Eagle Picher Carefree Batteries Superfund Site Final Baseline Risk Assessment

Prepared for

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Certification

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned.

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Key Terms

1,1,1-TCA	1,1,1-trichloroethane
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethylene
1,2-DCA	1,2-dichloroethane
95% UCL	95 percent upper confidence level on the mean
ACBM	asbestos containing building material
ALM	Adult Lead Model
As	arsenic
BISON-M	Biota Information System of New Mexico
BKSF	biokinetic slope factor
BLL	blood lead level
BLRA	Baseline Risk Assessment
Cd	cadmium
cis-1,2-DCE	cis-1,2-dichlorethylene
CLP	Contract Laboratory Program
Co	cobalt
COPC	contaminant of potential concern
Cr	chromium
Cr^{+3}	trivalent chromium
Cr^{+6}	hexavalent chromium
CSF	cancer slope factor
CSM	conceptual site model
DBS&A	Daniel B. Stephens & Associates, Inc.
DWBZ	deep water-bearing zone
EcoRA	ecological risk assessment
Eco-SL	ecological screening level

EcoSSL	ecological soil screening level
ECR	excess lifetime cancer risk
EEC	environmental exposure concentration
Fe	iron
FOD	frequency of detection
ft bgs	feet below ground surface
ft msl	feet above mean sea level
HHRA	human health risk assessment
HQ	hazard quotient
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
IWBZ	water-bearing zone
LBP	lead-based paint
LOAEL	lowest observed adverse effect level
MCL	maximum contaminant level
MDL	method detection limit
mg/kg	milligrams per kilogram
Mn	manganese
NMED	New Mexico Environment Department
NMT	New Mexico Institute of Mining and Technology (also known as "New Mexico Tech")
NOAEL	no observed adverse effect level
ORP	oxidation/reduction potential
Pb	lead
PCE	tetrachloroethylene
PQL	practical quantitation level
PSG	passive soil gas
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RI/FS	Remedial Investigation and Feasibility Study
RSL	regional screening level
Site	Eagle Picher Carefree Batteries Superfund Site
SL	screening level
SSL	soil screening level
SWBZ	shallow water-bearing zone
TCE	trichloroethylene
The City	the City of Socorro, New Mexico
TRV	toxicity reference value
USEPA	United States Environmental Protection Agency

VOC	volatile organic compound
XRF	X-ray fluorescence
µg/L	micrograms per liter
µg/L/d	micrograms per liter per day
µg/m^3	micrograms per cubic meter

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Executive Summary

Parametrix has prepared this Baseline Risk Assessment (BLRA) to support the Remedial Investigation and Feasibility Study (RI/FS) activities for the Eagle Picher Carefree Batteries Superfund Site. The purpose of this BLRA is to estimate the likelihood and magnitude of risks to human and ecological receptors posed by current or likely future exposure to contaminants of potential concern (COPCs) in soil, groundwater, plants, and biota at the Eagle Picher site and in the area of potential groundwater contamination to the south (plume area).

For the purposes of this investigation the Eagle Picher site (the Site) is defined to include the former Eagle Picher manufacturing facilities and surrounding properties east and west of New Mexico Highway 408 as shown on Figure 1. The study area of the RI encompasses both the Site and the groundwater plume area extending south of the Site to the New Mexico Institute of Technology (NMT) golf course

The Site encompasses approximately 173 acres and is owned by the City of Socorro (the City). The City, the New Mexico Environment Department (NMED), and the U.S. Environmental Protection Agency (USEPA) need to characterize risks associated with the Site and plume area to understand potential environmental liabilities that could materially impact redevelopment of the Site as commercial or industrial real estate, or that may affect future Site workers or area residents, as well as wildlife that live in or use the study area.

Contamination of soils at the Site and groundwater in the plume area are a result of disposal practices from historical manufacturing processes conducted on-Site and subsequent land use activities at the Site. Numerous investigative activities occurring at the Site and surrounding area since the 1980s identified elevated heavy metals concentrations in soils at the Site and elevated volatile organic compound (VOC) concentrations in plume area groundwater. Primary COPCs for the study area are heavy metals (cadmium [Cd], chromium [Cr], and lead [Pb]), chlorinated solvents (including 1,1-dichloroethylene [1,1-DCE], tetrachloroethylene [PCE], and trichloroethylene [TCE]), lead-based paint (LBP), and asbestos containing building material (ACBM).

In 2012, the NMED conducted groundwater sampling activities and a passive soil gas (PSG) survey to delineate the southern extent of the plume and attempt to identify any other possible TCE sources. In 2012 and 2013, Daniel B. Stephens & Associates (DBS&A) completed soil and groundwater sampling activities and a PSG survey to characterize the nature and extent of contamination in the study area for the RI/FS. DBS&A also surveyed and tested existing structures on-Site for the presence of hazardous materials (LBP and ACBM). Data from the NMED's 2012 sampling and DBS&A's 2012 and 2013 sampling were used to estimate the likelihood and magnitude of risks from COPCs based on complete exposure pathways for human and ecological receptors.

Human Health Risk Assessment

For the human health risk assessment (HHRA), environmental media that may serve as sources of human contact to COPCs are soil (surface and subsurface), groundwater, and indoor air. Complete exposure pathways identified in the conceptual site model (CSM) and quantitatively assessed in the HHRA are:

- Current or Future Off-Site Resident or Farmer
  - Ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing)
  - Dermal contact with groundwater
  - Ingestion of fruits and vegetables irrigated with groundwater
  - Inhalation of volatiles migrating from groundwater to indoor air
- Current or Future Off-Site Commercial/Industrial Worker
  - Inhalation of volatiles migrating from groundwater to indoor air
- Hypothetical Future On-Site Commercial/Industrial or Construction Worker
  - Ingestion of and dermal contact with surface soils
  - Ingestion of and dermal contact with subsurface soils
  - Inhalation of suspended soil particulates
  - Ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing)

- Dermal exposure to groundwater
- Inhalation of volatiles migrating from groundwater to indoor air

- Current or Future On-Site Intermittent Visitor (Trespasser, Recreator, or Visitor)
  - Ingestion of and dermal contact with surface soils
  - Ingestion of and dermal contact with subsurface soils
  - Inhalation of suspended soil particulates

The exposure pathways for LBP and ACBM were identified as complete at the Site for on-Site construction/industrial workers and intermittent visitors; however, they were only evaluated qualitatively in the HHRA. The preferred action is to demolish the buildings and clean up the ground adjacent to the buildings, and any such work will comply with state and federal standards to prevent worker exposure and release of hazardous materials, as well as ensure proper disposal of the building materials. If any of the buildings are not demolished, other abatement measures will be necessary to prevent exposure.

For other COPCs, a screening assessment was conducted to compare individual sample results to NMED and USEPA human health screening levels (SLs). All SLs were based on the NMED's recommended risk levels of 1×10^{-5} (1E-05) for carcinogens or 1.0 for noncarcinogens. From this screening assessment, the following COPCs were identified for further evaluation in the HHRA: Pb in Site soils and 1,1-DCE, PCE, and TCE in plume area groundwater.

Exposure to Pb in Site soils was assessed using USEPA's Adult Lead Model (ALM) (USEPA 1996). To characterize toxicity effects of other COPCs, chemical-specific and media-specific toxicity values for each COPC were identified from USEPA's May 2013 RSLs (USEPA 2013a). Risks from vapor intrusion were calculated using USEPA's Vapor Intrusion Assessment Calculators (USEPA 2013b), and risks from ingestion of irrigated fruits and vegetables were calculated using risk-based concentrations from Department of Energy's Risk Assessment Information System Preliminary Remediation Goals Calculator (Department of Energy 2014) . Noncancer health effects were quantified using a hazard quotient (HQ), the ratio of the estimated noncancer exposure dose to a published noncancer reference dose. Individual excess lifetime cancer risk (ECR) was evaluated using the estimated lifetime exposure and published cancer toxicity value. Following NMED guidance (2012), an ECR of 1E-05 and an HQ of 1 were used as thresholds for this risk characterization. However, USEPA (1989) often uses a range of 1E-04 to 1E-06 to evaluate potential cancer risks and remedial alternatives.

For the ALM, USEPA has selected a target blood lead level (BLL) for an adult female to protect a developing fetus such that the fetus has no more than a

5-percent probability of a BLL exceeding 10 micrograms per liter per day. The ALM indicated that risks from exposure to Pb in Site soils, based on an average Pb concentration for all Site soils, are below the BLL and probability targets. The ALM was modified to evaluate exposure to intermittent visitors (i.e., trespassers, recreators, or visitors) on-Site, and this modified ALM also indicated that risks are below the BLL and probability targets. Consequently, current Pb concentrations do not present an elevated risk for adult workers on-Site or intermittent visitors.

Ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing) and dermal exposure to groundwater were evaluated for each well individually from the plume area for both carcinogenic and noncarcinogenic risks, with TCE cancer risk estimates adjusted for mutagenicity. Within the plume area, 19 of the 33 wells were identified as having elevated risks from ingesting and inhaling VOCs (including all uses of household water, such as showering/bathing, laundering, and dishwashing) in groundwater (ECRs ranging from 1E-05 to 5E-04 and HQs ranging from 1.4 to 162): 1 former municipal supply well (Olson), 6 domestic wells (Alice Ease, Alice West, Hooper, Knight, Lopez, and Padilla), and 12 monitoring wells that are not used for water supply. Elevated risks were due to TCE in all 19 of these wells, although 1,1-DCE also had HQs greater than 1 for two domestic wells (Alice East and Padilla) and one monitoring well (DW-2). Residences with contaminated domestic wells have been connected to the municipal water supply; however, domestic well water use for indoor and/or outdoor purposes may still occur, and the extent of use is unknown. Water from the Alice West well is known to be used for showering/bathing, and water from the Hooper well is known to be used in swimming pools. Risks from exposure to VOCs in groundwater are likely substantially reduced for residents using municipal water.

Because water from some domestic wells may be used by residents for household use (including showering/bathing, laundering, and dishwashing) and for outdoor use (e.g., swimming pools) risks from dermal exposure to residents (child + adult) were evaluated. Exposure factors used in the risk calculations follow USEPA (2004), and daily showering/bathing was used to evaluate potential risk. Of the eight domestic wells evaluated, three were identified as having elevated risks from VOCs (primarily TCE) in groundwater (Alice East, Lopez, and Padilla), with ECRs ranging from 8E-06 to 4E-05 (within USEPA's acceptable range of 1E-06 to 1E-04) and HQs ranging from 1.2 to 7.2. The extent of domestic well water use for indoor and/or outdoor purposes is unknown; however, water from the Alice West well is known to be used for showering/bathing, and water from the Hooper well is known to be used in swimming pools.

Because water from some wells may be used by residents or farmers to irrigate vegetable gardens or fruit or nut trees, risks from ingesting fruits and vegetables irrigated with groundwater were evaluated. This evaluation was conducted only for the domestic supply wells because monitoring wells are not used by residents for water supply; PCE, TCE, and 1,1-DCE were not detected or detected at very low levels in the wells that are still used as municipal supply wells; and water from municipal supply wells is pre-treated to remove contaminants (Appendix A, Table A-6). Of the eight domestic wells evaluated, four were identified as having elevated risks from VOCs (almost entirely TCE) in fruits and vegetables irrigated with groundwater (Alice East, Alice West, Lopez, and Padilla), with ECRs ranging from 1E-05 to 1E-04 and HQs ranging from 1.6 to 19 (Appendix C, Table C-10). The extent of domestic well water use for irrigation is unknown; however, water from the Alice East well is known to be used for irrigation.

Risks from inhalation of VOCs migrating into indoor air from plume area groundwater were evaluated for individual groundwater wells that were screened at the water table. Indoor air exposure to VOCs via vapor intrusion estimated from plume area groundwater, as well as exterior soil gas, resulted in 4 of the 15 wells screened at the water table and one exterior soil gas sample with ECRs ranging from 1E-05 to 5E-05 (within USEPA's acceptable range of 1E-06 to 1E-04) and noncancer HQs greater than 1 (ranging from 2.3 to 11). For these four wells (OMW-6, OMW-7, SW-4, and SW-6) and one exterior soil gas sample (SGT-9), TCE concentrations were the primary contributors to the calculated HQs and ECRs. For commercial/industrial workers, the ECRs and HQs were lower, but three of the four wells (OMW-6, OMW-7, and SW-4) and the exterior soil gas sample (SGT-9) were identified as having elevated risks (ECRs ranging from 3E-06 to 8E-06 and HQs ranging from 1.0 to 2.6) (Appendix C, Tables C-11 and C-12). However, the model used to calculate indoor air concentrations from groundwater and exterior soil gas concentrations may be overestimating indoor air concentrations because the model relies on a number of conservative assumptions regarding subsurface to surface transport that could over-predict the amount of VOCs migrating into buildings. Further investigative efforts should therefore be focused on potentially affected buildings near the four wells and one exterior soil gas sampling location where ECRs and HQs from VOCs were elevated.

Based on all the exposure pathways evaluated, TCE is the primary constituent of concern in plume area groundwater. Elevated potential risks were identified for vapor intrusion from groundwater in monitoring wells OMW-6, OMW-7, SW-4, and SW-6, and from exterior soil gas at sample location SGT-9 near monitoring well OMW-7. Elevated potential risks were also identified for groundwater in several plume area domestic wells based on ingestion/inhalation, dermal exposure, and/or ingestion of irrigated fruits and vegetables: Alice East, Alice West, Hooper, Knight, Lopez, and Padilla. Residences with contaminated domestic wells have been connected to the municipal water supply; however, domestic well water use for indoor and/or outdoor purposes may still occur, and the extent of use is unknown. Water from the Alice West well is known to be used for showering/bathing, water from the Hooper well is known to be used in swimming pools, and water from the Alice East well is known to be used for irrigation. The calculated potential risks for exposure to VOCs in groundwater assume no use of municipal water, so risks from ingestion/inhalation, dermal exposure, and/or ingestion of irrigated fruits and vegetables are likely reduced for residents using municipal water.

Ecological Risk Assessment

Based on the history of the Site and the on-Site/off-Site nature of the contamination, consideration of potential ecological receptors was assessed by location for the ecological risk assessment (EcoRA). A site visit to the study area was conducted on November 15, 2012, to identify likely plant and animal receptors, as well as habitat types, present at the Site and in the plume area.

The Eagle Picher Site is a heavily disturbed and very weedy light industrial site with soils that are dry and primarily sandy. Patchy scrub/shrub vegetation covers most of the Site; there are no wooded or open field areas, and little available forage was observed on-Site. The Site was found to be generally devoid of animal life. A few harvester ants were seen, but no fish or mammals were observed, and no evidence of burrowing animals was observed. White-crowned sparrows were observed in shrubs, mostly along fences. The future land use on the Site will likely be limited to commercial and industrial activities, and the types of ecological receptors currently present are not expected to change.

The plume area is a mix of land uses, mostly rural with some residences; however, it also extends into the city and includes the northern portion of the NMT golf course. Approximately 20 percent of the plume area appears to be undisturbed. Sparse scrub/shrub vegetation covers most of the plume area; there are some open fields that are disturbed areas with patchy vegetation dominated by grasses and forbs. There is a wooded riparian habitat with mature cottonwood and tamarisk bordering the borrow pit on the east side of the plume area. Remaining areas are covered by residential landscaping and the NMT golf course. Several animal species were observed in the plume area: white-crowned sparrows, black-tailed jackrabbits, Gambel's quails, crows, coyote (scat and tracks), northern harriers, and cow (tracks). The future land use of the plume area will likely be a mix of residential housing, community agriculture, agriculture/farming, manufacturing, and commercial/industrial activities. Assuming existing habitat conditions remain unchanged, the types of ecological receptors currently present are not expected to change as a result of future activities.

The plume area includes three ponds, two associated with the NMT golf course, and the other an old quarry (i.e., borrow pit pond). The ponds appear to be fed by surface runoff, and no points of discharge were observed. No samples were collected from the golf course ponds during RI/FS sampling, so whether either of the ponds is connected to shallow groundwater is not known. Sampling of the borrow pit pond (locally known as the “Hefner Pond”) in 2006 did not indicate any contamination resulting from a groundwater connection to the groundwater plume. However, no samples were collected from this pond during RI/FS sampling due to access restrictions, so whether it is currently connected to shallow groundwater is not known.

Surrogate receptors representative of the groups of animals that are or could be present at the site were evaluated to address potential exposure for different trophic levels and feeding guilds representing different modes of exposure to Site COPCs. The general ecological trophic groups, with example surrogate receptors, evaluated in the EcoRA were:

- Terrestrial plants (primary producers, trophic level 1)
- Soil invertebrates (herbivores/detritivores, trophic level 2)
- Omnivorous mammals (e.g., rodents, trophic level 3)
- Omnivorous birds (e.g., sparrows, trophic level 3)
- Carnivorous mammals (e.g., coyote, trophic level 4)

In addition to plants and soil invertebrates, three wildlife species were selected as representative ecological receptors to characterize risk from exposure to Site soils: house sparrow, desert shrew, and coyote. These receptors are common residents in the shrub/scrub environments present at the Site, are consistent with those species identified by the NMED (2008) as appropriate for evaluating ecological risks, and have foraging habits consistent with the likely exposure pathways identified for the Site: particle inhalation, ingestion, and direct contact for heavy metals, and inhalation for VOCs.

Soil concentrations were screened against ecological SLs from the Los Alamos ECORISK Database (version 3.1) (LANL 2012), USEPA Region 5 (USEPA 2003b), and USEPA Ecological soil SLs (EcoSSLs) (USEPA 2005a,b; 2008). Based on the screening assessment of soil samples, Cd, Cr, and Pb were identified as COPCs posing potential ecological risk from exposure to Site soils.

Dermal contact and inhalation pathways were assessed qualitatively rather than quantitatively in the EcoRA. Because substantial VOCs have not been identified at the Site and VOCs rapidly volatilize from surface soil, dermal contact by terrestrial wildlife to VOCs is expected to be minimal (USEPA 2003c). For the inhalation pathway, VOCs are expected to disperse very rapidly in air following volatilization from soil or groundwater, and they are unlikely to be taken up and bioaccumulated in plant and animal tissues at significant levels (USEPA and USACE, 1998). Additionally, most VOCs are generally not highly toxic to wildlife species (USEPA 2003c).

Toxicity reference values (TRVs) used for the three representative ecological receptors were avian and mammalian no observed adverse effect levels (NOAELs) and lowest observed adverse effect levels (LOAELs) reported in USEPA's EcoSSL documents for Cd, Cr, and Pb (USEPA 2005a,b, 2008). The 95% upper confidence limit on the mean concentration (95% UCL) was used to estimate the exposure concentration for each COPC. Risk estimates were calculated by a ratio of the estimated exposure concentration (EEC) and the toxicity benchmark (i.e., HQ).

Potential risks to terrestrial wildlife posed by COPCs in Site soils were evaluated using several lines of evidence. Cr and Pb contributed most to the NOAEL and LOAEL exceedances (HQs > 1), while Cd contributed little to the benchmark exceedances. EECs exceeded NOAELs and LOAELs for all three receptors, although the HQs for the coyote were much lower than those for the house sparrow and desert shrew.

Through visual inspection of the data and distributions of Site soil concentrations, three isolated areas were identified with elevated concentrations: (1) around the unlined sewage lagoons, (2) at the former manufacturing building, and (3) southwest of the former manufacturing building (in an area of visible battery debris). To avoid overestimating risks Site-wide, an analysis of risks was conducted by excluding these areas of elevated contamination. After excluding soil samples from the three isolated areas with high Cd, Cr, and Pb concentrations, the number and magnitude of benchmark exceedances from the remaining Site were substantially reduced. Only one Pb concentration exceeded the terrestrial plant benchmark, and the Pb EEC did not exceed the benchmark. Individual Cr concentrations and the Cr EEC were all below the benchmark. Site-wide NOAEL and LOAEL HQs for house sparrow and desert shrew were reduced by about a factor of 10.

The risk estimates obtained in this analysis may be overestimated due to the use of conservative exposure metrics and assuming 100 percent metal bioavailability. Based on the results of this EcoRA, the presence of metals (Cr and Pb) in surface soils (limited to the unlined sewage lagoons, former manufacturing building, and an area southwest of the former manufacturing building where battery debris is visible) pose a potential risk to ecological receptors, and access to this area should be limited or surface soils removed to limit exposure.

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1 Introduction

Parametrix has prepared this Baseline Risk Assessment (BLRA) to support the Remedial Investigation and Feasibility Study (RI/FS) activities for the Eagle Picher Carefree Batteries Superfund Site, which was added to the National Priorities List on September 19, 2007. The Eagle Picher Carefree Batteries Superfund Site includes both the former Eagle Picher industrial site, as well as the area of potential groundwater contamination to the south (plume area). For the purposes of the RI/FS and this BLRA, the Eagle Picher site (the Site) is defined to include the former Eagle Picher manufacturing facilities and surrounding properties east and west of New Mexico Highway 408 as shown in Figure 1. The study area of the RI encompasses both the Site and the groundwater plume area extending south of the Site to the New Mexico Institute of Mining and Technology (NMT) golf course.

The current owner of the Site is the City of Socorro (the City). The Site has been planned for potential redevelopment with commercial or industrial uses. The City, the New Mexico Environment Department (NMED), and the U.S. Environmental Protection Agency (USEPA) are interested in characterizing risks associated with the Site because of the need to understand potential environmental liabilities that could materially impact redevelopment of the Site as commercial or industrial real estate, or that may affect future Site workers or study area residents, as well as wildlife that live in or use the study area (Daniel B. Stephens & Associates [DBS&A] 2012).

This BLRA has been prepared following published guidance from the NMED and USEPA (NMED 2008, 2012; USEPA 1989, 2004, 2009a). The purpose of the BLRA is to estimate the likelihood and magnitude of potential risks to human and ecological receptors posed by current or likely future exposure to metals and volatile organic compounds (VOCs) in soil, groundwater, plants, and biota at the Site and in groundwater south of the Site. Elevated metals concentrations have been identified in soils at the Site and elevated VOC concentrations have been identified in plume area groundwater. These elevated concentrations are primarily a result of releases from historical manufacturing activities at the Site, which are described in more detail below.

The remainder of this section summarizes the Site history, including historical Site owners and associated uses, as well as previous investigations. It also provides a brief description of RI/FS sampling conducted by DBS&A. Section 2 describes hydrogeology in the area, and Section 3 discusses sources of contamination at the Site. Section 4 presents the human health risk assessment (HHRA), and Section 5 presents the ecological risk assessment (EcoRA). Each of the risk assessments includes the following components.

1. Conceptual Site Model (CSM) – identification of primary Site-related chemical sources and environmental release mechanisms, transport routes and media (e.g., surface soil, groundwater), exposure pathways, and potential categories of receptors considered in conducting the risk assessment.
2. Screening Assessment – comparison of individual sample results to risk-based screening levels (SLs) to identify those exposure pathways and contaminants of potential concern (COPCs) that may pose risk in the study area.
3. Exposure Assessment – calculation of exposure concentrations for COPCs in environmental samples to evaluate risks to receptors potentially exposed to contaminated media.
4. Toxicity Effects Assessment – identification of appropriate toxicity values for the risk assessment.
5. Risk Characterization – characterization of risk from exposure to contaminated media.
6. Uncertainty Analysis – discussion of uncertainty associated with assumptions used in the risk assessment and how the variability in the assumptions affects the risk estimates.
7. Summary and Conclusions – synthesis of risk assessment results.

1.1 Site History

The Site encompasses approximately 173 acres located 2 miles north of Socorro, New Mexico (Figure 1). A chronology of historical Site owners and associated uses and a summary of previous Site investigations are provided below (from DBS&A 2012).

1.1.1 Site Owners and Uses

A chronology of the historical Site owners with associated uses as detailed below is based on work performed by Ecology and Environment (E&E 2007):

- 1932 to 1956: The Site was owned by the U.S. government with barracks constructed for use by the Civilian Conservation Corps. The facilities were later used by the State of New Mexico as a tuberculosis sanitarium.
- 1964 to 1976*:* After the sanitarium closed, the City acquired the property and subsequently sold it to Eagle Picher, Inc., in 1964. Eagle Picher manufactured various products, including printed circuit boards. What is now the former manufacturing building was constructed at the Site after a fire destroyed older sanitarium buildings used by Eagle Picher. Domestic sewage and industrial waste were discharged into unlined lagoons (Figure 1).
- 1977 to 1980*:* The City reacquired the property from Eagle Picher and leased part of the former manufacturing building to a jewelry manufacturer. The City also owned and operated a municipal landfill, located north of the former manufacturing building, from 1977 to January 1980.
- 1980 to 2000*:* Eagle Picher reoccupied the property with a lease from the City and produced non-automotive lead-acid batteries until the late 1990s. In the 1980s, Eagle Picher constructed two lined evaporation impoundments southwest of the former manufacturing building for containment of industrial waste (Figure 1). In 1988, the facility began the Resource Conservation and Recovery Act (RCRA) permitting process; however, the unlined lagoons were used until 1989. The industrial impoundments underwent RCRA closure in the 1990s, and Eagle Picher left the Site permanently in 2000.
- 2000 to present*:* The building and approximately 11 acres on the east side of the property were leased by the City for use as a motocross track. A flood in 2006 damaged the building and track, exposing lead battery plates and straps. The motocross operation was terminated, and this portion of the property is no longer used. A paintball operation was present on the northern portion of the Site; however, it is no longer operating. The Site is currently unoccupied and not being used for any business purposes.

1.1.2 Summary of Previous Investigations

Numerous investigation activities have occurred at the Site and surrounding area. These are detailed below (from DBS&A 2012):

- During routine Safe Drinking Water Act sampling, trichloroethylene (TCE) was detected in the Eagle Picher municipal supply well in 1987 and in the Olson municipal supply well in 1989, resulting in quarterly monitoring of both wells.
- A site inspection of the former Socorro landfill, which included the installation of three groundwater monitoring wells, was conducted by the NMED in November 1989. TCE was not detected in the wells; however, there was one detection of 1,2-dichloroethane (1,2-DCA) at a concentration of 60 micrograms per liter (µg/L). The landfill was eliminated as the source of TCE.
- A wellhead protection study performed by the NMED in 1991 indicated that the Eagle Picher facility may be the source of the TCE (NMED 1991).
- An expanded site investigation was conducted at the Site in November 1996. Analysis of soil and groundwater samples collected at the Site indicated elevated chromium (Cr) and lead (Pb) concentrations in the soil. It was concluded that TCE in the Eagle Picher well was from sources at the Eagle Picher facility. Soil and air exposure pathways were deemed insignificant (NMED 1996).
- In 1999, USEPA Region 6 issued a No Further Remedial Action Planned determination for the Site.
- The NMED completed an integrated assessment for the Olson well site in 1999 and 2000 (NMED 2001) that included sampling the Olson well and 15 nearby domestic wells, performing a soil vapor survey, installing and sampling 7 monitoring wells, and collecting soil samples. TCE was detected in 3 domestic wells and in the Olson well.
- A site investigation was conducted at the Olson well site in 2001 and 2002 (NMED 2003). A total of 5 monitoring wells were installed to refine plume definition and source determination. Samples from monitoring wells were sent to a Contract Laboratory Program (CLP) analytical laboratory for analysis, which confirmed the presence of TCE, 1,1-dichloroethylene (1,1-DCE), tetrachloroethylene (PCE), cis-1,2-dichlorethylene (cis-1,2-DCE), and 1,1-dichloroethane (1,1-DCA) in groundwater at the well site.

- From 2004 to 2006, an expanded site investigation/remedial investigation was completed at the Site that included installation of additional monitoring wells; collection of surface water samples, groundwater samples, soil samples, and soil gas samples; an X-ray fluorescence (XRF) soil survey for heavy metals; and off-site soil sampling (after the 2006 floods). This investigation determined that Eagle Picher was likely the source of TCE in the aquifer in Socorro and that (at least prior to the 2006 floods) concentrations of heavy metals in the soil were not “of sufficient levels to be of immediate health threat or concern over the course of the next year” (E&E 2007).
- In April and June 2012, the NMED conducted groundwater sampling activities and a passive soil gas (PSG) survey to delineate the southern extent of the plume and attempt to identify any other possible TCE sources. The results of this PSG survey were consistent with the contaminant distribution shown in the dissolved-phase plume (Figure 2 in DBS&A 2012). Low detections were noted along the southeastern plume margin near NMT golf course. As to be expected, greater masses were noted along the transect immediately north of the Alice East well, where high concentrations were reported in groundwater. Equally important, low masses of TCE were also detected in the western half of the northernmost transect on the Eagle Picher Site. These results indicated that residual mass is present on-Site.

1.2 Summary of RI/FS Sampling

In December 2012 and January 2013, DBS&A conducted soil and groundwater sampling activities, and a PSG survey, to characterize the nature and extent of contamination in the study area for the RI/FS. Soil, soil gas, and groundwater samples were analyzed for COPCs selected based on DBS&A’s understanding of previous Site use and the findings of previous investigations. In January 2013, the NMED and DBS&A also conducted a joint sampling event of new and existing monitoring, domestic, and municipal supply wells throughout the plume area. The results of this sampling event are included as part of the RI/FS.

DBS&A also surveyed and tested existing structures on-Site for the presence of hazardous materials (e.g., lead-based paint [LBP] and asbestos containing building material [ACBM]).

In June 2013, DBS&A conducted follow-up sampling activities that included collection of groundwater samples from three new wells, as well as soil and soil gas samples from two different locations within the plume area. Work to delineate the extent of contamination in deeper portions of the aquifer is ongoing, and includes an assessment of deep wells installed during October and November 2013 (these data are not included in the BLRA).

A summary of samples collected by DBS&A and the NMED as part of the RI/FS in 2012 and 2013 is provided in Table 1. Groundwater samples collected by the NMED in March 2012 were not collected as part of the RI/FS, but are included in this table and used in the BLRA.

2 Hydrogeology

The principal aquifer system in the Socorro Basin is composed of the Quaternary and Tertiary Santa Fe Group (Popotosa and Sierra Ladrones Formations) and the overlying Quaternary deposits (E&E 2007). The aquifer system is divided into three aquifer units: (1) an unconfined aquifer comprising the Quaternary deposits and the Sierra Ladrones Formations, (2) the Popotosa confining unit consisting of playa deposits and mudstones, and (3) the underlying Popotosa Aquifer. Within the Socorro Basin, the unconfined aquifer is commonly referred to as the shallow aquifer, or alluvial aquifer. Most of the wells in the Socorro Basin, including those that have been impacted by the solvent plume, are completed in the highly transmissive shallow aquifer (Anderholm, 1987).

Depths to water across the Eagle Picher study area typically range from over 100 feet on the higher terrain areas to less than 20 feet in low-lying areas. The groundwater flow direction is generally to the south-southwest with an average gradient of 0.0011 foot per foot. This flat gradient is to be expected, given the coarse nature of the sediments. Immediately west of the Site, groundwater flow direction is southeast, parallel to the Nogal Arroyo, indicating inflow from adjacent areas coincident with the Nogal Arroyo. A map showing groundwater levels and the potentiometric surface in January 2013 is provided as Figure 2.

Although the unconfined aquifer is undifferentiated (i.e., no laterally extensive confining units were found in the study area), one of the goals of the RI is to further delineate the vertical extent of contamination. Accordingly, DBS&A subdivided the upper sediments of the unconfined aquifer into three informal water-bearing zones based on the screened intervals of wells within the groundwater plume area:

- The shallow water-bearing zone (SWBZ) begins at the water table and extends to an elevation of approximately 4,560 feet above mean sea level (ft msl), which corresponds to the screened intervals of many existing monitoring wells. SWBZ wells are typically screened across the water table.

- The intermediate water-bearing zone (IWBZ) extends to an elevation of approximately 4,510 ft msl, encompassing the screened intervals of the Olsen well (a former municipal supply well), the Alice domestic wells, and other monitoring, domestic, and municipal supply wells (Table 1 in DBS&A 2013).
- The deep water-bearing zone (DWBZ) begins at an elevation of approximately 4,510 ft msl, and encompasses the screen intervals of the Eagle Picher municipal supply well and the Holmes municipal supply well. Monitoring wells were completed at depth intervals near the top of the DWBZ (similar to existing municipal supply wells) and at deeper intervals within the DWBZ down to an elevation of approximately 4,370 ft msl.

An aquifer test was conducted as part of the RI (Sections 5.6 and 7.3.4.2 in DBS&A 2013), using well SW-4 as a pumping well. An initial analysis using data from observation wells completed in the SWBZ, IWBZ, and DWBZ yielded a transmissivity value of 9,600 square feet per day, a confined storage coefficient of 0.0015, and a specific yield of 0.22. Given an aquifer thickness of 150 feet, this corresponds to an average hydraulic conductivity of 64 feet per day, or 0.023 centimeters per second and a specific storage of 1 x 10–5 feet^{-1}. A second analysis of the pumping test data, limited to the upper 80 feet of the aquifer and only using data from SWBZ and IWBZ observation wells, yielded a transmissivity value of 6,400 square feet per day, a confined storage coefficient of 0.0008, and a specific yield of 0.18. Given an aquifer thickness of 80 feet, this corresponds to an average hydraulic conductivity of 80 feet per day, or 0.029 centimeters per second, and a specific storage of 1 x 10–5 feet^{-1}. Using a gradient of 0.0011 feet/foot and a typical effective porosity of 0.27 (based on laboratory analyses of aquifer materials from the SWBZ and IWBZ, Appendix L in DBS&A 2013), the aquifer parameters derived from the pumping test analyses yield average linear groundwater velocities of approximately 95 feet per year and 120 feet per year, respectively.

Aquifer parameters calculated from the pumping test data are consistent with results of aquifer tests in the Socorro Basin reported by Hantush (1961). Pumping test analytical results are discussed in Section 7.3.4.2 of Draft RI (DBS&A 2013).

3 Sources of Contamination

Contamination of soils and groundwater are a result of disposal practices from historical manufacturing processes conducted on-Site and subsequent land use activities at the Site. In the CSMs, sources of contamination are considered regarding their location on-Site (on or immediately adjacent to the Eagle Picher property) or off-Site (contamination that has moved away from the property, primarily in the aquifer). This section was originally prepared by DBS&A (2012), and was updated for this document with new information from the RI/FS sampling conducted by the NMED in 2012 and DBS&A in 2012 and 2013. Sampling methods and results are summarized to describe the current extent of contamination of COPCs previously identified for the study area. These COPCs are then carried into the detailed HHRA (Section 4) and EcoRA (Section 5) for further evaluation.

3.1 Existing Facilities

During a preliminary inspection of the buildings at the Eagle Picher Site, suspect ACBM and LBP were identified. Workers and trespassers on-Site may be exposed to lead or asbestos through contact with soils or building materials. An LBP and asbestos investigation was conducted in December 2012. Results of this investigation confirmed the presence of LBP in three of the buildings comprising the historical facility, as well as lead-containing paint on all buildings. The asbestos investigation confirmed the presence of ACBM in two of the buildings comprising the historical facility, as well as the former manufacturing building. Contamination from LBP and ACBM appeared to be limited to the buildings, as there was no visual evidence suggesting migration of these contaminants to the soils on-Site (Acme Environmental 2013).

3.2 Soils

3.2.1 Heavy Metals

Surface soils have been impacted with heavy metals as a result of poor housekeeping and disposal practices at the Eagle Picher facility. Debris from lead acid batteries and related components used in their manufacture are known to be scattered in soils around the Site. Heavy metal contamination within surface soils was suspected to have been spread by the subsequent use of the property by off-road motorcycles and a flood event in 2006.

Cadmium (Cd), Cr, and Pb are the primary COPCs in soils on-Site. As part of the expanded environmental site investigation conducted by Ecology & Environment in April 2005, the eastern portion of the Site (the property surrounding the former manufacturing building) was overlain with a 100-foot by 100-foot grid, and a composite sample was collected from each grid square and analyzed with an XRF device (E&E 2007). For this characterization, 217 samples were collected and subjected to XRF analysis. Confirmatory laboratory analysis was performed on about 24 percent (53) of the XRF-analyzed samples (see Figures 4-1 through 4-7 in E&E 2007).

Although the work initially delineated the extent of contamination, use of the Site as a motocross course and the 2006 flood may have redistributed the surface contamination. In articles from the Socorro newspaper, the owner of the motocross operation stated that he imported approximately 175 truckloads of soil and 60 truckloads of Perlite (a chemically inert natural glassy volcanic rock used as a soil amendment) onto the Site (DBS&A 2012). This may account for an additional 4,500 cubic yards of material of unknown origin being present on-Site. This soil may have been placed over contaminated soil, possibly resulting in soil profiles where contaminated soil is overlain with clean fill. Further re-grading of the Site may also have redistributed some of this debris.

Surface and at-depth soil samples were collected in December 2012 to delineate the current extent of soil contamination for the RI/FS. Surface soil samples for the Eagle Picher Site were collected from a combination of statistically based grid locations, intended to characterize mean Cd, Cr, and Pb concentrations across the Site, and targeted locations, intended to characterize areas of known or suspected higher-level contamination. The grid-based sampling design was developed using Visual Sample Plan software and the 2005 data collected by Ecology & Environment (2007) to determine sample spacing and locations. The sampling protocol is described in detail in Section 5.1 of the draft RI report (DBS&A 2013), and a summary of samples collected and analyses conducted is provided in Table 1. Because the new soil sampling provided an entirely new (and current) characterization of potential contamination of Eagle Picher Site soils, and the area has been disturbed since the 2005 sampling was conducted, the 2005 data collected by Ecology & Environment (2007) were not included in the BLRA.

Analysis by an XRF device (with confirmatory laboratory analysis of 14 percent of the surface soil samples) confirmed the continued presence of Pb throughout the Site in both surface and at-depth soils (Figures 3 and 4) (Appendix A, Tables A-1 and A-2). Cr was detected in surface and at-depth soils at limited locations (Figures 5 and 6) (Appendix A, Tables A-1 and A-2), and low levels of Cd were only detected by the XRF device in three surface soil samples (Appendix A, Table A-1). The extent of Pb, Cr, and Cd measured by the XRF device in surface and subsurface soils are discussed in more detail below.

For surface soils, Pb was detected by the XRF device in all samples (100% frequency of detection [FOD]). Detected XRF Pb concentrations ranged from 15 to 6,166 milligrams per kilogram [mg/kg] in the primary manufacturing area (east of Highway 408) and from 9 to 347 mg/kg in the secondary area (west of Highway 408). The highest XRF Pb concentrations in surface soils were detected around the following locations (Figure 3) (Appendix A, Table A-1):

- Historical facility – ranging from 110 mg/kg (S-46) to 347 mg/kg (S-39)
- Former manufacturing building – ranging from 245 mg/kg (P-64) to 2,643 mg/kg (P-65)
- Wastewater treatment building and industrial lagoons – 186 mg/kg (P-35) and 187 mg/kg (P-58)
- Wastewater impoundments – ranging from 209 mg/kg (P-37 W1) to 6,166 mg/kg (P-37 N1); other samples with Pb above 1,000 mg/kg include P-60 (1,199 mg/kg), P-37 N2 (4,279 mg/kg), and P-37 E1 (5,020 mg/kg)
- The area between the former manufacturing building and the wastewater impoundments – 120 mg/kg (P-42) and 187 (P-43)
- An area southwest of the former manufacturing building (associated with visible battery debris) – 1,136 mg/kg (P-55).

For subsurface soils, Pb was detected by the XRF device in all but one of the samples (98% FOD). Detected XRF Pb concentrations ranged from 11 mg/kg to 2,809 mg/kg in the primary manufacturing area (east of Highway 408) and from 9 mg/kg to 1,265 mg/kg in the secondary area (west of Highway 408). The highest XRF Pb concentrations in subsurface soils (100 mg/kg or higher) were detected around the following locations (Figure 4) (Appendix A, Table A-2):

- Historical facility – 1,265 mg/kg (S-55 0-1′ interval)
- Former manufacturing building – ranging from 115 mg/kg (P-64 0-4′ interval) to 2,809 mg/kg (P-65, 2.5-4′ interval); other samples with Pb

above 1,000 mg/kg include P-66 (1,548 mg/kg in 2.5-4′ interval) and P-65 (2,133 mg/kg in 1-2′ interval)

- Unlined sump – 150 mg/kg (P-56 0-4′ interval)
- Wastewater impoundments – 146 mg/kg (P-60 0-1′ interval)
- An area southwest of the former manufacturing building (associated with visible battery debris) – 363 mg/kg (P-55 0-1′ interval).

As discussed in Section 6.3.1 of the draft RI report (DBS&A 2013), XRF analysis results for Cr near or below 100 mg/kg were considered unreliable. For Cr values in this range, no correlation was indicated between XRF values and confirmatory sample results. XRF values in this range may overestimate the Cr content by a factor ranging between approximately 5 and 10 and may correspond to concentrations close to established background values (i.e., <20 milligrams per kilogram [mg/kg]) (E&E, 2007). For this evaluation, XRF Cr concentrations at or below 100 mg/kg were considered non-quantified and are counted as non-detected concentrations. Additionally, for XRF Cr values higher than 100 mg/kg, there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation; therefore, XRF Cr values above 100 mg/kg are considered semi-quantitative and are only used qualitatively in the RI to identify areas of potentially elevated Cr.

For surface soils, Cr was detected by the XRF device in 21 of 138 samples (15% FOD). Detected XRF Cr concentrations ranged from 102 mg/kg to 8,697 mg/kg in the primary manufacturing area (east of Highway 408) and from 101 mg/kg to 139 mg/kg in the secondary area (west of Highway 408). Higher XRF Cr concentrations in surface soils were detected around the following locations (Figure 5) (Appendix A, Table A-1):

- An area southwest of the historical facility – 101 mg/kg (S-25) and 139 mg/kg (S-09)
- Former manufacturing building – 102 mg/kg (P-46) and 135 mg/kg (P-41)
- The area between the former manufacturing building and the unlined sump – 103 mg/kg (P-33) and 120 mg/kg (P-32)
- Wastewater treatment building and industrial lagoons – 114 mg/kg (P-58)
- Wastewater impoundments – ranging from 123 mg/kg (P-62) to 8,697 mg/kg (P-37 N1); other samples with Cr above 1,000 mg/kg include P-37 N2 (1,963 mg/kg), P-37 E1 (4,610 mg/kg), and P-60 (7,647 mg/kg)
- The area north of the berm in the primary manufacturing area – ranging from 102 mg/kg (P-06) to 159 mg/kg (P-09)

For subsurface soils, Cr was detected by the XRF device in 3 of 63 samples (5% FOD). Detected XRF Cr concentrations ranged from 107 mg/kg to 1,075 mg/kg in the primary manufacturing area (east of Highway 408).Cr was either not detected or non-quantified in all 35 subsurface samples analyzed in the secondary area (west of Highway 408). The highest XRF Cr concentrations in subsurface soils were detected around the wastewater impoundments, including 107 mg/kg in the 0-4′ interval at P-37, 118 mg/kg in the 1-2′ interval at P-60, and 1,075 mg/kg in the 0-1′ interval at P-60 (Figure 6) (Appendix A, Table A-2):

In surface soils, Cd was only detected by the XRF device in 3 of 136 samples (2.2% FOD) collected at the site (Appendix A, Table A-1). These three sample locations, P-09 (88 mg/kg), P-20 (46 mg/kg), and P-39 (37 mg/kg) are located in the southeast portion of the primary manufacturing area along the east side of Highway 408. In subsurface soils, Cd was not detected by the XRF device in any of the 57 samples analyzed (0% FOD; 6 samples were not analyzed for Cd) (Appendix A, Table A-2).

Total Cr and Pb were detected in all confirmatory surface soil samples analyzed by laboratory methods (100% FOD), while Cd was detected in more than half of the samples (63% FOD) and hexavalent chromium (Cr^{+6}) was detected in three samples (16% FOD) (Appendix A, Table A-3). Pb concentrations ranged from 8.3 to 1,700 mg/kg in the primary manufacturing area and from 5.4 to 32 mg/kg in the secondary area. In the primary manufacturing area, the highest Pb concentrations were found in confirmatory samples collected around the following locations:

- Former manufacturing building – 1,100 mg/kg (P-66)
- Wastewater treatment building and industrial lagoons – 200 mg/kg (P-35)
- Wastewater impoundments – 360 mg/kg (P-37) and 1,700 mg/kg (P-60)
- The area between the former manufacturing building and the wastewater impoundments – 120 mg/kg (P-42)
- An area southwest of the former manufacturing building (associated with visible battery debris) – 1,500 mg/kg (P-55)

Total Cr concentrations ranged from 12 to 3,300 mg/kg in the primary manufacturing area and from 7.3 to 16 mg/kg in the secondary area (Appendix A, Table A-3). In the primary manufacturing area, the highest Cr concentrations were found in confirmatory samples collected around the following locations:

- Former manufacturing building – 3,300 mg/kg (P-66)
- Wastewater impoundments – 550 mg/kg (P-37) and 3,000 mg/kg (P-60)

Detected concentrations of Cd ranged from 0.2 to 7.8 mg/kg in the primary manufacturing area (92% FOD). In the secondary area, Cd was only detected in one sample (0.22 mg/kg at S-51; 14% FOD) (Appendix A, Table A-3).

The three detected concentrations of Cr^{+6} ranged from 4.8 to 16 mg/kg in the primary manufacturing area (25% FOD). In the secondary area, Cr^{+6} was not detected in any samples (0% FOD) (Appendix A, Table A-3). Detected concentrations of Cr+6 were found in confirmatory samples collected around the following locations:

- Former manufacturing building – 15 mg/kg (P-66)
- Wastewater impoundments – 4.8 mg/kg (P-37) and 16 mg/kg (P-60)

For the 21 sub-slab soil samples collected under the former manufacturing building and analyzed for metals using XRF (Figure 7), Pb was detected in all samples (100% FOD), ranging from 15 to 217 mg/kg. Cr was detected in two of the samples (10% FOD), ranging from 101 to 124 mg/kg. Cd was not detected by the XRF device in any of the samples (0% FOD) (Appendix A, Table A-4). For the two sub-slab soil samples analyzed for metals using laboratory methods, Cd and Cr^{+6} were not detected (0% FOD), while Pb and Cr were detected at low levels in both samples (100% FOD). Pb ranged from 7 to 7.7 mg/kg, and Cr ranged from 14 to 15 mg/kg (Appendix A, Table A-5).

3.2.2 Volatile Organic Compounds

Chlorinated solvents were also routinely used at the Site. Soils beneath and near the buildings may have been impacted by:

- Chlorinated solvents leaking through cracks in drains and the floor slab
- Waste liquids containing VOCs directed to lined and unlined surface impoundments
- Leaking conveyance piping between the manufacturing facilities and the surface impoundments

For the RI/FS, sub-slab soil and air samples were collected in December 2012 from exploratory borings at seven locations inside the former manufacturing building where site inspections indicated cracking, staining, and/or other signs of possible chemical releases (Figure 7). VOCs were not detected (0% FOD) in any of the sub-slab soil samples collected from these borings at 6 feet below ground surface (ft bgs) (Appendix A, Table A-5). To measure VOCs in borehole vapor, one air sample was collected at the bottom of each borehole (6 ft bgs). In these samples, the only VOC detected above the reporting limit was 1,1,1-trichloroethane (1,1,1-TCA), which was detected in five of the seven samples (71% FOD), with detected concentrations ranging from 120 to

680 micrograms per cubic meter (μg/m^3) (Appendix A, Table A-9). However, PSG sampling at the Site and in the plume area by the NMED and DBS&A in 2012 indicate that TCE and PCE are present in soil vapors, and 1,1-DCE is present in soil vapors in the northern part of the plume area.

Follow-up sampling conducted by DBS&A in June 2013 included collection of nine subsurface soil samples for analysis of VOCs from two different locations within the plume area. No VOCs were detected in these samples (0% FOD) (DBS&A 2013).

3.3 Groundwater

The presence of chemicals in groundwater may have resulted from releases of chlorinated solvents from both the lined and unlined impoundments, sumps, and other unmanaged disposal operations at the Site. There is no evidence at this time of groundwater contamination from migration of heavy metals from the soils into the aquifer.

Water quality results indicate that the TCE plume in the SWBZ (approximately 4,590 ft msl) extends more than 9,000 feet to the south, with the plume encompassing approximately 265 acres (Figure 8). Groundwater sampling in December 2012 and January 2013 also detected concentrations of 1,1-DCE and PCE in the SWBZ, although they are not as extensive as TCE in the groundwater plume (Figures 9 and 10). Groundwater results from the 2012 and 2013 sampling events performed by the NMED and DBS&A were used to delineate the plume to the south (downgradient) in domestic wells (Figure 8). To determine whether there is a groundwater plume emanating from the Eagle Picher Site, DBS&A installed two SWBZ wells in December 2012 (SW-1 and SW-2). Concentrations of TCE, 1,1-DCE, and PCE were not detected above reporting limits in groundwater samples collected from these two wells. A third SWBZ well (SW-3) was installed south of the Eagle Picher Site to delineate the northern boundary of the plume.

There are currently two “hot spots,” with TCE reported above 100 μg/L in the Alice East domestic well and monitoring well OMW-7, more than 3,500 feet downgradient from the Alice East well (Figure 8). The NMED reported TCE concentrations of 240 and 125 μg/L, respectively, while concentrations of 187 and 113.5 μg/L, respectively, were reported for groundwater samples collected by DBS&A in December 2012 and January 2013 (Appendix A, Table A-6). DBS&A installed an additional well in each of the three water bearing zones near OMW-7 to assess vertical gradients (SW-4, IW-1, and DW-1). TCE and PCE were detected in SW-4 and IW-1 (125 and 13.2 μg/L, respectively, for SW-4; 125 and 11.9 μg/L, respectively, for IW-1). TCE and PCE were not detected above reporting limits in DW-1, and 1,1-DCE was not detected above reporting limits in any of the new wells

(Figures 8, 9, and 10) (Appendix A, Table A-6). DBS&A installed an additional well in the SWBZ and DWBZ near the Alice East well to assess vertical gradients (SW-6 and DW-2) (Figure 11). TCE and 1,1-DCE were detected above reporting limits in samples collected from these two wells in June 2013 (38 and 37 µg/L, respectively for the SW-6 well; 190 and 250 µg/L, respectively for the DW-2 well) (Appendix A, Table A-6). DBS&A installed another well (SW-7) south of the plume to further delineate its southern boundary. No VOCs were detected in the groundwater sample collected from this well (Figures 8, 9, and 10) (Appendix A, Table A-6).

To help assess the migration of VOCs from groundwater to soil vapor, DBS&A collected soil gas samples in June 2013 near the Alice East well (Figure 11) and from a transect near the TCE hot spot around monitoring wells DW-1, IW-1, OMW-7, and SW-4 (Figure 12). The soil gas samples were analyzed for VOCs using EPA Method 8260B. All results were non-detects, except for one detected concentration of TCE in the sample collected at SGT-9 (230 µg/m^3) (Appendix A, Table A-10).

3.4 Contaminants of Potential Concern

RI/FS sampling was conducted by the NMED in 2012 and DBS&A in 2012 and 2013 to describe the current extent of contamination of COPCs previously identified for the Site. The previous sections summarize sources of contamination and RI/FS sampling methods and results for these COPCs. In summary, the same primary COPCs previously identified for the Site—heavy metals (specifically Pb, Cr, and Cd), chlorinated solvents (including PCE, TCE, and 1,1-DCE), LBP, and ACBM—are currently present at the Site or in the groundwater plume. These COPCs are carried into the detailed HHRA (Section 4) and EcoRA (Section 5) for further evaluation, along with Cr^{+6} and 1,1,1-TCA, which were also detected.

4 Human Health Risk Assessment

This section summarizes the approach, analyses, and results of the HHRA, It describes the CSM, screening assessment, and detailed risk assessment to estimate the likelihood and magnitude of potential risks to humans posed by current or likely future exposure to metals in Eagle Picher Site soils and groundwater in the plume area.

4.1 Conceptual Site Model

The human health CSM provides a framework for assessing potential risks (for current and future human populations) from exposure to Site-related contaminants. It identifies the primary Site-related chemical sources and environmental release mechanisms, transport routes and media, exposure pathways, and potential categories of human receptors that were considered in conducting the HHRA in accordance with standard regulatory agency risk assessment guidance (including USEPA 1989). Each of these elements is further described in the following subsections, which were originally prepared by DBS&A (2012), then updated for this document with new information from the RI/FS sampling conducted by DBS&A in 2012 and 2013. Figure 13 summarizes the human health CSM, including sources of COPCs, affected environmental media, COPC release and transport mechanisms that may occur in the study area, potentially exposed receptors, and potential exposure pathways for each receptor.

4.1.1 Contaminant Migration

Exposure assessment is the process of measuring or estimating the potential current or future intensity, frequency, and duration of exposure (USEPA 1989). The exposure assessment step in the HHRA process involves identification of exposure pathways that could bring the receptors in contact with abiotic or biotic media in the study area. This step includes the characterization of the exposure settings, transport and fate pathways, and contact routes. The environmental media that may serve as sources of human contact to COPCs in the study area include the following:

- Soil (surface and subsurface)
- Groundwater
- Indoor Air

Because of the industrial nature of the Site and the fact that plants or animals from the Site are not expected to serve as human food sources, biotic uptake and potential exposures via biotic media were not included in the exposure analyses for this Site.

4.1.1.1 Soils

Residual debris from the lead-acid battery manufacturing is known to be scattered across the Site. Heavy metals may leach from the debris into the surrounding on-site soils. Once in the soil, the heavy metals can be transported by air and water.

VOCs released to the soil surface are likely to migrate to the vadose zone (i.e., the zone between soil surface and the water table within which the moisture content is less than 100% saturation). These chemicals can be transported spatially through movement of groundwater or in the vapor phase (e.g., in the soil air-filled pore space). Therefore, the primary exposure pathways include contact or ingestion of contaminated groundwater (on- or off-Site) and through inhalation of VOCs in indoor air (on- or off-Site).

4.1.1.2 Groundwater

Groundwater contaminants may migrate by advection and dispersion, volatilize to soil gas, and ultimately disperse into the atmosphere, or they may become adsorbed to aquifer soils. Groundwater flow may redistribute contaminants within the shallow groundwater environment or transfer them to deeper aquifers.

The groundwater table at the study area is located at elevations ranging from 4,598 ft msl under the Eagle Picher Site, to approximately 4,588 near the NMT golf course at the southern extent of the groundwater plume (Figure 2). Depth to groundwater varies with surface topography and ranges from less than 20 feet in monitoring wells to the east of the plume area, to over 100 feet west of the plume (Table 1 in DBS&A 2013).

The groundwater plume is defined by the extent of TCE, because this is the most widespread COPC in the groundwater and encompasses the extents of the other COPCs (1,1-DCE and PCE). The presence of TCE above the USEPA drinking water maximum contaminant level (MCL) of 5 µg/L begins just south of the site, near well SW-3, and extends for approximately 9,000 feet southward to near the NMT golf course. Based on the results of groundwater sampling conducted by the NMED and DBS&A during January and June of 2013, the extent of VOC contamination in the SWBZ is delineated by the existing network of monitoring wells. Existing groundwater data indicate that the plume has decoupled from the presumed source area at the Eagle Picher Site since COPCs have not been detected in groundwater from on-Site wells during recent sampling events. The distributions of TCE, 1,1-DCE, and PCE in groundwater are shown in Figures 8, 9, and 10, respectively.

Contamination appears limited to the SWBZ and IWBZ in the central part of the plume near well SW-4. However, near the Alice domestic wells, contamination extends at least as deep as the DWBZ (approximately 4,460 ft msl). Characterization of the deeper portion of the alluvial aquifer is ongoing.

4.1.1.3 Surface Water

Heavy metals contamination in on-Site soils can be transported by sheet flow or flooding events at the Site. Transport by surface water is exclusively stormwater, as there are no permanent or perennially flowing water channels on the property. The surface drainage on both the historical facility and the former manufacturing plant property is toward Nogal Arroyo to the south of the Site. Although large berms have been constructed to prevent discharge of surface water from the Site to the arroyo, evidence of flood-conveyed debris downstream in the arroyo has been reported by residents. Portions of the berm at the historical facility property have been observed to be damaged, and it was reported by the NMED that a portion of the berm at the southeastern corner of the Site was breached in 2006 and subsequently repaired. It is therefore possible that heavy metals-contaminated soils and debris may be suspended by surface water and transported off-Site down the Nogal Arroyo during rain events.

Several surface water ponds are present within the plume area. The NMT golf course contains two large ponds and a number of smaller ponds, and also features a small, man-made stream located just south of Canyon Road. Another pond is located in an old gravel quarry (i.e., borrow pit) just east of monitoring well SW-4 (Figure 8); this pond is locally known as the “Hefner Pond.” The substrate within the golf course ponds appears to be fine silt, while the borrow pit’s substrate appears to be slick clay. Another large pond is located in a private yard near the northeast part of the NMT golf course, near the Knight domestic well (Figure 8).

Water features on the NMT golf course are man-made and serve as holding facilities for irrigation water pumped from the Lattman, Holmes, and Bushman municipal supply wells. No samples were collected from the golf course ponds during RI/FS sampling. The pond near the Knight well is maintained by pumping from that domestic well.

The surface elevation and persistence of the borrow pit pond indicate a possible connection to shallow groundwater. The pond was identified by the NMED as a potential illegal dumping area and therefore a potential source of or contributor to the groundwater plume. No VOCs were detected above laboratory detection limits from two surface sediment and two surface water samples collected in May 2006 for the expanded environmental site investigation conducted by Ecology & Environment. These results indicate that the borrow pit pond is not a source/contributor to the identified groundwater plume (E&E 2007). Results of this sampling also do not indicate any detectable contamination resulting from a groundwater contribution. Due to access restrictions by the property owner, no additional samples were collected from this pond during RI/FS sampling to determine whether the pond is currently connected to shallow groundwater.

4.1.1.4 Air

Heavy metals bound to on-Site soils can be suspended in air particulates and transported off-Site or to other areas of the Site. The movement of heavy metal-contaminated soils through wind is likely the most frequent transport mechanism of heavy metals contamination off-Site. VOC contamination under the Site buildings can volatilize and migrate into the buildings through cracks in the floor or drain openings, thereby contaminating indoor air. Additionally, VOCs in the down-gradient groundwater plume can volatilize and migrate up through the soil to contaminate indoor air in homes and other buildings located above the plume. VOCs in groundwater from wells can also volatilize during showering/bathing, laundering, and dishwashing.

4.1.2 Exposed Populations

Based on the history of the Site and the on-Site/off-Site nature of the contamination, consideration of potential receptors is assessed by location.

The future land use on the Site will likely be limited to commercial and industrial activities, possibly including excavation, construction, or re-grading. Based on these potential on-Site future land uses, the following potential human receptors were identified (Figure 13):

- Hypothetical future commercial or industrial worker
- Hypothetical future construction worker
- Current or future intermittent visitors (trespassers, recreators, and hypothetical visitors to potential future businesses at the Site)

The future land use of the plume area will likely be a mix of residential housing, community agriculture, agriculture/farming, manufacturing, and commercial/industrial activities. Individuals (residents or farmers) using water from domestic and municipal supply wells for household use or outdoor use (e.g., filling swimming pools or irrigating vegetable gardens or fruit or nut trees) are the most likely potential exposure scenario in the plume area, although residents or workers may also be exposed to vapor-based contaminants inside homes and buildings. Based on these potential plume area future land uses, the following potential human receptors were identified (Figure 13):

- Current or future resident or farmer
- Current or future commercial/industrial worker

4.1.3 Potentially Complete Exposure Pathways

According to HHRA guidance (USEPA 1989), a complete exposure pathway consists of four elements:

1. A source and mechanism of chemical release
2. A retention or transport medium (or media in cases involving transfer of chemicals)
3. A point of potential human contact with the contaminated medium (“exposure point”)
4. An exposure route (such as ingestion) at the exposure point

If any of these elements are missing (except when the source itself is the exposure point), the exposure pathway is considered incomplete. For example, if receptor contact with the source or transport medium does not occur, the exposure pathway is considered incomplete and is not quantitatively evaluated for risk. Similarly, if human contact with an exposure medium is not possible, the exposure pathway is considered incomplete and is not evaluated.

The human health CSM for the study area (Figure 13) summarizes information on sources of COPCs, affected environmental media, COPC release and transport mechanisms that may occur in the study area, potential human receptors, and potential exposure pathways for each receptor. Potentially complete exposure pathways are designated by a "C." Incomplete exposure pathways are designated by an "I."

On-Site soils were evaluated using the hypothetical future commercial or industrial worker, hypothetical future construction worker, and current or future intermittent visitor scenarios. These receptors could be exposed to Site soils via direct dermal contact or ingestion or inhalation of soil particles. These receptors could also be exposed to Site groundwater through use of well water for domestic purposes, including as a source of drinking water and for showering/bathing, laundering, and dishwashing, as well as inhalation of indoor air in Site buildings. Risks for Site soils and groundwater were evaluated based the following complete exposure pathways:

- Ingestion of and dermal contact with Site soils
- Inhalation of suspended Site soil particulates
- Ingestion and inhalation of groundwater (including worker uses such as showering/bathing)
- Dermal contact with groundwater
- Inhalation of volatiles migrating from groundwater to indoor air

Plume area groundwater was evaluated using the current/future resident or farmer and current or future worker scenarios. Residential receptors could be exposed to plume area groundwater through use of well water for domestic purposes, including as a source of drinking water and for showering/bathing, laundering, and dishwashing, irrigation of vegetable gardens or fruit or nut trees, as well as inhalation of indoor air in residential buildings. Commercial/industrial workers could be exposed to plume area groundwater through inhalation of indoor air in commercial/industrial buildings; water used at these locations is assumed to be provided from the municipal water system and not domestic wells. Risks for plume area groundwater were evaluated based the following complete exposure pathways:

- Ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing)
- Dermal contact with groundwater
- Ingestion of fruits and vegetables irrigated with well water
- Inhalation of VOCs migrating from groundwater to indoor air

The exposure pathways for LBP and ACBM are identified as complete at the Site; however, they will be evaluated qualitatively in the HHRA. The preferred action is to demolish the buildings and clean up the ground adjacent to the buildings, and any such work will comply with state and federal standards to prevent worker exposure and release of hazardous materials, as well as ensure proper disposal of the building materials. If any of the buildings are not demolished, other abatement measures will be necessary to prevent exposure. Additionally, the LBP and ACBM surveys completed by Acme Environmental (2013) were conducted to confirm the presence of LBP and ACBM and not intended to quantify levels of LBP and ACBM for assessment of exposure.

The following complete exposure pathways are quantitatively assessed in the HHRA:

- Current or Future Off-Site Resident or Farmer
  - Ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing)
  - Dermal contact with groundwater
  - Ingestion of fruits and vegetables irrigated with groundwater
  - Inhalation of volatiles migrating from groundwater to indoor air
- Current or Future Off-Site Commercial/Industrial Worker
  - Inhalation of volatiles migrating from groundwater to indoor air
- Hypothetical Future On-Site Commercial/Industrial or Construction Worker
  - Ingestion of and dermal contact with surface soils
  - Ingestion of and dermal contact with subsurface soils
  - Inhalation of suspended soil particulates
  - Ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing)
  - Dermal exposure to groundwater
  - Inhalation of volatiles migrating from groundwater to indoor air
- Current or Future On-Site Intermittent Visitor (Trespasser, Recreator, or Visitor)
  - Ingestion of and dermal contact with surface soils
  - Ingestion of and dermal contact with subsurface soils
  - Inhalation of suspended soil particulates

4.2 Screening Assessment

The following subsections summarize the screening assessment, which is a comparison of individual sample results to human health screening levels (SLs). All SLs were based on the NMED's 2012 Risk Assessment Guidance for Site Investigation and Remediation recommended risk levels of $1x10^{-5}$ (carcinogens) or 1.0 (noncarcinogens). Minimum SLs for the receptors and complete exposure pathways identified in the CSM (Section 4.1) were used to conservatively screen sample concentrations to identify any chemicals that may pose potential risk and should be evaluated further in the risk assessment. Any chemicals detected in any samples collected were included in the screening assessment. Results of the screening assessment (FOD and exceedances of SLs) were used to identify COPCs to carry through to the detailed exposure assessment and risk characterization.

Individual sample results, SLs, and screening assessment results for all sampled media are provided in Appendix A. Non-detect sample results shown in Appendix A are designated by a “U” qualifier. For each non-detect sample result from XRF analysis, the concentration is the standard deviation recorded by the XRF device. For each laboratory non-detect sample result, the concentration is the laboratory’s reporting limit (practical quantitation level [PQL]) for the analytical method used. The PQL is the minimum concentration the laboratory can reliably quantify. It is higher than the laboratory’s method detection limit (MDL), which is the minimum concentration at which a substance can be identified as present in a sample (i.e., the result is greater than zero) with 99 percent confidence.

4.2.1 Soils

Surface soils (top 0 to 6 inches) and subsurface soils (various intervals between 0 and 6 ft bgs) at the Eagle Picher Site were sampled from both the primary area (southeast of Highway 408) and the secondary area (northwest of Highway 408). For direct soil exposure, soil concentrations were compared to NMED industrial/occupational and construction soil SLs (SSLs) (NMED 2012), as well as USEPA industrial SSLs (USEPA 2013a). USEPA direct soil exposure SSLs based on a cancer endpoint reflect a carcinogenic risk of $1x10^{-6}$ and were multiplied by a factor of 10 to reflect the NMED’s recommended risk level of $1x10^{-5}$. Soil concentrations were also compared to NMED groundwater protection SSLs (based on a dilution factor of 20) to screen for exposure to contaminants potentially migrating from soil to groundwater. USEPA SSLs for groundwater protection were not used in the screening assessment, since these SSLs are based on a dilution factor of 1 and NMED considers 20 an appropriate dilution factor for calculating groundwater protection SSLs (NMED 2012). The SSLs used to screen soil concentrations are provided in Table 2.

The NMED (2012) and USEPA (2013a) SL documents do not provide SLs for intermittent visitors to a site (i.e., trespassers or recreators); therefore, USEPA's on-line regional screening level (RSL) calculator (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search) was used to calculate SLs for this scenario (more specifically, SSLs for the Eagle Picher Site). All USEPA RSL default residential exposure assumptions and calculations were adopted, except for exposure frequency (assumed 1 visit per week or 52 days per year), a cancer risk level of 1×10^{-5} (per NMED 2012), and climate variables (e.g., particulate and volatile emission factors) for New Mexico. The soil screening levels developed for this scenario are presented in Table 2.

The soil screening assessment evaluated both industrial/construction workers and intermittent visitors (i.e., trespassers or recreators) for surface and subsurface soils at the Eagle Picher Site. For sub-slab soils, the screening assessment evaluated only industrial/construction workers since intermittent visitors would not be exposed to soils under the foundation of the former manufacturing building.

4.2.1.1 Primary Area of the Eagle Picher Site

Surface Soils

Surface soil samples for the primary area of the Eagle Picher Site were collected from a combination of statistically based grid locations (samples numbered 1 through 54), intended to characterize mean Cd, Cr, and Pb concentrations across the Site, and targeted locations (samples numbered 55 and higher), intended to characterize areas of known or suspected higher-level contamination. Surface soil samples from the primary area of the Eagle Picher Site were field-screened using XRF analysis for Cd, Cr (Figure 5), and Pb (Figure 3).

As discussed in Section 6.3.1 of the draft RI report (DBS&A 2013), XRF analysis results for Cr near or below 100 mg/kg were considered unreliable. For Cr values in this range, no correlation was indicated between XRF values and confirmatory laboratory results. XRF values in this range may overestimate the Cr content by a factor ranging between approximately 5 and 10 and may correspond to concentrations close to established background values (i.e., <20 milligrams per kilogram [mg/kg]) (E&E, 2007). Therefore, XRF Cr values at or below 100 mg/mg are considered non-quantified. Additionally, for XRF Cr values higher than 100 mg/kg, there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation; therefore, XRF Cr values above 100 mg/kg are considered semi-quantitative and are only used qualitatively in the RI to identify areas of potentially elevated Cr.

Results of the screening assessment for surface soils analyzed by XRF are provided in Appendix A, Table A-1 and are summarized below. SSLs are provided in Table 2.

Pb was detected in all 74 surface soil samples analyzed using XRF (100% FOD) (Appendix A, Table A-1):

- Detected concentrations ranged from 15 to 6,166 mg/kg.
- Detected Pb concentrations exceeded the NMED industrial/occupational, NMED construction, and USEPA industrial direct soil exposure SSLs (all 800 mg/kg) in 6 samples. These samples were located around the wastewater impoundments (P-37 E1, P-37 N1, P-37 N2, and P-60), around the former manufacturing building (P-65), and in an area southeast of the former manufacturing building (an area of visible battery debris) (P-55).
- In additional to the six samples listed above, one other sample (P-41, near the former manufacturing building) had a detected Pb concentration that exceeded the USEPA intermittent visitor direct soil exposure SSL (400 mg/kg).

Cd was detected in 3 of 72 surface soil samples analyzed by XRF (4.2% FOD; 2 samples were not analyzed for Cd) (Appendix A, Table A-1):

- Detected concentrations ranged from 37 to 88 mg/kg and were found in samples located in the primary manufacturing area along Highway 408 (P-09, P-20, and P-39).
- None of the detected concentrations exceeded the direct soil exposure SSLs of 897 mg/kg (NMED industrial/occupational), 277 mg/kg (NMED construction), 800 mg/kg (USEPA industrial), and 473 mg/kg (USEPA intermittent visitor).
- All three detected concentrations exceeded the NMED groundwater protection SSL (27.5 mg/kg), as did the reporting limits (approximated by the standard deviation reported by the XRF device) for the other 69 samples.

Cr was detected above 100 mg/kg in 19 of 74 surface soil samples analyzed by XRF (26% FOD) (Appendix A, Table A-1), and these concentrations are considered semi-quantified (as discussed above):

- Detected concentrations ranged from 102 to 8,697 mg/kg.
- The highest concentrations (from 512 to 8,697 mg/kg) were found in samples located around the wastewater impoundments (P-37, P-37 E1, P-37 N1, P-37 N2, P-37 S1, and P-60).
- None of the detected concentrations exceeded the direct soil exposure SSLs of 1,700,000 mg/kg (NMED industrial/occupational), 465,000 mg/kg

(NMED construction), and 1,970,000,000 mg/kg (NMED groundwater protection).

A subset of surface soil samples was collected for confirmatory laboratory analysis to compare XRF and laboratory results over a range of XRF values. These confirmatory samples were collected at 12 surface soil XRF analysis locations and analyzed for Cd, Cr, and Pb using EPA Method 6010A and for Cr^{+6} using EPA Method 3060A/7196A. However, because of how these samples were selected for analysis, results for Cd, Cr, Cr^{+6}, and Pb in these samples may be slightly biased toward higher concentrations. Results of the screening assessment for surface soils analyzed by laboratory methods are provided in Appendix A, Table A-3 and are summarized below. SSLs are provided in Table 2.

Pb was detected in all 12 surface soil confirmatory samples (100% FOD) (Appendix A, Table A-3):

- Detected concentrations ranged from 8.3 to 1,700 mg/kg.
- Detected Pb concentrations in three samples exceeded the direct soil exposure SSLs of 800 mg/kg (NMED industrial/occupational, NMED construction, and USEPA industrial) and 400 mg/kg (USEPA intermittent visitor). These samples were located around the wastewater impoundments (P-60), in an area southeast of the former manufacturing building (P-55), and around the former manufacturing building (P-66).

Cd was detected in 11 of 12 surface soil confirmatory samples (92% FOD) (Appendix A, Table A-3):

- Detected concentrations ranged from 0.21 to 7.8 mg/kg.
- None of the detected concentrations, or the reporting limit for the one non-detect result, exceeded the direct soil exposure SSLs of 897 mg/kg (NMED industrial/occupational), 277 mg/kg (NMED construction), 800 mg/kg (USEPA industrial), and 473 mg/kg (USEPA intermittent visitor) or the NMED groundwater protection SSL (27.5 mg/kg).

Cr was detected in all 12 surface soil confirmatory samples (100% FOD) (Appendix A, Table A-3):

- Detected concentrations ranged from 12 to 3,300 mg/kg.
- The three highest detected concentrations (from 550 to 3,300 mg/kg) were found in samples located around the wastewater impoundments (P-37 and P-60) and the former manufacturing building (P-66).
- None of the detected concentrations exceeded the direct soil exposure SSLs of 1,700,000 mg/kg (NMED industrial/occupational), 465,000 mg/kg

(NMED construction), and 1,970,000,000 mg/kg (NMED groundwater protection).

Cr^{+6} was detected in 3 of 12 surface soil confirmatory samples (25% FOD) (Appendix A, Table A-3):

- None of the Cr^{+6} concentrations or reporting limits for non-detects exceeded the direct soil exposure SSLs of 63.1 mg/kg (NMED industrial/occupational), 65.6 mg/kg (NMED construction), and 56 mg/kg (USEPA industrial).
- All 3 detected concentrations, as well as all of the reporting limits for non-detects, exceeded the NMED groundwater protection SSL (0.166 mg/kg based on a dilution attenuation factor of 20).

Subsurface Soils

Subsurface soils were collected from a subset of the grid-based and targeted sample locations in the primary area of the Eagle Picher Site. Subsurface soils from the primary area of the Eagle Picher Site were field-screened using XRF analysis for Cd, Cr (Figure 6), and Pb (Figure 4). Results of the screening assessment for subsurface soils analyzed by XRF are provided in Appendix A, Table A-2 and are summarized below. SSLs are provided in Table 2.

Pb was detected in all 28 subsurface soil samples analyzed using XRF (100% FOD) (Appendix A, Table A-2):

- Detected concentrations ranged from 11 to 2,809 mg/kg.
- Detected Pb concentrations in three samples exceeded the direct soil exposure SSLs of 800 mg/kg (NMED industrial/occupational, NMED construction, and USEPA industrial) and 400 mg/kg (USEPA intermittent visitor). These samples were located around the former manufacturing building (1-2′ and 2.5-4′ depth intervals at P-65, 2.5-4′ depth interval at P-66).

Cd was not detected in any of the 22 subsurface soil samples analyzed by XRF (0% FOD; 6 samples were not analyzed for Cd) (Appendix A, Table A-2):

- None of the reporting limits exceeded the direct soil exposure SSLs of 897 mg/kg (NMED industrial/occupational), 277 mg/kg (NMED construction), 800 mg/kg (USEPA industrial), and 473 mg/kg (USEPA intermittent visitor).
- All but one of the reporting limits exceeded the NMED groundwater protection SSL (27.5 mg/kg).

Cr was detected above 100 mg/kg in 3 of 28 subsurface soil samples analyzed by XRF (11% FOD) (Appendix A, Table A-2), and these concentrations are considered semi-quantified (as discussed above):

- Detected concentrations ranged from 107 to 1,075 mg/kg.
- All three detected concentrations (from 107 to 1,075 mg/kg) were found in samples located around the wastewater impoundments (0-4′ depth interval at P-37 and 0-1′ and 1-2′ depth intervals at P-60).
- None of the detected concentrations exceeded the direct soil exposure SSLs of 1,700,000 mg/kg (NMED industrial/occupational), 465,000 mg/kg (NMED construction), and 1,970,000,000 mg/kg (NMED groundwater protection).

Two subsurface soil samples were collected from the primary area of the Eagle Picher Site and analyzed for VOCs using laboratory methods. Results of the screening assessment for subsurface soils analyzed for VOCs are provided in Appendix A, Table A-3. No VOCs were detected in these two samples (0% FOD); however, the reporting limits for PCE and TCE exceeded minimum SSLs (NMED groundwater protection SSLs), but not the direct soil exposure SSLs (NMED industrial/occupational, NMED construction, USEPA industrial, and USEPA intermittent visitor), as listed in Table 2. Laboratory results for these two samples indicated that PCE and TCE were not detected in either sample at the MDL of 0.005 mg/kg (personal communication from Andy Freeman, HEAL, to Jason Raucci, DBS&A, email dated August 16, 2013), which is below the NMED groundwater protection SSLs.

Sub-slab Soils

Sub-slab soil samples were collected from three depth intervals at seven locations under the former manufacturing building and analyzed for Cd, Cr, and Pb using XRF (Figure 7). Results of the screening assessment for sub-slab soils analyzed by XRF are provided in Appendix A, Table A-4 and are summarized below. SSLs are provided in Table 2.

Pb was detected in all 21 sub-slab soil samples analyzed by XRF (100% FOD) (Appendix A, Table A-4):

- Detected concentrations ranged from 15 to 217 mg/kg.
- None of the detected Pb concentrations exceeded the direct soil exposure SSLs of 800 mg/kg (NMED industrial/occupational, NMED construction, and USEPA industrial) and 400 mg/kg (USEPA intermittent visitor).

Cd was not detected in any of the 21 sub-slab soil samples analyzed by XRF (0% FOD) (Appendix A, Table A-4):

- None of the reporting limits for non-detects exceeded the direct soil exposure SSLs of 897 mg/kg (NMED industrial/occupational), 277 mg/kg (NMED construction), 800 mg/kg (USEPA industrial), and 473 mg/kg (USEPA intermittent visitor).
- All of the reporting limits for non-detects exceeded the NMED groundwater protection SSL (27.5 mg/kg).

Cr was detected above 100 mg/kg in 2 of 21 subsurface soil samples analyzed by XRF (10% FOD) (Appendix A, Table A-4), and these concentrations are considered semi-quantified (as discussed above):

- Detected concentrations were 101 mg/kg (2-4′ depth interval at SS-6) and 124 mg/kg (0-2′ depth interval at SS-2).
- None of the detected concentrations exceeded the direct soil exposure SSLs of 1,700,000 mg/kg (NMED industrial/occupational), 465,000 mg/kg (NMED construction), and 1,970,000,000 mg/kg (NMED groundwater protection).

For laboratory analysis, a sample was collected from 6 ft bgs at each sub-slab sample location and analyzed for VOCs. Results are presented in Appendix A, Table A-5. No VOCs were detected in these two samples (0% FOD); however, the reporting limits for PCE and TCE exceeded minimum SSLs (NMED groundwater protection SSLs), but not the direct soil exposure SSLs (NMED industrial/occupational, NMED construction, USEPA industrial, and USEPA intermittent visitor), as listed in Table 2. Laboratory results for these seven samples indicated that PCE and TCE were not detected in any of the samples at the MDL of 0.005 mg/kg (personal communication from Andy Freeman, HEAL, to Jason Raucci, DBS&A, email dated August 16, 2013), which is below the NMED groundwater protection SSLs.

Two additional samples were collected from the 3 to 4 ft bgs interval and analyzed for metals using EPA Method 6010A for Cd, Cr, and Pb and EPA Method 3060A/7196A for Cr^{+6}. Results of the screening assessment for sub-slab soils analyzed by laboratory methods are provided in Appendix A, Table A-5.

- Pb was detected in both samples (100% FOD), but the concentrations (7 mg/kg at SS-5 and 7.7 mg/kg at SS-6) were lower than the SSL of 800 mg/kg (NMED industrial/occupational, NMED construction, and USEPA industrial, as listed in Table 2).
- Cd was not detected in either sample (0% FOD), and the reporting limit (0.2 mg/kg) was lower than all of the SSLs (NMED industrial/occupational,

NMED construction, NMED groundwater protection, USEPA industrial, and USEPA intermittent visitor, as listed in Table 2).

- Cr was detected in both samples (100% FOD), but the concentrations (15 mg/kg at SS-5 and 14 mg/kg at SS-6) were lower than all of the SSLs (897 mg/kg for NMED industrial/occupational, 277 mg/kg for NMED construction, 27.5 mg/kg for NMED groundwater protection, and 800 mg/kg for USEPA industrial, as listed in Table 2).

- Cr^{+6} was not detected in either sample (0% FOD); however, the reporting limit (2 mg/kg) exceeded the NMED groundwater protection SSL of 0.166 mg/kg (based on a dilution attenuation factor of 20), but not the direct soil exposure SSLs (63.1 mg/kg for NMED industrial/occupational, 65.6 mg/kg for NMED construction, and 56 mg/kg for USEPA industrial, as listed in Table 2).

4.2.1.2 Secondary Area of the Eagle Picher Site

Surface Soils

As described in Section 4.2.1.1, surface soil samples for the secondary area of the Eagle Picher Site were also collected from a combination of statistically based grid locations and targeted locations. Surface soil samples from the secondary area of the Eagle Picher Site were field-screened using XRF analysis for Cd, Cr (Figure 5), and Pb (Figure 3). Results of the screening assessment for surface soils are provided in Appendix A, Table A-1 and are summarized below. SSLs are provided in Table 2.

Pb was detected in all 64 surface soil samples analyzed using XRF (100% FOD) (Appendix A, Table A-1):

- Detected concentrations ranged from 9 to 347 mg/kg.

- None of the detected Pb concentrations exceeded the direct soil SSLs of 800 mg/kg (NMED industrial/occupational, NMED construction, and USEPA industrial) and 400 mg/kg (USEPA intermittent visitor).

Cd was not detected in any of 64 surface soil samples analyzed by XRF (0% FOD) (Appendix A, Table A-1):

- None of the reporting limits exceeded the direct soil exposure SSLs of 897 mg/kg (NMED industrial/occupational), 277 mg/kg (NMED construction), 800 mg/kg (USEPA industrial), and 473 mg/kg (USEPA intermittent visitor).

- All the reporting limits exceeded the NMED groundwater protection SSL (27.5 mg/kg).

Cr was detected above 100 mg/kg in 2 of 64 surface soil samples analyzed by XRF (3.1% FOD) (Appendix A, Table A-1), and these concentrations are considered semi-quantified (as discussed above):

- Detected concentrations ranged from 101 to 139 mg/kg and were located between the historical facility and the berm to the south (S-25 and S-09).
- Neither of the two detected concentrations exceeded the direct soil exposure SSLs of 1,700,000 mg/kg (NMED industrial/occupational), 465,000 mg/kg (NMED construction), and 1,970,000,000 mg/kg (NMED groundwater protection).

As described in Section 4.2.1.1, a subset of surface soil samples was also collected for confirmatory laboratory analysis to compare XRF and laboratory results over a range of XRF values. These confirmatory samples were collected at seven surface soil XRF analysis locations. Results of the screening assessment for surface soils analyzed by laboratory methods are provided in Appendix A, Table A-3 and are summarized below. SSLs are provided in Table 2.

Pb was detected in all 7 surface soil confirmatory samples (100% FOD) (Appendix A, Table A-3):

- Detected concentrations ranged from 5.4 to 32 mg/kg.
- None of the detected Pb concentrations exceeded the direct soil exposure SSLs of 800 mg/kg (NMED industrial/occupational, NMED construction, and USEPA industrial) and 400 mg/kg (USEPA intermittent visitor).

Cd was detected in 1 of 7 surface soil confirmatory samples (14% FOD) (Appendix A, Table A-3):

- The detected concentration was 0.22 mg/kg.
- Neither the detected concentration nor the reporting limits for non-detects, exceeded the direct soil exposure SSLs of 897 mg/kg (NMED industrial/occupational), 277 mg/kg (NMED construction), 800 mg/kg (USEPA industrial), and 473 mg/kg (USEPA intermittent visitor) or the NMED groundwater protection SSL (27.5 mg/kg).

Cr was detected in all 7 surface soil confirmatory samples (100% FOD) (Appendix A, Table A-3):

- Detected concentrations ranged from 7.3 to 16 mg/kg.
- None of the detected concentrations exceeded the direct soil exposure SSLs of 1,700,000 mg/kg (NMED industrial/occupational), 465,000 mg/kg (NMED construction), and 1,970,000,000 mg/kg (NMED groundwater protection).

Cr^{+6} was not detected in any of the 7 surface soil confirmatory samples (0% FOD) (Appendix A, Table A-3):

- None of the reporting limits for non-detects exceeded the direct soil exposure SSLs of 63.1 mg/kg (NMED industrial/occupational), 65.6 mg/kg (NMED construction), and 56 mg/kg (USEPA industrial).
- All the reporting limits for non-detects exceeded the NMED groundwater protection SSL (0.166 mg/kg based on a dilution attenuation factor of 20).

Subsurface Soils

Subsurface soils were collected from a subset of the grid-based and targeted sample locations in the secondary area of the Eagle Picher Site. Subsurface soils from the secondary area of the Eagle Picher Site were field-screened using XRF for Cd, Cr (Figure 6), and Pb (Figure 4). Results of the screening assessment for subsurface soils are provided in Appendix A, Table A-2 and are summarized below. SSLs are provided in Table 2.

Pb was detected in 34 of 35 subsurface soil samples analyzed using XRF (97% FOD) (Appendix A, Table A-2):

- Detected concentrations ranged from 9 to 1,265 mg/kg, and all but one of the detected Pb concentrations were below 30 mg/kg.
- The detected Pb concentration in one sample exceeded the direct soil exposure SSLs of 800 mg/kg (NMED industrial/occupational, NMED construction, and USEPA industrial) and 400 mg/kg (USEPA intermittent visitor). This sample was located around the historical facility (0-1′ depth interval at S-55).

Cd was not detected in any of the 35 subsurface soil samples analyzed by XRF (0% FOD) (Appendix A, Table A-2):

- None of the reporting limits exceeded the direct soil exposure SSLs of 897 mg/kg (NMED industrial/occupational), 277 mg/kg (NMED construction), 800 mg/kg (USEPA industrial), and 473 mg/kg (USEPA intermittent visitor).
- All but one of the reporting limits exceeded the NMED groundwater protection SSL (27.5 mg/kg).

Cr was not detected above 100 mg/kg in any of 35 subsurface soil samples analyzed by XRF (0% FOD) (Appendix A, Table A-2):

- None of the reporting limits exceeded the direct soil exposure SSLs of 1,700,000 mg/kg (NMED industrial/occupational), 465,000 mg/kg (NMED construction), and 1,970,000,000 mg/kg (NMED groundwater protection).

4.2.1.3 COPCs for Eagle Picher Site Soils

Based on the screening assessment of soil samples, summarized above, Pb was the only COPC identified as posing potential risk from exposure to Eagle Picher Site soils. All Cd concentrations and reporting limits from the confirmatory surface soil samples analyzed using laboratory methods were below all of the SSLs (Appendix A, Table A-3), and detected concentrations and reporting limits from all surface, subsurface, and sub-slab soil samples analyzed by XRF and sub-slab soil samples analyzed using laboratory methods were below the direct soil exposure SSLs (Appendix A, Tables A-1, A-2, A-4, and A-5). Additionally, as noted in Sections 4.2.2.1 and 4.2.2.2 below, Cd was not detected in any of the groundwater samples collected from the Eagle Picher Site and plume area and analyzed for metals, and reporting limits were below all of the SLs (Appendix A, Table A-7). Total Cr was not detected in any soil samples at concentrations above any of the SSLs, and reporting limits were also lower than all of the SSLs (Appendix A, Tables A-1 through A-5). Although reporting limits for PCE and TCE were above the NMED Groundwater Protection SSLs, they did not exceed the direct soil exposure SSLs (NMED Industrial/Occupational, NMED Construction, USEPA Industrial, and USEPA Intermittent Visitor), and no other VOCs were detected in the two samples analyzed (Appendix A, Table A-3). PCE and TCE are not identified as COPCs via direct soil contact for Eagle Picher Site soils; however, these chemicals are further evaluated for the groundwater and vapor intrusion pathways (see Sections 4.2.2 and 4.2.3).

For Cr^{+6}, none of the laboratory results (both detected concentrations and reporting limits) from 19 confirmatory surface soil samples and 2 confirmatory sub-slab soil samples exceeded the direct soil exposure SSLs (Appendix A, Tables A-3 and A-5). All laboratory Cr^{+6} soil sample concentrations exceeded the groundwater protection SSL (Appendix A, Tables A-3 and A-5). Because Cr^{+6} was not identified as a COPC in previous investigations (which were based on previous Site uses and Site conditions, and which provided the basis for the Sampling and Analysis Plan and RI), Cr^{+6} was not analyzed in groundwater samples. Additionally the MCL (5 µg/L) for total Cr was not exceeded by any of the groundwater samples, and this MCL was developed to be protective of Cr^{+6} in groundwater. To evaluate whether Cr^{+6} should be considered a groundwater COPC and further evaluated in the HHRA, soil conditions were examined to assess whether Cr and Cr^{+6} in soils were likely to lead to Cr^{+6} in groundwater at levels that could pose potential human health risks. In a study of soil Cr^{+6} contaminated soils through the continental U.S., Jardine et al. (2013) showed that bioaccessibility of total Cr and Cr^{+6} decreased with increasing total organic carbon and pH. Although total organic carbon was not measured in soil samples, measured pH levels in the 21 confirmatory samples ranged between 7.4 and 8.6, indicating slightly to moderately alkaline soils (Table 3). Existing site conditions indicate a low potential for the presence of Cr^{+6} in soils and transport to groundwater. Cr in soils is predominantly present in the trivalent state (Cr^{+3}) and strongly bound to organic materials (ATSDR 2012; USEPA1998a,b; Kimbrough et al. 1999; Stanin and Pirnie 2005). This strong binding renders the chromium insoluble, immobile, and unreactive (Kimbrough et al. 1999; Stanin and Pirnie 2005). The laboratory analyses confirmed this general state and indicated that only 3 of 21 soil samples had detectable concentrations of Cr^{+6} (Table 3). These samples showed that Cr^{+6} was less than 1 percent of the total measured Cr, suggesting a minimal amount of Cr was transformed to the hexavalent form. Further, Cr^{+3} is not likely to be oxidized to Cr^{+6} under current soil conditions of pH between 7.4 and 8.6and stable oxidation/reduction potential (ORP) (Table 3). Palmer and Puls (1994) state that Cr^{+3} is immobile under moderately alkaline to slightly acidic conditions. The ORP scale typically ranges from -1,000 mV (strongly reducing) to +1,000 mV (strongly oxidizing), and thus the low positive ORP values (Table 3) suggest minimal oxidizing activity. Because site conditions suggest a low potential for the mobilization of Cr^{+6} from soil to groundwater (slightly to moderately alkaline soils and lack of a strong oxidizing environment), Cr^{+6} is not evaluated further in the HHRA.

4.2.2 Groundwater

Groundwater samples collected by the NMED in 2012 and RI/FS samples collected by DBS&A in 2012 and 2013 were analyzed for VOCs and dissolved metals. Analysis results were compared to NMED and USEPA tap water SLs, as well as USEPA MCLs. USEPA tap water SLs based on a cancer endpoint reflect a carcinogenic risk of $1x10^{-6}$ and were multiplied by a factor of 10 to reflect the NMED's recommended risk level of $1x10^{-5}$. Although residents are provided municipal water, they are not prevented from using domestic well water for household or outdoor use. Therefore, tap water SLs were used to screen COPCs for further evaluation in the risk assessment. The SLs used to screen groundwater concentrations are provided in Table 4.

4.2.2.1 Eagle Picher Site

Organics (VOCs)

For groundwater at the Eagle Picher Site, 14 samples were collected by the NMED or DBS&A and analyzed for VOCs; however, analysis results from the sample collected from SW-1 indicated possible cross-contamination during sampling and were not included in the screening assessment[1]. Results of the screening assessment for VOCs in groundwater at the Eagle Picher property (excluding analysis results from SW-1) are provided in Appendix A, Table A-6. PCE, TCE, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, 1,1,1-TCA, and Freon 113 were not detected in any of the samples (0% FOD), and all reporting limits were below all of the SLs (NMED tap water, USEPA tap water, and MCLs, as listed in Table 4). Toluene was detected in one sample (7.7% FOD) at a level of 6.3 µg/L (SW-2); however, this concentration and all reporting limits were below all of the SLs.

Several other VOCs were detected in one or two of the groundwater samples: chloroform (7.7% FOD), bromodichloromethane (15% FOD), dibromochloromethane (15% FOD), and bromoform (15% FOD). Low-level detections of bromodichloromethane, and dibromochloromethane from the Eagle Picher municipal supply well exceeded the NMED and USEPA tap water SLs but not the MCLs (Appendix A, Table A-6). All other detected concentrations and reporting limits for these VOCs were lower than all of the SLs (Appendix A, Table A-6). Chloroform, bromodichloromethane, and dibromochloromethane were detected in multiple trip blanks from DBS&A sampling. Chloroform was also detected in multiple trip blanks from NMED sampling. Bromodichloromethane, dibromochloromethane, and bromoform are common lab contaminants, and they are also typically related to municipal water treatment (they were only detected in Eagle Picher municipal supply well) (ATSDR 2005).

Metals

For groundwater at the Eagle Picher Site, two samples were collected by DBS&A and analyzed for dissolved metals for the RI/FS; however, analysis results from the sample collected from SW-1 indicated possible cross-contamination during sampling and were not included in the screening assessment (as discussed above). Results of the screening assessment for metals in groundwater at the Eagle Picher Site are provided in Appendix A, Table A-7. Of the metals analyzed in the groundwater sample from SW-2, only arsenic [As] was detected at a concentration (1.9 µg/L) above the NMED and USEPA tap water SLs of 0.448 and 0.45 µg/L, respectively (Appendix A, Table A-7). Cobalt (Co) was not detected,

[1] Analytical results from new on-site monitoring well SW-1 indicate elevated concentrations of aluminum, iron, lead, and other metals. These results are consistent with possible cross-contamination from surficial soil particles, which may have occurred during sampling. Results from this well should not be considered representative of aquifer conditions and were not used for risk assessment purposes (DBS&A 2013).

but the reporting limit (6.0 µg/L) exceeded the USEPA tap water SL of 4.7 µg/L (Appendix A, Table A-7). All concentrations and reporting limits for other metals, including Cd, Cr, and Pb, were below the NMED and USEPA tap water SLs and MCLs (Appendix A, Table A-7).

For As, the detected sample concentration exceeded the NMED and USEPA tap water SLs, but not the MCL (10 µg/L) (Appendix A, Table A-7). As in groundwater can be the result of natural erosion processes, or runoff from orchards or glass or electronics production wastes (City of Socorro 2012). Based on previous investigations, As was not identified as a COPC in the CSM (Section 4.1); however, it has been detected at varying levels above the MCL in groundwater within the Socorro Basin. Brandvold (2001) analyzed 74 groundwater samples (72 wells, 2 springs) collected from 1998 through 2000 from Socorro Basin (city water supplies, private wells for irrigation, stock watering, and domestic supplies), and As ranged from 1 to 43 µg/L in those samples. Brandvold (2001) showed that As is present in groundwater throughout the Socorro Basin at levels similar to or higher than those detected in the RI/FS samples, including areas upgradient of the Site. Brandvold (2001) also noted that high concentrations of As in groundwater are generally associated with volcanic deposits and geothermal systems, which are present in the Socorro area.

COPCs for Eagle Picher Site Groundwater

Based on the screening assessment of groundwater samples, summarized above, no COPCs were identified as posing potential risk from exposure to Eagle Picher Site groundwater. The detected concentration of As was similar to levels generally found in the Socorro Basin (Brandvold 2001), while other VOCs detected in groundwater samples are common lab contaminants or typically related to municipal water treatment (Appendix A, Tables A-6 and A-7).

4.2.2.2 Plume Area

Organics (VOCs)

For groundwater in the plume area, 51 samples were collected by the NMED or DBS&A and analyzed for VOCs (Figures 8, 9, and 10). Results of the screening assessment for VOCs in plume area groundwater are provided in Appendix A, Table A-6 and are summarized below. Groundwater SLs are provided in Table 4.

PCE was detected in 8 of 51 groundwater samples (16% FOD), with detected concentrations ranging from 0.38 to 13.5 µg/L (Appendix A, Table A-6).

- Of the eight detected concentrations, five were higher than the NMED tap water SL (1.08 µg/L) and MCL (5 µg/L). These concentrations were in samples collected from monitoring wells OMW-7, IW-1, and SW-4 (Figure 10).

- Reporting limits for 10 of the non-detects were higher than the NMED tap water SL, but none were higher than the MCL.
- All of the detected concentrations and reporting limits for non-detects were lower than the USEPA tap water SL of 97 µg/L.

TCE was detected in 36 of 51 groundwater samples (71% FOD), with detected concentrations ranging from 0.43 to 240 µg/L (Appendix A, Table A-6).

- Of the 36 detected concentrations, 25 were higher than the NMED tap water SL (3.4 µg/L) and USEPA tap water SL (4.4 µg/L), and 24 were higher than the MCL (5 µg/L). These concentrations were in samples collected from domestic wells Alice East, Alice West, Hopper, Knight, Lopez, and Padilla and monitoring wells OMW-5, OMW-6, OMW-7, OMW-9, OMW-12, DW-2, IW-1, SW-4, SW-5, and SW-6 (Figure 8).
- None of the reporting limits for non-detects exceeded the NMED and USEPA tap water SLs and MCL.

1,1-DCE was detected in 18 of 51 groundwater samples (35% FOD), with detected concentrations ranging from 0.68 to 490 µg/L (Appendix A, Table A-6).

- Of the 18 detected concentrations, 15 were higher than the MCL (7 µg/L), and 2 were higher than the NMED tap water SL (340 µg/L) and USEPA tap water SL (260 µg/L). Sample concentrations exceeding the tap water SLs were collected from the domestic Alice East well. The other wells with detected concentrations exceeding the MCL were domestic wells Alice West, Hooper, and Padilla and monitoring wells OMW-5, OMW-6, OMW-9, DW-2, SW-5, and SW-6 (Figure 9).
- None of the reporting limits for non-detects exceeded the NMED and USEPA tap water SLs and MCL.

There were also multiple low-level detections for 1,1-DCA (20% FOD, 0.19 to 4.8 µg/L), cis-1,2-DCE (9.8% FOD, 1.1 to 3.1 µg/L), toluene (3.9% FOD, 3.4 to 9.3 µg/L), and Freon 113 (6.8% FOD, 0.25 to 9.75 µg/L), but concentrations and reporting limits were all below the NMED and USEPA tap water SLs and MCLs (Appendix A, Table A-6).

Similar to groundwater samples from the Eagle Picher Site, there were low-level detections of chloroform (2.0% FOD), 2-hexanone (2.0% FOD), and dibromochloromethane (2.0% FOD), as well as cis-1,3-dichloropropene (3.9% FOD), but all detections were below the tap water SLs and MCLs (Appendix A, Table A-6). Both detected cis-1,3-dichloropropene concentrations in

NMED samples from OMW-4 (0.21 µg/L) and OMW-12 (0.20 µg/L) were below contract-required quantitation limits. There were some reporting limits above NMED and USEPA tap water SLs for chloroform, cis-1,3-dichloropropene, bromodichloromethane, and dibromochloromethane (Appendix A, Table A-6); these were generally associated with samples having higher concentrations of PCE, TCE, and/or 1,1-DCE (which required sample dilution prior to analysis). Chloroform, bromodichloromethane, and dibromochloromethane were detected in multiple trip blanks from DBS&A sampling, and chloroform and 2-hexanone (also acetone and 2-butanone) were detected in multiple trip blanks from NMED sampling. Chloroform, bromodichloromethane, dibromochloromethane, and bromoform were also detected in a DBS&A equipment blank (SW-5 EB). Bromodichloromethane, dibromochloromethane, and bromoform are common lab contaminants.

Metals

For plume area groundwater, specific metals were analyzed in samples collected by DBS&A for the RI/FS. Results of the screening assessment for dissolved metals in plume area groundwater are provided in Appendix A, Table A-7.

- As detections (60% FOD) were higher than the NMED tap water SL (0.448 µg/L) and USEPA tap water SL (0.45 µg/L) but not the MCL (10 µg/L) for three samples (1.9, 2.6, and 2.8 µg/L); however, these concentrations are within the range (1 to 43 µg/L) generally found in the Socorro Basin (Brandvold 2001).
- For samples from SW-6 and DW-2, elevated reporting limits for As were higher than both of the SLs and MCL. These elevated reporting limits were also within the range typically found in the Socorro Basin.
- Other metals, including Cd, Cr, and Pb, did not exceed tap water SLs or MCLs (detected concentrations and reporting limits).

For As, the three detected sample concentrations exceeded the Tap Water SLs, but not the MCL (Appendix A, Table A-7). As discussed in Section 4.2.2.1, As was not identified as a COPC in the CSM (Section 4.1), and it is present in groundwater at levels typical of those found throughout the Socorro Basin by Brandvold (2001).

COPCs for Plume Area Groundwater

Based on the screening assessment of groundwater samples, summarized above, PCE, TCE, and 1,1-DCE were the COPCs identified as posing potential risk from exposure to plume area groundwater. Concentrations of As were similar to levels typically found in the Socorro Basin (Brandvold 2001), while other VOCs detected in groundwater samples are common lab contaminants (Appendix A, Tables A-6 and A-7).

4.2.3 Vapor Intrusion

4.2.3.1 Eagle Picher Property

Groundwater

Concentrations in groundwater samples collected at the Eagle Picher Site were compared to USEPA's commercial scenario SLs for vapor intrusion (Table 5). Results of the screening assessment for vapor intrusion from groundwater are provided in Appendix A, Table A-8. For the 13 groundwater samples (excluding results from monitoring well SW-1, as discussed in Section 4.2.2.1), no VOCs were detected, and all reporting limits were below USEPA's commercial vapor intrusion SLs, with one exception. Toluene was detected in monitoring well SW-2 (6.3 µg/L); however, the concentration did not exceed USEPA's commercial vapor intrusion SL (81,000 µg/L) (Appendix A, Table A-8).

Sub-slab Air

Concentrations in sub-slab air samples collected at the Eagle Picher Site were compared to USEPA's commercial scenario SLs for vapor intrusion. The SLs used to screen sub-slab air concentrations are provided in Table 5.

Results of the screening assessment for vapor intrusion from sub-slab air are provided in Appendix A, Table A-9. PCE, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, toluene, and Freon 113 were not detected in the seven sub-slab air samples (0% FOD), and the reporting limits were all below USEPA's commercial vapor intrusion SLs (Appendix A, Table A-9). TCE was not detected above the reporting limit in any of the sub-slab samples (0% FOD). While the reporting limit for the TCE samples slightly exceeded USEPA's commercial vapor intrusion SL of 88 µg/m^3 (Appendix A, Table A-9), laboratory results for these samples indicated that no TCE was detected for samples SS-1 through SS-6 and TCE was detected in the sample from SS-7 at a level below the reporting limit (estimated at 42 µg/m^3) (personal communication from Andy Freeman, HEAL, to Jason Raucci, DBS&A, email dated August 16, 2013). 1,1,1-TCA was detected in five sub-slab samples (71% FOD), ranging from 120 to 680 µg/m^3, but all concentrations were below USEPA's commercial vapor intrusion SL of 220,000 µg/m^3, as was the reporting limit for the two non-detect sample results (Appendix A, Table A-9).

COPCs for Eagle Picher Property Vapor Intrusion

Based on the screening assessment of groundwater and sub-slab air samples, summarized above, no COPCs were identified as posing potential risk from exposure to Eagle Picher Site groundwater or sub-slab soil via vapor intrusion. Although the reporting limit for TCE slightly exceeded USEPA's commercial vapor intrusion SL, the one estimated concentration of TCE was below the SL, and no TCE was detected by the laboratory in any of the other samples. Detected concentrations of 1,1,1-TCA in sub-slab air were all below USEPA's commercial vapor intrusion SL. Additionally, TCE and other VOCs were not detected in groundwater at the Site, and no other VOCs were detected in the sub-slab air samples at concentrations above USEPA's commercial vapor intrusion SLs (Appendix A, Tables A-8 and A-9).

4.2.3.2 Plume Area

Groundwater

Groundwater concentrations of VOCs in the 51 samples collected from wells in the plume area south of the Eagle Picher Site were compared to USEPA's residential and commercial scenario SLs for vapor intrusion. The SLs used to screen groundwater concentrations are provided in Table 5. Results of the screening assessment for exposure to groundwater via vapor intrusion are provided in Appendix A, Table A-8 and are summarized below.

PCE was detected in 8 of 51 groundwater samples (16% FOD), with detected concentrations ranging from 0.38 to 13.5 µg/L (Appendix A, Table A-8).

- None of the detected concentrations or reporting limits for non-detects exceeded USEPA's residential or commercial vapor intrusion SLs (58 and 240 µg/L, respectively).

TCE was detected in 36 of 51 groundwater samples (71% FOD), with detected concentrations ranging from 0.43 to 240 µg/L (Appendix A, Table A-8).

- Of the 36 detected concentrations, 23 were higher than USEPA's residential vapor intrusion SL (5.2 µg/L). These concentrations were in samples collected from domestic wells Alice East, Alice West, Hopper, Knight, Lopez, and Padilla and monitoring wells OMW-5, OMW-6, OMW-7, OMW-9, DW-2, IW-1, SW-4, SW-5, and SW-6 (Figure 8).
- Of the 36 detected concentrations, 15 were higher than USEPA's commercial vapor intrusion SL (22 µg/L). These concentrations were in samples collected from domestic wells Alice East, Alice West, Lopez, and

Padilla and monitoring wells OMW-6, OMW-7, DW-2, IW-1, SW-4, and SW-6 (Figure 8).

- The detected concentration of TCE reported by the NMED in groundwater from the Alice East well (240 µg/L) was flagged by the laboratory as “not recommended for use” due to inferior associated quality assurance/quality control performance. This well was re-sampled by DBS&A, and the result (187 µg/L) was similar to the flagged NMED result.
- None of the reporting limits for non-detects exceeded USEPA’s residential and commercial vapor intrusion SLs.

1,1-DCE was detected in 18 of 51 groundwater samples (35% FOD), with detected concentrations ranging from 0.68 to 490 µg/L (Appendix A, Table A-8).

- Of the 18 detected concentrations, 4 were higher than USEPA’s residential vapor intrusion SL (200 µg/L). Sample concentrations exceeding the SL were collected from the domestic wells Alice East and Padilla and monitoring well DW-2 (Figure 9).
- None of the 18 detected concentrations exceeded USEPA’s commercial vapor intrusion SL (820 µg/L).
- The detected concentration of 1,1-DCE reported by the NMED in groundwater from the Alice East and Padilla wells (490 and 230 µg/L, respectively) were flagged by the laboratory as “not recommended for use” due to inferior associated quality assurance/quality control performance. The Padilla well was not re-sampled by DBS&A; however, the Alice East well was re-sampled by DBS&A, and result (452 µg/L) was similar to the flagged NMED result.
- None of the reporting limits for non-detects exceeded USEPA’s residential and commercial vapor intrusion SLs.

Exterior Soil Gas

Exterior soil gas VOC concentrations in the 6 samples collected in the vicinity of the Alice East, DW-2, and SW-6 wells (Figure 11) and 10 samples collected in the plume area around wells DW-1, IW-1, OMW-7, and SW-4 (Figure 12) were compared to USEPA’s residential and commercial scenario SLs for vapor intrusion. The SLs used to screen exterior soil gas concentrations are provided in Table 5.

Results of the screening assessment for vapor intrusion from exterior soil gas are provided in Appendix A, Table A-10 and are summarized below.

PCE was not detected in any of the 16 exterior soil gas samples (0% FOD), (Appendix A, Table A-10).

- The reporting limit for non-detects did not exceed USEPA's residential and commercial vapor intrusion SLs (420 and 1,800 µg/m^3, respectively).

TCE was detected in 1 of 16 exterior soil gas samples (6% FOD), with a detected concentration of 230 µg/m^3 (Appendix A, Table A-10).

- The detected concentration was higher than USEPA's residential vapor intrusion SL (21 µg/m^3) and USEPA's commercial vapor intrusion SL (88 µg/m^3).
- The reporting limit for non-detects also exceeded USEPA's residential and commercial vapor intrusion SLs.

1,1-DCE was not detected in any of the 16 exterior soil gas samples (0% FOD) (Appendix A, Table A-10).

- The reporting limit for non-detects did not exceed USEPA's residential and commercial vapor intrusion SLs (2,100 and 8,800 µg/m^3, respectively).
- Exterior soil gas samples with non-detected levels of 1,1-DCE include six locations near the Alice East and DW-2 wells that are likely located above where the groundwater plume contains concentrations of 1,1-DCE exceeding USEPA's residential vapor intrusion SL for groundwater (Appendix A, Table A-8).

No other VOCs were detected, although reporting limits for chloroform, 2-hexanone, cis-1,3-dichloropropene, bromodichloromethane, and dibromochloromethane exceeded SLs (Appendix A, Table A-10). However, these VOCs are common field and lab contaminants in groundwater.

COPCs for Plume Area Vapor Intrusion

Based on the screening assessment of groundwater and exterior soil gas samples, summarized above, TCE and 1,1-DCE were identified as posing potential risk from exposure to plume area groundwater or exterior soil gas via vapor intrusion. Although 1,1-DCE was not detected in any of the exterior soil gas samples located over the portion of the groundwater plume that contains the highest concentrations of 1,1-DCE (around the Alice East and SW-6/DW-2 wells), groundwater concentrations from three wells in this area did exceed USEPA's residential scenario SLs for vapor intrusion from groundwater (Alice East, Padilla, and DW-2). Because these SLs are based on an assumption of shallow groundwater (i.e., less than approximately 20 ft bgs) and the wells in the plume area are typically deeper (and in some cases screened below the water table), the

SLs are conservatively screening 1,1-DCE as a COPC. Well depth is considered when assessing potential risk in the detailed risk assessment (Section 4.3).

4.2.4 CPOC Summary

Combining the COPCs identified for each location, medium, and exposure pathway discussed above, four COPCs were identified to be carried through the exposure assessment and risk characterization.

- Pb
  - Site surface soils (XRF and laboratory): 100% FOD
  - Site subsurface soils (XRF): 98% FOD
  - Site sub-slab soils (XRF and laboratory): 100% FOD
- PCE
  - Plume area groundwater: 16% FOD
- TCE
  - Plume area groundwater: 71% FOD
  - Plume area exterior soil gas: 6% FOD
- 1,1-DCE
  - Plume area groundwater: 35% FOD

These COPCs are those that pose potential risk from exposure to one or more of the media sampled and exposure pathways evaluated.

4.3 Detailed Risk Assessment

4.3.1 Exposure Assessment

The CSM (Section 4.1) describes the exposure media and exposure pathways identified to assess human health risk from Site COPCs. The following media and pathways were identified for quantitative risk assessment in the CSM.

- Current or Future Off-Site Resident or Farmer
  - Ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing)
  - Dermal exposure to groundwater
  - Ingestion of fruits and vegetables irrigated with groundwater
  - Inhalation of volatiles migrating from groundwater to indoor air
- Current or Future Off-Site Commercial/Industrial Worker
  - Inhalation of volatiles migrating from groundwater to indoor air

- Hypothetical Future On-Site Commercial/Industrial or Construction Worker
  - Ingestion of and dermal contact with surface soils
  - Ingestion of and dermal contact with subsurface soils
  - Inhalation of suspended soil particulates
  - Ingestion and inhalation of groundwater (including worker uses such as showering/bathing)
  - Dermal exposure to groundwater
  - Inhalation of volatiles migrating from groundwater to indoor air
- Current or Future On-Site Intermittent Visitor (Trespasser, Recreator, or Visitor)
  - Ingestion and dermal contact with surface soils
  - Ingestion and dermal contact with subsurface soils
  - Inhalation of suspended soil particulates

Pb exposure from Site soils was assessed using USEPA's Adult Lead Model (ALM) (USEPA 1996), which uses the mean Pb concentration. Because of the different types of surface soil samples collected (grid-based, targeted, confirmatory) and the high correlation between XRF and confirmatory sample Pb results for the gridded samples (DBS&A 2013), multiple mean Pb concentrations were calculated to capture the range of possible overall exposure to Pb from Eagle Picher Site soils (Appendix B, Table B-1):

- Mean Pb from all laboratory samples
- Mean Pb from all XRF surface samples
- Mean Pb from all XRF surface and subsurface samples
- Mean Pb from all grid-based XRF surface samples
- Mean Pb from all grid-based XRF surface and subsurface samples

To evaluate exposure to VOCs in groundwater, analytical results from samples collected by the NMED in 2012 and DBS&A in 2012 and 2013 were evaluated on an individual sample basis for two reasons. First, direct exposure (ingestion/inhalation, dermal contact, ingestion of irrigated fruits and vegetables) would be to groundwater extracted from a single well at a single point in time rather than to a blend of groundwater extracted from all wells or a group of wells at different times. Second, exposure through vapor intrusion is also location-specific. Because USEPA (2002a) considers contaminants in groundwater to affect buildings within approximately 100 feet of the sample location, combining samples from multiple locations would not be appropriate for evaluating exposure for buildings near each well.

4.3.2 Toxicity Effects Assessment

To characterize toxicity effects, chemical-specific and media-specific toxicity values for each COPC were identified from USEPA's May 2013 RSLs (which includes USEPA's Integrated Risk Information System [IRIS] as the primary source for toxicity values) (USEPA 2013a). The toxicity values provide reasonably conservative estimates of chemical doses that, if not exceeded, should be protective of human health (including sensitive individuals). Reference doses [RfDs] and reference concentrations [RfCs] were identified to evaluate noncancer oral or inhalation health effects. Cancer slope factors (CSFs) and inhalation unit risk (IUR) estimates were used to evaluate potentially carcinogenic chemicals. Toxicity values for PCE, TCE, and 1,1-DCE; exposure factors; and risk equations used to assess human health risks are provided in Appendix C (Tables C-3, C-4, C-6, C-7, and C-8).

4.3.3 Risk Characterization

Risks from exposure to the COPCs identified in the screening assessment (Section 4.2) were characterized for the complete exposure pathways identified in the CSM (Section 4.1). Complete exposure pathways that were quantitatively addressed are discussed in Section 4.3.3.1, and those that were qualitatively addressed are discussed in Section 4.3.3.2.

4.3.3.1 Complete Exposure Pathways Quantitatively Addressed

Risks to human health from the Eagle Picher Site and plume area were characterized following NMED (2012) and USEPA (1989, 2004, 2009a) guidance. The toxicity values, exposure factors, and equations used to quantitatively characterize risk, as well as calculated risk levels, are provided in Appendix C. Results of quantitative human health risk characterization are provided in Appendix C and summarized below and in Table 7.

Noncancer health effects were quantified using a hazard quotient (HQ), which is calculated as a ratio of the estimated noncancer exposure dose to a published noncancer RfD (or RfC for air exposures). An HQ greater than 1 indicates a potential for adverse effects from exposure to site media. Hazard quotients are based on noncancer health effects, while regulatory numeric standards (e.g., MCLs for drinking water) are codified in local, state, or federal law. As a result, an HQ may be greater than 1 (indicating a potential for adverse effects) for a chemical concentration that does not exceed its regulatory standard, or an HQ may be less than or equal to 1 (indicating no potential for adverse effects) for a chemical concentration that does exceed its regulatory standard.

Individual excess lifetime cancer risk (ECR) was evaluated using the estimated lifetime exposure and published cancer toxicity values (CSFs and IURs). Individual ECR is calculated as a probability, such as 1×10^{-4} (1E-04), 1×10^{-5} (1E-05), and 1×10^{-6} (1E-06), which correspond to 1 ECR per 10,000, 1 per 100,000, and 1 per 1,000,000, respectively. Following NMED guidance (2012), an ECR of 1E-05 was used as a threshold for this risk characterization. However, USEPA (1989) often uses a range of 1E-04 to 1E-06 to evaluate potential risks and remedial alternatives.

Eagle Picher Site Soils

Because there are no toxicity values for Pb, exposure to this COPC was assessed using USEPA's ALM (USEPA 1996, 2003a, 2009b), which predicts a median blood lead level (BLL) estimate for an adult as a function of the baseline BLL plus an increment that is attributable to exposure to Site soil (USEPA 2003a). This increment is a function of the biokinetic slope factor (BKSF), the concentration of Pb in soil, the soil ingestion rate, the fraction of Pb in soil that is absorbed, and the exposure frequency. USEPA has selected a target BLL for an adult female to protect a developing fetus such that the fetus has no more than a 5-percent probability of a BLL exceeding 10 µg/L per day (µg/L/d). The age of the adult receptor is different for Pb than for other non-Pb COPCs. For evaluation of Pb, USEPA considers the appropriate adult receptor to be a woman of child-bearing age (USEPA 2003a), assumed to be between the ages of 20 and 49 years old.

The evaluation of BLLs was conducted using the default exposure assumptions as provided in the ALM (Appendix C, Table C-1) and by inputting the maximum Site mean soil Pb concentration of 276 mg/kg for Eagle Picher Site soils (Appendix B, Table B-1). Based on the maximum Site mean, the ALM indicates that risks from exposure to Pb in Site soils are below the BLL and probability targets (Appendix C, Table C-1). Therefore, current Pb concentrations do not present an elevated risk for adult workers on-Site.

To address potential risk to intermittent visitors (i.e., trespassers or recreators), an evaluation of BLLs was conducted using a higher ingestion rate and absorption fraction (for adolescent receptors) and a lower exposure frequency (1 day per week) compared to the adult worker model. Based on the maximum Site mean Pb concentration of 276 mg/kg, the ALM indicates that risks from exposure to Pb in Site soils are below the BLL and probability targets (Appendix C, Table C-2). Based on the results of this model, current Pb concentrations do not present an elevated risk for intermittent visitors on-Site.

Plume Area Groundwater

Risk estimates from ingestion and inhalation of groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing) and dermal exposure to groundwater were evaluated for each well individually from the plume area. Carcinogenic and noncarcinogenic risks were calculated for detected PCE, TCE, and 1,1-DCE concentrations from each well and are provided in Appendix C. Risk-based concentrations (RBCs) protective of human health were derived for these three COPCs in the groundwater plume for multiple exposure pathways (see Table 6).

For the risk estimates calculated for groundwater, the CSF for TCE is based on three different cancer endpoints (kidney cancer, liver cancer, and non-Hodgkin lymphoma). For one of these endpoints (kidney cancer), TCE has a mutagenic mode of action (i.e., exposure during early life stages can lead to development of cancer later in life). To account for this mutagenicity for kidney cancer, the ECR for TCE was calculated by summing two separate ECRs, the kidney cancer ECR and a combined ECR for liver cancer and non-Hodgkin lymphoma. For the kidney cancer ECR, an age-dependent adjustment factor was used to account for mutagenicity (USEPA 2005, NMED 2012).

Within the plume area, 19 of the 33 wells were identified as having elevated risks from ingesting and inhaling VOCs (from household use, including showering/bathing, laundering, and dishwashing) in groundwater (ECRs greater than 1E-05 and/or HQs greater than 1). Of these 19 wells, 1 is a former municipal supply well (Olson), 6 are domestic wells (Alice East, Alice West, Hooper, Knight, Lopez, and Padilla), and the rest are monitoring wells that are not used for water supply. ECRs for these 19 wells ranged from 1E-05 to 5E-04, and HQs ranged from 1.4 to 162 (Appendix C, Table C-5). Elevated risks were due to TCE in all 19 of these wells; however, 1,1-DCE also had HQs greater than 1 for two domestic wells (Alice East and Padilla) and one monitoring well (DW-2). Although residences with contaminated domestic wells have been connected to the municipal water supply, use of domestic well water may still occur. The extent of domestic well water use for indoor and/or outdoor purposes is unknown; however, water from the Alice West well is known to be used for showering/bathing, and water from the Hooper well is known to be used in swimming pools. Risks from exposure to VOCs in groundwater are likely substantially reduced for residents using municipal water.

Because water from some wells may be used by residents for household use and/or for outdoor use (e.g., in swimming pools), risks from dermal exposure to residents (child + adult) were evaluated. This evaluation was conducted only for the domestic supply wells because monitoring wells are not used for water supply;

PCE, TCE, and 1,1-DCE were not detected or detected at very low levels in the municipal supply wells (the Olson well is no longer used for municipal supply); and water from municipal supply wells is pre-treated to remove contaminants (Appendix A, Table A-6). Exposure factors used in the risk calculations follow USEPA (2004), and daily showering/bathing was used to evaluate potential risk. Of the eight domestic wells evaluated, three were identified as having elevated risks from dermal contact with VOCs (primarily TCE) in groundwater (Alice East, Lopez, and Padilla), with ECRs ranging from 8E-06 to 4E-05 and HQs ranging from 1.2 to 7.2 (Appendix C, Table C-9). The extent of domestic well water use for indoor and/or outdoor purposes is unknown; however, water from the Alice West well is known to be used for showering/bathing, and water from the Hooper well is known to be used in swimming pools.

Because water from some wells may be used by residents or farmers to irrigate vegetable gardens or fruit or nut trees, risks from ingesting fruits and vegetables irrigated with groundwater were evaluated. Carcinogenic and noncarcinogenic risks were calculated using RBCs using the equestions obtained from Department of Energy's Risk Assessment Information System Preliminary Remediation Goals Calculator (Department of Energy 2014) to develop RBCs that are protective of human health for a variety of farmed fruits and vegetables. This evaluation was conducted only for the domestic supply wells because monitoring wells are not used by residents for water supply, PCE, TCE, and 1,1-DCE were not detected or detected at very low levels in the wells that are still used as municipal supply wells, and water from municipal supply wells is pre-treated to remove contaminants (Appendix A, Table A-6). Of the eight domestic wells evaluated, four were identified as having elevated risks from VOCs (almost entirely TCE) in fruits and vegetables irrigated with groundwater (Alice East, Alice West, Lopez, and Padilla), with ECRs ranging from 1E-05 to 1E-04 and HQs ranging from 1.6 to 19 (Appendix C, Table C-10). The extent of domestic well water use for irrigation is unknown; however, water from the Alice East well is known to be used for irrigation.

Vapor Intrusion

Risks from inhalation of VOCs migrating into indoor air from plume area groundwater were evaluated for individual groundwater wells. This evaluation was limited to wells that were screened at the water table, since samples collected from these wells reflect contaminant levels that could migrate up through soils and into nearby buildings. USEPA (2002a) guidance recommends screening wells at the water table to evaluate subsurface vapor intrusion. Several monitoring wells and all the municipal supply wells are screened below the water table. Although screen depths for most of the domestic wells are not known, these wells are typically screened below the water table, so they were also excluded from this evaluation. Carcinogenic and noncarcinogenic risks were calculated using USEPA's Vapor Intrusion Assessment Calculators (USEPA 2013b) and are provided in Appendix C. The default attenuation factor in the calculator was adjusted using attenuation factor curves in Figure 3b from USEPA (2002a) and site-specific information (soil type [loamy sand] and depth to groundwater) (Appendix C, Table C-11). Risk-based concentrations (RBCs) protective of human health were derived for PCE, TCE, and 1,1-DCE in the groundwater plume for the vapor intrusion are provided in Table 6.

Of the 15 plume area wells that are screened at the water table, 4 were identified as having elevated risks from VOCs (primarily TCE) in groundwater via vapor intrusion for residents (OMW-6, OMW-7, SW-4, and SW-6), with ECRs ranging from 1E-05 to 4E-05 and HQs ranging from 2.3 to 7.3) (Appendix C, Table C-11). For commercial/industrial workers, three of these wells (OMW-6, OMW-7, and SW-4) were identified as having elevated risks, with ECRs ranging from 3E-06 to 5E-06 and HQs ranging from 1.0 to 1.7 (Appendix C, Table C-11).

The one detected TCE concentration in exterior soil gas measured in samples collected around plume area wells DW-1, IW-1, OMW-7, and SW-4 was also evaluated individually using USEPA's Vapor Intrusion Assessment Calculators (USEPA 2013b) (Appendix C, Table C-12). Risk-based concentrations (RBCs) protective of human health were derived for PCE, TCE, and 1,1-DCE in exterior soil gas are provided in Table 6. For residents, the detected TCE concentration measured in the sample SGT-9 indicated elevated carcinogenic and noncarcinogenic risks (ECR = 5E-05, HQ = 11). For commercial/industrial workers, the TCE concentration from SGT-9 did not indicate an elevated carcinogenic risk (ECR = 8E-06), but did indicate an elevated noncarcinogenic risk (HQ = 2.6) (Appendix C, Table C-12).

The elevated risks from the TCE concentration in exterior soil gas from SGT-9 is consistent with the elevated risks calculated based on groundwater samples collected from nearby wells OMW-7 and SW-4 (Figure 12), indicating a possible elevated risk from exposure to TCE in groundwater via vapor intrusion for residences in that area. In the area around the Alice East well, TCE was not detected in any of the six soil gas samples collected; however elevated risks were calculated based on the groundwater sample collected from nearby well SW-6 (Figure 11). In this area, the results of the vapor intrusion risk calculations from groundwater and soil gas do not clearly indicate any potential elevated risk to nearby residences. Well OMW-6 also indicated a potential vapor intrusion risk from groundwater; however, no soil gas samples were collected in the vicinity of that well. There are no residences within about 1,000 feet that well (Figure 8), so any potential risk from groundwater in that location would not be expected to affect any residences.

4.3.3.2 Complete Exposure Pathways Qualitatively Addressed

The CSM (Section 4.1) identified the LBP and ACBM exposure pathways as complete but also specified that these pathways would be evaluated qualitatively. These pathways are discussed below.

Commercial/industrial workers, construction workers, and intermittent visitors (i.e., trespassers or recreators) on-Site may be exposed to lead or asbestos through contact with soils or building materials. Results of DBS&A's December 2012 LBP and asbestos investigation confirmed the presence of LBP in three of the buildings comprising the historical facility, as well as lead-containing paint on all buildings. The asbestos investigation confirmed the presence of ACBM in two of the buildings comprising the historical facility, as well as the former manufacturing building. Contamination from LBP and ACBM appeared to be limited to the buildings, as there was no visual evidence suggesting migration of these contaminants to the soils on-Site (Acme Environmental 2013).

Because the LBP and ACBM surveys completed by Acme Environmental (2013) were conducted to confirm the presence of LBP and ACBM and not intended to quantify levels of LBP and ACBM for assessment of exposure, potential risks cannot be quantitatively characterized.

The preferred action is to demolish the buildings and clean up the ground adjacent to the buildings. Any such work will comply with state and federal standards to prevent worker exposure and release of hazardous materials, as well as ensure proper disposal of the building materials. If any of the buildings are not demolished, other abatement measures will be necessary to prevent exposure.

4.3.4 Uncertainty Analysis

Uncertainties are inherent in the risk assessment process, ranging from the completeness and quality of the chemical data to the toxicity values, receptors, exposure factors, and models employed to evaluate risk. Many assumptions incorporated in risk assessment are intentionally conservative so that risks are unlikely to be underestimated. This uncertainty analysis provides perspective on the quantitative risk results to assist risk management decisions.

- **Exposure concentrations used to calculate risks.** The NMED (2012) specifies soil depth intervals to use for evaluating risks to various receptor types: 0 to 10 ft bgs for residents and construction workers and 0 to 1 ft bgs for commercial/industrial workers. XRF surface soil samples and confirmatory soil samples analyzed by laboratory methods were only collected from the top 6 inches or 1 foot of soils, and XRF subsurface samples were only collected from the top 4 to 6 feet of soils. Cd, Cr, and Pb levels from the full 0 to 10 ft bgs were not available to use in the screening assessment or detailed risk evaluation, so potential risks from the full exposure depth were not evaluated. However, concentrations measured by XRF in at-depth samples were typically lower than those measured from surface soils (as illustrated by mean Pb concentrations in Appendix B, Table B-1), indicating that the COPC concentrations in the top 6 inches or 1 foot of soils may overestimate exposure concentrations to some degree.

- **Cr^{+6} in groundwater.** While Cr^{+6} was analyzed in the laboratory soil samples, it was not analyzed in groundwater samples. As discussed in Section 4.2.1.3, based on the chemical conditions of the on-Site soils, Cr^{+6} is not expected to be present in the groundwater. However, this cannot be confirmed due to the lack of analytical data for groundwater collected from wells located on the Eagle Picher Site.

- **Analytical reporting limits versus SLs.** In some cases, chemicals were not detected, but reporting limits exceeded SLs. Some of these instances were due to the dilution of a sample to quantify a chemical present at a higher concentration (As and several VOCs in groundwater and Cr^{+6} in surface and sub-slab soils), resulting in higher reporting limits for other chemicals. Although there is uncertainty associated with elevated reporting limits in such cases, the magnitude of the uncertainty is unknown. In these instances, however, the elevated reporting limits were less than 1 order of magnitude higher than the standard reporting limits, so any potential unknown risks would not be expected to be higher than this difference.

  In other cases, the standard reporting limit for a laboratory method exceeded an SL (i.e., the laboratory method used was not sensitive enough to measure concentrations at or below the SL). This occurred for the following COPCs: Cr^{+6} in surface and sub-slab soils compared to the NMED groundwater protection SSL; PCE and TCE in subsurface and sub-slab soils compared to the NMED groundwater protection SSL; Co in groundwater compared to the USEPA tap water SL; TCE in sub-slab air compared to the USEPA commercial vapor intrusion SL; and TCE, chloroform, 2-hexanone, cis-1,3-dichloropropene, bromodichloromethane, and dibromochloromethane in exterior soil gas compared to the USEPA residential vapor intrusion SLs (Appendix A, Tables A-3, A-5, A-7, A-9, and A-10). In most of these cases, it was not possible to know whether the chemical was present in the sample or at what concentration. However, the laboratory was able to provide additional information for PCE and TCE in subsurface and sub-slab soils and TCE in sub-slab air indicating whether these chemicals were detected at any level in the samples. An examination of whether other chemicals in these samples were detected or exceeded SLs provided the basis for determining whether to identify the chemical as a COPC for evaluation of risk. If the chemical was not identified as a COPC but was actually present at an undetectable concentration above the SL, there may be some risk associated with that chemical that was not characterized. The magnitude of the risk, if any, is unknown. However, the reporting limits were less than 1 to 2 orders of magnitude higher than the SLs, so any potential unknown risks would not be expected to be higher than this difference.

- **Exposure to VOCs in groundwater from domestic wells.** All residents with contaminated domestic wells have been connected to the municipal water supply; however, there are no administrative controls preventing them from using domestic well water. The extent of domestic well water use is unknown; however, water from the Alice West well is known to be used for showering/bathing, water from the Hooper well is known to be used in swimming pools, and water from the Alice East well is known to be used for irrigation. Without site-specific information regarding the use of domestic well water for household use (including showering/bathing, laundering, and dishwashing) and outdoor use (e.g., in swimming pools), potential risks from ingestion and inhalation of, dermal contact with, and ingestion of fruits and vegetables irrigated with groundwater may be overestimated if any municipal water is used by residents.

- **Vapor intrusion.** The most complete set of data available to estimate risks from indoor air was groundwater concentrations from 15 wells located in and around the plume area that were screened at the water table (Appendix C, Table C-11). Other wells were screened below the water table and were not used to evaluate potential vapor intrusion risk in those locations. Well depths for the 15 wells screened at the water table range from 18 ft bgs to nearly 80 ft bgs. Adjustments were made to the vapor attenuation factor in the model used to calculate indoor air concentrations from groundwater based on depth to the water table. However, the model also relies on a number of conservative assumptions regarding subsurface to surface transport, and these generic assumptions tend to over-predict indoor air concentrations (USEPA 2002a). Consequently, indoor air risks based on groundwater VOC concentrations may be overestimated.

  PSG samples collected by both the NMED and DBS&A indicated the presence of VOCs at the soil surface around and to the south of the Alice East well. However, these field screening data were not adequate to quantitatively assess indoor air risks. In June 2013, DBS&A collected six soil gas samples around the Alice East well. While no VOCs were detected in these samples, reporting limits for several VOCs exceeded SLs. The TCE reporting limit exceeded the SL; however, laboratory reports for these six samples indicated that TCE was not detected in any of the samples at levels below the reporting limit. Because these reporting limits were not lower than the SLs, it is not possible to estimate how much risks calculated from groundwater VOC concentrations may be overestimated (or possibly underestimated).

- **Metals bioavailability.** A primary source of uncertainty in the exposure analysis lies in the assumption of 100 percent bioavailability of metals from environmental media (e.g., soils). Bioavailability considerations are critical for metals risk assessment since large proportions of metals may be bound to the soil/sediment matrix and unavailable to the receptor or target organ (USEPA 2007). No data were collected in this investigation to assess the proportion of bioavailable metals in soils. Therefore, risk estimates based on soil contact or ingestion pathways are likely overestimated.
- **Potential risk from exposure to contaminants in the Hefner pond.** Due to access restrictions, DBS&A was unable to collect samples in the Hefner pond to assess groundwater contribution. Since this pond is easily accessible to trespassers, there may be a risk of exposure to contaminants in the pond's water or sediment if contaminants are migrating from shallow groundwater.

4.4 Summary and Conclusions

Potential risks to humans posed by COPCs in various media at the Eagle Picher property were evaluated for several potential exposure pathways and exposed populations (Table 7). Based on nearly all detected concentrations and all reporting limits below direct soil exposure SLs, Cd, Cr, and Cr^{+6} in surface and subsurface soils and Cd, Cr, Cr^{+6}, and Pb in sub-slab soils, groundwater, and sub-slab air are not likely to pose risks to on-Site commercial/industrial and construction workers or intermittent visitors (i.e., trespassers or recreators). Additionally, the ALM indicated that Pb in soils do not present an elevated risk to adult workers or intermittent visitors on-Site.

Table 7 also summarizes the estimated risks to humans posed by ingestion and inhalation of COPCs in groundwater (including all uses of household water, such as showering/bathing, laundering, and dishwashing), dermal exposure to COPCs in groundwater, and ingestion of fruits and vegetables irrigated with groundwater in the plume area south of the Eagle Picher Site, as well as VOCs migrating to indoor air via vapor intrusion from groundwater and exterior soil gas.

For the 33 wells, risk estimates calculated for ingestion and inhalation of groundwater VOCs resulted in ECRs ranging from 1E-05 to 5E-04 and/or noncancer HQs exceeding 1 for 12 monitoring, 1 municipal supply (Olsen, which is no longer used as a municipal supply well), and 6 domestic wells (Appendix C, Table C-5). All of these exceedances were due to detected TCE concentrations, although HQs also exceeded 1 for 1,1-DCE concentrations at three of these wells. However, monitoring wells are not used for domestic water supply, and residences with contaminated domestic wells have been connected to the municipal water supply, so that risks from exposure to VOCs in groundwater may be less that estimated. The extent of domestic well water use for indoor and/or outdoor purposes is unknown; however, water from the Alice West well is known to be used for showering/bathing, and water from the Hooper well is known to be used in swimming pools. Risks from exposure to VOCs in groundwater are likely substantially reduced for residents using municipal water.

Residents may still use groundwater from domestic wells for household use (including showering/bathing, laundering, and dishwashing) and for outdoor use (e.g., swimming pools). Dermal exposure estimates for groundwater from three of eight domestic wells resulted in ECRs ranging from 8E-06 to 4E-05 (within USEPA's acceptable range of 1E-06 to 1E-04) and noncancer HQs greater than 1 (ranging from 1.2 to 7.2). For these three wells (Alice East, Lopez, and Padilla), TCE concentrations were the primary contributors to the calculated ECRs and HQs from dermal contact based on daily showering/bathing (Appendix C, Table C-9). The extent of domestic well water use for indoor and/or outdoor purposes is unknown; however, water from the Alice West well is known to be used for showering/bathing, and water from the Hooper well is known to be used in swimming pools.

Residents may still use groundwater from domestic wells to irrigate vegetable gardens or fruit or nut trees. Exposure from ingesting fruits and vegetables irrigated with groundwater from four of eight domestic wells resulted in ECRs ranging from 1E-05 to 1E-04 05 (within USEPA's acceptable range of 1E-06 to 1E-04) and noncancer HQs greater than 1 (ranging from 1.6 to 19). For these four wells (Alice East, Alice West, Lopez, and Padilla), TCE concentrations were the primary contributors to the calculated ECRs and HQs from ingestion of fruits and vegetables irrigated with groundwater (Appendix C, Table C-10). The extent of domestic well water use for irrigation is unknown; however, water from the Alice East well is known to be used for irrigation.

Residential indoor air exposure via vapor intrusion estimated from plume area groundwater, as well as exterior soil gas, resulted in 4 of the 15 wells screened at the water table and one exterior soil gas samples with ECRs ranging from 1E-05 to 5E-05 (within USEPA's acceptable range of 1E-06 to 1E-04) and noncancer

HQs greater than 1 (ranging from 2.3 to 11). For these four wells (OMW-6, OMW-7, SW-4, and SW-6) and the one exterior soil gas sample (SGT-9), TCE concentrations were the primary contributors to the calculated ECRs and HQs (Appendix C, Tables C-11 and C-12). For commercial/industrial workers, the ECRs and HQs were lower, but three of the four wells (OMW-6, OMW-7, and SW-4) and the exterior soil gas sample (SGT-9) were identified as having elevated risks (ECRs ranging from 3E-06 to 8E-06 and HQs ranging from 1.0 to 2.6) (Appendix C, Tables C-11 and C-12). As discussed in Section 4.3.4, the vapor intrusion model used to calculate indoor air concentrations from groundwater and exterior soil gas concentrations relies on a number of conservative assumptions regarding sub-surface to surface transport. These generic assumptions tend to over-predict indoor air concentrations (USEPA 2002a). Further investigative efforts should therefore be focused on potentially affected buildings near the four wells and one exterior soil gas sampling location where ECRs and HQs from VOCs were elevated.

Based on all the exposure pathways evaluated, TCE is the primary constituent of concern in plume area groundwater. Elevated potential risks were identified for vapor intrusion from groundwater in monitoring wells OMW-6, OMW-7, SW-4, and SW-6, and from exterior soil gas at sample location SGT-9 near monitoring well OMW-7. Elevated potential risks were also identified for groundwater in several plume area domestic wells based on ingestion/inhalation, dermal exposure, and/or ingestion of irrigated fruits and vegetables: Alice East, Alice West, Hooper, Knight, Lopez, and Padilla. Residences with contaminated domestic wells have been connected to the municipal water supply; however, domestic well water use for indoor and/or outdoor purposes may still occur, and the extent of use is unknown. Water from the Alice West well is known to be used for showering/bathing, water from the Hooper well is known to be used in swimming pools, and water from the Alice East well is known to be used for irrigation. The calculated potential risks for exposure to VOCs in groundwater assume no use of municipal water, so risks from ingestion/inhalation, dermal exposure, and/or ingestion of irrigated fruits and vegetables are likely reduced for residents using municipal water.

5 Ecological Risk Assessment

This section summarizes the approach, analyses, and results of the EcoRA, It describes the CSM, screening assessment, and detailed risk assessment to estimate the likelihood and magnitude of potential risks to ecological receptors posed by current or likely future exposure to metals in Eagle Picher Site soils and groundwater in the plume area.

5.1 Conceptual Site Model

The ecological CSM presented here constitutes the "Scoping Assessment Report" as defined in the NMED EcoRA guidance (NMED 2008). The scoping assessment (per NMED 2008) includes the following elements:

- Compile and assess basic site information (using the Site Assessment Checklist)
- Conduct site visit
- Identify preliminary contaminants of potential ecological concern
- Develop a preliminary conceptual site exposure model
- Prepare a scoping assessment report

The basic study area information is described in Sections 1 through 3 and further expanded below for ecological receptors. The Site Assessment Checklist for the Site is provided in Appendix D, and the checklist for the plume area is provided in Appendix E. Both appendices also include selected photographs from various viewpoints to illustrate the vegetation and habitat present in the study area. The primary chemicals of potential ecological concern (summarized in Section 3) include heavy metals (specifically Pb, Cr, and Cd) present in surface and subsurface soils, as well as chlorinated solvents (including PCE, TCE, and

1,1-DCE) in groundwater. This ecological CSM incorporates the evaluation of the chemical sources, fate and transport pathways, exposure media, ecological receptors, and exposure pathways, as detailed below.

5.1.1 Contaminant Migration

5.1.1.1 Soils

Residual debris from the lead-acid battery manufacturing is known to be scattered across the soils on-Site. Heavy metals in this debris have previously been demonstrated to leach from the debris into the surrounding soils. Once in the soil, the heavy metals can be transported by air and water. VOCs are also present in soils and groundwater due to historic Site-related activities. Per NMED (2008) guidance, the relevant ecological exposure pathways for soil include two approximate soil intervals:

- 0 to 5 ft bgs for all non-burrowing receptors
- 0 to 10 ft bgs for all burrowing receptors and plants

5.1.1.2 Surface Water

Heavy metals contamination in on-Site soils can be transported by sheet flow or flooding events at the Site. Transport by surface water is exclusively stormwater, as there are no permanent or perennially flowing water channels on the Site. The surface drainage on both the area around the historical facility and the area around the former manufacturing building is toward Nogal Arroyo to the south of the Site. Although large berms have been constructed to prevent discharge of surface water from the Site to the arroyo, evidence of flood-conveyed debris downstream in the arroyo has been reported by residents. Portions of the berm at south and southwest of the historical facility have been observed to be damaged, and it was reported by the NMED that a portion of the berm at the southeastern corner of the Site was breached in 2006 and subsequently repaired. It is therefore possible that heavy metals-contaminated soils and debris may be suspended by surface water and transported off-Site down the Nogal Arroyo during rain events.

Several surface water ponds are present within the plume area. The NMT golf course contains two large ponds and a number of smaller ponds, and also features a small, man-made stream located just south of Canyon Road. Another pond is located in an old gravel quarry (i.e., borrow pit) just east of monitoring well SW-4 (Figure 8); this pond is locally known as the “Hefner Pond.” The substrate within the golf course ponds appears to be fine silt, while the borrow pit’s substrate appears to be slick clay. Another large pond is located in a private yard near the northeast part of the NMT golf course, near the Knight domestic well (Figure 8).

Water features on the NMT golf course are man-made and serve as holding facilities for irrigation water pumped from the Lattman, Holmes, and Bushman municipal supply wells. No samples were collected from the golf course ponds during RI/FS sampling. The pond near the Knight well is maintained by pumping from the domestic well.

The surface elevation and persistence of the borrow pit pond indicate a possible connection to shallow groundwater. The pond was identified by the NMED as a potential illegal dumping area and therefore a potential source of or contributor to the groundwater plume. No VOCs were detected above laboratory detection limits from two surface sediment and two surface water samples collected in May 2006 for the expanded environmental site investigation conducted by Ecology & Environment. These results indicate that the borrow pit pond is not a source/contributor to the identified groundwater plume (E&E 2007). Results of this sampling also do not indicate any detectable contamination resulting from a groundwater contribution. Due to access restrictions by the property owner, no additional samples were collected from this pond during RI/FS sampling to determine whether the pond is currently connected to shallow groundwater.

5.1.1.3 Air

Heavy metals contamination in on-Site soils can be suspended in air and transported off-Site or to other areas of the Site. The movement of heavy metals-contaminated soils through windborne particulates is likely the most frequent transport mechanism of heavy metals contamination off-Site. VOCs in groundwater can volatilize and migrate into soil above the plume; however, inhalation of contaminants is generally assumed to be a minor pathway of exposure to wildlife, except in the case of burrowing animals.

5.1.2 Environmental Setting

Based on the history of the Site and the on-Site/off-Site nature of the contamination, consideration of potential ecological receptors is assessed by location. Likely ecological receptors were identified for the two areas during a site visit to the study area, which is summarized below.

5.1.2.1 Summary of Site Visit

A site visit was conducted on November 15, 2012, to identify plant and animal species, as well as habitat types, present at the Eagle Picher Site and in the area of the groundwater plume to the south. The two areas were evaluated using the ecological assessment checklist provided in the NMED's screening-level EcoRA guidance (NMED 2008). The completed checklists and photographs are provided in Appendix D (Eagle Picher Site) and Appendix E (plume area). Plant and animal species observed during the site visit are provided in Tables 8 and 9, respectively. Information regarding the species and habitats present at the Eagle Picher Site and the plume area are provided below. Appendix F contains a listing of amphibian, reptile, bird, and mammal species documented to occur in Socorro County, New Mexico, as reported by the Biota Information System of New Mexico (BISON-M).

Eagle Picher Site

The Eagle Picher Site is a heavily disturbed and very weedy light industrial site with soils that are dry and primarily sandy. The Site is dominated by kochia (*Kochia scoparia*), which is common in disturbed areas. Prickly Russian thistle (*Salsola* sp.), which is also commonly found in disturbed areas, was observed throughout the Site. Several other plant species were also found throughout the Site: apache plume (*Fallugia paradoxa*), blue grama (*Bouteloua gracilis*), fourwing saltbush (*Atriplex canescens*), and rabbitbrush (*Ericameria nauseous*). A complete list of plant species observed at the Eagle Picher Site is provided in Table 8.

Patchy scrub/shrub vegetation covers about 60 percent of the Site, with plant heights averaging 0 to 2 feet. Dominant scrub/shrub species at the Site are kochia and prickly Russian thistle. There are no wooded or open field areas. Not much available forage was observed on the Site (Appendix D).

As stated in Section 5.1.1.2, transport by surface water is exclusively stormwater, as there are no permanent or perennially flowing water channels on the Site. The surface water from the Site drains to Nogal Arroyo, which flows through the western half of the Site and just south of the eastern half of the Site. Evidence of past surface water runoff was observed during the site visit. To the east of the industrial lagoons, a strip of more dense vegetation appears to be a low spot that collects water (Appendix D, Photograph 6). The plant species identified in this low spot are found elsewhere on the Site and include facultative wetland species, such as Russian olive (*Elaeagnus angustifolia*) (Table 8).

During the site visit, the Site was found to be generally devoid of animal life. A few harvester ants were seen, but no fish or mammals were observed, and no evidence of burrowing animals was observed (Table 9, Appendix D). White-crowned sparrows (*Zonotrichia leucophrys*) were observed in shrubs, mostly along fences (Table 9). No threatened or endangered species (plant or animal) are known to be present.

As stated for the human health CSM (Section 4.1.2), the future land use on the Eagle Picher Site will likely be limited to commercial and industrial activities. If current habitat conditions remain unchanged, then the types of ecological receptors currently present are not expected to change as a result of future commercial or industrial activities.

Plume Area

The preliminary groundwater plume area surveyed during the site visit was delineated based on results from the NMED 2012 sampling (Figure 2 in DBS&A 2012). Most of the preliminary plume area is located northwest of the Socorro city limits, and it extends into the city to include the northern portion of the NMT golf course. The preliminary plume area encompasses approximately 265 acres of mixed land use that is mostly rural with some residences. Approximately 20 percent of the plume area appears to be undisturbed. Soil movement within the area has been caused by heavy equipment used to excavate borrow material in at least two locations, as well as precipitation-related erosion in all of the drainages and the excavated areas (Appendix E).

Plant species identified in the plume area during the site visit are listed in Table 8. The most abundant plant species observed were creosote bush (*Larrea tridentata*), cowpen daisy (*Verbesina* sp.), and kochia. Other common plant species observed were fourwing saltbush, pigweed (*Amaranthus* sp.), and prickly Russian thistle. Several emergent plants were identified at the three ponds located within the plume area: cattails (*Typha* sp.), cottonwood (*Populus deltoides*), Russian olive, and tamarisk (*Tamarix chinensis*). Algae was also observed floating in the ponds; no submergent plants were observed (Appendix E).

Sparse scrub/shrub vegetation covers about 60 percent of the plume area, with plant heights averaging 0 to 2 feet. Dominant scrub/shrub species in the plume area are creosote bush, fourwing saltbush, rabbitbrush. About 20 percent of the area is open field, and these are disturbed areas with patchy vegetation dominated by grasses and forbs less than 2 feet in height. There is a wooded riparian habitat (less than 1 percent of the area) bordering the borrow pit on the east side of the plume area. This habitat is dominated by deciduous trees, with mature cottonwood (predominantly greater than 12 inches diameter at breast height) forming the overstory; tamarisk is the dominant understory species. Remaining areas are covered by residential landscaping and the NMT golf course (lawns and cultivated ornamental species) (Appendix E).

Three ponds were observed within the plume area; two are associated with the NMT golf course, and the other is an old quarry (i.e., borrow pit). The substrate within the golf course ponds appears to be fine silt, while the borrow pit's substrate appears to be slick clay. The ponds appear to be fed by surface runoff, and no points of discharge were observed. No samples were collected from the golf course ponds during RI/FS sampling, so whether either of the ponds is connected to shallow groundwater is not known.

As noted in Section 5.1.1.2, the borrow pit pond (locally known as the “Hefner Pond”) was identified by the NMED as a potential illegal dumping area and therefore a potential source of or contributor to the groundwater plume. No VOCs were detected above laboratory detection limits from two surface sediment and two surface water samples collected in May 2006 for the expanded environmental site investigation conducted by Ecology & Environment. These results indicate that the borrow pit pond is not a source/contributor to the identified groundwater plume (E&E 2007). Results of this sampling also do not indicate any contamination resulting from a groundwater connection to the groundwater plume. However, no samples were collected from the pond during RI/FS sampling due to access restrictions, so whether the pond is currently connected to shallow groundwater is not known.

Several animal species were observed in the plume area (Table 9). White-crowned sparrows were observed throughout the plume area, as well as the Eagle Picher Site. Black-tailed jackrabbits (*Lepus insularis*), Gambel’s quails (*Callipepla gambelii*), crows (*Corvus brachyrhynchos*), and coyote (*Canis latrans*) scat and tracks were observed at a few locations in the plume area, while northern harriers (*Circus cyaneus*) and cow (*Bos primigenius*) tracks were observed less frequently. No threatened or endangered species (plant or animal) are known to be present in the plume area (Appendix E).

As stated for the human health CSM (Section 4.1.2), the future land use of areas with groundwater contamination will likely be a mix of residential housing, community agriculture, agriculture/farming, manufacturing, and commercial/industrial activities. Assuming existing habitat conditions remain unchanged, the types of ecological receptors currently present are not expected to change as a result of future activities.

5.1.2.2 Assessment and Measurement Endpoints

Representative assessment and measurement endpoints were developed to guide the EcoRA process. Assessment endpoints focus the risk assessment on the particular components of the ecosystem that could be adversely affected by Site contaminants (NMED 2008; USEPA 1997). These endpoints establish a clear connection between the management goals, ecological species, and the risk assessment objectives to protect the assessment endpoint (NMED 2008; USEPA 1997). The overall risk management goal for the study area is to reduce ecological risks, if necessary, to levels that will result in the maintenance of healthy local populations and communities of plants and organisms. The assessment endpoints for the study area considered ecologically relevant receptor groups (i.e., those identified in Section 5.1.2.3) that are potentially highly exposed to the COPCs. In addition, ecological risk questions were developed to provide a basis for developing the analysis and risk characterization phases of the risk assessment (USEPA 1997). Explicit assessment endpoints and risk questions for each receptor group are detailed in Table 10.

A measurement endpoint is defined as “a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint” (NMED 2008; USEPA 1997). To answer the risk questions for each assessment endpoint, multiple measures of effect are examined. These can include measures of exposure, effect, and receptor and ecosystem characteristics. Measurement endpoints for the study area are primarily based on evaluation of concentrations of COPCs in soils compared to toxicological benchmarks that are protective of the assessment endpoints. These endpoints are defined in Table 10 with the approach for analyzing the measures of exposure and effect in the EcoRA.

5.1.2.3 Ecological Receptors

Appendix F contains a list of amphibian, reptile, bird, and mammal species occurring in Socorro County from the BISON-M. Although not identified during the site visit, other species in this list that occur in habitats at or near the study area may also be present. The ecological food web developed for the study area (Figure 14) shows the different trophic levels and feeding guilds present in the study area and the modes of exposure to Site COPCs.

It is not feasible to evaluate every plant, animal, and microbial species that may be present in the study area and potentially exposed to contaminants. Consequently, surrogate receptors representative of the groups of animals that are or could be present in the study area were selected for evaluation. These representative receptors will be evaluated to address potential exposure for different trophic levels and feeding guilds representing different modes of exposure to Site COPCs. The general ecological trophic groups with example surrogate receptors include the following:

- Terrestrial plants (primary producers, trophic level 1)
- Soil invertebrates (herbivores/detritivores, trophic level 2)
- Omnivorous mammals (e.g., rodents, trophic level 3)
- Omnivorous birds (e.g., sparrows, trophic level 3)
- Carnivorous mammals (e.g., coyote, trophic level 4)

5.1.2.4 Potentially Complete Exposure Pathways

According to USEPA guidance (USEPA 1989; NMED 2008), a complete exposure pathway consists of four elements:

1. A source and mechanism of chemical release
2. A retention or transport medium (or media in cases involving transfer of chemicals)
3. A point of potential receptor contact with the contaminated medium (“exposure point”)
4. An exposure route (such as ingestion) at the exposure point

If any of these elements are missing (except when the source itself is the exposure point), the exposure pathway is considered incomplete. For example, if receptor contact with the source or transport medium does not occur, the exposure pathway is considered incomplete and is not quantitatively evaluated for risk. Similarly, if receptor contact with an exposure medium is not possible, the exposure pathway is considered incomplete and is not evaluated.

The ingestion and direct contact pathways are complete for metals for ecological receptors that have contact with soils contaminated by these COPCs. The site visit identified one animal burrow in the plume area, so the potential for inhalation of chlorinated solvents appears to be a complete pathway. Therefore, particle inhalation, ingestion, and direct contact pathways for heavy metals are considered complete, as is the inhalation pathway for VOCs. Dermal contact and inhalation pathways, however, will be assessed qualitatively rather than quantitatively in the EcoRA.

The ecological CSM for the Site (Figure 15) summarizes information on sources of COPCs, affected environmental media, COPC release and transport mechanisms that may occur in the study area, representative receptors, and potential exposure pathways for each receptor. Potentially complete exposure pathways are designated by a “C.” Incomplete exposure pathways are designated by an “I.”

5.2 Screening Assessment

The following subsections summarize the screening assessment to compare individual sample results to ecological SLs. Individual sample results and SLs for Eagle Picher Site soils are provided in Appendix G. Chemicals detected in any samples collected were included in the screening assessment. Results of the screening assessment (FOD and exceedances of SLs) were used to identify COPCs to carry through the exposure assessment and risk characterization.

5.2.1 Eagle Picher Site Soils

Surface soils (top 0 to 6 inches) and subsurface soils (various intervals between 0 and 6 ft bgs) at the Eagle Picher Site were sampled from both the primary area (southeast of Highway 408) and the secondary area (northwest of Highway 408). Soil concentrations were compared to ecological SSLs from the Los Alamos ECORISK Database (version 3.1) (LANL 2012), USEPA Region 5 (USEPA 2003b), and USEPA Ecological SSLs (EcoSSLs) (USEPA 2005a,b; 2008). The SSLs used to screen soil concentrations are provided in Table 11.

5.2.1.1 Primary Area of the Eagle Picher Site

Surface soil samples for the primary area of the Eagle Picher Site were collected from a combination of statistically based grid locations (samples numbered 1 through 54), intended to characterize mean Cd, Cr, and Pb concentrations across the Site, and targeted locations (samples numbered 55 and higher), intended to characterize areas of known or suspected higher-level contamination. Subsurface soils were collected from a subset of the grid-based and targeted sample locations in the primary area of the Eagle Picher Site. Surface and subsurface soils from the primary area of the Eagle Picher Site were field-screened using XRF analysis for Cd, Cr, and Pb.

As discussed in Section 6.3.1 of the draft RI report (DBS&A 2013), XRF analysis results for Cr near or below 100 mg/kg were considered unreliable. For Cr values in this range, no correlation was indicated between XRF values and confirmatory laboratory results. XRF values in this range may overestimate the Cr content by a factor ranging between approximately 5 and 10 and may correspond to concentrations close to established background values (i.e., <20 milligrams per kilogram [mg/kg]) (E&E, 2007). Therefore, XRF Cr values at or below 100 mg/mg are considered non-quantified. Additionally, for XRF Cr values higher than 100 mg/kg, there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation; therefore, XRF Cr values above 100 mg/kg are considered semi-quantitative and are only used qualitatively in the RI to identify areas of potentially elevated Cr.

Results of the screening assessment for surface soils analyzed by XRF are provided in Appendix G, Table G-1, and results for subsurface soils are provided in Appendix G, Table G-2.

- Cd was detected in 3 of 72 surface soil samples (4.2% FOD; 2 samples were not analyzed for Cd), with detected concentrations ranging from 37 to 88 mg/kg, and in none of the 22 subsurface soil samples (0% FOD; 6 samples were not analyzed for Cd).

- Cr was detected above 100 mg/kg in 19 of 74 surface soil samples (26% FOD), with detected concentrations ranging from 102 to 8,697 mg/kg, and in 3 of 28 subsurface soil samples (11% FOD), with detected concentrations ranging from 107to 1,075 mg/kg.

- Pb was detected in all 74 surface soil samples (100% FOD), with detected concentrations ranging from 15 to 6,166 mg/kg, and in all 28 subsurface soil samples (100% FOD), with detected concentrations ranging from 11 to 2,809 mg/kg.

All detected concentrations and reporting limits reported for Cd, Cr, and Pb in samples analyzed by XRF exceeded one or more of the SSLs.

A subset of surface soil samples was collected for confirmatory laboratory analysis to compare XRF and laboratory results over a range of XRF values. These confirmatory samples were collected at 12 surface soil XRF analysis locations and analyzed for Cd, Cr, and Pb using EPA Method 6010A and for Cr^{+6} using EPA Method 3060A/7196A. However, because of how these samples were selected for analysis, results for Cd, Cr, Cr^{+6}, and Pb in these samples may be slightly biased toward higher concentrations. For these laboratory analyzed soil sample results, all detected concentrations of Cd (92% FOD), Cr (100% FOD), and Pb (100% FOD), as well as the reporting limit for one Cd sample, exceeded one or more of the SSLs (Appendix G, Table G-3). For Cr^{+6} (25% FOD), all detected concentrations and reporting limits were below the only SSL available for Cr^{+6} (mammalian EcoSSL). No VOCs were detected in the two subsurface samples (5 ft bgs) analyzed by laboratory methods, and all reporting limits for these two samples were also below all of the SSLs(Appendix G, Table G-3).

5.2.1.2 Secondary Area of the Eagle Picher Site

As described in Section 5.2.1.1, surface and subsurface soil samples for the secondary area of the Eagle Picher Site were also collected from a combination of statistically based grid locations and targeted locations. Surface and subsurface soils from the secondary area of the Eagle Picher Site were field-screened using XRF for Cd, Cr, and Pb. Results of the screening assessment for surface soils analyzed by XRF are provided in Appendix G, Table G-1, and results for subsurface soils are provided in Appendix G, Table G-2.

- Cd was not detected in any of the 64 surface soil samples (0% FOD), or the 35 subsurface soil samples (0% FOD).

- Cr was detected above 100 mg/kg in 2 of 64 surface soil samples (3.1% FOD), with detected concentrations ranging from 101 to 139 mg/kg, but was not detected above 100 mg/kg in any of the 35 subsurface soil samples (0% FOD).

- Pb was detected in all 64 surface soil samples (100% FOD), with detected concentrations ranging from 9 to 347 mg/kg, and in 34 of 35 subsurface soil samples (97% FOD), with detected concentrations ranging from 9 to 1,265 mg/kg.

All detected concentrations and reporting limits reported for Cd, Cr, and Pb, in samples analyzed by XRF exceeded one or more of the SSLs.

As described in Section 5.2.1.1, a subset of surface soil samples was also collected for confirmatory laboratory analysis to compare XRF and laboratory results over a range of XRF values. These confirmatory samples were collected at seven surface soil XRF analysis locations. For laboratory analyzed soil sample results, all detected concentrations of Cd (14% FOD), Cr (100% FOD), and Pb (100% FOD), as well as the reporting limits for Cd, exceeded one or more of the SSLs (Appendix G, Table G-3). Cr^{+6} was not detected in any of the samples (0% FOD), and all reporting limits were below the only SSL available for Cr^{+6} (mammalian EcoSSL) (Appendix G, Table G-3).

5.2.1.3 COPCs for Eagle Picher Site Soils

Based on the screening assessment of soil samples, summarized above, Cd, Cr, and Pb were COPCs identified as posing potential ecological risk from exposure to Eagle Picher Site soils.

5.3 Detailed Risk Assessment

5.3.1 Exposure Assessment

The CSM (Section 5.1) describes the exposure media and exposure pathways identified to assess ecological risk from the study area. Particle inhalation, ingestion, and direct contact pathways for heavy metals are considered complete, as is the inhalation pathway for VOCs. Dermal contact and inhalation pathways, however, will be assessed qualitatively rather than quantitatively.

In addition to plants and soil invertebrates, three wildlife species were selected as representative ecological receptors to characterize risk from exposure to Eagle Picher Site soils. These receptors are common residents in the shrub/scrub environments present at the Site (see Appendix D). In addition, these receptors are consistent with those species identified by the NMED (2008) as appropriate for evaluating ecological risks. Finally, the foraging habits of the selected species are consistent with the likely exposure pathways identified for the Site. Therefore, since it is impractical to assess every possible species, these receptors are used in the EcoRA as surrogates for similar species within the same trophic levels.

1. House Sparrow (*Passer domesticus*) – an omnivorous avian species that feeds on terrestrial plants and terrestrial invertebrates (earthworms and insects)
2. Desert Shrew (*Nitiosorex crawfordi*) – a small burrowing carnivorous mammal that feeds on terrestrial invertebrates (earthworms and insects)
3. Coyote (*Canis latrans*) – a large carnivorous mammal that feeds on birds and mammals

Exposure parameters used to characterize risk for each of these three representative ecological receptors are provided in Appendix H, Table H-1. These parameters include body weight, incidental soil ingestion rate, and daily food ingestion rate. The basis for each of these parameters is also provided.

To account for uncertainty in estimating a true average concentration, USEPA recommends calculating the 95 percent upper confidence level on the mean (95% UCL) for each exposure area (USEPA, 1992a, 2002b). USEPA's ProUCL (version 4.1.01) was used to calculate 95% UCLs as EECs for characterizing risk. Appendix B, Table B-2 provides 95% UCLs and summary statistics for analytical results from Site soil samples collected for the RI/FS.

Exposure to Site soils was evaluated using EECs calculated from the laboratory analyzed soils data for Cd and Cr rather than the XRF soils data for the following reasons:

- Nearly all (133 of 136) cadmium XRF results were non-detects using XRF, and the reporting limits exceeded one or more of the SSLs. XRF was not sensitive enough to detect the low-level concentrations of Cd quantified using laboratory methods.
- Most XRF Cr results were below 100 mg/kg, and these values were found to not correlate well with confirmatory laboratory sample results and are thus considered non-quantifiable. Additionally, for XRF Cr values higher than 100 mg/kg, there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation; therefore, XRF Cr values above 100 mg/kg are considered semi-quantitative (DBS&A 2013).

To evaluate overall exposure to Eagle Picher Site soils, EECs were calculated using laboratory generated data from all confirmatory samples collected from both the primary and secondary areas of the Eagle Picher Site. Additionally, because of the different types of surface soil samples collected (grid-based, targeted, confirmatory) and the high correlation between XRF and confirmatory sample Pb results for the gridded samples (DBS&A 2013), multiple Pb 95% UCLs were calculated to capture the range of possible overall exposure to Pb from Eagle Picher Site soils (Appendix B, Table B-2):

- 95% UCL for Pb from all laboratory samples
- 95% UCL for Pb from all XRF surface and subsurface samples
- 95% UCL for Pb from all grid-based XRF surface and subsurface samples

5.3.2 Toxicity Effects Assessment

Toxicity reference values (TRVs) used for the three representative ecological receptors are provided in Appendix H, Table H-2. The TRVs are avian and mammalian no observed adverse effect levels (NOAELs) and lowest observed adverse effect levels (LOAELs) reported in USEPA's EcoSSL documents for Cd, Cr, and Pb (USEPA 2005a,b, 2008).

5.3.3 Risk Characterization

Risks to wildlife from the Eagle Picher Site and plume area were characterized following NMED (2012) guidance. The toxicity values, exposure factors, and equations used to quantitatively characterize risk, as well as calculated risk levels, are provided in Appendix H. Risk estimates were calculated by a ratio of the estimated exposure and the toxicity benchmark (i.e., HQ). An HQ greater than 1 indicates a potential for adverse effects from exposure to site media. Results of the quantitative ecological risk characterization are summarized below and in Table 12 for terrestrial plants, soil invertebrates, and the three representative wildlife receptors.

Through visual inspection of the data and distributions of soil concentrations at the Site (XRF data shown in Figures 3 and 5, as well as corresponding laboratory data in Appendix G, Table G-3), three isolated areas were identified with elevated concentrations: (1) around the unlined sewage lagoons, (2) at the former manufacturing building, and (3) southwest of the former manufacturing building (associated with visible battery debris). To avoid overestimating risks Site-wide, a second analysis of risks was conducted by excluding these areas of elevated contamination. Risk estimates are shown for both the entire data set and for the set excluding samples collected at these three locations. This was done to distinguish areas that may require further remedial investigation from those areas that are not likely contributing to potential risks.

For the three representative ecological receptors (house sparrow, desert shrew, and coyote), elevated risks from ingestion of contaminated soils and food were identified based on ratios of 95% UCLs from the confirmatory samples to both NOAELs and LOAELs. HQs were 88 and 79 for house sparrow, 170 and 147 for desert shrew, and 2.5 and 2.1 for coyote (Appendix H, Tables H-4 through H-6). Comparing 95% UCLs of Cd, Cr, and Pb to plant and soil invertebrate benchmarks indicate that Pb may pose elevated risks in terrestrial plants (HQ = 12.4, with 5 of 19 individual samples [P-35, P-37, P-55, P-60, and P-66] exceeding the benchmark) and Cr may pose elevated risks to soil invertebrates (HQ = 4.7, with 2 of 19 individual samples [P-60 and P-66] exceeding the benchmark) (Appendix H, Table H-7).

HQs were lower based on 95% UCLs calculated from Pb XRF results, because the 95% UCLs calculated from Pb XRF results (406 mg/kg for all samples and 82.3 mg/kg for gridded samples) were less than one-third the 95% UCL calculated from the confirmatory samples (1,491 mg/kg). However the HQs for house sparrow and desert shrew were still elevated, and plant and soil invertebrate benchmarks were exceeded by several individual samples. For gridded soil XRF samples, the HQs were 56 and 52 for house sparrow, 144 and 123 for desert shrew, and 2.1 and 1.8 for coyote (Appendix H, Tables H-4 through H-6). HQs for plant and soil invertebrate benchmarks based on the 95% UCL from gridded samples were less than one-tenth those calculated using the confirmatory sample Pb concentrations. For terrestrial plants, the HQ was 0.7, with 8 of 110 individual samples exceeding the benchmark. For soil invertebrates, the HQ was 0.0, with 0 of 110 individual samples exceeding the benchmark. For all XRF soil samples, HQs were higher than those calculated using the 95% UCL for gridded samples, and proportions of individual samples exceeding plant and soil invertebrate benchmarks were also higher (Appendix H, Tables H-4 through H-6).

Elevated ecological risks are primarily the result of Cd and Pb concentrations. Risk calculations using 95% UCLs that excluded higher Cd and Pb concentrations in selected areas (P-37, P-37E1, P-37E2, P-37N1, P-37N2, P-37S1, P-37S2, P-37W1, P-37W2, P-55, P-60, P-65, P-66) within the primary portion of the Eagle Picher property (unlined sewage lagoons, former manufacturing building, and southwest of the former manufacturing building) reduced calculated risks substantially (Table 12). Elevated risks were no longer identified for soil invertebrates, terrestrial plants, and coyote, while lower but still elevated risks remained for house sparrow (HQs of 4.0 and 3.3) and desert shrew (HQs of 5.5 and 4.9) (Appendix H, Tables H-9 through H-12). HQs based on 95% UCLs for Pb XRF results were similar to those calculated using confirmatory sample Pb results; there was a much smaller difference between the UCLs after the samples from the selected areas of higher Cd and Pb concentrations (identified above) were excluded from the calculations (Appendix H, Tables H-9 through H-12).

The dermal exposure pathway for absorption of metals was not evaluated quantitatively, consistent with USEPA Region 8 (USEPA 1992b). Information is limited on the rate and extent of dermal absorption of metals in soil across the skin of ecological receptors. Additionally, most scientists consider this pathway to be minor compared to exposure from direct soil ingestion because most metals tend to bind to soils, thus reducing the likelihood they would dissociate from the soil and cross the skin, and ionic species, such as metals, have a relatively low tendency to cross the skin, even when contact does occur (USEPA 2003c). Because substantial VOCs have not been identified at the Site and VOCs rapidly volatilize from surface soil, dermal contact by terrestrial wildlife to VOCs is expected to be minimal (USEPA 2003c).

The inhalation exposure pathway was also not evaluated quantitatively. Metals can sorb to dust particles and potentially be inhaled by ecological receptors. Non-respirable dust (the fraction of dust that cannot be inhaled) can potentially be ingested and is, in fact, accounted for in published incidental soil ingestion values for wildlife species (USEPA 1993). The fraction of dust that is respirable differs from species to species, and little data exist to determine exact respirable fractions for individual ecological receptors. For human receptors, dust inhalation exposure pathway generally makes up a relatively insignificant fraction of the total multi-pathway risk (less than 5 percent, based on best professional judgment and the results presented by Carlsen 1996). VOCs are expected to disperse very rapidly in air following volatilization from soil or groundwater, and they are unlikely to be taken up and bioaccumulated in plant and animal tissues at significant levels (USEPA and USACE, 1998). Additionally, most VOCs are generally not highly toxic to wildlife species (USEPA 2003c).

5.3.4 Uncertainty Analysis

Uncertainties are inherent in the risk assessment process, ranging from the completeness and quality of the chemical data to the toxicity values, receptors, exposure factors, and models employed to evaluate risk. Many assumptions incorporated in risk assessment are intentionally conservative so that risks are unlikely to be underestimated. This uncertainty analysis provides perspective on the quantitative risk results to assist risk management decisions.

- **EECs.** Estimated exposure concentrations for Eagle Picher property soils are potentially uncertain due to the use of a limited number of environmental samples (both spatially and at depth) to infer property-wide concentrations of Cd and Cr. Because five or more samples were available, EECs were based on the 95% UCL. This approach was intended to result in conservative estimates of exposure concentrations, which would reduce the likelihood of underestimating risks.

For the reasons discussed in Section 5.3.1, laboratory analytical data from a smaller set of samples was used to evaluate potential risks from exposure to Cd and Cr in soils instead of the larger set of analytical data generated by XRF. XRF was used to screen Cd, Cr, and Pb concentrations in 138 gridded and targeted samples collected across the Eagle Picher property, but only the Pb XRF data could be used for this detailed risk assessment. Laboratory analysis was conducted on 19 confirmatory surface soil samples from a non-random subset of XRF sample locations within the property; no subsurface soil samples were analyzed using laboratory methods. While laboratory based Cd and Cr soil concentrations were generally lower than corresponding XRF results, the set of samples analyzed by laboratory methods may not provide a complete picture of the nature and extent of soil contamination for the entire property. However, because the preliminary samples were selected to capture a range of detected levels, these samples may be slightly biased toward higher concentrations, and resulting exposure concentrations may be overestimated.

The NMED (2008) specifies soil depth intervals to use for evaluating risks to various ecological receptor types: 0 to 5 ft bgs for non-burrowing receptors and 0 to 10 ft bgs for burrowing receptors. Soil samples analyzed by laboratory methods for Cd and Cr were only collected from the top 6 inches or 1 foot of soils, so potential risks from Cd and Cr within the full exposure depth were not evaluated. However, concentrations measured by XRF in at-depth samples were typically lower than those measured from surface soils, indicating that EECs for Cd and Cr calculated from the top 6 inches or 1 foot of soils may overestimate exposure concentrations to some degree. The Pb XRF data used to calculate EECs did include both surface and subsurface sample results from across the Eagle Picher property, but these samples were only collected from the top 4 to 6 feet of soils, so the full exposure depth for burrowing receptors was not evaluated for Pb.

- **Analytical reporting limits versus SLs.** In some cases, chemicals were not detected, but reporting limits exceeded SLs. Some of these instances were due to the dilution of a sample to quantify a chemical present at a higher concentration, resulting in higher reporting limits for other chemicals. Although there is uncertainty associated with elevated reporting limits in such cases, the overall effect is likely insignificant relative to the risks posed by the higher concentrations of chemicals that required sample dilution.

  In other cases, the standard reporting limit for a laboratory method exceeded an SL (i.e., the laboratory method used was not sensitive enough to measure concentrations at or below the SL). This occurred for Cd in surface soils compared to the USEPA Region 5 Eco-SL. In this case, it was not possible to know whether the chemical was present in the sample or at what concentration. An examination of whether other chemicals in these samples were detected or exceeded SLs provided the basis for determining whether to identify the chemical as a COPC for evaluation of risk. If the chemical was not identified as a COPC but was actually present at an undetectable concentration above the SL, there may be some risk associated with that chemical that was not characterized.

- **Lack of tissue EECs.** Risks to terrestrial plants, soil invertebrates, and the three representative wildlife receptors were calculated based on COPC concentrations in soils. Tissue samples were not collected and analyzed to provide site- and receptor-specific data. Due to the lack of biota samples, bioaccumulation models were applied (as described in USEPA's EcoSSL guidance documents [USEPA 2005a,b; 2008]) to assess uptake of metals to biota. These models are limited in that they do not consider site-specific environmental factors that may limit bioaccumulation. Therefore, the exposure concentrations modeled for biota may be overestimated.

- **Ecological receptor home ranges.** Risks calculated based on soil EECs assume that the three wildlife receptors receive 100 percent of their food from the Eagle Picher property. Typical home ranges of house sparrows and coyotes likely include areas outside the property, so exposure and potential risk for these two receptors are likely overestimated.

- **Metals bioavailability.** Soil exposure estimates were also developed assuming 100 percent metal bioavailability. A number of factors affect metals bioavailability in soils, such as pH, organic matter content, aging, temperature, humidity, and chemical form (USEPA 2007). Bioavailability considerations are critical for metals risk assessment since large proportions of metals may be bound to the soil/sediment matrix and unavailable to the receptor or target organ (USEPA 2007). Thus, the use of total metals concentrations for estimating exposure is likely to overestimate exposure and potential risk.

- **Toxicity benchmarks for terrestrial plants.** The toxicity benchmarks used for evaluating potential risks to terrestrial plants relied primarily on data compiled for the USEPA EcoSSLs (USEPA 2005a,b; 2008). The EcoSSLs are generally derived using plant toxicity data obtained from standard test species (e.g., lettuce, alfalfa, wheat, rice, ryegrass) and using standard test soils under stringent test conditions (e.g., neutral pH and regular hydration). The available toxicity data is limited for some COPCs and may not be representative of all plant species and environmental conditions potentially present at the Eagle Picher property. For example, the USEPA EcoSSL for Pb (USEPA 2005b) was developed on the basis of four plant species exposed to Pb in soils with pH ranging from 4 to 6.7. These conditions are slightly acidic, while the soils at the Eagle Picher property are slightly alkaline (pH for the 12 soil samples analyzed by laboratory methods ranged from 7.4 to 8.6). Further, none of the plant species represented in the Pb toxicity database and used to derive the Pb EcoSSL (loblolly pine, red maple, berseem clover, or ryegrass) were identified in the biological surveys for the Site. Thus, risk estimates may be over- or underestimated due to limited toxicity data and differences in sensitivity between standard plant test species and plant species potentially present at the site.

- **Toxicity benchmarks for soil invertebrates.** The toxicity benchmarks used for evaluating potential risks to terrestrial invertebrates relied primarily on data compiled for the USEPA EcoSSLs (USEPA 2005a,b; 2008). The EcoSSLs are generally derived using terrestrial invertebrate toxicity data obtained from standard test species (e.g., earthworms, potworms, springtails) and using standard test soils under stringent test conditions (e.g., neutral pH, 5-10% organic matter, and 20-30% moisture). The available toxicity data is limited for some COPCs and may not be representative of all terrestrial invertebrate species or environmental conditions potentially present at the site. For example, the Pb EcoSSL (USEPA 2005b) for invertebrates was developed on the basis of four studies in which soil pH ranged from 4.5 to 6.0. These conditions are slightly acidic, while the soils at the Eagle Picher property are slightly alkaline (pH for the 12 soil samples analyzed by laboratory methods ranged from 7.4 to 8.6). Further, all four data points for the Pb EcoSSL were obtained using a hard-bodied invertebrate (springtail). Therefore, the EcoSSL may not be representative of the soil taxa typically present in soils at the Eagle Picher property. Thus, risk estimates for COPCs may be over- or underestimated due limited toxicity data and the relevance of the toxicity benchmarks for the site.
- **Organism versus population risks.** The EcoRA examined effects on individual organisms which are conservatively used to represent population-level effects in the risk assessment process (Suter et al., 2005). However, extrapolation from organism-level effects to population-level effects is a source of uncertainty. When individual-level endpoints are not identified through the risk assessment process, it is assumed that populations are protected. However, when individual-level risk estimates

are identified, one cannot assume a proportional risk at the population level. Chemicals with broad distributions and elevated magnitudes of toxicological benchmark exceedances generally have a greater potential for posing population-level risks. Elevated metals concentrations at this site are primarily isolated to a small area, thus elevated risks are not necessarily predictive of effects on ecological populations due to the limited extent of surface contamination.

- **Potential risk from exposure to contaminants in the NMT golf course and borrow pit ponds.** Due to access restrictions, DBS&A was unable to collect samples from the three ponds in the plume area to assess groundwater contribution. There may be a risk of exposure to contaminants in the ponds' water or sediment if contaminants are migrating there from shallow groundwater.

5.4 Weight-of-Evidence Summary and Conclusions

Potential risks to terrestrial wildlife posed by COPCs in Eagle Picher property soils were evaluated using several lines of evidence (Table 13). Comparison of COPC sample concentrations in confirmatory samples to terrestrial plant toxicity benchmarks indicated that Pb exceeded its benchmark in 5 of 19 samples and the Pb EEC exceeded the benchmark by a factor of 12 (i.e., HQ = 12). For soil invertebrates, comparisons to toxicity benchmarks resulted in Cr exceeding its benchmark in 2 of 19 samples and the Cr EEC exceeding the benchmark by a factor of 4.7. Modeled exposure concentrations exceeded NOAELs and LOAELs for all three receptors, although the HQs for the coyote were much lower than those for the house sparrow and desert shrew. Cr and Pb contributed most to the NOAEL and LOAEL HQs; Cd contributed little to the benchmark exceedances. Using Pb EECs based on XRF results (both all samples and just gridded samples), plant and soil invertebrate HQs were less than one-third of those calculated using the EEC calculated from the confirmatory samples. Although there were more individual XRF samples and more individual XRF samples exceeding the plant benchmark, the proportions of individual XRF samples exceeding the benchmarks were lower than the proportion based on the EEC. For the soil invertebrate benchmark, the proportions of individual XRF samples exceeding the benchmark were similar to the proportion based on the EEC.

By separating soil samples with high Cd, Cr, and Pb concentrations (around the unlined sewage lagoons, former manufacturing building, and southwest of the former manufacturing building), the number and magnitude of benchmark exceedances was substantially reduced. Only one Pb concentration exceeded the terrestrial plant benchmark, and the Pb EEC did not exceed the benchmark. All individual Cr concentrations and the Cr EEC were below the benchmark. NOAEL and LOAEL HQs for house sparrow and desert shrew were reduced by about a factor of 10. Results for Pb were similar using the XRF data.

The risk estimates obtained in this analysis may be overestimated due to the use of conservative exposure metrics and assuming 100 percent metal bioavailability. Based on the results of this EcoRA, the presence of metals (Cr and Pb) in surface soils (limited to the unlined sewage lagoons, former manufacturing building, and southwest of the former manufacturing building) pose a potential risk to ecological receptors and access to this area should be limited or surface soils removed to limit exposure.

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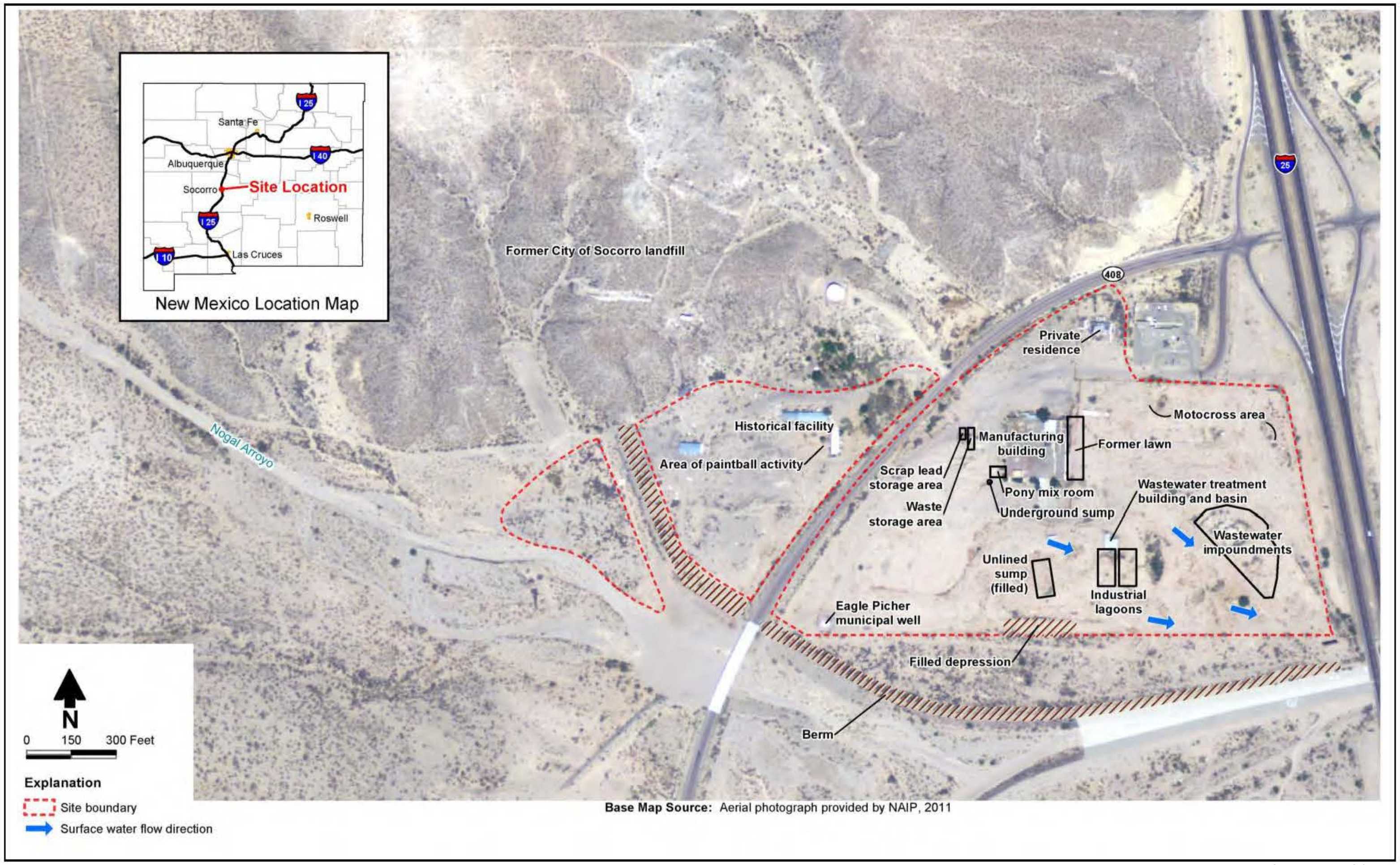
Figures



Map Source: DBS&A.

Figure 1. Site Map

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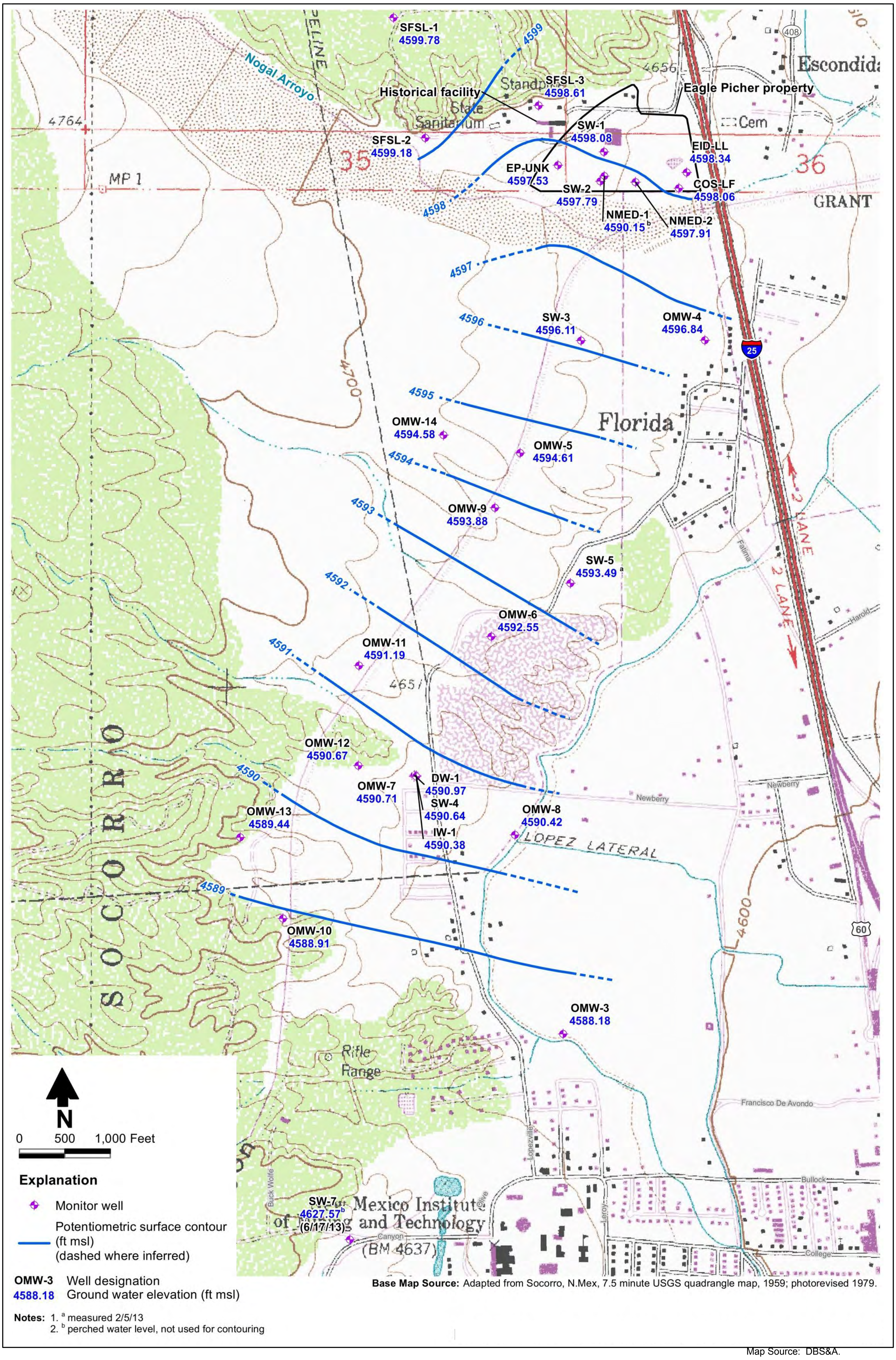

Map Source: DBS&A.

Figure 2. Groundwater Elevations, January 2013

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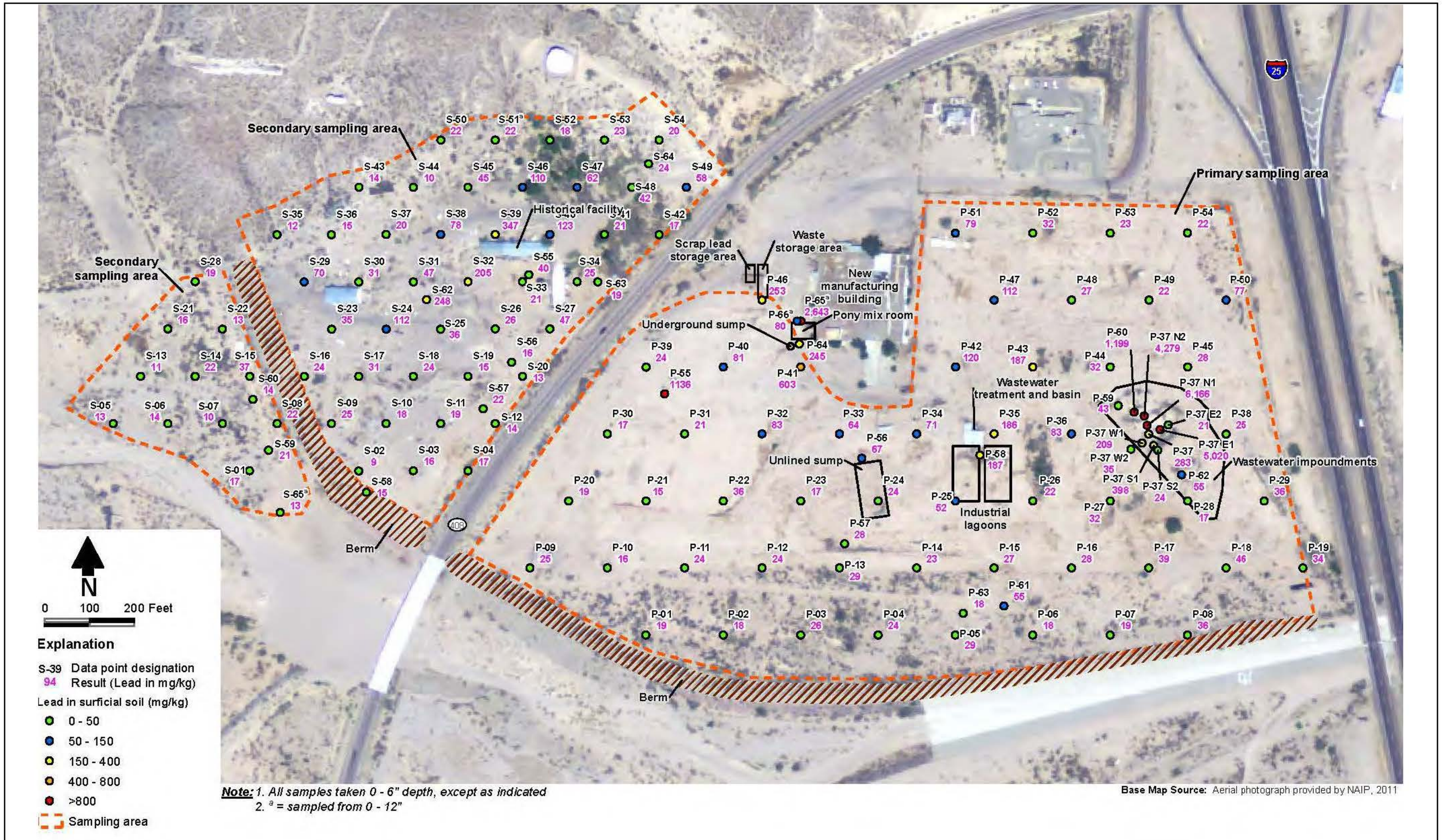

Map Source: DBS&A

Figure 3. Lead Concentrations in Surface Soil

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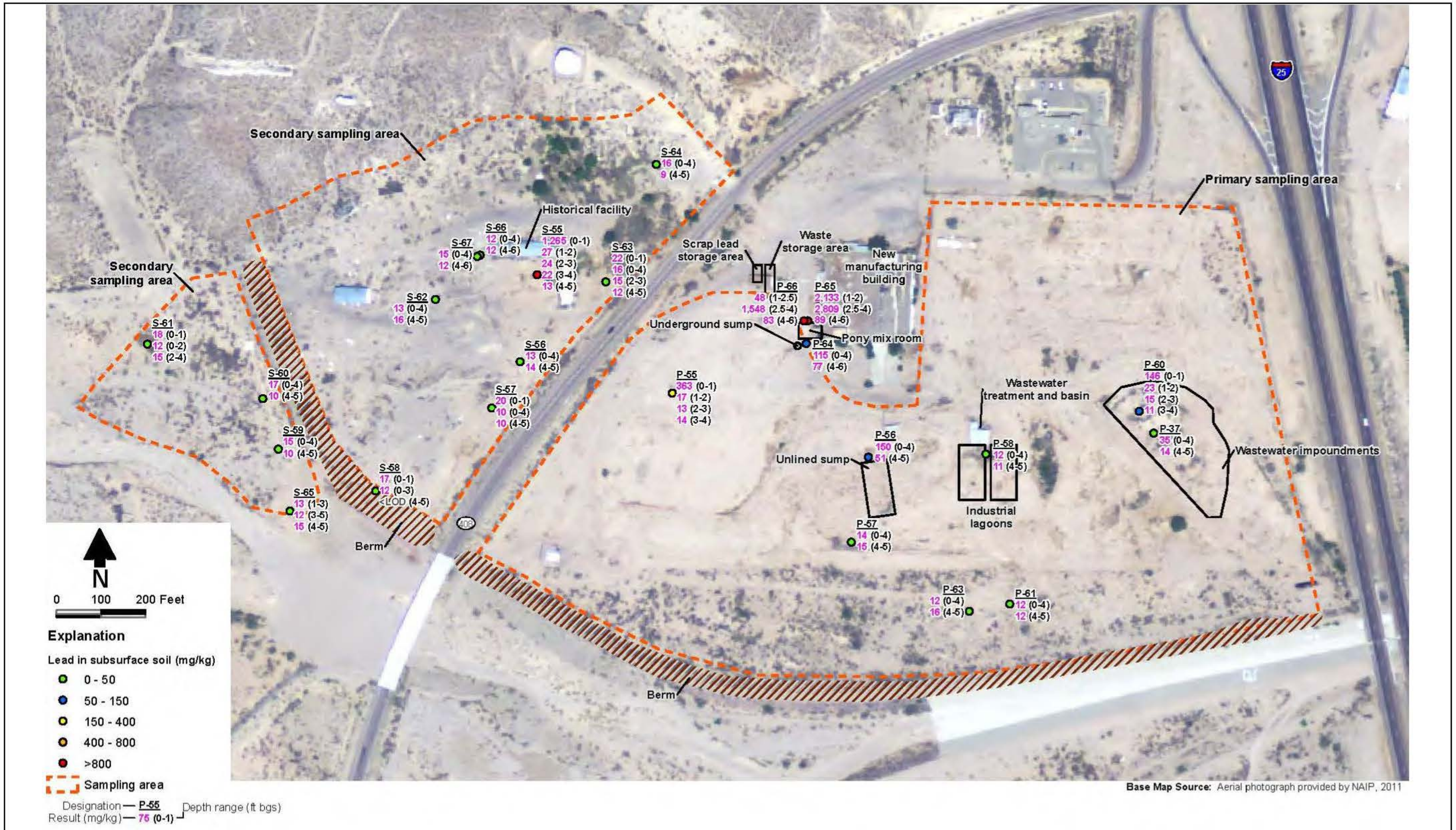

Map Source: DBS&A

Figure 4. Lead Concentrations in Subsurface Soil

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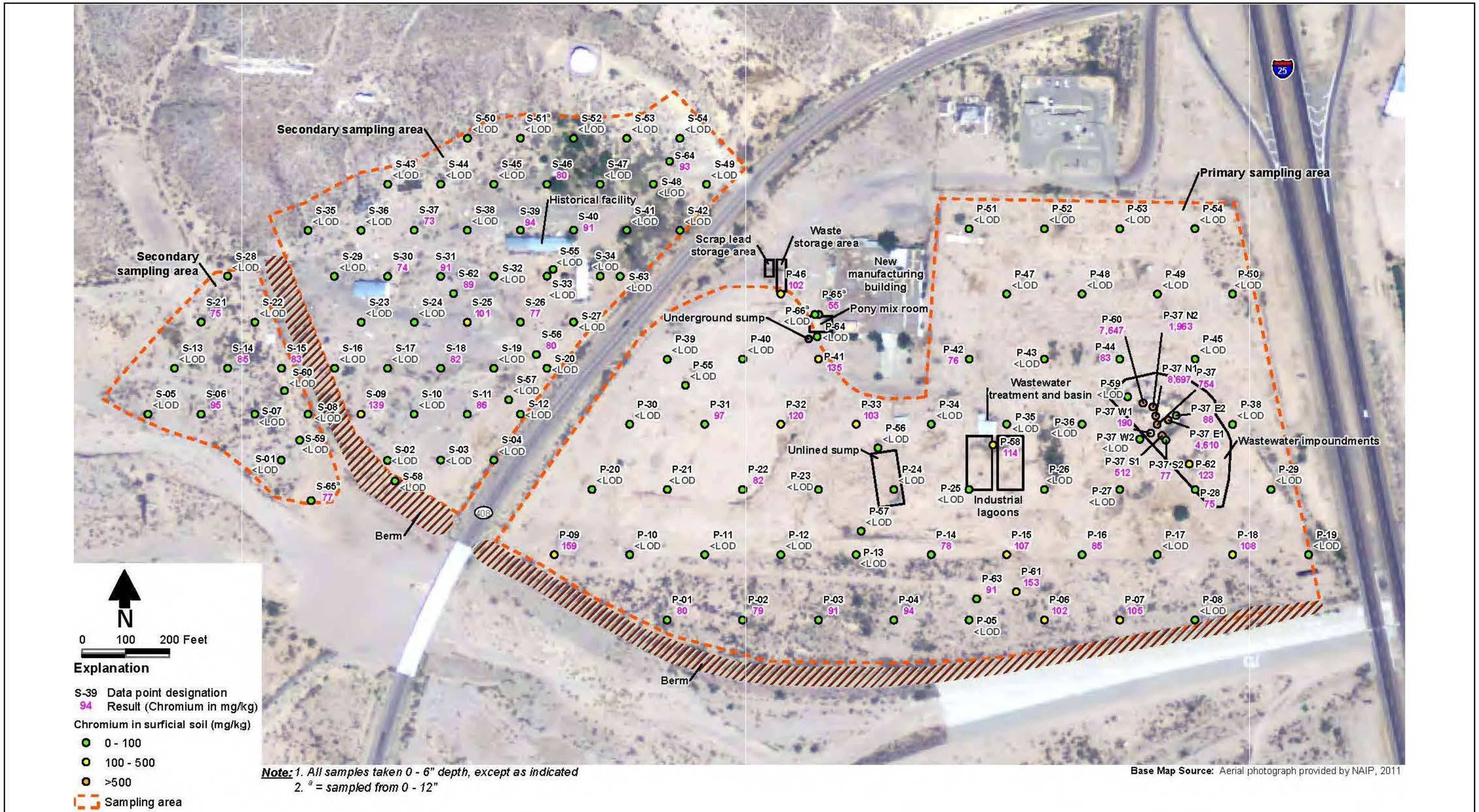

Map Source: DBS&A

Figure 5. Chromium Concentrations in Surface Soil

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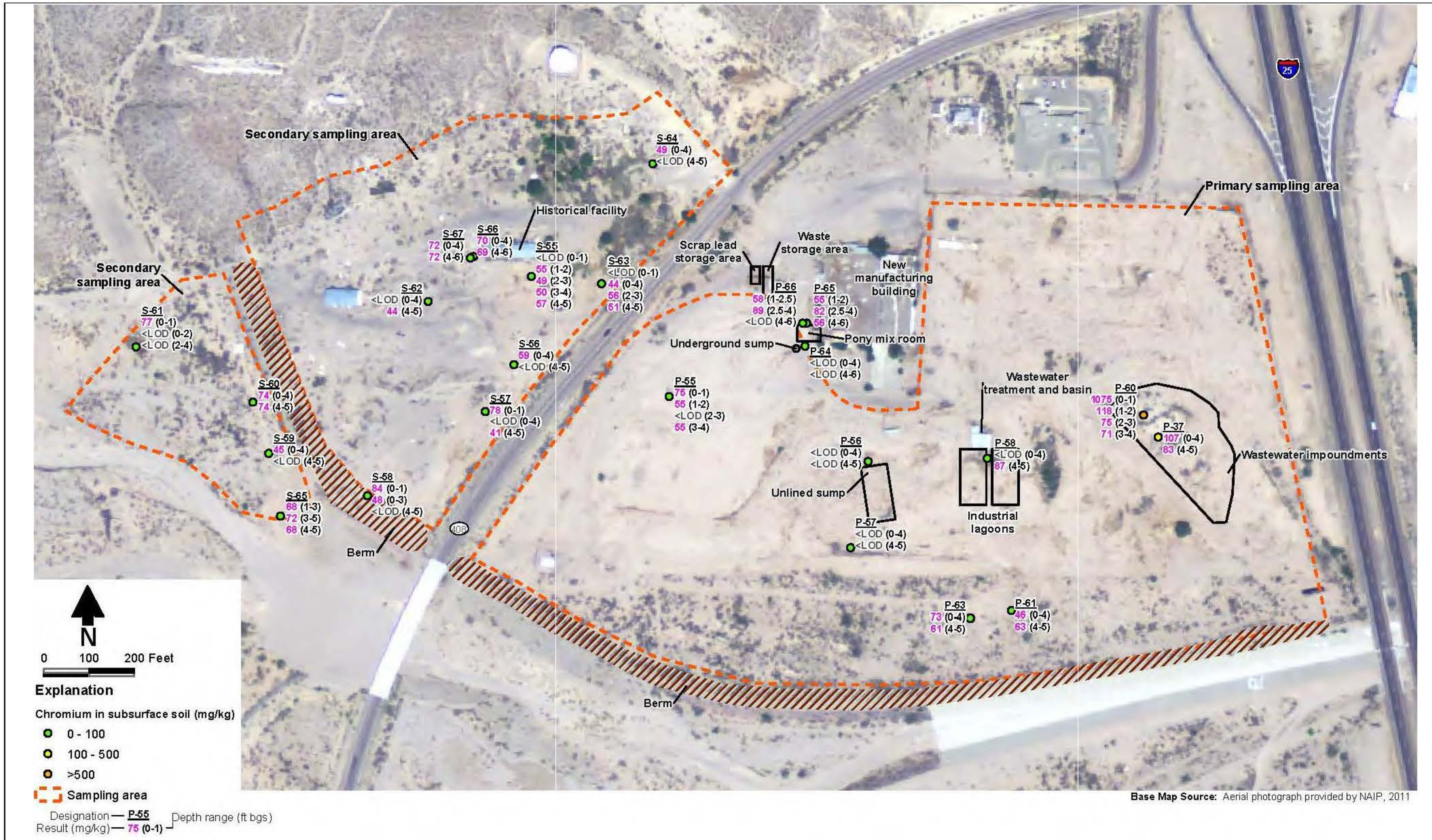

Map Source: DBS&A

Figure 6. Chromium Concentrations in Subsurface Soil

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Map Source: DBS&A.

Figure 7. Sub-slab Sampling Locations

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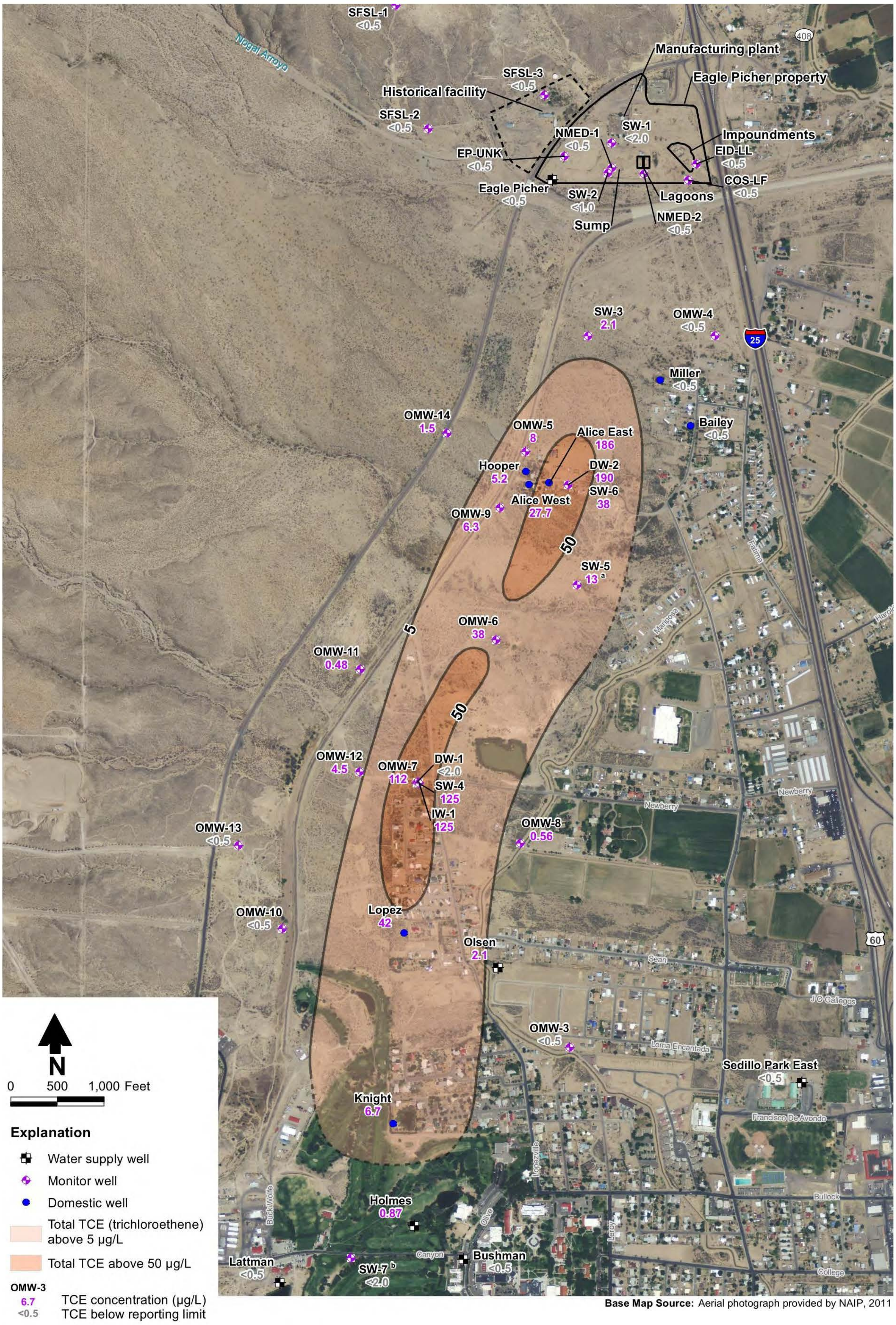

Notes: 1. [a] measured 2/6/13
2. [b] perched zone well not used for contouring
3. DW-2, SW-6 and SW-7 measured in June 2013

Map Source: DBS&A.

Figure 8. Concentrations of TCE in Groundwater, 2013

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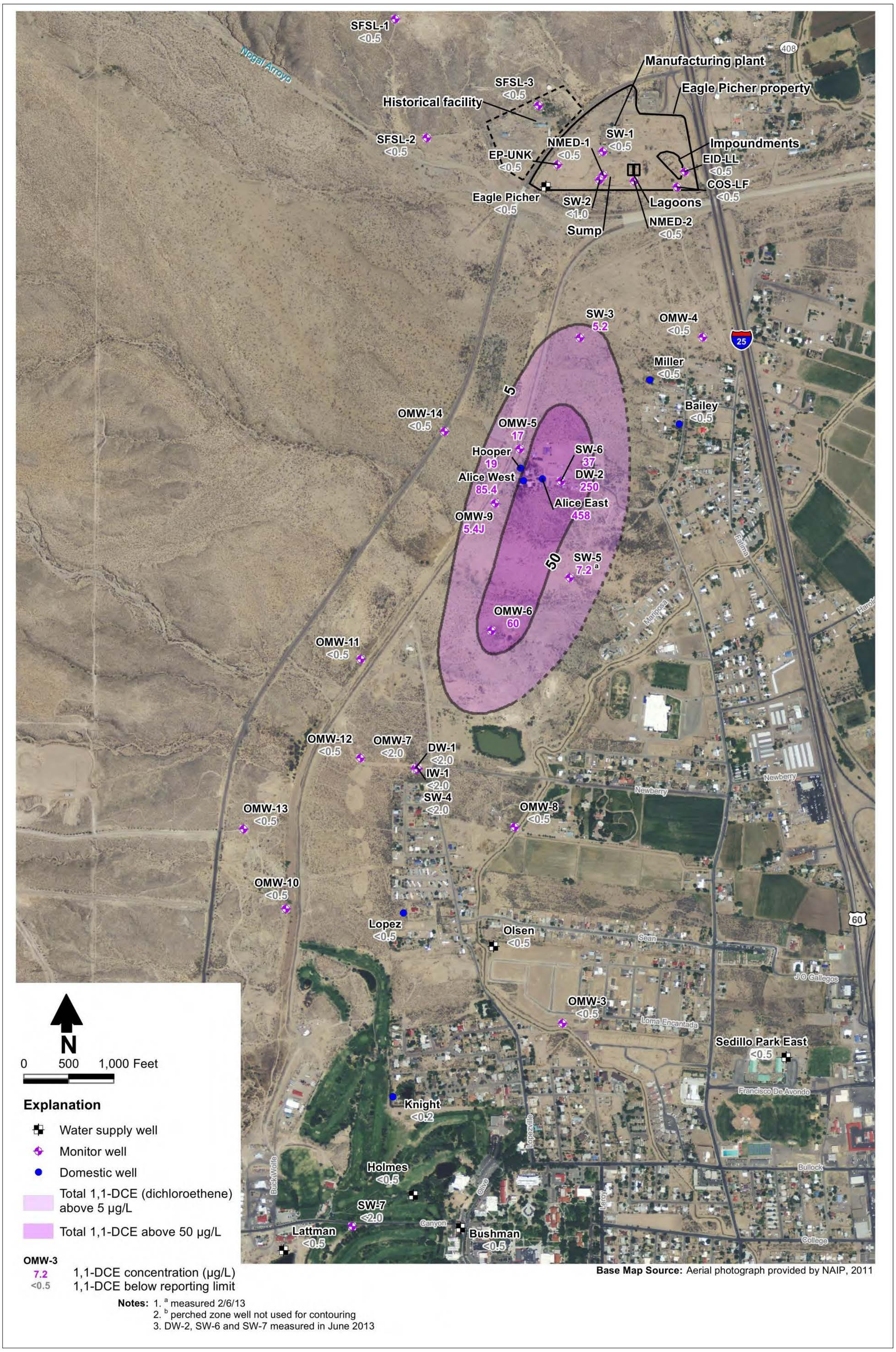

Map Source: DBS&A.

Figure 9. Concentrations of 1,1-DCE in Groundwater, 2013

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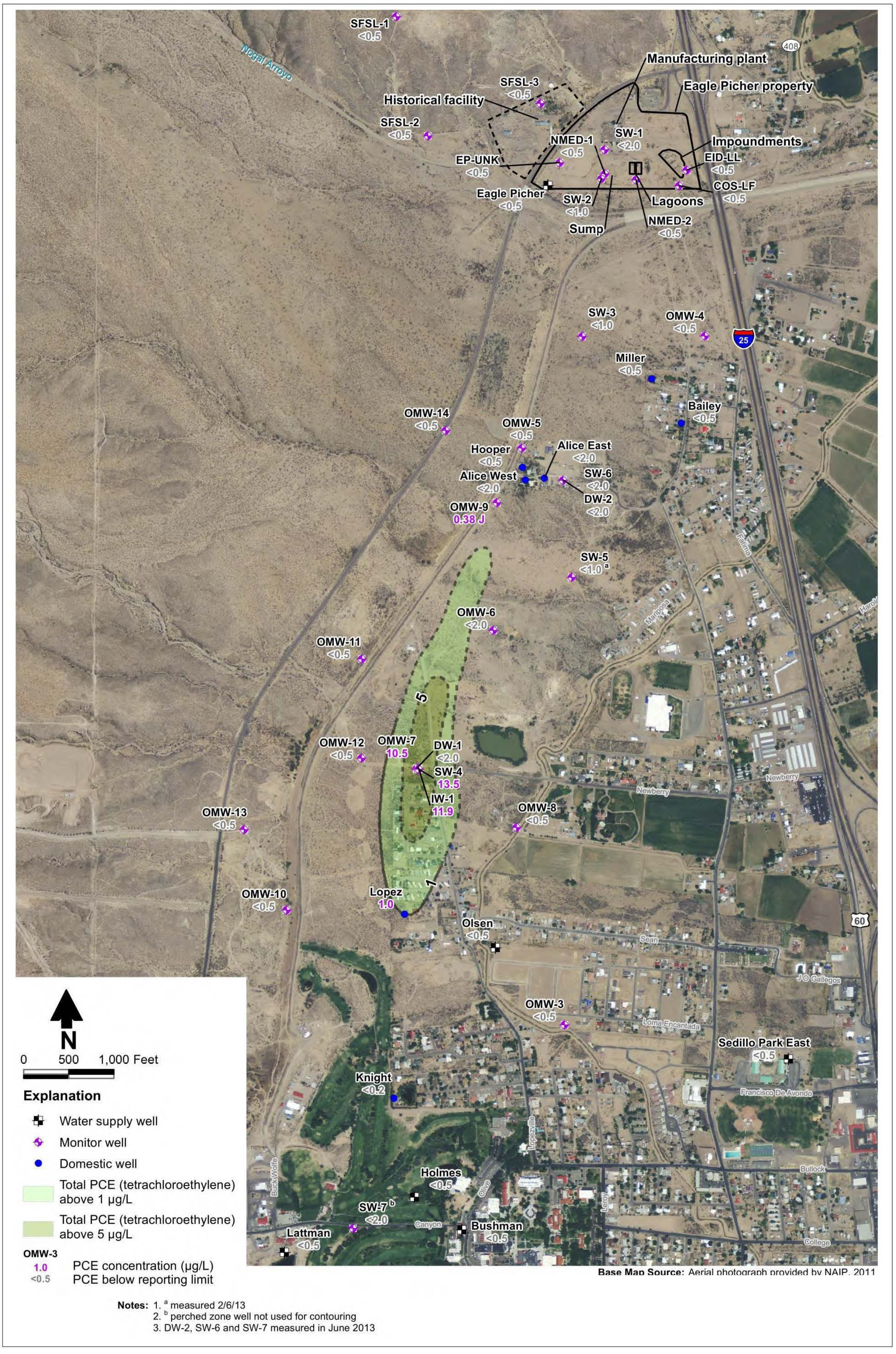

Map Source: DBS&A.

Figure 10. Concentrations of PCE in Groundwater, 2013

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Map Source: DBS&A.

Figure 11. Soil Gas Sampling Locations Near the Alice East Well

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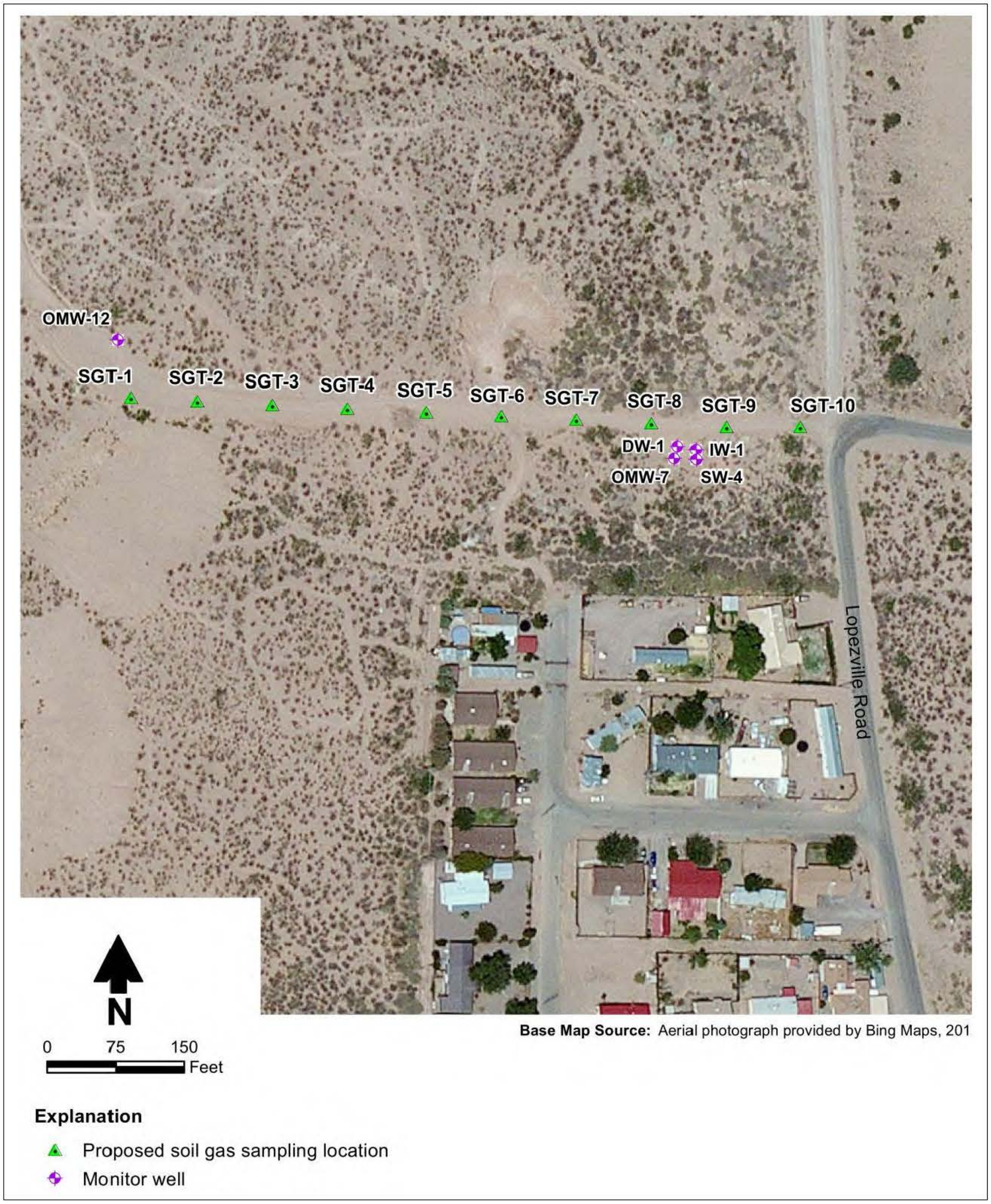

Map Source: DBS&A.

Figure 12. Soil Gas Sampling Locations Near Wells DW-1, IW-1, SW-4, OMW-7, and OMW-12

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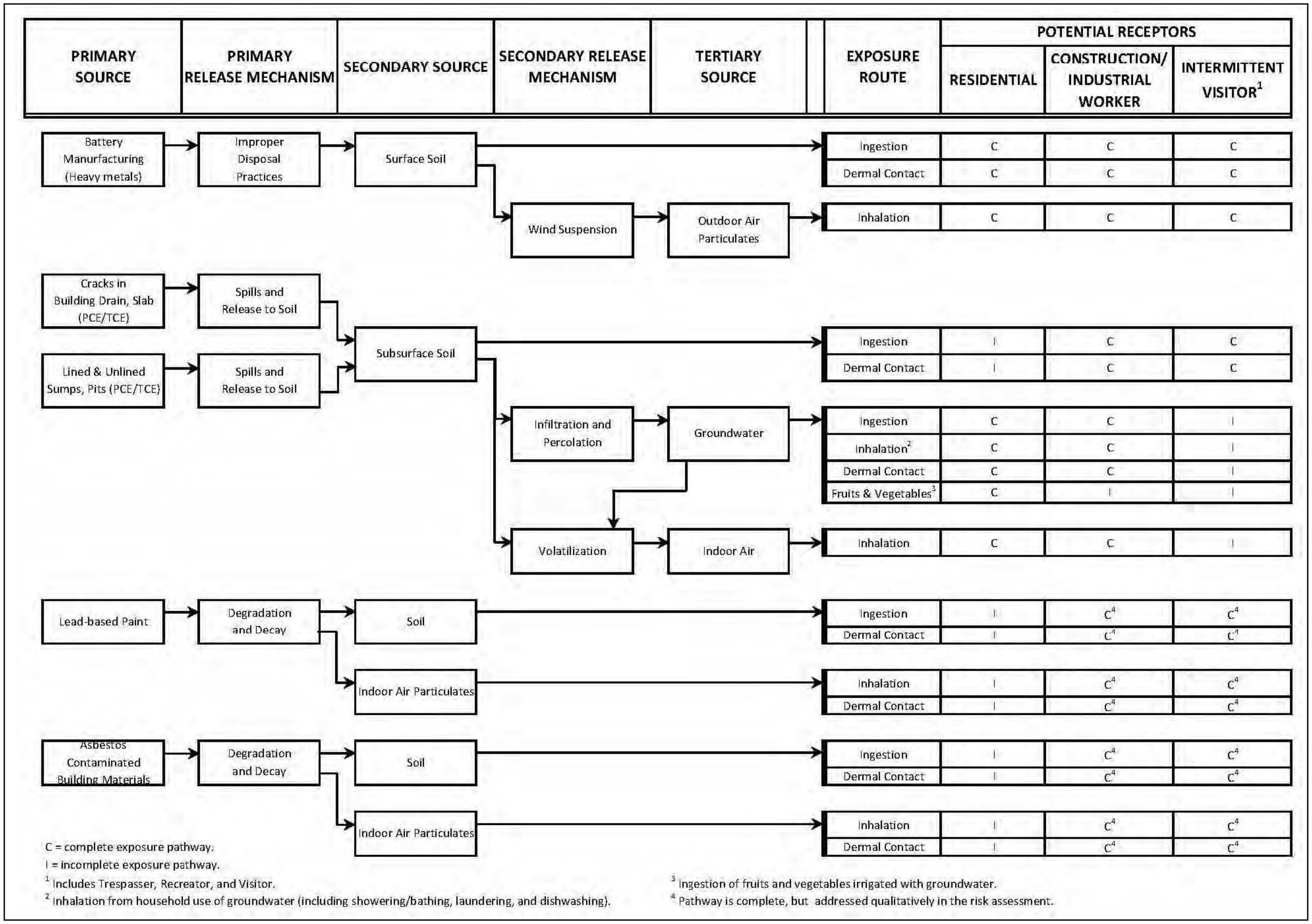

Figure 13. Human Health Conceptual Site Model

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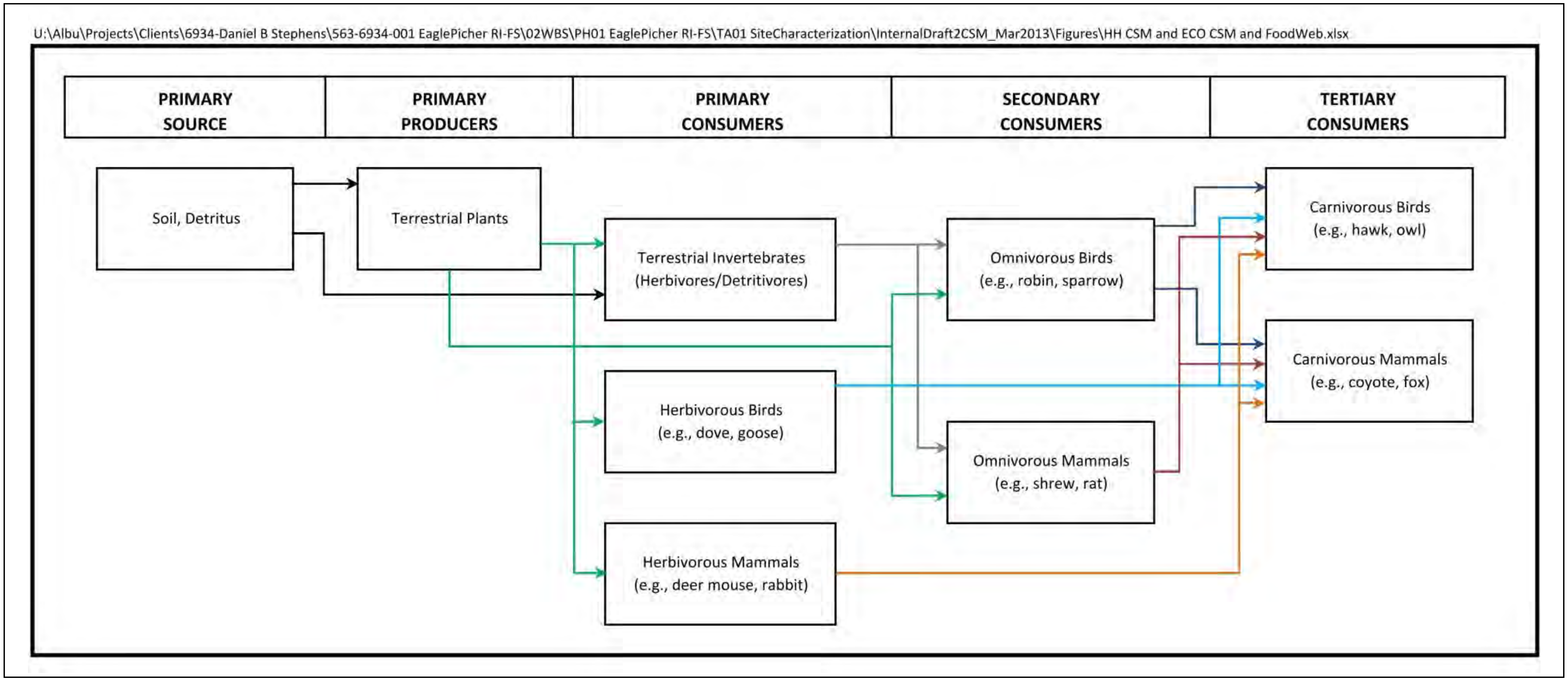

Figure 14. Ecological Food Web

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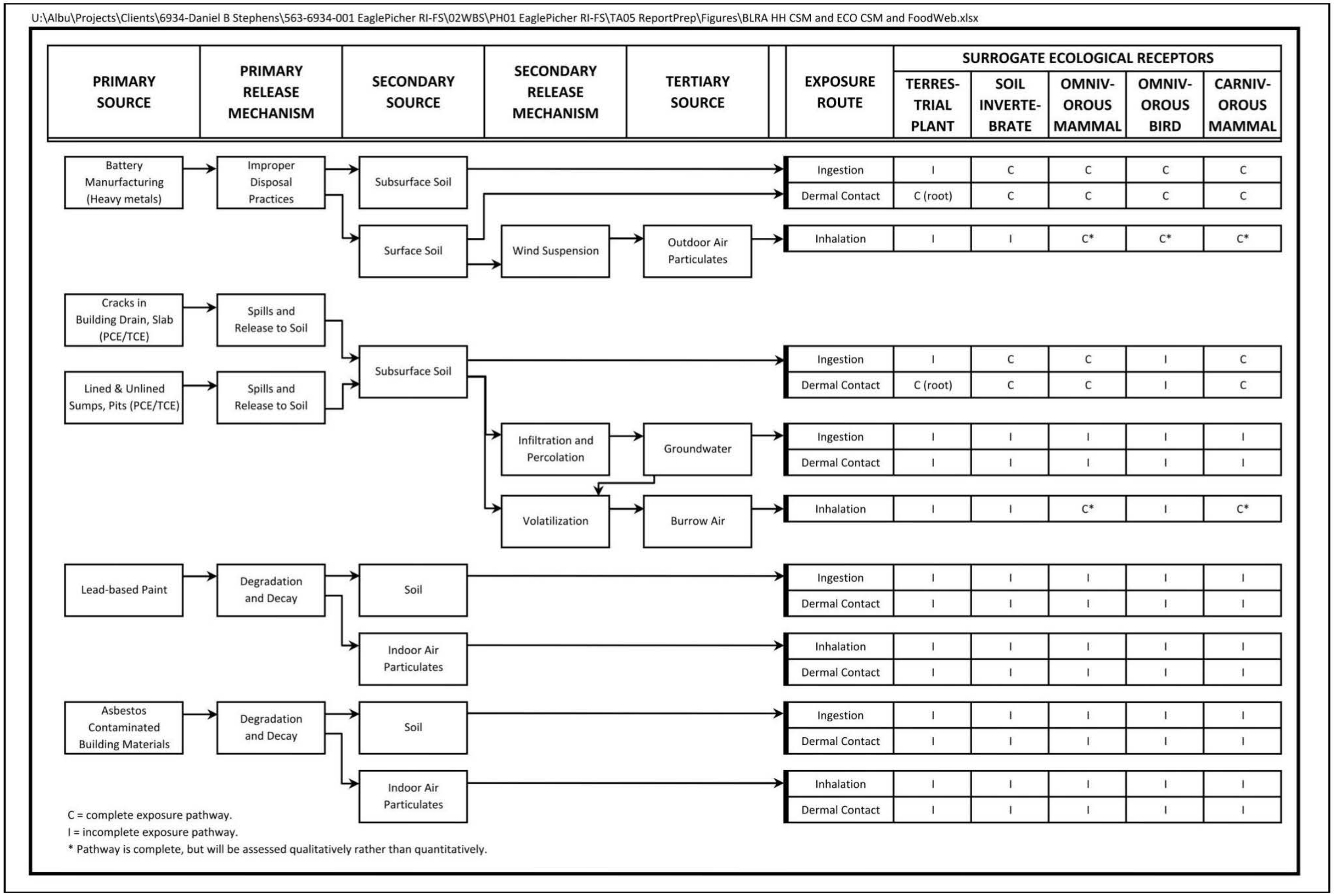

Figure 15. Ecological Conceptual Site Model

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Tables

Table 1. Summary of NMED 2012 Sampling and DBS&A 2012 and 2013 RI/FS Sampling

Medium	COPCs Measured	Number of Samples[a]			
		Primary Site (East of Hwy 408)	Secondary Site (West of Hwy 408)	Plume Area	Total
Surface Soil	Cd, Cr, Pb by XRF (Confirmatory Samples by EPA 6010B)	74 (12)	64 (7)	---	138 (19)
Subsurface Soil	Cd, Cr, Pb by XRF	28	35	---	63
Subsurface Soil	VOCs by EPA 8260B	2	---	9	11
Sub-slab Soil[b]	Cd, Cr, Pb by XRF (Confirmatory Samples by EPA 6010B)	21 (2)	---	---	21 (2)
Sub-slab Soil[b]	VOCs by EPA 8260B	7	---	---	7
Sub-slab Vapor[b]	VOCs by EPA 8260B	7	---	---	7
Lead-based Paint Survey	Lead-based Paint	13 (3 buildings)	33 (5 buildings)	---	46
Asbestos Survey	Asbestos Containing Building Materials	27 (2 buildings)[c]	68 (5 buildings)	---	95
Soil Vapor	VOCs by PSG	19	---	38	57
Soil Vapor (NMED, June 2012)	VOCs by PSG	20	---	5[d]	25
Soil Gas	VOCs by EPA 8260B	---	---	16	16

Table 1. Summary of NMED 2012 Sampling and DBS&A 2012 and 2013 RI/FS Sampling (continued)

Groundwater Sampling Event	COPCs Measured	Number of Samples[a] Domestic/ Municipal Wells	SWBZ Monitoring Wells	IWBZ Monitoring Wells	DWBZ Monitoring Wells	Total
NMED Annual Monitoring (March 2012)	VOCs by CLP Methods	9 (1 on-site)	10 (1 on-site)	---	---	19 (2 on-site)
DBS&A New Monitoring Well Sampling (December 2012 and January 2013)	VOCs by EPA 8260B SVOCs by EPA 8270C Dissolved Metals by EPA 200.7, 200.8 Mercury by EPA 245.1 Inorganics by EPA 300.0, 200.7	---	5 (2 on-site)	---	---	5 (2 on-site)
	SVOCs by EPA 8270C Inorganics by EPA 300.0, 200.7	---	---	1	1	2
DBS&A and NMED Joint Sampling (January 2013)	VOCs by CLP Methods	13 (1 on-site)	19 (6 on-site)	3 (2 on-site)	1	36 (9 on-site)
DBS&A Additional New Monitoring Well Sampling (June 2013)	VOCs by EPA 8260B SVOCs by EPA 8270C Dissolved Metals by EPA 200.7, 200.8 Mercury by EPA 245.1 Inorganics by EPA 300.0, 200.7	---	2	---	1	3

a Sample numbers do not include quality assurance/quality control samples.

b Sub-slab samples were collected at the new manufacturing building.

c Three buildings were inspected. No samples were collected from building 8 since there were no suspect materials found (Acme Environmental 2013).

d NMED collected 34 additional PSG points south of the plume area that are not included in the RI Report figures, but are included in the NMED PSG analytical report.

Table 2. Soil Screening Levels (mg/kg)

Chemical	NMED					USEPA		Intermittent Visitor (Trespasser or Recreator)		Minimum SSL
	Industrial/ Occupational		Construction		Groundwater Protection	Industrial				
	SSL	EP	SSL	EP		SSL	EP	SSL	EP	
Cadmium	897	n	277	n	27.5	800	n	473	n	27.5
Chromium (total)	1,700,000	n	465,000	n	1,970,000,000	NA		NA		465,000
Chromium +6	63.1	n	65.6	c	0.166	56	c	20.1	c	0.166
Lead	800	IEUBK	800	IEUBK	NA	800	IEUBK	400	n	400
PCE	36.6	c	212	c	0.00861	1,100	c	2,740	n	0.00861
TCE	41.3	c	7.68	c	0.0211	64	c	182	c	0.0211
1,1-DCA	359	c	1,700	c	0.120	170	c	3,520	c	0.120
1,1-DCE	2,290	n	432	n	2.32	1,100	n	17,300	n	2.32
cis-1,2-DCE	2,270	n	619	c	0.367	2,000	n	1,050	n	0.367
Toluene	57,700	n	13,400	n	25.3	45,000	n	41,700	n	25.3
1,1,1-TCA	78,900	n	14,800	n	58.2	38,000	n	664,000	n	58.2
Freon 113	347,000	n	64,700	n	3,450	180,000	n	5,480,000	n	3,450

NA = Not available.

EP = Endpoint use to derive SSL (see SSL Sources for more details):

c = carcinogenic.

nc = noncarcinogenic.

IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.

SSL Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Chromium (III) SSLs used for Chromium (Total). Groundwater protection SSLs are based on a dilution attenuation factor of 20.

USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html. SSLs based on a carcinogenic endpoint were multiplied by a factor of 10 to reflect the NMED's recommended carcinogenic risk of $1x10^{-5}$.

USEPA. 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-line RSL calculator available at http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search. Intermittent visitor SLs were calculated using default residential exposure assumptions and calculations, except for exposure frequency (assumed 1 visit per week or 52 days per year), carcinogenic risk (1E-05), and climate variables (e.g., particulate and volatile emission factors) for New Mexico.

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Table 3. Summary of Chromium Data for Soil Samples Collected from the Eagle Picher Property and Analyzed by Laboratory Methods

Location	Depth	Date	Units	Total Cr Conc.	Qual.	Cr^{+6} Conc.	Qual.	Cr^{+6} %	ORP (mV)	pH (s.u.)
P-3	0-6"	11/30/2012	mg/kg	14		2	U	-	49	8.4
P-10	0-6"	11/30/2012	mg/kg	16		2	U	-	51	8.4
P-16	0-6"	11/30/2012	mg/kg	14		2	U	-	57	8.5
P-27	0-6"	11/30/2012	mg/kg	16		2	U	-	70	8.3
P-35	0-6"	11/30/2012	mg/kg	14		2	U	-	77	8.2
P-37	0-6"	11/30/2012	mg/kg	550		4.8		0.9%	150	7.5
P-42	0-6"	11/30/2012	mg/kg	14		10	U	-	130	8.3
P-55	0-6"	11/30/2012	mg/kg	15		2	U	-	120	8.5
P-60	0-6"	11/30/2012	mg/kg	3000		16		0.5%	160	7.7
P-63	0-6"	11/30/2012	mg/kg	12		2	U	-	140	8.3
P-65	0-1'	11/30/2012	mg/kg	15		10	U	-	190	8.3
P-66	0-1'	11/30/2012	mg/kg	3300		15		0.5%	250	7.6
S-7	0-6"	11/30/2012	mg/kg	12		2	U	-	140	8.0
S-13	0-6"	11/30/2012	mg/kg	7.3		2	U	-	120	8.6
S-20	0-6"	11/30/2012	mg/kg	8.6		2	U	-	120	8.3
S-30	0-6"	11/30/2012	mg/kg	13		2	U	-	130	8.2
S-46	0-6"	11/30/2012	mg/kg	14		2	U	-	120	8.2
S-51	0-1'	11/30/2012	mg/kg	9.3		2	U	-	130	8.2
S-65	0-1'	11/30/2012	mg/kg	16		2	U	-	150	7.9
SS-5	3-4'	12/3/2012	mg/kg	15		2	U	-	240	7.4
SS-6	3-4'	12/3/2012	mg/kg	14		2	U	-	210	8.2

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Table 4. Groundwater Screening Levels (µg/L)

	NMED		USEPA			
	Tap Water		Tap Water			
	SL	EP	SL	EP	MCL	Minimum SL
Conventionals						
Nitrate-N	58,400	n	25,000	n	10,000	10,000
Metals						
Aluminum	36,500	n	16,000	n	NA	16,000
Arsenic	0.448	c	0.45	c	10	0.448
Barium	7,300	n	2,900	n	2,000	2,000
Cadmium	18.3	n	6.9	n	5	5
Chromium	54,800	n	NA		100	100
Cobalt	NA		4.7	n	NA	4.7
Copper	1,460	n	620	n	1,300	620
Iron	25,600	n	11,000	n	NA	11,000
Lead	NA		NA		15	15
Manganese	876	n	NA		NA	876
Mercury	0.626	n	0.63	n	2	0.626
Selenium	183	n	78	n	50	50
Zinc	11,000	n	4,700	n	NA	4,700
VOCs						
PCE	1.08	c	97	c	5	1.08
TCE	3.40	n	4.4	c	5	3.4
1,1-DCA	24.2	c	24	c	NA	24
1,1-DCE	340	n	260	n	7	7
cis-1,2-DCE	73.0	n	28	n	70	28
Toluene	2,280	n	860	n	1,000	860
1,1,1-TCA	9,130	n	7,500	n	200	200
Freon 113	59,200	n	53,000	n	NA	53,000
Chloroform	1.93	c	1.9	c	80	1.9
2-Hexanone	NA		34	n	NA	34
cis-1,3-DCPe	4.33	c	4.1	c	NA	4.1
BromoDCM	1.17	c	1.2	c	80	1.17
DibromoCM	1.47	c	1.5	c	80	1.47
Bromoform	NA		79	c	80	79

MCL = Maximum contaminant level.

NA = Not available.

EP = Endpoint use to derive SL (see SL Sources for more details):

c = carcinogenic.

nc = noncarcinogenic.

IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.

SL Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Chromium (III) tap water SL used for Chromium (Total). Tap water SL for 1,3-dichloropropene used for cis-1,3-dichloropropene.

USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html. Tap water SL and MCL for 1,3-dichloropropene used for cis-1,3-dichloropropene. SLs based on a carcinogenic endpoint were multiplied by a factor of 10 to reflect the NMED's recommended carcinogenic risk of $1x10^{-5}$.

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Table 5. Indoor Air Screening Levels

	USEPA Commercial Vapor Intrusion Screening Level (Groundwater, µg/L)	USEPA Residential Vapor Intrusion Screening Level (Groundwater, µg/L)	USEPA Commercial Vapor Intrusion Screening Level (Sub-slab Gas, µg/m^3)	USEPA Residential Vapor Intrusion Screening Level (Exterior Soil Gas, µg/m^3)
PCE	240	58	1,800	420
TCE	22	5.2	88	21
1,1-DCA	330	66	770	150
1,1-DCE	820	200	8,800	2,100
cis-1,2-DCE	NA	NA	NA	NA
Toluene	81,000	19,000	220,000	52,000
1,1,1-TCA	31,000	7,400	220,000	52,000
Freon 113	6,100	1,500	1,300,000	310,000
Chloroform	36	7.1	53	11
2-Hexanone	34,000	8,200	1,300	310
cis-1,3-DCPe	210	42	310	61
BromoDCM	38	7.6	33	6.6
DibromoCM	140	28	45	9.0
Bromoform	NA	NA	NA	NA

NA = Not available.

SL Source:

USEPA. 2013. Vapor Intrusion Screening Level (VISL) Calculator. Version 3.1, June 2013 RSLs. Available at http://www.epa.gov/oswer/vaporintrusion/guidance.html. SLs are Target Concentrations for Groundwater using the following parameters: Exposure Scenario = Residential, Commercial; Target Cancer Risk = 1E-05; Target Noncancer Hazard Quotient = 1.0; Groundwater temperature = 25°C. SLs for 1,3-dichloropropene used for cis-1,3-dichloropropene.

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Table 6. Risk-based Concentrations for COPCs in Groundwater

Chemical	RBC for Ingestion and Inhalation from Household Use of Groundwater (μg/L)		RBC for Dermal Contact with Groundwater (μg/L)		RBC for Ingestion of Fruits and Vegetables Irrigated with Groundwater (μg/L)		RBC for Inhalation of Groundwater COPCs via Vapor Intrusion into Residential Indoor Air (μg/L)		RBC for Inhalation of Groundwater COPCs via Vapor Intrusion into Exterior Soil Gas (μg/L)	
	Cancer	Noncancer	Cancer	Noncancer	Cancer	Noncancer	Cancer	Noncancer	Cancer	Noncancer
1,1-Dichloroethylene (1,1-DCE)	nc	151	nc	4,150	nc	1,070	nc	200	nc	2,100
Tetrachloroethylene (PCE)	120	25.5	554	115	560	235	130	58	940	420
Trichloroethylene (TCE)	4.70	1.51	62.8	34.0	17.0	13.0	11	5.2	43	21
Source	(1)		(2)		(3)		(4)		(4)	

nc = Not calculated (non-carcinogen).

RBC= risk-based concentration.

Per NMED (2012), ingestion and inhalation includes all uses of household water (i.e., showering/bathing, laundering, dishwashing).

Sources:

(1) Based on current USEPA toxicity values and exposure factors and equations in Tables C-3 through C-5 following NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012).

(2) Based on current USEPA toxicity values and exposure factors and equations in Tables C-6 through C-9 following USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA-540-R-99-005.

(3) Risk Assessment Information System (RAIS) Preliminary Remediation Goals (PRGs) Calculator at http://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem. Accessed January 13, 2014. SLs based on a carcinogenic endpoint were multiplied by a factor of 10 to reflect the NMED's recommended carcinogenic risk of 1x10-5.

(4) USEPA. 2013. Vapor Intrusion Screening Level (VISL) Calculator. Version 3.1, June 2013 RSLs. Available at http://www.epa.gov/oswer/vaporintrusion/guidance.html. The following parameters were used: Exposure Scenario = Residential; Target Cancer Risk = 1E-05; Target Noncancer Hazard Quotient = 1.0; Groundwater temperature = 25°C.

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Table 7. Risk Characterization Summary for Human Health

Medium	Receptor	Cancer Risk	Noncancer Hazard
Eagle Picher Property			
Soils – Based on All Samples			
	Commercial/Industrial Worker	All detected concentrations and reporting limits for Cd and Cr lower than direct soil exposure SLs. All Cr^{+6} concentrations from laboratory analyzed samples below direct soil exposure SLs.	
	Construction Worker		
	Intermittent Visitor (Trespasser, Recreator, Visitor)		
	Adult Pb Model	Less than 5% probability of a blood lead level exceeding 10 µg/L/d	
	Adult Pb Model Modified for Adolescent Trespasser	Less than 5% probability of a blood lead level exceeding 10 µg/L/d	
Sub-slab Soils			
	Commercial/Industrial Worker	Detected concentrations and reporting limits for all COPCs lower than direct soil exposure SLs.	
	Construction Worker		
Groundwater			
	Commercial/Industrial Worker	PCE not detected, but reporting limit for one sample higher than SL. Detected concentrations and reporting limits for all other COPCs lower than SLs.	
Sub-slab Air (Vapor Intrusion)			
	Commercial/Industrial Worker	TCE not detected, but reporting limit slightly higher than SL. Detected concentrations and reporting limits for all other COPCs lower than SLs.	
Plume Area			
Groundwater (Ingestion and Inhalation)[a]			
	Resident (Risk calculation by well and sample date)	9E-07 to 5E-04	0.3 to 162
Groundwater (Dermal Contact)[b]			
	Resident (Risk calculation by well and sample date)	8E-07 to 4E-05	0.2 to 7.2
Groundwater (Ingestion of Fruits and Vegetables)[c]			
	Resident (Risk calculation by well and sample date)	1E-05 to 1E-04	1.6 to 19
Groundwater (Vapor Intrusion; groundwater-based risk calculation by well and sample date for wells screened at the water table)[d]			
	Resident	1E-07 to 4E-05	0.02 to 7.3
	Commercial/Industrial Worker	2E-08 to 5E-06	0.01 to 1.7
Exterior Soil Gas (Vapor Intrusion; exterior soil gas-based risk calculation for detected TCE concentrations)[e]			
	Resident	5E-05	11
	Commercial/Industrial Worker	8E-06	2.6

a Wells identified as having elevated risks from ingesting and inhaling VOCs (detected concentrations only): Olson (former municipal supply well), Alice East, Alice West, Hooper, Knight, Lopez, Padilla, OMW-5, OMW-6, OMW-7, OMW-9, OMW-12, OMW-14, DW-2, IW-1, SW-4, SW-5, and SW-6.

b Domestic wells identified as having elevated risks from dermal contact with VOCs (primarily TCE) in groundwater (detected concentrations only): Alice East, Lopez, and Padilla.

c Domestic wells identified as having elevated risks from VOCs (almost entirely TCE) in fruits and vegetables irrigated with groundwater (detected concentrations only): Alice East, Alice West, Lopez, and Padilla.

d Wells screened at the water table identified as having elevated risks from VOCs (primarily TCE) in groundwater via vapor intrusion (detected concentrations only): OMW-6, OMW-7, SW-4, and SW 6.

e Exterior soil gas samples identified as having elevated risks from VOCs (TCE) in exterior soil gas via vapor intrusion (detected concentrations only): SGT-9.)

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Table 8. Plant Species Observed during Eagle Picher Site Visit, November 15, 2012

Scientific Name	Common Name	National Wetland Plant List Status[a]	Prefers or is Common in Disturbed Areas	Preferred by Local Wildlife[b]	Presence at Industrial Site[c]	Presence in Plume Area[c]
Acourtia nana	Desert holly					U
Amaranthus sp.	Pigweed		D	P		C
Ambrosia sp.	Ragweed		D			U
Atriplex canescens	Fourwing saltbush			P	A	C
Bouteloua curtipendula	Sideoats grama			P	U	
Bouteloua eriopoda	Black grama			P	F	
Bouteloua gracilis	Blue grama			P	C	
Dimorphocarpa wislizeni	Spectacle pod				F	
Elaeagnus angustifolia	Russian olive	Facultative			F	F
Ephedra sp.	Jointfir				F	F
Ericameria nauseous	Rabbitbrush			P	C	
Fallugia paradoxa	Apache plume			P	C	
Gutierrezia sarothrae	Broom snakeweed				U	
Kochia scoparia	Kochia, Summer cypress, Mexican fireweed		D		A	A
Larrea tridentata	Creosote bush			P	F	A
Opuntia longispina	Prickly pear			P	U	U
Paspalum sp.	Knotgrass			P		U
Populus deltoides	Cottonwood	Facultative		P		F
Prosopis glandulosa	Honey mesquite	Obligate Upland		P	U	U
Salsola sp.	Prickly Russian thistle, Tumbleweed		D		C	C
Senecio sp.	Groundsel, Ragwort				F	
Setaria viridis	Green bristlegrass			P	U	
Solanum elaeagnifolium	Horse nettle, Silverleaf nightshade				U	
Sphaeralcea sp.	Globemallow				F	
Sporobolus contractus	Spike dropseed			P	U	
Tamarix chinensis	Tamarisk, Saltcedar	Facultative			F	F
Typha sp.	Cattail	Obligate Wetland				F
Ulmus pumila	Siberian elm			P	F	F
Verbesina sp.	Cowpen daisy, Golden crownbeard			P		A
Xanthium strumarium	Cocklebur		D			F

a Source: 2012 National Wetland Plant List (http://plants.usda.gov/wetland.html)

b Preferred for cover, food, nesting, perching, or shade

c A = abundant (dominant)
C = common (found everywhere)
U = uncommon (found in a few areas)
F = few (one or a few found in a single location)

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Table 9. Animal Species Observed during Eagle Picher Site Visit, November 15, 2012

Scientific Name	Common Name	Presence at Industrial Site[a]	Presence in Plume Area[a]
Bos primigenius	Cow (tracks)		F
Callipepla gambelii	Gambel's quail		U
Canis latrans	Coyote (scat/tracks)		U
Circus cyaneus	Northern harrier		F
Corvus brachyrhynchos	Crow		U
Lepus insularis	Black-tailed jackrabbit		U
Zonotrichia leucophrys	White-crowned sparrow	C	C

a A = abundant (dominant)
C = common (found everywhere)
U = uncommon (found in a few areas)
F = few (one or a few found in a single location)

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Table 10. Assessment and Measurement Endpoints and Analysis Approach Proposed for the Eagle Picher Ecological Risk Assessment

Assessment Endpoint	Candidate Species/ Feeding Guilds	Risk Question	Measurement Endpoints	Analysis Approach
Survival and growth of terrestrial plants	Primary producers: grasses, forbes, woody shrubs, and trees	Are the levels of COPCs in soils from the Site greater than benchmarks for the survival or growth of terrestrial plants?	COPC concentrations in soils and associated physical/chemical measurements	COPC concentrations in soils vs. benchmarks/literature-based toxicity thresholds
Survival, growth, and reproduction of terrestrial invertebrates	Decomposers/detritivores: soft- and hard-bodied organisms (e.g., arthropods, gastropods, oligochaetes)	Are the levels of COPCs in soils from the Site greater than benchmarks for the survival, growth, or reproduction of terrestrial invertebrates?	COPC concentrations in soils and associated physical/chemical measurements	COPC concentrations in soils vs. benchmarks/literature-based toxicity thresholds
Survival, growth, and reproduction of birds	Herbivorous/omnivorous birds (e.g., sparrows, doves, and robins)	Are the levels of COPCs in soils from the Site greater than benchmarks for the survival, growth, or reproduction of birds?	COPC concentrations in soils and associated physical/chemical measurements	COPC concentrations in soils vs. benchmarks/literature-based toxicity thresholds for birds
		Do the daily doses of COPCs received by birds from consumption of the tissues of prey species and other media at the Site exceed toxicity reference values for survival, growth, or reproduction of birds?	COPC concentrations in soils and the modeled and/or measured tissues of prey species	Modeled dietary uptake COPC concentrations for birds vs. literature-based toxicity thresholds
Survival, growth, and reproduction of mammals	Omnivorous mammals (e.g., shrew, rat) Carnivorous mammals (e.g., coyote, fox)	Are the levels of COPCs in soils from the Site greater than benchmarks for the survival, growth, or reproduction of mammals?	COPC concentrations in soils and associated physical/chemical measurements	COPCs concentrations in soils vs. benchmarks/literature-based toxicity thresholds for mammals
		Do the daily doses of COPCs received by mammals from consumption of the tissues of prey species and other media at the Site exceed toxicity reference values for survival, growth, or reproduction of mammals?	COPC concentrations in soils and the modeled and/or measured tissues of prey species	Modeled dietary uptake COPC concentrations for mammals vs. literature-based toxicity thresholds

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Table 11. Soil Screening Levels for Wildlife (mg/kg)

	Los Alamos ECORISK Database (Release 3.1)											USEPA R5	USEPA EcoSSLs				
	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	American robin (Avian herbivore)	American robin (Avian insectivore)	American robin (Avian omnivore)	Deer mouse (Mammalian omnivore)	Desert cottontail (Mammalian herbivore)	Earthworm (Soil-dwelling invertebrate)	Generic plant (Terrestrial autotroph - producer)	Montane shrew (Mammalian insectivore)	Red fox (Mammalian top carnivore)	Eco-SL	Plants	Soil Inverte-brates	Avian	Mammalian	Minimum SSL
Cadmium	2	580	4.4	0.29	0.54	0.51	9.9	140	32	0.27	510	0.00222	32	140	0.77	0.36	0.00222
Chromium (total)	260	1,200	68	28	40	110	840	NA	NA	45	1,800	0.4	NA	NA	26	34	0.4
Chromium +6	2,200	5,400	280	190	220	860	3,200	See note	See note	280	7,200	NA	NA	NA	NA	130	130
Lead	120	810	21	14	16	120	370	1,700	120	72	3,700	0.0537	120	1,700	11	56	0.0537
PCE	NA	NA	NA	NA	NA	0.36	8.8	NA	10	0.18	31	9.92	NA	NA	NA	NA	0.18
TCE	NA	NA	NA	NA	NA	55	170	NA	NA	42	6,400	12.4	NA	NA	NA	NA	12.4
1,1-DCA	NA	NA	NA	NA	NA	210	370	NA	NA	290	85,000	20.1	NA	NA	NA	NA	20.1
1,1-DCE	NA	NA	NA	NA	NA	14	40	NA	NA	11	2,900	8.28	NA	NA	NA	NA	8.28
cis-1,2-DCE	NA	NA	NA	NA	NA	25	58	NA	NA	23	7,100	0.784	NA	NA	NA	NA	0.784
Toluene	NA	NA	NA	NA	NA	25	61	NA	200	23	3,100	5.45	NA	NA	NA	NA	5.45
1,1,1-TCA	NA	NA	NA	NA	NA	400	1,800	NA	NA	260	50,000	29.8	NA	NA	NA	NA	29.8
Freon 113	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NA = Not available.

Note: The earthworm and generic plant SLs from the Los Alamos Ecorisk Database were not used. These SLs were based on studies completed in the 1980s; however, USEPA's EcoSSL document for chromium (updated in 2008) determined that there was insufficient data to develop soil invertebrate and plant EcoSSLs for chromium +6.

SL Sources:

Los Alamos National Laboratory. 2012. ECORISK Database Release 3.1 (October 1, 2012). Available at http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php.

USEPA. 2003. RCRA Ecological Screening Levels. USEPA Region 5. August 22, 2003. Available at http://www.epa.gov/Region5/waste/cars/esl.htm.

USEPA. 2005. Ecological Screening Levels for Cadmium. Interim Final. OSWER Directive 9285.7-65. March 2005. Available at http://www.epa.gov/ecotox/ecossl/.

USEPA. 2008. Ecological Screening Levels for Chromium. Interim Final. OSWER Directive 9285.7-66. March 2005. Revised April 2008. Available at http://www.epa.gov/ecotox/ecossl/.

USEPA. 2005. Ecological Screening Levels for Lead. Interim Final. OSWER Directive 9285.7-70. March 2005. Available at http://www.epa.gov/ecotox/ecossl/.

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Table 12. Risk Characterization Summary for Wildlife

Receptor	NOAEL				LOAEL			
	HQ < 5	5 < HQ < 10	10 < HQ < 100	HQ > 100	HQ < 5	5 < HQ < 10	10 < HQ < 100	HQ > 100
Based on All Soil Samples								
Desert shrew	**Pb**	Cd, ***Pb***	Pb	Cr	**Pb**	Cd, ***Pb***	Pb	Cr
House sparrow	Cd, **Pb**		Cr, Pb, ***Pb***		Cd, **Pb**	***Pb***	Cr, Pb	
Coyote	Cd, Cr, Pb, ***Pb***, **Pb**				Cd, Cr, Pb, ***Pb***, **Pb**			
Soil Invertebrate[2]	Cd, Cr, Pb, ***Pb***, **Pb**							
Terrestrial Plant[2]	Cd, ***Pb***, **Pb**		Pb					
Based on Reduced Set of Soil Samples[1]								
Desert shrew	Cd, Cr, Pb, ***Pb***, **Pb**				Cd, Cr, Pb, ***Pb***, **Pb**			
House sparrow	Cd, Cr, Pb, ***Pb***, **Pb**				Cd, Cr, Pb, ***Pb***, **Pb**			
Coyote	Cd, Cr, Pb, ***Pb***, **Pb**				Cd, Cr, Pb, ***Pb***, **Pb**			
Soil Invertebrate[2]	Cd, Cr, Pb, ***Pb***, **Pb**							
Terrestrial Plant[2]	Cd, Pb, ***Pb***, **Pb**							

Cd, Cr, Pb: EECs calculated from confirmatory samples.

Pb: EEC calculated from all surface and subsurface XRF Pb results.

Pb: EEC calculated from gridded surface and subsurface XRF Pb results

[1] Soil concentrations from samples P-37, P-37E1, P 37E2, P-37N1, P-37N2, P-37S1, P-37S2, P-37W1, P-37W2, P-55, P-60, P-65, P-66 were excluded from the EEC calculations. These samples are located around the unlined sewage lagoons, at the new manufacturing plant, and southwest of the new manufacturing plant.

[2] Summary of HQs for soil invertebrate and terrestrial plant are based on benchmarks, rather than NOAELs. There is no terrestrial plant benchmark for Cr.

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Table 13. Weight of Evidence Summary for Wildlife

Medium	Line of Evidence	Weight-of-Evidence Evaluation[1] -	0	+	COPCs (Based on Confirmatory Samples)	COPCs (Based on XRF Pb Samples)
Based on All Soil Samples						
Terrestrial Plants	Soil Chemistry vs. Benchmarks		0[3] (XRF)	+	Pb (HQ = 12)	HQs < 5
Soil Invertebrates	Soil Chemistry vs. Benchmarks	- (XRF)	0[3]		HQs < 5	HQs < 1
Desert shrew	Soil Chemistry vs. NOAEL/LOAEL			+	Cr (HQs > 100), Pb (HQs ~ 30)	Cr (HQs > 100), Pb (HQs ~ 11)
House sparrow	Soil Chemistry vs. NOAEL/LOAEL			+	Cr (HQs ~ 50), Pb (HQs ~ 30)	Cr (HQs ~ 50), Pb (HQs ~ 11)
Coyote	Soil Chemistry vs. NOAEL/LOAEL	-			HQs < 5	same
Based on Reduced Set of Soil Samples[2]						
Terrestrial Plants	Soil Chemistry vs. Benchmarks	-			HQs < 1	same
Soil Invertebrates	Soil Chemistry vs. Benchmarks	-			HQs < 1	same
Desert shrew	Soil Chemistry vs. NOAEL/LOAEL		0[3]		HQs < 5	same
House sparrow	Soil Chemistry vs. NOAEL/LOAEL		0[3]		HQs < 5	same
Coyote	Soil Chemistry vs. NOAEL/LOAEL	-			HQs < 1	same

[1] Weight of evidence rating:

"-" = data indicate that metals are not expected to pose potential risk.

"0" = data do not support a conclusion regarding potential risk.

"+" = data indicate that metals are expected to pose potential risk.

[2] Soil concentrations from samples P-37, P-37E1, P 37E2, P-37N1, P-37N2, P-37S1, P-37S2, P-37W1, P-37W2, P-55, P-60, P-65, P-66 were excluded from the EEC calculation. These samples are located around the unlined sewage lagoons, at the new manufacturing plant, and southwest of the new manufacturing plant.

[3] HQ estimates site-wide (except for limited areas) are estimated to be low and are likely overestimated due to conservative assumptions regarding exposure assumptions and bioavailability assumptions.

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Appendix A

Human Health Screening Assessment

Table A-1. Screening Assessment for Surface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
Eagle Picher Site - Primary Manufacturing Area (East of Hwy 408)												
P-01	0-6"	11/26/2012	mg/kg	***35***	U	35	80*		26	19		3
P-02	0-6"	11/26/2012	mg/kg	***34***	U	34	79*		24	18		3
P-03	0-6"	11/26/2012	mg/kg	***36***	U	36	91*		26	26		3
P-04	0-6"	11/26/2012	mg/kg	***35***	U	35	94*		25	24		3
P-05	0-6"	11/26/2012	mg/kg	***35***	U	35	76*	U	76	29		3
P-06	0-6"	11/26/2012	mg/kg	***36***	U	36	102		28	18		3
P-07	0-6"	11/26/2012	mg/kg	***36***	U	36	105		26	19		3
P-08	0-6"	11/26/2012	mg/kg	***35***	U	35	72*	U	72	36		3
P-09	0-6"	11/26/2012	mg/kg	***88***		12	159		28	25		3
P-10	0-6"	11/26/2012	mg/kg	***36***	U	36	79*	U	79	16		3
P-11	0-6"	11/27/2012	mg/kg	***35***	U	35	73*	U	73	24		3
P-12	0-6"	11/27/2012	mg/kg	***34***	U	34	68*	U	68	24		3
P-13	0-6"	11/27/2012	mg/kg	***35***	U	35	77*	U	77	29		3
P-14	0-6"	11/27/2012	mg/kg	***35***	U	35	78*		25	23		3
P-15	0-6"	11/27/2012	mg/kg	***35***	U	35	107		26	27		3
P-16	0-6"	11/27/2012	mg/kg	***36***	U	36	85*		27	28		3
P-17	0-6"	11/27/2012	mg/kg	***35***	U	35	73*	U	73	39		3
P-18	0-6"	11/27/2012	mg/kg	***35***	U	35	108		26	46		3
P-19	0-6"	11/27/2012	mg/kg	***38***	U	38	78*	U	78	34		3
P-20	0-6"	11/27/2012	mg/kg	***46***		12	70*	U	70	19		3
P-21	0-6"	11/27/2012	mg/kg	***37***	U	37	84*	U	84	15		3
P-22	0-6"	11/27/2012	mg/kg	***35***	U	35	82*		26	36		3
P-23	0-6"	11/27/2012	mg/kg	***35***	U	35	75*	U	75	17		3
P-24	0-6"	11/27/2012	mg/kg	***35***	U	35	74*	U	74	24		3
P-25	0-6"	11/27/2012	mg/kg	***35***	U	35	75*	U	75	52		3
P-26	0-6"	11/27/2012	mg/kg	***34***	U	34	66*	U	66	22		3
P-27	0-6"	11/27/2012	mg/kg	***35***	U	35	78*	U	78	32		3
P-28	0-6"	11/27/2012	mg/kg	***35***	U	35	75*		24	17		3
P-29	0-6"	11/27/2012	mg/kg	***35***	U	35	72*	U	72	36		3
P-30	0-6"	11/27/2012	mg/kg	***35***	U	35	72*	U	72	17		3
P-31	0-6"	11/27/2012	mg/kg	***36***	U	36	97*		27	21		3
P-32	0-6"	11/27/2012	mg/kg	***35***	U	35	120		26	83		4
P-33	0-6"	11/27/2012	mg/kg	***35***	U	35	103		26	64		4
P-34	0-6"	11/27/2012	mg/kg	***35***	U	35	75*	U	75	71		4
P-35	0-6"	11/27/2012	mg/kg	***35***	U	35	73*	U	73	186		5
P-36	0-6"	11/27/2012	mg/kg	***35***	U	35	73*	U	73	83		4
P-37	0-6"	11/27/2012	mg/kg	***38***	U	38	754		44	283		7
P-37 E1	0-6"	12/4/2012	mg/kg	***40***	U	40	4,610		96	***5,020***		46
P-37 E2	0-6"	12/5/2012	mg/kg	***35***	U	35	88*		26	21		3
P-37 N1	0-6"	12/5/2012	mg/kg	***40***	U	40	8,697		138	***6,166***		55
P-37 N2	0-6"	12/5/2012	mg/kg	***39***	U	39	1,963		64	***4,279***		40
P-37 S1	0-6"	12/4/2012	mg/kg	***36***	U	36	512		37	398		7
P-37 S2	0-6"	12/4/2012	mg/kg	***35***	U	35	77*		25	24		3
P-37 W1	0-6"	12/5/2012	mg/kg	***35***	U	35	190		28	209		5
P-37 W2	0-6"	12/5/2012	mg/kg	***36***	U	36	72*	U	72	35		3
P-38	0-6"	11/27/2012	mg/kg	***35***	U	35	73*	U	73	25		3
P-39	0-6"	11/27/2012	mg/kg	***37***		12	70*	U	70	24		3
P-40	0-6"	11/27/2012	mg/kg	***35***	U	35	75*	U	75	81		4
P-41	0-6"	11/27/2012	mg/kg	***35***	U	35	135		27	***603***		9
P-42	0-6"	11/27/2012	mg/kg	***35***	U	35	76*		25	120		4
P-43	0-6"	11/27/2012	mg/kg	***35***	U	35	75*	U	75	187		5
P-44	0-6"	11/27/2012	mg/kg	***34***	U	34	83*		24	32		3
P-45	0-6"	11/27/2012	mg/kg	***35***	U	35	71*	U	71	28		3
P-46	0-6"	11/27/2012	mg/kg	***35***	U	35	102		25	253		6
P-47	0-6"	11/27/2012	mg/kg	***35***	U	35	71*	U	71	112		4
P-48	0-6"	11/27/2012	mg/kg	***35***	U	35	70*	U	70	27		3
P-49	0-6"	11/27/2012	mg/kg	***35***	U	35	73*	U	73	22		3
P-50	0-6"	11/27/2012	mg/kg	***35***	U	35	73*	U	73	77		4
P-51	0-6"	11/27/2012	mg/kg	***35***	U	35	71*	U	71	79		4
P-52	0-6"	11/27/2012	mg/kg	***34***	U	34	70*	U	70	32		3
P-53	0-6"	11/27/2012	mg/kg	***34***	U	34	68*	U	68	23		3
P-54	0-6"	11/27/2012	mg/kg	***35***	U	35	74*	U	74	22		3
P-55	0-6"	11/27/2012	mg/kg	***36***	U	36	78*	U	78	***1,136***		14

Table A-1. Screening Assessment for Surface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
P-56	0-6"	11/27/2012	mg/kg	***35***	U	35	74*	U	74	67		4
P-57	0-6"	11/27/2012	mg/kg	***35***	U	35	74*	U	74	28		3
P-58	0-6"	11/27/2012	mg/kg	***36***	U	36	114		28	187		5
P-59	0-6"	11/27/2012	mg/kg	***35***	U	35	68*	U	68	43		3
P-60	0-6"	11/27/2012	mg/kg	***41***	U	41	7,647		132	***1,199***		16
P-61	0-6"	11/27/2012	mg/kg	***35***	U	35	153		28	55		3
P-62	0-6"	11/27/2012	mg/kg	***35***	U	35	123		28	55		3
P-63	0-6"	11/27/2012	mg/kg	***36***	U	36	91*		26	18		3
P-64	0-6"	11/27/2012	mg/kg	***36***	U	36	72*	U	72	245		6
P-65	0-12"	12/20/2012	mg/kg	N/A			55*		28	***2,643***		33
P-66	0-12"	12/20/2012	mg/kg	N/A			41*	U	41	80		7
Number of Samples Analyzed				72			74			74		
Number of Samples > Minimum SSL				72			0			7		
Number of Detected Samples				3			19			74		
Number of Detected Samples > Minimum SSL				3			0			7		
Frequency of Detection				4.2%			26%			100%		
Eagle Picher Site - Secondary (Historical Facility) Area (West of Hwy 408)												
S-01	0-6"	11/28/2012	mg/kg	***34***	U	34	68*	U	68	17		3
S-02	0-6"	11/28/2012	mg/kg	***34***	U	34	71*	U	71	9		3
S-03	0-6"	11/28/2012	mg/kg	***34***	U	34	65*	U	65	16		3
S-04	0-6"	11/28/2012	mg/kg	***33***	U	33	60*	U	60	17		3
S-05	0-6"	11/28/2012	mg/kg	***36***	U	36	73*	U	73	13		3
S-06	0-6"	11/28/2012	mg/kg	***35***	U	35	95*		28	14		3
S-07	0-6"	11/28/2012	mg/kg	***35***	U	35	69*	U	69	10		3
S-08	0-6"	11/28/2012	mg/kg	***35***	U	35	71*	U	71	22		3
S-09	0-6"	11/28/2012	mg/kg	***35***	U	35	139		26	25		3
S-10	0-6"	11/28/2012	mg/kg	***35***	U	35	77*	U	77	18		3
S-11	0-6"	11/28/2012	mg/kg	***35***	U	35	86*		24	19		3
S-12	0-6"	11/28/2012	mg/kg	***35***	U	35	68*	U	68	14		3
S-13	0-6"	11/28/2012	mg/kg	***36***	U	36	77*	U	77	11		3
S-14	0-6"	11/28/2012	mg/kg	***35***	U	35	85*		24	22		3
S-15	0-6"	11/28/2012	mg/kg	***35***	U	35	83*		24	37		3
S-16	0-6"	11/28/2012	mg/kg	***35***	U	35	69*	U	69	24		3
S-17	0-6"	11/28/2012	mg/kg	***34***	U	34	69*	U	69	31		3
S-18	0-6"	11/28/2012	mg/kg	***35***	U	35	82*		25	24		3
S-19	0-6"	11/28/2012	mg/kg	***34***	U	34	67*	U	67	15		3
S-20	0-6"	11/28/2012	mg/kg	***35***	U	35	68*	U	68	13		3
S-21	0-6"	11/28/2012	mg/kg	***34***	U	34	75*		23	16		3
S-22	0-6"	11/28/2012	mg/kg	***34***	U	34	67*	U	67	13		3
S-23	0-6"	11/28/2012	mg/kg	***34***	U	34	67*	U	67	35		3
S-24	0-6"	11/28/2012	mg/kg	***35***	U	35	70*	U	70	112		4
S-25	0-6"	11/28/2012	mg/kg	***36***	U	36	101		26	36		3
S-26	0-6"	11/28/2012	mg/kg	***35***	U	35	77*		24	26		3
S-27	0-6"	11/28/2012	mg/kg	***35***	U	35	73*	U	73	47		3
S-28	0-6"	11/28/2012	mg/kg	***34***	U	34	65*	U	65	19		3
S-29	0-6"	11/28/2012	mg/kg	***34***	U	34	66*	U	66	70		3
S-30	0-6"	11/28/2012	mg/kg	***35***	U	35	74*		24	31		3
S-31	0-6"	11/28/2012	mg/kg	***34***	U	34	91*		24	47		3
S-32	0-6"	11/28/2012	mg/kg	***35***	U	35	67*	U	67	205		5
S-33	0-6"	12/4/2012	mg/kg	***35***	U	35	77*	U	77	21		3
S-34	0-6"	12/4/2012	mg/kg	***35***	U	35	72*	U	72	25		3
S-35	0-6"	12/4/2012	mg/kg	***34***	U	34	62*	U	62	12		3
S-36	0-6"	12/4/2012	mg/kg	***35***	U	35	68*	U	68	15		3
S-37	0-6"	12/4/2012	mg/kg	***35***	U	35	73*		24	20		3
S-38	0-6"	12/4/2012	mg/kg	***34***	U	34	64*	U	64	78		4
S-39	0-6"	12/4/2012	mg/kg	***35***	U	35	94*		27	347		7
S-40	0-6"	12/4/2012	mg/kg	***35***	U	35	91*		25	123		4
S-41	0-6"	12/4/2012	mg/kg	***35***	U	35	72*	U	72	21		3
S-42	0-6"	12/4/2012	mg/kg	***34***	U	34	71*	U	71	17		3
S-43	0-6"	12/4/2012	mg/kg	***33***	U	33	59*	U	59	14		2
S-44	0-6"	12/4/2012	mg/kg	***33***	U	33	58*	U	58	10		2
S-45	0-6"	12/4/2012	mg/kg	***34***	U	34	70*	U	70	45		3
S-46	0-6"	12/4/2012	mg/kg	***35***	U	35	80*		25	110		4

Table A-1. Screening Assessment for Surface Soils Analyzed by XRF at the Eagle Picher Site

Location	Depth	Date	Units	Cadmium Conc.	Cadmium Qual.	Cadmium StdDev	Chromium Conc.	Chromium Qual.	Chromium StdDev	Lead Conc.	Lead Qual.	Lead StdDev
S-47	0-6"	12/4/2012	mg/kg	***35***	U	35	72*	U	72	62		3
S-48	0-6"	12/4/2012	mg/kg	***34***	U	34	68*	U	68	42		3
S-49	0-6"	12/4/2012	mg/kg	***34***	U	34	63*	U	63	58		3
S-50	0-6"	12/4/2012	mg/kg	***34***	U	34	63*	U	63	22		3
S-51	0-12"	12/4/2012	mg/kg	***35***	U	35	64*	U	64	22		3
S-52	0-6"	12/4/2012	mg/kg	***34***	U	34	66*	U	66	18		3
S-53	0-6"	12/4/2012	mg/kg	***35***	U	35	75*	U	75	23		3
S-54	0-6"	12/4/2012	mg/kg	***34***	U	34	68*	U	68	20		3
S-55	0-6"	12/4/2012	mg/kg	***35***	U	35	77*	U	77	40		3
S-56	0-6"	12/4/2012	mg/kg	***35***	U	35	80*		24	16		3
S-57	0-6"	12/4/2012	mg/kg	***35***	U	35	68*	U	68	22		3
S-58	0-6"	12/4/2012	mg/kg	***35***	U	35	76*	U	76	15		3
S-59	0-6"	12/4/2012	mg/kg	***36***	U	36	73*	U	73	21		3
S-60	0-6"	12/4/2012	mg/kg	***34***	U	34	66*	U	66	14		3
S-62	0-6"	12/4/2012	mg/kg	***36***	U	36	89*		29	248		6
S-63	0-6"	12/4/2012	mg/kg	***34***	U	34	66*	U	66	19		3
S-64	0-6"	12/4/2012	mg/kg	***35***	U	35	93*		25	24		3
S-65	0-12"	12/20/2012	mg/kg	***35***	U	35	77*		28	13		4
Number of Samples Analyzed				64			64			64		
Number of Samples > Minimum SSL				64			0			0		
Number of Detected Samples				0			2			64		
Number of Detected Samples > Minimum SSL				0			0			0		
Frequency of Detection				0.0%			3.1%			100%		
Eagle Picher Site - Primary and Secondary Areas Combined												
Number of Samples Analyzed				136			138			138		
Number of Samples > Minimum SSL				136			0			7		
Number of Detected Samples				3			21			138		
Number of Detected Samples > Minimum SSL				3			0			7		
Frequency of Detection				2.2%			15%			100%		
Soil Screening Level (SSL)				SSL	EP		SSL	EP		SSL	EP	
NMED												
Industrial/Occupational				897	n		1,700,000	n		800	IEUBK	
Construction				277	n		465,000	n		800	IEUBK	
Groundwater Protection				27.5			1,970,000,000			NA		
USEPA (each SSL based on a carcinogenic endpoint was multiplied by 10 to achieve a risk level of 1E-05 for that SSL)												
Industrial				800	n		NA			800	IEUBK	
USEPA RSL Calculator												
Intermittent Visitor (Trespasser, Recreator, Visitor)				473	n		NA			400	n	
Minimum SSL				**27.5**			**465,000**			**400**		

* XRF detections of Cr below 100 mg/kg are considered non-quantified because there was no correlation between these results and the confirmational samples analyzed using laboratory methods. Detected above 100 mg/kg are considered semi-quantified because there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation (DBS&A 2013).

N/A = Not analyzed.

NA = Not available.

EP = Endpoint used to derive SSL (see SSL Sources for more details):

c = carcinogenic.

nc = noncarcinogenic.

IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.

U = Not detected by XRF device. Concentration reported is standard deviation reported by the XRF device.

SSL Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Groundwater protection SSLs are based on a dilution attenuation factor of 20.

USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html.

USEPA. 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-line RSL calculator available at http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search. Intermittent visitor SLs were calculated using default residential exposure assumptions and calculations, except for exposure frequency (assumed 1 visit per week or 52 days per year), carcinogenic risk (1E-05), and climate variables (e.g., particulate and volatile emission factors) for New Mexico.

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Table A-2. Screening Assessment for Subsurface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
Eagle Picher Site - Primary Manufacturing Area (East of Hwy 408)												
P-37	0-4'	12/5/2012	mg/kg	***35***	U	35	107		26	35		3
P-37	4-5'	12/5/2012	mg/kg	***35***	U	35	83*		26	14		3
P-55	0-1'	12/20/2012	mg/kg	***35***	U	35	75*		30	363		12
P-55	1-2'	12/19/2012	mg/kg	***35***	U	35	55*		29	17		4
P-55	2-3'	12/19/2012	mg/kg	***35***	U	35	44*	U	44	13		4
P-55	3-4'	12/19/2012	mg/kg	***36***	U	36	55*		27	14		4
P-56	0-4'	12/5/2012	mg/kg	***35***	U	35	75*	U	75	150		5
P-56	4-5'	12/5/2012	mg/kg	***36***	U	36	81*	U	81	51		4
P-57	0-4'	12/19/2012	mg/kg	***35***	U	35	37*	U	37	14		4
P-57	4-5'	12/19/2012	mg/kg	***35***	U	35	33*	U	33	15		4
P-58	0-4'	12/19/2012	mg/kg	***34***	U	34	43*	U	43	12		4
P-58	4-5'	12/19/2012	mg/kg	***38***	U	38	87*		27	11		4
P-60	0-1'	12/19/2012	mg/kg	***35***	U	35	1,075		57	146		8
P-60	1-2'	12/19/2012	mg/kg	***35***	U	35	118		30	23		5
P-60	2-3'	12/19/2012	mg/kg	***38***	U	38	75*		28	15		4
P-60	3-4'	12/19/2012	mg/kg	***34***	U	34	71*		27	11		4
P-61	0-4'	12/19/2012	mg/kg	***35***	U	35	46*		27	12		4
P-61	4-5'	12/19/2012	mg/kg	***35***	U	35	63*		27	12		4
P-63	0-4'	12/19/2012	mg/kg	12	U	12	73*		28	12		4
P-63	4-5'	12/19/2012	mg/kg	***37***	U	37	61*		29	16		4
P-64	0-4'	12/20/2012	mg/kg	***36***	U	36	70*	U	70	115		4
P-64	4-6'	12/20/2012	mg/kg	***35***	U	35	72*	U	72	77		6
P-65	1-2'	12/20/2012	mg/kg	N/A			55*		30	***2,133***		29
P-65	2.5-4'	12/20/2012	mg/kg	N/A			82*		30	***2,809***		34
P-65	4-6'	12/20/2012	mg/kg	N/A			56*		31	89		7
P-66	1-2.5'	12/20/2012	mg/kg	N/A			58*		27	48		5
P-66	2.5-4'	12/20/2012	mg/kg	N/A			89*		29	***1,548***		25
P-66	4-6'	12/20/2012	mg/kg	N/A			38*	U	38	83		6.47
Number of Samples Analyzed				22			28			28		
Number of Samples > Minimum SSL				21			0			3		
Number of Detected Samples				0			3			28		
Number of Detected Sample > Minimum SSL				0			0			3		
Frequency of Detection				0.0%			11%			100%		
Eagle Picher Site - Secondary (Historical Facility) Area (West of Hwy 408)												
S-55	0-1'	12/19/2012	mg/kg	***35***	U	35	41*	U	41	***1,265***		22
S-55	1-2'	12/19/2012	mg/kg	***35***	U	35	55*		28	27		5
S-55	2-3'	12/19/2012	mg/kg	***36***	U	36	49*		27	24		4
S-55	3-4'	12/19/2012	mg/kg	***35***	U	35	50*		28	22		5
S-55	4-5'	12/19/2012	mg/kg	***36***	U	36	57*		28	13		4
S-56	0-4'	12/20/2012	mg/kg	***35***	U	35	59*		27	13		4
S-56	4-5'	12/20/2012	mg/kg	***35***	U	35	41*	U	41	14		4
S-57	0-1'	12/4/2012	mg/kg	***35***	U	35	78*		25	20		3
S-57	0-4'	12/20/2012	mg/kg	***34***	U	34	41*	U	41	10		4
S-57	4-5'	12/20/2012	mg/kg	***35***	U	35	41*		27	10		4
S-58	0-1'	12/4/2012	mg/kg	***35***	U	35	84*		26	17		3
S-58	0-3'	12/19/2012	mg/kg	***35***	U	35	48*		26	12		4
S-58	4-5'	12/19/2012	mg/kg	***40***	U	40	41*	U	41	4	U	4
S-59	0-4'	12/20/2012	mg/kg	12	U	12	45*		29	15		4
S-59	4-5'	12/20/2012	mg/kg	***36***	U	36	41*	U	41	10		4
S-60	0-4'	12/20/2012	mg/kg	***35***	U	35	74*		29	17		4
S-60	4-5'	12/20/2012	mg/kg	***35***	U	35	74*		29	10		4
S-61	0-1'	12/20/2012	mg/kg	***35***	U	35	77*		29	18		4
S-61	0-2'	12/20/2012	mg/kg	***35***	U	35	36*	U	36	12		4
S-61	2-4'	12/20/2012	mg/kg	***35***	U	35	44*	U	44	15		4
S-62	0-4'	12/19/2012	mg/kg	***35***	U	35	38*	U	38	13		4
S-62	4-5'	12/19/2012	mg/kg	***35***	U	35	44*		28	16		4
S-63	0-1'	12/4/2012	mg/kg	***35***	U	35	71*	U	71	22		3
S-63	0-4'	12/19/2012	mg/kg	***35***	U	35	44*		27	16		4
S-63	2-3'	12/20/2012	mg/kg	***35***	U	35	56*		29	15		4
S-63	4-5'	12/19/2012	mg/kg	***40***	U	40	51*		27	12		4
S-64	0-4'	12/20/2012	mg/kg	***35***	U	35	49*		28	16		4
S-64	4-5'	12/20/2012	mg/kg	***35***	U	35	39*	U	39	9		4

Table A-2. Screening Assessment for Subsurface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
S-65	1-3'	12/20/2012	mg/kg	***35***	U	35	68*		31	13		3
S-65	3-5'	12/20/2012	mg/kg	***35***	U	35	72*		28	12		4
S-65	4-5'	12/20/2012	mg/kg	***35***	U	35	68*		29	15		4
S-66	0-4'	12/20/2012	mg/kg	***35***	U	35	70*		28	12		4
S-66	4-6'	12/20/2012	mg/kg	***35***	U	35	69*		28	12		4
S-67	0-4'	12/20/2012	mg/kg	***35***	U	35	72*		29	15		4
S-67	4-6'	12/20/2012	mg/kg	***34***	U	34	72*		29	12		4
Number of Samples Analyzed				35			35			35		
Number of Samples > Minimum SSL				34			0			1		
Number of Detected Samples				0			0			34		
Number of Detected Samples > Minimum SSL				0			0			1		
Frequency of Detection				0.0%			0%			97%		
Eagle Picher Site - Primary and Secondary Areas Combined												
Number of Samples Analyzed				57			63			63		
Number of Samples > Minimum SSL				55			0			4		
Number of Detected Samples				0			3			62		
Number of Detected Samples > Minimum SSL				0			0			4		
Frequency of Detection				0.0%			5%			98%		
Soil Screening Level (SSL)				SSL	EP		SSL	EP		SSL	EP	
NMED												
Industrial/Occupational				897	n		1,700,000	n		800	IEUBK	
Construction				277	n		465,000	n		800	IEUBK	
Groundwater Protection				27.5			1,970,000,000			NA		
USEPA (each SSL based on a carcinogenic endpoint was multiplied by 10 to achieve a risk level of 1E-05 for that SSL)												
Industrial				800	n		NA			800	IEUBK	
USEPA RSL Calculator												
Intermittent Visitor (Trespasser, Recreator, Visitor)				473	n		NA			400	n	
Minimum SSL				**27.5**			**465,000**			**400**		

* XRF detections of Cr below 100 mg/kg are considered non-quantified because there was no correlation between these results and the confirmational samples analyzed using laboratory methods. Detected above 100 mg/kg are considered semi-quantified because there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation (DBS&A 2013).

N/A = Not analyzed.

NA = Not available.

EP = Endpoint used to derive SSL (see SSL Sources for more details):

c = carcinogenic.

nc = noncarcinogenic.

IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.

U = Not detected by XRF device. Concentration reported is standard deviation reported by the XRF device.

SSL Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Groundwater protection SSLs are based on a dilution attenuation factor of 20.

USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html.

USEPA. 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-line RSL calculator available at http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search. Intermittent visitor SLs were calculated using default residential exposure assumptions and calculations, except for exposure frequency (assumed 1 visit per week or 52 days per year), carcinogenic risk (1E-05), and climate variables (e.g., particulate and volatile emission factors) for New Mexico.

Table A-3. Screening Assessment for Soils Analyzed by Laboratory Methods at the Eagle Picher Site

Location	Depth	Date	Units	Cadmium		Chromium (Total)		Chromium +6		Lead		PCE*		TCE*		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113	
				Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
Eagle Picher Site - Surface Soils at the Primary Manufacturing Area (East of Hwy 408)																											
P-3	0-6"	11/30/2012	mg/kg	0.72		14		***2***	U	11		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-10	0-6"	11/30/2012	mg/kg	0.88		16		***2***	U	8.3		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-16	0-6"	11/30/2012	mg/kg	0.21		14		***2***	U	13		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-27	0-6"	11/30/2012	mg/kg	0.51		16		***2***	U	23		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-35	0-6"	11/30/2012	mg/kg	1.2		14		***2***	U	200		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-37	0-6"	11/30/2012	mg/kg	1.7		550		***4.8***		360		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-42	0-6"	11/30/2012	mg/kg	1		14		***10***	U	120		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-55	0-6"	11/30/2012	mg/kg	0.7		15		***2***	U	***1,500***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-60	0-6"	11/30/2012	mg/kg	7.8		3000		***16***		***1,700***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-63	0-6"	11/30/2012	mg/kg	0.2	U	12		***2***	U	12		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-65	0-1'	11/30/2012	mg/kg	1.2		15		***10***	U	98		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-66	0-1'	11/30/2012	mg/kg	5.8		3300		***15***		***1,100***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
Number of Samples Analyzed				12		12		12		12																	
Number of Samples > Minimum SSL				0		0		12		3																	
Number of Detected Samples				11		12		3		12																	
Number of Detected Samples > Minimum SSL				0		0		3		3																	
Frequency of Detection				92%		100%		25%		100%																	
Eagle Picher Site - Subsurface Soils at the Primary Manufacturing Area (East of Hwy 408)																											
P-60	5'	12/4/2012	mg/kg	N/A		N/A		N/A		N/A		***0.048***	U	***0.048***	U	0.097	U	0.048	U	0.048	U	0.048	U	0.048	U	N/A	
P-62	5'	12/4/2012	mg/kg	N/A		N/A		N/A		N/A		***0.046***	U	***0.046***	U	0.092	U	0.046	U	0.046	U	0.046	U	0.046	U	N/A	
Number of Samples Analyzed												2		2		2		2		2		2		2			
Number of Samples > Minimum SSL												2		2		0		0		0		0		0			
Number of Detected Samples												0		0		0		0		0		0		0			
Number of Detected Samples > Minimum SSL												0		0		0		0		0		0		0			
Frequency of Detection												0%		0%		0%		0%		0%		0%		0%			
Eagle Picher Site - Surface Soils at the Secondary Area (Historical Facility, West of Hwy 408)																											
S-7	0-6"	11/30/2012	mg/kg	0.2	U	12		***2.0***	U	7.8		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-13	0-6"	11/30/2012	mg/kg	0.1	U	7.3		***2.0***	U	7.7		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-20	0-6"	11/30/2012	mg/kg	0.1	U	8.6		***2.0***	U	5.4		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-30	0-6"	11/30/2012	mg/kg	0.2	U	13		***2.0***	U	21		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-46	0-6"	11/30/2012	mg/kg	0.2	U	14		***2.0***	U	32		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-51	0-1'	11/30/2012	mg/kg	0.22		9.3		***2.0***	U	22		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-65	0-1'	11/30/2012	mg/kg	0.2	U	16		***2.0***	U	6.1		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
Number of Samples Analyzed				7		7		7		7																	
Number of Samples > Minimum SSL				0		0		7		0																	
Number of Detected Samples				1		7		0		7																	
Number of Detected Samples > Minimum SSL				0		0		0		0																	
Frequency of Detection				14%		100%		0%		100%																	
Eagle Picher Site - Primary and Secondary Areas Combined (Surface Soils for Metals, Subsurface Soils for VOCs)																											
Number of Samples Analyzed				19		19		19		19		2		2		2		2		2		2		2		0	
Number of Samples > Minimum SSL				0		0		19		3		2		2		0		0		0		0		0			
Number of Detected Samples				12		19		3		19		0		0		0		0		0		0		0			
Number of Detected Samples > Minimum SSL				0		0		3		3		0		0		0		0		0		0		0			
Frequency of Detection				63%		100%		16%		100%		0%		0%		0%		0%		0%		0%		0%			
Soil Screening Level (SSL)				SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP
NMED																											
Industrial/Occupational				897	n	1,700,000	n	63.1	n	800	IEUBK	36.6	c	41.3	c	359	c	2,290	n	2,270	n	57,700	n	78,900	n	347,000	n
Construction				277	n	465,000	n	65.6	c	800	IEUBK	212	c	7.68	c	1,700	c	432	n	619	c	13,400	n	14,800	n	64,700	n
Groundwater Protection				27.5		1,970,000,000		0.166		NA		0.00861		0.0211		0.12		2.32		0.367		25.3		58.2		3,450	
USEPA (each SSL based on a carcinogenic endpoint was multiplied by 10 to achieve a risk level of 1E-05 for that SSL)																											
Industrial				800	n	NA		56	c	800	IEUBK	1,100	c	64	c	170	c	1,100	n	2,000	n	45,000	n	38,000	n	180,000	n
USEPA RSL Calculator																											
Intermittent Visitor (Trespasser, Recreator, Visitor)				473	n	NA		20.1	c	400	n	2,740	n	182	c	3,520	c	17,300	n	1,050	n	41,700	n	664,000	n	5,480,000	n
Minimum SSL				**27.5**		**465,000**		**0.166**		**400**		**0.00861**		**0.0211**		**0.12**		**2.32**		**0.367**		**25.3**		**58.2**		**3,450**	

* Although the PQL is reported for non-detect results from subsurface soil samples collected at the primary manufacturing area, PCE and TCE results were not detectable at the laboratory's MDL of 0.005 mg/kg.

N/A = Not analyzed.

NA = Not available.

EP = Endpoint used to derive SSL (see SSL Sources for more details):

c = carcinogenic.

nc = noncarcinogenic.

IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.

U = Not detected. Concentration reported is reporting limit (PQL).

SSL Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Chromium (III) SSLs used for Chromium (Total). Groundwater protection SSLs are based on a dilution attenuation factor of 20.

USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html.

USEPA. 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. On-line RSL calculator available at http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search. Intermittent visitor SLs were calculated using default residential exposure assumptions and calculations, except for exposure frequency (assumed 1 visit per week or 52 days per year), carcinogenic risk (1E-05), and climate variables (e.g., particulate and volatile emission factors) for New Mexico.

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Table A-4. Screening Assessment for Sub-slab Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
SS-1	0-2'	12/5/2012	mg/kg	***36***	U	36	81*	U	81	217		6
SS-1	2-4'	12/5/2012	mg/kg	***36***	U	36	90*		26	21		3
SS-1	4-6'	12/5/2012	mg/kg	***36***	U	36	79*	U	79	24		3
SS-2	0-2'	12/5/2012	mg/kg	***36***	U	36	124		28	20		3
SS-2	2-4'	12/5/2012	mg/kg	***35***	U	35	75*	U	75	25		3
SS-2	4-6'	12/5/2012	mg/kg	***35***	U	35	76*	U	76	19		3
SS-3	0-2'	12/5/2012	mg/kg	***34***	U	34	70*	U	70	29		3
SS-3	2-4'	12/5/2012	mg/kg	***35***	U	35	74*	U	74	22		3
SS-3	4-6'	12/5/2012	mg/kg	***35***	U	35	88*		25	15		3
SS-4	0-2'	12/5/2012	mg/kg	***34***	U	34	71*	U	71	19		3
SS-4	2-4'	12/5/2012	mg/kg	***36***	U	36	81*	U	81	23		3
SS-4	4-6'	12/5/2012	mg/kg	***35***	U	35	90*		25	18		3
SS-5	0-2'	12/5/2012	mg/kg	***35***	U	35	79*	U	79	29		3
SS-5	2-4'	12/5/2012	mg/kg	***36***	U	36	80*	U	80	20		3
SS-5	4-6'	12/5/2012	mg/kg	***34***	U	34	76*	U	76	18		3
SS-6	0-2'	12/5/2012	mg/kg	***35***	U	35	70*	U	70	32		3
SS-6	2-4'	12/5/2012	mg/kg	***35***	U	35	101		26	23		3
SS-6	4-6'	12/5/2012	mg/kg	***35***	U	35	86*		25	20		3
SS-7	0-2'	12/5/2012	mg/kg	***34***	U	34	86*		29	31		4
SS-7	2-4'	12/5/2012	mg/kg	***35***	U	35	90*		41	23		3
SS-7	4-6'	12/5/2012	mg/kg	***35***	U	35	77*		29	27		3
Number of Samples Analyzed				21			21			21		
Number of Samples > Minimum SSL				21			0			0		
Number of Detected Samples				0			2			21		
Number of Detected Samples > Minimum SSL				0			0			0		
Frequency of Detection				0.0%			10%			100.0%		
Soil Screening Level (SSL)				SSL	EP		SSL	EP		SSL	EP	
NMED												
Industrial/Occupational				897	n		1,700,000	n		800	IEUBK	
Construction				277	n		465,000	n		800	IEUBK	
Groundwater Protection				27.5			1,970,000,000			NA		
USEPA (each SSL based on a carcinogenic endpoint was multiplied by 10 to achieve a risk level of 1E-05 for that SSL												
Industrial				800	n		NA			800	IEUBK	
Minimum SSL				**27.5**			**465,000**			**800**		

* XRF detections of Cr below 100 mg/kg are considered non-quantified because there was no correlation between these results and the confirmational samples analyzed using laboratory methods. Detected above 100 mg/kg are considered semi-quantified because there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation (DBS&A 2013).

NA = Not available.

EP = Endpoint used to derive SSL (see SSL Sources for more details):

c = carcinogenic.

nc = noncarcinogenic.

IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.

U = Not detected by XRF device. Concentration reported is standard deviation reported by the XRF device.

SSL Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Groundwater protection SSLs are based on a dilution attenuation factor of 20.

USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html.

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Table A-5. Screening Assessment for Sub-slab Soils Analyzed by Laboratory Methods at the Eagle Picher Site

				Cadmium		Chromium (Total)		Chromium +6		Lead		PCE*		TCE*		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113	
Location	Depth	Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
SS-1	6'	12/3/2012	mg/kg	N/A		N/A		N/A		N/A		***0.046***	U	***0.046***	U	0.092	U	0.046	U	0.046	U	0.046	U	0.046	U	N/A	
SS-2	6'	12/3/2012	mg/kg	N/A		N/A		N/A		N/A		***0.047***	U	***0.047***	U	0.094	U	0.047	U	0.047	U	0.047	U	0.047	U	N/A	
SS-3	6'	12/3/2012	mg/kg	N/A		N/A		N/A		N/A		***0.049***	U	***0.049***	U	0.098	U	0.049	U	0.049	U	0.049	U	0.049	U	N/A	
SS-4	6'	12/3/2012	mg/kg	N/A		N/A		N/A		N/A		***0.049***	U	***0.049***	U	0.098	U	0.049	U	0.049	U	0.049	U	0.049	U	N/A	
SS-5	6'	12/3/2012	mg/kg	N/A		N/A		N/A		N/A		***0.048***	U	***0.048***	U	0.095	U	0.048	U	0.048	U	0.048	U	0.048	U	N/A	
SS-6	6'	12/3/2012	mg/kg	N/A		N/A		N/A		N/A		***0.049***	U	***0.049***	U	0.098	U	0.049	U	0.049	U	0.049	U	0.049	U	N/A	
SS-7	6'	12/4/2012	mg/kg	N/A		N/A		N/A		N/A		***0.047***	U	***0.047***	U	0.094	U	0.047	U	0.047	U	0.047	U	0.047	U	N/A	
SS-5	3-4'	12/3/2012	mg/kg	0.2	U	15		***2***	U	7		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
SS-6	3-4'	12/3/2012	mg/kg	0.2	U	14		***2***	U	7.7		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
Number of Samples Analyzed				2		2		2		2		7		7		7		7		7		7		7			
Number of Samples > Minimum SSL				0		0		2		0		7		7		0		0		0		0		0			
Number of Detected Samples				0		2		0		2		0		0		0		0		0		0		0			
Number of Detected Samples > Minimum SSL				0		0		0		0		0		0		0		0		0		0		0			
Frequency of Detection				0%		100%		0%		100%		0%		0%		0%		0%		0%		0%		0%			
Soil Screening Level (SSL)				SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP	SSL	EP
NMED																											
Industrial/Occupational				897	n	1,700,000	n	63.1	n	800	IEUBK	36.6	c	41.3	c	359	c	2,290	n	2,270	n	57,700	n	78,900	n	347,000	n
Construction				277	n	465,000	n	65.6	c	800	IEUBK	212	c	7.68	c	1,700	c	432	n	619	c	13,400	n	14,800	n	64,700	n
Groundwater Protection				27.5		1,970,000,000		0.166		NA		0.00861		0.0211		0.12		2.32		0.367		25.3		58.2		3,450	
USEPA (each SSL based on a carcinogenic endpoint was multiplied by 10 to achieve a risk level of 1E-05 for that SSL)																											
Industrial				800	n	NA		56	c	800	IEUBK	1,100	c	64	c	170	c	1,100	n	2,000	n	45,000	n	38,000	n	180,000	n
Minimum SSL				**27.5**		**465,000**		**0.166**		**800**		**0.00861**		**0.0211**		**0.12**		**2.32**		**0.367**		**25.3**		**58.2**		**3,450**	

* Although the PQL is reported for non-detect results, PCE and TCE results were not detectable at the laboratory's MDL of 0.005 mg/kg.

N/A = Not analyzed.

NA = Not available.

EP = Endpoint used to derive SSL (see SSL Sources for more details):

c = carcinogenic.

nc = noncarcinogenic.

IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.

U = Not detected. Concentration reported is reporting limit (PQL).

SSL Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Chromium (III) SSLs used for Chromium (Total). Groundwater protection SSLs are based on a dilution attenuation factor of 20.

USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html.

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Table A-6. Screening Assessment for VOCs in Groundwater at the Eagle Picher Site

					PCE		TCE		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113		Chloroform		2-Hexanone		cis-1,3-DCPe*		BromoDCM		DibromoCM		Bromoform	
Well	Type	Study	Sample Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
Eagle Picher Site																																
Eagle Picher	Municipal Supply	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	***1.6***		***2.9***		1.7	
Eagle Picher	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.2	UM	0.50	U	***1.6***		***3.0***		1.8	
COS-LF	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
EID-LL	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
EP-UNK	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	Ujv	0.50	U	0.50	U	0.50	U
EP-UNK	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
NMED-1	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
NMED-2	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-1	Monitoring	DBS&A (RI/FS)	01/07/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-2	Monitoring	DBS&A (RI/FS)	01/07/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-2	Monitoring	NMED 2012	03/12/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.18	LJ	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-3	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SW-2	Monitoring	DBS&A (RI/FS)	01/28/13	µg/L	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	6.3		1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.0	U	1.0	U
Number of Samples Analyzed					13		13		13		13		13		13		13		12		13		13		13		13		13		13	
Number of Samples > Minimum SL					0		0		0		0		0		0		0		0		0		0		0		2		2		0	
Number of Detected Samples					0		0		0		0		0		1		0		0		1		0		0		2		2		2	
Number of Detected Samples > Minimum SL					0		0		0		0		0		0		0		0		0		0		0		2		2		0	
Frequency of Detection					0.0%		0.0%		0.0%		0.0%		0.0%		7.7%		0.0%		0.0%		7.7%		0.0%		0.0%		15%		15%		15%	
Groundwater Plume South of the Eagle Picher Site																																
Alice East	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	***2.0***	U	***187***		4.5		***452***		2.1		2.0	U	2.0	U	9.75		***2.0***	U	5.0	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
Alice East	Domestic	NMED 2012	03/14/12	µg/L	***5.0***	U	***240***	**	4.8	LJ	***490***	**	2.8	LJ	5.0	U	5.0	U	5.0	U	***5.9***	UM	10	U	***5.0***	U	***5.0***	U	***5.0***	U	5.0	U
Alice West	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	***2.0***	U	***27.7***		2.0	U	***85.4***		2.0	U	2.0	U	2.0	U	2.0	U	***2.0***	U	5.0	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
Alice West	Domestic	NMED 2012	03/14/12	µg/L	***5.0***	U	***20***		5.0	U	***81***		5.0	U	5.0	U	5.0	U	5.0	U	***5.0***	U	10	U	***5.0***	U	***5.0***	U	***5.0***	U	5.0	U
Bailey	Domestic	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Hooper	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	***5.2***		0.22	J	***19***		0.5	U	0.50	U	0.50	U	0.26	J	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Hooper	Domestic	NMED 2012	03/14/12	µg/L	0.50	U	***5.4***		0.19	LJ	***14***		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Knight	Domestic	DBS&A (RI/FS)	01/31/13	µg/L	0.2	U	***6.7***		0.10	U	0.20	U	0.10	U	0.2	U	0.2	U	N/A		NA		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Lopez	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	1.1		***41***		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Lopez	Domestic	NMED 2012	03/14/12	µg/L	***5.0***	U	***49***		5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	***5.0***	U	10	U	***5.0***	U	***5.0***	U	***5.0***	U	5.0	U
Miller	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Padilla	Domestic	DBS&A (RI/FS)	*Not Smpld*	µg/L																												
Padilla	Domestic	NMED 2012	03/14/12	µg/L	***5.0***	U	***86***		1.8	LJ	***230***	**	5.0	U	5.0	U	5.0	U	5.0	U	***5.3***	UM	10	U	***5.0***	U	***5.0***	U	***5.0***	U	5.0	U
Bushman	Municipal Supply	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Bushman	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Holmes	Municipal Supply	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.87		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Holmes	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.71		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Lattman	Municipal Supply	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Lattman	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Olson	Municipal Supply	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	2.1		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Olson	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	2.3		0.50	U	0.68		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Sedillo Park	Municipal Supply	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-3	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-4	Monitoring	DBS&A (RI/FS)	01/07/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-4	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.21	LJ	0.50	U	0.50	U	0.50	U
OMW-5	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	***7.8***		0.27	J	***16.5***		0.50	U	0.50	U	0.50	U	0.25	LJ	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-5	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	***8.5***		0.27	LJ	***19***		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	6.0	UM	0.50	U	0.50	U	0.50	U	0.50	U
OMW-6	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	***2.0***	U	***38***		2.2		***60***		2.0	U	2.0	U	2.0	U	2.0	U	***2.0***	U	5.0	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
OMW-6	Monitoring	NMED 2012	03/14/12	µg/L	***5.0***	U	***54***		3.0	LJ	***91***		1.1	LJ	5.0	U	5.0	U	5.0	U	***5.5***	UM	23		***5.0***	U	***5.0***	U	***5.0***	U	5.0	U
OMW-7	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	***10.85***		***113.5***		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	***2.0***	U	5.0	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
OMW-7	Monitoring	NMED 2012	03/14/12	µg/L	***13.5***		***125***		5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	***5.3***	UM	10	U	***5.0***	U	***5.0***	U	***5.0***	U	5.0	U
OMW-8	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	0.50	U	0.56		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-8	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.43	LJ	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-9	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.38	LJ	***6.3***		0.50	U	5.4	J	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-9	Monitoring	NMED 2012	03/13/12	µg/L	0.52		***9.0***		0.50	U	***7.4***		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-10	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-10	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-11	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.48	J	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-12	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	0.50	U	***4.5***		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-12	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	2.8		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.20	LJ	0.50	U	0.50	U	0.50	U
OMW-13	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.5	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-14	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	1.5		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-14	Monitoring	NMED 2012	03/12/12	µg/L	0.50	U	2.5		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.17	LJ	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U

Table A-6. Screening Assessment for VOCs in Groundwater at the Eagle Picher Site

					PCE		TCE		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113		Chloroform		2-Hexanone		cis-1,3-DCPe*		BromoDCM		DibromoCM		Bromoform	
Well	Type	Study	Sample Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
DW-1	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	***2.0***	U	2	U	2.0	U	2.0	U	2.0	U	3.4		2.0	U	2.0	U	***2.0***	U	5.0	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
DW-2	Monitoring	DBS&A (RI/FS)	06/19/13	µg/L	1.0	U	***190***		1.3		***250***		2.4		1	U	1.0	U	N/A		1.0	U	10.0	U	1.0	U	1.0	U	1.0	U	1.0	U
IW-1	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	***11.9***		***125***		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	***2.0***	U	5.0	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
SW-3	Monitoring	DBS&A (RI/FS)	01/29/13	µg/L	1.0	U	2.1		1.0	U	5.2		1.0	U	9.3		1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.0	U	1.0	U
SW-4	Monitoring	DBS&A (RI/FS)	12/19/12	µg/L	***12.5***		***100***		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.0	U	1.0	U
SW-4	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	***13.2***		***125***		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	***2.0***	U	5.0	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
SW-5	Monitoring	DBS&A (RI/FS)	02/06/13	µg/L	1.0	U	***13***		1.0	U	***7.2***		1.0	U	1.0	U	0.50	U	N/A		1.0	U	10	UM	1.0	U	1.0	U	1.0	U	1.0	U
SW-6	Monitoring	DBS&A (RI/FS)	06/19/13	µg/L	1.0	U	***38***		1.0	U	***37***		3.1		1.0	U	1.00	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.2		1.0	U
SW-7	Monitoring	DBS&A (RI/FS)	06/17/13	µg/L	***2.0***	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.00	U	N/A		***2.0***	U	20	U	2.0	U	***2.0***	U	***2.0***	U	2.0	U
Number of Samples Analyzed					51		51		51		51		51		51		51		44		50		51		51		51		51		51	
Number of Samples > Minimum SL					15		25		0		15		0		0		0		0		14		0		6		14		14		0	
Number of Detected Samples					8		36		10		18		5		2		0		3		1		1		2		0		1		0	
Number of Detected Samples > Minimum SL					5		25		0		15		0		0		0		0		0		0		0		0		0		0	
Frequency of Detection					16%		71%		20%		35%		9.8%		3.9%		0.0%		6.8%		2.0%		2.0%		3.9%		0.0%		2.0%		0.0%	
Groundwater Screening Levels (SLs)					SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP
NMED																																
Tap Water					1.08	c	3.4	n	24.2	c	340	n	73	n	2,280	n	9130	n	59,200	n	1.93	c	N/A		4.33	c	1.17	c	1.47	c	NA	
USEPA (each SL based on a carcinogenic endpoint was multiplied by 10 to achieve a risk level of 1E-05 for that SL)																																
Tap Water					97	c	4.4	c	24	c	260	n	28	n	860	n	7,500	n	53,000	n	1.9	c	34	n	4.1	c	1.2	c	1.5	c	79	c
Maximum Contaminant Level (MCL)					5		5		N/A		7		70		1,000		200		N/A		80		N/A		N/A		80		80		80	
Minimum SL					**1.08**		**3.4**		**24**		**7**		**28**		**860**		**200**		**53,000**		**1.9**		**34**		**4.1**		**1.17**		**1.47**		**79**	

* SL for 1,3-dichloropropene used for cis-1,3-dichloropropene.
** Result not recommended for use because of associated QA/QC performance inferior to that from other analysis (sic).
N/A = Not analyzed.
NA = Not available.
Qualifiers:
J = Estimated value; analyte detected below quantitation limit.
L = Reported concentration is below the contract-required quantitation limit.
M = Reported concentration should be used as a raised quantitation limit because of interferences and/or laboratory contamination.
U = Not detected. Concentration reported is reporting limit (PQL).
Results from the groundwater sample collected from well SW-1 were excluded from the screening assessment due to possible cross-contamination from surface soil particles during field sampling.
EP = Endpoint used to derive SSL (see SSL Sources for more details):
c = carcinogenic.
nc = noncarcinogenic.
SL Sources:
NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012).
USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html.

cis-1,3-DCPe = cis-1,3-dichloropropene
BromoDCM = bromodichloromethane
DibromoCM = dibromochloromethane

Table A-7. Screening Assessment for Dissolved Metals in Groundwater at the Eagle Picher Site

			Nitrate-N		Aluminum		Arsenic		Barium		Cadmium		Chromium		Cobalt		Copper		Iron		Lead		Manganese		Mercury		Selenium		Zinc	
Location	Sample Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
Eagle Picher Site																														
SW-2	1/28/2013	µg/L	680		20	U	***1.9***		58		2.0	U	6.0	U	***6.0***	U	6.0	U	20	U	5.0	U	330		0.20	U	6.0		31	
Number of Samples Analyzed			1		1		1		1		1		1		1		1		1		1		1		1		1		1	
Number of Samples > Minimum SL			0		0		1		0		0		0		1		0		0		0		0		0		0		0	
Number of Detected Samples			1		0		1		1		0		0		0		0		0		0		1		0		1		1	
Number of Detected Samples > Minimum SL			0		0		1		0		0		0		0		0		0		0		0		0		0		0	
Frequency of Detection			100%		0%		100%		100%		0%		0%		0%		0%		0%		0%		100%		0%		100%		100%	
Groundwater Plume South of the Eagle Picher Site																														
SW-3	1/29/2013	µg/L	770		20	U	***2.6***		6.2		2.0	U	15		***6.0***	U	6.0	U	20	U	5.0	U	90		0.20	U	2.6		41	
SW-4	12/19/2012	µg/L	2,400		20	U	***2.8***		53		2.0	U	6.0	U	***6.0***	U	6.0	U	20	U	5.0	U	110		0.20	U	8.8		34	
SW-5	2/6/2013	µg/L	370																20	U			80							
SW-6	6/19/2013	µg/L	170				***20***	U	79		2.0	U	6.0	U					2,500		5.0	U	94		0.20	U	50	U		
SW-7	6/17/2013	µg/L	500	U			***1.9***		61		2.0	U	6.0	U					20	U	5.0	U	350		0.20	U	6.5			
IW-1	1/9/2013	µg/L	2,400																20	U			57							
DW-1	1/9/2013	µg/L	100	U															390				55							
DW-2	6/19/2013	µg/L	100				***20***	U	85		2.0	U	6.0	U					26		5.0	U	69		0.20	U	50	U		
Number of Samples Analyzed			8		2		5		5		5		5		2		2		8		5		8		5		5		2	
Number of Samples > Minimum SL			0		0		5		0		0		0		2		0		0		0		0		0		0		0	
Number of Detected Samples			6		0		3		5		0		1		0		0		3		0		8		0		3		2	
Number of Detected Samples > Minimum SL			0		0		3		0		0		0		0		0		0		0		0		0		0		0	
Frequency of Detection			75%		0%		60%		100%		0%		20%		0%		0%		38%		0%		100%		0%		60%		100%	
Groundwater Screening Levels (SLs)			SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP	SL	EP
NMED																														
Tap Water			58,400	n	36,500	n	0.448	c	7,300	n	18.3	n	54,800	n	NA		1,460	n	25,600	n	NA		876	n	0.626	n	183	n	11,000	n
USEPA (each SL based on a carcinogenic endpoint was multiplied by 10 to achieve a risk level of 1E-05 for that SL)																														
Tap Water			25,000	n	16,000	n	0.45	c	2,900	n	6.9	n	NA		4.7	n	620	n	11,000	n	NA		NA		0.63	n	78	n	4,700	n
Maximum Contaminant Level (MCL)			10,000		NA		10		2,000		5		100		NA		1,300		NA		15		NA		2		50		NA	
Minimum SL			**10,000**		**16,000**		**0.448**		**2,000**		**5**		**100**		**4.7**		**620**		**11,000**		**15**		**876**		**0.626**		**50**		**4,700**	

NA = Not available.
EP = Endpoint used to derive SSL (see SSL Sources for more details):
c = carcinogenic.
nc = noncarcinogenic.
IEUBK = Derived via blood lead modeling using the Integrated Exposure-Uptake Biokinetic Model.
U = Not detected. Concentration reported is reporting limit (PQL).
Results from the groundwater sample collected from well SW-1 were excluded from the screening assessment due to possible cross-contamination from surface soil particles during field sampling.
SL Sources:
NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. February 2012 (updated June 2012). Chromium (III) tap water SL used for Chromium (Total).
USEPA. 2013. Regional Screening Levels (formerly PRGs). May 2013. Available at http://www.epa.gov/region9/superfund/prg/index.html.

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Table A-8. Screening Assessment for Groundwater VOC Vapor Intrusion at the Eagle Picher Site

					PCE		TCE		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113		Chloroform		2-Hexanone		cis-1,3-DCPe*		BromoDCM		DibromoCM		Bromoform	
Well	Type	Study	Sample Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
Eagle Picher Site (Commercial Scenario)																																
Eagle Picher	Municipal Supply	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	1.6		2.9		1.7	
Eagle Picher	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.2	UM	0.50	U	1.6		3.0		1.8	
COS-LF	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
EID-LL	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
EP-UNK	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	Ujv	0.50	U	0.50	U	0.50	U
EP-UNK	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
NMED-1	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
NMED-2	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-1	Monitoring	DBS&A (RI/FS)	01/07/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-2	Monitoring	DBS&A (RI/FS)	01/07/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-2	Monitoring	NMED 2012	03/12/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.18	L J	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SFSL-3	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
SW-2	Monitoring	DBS&A (RI/FS)	01/28/13	µg/L	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	6.3		1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.0	U	1.0	U
Number of Samples Analyzed					13		13		13		13		13		13		13		12		13		13		13		13		13		13	
Number of Samples > SL					0		0		0		0				0		0		0		0		0		0		0		0			
Number of Detected Samples					0		0		0		0		0		1		0		0		1		0		0		2		2		2	
Number of Detected Samples > SL					0		0		0		0				0		0		0		0		0		0		0		0			
Frequency of Detection					0%		0%		0%		0%		0%		7.7%		0%		0%		7.7%		0%		0%		15%		15%		15%	
USEPA Commercial Vapor Intrusion SL (Groundwater)				µg/L	240		22		330		820		NA		81,000		31,000		6,100		36		34,000		210		38		140		NA	
Groundwater Plume South of the Eagle Picher Site (Residential and Commercial Scenarios)																																
Alice East	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	2.0	U	***187***		4.5		***452***		2.1		2.0	U	2.0	U	9.75		2.0	U	5.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Alice East	Domestic	NMED 2012	03/14/12	µg/L	5.0	U	***240***	**	4.8	L J	***490***	**	2.8	L J	5.0	U	5.0	U	5.0	U	5.9	UM	10	U	5.0	U	5.0	U	5.0	U	5.0	U
Alice West	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	2.0	U	***27.7***		2.0	U	85.4		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	5.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Alice West	Domestic	NMED 2012	03/14/12	µg/L	5.0	U	***20***		5.0	U	81		5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0	U	5.0	U	5.0	U	5.0	U
Bailey	Domestic	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Hooper	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	***5.2***		0.22	J	19		0.5	U	0.50	U	0.50	U	0.26	J	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Hooper	Domestic	NMED 2012	03/14/12	µg/L	0.50	U	***5.4***		0.19	L J	14		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Knight	Domestic	DBS&A (RI/FS)	01/31/13	µg/L	0.2	U	***6.7***		0.10	U	0.20	U	0.10	U	0.2	U	0.2	U	N/A		N/A		0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
Lopez	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	1.1		***41***		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Lopez	Domestic	NMED 2012	03/14/12	µg/L	5.0	U	***49***		5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0	U	5.0	U	5.0	U	5.0	U
Miller	Domestic	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Padilla	Domestic	DBS&A (RI/FS)	*Not Smpld*	µg/L																												
Padilla	Domestic	NMED 2012	03/14/12	µg/L	5.0	U	***86***		1.8	L J	***230***	**	5.0	U	5.0	U	5.0	U	5.0	U	5.3	UM	10	U	5.0	U	5.0	U	5.0	U	5.0	U
Bushman	Municipal Supply	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Bushman	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Holmes	Municipal Supply	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.87		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Holmes	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.71		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Lattman	Municipal Supply	DBS&A (RI/FS)	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Lattman	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Olson	Municipal Supply	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	2.1		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Olson	Municipal Supply	NMED 2012	03/13/12	µg/L	0.50	U	2.3		0.50	U	0.68		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
Sedillo Park	Municipal Supply	DBS&A (RI/FS)	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-3	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-4	Monitoring	DBS&A (RI/FS)	01/07/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-4	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.21	L J	0.50	U	0.50	U	0.50	U
OMW-5	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	***7.8***		0.27	J	16.5		0.50	U	0.50	U	0.50	U	0.25	L J	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-5	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	***8.5***		0.27	L J	19		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	6.0	UM	0.50	U	0.50	U	0.50	U	0.50	U
OMW-6	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	2.0	U	***38***		2.2		60		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	5.0	U	2.0	U	2.0	U	2.0	U	2.0	U
OMW-6	Monitoring	NMED 2012	03/14/12	µg/L	5.0	U	***54***		3.0	L J	91		1.1	L J	5.0	U	5.0	U	5.0	U	5.5	UM	23		5.0	U	5.0	U	5.0	U	5.0	U
OMW-7	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	10.85		***113.5***		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	5.0	U	2.0	U	2.0	U	2.0	U	2.0	U
OMW-7	Monitoring	NMED 2012	03/14/12	µg/L	13.5		***125***		5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.3	UM	10	U	5.0	U	5.0	U	5.0	U	5.0	U
OMW-8	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	0.50	U	0.56		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-8	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.43	L J	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-9	Monitoring	DBS&A (RI/FS)	01/08/13	µg/L	0.38	L J	***6.3***		0.50	U	5.4	J	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-9	Monitoring	NMED 2012	03/13/12	µg/L	0.52		***9.0***		0.50	U	7.4		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-10	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-10	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-11	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.48	J	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-12	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	0.50	U	4.5		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-12	Monitoring	NMED 2012	03/13/12	µg/L	0.50	U	2.8		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.20	L J	0.50	U	0.50	U	0.50	U
OMW-13	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	0.5	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-14	Monitoring	DBS&A (RI/FS)	01/10/13	µg/L	0.50	U	1.5		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U
OMW-14	Monitoring	NMED 2012	03/12/12	µg/L	0.50	U	2.5		0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.17	L J	5.0	U	0.50	U	0.50	U	0.50	U	0.50	U

Table A-8. Screening Assessment for Groundwater VOC Vapor Intrusion at the Eagle Picher Site

					PCE		TCE		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113		Chloroform		2-Hexanone		cis-1,3-DCPe*		BromoDCM		DibromoCM		Bromoform	
Well	Type	Study	Sample Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
DW-1	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	2.0	U	2	U	2.0	U	2.0	U	2.0	U	3.4		2.0	U	2.0	U	2.0	U	5.0	U	2.0	U	2.0	U	2.0	U	2.0	U
DW-2	Monitoring	DBS&A (RI/FS)	06/19/13	µg/L	1.0	U	***190***		1.3		***250***		2.4		1.0	U	1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.0	U	1.0	U
IW-1	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	11.9		***125***		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	5.0	U	2.0	U	2.0	U	2.0	U	2.0	U
SW-3	Monitoring	DBS&A (RI/FS)	01/29/13	µg/L	1.0	U	2.1		1.0	U	5.2		1.0	U	9.3		1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.0	U	1.0	U
SW-4	Monitoring	DBS&A (RI/FS)	12/19/12	µg/L	12.5		***100***		1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.0	U	1.0	U
SW-4	Monitoring	DBS&A (RI/FS)	01/09/13	µg/L	13.2		***125***		2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	5.0	U	2.0	U	2.0	U	2.0	U	2.0	U
SW-5	Monitoring	DBS&A (RI/FS)	02/06/13	µg/L	1.0	U	***13***		1.0	U	7.2		1.0	U	1.0	U	0.50	U	N/A		1.0	U	10	UM	1.0	U	1.0	U	1.0	U	1.0	U
SW-6	Monitoring	DBS&A (RI/FS)	06/19/13	µg/L	1.0	U	***38***		1.0	U	37		3.1		1.0	U	1.0	U	N/A		1.0	U	10	U	1.0	U	1.0	U	1.2		1.0	U
SW-7	Monitoring	DBS&A (RI/FS)	06/17/13	µg/L	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	N/A		2.0	U	20	U	2.0	U	2.0	U	2.0	U	2.0	U
Number of Samples Analyzed					51		51		51		51		51		51		51		44		50		51		51		51		51		51	
Number of Samples > Minimum SL					0		23		0		4		0		0		0		0		0		0		0		0		0			
Number of Detected Samples					8		36		10		18		5		2		0		3		1		1		2		0		1		0	
Number of Detected Samples > Minimum SL					0		23		0		4		0		0		0		0		0		0		0		0		0			
Frequency of Detection					16%		71%		20%		35%		9.8%		3.9%		0%		6.8%		2.0%		2.0%		3.9%		0%		2%		0%	
USEPA Residential Vapor Intrusion SL (Groundwater)				µg/L	58		5.2		66		200		NA		19,000		7,400		1,500		7.1		8,200		42		7.6		28		NA	
USEPA Commercial Vapor Intrusion SL (Groundwater)				µg/L	240		22		330		820		NA		81,000		31,000		6,100		36		34,000		210		38		140		NA	
Minimum SL				**µg/L**	**58**		**5.2**		**66**		**200**		**NA**		**19,000**		**7,400**		**1,500**		**7.1**		**8,200**		**42**		**7.6**		**28**		**NA**	

* SL for 1,3-dichloropropene used for cis-1,3-dichloropropene.

** Result not recommended for use because of associated QA/QC performance inferior to that from other analysis (sic).

N/A = Not analyzed.

NA = Not available.

Qualifiers:

J = Estimated value; analyte detected below quantitation limit.

L = Reported concentration is below the contract-required quantitation limit.

M = Reported concentration should be used as a raised quantitation limit because of interferences and/or laboratory contamination.

U = Not detected. Concentration reported is reporting limit (PQL).

Results from the groundwater sample collected from well SW-1 were excluded from the screening assessment due to possible cross-contamination from surface soil particles during field sampling.

SL Source:

USEPA. 2013. Vapor Intrusion Screening Level (VISL) Calculator. Version 3.1, June 2013 RSLs. Available at http://www.epa.gov/oswer/vaporintrusion/guidance.html. SLs are Target Concentrations for Groundwater using the following parameters: Exposure Scenario = Residential; Target Cancer Risk = 1E-05; Target Noncancer Hazard Quotient = 1.0; Groundwater temperature = 25°C.

cis-1,3-DCPe = cis-1,3-dichloropropene

BromoDCM = bromodichloromethane

DibromoCM = dibromochloromethane

Table A-9. Screening Assessment for Sub-slab VOC Vapor Intrusion at the Eagle Picher Site

		Sample		PCE		TCE*		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113		Chloroform		2-Hexanone		cis-1,3-DCPe**		BromoDCM		DibromoCM		Bromoform	
Location	Date	Depth	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
SS-1	12/3/2012	6'	ug/m^3	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		100	U	1000	U	100	U	100	U	100	U	100	U
SS-2	12/3/2012	6'	ug/m^3	100	U	***100***	U	100	U	100	U	100	U	100	U	140		N/A		100	U	1000	U	100	U	100	U	100	U	100	U
SS-3	12/3/2012	6'	ug/m^3	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		100	U	1000	U	100	U	100	U	100	U	100	U
SS-4	12/3/2012	6'	ug/m^3	100	U	***100***	U	100	U	100	U	100	U	100	U	290		N/A		100	U	1000	U	100	U	100	U	100	U	100	U
SS-5	12/3/2012	6'	ug/m^3	100	U	***100***	U	100	U	100	U	100	U	100	U	680		N/A		100	U	1000	U	100	U	100	U	100	U	100	U
SS-6	12/3/2012	6'	ug/m^3	100	U	***100***	U	100	U	100	U	100	U	100	U	120		N/A		100	U	1000	U	100	U	100	U	100	U	100	U
SS-7	12/4/2012	6'	ug/m^3	100	U	***100***	U	100	U	100	U	100	U	100	U	130		N/A		100	U	1000	U	100	U	100	U	100	U	100	U
Number of Samples Analyzed				7		7		7		7		7		7		7				7		7		7		7		7		7	
Number of Samples > SL				0		7		0		0				0		0				7		0		0		7		7			
Number of Detected Samples				0		0		0		0		0		0		5				0		0		0		0		0		0	
Number of Detected Samples > SL				0		0		0		0				0		0				0		0		0		0		0			
Frequency of Detection				0%		0%		0%		0%		0%		0%		71%				0%		0%		0%		0%		0%		0%	
USEPA Commercial Vapor Intrusion SL (Sub-slab Gas)			ug/m^3	1,800		88		770		8,800		NA		220,000		220,000		1,300,000		53		1,300		310		33		45		NA	

* The laboratory did not detect any TCE below the PQL for samples SS-1 through SS-6. For sample SS-7, TCE was detected at a level below than reporting limit (PQL) (estimated at 42 $\mu g/m^3$) (personal communication from Andy Freeman, HEAL, to Jason Raucci, DBS&A; email dated August 16, 2013).

** SL for 1,3-dichloropropene used for cis-1,3-dichloropropene.

N/A = Not analyzed.

NA = Not available.

Qualifier:

U = Not detected. Concentration reported is reporting limit (PQL).

cis-1,3-DCPe = cis-1,3-dichloropropene

BromoDCM = bromodichloromethane

DibromoCM = dibromochloromethane

SL Source:

USEPA. 2013. Vapor Intrusion Screening Level (VISL) Calculator. Version 3.1, June 2013 RSLs. Available at http://www.epa.gov/oswer/vaporintrusion/guidance.html. SLs are Target Concentrations for Sub-slab Gas using the following parameters: Exposure Scenario = Commercial; Target Cancer Risk = 1E-05; Target Noncancer Hazard Quotient = 1.0; Groundwater temperature = 25°C.

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Table A-10. Screening Assessment for VOCs in Exterior Soil Gas at the Eagle Picher Site

			PCE		TCE		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113		Chloroform		2-Hexanone		cis-1,3-DCPe*		BromoDCM		DibromoCM		Bromoform	
Location	Sample Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
Exterior Soil Gas Samples Collected Near the Alice East Well																														
AB-1	06/20/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
AB-2	06/20/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
AB-3	06/20/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
AB-4	06/20/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
AB-5	06/20/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
AB-6	06/20/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
Number of Samples Analyzed			6		6		6		6		6		6		6				6		6		6		6		6		6	
Number of Samples > Minimum SL			0		6		0		0				0		0				6		6		6		6		6			
Number of Detected Samples			0		0		0		0		0		0		0				0		0		0		0		0		0	
Number of Detected Samples > Minimum SL			0		0		0		0				0		0				0		0		0		0		0			
Frequency of Detection			0%		0%		0%		0%		0%		0%		0%				0%		0%		0%		0%		0%		0%	
Exterior Soil Gas Samples Collected Near Monitoring Wells OMW-12 and OMW-7/SW-4/IW-1/DW-1																														
SGT-1	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-2	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-3	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-4	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-5	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-6	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-7	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-8	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-9	06/11/13	$\mu g/m^3$	100	U	***230***		100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
SGT-10	06/11/13	$\mu g/m^3$	100	U	***100***	U	100	U	100	U	100	U	100	U	100	U	N/A		***100***	U	***1,000***	U	***100***	U	***100***	U	***100***	U	100	U
Number of Samples Analyzed			10		10		10		10		10		10		10				10		10		10		10		10		10	
Number of Samples > Minimum SL			0		10		0		0				0		0				10		10		10		10		10			
Number of Detected Samples			0		1		0		0		0		0		0				0		0		0		0		0		0	
Number of Detected Samples > Minimum SL			0		1		0		0				0		0				0		0		0		0		0			
Frequency of Detection			0%		10%		0%		0%		0%		0%		0%				0%		0%		0%		0%		0%		0%	
All Exterior Soil Gas Samples Combined																														
Number of Samples Analyzed			16		16		16		16		16		16		16				16		16		16		16		16		16	
Number of Samples > Minimum SL			0		16		0		0				0		0				16		16		16		16		16			
Number of Detected Samples			0		1		0		0		0		0		0				0		0		0		0		0		0	
Number of Detected Samples > Minimum SL			0		1		0		0				0		0				0		0		0		0		0			
Frequency of Detection			0%		6%		0%		0%		0%		0%		0%				0%		0%		0%		0%		0%		0%	
Exterior Soil Gas Screening Level (SL)																														
USEPA Residential Scenario		$\mu g/m^3$	420		21		150		2,100		NA		52,000		52,000		310,000		11		310		61		6.6		9.0		NA	
USEPA Commercial Scenario		$\mu g/m^3$	1800		88		770		8,800		NA		220,000		220,000		1,300,000		53		1,300		310		33		45		NA	
Minimum SL		$\mu g/m^3$	420		21		150		2,100		NA		52,000		52,000		310,000		11		310		61		6.6		9.0		NA	

* SLs for for 1,3-dichloropropene were used for cis-1,3-dichloropropene.
N/A = Not analyzed.
NA = Not available.
Qualifier:
U = Not detected. Concentration reported is reporting limit (PQL).
SL Source:
USEPA. 2013. Vapor Intrusion Screening Level (VISL) Calculator. Version 3.1, June 2013 RSLs. Available at http://www.epa.gov/oswer/vaporintrusion/guidance.html. SLs are Target Concentrations for Exterior Soil Gas using the following parameters: Exposure Scenario = Residential, Commercial; Target Cancer Risk = 1E-05; Target Noncancer Hazard Quotient = 1.0; Groundwater temperature = 25°C.

cis-1,3-DCP = cis-1,3-dichloropropene
BromoDCM = bromodichloromethane
DibromoCM = dibromochloromethane

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Appendix B

Summary Statistics and 95% UCLs for Soils

Table B-1. Summary Statistics Calculated by ProUCL for Lead Concentrations Measured by Laboratory Methods and XRF in Eagle Picher Site Soils

Variable	Units	Sample Size	# Detects	# NDs	% NDs	Minimum	Maximum	Mean	Median	StdDev	Skewness	CV
Confirmational Surface Samples Analyzed Using Laboratory Methods												
All Surface Samples	mg/kg	19	19	0	0.00%	5.4	1,700	276	22.0	532	2.08	1.93
All Surface Samples w/o Hot Spots	mg/kg	14	14	0	0.00%	5.4	200	35.0	12.5	55.8	2.56	1.60
Samples Analyzed Using XRF												
All Surface and Subsurface Samples	mg/kg	201	200	1	0.50%	9	6,166	187	23.0	717	6.07	3.83
All Surface Samples	mg/kg	138	138	0	0.00%	9	6,166	202	25.5	797	5.97	3.95
All Surface and Subsurface Samples w/o Hot Spots	mg/kg	172	171	1	0.58%	9	1,265	50.2	22.0	115	7.96	2.29
All Surface Samples w/o Hot Spots	mg/kg	125	125	0	0.00%	9	603	50.6	24.0	74.9	4.45	1.48
All Gridded Surface and Subsurface Samples	mg/kg	110	110	0	0.00%	9	603	50.3	24.5	77.0	4.59	1.53
All Gridded Surface Samples	mg/kg	108	108	0	0.00%	9	603	50.8	24.5	77.6	4.55	1.53
All Gridded Surface and Subsurface Samples w/o Hot Spots	mg/kg	107	107	0	0.00%	9	603	48.6	24.0	74.6	4.97	1.54
All Gridded Surface Samples w/o Hot Spots	mg/kg	107	107	0	0.00%	9	603	48.6	24.0	74.6	4.97	1.54
Maximum Mean Pb Concentration								**276**				

Notes:

Gridded samples are numbered 1-54 and were located using a grid developed in VSP. Samples numbered 55 and higher, as well as step-out samples from P-37 (E1, E2, N1, N2, S1, S2, W1, and W2), were located in areas of expected elevated concentrations.

Hot spot locations are P-37, P-55, P-60, P-65, and P-66.

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Table B-2. Summary Statistics and 95% UCLs Calculated by ProUCL for Metals Concentrations in Eagle Picher Site Soils

All Surface Soil Samples Analyzed by Laboratory Methods

Variable	Units	Sample Size	# Detects	# NDs	% NDs	Minimum	Maximum	Mean	Median	StdDev	Skewness	CV	95% UCL	95% UCL Method
Cadmium	mg/kg	19	12	7	36.84%	0.21	7.8	1.83	0.94	2.40	2.06	1.31	4.20	97.5% KM (Chebyshev) UCL
Chromium	mg/kg	19	19	0	0.00%	7.3	3,300	371.60	14	988	2.74	2.66	2,627	99% Chebyshev (Mean, Sd) UCL
Chromium +6	mg/kg	19	3	16	84.21%	4.8	16	11.9	15	6.20	-1.68	0.519	7.53	95% KM (t) UCL
Lead	mg/kg	19	19	0	0.00%	5.4	1,700	276.20	22	532	2.08	1.93	1,491	99% Chebyshev (Mean, Sd) UCL

Surface Soil Samples Analyzed by Laboratory Methods Excluding Hot Spot Locations (P-37, P-37E1, P 37E2, P-37N1, P-37N2, P-37S1, P-37S2, P-37W1, P-37W2, P-55, P-60, P-65, P-66

Variable	Units	Sample Size	# Detects	# NDs	% NDs	Minimum	Maximum	Mean	Median	StdDev	Skewness	CV	95% UCL	95% UCL Method
Cadmium	mg/kg	14	7	7	50.00%	0.21	1.2	0.677	0.72	0.382	-0.0717	0.564	0.619	95% KM (t) UCL
Chromium	mg/kg	14	14	0	0.00%	7.3	16	12.9	14	2.76	-0.845	0.215	14.2	95% Student's-t UCL
Chromium +6	mg/kg	14	0	14	100.00%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	mg/kg	14	14	0	0.00%	5.4	200	35.0	12.5	55.8	2.56	1.60	100.0	95% Chebyshev (Mean, Sd) UCL

Surface Soil Samples Analyzed by Laboratory Methods from Hot Spot Locations (P-37, P-37E1, P 37E2, P-37N1, P-37N2, P-37S1, P-37S2, P-37W1, P-37W2, P-55, P-60, P-65, P-66

Variable	Units	Sample Size	# Detects	# NDs	% NDs	Minimum	Maximum	Mean	Median	StdDev	Skewness	CV	95% UCL	95% UCL Method
Cadmium	mg/kg	5	5	0	0.00%	0.7	7.8	3.44	1.7	3.17	0.773	0.921	6.46	95% Student's-t UCL
Chromium	mg/kg	5	5	0	0.00%	15	3,300	1,376	550	1,638	0.55	1.19	2,937	95% Student's-t UCL
Chromium +6	mg/kg	5	3	2	40.00%	4.8	16	11.9	15	6.20	-1.681	0.519	15.2	95% KM (t) UCL
Lead	mg/kg	5	5	0	0.00%	98	1,700	951.60	1,100	700	-0.293	0.736	1619	95% Student's-t UCL

Lead Analyzed by XRF

Variable	Units	Sample Size	# Detects	# NDs	% NDs	Minimum	Maximum	Mean	Median	StdDev	Skewness	CV	95% UCL	95% UCL Method
All Samples														
All Surface and Subsurface Samples	mg/kg	201	200	1	0.50%	9	6,166	187	23.0	717	6.07	3.83	406	95% KM (Chebyshev) UCL
All Surface Samples	mg/kg	138	138	0	0.00%	9	6,166	202	25.5	797	5.97	3.95	497	95% Chebyshev (Mean, Sd) UCL
All Gridded Surface and Subsurface Samples	mg/kg	110	110	0	0.00%	9	603	50.3	24.5	77.0	4.59	1.53	82.3	95% Chebyshev (Mean, Sd) UCL
All Gridded Surface Samples	mg/kg	108	108	0	0.00%	9	603	50.8	24.5	77.6	4.55	1.53	83.3	95% Chebyshev (Mean, Sd) UCL
Excluding Hot Spot Locations														
All Surface and Subsurface Samples	mg/kg	172	171	1	0.58%	9	1,265	50.2	22.0	115	7.96	2.29	66.6	95% KM (BCA) UCL
All Surface Samples	mg/kg	125	125	0	0.00%	9	603	50.6	24.0	74.9	4.45	1.48	79.8	95% Chebyshev (Mean, Sd) UCL
All Gridded Surface and Subsurface Samples	mg/kg	107	107	0	0.00%	9	603	48.6	24.0	74.6	4.97	1.54	80.0	95% Chebyshev (Mean, Sd) UCL
All Gridded Surface Samples	mg/kg	107	107	0	0.00%	9	603	48.6	24.0	74.6	4.97	1.54	80.0	95% Chebyshev (Mean, Sd) UCL

Notes:

Gridded samples are numbered 1-54 and were located using a grid developed in VSP. Samples numbered 55 and higher, as well as step-out samples from P-37 (E1, E2, N1, N2, S1, S2, W1, and W2), were located in areas of expected elevated concentrations.

Hot spot locations are P-37, P-55, P-60, P-65, and P-66.

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Appendix C

Human Health Risk Calculations

Table C-1. Calculations of Blood Lead Concentrations (PbBs) for Eagle Picher Site Soils Using the USEPA Adult Lead Model (USEPA Technical Review Workgroup for Lead, Adult Lead Committee, version date 6/21/09)

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004	GSDi and PbBo from Analysis of NHANES III (Phases 1 & 2)
PbS	Soil lead concentration	ug/g or ppm	276.2	276.2
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/L/d per ug/day	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	Baseline PbB	ug/L/d	1.0	1.5
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	219	219
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365
PbB_{adult}	PbB of adult worker, geometric mean	ug/L/d	1.4	1.9
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	ug/L/d	3.3	5.8
PbB_t	Target PbB level of concern (e.g., 10 ug/L/d)	ug/L/d	10.0	10.0
$P(PbB_{fetal} > PbB_t)$	Probability that fetal PbB > PbB_t, assuming lognormal distribution	%	0.0%	0.9%

Source:

USEPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil (available at http://www.epa.gov/superfund/lead/products.htm).

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Table C-2. Calculations of Blood Lead Concentrations (PbBs) for Eagle Picher Site Soils Using the USEPA Adult Lead Model (USEPA Technical Review Workgroup for Lead, Adult Lead Committee, version date 6/21/09) Modified for Intermittent Visitor (Trespasser, Recreator, Visitor)

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004	GSDi and PbBo from Analysis of NHANES III (Phases 1 & 2)
PbS	Soil lead concentration	ug/g or ppm	276	276
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/L/d per ug/day	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	2.1
PbB_0	Baseline PbB	ug/L/d	1.0	1.5
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.200	0.200
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.30	0.30
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52	52
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365
PbB_{adult}	PbB of visitor, geometric mean	ug/L/d	1.9	2.4
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of visitors	ug/L/d	4.6	7.5
PbB_t	Target PbB level of concern (e.g., 10 ug/L/d)	ug/L/d	10.0	10.0
$P(PbB_{fetal} > PbB_t)$	Probability that fetal PbB > PbB_t, assuming lognormal distribution	%	0.2%	2.1%

The ALM was modified for intermittent visitors (trespassers, recreators, visitors) by increasing the soil ingestion rate and absorption factor (to evaluate adolescent receptors) and decreasing exposure frequency (1 day per week or 52 days per year).

Sources:

USEPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil (available at http://www.epa.gov/superfund/lead/products.htm).

USEPA. 2013. Frequent Questions from Risk Assessors on the Adult Lead Methodology (ALM) (http://www.epa.gov/superfund/lead/almfaq.htm#trespass).

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. June, 2012.

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Table C-3. Human Health Toxicity Values for Evaluation of Potential Risks from Ingestion and Inhalation of COPCs in Plume Area Groundwater

Chemical	Oral RfD (mg/kg-day)	Source	Oral CSF $(mg/kg\text{-}day)^{-1}$	Source	RfC (mg/m^3)	Source	IUR $(ug/m^3)^{-1}$	Source
Organics								
1,1-Dichloroethylene (1,1-DCE)	5.0E-02	IRIS	nc		2.0E-01	IRIS	nc	
Tetrachloroethylene (PCE)	6.0E-03	IRIS	2.1E-03	IRIS	4.0E-02	IRIS	2.6E-07	IRIS
Trichloroethylene (TCE)	5.0E-04	IRIS	4.6E-02	IRIS	2.0E-03	IRIS	4.1E-06	IRIS
Kidney Cancer (mutagenic)			9.3E-03	IRIS			1.0E-06	IRIS
Liver Cancer & Non-Hodgkin Lymphoma			3.7E-02	IRIS			3.1E-06	IRIS

Note: Per NMED (2012), ingestion and inhalation includes all uses of household water (i.e., showering/bathing, laundering, dishwashing).

Definitions:

nc = chemical is non-carcinogenic.

Sources:

USEPA Region 9 Regional Screening Levels (Master Screening Level table, May 2013), available at http://www.epa.gov/region9/superfund/prg/.

USEPA Region 9 Regional Screening Levels Frequently Asked Questions (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/faq.htm#FAQ19).

Toxicity value source definitions:

IRIS = Integreated Risk Information System (USEPA).

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Table C-4. Human Health Exposure Factors for Evaluation of Potential Risks from Ingestion and Inhalation of COPCs in Plume Area Groundwater

		Child Resident		Adult Resident	
Exposure Pathway/Exposure Factor	**Abbreviation**	**Value**	**Source**	**Value**	**Source**
General					
Body Weight (kg)	BW	15	NMED, 2012	70	NMED, 2012
Exposure Duration (yrs)	ED	6	NMED, 2012	24	NMED, 2012
Exposure Duration Adjusted for Mutagenicity (yrs)	ED_{MUT}	32	NMED, 2012	44	NMED, 2012
Exposure Frequency (d/yr)	EF	350	NMED, 2012	350	NMED, 2012
Averaging Period - Cancer (d)	AT_C	25,550	NMED, 2012	25,550	NMED, 2012
Averaging Period - Noncancer (d)	AT_{NC}	2,190	NMED, 2012	8,760	NMED, 2012
Ingestion of Water					
Water Ingestion Rate (L/d)	IR_W	1	NMED, 2012	2	NMED, 2012
Conversion Factor (µg/mg)	CF	1,000	NMED, 2012	1,000	NMED, 2012
Inhalation of Water					
Andelman Volatilization Factor (L/m^3)	K	0.5	NMED, 2012	0.5	NMED, 2012
Exposure Time (hrs/event)	ET	1	NMED, 2012	1	NMED, 2012

Note: Per NMED (2012), ingestion and inhalation includes all uses of household water (i.e., showering/bathing, laundering, dishwashing).

Sources:

NMED. 2012. Risk Assessment Guidance for Site Investigations and Remediation. June, 2012.

Exposure Duration Adjusted for Mutagenicity:

Child: $(ED_{0\text{-}2} \times 10) + (ED_{2\text{-}6} \times 3) = (2 \times 10) + (4 \times 3) = 20 + 12 = 32$

Adult: $(ED_{6\text{-}16} \times 3) + (ED_{16\text{-}30} \times 1) = (10 \times 3) + (14 \times 1) = 30 + 14 = 44$

Risk calculations:

Cancer = $C_{ING} + C_{INH}$

$C_{ING} = CSF * (C_{GW} * EF * ED * IR_W) / (BW * AT_C * 1000)$

$C_{INH} = IUR * (C_{GW} * K * EF * ED * ET) / (AT_C)$

Noncancer = $NC_{ING} + NC_{INH}$

$NC_{ING} = (C_{GW} * EF * ED * IR_W) / (BW * CF * AT_{NC}) / RfD$

$NC_{INH} = (C_{GW} * K * EF * ED * ET) / (AT_{NC} * CF) / RfC$

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Table C-5. Well- and Sample-specific Evaluation of Potential Risks from from Ingestion and Inhalation of COPCs in Plume Area Groundwater (Detected Results Only)

		Sample		PCE		TCE		1,1-DCE		Noncancer (Child + Adult)				Cancer (Child + Adult)			
Location	Type	Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	PCE	TCE	1,1-DCE	Total	PCE	TCE	1,1-DCE	Total
Groundwater Plume South of the Eagle Picher Site																	
Alice East	Domestic	01/15/13	µg/L	2.0	U	187		452		-	***123.81***	***2.99***	***126.81***	-	***4.0E-04***	No CSF	***4.0E-04***
Alice East	Domestic	03/14/12	µg/L	5.0	U	240	*	490	*	-	***158.90***	***3.24***	***162.15***	-	***5.1E-04***	No CSF	***5.1E-04***
Alice West	Domestic	01/15/13	µg/L	2.0	U	27.7		85.4		-	***18.34***	0.57	***18.91***	-	***5.9E-05***	No CSF	***5.9E-05***
Alice West	Domestic	03/14/12	µg/L	5.0	U	20		81.0		-	***13.24***	0.54	***13.78***	-	***4.3E-05***	No CSF	***4.3E-05***
Bailey	Domestic	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Hooper	Domestic	01/15/13	µg/L	0.50	U	5.2		19		-	***3.44***	0.13	***3.57***	-	***1.1E-05***	No CSF	***1.1E-05***
Hooper	Domestic	03/14/12	µg/L	0.50	U	5.4		14		-	***3.58***	0.09	***3.67***	-	***1.2E-05***	No CSF	***1.2E-05***
Knight	Domestic	01/31/13	µg/L	0.2	U	6.7		0.20	U	-	***4.44***	-	***4.44***	-	***1.4E-05***	-	***1.4E-05***
Lopez	Domestic	01/15/13	µg/L	1.1		41		0.50	U	0.04	***27.15***	-	***27.19***	8.9E-08	***8.8E-05***	-	***8.8E-05***
Lopez	Domestic	03/14/12	µg/L	5.0	U	49		5.0	U	-	***32.44***	-	***32.44***	-	***1.0E-04***	-	***1.0E-04***
Miller	Domestic	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Padilla	Domestic	03/14/12	µg/L	5.0	U	86		230	*	-	***56.94***	***1.52***	***58.46***	-	***1.8E-04***	No CSF	***1.8E-04***
Bushman	Municipal Supply	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Bushman	Municipal Supply	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Holmes	Municipal Supply	01/15/13	µg/L	0.50	U	0.87		0.50	U	-	0.58	-	0.58	-	1.9E-06	-	1.9E-06
Holmes	Municipal Supply	03/13/12	µg/L	0.50	U	0.71		0.50	U	-	0.47	-	0.47	-	1.5E-06	-	1.5E-06
Lattman	Municipal Supply	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Lattman	Municipal Supply	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Olson	Municipal Supply	01/14/13	µg/L	0.50	U	2.1		0.50	U	-	***1.39***	-	***1.39***	-	4.5E-06	-	4.5E-06
Olson	Municipal Supply	03/13/12	µg/L	0.50	U	2.3		0.68		-	***1.52***	0.00	***1.53***	-	4.9E-06	No CSF	4.9E-06
Sedillo Park	Municipal Supply	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
OMW-3	Monitoring	01/10/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
OMW-4	Monitoring	01/07/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
OMW-4	Monitoring	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
OMW-5	Monitoring	01/10/13	µg/L	0.50	U	7.8		16.5		-	***5.16***	0.11	***5.27***	-	***1.7E-05***	No CSF	***1.7E-05***
OMW-5	Monitoring	03/13/12	µg/L	0.50	U	8.5		19		-	***5.63***	0.13	***5.75***	-	***1.8E-05***	No CSF	***1.8E-05***
OMW-6	Monitoring	01/09/13	µg/L	2.0	U	38		60		-	***25.16***	0.40	***25.56***	-	***8.1E-05***	No CSF	***8.1E-05***
OMW-6	Monitoring	03/14/12	µg/L	5.0	U	54		91.0		-	***35.75***	0.60	***36.36***	-	***1.2E-04***	No CSF	***1.2E-04***
OMW-7	Monitoring	01/09/13	µg/L	10.85		113.5		2.0	U	0.43	***75.15***	-	***75.57***	9.2E-07	***2.4E-04***	-	***2.4E-04***
OMW-7	Monitoring	03/14/12	µg/L	13.5		125		5.0	U	0.53	***82.76***	-	***83.29***	1.1E-06	***2.7E-04***	-	***2.7E-04***
OMW-8	Monitoring	01/09/13	µg/L	0.50	U	0.56		0.50	U	-	0.37	-	0.37	-	1.2E-06	-	1.2E-06
OMW-8	Monitoring	03/13/12	µg/L	0.50	U	0.43	L J	0.50	U	-	0.28	-	0.28	-	9.2E-07	-	9.2E-07
OMW-9	Monitoring	01/08/13	µg/L	0.38	L J	6.3		5.40	J	0.01	***4.17***	0.04	***4.22***	3.2E-08	***1.3E-05***	No CSF	***1.4E-05***
OMW-9	Monitoring	03/13/12	µg/L	0.52		9		7.40		0.02	***5.96***	0.05	***6.03***	4.4E-08	***1.9E-05***	No CSF	***1.9E-05***
OMW-10	Monitoring	01/10/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
OMW-10	Monitoring	03/13/12	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-

Table C-5. Well- and Sample-specific Evaluation of Potential Risks from from Ingestion and Inhalation of COPCs in Plume Area Groundwater (Detected Results Only)

		Sample		PCE		TCE		1,1-DCE		Noncancer (Child + Adult)				Cancer (Child + Adult)			
Location	Type	Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	PCE	TCE	1,1-DCE	Total	PCE	TCE	1,1-DCE	Total
OMW-11	Monitoring	01/10/13	µg/L	0.50	U	0.48	J	0.50	U	-	0.32	-	0.32	-	1.0E-06	-	1.0E-06
OMW-12	Monitoring	01/09/13	µg/L	0.50	U	4.5		0.50	U	-	***2.98***	-	***2.98***	-	9.6E-06	-	9.6E-06
OMW-12	Monitoring	03/13/12	µg/L	0.50	U	2.8		0.50	U	-	***1.85***	-	***1.85***	-	6.0E-06	-	6.0E-06
OMW-13	Monitoring	01/10/13	µg/L	0.50	U	0.5	U	0.50	U	-	-	-	-	-	-	-	-
OMW-14	Monitoring	01/10/13	µg/L	0.50	U	1.5		0.50	U	-	0.99	-	0.99	-	3.2E-06	-	3.2E-06
OMW-14	Monitoring	03/12/12	µg/L	0.50	U	2.5		0.50	U	-	***1.66***	-	***1.66***	-	5.3E-06	-	5.3E-06
DW-1	Monitoring	01/09/13	µg/L	2.0	U	2.0	U	2.0	U	-	-	-	-	-	-	-	-
DW-2	Monitoring	06/19/13	µg/L	1.0	U	190		250		-	***125.80***	***1.66***	***127.45***	-	***4.1E-04***	No CSF	***4.1E-04***
IW-1	Monitoring	01/09/13	µg/L	11.9		125		2.0	U	0.47	***82.76***	-	***83.23***	1.0E-06	***2.7E-04***	-	***2.7E-04***
SW-3	Monitoring	01/29/13	µg/L	1.0	U	2.1		5.2		-	***1.39***	0.03	***1.42***	-	4.5E-06	No CSF	4.5E-06
SW-4	Monitoring	12/19/12	µg/L	12.5		100		1.0	U	0.49	***66.21***	-	***66.70***	1.1E-06	***2.1E-04***	-	***2.2E-04***
SW-4	Monitoring	01/09/13	µg/L	13.2		125		2.0	U	0.52	***82.76***	-	***83.28***	1.1E-06	***2.7E-04***	-	***2.7E-04***
SW-5	Monitoring	02/06/13	µg/L	1.0	U	13		7.2		-	***8.61***	0.05	***8.65***	-	***2.8E-05***	No CSF	***2.8E-05***
SW-6	Monitoring	06/19/13	µg/L	1.0	U	38		37		-	***25.16***	0.24	***25.40***	-	***8.1E-05***	No CSF	***8.1E-05***
SW-7	Monitoring	06/17/13	µg/L	2.0	U	2.0	U	2.0	U	-	-	-	-	-	-	-	-
								Minimum Risk Value		0.01	0.28	0.005	0.28	3.2E-08	9.2E-07		9.2E-07
								Maximum Risk Value		0.53	***158.90***	***3.24***	***162.15***	1.1E-06	***5.1E-04***		***5.1E-04***

\- = Not calculated (result was non-detect).

* Result not recommended for use because of associated QA/QC performance inferior to that from other analysis (sic).

Qualifiers:

J = Estimated value; analyte detected below quantitation limit.

L = Reported concentration is below the contract-required quantitation limit.

U = Not detected. Concentration reported is reporting limit (PQL).

Note: Per NMED (2012), ingestion and inhalation includes all uses of household water (i.e., showering/bathing, laundering, dishwashing).

Table C-6. Human Health Toxicity Values for Evaluation of Potential Risks from Dermal Exposure to COPCs in Plume Area Groundwater

Chemical	Oral RfD (mg/kg-day)	Source	Oral CSF $(mg/kg\text{-}day)^{-1}$	Source	GI Absorption (ABS_{GI})
Volatile Organic Compounds					
1,1-Dichloroethylene (1,1-DCE)	5.0E-02	IRIS	nc		1
Tetrachloroethylene (PCE)	6.0E-03	IRIS	2.1E-03	IRIS	1
Trichloroethylene (TCE)	5.0E-04	IRIS	4.6E-02	IRIS	1
Kidney Cancer (mutagenic)			9.30E-03	IRIS	1
Liver Cancer & Non-Hodgkin Lymphoma			3.70E-02	IRIS	1

Definitions:

nc = chemical is non-carcinogenic.

Source:

USEPA Region 9 Regional Screening Levels (Master Screening Level table, May 2013), available at http://www.epa.gov/region9/superfund/prg/.

USEPA Region 9 Regional Screening Levels Frequently Asked Questions (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/faq.htm#FAQ19).

Toxicity value source definitions:

IRIS = Integrated Risk Information System (USEPA).

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Table C-7. Human Health Exposure Factors for Evaluation of Potential Risks from Dermal Exposure to COPCs in Plume Area Groundwater

		Child Resident		Adult Resident	
Exposure Pathway/Exposure Factor	**Abbreviation**	**Value**	**Source**	**Value**	**Source**
Body Weight (kg)	BW	15	USEPA 2004	70	USEPA 2004
Exposure Duration (yrs)	ED	6	USEPA 2004	24	USEPA 2004
Exposure Duration Adjusted for Mutagenicity (yrs) for TCE	ED_{MUT}	32	USEPA 2005	44	USEPA 2005
Exposure Frequency (d/yr)	EF	350	USEPA 2004	350	USEPA 2004
Event Time (hr/event)	ET	1	USEPA 2004	0.58	USEPA 2004
Event Frequency (events/d)	EV	1	USEPA 2004	1	USEPA 2004
Averaging Period - Cancer (d)	AT_C	25,550	USEPA 2004	25,550	USEPA 2004
Averaging Period - Noncancer (d)	AT_{NC}	2,190	USEPA 2004	8,760	USEPA 2004
Skin Surface Area Exposed (cm^2)	SA	6,600	USEPA 2004	18,000	USEPA 2004

Sources:

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA-540-R-99-005.

USEPA. 2005. Supplemental Guidance for Assessing Susceptibility from Early-life Exposure to Carcinogens. EPA-630-R-03-003F.

Exposure Duration Adjusted for Mutagenicity (for TCE):

Child: $(ED_{0\text{-}2} \times 10) + (ED_{2\text{-}6} \times 3) = (2 \times 10) + (4 \times 3) = 20 + 12 = 32$

Adult: $(ED_{6\text{-}16} \times 3) + (ED_{16\text{-}30} \times 1) = (10 \times 3) + (14 \times 1) = 30 + 14 = 44$

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Table C-8. Absorbed Dose Parameters for Evaluation of Potential Risks from Dermal Exposure to COPCs in Plume Area Groundwater

Child Resident

Chemical	MW (g/mole)	Log K_{ow} (unitless)	K_p (cm/hr)	B (unitless)	D_{sc} (cm^2/hr)	τ_{event} (hr/event)	t* (hr)	b (unitless)	c (unitless)	t_{event} (hr/event)	FA (unitless)
Volatile Organic Compounds											
1,1-Dichloroethylene (1,1-DCE)	96.9	2.13	1.16E-02	4.38E-02	4.54E-07	3.67E-01	8.80E-01	3.30E-01	3.63E-01	1.0	1.0
Tetracloroethylene (PCE)	165.8	3.40	3.28E-02	1.62E-01	1.87E-07	8.92E-01	2.14E+00	4.11E-01	4.49E-01	1.0	1.0
Trichloroethylene (TCE)	131.4	2.42	1.15E-02	5.08E-02	2.91E-07	5.72E-01	1.37E+00	3.35E-01	3.68E-01	1.0	1.0

Adult Resident

Chemical	MW (g/mole)	Log K_{ow} (unitless)	K_p (cm/hr)	B (unitless)	D_{sc} (cm^2/hr)	τ_{event} (hr/event)	t* (hr)	b (unitless)	c (unitless)	t_{event} (hr/event)	FA (unitless)
Volatile Organic Compounds											
1,1-Dichloroethylene (1,1-DCE)	96.9	2.13	1.16E-02	4.38E-02	4.54E-07	3.67E-01	8.80E-01	3.30E-01	3.63E-01	0.58	1.0
Tetracloroethylene (PCE)	165.8	3.40	3.28E-02	1.62E-01	1.87E-07	8.92E-01	2.14E+00	4.11E-01	4.49E-01	0.58	1.0
Trichloroethylene (TCE)	131.4	2.42	1.15E-02	5.08E-02	2.91E-07	5.72E-01	1.37E+00	3.35E-01	3.68E-01	0.58	1.0

Notes:

Dermal exposure pathway based on USEPA (2004).

Thickness of skin (0.001 cm).

MW = Molecular weight (g/mole).

LogK_{ow} = Octanol/water partition coefficient (unitless).

K_p = Strateum corneum (sc) permeability constant (cm/hr).

B = Ratio of permeability of chemical in strateum corneum to permeability in viable epidermis (unitless).

D_{sc} = Effective diffusivity for chemical transfer through the skin (cm^2/hr).

τ_{event} = Lag time per event (hr/event)

t* = Time to reach steady state (hr).

b & c = Parameters used to calculate time to reach steady state.

t_{event} - Event Time (ET) - Water Contact Duration (hr).

FA = Fraction absorbed (unitless).

Conc = Groundwater concentration (ug/L * 1E-6 = mg/cm^3).

DA_{event} = Absorbed dose (mg/cm^2-event).

Source:

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA-540-R-99-005.

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Table C-9. Well- and Sample-specific Evaluation of Potential Risks from Dermal Exposure to COPCs in Plume Area Groundwater (Detected Results from Domestic Wells Only)

Child Resident

									Cancer													Noncancer									
	Sample		PCE		TCE		1,1-DCE		PCE			TCE						1,1-DCE			Total	PCE			TCE			1,1-DCE			Total
Well	Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	DAD_{event}	DAD	Risk	DAD_{event}	DAD-m	Risk-m	DAD-nm	Risk-nm	Risk	DAD_{event}	DAD	Risk	Risk	DAD_{event}	DAD	Hazard	DAD_{event}	DAD	Hazard	DAD_{event}	DAD	Hazard	Hazard
Alice East	01/15/13	µg/L	2.0	U	187		452					4.50E-06	8.69E-04	8.08E-06	1.63E-04	6.03E-06	***1.41E-05***	9.01E-06	3.26E-04	No CSF	***1.41E-05***				4.50E-06	1.90E-03	***3.80***	9.01E-06	3.80E-03	0.08	***3.88***
Alice East	03/14/12	µg/L	5.0	U	240	*	490	*				5.78E-06	1.11E-03	1.04E-05	2.09E-04	7.73E-06	***1.81E-05***	9.77E-06	3.53E-04	No CSF	***1.81E-05***				5.78E-06	2.44E-03	***4.88***	9.77E-06	4.12E-03	0.08	***4.96***
Alice West	01/15/13	µg/L	2.0	U	27.7		85.4					6.67E-07	1.29E-04	1.20E-06	2.41E-05	8.93E-07	2.09E-06	1.70E-06	6.16E-05	No CSF	2.09E-06				6.67E-07	2.81E-04	0.56	1.70E-06	7.18E-04	0.01	0.58
Alice West	03/14/12	µg/L	5.0	U	20		81.0					4.82E-07	9.29E-05	8.64E-07	1.74E-05	6.45E-07	1.51E-06	1.61E-06	5.84E-05	No CSF	1.51E-06				4.82E-07	2.03E-04	0.41	1.61E-06	6.81E-04	0.01	0.42
Bailey	01/14/13	µg/L	0.50	U	0.50	U	0.50	U																							
Hooper	01/15/13	µg/L	0.50	U	5.2		19					1.25E-07	2.42E-05	2.25E-07	4.53E-06	1.68E-07	3.92E-07	3.79E-07	1.37E-05	No CSF	3.92E-07				1.25E-07	5.28E-05	0.11	3.79E-07	1.60E-04	0.003	0.11
Hooper	03/14/12	µg/L	0.50	U	5.4		14					1.30E-07	2.51E-05	2.33E-07	4.70E-06	1.74E-07	4.07E-07	2.79E-07	1.01E-05	No CSF	4.07E-07				1.30E-07	5.49E-05	0.11	2.79E-07	1.18E-04	0.002	0.11
Knight	01/31/13	µg/L	0.2	U	6.7		0.20	U				1.61E-07	3.11E-05	2.89E-07	5.84E-06	2.16E-07	5.05E-07				5.05E-07				1.61E-07	6.81E-05	0.14				0.14
Lopez	01/15/13	µg/L	1.1		41		0.50	U	8.98E-08	3.25E-06	6.82E-09	9.87E-07	1.90E-04	1.77E-06	3.57E-05	1.32E-06	3.09E-06				3.10E-06	8.98E-08	3.79E-05	0.01	9.87E-07	4.17E-04	0.83				0.84
Lopez	03/14/12	µg/L	5.0	U	49		5.0	U				1.18E-06	2.28E-04	2.12E-06	4.27E-05	1.58E-06	3.70E-06				3.70E-06				1.18E-06	4.98E-04	1.00				1.00
Miller	01/15/13	µg/L	0.50	U	0.50	U	0.50	U																							
Padilla	03/14/12	µg/L	5.0	U	86		230	*				2.07E-06	3.99E-04	3.72E-06	7.49E-05	2.77E-06	6.49E-06	4.59E-06	1.66E-04	No CSF	6.49E-06				2.07E-06	8.74E-04	***1.75***	4.59E-06	1.93E-03	0.04	***1.79***

Adult Resident

									Cancer													Noncancer									
	Sample		PCE		TCE		1,1-DCE		PCE			TCE						1,1-DCE			Total	PCE			TCE			1,1-DCE			Total
Well	Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	DAD_{event}	DAD	Risk	DAD_{event}	DAD-m	Risk-m	DAD-nm	Risk-nm	Risk	DAD_{event}	DAD	Risk	Risk	DAD_{event}	DAD	Hazard	DAD_{event}	DAD	Hazard	DAD_{event}	DAD	Hazard	Hazard
Alice East	01/15/13	µg/L	2.0	U	187		452					3.43E-06	5.32E-04	4.94E-06	2.90E-04	1.07E-05	***1.57E-05***	6.66E-06	5.63E-04	No CSF	***1.57E-05***				3.43E-06	8.46E-04	***1.69***	6.66E-06	1.64E-03	0.03	***1.72***
Alice East	03/14/12	µg/L	5.0	U	240	*	490	*				4.40E-06	6.82E-04	6.35E-06	3.72E-04	1.38E-05	***2.01E-05***	7.23E-06	6.11E-04	No CSF	***2.01E-05***				4.40E-06	1.09E-03	***2.17***	7.23E-06	1.78E-03	0.04	***2.21***
Alice West	01/15/13	µg/L	2.0	U	27.7		85.4					5.08E-07	7.87E-05	7.32E-07	4.30E-05	1.59E-06	2.32E-06	1.26E-06	1.06E-04	No CSF	2.32E-06				5.08E-07	1.25E-04	0.25	1.26E-06	3.10E-04	0.01	0.26
Alice West	03/14/12	µg/L	5.0	U	20		81.0					3.67E-07	5.69E-05	5.29E-07	3.10E-05	1.15E-06	1.68E-06	1.19E-06	1.01E-04	No CSF	1.68E-06				3.67E-07	9.05E-05	0.18	1.19E-06	2.94E-04	0.01	0.19
Bailey	01/14/13	µg/L	0.50	U	0.50	U	0.50	U																							
Hooper	01/15/13	µg/L	0.50	U	5.2		19					9.54E-08	1.48E-05	1.37E-07	8.06E-06	2.98E-07	4.36E-07	2.80E-07	2.37E-05	No CSF	4.36E-07				9.54E-08	2.35E-05	0.05	2.80E-07	6.91E-05	0.001	0.05
Hooper	03/14/12	µg/L	0.50	U	5.4		14					9.90E-08	1.54E-05	1.43E-07	8.37E-06	3.10E-07	4.53E-07	2.06E-07	1.75E-05	No CSF	4.53E-07				9.90E-08	2.44E-05	0.05	2.06E-07	5.09E-05	0.001	0.05
Knight	01/31/13	µg/L	0.2	U	6.7		0.20	U				1.23E-07	1.90E-05	1.77E-07	1.04E-05	3.84E-07	5.62E-07				5.62E-07				1.23E-07	3.03E-05	0.06				0.06
Lopez	01/15/13	µg/L	1.1		41		0.50	U	6.84E-08	5.78E-06	1.21E-08	7.52E-07	1.17E-04	1.08E-06	6.36E-05	2.35E-06	3.44E-06				3.45E-06	6.84E-08	1.69E-05	0.003	7.52E-07	1.85E-04	0.37				0.37
Lopez	03/14/12	µg/L	5.0	U	49		5.0	U				8.99E-07	1.39E-04	1.30E-06	7.60E-05	2.81E-06	4.11E-06				4.11E-06				8.99E-07	2.22E-04	0.44				0.44
Miller	01/15/13	µg/L	0.50	U	0.50	U	0.50	U																							
Padilla	03/14/12	µg/L	5.0	U	86		230	*				1.58E-06	2.44E-04	2.27E-06	1.33E-04	4.93E-06	7.21E-06	3.39E-06	2.87E-04	No CSF	7.21E-06				1.58E-06	3.89E-04	0.78	3.39E-06	8.36E-04	0.02	0.79

Child Resident + Adult Resident

Well	Sample Date	Total Cancer Risk	Total Noncancer Hazard
Alice East	01/15/13	***3.0E-05***	***5.6***
Alice East	03/14/12	***3.8E-05***	***7.2***
Alice West	01/15/13	4.4E-06	0.8
Alice West	03/14/12	3.2E-06	0.6
Bailey	01/14/13	All Non-detects	
Hooper	01/15/13	8.3E-07	0.2
Hooper	03/14/12	8.6E-07	0.2
Knight	01/31/13	1.1E-06	0.2
Lopez	01/15/13	6.5E-06	***1.2***
Lopez	03/14/12	7.8E-06	***1.4***
Miller	01/15/13	All Non-detects	
Padilla	03/14/12	***1.4E-05***	***2.6***

Note:
For TCE, DAD-m and Risk-m are calculated using the kidney cancer CSF and exposure duration for mutagenicity, and DAD-nm and Risk-nm are calculated using the liver cancer and non-Hodgkin CSF.

Qualifiers:
U = Not detected. Concentration reported is reporting limit (PQL).
* Result not recommended for use because of associated QA/QC performance inferior to that from other analysis (sic).

Source:
USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA-540-R-99-005.

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Table C-10. Well- and Sample-specific Evaluation of Potential Risks from Ingestion of COPCs in Fruits and Vegetables Irrigated with Plume Area Groundwater (Detected Results from Domestic Wells Only)

				PCE		TCE		1,1-DCE		Noncancer				Cancer			
Location	Type	Sample Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	PCE	TCE	1,1-DCE	Total	PCE	TCE	1,1-DCE	Total
Groundwater Plume South of the Eagle Picher Site																	
Alice East	Domestic	01/15/13	µg/L	2.0	U	187		452		-	***14.38***	0.42	***14.81***	-	***1.1E-04***	No CSF	***1.1E-04***
Alice East	Domestic	03/14/12	µg/L	5.0	U	240	*	490	*	-	***18.46***	0.46	***18.92***	-	***1.4E-04***	No CSF	***1.4E-04***
Alice West	Domestic	01/15/13	µg/L	2.0	U	27.7		85.4		-	***2.13***	0.08	***2.21***	-	***1.6E-05***	No CSF	***1.6E-05***
Alice West	Domestic	03/14/12	µg/L	5.0	U	20		81.0		-	***1.54***	0.08	***1.61***	-	***1.2E-05***	No CSF	***1.2E-05***
Bailey	Domestic	01/14/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Hooper	Domestic	01/15/13	µg/L	0.50	U	5.2		19		-	0.40	0.02	0.42	-	3.1E-06	No CSF	3.1E-06
Hooper	Domestic	03/14/12	µg/L	0.50	U	5.4		14		-	0.42	0.01	0.43	-	3.2E-06	No CSF	3.2E-06
Knight	Domestic	01/31/13	µg/L	0.2	U	6.7		0.20	U	-	0.52	-	0.52	-	3.9E-06	-	3.9E-06
Lopez	Domestic	01/15/13	µg/L	1.1		41		0.50	U	0.00	***3.15***	-	***3.16***	1.9E-08	***2.4E-05***	-	***2.4E-05***
Lopez	Domestic	03/14/12	µg/L	5.0	U	49		5.0	U	-	***3.77***	-	***3.77***	-	***2.9E-05***	-	***2.9E-05***
Miller	Domestic	01/15/13	µg/L	0.50	U	0.50	U	0.50	U	-	-	-	-	-	-	-	-
Padilla	Domestic	03/14/12	µg/L	5.0	U	86		230	*	-	***6.62***	0.21	***6.83***	-	***5.1E-05***	No CSF	***5.1E-05***
								Minimum Risk Value		0.00	0.40	0.013	0.42	1.9E-08	3.1E-06		3.1E-06
								Maximum Risk Value		0.00	***18.46***	0.46	***18.92***	1.9E-08	***1.4E-04***		***1.4E-04***

- = Not calculated (result was non-detect).

* Result not recommended for use because of associated QA/QC performance inferior to that from other analysis (sic).

Qualifiers:

U = Not detected. Concentration reported is reporting limit (PQL).

Calculations of noncancer hazard and cancer risk from ingestion of fruits and vegetables irrigated with groundwater are based on risk-based concentrations obtained from the Risk Assessment Information System (RAIS) Preliminary Remediation Goals (PRGs) Calculator at http://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem. Accessed January 13, 2014. SLs based on a carcinogenic endpoint were multiplied by a factor of 10 to reflect the NMED's recommended carcinogenic risk of 1×10^{-5} (Table 6).

COPC	Cancer	Noncancer
1,1-Dichloroethylene (1,1-DCE)	---	1,070
Tetrachloroethylene (PCE)	560	235
Trichloroethylene (TCE)	17.0	13.0

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Table C-11. Well- and Sample-specific Evaluation of Potential Risks from Exposure to COPCs in Groundwater via Vapor Intrusion (Detected Results Only from Plume Area Wells Screened at the Water Table)

Residential Scenario

						PCE					TCE					1,1-DCE					TOTAL	
						Groundwater Concentration (µg/L)		Calculated Indoor Air Concentration ($\mu g/m^3$)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard	Groundwater Concentration (µg/L)		Calculated Indoor Air Concentration ($\mu g/m^3$)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard	Groundwater Concentration (µg/L)		Calculated Indoor Air Concentration ($\mu g/m^3$)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard	Cancer Risk	Hazard Quotients
Well	Type	Depth to Water*	Estimated Vapor Attenuation Factor**	Sample Date	Units	Conc.	Qual.				Conc.	Qual.				Conc.	Qual.					
OMW-3	Monitoring	24.75	4.0E-04	01/10/13	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-4	Monitoring	41.95	3.0E-04	01/07/13	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-4	Monitoring		3.0E-04	03/13/12	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-5	Monitoring	62.51	2.5E-04	01/10/13	µg/L	0.50	U	-	-	-	7.8		0.79	1.82E-06	0.38	16.5		4.40	No IUR	0.02	1.82E-06	0.40
OMW-5	Monitoring		2.5E-04	03/13/12	µg/L	0.50	U	-	-	-	8.5		0.86	1.98E-06	0.41	19		5.07	No IUR	0.02	1.98E-06	0.43
OMW-6	Monitoring	39.92	4.0E-04	01/09/13	µg/L	2.0	U	-	-	-	38		6.12	***1.42E-05***	***2.93***	60		25.60	No IUR	0.12	***1.42E-05***	***3.06***
OMW-6	Monitoring		4.0E-04	03/14/12	µg/L	5.0	U	-	-	-	54		8.70	***2.01E-05***	***4.17***	91		38.83	No IUR	0.19	***2.01E-05***	***4.36***
OMW-7	Monitoring	48.54	3.0E-04	01/09/13	µg/L	10.85		2.35	2.52E-07	0.06	113.5		13.71	***3.17E-05***	***6.57***	2.0	U	-	-	-	***3.20E-05***	***6.63***
OMW-7	Monitoring		3.0E-04	03/14/12	µg/L	13.5		2.93	3.13E-07	0.07	125		15.10	***3.50E-05***	***7.24***	5.0	U	-	-	-	***3.53E-05***	***7.31***
OMW-8	Monitoring	18.37	5.0E-04	01/09/13	µg/L	0.50	U	-	-	-	0.56		0.11	2.61E-07	0.05	0.50	U	-	-	-	2.61E-07	0.05
OMW-8	Monitoring		5.0E-04	03/13/12	µg/L	0.50	U	-	-	-	0.43	L J	0.09	2.00E-07	0.04	0.50	U	-	-	-	2.00E-07	0.04
OMW-9	Monitoring	63.01	2.5E-04	01/08/13	µg/L	0.38	L J	0.07	7.34E-09	0.002	6.3		0.63	1.47E-06	0.30	5.40	J	1.44	No IUR	0.01	1.48E-06	0.31
OMW-9	Monitoring		2.5E-04	03/13/12	µg/L	0.52		0.09	1.00E-08	0.002	9.0		0.91	2.10E-06	0.43	7.40		1.97	No IUR	0.01	2.11E-06	0.45
OMW-10	Monitoring	77.32	2.5E-04	01/10/13	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-10	Monitoring		2.5E-04	03/13/12	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-11	Monitoring	71.63	2.5E-04	01/10/13	µg/L	0.50	U	-	-	-	0.48	J	0.05	1.12E-07	0.02	0.50	U	-	-	-	1.12E-07	0.02
OMW-12	Monitoring	56.81	3.0E-04	01/09/13	µg/L	0.50	U	-	-	-	4.5		0.54	1.26E-06	0.26	0.50	U	-	-	-	1.26E-06	0.26
OMW-12	Monitoring		3.0E-04	03/13/12	µg/L	0.50	U	-	-	-	2.8		0.34	7.83E-07	0.16	0.50	U	-	-	-	7.83E-07	0.16
SW-3	Monitoring	61.55	2.5E-04	01/29/13	µg/L	1.0	U	-	-	-	2.1		0.21	4.89E-07	0.10	5.2		1.39	No IUR	0.01	4.89E-07	0.11
SW-4	Monitoring	47.65	3.0E-04	01/09/13	µg/L	13.2		2.86	3.06E-07	0.07	125		15.10	***3.50E-05***	***7.24***	2.0	U	-	-	-	***3.53E-05***	***7.31***
SW-4	Monitoring		3.0E-04	12/19/12	µg/L	12.5		2.71	2.90E-07	0.07	100		12.08	***2.80E-05***	***5.79***	1.0	U	-	-	-	***2.83E-05***	***5.86***
SW-5	Monitoring	42.32	3.0E-04	02/06/13	µg/L	1.0	U	-	-	-	13		1.57	3.64E-06	0.75	7.2		2.30	No IUR	0.01	3.64E-06	0.76
SW-6	Monitoring	55.62	3.0E-04	06/19/13	µg/L	1.0	U	-	-	-	38		4.59	***1.06E-05***	***2.20***	37		11.84	No IUR	0.06	***1.06E-05***	***2.26***
SW-7	Monitoring	45.51	3.0E-04	06/17/13	µg/L	2.0	U	-	-	-	2.0	U	-	-	-	2.0	U	-	-	-	-	-
																		Minimum Risk Value			1.12E-07	0.02
																		Maximum Risk Value			***3.53E-05***	***7.31***

Table C-11. Well- and Sample-specific Evaluation of Potential Risks from Exposure to COPCs in Groundwater via Vapor Intrusion (Detected Results Only from Plume Area Wells Screened at the Water Table)

Commerical Scenario

						PCE					TCE					1,1-DCE					TOTAL	
Well	Type	Depth to Water*	Estimated Vapor Attenuation Factor**	Sample Date	Units	Groundwater Concentration (µg/L) Conc.	Qual.	Calculated Indoor Air Concentration (µg/m^3)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard	Groundwater Concentration (µg/L) Conc.	Qual.	Calculated Indoor Air Concentration (µg/m^3)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard	Groundwater Concentration (µg/L) Conc.	Qual.	Calculated Indoor Air Concentration (µg/m^3)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard	Cancer Risk	Hazard Quotients
OMW-3	Monitoring	24.75	4.0E-04	01/10/13	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-4	Monitoring	41.95	3.0E-04	01/07/13	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-4	Monitoring		3.0E-04	03/13/12	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-5	Monitoring	62.51	2.5E-04	01/10/13	µg/L	0.50	U	-	-	-	7.8		0.79	2.62E-07	0.09	16.5		4.40	No IUR	0.01	2.62E-07	0.09
OMW-5	Monitoring		2.5E-04	03/13/12	µg/L	0.50	U	-	-	-	8.5		0.86	2.86E-07	0.10	19		5.07	No IUR	0.01	2.86E-07	0.10
OMW-6	Monitoring	39.92	4.0E-04	01/09/13	µg/L	2.0	U	-	-	-	38		6.12	2.05E-06	0.70	60		25.60	No IUR	0.03	2.05E-06	0.73
OMW-6	Monitoring		4.0E-04	03/14/12	µg/L	5.0	U	-	-	-	54		8.70	2.91E-06	0.99	91		38.83	No IUR	0.04	2.91E-06	***1.04***
OMW-7	Monitoring	48.54	3.0E-04	01/09/13	µg/L	10.85		2.35	4.99E-08	0.01	113.5		13.71	4.58E-06	***1.56***	2.0	U	-	-	-	4.63E-06	***1.58***
OMW-7	Monitoring		3.0E-04	03/14/12	µg/L	13.5		2.93	6.21E-08	0.02	125		15.10	5.05E-06	***1.72***	5.0	U	-	-	-	5.11E-06	***1.74***
OMW-8	Monitoring	18.37	5.0E-04	01/09/13	µg/L	0.50	U	-	-	-	0.56		0.11	3.77E-08	0.01	0.50	U	-	-	-	3.77E-08	0.01
OMW-8	Monitoring		5.0E-04	03/13/12	µg/L	0.50	U	-	-	-	0.43	L J	0.09	2.89E-08	0.01	0.50	U	-	-	-	2.89E-08	0.01
OMW-9	Monitoring	63.01	2.5E-04	01/08/13	µg/L	0.38	L J	0.07	1.46E-09	0.000	6.3		0.63	2.12E-07	0.07	5.40	J	1.44	No IUR	0.002	2.13E-07	0.07
OMW-9	Monitoring		2.5E-04	03/13/12	µg/L	0.52		0.09	1.99E-09	0.001	9.0		0.91	3.03E-07	0.10	7.40		1.97	No IUR	0.002	3.05E-07	0.11
OMW-10	Monitoring	77.32	2.5E-04	01/10/13	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-10	Monitoring		2.5E-04	03/13/12	µg/L	0.50	U	-	-	-	0.50	U	-	-	-	0.50	U	-	-	-	-	-
OMW-11	Monitoring	71.63	2.5E-04	01/10/13	µg/L	0.50	U	-	-	-	0.48	J	0.05	1.62E-08	0.01	0.50	U	-	-	-	1.62E-08	0.01
OMW-12	Monitoring	56.81	3.0E-04	01/09/13	µg/L	0.50	U	-	-	-	4.5		0.54	1.82E-07	0.06	0.50	U	-	-	-	1.82E-07	0.06
OMW-12	Monitoring		3.0E-04	03/13/12	µg/L	0.50	U	-	-	-	2.8		0.34	1.13E-07	0.04	0.50	U	-	-	-	1.13E-07	0.04
SW-3	Monitoring	61.55	2.5E-04	01/29/13	µg/L	1.0	U	-	-	-	2.1		0.21	7.07E-08	0.02	5.2		1.39	No IUR	0.002	7.07E-08	0.03
SW-4	Monitoring	47.65	3.0E-04	01/09/13	µg/L	13.2		2.86	6.07E-08	0.02	125		15.10	5.05E-06	***1.72***	2.0	U	-	-	-	5.11E-06	***1.74***
SW-4	Monitoring		3.0E-04	12/19/12	µg/L	12.5		2.71	5.75E-08	0.02	100		12.08	4.04E-06	***1.38***	1.0	U	-	-	-	4.10E-06	***1.39***
SW-5	Monitoring	42.32	3.0E-04	02/06/13	µg/L	1.0	U	-	-	-	13		1.57	5.25E-07	0.18	7.2		2.30	No IUR	0.003	5.25E-07	0.18
SW-6	Monitoring	55.62	3.0E-04	06/19/13	µg/L	1.0	U	-	-	-	38		4.59	1.53E-06	0.52	37		11.84	No IUR	0.01	1.53E-06	0.54
SW-7	Monitoring	45.51	3.0E-04	06/17/13	µg/L	2.0	U	-	-	-	2.0	U	-	-	-	2.0	U	-	-	-	-	-
																		Minimum Risk Value			1.62E-08	0.01
																		Maximum Risk Value			5.11E-06	***1.74***

\- = Not calculated (result was non-detect).

* Depth to water (feet below top of casing) as recorded by DBS&A during sampling in 2013.

** Estimated from Figure 3b in USEPA's 2002 OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), assuming a Loamy Sand soil type. Vapor attenuation factors were estimated for the following depth-to-water ranges: < 20 feet, 20 - 40 feet, 40-60 feet, and 60 -80 feet.

Qualifiers:

J = Estimated value; analyte detected below quantitation limit.

L = Reported concentration is below the contract-required quantitation limit.

U = Not detected. Concentration reported is reporting limit (PQL).

Cancer Risk and Noncancer Hazard Quotients calculated using:

USEPA. 2013. Groundwater Concentration to Indoor Air Concentration (GWC-IAC) Calculator. Version 3.1, June 2013 RSLs. Available at http://www.epa.gov/oswer/vaporintrusion/guidance.html. The following parameters were used: Exposure Scenario = Residential or Commerical; Target Cancer Risk = 1E-05; Target Noncancer Hazard Quotient = 1.0; Groundwater temperature = 25°C. Attenuation factors used are listed in the table.

Table C-12. Location-specific Evaluation of Potential Risks from Exposure to VOCs Detected in Exterior Soil Gas in the Plume Area

Residential Scenario

Chemical	Location	Detected Concentration ($\mu g/m^3$)	Calculated Indoor Air Concentration ($\mu g/m^3$)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard
TCE	SGT-9	230	23	***5.32E-05***	***11.03***

Commercial Scenario

Chemical	Location	Detected Concentration ($\mu g/m^3$)	Calculated Indoor Air Concentration ($\mu g/m^3$)	Vapor Intrusion Cancer Risk	Vapor Intrusion Noncancer Hazard
TCE	SGT-9	230	23	7.69E-06	***2.63***

Cancer Risk and Noncancer Hazard Quotients calculated using:

USEPA. 2013. Sub-slab or Exterior Soil Gas Concentration to Indoor Air Concentration (SGC-IAC) Calculator. Version 3.1, June 2013 RSLs. Available at http://www.epa.gov/oswer/vaporintrusion/guidance.html. The following parameters were used: Exposure Scenario = Residential or Commercial; Target Cancer Risk = 1E-05; Target Noncancer Hazard Quotient = 1.0; Groundwater temperature = 25°C.

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Appendix D

Ecological Site Visit Documents for the Eagle Picher Property

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Checklist for Ecological Assessment/Sampling

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Industrial Site
(north end)

I. SITE DESCRIPTION

1. Site Name: Eagle Picher Caretree Batteries Superfund Site

Location: West side I-25 @ Exit 152, along NM Hwy 408

County: Socorro City: Socorro State: NM

2. Latitude: 34° 5' 58" N Longitude: 106° 54' 14" W

2a. Latitude: 34° 4' 59" N Longitude: 106° 54' 30" W

3. What is the approximate area of the site: ______

4. Is this the first site visit? Yes / No. If no, attach trip report of previous site visit(s), if available.

Date(s) of previous site visit(s): ______

5. Please attach to the checklist USGS topographic map(s) of the site, if available.

6. Are aerial or other site photographs available? Yes No. If yes, please attach any available photo(s) to the site map at the conclusion of this section.

7. The land use of the site is: The area surrounding the site is:

1 mile radius

0 % Urban 0 % Urban

100 % Rural 100 % Rural

0 % Residential 0 % Residential

100 % Industrial (100 light 0 heavy) 0 % Industrial (___light ____heavy)

0 % Agricultural 0 % Agricultural

(Crops: ____________________________) (Crops: ____________________________)

2 % Recreational 0 % Recreational

(Describe: note if it is a park etc.) (Describe: note if it is a park, etc.)

Target practice on west side ____________________________

of hwy near "Old Facility" ____________________________

0 % Undisturbed 0 % Undisturbed

_____ % Other _____ % Other

8. Has any movement of soil taken place at the site? Yes No. If yes, please identify the most likely cause of this disturbance:

____ Agricultural Use X Heavy Equipment ____ Mining

____ Natural Events ____ Erosion ____ Other

Please describe:

The entire site has been disturbed by heavy earthmoving equipment. The surface soil has all been pushed around into berms, excavated areas, ridges, and roads, + storage piles.

9. Do any potential sensitive environmental areas exist adjacent to or in proximity to the site, e.g., Federal and State parks, National and State monuments, wetlands, prairie potholes? *Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information.*

No

Please provide the source(s) of the information used to identify these sensitive areas, and indicate their general location on the site map.

10. What type of facility is located at the site?

Chemical　Manufacturing　Mixing　Waste disposal

Other (specify) Former battery manufacturer

11. What are the suspected contaminants of concern at the site? If know, what are the maximum concentration levels?

trichloroethane

12. Check any potential routes of off-site migration of contaminants observed at the site:

Swales　Depressions　Drainage ditches

Runoff　Windblown particulates　Vehicular traffic

Other (specify)

004063

13. If known, what is the approximate depth to the water Table? n/a

14. Is the direction of surface runoff apparent from site observations? yes no. If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

Surface water   Groundwater   Sewer   Collection impoundment

15. Is there a navigable waterbody or tributary to a navigable waterbody? yes no

Large arroyo runs through property

16. Is there a waterbody anywhere on or in the vicinity of the site? If yes, also complete Section III: Aquatic Habitat Checklist – Non-Flowing Systems and/or Section IV: Aquatic Habitat Checklist – Flowing Systems.   yes (approx. distance ____________________)   no

17. Is there evidence of flooding?   yes   no *Wetlands and flood plains are not always obvious; do not answer "no" without confirming information.* If yes, complete Section V: Wetland Habitat Checklist.

18. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. [Use a blank sheet if additional space is needed for text.]

____

____

____

____

19. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site?

yes no *If yes, you are required to verify this information with the U.S. Fish and Wildlife Service.* If species' identities are known, please list them next.

____

____

____

____

20. Record weather conditions at the time this checklist was prepared:

Date: 11/15/12

70° Temperature (EC/EF) 61.8 Normal daily high temperature

NW 5-10 mph Wind (direction/speed) none Precipitation (rain, snow)

high cirrus Cloud cover

IA. SUMMARY OF OBSERVATIONS AND SITE SETTING

Completed by Devin Kennemore Affiliation Parametrix

Additional Preparers

Site Manager

Date 11/15/12

II TERRESTRIAL HABITAT CHECKLIST

IIA. WOODED

1. Are there any wooded areas at the site? yes no If no, go to Section IIB: Shrub/Scrub.

2. What percentage or area of the site is wooded? (________ % ________ acres). Indicate the wooded area on the site map which is attached to a copy of this checklist. Please identify what information was used to determine the wooded area of the site.

3. What is the dominant type of vegetation in the wooded area? (Circle one: Evergreen/Deciduous/Mixed) Provide a photograph, if available.

Dominant plant, if known: ____

4. What is the predominant size of the trees at the site? Use diameter at breast height.

0 - 6 in. 6 - 12 in. >12 in.

5. Specify type of understory present, if known. Provide a photograph, if available.

____

IIB. SCHRUB/SCRUB

1. Is shrub/scrub vegetation present at the site? yes no If no, go to Section IIC: Open Field.

2. What percentage of the site is covered by scrub/shrub vegetation? (60 % _____ acres).

Indicate the areas of shrub/scrub on the site map. Please identify what information was used to determine this area.

The entire area.

3. What is the dominant type of scrub/shrub vegetation, if known? Provide a photograph, if available.

Kochia scoparia Salsola sp.

4. What is the approximate average height of the scrub/shrub vegetation?

0 - 2 ft. 2 - 5 ft. > 5 ft.

5. Based on site observations, how dense is the scrub/shrub vegetation?

Dense Patchy Sparse

IIC. OPEN FIELD

1. Are there open (bare, barren) field areas present at the site? 9 yes 9 no If yes, please indicate the type below:

Prairie/plains Savannah Old field Other (specify) ________________

2. What percentage of the site is open field? (_________ % _______ acres). Indicate the open fields on the site map.

3. What is/are the dominant plant(s)? Provide a photograph, if available.

____

____

4. What is the approximate average height of the dominant plant? ______________________

5. Describe the vegetation cover: Dense Sparse Patchy

IID. MISCELLANEOUS

1. Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub, and open field?

   yes no If yes, identify and describe them below.

____

2. Describe the terrestrial miscellaneous habitat(s) and identify these area(s) on the site map.

____

____

____

____

3. What observations, if any, were made at the site regarding the presence and/or absence of insects, fish, birds, mammals, etc.?

A few harvester ants seen, no fish or mammals observed. a few birds - ~~house~~ white crowned sparrows, mostly along the fence lines

4. Review the questions in Section I to determine if any additional habitat checklists should be completed for this site.

Selected Site Photographs

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Photograph 1. Points within the Eagle Picher property where photographs were taken. Not all photos taken are included in this appendix; those that are included provide a representative summary of site conditions.

Photograph 2. Photo Point 1, looking southeast from Highway 408.


Photograph 3. Photo Point 2, looking northwest from Highway 408.

Photograph 4. Photo Point 3, looking from the Nogal Arroyo to Highway 408.

Photograph 5. Photo Point 9, looking west over the impoundments.

Photograph 6. Photo Point 10, looking north at the wet area located east of the industrial lagoons.

Photograph 7. Photo Point 13, looking at the old facility.

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Appendix E

Ecological Site Visit Documents for the TCE Plume Area

Table of Contents

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Checklist for Ecological Assessment/Sampling

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II TERRESTRIAL HABITAT CHECKLIST

IIA. WOODED

1. Are there any wooded areas at the site? yes no If no, go to Section IIB: Shrub/Scrub.

2. What percentage or area of the site is wooded? (< 1 % < 1 acres). Indicate the wooded area on the site map which is attached to a copy of this checklist. Please identify what information was used to determine the wooded area of the site. Riparian habitat surrounding (bordering) Borrow Pit Pond on east side of Plume area dominated by cottonwood + tamarisk.

3. What is the dominant type of vegetation in the wooded area? (Circle one: Evergreen/Deciduous/Mixed)
Provide a photograph, if available. See photos of Borrow Pit Pond.
Dominant plant, if known: Cottonwood/Tamarisk

4. What is the predominant size of the trees at the site? Use diameter at breast height.

0 - 6 in. 6 - 12 in. >12 in.

5. Specify type of understory present, if known. Provide a photograph, if available.
Tamarisk is the dominant understory species

IIB. SCHRUB/SCRUB

1. Is shrub/scrub vegetation present at the site? yes no If no, go to Section IIC: Open Field.

2. What percentage of the site is covered by scrub/shrub vegetation? (60 % _____ acres).

Indicate the areas of shrub/scrub on the site map. Please identify what information was used to determine this area.

Aerial Photography in Google Earth - ground truthed during site visit.

3. What is the dominant type of scrub/shrub vegetation, if known? Provide a photograph, if available.
Creosote bush / fourwing saltbush / rabbitbrush

4. What is the approximate average height of the scrub/shrub vegetation?

0 - 2 ft.   2 - 5 ft.   > 5 ft.

5. Based on site observations, how dense is the scrub/shrub vegetation?

Dense   Patchy   Sparse

IIC. OPEN FIELD

1. Are there open (bare, barren) field areas present at the site? 9 yes 9 no If yes, please indicate the type below:

Prairie/plains   Savannah   Old field   Other (specify) disturbed areas

2. What percentage of the site is open field? (~ 20 % _______ acres). Indicate the open fields on the site map.

3. What is/are the dominant plant(s)? Provide a photograph, if available.

Grasses + forbs as listed in the Species List for the site.

4. What is the approximate average height of the dominant plant? < 2 ft

5. Describe the vegetation cover: Dense Sparse Patchy

IID. MISCELLANEOUS

1. Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub, and open field?

yes no If yes, identify and describe them below.

Residential landscaping, golf course

2. Describe the terrestrial miscellaneous habitat(s) and identify these area(s) on the site map.

Lawns, cultivated ornamental species

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Selected Site Photographs

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Photograph 1. Points within the TCE plume area where photographs were taken. Not all photos taken are included in this appendix; those that are included provide a representative summary of site conditions.

Photograph 2. Photo Point 1, a rodent burrow located between the TCE plume and Highway 408.

Photograph 3. Photo Point 3, looking south-southwest at a semi-wet drainage area.

Photograph 4. Photo Point 4, looking at an off-highway vehicle trail in a semi-wet drainage area.

Photograph 5. Photo Point 7, looking northeast.

Photograph 6. Photo Point 8, looking southeast at golf course and pond.

Photograph 7. Photo Point 12, looking at the borrow pit pond from Newberry Road.

Photograph 8. Photo Point 13, looking at the borrow pit pond from the bank on the southwest corner.

Photograph 9. Photo Point 17, looking south-southwest.

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Appendix F

Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
AMPHIBIANS	
Bullfrog	Lithobates catesbeiana
Frog, Chorus, Western	Pseudacris triseriata triseriata (NM,AZ);maculata (NM)
Frog, Leopard, Chiricahua	Lithobates chiricahuensis
Frog, Leopard, Northern	Lithobates pipiens
Frog, Tree, Canyon	Hyla arenicolor
Salamander, Tiger	Ambystoma tigrinum mavortium (NM,TX);nebulosum (NM,AZ)
Spadefoot, Couch's	Scaphiopus couchii
Spadefoot, New Mexico	Spea multiplicata
Spadefoot, Plains	Spea bombifrons
Toad, Great Plains	Anaxyrus cognatus
Toad, Green, Western	Anaxyrus debilis insidior (NM,AZ)
Toad, Red-spotted	Anaxyrus punctatus
Toad, Arizona	Anaxyrus microscaphus microscaphus (NM,AZ)
Toad, Woodhouse's	Anaxyrus woodhousii woodhousii (NM,AZ,TX);australis (NM,AZ,TX)
REPTILES	
Coachwhip	Masticophis flagellum testaceus (NM,TX);piceus (NM)
Lizard, Alligator, Madrean	Elgaria kingii nobilis (NM)
Lizard, Collared	Crotaphytus collaris auriceps (NM);baileyi (NM,AZ);collaris (NM,TX); fuscus (NM,TX);nebrius (AZ)
Lizard, Earless, Greater	Cophosaurus texanus scitulus (NM,TX);texanus (TX)
Lizard, Earless, Lesser	Holbrookia maculata approximans (NM,TX);maculata (NM,TX);elegans (NM);bunkeri (NM)
Lizard, Fence, Eastern	Sceloporus undulatus consobrinus (NM,TX);erythrocheilus (NM);elongatus (NM);garmani (NM,TX);tedbrowni (NM);tristichus (NM)
Lizard, Horned, Roundtail	Phrynosoma modestum
Lizard, Horned, Texas	Phrynosoma cornutum
Lizard, Leopard, Longnose	Gambelia wislizenii wislizenii (NM,AZ,TX);punctata (NM,AZ)
Lizard, Short-horned, Mt.	Phrynosoma hernandesi hernandesi (NM)
Lizard, Side-blotched	Uta stansburiana stejnegeri (NM,TX);uniformis (NM)
Lizard, Spiny, Crevice	Sceloporus poinsettii poinsettii (NM)
Lizard, Spiny, Desert	Sceloporus magister bimaculosus (NM,TX);cephaloflavus (NM)
Lizard, Tree, Northern	Urosaurus ornatus wrighti (NM);schmidti (NM,TX);levis (NM);linearis (NM)
Massasauga, Desert	Sistrurus catenatus edwardsii (NM,AZ)
Racer, Yellowbelly, E.	Coluber constrictor flaviventris (NM,TX);mormon (NM,TX,CO)
Rattlesnake, Blacktail	Crotalus molossus molossus (NM)
Rattlesnake, Diamondback, W.	Crotalus atrox
Rattlesnake, Rock, Banded	Crotalus lepidus klauberi (NM,AZ)
Rattlesnake, Western	Crotalus viridis cerberus (NM);nuntius (NM);viridus (NM,TX);abyssus (AZ)
Skink, Great Plains	Plestiodon obsoletus
Skink, Many-lined	Plestiodon multivirgatus epipleurotus (NM)
Slider, Big Bend	Trachemys gaigeae
Slider, Red-eared	Trachemys scripta elegans (NM)
Snake, Blackhead, Plains	Tantilla nigriceps

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Snake, Blind, Texas	Leptotyphlops dissectus
Snake, Blind, Western	Leptotyphlops humilis segregus (NM)
Snake, Rat, Great Plains	Elaphe guttata emoryi (NM,TX);meahllmorum (NM,TX)
Snake, Garter, Blackneck, W.	Thamnophis cyrtopsis cyrtopsis (NM)
Snake, Garter, Checkered	Thamnophis marcianus marcianus (NM)
Snake, Garter, New Mexico	Thamnophis sirtalis dorsalis (NM)
Snake, Garter, Wandering	Thamnophis elegans arizonae (NM);vagrans (NM)
Snake, Glossy	Arizona elegans elegans (NM,TX);philipi (NM,TX)
Snake, Gopher	Pituophis catenifer affinis (NM);sayi (NM)
Snake, Ground	Sonora semiannulata
Snake, Hognose, W.	Heterodon nasicus nasicus (NM,TX);kennerlyi (NM,AZ,TX)
Snake, Hooknose, Western	Gyalopion canum
Kingsnake, Desert	Lampropeltis getula splendida (NM,AZ)
Snake, Longnose, Texas	Rhinocheilus lecontei lecontei (NM);tessellatus (NM,TX)
Snake, Milk	Lampropeltis triangulum celaenops (NM,TX);amaura (OK);taylori (AZ,CO,UT)
Snake, Night	Hypsiglena torquata jani (NM,TX);loreala (NM)
Snake, Patchnose, Big Bend	Salvadora hexalepis deserticola
Snake, Patchnose, Mountain	Salvadora grahamiae grahamiae (NM)
Snake, Rat, Trans-Pecos	Bogertophis subocularis subocularis (NM)
Snake, Ringneck	Diadophis punctatus arnyi (NM,TX);regalis (NM,TX)
Turtle, Softshell, Spiny	Apalone spiniferus emoryi (NM,TX);hartwegi (NM,TX)
Turtle, Box, Ornate	Terrapene ornata ornata (NM,TX);luteola (NM,AZ,TX)
Turtle, Mud, Yellow	Kinosternon flavescens flavescens (NM,AZ)
Turtle, Painted, Western	Chrysemys picta bellii (NM,AZ)
Turtle, Snapping	Chelydra serpentina serpentina (NM)
Whipsnake, Striped, Desert	Masticophis taeniatus taeniatus (NM)
Whiptail, Checkered, CO	Aspidoscelis tesselata
Whiptail, Grassland, Desert	Aspidoscelis uniparens
Whiptail, New Mexico	Aspidoscelis neomexicana
Whiptail, Western	Aspidoscelis tigris septentrionalis (NM);punctilinealis (NM);marmoratus (NM,TX);reticuloriens (NM)
Whiptail, Spotted, Chihuahuan	Aspidoscelis exsanguis
Whiptail, Striped, Trans-pecos	Aspidoscelis inornatus heptagrammus (NM)
Whiptail, Striped, Woodland	Aspidoscelis inornatus juniperus (NM)
Whiptail, Striped, Plains	Aspidoscelis inornatus llanuras (NM)
Whiptail, Striped, Plateau	Aspidoscelis velox

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
BIRDS	
Avocet, American	Recurvirostra americana
Bittern, American	Botaurus lentiginosus
Bittern, Least	Ixobrychus exilis exilis (NM)
Black-Hawk, Common	Buteogallus anthracinus anthracinus (NM)
Blackbird, Brewer's	Euphagus cyanocephalus
Blackbird, Red-winged	Agelaius phoeniceus nevadensis (NM);fortis (NM);arctolegus (NM);sonoriensis (NM)
Blackbird, Rusty	Euphagus carolinus carolinus (NM)
Blackbird, Yellow-headed	Xanthocephalus xanthocephalus
Bluebird, Eastern	Sialia sialis sialis (NM);fulva (AZ)
Bluebird, Mountain	Sialia currucoides
Bluebird, Western	Sialia mexicana bairdi (NM)
Bobolink	Dolichonyx oryzivorus
Bunting, Indigo	Passerina cyanea
Bunting, Lark	Calamospiza melanocorys
Bunting, Lazuli	Passerina amoena
Bunting, Painted	Passerina ciris pallidior (NM)
Bunting, Varied	Passerina versicolor versicolor (NM);dickeyae (NM)
Bushtit	Psaltriparus minimus plumbeus (NM);lloydi (NM)
Cardinal, Northern	Cardinalis cardinalis superbus (NM);affinis (NM)
Catbird, Gray	Dumetella carolinensis ruficrissa (NM)
Chat, Yellow-breasted	Icteria virens auricollis (NM)
Chickadee, Mountain	Poecile gambeli gambeli (NM)
Coot, American	Fulica americana americana (NM)
Cormorant, Double-crested	Phalacrocorax auritus auritus (NM);albociliatus (NM,AZ)
Cormorant, Neotropic	Phalacrocorax brasilianus
Cowbird, Bronzed	Molothrus aeneus loyei (NM)
Cowbird, Brown-headed	Molothrus ater obscurus (NM);artemisiae (NM)
Crane, Sandhill	Grus canadensis canadensis (NM);tabida (NM);rowani (NM)
Creeper, Brown	Certhia americana montana (NM);americana (NM);albescens (NM)
Crossbill, Red	Loxia curvirostra bendirei (NM);sitkensis (NM);benti (NM);stricklandi (NM)
Crow, American	Corvus brachyrhynchos hesperis (NM);hargravei (NM)
Cuckoo, Yellow-billed	Coccyzus americanus occidentalis (western pop)
Curlew, Long-billed	Numenius americanus americanus (NM)
Dickcissel	Spiza americana
Dipper, American	Cinclus mexicanus unicolor (NM)
Dove, Inca	Columbina inca
Dove, Mourning	Zenaida macroura marginella (NM);carolinensis (NM)
Pigeon, Rock	Columba livia
Dove, White-winged	Zenaida asiatica mearnsi (NM);monticola (NM);grandis (NM)
Dowitcher, Long-billed	Limnodromus scolopaceus
Dowitcher, Short-billed	Limnodromus griseus hendersoni (NM)
Duck, Bufflehead	Bucephala albeola
Duck, Canvasback	Aythya valisineria

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Duck, Gadwall	Anas strepera
Duck, Goldeneye, Barrow's	Bucephala islandica
Duck, Goldeneye, Common	Bucephala clangula americana (NM)
Duck, Mallard	Anas platyrhynchos platyrynchos (NM);diazi (NM,AZ)
Duck, Merganser, Common	Mergus merganser americanus (NM)
Duck, Merganser, Hooded	Lophodytes cucullatus
Duck, Merganser, Red-breasted	Mergus serrator serrator (NM)
Duck, Pintail, Northern	Anas acuta
Duck, Redhead	Aythya americana
Duck, Ring-necked	Aythya collaris
Duck, Ruddy	Oxyura jamaicensis rubida (NM)
Duck, Scaup, Greater	Aythya marila nearctica (NM)
Duck, Scaup, Lesser	Aythya affinis
Duck, Shoveler, Northern	Anas clypeata
Duck, Teal, Blue-winged	Anas discors discors (NM)
Duck, Teal, Cinnamon	Anas cyanoptera septentrionalium (NM)
Duck, Teal, Green-winged	Anas crecca carolinensis (NM)
Duck, Wigeon, American	Anas americana
Duck, Wood	Aix sponsa
Dunlin	Calidris alpina pacifica (NM)
Eagle, Bald	Haliaeetus leucocephalus alascanus (NM)
Eagle, Golden	Aquila chrysaetos canadensis (NM)
Egret, Cattle	Bubulcus ibis ibis (NM)
Egret, Great	Ardea alba egretta (NM)
Egret, Snowy	Egretta thula brewsteri (NM)
Falcon, Aplomado	Falco femoralis septentrionalis (NM)
Falcon, Peregrine	Falco peregrinus anatum
Falcon, Peregrine, Arctic	Falco peregrinus tundrius
Falcon, Prairie	Falco mexicanus
Finch, Cassin's	Carpodacus cassinii
Finch, House	Carpodacus mexicanus frontalis (NM)
Flicker, Northern	Colaptes auratus borealis (NM);collaris (NM)
Flycatcher, Ash-throated	Myiarchus cinerascens cinerascens (NM)
Flycatcher, Brown-crested	Myiarchus tyrannulus magister (NM)
Flycatcher, Cordilleran	Empidonax occidentalis
Flycatcher, Dusky	Empidonax oberholseri
Flycatcher, Gray	Empidonax wrightii
Flycatcher, Crested, Great	Myiarchus crinitus boreus (NM)
Flycatcher, Hammond's	Empidonax hammondii
Flycatcher, Olive-sided	Contopus cooperi
Flycatcher, Scissor-tailed	Tyrannus forficatus
Flycatcher, Vermilion	Pyrocephalus rubinus flammeus (NM);mexicanus (NM)
Flycatcher, Willow	Empidonax traillii brewsteri (NM);adastus (NM)
Flycatcher, Willow, SW.	Empidonax traillii extimus

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Gnatcatcher, Black-tailed	Polioptila melanura melanura (NM)
Gnatcatcher, Blue-gray	Polioptila caerulea amoenissima (NM)
Godwit, Marbled	Limosa fedoa
Goldfinch, American	Spinus tristis pallidus (NM)
Goldfinch, Lesser	Spinus psaltria psaltria (NM);hesperophilus (NM)
Goose, Canada	Branta canadensis moffitti (NM);parvipes (NM);interior (NM)
Goose, Ross's	Chen rossii
Goose, Snow	Chen caerulescens hyperborea (NM)
Goose, White-fronted, Greater	Anser albifrons frontalis (NM)
Goshawk, Northern	Accipiter gentilis atricapillus (NM,AZ);apache (NM,AZ)
Grackle, Common	Quiscalus quiscula versicolor (NM)
Grackle, Great-tailed	Quiscalus mexicanus prosopidicola (NM);monsoni (NM)
Grebe, Clark's	Aechmophorus clarkii
Grebe, Eared	Podiceps nigricollis californicus (NM)
Grebe, Horned	Podiceps auritus cornutus (NM)
Grebe, Pied-billed	Podilymbus podiceps podiceps (NM)
Grebe, Western	Aechmophorus occidentalis
Grosbeak, Black-headed	Pheucticus melanocephalus melanocephalus (NM);maculatus (NM)
Grosbeak, Blue	P. caerulea interfusa (NM)
Grosbeak, Evening	Coccothraustes vespertinus montanus (NM);brooksi (NM);vespertinus (NM)
Grosbeak, Pine	Pinicola enucleator montana (NM)
Grosbeak, Rose-breasted	Pheucticus ludovicianus
Ground-dove, Common	Columbina passerina pallescens (NM)
Grouse, Blue	Dendragapus obscurus
Gull, Bonaparte's	Choricocephalus philadelphia
Gull, California	Larus californicus
Gull, Franklin's	Larus pipixcan
Gull, Herring	Larus argentatus smithsonianus (NM)
Gull, Ring-billed	Larus delawarensis
Harrier, Northern	Circus cyaneus hudsonius (NM)
Hawk, Cooper's	Accipiter cooperii
Hawk, Ferruginous	Buteo regalis
Hawk, Harris's	Parabuteo unicinctus harrisi (NM)
Hawk, Red-tailed	Buteo jamaicensis calurus (NM);harlani (NM);fuertesi (NM)
Hawk, Rough-legged	Buteo lagopus johannis (NM)
Hawk, Sharp-shinned	Accipiter striatus velox (NM)
Hawk, Swainson's	Buteo swainsoni
Hawk, Zone-tailed	Buteo albonotatus
Heron, Blue, Great	Ardea herodias herodias (NM);tregansai (NM)
Heron, Blue, Little	Egretta caerulea caerulea (NM)
Heron, Green	Butorides virescens virescens (NM);anthonyi (NM)
Night-Heron, Black-crowned	Nycticorax nycticorax hoactli (NM)
Heron, Tricolored	Egretta tricolor ruficollis (NM)
Hummingbird, Black-chinned	Archilochus alexandri

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Hummingbird, Broad-tailed	Selasphorus platycercus platycercus (NM)
Hummingbird, Calliope	Stellula calliope
Hummingbird, Rufous	Selasphorus rufus
Hummingbird, Violet-crowned	Amazilia violiceps ellioti (NM)
Ibis, White-faced	Plegadis chihi
Jay, Pinyon	Gymnorhinus cyanocephalus
Jay, Scrub, Western	Aphelocoma californica woodhouseii (NM);californica (NM)
Jay, Steller's	Cyanocitta stelleri macrolopha (NM)
Junco, Dark-eyed	Junco hyemalis hyemalis (NM);aikeni (NM);cismontanus (NM);montanus (NM);mearnsi (NM);oreganus (NM);shufeldti (NM);thurberi (NM);caniceps (NM);dorsalis (NM)
Kestrel, American	Falco sparverius sparverius (NM)
Killdeer	Charadrius vociferus vociferus (NM)
Kingbird, Cassin's	Tyrannus vociferans vociferans (NM)
Kingbird, Eastern	Tyrannus tyrannus
Kingbird, Western	Tyrannus verticalis
Kingfisher, Belted	Megaceryle alcyon
Kinglet, Golden-crowned	Regulus satrapa amoenus (NM);apache (NM)
Kinglet, Ruby-crowned	Regulus calendula calendula (NM)
Kite, White-tailed	Elanus leucurus majusculus (NM)
Kite, Mississippi	Ictinia mississippiensis
Lark, Horned	Eremophila alpestris adusta (NM);leucolaema (NM);occidentalis (NM)
Longspur, Chestnut-collared	Calcarius ornatus
Longspur, McCown's	Rhynchophanes mccownii
Loon, Common	Gavia immer
Loon, Pacific	Gavia pacifica
Magpie, Black-billed	Pica hudsonia
Martin, Purple	Progne subis subis (NM);hesperia (AZ)
Meadowlark, Eastern	Sturnella magna lilianae (NM)
Meadowlark, Western	Sturnella neglecta neglecta (NM);confluenta (NM)
Merlin	Falco columbarius bendirei (NM);columbarius (NM);suckleyi (NM);richardsonii (NM)
Mockingbird, Northern	Mimus polyglottos leucopterus (NM)
Gallinule, Common	Gallinula galeata
Nighthawk, Common	Chordeiles minor henryi (NM);howelli (NM);hesperis (NM);sennetti (NM)
Nighthawk, Lesser	Chordeiles acutipennis texensis (NM)
Nutcracker, Clark's	Nucifraga columbiana
Nuthatch, Pygmy	Sitta pygmaea melanotis (NM)
Nuthatch, Red-breasted	Sitta canadensis
Nuthatch, White-breasted	Sitta carolinensis nelsoni (NM)
Oriole, Hooded	Icterus cucullatus
Oriole, Bullock's	Icterus bullockii
Oriole, Baltimore	Icterus galbula

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Oriole, Orchard	Icterus spurius
Oriole, Scott's	Icterus parisorum
Osprey	Pandion haliaetus carolinensis (NM)
Ovenbird	Seiurus aurocapillus cinereus (NM)
Owl, Barn	Tyto alba pratincola (NM)
Owl, Burrowing	Athene cunicularia hypugaea (NM,AZ)
Owl, Elf	Micrathene whitneyi whitneyi (NM)
Owl, Flammulated	Otus flammeolus
Owl, Horned, Great	Bubo virginianus pallescens (NM);occidentalis (NM)
Owl, Long-eared	Asio otus wilsonianus (NM);tuftsi (NM)
Owl, Pygmy, Northern	Glaucidium gnoma californicum (NM)
Owl, Saw-whet, Northern	Aegolius acadicus acadicus (NM)
Screech-Owl, Western	Megascops kennicottii aikeni (NM);cinerascens (NM)
Owl, Short-eared	Asio flammeus flammeus (NM)
Owl, Spotted, Mexican	Strix occidentalis lucida (NM,AZ)
Parula, Northern	Setophaga americana
Pelican, Brown	Pelecanus occidentalis carolinensis (NM)
Pelican, White, American	Pelecanus erythrorhynchos
Pewee, Greater	Contopus pertinax pallidiventris (NM)
Pewee, Wood, Western	Contopus sordidulus veliei (NM);saturatus (NM)
Phainopepla	Phainopepla nitens lepida (NM)
Phalarope, Red-necked	Phalaropus lobatus
Phalarope, Wilson's	Phalaropus tricolor
Pheasant, Ring-necked	Phasianus colchicus
Phoebe, Black	Sayornis nigricans semiatra (NM)
Phoebe, Eastern	Sayornis phoebe
Phoebe, Say's	Sayornis saya saya (NM);yukonensis (NM)
Pigeon, Band-tailed	Patagioenas fasciata
Pipit, Sprague's	Anthus spragueii
Pipit, American	Anthus rubescens pacificus (NM);alticola (NM);rubescens (NM)
Plover, Black-bellied	Pluvialis squatarola
Plover, Golden, American	Pluvialis dominica dominica (NM)
Plover, Mountain	Charadrius montanus
Plover, Piping	Charadrius melodus circumcinctus (NM)
Plover, Semipalmated	Charadrius semipalmatus
Plover, Snowy	Charadrius nivosus
Poorwill, Common	Phalaenoptilus nuttalli nuttalli (NM)
Pyrrhuloxia	Cardinalis sinuatus sinuatus (NM)
Quail, Gambel's	Callipepla gambelii gambelii (NM);sanus (NM);ignoscens (NM)
Quail, Montezuma	Cyrtonyx montezumae mearnsi (NM)
Quail, Scaled	Callipepla squamata pallida (NM)
Rail, Virginia	Rallus limicola limicola (NM)
Raven, Chihuahuan	Corvus cryptoleucus
Raven, Common	Corvus corax sinuatus (NM)

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Redstart, American	Setophaga ruticilla
Redstart, Painted	Myioborus pictus pictus (NM)
Roadrunner, Greater	Geococcyx californianus
Robin, American	Turdus migratorius migratorius (NM);propinquus (NM)
Sanderling	Calidris alba
Sandpiper, Baird's	Calidris bairdii
Sandpiper, Least	Calidris minutilla
Sandpiper, Pectoral	Calidris melanotos
Sandpiper, Semipalmated	Calidris pusilla
Sandpiper, Solitary	Tringa solitaria solitaria (NM);cinnamomea (NM)
Sandpiper, Spotted	Actitis macularia
Sandpiper, Stilt	Calidris himantopus
Sandpiper, Upland	Bartramia longicauda
Sandpiper, Western	Calidris mauri
Sandpiper, White-rumped	Calidris fuscicollis
Sapsucker, Red-naped	Sphyrapicus nuchalis
Sapsucker, Williamson's	Sphyrapicus thyroideus nataliae (NM)
Sapsucker, Yellow-bellied	Sphyrapicus varius varius (NM)
Shrike, Loggerhead	Lanius ludovicianus excubitorides (NM);sonoriensis (NM);gambeli (NM)
Shrike, Northern	Lanius excubitor invictus (NM)
Siskin, Pine	Spinus pinus
Snipe, Wilson's	Gallinago delicata
Solitaire, Townsend's	Myadestes townsendi townsendi (NM)
Sora	Porzana carolina
Sparrow, Baird's	Ammodramus bairdii
Sparrow, Black-chinned	Spizella atrogularis evura (NM)
Sparrow, Black-throated	Amphispiza bilineata opuntia (NM);deserticola (NM)
Sparrow, Brewer's	Spizella breweri breweri (NM);taverneri (NM)
Sparrow, Cassin's	Peucaea cassinii
Sparrow, Chipping	Spizella passerina arizonae (NM)
Sparrow, Clay-colored	Spizella pallida
Sparrow, Fox	Passerella iliaca zaboria (NM);schistacea (NM);altivagaus (NM)
Sparrow, Golden-crowned	Zonotrichia atricapilla
Sparrow, Grasshopper	Ammodramus savannarum perpallidus (NM)
Sparrow, Harris's	Zonotrichia querula
Sparrow, House	Passer domesticus
Sparrow, Lark	Chondestes grammacus strigatus (NM)
Sparrow, Lincoln's	Melospiza lincolnii lincolnii (NM);alticola (NM)
Sparrow, Rufous-crowned	Aimophila ruficeps scottii (NM);rupicola (AZ)
Sparrow, Sage	Amphispiza belli nevadensis (NM)
Sparrow, Savannah	Passerculus sandwichensis nevadensis (NM);anthinus (NM)
Sparrow, Song	Melospiza melodia juddi (NM);montana (NM);fallax (NM)
Sparrow, Swamp	Melospiza georgiana ericrypta (NM)
Sparrow, Tree, American	Spizella arborea ochracea (NM)

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Sparrow, Vesper	Pooecetes gramineus confinis (NM);altus (NM)
Sparrow, White-crowned	Zonotrichia leucophrys oriantha (NM);gambelii (NM)
Sparrow, White-throated	Zonotrichia albicollis
Starling, European	Sturnus vulgaris
Stilt, Black-necked	Himantopus mexicanus
Swallow, Bank	Riparia riparia riparia (NM)
Swallow, Barn	Hirundo rustica erythrogaster (NM)
Swallow, Cliff	Petrochelidon pyrrhonota tachina (NM);minima (NM)
Swallow, Rough-winged, N.	Stelgidopteryx serripennis serripennis (NM);psammochrous (NM)
Swallow, Tree	Tachycineta bicolor
Swallow, Violet-green	Tachycineta thalassina lepida (NM)
Swan, Tundra	Cygnus columbianus columbianus (NM)
Swift, Chimney	Chaetura pelagica
Swift, White-throated	Aeronautes saxatalis saxatalis (NM)
Tanager, Hepatic	Piranga flava dextra (NM);hepatica (NM)
Tanager, Summer	Piranga rubra rubra (NM);cooperi (NM)
Tanager, Western	Piranga ludoviciana
Tern, Black	Chlidonias niger surinamensis (NM)
Tern, Common	Sterna hirundo hirundo (NM)
Tern, Forster's	Sterna forsteri
Tern, Least	Sternula antillarum athalassos (NM)
Thrasher, Bendire's	Toxostoma bendirei
Thrasher, Brown	Toxostoma rufum longicauda (NM)
Thrasher, Crissal	Toxostoma crissale crissale (NM)
Thrasher, Curve-billed	Toxostoma curvirostre celsum (NM)
Thrasher, Sage	Oreoscoptes montanus
Thrush, Hermit	Catharus guttatus guttatus (NM);nanus (NM);sequoiensis (NM);auduboni (NM);slevini (NM)
Titmouse, Bridled	Baeolophus wollweberi phillipsi (NM)
Titmouse, Juniper	Baeolophus ridgwayi
Towhee, Canyon	Melozone fuscus mesoleucus (NM);mesatus (NM);relictus (AZ)
Towhee, Green-tailed	Pipilo chlorurus
Towhee, Spotted	Pipilo maculatus
Turkey, Wild	Meleagris gallopavo merriami (NM,AZ);intermedia (NM);silvestris (NM)
Verdin	Auriparus flaviceps ornatus (NM)
Vireo, Bell's	Vireo bellii arizonae (NM,AZ);medius (NM)
Vireo, Gray	Vireo vicinior
Vireo, Blue-headed	Vireo solitarius
Vireo, Cassin's	Vireo cassinii
Vireo, Plumbeous	Vireo plumbeus
Vireo, Warbling	Vireo gilvus swainsoni (NM)
Vulture, Turkey	Cathartes aura septentrionalis (NM);teter (NM)
Warbler, Black-and-white	Mniotilta varia
Warbler, Blue, Black-throated	Setophaga caerulescens
Warbler, Grace's	Setophaga graciae

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Warbler, Gray, Black-throated	Setophaga nigrescens
Warbler, Green, Black-throated	Setophaga virens
Warbler, Lucy's	Oreothlypis luciae
Warbler, Macgillivray's	Geothlypis tolmiei tolmiei (NM);monticola (NM)
Warbler, Nashville	Oreothlypis ruficapilla ridgwayi (NM)
Warbler, Orange-crowned	Oreothlypis celata celata (NM);orestera (NM);lutescens (NM)
Warbler, Palm	Setophaga palmarum
Warbler, Prothonotary	Protonotaria citrea
Warbler, Red-faced	Cardellina rubrifrons
Warbler, Tennessee	Oreothlypis peregrina
Warbler, Townsend's	Setophaga townsendi
Warbler, Virginia's	Oreothlypis virginiae
Warbler, Wilson's	Wilsonia pusilla pusilla (NM);pileolata (NM);chryseola (NM)
Warbler, Yellow	Setophaga petechia
Warbler, Yellow-rumped	Setophaga coronata
Waterthrush, Northern	Seiurus noveboracensis
Waxwing, Cedar	Bombycilla cedrorum
Whip-poor-will	Caprimulgus vociferus arizonae (NM)
Willet	Catoptrophorus semipalmatus inornatus (NM)
Woodpecker, Acorn	Melanerpes formicivorus formicivorus (NM)
Woodpecker, Downy	Picoides pubescens leucurus (NM)
Woodpecker, Hairy	Picoides villosus monticolus (NM);leucothorectis (NM);icastus (NM)
Woodpecker, Ladder-backed	Picoides scalaris cactophilus (NM);symplectus (NM)
Woodpecker, Lewis's	Melanerpes lewis
Woodpecker, Red-headed	Melanerpes erythrocephalus caurinus (NM)
Wren, Bewick's	Thryomanes bewickii eremophilus (NM);cryptus (NM)
Wren, Cactus	Campylorhynchus brunneicapillus couesi (NM)
Wren, Canyon	Catherpes mexicanus conspersus (NM)
Wren, House	Troglodytes aedon parkmannii (NM)
Wren, Marsh	Cistothorus palustris iliacus (NM);plesius (NM)
Wren, Rock	Salpinctes obsoletus obsoletus (NM)
Wren, Sedge	Cistothorus platensis stellaris (NM)
Wren, Winter	Troglodytes troglodytes hiemalis (NM);pacificus (NM)
Yellowlegs, Greater	Tringa melanoleuca
Yellowlegs, Lesser	Tringa flavipes
Yellowthroat, Common	Geothlypis trichas campicola (NM);occidentalis (NM);chryseola (NM)

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
MAMMALS	
Badger, American	Taxidea taxus berlandieri (NM,AZ)
Bat, Big-eared, Allen's	Idionycteris phyllotis
Bat, Big-eared, Townsend's, Pale	Corynorhinus townsendii pallescens (NM,AZ)
Bat, Brown, Big	Eptesicus fuscus pallidus (NM,AZ)
Bat, Myotis, Arizona	Myotis occultus
Bat, Myotis, California	Myotis californicus californicus (NM,AZ);stephensi (NM,AZ)
Bat, Free-tailed, Brazilian	Tadarida brasiliensis mexicana (NM,AZ)
Bat, Myotis, Fringed	Myotis thysanodes thysanodes (NM,AZ)
Bat, Hoary	Lasiurus cinereus cinereus (NM,AZ)
Bat, Myotis, Long-eared	Myotis evotis evotis (NM,AZ)
Bat, Myotis, Southwestern	Myotis auriculus apache (NM,AZ)
Bat, Myotis, Long-legged	Myotis volans interior (NM,AZ)
Bat, Pallid	Antrozous pallidus pallidus (NM,AZ)
Bat, Canyon	Parastrellus hesperus hesperus (NM,AZ);maximus (NM)
Bat, Red, Eastern	Lasiurus borealis
Bat, Silver-haired	Lasionycteris noctivagans
Bat, Myotis, Small-footed, W.	Myotis ciliolabrum melanorhinus (NM,AZ)
Bat, Spotted	Euderma maculatum
Bat, Myotis, Yuma	Myotis yumanensis yumanensis (NM,AZ)
Bear, Black	Ursus americanus amblyceps (NM,AZ)
Beaver, American	Castor canadensis frondator (NM);mexicanus (NM);concisor (NM);missouriensis
Bobcat	Lynx rufus baileyi (NM,AZ)
Chipmunk, Cliff	Neotamias dorsalis dorsalis (NM)
Chipmunk, Colorado	Neotamias quadrivittatus quadrivittatus (NM);australis (NM)
Chipmunk, Colorado, Oscura Mtns.	Neotamias quadrivittatus oscuraensis (NM)
Chipmunk, Gray-collared	Neotamias cinereicollis cinereicollis (NM,AZ)
Chipmunk, Gray-collared	Neotamias cinereicollis cinereus (NM)
Coyote	Canis latrans lestes (NM);mearnsi (NM);texensis (NM)
Deer, Mule	Odocoileus hemionus hemionus (NM,AZ);crooki (NM,AZ)
Deer, White-tailed, Coues'	Odocoileus virginianus couesi (NM,AZ)
Prairie Dog, Gunnison's, prairie populations	Cynomys gunnisoni gunnisoni (NM);zuniensis (NM)
Prairie Dog, Gunnison's, montane populations	Cynomys gunnisoni gunnisoni (NM);zuniensis (NM)
Elk	Cervus elaphus nelsoni (NM,AZ)
Fox, Gray, Common	Urocyon cinereoargenteus scottii (NM,AZ)
Fox, Kit	Vulpes macrotis neomexicanus (NM,AZ);macrotis (AZ)
Fox, Red	Vulpes vulpes fulva (NM);macroura (NM)
Gopher, Pocket, Botta's	Thomomys bottae albatus (AZ);alexandrae (AZ);alienus (NM);aureus (NM,AZ);catalinae (AZ);cervinus (AZ);cultellus (NM);desertorum (AZ);fulvus (NM,AZ);lachuguilla (NM);modicus (AZ);pectoralis (NM);peramplus (NM,AZ);pervagus (NM);pinalensis (AZ);planirostris (AZ);pusillus (AZ);rufidulus (NM);toltecus (NM)
Gopher, Pocket, Desert	Geomys arenarius brevirostris (NM)
Gopher, Pocket, Desert	Geomys arenarius arenarius (NM)

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Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Gopher, Pocket, Yellow-faced	Cratogeomys castanops castanops (NM);hirtus (NM);parviceps (NM);perplanus (NM)
Horse, Feral	Equus caballus
Lion, Mountain	Puma concolor azteca (NM,AZ);kaibabensis (NM,AZ);stanleyana (NM)
Mouse, Brush	Peromyscus boylii rowleyi (NM,AZ)
Mouse, Cactus	Peromyscus eremicus anthonyi (NM);eremicus (NM)
Mouse, Deer	Peromyscus maniculatus blandus (NM);rufinus (NM)
Mouse, Grasshopper, Mearn's	Onychomys arenicola
Mouse, Grasshopper, N.	Onychomys leucogaster arcticeps (NM);pallescens (NM);ruidosae (NM)
Mouse, Harvest, Plains	Reithrodontomys montanus montanus (NM);griseus (NM)
Mouse, Harvest, Western	Reithrodontomys megalotis megalotis (NM);aztecus (NM)
Mouse, House	Mus musculus
Mouse, Jumping, Meadow	Zapus hudsonius luteus (NM,AZ)
Mouse, Osgood's	Peromyscus gratus gentilis (NM)
Mouse, Pinyon	Peromyscus truei truei (NM,AZ)
Mouse, Pocket, Apache	Perognathus apache apache (AZ);caryi (AZ)
Mouse, Pocket, Plains	Perognathus flavescens copei (NM);melanotis (NM);relictus (NM)
Mouse, Pocket, Rock	Chaetodipus intermedius intermedius (NM,AZ);crititus (AZ);phasma (AZ);umbrosus (AZ)
Mouse, Pocket, Rock	Chaetodipus intermedius beardi (NM)
Mouse, Pocket, Silky	Perognathus flavus flavus (NM);hopiensis (NM)
Mouse, Rock, Northern	Peromyscus nasutus nasutus (NM,AZ);penicillatus (NM)
Mouse, White-footed	Peromyscus leucopus arizonae (NM);tornillo (NM)
Muskrat, Pecos River	Ondatra zibethicus ripensis (NM)
Oryx	Oryx gazella
Peccary, Collared	Peccari tajacu sonoriensis (NM,AZ);angulatus (NM)
Porcupine, Common	Erethizon dorsatum couesi (NM);epixanthum (NM)
Pronghorn	Antilocapra americana americana (NM,AZ)
Rabbit, Cottontail, Eastern	Sylvilagus floridanus cognatus (NM)
Rabbit, Cottontail, Desert	Sylvilagus audubonii cedrophilus (NM);minor (NM);neomexicana (NM)
Rabbit, Jack, Black-tailed	Lepus californicus melanotis (NM);texianus (NM)
Raccoon, Common	Procyon lotor hirtus (NM);mexicanus (NM);pallidus (NM)
Rat, Cotton, Hispid	Sigmodon hispidus berlandieri (NM);confinis (AZ)
Rat, Cotton, Tawny-bellied	Sigmodon fulviventer minimus (NM,AZ)
Rat, Kangaroo, Banner-tailed, NM	Dipodomys spectabilis baileyi (NM,AZ)
Rat, Kangaroo, Merriam's	Dipodomys merriami ambiguus (NM);olivaceus (NM)
Rat, Kangaroo, Ord's	Dipodomys ordii longipes (NM);medius (NM);montanus (NM);ordii (NM);richardsoni (NM)
Rat, Wood, Mexican	Neotoma mexicana mexicana (NM,AZ);inopinata (NM);pinetorum (NM,AZ);scopulorum (NM)
Rat, Wood, S. Plains	Neotoma micropus canescens (NM)
Rat, Wood, Stephen's	Neotoma stephensi stephensi (NM);relicta (NM)
Rat, Wood, White-throated	Neotoma albigula albigula (NM,AZ);laplataensis (NM);warreni (NM);mernsi (AZ);venusta (AZ)
Ringtail	Bassariscus astutus arizonensis (NM,AZ);flavus (NM);yumanensis (AZ);nevadensis (AZ)

Table F-1. Amphibian, Reptile, Bird, and Mammal Species that Occur in Socorro County, New Mexico, as Reported by the Biota Information System of New Mexico (BISON-M)

Common Name	Scientific Name
Sheep, Barbary	Ammotragus lervia
Sheep, Bighorn, Desert	Ovis canadensis mexicana (delisted pops)
Shrew, Desert, Crawford's	Notiosorex crawfordi crawfordi (NM,AZ)
Shrew, Dusky	Sorex monticolus monticolus (NM);obscurus (NM)
Skunk, Hog-nosed, Common	Conepatus leuconotus mearnsi (NM);venaticus (NM,AZ)
Skunk, Spotted, Western	Spilogale gracilis
Skunk, Striped	Mephitis mephitis estor (NM);hudsonica (NM);varians (NM)
Squirrel, Abert's	Sciurus aberti aberti (NM,AZ);chuscensis (NM,AZ);mimus (NM)
Squirrel, Antelope, Texas	Ammospermophilus interpres
Squirrel, Antelope, White-tailed	Ammospermophilus leucurus pennipes (NM);tersus (AZ);cinnamomeus (AZ);escalante (AZ);leveurus (AZ)
Squirrel, Ground, Spotted	Spermophilus spilosoma canescens (NM);cryptospilotus (NM);marginatus (NM)
Squirrel, Ground, White-Mtns.	Spermophilus tridecemlineatus monticola (NM,AZ)
Squirrel, Red	Tamiasciurus hudsonicus fremonti (NM);mogollonensis (NM,AZ)
Squirrel, Rock	Spermophilus variegatus grammurus (NM,AZ)
Vole, Mogollon	Microtus mogollonensis guadalupensis (NM);mogollonensis (NM,AZ)
Vole, Red-backed, Southern	Clethrionomys gapperi gauti (NM);limitis (NM);arizonensis (AZ)
Weasel, Long-tailed	Mustela frenata arizonensis (NM,AZ);neomexicana (NM,AZ);nevadensis (NM,AZ)

Source: New Mexico Game and Fish Biota Information System of New Mexico (BISON-M). Available at http://www.bison-m.org. Accessed February 28, 2013.

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Appendix G

Ecological Screening Assessment

Table G-1. Ecological Screening Assessment for Surface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
Eagle Picher Site - Primary Manufacturing Area (East of Hwy 408)												
P-01	0-6"	11/26/2012	mg/kg	***35***	U	35	***80****		26	***19***		3
P-02	0-6"	11/26/2012	mg/kg	***34***	U	34	***79****		24	***18***		3
P-03	0-6"	11/26/2012	mg/kg	***36***	U	36	***91****		26	***26***		3
P-04	0-6"	11/26/2012	mg/kg	***35***	U	35	***94****		25	***24***		3
P-05	0-6"	11/26/2012	mg/kg	***35***	U	35	***76****	U	76	***29***		3
P-06	0-6"	11/26/2012	mg/kg	***36***	U	36	***102***		28	***18***		3
P-07	0-6"	11/26/2012	mg/kg	***36***	U	36	***105***		26	***19***		3
P-08	0-6"	11/26/2012	mg/kg	***35***	U	35	***72****	U	72	***36***		3
P-09	0-6"	11/26/2012	mg/kg	***88***		12	***159***		28	***25***		3
P-10	0-6"	11/26/2012	mg/kg	***36***	U	36	***79****	U	79	***16***		3
P-11	0-6"	11/27/2012	mg/kg	***35***	U	35	***73****	U	73	***24***		3
P-12	0-6"	11/27/2012	mg/kg	***34***	U	34	***68****	U	68	***24***		3
P-13	0-6"	11/27/2012	mg/kg	***35***	U	35	***77****	U	77	***29***		3
P-14	0-6"	11/27/2012	mg/kg	***35***	U	35	***78****		25	***23***		3
P-15	0-6"	11/27/2012	mg/kg	***35***	U	35	***107***		26	***27***		3
P-16	0-6"	11/27/2012	mg/kg	***36***	U	36	***85****		27	***28***		3
P-17	0-6"	11/27/2012	mg/kg	***35***	U	35	***73****	U	73	***39***		3
P-18	0-6"	11/27/2012	mg/kg	***35***	U	35	***108***		26	***46***		3
P-19	0-6"	11/27/2012	mg/kg	***38***	U	38	***78****	U	78	***34***		3
P-20	0-6"	11/27/2012	mg/kg	***46***		12	***70****	U	70	***19***		3
P-21	0-6"	11/27/2012	mg/kg	***37***	U	37	***84****	U	84	***15***		3
P-22	0-6"	11/27/2012	mg/kg	***35***	U	35	***82****		26	***36***		3
P-23	0-6"	11/27/2012	mg/kg	***35***	U	35	***75****	U	75	***17***		3
P-24	0-6"	11/27/2012	mg/kg	***35***	U	35	***74****	U	74	***24***		3
P-25	0-6"	11/27/2012	mg/kg	***35***	U	35	***75****	U	75	***52***		3
P-26	0-6"	11/27/2012	mg/kg	***34***	U	34	***66****	U	66	***22***		3
P-27	0-6"	11/27/2012	mg/kg	***35***	U	35	***78****	U	78	***32***		3
P-28	0-6"	11/27/2012	mg/kg	***35***	U	35	***75****		24	***17***		3
P-29	0-6"	11/27/2012	mg/kg	***35***	U	35	***72****	U	72	***36***		3
P-30	0-6"	11/27/2012	mg/kg	***35***	U	35	***72****	U	72	***17***		3
P-31	0-6"	11/27/2012	mg/kg	***36***	U	36	***97****		27	***21***		3
P-32	0-6"	11/27/2012	mg/kg	***35***	U	35	***120***		26	***83***		4
P-33	0-6"	11/27/2012	mg/kg	***35***	U	35	***103***		26	***64***		4
P-34	0-6"	11/27/2012	mg/kg	***35***	U	35	***75****	U	75	***71***		4
P-35	0-6"	11/27/2012	mg/kg	***35***	U	35	***73****	U	73	***186***		5
P-36	0-6"	11/27/2012	mg/kg	***35***	U	35	***73****	U	73	***83***		4
P-37	0-6"	11/27/2012	mg/kg	***38***	U	38	***754***		44	***283***		7
P-37 E1	0-6"	12/4/2012	mg/kg	***40***	U	40	***4610***		96	***5,020***		46
P-37 E2	0-6"	12/5/2012	mg/kg	***35***	U	35	***88****		26	***21***		3
P-37 N1	0-6"	12/5/2012	mg/kg	***40***	U	40	***8,697***		138	***6,166***		55
P-37 N2	0-6"	12/5/2012	mg/kg	***39***	U	39	***1,963***		64	***4,279***		40
P-37 S1	0-6"	12/4/2012	mg/kg	***36***	U	36	***512***		37	***398***		7
P-37 S2	0-6"	12/4/2012	mg/kg	***35***	U	35	***77****		25	***24***		3
P-37 W1	0-6"	12/5/2012	mg/kg	***35***	U	35	***190***		28	***209***		5
P-37 W2	0-6"	12/5/2012	mg/kg	***36***	U	36	***72****	U	72	***35***		3
P-38	0-6"	11/27/2012	mg/kg	***35***	U	35	***73****	U	73	***25***		3
P-39	0-6"	11/27/2012	mg/kg	***37***		12	***70****	U	70	***24***		3
P-40	0-6"	11/27/2012	mg/kg	***35***	U	35	***75****	U	75	***81***		4
P-41	0-6"	11/27/2012	mg/kg	***35***	U	35	***135***		27	***603***		9
P-42	0-6"	11/27/2012	mg/kg	***35***	U	35	***76****		25	***120***		4
P-43	0-6"	11/27/2012	mg/kg	***35***	U	35	***75****	U	75	***187***		5
P-44	0-6"	11/27/2012	mg/kg	***34***	U	34	***83****		24	***32***		3
P-45	0-6"	11/27/2012	mg/kg	***35***	U	35	***71****	U	71	***28***		3
P-46	0-6"	11/27/2012	mg/kg	***35***	U	35	***102***		25	***253***		6
P-47	0-6"	11/27/2012	mg/kg	***35***	U	35	***71****	U	71	***112***		4
P-48	0-6"	11/27/2012	mg/kg	***35***	U	35	***70****	U	70	***27***		3
P-49	0-6"	11/27/2012	mg/kg	***35***	U	35	***73****	U	73	***22***		3
P-50	0-6"	11/27/2012	mg/kg	***35***	U	35	***73****	U	73	***77***		4
P-51	0-6"	11/27/2012	mg/kg	***35***	U	35	***71****	U	71	***79***		4
P-52	0-6"	11/27/2012	mg/kg	***34***	U	34	***70****	U	70	***32***		3
P-53	0-6"	11/27/2012	mg/kg	***34***	U	34	***68****	U	68	***23***		3
P-54	0-6"	11/27/2012	mg/kg	***35***	U	35	***74****	U	74	***22***		3
P-55	0-6"	11/27/2012	mg/kg	***36***	U	36	***78****	U	78	***1,136***		14
P-56	0-6"	11/27/2012	mg/kg	***35***	U	35	***74****	U	74	***67***		4
P-57	0-6"	11/27/2012	mg/kg	***35***	U	35	***74****	U	74	***28***		3

Table G-1. Ecological Screening Assessment for Surface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
P-58	0-6"	11/27/2012	mg/kg	36	U	36	114		28	187		5
P-59	0-6"	11/27/2012	mg/kg	35	U	35	68*	U	68	43		3
P-60	0-6"	11/27/2012	mg/kg	41	U	41	7,647		132	1,199		16
P-61	0-6"	11/27/2012	mg/kg	35	U	35	153		28	55		3
P-62	0-6"	11/27/2012	mg/kg	35	U	35	123		28	55		3
P-63	0-6"	11/27/2012	mg/kg	36	U	36	91*		26	18		3
P-64	0-6"	11/27/2012	mg/kg	36	U	36	72*	U	72	245		6
P-65	0-12"	12/20/2012	mg/kg	N/A			55*		28	2,643		33
P-66	0-12"	12/20/2012	mg/kg	N/A			41*	U	41	80		7
Number of Samples Analyzed				72			74			74		
Number of Samples > Minimum Eco SL				72			74			74		
Number of Detected Samples				3			19			74		
Number of Detected Samples > Minimum Eco SL				3			19			74		
Frequency of Detection				4.2%			26%			100%		
Eagle Picher Site - Secondary (Historical Facility) Area (West of Hwy 408)												
S-01	0-6"	11/28/2012	mg/kg	34	U	34	68*	U	68	17		3
S-02	0-6"	11/28/2012	mg/kg	34	U	34	71*	U	71	9		3
S-03	0-6"	11/28/2012	mg/kg	34	U	34	65*	U	65	16		3
S-04	0-6"	11/28/2012	mg/kg	33	U	33	60*	U	60	17		3
S-05	0-6"	11/28/2012	mg/kg	36	U	36	73*	U	73	13		3
S-06	0-6"	11/28/2012	mg/kg	35	U	35	95*		28	14		3
S-07	0-6"	11/28/2012	mg/kg	35	U	35	69*	U	69	10		3
S-08	0-6"	11/28/2012	mg/kg	35	U	35	71*	U	71	22		3
S-09	0-6"	11/28/2012	mg/kg	35	U	35	139		26	25		3
S-10	0-6"	11/28/2012	mg/kg	35	U	35	77*	U	77	18		3
S-11	0-6"	11/28/2012	mg/kg	35	U	35	86*		24	19		3
S-12	0-6"	11/28/2012	mg/kg	35	U	35	68*	U	68	14		3
S-13	0-6"	11/28/2012	mg/kg	36	U	36	77*	U	77	11		3
S-14	0-6"	11/28/2012	mg/kg	35	U	35	85*		24	22		3
S-15	0-6"	11/28/2012	mg/kg	35	U	35	83*		24	37		3
S-16	0-6"	11/28/2012	mg/kg	35	U	35	69*	U	69	24		3
S-17	0-6"	11/28/2012	mg/kg	34	U	34	69*	U	69	31		3
S-18	0-6"	11/28/2012	mg/kg	35	U	35	82*		25	24		3
S-19	0-6"	11/28/2012	mg/kg	34	U	34	67*	U	67	15		3
S-20	0-6"	11/28/2012	mg/kg	35	U	35	68*	U	68	13		3
S-21	0-6"	11/28/2012	mg/kg	34	U	34	75*		23	16		3
S-22	0-6"	11/28/2012	mg/kg	34	U	34	67*	U	67	13		3
S-23	0-6"	11/28/2012	mg/kg	34	U	34	67*	U	67	35		3
S-24	0-6"	11/28/2012	mg/kg	35	U	35	70*	U	70	112		4
S-25	0-6"	11/28/2012	mg/kg	36	U	36	101		26	36		3
S-26	0-6"	11/28/2012	mg/kg	35	U	35	77*		24	26		3
S-27	0-6"	11/28/2012	mg/kg	35	U	35	73*	U	73	47		3
S-28	0-6"	11/28/2012	mg/kg	34	U	34	65*	U	65	19		3
S-29	0-6"	11/28/2012	mg/kg	34	U	34	66*	U	66	70		3
S-30	0-6"	11/28/2012	mg/kg	35	U	35	74*		24	31		3
S-31	0-6"	11/28/2012	mg/kg	34	U	34	91*		24	47		3
S-32	0-6"	11/28/2012	mg/kg	35	U	35	67*	U	67	205		5
S-33	0-6"	12/4/2012	mg/kg	35	U	35	77*	U	77	21		3
S-34	0-6"	12/4/2012	mg/kg	35	U	35	72*	U	72	25		3
S-35	0-6"	12/4/2012	mg/kg	34	U	34	62*	U	62	12		3
S-36	0-6"	12/4/2012	mg/kg	35	U	35	68*	U	68	15		3
S-37	0-6"	12/4/2012	mg/kg	35	U	35	73*		24	20		3
S-38	0-6"	12/4/2012	mg/kg	34	U	34	64*	U	64	78		4
S-39	0-6"	12/4/2012	mg/kg	35	U	35	94*		27	347		7
S-40	0-6"	12/4/2012	mg/kg	35	U	35	91*		25	123		4
S-41	0-6"	12/4/2012	mg/kg	35	U	35	72*	U	72	21		3
S-42	0-6"	12/4/2012	mg/kg	34	U	34	71*	U	71	17		3
S-43	0-6"	12/4/2012	mg/kg	33	U	33	59*	U	59	14		2
S-44	0-6"	12/4/2012	mg/kg	33	U	33	58*	U	58	10		2
S-45	0-6"	12/4/2012	mg/kg	34	U	34	70*	U	70	45		3
S-46	0-6"	12/4/2012	mg/kg	35	U	35	80*		25	110		4
S-47	0-6"	12/4/2012	mg/kg	35	U	35	72*	U	72	62		3
S-48	0-6"	12/4/2012	mg/kg	34	U	34	68*	U	68	42		3
S-49	0-6"	12/4/2012	mg/kg	34	U	34	63*	U	63	58		3
S-50	0-6"	12/4/2012	mg/kg	34	U	34	63*	U	63	22		3

Table G-1. Ecological Screening Assessment for Surface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
S-51	0-12"	12/4/2012	mg/kg	***35***	U	35	***64****	U	64	***22***		3
S-52	0-6"	12/4/2012	mg/kg	***34***	U	34	***66****	U	66	***18***		3
S-53	0-6"	12/4/2012	mg/kg	***35***	U	35	***75****	U	75	***23***		3
S-54	0-6"	12/4/2012	mg/kg	***34***	U	34	***68****	U	68	***20***		3
S-55	0-6"	12/4/2012	mg/kg	***35***	U	35	***77****	U	77	***40***		3
S-56	0-6"	12/4/2012	mg/kg	***35***	U	35	***80****		24	***16***		3
S-57	0-6"	12/4/2012	mg/kg	***35***	U	35	***68****	U	68	***22***		3
S-58	0-6"	12/4/2012	mg/kg	***35***	U	35	***76****	U	76	***15***		3
S-59	0-6"	12/4/2012	mg/kg	***36***	U	36	***73****	U	73	***21***		3
S-60	0-6"	12/4/2012	mg/kg	***34***	U	34	***66****	U	66	***14***		3
S-62	0-6"	12/4/2012	mg/kg	***36***	U	36	***89****		29	***248***		6
S-63	0-6"	12/4/2012	mg/kg	***34***	U	34	***66****	U	66	***19***		3
S-64	0-6"	12/4/2012	mg/kg	***35***	U	35	***93****		25	***24***		3
S-65	0-12"	12/20/2012	mg/kg	***35***	U	35	***77****		28	***13***		4
Number of Samples Analyzed				64			64			64		
Number of Samples > Minimum Eco SL				64			64			64		
Number of Detected Samples				0			2			64		
Number of Detected Samples > Minimum Eco SL				0			2			64		
Frequency of Detection				0.0%			3%			100%		
Eagle Picher Site - Primary and Secondary Areas Combined												
Number of Samples Analyzed				136			138			138		
Number of Samples > Minimum Eco SL				136			138			138		
Number of Detected Samples				3			21			138		
Number of Detected Samples > Minimum Eco SL				3			21			138		
Frequency of Detection				2.2%			15%			100%		
Ecological Screening Level												
Los Alamos ECORISK Database (version 3.1)												
American kestrel (Avian intermediate carnivore)				2			260			120		
American kestrel (Avian top carnivore)				580			1,200			810		
American robin (Avian herbivore)				4.4			68			21		
American robin (Avian insectivore)				0.29			28			14		
American robin (Avian omnivore)				0.54			40			16		
Deer mouse (Mammalian omnivore)				0.51			110			120		
Desert cottontail (Mammalian herbivore)				9.9			840			370		
Earthworm (Soil-dwelling invertebrate)				140			NA			1,700		
Generic plant (Terrestrial autotroph - producer)				32			NA			120		
Montane shrew (Mammalian insectivore)				0.27			45			72		
Red fox (Mammalian top carnivore)				510			1,800			3,700		
USEPA Region 5												
Eco-SL				0.00222			0.4			0.0537		
USEPA EcoSSLs												
Plants				32			NA			120		
Soil Invertebrates				140			NA			1,700		
Avian				0.77			26			11		
Mammalian				0.36			34			56		
Minimum SSL				**0.00222**			**0.4**			**0.0537**		

* XRF detections of Cr below 100 mg/kg are considered non-quantified because there was no correlation between these results and the confirmational samples analyzed using laboratory methods. Detected above 100 mg/kg are considered semi-quantified because there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation (DBS&A 2013).

N/A = Not analyzed.

NA = Not available.

U = Not detected by XRF device. Concentration reported is standard deviation reported by the XRF device.

SL Sources:

Los Alamos National Laboratory. 2012. ECORISK Database Release 3.1 (October 1, 2012). Available at http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php.

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USEPA. 2008. Ecological Screening Levels for Chromium. Interim Final. OSWER Directive 9285.7-66. March 2005. Revised April 2008. Available at http://www.epa.gov/ecotox/ecossl/.

USEPA. 2005. Ecological Screening Levels for Lead. Interim Final. OSWER Directive 9285.7-70. March 2005. Available at http://www.epa.gov/ecotox/ecossl/.

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Table G-2. Ecological Screening Assessment for Subsurface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
Eagle Picher Site - Primary Manufacturing Area (East of Hwy 408)												
P-37	0-4'	12/5/2012	mg/kg	***35***	U	35	***107***		26	***35***		3
P-37	4-5'	12/5/2012	mg/kg	***35***	U	35	***83****		26	***14***		3
P-55	0-1'	12/20/2012	mg/kg	***35***	U	35	***75****		30	***363***		12
P-55	1-2'	12/19/2012	mg/kg	***35***	U	35	***55****		29	***17***		4
P-55	2-3'	12/19/2012	mg/kg	***35***	U	35	***44****	U	44	***13***		4
P-55	3-4'	12/19/2012	mg/kg	***36***	U	36	***55****		27	***14***		4
P-56	0-4'	12/5/2012	mg/kg	***35***	U	35	***75****	U	75	***150***		5
P-56	4-5'	12/5/2012	mg/kg	***36***	U	36	***81****	U	81	***51***		4
P-57	0-4'	12/19/2012	mg/kg	***35***	U	35	***37****	U	37	***14***		4
P-57	4-5'	12/19/2012	mg/kg	***35***	U	35	***33****	U	33	***15***		4
P-58	0-4'	12/19/2012	mg/kg	***34***	U	34	***43****	U	43	***12***		4
P-58	4-5'	12/19/2012	mg/kg	***38***	U	38	***87****		27	***11***		4
P-60	0-1'	12/19/2012	mg/kg	***35***	U	35	***1,075***		57	***146***		8
P-60	1-2'	12/19/2012	mg/kg	***35***	U	35	***118***		30	***23***		5
P-60	2-3'	12/19/2012	mg/kg	***38***	U	38	***75****		28	***15***		4
P-60	3-4'	12/19/2012	mg/kg	***34***	U	34	***71****		27	***11***		4
P-61	0-4'	12/19/2012	mg/kg	***35***	U	35	***46****		27	***12***		4
P-61	4-5'	12/19/2012	mg/kg	***35***	U	35	***63****		27	***12***		4
P-63	0-4'	12/19/2012	mg/kg	***12***	U	12	***73****		28	***12***		4
P-63	4-5'	12/19/2012	mg/kg	***37***	U	37	***61****		29	***16***		4
P-64	0-4'	12/20/2012	mg/kg	***36***	U	36	***70****	U	70	***115***		4
P-64	4-6'	12/20/2012	mg/kg	***35***	U	35	***72****	U	72	***77***		6
P-65	1-2'	12/20/2012	mg/kg	N/A			***55****		30	***2,133***		29
P-65	2.5-4'	12/20/2012	mg/kg	N/A			***82****		30	***2,809***		34
P-65	4-6'	12/20/2012	mg/kg	N/A			***56****		31	***89***		7
P-66	1-2.5'	12/20/2012	mg/kg	N/A			***58****		27	***48***		5
P-66	2.5-4'	12/20/2012	mg/kg	N/A			***89****		29	***1,548***		25
P-66	4-6'	12/20/2012	mg/kg	N/A			***38****	U	38	***83***		6.5
Number of Samples Analyzed				22			28			28		
Number of Samples > Minimum Eco SL				22			28			28		
Number of Detected Samples				0			3			28		
Number of Detected Samples > Minimum Eco SL				0			3			28		
Frequency of Detection				0.0%			11%			100%		
Eagle Picher Property - Secondary (Historic Facility) Area (West of Hwy 408)												
S-55	0-1'	12/19/2012	mg/kg	***35***	U	35	***41***	U	41	***1,265***		22
S-55	1-2'	12/19/2012	mg/kg	***35***	U	35	***55***		28	***27***		5
S-55	2-3'	12/19/2012	mg/kg	***36***	U	36	***49***		27	***24***		4
S-55	3-4'	12/19/2012	mg/kg	***35***	U	35	***50***		28	***22***		5
S-55	4-5'	12/19/2012	mg/kg	***36***	U	36	***57***		28	***13***		4
S-56	0-4'	12/20/2012	mg/kg	***35***	U	35	***59***		27	***13***		4
S-56	4-5'	12/20/2012	mg/kg	***35***	U	35	***41***	U	41	***14***		4
S-57	0-1'	12/4/2012	mg/kg	***35***	U	35	***78***		25	***20***		3
S-57	0-4'	12/20/2012	mg/kg	***34***	U	34	***41***	U	41	***10***		4
S-57	4-5'	12/20/2012	mg/kg	***35***	U	35	***41***		27	***10***		4
S-58	0-1'	12/4/2012	mg/kg	***35***	U	35	***84***		26	***17***		3
S-58	0-3'	12/19/2012	mg/kg	***35***	U	35	***48***		26	***12***		4
S-58	4-5'	12/19/2012	mg/kg	***40***	U	40	***41***	U	41	***4***	U	4
S-59	0-4'	12/20/2012	mg/kg	***12***	U	12	***45***		29	***15***		4
S-59	4-5'	12/20/2012	mg/kg	***36***	U	36	***41***	U	41	***10***		4
S-60	0-4'	12/20/2012	mg/kg	***35***	U	35	***74***		29	***17***		4
S-60	4-5'	12/20/2012	mg/kg	***35***	U	35	***74***		29	***10***		4
S-61	0-1'	12/20/2012	mg/kg	***35***	U	35	***77***		29	***18***		4
S-61	0-2'	12/20/2012	mg/kg	***35***	U	35	***36***	U	36	***12***		4
S-61	2-4'	12/20/2012	mg/kg	***35***	U	35	***44***	U	44	***15***		4
S-62	0-4'	12/19/2012	mg/kg	***35***	U	35	***38***	U	38	***13***		4
S-62	4-5'	12/19/2012	mg/kg	***35***	U	35	***44***		28	***16***		4
S-63	0-1'	12/4/2012	mg/kg	***35***	U	35	***71***	U	71	***22***		3
S-63	0-4'	12/19/2012	mg/kg	***35***	U	35	***44***		27	***16***		4
S-63	2-3'	12/20/2012	mg/kg	***35***	U	35	***56***		29	***15***		4
S-63	4-5'	12/19/2012	mg/kg	***40***	U	40	***51***		27	***12***		4
S-64	0-4'	12/20/2012	mg/kg	***35***	U	35	***49***		28	***16***		4
S-64	4-5'	12/20/2012	mg/kg	***35***	U	35	***39***	U	39	***9***		4
S-65	1-3'	12/20/2012	mg/kg	***35***	U	35	***68***		31	***13***		3
S-65	3-5'	12/20/2012	mg/kg	***35***	U	35	***72***		28	***12***		4

Table G-2. Ecological Screening Assessment for Subsurface Soils Analyzed by XRF at the Eagle Picher Site

				Cadmium			Chromium			Lead		
Location	Depth	Date	Units	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev	Conc.	Qual.	StdDev
S-65	4-5'	12/20/2012	mg/kg	***35***	U	35	***68***		29	***15***		4
S-66	0-4'	12/20/2012	mg/kg	***35***	U	35	***70***		28	***12***		4
S-66	4-6'	12/20/2012	mg/kg	***35***	U	35	***69***		28	***12***		4
S-67	0-4'	12/20/2012	mg/kg	***35***	U	35	***72***		29	***15***		4
S-67	4-6'	12/20/2012	mg/kg	***34***	U	34	***72***		29	***12***		4
Number of Samples Analyzed				35			35			35		
Number of Samples > Minimum Eco SL				35			35			35		
Number of Detected Samples				0			0			34		
Number of Detected Samples > Minimum Eco SL				0			0			34		
Frequency of Detection				0.0%			0%			97%		
Eagle Picher Property - Primary and Secondary Areas Combined												
Number of Samples Analyzed				57			63			63		
Number of Samples > Minimum Eco SL				57			63			63		
Number of Detected Samples				0			3			62		
Number of Detected Samples > Minimum Eco SL				0			3			62		
Frequency of Detection				0.0%			5%			98%		
Ecological Screening Level												
Los Alamos ECORISK Database (version 3.1)												
American kestrel (Avian intermediate carnivore)				2			260			120		
American kestrel (Avian top carnivore)				580			1,200			810		
American robin (Avian herbivore)				4.4			68			21		
American robin (Avian insectivore)				0.29			28			14		
American robin (Avian omnivore)				0.54			40			16		
Deer mouse (Mammalian omnivore)				0.51			110			120		
Desert cottontail (Mammalian herbivore)				9.9			840			370		
Earthworm (Soil-dwelling invertebrate)				140			NA			1,700		
Generic plant (Terrestrial autotroph - producer)				32			NA			120		
Montane shrew (Mammalian insectivore)				0.27			45			72		
Red fox (Mammalian top carnivore)				510			1,800			3,700		
USEPA Region 5												
Eco-SL				0.00222			0.4			0.0537		
USEPA EcoSSLs												
Plants				32			NA			120		
Soil Invertebrates				140			NA			1,700		
Avian				0.77			26			11		
Mammalian				0.36			34			56		
Minimum SSL				**0.00222**			**0.4**			**0.0537**		

* XRF detections of Cr below 100 mg/kg are considered non-quantified because there was no correlation between these results and the confirmational samples analyzed using laboratory methods. Detected above 100 mg/kg are considered semi-quantified because there were not enough higher XRF detections with confirmatory laboratory results to calculate a meaningful correlation (DBS&A 2013).

N/A = Not analyzed.

NA = Not available.

U = Not detected by XRF device. Concentration reported is standard deviation reported by the XRF device.

SL Sources:

Los Alamos National Laboratory. 2012. ECORISK Database Release 3.1 (October 1, 2012). Available at http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php.

USEPA. 2003. RCRA Ecological Screening Levels. USEPA Region 5. August 22, 2003. Available at http://www.epa.gov/Region5/waste/cars/esl.htm.

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USEPA. 2008. Ecological Screening Levels for Chromium. Interim Final. OSWER Directive 9285.7-66. March 2005. Revised April 2008. Available at http://www.epa.gov/ecotox/ecossl/.

USEPA. 2005. Ecological Screening Levels for Lead. Interim Final. OSWER Directive 9285.7-70. March 2005. Available at http://www.epa.gov/ecotox/ecossl/.

Table G-3. Ecological Screening Assessment for Soils Analyzed by Laboratory Methods at the Eagle Picher Site

				Cadmium		Chromium (Total)		Chromium +6		Lead		PCE		TCE		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113	
Location	Depth	Date	Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
Eagle Picher Site - Surface Soils at the Primary Manufacturing Area (East of Hwy 408)																											
P-3	0-6"	11/30/2012	mg/kg	***0.72***		***14***		2.0	U	***11***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-10	0-6"	11/30/2012	mg/kg	***0.88***		***16***		2.0	U	***8.3***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-16	0-6"	11/30/2012	mg/kg	***0.21***		***14***		2.0	U	***13***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-27	0-6"	11/30/2012	mg/kg	***0.51***		***16***		2.0	U	***23***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-35	0-6"	11/30/2012	mg/kg	***1.2***		***14***		2.0	U	***200***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-37	0-6"	11/30/2012	mg/kg	***1.7***		***550***		4.8		***360***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-42	0-6"	11/30/2012	mg/kg	***1.0***		***14***		10	U	***120***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-55	0-6"	11/30/2012	mg/kg	***0.70***		***15***		2.0	U	***1,500***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-60	0-6"	11/30/2012	mg/kg	***7.8***		***3,000***		16		***1,700***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-63	0-12"	11/30/2012	mg/kg	***0.20***	U	***12***		2.0	U	***12***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-65	0-1'	11/30/2012	mg/kg	***1.2***		***15***		10	U	***98***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
P-66	0-1'	11/30/2012	mg/kg	***5.8***		***3,300***		15		***1,100***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
Number of Samples Analyzed				12		12		12		12																	
Number of Samples > Minimum Eco SL				12		12		0		12																	
Number of Detected Samples				11		12		3		12																	
Number of Detected Samples > Minimum Eco SL				11		12		0		12																	
Frequency of Detection				92%		100%		25%		100%																	
Eagle Picher Site - Surface Soils at the Secondary Area (Historical Facility, West of Hwy 408)																											
S-7	0-6"	11/30/2012	mg/kg	***0.20***	U	***12***		2.0	U	***7.8***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-13	0-6"	11/30/2012	mg/kg	***0.10***	U	***7.3***		2.0	U	***7.7***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-20	0-6"	11/30/2012	mg/kg	***0.10***	U	***8.6***		2.0	U	***5.4***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-30	0-6"	11/30/2012	mg/kg	***0.20***	U	***13***		2.0	U	***21***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-46	0-6"	11/30/2012	mg/kg	***0.20***	U	***14***		2.0	U	***32***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-51	0-12"	11/30/2012	mg/kg	***0.22***		***9.3***		2.0	U	***22***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
S-65	0-12"	11/30/2012	mg/kg	***0.20***	U	***16***		2.0	U	***6.1***		N/A		N/A		N/A		N/A		N/A		N/A		N/A		N/A	
Number of Samples Analyzed				7		7		7		7																	
Number of Samples > Minimum Eco SL				7		7		0		7																	
Number of Detected Sample				1		7		0		7																	
Number of Detected Samples > Minimum Eco SL				1		7		0		7																	
Frequency of Detection				14%		100%		0%		100%																	
Eagle Picher Site - Subsurface Soils at the Primary Manufacturing Area (East of Hwy 408)																											
P-60	5'	12/4/2012	mg/kg	N/A		N/A		N/A		N/A		0.048	U	0.048	U	0.097	U	0.048	U	0.048	U	0.048	U	0.048	U	N/A	
P-62	5'	12/4/2012	mg/kg	N/A		N/A		N/A		N/A		0.046	U	0.046	U	0.092	U	0.046	U	0.046	U	0.046	U	0.046	U	N/A	
Number of Samples Analyzed												2		2		2		2		2		2		2			
Number of Samples> Minimum Eco SL												0		0		0		0		0		0		0			
Number of Detected Samples												0		0		0		0		0		0		0			
Number of Detected Samples > Minimum Eco SL												0		0		0		0		0		0		0			
Frequency of Detection												0%		0%		0%		0%		0%		0%		0%			
Eagle Picher Site - Primary and Secondary Areas Combined (Surface Soils for Metals, Subsurface Soils for VOCs)																											
Number of Samples Analyzed				19		19		19		19		2		2		2		2		2		2		2			
Number of Samples > Minimum Eco SL				19		19		0		19		0		0		0		0		0		0		0			
Number of Detected Sample				12		19		3		19		0		0		0		0		0		0		0			
Number of Detected Samples > Minimum Eco SL				12		19		0		19		0		0		0		0		0		0		0			
Frequency of Detection				63%		100%		16%		100%		0%		0%		0%		0%		0%		0%		0%			

Table G-3. Ecological Screening Assessment for Soils Analyzed by Laboratory Methods at the Eagle Picher Site

	Cadmium		Chromium (Total)		Chromium +6		Lead		PCE		TCE		1,1-DCA		1,1-DCE		cis-1,2-DCE		Toluene		1,1,1-TCA		Freon 113	
Location Depth Date Units	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.	Conc.	Qual.
Ecological Screening Level																								
Los Alamos ECORISK Database (version 3.1)																								
American kestrel (Avian intermediate carnivore)	2		260		2,200		120		NA		NA		NA		NA		NA		NA		NA		NA	
American kestrel (Avian top carnivore)	580		1,200		5,400		810		NA		NA		NA		NA		NA		NA		NA		NA	
American robin (Avian herbivore)	4.4		68		280		21		NA		NA		NA		NA		NA		NA		NA		NA	
American robin (Avian insectivore)	0.29		28		190		14		NA		NA		NA		NA		NA		NA		NA		NA	
American robin (Avian omnivore)	0.54		40		220		16		NA		NA		NA		NA		NA		NA		NA		NA	
Deer mouse (Mammalian omnivore)	0.51		110		860		120		0.36		55		210		14		25		25		400		NA	
Desert cottontail (Mammalian herbivore)	9.9		840		3,200		370		8.8		170		370		40		58		61		1,800		NA	
Earthworm (Soil-dwelling invertebrate)	140		NA		*see note*		1,700		NA		NA		NA		NA		NA		NA		NA		NA	
Generic plant (Terrestrial autotroph - producer)	32		NA		*see note*		120		10		NA		NA		NA		NA		200		NA		NA	
Montane shrew (Mammalian insectivore)	0.27		45		280		72		0.18		42		290		11		23		23		260		NA	
Red fox (Mammalian top carnivore)	510		1,800		7,200		3,700		31		6,400		85,000		2,900		7,100		3,100		50,000		NA	
USEPA Region 5																								
Eco SL	0.00222		0.4		NA		0.0537		9.92		12.4		20.1		8.28		0.784		5.45		29.8		NA	
USEPA EcoSSLs																								
Plants	32		NA		NA		120		NA		NA		NA		NA		NA		NA		NA		NA	
Soil Invertebrates	140		NA		NA		1700		NA		NA		NA		NA		NA		NA		NA		NA	
Avian	0.77		26		NA		11		NA		NA		NA		NA		NA		NA		NA		NA	
Mammalian	0.36		34		130		56		NA		NA		NA		NA		NA		NA		NA		NA	
Minimum SSL	**0.00222**		**0.4**		**130**		**0.0537**		**0.18**		**12.4**		**20.1**		**8.28**		**0.784**		**5.45**		**29.8**		**NA**	

N/A = Not analyzed.

NA = Not available.

U = Not detected. Concentration reported is reporting limit (PQL).

Note: The earthworm and generic plant SLs from the Los Alamos Ecorisk Database were not used. These SLs were based on studies completed in the 1980s; however, USEPA's Eco-SSL document for chromium (updated in 2008) determined that there was insufficient data to develop soil invertebrate and plant Eco-SSLs for chromium +6.

SL Sources:

Los Alamos National Laboratory. 2012. ECORISK Database Release 3.1 (October 1, 2012). Available at http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php

USEPA. 2003. RCRA Ecological Screening Levels. USEPA Region 5. August 22, 2003. Available at http://www.epa.gov/Region5/waste/cars/esl.htm

USEPA. 2005. Ecological Screening Levels for Cadmium. Interim Final. OSWER Directive 9285.7-65. March 2005. Available at http://www.epa.gov/ecotox/ecossl/

USEPA. 2008. Ecological Screening Levels for Chromium. Interim Final. OSWER Directive 9285.7-66. March 2005. Revised April 2008. Available at http://www.epa.gov/ecotox/ecossl/

USEPA. 2005. Ecological Screening Levels for Lead. Interim Final. OSWER Directive 9285.7-70. March 2005. Available at http://www.epa.gov/ecotox/ecossl/

Appendix H

Ecological Risk Calculations

Table H-1. Wildlife Exposure Parameters

Receptor	Parameter	Value	Basis	Reference
House Sparrow (*Passer domesticus*)	Incidental soil ingestion rate (kg/d dw)	0.0005	Assumes 9.3% soil in diet based on food ingestion rate (based on wild turkey)	Beyer et al. 1994
	Daily Food Ingestion Rate (kg/d dw)	0.005	Assumes 50% of diet is terrestrial invertebrates (earthworms and insects) Assumes 50% of diet is terrestrial plants	Nagy 2001
	Body Weight (kg)	0.028	Range 27-29 g	Cornell 2013
Desert Shrew (*Nitiosorex crawfordi*)	Incidental soil ingestion rate (kg/d dw)	0.0001	Assumes 13% soil in diet based on food ingestion (based on short-tailed shrew)	U.S. Army 2004
	Daily Food Ingestion Rate (kg/d dw)	0.001	Assumes 100% of diet is terrestrial invertebrates (earthworms and insects)	Nagy 2001; U.S. Army 2004
	Body Weight (kg)	0.004	Average for adults; range of 3.5-4.5 g	ARAMS 2004
Coyote (*Canis latrans*)	Incidental soil/sediment ingestion rate (kg/d dw)	0.011	Assumes 2.8% soil in diet based on food ingestion (based on red fox)	Beyer et al. 1994
	Daily Food Ingestion Rate (kg/d dw)	0.40	Assumes 100% of diet is from birds and mammals	Nagy 2001
	Body Weight (kg)	12.5	Average for adults; range of 7.7 - 15.9 kg	ORNL 1997; U.S. Army 2004

Notes:

kg/d dw = kilograms per day dry weight.

Beyer, W.N., E. Conner, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. J. Wildl. Manage. 58:375-382.

Cornell. 2013. Cornell Lab of Ornithology: All About Birds. Accessed at: http://www.allaboutbirds.org/guide/house_sparrow/lifehistory.

Nagy, K.A. 2001. Food requirements of wild animals: Predictive equations for free-living mammals, reptiles, and birds. Nutr. Abstr. Rev. Ser. B 71:21R-31R.

All omnivorous birds: Food ingestion (kg/d dw) = 0.670*(Body Weight)^0.627.

All omnivorous mammals: Food ingestion (kg/d dw) = 0.432*(Body Weight)^0.678.

All carnivorous mammals: Food ingestion (kg/d dw) = 0.153*(Body Weight)^0.834.

ORNL. 1997. Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants. ORNL/TM-13391.

U.S. Army. 2004. Development of Terrestrial Exposure and Bioaccumulation Information for the Army Risk Assessment Modeling System (ARAMS). U.S. Army Center for Health Promotion and Preventive Medicine.

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Table H-2. Wildlife Toxicity Reference Values

Chemical	Avian TRV (mg/kg-d)		Reference	Mammalian TRV (mg/kg-d)		Reference
	NOAEL	LOAEL		NOAEL	LOAEL	
Metals						
Cadmium	1.47	2.37	USEPA EcoSSLs	0.77	0.909	USEPA EcoSSLs
Chromium	2.66	2.78	USEPA EcoSSLs	2.4	2.82	USEPA EcoSSLs
Lead	1.63	1.94	USEPA EcoSSLs	4.7	5.0	USEPA EcoSSLs

Notes:

NOAEL = No Observed Adverse Effect Level as reported in EcoSSL document, unless otherwise noted.

LOAEL = Lowest Observed Adverse Effect Level, lowest bounded LOAEL above the NOAEL as reported in EcoSSL document for studies evaluating reproduction or growth effects. For the mammalian LOAEL for chromium, the lowest LOAEL reported from studies on reproduction, growth, or survival effects was used.

USEPA EcoSSLs (USEPA 2005-2008) available at http://www.epa.gov/ecotox/ecossl/.

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Table H-3. Estimated Exposure Concentrations (EECs) for the Eagle Picher Site - All Laboratory Surface Soils Data

	Eagle Picher Property Soil EECs		
Chemical	**95% UCL Concentration[a] (mg/kg)**	**Sample Size**	**Statistic [b]**
Metals			
Cadmium	4.20	19	97.5% KM (Chebyshev) UCL
Chromium	2,627	19	99% Chebyshev (Mean, Sd) UCL
Lead	1,491	19	99% Chebyshev (Mean, Sd) UCL
XRF Lead Data			
All Surface and Subsurface Samples	406	201	95% KM (Chebyshev) UCL
All Gridded Surface and Subsurface Samples	82.3	110	95% Chebyshev (Mean, Sd) UCL

[a] 95% UCL = 95% upper confidence level on the mean.

[b] EECs estimated using USEPA's ProUCL (V4.1.01) software, when sample sizes were ≥ 5.

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Table H-4. Risk Estimates for House Sparrow - All Laboratory Surface Soils Data

		Predicted Concentrations				Exposure				NOAEL		LOAEL	
Chemical	Soil Concentration (mg/kg dw)	Invertebrate (mg/kg dw)	Model Source	Plant (mg/kg dw)	Model Source	Soil Ingestion (mg/kg-d)	Invertebrate Ingestion (mg/kg-d)	Plant Ingestion (mg/kg-d)	Total (mg/kg-d)	Toxicity Criteria (mg/kg-d)	Hazard Quotient	Toxicity Criteria (mg/kg-d)	Hazard Quotient
Metals													
Cadmium	4.20	25.93	a	1.36	a	7.6E-02	2.5E+00	1.3E-01	2.7E+00	1.47	1.8	2.37	1.1
Chromium	2,627	803.86	a	107.71	a	4.7E+01	7.8E+01	1.0E+01	1.4E+02	2.66	50.9	2.78	48.7
Lead	1,491	292.63	a	15.98	a	2.7E+01	2.8E+01	1.5E+00	5.7E+01	1.63	34.7	1.94	29.2
										Total HI	87.5		79.0
XRF Lead Data													
All Surface and Subsurface Samples	406	102.44	a	7.70	a	7.3E+00	9.9E+00	7.4E-01	1.8E+01	1.63	11.0	1.94	9.3
										Total HI	63.7		59.1
All Gridded Surface and Subsurface Samples	82.3	28.25	a	3.15	a	1.5E+00	2.7E+00	3.0E-01	4.5E+00	1.63	2.8	1.94	2.3
										Total HI	55.5		52.2

Model Source:

a = Soil to Invertebrate (earthworm) uptake equations obtained from USEPA EcoSSLs (http://www.epa.gov/ecotox/ecossl/).

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Table H-5. Risk Estimates for Desert Shrew - All Laboratory Surface Soils Data

Chemical	Soil Concentration (mg/kg dw)	Predicted Concentrations Invertebrate (mg/kg dw)	Predicted Concentrations Model Source	Exposure Soil Ingestion (mg/kg-d)	Exposure Invertebrate Ingestion (mg/kg-d)	Exposure Total (mg/kg-d)	NOAEL Toxicity Criteria (mg/kg-d)	NOAEL Hazard Quotient	LOAEL Toxicity Criteria (mg/kg-d)	LOAEL Hazard Quotient
Metals										
Cadmium	4.20	25.93	a	1.5E-01	7.2E+00	7.3E+00	0.77	9.5	0.91	8.1
Chromium	2,627	803.86	a	9.4E+01	2.2E+02	3.2E+02	2.40	131.9	2.82	112.3
Lead	1,491	292.63	a	5.4E+01	8.1E+01	1.3E+02	4.70	28.6	5.00	26.9
							Total HI	170.1		147.2
XRF Lead Data										
All Surface and Subsurface Samples	406	102.44	a	1.5E+01	2.8E+01	4.3E+01	4.70	9.1	5.00	8.6
							Total HI	150.6		128.9
All Gridded Surface and Subsurface Samples	82.3	28.25	a	3.0E+00	7.8E+00	1.1E+01	4.70	2.3	5.00	2.2
							Total HI	143.7		122.5

Model Source:

a = Soil to Invertebrate (earthworm) uptake equations obtained from USEPA EcoSSLs (http://www.epa.gov/ecotox/ecossl/).

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Table H-6. Risk Estimates for Coyote - All Laboratory Surface Soils Data

Chemical	Sediment Concentration (mg/kg dw)	Predicted Concentrations		Exposure			NOAEL		LOAEL	
		Small Mammal (mg/kg dw)	Model Source	Soil Ingestion (mg/kg-d)	Small Mammal Ingestion (mg/kg-d)	Total (mg/kg-d)	Toxicity Criteria (mg/kg-d)	Hazard Quotient	Toxicity Criteria (mg/kg-d)	Hazard Quotient
Metals										
Cadmium	4.20	0.56	a	3.8E-03	1.8E-02	2.2E-02	0.77	0.0	0.91	0.0
Chromium	2,627	75.02	a	2.4E+00	2.4E+00	4.7E+00	2.40	2.0	2.82	1.7
Lead	1,491	27.31	a	1.3E+00	8.7E-01	2.2E+00	4.70	0.5	5.00	0.4
							Total HI	2.5		2.1
XRF Lead Data										
All Surface and Subsurface Samples	406	15.37	a	3.6E-01	4.9E-01	8.5E-01	4.70	0.2	5.00	0.2
							Total HI	2.2		1.9
All Gridded Surface and Subsurface Samples	82.3	7.59	a	7.4E-02	2.4E-01	3.2E-01	4.70	0.1	5.00	0.1
							Total HI	2.1		1.8

Model Source:
a = Soil to Small Mammal uptake equations obtained from USEPA EcoSSLs (http://www.epa.gov/ecotox/ecossl/).

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Table H-7. Risk Estimates for Terrestrial Plants and Soil Invertebrates - All Laboratory Surface Soils Data

	Soil EEC	Soil Benchmarks		Hazard Quotients (HQs)			
Chemical	**95% UCL Concentration (mg/kg)**	**Terrestrial Plant (mg/kg)**	**Soil Invertebrate (mg/kg)**	**Terrestrial Plant**	**Number of Detected Samples Above Benchmark**	**Soil Invertebrate**	**Number of Detected Samples Above Benchmark**
Metals							
Cadmium	4.20	32	140	0.1	0 of 19	0.0	0 of 19
Chromium	2,627	-	560	-	-	4.7	2 of 19
Lead	1,491	120	1700	12.4	5 of 19	0.9	0 of 19
XRF Lead Data							
All Surface and Subsurface Samples	406	120	1700	3.4	26 of 201	0.2	6 of 201
All Gridded Surface and Subsurface Samples	82.3	120	1700	0.7	8 of 110	0.0	0 of 110

Notes:

Soil benchmarks from USEPA Eco-SSLs (USEPA 2005-2008) available at http://www.epa.gov/ecotox/ecossl/, except for chromium in soil invertebrates.

Soil benchmark for chromium in soil invertebrates from Lock, K. and C.R. Janssen. 2002. Ecotoxicity of chromium (III) to *Eisenia fetida* , *Enchytraeus albidus* , and *Folsomia candida* . Ecotoxicology and Environmental Safety 51:203-205.

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Table H-8. Estimated Exposure Concentrations (EECs) for the Eagle Picher Site - Reduced Set of Laboratory Surface Soils Data

	Eagle Picher Property Soil EECs		
Chemical	**95% UCL Concentration[a] (mg/kg)**	**Sample Size**	**Statistic [b]**
Metals			
Cadmium	0.619	14	95% KM (t) UCL
Chromium	14.18	14	95% Student's-t UCL
Lead	99.95	14	95% Chebyshev (Mean, Sd) UCL
XRF Lead Data			
All Surface and Subsurface Samples	66.6	172	95% KM (BCA) UCL
All Gridded Surface and Subsurface Samples	80.0	107	95% Chebyshev (Mean, Sd) UCL

[a] 95% UCL = 95% upper confidence level on the mean.

[b] EECs estimated using USEPA's ProUCL (V4.1.01) software, when sample sizes were ≥ 5.

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Table H-9. Risk Estimates for House Sparrow - Reduced Set of Laboratory Surface Soils Data

Chemical	Soil Concentration (mg/kg dw)	Predicted Concentrations				Exposure				NOAEL		LOAEL	
		Invertebrate (mg/kg dw)	Model Source	Plant (mg/kg dw)	Model Source	Soil Ingestion (mg/kg-d)	Invertebrate Ingestion (mg/kg-d)	Plant Ingestion (mg/kg-d)	Total (mg/kg-d)	Toxicity Criteria (mg/kg-d)	Hazard Quotient	Toxicity Criteria (mg/kg-d)	Hazard Quotient
Metals													
Cadmium	0.619	5.66	a	0.48	a	1.1E-02	5.5E-01	4.6E-02	6.0E-01	1.47	0.4	2.37	0.3
Chromium	14.2	4.34	a	0.58	a	2.5E-01	4.2E-01	5.6E-02	7.3E-01	2.66	0.3	2.78	0.3
Lead	99.95	33.05	a	3.51	a	1.8E+00	3.2E+00	3.4E-01	5.3E+00	1.63	3.3	1.94	2.7
										Total HI	4.0		3.3
XRF Lead Data													
All Surface and Subsurface Samples	66.6	23.82	a	2.79	a	1.2E+00	2.3E+00	2.7E-01	3.8E+00	1.63	2.3	1.94	1.9
										Total HI	3.0		2.5
All Gridded Surface and Subsurface Samples	80.0	27.62	a	3.10	a	1.4E+00	2.7E+00	3.0E-01	4.4E+00	1.63	2.7	1.94	2.3
										Total HI	3.4		2.8

Model Source:

a = Soil to Invertebrate (earthworm) uptake equations obtained from USEPA EcoSSLs (http://www.epa.gov/ecotox/ecossl/).

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Table H-10. Risk Estimates for Desert Shrew - Reduced Set of Laboratory Surface Soils Data

Chemical	Soil Concentration (mg/kg dw)	Predicted Concentrations Invertebrate (mg/kg dw)	Predicted Concentrations Model Source	Exposure Soil Ingestion (mg/kg-d)	Exposure Invertebrate Ingestion (mg/kg-d)	Exposure Total (mg/kg-d)	NOAEL Toxicity Criteria (mg/kg-d)	NOAEL Hazard Quotient	LOAEL Toxicity Criteria (mg/kg-d)	LOAEL Hazard Quotient
Metals										
Cadmium	0.619	5.66	a	2.2E-02	1.6E+00	1.6E+00	0.77	2.1	0.91	1.7
Chromium	14.2	4.34	a	5.1E-01	1.2E+00	1.7E+00	2.40	0.7	2.82	0.6
Lead	99.95	33.05	a	3.6E+00	9.1E+00	1.3E+01	4.70	2.7	5.00	2.5
							Total HI	5.5		4.9
XRF Lead Data										
All Surface and Subsurface Samples	66.6	23.82	a	2.4E+00	6.6E+00	9.0E+00	4.70	1.9	5.00	1.8
							Total HI	4.7		4.1
All Gridded Surface and Subsurface Samples	80.0	27.62	a	2.9E+00	7.6E+00	1.1E+01	4.70	2.2	5.00	2.1
							Total HI	5.0		4.5

Model Source:

a = Soil to Invertebrate (earthworm) uptake equations obtained from USEPA EcoSSLs (http://www.epa.gov/ecotox/ecossl/).

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Table H-11. Risk Estimates for Coyote - Reduced Set of Laboratory Surface Soils Data

Chemical	Sediment Concentration (mg/kg dw)	Predicted Concentrations		Exposure			NOAEL		LOAEL	
		Small Mammal (mg/kg dw)	Model Source	Soil Ingestion (mg/kg-d)	Small Mammal Ingestion (mg/kg-d)	Total (mg/kg-d)	Toxicity Criteria (mg/kg-d)	Hazard Quotient	Toxicity Criteria (mg/kg-d)	Hazard Quotient
Metals										
Cadmium	0.619	0.23	a	5.5E-04	7.2E-03	7.8E-03	0.77	0.0	0.91	0.0
Chromium	14.2	1.63	a	1.3E-02	5.2E-02	6.5E-02	2.40	0.0	2.82	0.0
Lead	99.95	8.27	a	8.9E-02	2.6E-01	3.5E-01	4.70	0.1	5.00	0.1
							Total HI	0.1		0.1
XRF Lead Data										
All Surface and Subsurface Samples	66.6	6.91	a	6.0E-02	2.2E-01	2.8E-01	4.70	0.1	5.00	0.1
							Total HI	0.1		0.1
All Gridded Surface and Subsurface Samples	80.0	7.49	a	7.2E-02	2.4E-01	3.1E-01	4.70	0.1	5.00	0.1
							Total HI	0.1		0.1

Model Source:
a = Soil to Small Mammal uptake equations obtained from USEPA EcoSSLs (http://www.epa.gov/ecotox/ecossl/).

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Table H-12. Risk Estimates for Terrestrial Plants and Soil Invertebrates - Reduced Set of Laboratory Surface Soils Data

	Soil EEC	Soil Benchmarks		Hazard Quotients (HQs)			
Chemical	**95% UCL Concentration (mg/kg)**	**Terrestrial Plant (mg/kg)**	**Soil Invertebrate (mg/kg)**	**Terrestrial Plant**	**Number of Detected Samples Above Benchmark**	**Soil Invertebrate**	**Number of Detected Samples Above Benchmark**
Metals							
Cadmium	0.619	32	140	0.0	0 of 14	0.0	0 of 14
Chromium	14.2	-	560	-	-	0.0	0 of 14
Lead	99.95	120	1700	0.8	1 of 14	0.1	0 of 14
XRF Lead Data							
All Surface and Subsurface Samples	66.6	120	1700	0.6	12 of 172	0.0	1 of 172
All Gridded Surface and Subsurface Samples	80.0	120	1700	0.7	7 of 107	0.0	0 of 107

Notes:

Soil benchmarks from USEPA Eco-SSLs (USEPA 2005-2008) available at http://www.epa.gov/ecotox/ecossl/, except for chromium in soil invertebrates.

Soil benchmark for chromium in soil invertebrates from Lock, K. and C.R. Janssen. 2002. Ecotoxicity of chromium (III) to *Eisenia fetida* , *Enchytraeus albidus* , and *Folsomia candida* . Ecotoxicology and Environmental Safety 51:203-205.

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