REMEDIAL INVESTIGATION

VB/I-70 Superfund Site

Operable Unit 2

Prepared for:
City and County of Denver

Prepared by:
Engineering Management Support, Inc.

cember 16, 2009

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REMEDIAL INVESTIGATION
Vasquez Boulevard/Interstate 70 Superfund Site
Operable Unit 2 – On-Facility Soils
Former Omaha and Grant Smelter

Prepared for

City and County of Denver
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1 SITE BACKGROUND

The Vasquez Boulevard and Interstate 70 (VB/I-70) Superfund Site is an approximately four square mile area located in the north-central portion of Denver, Colorado near the intersections of Interstate 70 and Interstate 25 (Figure 1).

The VB/I-70 Site consists of the following three operable units (OUs) (Figure 2):

- OU-1 – Off-Facility Soils which includes soils in the residential portions of the Superfund Site;
- OU-2 – On-Facility Soils which includes soils located in the vicinity of the former Omaha & Grant Smelter; and
- OU-3 – On-Facility Soils which includes soils located in the vicinity of the former Argo Smelter.

The VB/I-70 Superfund Site is located in the vicinity of the Globe Smelter (Figure 2). The Globe Smelter is not part of the Site, but rather has been evaluated and remediated as part of a separate cleanup conducted by ASARCO, Inc. and overseen by the Colorado Department of Public Health and the Environment (CDPHE).

This Remedial Investigation (RI) report describes the On-Facility Soils of OU-2 (the Site). Figure 3 shows the extent of the Site as detined by the United States Environmental Protection Agency (USEPA). The Site consists primarily of the southern portion of Denver Coliseum property (that portion of the Coliseum property located south of Interstate 70) which is owned by the City and County of Denver (CCoD). The Site also includes the Forney Transportation Museum property along Brighton Boulevard, the Pepsi Bottling Company property along Brighton Boulevard, and various other commercial properties located along Brighton Boulevard (Figure 3). The Site also encompasses the Globeville Landing Park. The Site is generally bounded by Interstate 70 on the north, the South Platte River on the west, Brighton Boulevard on the east, and the southem boundaries of the Globeville Landing Park and the Pepsi Bottling Company property on the south.

Previous investigations by USEPA identitied the presence of levels of arsenic and lead in soil at concentrations above human health screening levels. Therefore, the focus of the RI is on assessment of arsenic and lead occurrences in surface and subsurface soil. Previous groundwater sampling conducted by CCoD reported the presence of arsenic in one monitoring well at levels above state and federal drinking water standards. As it was only reported to be present in one well and there is no use of groundwater at or in the vicinity of the Site, EPA concluded that groundwater was not signiticant exposure pathway and therefore did not require additional investigations of groundwater conditions. As discussed later in this report (Section 5.2), additional soil sampling was performed in the vicinity of this well. The results of the additional soil sampling did not indicate the presence of anomalously high levels of arsenic in soil in the vicinity of this well. Elevated levels of arsenic have not been detected in any of the other groundwater monitoring wells at the Site or in the Coliseum cooling water supply wells. As discussed further in Section 5.2, the higher levels of arsenic detected in well MW-2 appear to be anomalous and result from a lack of development of this well at the time it was constructed. Neither arsenic nor lead were detected at elevated levels in the upstream or downstream surface water or sediment in the South Platte River adjacent to the Site proving no impact to the river.

The investigations described in this RI report as well as preparation of this report were performed on behalf of the City and County of Denver (CCoD) pursuant to Administrative Order on Consent (AOC) with the USEPA Docket No. CERCLA-08-2008-0011. This RI report describes the Site history and physical setting, includes a summary of the RI and previous investigations at or in the vicinity of the Site, and provides an interpretation of the nature and extent of contamination. A baseline risk assessment (BRA) that includes an update to the previous draft Baseline Human Health and Screening Level Ecological Risk Assessment (USEPA, 2006) has been prepared separately by USEPA. Information presented in this RI report will be used by USEPA to manage potential risks and define appropriate remedial actions as necessary to protect human health and the environment at the Site.

2 SITE HISTORY

The original Omaha & Grant Smelter facility was built on approximately 50 acres bordering the South Platte River. Figure 4 shows the approximate locations of buildings and other facilities that were associated with the historical operations of the Omaha and Grant Smelter at the Site. This property generally coincided with an area that is currently bounded by Colorado and Eastem Railroad (Buriington Northem Santa Fe Railroad) on the northwest, the Union Pacitic Railroad on the northeast, 39th Avenue on the southwest, and Brighton Boulevard on the southeast (formerly Wewatta Street). This area constitutes the Site.

2.1 Corporate History

The Omaha & Grant Smelter got its start from the Grant Smelter located in Leadville, Colorado. The Grant Smelter operated in Leadville from 1878 until 1882 and was owned by the Grant Smelting Company, an unincorporated company. When the Grant Smelter was destroyed by tire in 1882, a replacement smelter was built in Denver.
The Grant Smelter shipped bullion to the Omaha Smelting Works located in Omaha, Nebraska. On July 5, 1883, the Grant Smelter merged with the Omaha Smelting Works and on July 18, 1892 the corporation was renamed the Omaha & Grant Smelting and Refining Company.

In 1899, the Omaha & Grant Smelting and Refining Company joined other smelting companies to fonn the American Smelting and Retining Company. The American Smelting and Retining Company continued to operate the Omaha & Grant Smelter until 1903. The American Smelting and Refining Company changed its name to ASARCO Incorporated (ASARCO) on May 15, 1975.

2.2 Facility Operations

The Omaha and Grant Smelter facility commenced operations at the Site in October 1882. In 1887, the facility was expanded. In 1892, the facility expanded again and a 352-foot tall smelter stack was built. The smelter operated for approximately 21 years and was closed in 1903.

The smelter buildings were subsequentiy demolished. Sometime later, all of the slag, with the exception of any residual that could be buried under modem parking lots, was removed. Based on historic aerial photographs, all of the visible slag was removed by 1949. Between 1920 and 1940, various portions of the facility were deeded to CCoD and other portions of the facility have been, and continue to be, owned or operated by the Union Pacific Railroad, the Pepsi Bottling Company and various other corporate entities or individuals.

The properties still owned and used by CCoD are the Globeville Landing Park and the Denver Coliseum, which opened in 1952. The CCoD constmcted the Denver Stadium and Coliseum circa 1950 which encompassed part of the northeast portion of the former Omaha and Grant smelter facility. The approximately 10-acre Globeville Landing Park is located along the east side of the South Platte River. The park, constmcted in the 1970s encompasses part of the southwest portion of the former Omaha and Grant smelter facility as shown on Figure 4.

2.3 Process Description

The Omaha & Grant Smelter facility employed a lead smelting process to produce gold, silver, copper, and lead. The smelting process involved the fusing of ore, fuel, and lime to form a melted product. As a result of this process, lead and silver would sink to the bottom of an iron chamber and the slag would float on the surface of the liquid metals.

2.4 Waste and Waste Disposal Practices

Although detailed information about the wastes from the smelting operations is not well documented, it is known that blast fumace slag was produced from the smelting operations. Ores, fuel and flux were delivered by rail car direcdy to the fumace charging doors on the upper levels of the smelter. As the smelting operations proceeded, the intermediate products flowed downhill to a lower level. Smelter workers would mn slag onto a dump and load bullion onto rail cars. An 1890 Sanbom Fire Insurance Map identities a slag dump to the north of the Omaha & Grant Smelter property (Figure 4).

Prior to constmcting the Coliseum and associated parking lot, portions of the Site were used as a landtill for disposal or municipal solid wastes. The presence of the landtill materials beneath the Coliseum parking lot area is evidenced by the undulating nature of the parking lot pavement owing to differential compaction and decomposition of the underlying solid waste materials. No specitic information or documentation of the time periods when the landfill occurred, the nature of the landfill activities, or the nature of wastes disposed in the landtill could be located. Consequentiy, additional investigation of the nature, extent, and depth of the landtill materials was performed as part of the tield investigations conducted for this RI report.

3 PHYSICAL SETTING

3.1 Topography

The Site topography is mainly flat, sloping gently toward the South Platte River located along the westem boundary of the Site. The Site is located on terraces above the modem-day channel flood plain of the South Platte River.

Site elevations vary from 5,200 feet (ft) above mean sea level (msl) along the northem boundary of the Site to about 5,140 ft above msl within the flood plain of the South Platte River. The flood plain is flat with a slope of 0.25 percent to the northeast.

The surface of the primary terrace portion of the Site generally slopes toward the northwest toward the floodplain with a typical grade of 4%. The edge of the terrace drops off fairiy steeply to the flood plain from about 5,170 ft above msl, with a narrow bench at 5,150 ft above msl. A second, higher terrace is located to the southeast beneath the Forney Transportation Museum property and the commercial properties along Brighton Boulevard.

3.2 Climate

The climate of the Site is typical of Colorado's semi-arid eastem plains. Temperatures are moderate throughout the year, with monthly averages ranging from 30° F in January to 73° F in July.

Annual precipitation totals are approximately 16 inches, 60% of which occurs during the spring and summer months. The rainiest month is May, with an average precipitation of 2.6 inches. Snowfall totals in the Denver Metro area average 60 inches per year with March usually receiving the greatest amount of snowfall (12.5 inches).

The predominant wind direction is from the south with an annual average velocity of 8.5 miles per hour (mph). Peak winds can reach velocities of 30-50 mph with the highest winds tending to be from the north-northwest.

3.3 Surface Water and Drainage

Other than the Platte River, there are no major surface water bodies within the Site area. Drainage in the Site area is largely controlled by man-made features such as ditches, roads, and storm sewers as the majority of the Site is paved or covered by buildings.

3.4 Geology

The Site lies to the east of the Front Range of the Southem Rocky Mountains, in the Colorado Piedmont section of the Great Plains. The sedimentary rocks that underlie the region form an asymmetric, north-south trending structural basin known as the Denver Basin, which is more than 13,000 ft deep at its deepest point below the City of Denver. The uppermost bedrock formation beneath the Site is the Denver Formation, which consists of river and stream channel and overbank deposits deposited in the late Cretaceous and early Tertiary periods. The Denver Formation consists of claystone, shale, and siltstone with silty-sandstone lenses and typically contains approximately 70% claystone and shale and 30% sandstone and siltstone.

The Denver Fonnation is underlain by the Arapahoe Formation at a depth of approximately 200 ft below the Site. The Arapahoe Formation consists of about 40% conglomerate, sandstone and siltstone, and about 60% shale. The Arapahoe Fonnation includes the Arapahoe Aquifer which is the shallowest bedrock aquifer of signiticant yield in the Site area. Underlying the Arapahoe Formation are the Laramie Formation and the Fox Hills Sandstone at depths of approximately 70 and 1,000ft, respectively, beneath the Site. The extensive Pierre Shale Formation is located beneath the Fox Hills Sandstone. Due to its low permeability and thickness of up to 8,000 ft, the Pierre Shale is considered to be the base of the Denver Basin aquifer system.

Most of the bedrock in the Denver area is covered by alluvial and eolian deposits to depths as great as 100 ft. The oldest alluvial deposit still remaining at the Site is the Slocum Alluvium, consisting of cobbles, gravel, and clayey sand deposited in rivers that flowed east during the warming period after the Illinoisan glaciation. Subsequent erosion removed most of the Slocum Alluvium and, at the same time, cut into the Denver Fomation to form the South Platte River drainage system.

3.5 Hydrogeology

The two uppermost principal groundwater systems that underlie the Site are the upper shallow alluvial aquifer and the deeper bedrock Denver Aquifer. The shallow alluvial aquifer is unconfined and generally composed of sand and gravel that contain various amounts of clay and silt. In some areas these coarse-grained materials grade to a tiner material, and clay and silty materials predominate.

The depth to groundwater in alluvial deposits ranges from 10 to 20 ft below groundwater surface in areas of the Site nearest to the South Platte River. Generally, the direction of groundwater flow in the alluvial deposits beneath the Site is from the southeast to the northwest toward the South Platte River at a rate of approximately 20 to 200 ft per year then becoming northeast parallel to the river as the river is approached. The rate of groundwater movement through the alluvial deposits is governed principally by the variable nature of these deposits.

4 SITE INVESTIGATIONS

This section describes previous investigations tirst, followed by a discussion of the Site investigations performed to prepare this Rl pursuant to the AOC. The summary of the prior investigations was previously presented in the Quality Assurance Project Plan (QAPP) prepared for the RI investigations (EMSI, 2008).

4.1 Previous Investigations

Various organizations have conducted tield and laboratory investigations within or in the immediate vicinity of the Site. At least 13 investigations have information available for the Site (Walsh 1996 and 1997; Pepsi, 2001 and 2002; CH_2MHill, 2002a, 2002b, and 2004; EnviroGroup Ltd., 2004, 2005; and CCoD 2000, 2001, 2005, 2006). Table 1 summarizes these investigations.

Some of these studies collected soil and/or groundwater samples within or near the boundaries of the Site. Figure 5 shows the prior sample locations from each of these historical studies. The available laboratory analytical data for soil obtained by these investigations were presented in Attachment A of the QAPP (EMSI, 2008) and are also included along with the results obtained during the Rl investigations in Appendix A. Each of the relevant investigations is described briefly below. An overall summary of the results of the various prior investigations of the Site is presented at the end of this section.

4.1.1 Omaha and Grant Smelter Site, Preliminary Assessment (CDPHE, 1992)

A Preliminary Assessment (PA) was conducted in 1992 by the CDPHE, Hazardous Materials and Waste Management Division to characterize potential onsite wastes, assess their potential for migration, and to detennine potential impacts of the Site to public health and the environment. The PA consisted of a site visit, summary of site history and site characteristics, domestic well survey, completion of a Hazardous Waste Site Identitication form, and preliminary human health and ecological pathway analysis. No environmental samples were collected from the Site as part of this study. However studies performed in the general area of the ASARCO Omaha and Grant Smelter site where environmental samples were collected are summarized in this report.

4.1.2 Initial Site Assessment Update for 1-70 Moditications Washington Avenue to High Street (Walsh, 1996)

As part of planning moditications to Interstate Highway 70 in the vicinity of Washington Street, the Colorado Department of Transportation (CDOT) conducted investigations along 1-70 in the vicinity of the former ASARCO Omaha and Grant smelter facility.

4.1.3 Site Investigation Phase I Constmction 1-70 Moditications North Washington Street to Humboldt Ave. Denver, CO (Walsh, 1997)

This tield investigation expanded on the results of the study listed above. Soil and groundwater samples were collected in an area that is on the north side of the Site.

4.1.4 CCoD Groundwater Sampling of Coliseum Cooling Water Wells

In May of 2000 and 2001 CCoD collected water samples from the four wells that provide cooling water for the Coliseum. Water samples were analyzed for total and dissolved metal constituents. Results of the analyses for these groundwater samples are presented in Appendix F.

4.1.5 OU-1 Remedial Investigation (July 2001)

On behalf of USEPA, Washington Group Intemational prepared a RI Report for OU-1 of the VB/1-70 Superfund Site. OU-1 includes the Off-Facility Soils portion of the VB/I-70 Superfund Site; the residential soils in the neighborhoods adjacent to the fonner ASARCO Omaha & Grant Smelter (OU-2) and Argo Smelter (OU-3).

The OU-1 RI report identitied elevated levels of arsenic and lead in soil that could present human health concems over long term exposures. The RI indicated that the majority of properties have low-levels of arsenic. The RI concluded that occurrences of elevated arsenic levels were randomly distributed within the study area, while the lead concentrations tended to decrease with distance from one or more of the historical smelter locations.

4.1.6 Pepsi Property Investigations (Fall 2001 and March 2002)

Transportation & Industrial Services, Inc. perfonned at least six different investigations to assess the concentrations of arsenic and lead in soils that would be removed as part of the expansion of the Pepsi bottling facility. Soil samples were collected and analyzed to determine the proper disposition of soil excavated from the Pepsi property.

Eighty-two (82) composite samples were collected from various phases of work. These include the following samples and composite sample intervals:

- Twenty (20) composite soil samples were collected from a depth interval of 0 to 2 ft below ground surface (bgs);
- Sixteen (16) samples from an interval of 0 to 3 ft bgs;
- Ten (10) samples from 0 to 6 ft bgs;
- Twenty-tive (25) samples were collected from the interval of 0 to 10 ft bgs; and
- Eleven (11) samples from an interval of 10 to 20 ft bgs.

The sample results showed a wide range of arsenic and lead concentrations. It must be noted that much of this sampling was performed in support of installation of additional underground utility lines at the Pepsi property. No environmental report or documentation are available regarding the amount and extent of contaminated soil that may have been removed, relocated, or left in place as a result of the utility construction work. Consequently, these sample results may not accurately reflect the current conditions at the Pepsi property; however, owing to the lack of any other information, these data are assumed to be representative of the conditions at the Pepsi property for purposes of preparing this RI report, the Human Health Risk Assessment, and the forthcoming Feasibility Study.

4.1.7 Globeville Landing Park Soil Sampling Plan and Results (CH_2MHill, 2002)

In July 2002, soil samples were collected in the Globeville Landing Park to characterize the surface (0 to 2 ft bgs) and subsurface soil (2 to 6 ft bgs) in terms of total arsenic and lead concentrations. The data were used to evaluate potential health risks associated with exposure of workers to arsenic or lead in soil at the park as they perform various maintenance activities. The results were subsequently used by CCoD to obtain a No Further Action Letter from the USEPA for surface soils at the Globeville Landing Park in April 2003.

4.1.8 Denver Coliseum Bam Soils Excavations and Stockpile Summary Report, Final Summary Report (CH_2MHill, 2004)

The presence of slag and brick remnants from the Omaha and Grant Smelter had been identified near the Denver Coliseum during previous maintenance activities by CCoD. Subsurface excavations within the Coliseum bam (located on the west side of the Coliseum proper) to support the stmctural reinforcement of the bam roof penetrated the ham's dirt floor and excavated dark colored soil with evidence of slag and bricks. During excavation, a relatively clear demarcation between bam floor soil and underlying soil from the former smelter was observed. Eight (8) of the excavations at depths of 4 to 5 ft bgs encountered the darker material. The other eight (8) excavations at approximately 2 ft bgs did not encounter the darker material.

Four (4) composite subsurface samples from (4 to 5 ft bgs) were collected together with a grab sample of what appeared to be the most contaminated (darker) material and two (2) surface soil composite samples. Two (2) of the soil samples of the darker material exceeded CCoD's arsenic standard of 16 milligrams per kilogram (mg/kg) for placement of the soil back into the excavation, having concentrations of 17 mg/kg and 24 mg/kg, respectively. All of the eight (8) soil samples had lead concentrations less than CCoD's criterion of 1,460 mg/kg.

A five-point composite soil sample was collected from a soil stockpile of unknown origin that was located on the west side of the Site, but which may have originated from Coliseum operations. The concentrations of all metal constituents were very low in the collected composite soil sample. The arsenic concentration was 2.6 mg/kg and the lead concentration was 38 mg/kg. In comparison with the results from previous soil stockpiles identified near the Denver Coliseum, the soil is most comparable with the soil from Stockpile 2 that was removed in December 2002 (CH_2M Hill, 2002b).

4.1.9 Brighton Boulevard Targeted Browntields Assessment, (URS Operating Services, Inc., April, 2004)

During April and May 2003 and January 2004, URS conducted an USEPA sponsored targeted Browntields investigation of the Brighton Boulevard area for CCoD to help with the redevelopment and revitalization of the Brighton Boulevard corridor. This investigation included collection of soil and groundwater samples along Brighton Boulevard. None of the sample locations were located within the boundaries of the former ASARCO Omaha and Grant smelter facility; however, several samples were located adjacent to the Site boundary. The locations of these samples are provided on Figure 5.

Seventy-tive (75) soil samples were collected from seventy-tive (75) locations for laboratory analyses. Soil samples were obtained from continuous cores from soil borings drilled to groundwater or refusal using either a geoprobe (60 samples) or auger rig (15 samples). The collected cores were logged and screened with a photo-ionization detector (PID) or a flame-ionization detector (FID) for volatile organic compound (VOC) concentrations.

Laboratory soil samples were collected from the top coring interval (0 to 4 ft bgs or 0 to 3 ft bgs) unless visual staining was observed or elevated PID/FID readings were obtained. Laboratory samples for metals analyses were obtained from stained areas and soil samples for VOCs and semi-volatile organic compounds (SVOCs) analyses were collected from areas with elevated PID/FID readings. Most of the laboratory soil samples were collected over the 0 to 4 ft depth interval. In addition, a soil sample for X-ray Fluorescence (XRF) total metal analysis was collected from each boring interval at all boring locations. Laboratory soil samples were analyzed for VOCs, SVOCs, and Target Analyte List (TAL) total metals by USEPA Contract Laboratory (CLP) laboratories and three laboratory soil samples were analyzed for Total Extractable Petroleum Hydrocarbons (TEPH) by the USEPA laboratory.

Inorganic groundwater constituents and the number of occurrences (as shown in parentheses) exceeding federal and state drinking water standards for the particular chemical included: arsenic (56), vanadium (48), manganese (47), iron (43), aluminum (26), and thallium (13). It must be noted however that the groundwater samples were generally collected from open (uncased) boreholes and were not tiltered and as a result turbidity and suspended sediment likely affected the metals concentrations in the samples. As such, the values for the various constituents are judged not to be reflective of in-situ conditions.

Numerous inorganic and organic analytes were detected at levels above USEPA risk-based screening level criteria for soil and groundwater. It was noted that there are numerous potential sources for contamination within and around the Brighton Boulevard area. No attempt was made to attribute contamination to sources due to the numerous potential sources.

4.1.10 EnviroGroup Soil Sampling (December 2004, March 2005, and June 2005)

EnviroGroup, Ltd., under contract to ASARCO collected approximately twenty-seven (27) surface soil samples from the Denver Coliseum property from areas where bare soil is exposed. These samples were obtained from south and east margins of the Denver Coliseum parking lot (4600 Humboldt St.), and at various locations along Brighton Boulevard (3801, 4201, 4301, and 4375 Brighton Boulevard) (Figure 5). The samples were composites of soil samples collected from grids established in each area. The composites were collected from a depth interval of 0 to 2 inches bgs. These samples were analyzed in the laboratory for arsenic and lead.

EnviroGroup, Ltd. also drilled seven (7) soil borings in the Site area (BH-1 through BH-7) and collected surface and subsurface soil samples from these locations. These samples were also analyzed for arsenic and lead. In addition, they installed tive (5) groundwater monitoring wells in the Site area (Figure 6) and collected surface and subsurface soil samples from the borings drilled for the monitoring wells. Analytical laboratory reports are available for the soil samples. These samples were collected as part of initial work towards completion of an RI/Feasibility Study for the Site by ASARCO; however, due to the subsequent ASARCO bankruptcy proceedings, a formal report of the results of these investigations, including presentation of soil boring logs and well construction records, was not completed.

4.1.11 CCoD Sediment, Surface water and Groundwater Sampling (August 2005 through July 2006)

The CCoD with its contractors performed sampling of surface water and sediment at two (2) locations within the South Platte River (Figure 7). These samples were collected from a location that was deemed to be upstream of the Site and from another located downstream of the Site. The samples were collected to assess whether the Site was impacting the South Platte River. Samples were collected on four occasions between November 2005 and July 2006 and were analyzed for a variety of metal constituents. The data demonstrated that there was no significant difference in metals concentrations between upstream and downstream locations.

CCoD also sampled the tive (5) groundwater monitoring wells that are located on or upgradient of the Site (Figure 6). The wells were installed by EnviroGroup, Ltd., but were sampled by CCoD. The samples were analyzed for both total and dissolved metal constituents. The samples from well MW-2 had dissolved arsenic concentrations that exceeded the federal and state drinking water standard of 0.010 milligram per liter (mg/L). The values varied from 0.063 to 0.15 mg/L. Groundwater sample results from the other wells and for other constituents in samples from well MW-2 did not exceed their respective drinking water standards.

4.1.12 Summary of the Results of Prior Environmental Sampling

At least 13 investigations have information available for the Site (Walsh 1996 and 1997; Pepsi, 2001 and 2002; CH2MHill, 2002a, 2002b, and 2004; EnviroGroup Ltd., 2004, 2005; and CCoD 2000, 2001, 2005, 2006).

Eleven (11) soil samples were obtained on the north side of the Site (Walsh, 1996 & 1997). Soil borings drilled for collection of these samples identitied the presence of black till consisting of coal, coal ash, coal dust, smelter slag; brick, concrete and asphalt fragments; metal, glass, and porcelain fragments; wood and trash consisting of plastic, wood, glass, msted metal, and porcelain fragments with lesser amounts of sand and gravel. The black till material reportedly contained some oily hydrocarbons and exuded an offensive, foul odor which did not register on a combustible gas indicator or PID. Analytical results for these soil samples contained elevated levels of zinc, copper, lead, mercury and in one sample, cadmium. The samples also contained polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbons (TPH).

Eighty-two (82) soil samples were collected from a variety of sample locations at the Pepsi Bottling facility which is located in the southem portion of the former ASARCO Omaha and Grant Smelter site. Laboratory analyses of the soil samples identified elevated levels of arsenic and lead in surface and subsurface soil. The collected soil samples were used to guide the management of materials excavated in conjunction with underground utility installations.

Thirty seven (37) surface soil and ten (10) subsurface soil samples were collected by EnviroGroup, Ltd., on behalf of ASARCO, from OU-2. These samples were analyzed for arsenic and lead. Laboratory reports of the sample results are available; however, an interpretive report including presentation of soil boring logs and well constrnction records was never prepared.

Approximately sixty-seven (67) soil samples were collected from CCoD's Globeville Landing Park (CH_2MHill, 2002a). Analytical results for these samples indicated the presence of arsenic at background levels and lead at levels below the risk-based screening level of 500 mg/Kg established by EPA. The collected samples were subsequentiy used to obtain a No Further Action Detennination from the USEPA with respect to surface soil (USEPA, April 2003).

Seventy-tive (75) soil core samples were collected from seventy-tive (75) locations as part of EPA's Targeted Brownfield study of the Brighton Boulevard area including soil samples collected from the top coring interval (0 to 4 ft bgs or 0 to 3 ft bgs). These samples were analyzed for VOCs, SVOCs and TAL metals by USEPA CLP laboratories and three laboratory soil samples were analyzed for TEPH by the USEPA laboratory. All of these samples reportedly contained arsenic at concentrations greater than USEPA risk-based soil screening levels for residential land use and most of the samples contained levels of arsenic above USEPA industrial use risk-based soil screening levels.

Twenty (20) soil samples were collected from two (2) soil stockpiles of unknown origin located between the Denver Coliseum West Parking lot and Globeville Landing Park (CH_2MHill 2002b). Due to the unknown origin of these stockpiles, these samples do not provide adequate infonnation to make decisions about surface or subsurface soils at the Site.

One 5-point composite soil sample was collected from a soil stockpile of unknown origin located west of the Denver Coliseum (CH_2MHill 2004). Due to the unknown origin of this stockpile, the sample does not provide adequate information to make decisions about surface or subsurface soils at the Site.

Eight (8) soil samples were collected from strnctural excavations within the Denver Coliseum West bam which is within the boundaries of the former Omaha and Grant Smelter site (CH_2MHill, 2004). Information from this study indicates that soils beneath till materials may exhibit elevated levels of arsenic and lead.

At least eight (8) groundwater samples have been collected from the Coliseum cooling water wells. Analyses of these samples have not identified the presence of elevated levels of trace metals in groundwater.

The five (5) groundwater monitoring wells (3 that are upgradient and 2 within the Site boundary) have been sampled on at least four (4) occasions. Wells MW-2 and MW-3 (located within the Site) were also sampled in August 2005. With the exception of well MW-2, that showed elevated levels of arsenic, none of the groundwater sample results obtained from these wells displayed elevated levels of trace metals.

Surface water and sediment samples were collected by CCoD at two (2) locations in the South Platte River. Samples were collected on at least four (4) occasions. Elevated levels of trace metals were not found in any of these samples.

As part of the preparation of the *Quality Assurance Project Plan (QAPP)/Work Plan, and Sampling and Analysis Plan (SAP)* (EMSI, 2008) for the Site sampling activities conducted to prepare this RI, the chemical data for arsenic and lead in soil in the Site area that were developed by these various studies were reviewed. These data were assessed with respect to the usability of the data for completion of the RI and preparation of the BRA. Although complete laboratory data packages were not available for review, the data were determined to be acceptable for use in the RI as they were collected in accordance with documented plans and/or procedures and for the most part using EPA-approved analytical methods. Although the analytical reporting limits obtained by the various investigations did vary, most of the results are reported as detects and therefore should be suitable for use in the RI and BRA. Data obtained from the Brighton Boulevard studies using XRF methods instead of EPA SW-846 methods were not considered during the evaluation of the number of additional samples that may be required to complete the RI.

4.1.13 Draft Baseline Human Health and Screening Level Ecological Risk Assessment

A Draft Baseline Human Health and Screening Level Ecological Risk Assessment for VB/I-70 Site, OU-2 was previously prepared by EPA (October 2006). Based on the results of the draft risk assessment and a review of the data listed above, the risk assessors identified surface and subsurface soil as the potential media of concern and arsenic and lead as the potential chemicals of concern. Due to the limited occurrences of trace metals in groundwater and the lack of use of shallow groundwater for domestic supply in the area, groundwater was not found to be a media of concern. An updated BRA that considers the additional data obtained as part of the field investigations performed for the RI has been prepared separately by EPA

4.2 RI Field Investigations and Sampling

Field sampling activities for the RI entailed collection of shallow surface and subsurface soil samples in accordance with the *QAPP/Work Plan, and Sampling and Analysis Plan (SAP)* (EMSI, September, 2008). Additional data needs were identitied through consultation with the EPA's risk assessment team and are documented in the QAPP/Work Plan/SAP.

Based on the current and potential future land uses of the Site, four (4) areal exposure units (EUs) were identified (Figure 8). As described in the QAPP/Work Plan/SAP, the rationale for selecting the sampling locations was to obtain spatially distributed samples from each EU to augment the available data. Selection of additional sampling locations was predicated on the locations of the previously collected environmental samples and a requirement to have approximately ten (10) surface and ten (10) subsurface samples for each EU. As USEPA had previously issued a No Further Action Determination for the Globeville Landing Park, no additional sampling was conducted in the park.

The RI field work consisted of drilling and coring sixteen (16) soil borings and collection of soil samples for laboratory analyses. Field work was performed on December 17 and December 18, 2008.

Figure 9 illustrates the locations of the sixteen (16) borings drilled as part of the RI field investigations. Two (2) borings (SS-3-1 and SS-3-2) were drilled for the collection of surface soil samples immediately underlying the asphalt and road base. The borings extended 12 inches into the underlying surface soil to effectively sample between 12 and 24 inches bgs. The remaining fourteen (14) locations were boreholes drilled to minimum depths of 14 ft. A minimum of two (2) samples (one sample from at least two discrete depths) were collected from each subsurface soil boring.

It should be noted that the QAPP/Work Plan/SAP required soil sampling from only fifteen (15) locations. An additional subsurface boring was added at the northwestern corner of the EU-3 (boring SB-3-5) at the request of a prospective lessee to better characterize subsurface conditions in this area.

All surface and sub-surface soil samples were visually characterized and analyzed for arsenic and lead. In addition, samples that exhibited staining or indications of hazardous substances were sampled for VOCs, SVOCs and the Resource Conservation and Recovery Act (RCRA) list of eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver).

Standard Operating Procedures detailed in the SAP were followed throughout the investigation. An overview of the field program and clarification of operating procedures that may have deviated from the prescribed standard operating procedures are presented in the following subsections.

4.2.1 Borehole Drilling Program

Prior to drilling, the locations of all of the additional boreholes were surveyed and marked in the field by a Colorado Licensed Surveyor from Foresight West. Each boring location was subsequently cleared for utilities prior to drilling in accordance with the SAP. Site Services, Inc. of Arvada, Colorado then mobilized a hollow-stem auger rig equipped with a 5-foot long core barrel to collect continuous samples.

A specialized asphalt drilling bit was used to advance through the asphalt and road base. Then the hollow-stem augers were advanced with the continuous core barrel. For the surface samples, the core barrel was advanced to approximately 24 inches bgs and retracted. For the sub-surface samples, the first core typically extended from immediately beneath the asphalt road base to a depth of approximately 4 feet bgs. The second core typically extended between 4 feet and 9 feet bgs. Subsequent cores were collected from approximately five-foot depth intervals until undisturbed soil or bedrock underlying fill material was encountered.

Soil samples were collected from the core obtained from each boring. Table 2 presents a summary of the boring locations, sample depths, analytical program and other information for each soil sample collected during the RI field investigations.

Samples were identified and numbered using a four-part system that consisted of the following:

- Type of sample (SS is Surface Soil and SB is Soil Boring);
- EU Number
- Borehole Number
- Sample Depth Interval (SS is surface sample collected from soil immediately underlying the road base and the numeric range is the depth interval of sub-surface sample in feet)

For example, SB-2-4-SS is the surface sample obtained from the fourth boring in EU-2. Another example is SB-4-1-12-14 which represents the soil sample obtained from the 12 to 14 ft depth interval bgs from the first boring drilled in EU- 4. A field duplicate sample was identified by adding a "1" to the front of the EU number. For example, SB-14-1-12-14 is a duplicate of the previous example.

Borehole cuttings and core samples retrieved at the surface were logged using ASTM Standard Practice for Description and Visual Identification of Soils (Visual-Manual Procedure) (ASTM D 2488-06) with the resultant soil descriptions recorded on the borehole geologic logs. Geologic interpretations and observations such as oxide staining, type of fill material encountered, discoloration, odor, presence of groundwater, PID or FID readings and core recovery were also noted on the logs. Copies of the borehole logs are presented in Appendix B. As noted on the logs, PID or FID readings could not be obtained from several of the borings due to instrument difficulties caused by lengthy calibration durations or battery problems believed to be attributable to low ambient temperatures. However, all samples were monitored for odors and results were recorded on the logs.

Following extraction and logging, soil cores were placed into core boxes, labeled and transported to a locked storage facility located adjacent to the northern entrance to the

Coliseum. The boxes were then loaded into the storage facility for future reference. Access to the storage facility may be obtained by contacting CCoD Coliseum personnel.

Following completion of each borehole, the borings were backfilled with bentonite chips in 4-foot lifts and hydrated with water. The top two feet of the borehole below the asphalt were backfilled with coarse sand. From there to the ground surface, the borehole was backfilled with a cold-tar latex asphalt patch. The vertical elevation and horizontal position of the new boring and the boring locations that were moved (to avoid utilities) after the original survey was completed were resurveyed by a surveyor licensed in Colorado. Survey results are included in Appendix B.

4.2.2 Analytical Program

All of the collected samples were packaged, and delivered to Test America Analytical in Arvada, Colorado in accordance with the methods specified in the SAP. Soils were analyzed (including moisture content) by the following methods:

Media	Analysis	Analytical Method
Soil (all samples)	Total arsenic and lead	SW-846 6020B
Soil (samples from landfill materials)	VOCs	SW-846 8260B
Soil (samples from landfill materials)	SVOCs, PAHs	SW-846 8270C
Soil (samples from landfill materials)	8 RCRA Metals	SW-846 6010B

Analytical laboratory reports and chain of custody records are contained in Appendix C.

4.2.3 Data Quality

Results of the laboratory analyses were subjected to Level III data validation as specified in the QAPP/Work Plan/SAP. Data validation was performed by a CCoD staff chemist. Results of the data validation are summarized in data validation reports that are included in Appendix D. Based on the data validation, all of the analytical results are suitable for the intended use as qualified by the analytical laboratory and the data validation process.

One error was identified in the sampling idenfification numbers. The surface soil sample obtained from location SS-3-2 in the parking lot of the Denver Coliseum was correcfiy idenfified on the chain-of-custody form as SS-3-2-SS; however, in the laboratory report this sample is identified as SB-3-2-SS. There was no surface soil sample collected from soil boring SB-3-2 and the fime of sample collection is inconsistent with collecfion of the other samples obtained from boring SB- 3-2. Either the sample identificafion was incorrectly entered or transcribed by the analytical laboratory or it was incorrectly identified on the sample container label in the field and the analytical laboratory reported the sample identification as shown on the sample container label and not as shown on the chain-of-custody form. Either way, the sample result reported by the analytical laboratory as SB-3-2-SS should actually be SS-3-2-SS.

5 NATURE AND EXTENT OF CONTAMINATION

This section of the report discusses the results of the soil sample analyses obtained during the RI in combinafion with the prior sample results to describe the nature and extent of contamination. This section is divided into two separate discussions. The first part this section describes the nature and extent of arsenic and lead occurrences in surface and subsurface soil. This is followed by discussions of the prior analytical results for surface water, sediment and groundwater samples obtained at or in the immediate vicinity of the Site. The last part of this secfion discusses of the nature and extent of landfill materials and the arsenic, lead, eight RCRA metals, VOC and SVOC results from soil samples idenfified in the field as being contained within or located immediately below landfill materials.

5.1 Arsenic and Lead in Surface and Subsurface Soil

As described in the QAPP/Work Plan/SAP, USEPA identified arsenic and lead as the primary chemicals of concem and surface soil and subsurface soil as the primary media of concern.

5.1.1 Surface Soil

Based on discussions with USEPA's risk assessors, surface soil was defined to be soil located from the ground surface to a depth of 12inches or for areas covered by pavement, the uppennost 12 inches of soil presented beneath the pavement and any associated base course material. As the prior investigations may not have collected samples exclusively from the uppennost 12 inches of native soil, results obtained from the uppermost samples obtained by these investigafions (e.g., samples obtained from the 0 – 2 ft depth) were treated as surface soil samples. In instances where only composite samples that included the uppennost 12 inches plus a substantial amount of subsurface soil (e.g., composite sample from a 0 – 10 ft interval) were collected, results for these samples are plotted and discussed as both surface and subsurface soil samples.

As the occurrences of arsenic and lead at concentrations greater than background levels are localized and discontinuous, the results cannot be described in terms of broad areas of contaminafion but only as isolated areas of discrete occurrences of arsenic and lead above background levels. Consequently, occurrences of arsenic and lead discussed below are described on a property-by-property basis.

Arsenic and lead analytical results obtained during the RI investigations combined with the results obtained during prior investigations for surface soil samples collected in the OU-2 area are presented on Figures 10 and 11 respectively. Samples with arsenic or lead concentrations greater than the background soil levels, 15 mg/Kg or parts per million (ppm) for arsenic and 400 mg/Kg for lead, are highlighted in red on these figures.

Review of these data results in the following conclusions regarding occurrences of arsenic or lead in surface soil at concentrations greater than background (15 mg/Kg for arsenic and 400 mg/Kg for lead):

- CCoD Property (Denver Coliseum):
  - Unpaved strip along the southeast side of the parking lot (adjacent to the Forney Transportafion Museum property contains both arsenic (16, 17 and 52 mg/Kg) and lead (460 mg/Kg) concentrafions greater than background levels;
  - Unpaved strip along the west side of the parking lot (adjacent to the Globeville Landing Park) contains arsenic (27 and 46 mg/Kg) concentrations greater than the background level; and
  - Surface soil sample obtained from boring SB- 4-5 located in Arkins Court south of the southem entrance/exit to the Coliseum parking lot contained arsenic (22 mg/Kg) above the background level.

- Fomey Transportation Museum property:
  - Arsenic or lead occurrences at concentrations above background levels were only found to be present in surface soil within the bare ground area along the slope on the west and north sides of this property.

- Union Pacific/Witulski properties:
  - Unpaved area between the northwest side of the building on the Witulski property and the southeast side of the Union Pacific rail spur (exact location of the subject property relative to the boundaries of the Union Pacific and Witulski parcels is uncertain) contains arsenic (23 mg/Kg) and lead (470 mg/Kg) concentrations greater than background levels.

- Morales property:
  - Surface soil sample collected from boring BH-7 contained arsenic (510 mg/Kg) and lead (15,000 mg/Kg) levels greater than background; and
  - Sample BB-BB-37 collected along Brighton Boulevard, in front of the Morales property, contained lead (576 mg/Kg) at a concentration above the background level, (Note: the arsenic results for this sample were non- detect; however, the detection limit of 56 mg/Kg was greater than the background value).

- Rossi property:
  - Based on the results obtained from soil boring SB- 2-4, no occurrences of arsenic or lead at levels greater than background were detected in

surface soil at this property; however, surface soil sample BB-BB-35 collected along Brighton Boulevard, in front of the Rossi property, contained lead (4,086 mg/Kg) above the background level, (Note: arsenic result was non-detect but the detection limit of 409 mg/Kg for this sample greatly exceeded the background level).

- Hunt property:
  - Several surface soil samples were collected from this property that contained arsenic (34, 36, 48, 86, and 270 mg/Kg) and lead (540, 880, 1,300, 1,600, and 34,000 mg/Kg) concentrations greater than background; and
  - Surface soil samples BB-BB-33 and BB-BB-34 collected along Brighton Boulevard, in front of the Hunt property, contained lead (774 and 2,836 mg/Kg) above the background level, (Note: arsenic results for these samples were non-detect but the detection limits for these samples exceeded the background level).

- Pepsi Bottling Company property:
  - Both arsenic and lead were detected at concentrations (up to 630 and 2,800 mg/Kg for arsenic and lead respectively) greater than the background levels in numerous surface soil samples;
  - It must be noted that many of the samples collected from this property were composites from depth intervals that included both surface soil and underlying soil such as samples from the 0 to 2 ft bgs depth interval or 0 to 10 ft bgs depth interval. Due to the lack of samples obtained only from the 0 to 1 ft (surface sample) depth interval for most of the Pepsi properties, these samples have been considered as both surface and subsurface samples for purposes of this RI. True surface soil samples were collected from portions of the Pepsi property and also contained arsenic and lead (at levels up to 94 and 790 ug/Kg, respectively) at concentrations greater than the background levels; and
  - Soil samples obtained from the Pepsi property were collected during installation of subsurface utilities and other work at this property and as such some of the soil may have been removed from the property.

- Globeville Landing Park:
  - Arsenic was not detected at concentrations greater than the background level in any of the surface soil samples (or the subsurface soil samples) obtained from this property; and
  - Lead was not detected at concentrations greater than the background level in any of the surface soil samples.

5.1.2 Subsurface Soil

Arsenic analytical results obtained during the RI investigations combined with the results obtained during prior investigations for subsurface soil samples collected in the Site area are presented on Figures 12 and 13 for the 5- 10 ft and greater than 10 ft depth samples, respectively. Lead analytical results for subsurface soil samples are presented on Figures 14 and 15. Sample results with arsenic or lead concentrations greater than the background levels, 15 mg/Kg for arsenic and 400 mg/Kg for lead are highlighted in red on these figures.

Review of these data results in the following conclusions regarding occurrences of arsenic or lead in subsurface soil at concentrations greater than background (15 mg/Kg for arsenic and 400 mg/Kg for lead):

- CCoD Property (Denver Coliseum):
  - Two (2) of the four (4) soil borings drilled along the south side of the Coliseum bam contained arsenic (17 and 24 mg/Kg) at concentrations greater than the background level;
  - Subsurface soil samples obtained beneath 1-70 and beneath the northem portion of the parking lot (boring TH-2, from borings drilled for monitoring wells MW-2 and MW-3 and from soil boring SB- 3-1) contained isolated depth intervals with arsenic concentrations (maximum of 96 mg/Kg) and lead concentrations (maximum of 3600 mg/Kg) greater than the background levels;
  - Subsurface soil samples obtained from the central portion of the parking lot (from borings BH-2 and SB- 4-3) contained arsenic concentrations (up to 48 mg/Kg) greater than the background level throughout the soil column (BH-2) or in discrete (22 - 24 ft bgs) intervals (SB- 4-3) and lead was also found in discrete depth intervals at concentrations (up to 1400 mg/Kg) greater than the background level; and
  - Soil from the 8 - 9 ft bgs depth interval along Arkins Court (boring SB 4-5) contained arsenic (22 mg/Kg) and lead (780 mg/Kg) above the background levels.

- Fomey Transportation Museum property:
  - No occurrences of arsenic or lead above background levels were found to be present in subsurface soil on this property.

- Union Pacific/Witulski properties:
  - No subsurface soil samples have been obtained from this property.

- Morales property:
  - The shallow (1.5 to 1.8 ft bgs) subsurface soil sample obtained from boring BH-7 contained arsenic (17 mg/Kg) at a concentration slightly above the background level; and
  - Lead and arsenic were not detected in subsurface soil samples obtained from boring BB-BB-37 along Brighton Boulevard, in front of the Morales property, at concentrations above the background level, (Note: the arsenic results for these samples were non- detect; however, the detection limit [56 mg/Kg] was greater than the background value).

- Rossi property:
  - Based on the results obtained from soil boring SB 2-4, no occurrences of arsenic or lead at levels greater than background were detected in subsurface soil at this property; and
  - Subsurface soil samples obtained from boring BB-BB-35 located along Brighton Boulevard, in front of the Rossi property, also did not contain arsenic or lead at concentrations above the background levels, (Note: arsenic results were non-detect but the detection limits for these samples exceeded the background level).

- Hunt property:
  - Neither arsenic nor lead was detected at concentrations greater than the background levels in subsurface soil samples collected from this property; and
  - Subsurface soil samples obtained from borings BB-BB-33 and BB-BB-34 located along Brighton Boulevard, in front of the Hunt property, did not contain either arsenic or lead at concentrations above the background level, (Note: arsenic results for these samples were non-detect but the detection limits of 70 mg/Kg for these samples exceeded the background level).

- Pepsi Bottling Company property:
  - Both arsenic and lead were detected in subsurface soil at concentrations greater than the background levels in numerous discrete subsurface samples as well as in samples that included composites of soil beginning at the ground surface and extending into the subsurface;
  - As previously noted, many of the samples collected from this property were composites from depth intervals that included both surface soil and underlying soil such as samples from the 0 to 2 ft bgs depth interval or 0 to 10 ft bgs depth interval;
  - The highest arsenic (1,500 mg/Kg) and lead (100,000 mg/Kg) concentrations detected on the Site were obtained from the 14 ft depth in boring BH-3 located in the northem portion of the Pepsi property; and

  - As previously noted, the soil sample results obtained from the Pepsi property were collected during installation of subsurface utilities and other work at this property and as such some of the soil may have been removed from the property.

- Globeville Landing Park:
  - Arsenic was not detected at concentrations greater than the background level in any of the subsurface soil samples (or the surface soil samples); and
  - Lead was detected in two (2) shallow (2-3 ft bgs) subsurface soil samples at concentrations greater than the background level and in one deeper sample (19 ft interval in the boring drilled for monitoring well MW-1) at concentrations greater than the background level.

5.1.3 Occurrences of Other Trace Metals in Surface and Subsurface Soil

Based on the results of previous sampling, arsenic and lead were identitied as the chemicals of concern for the Site. As a result, sample collection and analyses perfonned for the RI were focused on arsenic and lead only. Prior sampling had also been performed for cadmium and zinc. Results of the prior sampling for these metals are summarized below.

<u>Cadmium</u>

Cadmium results for surface soil samples collected during the previous investigations are presented on Figure 16. Cadmium results for subsurface samples are presented on Figures 17 and 18.

None of the previously collected soil samples contained cadmium at concentrations greater than the 810 mg/Kg level for commercial (worker) land use established by Colorado Soil Evaluation Values (CSEV) (CDPHE, 2007). Soil samples obtained from the 0 – 5 ft depth interval from boring BH-06 exceeded the CSEV residential use criterion for cadmium of 70 mg/Kg. Soil samples exceeding the residential use criterion were also obtained near or within the Pepsi Bottling plant property at depths greater than 10 ft bgs (Figure 18).

Soil samples obtained at various depths from borings along Brighton Boulevard potentially contain cadmium concentrations in excess of the residential criterion of 70 mg/Kg (Figures 16, 17 and 18). The purported exceedences of the residential use criterion along Brighton Boulevard shown on these tigures are due entirely to the high detection limits of the XRF analyses. All of the XRF results for cadmium obtained along Brighton Boulevard were reported as non-detect. The detection limits achieved by the XRF method were either 172 or 207 mg/Kg, both of which exceed the residential use criterion for cadmium. In reviewing the laboratory data (Appendix A), the cadmium concentrations measured in the laboratory do not exceed the residential use criterion. Thus, the cadmium concentrations denoted in red along Brighton Boulevard, that are based on XRF detection limit data, are not considered to be representative of actual conditions as the laboratory data do not indicate that the residential use criterion were exceeded in the area along Brighton Boulevard.

Zinc

The CSEV residential use criterion for zinc is 23,000 mg/Kg. Based upon a comparison of the zinc results to the CSEV residential use criterion, zinc does not appear to be an element of concern at the Site. The only soil sample that exceeded the residential use criterion was the sample obtained from boring TH-2 located beneath Interstate 70 (Figures 19 - 21). The available information does not specify the depth interval associated with this sample.

5.1.4 Volume of Soil Containing Arsenic and Lead Above Background Levels

The volume of soil containing arsenic and/or lead at concentrations greater than the background level was estimated by depth layers (e.g., 0 to 5 ft, 5 to 10 ft, and greater than 10 ft) for both arsenic and lead. The depth intervals were assigned a thickness of 5ft or in the case of the interval greater than 10 ft, a thickness of 20 ft.

Soil volumes within each layer were estimated using Geographic Information System software through development of Thiessen polygons around each soil sample and soil boring location. Thiessen polygons are polygons whose boundaries define the areas closest to each sample point relative to all other sample points. They are mathematically detined by the perpendicular bisectors of the lines between all points. The Thiessen polygons used for estimation of the soil volumes along with a summary table of the soil volumes associated with each polygon are presented in Appendix E.

In cases where areal samples of surface soil (as opposed to point location samples) had previously been collected, the areal extent of the surface soil samples were also considered. Areas associated with these samples are shown using a separate color on the tigures in Appendix E. For areal surface soil samples that were above background and were located outside of Thiessen polygons containing point samples with arsenic or lead concentrations above background, the areas of these samples were treated separately. For area samples that were included in or cut across Thiessen polygons, the Thiessen polygons were split by the areal surface sample areas and the remaining pieces of the polygons were merged back into one polygon to avoid double counting volumes.

The estimated volumes of soil containing arsenic at concentrations greater than background (15 mg/Kg) were as follows (Appendix E):

Depth Interval (ft)	Soil Volume (cubic yards)
0 – 5	175,235
5 – 10	96,373
10 - 20	116,104
Total Volume	387,712

The estimated volumes of soil containing lead at concentrations greater than background (400 mg/Kg) were as follows (Appendix E):

Depth Interval (ft)	Soil Volume (cubic yards)
0 – 5	131,116
5 – 10	40,793
10 - 20	86,990
Total Volume	258,899

To arrive at the total volume of soil containing arsenic or lead at concentrations greater than background, the extent of the arsenic polygons was compared to the extent of the lead polygons for each depth interval (Appendix E). Overall, most of the areas containing lead at concentrations above background are coincident with areas containing arsenic at concentrations above background although there are some areas that only contain lead above background. Areas that contain lead above background that were not coincident with the areas containing arsenic above background were idenfified in each soil layer. The volume of soil containing lead but not arsenic above background levels was esfimated to be 22,281 cubic yards. The total volume of soil containing lead but not arsenic above background levels was then added to the total volume of soil containing arsenic above background. The net result is an overall total volume of soil above background for both arsenic or lead of approximately 410,000 cubic yards.

5.2 Groundwater

Groundwater samples were collected from the five monitoring wells located within or near the Site, from the four (4) cooling water supply wells at the Denver Coliseum, and from open boreholes drilled as part of the Brighton Boulevard Brownfield investigation (URS, 2004). Analytical results for these samples are summarized in Appendix F-1.

Figures 22 through 26 are plots of concentrations of arsenic, lead, cadmium, copper and zinc, respectively, as measured in the tive (5) groundwater monitoring wells located within and near the Site. Groundwater analyses are also posted for samples collected from temporary monitoring wells that were installed by Walsh Consultants under contract to the Colorado Department of Transportation and samples collected from the four (4) cooling wells that are located around the Denver Coliseum. The analyses from the samples collected from the open soil borings located along Brighton Boulevard were not plotted because they were one-time samples collected from open (uncased) boreholes. The "total" analyses for water samples collected from open boreholes are generally not indicative of in-situ conditions due to the turbid nature of the samples resulting in the presence of extensive amounts of suspended sediment in the water samples.

The presumed direction of groundwater flow is from southeast to northwest with groundwater discharging to the South Platte River. The tive (5) permanent groundwater monitoring wells (MW-1 through MW-3, MW-5 and MW-6) have not been surveyed; however, Walsh Consultants did survey several of their temporary wells and calculated that the groundwater flow direction is towards the northwest.

Based on the presumed groundwater flow direction towards the northwest, monitoring wells MW-5 and MW-6 are upgradient of the Site and the remaining wells are downgradient. The only constituent that exceeds its respective federal and state drinking water standard is arsenic as measured in monitoring well MW-2. Both the dissolved and total arsenic concentrations in samples from this well exceeded the federal and state drinking-water standard of 0.010 mg/Kg. The tirst dissolved water sample from well MW-3 exceeded the federal and state drinking water standard for arsenic, but results of subsequent sampling events indicated that the dissolved arsenic concentrations in this monitoring well were all below the drinking water standard.

Arsenic in groundwater does not appear to be a widespread issue as evidenced by its presence at elevated concentrations in only one well (MW-2). The water samples from the Coliseum cooling wells indicate that arsenic and the other trace metals do not exceed federal or state drinking water standards in water samples obtained from these wells. Data from these wells are more representative of groundwater conditions because they reflect water obtained from a properly developed water-supply well that integrates water from a larger portion of the aquifer rather than what is likely a more turbid (higher level of suspended sediment) sample obtained from a groundwater monitoring well (MW-2) that was never properly developed. Additional soil borings were drilled and soil samples collected in the vicinity of well MW-2; however, highly elevated levels of arsenic, indicative of a possible localized area of higher concentrations of arsenic in soil (e.g., a "hot spot") were not found in these borings. Consequently, the higher levels of arsenic detected in well MW-2 appear to be an anomaly. None of the other monitoring wells detected the presence of elevated levels of arsenic in groundwater and elevated levels of arsenic were not detected in any of the surface water samples obtained from the nearby South Platte River. As discussed above, the higher arsenic levels detected in well MW-2 appear to be the result of the lack of proper development of this well at the time it was installed.

5.3 Surface Water

Prior sampling included two (2) sampling locations for surface water and sediment along the South Platte River. One location (N43) is upstream of the Site and the other (N46) is downstream of the Site (Figure 7). Analytical results for the surface water samples collected during the prior investigations are presented in Appendix F-2. Results of the surface water sample analyses were evaluated by comparing trace metal results obtained from samples collected upstream (N43) and downstream (N46) of the Site rather than against health-based or regulatory criteria. Surface water data collected at these two locations also indicate no signiticant differences in concentrations of trace metals upstream and downstream of the Site.

5.4 Sediment

Sediment samples were obtained from the South Platte River during prior investigations. Samples were collected upstream (N43) and downstream (N46) of the Site (Figure 7). A summary of the analytical laboratory results for these samples is presented in Appendix F-3.

Results of the sediment sample analyses were evaluated by comparing trace metal results obtained from samples collected upstream (N43) and downstream (N46) of the Site rather than against health-based or regulatory criteria. A review of the sediment data collected at these two locations indicates no significant difference between the concentrations upstream versus downstream. In summary, the data indicate that the Site is not impacting the concentrations of trace metals (arsenic, lead, cadmium, zinc) in sediments in the South Platte River.

5.5 Landtill Material

As previously discussed, prior to construction of the Denver Coliseum, the area of the Denver Coliseum parking lots was used as a landfill for disposal of municipal solid wastes. Characterization of the nature and extent of the buried solid wastes along with assessment of chemical migration, if any, from the solid wastes was determined to be a data need for the RI.

5.5.1 Nature, Occurrence and Volume of Landfilled Wastes

Soil borings located within the areas of known or suspected solid waste occurrences were drilled below the 10 ft target depth for the arsenic and lead characterization to determine if solid wastes were present in these areas. Where solid wastes were encountered, the soil borings extended at least through the base of the solid waste materials. If solid wastes were not encountered, soil borings in these areas were extended to bedrock or auger refusal.

Subsurface material encountered in the soil borings typically consisted of alluvial soils without evidence of disturbance; alluvial soils mixed with brick fragments and/or fly ash; and/or alluvial soils mixed with brick fragments, fly ash, woody debris, and municipal solid waste. For delineation purposes, the latter mixture was identified as "landfill" material. Landfill materials were idenfified as being present beneath EU-3 and EU-4 in the area of the Denver Coliseum parking lot. Subsurface material encountered in EU 2 was predominantly undisturbed alluvial soils, or in the case of boring SB-2-3, located in the eastem half of the Fomey Museum property, brick and mortar down to 17.5 ft, underlain by silty gravel.

The areal extent of "landfill" material beneath EU-3 and -4 is illustrated on Figure 27. The extent of landfill material is inferred based on subsurface data collected during drilling, on the undulating surface topography of the parking lot and perimeter roads surrounding the parking lot, and on land topography immediately south and east of the CCoD property. Specifically, the northem, northeastem, and westem boundaries were based on an absence of landfill material encountered in these areas, and on relatively uniform surface topography observed outside of the inferred boundary of the extent of landfill material occurrences in these areas. The southem and eastem boundaries were established based on the southem and eastem limits of the undulafing surface of the CCoD property where the land surface meets the toe of the Pepsi Bottling Company parking lot embankment. The northwestern extension of this intersection completes the boundary to Arkins Court.

The thickness of the "landfill" material beneath EU- 3 and -4 is also illustrated on Figure 20. It is based on the thickness of the "landfill" material encountered during drilling, and on the inferred perimeter discussed above. Measured landfill thicknesses ranged from 2 to 16 ft and were encountered down to a maximum depth of 22 ft bgs in boring SB-4-3. Landfill thickness isopleths were then interpolated using a kriging model.

The surface area and thicknesses were then combined using AutoCad Civil 3D to compute the total volume of "landfill" material. This approach resulted in a total volume of approximately 198,000 cubic yards of landfill wastes beneath the Site.

5.5.2 Chemical Occurrences in Landfill Wastes

Samples of soil material contained within the landfill wastes or present immediately beneath landfill wastes were collected and submitted for laboratory analyses. Samples of soil located within or below landfill materials that were collected during the RI included the following six samples:

- SB- 3-2 from the 4 to 9 ft depth interval
- SB- 3-4 from the 14 to 15 ft depth interval
- SB- 3-5 from the 10 to 15 ft depth interval
- SB- 4-2 from the 12 to 14 ft depth interval
- SB- 4-3 from the 22 to24 ft depth interval
- SB- 4-4 from the 23 to 24.5 ft depth interval

These samples were analyzed for VOCs, PAHs, and the eight RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver).

Results of the laboratory analyses indicated most of the samples were non-detect for organic compounds. There were some limited, low concentration detections of common laboratory contaminants such as acetone, 2-butanone, methylene chloride and other compounds found to be present in the laboratory blanks that were also reported in several of the samples. Other than arsenic and lead, trace metals were detected only at low levels (less than the CSEV criteria for either residential use or worker exposures) in these samples.

Three of the samples contained organic chemicals beyond the common laboratory contaminants or other compounds detected in the laboratory blank samples. Pyrene was reported to be present at an estimated concentration of 27 ug/Kg in the sample obtained from the 22 to 24 ft depth interval bgs from boring SB 4-3. Pyrene was also detected, along with a low levels of 1,2,4-trimethyl benzene (1.1 J ug/Kg [results qualified with a "J" qualifier represent estimated concentrations]) and tetrachloroethene (0.89 J ug/Kg) in the 10 to 15 depth interval bgs sample obtained from boring SB 3-5. The largest number of chemical occurrences and the highest concentrations detected in all of the samples were found in the 12 to 14 ft depth interval bgs sample obtained from boring SB 4-2. This sample contained numerous hydrocarbon-related compounds including the following:

- 1,2,4-Trichlorobenzene 84 J ug/Kg
- 1,2,4-Trimethylbenzene 6,400 ug/Kg
- 1,3,5-Trimethylbenzene 2,800 ug/Kg
- 2-Methylnaphthalene 680 ug/Kg
- 4-Isopropyltoluene 1,000 ug/Kg
- Ethyl benzene 230 J ug/Kg
- Isopropylbenzene 280 J ug/Kg

- m & p Xylenes 600 ug/Kg
- Naphthalene 770 ug/Kg
- n-Butylbenzene 1,200 ug/Kg
- n-Propylbenzene 680 ug/Kg
- o-Xylene 560 ug/Kg
- sec-Butylbenzene 1,100 ug/Kg
- tert-Butylbenzene 94 J ug/Kg

This sample also contained the following PAHs:

- Fluoranthene 300 J ug/Kg
- Fluorene 250 J ug/Kg
- Phenanthrene 440 J ug/Kg
- Pyrene 280 J ug/Kg

Samples of soil obtained within or below landtill materials were also analyzed for the eight RCRA metals. Concentrations of these metals in the soil samples obtained from within or below the landtill materials were all less than the CSEV residential land use criteria or in the case of arsenic, the background level of 15 mg/Kg.

The results of the arsenic and lead analyses obtained from soil samples collected within or below landtill materials were also considered as part of the discussion of the distribution of arsenic and lead occurrences in subsurface soils presented previously in Section 5.1.2 of this report.

5.6 Contaminant Fate and Transport

Surface and shallow subsurface soil containing arsenic and lead could be subject to erosion and subsequent transport as windblown material or as suspended phase material in stormwater. As the majority of the site is covered with buildings or pavement, these processes are not considered to be significant for OU-2.

Arsenic and lead occurrence in soil are subject to potential leaching. Precipitation at the ground surface results in soil moisture that can evaporate, be transpired by vegetation back to the atmosphere, or, in response to further addition of moisture from subsequent precipitation events, move vertically downward through the soil column. As soil moisture moves downward it has the ability to pick up (leach) chemicals present in the soil and transport those chemicals further downward in the soil column or potentially down to the underlying groundwater. The leaching potential of arsenic and lead is a function of the amount of soil moisture and magnitude of the soil moisture flux, the oxidation-reduction conditions of the soil moisture, and the presence of organic acids or other agents that could act to increase the mobility of these trace metals. Leaching potential may be offset by the sorption potential of the underlying soil which will tend to

- get conclusion on groundwater 11/23/10
- from Andrew

Vasquez Boulevard and Interstate 70 Superfund Site Operable Unit 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY • REGION 8 • JANUARY 2011

DRAFT Proposed Plan for Public Comment

Introduction

The U.S. Environmental Protection Agency (EPA) and the State of Colorado invite the public to review and comment on a proposed plan to address contaminants located within Operable Unit 2 (OU2) of the Vasquez Boulevard and Interstate 70 Superfund Site (VB/I-70), in Denver.

This proposed plan explains EPA's and the State's proposed remedy for contaminated soil at the site. This plan also provides a summary of cleanup alternatives evaluated for use at the site. This document is issued by EPA Region 8, ~~the lead agency for site activities,~~ and the Colorado Department of Public Health and the Environment (CDPHE), the support agency. The City and County of Denver conducted the remedial investigation and feasibility study.

In an effort to help you better understand the plan, page 12 provides a list of commonly used environmental terms that appear in bold throughout this proposed plan.

EPA is asking the public to review the site documents and provide comments on the proposed cleanup plan as well as other alternatives considered. EPA, in consultation with CDPHE, will select a final remedy for the site after reviewing and considering all information submitted during the 30-day public comment period. Public Involvement, review, and feedback are encouraged on all of the alternatives under consideration for Operable Unit 2 of the VB/I-70 Site.

EPA and CDPHE will host a public comment period and public meeting to explain the proposed plan and to accept comments (please see details in box above). EPA, in consultation with CDPHE,

Opportunity for Public Comment

Public Meeting Invitation
XXday, xxx, 2010? at 6:30 pm
Place TBD

Public Comment Period
xxx xx, 2010-xxx xx, 2010?

Send Written Comments to:

Sam Garcia, EPA Project Manager
U.S. EPA Region 8 (EPR-SR)
1595 Wynkoop Street
Denver, CO 80202-1129
E-mail: garcia.sam@epa.gov

Written comments will be accepted and must be postmarked or sent by e-mail by close of business on xxx xx, 2010. Requests for an extension of the comment period must be made in writing to Sam Garcia at the above address and received by 5:00 pm on xxx xx, 2010.

Documents regarding VB/I-70 OU2 are available to the public at the following places:

Valdez-Perry Library 4690 Vine Street Denver, CO 80216 720-865-0300	EPA Superfund Records Center 1595 Wynkoop Street Denver, CO 80202-1129 303-312-6473

epa.gov/region8/superfund/co/vbi70/

Questions? Contact:

Jennifer H. Lane
EPA Community Involvement Coordinator
303-312-6813
800-227-8917, ext 312-6813 (toll free Region 8)
E-mail: lane.jennifer@epa.gov

will review and consider all comments received during the public comment period. EPA and CDPHE may select the preferred cleanup alternative, modify it, select another response action, or develop other alternatives if public comment warrants or if new material is presented.

Understanding the Superfund Process

Release of the proposed plan is part of a detailed process that includes everything from site discovery through cleanup (Exhibit 1).

The **remedial investigation (RI) and feasibility study (FS)** for OU2 were completed in May and August 2010. These documents are prepared concurrently, as data collected during the investigation influences development of remedial alternatives in the FS. The RI characterizes the site conditions, determines the nature and extent of the waste, and assesses risk to human health and the environment.

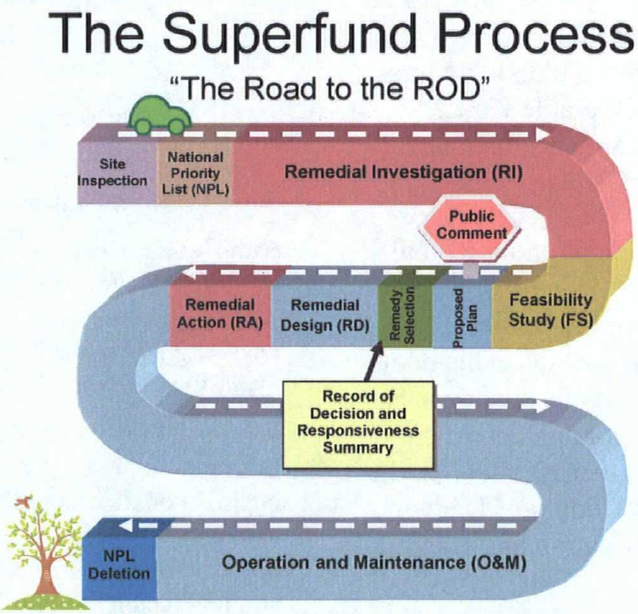

Exhibit 1. The **Superfund** Process

The **FS** identifies, develops, screens, and evaluates remedial alternatives to address risks to human health and the environment from contaminated soil.

- The general **FS** process follows the steps summarized in the following bullets:
- Identify **remedial action objectives (RAOs)**;
- Identify and screen potential remedial technologies that will satisfy RAOs;
- Assemble remedial alternatives that can provide protection of human health and the environment from the retained remedial technologies;
- Screen the alternatives based on effectiveness, implementability and cost; and
- For alternatives that make it through the screening process, conduct a detailed analysis against seven of nine evaluation criteria (the two threshold criteria and the five primary balancing criteria) and a comparison between alternatives.

After the FS is finalized, a preferred alternative for the site is presented to the public in a **proposed plan** (this document). The **proposed plan** briefly summarizes the alternatives studied in the detailed analysis phase of the RI/FS and, highlights the key factors that led to identifying the preferred alternative. The 30-day public comment period allows the State of Colorado and the community to provide comment on the preferred alternative.

The final phase of the RI/FS process is to prepare a **Record of Decision (ROD)**. Following the receipt and evaluation of public comments and any final comments from DEQ, EPA selects and documents the remedy for the site in a ROD.

Site Background

The VB/I-70 site is an area of approximately four square miles located in north-central Denver. Historically, this area was a major smelting center for the Rocky Mountain West. Three smelting plants: Omaha-Grant, Argo, and Globe operated in the area for varying lengths of time, beginning as early as 1870, refining gold, silver, copper, lead, and zinc. On July 22, 1999 the VB/I70 site was listed on the EPA Superfund National Priorities List (NPL).

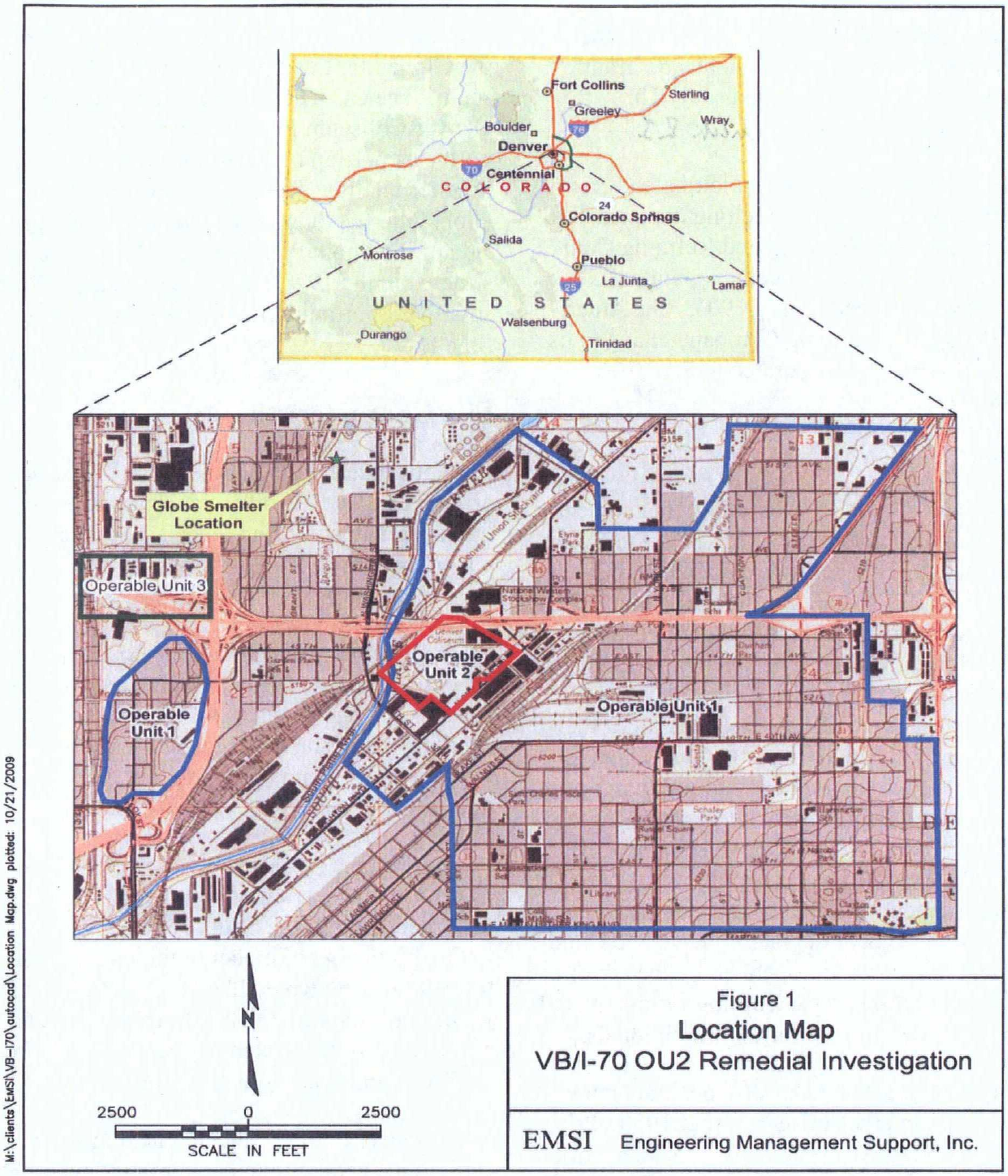

Figure 1
Location Map
VB/I-70 OU2 Remedial Investigation

EMSI Engineering Management Support, Inc.

Operable Unit 2. (OU2) encompasses approximately 50 acres of the original Omaha & Grant Smelter facility and includes a portion of the Globeville Landing Park. The site is generally bound by I-70 on the north, the South Platte River on the west, Brighton Boulevard on the east, the southern boundaries of the Globeville Landing Park, and the Pepsi Bottling Company property on the south.

OU2 Area History

The Omaha & Grant Smelter got its start as the Grant Smelter located in Leadville, Colorado. The Grant Smelter operated in Leadville from 1878 until 1882 and was owned by the Grant Smelting Company. When the Grant Smelter was destroyed by fire in 1882, a replacement smelter was built in Denver. The Grant Smelter merged with the

Omaha Smelfing Works July 15, 1883 and the corporation was renamed the Omaha & Grant Smelting and Refining Company July 18, 1902 ????? (confirm date). Check RI

In 1899, the Omaha & Grant Smelting and Refining Company joined other smelting companies to form the American Smelting and Refming Company. The company continued to operate the Omaha & Grant Smelter unfil 1903. The American Smelting and Refining Company changed its name to ASARCO Incorporated (ASARCO) on May 15, 1975.

Facility Operations

The Omaha & Grant Smelter facility began operation at OU2 in October 1882. In 1887, the facility was expanded. The facility expanded again in 1892, and a 352 foot-tall smelter stack was built. The smelter operated for approximately 21 years and was closed in 1903. The smelter buildings were subsequently demolished once the smelter operation was closed. Sometime later all of the slag, with the exception of any residual slag that could be buried under modem parking lots, was removed. Based on historical aerial photographs, all of the visible slag was removed by 1949. Between 1920 and 1940, various portions of the facility were deeded to the City and County of Denver. Other portions of the facility have been, and continue to be, owned or operated by the Union Pacific Railroad, the Pepsi Bottling Company and various other corporate enfities or individuals.

The City and County of Denver constmcted the Denver Stadium and Coliseum about 1950. Prior to constmcting the coliseum and associated parking lot, portions of OU2 were used as a landfill for disposal of constmcfion debris and possibly municipal solid wastes. The presence of landfill materials beneath the coliseum parking lot area is evidenced by the undulating nature of the parking lot pavement. This has resulted in different compaction and decomposition of the underlying materials. No specific information or documentation of the time period when the landfill was active could be located.

The properties still owned and used by CCoD are the Globeville Landing Park and the Denver Coliseum. The CCoD completed constmction of the Denver Coliseum in 1952 which encompassed the northeast portion of the former Omaha and Grant Smelter facility. The approximately 10-acre Globeville Landing Park is located along the east side of the South Platte River. The park, constmcted in the 1970s, encompassed part of the southwest portion of the former Omaha & Grant Smelter.

Site Characteristics

Previous investigations by EPA identified levels of arsenic and lead in soil at concentrations above human health screening levels. Therefore, the focus of the RI was on assessment of arsenic and lead occurrences in surface and subsurface soil.

Previous groundwater sampling conducted by CCoD on four out of five monitoring wells indicate arsenic and lead are below state and federal drinking water standards. One monitoring well was never developed properly and data was of questionable quality.

Neither arsenic nor lead were detected at elevated levels in the upstream or downstream surface water or sediment in the South Platte River adjacent to OU2 proving no impact to the river. Other than the South Platte River, there are no major surface water bodies within OU2. Draining in the OU2 area is largely controlled by man-mad features such as ditches, roads, and storm sewers.

The occurrence of arsenic and lead in soil at concentrations greater than background levels are localized and discontinuous. Sample results indicated only isolated areas of contamination containing concentrations of arsenic and lead above background levels. Since buildings and pavement in the area reduce erosion, windblown dust, and storm water mnoff, significant transport and migration of arsenic and lead from the soil is not expected to occur.

EPA also investigated an area of the coliseum parking lot that was thought to have been used as a landfill for construction debris. The study characterized the nature and extent of wastes and assessed the possibility of chemical migration. Results of the laboratory analyses indicated . . .

Overall, leaching of landfill contaminants is not expected to be a significant means of transporting chemicals at the site??????????????

Summary of Site Risks

As part of the Remedial Investigation, the EPA completed a Baseline Human Health and Screening Level Ecological Risk Assessment for OU2 to estimate the current and future risk of site-related metals on human health and the environment.

Human Exposure Pathways

The Human Health Risk Assessment looked at potential risk to 1) current or fiture commercial workers; 2) construction workers; 3) recreational visitors; and 4) fiture residents. The assessruent identified the primary exposure pathways to be incidental ingestion of surface and subsurface soil, surface water, or sediment.

Even though few people intentionally ingest soil, commercial workers, construction workers and residents who have direct contact with soil at OU2 might ingest small amounts that adhere to their hands during outdoor activities. In addition, soil can enter buildings (such as workplaces or residences) leading to contamination of indoor dust, which also ruay be ingested by hand-to-mouth activities. Although exposure of commercial workers to surface soil is largely prevented by the high degree of building and pavement cover at OU2, future land owners at the site could potentially remove existing buildings or pavement and expose the underlying surface soils. Construction workers also could be exposed now or in the fiture as a consequence of excavation activities such as installation or repair of utility lines, building foundations, or other similar activities. If in the fiture OU2 were redeveloped for residential use, hypothetical fiture residents could be exposed to surface soil at the site.

Arsenic

Arsenic is a naturally occurring element widely distributed in the earth's crust. Arsenic cannot be destroyed in the environment; it can only change its form. Environmental exposure can occur through ingestion of food and/or water and by breathing in dust that contains arsenic.

Several studies have shown that inorganic arsenic can increase the risk of lung, skin, bladder, liver, kidney and prostate cancers. Symptoms of short-term high-level arsenic poisoning in humans are nausea, loss of appetite, vomiting, abdominal pain, and diarrhea. General symptoms of long-term, arsenic poisoning are weakness, exhaustion, loss of appetite, loss of hair, hoarseness of voice, loss of weight and mental disorders. Primary target organs are the skin and nervous and vascular systems.

Cadmium

Cadmium is a natural element in the earths crust. All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Cadmium does not corrode easily and has many uses including batteries, pigments, metal coatings, and plastics. Environmental exposure can occur through ingestion or inhalation. Breathing high levels of cadmium severely damages the lungs and can cause death. Eating food or drinking water with very high levels severely irritates the stomach, leading to vomiting and diarrhea. Long-term exposure to lower levels of cadmium in air, food or water leads to a buildup of cadmium in the kidneys and possible kidney disease. Other long-term effects are lung damage and fragile bones.

Lead

Lead is a natural element that is persistent in water and soil. Most of the lead in the environment is from human sources as the result of smelting and historical use in paints and gasoline. Human exposure occurs primarily through ingestion of food, water, dirt and paint chips and by breathing in dust that contains lead.

Although similar adverse nervous systems effects occur in adults and children, children are more sensitive to lead exposure than are adults. High levels of exposure to lead can kill children. Children who survive high levels of lead exposure suffer permanent severe mental disorders.

On-Site Recreational Visitors

Recreational visitors that picnic, walk or bike at the Globeville Landing Park might have direct contact with surface soil leading to potential ingestion or dermal exposure. However, the soils in the park area are mainly clean fill that was brought in from other areas during park constmction, so evaluation of this pathway was not needed in the risk assessment.

Ecological Risks

A Screening Level Ecological Risk Assessment (SLERA) was conducted by EPA in 2009. This risk assessment qualitatively evaluated potential exposures of plants to trace metals in surface and subsurface soil, and aquatic receptors (fish, benthic macro invertebrates and amphibians) to trace metals in surface water and sediment along the South Platte River. These evaluations were performed by comparing the trace metal concentrations at OU2 to benchmark values that are believed to be without significant risk of unacceptable adverse effects.

The SLERA found few locations where concentrations of arsenic and lead in surface soil could currently be toxic to plants. Most of the locations that are of potential concem are in subsurface soils. Therefore, the predicted risks are not currently of concem, but could be of concem if soils became exposed and subsurface materials were brought to the surface.

The levels of metals detected in surface water at both upstream and downstream sampling locations along the South Platte River were less than benchmark values. This indicates that any impacts of groundwater discharging from OU2 to the South Platter River are not of ecological concem.

Environmental Justice Concerns

Community input is very important to EPA. EPA and CDPHE recognize that the VB/I-70 site is an Environmental Justice site because the community is predominately low-income and minority. These types of communities may be disproportionately affected by enviroimental impacts from many sources including industry other Superfund sites.

Remedial Action Objectives

Remedial Action Objectives (RAOs) are goals developed by EPA to protect human health and the environment. These RAOs are the overarching goals that all cleanup activities selected for OU2 should meet. EPA considers current and fiiture land use of the site when determining RAOs. Commercial/industrial is the primary current use and the reasonably anticipated fiiture land use for OU2.

However, the Human Health Risk Assessment also included evaluation of potential hypothetical future residential use of OU2 in the event that the site was ever redeveloped from a commercial/ industrial use to residential use. This evaluation was conducted in part to evaluate potential risks if land uses at the site were unrestricted, and in part, at the request of CCoD, to allow for evaluation of what actions might be necessary should the land use at OU2 ever change in the fiiture.

As discussed previously, surface and shallow subsurface soil media are of concem at OU2. The following preliminary RAOs have been identified for OU2.

1. Limit exposure of commercial and constmction workers to lead; and
2. Limit or prevent exposure of potential fiiture residential users to lead and other metals (arsenic, manganese, and thallium).

Summary of Remedial Action Alternatives

Remedial altematives for the VB/I-70 site are presented in this section.

In evaluating potential fiiture activities at the site, the final condition of the remediated area must be considered. For each of the altematives evaluated, institutional controls (ICs) would be implemented to prevent unacceptable future human exposure to contaminated soil and to prevent disturbance of the selected remedy. ICs are community protective measures such as restrictive covenants, zoning ordinances, easements, deed restrictions and building permits. ICs would be developed in cooperation with local government to ensure that future land uses are consistent with the selected remedy.

Alternative 1: No Action

EPA is required pursuant to 40 CFR §300.430(e)(6) to evaluate the No Action Alternative. Under this alternative, no engineered measures or monitoring would be implemented to reduce contaminant concentrations, prevent chemical migration, restrict or eliminate potential exposures to site chemicals, or reduce exposure of chemical concentrations to potential humans. This alternative is not protective of human health or the environment and does not comply with the RAOs. The No Action Alternative provides a baseline for evaluation/comparison of the costs and benefits of other alternatives.

Cost: No costs are associated with the No Action Alternative, as no remedial actions would be implemented.

Alternative 2: Institutional Controls

ICs would be developed, applied and maintained under Alternative 2. The objective of the ICs to be developed and implemented under this alternative are expected to include the following:

- Prevent residential land use by restricting land uses to commercial or industrial uses in areas where residual contamination will remain at concentrations above levels that would otherwise allow for unrestricted use.
- Require appropriate health and safety and materials management procedures for any excavations conducted in conjunction with subsurface infrastructure upgrades, repairs or replacements in areas of residual contamination
- Require implementation of appropriate remedial actions in conjunction with any building demolition or redevelopment activities that may occur in the future in the areas of residual contamination.

Under Alternative 2, the risks would be reduced and controlled through implementation, monitoring, and enforcement of ICs that would only allow land uses compatible with the presence of the types of residual contaminants of concern in soil and would restrict use of the land that could result in exposure to residual contaminants of concern at levels that could pose an unacceptable risk.

Costs:

Capital Cost:	**$ 31,000**
Monitoring Costs/Year:	**$2,000**
30-year Present Worth Cost:	**$70,000**

Alternative 3: Capping

Soil sample locations at OU2 where concentrations of lead in surface and subsurface soil **0** to 5 feet deep exceeding the **800** mg/kg action level will be capped to prevent exposure by commercial workers. The majority of OU2 is covered by existing paved surfaces or buildings. For this alternative, it is assumed that cracks existing in these paved surfaces would be sealed.

Asphalt pavement or another form of surface cap would be placed over those areas that are currently not covered by a paved surface.

Following the crack sealing, the areas would be seal-coated every five years and a resurfacing overlay would be placed over those areas that are currently not covered by a paved surface. In addition, Alternative 3 would include the IC components described as part of Alternative 2.

Costs:

Capital Cost:	**$1,680,000**
Monitoring Costs/Year:	**$2,000**
30-year Present Worth Cost:	**$1,450,000**

Alternative 4: Excavation/Disposal of Soil

Altemative 4 would involve the excavation and subsequent disposal of contaminated soil containing lead at concentrations greater than **800** mg/kg. This volume of soil is estimated to be approximately **160,000** cubic yards. There are some areas in OU2 where soils proposed for excavation are immediately accessible and other areas where the presence of buildings and other site stmctures limit access to the contaminated soil. For those areas where access is currently limited, excavafion of soil would be implemented as a part of future property redevelopment after buildings and site stmctures are demolished.

Potentially contaminated soil would be tmcked to the Denver-Arapahoe Disposal site (DADS), a permitted solid waste disposal facility in Arapahoe County, Colorado. Following excavafion, approximately 205,000 loose cubic yards of clean fill would need to be tmcked to OU2 for backfill. The open excavations would be backfilled and compacted. It is assumed that an asphalt cap would be placed over the excavation areas after they are backfilled.

Altemative 4 would include the IC components for restriction of residential land use as described as part of Altemative 2. This would apply to areas where contaminants are located in soil beneath some buildings and other stmctures, until a time when areas are redeveloped.

Costs:

Capital Cost:	**$11,320,000**
Monitoring Costs/Year:	**$2,000**
30-year Present Worth Cost:	**$8,600,000**

Evaluation of Remedial Alternatives

Nine criteria are used to evaluate the different remediation altematives, individually, and against each other. The nine evaluation criteria are categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. During the evaluation of remedial altematives, the altematives are initially evaluated according to the threshold criteria, which must be met. Then the altematives are compared with each other to idenfify relative advantages and disadvantages among the different balancing criteria and modifying criteria. The purpose of the comparative analysis is to provide information for a balanced remedy selection.

Threshold Criteria

Altematives must, at a minimum, meet the first two criteria to be eligible for selection as the preferred altemative.

1. **Overall Protection of Human Heath and the Environment** considers whether or not an altemative provides adequate protection by eliminating, reducing, or controlling unacceptable risks.

2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARS)** considers whether or not an altemative will meet all federal or state standards required by environmental laws or whether there is justification for waiving the standards.

Primary Balancing Criteria

The primary balancing criteria are used to weigh effectiveness and cost tradeoffs among altematives and the main technical criteria upon which the altemative evaluation is based.

3. **Reduction of Toxicity, Mobility, and Volume through Treatment** indicates EPA's preference for altematives that include treatment processes to lower or eliminate the hazardous nature of material, its ability to move in the environment, and the amount left after treatment.

4. **Long-Term Effectiveness and Permanence** considers the long-term effectiveness and permanence of maintaining the protection of human health and the environment after implementing each altemative.

5. **Short-Term Effectiveness** considers the effect of each remedial alternative on the protection of human health and the environment during the constrnction and implementation phase.

6. **Implementability** considers the technical and administrative feasibility of irnplementing each alternative and the availability of the services and materials required during implementation.

7. **Cost** considers constrnction costs as well as long-terrn operation and maintenance costs of each alternative by considering whether more costly alternatives provide additional public health benefits for the increased cost.

Modifying Criteria

The last two criteria are used to deterrnine whether the concerns of the state and the public should modify EPA's approach to the cleanup of OU2.

8. **State Acceptance** considers whether the state agrees with, disagrees with, or has no comment on EPA's preferred alternative.

9. **Community Acceptance** considers the concerns or support the public may offer regarding each alternative. EPA will evaluate community acceptance of cleanup alternatives after receiving public comment on the propose plan.

Summary of the Preferred Alternative

Alternative 3 – Capping with Institutional Controls

The preferred alternative for Operable Unit 2 is Capping with Institutional Controls ~~as described in Alternative 2~~ Alternatives 2 & 3. Based on the inforrnation currently available, EPA and the State of Colorado believe the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria.

The majority of OU 2 is covered by existing pavement and buildings. Areas not covered by pavement or buildings that would require a cap are identified in Figure ?. Figure ? also shows existing paved areas that would require sealing of cracks.

Because hazardous substances, pollutants, or contarninants will remain on site above health-based levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action. This will ensure that the remedy is protective of human health and the environment. If EPA and the State determine the remedy is not protective, a different remedy would be developed and implemented.

The preferred alternative may change in response to public comment or new information. For this reason, EPA and the State of Colorado encourage the public to review and comment on all the alternatives presented in this proposed plan.

Community Participation

EPA and CDPHE provide information regarding Operable Unit 2 of the VB-I-70 site through fact sheets, one-on-one meetings, announcements in the Denver Post, EPA's web site and the information repository containing the Administrative Record. The inforrnation repository is located at the Valdez-Perry Library.

EPA and CDPHE encourage citizens to comment on this proposed plan Please see page one for information about how you can comment and for details about a public meeting.

Note: we need the newer version of this table in Word format.

Evaluation of Remedial Alternatives for VB/I-70 OU2

Evaluation Criteria			1 No Action	2 Institutional Controls	3 Capping and Institutional Controls	4 Soil Excavation and Institutional	Notes
Threshold	1	Protection of Human Health and the Environment	●	●●●	●●●	●●●	All alternatives except No Action would be protective of Human health.
	2	Compliance with ARARs	●	●●●	●●●	●●●	There are no chemical-specific ARARs for lead and arsenic in soil. No location-specific ARARs were identified. All alternatives would comply with action-specific ARARs.
Primary Balancing	3	Long-term Effectiveness	●	●●	●●●	●●●	Soil excavation and offsite disposal provides the greatest degree of effectiveness and permanence followed by capping. Institutional controls are the least effective and permanent.
	4	Reduction of Toxicity, Mobility, or Volume through Treatment	●	●●	●●	●●●	None of the alternatives include treatment.
	5	Short-term Effectiveness	●	●●●	●●	●●	Excavation and offsite disposal poses the greatest short-term risks to the community and workers.
	6	Implementability	●●●	●●	●	●	Soil excavation would be more difficult to implement and could not be fully implemented until buildings are removed as part of future redevelopment.
	7	Cost	●●●	●●●	●	●	Soil excavation would not provide a substantial increase in overall protection for the increased cost.
Modifying	8	State Acceptance					CDPHE acceptance will be evaluated at the close of the Public Comment Period.
	9	Community Acceptance					Community acceptance will be evaluated at the close of the public comment period.

Legend for Qualitative Ratings System: Performance of Alternatives: Low ● Moderate ●● High ●●●

Map to go here

Useful Terms

Understanding environmental cleanup can be daunting for the average person. The following are definitions of commonly used terms at the Libby Asbestos Site to aid your understanding of this document.

Applicable or relevant and appropriate requirements (ARARs). Any state or federal statute that pertains to protection of human life and the environment in addressing specific conditions or use of a particular cleanup technology at a Superfund site.

Exposure. The amount of pollutant present in a given environment that represents a potential health threat to living organisms.

Exposure Pathway. The path from sources of pollutants via, soil, water, or food to man and other species or settings.

Feasibility Study (FS). The FS is the mechanism for the development, screening, and detailed evaluafion of alternative remedial actions. It is conducted concurrently with the RI.

Five-Year Review. Remedial actions that result in hazardous substances, pollutants, or contaminants remaining at a site above levels that allow for unlimited use and unrestricted exposure are required to be reviewed every five years to ensure protection of human health and the environment.

ICs and Engineered Controls. ICs are actions, such as restrictive covenants, zoning ordinances, easements, deed restrictions, and building permits, that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use. Engineered controls are physical controls, such as fencing. Both types of controls are used to help preserve the integrity of the remedy.

National Priorities List (NPL). EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. A site must be on the NPL to receive money for remedial action.

Operable Unit (OU). A designation based on geography or other characteristics that defines a specific area of a site and enables the Superfiind process to move forward in different areas at different times, speeding up the overall cleanup process at the site.

Operation and Maintenance (O&M). Activities conducted after a Superfund site action is completed to ensure that the action is effective for the long-term.

Present Worth. The present value (of a sum payable in the future) calculated by deducting interest that will accrue between the current and future date.

Remedial Investigation (RI). The investigation phase of the Superfund process that determines the nature and extent of contamination and assesses the risk to human health and the environment.

Remedial Action (RA). The actual construction or implementation phase of a Superfund site cleanup that follows remedial design. The remedial design is the design phase of a Superfund site cleanup that follows the signing of the ROD and precedes the RA..

Record of Decision (ROD). A public document that explains which cleanup altemative(s) will be used at NPL sites.

Superfund. The program that funds and carries out EPA solid waste emergency and long-term removal and remedial activities. These activities include establishing the NPL, investigating sites for inclusion, determining priority, and conducting and/or supervising cleanup and other actions.

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restrict soil moisture transport and also act to remove the trace metals from the soil moisture.

As the vast majority of OU-2 is capped with buildings, asphalt or concrete and is subject to stormwater diversion and control, infiltration of precipitation into the underlying soil is extremely limited. Consequently, the amount of water being added to the soil moisture over time is small and therefore, the soil moisture flux is anticipated to be small. As a result, leaching is not expected to be a significant process over most of the site. Leaching could be more significant in areas where pavement is not present or where the overlying pavement is depressed, fractured, disintegrated, or otherwise would act to focus stormwater into areas where it could potentially drain into the underlying soil. Visual inspection of the site did not indicate any significant areas where these conditions currently exist. The presence of the landfill materials could enhance the solubility of the trace metals through contribution of organic acids to the soil moisture or through presence of anaerobic bacteria which could result in reducing conditions that could increase trace metal mobility. Monitoring conducted during the drilling of the soil borings did not detect the presence of methane indicative of anaerobic conditions in the landfill. Overall, leaching is not expected to be a significant process for chemical transport at the site. The lack of significant leaching is supported by the overall lack of elevated occurrences of arsenic or lead in the groundwater samples.

The hydrocarbon compounds found in the landfill materials are also subject the leaching and sorption processes described above. In addition, these compounds are also subject to one degree or another to volatilization and microbial degradation. Volatilization is the process where chemicals dissolved in soil moisture or groundwater migrate into the soil vapor phase. Microbial degradation is a process where soil microbes degrade organic compounds. The presence of the landfill materials could act to increase anaerobic microbial degradation. Field measurements made during drilling of the soil borings did not detect the presence of significant amounts of volatile organic compounds in the soil vapor or the presence of methane indicative of anaerobic degradation. The lack of significant methane likely is a result of the overall age of the landfill materials and the lack of soil moisture necessary for methane generation.

The overall fate of the arsenic, lead and organic chemical occurrences in OU-2 is to remain sorbed onto the soil beneath the site. Due the presence of buildings and pavement that prevent erosion and subsequent windblown or stonnwater transport and that greatly limit the amount of soil moisture, significant transport and migration of the arsenic, lead, and organic chemical occurrences from the soil is not expected to occur.

6 SUMMARY OF BASELINE RISK ASSESSMENT

A Baseline Human Health Risk Assessment (HHRA) and a Screening-Level Ecological Risk Assessment (SLERA) for OU-2 were prepared by EPA with technical assistance from SRC, Inc. (EPA, 2009a and 2009b). The following sections provide brief summaries of the results of these risk assessments.

6.1 Baseline Human Health Risk Assessment

The Baseline Human Health Risk Assessment (EPA, 2009a) identitied incidental ingestion of surface and subsurface soil, surface water, or sediment by current or future on-site commercial works, constmction workers, or recreational visitors or by future residents to be the primary exposure pathways of potential concem. Four different exposure areas were identified for future residents (Figure 8) and two different exposure pathways were identitied for current or future commercial and constmction workers (Figure 28). Potential exposures by recreation visitors were limited to exposure to surface water and sediment along the South Platte River.

The following chemicals of potential concem were identitied and evaluated by the risk assessment:

Chemical	Soil	Sediment	Surface Water
Antimony	X		
Arsenic	X	X	X
Cadmium	X	X	X
Cobalt	X		
Copper	X	X	X
Iron	X		
Lead	X	X	X
Manganese	X		
Silver	X		
Thallium	X		
Vanadium	X		
Zinc	X	X	X

Both potential risks from cancer and non-cancer health effects from possible exposures to these chemicals were quantitatively evaluated in the risk assessment. Exposures to lead were also evaluated relative to the probability that exposure could result in a blood lead value of concem to a fetus (blood lead level greater than 10ug/dl)

Based on the evaluations conducted for the risk assessment, exposure to lead from incidental ingestion of soil by a current or fiiture pregnant commercial or constmction worker is of potential concem in commercial exposure unit C2 (generally the Pepsi property and other commercial properties along Brighton Boulevard). Exposure to lead through incidental ingestion of soil by a current or future pregnant constmction work is also a potential concem for residential exposure unit R2 (generally the commercial properties along the northem portion of Brighton Boulevard).

Ingestion of surface soil containing arsenic, manganese, and thallium was identitied as a potential concem for future residents. Exposure to lead in soil was identified as a potential concem for a future child resident in residential exposure units Rl, R2, and R3.

The results of the risk assessment indicated that there is little risk to recreation visitors who may have contact with surface water or sediment along the South Platte River.

6.2 Screening-Level Ecological Risk Assessment

The SLERA qualitatively evaluated potential exposures of terrestrial plants to trace metals in surface and subsurface soil and aquatic receptors (tish, benthic macro invertebrates, and amphibians) to trace metals in surface water and sediment along the South Platte River. These evaluations were performed by comparing the trace metal concentrations at the site to benchmark values that are believed to be without significant risk of unacceptable adverse effects.

Because the concentrations of metals in soil vary from location to location, and because plants are not mobile, each soil sample was evaluated as an individual exposure point. The detected concentrations (or in the case of non-detect results one-half the detection limit) of metals at each sample location were compared to benchmark values. EPA Ecological Soil Screening Levels (EPA, 2003) and lowest observed effect concentrations detennined by Oak Ridge National Laboratory (Efroymson et al. 1997) were used as benchmark levels for terrestrial plants. Average soil concentrations measured by the U.S. Geological Survey (Shacklette, and Boemgen, 1984) in Colorado counties near the site (Arapahoe, Douglas, and Jefferson) were used to represent state background. These values were also compared to the benchmark values as it is considered likely that if the hazard quotients for the state background levels exceed the benchmark values, the benchmark values may be overly conservative since risks to plants are not expected in background soils.

These evaluations indicate that levels of arsenic and lead, and perhaps a few other metals in soils from areas within the former smelter area and known slag deposits may be within range of potential phytotoxicity in some locations. There are few locations where concentrations of arsenic and lead in surface soil could currently be phytotoxic to plants. Most of the locations that are of potential concem are in subsurface soils. Therefore, the predicted risks are not currently of concem, but could be of concem if soils became exposed and subsurface materials were brought to the surface.

For surface water and sediment, the 95% upper contidence limit values calculated from the site data were compared to EPA's National Ambient Water Quality Criteria (EPA, 2002b). The levels of metals detected in surface water at both the upstream (reference) and downstream sampling locations along the South Platte River were less than the benchmark values. This indicates that any impacts of groundwater discharging from the site to the South Platte River are not of ecological concem. With the exception of lead in the upstream sample location, the levels of metals detected in sediment at both the upstream (reference) and downstream sampling locations along the South Platte River wee less than the benchmark values. This indicates that any impacts of groundwater discharging from the site and potentially impacting sediment in the South Platte River are not of ecological concem to benthic organisms in sediment.

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