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Phase 2 Removal Site Evaluation Work Plan for National Zinc Site, Cherryvale, Kansas

Phase 2 Removal Site Evaluation Work Plan for National Zinc Site, Cherryvale, Kansas

Prepared for

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Acronyms and Abbreviations

COC	chain of custody
CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
ESI	expanded site inspection
former smelter property	former National Zinc Smelter Property
GIS	geographic information system
GPS	global positioning system
HSP	health and safety plan
KDHE	Kansas Department of Health and Environment
PNL	Project Navigator Ltd.
QAPP	quality assurance project plan
Respondents	United States Steel Corporation and Citigroup Global Market Holdings, Inc.
ROW	right-of-way
RSE	removal site evaluation
SACO	Second Amendment to Consent Order
Site	the corporate limits of the City of Cherryvale
SOP	standard operating procedure
SRM	smelter residue material
TCLP	toxicity characteristic leaching procedure
XRF	x-ray fluorescence

1 Introduction

This Removal Site Evaluation (RSE) Work Plan for the National Zinc Site, Cherryvale, Kansas, has been prepared on behalf of United States Steel Corporation and Citigroup Global Market Holdings, Inc. (Respondents), pursuant to the Second Amendment to Consent Order (SACO; KDHE 2013a) between the Respondents and the Kansas Department of Health and Environment (KDHE) dated May 3, 2013.

The RSE is being done in two phases. Under the Phase 1 RSE, soil bioavailability testing was conducted to develop site-specific soil delineation and screening levels for arsenic and lead. The Phase 1 report (Exponent 2014) was approved by KDHE on April 10, 2014 (KDHE 2014a). This RSE constitutes the second phase of this work.

1.1 Purpose

The purpose of the Phase 2 RSE Work Plan, as stated in §13.d of the SACO (KDHE 2013a), is to provide "…an assessment of the nature and extent of smelter related contamination located in areas in the City of Cherryvale outside the former National Zinc Site, and shall incorporate and apply the Site specific clean up levels established in the Phase 1 RSE and set forth in the approved Phase 1 RSE Report." The Phase 2 RSE Work Plan is due to KDHE on June 30, 2014.

This Phase 2 RSE Work Plan has been developed pursuant to the SACO and the requirements described in the SACO Exhibit 8 Statement of Work (KDHE 2013a). As stated, the focus is to assess the nature and extent of smelter-related contamination located in areas within the corporate limits of the City of Cherryvale (the Site) outside the former National Zinc Smelter Property (former smelter property) that exceeds the site-specific screening levels. The Cherryvale city limits are shown in Figure 1-1.

The information developed as a result of implementing this work plan will be presented in a Phase 2 RSE report, which will support the development of the Removal Action Design Plan.

2 Review of Available Site Information

This section presents a general description and brief history of the former smelter property, a brief history of the City of Cherryvale, a description of the physical characteristics of the Site, and a summary of relevant previous studies and removal actions conducted at the former smelter property and the Site.

2.1 Former Smelter Property Description

The former smelter property is located in the northwest part of the City of Cherryvale in Montgomery County, Kansas (Figure 1-1). The approximately 360-acre property is east of U.S. Highway 169, and is bounded on three sides by County Roads 5200 and 5500 to the north and east, and Martin Street (County Road 5050) to the south. The former smelter property is bounded by rural land on the north and west, by a Rodeo Grounds and residential properties on the south, and commercial/industrial properties on the east. The property currently has a few minor structures near the U.S. Environmental Protection Agency (EPA) soil repository (which is discussed in Section 2.4.2.3). The South Kansas and Oklahoma Railroad transects the former smelter property generally from northwest to southeast. The former Cherryvale wastewater treatment plant is located immediately southeast of the property.

2.2 History

The general history of the former smelter property and the City of Cherryvale is discussed below.

2.2.1 Former Smelter Property

The Edgar Zinc Company facility was built in 1898 on 40 acres northwest of town. Initially a primary lead and zinc smelter, it had 1,800 retorts and 3 furnace buildings; in a decade, it had grown to 4,800 retorts and 24 furnaces on over 350 acres. At its peak operation, it was reportedly the largest zinc plant in the world, employing 458 workers. For 8 years, the plant maintained a day-and-night operation (Harper 2014). By 1928, the facility had 4 massive ore roasters and 24 furnaces still in operation (KDHE 2001a).

The smelter was established in Cherryvale because of the availability of cheap natural gas. When the gas supply dwindled, the smelter turned to petroleum to fire its roasting kilns (Junge and Bean 2006). After World War I, zinc demand dropped, and by1921, the Edgar Zinc Company in Cherryvale was one of only two remaining zinc smelters operating in Kansas; the other smelter was located in Caney. These two plants managed to hang on for another 10 years, until competition from the new electrolytic smelting methods and the Depression closed the Caney plant for good in 1931. Sometime after 1928, the Edgar Zinc Company was reorganized as the National Zinc Company. The Cherryvale plant continued operating on a small scale, reprocessing smelter wastes, until 1976 (Junge and Bean 2006).

In the 1970s and 1980s, the National Zinc Company conducted response actions at the former zinc smelter property. They closed the former settling ponds that had been affected by runoff from slag and roasted ore, and they encapsulated materials in a former lagoon area located on the western portion of the property (KDHE 2013b). After a restrictive covenant was issued on the property in 1989, the City of Cherryvale acquired the property. The former smelter property was remediated in 2007 and is currently in the operation and maintenance phase.

2.2.2 City of Cherryvale

This summary is based on "Cherryvale History" (Harper 2014). The town site of Cherryvale was plotted in 1871 by the Leavenworth, Lawrence & Galveston Railway and was incorporated in 1880. Railroads were a major influence in the development of Cherryvale. "The railroad boom began in 1879, when the St. Louis-San Francisco 'Frisco' Railway reached Cherryvale, crossing the already built Atchison-Topeka & Santa Fe Railway. By 1886, there were railroads branching in many different directions."

Harper (2014) described the residential area around the zinc smelter as follows: "The zinc company built fifty cottages and a boarding house south of the plant, plus a general store, Baptist church, and hospital. They also built a company store on Cherryvale's Main Street. With its up-to-date cottages, broad streets and lawns, the area south of the smelter became known as 'Smelter Town.' These cottages were later purchased after the plant closed and moved to different locations within the city. Many can be spotted today by their distinctive architecture."

With abundant natural gas—there were more than 30 natural gas wells within the city limits by the turn of the century—and suitable raw materials, Cherryvale became a center of brick manufacturing. By 1908, six plants were producing 500,000 bricks per day: the Coffeyville Vitrified Brick and Tile Company, the Cherryvale Brick Company, the Southwestern Brick Company, the Federal Betterment Company, Union Brick and Gas Company, and the W.H. Crowl Brick and Tile Company. The brick plants closed in 1930.

Other manufacturing activities described in 1901 included a glass factory, shovel and barrel factories, a marble works, an iron works, and a bicycle factory.

2.3 Physical Characteristics

The general physical characteristics of the Site, including topography and surroundings, climate, and soils, are presented below. This information is generally from the expanded site inspection (ESI) report (KDHE 2001a).

2.3.1 Topography and Surroundings

Residences, agriculture, and light industry surround the former smelter property. The overall area is generally flat, with approximately 30 ft of relief across the former smelter property. The

former smelter property drains to the west via an unnamed intermittent stream that enters Drum Creek 0.75 miles west of the former smelter property.

2.3.2 Climate

The climate in Montgomery County, Kansas, is continental, typically warm to hot in the summers (average at 79°F) and cold in the winters (average at 37°F). Most precipitation occurs in spring and early summer, with average annual precipitation of 36.95 in. per year, and a maximum 24-hour event of 6.38 in. The prevailing winds in Montgomery County are generally from the south, with an average annual speed of 11 miles per hour.

2.3.3 Soils

Soils at the Site (in undisturbed areas) are Kenoma series soils, which are generally deep, moderately well drained, very slowly permeable soils on uplands of 0–2% slope. The surface layer (A horizon) typically consists of a dark grayish brown silt loam about 6–12 in. thick. The upper portion of the subsoil layer (B horizon) is typically 9 in. thick and consists of very dark grayish brown to grayish brown silty clay. The lower portion of the subsoil layer is typically 40 in. thick and consists of dark yellowish brown to dark brown to reddish brown silty clay. The average depth of Kenoma soils is 60 in. or greater.

2.4 Previous Studies and Removal Actions

The summary below focuses on those studies and removal actions that are pertinent to the work proposed in this Phase 2 RSE Work Plan—namely, available information about smelter residue material (SRM) and its placement beyond the aerial deposition zone. For completeness, brief summaries of activities conducted on the former smelter property and in the aerial deposition zone are also presented.

2.4.1 Former Smelter Property

In 1976, KDHE identified heavy metals in sludge and liquid waste in the former smelter settling ponds. The National Zinc Company conducted a cleanup that included treatment and dewatering of approximately 95 million gallons of liquid from the settling ponds, removing ore and sludge from the former facility, and encapsulating approximately 300 tons of remaining ore and sludge in a former lagoon area onsite. In 1983, the former smelter property was considered "remediated," with a restrictive covenant on the future use of the former smelter property.

2.4.1.1 Early Investigations and KDHE's Expanded Site Inspection

In 1995, KDHE determined that prior encapsulation efforts had failed, and significant concentrations of heavy metals were present in sludge, soil, and sediment. KDHE began a series of investigations at the former smelter property that led to additional remediation on- and offsite. In 1999, approximately 659 *in situ* soil samples were screened with x-ray fluorescence

(XRF) (KDHE 2001a). In addition, 19 samples were collected to evaluate the leachability of lead and cadmium using the toxicity characteristic leaching procedure (TCLP). KDHE also collected groundwater, surface water, and sediment samples.

2.4.1.2 Respondents' Investigation and Remedial Activities

Between 2003 and 2007, the Respondents investigated the property further. In 2007, soils and sediments at the property with heavy metal concentrations above commercial/industrial standards were excavated, consolidated, and capped onsite. Visibly affected sediments from segments of a nearby unnamed creek and Drum Creek were also excavated. A sediment catchment basin was installed downstream in Drum Creek.

2.4.2 Aerial-Deposition-Zone Soils

Sampling was conducted in residential areas adjacent to the former smelter property, primarily to the south. Figure 2-1 shows the general locations of areas sampled by KDHE and EPA. These residential areas were potentially affected by aerial deposition of smelter emissions and/or fugitive dust. However, direct placement of SRM also occurred sporadically in some of these areas.

2.4.2.1 KDHE Removal Site Evaluation

In March 2001, KDHE sampled surface soils at 11 residential yards on Martin and Front streets south of the former smelter property (KDHE 2001b; see Figure 2-1) and collected four background samples (one from Logan Park and three located beyond the Cherryvale city limits). Some samples were located in adjacent alleys and right-of-ways (ROWs), likely roadside ditches or sidewalks. The surface soil samples were 0 to 6 in. deep. Soil samples from the residential yards, alleys, and ROWs were analyzed with an XRF before and after drying (a minimum of 4 hours of drying time), and some were sent to a wet laboratory for confirmatory analysis. The background samples were sent to the laboratory without XRF screening. In addition, KDHE designated eight samples from the residential yards, including those with the highest detections, to evaluate lead leachability by TCLP. TCLP results indicated that the soils would not be considered hazardous waste when excavated. Approximately 57 samples were collected at and around the residential properties. Many samples indicated lead concentrations above the screening level of 400 mg/kg.

2.4.2.2 KDHE Phase II Removal Site Evaluation

In October through December 2001, KDHE expanded the areas for sampling surface soils in residential yards (KDHE 2002). The primary area or main survey area expanded the previous residential yard area to the south and east, to include First, Second, Liberty, and Coyle streets (see Figure 2-1) and one block south of the Rodeo Grounds. In addition, three other residential properties were sampled outside of this general area (see Figure 2-1).

During this investigation, soils were screened *in situ* by using an XRF on a base placed over exposed soil that was cleared of vegetation. KDHE then flagged these areas for subsequent collection of soils from 0 to 6 in. below the ground surface for laboratory analysis.

2.4.2.3 EPA Time-Critical Removal Action (2001–2002)

In November 2001 through May 2002, EPA sent their Superfund Technical Assessment and Response Team contractors to begin a removal action at the residential yards, Rodeo Grounds, and wastewater treatment plant (Tetra Tech 2014) near the former smelter property. Properties with removal action activities, along with relevant soil lead measurements compared to the removal action criterion of 400 mg/kg, are shown on Figure 2-2.

Prior to excavating soils, EPA's contractors also screened soil samples from the residential yards, the Rodeo Grounds, and the wastewater treatment plant property (Tetra Tech 2014). At the residential properties, the contractors typically established four quadrants, from which a nine-point composite soil sample was screened with an XRF (Tetra Tech 2002). The contractors recorded three readings to calculate an average lead concentration. Quadrants were flagged for excavation unless the average of the three readings was less than 400 mg/kg lead. At the Rodeo Grounds property, EPA contractors established a grid consisting of 158 cells (mostly 100 by 100 ft) over the 35-acre site. Contractors collected 9- to 12-point composite samples for screening with XRF. Approximately 10% of the samples were submitted to the laboratory for analysis (27 residential property samples and 32 Rodeo Grounds samples).

According to later re-analysis and reporting[1] of the EPA removal action, 35 of 67 residential properties were flagged as having some excavation (Tetra Tech 2014). However, the scope of EPA's removal action did not include alleys and ROWs. Figure 2-3 shows locations and analytical results from alley and ROW samples where soils did not appear to have been excavated. Of the 158 cells at the Rodeo Grounds, 135 were also excavated. Excavation consisted of removing the top 12 in. of soil from the flagged quadrant. In the residential areas, if post-excavation screening indicated elevated lead concentrations at 12 in. below the surface, then orange fencing material (plastic barrier mesh fencing) was placed atop the excavated surface prior to backfilling with clean soils. At the Rodeo Grounds, post-excavation XRF readings indicated that soils with lead concentrations greater than 400 mg/kg were no longer present, and no mesh barrier was placed. However, some deeper excavations occurred in isolated areas where cisterns, trenches, and a large abandoned cast-iron pipe were located. The soil (76,000 cubic yards [cy]) was excavated and transported to the former smelter property for consolidation into a soil repository (the "EPA Repository"), which was capped with clean soil and vegetated (KDHE 2013b).

As shown in Figure 2-2, the 2001 and 2002 soil sampling results along the perimeter of the aerial deposition zone soils were generally less than 400 mg/kg lead. Therefore, additional sampling to further define the aerial deposition zone will not be conducted during the Phase 2

[1] The original removal action report (Tetra Tech 2002) did not adequately document the actions at the site or present results in a clear fashion. To address the adequacy and documentation of the time-critical removal action, EPA required that Tetra Tech provide additional review and prepare an addendum to the 2002 report (Tetra Tech 2014).

RSE. However, inspection and potential sampling will be conducted in these areas as well as east of North Liberty Street (so that areas in the vicinity of and to the east of the former smelter are adequately represented) as part of the validation process for the SRM survey, discussed in Section 4 below.

2.4.3 Identified Smelter Residue Material

Various types of solid waste were present on the former smelter property. This material (referred to as SRM in this work plan) was used over the decades by the City of Cherryvale as a base for roads and sidewalks, as gravel for alleys, and as riprap for ditches. Property owners also reportedly used this material as fill and/or gravel for building foundations or for driveways and parking areas. The solid waste consisted of granular slag or cinder waste, which can be present in sizes from sand-size to gravel-size. Other common SRM is crushed retort. Larger pieces of hard slag are also observed in fill locations throughout the City. The typical types of smelter residue that have been observed in Cherryvale are shown in Figure 2-4. Below are the most common types of observed SRM and its typical settings.

2.4.3.1 Slag and Retort Fragments

These are gravel to larger size fragments that are typically black, gray, red, or purple, and often display hard, black, glassy crust with air bubbles on one or more surfaces (Figure 2-4, Photo A). The fragments may have a curved, flat, or blocky appearance with white or gray inclusions. They may appear fused, baked, burned, or rusty. These fragments have been observed in ditches, alleys, under roads, and in isolated areas. They can be found with brick, glass, wood, or metal debris and have sometimes been used as construction fill. They can be distinguished from local lime rock, shale, and sandstone by dark color, glassy crust, and irregular appearance.

2.4.3.2 Granular Slag

Granular slag is sand- to gravel-sized material that is black to red (Figure 2-4, Photo B). The particles may appear rounded or angular and look like cinders but are harder. They are typically hard and glassy with small air bubbles and white inclusions. However, they can be softer where weathered. Granular slag may have been used as a gravel surrogate in driveways, alleys, parking areas, and building foundations. It was also used as a base for brick sidewalks Figure 2-4, Photo C) and probably paved or brick streets. It can be distinguished from common gravel by its dark color and hard glassy appearance with air bubbles. Grass in areas where granular slag is present may be thin or patchy.

2.4.3.3 Isolated Slag Fragments

This category refers to occurrences of isolated slag fragments (Figure 2-4, Photo D*)* that do not occur as a large collection as in the “Slag and Retort Fragments” category. These are broken fragments with hard, black, glassy crusts, sometimes with air bubbles on one or more surfaces. They have a curved, flat, or blocky appearance and are up to several inches in size. They may contain hard white or gray inclusions. On fresh surfaces, the color is gray, purple, or reddish. Isolated slag fragments have been observed in ditches, along alleys, under roads, and in isolated

areas used as construction fill. The fragments can be distinguished from local lime rock, shale, and sandstone by their dark color, glassy crust, and irregular appearance.

2.4.4 SRM Placement beyond Aerial Deposition Zone

SRM has been reported by residents of the Site, and investigated by KDHE and the Respondents. These observations and investigations are summarized below.

2.4.4.1 2011 Observation of Slag Fragments Leading to Investigation

On May 31, 2011, KDHE notified the Respondents regarding slag fragments observed at residential properties at 504–506[2] Coyle Street that KDHE had sampled and found to have elevated metal concentrations (PNL 2011). The Respondents' contractors then collected composite samples at eight residential addresses: 500, 502, 504, 506, and 508 Coyle Street, 501 Martin Street, and 502 and 508 Liberty Street. These addresses fell within the aerial deposition zone that had been southeast of the former National Zinc Company property, at locations previously determined by EPA to have average lead concentrations below 400 mg/kg, and were also within the boundaries of the former smelter property as defined in the action conducted between 2003 and 2007 (see Section 2.4.1.2). One of these addresses was a grass-covered lot, and several had unoccupied buildings (single-wide trailers). Results from composite soil samples indicated lead concentrations above residential soil levels, and further explorations identified slag fill or soil with small slag fragments at other locations. In general, samples that contained visible slag tested above the 400-mg/kg screening limit.

2.4.4.2 Respondents' 2012 Removal Action

In May and June 2012, the Respondents removed soils from the areas identified during the 2011 investigation that contained lead concentrations greater than or equal to 400 mg/kg (PNL 2013). The designated residential properties were 500, 502, 504, 506, 508 Coyle Street; 501 Martin Street; and 502 and 508 Liberty Street, as shown in Figure 2-2. Areas were excavated to a nominal depth between 1 and 2 ft deep. Visible slag fill was removed, including slag fill at two cisterns encountered at 502 and 506 Coyle Street. Excavation limits are shown in Figure 2-3.

Confirmation sampling of the excavation floor and sidewalls indicated that soil lead remaining in the excavated areas was generally below residential criteria. With only one exception (the sidewall sample at 502 North Liberty), the 23 confirmation samples had lead results below 400 mg/kg. Marker fabric was placed where soils above the KDHE residential soil limits for either lead or arsenic remained in place, which was a 10-ft-wide zone along Front Street (east of Coyle Street), and the east side of Coyle Street where only the top 6–8 in. of soil was excavated due to utilities and tree roots. Approximately 2,800 cy of soil was removed and transported to the EPA Repository at the former smelter property.

[2] Report text states "504-406" as address, assumed to be 504–506.

2.4.4.3 2012 KDHE Sampling

In May through August 2012, KDHE responded to residents reporting slag on or near their properties (KDHE 2012a,b; PNL 2012). KDHE inspected soils in various parts of town, including some city streets, parks, schools, and preschools, and collected samples at or near these sites (see Figure 2-5 and Table 2-1). Of the 14 residential properties, soil samples from 3 residential properties had XRF lead results above the residential criterion of 400 mg/kg:

- 334 Front Street (Residential Property 1)
- 212 West 3rd Street (Residential Property 6)[3]
- 326 West 4th Street (Residential Property 8).

Three other residential properties (Residential Properties 12, 13, and 14), an alley, and several ditches in the City were listed as "smelter waste observed" but soil samples were not collected at these locations. Soils from four other residential properties were sampled and found to have lead concentrations below 400 mg/kg. The other two residential sampling sites appeared to have SRM that did not exceed the lead criterion (Residential Properties 7 and 10). Four residential properties were investigated and determined to not have SRM, and therefore were not sampled (Residential Properties 4, 5, 9, and 11).

KDHE also visited and inspected portions of the three school properties and two parks in the City. KDHE made the following observations about SRM at these locations:

- At the former McKinley Elementary school, identified as the Thayer Preschool (in 2012), SRM was noted at the base of a tree located at the southwest corner of the intersection of West 3rd and North School Streets. One soil sample (0–1 in depth) was collected at this location and had a soil lead concentration greater than 400 mg/kg.
- At the Lincoln Central Elementary School, SRM ("2 rocks") was observed in the parking area along South Carson Street and appeared to be associated with a broken sidewalk. SRM was also noted around one or two trees and next to a stone wall located on South Montgomery Street. No samples were collected.
- At the Cherryvale Middle/High School, KDHE noted SRM in ditches around the school along South Carson and East 7th Streets. KDHE collected samples (0–1 in.) from four ditch locations. Soil lead concentrations were below 400 mg/kg.
- At Logan Park, KDHE noted SRM in drainage ditches near the track and field facilities, ticket booth box, pole vault pit, and long jump runways.

[3] In addition, KDHE cited a Brownfields assessment (Terracon 2012) conducted near this residential property and Residential Property 7 (216 West 3rd Street) that may indicate past placement of smelter materials as fill in this area.

KDHE collected four shallow samples, all of which had soil lead concentrations below 400 mg/kg.

- At the Cherryvale Ball Field, KDHE noted SRM along the driveway near the ball fields, bleachers, and picnic area, in the ball fields, and in the drainage ditches. KDHE collected 10 shallow samples, all of which had soil lead concentrations below 400 mg/kg.

2.4.4.4 2013 Bioavailability Study

In August 2013, the Respondent's contractor (Project Navigator Ltd. [PNL]) collected soil samples at select locations in Cherryvale for evaluation by Exponent of the bioavailability of lead and arsenic. Results of the evaluation are presented in Exponent (2014) and summarized in Section 3.1. Most sample locations in the bioavailability study were related to sample locations from previous studies. Bioavailability sample locations included four sites (three residential properties and a preschool) where KDHE found lead concentrations greater than 400 mg/kg in 2012, and several other sites that KDHE had sampled (e.g., both parks). Bioavailability samples were also collected from six unremediated locations in the aerial deposition zone (on 1st and 2nd Streets). In addition, samples were collected from near (or under) brick sidewalks and in some ditches. Samples were from a 2-cm horizon, and most were surficial (0–2 cm). Several samples exceeded the residential lead criteria of 400 mg/kg, as shown in Figure 2-5.

2.4.4.5 2013 Blood Lead Screening

KDHE's Kansas Healthy Homes and Lead Hazard Prevention Program, in partnership with the Bureau of Epidemiology and Public Health Informatics, Bureau of Environmental Remediation, the City of Cherryvale, and the Montgomery County Health Department, held a free county-wide blood lead screening clinic in Cherryvale on November 13 and 14, 2013 (KDHE 2013c). The clinic was intended to give all Montgomery County residents, including residents of the Site, an opportunity for a free assessment of their blood lead levels (KDHE 2013c). In an effort to reach all residents of Montgomery County, the clinic was publicized in advance with handouts, fact sheets, press releases, articles in multiple local newspapers, posts on social media sites, telephone calls, and fliers left in various locations around the community. A total of 133 residents participated in the screening. Forty-seven children were screened, of whom two had blood lead levels at or above the level (10 μg/dL) recommended for case management by a health-care professional (KDHE 2014b). Eighty-five adults were screened, of whom zero had blood lead levels at or above the level (25 μg/dL) recommended for case management by a health-care professional (KDHE 2014b).

As part of the screening, participants were asked to report any smelter-related residues or materials on their property (i.e., SRM). Fourteen of the 133 residents who participated in the screening reported SRM on 17 properties in Cherryvale (KDHE 2013d). These properties are listed in Table 2-1 and shown on Figure 2-6. Given the high level of promotion for the clinic through multiple media channels, and the publicity generated by previous residential removal actions, it is likely that residents who have observed smelter residue on their own or other properties have already come forward.

3 Conceptual Site Model

The conceptual site model (CSM) presented in this section describes the pathways by which people may be exposed to lead at the Cherryvale Site. A CSM is useful in identifying affected media to help design the sampling program. The elements of the CSM include identification of the chemical(s) of concern, sources of contamination, release mechanisms, exposure media, and exposure route. The CSM is modified as the investigation proceeds. Components of a preliminary CSM are discussed in this section and illustrated in Figure 3-1. Note that this is not intended as a screening-level risk assessment. A risk assessment is not required for this Site.

3.1 Lead is the Primary Chemical of Concern

Based on the Phase 1 RSE report (Exponent 2014), the KDHE standards for arsenic should be adjusted for results from the bioavailability testing of Site soils. Briefly, the Tier 2 risk-based standards from KDHE indicate default soil screening values for arsenic of 18.8 mg/kg for residential scenarios and 63.3 mg/kg for non-residential scenarios (adjusted for 60% relative bioavailability per new default guidelines from EPA as implemented by KDHE); the residential and non-residential soil screening value for lead is 400 mg/kg and 1,000 mg/kg, respectively (KDHE 2010, augmented by per personal communication with KDHE regarding arsenic). Applying site-specific bioavailability to the residential soil screening concentration for arsenic results in a site-specific screening criterion of 53.6 mg/kg for application at the Cherryvale Site (Exponent 2014). The non-residential, site-specific soil standard for arsenic likewise increases to 179.2 mg/kg. The residential soil screening value for lead remains the same, at 400 mg/kg; the commercial/industrial soil screening value for lead also remains the same, at 1,000 mg/kg.

The residential soil screening value for lead will also apply to ROWs (i.e., unpaved alleys, ditches, and vegetated drainage swales) adjacent to residential properties. However, it is important to note that these public ROWs are controlled by the City. Potential recontamination of residential property will most likely be mitigated by institutional controls (discussed in Section 5.3) applicable to both the streets and the ROWs.

In addition to arsenic and lead, cadmium and zinc have been measured in Site soils at levels that exceed, in some samples, the applicable Tier 2 levels as specified in the Risk-Based Standards for Kansas Manual dated October 2010 (KDHE 2010). Where soil samples have been analyzed for these other metals, the data show that lead is the driver for determining whether a property exceeds standards for any of the four metals. That is, if lead is greater than 400 mg/kg, then exceedances of any other metals, if present, would be addressed by dealing with the lead. This is illustrated in Table 3-1, which shows the concentrations of these four chemicals in the soil samples collected for the Phase 1 RSE in August 2013. Therefore, lead concentration, measured by XRF, will be the driver for removal-action decisions at the Site.

3.2 Sources

Historical smelter operations are a source of lead at the Site. Two other sources (Figure 3-1) were air emissions via stack and fugitive dust and SRM (slag and crushed retorts).

There are other sources of lead to residential and commercial/industrial properties, unrelated to the smelter, that are not shown on Figure 3-1. The most important of these alternative sources are historical emissions of leaded gasoline, flaking of exterior lead paint, and lead arsenate pesticides. Historical use of lead arsenate pesticides was predominantly in orchards and along railroad ROWs. Lead sources also include other industrial materials such as chat, which was used as ballast for railroads in Cherryvale and in asphalt and concrete as aggregate throughout Cherryvale.

As discussed later, the confounding effects of lead paint will be addressed by avoiding sampling adjacent to a structure. The sampling program will also avoid railroad ROWs and areas in proximity thereto, to minimize the effect of other industrial materials and/or historical use of lead arsenate pesticides. This will be consistent with the approach at the former smelter property, where the railroad ROW and abutting areas were excluded from sampling and remedial activities.

3.3 Primary and Secondary Release and Transport Mechanisms

Aerial emissions from smelter operations and the exposed waste piles were transported by wind, and the dust settled out on properties near the former smelter property. The deposited lead was subject to surface-water runoff and erosion and, to a certain extent, leaching into lower soil horizons. Lead is generally strongly attenuated in surface soils (McLean and Bledsoe 1992). The properties affected by aerial dispersion have been the focus of the previous sampling and soil remediation by EPA, KDHE, and the Respondents.

3.4 Secondary Release/Transport Mechanisms

Both aerially deposited particles and directly placed residue would have been subject, in some degree, to surface-water runoff and erosion, as well as some leaching into the soil profile. As mentioned above, lead is generally attenuated in the upper soil horizons.

The most important secondary release mechanisms of lead from emplaced residue would likely have been by mechanical abrasion (i.e., traffic), and to a lesser extent, by leaching. Slag used for driveways and alleys could also have been spread beyond the original placement due to traffic or grading.

Release of lead from emplaced residue has been contained or minimized by covering the material used for roads, alleys, and driveways with pavement and/or clean gravel; sidewalks with bricks or concrete; and building pads with structures.

3.5 Affected Media and Exposure Routes

3.5.1 Surface Water and Soils in Ditches

As shown in Figure 3-1, ingestion or dermal contact with surface water by residents or workers is a "complete pathway," though a minor one because there are very few opportunities for exposure. A "complete pathway" refers to a pathway by which a receptor could feasibly be exposed. Roadside ditches and temporarily ponded water would offer only temporary exposure opportunities. Soils in roadside ditches also offer very minimal opportunities for exposure.

3.5.2 Groundwater

Groundwater is an incomplete pathway, because Cherryvale residents obtain their water from Big Hill Lake, which is approximately 5 miles east of town according to the ESI report (KDHE 2001a). No domestic wells were identified within the City limits, according to Figure 9 from the ESI (KDHE 2001a). Moreover, the ESI reported that shallow groundwater in this area is of marginal quality due to sulfates and excessive hardness.

3.5.3 Accessible Soil

Accessible soils are considered those at the surface (e.g., granulated slag mixed with soil on a driveway or former building foundation, or bare or thinly vegetated soil in a residential yard) or found at shallow depths beneath grass, which could easily be exposed through landscaping or casual digging by people or pets. Residents and workers can be exposed to lead in accessible soil by incidental ingestion or dermal absorption.

Indirect pathways from accessible soils to people include plant uptake and vegetable consumption[4] and particle resuspension and inhalation. Both of these pathways are minor compared to the direct-contact route.[5]

3.5.4 Inaccessible Soil

Soil that is inaccessible because of capping with pavement, packed gravel, or other surface covering or a structure, does not provide an exposure route unless it is disturbed. As shown on Figure 3-1, workers who expose these soils during construction (e.g., trenching along a road to install a utility line), and residents who expose these soils during excavation work on their

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[4] An article in the *Montgomery County Chronicle* newspaper (Celaya 2014), titled *Despite metals in soil, garden produce still edible*, quotes Sarah Belfry, the communications director for KDHE: "…[T]he main contaminant in Cherryvale is the lead, and lead is not know[n] to 'bio-accumulate' in vegetation. 'So just be sure you wash off any dirt before you eat the produce from your garden or your fruits and you should be fine,' Belfry said."

[5] If vegetable gardens are present at residential properties designated for soil sampling, soil samples will be collected from the garden area in addition to the yard sampling.

property (e.g., landscaping, foundation or driveway repair) could be exposed via incidental ingestion, dermal contact, or dust inhalation.[6]

[6] Protection of workers and proper management of exposed smelter residue as a result of construction can be mitigated by institutional controls; see Section 5, Preliminary Screening of Potential Removal Actions.

4 Site Evaluation Plan

This section outlines the general approach of the Site evaluation plan and describes detailed procedures for determining the nature and extent of soil with elevated lead resulting from direct placement of SRM within the city limits of Cherryvale. Standard operating procedures (SOPs),[7] a project-specific quality assurance project plan (QAPP), and a health and safety plan (HSP) are referenced in relevant sections below and included in Appendices A, B, and C, respectively.

4.1 General Approach

The Site evaluation is designed to build on existing information (previous sampling and understanding of past SRM use are discussed in Section 2.4) to establish the nature and extent of properties with elevated lead concentrations attributable to direct placement of SRM within the city limits of Cherryvale. Residential properties, daycare facilities, alleys, roadside ditches, schools, and parks throughout the Site will be evaluated in a series of field surveys, during which the relative amount of SRM at a property (if present) will be visually classified (with classes ranging from SRM commonly observed to no SRM apparent) so that the class of SRM observed at a property can be correlated to the likelihood of associated soils exceeding the screening criterion for lead. This phased approach to the Site evaluation, which will ultimately include the entire Site, will be conducted in close consultation with KDHE. The elements of the Site evaluation are summarized in Table 4-1 and below:

- **Conduct initial SRM surveys to develop SRM classes.** Preliminary SRM classes for residential, daycare facility, alley, and roadside ditch properties are proposed in this work plan, and will be tested and refined on a subset of properties during two initial field surveys. Because there are only three schools and two parks in the City, the presence (or absence) of SRM at each of these properties will be surveyed and classified on a site-specific basis. A general description of how the SRM surveys are to be conducted is presented in Section 4.2. A detailed description of the initial SRM field surveys is presented in Section 4.3.
- **Collect soil samples to validate SRM classes.** Soil from a subset of the classified residential (including daycare facilities), alley, and roadside ditch properties will be sampled and analyzed in a field laboratory by XRF to validate and evaluate the SRM classes. The subset of properties to be sampled will be reviewed with KDHE. The soil sampling design for each property type to be sampled is presented in Section 4.4.1, and the soil sampling methods are presented in Section 4.4.2.

[7] SOPs are provided as general guidelines for the work to be performed as part of the Site evaluation; however, site-specific adjustments will likely occur during the Site evaluations based on conditions encountered in the field as the evaluation progresses. These adjustments will be described in the RSE report.

- **Finalize SRM classes with KDHE input.** The sampling results will be reviewed with KDHE, and SRM classes for residential, alley, and roadside ditch properties will be finalized for use in the city-wide SRM survey. The outline for this work is given in Section 4.5.
- **Conduct city-wide SRM survey with finalized SRM classes.** The final SRM classes for residential, alley, and roadside ditch properties will be applied to all of the remaining properties at the Site. A description of this city-wide SRM survey is presented in Section 4.6.

The results of the city-wide SRM survey will be presented in the RSE Report, which will include a database containing the properties surveyed, associated SRM classes observed during the city-wide SRM survey, and any soil sampling results. Figures showing property SRM class(es) and any associated soil sampling results will also be presented in the RSE report. Any field adjustments made to the Site evaluation plan will be documented in the RSE report.

4.2 General Conduct of SRM Surveys

The SRM surveys are a series of surveys in which a survey team (or teams) will visually inspect properties within the city limits of Cherryvale and classify observed SRM (if present). Preliminary SRM classes are based on frequency, abundance, type, and location, with classes ranging from SRM commonly observed (Class A) to no SRM apparent (Class D). Preliminary SRM classes for each of the property types expected to be encountered during the surveys are presented in Section 4.3. As described in Section 4.1 (General Approach), those SRM classes will be tested, refined, validated and finalized in three phases of SRM surveys (listed in Table 4-1). This section describes the general manner in which the SRM surveys will be conducted, including the type of information, and the method by which that information will be collected. Detailed information about each SRM survey phase is presented in subsequent sections of the work plan (Section 4.3, Initial SRM Surveys to Develop SRM Classes, and Section 4.6, City-Wide SRM Survey with Finalized SRM Classes).

4.2.1 Property Examination

Public ROWs (i.e., alleys, roadside ditches, and sidewalks) adjacent to residential properties will be examined directly during the SRM surveys. Private properties will also be examined directly if the owner offers access. Otherwise, private properties will be examined from the property boundary. The same SRM survey method will be used on each property (public ROW and private) whether vegetation is present or not. Each field crew (if there is more than one) will have a tablet computer that will be able to access a high-resolution aerial photo, as well as parcel boundary and zoning information for each property to be examined.[8] Survey information will be recorded on the tablet computer or hard-copy field forms, or a combination of both. The survey crew(s) will document (at a minimum) the following information:

[8] The Respondents are in the process of acquiring zoning and parcel maps for the City of Cherryvale. These maps will be provided to KDHE under separate cover (i.e., as part of a Phase 2 RSE Progress Report).

- Date
- Survey crew names
- Property address
- Property owner(s) and/or tenant(s) names, if available
- Location(s) of the SRM marked on a high-resolution aerial photo (either on a hard copy or tablet computer) and with a global positioning system (GPS) unit to record the latitude and longitude, if possible
- Description of the SRM observed; see Figure 2-4 for photos of typical SRM, and Section 2.4.3 for general descriptions of SRM typically encountered in Cherryvale
- SRM class(es) observed; see preliminary SRM classes in Table 4-2
- Photograph(s) of SRM
- Interpretation of why the SRM is present, if possible (e.g., spreading from sidewalk underlayment, driveway, fill, etc.)
- Paint condition of any structures on the property (e.g., flaking), and if paint chips are present in soil adjacent to the painted structure(s), along with photographs as appropriate
- Foundation condition of any structures on the property, along with photographs as appropriate.

The SRM survey team(s) will wear orange traffic vests and will have a handout to provide residents with information about the Site evaluation. Contact information for representatives of KDHE will be included on the handout. City staff will be briefed on the SRM survey and will be kept current on the status during the surveys.

4.2.2 Access Agreements

Efforts will be made by the Respondents to obtain access prior to mobilization. In addition, the SRM survey team(s) will carry access agreement forms that can be filled in by property owners as they are encountered during the SRM surveys. Additional efforts to obtain access may be initiated prior to mobilization of the SRM survey team(s), if feasible. The access agreements will include provisions for elements of the Site evaluation described in this work plan (i.e., SRM survey and potential soil sampling), as well as provisions for potential future assessment, soil sampling, and removal activities. The Respondents will notify the property owners before any activities outlined in the signed access agreements begin.

4.2.3 Database

Data gathered during the SRM surveys (as well as any relevant historical data) will be stored in a project database, which will allow project data to be easily accessed, managed, and updated. Data to be stored in the project database include locations and types of SRM observed during the SRM surveys, XRF soil lead measurements, and laboratory soil lead measurements. All data will be stored with the locations from which they are gathered (i.e., latitude and longitude), so that a geographic information system (GIS) can be used to visualize and analyze the data.

4.3 Initial SRM Surveys to Develop SRM Classes

The initial SRM surveys will be conducted as described in Section 4.2 above (General Conduct of SRM Surveys) on a representative group of properties within each property type, including residential properties, daycare facilities, alleys, roadside ditches, schools, and parks. As described in Section 4.1 (General Approach), the initial SRM surveys will test and refine the SRM classes for residential properties (including daycare facilities), alleys, and roadside ditches, while each of the three schools and two parks in the City, along with another playground area owned by the City (see footnote 10 in Section 4.3.6 below), will be surveyed and classified on a site-specific basis. The initial SRM surveys for each property type are described below.

4.3.1 Residential Properties

The proposed SRM classes for residential properties are presented in Table 4-2. Approximately 25 residential properties will be surveyed and classified to test these proposed SRM classes. We will meet with KDHE and the City to review SRM use at residential properties to help select the first 25 residential properties to survey. Some of the properties, along the east side of Coyle Street, between West 1st and 2nd Streets, and along the east and west sides of North Liberty Street north of West 2nd Street and along West Front Street, located adjacent to the aerial deposition zone previously investigated by EPA (which are shown in Figure 2-2), will be included among the first 25 residential properties surveyed. In addition, some properties identified by or reported to KDHE as having SRM (which are listed in Table 2-1), and the daycare facilities referenced in Section 4.3.2, will be included among the first 25 residential properties surveyed. Because the initial phase of properties to be surveyed must also include properties that have little or no SRM, some of the properties identified by or reported to KDHE as having SRM may be deferred to the next phase of SRM surveys.

If SRM is observed in an unpaved driveway or parking area on a residential property, then the property will be classified as Class A and will be considered for gradient sampling, which is described in Section 4.4.1.4 (Gradient Sampling). Additionally, any SRM observed at sidewalks adjacent to the property will be noted, and its presence will make the property eligible for gradient sampling.

The initial survey results will be reviewed with KDHE, and any necessary refinement to the SRM classes will be discussed. Following any needed refinement of the SRM classes, approximately 75 additional residential properties will be surveyed and classified. Remaining

properties adjacent to the aerial deposition zone investigated by EPA or those reported to and by KDHE as having SRM (and not classified as part of the initial 25 residential properties surveyed) will be prioritized for inclusion in this phase.

4.3.2 Daycare Facilities

Five daycare facilities have been identified within the city limits and one just outside the western Site boundary[9] (see Figure 4-1). These daycare facilities appear to be located on residential properties; therefore, the daycare facilities will be surveyed as residential properties and will be included in the first 25 residential properties selected to test the proposed SRM classes described above in Section 4.3.1 and listed in Table 4-2. Because the daycare properties will be among the 100 residential properties that will be classified, they will also be considered for sampling to validate the classification system.

4.3.3 Alleys

The proposed SRM classes for alleys are presented in Table 4-2. Approximately 25 alleys will be surveyed and classified to test the applicability of these proposed SRM classes. We will meet with KDHE and the City to review SRM use in alleys to aid in the selection of the first 25 alleys to survey. In addition, some of the alleys in the aerial deposition zone previously investigated by EPA, including those indicated on Figure 2-3, will be included in the first 25 alleys surveyed.

Initial survey results will be reviewed with KDHE, and any refinements to the SRM classes that may be necessary will be discussed. Following any needed refinement of the SRM classes, approximately 75 additional alleys will be surveyed and classified. The remaining alleys in the aerial deposition zone investigated by EPA (and not classified as part of the initial 25 alleys surveyed) will be included in this phase.

4.3.4 Roadside Ditches

The proposed SRM classes for roadside ditches are presented in Table 4-2. Approximately 25 ditches will be surveyed and classified to test these proposed SRM classes. We will meet with KDHE and the City to review SRM use in roadside ditches to aid in the selection of the first 25 ditches. In addition, some of the ditches in the aerial deposition zone previously investigated by EPA, including those shown on Figure 2-3, that were reported not investigated or remediated will be included in the first 25 ditches surveyed.

The initial survey results will be reviewed with KDHE, and any necessary refinement to the SRM classes will be discussed. Following any needed refinement of the SRM classes for

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[9] This property is technically located outside the Site and would not normally be included in the SRM survey or any soil sampling. However, KDHE requested that it be included as an exceptional case, because it is immediately adjacent to the City boundary and serves the Cherryvale community. Its inclusion is not precedential for any change in Site boundaries, and is without prejudice to the Respondents' rights under the SACO (KDHE 2013a) and the original Consent Order.

roadside ditches, approximately 75 additional ditches will be surveyed and classified. The remaining ditches in the aerial deposition zone investigated by EPA (and not classified as part of the initial 25 ditches surveyed) will be included in this phase.

4.3.5 Schools

As discussed in Section 2.4.4.3 (2012 KDHE Sampling), KDHE has inspected the three schools in the City (former McKinley Elementary school at 600 West Main Street, Lincoln Central Elementary at 401 East Main Street, and Cherryvale Middle/High School at 618 East 4th Street). Results of soil samples collected during these inspections are summarized in Table 2-1 and shown in Figure 2-5. During the survey, any SRM observed on school properties will be documented. (Note that no SRM classification system for schools will be developed, because there are only three school properties to evaluate.) Then the need for soil sampling will be evaluated for each school property on a site-specific basis. Any soil samples will be collected using the methods described in Section 4.4.2 (Soil Sampling Methods). Information that may be taken into account when evaluating the need for sampling includes prioritization of potential high-use areas, and possible gradient sampling from sidewalks, which is described in Section 4.4.1.4 (Gradient Sampling).

4.3.6 Parks

As discussed in Section 2.4.4.3, KDHE has inspected and, along with the Respondents, sampled the two parks in the city (Cherryvale Ball Field and Logan Park). Results of soil samples collected at the two City parks are summarized in Table 2-1 and shown on Figure 2-5. During the survey, any SRM observed in these two parks, along with another playground area owned by the City,[10] will be documented. (Note that no SRM classification system for parks will be developed, because there are only two park properties to evaluate.) Then the need for additional soil sampling (e.g., to fill any data gaps) will be evaluated for each park on a site-specific basis. Any soil samples will be collected using the methods described in Section 4.4.2 (Soil Sampling Methods).

4.4 Soil Sampling to Validate SRM Classes

After the initial SRM surveys described above are complete and the results are analyzed and reviewed with KDHE, soil from each SRM class at a subset of properties within the residential (including daycare facilities), alley, and roadside ditch property types will be sampled. As noted above, soil samples may also be collected from schools and parks, depending on the results of the SRM surveys of those properties. First, the general sampling design for each property type is described. Elements of the sampling design include a general discussion of soil sample locations at each property type, the approximate number of samples to be collected during this phase, a description of gradient sampling and how and when it will be used, and a discussion of

[10] KDHE has requested that this City-owned property on East 1st Street, which is currently used as a playground, be included in the initial SRM survey. It is reported that the property has been used as a playground since the 1950s and that there may be SRM on the property.

XRF analysis, which will be used to determine soil lead concentrations during the sampling phase of the Site evaluation. Then specific soil sampling methods are outlined.

4.4.1 Soil Sampling Design

The soil sampling designs for residential properties (including daycare facilities), alleys, and roadside ditches are described below. Gradient sampling, which will be conducted to determine whether a soil lead concentration gradient exists from a feature or structure with observed SRM into the rest of a residential (or other) property, is also described in this section, along with the method of determining soil lead concentrations by XRF analysis.

4.4.1.1 Residential Properties (including Daycare facilities)

On residential properties with no SRM in their driveways (or no driveway), five-point composite samples will be collected. Small yards (approximately 5,000 square feet [sf]) will have two composite samples (per depth interval) collected, one from the front yard and one from the back yard. A substantial side yard may need an additional composite sample (per depth interval). Larger yards (up to an acre) will be divided into quadrants for four composite samples (per depth interval); an example is shown on Figure 4-2. If a residential property is larger than an acre, a composite sample (per depth interval) will be collected from each quarter acre. Yards with distinct gardens or children's play areas or may require additional samples, with the aliquots that make up the composites collected solely within the garden or play area.

The five aliquot locations for each composite sample will be set approximately 5 ft away from structures to avoid any influence from lead-based paint. The aliquot locations will also be approximately 5 ft away from any trash piles, burn pits, roads, sidewalks, driveways, parking pads, and alleys, and 20 ft away from current and former railroad tracks. The presence of SRM in these named features, if any, will be recorded, and could also make the property eligible for gradient sampling (see Section 4.4.1.4, Gradient Sampling).

Of the 100 residential properties that are classified, we anticipate selecting five Class A, five Class B, three Class C, and three Class D residential properties for validating the SRM classes (see Table 4-1). We anticipate also selecting five Class A properties with SRM in driveways and five properties with SRM in sidewalks for gradient sampling (which is described in Section 4.4.1.4, Gradient Sampling).

Drip Zone around House Foundations—SRM has been observed in drip zones near house foundations in Cherryvale (KDHE 2012a). The presence of lead paint would confound sampling of SRM within the drip zone; therefore, these potentially lead-paint-affected zones will not be sampled during the Site evaluation. To assess whether SRM-associated soils in the drip zone may exceed the screening criterion for lead, the lead concentration gradient established with other gradient samples from Class A SRM source areas *without* paint influence (e.g., driveways, sidewalks, alleys, ditches) will be used as a proxy for the lead concentration gradient potentially present in SRM observed within drip zones and adjacent to foundations.

4.4.1.2 Alleys

The proposed sampling design for alleys will depend on the presence of SRM clusters. For a block-long alley with an SRM cluster (e.g., a portion of the alley that received SRM fill to repair an area of heavy erosion or vehicle damage), one composite sample will be collected near the cluster, and one away from the cluster. The number of aliquots (three to five) will depend on the length of the alley. An example of two composite samples for an alley with clustered SRM is shown on Figure 4-2. Alleys without SRM clusters will likely have one five-point composite per block-long alley. This one five-point composite sample assumes that SRM placement is consistent throughout the alley.

Of the 100 alleys that are initially classified (as discussed in Section 4.3.3), we anticipate selecting four Class A, four Class B, two Class C, and two Class D alleys for validating the SRM classes. We anticipate also selecting five Class A alleys for gradient sampling (which is discussed in Section 4.4.1.4, Gradient Sampling).

4.4.1.3 Roadside Ditches

The proposed sampling design for ditches will depend on the presence of SRM clusters. For a block-long ditch with an SRM cluster (i.e., at a culvert), one composite sample will be collected near the cluster and one away from the cluster. The number of aliquots (three to five) will depend on the length of the ditch. Ditches without SRM clusters, or short ditches, will likely have a single three- to five-point composite sample. An example of two composite samples for a ditch with SRM surrounding a culvert is shown on Figure 4-2.

Of the 100 ditches that are initially classified (as discussed in Section 4.3.4), we anticipate selecting four Class A, four Class B, two Class C, and two Class D ditches for validating the SRM classes. We anticipate also selecting five Class A ditches for gradient sampling (which is discussed in Section 4.4.1.4, Gradient Sampling).

4.4.1.4 Gradient Sampling

Several properties will be selected for gradient sampling, defined generally as three five-point, linear composites collected to determine whether a soil lead concentration gradient exists from a structure with observed SRM into the rest of a residential (or other) property. Soil lead concentrations from the three composites would be evaluated to determine whether a pattern of decreasing soil lead concentrations (a gradient) exists. Gradient sampling may be conducted if SRM is observed:

- On-property, unpaved (e.g., gravel or earthen) driveways or parking areas (Class A residential property)
- Off-property, unpaved alleys (Class A alleys)
- In roadside ditches (Class A ditches)
- At sidewalks.

On-Property Gravel/Earthen Driveways or Parking Areas—Five Class A residential properties on which SRM has been observed in unpaved, on-property driveways or parking areas will be selected for gradient sampling. These properties may (or may not) coincide with the properties selected for residential yard sampling to validate the SRM. Beginning at the edge of the driveway or parking area bordering the main part of the residential yard, three lines will be marked parallel to the driveway or parking area edge, at 1.5, 3, and 4.5 ft from the edge. Five aliquots will be collected spread out along the parallel line to create three composite samples (per depth interval). Figure 4-2 shows gradient sampling locations at an example Class A residential property with observed SRM in an unpaved driveway.

Class A Alleys, Class A Roadside Ditches, and Sidewalks—A total of 15 residential properties that are adjacent to observed SRM in Class A alleys (five), Class A ditches (five) and sidewalks (five) will be selected for gradient sampling. These properties may (or may not) coincide with the properties selected for residential yard sampling to validate the SRM classes. Beginning at the edge of the alley, ditch, or sidewalk bordering the main part of the residential yard, three lines will be marked parallel to the alley, ditch, or sidewalk edge, at 1.5, 3, and 4.5 ft from the edge. Five aliquots will be collected spread out along the parallel line to create three composite samples (per depth interval).

4.4.1.5 Sample Depth

Composite samples will be collected at 6-in. depth intervals: 0–6, 6–12, and 12–18 in. The shallowest depth horizon contains the most accessible soil and takes into account potential exposure routes, as well as potential smelter residue below a sod layer.

During the soil sampling phase to validate the SRM classes, the need for collecting the deepest sample will be evaluated. A decision to discontinue collecting the deepest sample for each property type may be made if, after half of the properties have been sampled, the soil lead concentrations are less than 400 mg/kg. For example, after eight of sixteen residential properties have been sampled, if soil lead is less than 400 mg/kg in the deepest samples (12–18 in.), then only depth intervals 0–6 and 6–12 in. would be sampled on the remaining eight residential properties.

4.4.1.6 Soil Lead Analysis with XRF

An XRF set up in a Cherryvale field laboratory will be used to analyze soils collected as part of this soil sampling program. EPA recommends the use of XRF field analysis at lead-contaminated residential sites (U.S. EPA 2003), and XRF analysis has been conducted during previous residential soil assessments at the Site. A comparison between XRF field measurements and laboratory confirmatory samples collected during the 2011 residential soil assessment (Figure 4-3) show that XRF field measurements are reasonably consistent with laboratory confirmatory samples ($r^2 = 0.857$) (PNL 2011). Regression curves indicate that the XRF reads approximately 50 mg/kg high for lead, compared with laboratory results near the threshold of 400 mg/kg (PNL 2011). In addition, the XRF field measurements for lead do not appear to be related to soil moisture (20% or below), as shown in Figure 4-4. The relationship between XRF field measurements and laboratory analyses is consistent with EPA's conclusion that XRF provides reliable information (U.S. EPA 2003). Laboratory analysis of a portion of

the samples collected will be conducted for verification purposes, as provided in Section 4.4.2.3, Laboratory Verification and Field Duplicate Samples.

4.4.2 Soil Sampling Methods

Soil sampling methods to be followed during the Site evaluation are described below.

4.4.2.1 Sample Collection

At each sampling site, the Respondents' representatives will verify possession of signed property access agreements, utility clearances, and relevant permits for each property location before beginning any sampling activities. Utility clearances will include contacting One-Call System, Inc., or the appropriate underground utility contacts to mark underground utilities, and requesting information from the property owner.

At each sampling site, the presence of SRM and the size of the area will determine how many composite samples will be collected (see Section 4.4.1, Soil Sampling Design). Generally, composite samples will be composed of five aliquots. Composite samples will consist of discrete aliquots of equal amounts of soil. Previous observations (from the initial SRM surveys described in Section 4.3) will be verified, and any changes will be documented with photographs, notes, and GPS. A field logbook (hard copy or on computer tablet) will be kept in accordance with SOP GEN-01 in Appendix A, to document events and record data during sample collection and other field efforts (see also Section 4.4.2.5, Sample Documentation).

Details for sample collection are provided in SOP SL-04, Soil Sample Collection, in Appendix A. At each aliquot location, any cover material that may be present (i.e., grass, wood chips, playground sand, etc.) will be removed before sampling. GPS locations (latitude and longitude) will be recorded. A bucket auger, or equivalent, will be advanced and used to collect either a series of 6-in. cores or an 18-in. core. If 6-in. cores are collected, the 0- to 6-in. core will be extracted from each subsample location and placed into a stainless-steel mixing bowl. No decontamination is required between subsample locations at a given depth. Then the sampler will be decontaminated, and the 6- to 12-in. sample will be collected from each subsample location and placed into a separate stainless-steel bowl. Finally, the process is repeated for the 12- to 18- in. subsamples (if collected).

If a single 0- to 18-in. core is collected, the core from a subsample location will be sectioned into 6-in. intervals, and each interval (0–6, 6–12, and 12–18 in.) will be placed in its respective stainless-steel mixing bowl. This process is repeated at the other subsample locations. No decontamination is needed between subsample locations.

The aliquots placed into the depth-specific, stainless-steel mixing bowl will be mixed thoroughly with a stainless-steel spoon, and a subsample of about 200 g (about 1 cup) will be placed into a pre-labeled one-quart Ziploc®-type plastic freezer bag. The labeled bag will be placed in a second bag for safety (to prevent rupture and cross-contamination of other samples) and placed in a cooler or box for ultimate transport to the field laboratory. Sample names (or

numbers), at a minimum, will denote property, location, and depth (A, B, and C can be used to represent soil horizons 0–6, 6–12, and 12–18 in., respectively).

Excess soil material not recovered for the sample will be returned to the auger hole. The auger hole will then be filled in with potting soil, and the sod (if present and retained) will be replaced to minimize disturbance. Sampling equipment will be decontaminated prior to sampling at the next location (see Section 4.4.2.6, Equipment Decontamination).

4.4.2.2 Sample Preparation and XRF Analysis

Labeled samples will be brought to a field laboratory for sample preparation and XRF analysis. If SRM fragments are observed in the sample, the sample will be dried for 2–4 hours at a temperature not greater than 150°C (U.S. EPA 2007a), or alternatively, the sample can be allowed to dry at room temperature for 24 hours. The dried soil sample will then be sieved with a No. 10 sieve (2 mm) and homogenized (U.S. EPA 2007b). The dried and sieved sample is then ready for XRF analysis.

XRF Operation—All samples will be analyzed in the field laboratory for lead using an Innov-X Alpha portable XRF analyzer or equivalent, operating in soil mode. The instrument will be operated in general accordance with U.S. EPA Method 6200, *Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment*. The instrument operators will receive x-ray radiation safety training prior to using the instrument in Kansas, and PNL will hold a current KDHE/Bureau of Environmental Health Radiation and Asbestos Control Section Certificate to operate XRF analyzers in the state of Kansas.

Parameters and calibrations that are not user selectable will be maintained per the manufacturer's specifications. The instrument will be considered usable if it passes instrument standardization checks to its internal factory calibration and can reliably reproduce results on control samples. Instrument standardization occurs at start-up and will be performed after 4 hours of use. Field personnel will periodically analyze National Institute for Standards and Technology soil standards and complete replicate analyses on field samples (for every 20 samples, a field replicate will be collected) to check the reproducibility of the instrument.

The appropriate amount of composite soil sample will be transferred into an XRF sample cup or other appropriate container, and the XRF results will be recorded.

Laboratory Sample Preparation—If a particular sample is designated as a laboratory verification sample, two aliquots (rather than one) will be taken after mixing in the stainless-steel bowl in the field. The aliquot to be sent to the wet-chemistry laboratory will be placed in a clean glass container for labeling and shipping. Sample transfer to the pre-approved laboratory will occur under chain-of-custody (COC) procedures (see the project-specific QAPP in Appendix B). Remaining soil will also be placed in clean containers for archiving (see Section 4.4.2.4, Sample Archiving). Excess soil can be disposed in the general location where it was collected.

4.4.2.3 Laboratory Verification and Field Duplicate Samples

To confirm the XRF field measurement results, 5% of samples (i.e., 1 per 20 samples) will be sent to a wet-chemistry laboratory for confirmatory analysis, as described in U.S. EPA Method 6200. These samples will be collected from the sieved and dried samples that were analyzed by XRF. An approximately 100-g subsample will be placed into a clean glass sample jar and shipped to the wet chemistry laboratory. Additional verification samples will be analyzed at key decision points (as recommended by U.S. EPA [2003]), including (1) when the XRF results are close to the action level of 400 mg/kg lead, or (2) when the reliability of the XRF unit is in question.

As specified in the QAPP (Appendix B), field duplicates will be collected at a frequency of 1 per 20 samples for analysis by XRF at the field laboratory. Laboratory duplicates and matrix spike samples will also be included at a frequency of 1 per 20 samples that are being sent to the wet-chemistry laboratory. The field team will need to collect enough sample mass to allow for analysis of these selected samples in triplicate. Samples that are submitted with extra sample quantity for matrix spike/matrix spike duplicate/duplicate analyses will be indicated on the COC form. Equipment rinsate blanks are not required.

4.4.2.4 Sample Archiving

Soil samples sent to the field laboratory will be archived at the laboratory; if the field laboratory is closed after the sampling season, then the samples will be transferred to a secure storage facility under COC procedures. Storage of soil samples is anticipated to be at room temperature. The samples will be properly disposed only after receiving approval from the Respondents and KDHE. Samples sent to the wet-chemistry laboratory will be archived at that laboratory until approved for disposal by Respondents and KDHE.

4.4.2.5 Sample Documentation

The following information is needed to document the collection of soil samples and should be recorded primarily in a dedicated project field logbook (either hard copy or on a tablet computer). (Note that the information to be collected during SRM surveys is detailed in Section 4.2, General Conduct of SRM Surveys) Field personnel will note in the logbook when data are being gathered electronically and will provide filenames where possible. SOP GEN-01, Field Documentation, in Appendix A, contains detailed descriptions and procedures of the information to be collected. Required information includes, but is not limited to:

- Daily information: date, times, weather, onsite field personnel, visitors, other observations, signature (at the end of the day)
- At each sampling location:
  - Address and brief description of property/site, general site photograph, field contacts
  - Observations of SRM (if present)

    - Description of SRM and location (refer to descriptions noted during the initial SRM surveys if possible)
    - GPS information (latitude and longitude)
    - Photograph(s)
  - Measurements/calculations to determine:
    - Overall unpaved areas
    - Number of composite samples
    - Number of aliquots per composite
  - Site sketch
- At each aliquot location:
  - Description and photograph(s) of location
  - GPS information (latitude and longitude)
  - Time of sampling
  - Equipment used
  - Description of aliquots (three, or one per soil horizon), soil characteristics
  - Aliquot sample names, if needed
- Composite samples
  - Sample names
  - Field duplicate sample names
  - Laboratory quality control sample names
  - Measurements
  - XRF results
  - Observations, variations, if any.

Procedures for sample labeling, COC forms, sample packaging, and shipping are provided in the QAPP in Appendix B and SOPs GEN-02 and GEN-03 in Appendix A.

4.4.2.6 Equipment Decontamination

To prevent potential cross-contamination of samples, all reusable soil sampling equipment will be decontaminated before each use, except that decontamination is not required between the collection of subsamples that will be blended into one composite sample. At the sample collection site, a decontamination area will be established in a clean location upwind from the actual sampling locations. This is where all soil sampling and compositing equipment will be cleaned. The decontamination area will consist of three stations, as described below. Decontaminated equipment will be stored away from areas that may cause recontamination. Field personnel will follow all relevant procedures outlined in the site-specific HSP, and will wear disposable gloves as stipulated in the site-specific HSP.

Non-disposable sampling equipment that will come in contact with samples will be cleaned prior to sampling. Equipment will be cleaned between each composite sample and at the start of each day's sampling event. The standard cleaning protocol will include:

- Removing any excess dust or dirt from the equipment with paper towels and/or wire brushes and tap water, if needed
- Washing the equipment with a water solution containing a detergent, such as Alconox® or similar laboratory-grade detergent
- Double rinsing the equipment with tap water
- Double rinsing the equipment with distilled/deionized water
- Wrapping the sampling equipment in plastic wrap or other materials if the equipment is to be transported to another location; otherwise, wrapping is not necessary if the field staff is simply walking to the next location with the sampler.

After use, disposable gloves and used foil will be placed in garbage bags and disposed of as normal trash. All wash and rinse waters will be disposed of in the closest roadside ditch.

4.5 Finalizing SRM Classes with KDHE Input

After the initial SRM surveys are complete, and soil sample results from the laboratories are received, all of the collected data will be compiled in a database and analyzed to determine the final SRM classes for residential (and daycare facility) properties, alleys, and roadside ditches. This analysis work will be conducted with input from KDHE (as is the case with the initial testing and refining of the SRM classes as described in Section 4.3, Initial SRM Surveys to Develop SRM Classes). The SRM classes will be finalized such that the SRM classes observed at a property can be correlated to the likelihood of associated soils exceeding the screening criterion for lead, and will be used in the city-wide SRM survey described below in Section 4.6. All field survey team members will be fully trained in applying the SRM classes consistently before the city-wide SRM survey begins.

4.6 City-Wide SRM Survey with Finalized SRM Classes

The city-wide SRM survey will be conducted on residential properties, alleys, and roadside ditches within the city limits of Cherryvale that have not already been surveyed during the initial SRM surveys. The SRM survey will be conducted as described in Section 4.2, General Conduct of SRM Surveys.

5 Preliminary Screening of Potential Removal Actions

This section will provide a brief description of possible removal actions, general response actions, or a presumptive remedy to address threats to human health and the environment.

5.1 Preliminary Screening of Removal Actions

U.S. EPA (2003) states that, at present, only two remedial actions are considered to be protective, long-term remedial actions for residential properties at lead-contaminated sites: (1) excavation of contaminated soil followed by placement of a soil cover barrier, and (2) placement of a soil cover barrier without any excavation of contaminated soils. EPA did not consider other treatment technologies to be protective in the long term.

5.2 Screening Levels

The residential and non-residential soil screening values for lead are 400 and 1,000 mg/kg, respectively. These have been accepted as the residential and non-residential soil screening levels for lead at this Site. As described elsewhere in this work plan, lead is the driver for removal decisions. If lead exceedances are addressed, then exceedances of arsenic, cadmium, and zinc would also be addressed.

5.3 Institutional Use Controls

Institutional controls are administrative and/or legal mechanisms that can (1) help minimize the potential for human exposure to contamination, and (2) protect the integrity of the remedy (U.S. EPA 2003). Institutional controls accomplish these objectives by directly limiting land or resource use, and/or by providing information that modifies behavior. Examples of institutional controls include, but are not limited to, the following:

- Zoning restrictions
- Permits for building/excavation or for groundwater drilling and use
- Ordinances (e.g., for an overlay zone that specifies proper handling of smelter residue encountered during excavations and utility maintenance)
- Provisions that restrict land or resource use at a remediated site (e.g., not excavating below a certain depth, requirements for elevated gardens)
- Property access easements to an agency for long-term monitoring of a remedial action (i.e., soil cover)

- Establishment of a disposal location (i.e., on the former smelter property).

5.4 Potential Removal Actions

At this Site, excavation of the upper 6 in. to upper 12 in. of soil, followed by placement of a soil cover and sod, will likely be the primary removal action for residential yards. A detailed discussion of removal alternatives based on depth of excavation will be presented in the Phase 2 RSE Report, following an evaluation of the SRM survey and soil sampling results. Removal alternatives for driveways, alleys, and ditches will also be presented in the RSE report.

6 RSE Implementation Schedule

The RSE implementation schedule is presented below and incorporates the deliverable schedule set forth in §13 of the SACO (KDHE 2013a).

Event or Activity	Due Date
Submit Draft Phase 2 RSE Work Plan to KDHE	June 30, 2014
Receive comments from KDHE on Draft Phase 2 RSE Work Plan	July 16, 2014
KDHE approval of responses to comments	August 1, 2014
Submit Final Phase 2 RSE Work Plan to KDHE	August 15, 2014 (hard copy August 18, 2014)
KDHE Phase 2 RSE Work Plan approval	August 18, 2014
Start field work	September 8, 2014
Review soil sampling results with KDHE and finalize SRM classes	December 31, 2014, or within 90 snow-free days after the start of field work
KDHE approval of SRM classes	January 15, 2015 (assume 14 days after data review)
Complete city-wide SRM survey	April 30, 2015, or within 90 snow-free days after KDHE approval of SRM classes
Submit Draft Phase 2 RSE Report	June 30, 2015, or within 60 days of completion of the city-wide SRM survey

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Figures

Source: KDHE (2013a), City limits boundary from http://kansasgis.org

Figure 1-1. Cherryvale city limits and boundary of former National Zinc Smelter property

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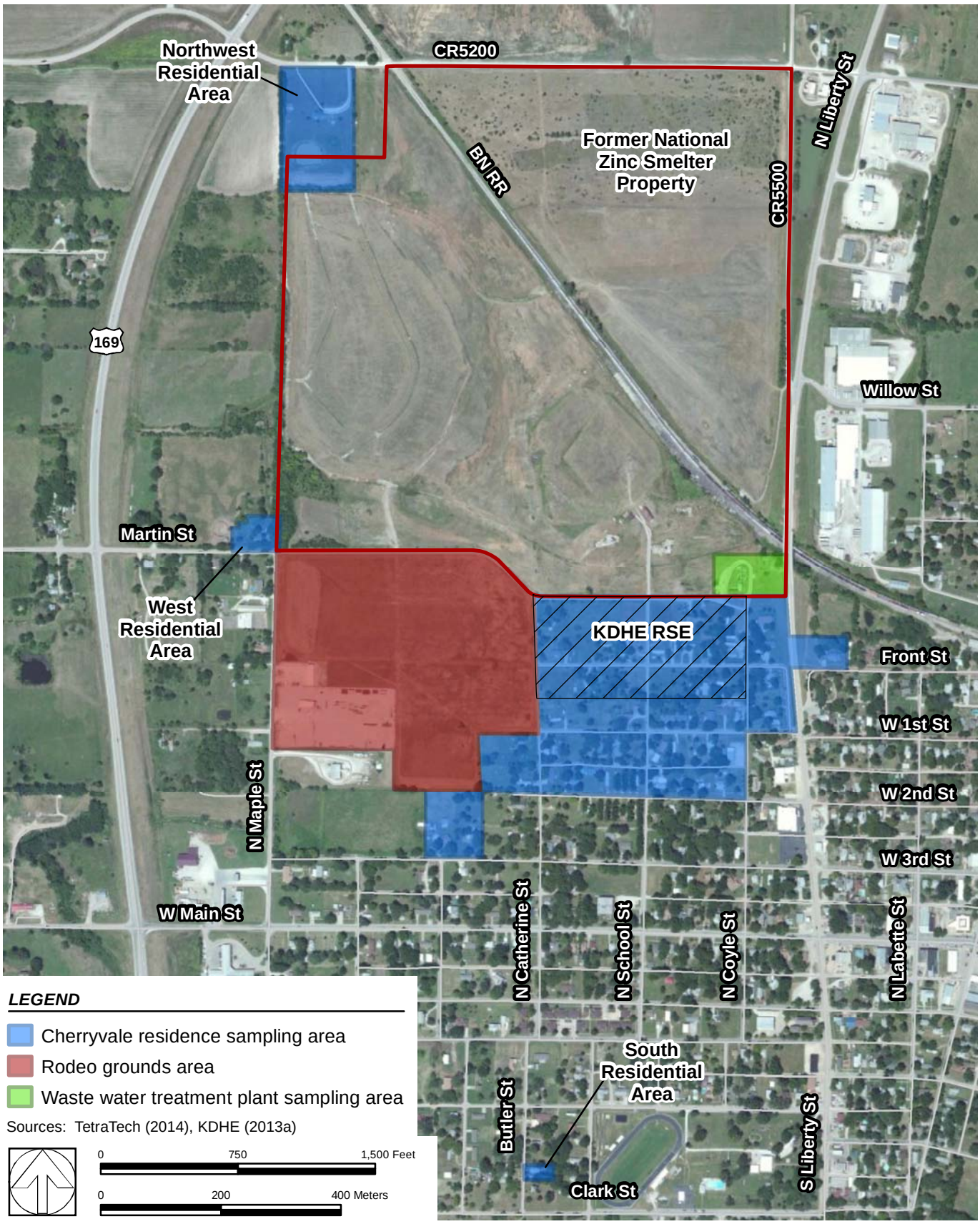

Figure 2-1. KDHE and EPA areas sampled in 2001 and 2002

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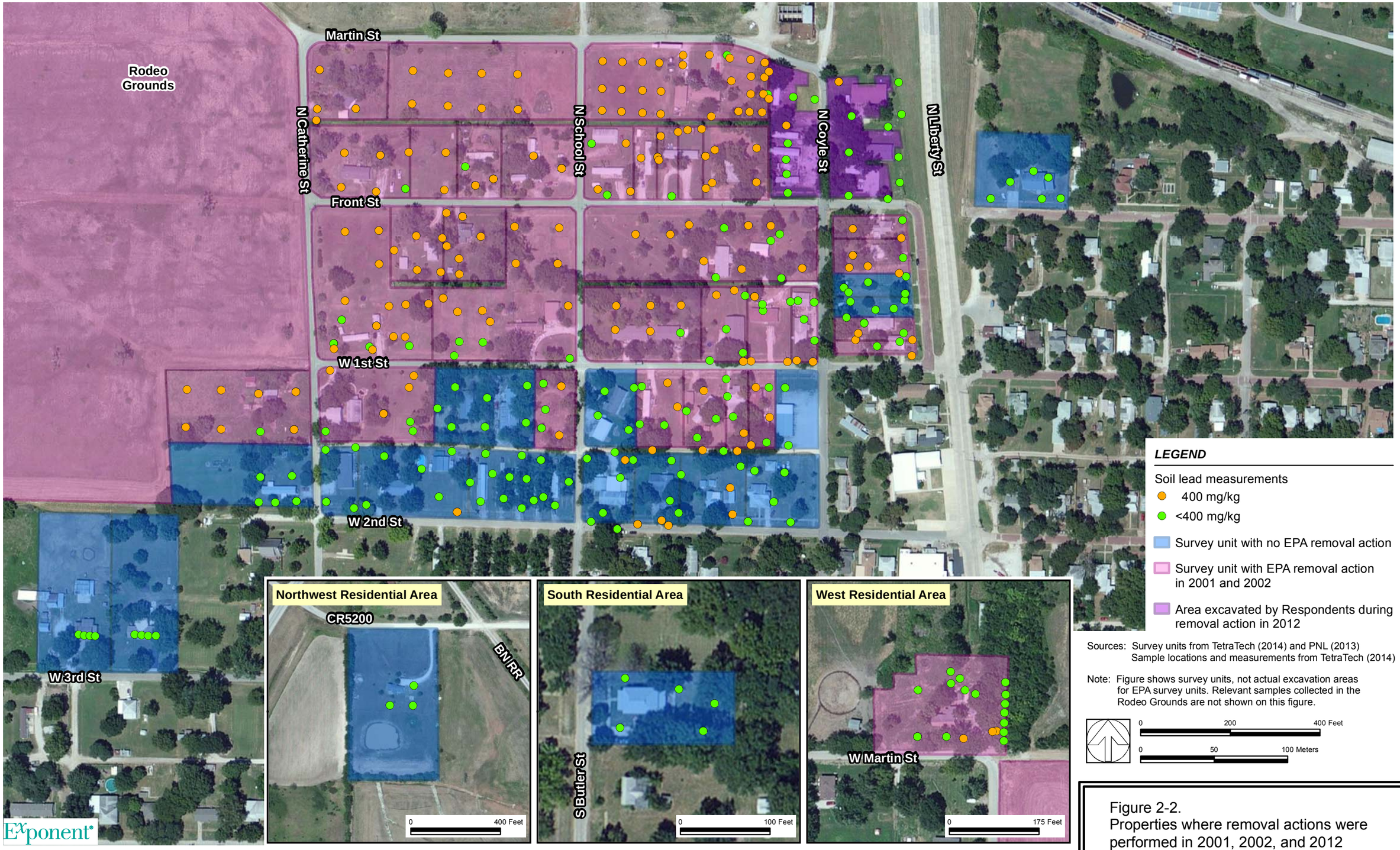

Figure 2-2.
Properties where removal actions were performed in 2001, 2002, and 2012

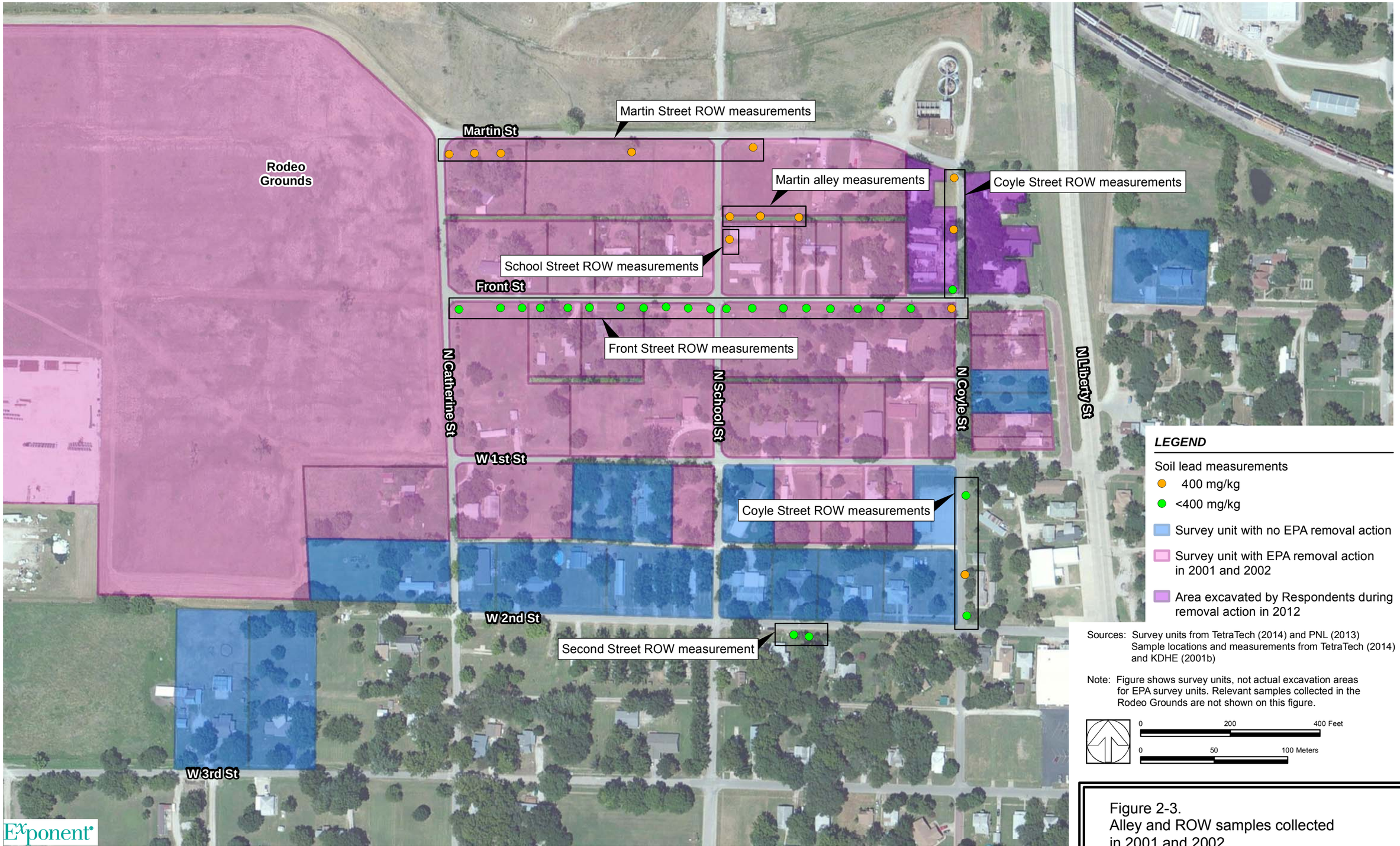

Figure 2-3.
Alley and ROW samples collected in 2001 and 2002

A Slag and retort fragments

B Granular slag

C Granular slag underlying brick sidewalk

D Isolated slag fragments

Source: Mark Landress, PNL

Figure 2-4. Smelter residue material

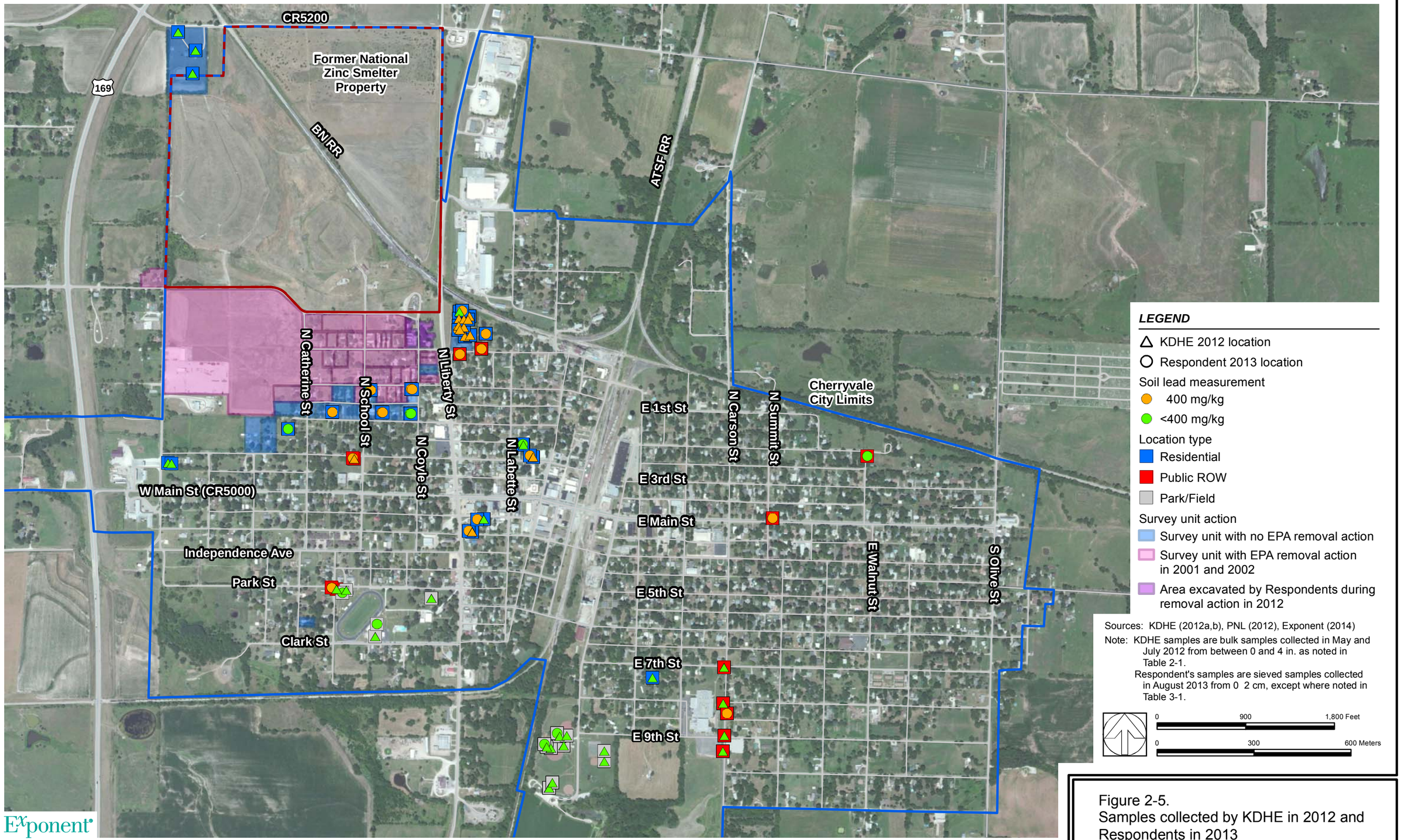

Figure 2-5.
Samples collected by KDHE in 2012 and Respondents in 2013

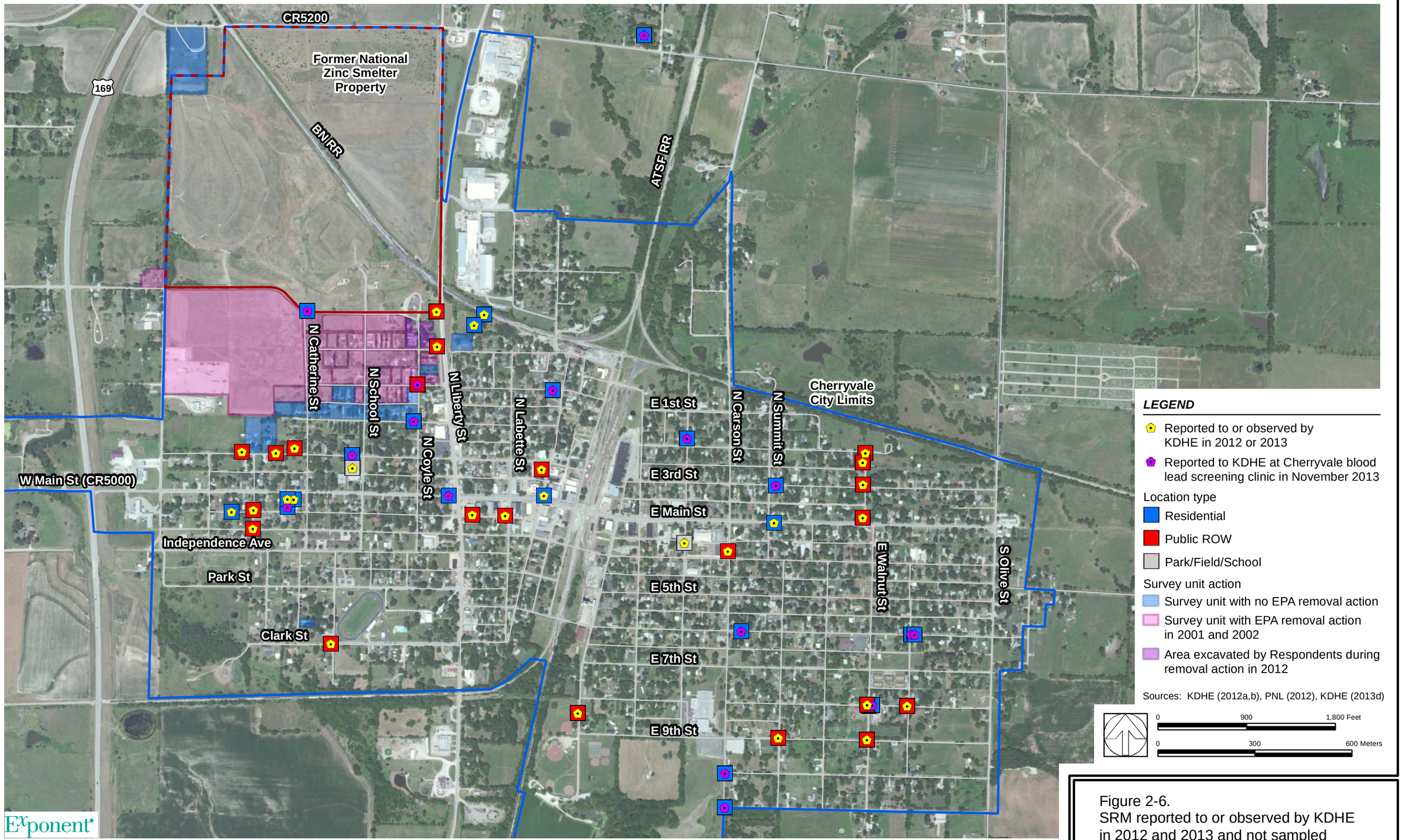

Figure 2-6.
SRM reported to or observed by KDHE in 2012 and 2013 and not sampled

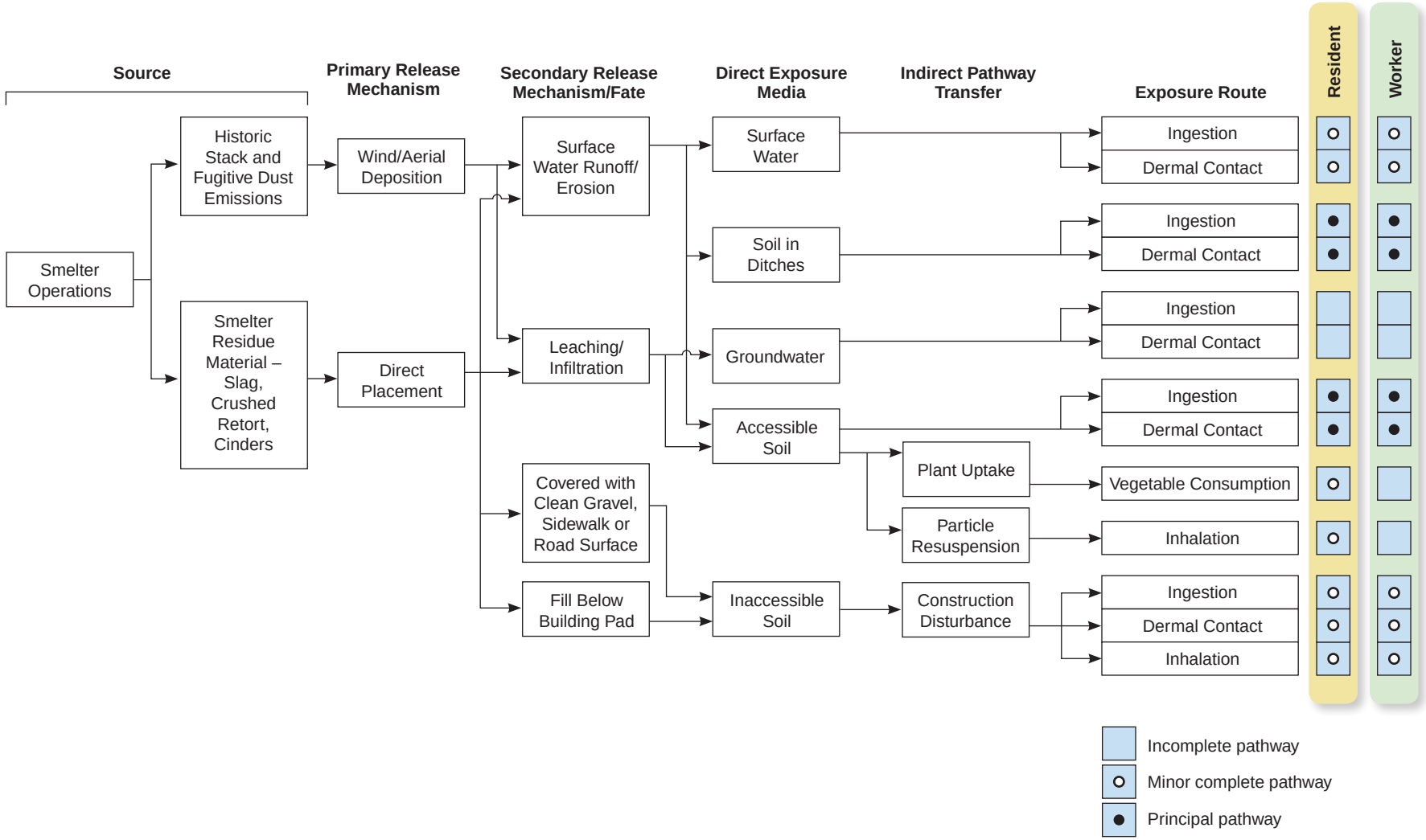

Figure 3-1. Preliminary conceptual site model for residential and worker exposure

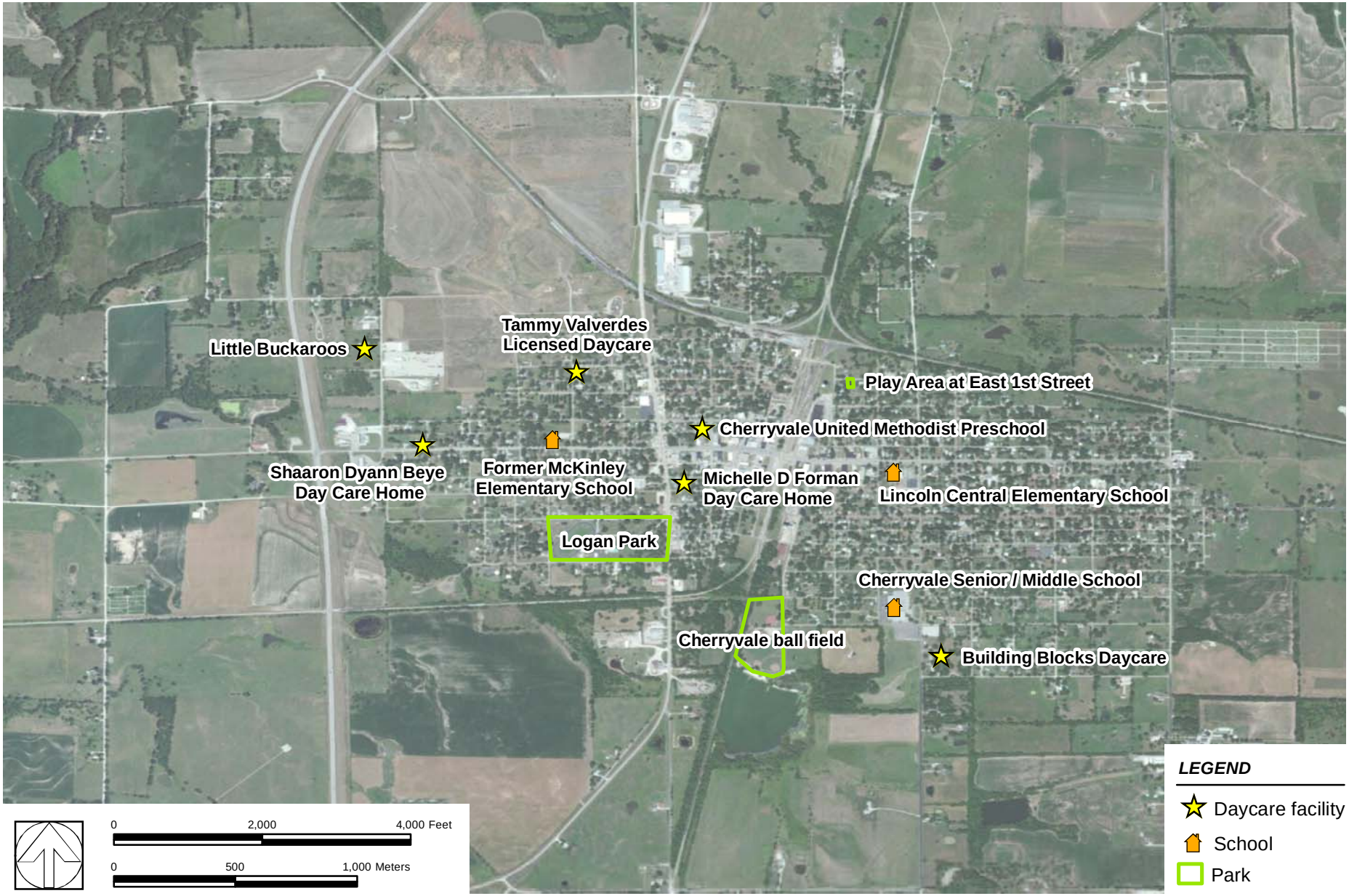

Figure 4-1. Locations of daycare facilities, schools, and parks

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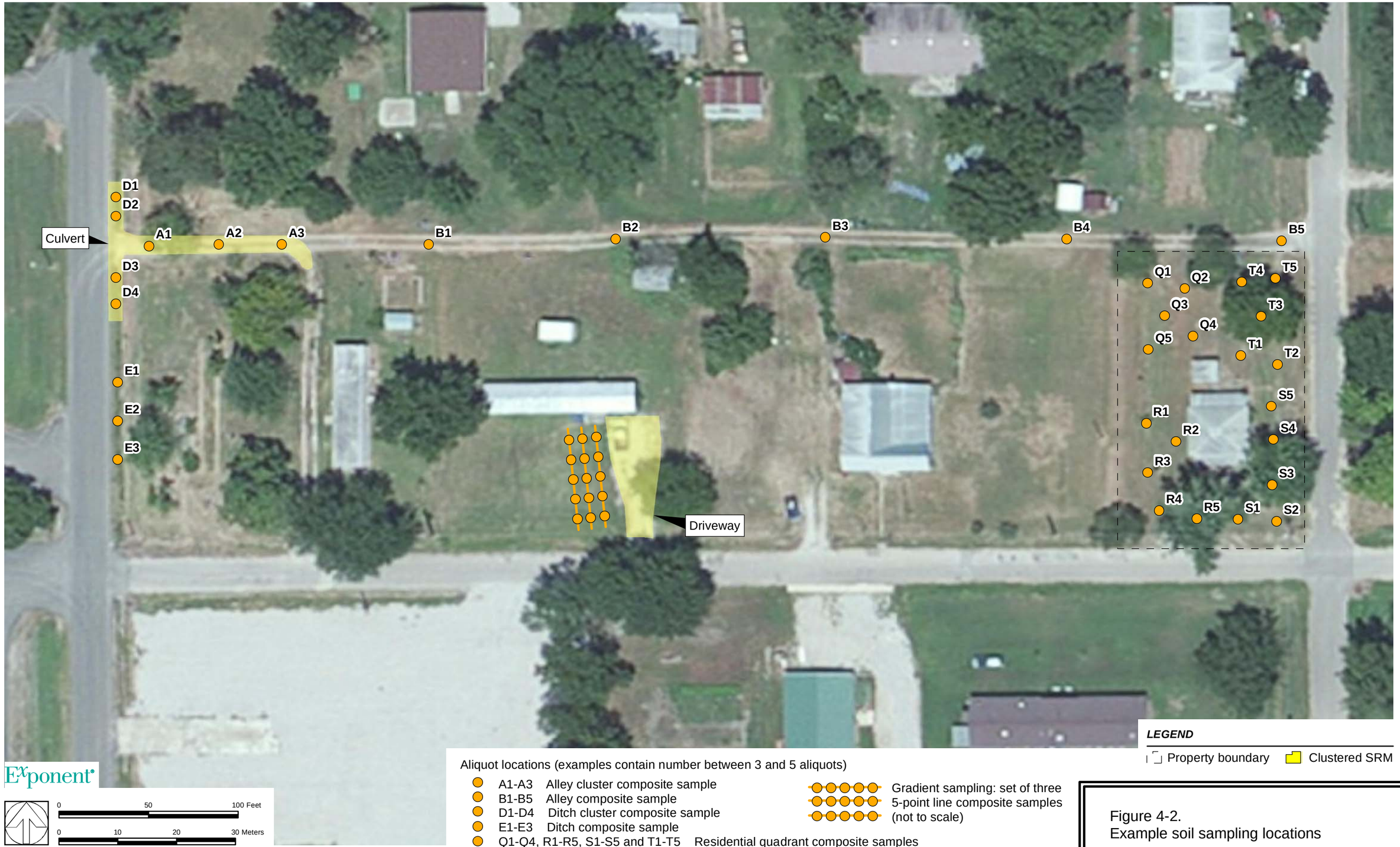
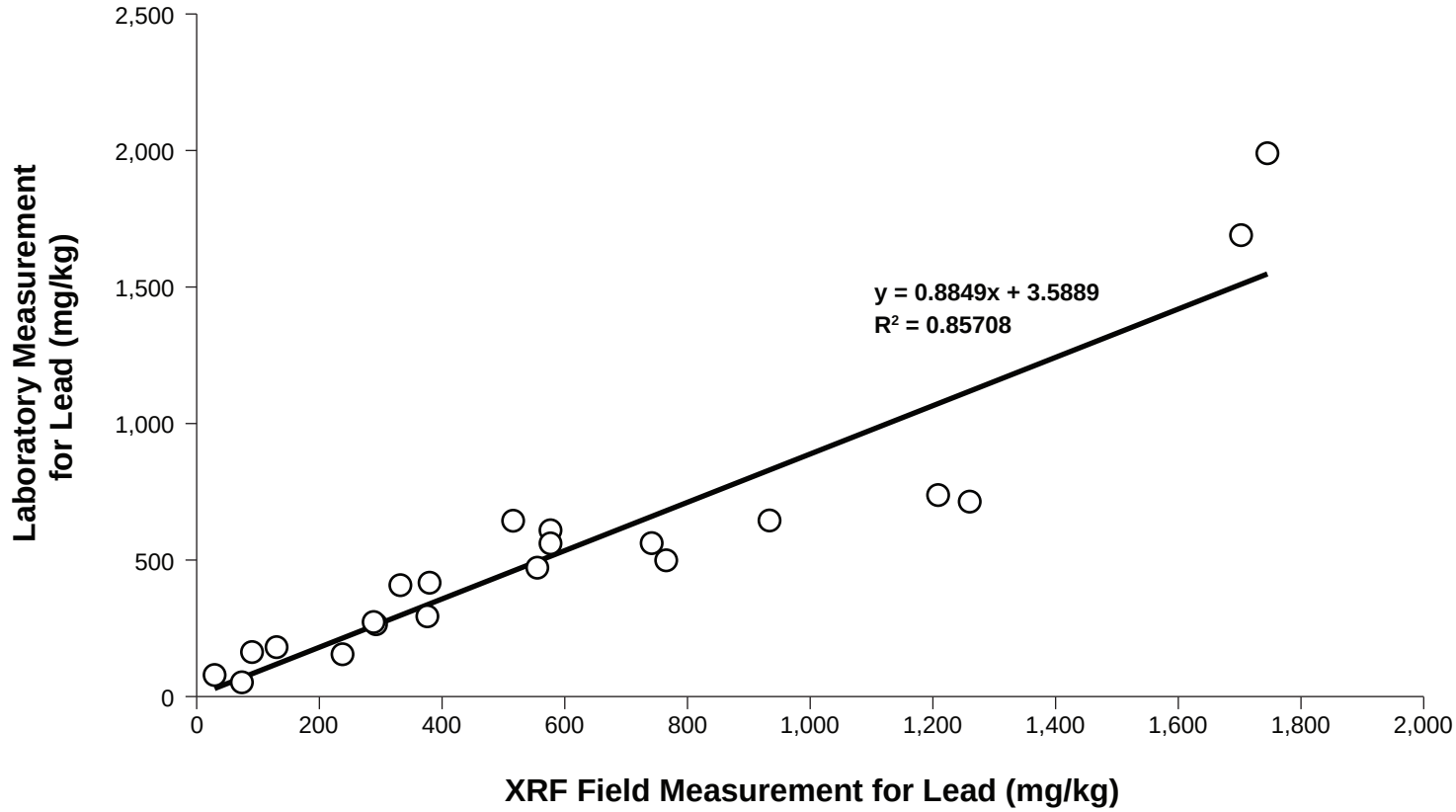
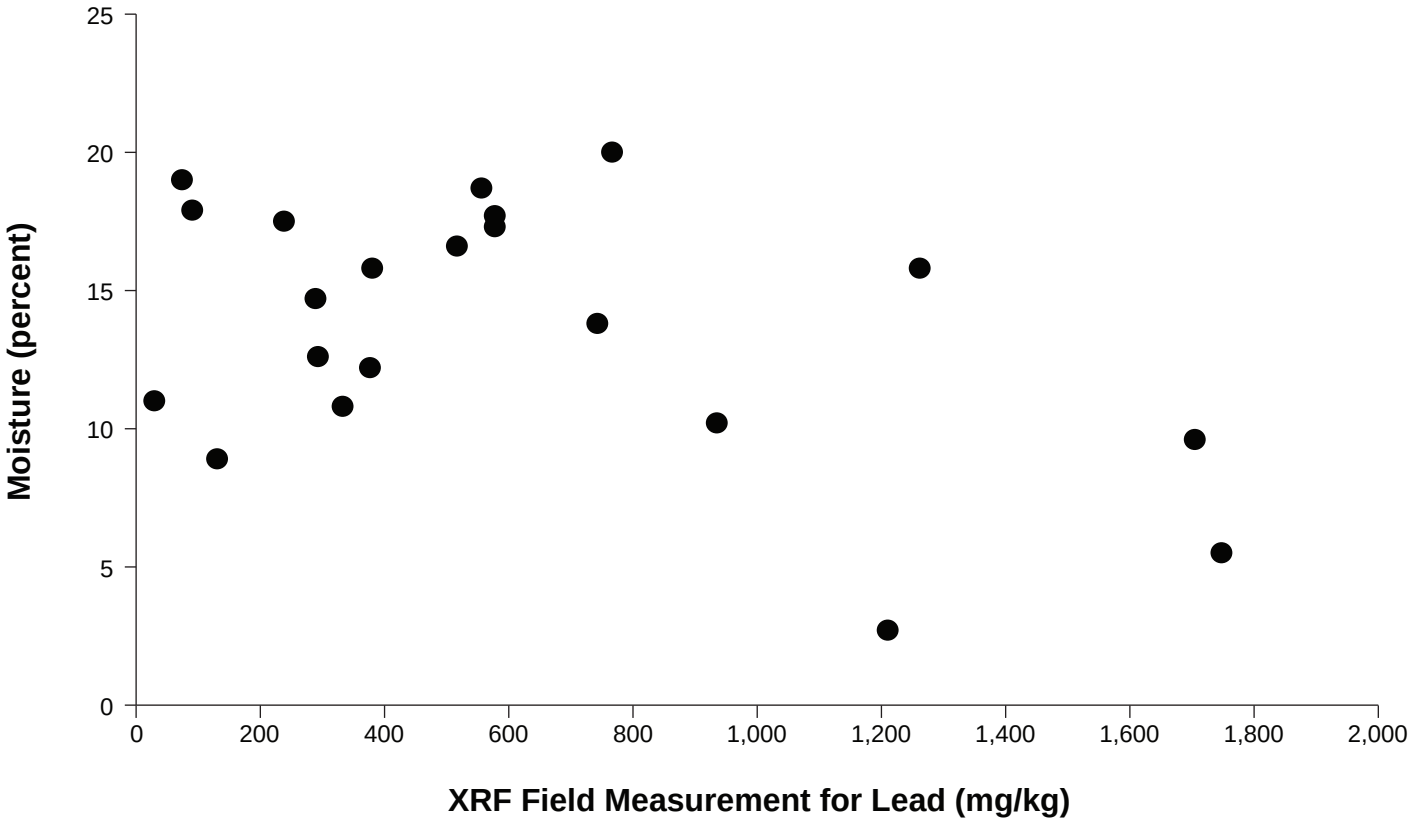


Figure 4-2.
Example soil sampling locations



Source: PNL (2011)

Figure 4-3. Comparison of XRF field and laboratory measurements for lead



Source: PNL (2011)

Figure 4-4. Moisture content of samples used in comparison of XRF field and laboratory measurements for lead

Tables

Table 2-1. Summary of SRM observations and soil sample results collected by KDHE in 2012 and 2013

Address or Property Description	Latitude	Longitude	Property Type	Sample ID	Sample Depth (in.)	Lead in Soil (mg/kg) via XRF (and Wet Lab)[a]	Description	Source
Inspected by KDHE in 2012								
750 S Carson St (Middle/High School)	37.261971	-95.546272	Ditch	CSM-Ditch 1	0–1	186	Coarse slag frags in ditch. >2cm	KDHE 2012b, PNL 2012
700 S Carson St (Middle/High School)	37.262407	-95.546236	Ditch	CSM-Ditch 2	0–1	241 (210)	Coarse slag frags in ditch. >2cm	KDHE 2012b, PNL 2012
600 S Carson (Middle/High School)	37.263304	-95.546307	Ditch	CSM-Ditch 3	0–1	217	Coarse slag frags in ditch. >2cm	KDHE 2012b, PNL 2012
500 S Carson (Middle/High School)	37.264313	-95.546318	Ditch	CSM-Ditch 4	0–1	154	Coarse slag frags in ditch. >2cm	KDHE 2012b, PNL 2012
400 W Walnut (Logan Park)	37.266203	-95.559900	Ditch	PL Ditch 1	0–1	126	Coarse slag with chat. 1->2cm	KDHE 2012b, PNL 2012
400 S Liberty (Logan Park NE)	37.266018	-95.556583	Park/field	PL1	0–1	179	Not specified	KDHE 2012b, PNL 2012
500 W Walnut (Logan Park ticket booth)	37.264914	-95.558499	Park/field	PL2	0–1	186	Not specified	KDHE 2012b, PNL 2012
400 W Walnut (Logan Park long jump track)	37.266188	-95.559555	Park/field	PL3	0–1	248 (160)	Pea-sized granular slag	KDHE 2012b, PNL 2012
700 S Galveston (Ball field north)	37.262007	-95.551836	Park/field	P Drive	0–1	365 (100)	Granular slag near tree. <1-2cm	KDHE 2012b, PNL 2012
700 S Galveston (Ball field north)	37.262270	-95.551985	Park/field	PN1	0–1	142 (71)	Granular slag near tree. <1-2cm	KDHE 2012b, PNL 2012
700 S Galveston (Ball field north)	37.262294	-95.551731	Park/field	PN2	0–1	55	Granular slag near tree. <1-2cm	KDHE 2012b, PNL 2012
700 S Galveston (Ball field E tennis court)	37.261603	-95.550396	Park/field	PN1-1	0–1	109 (69)	Granular slag	KDHE 2012b, PNL 2012
700 S Galveston (Ball field E tennis court)	37.261894	-95.550404	Park/field	PN1-2	0–1	51	Granular slag	KDHE 2012b, PNL 2012
700 S Galveston (Ball field middle)	37.261934	-95.552272	Park/field	PM1	0–1	ND	East of dugout on red field	KDHE 2012b, PNL 2012
700 S Galveston (Ball field middle)	37.261967	-95.552426	Park/field	PM2	0–1	40 (160)	Granular slag near tree. <1-2cm	KDHE 2012b, PNL 2012
850 S Galveston (Ball field SE)	44.456104	-95.235591	Park/field	PSE1	0–1	ND	Not specified	KDHE 2012b, PNL 2012
850 S Galveston (Ball field SW)	37.260822	-95.552295	Park/field	PSW1	0–2	43	Not specified	KDHE 2012b, PNL 2012
850 S Galveston (Ball field SW)	37.260970	-95.552195	Park/field	PSW2	0–1	ND	Not specified	KDHE 2012b, PNL 2012
W 3rd St and N School St (former McKinley School/Thayer Preschool)	37.269851	-95.559397	School/ Sidewalk	PRES1	0–1	619 (790)	Dark soil, isolated slag fragments near tree and brick sidewalk. <1cm	KDHE 2012b, PNL 2012
Lincoln Central Elementary School	37.268399	-95.547786	School/ Public ROW	--	--	--	Smelter waste observed on sidewalks and parking lot along public ROW, on school property around trees bordering the public ROW, and along a stone wall that surrounds the property	KDHE 2012b
334 Front St (Schaper—Residential Property 1)	37.273343	-95.555665	Residential	Res 1 S1	0–4	418 (360)	Granular slag in yard and adjacent to building. Concentrations near rail ROW to north. Possibly old driveway or building foundation. Generally <1 -1 cm	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273906	-95.555518	Residential	Res 1 S2	0–4	590	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.274032	-95.555874	Residential	Res 1 S3	0–4	433	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273374	-95.555475	Residential	Res 1 S4	0–4	601	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273827	-95.555880	Residential	Res 1 S5	0–4	620 (540)	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273816	-95.555710	Residential	Res 1 S6	0–4	1,007	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273631	-95.555888	Residential	Res 1 S7	0–4	1,508	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273597	-95.555703	Residential	Res 1 S8	0–4	1,924 (3,300)	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273523	-95.555847	Residential	Res 1 S9	0–4	522	Granular slag and soil	KDHE 2012a, PNL 2012
334 Front St (Schaper—Residential Property 1)	37.273813	-95.555561	Residential	Res 1 S10	0–4	555	Granular slag and soil	KDHE 2012a, PNL 2012
925 W 5200 Rd (Blake—Residential Property 2)	37.281604	-95.565940	Residential	Res 2 #1	0–4	20	No slag	KDHE 2012a, PNL 2012
925 W 5200 Rd (Blake—Residential Property 2)	37.281107	-95.565316	Residential	Res 2 #2	0–4	45	No slag	KDHE 2012a, PNL 2012
925 W 5200 Rd (Blake—Residential Property 2)	37.280461	-95.565402	Residential	Res 2 #3	0–4	88 (100)	No slag	KDHE 2012a, PNL 2012
115 N Maple St (Hey—Residential Property 3)	37.269590	-95.565890	Residential	Res 3 #1	0–4	197	No slag	KDHE 2012a, PNL 2012
115 N Maple St (Hey—Residential Property 3)	37.269581	-95.565761	Residential	Res 3 #2	0–4	104	No slag	KDHE 2012a, PNL 2012
W 1st St (Residential Property 4)	Unknown	Unknown	Residential	--	--	--	No smelter waste	KDHE 2012a
W 1st St (Residential Property 5)	Unknown	Unknown	Residential	--	--	--	No smelter waste	KDHE 2012a
212 W 3rd St (Brooks—Residential Property 6)	37.270029	-95.553171	Residential	Res 6 #1	0–4	593 (700)	Old demolished structure with isolated coarse fragments and slag in mortar. >2cm	KDHE 2012a, PNL 2012
216 W 3rd St (Brooks—Residential Property 7)	37.270367	-95.553517	Residential	Res 7 #1	0–4	267 (310)	Old structure with isolated coarse fragments. Coarse slag frags. Play area noted. >2cm	KDHE 2012a, PNL 2012
326 W 4th St (Jewitt—Residentail Property 8)	37.268269	-95.554835	Residential	Res 8 #1	0–4	366 (310)	Granular slag in idle driveway. <1-2 cm	KDHE 2012a, PNL 2012
326 W 4th St (Jewitt—Residentail Property 8)	37.267906	-95.555217	Residential	Res 8 #2	0–4	451 (450)	Near old brick walk	KDHE 2012a, PNL 2012

Table 2-1. (cont.)

Address or Property Description	Latitude	Longitude	Property Type	Sample ID	Sample Depth (in.)	Lead in Soil (mg/kg) via XRF (and Wet Lab)[a]	Description	Source
Inspected by KDHE in 2012 (cont.)								
E 6th St (Residential Property 9)	37.265473	-95.540992	Residential	--	--	--	No smelter waste	KDHE 2012a, PNL 2012
321 E 7th St (Brooks—Residential Property 10)	37.263972	-95.548795	Residential	Res 10 #1	0–4	77	Very isolated coarse slag fragments in brick pile. >2 cm	KDHE 2012a, PNL 2012
W Main St (Residential Property 11)	37.268451	-95.563514	Residential	--	--	--	No smelter waste	KDHE 2012a
W Main St (Residential Property 12)	37.268458	-95.563093	Residential	--	--	--	Smelter waste	KDHE 2012a
Unknown (Residential Property 13)	37.273972	-95.555021	Residential	--	--	--	Smelter waste	KDHE 2012a
Unknown (Residential Property 14)	Unknown	Unknown	Residential	--	--	--	Smelter waste	KDHE 2012a
N Liberty St near Martin St	37.274022	-95.556687 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
N Liberty St near Front St	37.273044	-95.556630 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
W 3rd St between Walnut and Oak Sts	37.269973	-95.563327 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
W 3rd St between Oak and Catherine Sts	37.269960	-95.562150 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
W 3rd St between Oak and Catherine Sts	37.270107	-95.561501 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
S Oak St between Main and 4th Sts	37.268358	-95.562880 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
W 4th St and S Oak St	37.267835	-95.562874 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
W Main St between Liberty and Labette Sts	37.268390	-95.555248 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
S Labette St between Main and 4th Sts	37.268386	-95.554107 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
Clark St and W Walnut St	37.264694	-95.560045 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
S Galveston St between 8th and 9th Sts	37.262943	-95.551379 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
W 3rd St and N Neosho St	37.269705	-95.552879 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
E 2nd St and N East Walnut St	37.270403	-95.541607 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
N East Walnut St between 2nd and 3rd Sts	37.270135	-95.541694 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
E 3rd St and N East Walnut St	37.269519	-95.541661 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
E Main St and N East Walnut St	37.268597	-95.541642 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
E 9th St and S Baldwin St	37.262400	-95.544382 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
E 9th St and S East Walnut St	37.262419	-95.541291 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
8th St and Hickory St	37.263389	-95.539921 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
8th St and S East Walnut St	37.263390	-95.541314 [b]	Public ROW	--	--	--	Not specified	KDHE 2012a
Front St between Liberty and Labette Sts	37.273669	-95.555364 [b]	Residential	--	--	--	Not specified	KDHE 2012a
Reported to KDHE at Cherryvale Blood Lead Screening Clinic in November 2013								
422 W Main St	37.268910	-95.556090 [c]	Residential	--	--	--	Smelting slag observed at property	KDHE 2013d
Property behind 735 W Main St	37.268464	-95.561696 [c]	Residential	--	--	--	Reported that property behind the listed address had cinders in backyard	KDHE 2013d
219 W 1st St	37.271920	-95.552561 [c]	Residential	--	--	--	Cinders observed during landscape work under sidewalk by the porch at the property	KDHE 2013d
508 W 2nd St	37.270948	-95.557376 [c]	Residential	--	--	--	Cinders reported underneath house	KDHE 2013d
620 W 3rd St	37.269960	-95.559487 [c]	Residential	--	--	--	Reported that yard was tested in the 1970s or 1980s and told it was contaminated, but the property was not cleaned up	KDHE 2013d
613 E 3rd St	37.269433	-95.544703 [c]	Residential	--	--	--	Smelting retorts observed in backyard and more keep coming to the surface	KDHE 2013d
525 E 6th St	37.265348	-95.545767 [c]	Residential	--	--	--	Smelting slag observed in yard	KDHE 2013d
900 E 6th St	37.265381	-95.539849 [c]	Residential	--	--	--	Smelting slag observed after sewer line work at the property	KDHE 2013d

Table 2-1. (cont.)

Address or Property Description	Latitude	Longitude	Property Type	Sample ID	Sample Depth (in.)	Lead in Soil (mg/kg) via XRF (and Wet Lab)[a]	Description	Source
Reported to KDHE at Cherryvale Blood Lead Screening Clinic in November 2013 (cont.)								
908 E 6th St (lot—garden)	37.265382	-95.539736 [c]	Residential	--	--	--	Smelting slag observed at lot after house at the property was demolished, slag also observed in dirt pile at the property	KDHE 2013d
801 E 8th St (lot—garden)	37.263360	-95.541248 [c]	Residential	--	--	--	Smelter waste in garden	KDHE 2013d
808 E 8th St	37.263388	-95.541135 [c]	Residential	--	--	--	Smelter waste in yard	KDHE 2013d
505 E 10th St	37.261373	-95.546206 [c]	Residential	--	--	--	Cinders observed in yard	KDHE 2013d
504 E 11th Street	37.260428	-95.546184 [c]	Residential	--	--	--	Cinders observed in yard and after demolition of porch at the property	KDHE 2013d
322 N Montgomery St	37.270671	-95.547838 [c]	Residential	--	--	--	Cinders observed in the driveway of property	KDHE 2013d
1155 N Washington St	37.281878	-95.549709 [c]	Residential	--	--	--	Smelting slag observed after sewer line work at the property	KDHE 2013d
500 W 1st St	37.271969	-95.557272 [c]	Residential/ Ditch	--	--	--	Smelter waste observed on and near the property in ditches	KDHE 2013d
1069 W Martin St	37.273957	-95.567514 [c]	Residential	--	--	--	Cinders observed in the driveway with some possibly covered by now, and also near the foundation of a shed that was demolished	KDHE 2013d
Reported to or Observed by KDHE in 2013								
725 W Main St	37.268685	-95.561480 [c]	Residential	--	--	--	Cinders observed underneath the cement slab foundation for the garage attached to the house	KDHE 2013d
735 W Main St	37.268683	-95.561703 [c]	Residential	--	--	--	Smelter waste fragments observed near a storage shed on the property and in the ditch bordering the west side of the property	KDHE 2013d
611 E Main St	37.268397	-95.544727 [c]	Residential	--	--	--	Smelter waste observed while installing fence posts in yard at approximately 1ft below ground surface; also observed along roads and alleys near the property	KDHE 2013d
113–115 N Neosho St	37.268980	-95.552776 [c]	Residential	--	--	--	Cinders observed at base of building foundation after buildings demolished	KDHE 2013d

Note: -- - no data available
[ ] - exceeds residential criterion

[a] All samples were analyzed with XRF, and a subset of samples were analyzed by a wet laboratory. XRF results are listed first, and wet laboratory results (if analyzed) are listed in parentheses after the XRF result.

[b] Locations are approximate; digitized from figure in KDHE (2012a).

[c] Locations are approximate; determined from address information in KDHE (2013d).

Table 3-1. Metal concentrations in soil samples (<250-μm fraction) from Phase I RSE collected August 5–7, 2013

Sample Type	Address or Location	Sample ID	Depth (cm)	Zn (mg/kg)	As (mg/kg)	Cd (mg/kg)	Pb (mg/kg)
Historical Aerial Deposition							
	630 W 2nd St	EX001	13–18	2,721	12.4	19.2	656
	529 W 1st St	EX002	0–2	1,503	11.9	8.9	295
	529 W 1st St	EX003	10–12	4,651	25.2	21.5	834
	709 W 2nd St	EX004	0–2	1,925	11.4	9.0	230
	630 W 2nd St	EX006	0–2	2,527	10.6	15.3	781
	524 W 2nd St	EX008	0–2	2,222	10.2	15.0	518
	508 W 2nd St	EX009	20–25	2,213	12.2	11.3	387
	MCFD (W 1st and Coyle Sts)	EX012	0–2	2,911	15.5	17.7	481
	MCFD (W 1st and Coyle Sts)	EX014	13–15	3,379	19.8	20.8	629
	524 W 2nd St	EX018	5–8	3,231	16.8	21.3	806
	508 W 2nd St	EX020	0–2	1,049	8.4	5.4	151
Parks/Fields							
	Ball field	EX010	0–2	551	30.5	1.9	66
	Logan Park	EX023	0–2	3,032	29.6	4.6	129
	Logan Park	EX026	0–2	1,061	8.1	4.0	152
	Ball field	EX027	0–2	1,015	18.3	2.2	84
Sidewalk Underlayment							
	600 E Main St	EX005	0–2	120,953	481	255	14,344
	312 Front St	EX011	0–2	4,292	29.3	11.9	484
	Thayer Preschool	EX022	0–2	5,412	16.5	21.2	802
	335 Front St	EX028	0–2	9,850	34.5	23.4	1,020
Residential SRM							
	334 Front St	EX007	0–2	5,841	79.3	14.6	1,107
	326 W 4th St	EX015	0–2	1,657	11.7	8.1	425
	216 W 3rd St	EX016	0–2	1,302	12.0	4.3	286
	212 W 3rd St	EX017	0–2	3,727	18.1	10.1	2,245
	326 W 4th St	EX024	0–2	2,265	175	4.4	606
	334 Front St	EX025	0–2	17,986	41.7	32.4	3,831
	312 Front St	EX029	0–2	4,438	15.7	12.2	802
Ditches							
	S Carson St	EX013	0–2	9,499	64.1	17.9	676
	Walnut and Second Sts	EX019	0–2	3,503	32.2	8.4	290
	Walnut and Park Sts	EX021	0–2	22,029	22.4	26.7	506
Residential Soil Screening Criteria				23,500	53.6	39	400
Non-residential Soil Screening Criteria				613,000	179.2	965	1,000

Note: Modified from Table 1 in Exponent (2014) and PNL (2014).

Soil screening criteria are from KDHE (2010), except arsenic criteria, which are based on an adjustment for site-specific bioavailability.

MCFD - Montgomery County Fire Department
RSE - removal site evaluation
SRM - smelter residue material

- exceeds residential criterion

- exceeds non-residential criterion

Table 4-1. Site evaluation elements

Site Evaluation Element	Work Type	Property Type: Residential (including Daycare Facilities)	Property Type: Alley	Property Type: Roadside Ditch	Property Type: School/ Park
Conduct initial SRM surveys to develop SRM classifications					
Propose SRM classes[a] (see work plan Section 4.3)	Work plan	A, B, C, D classes	A, B, C, D classes	A, B, C, D classes	Site-specific (see work plan for details)
Test SRM classes (see work plan Section 4.3)	Field survey	~25 properties	~25 alleys	~25 ditches	Site-specific (see work plan for details)
Refine SRM classes (see work plan Section 4.3)	Field survey	~75 properties	~75 alleys	~75 ditches	Site-specific (see work plan for details)
Collect soil samples to validate SRM classifications					
Collect soil samples (see work plan Section 4.4)	Soil sampling	~5 of A & B and ~3 of C & D = ~16 properties	~4 of A & B and ~2 of C & D = ~12 properties	~4 of A & B and ~2 of C & D = ~12 properties	Site-specific (see work plan for details)
Collect gradient soil samples (see work plan Section 4.4)	Gradient soil sampling	~5 of A w/SRM in driveways; ~5 of A w/SRM in sidewalks	~5 of A	~5 of A	Site-specific (see work plan for details)
Finalize SRM classes with KDHE input (see work plan Section 4.5)	Analysis	Analyze data	Analyze data	Analyze data	Not applicable
Conduct city-wide SRM survey with finalized SRM classes (see work plan Section 4.6)	Field survey	All properties within the Site	All properties within the Site	All properties within the Site	Not applicable

[a] Propsed SRM classes for each property type are listed in Table 4-2.

Table 4-2. Proposed SRM classes for residential properties, daycare facilities, alleys, and roadside ditches

Residential Properties and Daycare Facilities

Class	Description
A	SRM observed commonly on property as fill or driveway/parking area
B	Moderate SRM observed on property
C	Sparse to moderate SRM observed on property without clear source
D	SRM not observed at or adjacent to residence

Alleys

Class	Description
A	SRM present and visible throughout alley (moderate amounts or greater)
B	Moderate SRM observed to be clustered at one or two locations in the alley
C	Some SRM observed in alley without clear cluster (isolated fragments)
D	SRM not observed in alley

Roadside Ditches

Class	Description
A	SRM observed in bedding of culvert (or like cluster) and SRM observed throughout the ditch
B	SRM observed in bedding of culvert (or like cluster) and no (or sparse) SRM observed throughout the ditch
C	SRM observed in ditch without clear cluster (isolated fragments)
D	SRM not observed in ditch

Note: As described in the work plan, SRM classes were not developed for schools and parks, because they will be treated on a site-specific basis.

APPROVED

Appendix A

Standard Operating Procedures

SOP GEN-01
FIELD DOCUMENTATION

The integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record keeping will be implemented in the field to allow samples to be traced from collection to final disposition. All information relevant to field operations must be properly documented to ensure that activities are accounted for and can be reconstructed from written records. Several types of field documents and sample tracking information will be used for this purpose and should be consistently used by field personnel.

FIELD LOGBOOKS

During field sampling events, field logbooks are used to record all daily field activities. The purpose of the field logbook is to document events that occur and record data measured in the field to the extent that someone not present at the site can reconstruct the activity without relying on the memory of the field crew.

A bound, waterproof field logbook with consecutively numbered pages will be completed using indelible ink for each sampling event. All daily field activities will be documented in indelible ink in this logbook and no erasures will be made. All corrections should consist of a single line-out deletion, followed by the sampler's initials and the date. The sampler will initial and date each page of the field logbook. The sampler will sign and date the last page at the end of each day, and a line will be drawn through the remainder of the page.

The project name, site name and location (city and state), Exponent contract number, and the dates (i.e., duration) of sampling activity should be written on the cover of the field logbook. If more than one logbook is used during a single sampling event, then the upper right hand corner of the logbook will be annotated (e.g., 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event.

Field logbooks will be stored in a secure manner when not in use in the field. At a minimum, the sampler will record the following information in the field logbook:

- Project name, project location, and project number
- Purpose and description of the field task
- Project start date and end date
- Date and time of entry (24-hour clock)

- Time and duration of daily sampling activities
- Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change (e.g., wind speed and direction, wave action, current, tide, vessel traffic, temperature of both the air and water, thickness of ice if present)
- Name of person making entries and other field personnel and their duties, including the times that they are present
- Level of personal protection being used
- Onsite visitors, if any, including the times that they are present
- The name, agency, and telephone number of any field contacts
- Notation of the system used to determine the station location information
- The sample identifier and analysis code for each sample to be submitted for laboratory analysis
- All field measurements made (or reference to specific field data sheets used for this purpose), including the time that the measurement was collected and the date of calibration, if appropriate
- The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates
- The type of vessel used (e.g., size, power, type of engine) (for aquatic sampling only)
- The location and description of the work area, including sketches and map references, if appropriate
- Specific information on each type of sampling activity
- The sample type (i.e., groundwater, soil, surface sediment), sample number, and sample tag number
- Preservatives used, if any
- Sample storage methods
- Cross-references of numbers for duplicate samples
- A description of the sample (source and appearance, such as soil or sediment type, color, texture, consistency, presence of biota or debris, presence of oily sheen, changes in sample characteristics with depth, presence/location/ thickness of the redox potential discontinuity (RPD) layer, and odor) and penetration depth

- Estimate of length and appearance of recovered cores
- Photographs (uniquely identified) taken at the sampling location, if any
- Variations, if any, from specified sampling protocols and reasons for deviation
- Details pertaining to unusual events which might have occurred during sample collection (e.g., possible sources of sample contamination, equipment failure, unusual appearance of sample integrity, control of vertical descent of the sampling equipment)
- References to other logbooks used to record information (e.g., field data sheets, health and safety log).
- The signature of the person making the entry.

Upon completion of the field sampling event, the field team leader will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

FIELD DATA FORMS

Occasionally, additional field data forms are generated during a field sampling event (e.g., Station/Sample Log, Groundwater Monitoring Form, Sediment Core Profile Form) to record the relevant sample information collected during a sampling event. For instructions regarding the proper identification of field data forms, sampling personnel should consult the project-specific field sampling plan.

Upon completion of the field sampling event, the field team leader will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

PHOTOGRAPHS

In certain instances, photographs (print or digital) of sampling stations will be taken using a camera-lens system with a perspective similar to the naked eye. Photographs may also be taken of sample characteristics and routine sampling activities. Photographs should include a measured scale in the picture, when practical. Telephoto or wide-angle shots will not be used because they cannot be used in enforcement proceedings. The following items should be recorded in the field logbook for each photograph taken:

1. The photographer's name, the date, the time of the photograph, and the general direction faced
2. A brief description of the subject and the field work portrayed in the picture

3. The sequential number of the photograph (filename for digital) and the roll number (disk number for digital, if applicable) on which it is contained.

Upon completion of the field sampling event, the field team leader will be responsible for submitting all photographic materials to be developed (slides, prints) or to be copied (disks), as appropriate. The slides, prints, or disks (as appropriate) and associated negatives will be placed in the project files (at the Exponent Project Manager's location [project-specific]). Photo logs and any supporting documentation from the field logbooks will be photocopied and placed in the project files with the slides, prints, or disks.

SAMPLE LABELS

Exponent sample labels are designed to uniquely identify each sample container that is collected during a sampling event. Field crews will be provided with preprinted sample labels, which must be affixed to each sample container used. The labels should be filled out at the time the samples are collected and should consist of the following information:

1. Sample number
2. Site name or project number
3. Date and time sample is collected
4. Initials of the samplers
5. Preservatives used, if any
6. A unique number (commonly referred to as the "Tag Number") that is preprinted on the label consisting of six digits; used to identify individual containers.

SAMPLE TAGS

Exponent sample tags are designed to be affixed to each container that is used for a sample. Sample tags are only required for environmental samples collected in U.S. Environmental Protection Agency (EPA) Region 5. Field crews will be provided with preprinted sample tags. Sample tags must be attached to each individual sample container with a rubber band or wire through a reinforced hole in the tag. All sample tag entries will be made with indelible ink. The tags should be filled out at the time the samples are collected and should consist of the following information:

1. Sample number
2. Site name or project number

3. Date and time sample is collected
4. Initials of the samplers
5. Preservatives used, if any
6. Type of analysis.

A space for the laboratory sample number (provided by the laboratory at log-in) will also be provided on the sample tag.

INTERNAL SAMPLE LABELS

For benthic infaunal samples, the sediment is washed away from the sample and the remaining benthic infauna are collected into a sample container. A sample label as discussed above is affixed to the outside of the sample container. In addition, an internal sample label is placed inside the sample container. This internal sample label is made of water-proof paper and all internal sample label entries will be made with pencil. The internal sample labels should be filled out at the time the samples are collected and should consist of the following information:

1. Sample number
2. Site name or project number
3. Date and time sample is collected
4. Initials of the samplers
5. Preservative used (i.e., formalin).

CHAIN-OF-CUSTODY/SAMPLE ANALYSIS REQUEST FORMS

Exponent uses a combined chain-of-custody/sample analysis request (COC/SAR) form. The sample number and the unique number at the bottom of each sample label will be recorded on the COC/SAR form. The COC/SAR form will also identify the sample collection date and time, the type of sample, the project, and the field team leader. In addition, the COC/SAR form provides information on the preservative or other sample pretreatment applied in the field and the analyses to be conducted by referencing a list of specific analyses or the statement of work for the laboratory. The COC/SAR form will be sent to the laboratory along with the sample(s).

The COC/SAR form will be completed in triplicate and consists of three pages: a white sheet, which always remains with the samples; a yellow sheet, which remains with the samples when they are shipped to the laboratory; and a pink sheet, which is removed by field staff prior to shipping to the laboratory or prior to placing the samples into the sample archives. The white sheet and the yellow sheet will be placed into a plastic sealable bag and secured to the inside top

of each sample cooler. The pink sheet will be retained by the field staff for filing at the Exponent Project Manager's location (project-specific).

Exponent also uses computer-generated COC/SAR forms. If computer-generated forms are used, then the forms must be printed in triplicate and all three sheets signed so that two sheets can accompany the shipment to the laboratory and one sheet can be retained on file at the Exponent Project Manager's location (project-specific).

At the end of each sampling day and prior to shipping or storage, chain-of-custody entries will be made for all samples. Information on the labels and tags will be checked against filed logbook entries. Upon completion of the field sampling event, the field team leader will be responsible for submitting all COC/SAR forms to be copied. A discussion of copy distribution is provided below.

CUSTODY SEAL

As security against unauthorized handling of the samples during shipping, two custody seals will be affixed to each sample cooler (example provided in Attachment GEN-03-1). The custody seals will be placed across the opening of the cooler (front right and back left) prior to shipping. Be sure the seals are properly affixed to the cooler so they cannot be removed during shipping. Additional tape across the seal may be prudent.

SHIPPING AIRBILLS

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., Federal Express, UPS), an airbill or receipt is provided by the shipper. Upon completion of the field sampling event, the field team leader will be responsible for submitting the sender's copy of all shipping airbills to be copied. A discussion of copy distribution is provided below. The airbill number (or tracking number) should be noted on the applicable COC/SAR forms or alternatively the applicable COC/SAR form number should be noted on the airbill to enable the tracking of samples if a cooler becomes lost.

ACKNOWLEDGMENT OF SAMPLE RECEIPT FORMS

In most cases, when samples are sent to a testing laboratory, an Acknowledgment of Sample Receipt form is faxed to the Exponent QA/QC coordinator the day the samples are received by the laboratory. It is the responsibility of the person receiving this form to review the form and make sure that all the samples that were sent to the laboratory were received by the laboratory and that the correct analyses were requested. If an error is found, the laboratory must be called immediately. Decisions made during the telephone conversation should be documented in writing on the Acknowledgment of Sample Receipt Form. In addition, corrections should be made to the COC/SAR form and the corrected version of the COC/SAR form should be faxed to the laboratory.

The Acknowledgment of Sample Receipt form (and any modified COC/SAR forms) will then be submitted to be copied. A discussion of copy distribution is provided below.

ARCHIVE RECORD FORMS

On rare occasions, samples are archived at an Exponent office. If samples are to be archived at Exponent, it is the responsibility of the project manager to complete an Archive Record form. This form is to be accompanied by a copy of the COC/SAR form for the samples, and will be placed in a locked file cabinet.

DISTRIBUTION OF COPIES

Two copies of all field logbooks, additional field data forms, COC/SAR forms, and Acknowledgement of Sample Receipt forms will be made at Exponent. The first copy will be stamped with a "COPY" stamp. This copy will be placed in the project file and will be available for general staff use. The second copy will be stamped with a "FILE" stamp. This copy will be placed in the data management file with the laboratory data packages and will be used by the data management and quality assurance staff only. The original field logbooks and forms will be placed in a locked file cabinet.

One copy of the shipping airbill will be made and placed in the project file. The original airbill will be given to the respective Exponent receptionist for filing and billing purposes.

Setup of Locking File Cabinet

Each project will have its own file folder in a locking file cabinet. The folder label will include the project name and charge number. As many as five kinds of files will be included in this folder for each project:

- Field logbook(s)
- Additional field data forms
- COC/SAR forms
- Acknowledgment of Sample Receipt forms
- Archive Record form (to be completed only if samples are archived at the Bellevue field storage facility or at the Boulder laboratory).

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SOP GEN-02
SAMPLE CUSTODY

A stringent, established program of sample chain-of-custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used with SOP GEN-01, *Field Documentation*, and SOP GEN-03, *Sample Packaging and Shipping*. Chain-of-custody record/sample analysis request (COC/SAR) forms (Attachment GEN-03-1) ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

At no time is it acceptable for samples to be outside of Exponent personnel's custody unless the samples have been transferred to a secure area (i.e., locked up). If the samples cannot be placed in a secure area, then an Exponent field team member must physically remain with the samples (e.g., at lunch time one team member must remain with the samples).

PROCEDURE

The chain-of-custody record portion of the COC/SAR form is the most critical because it documents sample possession from the time of collection through the final disposition of the sample. The sample analysis request portion of the form provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

The COC/SAR form will be completed after each field collection activity and before the samples are shipped to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. When transferring possession of the samples, the individuals relinquishing and receiving the samples must sign the COC/SAR form(s), indicating the time and date that the transfer occurs. Copies of the forms will be made and kept by Exponent, and the originals will be included with the samples in the sample cooler. The following guidelines will be followed to ensure consistent shipping procedures and to maintain the integrity of the samples:

1. Each chain-of-custody record/sample analysis request form must be appropriately signed by the sampling personnel. The person who relinquishes custody of the samples must also sign this form.

2. The chain-of-custody record/sample analysis request form should not be signed until the information has been checked for inaccuracies by the field team leader. All changes should be made by drawing a single line through the incorrect entry and initialing and dating it. Revised entries should be made in the space below the entries. Any blank lines remaining on the COC/SAR form after corrections are made should be marked out with single lines. This procedure will preclude any unauthorized additions.

3. At the bottom of each COC/SAR form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date that the transfer occurred. The time that the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.

4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as Federal Express or UPS, the name of the carrier should be entered in the "received by" block. Any tracking numbers supplied by the carrier should be also entered in the "received by" block. The time of transfer should be as close to the actual drop-off time as possible. After the COC/SAR forms are signed and copied, they should be sealed inside the transfer container.

5. If errors are found after the shipment has left the custody of Exponent personnel, a corrected version of the forms must be made and sent to all relevant parties. Minor errors can be rectified by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.

6. Samples that are archived internally at Exponent must be accompanied by a COC/SAR form and an Archive Record form (see SOP GEN-01).

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SOP GEN-03
SAMPLE PACKAGING AND SHIPPING

Specific requirements for sample packaging and shipping must be followed to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein.

EQUIPMENT REQUIRED

Specific equipment or supplies necessary to properly pack and ship environmental samples include the following:

- Ice in doubled, sealable bags (e.g., Ziplocs®), frozen Blue Ice®, or dry ice
- Sealable airtight bags (assorted sizes)
- Large plastic garbage bags
- Paper towels
- Coolers
- Bubble wrap
- Fiber reinforced packing tape
- Duct tape
- Clear plastic packing tape
- Scissors
- Chain-of-custody seals
- “Fragile,” “This End Up,” or “Handle With Care” labels
- Mailing labels
- Airbills for overnight shipment
- Chain-of-custody record/sample analysis request forms.

PROCEDURE

The logistics for sample packaging and shipping should be specifically tailored to each study. In some cases, samples may be transferred from the field to a local storage facility where they can be either frozen or refrigerated. Depending on the logistics of the operation, field personnel may transport samples to the laboratory themselves or utilize an overnight courier service. If a courier service is used, then Exponent field personnel need to be aware of any potentially limiting factors to timely shipping (e.g., availability of overnight service and weekend deliveries to specific areas of the country, shipping regulations "restricted articles" [e.g., dry ice, formalin]) prior to shipping the samples. Federal Express service locations can be determined by calling 1-800-463-3339. United Parcel Service locations can be determined by calling 1-800-742-5877.

The following steps should be followed to ensure the proper transfer of samples from the field to the laboratories:

<u>At the sample collection site:</u>

1. Appropriately document all samples using a logbook (see SOP GEN-01), the required sample container identification (i.e., sample labels and sample tags), and a chain-of-custody record/sample analysis request (COC/SAR) form (example provided in Attachment GEN-03-1). Fill out the COC/SAR form as described in SOP GEN-02.

2. Make sure all applicable laboratory quality control sample designations have been made on the COC/SAR form. Samples that will be archived for future possible analysis should be clearly identified on the COC/SAR form by noting the following: "Do Not Analyze: Hold and archive for possible future analysis," as some laboratories interpret "archive" to mean continue holding the residual sample after analysis.

3. Clean the gross contamination from the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.

4. Store each sample container in an individual sealable plastic bag that allows the sample label (example provided in Attachment GEN-03-1) to be read. Volatile organic analyte (VOA) vials for a single sample must be encased in bubble wrap before being sealed in bags.

5. If the samples have a required storage temperature, place a sufficient amount of ice in the sample cooler to maintain the temperature inside the cooler (e.g., 4°C) throughout the sampling day.

<u>At the sample processing area (immediately after sample collection):</u>

1. If the samples have a required storage temperature, then the samples should be cooled to and maintained at that temperature prior to shipping. For example, a sufficient amount of ice must be present in each sample cooler to maintain the

temperature inside the cooler at 4°C until processing begins to ship the samples to the testing laboratory.

2. Be aware of holding time requirements for project-specific analytes and arrange the sample shipping schedule accordingly.

3. Samples will be placed in secure storage (i.e., locked room or vehicle) or remain in the possession of Exponent sampling personnel until they are shipped to maintain sample integrity and chain-of-custody requirements.

4. Samples should be stored in the dark (e.g., coolers kept shut).

At the sample processing area (just prior to shipping):

1. Check sample containers against the COC/SAR form to ensure all samples intended for shipment are accounted for.

2. Choose the appropriate size cooler (or coolers) and make sure that the outside and inside of the cooler is clean of gross contamination. If the cooler has a drain on the outside at the bottom of the cooler, the drain should be capped and thoroughly taped shut with duct tape to prevent leakage.

3. The cooler should be lined with bubble wrap and a large plastic bag should be opened and placed inside the cooler.

4. Individually wrap each glass container (which at the sample collection site had already been placed in an individual sealable plastic bag) in bubble wrap. Place the wrapped samples into the large plastic bag in the cooler; leaving sufficient room for ice to keep the samples cold (i.e., 4°C).

5. If the samples have a required storage temperature, add enough ice or Blue Ice® to keep the samples refrigerated during overnight shipping (i.e., 4°C). Always over-estimate the amount of ice that you think will be required. Ice should be enclosed in a sealable plastic bag and then placed in a second sealable plastic bag to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it will insulate the containers from the ice. After all samples and ice have been added to the cooler, use bubble wrap to fill any empty space to keep the samples from shifting during transport.

6. If possible, consolidate all VOA samples in a single cooler and ship them with (a) trip blank(s) if the quality assurance project plan calls for one.

7. If temperature blanks have been provided by the testing laboratory, include one temperature blank in each sample cooler.

8. Sign, date, and include any tracking numbers provided by the shipper on the COC/SAR form. Remove the back copy of the original COC/SAR form and retain this copy for the project records.

9. Place the rest of the signed COC/SAR form in a sealable bag and tape the bag containing the form to the inside of the cooler lid. Each cooler should contain an individual COC/SAR form for the samples contained in each respective cooler. If time constraints impact sample shipping and it becomes necessary to combine all of the samples onto a single set of COC/SAR forms and the shipment contains multiple coolers, indicate on the outside of the respective cooler "Chain-of-Custody Inside."

10. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it shut with fiber-reinforced packing tape. The cooler should be taped shut around the opening between the lid and the bottom of the cooler and around the circumference of the cooler at both hinges.

11. As security against unauthorized handling of the samples, apply two chain-of-custody seals across the opening of the cooler lid (example provided in Attachment GEN-03-1). One seal should be placed on the front of the cooler and one seal should be placed on the side of the cooler opposite the first seal. Be sure the seals are properly affixed to the cooler so they are not removed during shipment. Additional tape across the seal may be necessary if the outside of the cooler is wet.

12. Use a mailing label and label the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care." If the shipment contains multiple coolers, indicate on the mailing label the number of coolers that the testing laboratory should expect to receive (e.g., 1 of 2; 2 of 2). Place clear tape over the mailing label to firmly affix it to the outside of the cooler and to protect it from the weather. This is a secondary label in case the airbill is lost during shipment.

13. If an overnight courier is used, fill out the airbill as required and fasten it to either the top of the cooler or to handle tags provided by the shipper. In addition to the adhesive backing on many airbills, the airbill and/or mailing label should also be taped to the lid, because tracking problems can occur if a sticker is removed during shipment.

14. If samples need to be frozen (–20°C) during shipping, then dry ice will need to be placed in the sample cooler. Be aware of any additional shipping, handling, and special labeling requirements that may be required by the shipper for these samples. Exponent has arranged with CHEM-TEL (813-248-0573) to provide advisory services (i.e., information on how to label, ship, and package chemicals) for "restricted articles" (e.g., dry ice).

15. Benthic infauna samples will need to be preserved with formalin in the field prior to shipping. Be aware of any additional shipping, handling, and special labeling requirements that may be required by the shipper for these samples. Exponent has arranged with CHEM-TEL (813-248-0573) to provide advisory services (i.e.,

information on how to label, ship, and package chemicals) for “restricted articles” (e.g., formalin).

16. If samples are shipped that contain “restricted articles” (e.g., dry ice, formalin), then Exponent personnel must provide a 24-hour emergency number to the shipper. Exponent has arranged with CHEM-TEL to provide a 24-hour emergency contact number for all chemical shipments. Before shipping chemicals (and listing the CHEM-TEL emergency number), Exponent personnel must FAX the shipping document (manifest, declaration of dangerous goods, etc.) to CHEM-TEL informing them of the shipment. The fax number is 813-248-0581.

    For any shipment (air, rail, sea, or ground) within the United States, Canada, Puerto Rico, and the U.S. Virgin Islands, the telephone number to include on the shipping form is 1-800-255-3924. Any shipment outside the North American continent should reference “813-248-0573 (use the AT&T collect call operator)” on the shipping document. On the shipping documents, remember to indicate that the phone number specified is an emergency response contact number.

17. Notify the laboratory contact and the Exponent project QA/QC coordinator that samples will be shipped and the estimated arrival date and time. All environmental samples that are shipped at 4°C or –20°C will be shipped overnight for next morning delivery. If possible, fax copies of all chain-of-custody record/sample analysis request forms to the Exponent QA/QC coordinator. **Note:** Prior to faxing, it may be necessary to Xerox the COC/SAR form on a slightly darker setting so that the form is readable after it has been faxed. Never leave the original COC/SAR form in the custody of non-Exponent staff.

ATTACHMENT GEN-03-1

Example Chain-of-Custody Record/Sample Analysis Request Form, and Label and Custody Seal

CHAIN OF CUSTODY RECORD/SAMPLE ANALYSIS REQUEST FORM

Page ____ of ____

Project:
(Name and Number)

Exponent

Exponent Contact: _____ Office: _____

Ship to: _____

Lab Contact/Phone: _____

Samplers:

Environmental Group

Bellevue, WA (425) 643-9803
Boulder, CO (303) 444-7270
Lake Oswego, OR (503) 636-4338
Los Angeles, CA (310) 823-2035
Natick, MA (508) 652-8500

Sample No.	Tag No.	Date	Time	Matrix	Analyses Requested						Extra Container	Archive	Remarks

Matrix Code: GW - Groundwater SL - Soil SD - Sediment SW - Surface water

OTHER - Please identify codes _____

Priority: ☐ Normal ☐ Rush Rush time period _____

Shipped via: ☐ FedEx/UPS ☐ Courier Other _____

Condition of Samples Upon Receipt: _____

Custody Seal Intact: ☐ Yes ☐ No ☐ None

Relinquished by: _____ (Signature) Date/Time: _____ Received by: _____ (Signature) Date/Time: _____

Relinquished by: _____ (Signature) Date/Time: _____ Received by: _____ (Signature) Date/Time: _____

Distribution: White and Yellow Copies - Accompany Shipment; Pink Copy - Project File

Chain-of-custody/sample analysis request form.

SOP 05/31/02 WA

Exponent®

OFFICIAL SAMPLE SEAL

SAMPLE NO.	DATE
SIGNATURE	
PRINT NAME AND TITLE	

Exponent®

SAMPLE NO.

SITE NAME

DATE TIME

SAMPLER PRESERVATIVE

TAG NO. 25101

Example label and custody seal.

SOP SL-02
PREPARATION OF FIELD QUALITY CONTROL SAMPLES—SOIL

This SOP describes the purpose, preparation, and collection frequency of field duplicate samples, field replicate samples, matrix spike/matrix spike duplicates, equipment rinsate blanks, bottle blanks, trip blanks, temperature blanks, environmental blanks, and reference materials (i.e., a standard reference material, a certified reference material, or other reference material; for the purposes of this document the acronym SRM will be used for all types of reference materials) for soil samples. Not all of the field quality control (QC) samples discussed in this SOP may be required for a given project. The specific field quality control samples will be identified in the project-specific field sampling and analysis plan (FSP) and quality assurance project plan (QAPP). For most projects, Exponent's recommended field QC samples are: an equipment rinsate blank, a field duplicate, and trip blanks if volatile organic compounds (VOCs) are to be analyzed. Definitions of all potential QC samples are described below.

As part of the quality assurance/quality control (QA/QC) program, all field QC samples will be sent to the laboratories blind. To accomplish this, field QC samples will be prepared and labeled in the same manner as regular samples, with each QC sample being assigned a unique sample number that is consistent with the numbering for regular samples. All of the containers with preservatives that are required to complete the field QC sample for the applicable analyte list shall be labeled with the same sample number. The sample ID for field quality control samples should allow data management and data validation staff to identify them as such and should only be recorded in the field logbook. Under no circumstances should the laboratory be allowed to use reference materials, rinsate blanks, or trip blanks for laboratory QC analysis (i.e., duplicates, matrix spike, and matrix spike duplicates). To prevent this from happening, regular samples should be selected and marked on the chain-of-custody/sampling analysis request (COC/SAR) form or the laboratory should be instructed to contact the project QA/QC coordinator to select appropriate samples for each sample group.

All field quality control samples will be packaged and shipped with other samples in accordance with procedures outlined in SOP GEN-03, *Sample Packaging and Shipping*. Sample custody will be maintained in accordance with procedures outlined in SOP GEN-02, *Sample Custody*.

Field quality control samples will be prepared at least once per sampling event, and certain types will be prepared more often at predetermined frequencies. If the number of samples taken does not equal an integer multiple of the intervals specified in this SOP, the number of field quality control samples is specified by the next higher multiple. For example, if a frequency of 1 quality control sample per 20 is indicated and 28 samples are collected, 2 quality control samples will be prepared. The text below describes the preparation and frequency of field

quality control samples required for soil sampling activities, and shall be followed, unless different frequency requirements are listed in the FSP and QAPP.

Table SL-02-1 lists the quality control sample types and suggested frequencies for soil sampling programs. Because soil quality control sampling may require assessment of site cross-contamination, additional blanks may be required. A detailed explanation of each quality control sample type with the required preparation follows.

TABLE SL-02-1. FIELD QUALITY CONTROL SAMPLE REQUIREMENTS FOR SOIL SAMPLING

Quality Control sample Name	Abbre-viation	Preparation		Frequency[a]
		Location	Method	
Duplicate	DUP	Sampling site	Additional natural sample	One per 20 samples. May not be applicable if REP is being collected.
Replicate	REP	Sampling site	Additional natural sample	One replicate per 20 samples. May not be applicable if DUP is being collected.
Matrix spike/matrix spike duplicate	MS/MSD	Sampling site	Additional sample bottles filled for laboratory quality control requirements	One per 20 samples.
Equipment rinsate blank	ER	Sampling site	Deionized water collected after pouring through and over decontaminated equipment	Minimum of one per sampling event per type of sampling equipment used and then 1:20 thereafter.
Field cross-contamination blank	CCB	Sampling site	Filter wipe with decontaminated collection equipment	One per 20 samples
Field external contamination blank	ECB	Sampling site	Unused material used for CCB	One per 20 samples
Bottle blank	BB	Field	Unopened bottle	One per sample episode or one per bottle type.
Trip blank	TB	Laboratory	Deionized water with preservative	One pair per each VOC sample cooler shipment.
Temperature blank	TMB	Laboratory	Deionized water	One per sample cooler.
Environmental blank	EB	Field	Bottle filled at sample site with DI water	One per 20 samples.
Standard reference material	SRM	Field laboratory or Sampling site	SRM ampules or other containers for each analyte group	One set per 50 samples or one per episode.

[a] Frequencies provided here are general recommendations; specific frequencies should be provided in the project-specific FSP or QAPP.

FIELD DUPLICATE SAMPLES

Field duplicate (or split) samples are collected to assess the homogeneity of the samples collected in the field and the precision of the sampling process. Field duplicates will be prepared by collecting two aliquots for the sample and submitting them for analysis as separate samples. Field duplicates will be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. The actual number of field duplicate samples collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of field duplicate collection may vary by EPA region or state).

FIELD REPLICATE SAMPLES

Field replicate samples are co-located samples collected in an identical manner over a minimum period of time to provide a measure of the field and laboratory variance, including variance resulting from sample heterogeneity. Field replicates will be prepared by collecting two completely separate samples from the same station and submitting them for analysis as separate samples. Field replicates will be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. If field duplicate samples are collected, then it is unlikely that field replicate samples will also be collected during a sampling event. The actual number of field replicate samples collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of field duplicate collection may vary by EPA region or state).

MATRIX SPIKE/MATRIX SPIKE DUPLICATES

The matrix spike/matrix spike duplicate (MS/MSD) analyses provide information about the effect of the sample matrix on the design and measurement methodology used by the laboratory. To account for the additional volume needed by the laboratory to perform the analyses, extra sample volumes may be required to be collected from designated soil stations. MS/MSDs may be collected at a minimum frequency of 1 per 20 samples or once per sampling event, whichever is more frequent. The actual number of extra bottles collected during a sampling event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements may vary by analyte group).

EQUIPMENT RINSATE BLANKS

Equipment rinsate blanks will be used to help identify possible contamination from the sampling environment and/or from decontaminated sampling equipment. Equipment rinsate blanks will be prepared by pouring laboratory distilled/deionized water through, over, and into the decontaminated sample collection equipment, then transferring the water to the appropriate sample containers and adding any necessary preservatives. Equipment rinsate blanks will be

prepared for all inorganic, organic, and conventional analytes at least once per sampling event per the type of sampling equipment used. The actual number of equipment rinsate blanks prepared during an event will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of equipment rinsate blank collection may vary by EPA region or state).

FIELD CROSS-CONTAMINATION BLANK

The field cross-contamination blank is a sample bottle prepared at the sample site that contains filter wipes of decontaminated field collection equipment. This blank will check the effectiveness of the decontamination procedures. At the appropriate frequency during sample collection, prepare a field cross-contamination blank at the sample site by vigorously rubbing the sample collection equipment with a clean paper filter. Do not use Kimwipes® because they contain significant impurities. Place the filters in the sample bottle and label it as the "Cross-Contamination Blank" on the sample label. Send the bottle to the laboratory with the field samples per SOP GEN-03.

FIELD EXTERNAL CONTAMINATION BLANK

The field external contamination blank is a sample bottle prepared at the sample site containing a single unused paper filter of the type used for the field cross-contamination blank. At the appropriate frequency during sample collection, prepare a field external contamination blank at the sample site by placing a clean, unused filter from the sample lot used for the cross-contamination in a sample bottle. Label the bottle "External Contamination Blank" on the sample label, note filter name and lot number in the field logbook, and send the bottle to the laboratory with the field samples per SOP GEN-03.

BOTTLE BLANKS

The bottle blank is an unopened sample bottle. Bottle blanks are submitted along with soil samples to ensure that contaminants are not originating from the bottles themselves because of improper preparation, handling, or cleaning techniques. If required, one bottle blank per lot of prepared bottles will be submitted for analysis. If more than one type of bottle will be used in the sampling (e.g., HPDE or glass), then a bottle blank should be submitted for each type of bottle and preservative. The actual number of bottle blanks analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of bottle blank analysis may vary by EPA region or state).

To prepare a bottle blank in the field, set aside one unopened sample bottle from each bottle lot sent from the testing laboratory. Label the bottle as "Bottle Blank" on the sample label (and in the "Remarks" column on the COC/SAR form), and send the empty bottle to the laboratory with the field samples per SOP GEN-03.

TRIP BLANKS

Trip blanks will be used to help identify whether contaminants may have been introduced during the shipment of the soil samples from the field to the laboratory for VOC analyses only. Trip blanks are prepared at the testing laboratory by pouring distilled/deionized water into two 40-mL VOC vials and tightly closing the lids. Each vial will be inverted and tapped lightly to ensure no air bubbles exist.

The trip blanks will be transported unopened to and from the field in the cooler with the VOC samples. A trip blank shall be labeled and placed inside the cooler that contains newly collected VOC samples and it shall remain in the cooler at all times. A trip blank must accompany samples at all times in the field. One trip blank (consisting of a pair of VOC vials) will be sent with each cooler of samples shipped to the testing laboratory for VOCs analysis.

TEMPERATURE BLANKS

Temperature blanks will be used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. Temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid. The blanks will be transported unopened to and from the field in the cooler with the sample containers. A temperature blank shall be included with each sample cooler shipped to the testing laboratory.

FIELD BLANKS

The field blank is prepared in the field to evaluate potential background concentrations present in the air and in the distilled/deionized water used for the final decontamination rinse. If unpreserved bottles are to be used, then the appropriate preservative (i.e., for metals samples use a 10-percent nitric acid solution to bring sample pH to 2 or less) must be added, as may be required. Field blanks should be collected at a minimum frequency of 1 in 20 samples. The actual number of field blanks analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of field blank analysis may vary by EPA region or state).

To prepare a field blank in the field, open the laboratory-prepared sample bottle while at a sample collection site, fill the sample bottle with distilled/deionized water and then seal. Assign the field blank a unique sample number, label the bottle, and then send the bottle to the laboratory with the field samples per SOP GEN-03.

REFERENCE MATERIALS

Reference materials (i.e., a standard reference material, a certified reference material, or other reference material; for the purposes of this document the acronym SRM will be used for all types of reference materials) are samples containing known analytes at known concentrations that have been prepared by and obtained from EPA-approved sources. The SRMs have undergone multilaboratory analyses using a standard method which provides certified concentrations. When available for a specific analyte, SRM samples provide a measure of analytical performance and/or analytical method bias (i.e., accuracy) of the laboratory. Several SRMs may be required to cover all analytical parameters. For all analytes where available, one SRM will be analyzed at a frequency of one per 50 samples. The actual number of SRMs analyzed during a project will be determined on a case-by-case basis by the project QA/QC coordinator (consult the project-specific FSP and QAPP, as the requirements on frequency of SRM analysis may vary by EPA region or state).

SOP SL-04
SOIL SAMPLE COLLECTION

This SOP presents procedures for the collection of soil samples by excavating, hand auguring or hand coring. Soil is typically analyzed for various physical and chemical variables. For the purposes of this SOP, soil is defined as the upper 6 in. of the soil. The specific sampling interval will be identified in the project-specific field sampling plan (FSP).

When the procedures call for stainless-steel or plastic equipment, the plastic equipment is only applicable when collecting samples for inorganic (i.e., metals) parameter analysis. Stainless-steel sampling equipment is applicable for all parameter groups (i.e., organic and inorganic).

EQUIPMENT

- Stainless-steel or plastic sampling tool
  - Scoop, trowel, or spoon
  - Hand auger equipped with extension rod and T-handle
  - Hand corer (one piece or split-spoon) equipped with extension rod and slide hammer attachment
- Stainless-steel or plastic bowls
- Stainless-steel or plastic spoons
- Shovel
- Laboratory-supplied sample containers
- Field logbook
- Crescent wrench and core wrench
- Tape measure or ruler.

SOIL SAMPLING PROCEDURES

The following procedures are designed to be used to collect surface soil samples. The procedures listed below may be modified in the field by the agreement of the lead site sampler and field personnel, based on field and site conditions, after appropriate annotations have been

made in the appropriate field logbook. If specialized sampling methods (e.g., ENCORE®) are to be used, refer to the manufacturer's recommended procedures.

DECONTAMINATION

To prevent potential cross-contamination of samples, all reusable soil sampling equipment will be decontaminated. Before each station is sampled, decontaminate the surfaces of the sampling tool (e.g., scoop, trowel, spoon, augur) and all stainless-steel sample compositing equipment. The project-specific FSP should also be consulted to determine any project-specific decontamination procedures. The personnel performing the decontamination procedures will wear protective clothing as specified in the site-specific health and safety plan.

All solvent rinsates (if used) will be collected into a bucket or tub and allowed to evaporate over the course of the day. Any rinsate that has not evaporated by the end of the sampling event will be containerized and disposed of in accordance with federal regulations.

PROCEDURES

1. Locate the sampling site as directed in the project-specific work plan or FSP. Label sample containers with completed Exponent sample labels before filling.
2. Expose the soil surface by clearing an approximately 1-ft^2 area at the sampling site of any rocks or organic material greater than approximately 1 in. in size. Note any material removed from the sampling site in the field logbook. New disposable latex or nitrile gloves shall be worn while collecting a soil sample.
3. If required for analysis, first collect three VOC samples using an ENCORE® sampler (before any homogenization) with a minimum of disturbance and seal the ENCORE® sampler tightly. The three samples shall be collected in a small area immediately adjacent to each other. Due to the small size of the VOC samples (5 g plug), VOC samples cannot be collected over large depth intervals. The FSP should be consulted to determine the appropriate depth for collection.
4. Using a decontaminated sampling tool, excavate soil to the depth specified in the work plan or FSP and place the soil into a composite bowl. If excavating with a scoop, trowel, or spoon, care must be taken to remove a square or round block of soil when excavating to the required depth. Avoid excavating "V" shaped plugs as this includes more of the upper soil depths and less of the lower soil depths which can affect the sample results.
5. Characterize the soil sample as specified in the project-specific FSP.

6. After a sufficient volume of soil is transferred to the mixing bowl, homogenize the contents of the bowl using a decontaminated spoon until the texture and color of the soil appears to be uniform.

7. After shaking to remove soil adhering to them, rocks that are greater than 0.5 in. in diameter and organic material (i.e., roots, sticks, leaves) may be discarded from the homogenized soil. Material that is removed shall be positively identified and their percentage contribution to the homogenized soil volume determined and noted in the field logbook.

8. Remove samples of the homogenized soil from the composite bowl and transfer to the appropriate size sample container. The soil in the composite bowl should be briefly mixed in between each spoon transfer to the sample container unless the entire volume is being transferred to the sample container. The sample container should be filled with soil to just below the container lip, and the container should be sealed tightly.

9. After all soil for testing has been placed in the sample containers, if it is suspected that there is a clay component to the soil, a "ribbon test" should be performed on the soil to confirm this suspicion. In this "texture-by-feel" test, a small piece of suspected clay is rolled between the fingers while wearing protective gloves. If the piece easily rolls into a ribbon it is clay; if it breaks apart, it is silt. This information should be noted in the field logbook.

10. Complete all pertinent field QA/QC documentation, logbooks, and field data sheets.

11. Mark the sampling site with a wire flag, wooden stake, metal rebar, or flagging, as appropriate per the project-specific FSP.

SAMPLE CUSTODY AND SAMPLE SHIPPING

Sample custody will be maintained in accordance with procedures outlined in SOP GEN-02, *Sample Custody*. All samples will be packaged and shipped with other samples in accordance with procedures outlined in SOP GEN-03, *Sample Packaging and Shipping*.

FIELD QUALITY CONTROL SAMPLES

Details on collection of field quality control samples and preparation of the certified reference materials can be found in SOP SL-02, *Preparation of Field Quality Control Samples—Soil*.

STATION LOCATION COORDINATES

Station locations for all field sampling will be determined using a differential global positioning system (DGPS), which is capable of providing latitude and longitude coordinates with an accuracy of approximately 2 m. The DGPS consists of two satellite receivers linked to each other by a VHF telemetry radio system. The receiver will be with the field sampling team.

APPROVED

Appendix B

Quality Assurance Project Plan

August 15, 2014

Quality Assurance Project Plan

Phase 2 Removal Site Evaluation Work Plan for National Zinc Site Cherryvale, Kansas

Prepared by: Exponent
August 15, 2014

Prepared for: CitiGroup Global Market Holdings, Inc. and
United States Steel Corporation
(Respondents)

Approvals:

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Mark Landress, Project Navigator, Field Team Leader

Philip Jen, Project Navigator, QA/QC and Database Coordinator

Jamie Church, Pace Analytical Services, Inc., Laboratory Project Manager

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A copy of this quality assurance project plan will also be provided to all contractors hired by the Respondents to complete any phase of the sampling, including field sampling crews and testing laboratories.

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Tables are located at the end of the main text.

Acronyms and Abbreviations

COC	chain-of-custody
DQI	data quality indicator
DQO	data quality objective
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
GPS	global positioning system
ICP-MS	inductively coupled plasma-mass spectrometry
LCS	laboratory control sample
LIMS	laboratory information management system
MDL	method detection limit
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
PNL	Project Navigator Ltd
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
Respondents	United States Steel Corporation and Citigroup Global Market Holdings, Inc.
RPD	relative percent difference
RSE	removal site evaluation
SDG	sample delivery group
Site	the corporate limits of the City of Cherryvale
SOP	standard operating procedure
SRM	smelter residue material
Work Plan	Phase 2 Removal Site Evaluation Work Plan for National Zinc Site Cherryvale, Kansas
XRF	x-ray fluorescence

Introduction

This quality assurance project plan (QAPP) describes the quality assurance and quality control (QA/QC) procedures that will be used to support the analytical data generated from the soil sampling described in Section 4.4 (Soil Sampling to Validate SRM [Smelter Residue Material] Classes) of the Phase 2 Removal Site Evaluation (RSE) Work Plan (the Work Plan) for the National Zinc Site in Cherryvale, Kansas. As stated in §13.d of the SACO (KDHE 2013), the Phase 2 RSE is to provide "…an assessment of the nature and extent of smelter related contamination located in areas in the City of Cherryvale outside the former National Zinc Site, and shall incorporate and apply the Site specific clean up levels established in the Phase 1 RSE and set forth in the approved Phase 1 RSE Report."

The QA/QC procedures ensure the data generated are representative of actual field conditions and meet the project's data quality objectives (DQOs). This QAPP was developed using guidance provided by the U.S. Environmental Protection Agency (EPA) (U.S. EPA 2007 and 2012). Descriptions of the soil sampling to be conducted, including the sampling design and methods, the tentative schedule for the fieldwork, and the intended end use of the data acquired from these sampling efforts, are provided in the main body of the Work Plan. This QAPP contains the following sections:

- Section 1. Project Management
- Section 2. Measurement and Data Acquisition
- Section 3. Assessment and Oversight
- Section 4. Data Review, Verification, Validation, and Usability
- Section 5. References.

Various elements of the field and laboratory procedures are addressed in each section, as applicable.

1 Project Management

Well-defined project management procedures, QA/QC procedures, and quality assessment checkpoints are instrumental in the execution of a successful field effort and the generation of well-documented, high-quality data. This section of the QAPP includes descriptions of the project structure and management procedures that relate to project quality assurance.

1.1 Project Organization

United States Steel Corporation and CitiGroup Global Market Holdings, Inc. (the Respondents) are responsible for conducting the Phase 2 RSE. Table B-1 identifies the personnel responsible for planning and implementing field and laboratory operations and QA/QC procedures for this sampling program, and describes each individual's tasks for project management and quality assurance. The laboratory project manager, also described in Table B-1, will ensure that appropriate procedures are followed during sample analysis and preparation of the data packages and electronic deliverables.

The testing laboratory may be required to provide its quality assurance manual for review and approval by the project QA/QC coordinator. The quality assurance manual will include a description of the laboratory organization, personnel, and responsibilities; facilities and equipment; analytical methods and QA/QC protocols; and routine procedures for sample custody and data handling. The laboratory quality assurance manuals will be provided if requested.

No changes in the QAPP procedures will be permitted without written justification and a detailed explanation of the intended change. All changes are subject to approval by the QA/QC coordinator and project managers. A description of all changes, with justification, will be included in applicable quality assurance or data reports generated for this project.

1.2 Project Description

A description of the general approach to the Site evaluation plan is described in the Work Plan (see Section 4.1, General Approach). The details for the soil sampling design and soil sampling methods are provided in Section 4.4 (Soil Sampling to Validate SRM Classes) of the Work Plan. Referenced field standard operating procedures (SOPs) are included in Appendix A of the Work Plan.

1.3 Quality Objectives and Criteria for Measurement Data

Quality objectives for this investigation primarily include obtaining data that are of acceptable quality, are representative of the conditions at the Site, and are sufficient to support the end uses of the data.

To meet the overall quality objectives of a project, the production of valid and acceptable data begins with establishing DQOs prior to the collection of field samples and measurement data. As outlined in *Generic Quality Assurance Project Plan for Region 7's Superfund Lead-Contaminated Sites* (U.S. EPA 2007) and *Guidance on Quality Assurance Project Plans* CIO 2106-G-05 QAPP (U.S. EPA 2012), the specific quality objectives and criteria for measurement data for these sampling programs are discussed below.

Measurement performance criteria for data quality indicators (DQIs) have been established for the sampling programs to ensure that chemical data are of known and sufficiently high quality to support the project objectives. Quantitative DQIs for field quality control samples and laboratory analyses include indicators for precision, accuracy, completeness, and sensitivity. The DQI for completeness is 95 percent for all analyses for these programs. Measurement performance criteria for the quantitative DQIs for laboratory analyses are provided in Table B-2 for matrix spike (MS) and laboratory control sample (LCS) recoveries, and Table B-3 for laboratory duplicate sample or matrix spike duplicate (MSD) sample analyses. Field duplicate and/or replicate samples will be collected to determine overall precision. Laboratory duplicates or MSDs will be analyzed to check for analytical precision. Matrix spike samples will be used to determine analytical accuracy. Laboratory method blanks will serve as additional quality control checks. Method detection limits (MDLs) or method reporting limits (MRLs) will be determined to quantify sensitivity of the system.

The qualitative goals of representativeness and comparability of the data will be met by the careful collection of samples according to protocols established for the sampling program in the Work Plan and the use of standard methodology for laboratory testing and analyses. These procedures are described or referenced in Section 3 of this QAPP.

1.4 Special Training and Certification

Procedures to be completed for soil sampling are routine and no special training or certification is necessary. Standard procedures will be used to collect the soil samples and to complete laboratory analyses.

1.5 Required Data Records and Reports

Procedures, observations, and test results will be documented for all sample collection, laboratory analysis and reporting, and data validation activities. In addition to data reports provided by the laboratory, reports will be prepared that address data quality and usability and that provide tabulated laboratory and field data. Internal and external reporting procedures for this study are described in this section.

The required records and reports for the soil sampling include the following:

- A field logbook for recording daily sampling activities, field conditions, field measurements, and any deviations from sampling procedures specified in this QAPP (as well as any other field observations described in the Work Plan)

- Laboratory data reports that will include complete documentation of all analytical results, analytical methods, reporting limits, results of QA/QC measurements, and any problems that arise during analysis
- Electronic data deliverables (EDDs) provided by the laboratory for direct entry into the project database
- Quality assurance reports that detail the results of the data review and validation of the analytical results from the laboratory.

1.5.1 Field Records

Field records will be maintained during all stages of the project, including sample collection and preparation for shipment to the laboratory. Field records will include the following items:

- Field logbook (including electronic files) to record daily observations, sampling activities, and conditions
- External sample labels on all sample jars and bags
- Chain-of-custody (COC) forms
- Custody seals to monitor cooler security during shipment
- Photographic documentation.

Detailed descriptions of the sampling information that will be documented during the fieldwork are provided in Section 4.4.2.5 (Sample Documentation) of the Work Plan.

1.5.2 Laboratory Data Reports

The laboratory will perform data reduction as described in each test method for this project (Table B-4) and submit a complete data package with full documentation for all analyses or other determinations. The laboratory project manager is responsible for reviewing the laboratory data packages and checking data reduction prior to submittal to PNL. Any transcription or computation errors identified during this review will be corrected by the laboratory.

1.5.2.1 Chemical Analyses

The analytical laboratory will provide all information (as appropriate for the specific analyses) required for a complete quality assurance review, including the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered

- A summary of analyte concentrations (to two significant figures, unless otherwise justified) and MRLs
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions
- Instrument tuning, initial and continuing calibration data, including instrument printouts and quantification summaries for all analytes
- Results for method and calibration blanks
- Results for all QA/QC checks, including internal standards, LCSs, MS/MSD samples, and laboratory duplicate samples
- Results for all instrument-specific QA/QC checks (e.g., inductively coupled plasma interference check sample analyses and inductively coupled plasma serial dilution results) that are specified in the applicable analytical methods
- Original data quantification reports for all analyses and samples
- All laboratory worksheets and standards preparation logs (data include final dilution volumes, sample sizes, wet-to-dry ratios, and spiking and standards preparation procedures for all analyses).

1.5.3 Data Quality and Usability Report

A data quality and usability report will be prepared in conjunction with a data report for each sampling event. The data quality report will summarize the results of the data validation and data quality review and will describe any significant quality assurance problems that were encountered. The report will include the following items:

- Executive summary of overall data quality and recommendations for data use and limitations
- Description of sample collection and shipping, including COC and holding time documentation
- Description of analytical methods and detection limits (chemical data only)
- Description of data reporting
- Description of completeness relative to QAPP objectives
- Description of any contamination in field and laboratory blanks and implications for bias of the data (chemical data only)
- Description of accuracy relative to QAPP objectives, including results for matrix spikes and LCSs (chemical data only)

- Description of precision relative to QAPP objectives, including results for field and laboratory replicate analyses
- Identification of all cases where control limits or measurement performance criteria were not met and a discussion of the significance of these deviations
- Description of analyte identification and quantification (chemical data only).

All data and any qualifiers applied to the data as a result of the quality assurance review will be reported in the final data report.

1.5.4 Location of Records and Reports

The electronic and hard copy data generated for this study will be retained by Project Navigator Ltd. (PNL) in the custody of the project data manager. Field logs, sample records, and COC records will be kept with the PNL project files for reference purposes. Data reports (which will also incorporate the data quality and usability reports) will be transmitted electronically to the Respondents.

2 Measurement and Data Acquisition

The purpose of this section is to provide sufficient detail to evaluate whether the methods used for this project have been verified and documented.

2.1 Experimental Design

As described in Section 4 of the Work Plan, a series of SRM surveys will be conducted as described in the Site evaluation plan. During these SRM surveys, a survey team (or teams) will visually inspect properties within the city limits of Cherryvale and classify observed SRM (if present). After the initial SRM surveys are complete and the results are analyzed and reviewed with KDHE, soil samples will be collected to validate the SRM classes developed in the initial SRM surveys (see Section 4.4 of the Work Plan, Soil Sampling to Validate SRM Classes). All soil samples collected in the field will be analyzed with x-ray fluorescence (XRF); a subset of those samples (i.e., 5% or 1 per 20 samples) will be sent to the laboratory for analysis. The soil sampling design and methods are described in Sections 4.4.1 and 4.4.2, respectively, of the Work Plan.

2.1.1 Quality Control Sample Collection

Collection of the quality control samples described below will be in accordance with SOP SL-02, *Preparation of Field Quality Control Samples – Soil*, in Appendix A of the Work Plan.

Field Duplicates for Samples Sent to Laboratory—Field duplicates will be collected at a frequency of 1 per 20 samples sent to the laboratory. Field duplicate samples will give an indication of the overall precision, and estimate of the variability of the field team subsample location selection in addition to matrix heterogeneity at a sample location.

Matrix Spike/Matrix Spike Duplicates/Laboratory Duplicates—Laboratory duplicates, along with matrix spike samples, will be implemented at a frequency of 1 per 20 samples (i.e., 5%) sent to the laboratory. At selected sample stations, the field team will collect enough sample mass to allow for analysis of the sample in triplicate. Samples that are submitted with extra sample quantity for MS/MSD/duplicate analyses will be designated by the field team on the COC form in the Comments section of the form.

For the soil sampling, MS and MSD analyses will be used as a measure of laboratory accuracy. The laboratory duplicate and/or MS/MSD analyses will be used as a measure of laboratory precision.

2.1.2 Shipping

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the COC intact. An example of a COC form is presented in SOP GEN-03 *Sample Packaging and Shipping* (see Appendix A of the Work Plan). When samples are shipped, the sample containers will be securely packed inside the shipping coolers and placed on ice as specified in SOP GEN-03.

- Sample custody documentation is initiated in the field as each sample is collected. The designated sampler assumes custody of the samples as soon as they are collected. The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples. See SOP GEN-02, *Sample Custody*, in Appendix A of the Work Plan.

- All jars or containers will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis.

- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the pen would not function in freezing weather.

- Samples will be accompanied by a properly completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to the permanent laboratory, or to/from a secure storage location. An example COC form is presented in Appendix A of the Work Plan.

- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and the pink and yellow copies will be retained by the sampler and placed in the project files.

- Samples will be properly packaged on ice at 4°C if required for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed COC record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be locked and secured with strapping tape and seals for shipment to the laboratory. The custody seals will be attached to opposite corners (front and back) of the cooler and covered with clear plastic tape after being signed by field personnel. The cooler will be strapped shut with strapping tape in at least two locations.

- If the samples are sent by common carrier, a waybill will be used. Waybills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the COC forms since the COC forms

will be sealed inside the sample cooler and the custody seals will remain intact.

- Samples will be maintained under custody in cold storage at the mine site prior to shipment to the laboratory on the next available flight. Samples will be shipped to the following address:

  Pace Analytical Services, Inc.
  9608 Loiret Blvd
  Lenexa, KS 66219
  Phone: (913) 599-5665
  www.pacelabs.com

- Packaging will conform to applicable U.S. Department of Transportation regulations.

Sample information from the COC forms will be transferred electronically into the database. Paper copies of completed COC forms will be provided by the laboratory with the data packages and will be stored with the data by the project data manager.

2.1.3 Laboratory Operations

Samples will be received and logged in by a designated sample custodian or his/her designee. Upon sample receipt, the sample custodian will:

- Examine the shipping containers to verify that the custody tape is intact
- Examine all sample containers for damage
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the cooler receipt or COC form
- Compare samples received against those listed on the COC form
- Verify that sample holding times have not been exceeded
- Examine all shipping records for accuracy and completeness
- Determine sample pH (if applicable) and record on the cooler receipt form or COC form
- Sign and date the COC form immediately (if shipment is accepted) and attach the waybill
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the laboratory project manager, who will be responsible for contacting the client

- Attach laboratory sample container labels with unique laboratory identification and test
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory information management system (LIMS). At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory, type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The laboratory project manager and other appropriate laboratory personnel will be notified of sample arrival.
- The completed COC form, waybills, and any additional documentation will be placed in the project file.
- The laboratory project manager will verify receipt of each sample shipment and will contact the QA/QC coordinator to provide notification that all samples were received and to relay any concerns or observations regarding sample integrity or documentation.
- The laboratory project manager will also be responsible for ensuring that laboratory COC forms and tracking records are completed upon receipt of the samples and maintained through all stages of laboratory analysis.
- Storage information must be maintained until disposal of the samples. The sample tracking records must show the date of sample extraction or preparation and the date of instrument analysis for each analytical procedure. These records will be used to determine compliance with holding time requirements.
- The laboratory will maintain daily temperature logs for all refrigerators and freezers that contain samples for this project. These logs will be stored at the laboratory and copies will be provided to the Respondents, if requested. The laboratory project manager will notify the project QA/QC coordinator if storage temperatures deviate from those specified in Table B-5.

Laboratory custody procedures for sample receiving, sample identification, sample control, and record retention are described in the laboratory's quality assurance manual and SOPs.

2.2 Analytical Method Requirements

2.2.1 Chemical Analyses

Chemical and physical analyses that will be completed for the sampling will be performed using EPA-approved methods. The laboratory will have established protocols and quality assurance procedures that meet or exceed any applicable EPA guidelines.

Chemical analyses of the soil samples collected will be completed by Pace Analytical Services, Inc., located in Lenexa, Kansas.

The soil samples will be analyzed for lead and total solids (listed in Table B-4).

Chemical analyses will be completed according to methods described in *Test Methods for Evaluating Solid Wastes*, EPA SW-846 (U.S. EPA 2009) or other EPA-approved methods when available, and will include all associated QA/QC procedures recommended in each method.

Laboratory procedures for chemical and physical analyses may be completed for the target analytes (Table B-4) by one or more of the following methods:

- Inductively coupled plasma-mass spectrometry (ICP-MS) in accordance with EPA Method 6020A (U.S. EPA 2007) for analysis of specific metals
- Inductively coupled plasma-atomic emission spectrometry in accordance with EPA SW-846 Method 6010C (U.S. EPA 2007) for analyses of specific metals
- Desiccation and gravimetric determination in accordance with EPA Method 160.3 (modified) (U.S. EPA 1983) for total solids determination.

The project-specific target compounds, MDLs, and MRLs for the chemical analyses that will be completed are provided in Table B-4. These MDLs and MRLs reflect laboratory capabilities or reporting limits that can reasonably be expected from a competent laboratory. Analytical methods that yield MDLs and MRLs that are sufficiently low to support the objectives of this investigation were selected, whenever possible, to meet the DQOs of the project. The actual MDLs and MRLs attained during this Site evaluation may be elevated with respect to theoretical detection limits if interferences are encountered because of the sample matrices.

2.3 Quality Control Requirements

Quality control samples and procedures are used to obtain quantitative information regarding the execution of field sampling and laboratory testing activities. Quality control results may be used to estimate the magnitude of bias and level of precision inherent in the test data. Various quality control samples will be collected in the field and initiated by the laboratory for every test. The sections presented below describe field and laboratory quality control samples and procedures in more detail.

2.3.1 Field Quality Control

Field quality control samples will include field duplicate samples, which will be collected or prepared by sampling personnel in the field and submitted to the laboratory as natural samples. Field duplicate samples will be collected to assess the homogeneity of the samples collected in the field and the precision of the sampling process. Field duplicates will be prepared by collecting two aliquots of sample from the homogenization bowl and submitting them for analysis as separate samples.

2.3.2 Laboratory Quality Control

Each analytical protocol used in this investigation includes specific instructions for analysis of quality control samples and completion of quality control procedures during sample analysis. These quality control samples and procedures verify that the instrument is calibrated properly and remains in calibration throughout the analytical sequence and that the sample preparation procedures have been effective and have not introduced contaminants into the samples. Additional quality control samples are used to identify and quantify positive or negative interference caused by the sample matrix. Each method protocol provides control limits that indicate acceptable conditions for analysis of samples as well as unacceptable conditions that would necessitate reanalysis of samples.

The following laboratory quality control procedures are required for chemical and physical analyses:

- **Holding Times—**Holding time constraints for each method will be met to ensure the validity of the results reported.
- **Instrument Tuning—**Instrument tuning for analyses by ICP-MS will be completed to ensure that mass resolution, identification, and, to some degree, sensitivity of the analyses are acceptable. Instrument tuning will be completed in accordance with the requirements stated in the analytical method during which samples or standards are analyzed. In the event that an instrument tuning does not meet control limits, analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument is out of tune will be reanalyzed.
- **Initial and Continuing Calibration—**Initial calibration of instruments will be performed at the start of the project and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibration will be performed as specified in the analytical methods to track instrument performance. In the event that a continuing calibration does not meet control limits, analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument was out of calibration will be reanalyzed.

- **Method Blanks—**Method blanks are used to assess possible laboratory contamination of samples during all stages of preparation and analysis. Blank corrections will not be applied by the laboratory to the original data. A minimum of one method blank will be analyzed for every sample delivery group (SDG) or 1 for every 20 samples, whichever is more frequent.
- **Laboratory Control Samples—**LCSs (reference material or spiked blanks) will be used as a check on overall method performance. An LCS (and possibly a duplicate LCS) will be analyzed for each SDG or for every 20 samples, whichever is more frequent.
- **Matrix Spike and Matrix Spike Duplicates—**MS/MSD samples are used to assess the effects of the sample matrix on the accuracy of analytical measurements. For metals, a minimum of one matrix spike (and possibly an MSD) will be analyzed for each SDG or for every 20 samples, whichever is more frequent.
- **Laboratory Duplicates—**Replicate laboratory analyses are indicators of laboratory precision. For metals and conventional analyses, one laboratory duplicate will be analyzed for every SDG or for every 20 samples, whichever is more frequent. An MSD for metals may also be analyzed with every SDG or for every 20 samples.
- **Internal Standards—**Internal standards are added to all field and quality control samples for analyses completed by ICP-MS. The internal standards are used for quantification of target compounds and to ensure that the instrument is stable and functioning as calibrated.

No special quality control procedures will be required for this project. Laboratory-established control limits for MS/MSD and LCS recoveries and laboratory duplicate sample analyses, as may be applicable, are provided in Tables B-2 and B-3.

2.4 Instrument and Equipment Testing, Inspection, and Maintenance

Preventive maintenance of field equipment and laboratory instruments is essential if project resources are to be used in a cost-effective manner. Preventive maintenance will take two forms: 1) a schedule of preventive maintenance activities to minimize downtime and ensure the accuracy of measurement systems and 2) availability of critical spare parts and backup systems and equipment. The performance of these maintenance procedures will be documented in field and laboratory notebooks.

A qualified third party consultant will be responsible for ensuring that routine preventive maintenance and calibration is performed and documented for field instrumentation and equipment to be used in the field program (e.g., global positioning system [GPS] and XRF).

The laboratory quality assurance officer will be responsible for ensuring that routine preventive maintenance is performed and documented for each analytical instrument and that spare parts or additional instruments are available in case of instrument breakdown or failure. Instrument quality control procedures (e.g., initial and continuing calibration, LCSs, calibration blanks) will be used to verify the continuing acceptable performance of each instrument. Details are provided in the referenced method descriptions (Table B-3), the laboratory SOPs, the laboratory quality assurance manuals, and the SOPs for field procedures (contained in the Work Plan).

2.5 Instrument and Equipment Calibration

Initial and continuing calibration procedures for laboratory instruments will be performed in accordance with the cited analytical method for each analysis (Table B-4). The method descriptions for each analysis specify acceptance criteria for initial and continuing calibration and state the conditions where recalibration is necessary.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology or other documented, reliable, commercial sources. At the laboratory, standards are validated prior to use to verify their accuracy by comparison with an independent standard. Reagents are examined for purity by performing method blank analyses.

Field instruments (e.g., GPS and XRF) will be calibrated according to and at the frequency specified in the manufacturers' instructions.

2.6 Inspection and Acceptance of Supplies and Consumables

Supplies and consumables are required for sample collection and laboratory activities. During sample collection, the most critical supplies affecting data quality are those used for decontamination of the sampling equipment. Supplies of appropriate, documented purity will be used for sample collection and decontamination. Acceptance for all supplies will require an intact seal upon receipt, maintenance at appropriate temperature, and use only prior to the expiration date. This method of documentation allows any contamination problem to be traced to its source and will enable identification of related samples that may have been affected. Acceptance requirements will include a basic inspection of all containers received and rejection of unacceptable supplies.

Reagents of appropriate purity and suitably cleaned equipment must be used for all stages of laboratory analyses. In addition, the laboratory must ensure that the concentrations of calibration and spiking standard are accurate and that instrumentation is functioning properly. The lot numbers of all standards are routinely tracked by the laboratory, from purchase of stock standards to preparation of secondary and working calibration standards. All calibration and spiking standards are checked against standards from another source. LCS results provide an additional check for accuracy. Details for acceptance requirements for supplies and consumables at the laboratory are provided in the laboratory SOPs and quality assurance manuals.

2.7 Data Acquisition Requirements for Non-direct Measurements

In addition to the direct Site measurement data that will be collected, other data and information may be used in data assessment and evaluation. Although not specified at this time, additional analyses and data collection may be required to meet the project objectives. These data (if collected), which constitute non-direct measurements, will be carefully evaluated to determine quality and usability. Data characteristics that may be evaluated can include the following:

- Technical basis
- Experimental bias
- Relevance to Site conditions
- Natural variability
- Uncertainty
- Validation processes applied to the data (if applicable).

2.8 Data Management

Computerized systems will be used to record, store, and sort the technical data that will be generated to support the soil sampling. Automated data handling increases data integrity by reducing errors, omissions, and ambiguities that can be introduced by manual procedures. In addition, automated procedures will be used by the laboratory to capture and summarize analytical results. In this case, electronic data files can be imported directly from the laboratory to the project database, minimizing both data entry effort and opportunities for error. Sampling location coordinates will be entered into the database to enable the generation of maps and figures using appropriate software.

Field logbooks and COC forms are prepared by the field team while sample collection activities are in progress. Sample information from the field is entered manually into the database in PNL's office. Each data record will include a unique sample code, station ID, sample type (matrix), analyte, analyte concentration, and concentration units. Data from the laboratory are entered directly from the EDDs. A small portion of the laboratory data may be entered manually if electronic data cannot be supplied. Electronic data summaries are produced to support data validation procedures. Data qualifiers are entered into the database when validation is completed and verified, and the data set is approved as final. All manual and electronic entries are verified by the data manager or validation personnel.

Project data tables and reports are prepared using customized retrievals that filter and sort the data according to criteria specified by the user. The data are automatically formatted for direct use with statistics software packages and various geographic information system (GIS) software. The maintenance of a single authoritative database prevents the proliferation of multiple versions of data and the introduction and proliferation of errors.

3 Assessment and Oversight

The sections below describe the internal and external checks used to ensure that the elements specified in this QAPP are correctly implemented as prescribed, the quality of the field and laboratory data is adequate to support their intended purpose, and corrective actions, if required, are implemented efficiently and effectively.

No changes in the QAPP procedures will be permitted without written justification and a detailed explanation of the intended change. All changes are subject to approval by the QA/QC coordinator and project managers. A description of all changes, with justification, will be included in applicable quality assurance or data reports generated for this project. Any major deviations from the QAPP will be discussed with the applicable project managers.

3.1 Assessment Activities

Various types of assessment activities may be implemented during the course of the soil sampling to determine compliance with the planning documents and ensure efficiency in completing the project tasks. Assessment activities will include readiness reviews prior to commencement of the project work and surveillance while work is in progress.

Readiness reviews are completed to ensure that the components of the project are in place so that work can be completed efficiently. Generally, two readiness reviews are conducted, one prior to the initiation of fieldwork and the other prior to data interpretation activities for the sampling event.

The field team leader will verify that the following conditions are met prior to field sampling:

- All of the field equipment is ready and available, and shipment to the sampling Site has been arranged
- The field sampling team has been scheduled, and transportation has been arranged
- Subcontractors have been contracted and scheduled.

The data manager, at the Exponent and PNL project managers' direction, will finalize the project data after all results have been received from the laboratory, data validation has been completed, and data qualifiers have been entered into the database. This process constitutes the readiness review for data use. The PNL project manager will be responsible for addressing any deficiencies in the readiness review. No report will be prepared.

Project surveillance may be conducted throughout the course of the sampling event to ensure that the work (fieldwork, laboratory analysis, data review/validation, data interpretation, and report preparation) follows the quality assurance procedures outlined in this QAPP. The Exponent project manager will be responsible for conducting surveillance with the assistance of

the field sampling leader, data validation manager, laboratory quality assurance officer, and lead technical personnel. Technical problems will be noted in the field sampling or quality assurance report if appropriate. Any noncompliance issues will be addressed as described below in Section 3.2.

All personnel engaged in sampling and analysis tasks will have appropriate training and required certifications. The laboratory is required to have written procedures addressing internal QA/QC; if requested, these procedures must be submitted to and will be reviewed by the project QA/QC coordinator to ensure compliance with this QAPP. The QA/QC coordinator will discuss any serious problems with the Exponent project manager and the Respondent project managers will be notified of the situation. Any problems identified during the course of the project that affect data quality will be discussed in the quality assurance report.

3.2 Response Actions

While the entire quality assurance program is designed and implemented to avoid problems, it also serves to identify unexpected or unavoidable problems that may be encountered during sample collection and analysis. An important part of any quality assurance program is a well-defined policy that can effectively correct these problems after they have been identified.

3.2.1 Short-Term Corrective Action

Short-term corrective actions fall into two categories: 1) analytical instrument or field equipment malfunctions, and 2) nonconformance or noncompliance with the quality assurance requirements that have been established for the project.

During field operations and sampling procedures, the field team leader will be responsible for correcting equipment malfunctions. Acceptable equipment operating parameters and control limits are specified in the operating instructions and SOPs. If any piece of equipment fails to meet established quality control criteria or cannot be properly repaired, it will be replaced. All equipment malfunctions and subsequent corrective measures will be documented in the field logbook.

The laboratory project manager is responsible for ensuring that laboratory results comply with project, method, and laboratory quality control requirements and that all analytical instruments and laboratory equipment are properly maintained. Acceptable instrument operating parameters, control limits for quality control results, and required corrective actions are specified in the laboratory SOPs, method protocols, and manufacturers' instructions provided with laboratory instruments. Control limit specifications are designed to help analysts detect the need for corrective action. Often an analyst's experience will be most valuable in identifying suspicious data or malfunctioning equipment. Immediate corrective action must be taken by the laboratory if any phase of the sample preparation and analysis process is considered suspect. Any corrective actions will be noted in the laboratory notebooks and, if appropriate, discussed in the case narratives for all affected sample sets.

3.2.2 Long-Term Corrective Action

In addition to short-term corrective actions taken by field and laboratory personnel, a mechanism is required to address long-term, systemic corrective actions. The need for long-term corrective action may be identified by an overview of compliance with standard quality control procedures, control charts, and performance or system audits. Any quality control problem that cannot be solved by immediate corrective action falls into this long-term category. The long-term system will be used to ensure that the condition is reported to the person responsible for the corrective action and follow-up plan.

The required corrective actions will vary, depending on the nature of the problem; however, the essential steps in the closed-loop, along-term corrective action system is as follows:

- Identify the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Determine a corrective action to eliminate the problem
- Establish responsibility for implementing the corrective action and implement the corrective action
- Verify that the corrective action has eliminated the problem
- Document the complete process of establishing and implementing the corrective action in a project memorandum that specifies the problem areas requiring corrective action and how they were detected, the individual initiating corrective action, the samples concerned, the acceptable data range, the measures taken to correct the problems, and the individual approving the corrective action.

The QA/QC coordinator, who has the authority to enforce necessary corrective measures, will routinely review the documentation of corrective actions.

3.3 Reports to Management

Reports will be prepared for any condition that requires corrective action. The reports will be prepared by the individual who conducted the audit, approved by the project QA/QC coordinator, and provided to the Respondents and Exponent.

Prior to inclusion or presentation of any of the data in a report, a data quality report will be prepared that will include the following items:

- A discussion of sampling procedures and any anomalies encountered during sample collection

- A discussion of laboratory procedures
- A discussion of quality control procedures and data validation results
- A description and discussion of any other conditions that may have affected the quality of the data
- A summary of the quality of the project data
- A description of the data usability and limitations for the project.

The data quality report will be prepared by or under the direction of the field team leader (for discussions related to fieldwork) and the QA/QC coordinator (for data quality evaluation).

4 Data Review, Verification, Validation, and Usability

Data review, verification and validation are conducted to establish the data quality and usability for the project. Data verification is the process of determining whether samples have been collected and analyzed according to sampling procedures described in the Work Plan, field and laboratory SOPs, and this QAPP. Data verification includes checking for compliance of procedures with the project plan, correctness of protocols used in the field and at the laboratory, comparability of the data collection and analysis procedures, and completeness of the set and supporting documentation. Data validation is the process of evaluating the technical quality of the verified data with respect to the project DQOs. The implementation of these procedures will ensure that the data conform to the project requirements and DQOs and that limitations are specified when DQOs are not met.

Verification of sampling information and chemical data occurs at several levels throughout the course of sample collection and analysis. The project data are validated after the field activities are completed, the results reported by the laboratory are available, and all data have been verified, prior to use of the data for interpretive activities. The purpose of the verification and validation procedures is to assess whether the data conform to the project requirements and DQOs, and to identify data limitations when data do not conform to the project requirements and DQOs. Data review, verification, and validation criteria and procedures are described below.

4.1 Data Review, Verification, and Validation Requirements

Data verification is the process of determining whether data have been collected or generated according to the Work Plan and the respective SOPs or method descriptions. Data verification consists of the following categories: 1) verifying compliance with SOPs, QAPP, and contractual agreements; 2) verifying correctness to determine that the data collection plans and protocols were followed; and 3) verifying completeness to establish that all data necessary to meet project objectives have been collected.

Data validation is the process of evaluating the technical usability of the verified data with respect to the planned objectives of the project. Data validation consists of the following objectives: 1) verifies that measurements (field and laboratory) meet the user's needs, 2) provides information to the data user regarding data quality by assignment of individual data qualifiers based on the associated degree of variability, and 3) determines whether DQOs were met.

4.1.1 Sampling Design and Sample Collection Procedures

The conformance of the field activities to specifications in the sampling plan will be evaluated on an ongoing basis while field activities are in progress. Additional verification will be provided through oversight of the field activities by the field team leader and by contacts with the Exponent project manager. If a sample cannot be collected as planned, the Exponent project manager will be notified and an alternate location or sampling method may be selected if

possible. The review process will include immediate evaluation of any change to the sampling plan so that an alternate field procedure may be established quickly, if necessary.

Additional verification procedures may be completed for information generated in the field. Field information recorded in the sample logs will be verified when these data are entered into the database and station location information will be verified when station coordinates are used to generate project maps. A final verification review of field activities will be made when the field effort is complete. The verification results will be included in the data quality and usability report.

4.1.2 Sample Handling

Standard procedures for sample collection and shipping will be followed to ensure that samples are preserved and stored as required (Table B-5). Any sample handling difficulties that are encountered in the field will be described in the field log. The field log will be reviewed and sample integrity verified as part of the data validation procedures.

Samples will be checked by laboratory personnel upon receipt and the cooler temperature will be determined. The temperature and condition of the samples will be recorded at the laboratory and any problems will be described in the case narrative for the data report. The field log and case narrative will be reviewed during the quality assurance review, and data will be flagged if the sample integrity was compromised. Data may be rejected as unusable if severe handling problems are encountered.

4.1.3 Analytical Procedures, Calibration, and Quality Control

Review and verification of testing procedures, including instrument calibration and analysis of all field samples and quality control samples, will initially be completed at the laboratory during and after sample analyses. The laboratory will complete quality control procedures as specified in the method descriptions and in the laboratory's SOPs and quality assurance manual. The laboratory will perform internal quality assurance checks on the reported data to verify data quality prior to submitting the data packages to PNL. Any nonconformance issues identified during this quality assurance check will be corrected and noted by the laboratory. Close contact will be maintained between the QA/QC coordinator and laboratory project chemist so that all quality issues can be resolved in a timely manner.

PNL may complete additional data verification and validation when data are received from the laboratory. All data will be reviewed as described below in Section 4.2.2.

4.1.4 Data Reduction and Processing

Review procedures for laboratory data are described in the previous section and in Section 4.2.2. These procedures include the verification of correct transcription and reduction procedures at the laboratory. Data verification procedures also include verification of the field information and laboratory data in the project database, as described in Sections 4.2.1 and 4.2.2. Data

integrity during data processing will be maintained through the exclusive use of electronic data transfer and manipulation.

4.2 Verification and Validation Methods

Verification procedures will be completed in the field during sample collection and in the laboratory during sample analysis and testing. In addition, verification and validation of all field and laboratory documentation and reports will be conducted after the analyses and tests are completed. The data will be released for interpretation only after validation has been completed and all qualifiers have been correctly entered into the database.

4.2.1 Field Procedures

The conformance of field activities to specifications in the Work Plan and the QAPP will be verified by the field team leader on an ongoing basis while field activities are in progress. Verification procedures will include the review of any deviation from prescribed sampling procedures described in the field logbook.

Planned sampling locations are described in the Work Plan and the QAPP. If a sample cannot be collected as planned, the Exponent project manager will be notified and an alternate location or sampling method will be selected, if possible. The review process will include immediate evaluation of any sampling difficulties so that an alternate field procedure or location may be established quickly, if necessary.

Sample completeness will be verified at the end of each sampling day and again when samples are packed for shipment to the laboratory. Laboratory personnel will provide an additional completeness check when the samples are received and logged in and checked against the COC forms.

Sample identification information in the sample logs and COC forms will be verified by the data manager or sampling personnel when the field data are entered into the database. Station location information will be verified by the PNL project manager or designee when station coordinates are used to generate project maps. Any discrepancies will be brought to the attention of the field team leader, who will be responsible for resolving the issue. Any deviations that affect data quality or completeness will be discussed in the data quality report, and data will be qualified or rejected, as appropriate.

4.2.2 Verification and Validation of Chemical Data

Verification of chemical data will be completed at the laboratory and by PNL. The laboratory will be responsible for the review and verification of all bench sheets, manual entry or transcriptions of data, and any professional judgments made by a chemist during sample preparation, analysis, and calculation and reporting of the final concentrations. The laboratory will also be responsible for the review of quality control results to determine whether data are of usable quality or re-analyses are required. Any nonconformance issues identified during the

laboratory's quality assurance checks will be corrected and noted by the laboratory. Close contact will be maintained between the project QA/QC coordinator and the laboratory project manager so that any quality issues can be resolved in a timely manner. Any data quality deviations will be discussed in the laboratory case narrative, including the direction or magnitude of any bias to the data, if possible.

Data validation and verification will be completed by PNL prior to finalization of the data and release of the data set for interpretation. All data will be verified and validated in accordance with U.S. EPA (2010) validation guidance for inorganic analyses and in the context of method-specific quality control requirements and laboratory-established control limits as they are applicable to the methods being used. Data will be assigned qualifiers when quality control procedures are not completed as required, when measurement performance criteria established in the applicable method (e.g., criteria for acceptable calibration) are not met, or when specific DQIs established for this project (e.g., control limits for bias and precision) are not achieved.

4.2.3 Algorithms to Assess Quality Control Results

Data verification includes checking that quality control procedures were included at the required frequencies and that the quality control results meet control limits defined in the method descriptions or by the project DQIs. The equations that will be used to determine whether measurement targets for project DQIs were met for each quality control procedure are provided below.

Duplicate/Replicate Analyses—Precision for duplicate or replicate chemical analyses will be calculated as the relative percent difference (RPD), expressed as an absolute value, between laboratory and/or field duplicate/replicate samples. The formula that will be used to assess precision for duplicate/replicate samples is as follows:

$$\mathrm{RPD} = \left| \frac{D_1 - D_2}{(D_1 + D_2)/2} \right| \times 100$$

where:

D1 = sample value

D2 = duplicate/replicate sample value.

Matrix Spikes Recoveries—Spiked samples provide an indication of the bias of the analysis system. The recovery of matrix spikes will be calculated as the ratio of the recovered spike concentration to the known spiked quantity:

$$\%R = \frac{A - B}{C} \times 100$$

where:

A = the analyte concentration determined experimentally from spiked sample

B = the background level determined by a separate analysis of the unspiked sample

C = the amount of the spike added.

Completeness—Completeness will be calculated for each sample type by dividing the number of valid measurements (all measurements except rejected data) actually obtained by the number of valid measurements that were planned:

$$\%\text{Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Planned}} \times 100$$

To be considered complete, the data sets must also contain all quality control check analyses that verify the precision and accuracy of the results.

4.2.3.1 Sensitivity

The detection limit of the sample preparation and analysis process is defined as "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte is greater than zero" (40 CFR 136B). In other words, it is the point at which qualitative, not quantitative, identification can be made. In practice, the limit of detection is defined as three times the standard deviation of the blank or background response adjusted for the amount of sample typically extracted and the final extract volume of the method.

Best professional judgment is used to adjust the limit of detection upward in cases where high instrument precision (i.e., low variability) results in a calculated limit of detection and equivalent instrument response less than the absolute sensitivity of the analytical instrument. The actual reporting limit for environmental samples is generally higher than the instrument detection limit because the sample matrix tends to contribute to fluctuations in the instrument's background signal. Laboratory personnel will determine reporting limits based on their experience with samples of similar matrix to those collected for this study and on the response of each instrument to samples for this study. The MRLs will be verified during data validation.

4.3 Reconciliation with Data Quality Objectives

The goal of data validation is to determine the quality of each data point and to identify data that do not meet the project DQOs. Nonconforming data may be qualified as estimated (J) or rejected as unusable (R) during data validation if criteria for data quality are not met. Rejected data will be flagged as unreportable in the project database and will not be used for any purpose. An explanation of the rejected data will be included in the data validation report. If the rejected data are needed to make a decision, then it may be necessary to resample. Any decision to

resample will be based on discussions among the project management team (Respondents, PNL, and Exponent).

Data qualified as estimated (J) are less precise or less accurate than unqualified data but are still acceptable for use. The data users and the Exponent project manager are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on statistical procedures and other data uses. The data quality report will include all available information regarding the direction or magnitude of bias or the degree of imprecision for qualified data to facilitate the assessment of data usability. The data reporting will include a discussion of data limitations and their effect on data interpretation activities.

5 References

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Tables

Table B-1. Project personnel and responsibilities

Personnel	Responsibilities
William Anderson Project Coordinator, Doerner, Saunders, Daniel & Anderson, LLP	Overall responsibility for project activities. Oversee all program activities to ensure compliance; perform technical oversight and consultation on major quality assurance problems; provide final approval of all necessary actions and adjustments for activities to accomplish project objectives.
J. Preston Turner Counsel, CitiGroup Global Market Holdings, Inc.	Overall responsibility for CitiGroup Global Market Holdings, Inc. activities. Oversee all program activities to ensure compliance; perform technical oversight and consultation on major quality assurance problems; provide final approval of all necessary actions and adjustments for activities to accomplish project objectives.
Jeffrey Rey Project Manager, United States Steel Corporation	Overall responsibility for United States Steel Corporation activities. Oversee all program activities to ensure compliance; perform technical oversight and consultation on major quality assurance problems; provide final approval of all necessary actions and adjustments for activities to accomplish project objectives.
Walter Shields Project Manager, Exponent	Oversee all investigation activities under the Respondents' direction to ensure appropriate quality control review; provide technical oversight; implement necessary actions and adjustments for activities to accomplish project objectives.
Mark Landress Field Team Leader, Project Navigator Ltd.	Coordinate and supervise field activities; ensure field procedures are completed in accordance with the Work Plan and QAPP; authorize and document minor adjustments to the sampling plan in response to field conditions, as necessary, and notify project managers and QA/QC coordinator; track submittal and receipt of samples at the laboratory; verify chain-of-custody/sample analysis request forms.
Philip Jen QA/QC Coordinator and Database Administrator, Project Navigator Ltd.	Provide technical quality assurance assistance; oversee quality assurance activities to ensure compliance with QAPP; coordinate and supervise data validation and data quality report preparation; review and submit quality assurance reports. Organize and maintain project database. Ensure that the data are stored in accordance with the QAPP. Supervise data management personnel.
Jamie Church Laboratory Project Manager, Pace Analytical Services, Inc.	Ensure that sample receipt and custody records are properly handled and data are reported within specified turnaround times: calibrate and maintain instruments as specified; perform internal quality control measures and analytical methods as required; take appropriate corrective action as necessary; notify the QA/QC coordinator when problems occur; report data and supporting quality assurance information as specified in this QAPP.

Note: QA/QC - quality assurance and quality control
QAPP - quality assurance project plan

Table B-2. Summary of data quality indicators for matrix spike and laboratory control sample recoveries[a,b]

Analyte	Soil (MS %Rec)	Soil (LCS %Rec)
Metals by ICP-MS		
Lead	75–125	73-121
Conventionals		
Total solids	NA	NA

Note: ICP-MS - inductively coupled plasma-mass spectrometry
LCS - laboratory control sample recovery
MS - matrix spike
NA - not applicable

[a] Control limits provided by Pace Analytical Services, Inc., in Lenexa, Kansas, are as listed in the laboratory quality assurance manual. Control limits are continually updated; therefore, the control limits listed above may be different when data are reported.

[b] In-house limits for Pace Analytical Services, Inc., unless footnoted.

Table B-3. Summary of data quality indicators for duplicate analyses

Analyte	Precision[a] Soil
Metals by ICP-MS	
Lead	20
Conventionals	
Total solids	20

Note: ICP-MS - inductively coupled plasma-mass spectrometry

[a] Control limits provided by Pace Analytical Services, Inc., in Lenexa, Kansas, are as listed in the laboratory quality assurance manual. Control limits are continually updated; therefore, the control limits listed above may be different when data are reported.

Table B-4. Target analyte list, methods, method detection limits, and method reporting limits[a]

Analyte	Method	Soil (mg/kg) Method Detection Limit	Soil (mg/kg) Method Reporting Limit
Metals			
Lead	ICP-MS	0.005	0.05
Conventionals			
Total solids	EPA 160.3	0.1	0.1

Note: ICP-MS - inductively coupled plasma-mass spectrometry (EPA SW-846 6020A)
EPA - U.S. Environmental Protection Agency

[a] Control limits provided by Pace Analytical Services, Inc. in Lenexa, Kansas, are as listed in the laboratory quality assurance manual. Control limits are continually updated; therefore, the control limits listed above may be different when data are reported.

Table B-5. Sample preservation, handling procedures, and holding time requirements

Analyte	Approximate Laboratory Subsample[a]	Container	Preservation and Handling	Maximum Holding Time[b]
Soil				
Conventionals				
Total solids	10 g	8-oz glass jar with HPDE-lined lid	Cool (4°C)	7 days
Metals				
Lead	10 g	8-oz glass jar with HPDE-lined lid	Cool (4°C)	180 days
Total Mass/Sample:	20 g	8-oz glass jar with HPDE-lined lid	Cool (4°C)	

Note: HDPE - high density polyethylene

[a] Sample quantities listed are the optimum amounts that should be used to conduct the target analyses to achieve the detection limit goals. However, the sample mass/volume that will be used at the laboratory may vary if a limited amount of sample is collected or if concentrations of target analytes are elevated.

[b] Sample collection to preparation holding time/sample preparation to analysis holding time.

Accepted Into
Administrative
Record File

NOT APPROVED
OR REVIEWED BY KDHE

Appendix C

Health and Safety Plan

NATIONAL ZINC - REMOVAL SITE EVALUATION
HEALTH AND SAFETY PLAN

Cherryvale, Kansas

June 2014

PROJECT NAVIGATOR, LTD.®

1.0 SITE BACKGROUND

1.1 Site Location and Operations

A description of the location and operations of the former National Zinc Smelter Property at the City of Cherryvale (Site) is described in Section 2 of the Removal Site Evaluation (RSE) Work Plan, to which this Health and Safety Plan (HASP) is attached.

1.2 Preparation and Applicability

This HASP is intended to inform personnel and subcontractors of the potential hazards at the site and to provide specific work practices and procedures for eliminating or controlling these hazards. The provisions of this HASP are mandatory for personnel engaging in operations at the Site.

The guidelines and requirements contained herein are based on a review of available information and an evaluation of the potential hazards. This document presents the health and safety procedures and equipment necessary to minimize safety hazards, chemical exposure potentials and risks for personnel and subcontractors during expected operations. Should unexpected hazards be encountered during operations at the site, or site activities performed by site personnel change significantly, work shall halt temporarily so that new hazard potentials can be evaluated and appropriate additional precautions can be implemented.

1.3 Work Plan

The objective of work under the RSE Work Plan is to assess the nature and extent of smelter-related impacts located in areas within the corporate limits of the Site outside the former National Zinc Smelter Property.

The following tasks will meet the objective:

- Perform an initial Smelter Residue Materials (SRM) survey to develop SRM classes.
- Collect soil samples to validate SRM classes.
- Finalize SRM classes with KDHE input.
- Conduct city-wide SRM survey with finalized SRM classes.

The fieldwork is expected to be conducted as per the schedule identified in Section 6 of the RSE Work Plan.

2.0 KEY PERSONNEL AND RESPONSIBILITIES

1.1 Regulatory Authority

The Kansas Department of Health and Environment (KDHE) is the lead regulatory authority.

2.1 The Respondents

The work is being performed on behalf of United States Steel Corporation and Citigroup Global Market Holdings, Inc. (Respondents) as described in Section 1 of the RSE Work Plan.

2.2 Field Project Manager

Project Navigator, Ltd. is the Project Manager who will manage field data collection on behalf of the Respondents. The Field Project Manager serves as the primary point of contact for any Subcontractors that may be engaged to perform field work. The Field Project Managers designated for this project are Mark Landress and Philip Jen of Project Navigator, Ltd. Other staff may be designated as Field Project Managers from time to time depending on work demand.

2.2.1 Field Project Manager:

Responsibilities:

- Approve the appointment of the Site Safety Officer (SSO)
- Ensure that a HASP is prepared and reviewed by the SSO
- Ensure that required health and safety equipment and supplies are available
- Ensure that all field team members receive site-specific health and safety training
- Promote and maintain a heightened awareness of health and safety among project team members
- Communicate regularly with the SSO

2.2.2 Corporate Safety Officer:

The Corporate Safety Officer with overall responsibility for the project will be Mark Landress of Project Navigator, Ltd.

Responsibilities:

- Promote and maintain a health and safety consciousness among project team members
- Ensure that all field team members receive health and safety training
- Ensure that all personnel submit the documentation of employee participation in a medical monitoring program and health and safety program
- Perform field audits to monitor the effectiveness of the HASP and to assure compliance to the HASP by the field team
- Communicate regularly with the SSO

2.2.3 Site Safety Officer: Philip Jen, Mark Landress, Raudel Sanchez, Robert Potter

The SSO is authorized to enforce the HASP and stop operations if personnel or community safety and health may be jeopardized.

Responsibilities:

- Promote and maintain a heightened awareness of health and safety among project team members
- Ensure the implementation of and compliance with the HASP
- Ensure that general safe work practices and site-specific work requirements are followed
- Conduct daily tailgate safety meetings
- Decide when to upgrade or downgrade Personal Protective Equipment (PPE)
- Set up and maintain the decontamination area
- Conduct accident investigations and prepare accident reports
- Observe personnel for signs of onsite exposure or stress
- Maintain an adequate stock of and control over first aid supplies and other safety equipment to insure their immediate availability and making sure there are an adequate number of first aid trained people on the project at all times.
- Initiate and direct emergency response efforts during field activities
- Perform field audits to monitor the effectiveness of the HASP and to assure compliance to the HASP by field workers
- Effect evacuation of the site if necessary

- Communicate regularly with the Project Manager and CSO

2.3 Subcontractors

Subcontractors performing work at the Site will have the following responsibilities:

Responsibilities:

- Comply with procedures set forth in this HASP and all applicable federal, state and local government regulations
- Take direction from and report directly to the SSO
- Review this HASP and sign the associated HASP Distribution Record
- Act in a safe manner and taking all reasonable precautions to prevent injury or illness to themselves or fellow employees
- Report any injuries, incidents or unsafe conditions to the designated SSO immediately
- Report any deviations from this HASP or any unanticipated conditions or hazards to the designated SSO immediately.

3.0 JOB HAZARD ANALYSIS AND SUMMARY

3.1 Health and Safety Evaluation

This section provides the hazard assessment for activities on this Site.

A focused list of Constituents of Concern (COCs) in soil and/or groundwater at the site, based on previous investigations, includes arsenic, cadmium, lead, and zinc.

The possibility of employees and subcontractors to be exposed to chemical hazards during site activities exists. The information contained in this HASP is extremely important because the substances identified herein have been identified as regulated hazardous substances and/or carcinogens, as such, they may cause harm. The effects of exposure to any hazardous substance depends on the dose, the duration (time), method of exposure, personal traits and habits such as smoking, and whether other chemicals are present.

3.1.1 Task-Specific Potential Safety Hazards

The following sections describe hazards that are known or suspected to exist onsite. All site-specific tasks have the potential to expose personnel to the hazards listed below. During site activities, if additional hazardous constituents, materials, or conditions are discovered onsite, the field personnel will alert the SSO, so that the HASP can be re-evaluated and updated to ensure that all potential hazards and exposure controls are addressed.

The hazard analysis of anticipated tasks to be conducted at the Site is presented in **Table 1**.

3.1.1.1 *Constituents of Concern*

The COCs at the Site consists of the metals arsenic, cadmium, lead, and zinc.

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The following exposure potentials for Site personnel involved with soil intrusive operations at the worksite may exist:

- Skin contact with impacted soils;
- Inhalation of particulate matter; and
- Ingestion of impacted materials.

COCs that may be encountered during anticipated activities performed by site personnel are not expected to represent a serious concern provided that the provisions of this HASP are met.

3.1.1.2 *Chemical Hazards*

The chemical hazards consist of the metals arsenic, cadmium, lead, and zinc.

3.1.1.2.1 Skin Contact

Skin contact with hazardous or potentially hazardous materials shall be minimized as follows:

- Through the use of appropriate engineering controls;
- Through the use of appropriate work practices; and
- Through the use of appropriate gloves and protective clothing, as outlined in Section 5 of this plan.

3.1.1.2.2 Inhalation

Inhalation exposure to hazardous materials shall be minimized as follows:

- Through the use of appropriate engineering controls;
- Respiratory protection;
- Through the use of appropriate work practices.

3.1.1.2.3 Ingestion

Ingestion of contaminated or potentially contaminated materials shall be minimized through the use of appropriate decontamination and hygiene procedures, as outlined in Section 6 of this plan.

3.1.1.3 *Mechanical Hazards*

3.1.1.3.1 Vehicles

Information on controlling hazards for general vehicle safety is listed below.

- Obey all applicable traffic rules;
- Seatbelts must be worn at all times;
- Only authorized individuals are allowed to operate company vehicles;

- Inspect and check brakes, horns, steering, tires, lights, and other items daily;
- Inspect heavy equipment daily and document the inspections;
- Always look before backing;
- Never carry more passengers than the vehicle is designed for;
- Never carry passengers in areas that are not specifically designed for them (e.g. truck bumpers, pickup truck beds)
- Stay out of areas where heavy equipment is operating; and
- Wear high-visibility traffic vests when working near roadways.

3.1.1.3.2 Fire Hazards

Fire hazards are not expected to be a material risk for field sampling; however, use of motor vehicles, generators, heaters and other mechanized or motorized equipment may pose fire hazards under certain conditions. The following will help minimize fire hazards:

- All stationary or mobile equipment, except for motor trucks, tractors, buses and passenger vehicles, shall have spark arresters that meet applicable standards;
- Flammable materials shall be stored within 15 feet of a small mobile or stationary vehicle;
- Each vehicle and piece of equipment shall have the following:
- One fully charged fire extinguisher rated a 4 BC on each piece of mobile equipment.
- One 10 BC fire extinguisher for each gasoline-powered tool. The fire tools shall be no farther than 25 feet from the point of operation of the tool.
- Appropriate fire extinguishers shall be available in field offices, laboratory and other work areas as appropriate.

3.1.1.4 *Temperature*

At elevated ambient temperatures, workers, particularly those wearing protective clothing, may experience varying degrees of heat stress if prudent precautions are not taken. Recognized forms of heat stress and the associated symptoms are:

- Heat Rash can be caused by continuous exposure to hot and/or humid air. The condition is characterized by a localized red skin rash and reduced sweating;
- Heat Cramps can be caused by profuse perspiration with inadequate fluid intake and electrolyte replacement. This condition is characterized by muscle spasm and pain in the extremities and abdomen;

- Heat Exhaustion, a mild form of shock, can be caused by substantial physical activity in heat and profuse perspiration without adequate fluid and electrolyte replacement. The symptoms include weak pulse; shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; and fatigue; and
- Heat Stroke, the most severe form of heat stress, can be fatal. The symptoms include red, hot, dry skin; body temperature of 105°F or greater; no perspiration; nausea; dizziness and confusion; strong rapid pulse; coma; and death.

When temperatures exceed 85°F, employees shall be allowed to take frequent breaks in a shaded area, and frequent breaks shall be mandatory when temperatures exceed 100°F. If coveralls or other protective clothing is worn, they should be unzipped or removed during breaks. Cool water and Gatorade (or other electrolyte replacement beverage) shall be provided, and employees should be encouraged to drink small amounts frequently to avoid dehydration. Workers shall be encouraged to salt their food more liberally and to avoid drinking alcoholic beverages. Additionally, a buddy system shall be implemented to enable workers to monitor each other for signs and symptoms of heat stress. The SSO shall be notified immediately if any person starts to show signs or symptoms of heat stress.

3.1.1.5 *Acoustic Hazards*

Elevated noise levels shall be assumed to be present in the vicinity of all heavy equipment operations.

Hearing protectors will be made available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

3.1.1.6 *Biological Hazards*

Biological hazards that may be encountered for the project include rodents, snakes, spiders, dogs, cats, and bees/hornets. Identify site personnel with a known reaction to any such bites and/or insect stings. Avoid nesting areas and habitats, when possible and wear protective clothing.

Poison ivy may be present on the site. Review the identification characteristics of poison oak and poison ivy. Avoid contact with these plants, and any unknown plants when possible, and wear protective clothing.

Avoid animal and bird droppings. These materials often contain mold, fungus, or bacteria that can cause respiratory problems such as lung diseases and allergies.

3.1.1.7 *Physical Hazards*

3.1.1.7.1 Dust Control

In the course of routine sampling, dust is not expected to be a significant hazard. During processing of samples, sieving, sample splitting dust may be generated. Dusty conditions may increase the potential of contaminated and non-contaminated particulate inhalation; dry, windy weather and erodible surface soils may potentially expose site personnel to airborne particulates. Dust control measures should be implemented (e.g. water spray) to prevent or minimize dust emissions, and dust/particulate air monitoring shall be conducted if dusty conditions exist. Engineering controls including hoods or additional ventilation may be required for laboratory work where activities generate dust. Dust masks, respirators or other personal protective equipment may be needed in addition to engineering controls depending on conditions.

3.1.1.7.2 Slip and Trip Hazards

Slip and trip hazards may be present during work activities where wet or uneven terrain is present. Tree roots, fencing, brick, rock, wood and other materials that may be present in the work area that could constitute slip and trip hazards.

To avoid injury due to slips and trips the following is suggested:

- Perform a reconnaissance survey of the area to identify potential hazards and flat these areas to avoid if possible:
- Wear sturdy boots with nonskid soles;
- Walk slowly, never run;
- Take extra precautions on wet or slippery surfaces;
- Be alert for tripping hazards; and
- Keep housekeeping a priority.

3.1.1.7.3 Hand, Foot, and Head Hazards

Hand, foot, and head hazards may be present during surveying, sampling, and laboratory activities. To avoid injury due to hand, foot, and head hazards the following is suggested:

- Appropriate PPE shall be worn to prevent hand, foot, or head injuries that may result from contact with structural components, glass, debris, wire or nails and sampling equipment.
- Gloves should be worn during all sampling activities.
- Equipment should be inspected before use to ensure it is in good condition, free from defects and in proper working order.
- Caution should be practiced when handling or removing samples from sample tools to limit the potential for cuts, sprains, punctures or pinches.
- Sample equipment with extension poles shall be operated such that they are clear from the face and head and that torque on sample tools will not result in breakage or uncontrolled release that could result in bodily injury.
- Sample sleeves and tubes that may require cutting shall be handled with caution. Saw cuts are preferable to knife cuts where applicable. All cutting will be done directed to minimize the potential for cuts or punctures.
- Cut-resistant gloves shall be available when handling knives and other cutting tools that may be needed for sample handling and processing.

3.1.1.8 *Radiological Hazards*

As part of the soil evaluation, an X-ray fluorescence analyzer (XRF) will be used. To minimize hazards associated with the use of an XRF the following are suggested:

- The XRF will be inspected each day prior to use to insure there is no damage visible that may contribute to malfunction.
- Use of the XRF will be conducted by trained operators as discussed in Section 4.1 of this HASP.
- In the case of a malfunction the XRF will be immediately powered down, power source removed (battery), and returned to the manufacture to be serviced.
- When the XRF is not in use it should be properly stored with its power source removed.

4.0 EMPLOYEE TRAINING

4.1 Training Requirements for Onsite Personnel

All employees working onsite who may be exposed to hazardous substances, health hazards or safety hazards, and their supervisors and managers responsible for onsite activities must have met the training requirements OSHA 29 CFR 1910.120 prior to the start of operations at the site.

Supervisory personnel will have 40 hour OSHA HAZWOPR training.

Workers performing sampling and who may be in contact with metal impacted materials above residential exposure limits will receive a minimum of 24 hours training.

Workers onsite only occasionally for a specific limited task and who are unlikely to be exposed over permissible and published exposure limits shall have received a minimum of a worker awareness briefing notifying them of the potential hazards and conditions that may be encountered. Occasional workers will be accompanied by trained and experienced personnel for a minimum of one day actual field experience prior to unsupervised access.

Personnel performing sample analysis using X-ray fluorescence analyzers shall have a minimum of 8 hours training in the safe use and operation of the XRF. Contractors performing XRF analysis shall hold applicable current state radioactive material licenses.

Personnel who have not received the required training prior to the start of site operations are not to engage in site operations until such training has been completed. Subcontractors working onsite will be required to provide proof of training to the SSO before beginning work on the site. A list of all trained and authorized personnel for each contractor involved in surface-disturbing activities will be submitted to the SSO before commencement of field activities.

4.2 Site-Specific Training

The SSO shall perform pre-entry site-specific safety training for personnel prior to participation in field activities. Additionally, safety briefings must be performed with adequate frequency to provide an awareness of planned operations and HASP requirements.

Onsite meetings will be held to reinforce health and safety during the following:

- Safety briefings will be held daily at the start of work.
- Prior to significant changes in work tasks.
- At any time when there are material changes in work conditions.

5.0 PERSONNEL PROTECTION

5.1 Engineering and Work Practice Controls

Personal protective equipment is fundamental to the safety of the personnel conducting the field activities falling within the scope of this HASP. All site personnel must wear appropriate PPE when site activities involve exposure to hazards that cannot be adequately or feasibly controlled by engineering or administrative controls.

5.1.1 Engineering Controls

When practical, engineering controls shall be implemented to reduce and maintain employee exposure to or below safe levels for those tasks demonstrating known or suspected hazards.

5.1.2 Standard Safe Work Practices

In addition to the specific requirements of this HASP, following standard safe work practices and safety rules will be practiced during the field operations.

- Prior to conducting subsurface activities, underground utility locations will be identified.
- The movement and use of vehicles and heavy equipment will be planned and performed with consideration for the location, height, and position of fixtures and structures and natural features.
- Each sample and all waste will be treated and handled as though it were hazardous, until sample analysis indicates otherwise.
- Avoidance of contact with chemicals or products and chemically impacted materials surfaces will be practiced.
- Smoking, eating, drinking, and chewing gum or tobacco will not be permitted within the exclusion zone and the contamination reduction zone.
- Personnel will keep track of weather conditions and wind direction to the extent they could affect potential exposure. Work will be limited to daylight hours and during normal weather conditions. Extremes in temperature and weather conditions may restrict working hours.

- Personnel will be alert to any abnormal behavior on the part of other coworkers that might indicate distress, disorientation, or other ill effects.
- Personnel should never ignore symptoms that could indicate potential exposure to chemical contaminants. Any symptoms or ill effects will be immediately reported to the SSO.
- Personnel with long hair will secure it in a safe manner; loose-fitting clothing that could become entangled in power equipment will not be permitted in the work zones.
- Horseplay is prohibited on the site.
- Working while under the influence of intoxicants, narcotics, or controlled substances is prohibited. Persons deemed under the influence of alcohol or drugs will be prohibited from working at the site.
- Hands and face should be thoroughly washed and wiped before leaving the work area or site before eating, drinking, or at the end of the workday.

Work practice controls shall next be applied when engineering controls are impractical and shall be incorporated as site-specific standard operating procedures (SOPs) for personal precautions and routine operations.

5.2 Personal Protective Equipment

5.2.1 Levels of Protection

There are four designated levels of protection offered by PPE. These are described from the highest level of protection to the lowest level of protection as follows:

Level A: Should be worn when the highest level of respiratory, skin, and eye protection is needed.

Level B: Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection is needed.

Level C: Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin protection is needed.

Level D: Should be worn only as a work uniform and not in any area with respiratory or skin hazards. It provides minimal protection against chemical hazards.

Modifications of these levels are permitted, and routinely employed during site work activities to maximize efficiency. For example, Level C respiratory protection and Level D skin protection may be required for a given task. Likewise, the type of chemical protective ensemble (*i.e.*, material, format) will depend upon the constituents and degrees of contact.

The level of protection selected for a task is based on the following:

- Type and measured concentration of the chemical substance in the ambient atmosphere and its toxicity.
- Potential for exposure to substances in air, splashes of liquids, or other direct contact with material due to work being done.
- Knowledge of chemicals onsite along with properties such as toxicity, route of exposure, and contaminant matrix.

In situations where the type of chemical, concentration, and possibilities of contact are not known, the appropriate level of protection must be selected based on professional experience and judgment until the hazards can be better identified.

5.2.2 Specific levels of protection planned for the site

Level D will be appropriate for the work performed as part of the field assessment, based on evaluation of previous investigation reports. All subcontractors will be responsible for providing their employees with the proper PPE during work activities. All site personnel shall wear, at a minimum; steel-toe work boots, safety glasses, and coveralls or work clothes. Additional PPE may be required for specific operations as described in the following table:

Operations	Additional PPE Required
Work in the vicinity of heavy equipment or vehicle traffic	High-visibility traffic vests with reflective strips
Work collecting soil samples	Nitrile gloves
Work in vicinity of equipment that presents a potential foot hazard	Steel-toed safety boots
Elevated noise levels present	Hearing protection (foam ear plugs)

During operations, the SSO will insure that all PPE is properly stored, cleaned/decontaminated, and replaced when damaged or defective.

5.2.3 Reassessment of protection program

The level of protection provided by PPE selection shall be upgraded or downgraded based upon changes in site conditions. The SSO has the authority to change PPE requirements at any time.

When a significant change occurs, the hazards should be reassessed. Some indicators of the need for reassessment are:

- The commencement of a new work task, or the start of sampling or work in an unfamiliar portion of the Site;
- A change in job tasks during a work phase;
- A change in the season/weather;
- Individual medical considerations;
- Encountering contaminants other than those previously prepared for;
- A change in ambient levels of contaminants; and
- A change in work scope, which affects the degree of contact with contaminants.

5.2.4 Standard operating procedures for personal protective clothing

The primary inspection of PPE in use for activities at the Site will occur prior to immediate use and will be conducted by the user. This ensures that the user has checked the specific device or article and that the user is familiar with its use and limitations. Any damaged or defective PPE noted by the user should be reported to the SSO, who will make a determination if replacement of the item warrants replacement or repair prior to use.

Proper inspection of PPE includes:

- Inspection and operational testing of equipment received from the factory or distributor;
- Inspection of equipment as it is issued to workers;
- Inspection after use or training and prior to maintenance;
- Periodic inspection of stored equipment; and

- Periodic inspection when a question arises concerning the applicability of the selected equipment, or when problems with similar equipment arise.

6.0 DECONTAMINATION

6.1 Personal Decontamination

Personal decontamination will be used to minimize the potential of being exposed to contaminants and consist of the following:

- Removal and cleaning of non-disposable PPE (e.g. washing off soil from boots).
- Disposable PPE will be properly discarded once its use in complete.
- Proper personal hygiene will be practiced (showering, washing hands, etc.).

6.2 Equipment Decontamination

Decontamination of equipment is discussed in Section 4.4.2.6 of the RSE Work Plan.

7.0 CONTINGENCY PLANNING

This section describes possible contingencies and emergency procedures to be implemented at the Site. The HASP Distribution Record, HASP Meeting Record and Site Visitor Record are shown in **Tables 2, 3, and 4**, respectively.

7.1 Pre-emergency planning

Prior to commencing with monitoring and/or remediation activities and during site daily tailgate safety meetings, all employees will be trained in and reminded of provisions of the HASP, emergency response plan, communication systems, and evacuation routes. In addition to this, the SSO is responsible for notifying appropriate offsite emergency responders (e.g. fire department, police, etc.) about the remedial activities being undertaken and their roles in response to emergencies at the Site. At a minimum, these responders should be informed about the Site-specific hazards, appropriate response techniques, site emergency procedures, and decontamination procedures. The SSO will also coordinate notification procedures with industrial facilities that may impact the Site. The HASP will be reviewed periodically and revised as necessary by the SSO to ensure that the HASP is adequate and consistent with the prevailing site conditions.

7.2 Emergency personnel roles and lines of authority

During an emergency on the Site, the Site Safety Officer (SSO) is ultimately responsible for and authorized to initiate response activities to correct the emergency situations. This includes taking any and all appropriate measures necessary to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the Site area or of adjacent residents. The SSO is also responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. Subcontractors are responsible for assisting the SSO within the parameters of their scope of work. In addition to these specified roles, other personnel onsite and agencies or entities offsite may need to be identified as responders to site emergencies. These designations may include rescue teams, a decontamination station officer, a 24-hour medical team, communication

personnel, environmental scientists, hazardous chemical experts, firefighters, meteorologists, public safety personnel, public evacuation personnel, and/or on-scene coordinators.

7.3 Communication

In an emergency, crucial messages must be conveyed quickly and accurately in order to communicate information such as the location of injured personnel, orders to evacuate the Site, and notice of blocked evacuation routes. Field emergencies will be communicated using telephones to alert workers of the exact danger, convey safety information.

Emergency notification of outside entities will be performed using telephones (land lines or cellular).

7.4 Emergency recognition/prevention

All personnel entering the Site (e.g. visitors, subcontractors, offsite emergency response groups, etc.) must be made aware of the identified site hazards and become familiar with techniques of hazard recognition from pre-assignment training and site-specific briefings.

7.5 Emergency contact/notification system

Table 5 provides names and telephone numbers for emergency contact personnel. In the event of a medical emergency, personnel will take direction from the SSO and notify the appropriate emergency organization. Standard Procedures for reporting emergencies are listed in **Table 6**. Directions and map to the nearest hospital is provided in **Table 7**. In the event of a fire, the SSO, or his designee, will notify the appropriate local, state, and federal agencies.

7.6 Emergency medical treatment procedures

Any person who becomes ill or injured in an affected area must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport.

If the patient's condition is serious, gross contamination should be removed. First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must be immediately reported to the SSO, who will notify the appropriate client and regulatory representatives.

Any person being transported to a clinic or hospital for treatment should take with them information on the chemical(s) they have been exposed to at the Site. A map and directions indicating the route to the nearest hospital can be found in **Table 7**.

Any vehicle used to transport contaminated personnel will be decontaminated as necessary.

7.7 Fire or explosion

In the event of a fire or explosion, the City of Cherryvale Fire Department should be summoned immediately. Upon their arrival, the SSO or designated alternate will advise the fire commander of the location, nature, and identification of hazardous materials, if any, onsite.

7.8 Emergency equipment/facilities

Emergency equipment and facilities will be described and located before the beginning of work operations at the Site. All personnel involved in the operation will be informed of the location and use of emergency equipment and emergency facilities.

8.0 MOTOR VEHICLE SAFETY AND TRAFFIC CONTROL PLAN

This section outlines the requirements of the Motor Vehicle Safety Program and provides information on the procedures and guidelines utilized in identifying approved drivers. The objective is to provide a place of employment that is safe and healthful, and will not subject employees to avoidable hazards associated with the operation of a motor vehicle.

One of the leading causes of industrial or workplace injuries and fatalities are derived from the operation of motor vehicles. Contractors typically utilize company vehicles for activities associated with deliveries, traveling to a project, as well as other various activities.

8.1 Responsibilities

Before authorized to operate a company vehicle, each employee must allow Project Navigator to perform a Motor Vehicle Record evaluation. The record will be examined to determine the employee's responsibility when operating a vehicle.

8.2 Traffic Control

Where a hazard exists to employees because of traffic or haulage conditions at work sites that encroach upon public streets, a system of traffic controls guidelines will be enforced.

Employees (on foot) exposed to the hazard of vehicular traffic shall wear orange, strong yellow-green, or fluorescent versions of these colored warning garments such as vests, jackets, or shirts. Traffic cones will be used to mark off the work area from potential traffic. During rainy weather, employees exposed to the hazard of vehicular traffic may wear orange, strong yellow-green or yellow rainwear.

TABLES

TABLE 1

TASK HAZARD ANALYSIS

Task	Mechanical	Electrical	Chemical	Temperature	Acoustic	Biological	Radiological	O_2 Deficiency Confined Space	Physical
Surveying	Vehicle Operation	NE	Potentially in soil	Heat stress	NE	Insects, dogs, cats, etc.	NE	NA	Traffic, slips, trips, falls, hand, foot, and head
Soil Sampling	Operating hand tools	Overhead & buried power lines	Potentially in soil	Heat stress	NE	Insects, dogs, cats, etc.	NE	NA	Traffic, slips, trips, falls, hand, foot, and head
XRF Use	NA	Use of XRF	Potentially in soil	NE	NE	NA	Use of XRF	NA	NE
Decon of sampling equipment	NA	NE	Potentially in soil and water	Heat stress	NE	Insects, dogs, cats, etc.	NE	NA	slips, trips, falls, hand, foot, and head

Notes:

NA – Not Applicable

NE – Not Expected

O_2 – Oxygen

XRF – X-ray fluorescence analyzer

TABLE 2

HEALTH AND SAFETY PLAN DISTRIBUTION RECORD

Project Navigator, Ltd. Staff

All PNL project staff who will visit the Site will sign the form below to indicate that they have read and understood the HASP as part of their site-specific training. A copy of this plan will be available for review at the Site.

Name/Job Title	Date Distributed	Signature

Contractors and Subcontractors

Before beginning any work on the Site, a copy of this HASP will be provided for review to contractors and subcontractors who may be affected by activities under this HASP. All contractors and subcontractors also must comply with applicable federal, state and local government regulations.

Name of Firm	Contact Person (print)	Date Distributed

TABLE 3

HEALTH AND SAFETY MEETING RECORD

All personnel working onsite will receive an initial health and safety orientation before working onsite. Thereafter, a required tailgate safety meeting will be held daily before the start of work, or more frequently as deemed necessary by the Site Safety Officer.

Date	Name of Attendee (Print)	Name of Firm (Print)	Signature

TABLE 4

SITE VISITOR RECORD

All visitors are required to sign the visitor log and comply with the HASP requirements.

Date	Name of Visitor (Print)	Name of Firm (Print)	Purpose of Visit	Arrival Time	Departure Time

TABLE 5

EMERGENCY TELEPHONE NUMBERS

Ambulance	911
Police	911
Fire Department	911
Chemical Transportation Emergency Center (CHEMTREC) ♦ Emergency Use Only ♦ Non-Emergency	 800-424-9300 202-887-1255
One Call Notification	811
Regulatory Agency Contact: ♦ Holly Burke	 785-296-6242
Project Navigator Ltd. Corporate Safety Officer ♦ Mark Landress	Office: 713-468-5004 Cell: 713-539-3636
Project Navigator, Ltd. Project Manager: ♦ Mark Landress	Office: 713-468-5004 Cell: 713-539-3636
Project Navigator, Ltd. Geologist: ♦ Philip Jen	Office: 713-468-5004 Cell: 832-215-5589

TABLE 6

STANDARD PROCEDURES FOR REPORTING EMERGENCIES

When calling for emergency assistance, provide the following information:

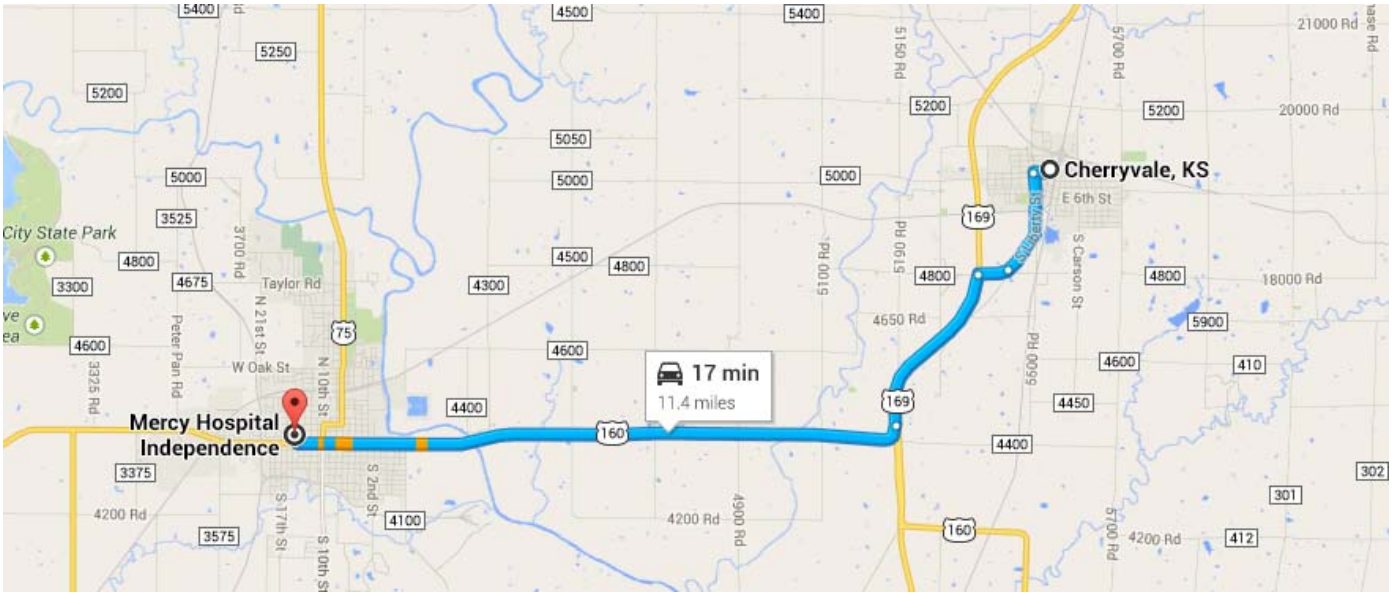
- Your name
- Your location
- The telephone number at your location
- The nature of the emergency
- The names of all exposed or injured persons
- Actions already taken

IMPORTANT: The recipient of the call should hang up first, NOT the caller.

TABLE 7

DIRECTIONS TO THE HOSPITAL

For emergency life-saving care, call 911



- From Cherryvale, KS take N. Liberty St. to US-169 S (1.9 miles)
- Take a right onto US-160 towards Independence, KS (9.5 miles)
- Take a right onto 14th St. (0.1 miles)
- Take a left onto W Myrtle St.
- Mercy Hospital Independence will be on the right.