phase B
	SG24	Phase B
	SG90	Phase B
	SG91	Phase B
Parcel D	E-SG-1	ENVIRON (proposed)
	SG06	Phase B
	SG11	Phase B
	SG12	Phase B
	SG13	Phase B
	SG14	Phase B
	SG16	Phase B
	SG17	Phase B
	SG18	Phase B
Parcel F	E-SG-4	ENVIRON (proposed)
	E-SG-5	ENVIRON (proposed)
	E-SG-6	ENVIRON (proposed)
	SG33	Phase B
	SG34	Phase B
	SG63	Phase B
	SG72	Phase B
	SG73	Phase B
	SG74	Phase B
	SG88	Phase B
Parcel G	E-SG-7	ENVIRON (proposed)
	E-SG-8	ENVIRON (proposed)
	SG44	Phase B
	SG45	Phase B
	SG64	Phase B
Parcel H[c]	NS	ENVIRON (proposed)
	SG47	Phase B
	SG48	Phase B
	SG49	Phase B
	SG50	Phase B
	SG66	Phase B
	SG67	Phase B
	SG68	Phase B

Notes:
bgs = below ground surface
NS = no sample

[a] Phase B soil gas samples that will be used in support of the vapor intrusion health risk assessment were collected at a depth of 5 feet bgs. All ENVIRON samples will also be collected at 5 feet bgs.

[b] For each Parcel, listed samples include locations within or near the Parcel. Results for sample locations outside a Parcel will be discussed in the HRA, as appropriate to understanding of extent of contamination and may be used in the quantitative evaluation, as appropriate.

[c] No additional samples will be collected in Parcel H because adequate soil gas and groundwater samples exist to characterize the contaminant distribution.

TABLE 2
Shallow Groundwater Locations with VOC Sampling Data

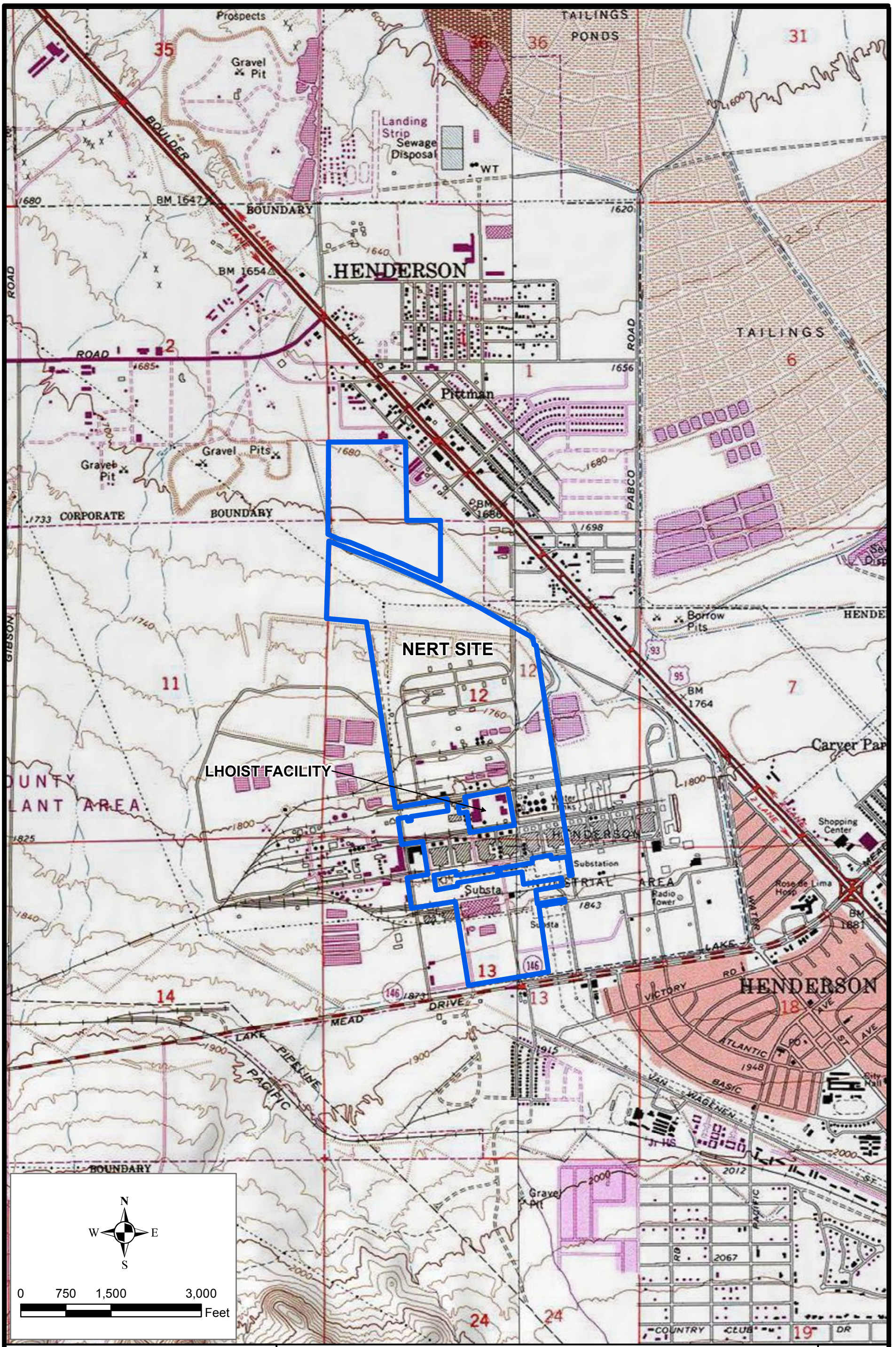
Parcel[a]	Well ID	Screen Interval (feet bgs)[b]	Lithology	Water-Bearing Zone[b]	Investigation Source (Well Owner)
Parcel C	AA-BW-04A	32 - 52	Qal	Shallow	Phase B (BRC)
	AA-BW-05A	34 - 64	Qal	Shallow	Phase B (BRC)
	H-28A	37.4 - 50.5	Qal	--	Phase B (Stauffer)
	M-6A	26.8 - 41.5	Qal/xMCf/UMCf	Shallow	Phase B (NERT)
	M-7B	25.5 - 50.5	Qal/xMCf/UMCf	Shallow	Phase B (NERT)
	M-23	9.4 - 37.4	Qal	Shallow	Phase B (NERT)
	MC3	--	Qal	Shallow	Phase B (Stauffer)
	MC97	31 - 41	Qal/UMCf	Shallow	Phase B (Stauffer)
Parcel D	M-23	9.4 - 37.4	Qal	Shallow	Phase B (NERT)
	M-48	6.1 - 36.1	Qal/xMCf/UMCf	Shallow	Phase B (NERT)
	MC45	30 - 34	Qal	Shallow	Phase B (Stauffer)
	MC53	20 - 40	Qal/UMCf	Shallow	Phase B (Stauffer)
	MC94	30 - 40	Qal/UMCf	Shallow	Phase B (Stauffer)
	MC97	31 - 41	Qal/UMCf	Shallow	Phase B (Stauffer)
	PC-37	16.8 - 41.8	Qal	Shallow	Phase B (NERT)
Parcel F	M-92	34.9 - 44.9	UMCf	Shallow	Phase B (NERT)
	M-97	35 - 45	UMCf	Shallow	Phase B (NERT)
	M124	34 - 49	UMCf	Shallow	Phase B (NERT)
	TR-6	60 - 80	UMCf	Middle	Phase B (NERT)
Parcel G[c]	NS	NS	NS	NS	NS
Parcel H	M-10	43 - 63	Qal/xMCf/UMCf	Shallow	Phase B (NERT)
	M-103	69.5 - 89.5	UMCf	Shallow	Phase B (NERT)
	M-137	52 - 72	UMCf	Shallow	Phase B (NERT)
	M-138	50.5 - 65.5	UMCf	Shallow	Phase B (NERT)

Notes:
-- = value not available
bgs = below ground surface
NS = no sample
Qal = Quaternary alluvium
UMCf =Upper Muddy Creek Formation
VOC = volatile organic compound
xMCf= transitional Muddy Creek Formation

[a] Sample locations that are located near more than one Parcel are listed for the respective Parcels.
[b] Wells located within the shallow portion of the aquifer were evaluated because the primary source of chloroform is believed to be shallow groundwater (Northgate 2010).
[c] Wells with VOC data relevanat to an understanding of soil gas contamination were not identified in Parcel G. Parcel G.

Reference:
Northgate Environmental Management, Inc. (Northgate), 2010. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada. November 22.

Figures



ENVIRON

2200 Powell St., Suite 700, Emeryville, CA 94608

Site Location Map

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **1**

Drafter: RS | Date: 10/26/2012 | Contract Number: 21-29100H | Approved by: | Revised:

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N
W E
S
0 325 650
Feet

Parcel A
Parcel B
Parcel C
Parcel D
Parcel E
Former Parcel I
Former portion of Parcel B
Former Parcel J
Parcel F
Parcel G
Parcel H

SG01 SG02 SG03 SG04 SG05 SG06 SG10 SG11 SG12 SG13 SG14 SG16 SG17 SG18 SG19 SG24 SG33 SG34 SG44 SG45 SG47 SG48 SG49 SG50 SG63 SG64 SG66 SG67 SG68 SG72 SG73 SG74 SG88 SG90 SG91

PC37

MC3 MC45 MC53 MC94 MC97

E-SG-1 E-SG-2 E-SG-3 E-SG-4 E-SG-5 E-SG-6 E-SG-7 E-SG-8

AA-BW-05A AA-BW-04A H28A M6A M7B M10 M23 M48 M92 M97 M103 M124 M137 M138 TR-6

Data Sources:
ESRI 2010 Bing Maps

Legend

Sample Locations:

- Proposed Soil Gas Sample
- Previous Phase B Soil Gas Location
- Shallow Groundwater Well with VOC Results
- Sale Parcel Boundary
- Approximate Site Boundary
- Groundwater Barrier Wall
- Well Fields

Chloroform Concentrations (µg/L)

- <1.62
- 1.62-16.2
- 16.2-162
- 162-1,620
- 1,620-16,200
- >16,200

Chloroform sampling data from 2006 to 2009.
Based on Figure 5 of Northgate 2010b.

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Soil Gas and Groundwater Sampling Locations

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure 2

Drafter: EA/RS Date: 10/26/12 Contract Number: 21-29100H Approved by: JMP Revised: