SUPPORTING INFORMATION FOR THE EAST VALLEY CONTROLLED GROUNDWATER AREA PETITION - LEWIS AND CLARK COUNTY, MONTANA

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August 2014

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LIST OF ABBREVIATIONS AND TERMS

AOC – Area of Contamination

BGS – Below Ground Surface

CAMU – Corrective Action Management Unit

CD – Consent Decree

CERCLA – Comprehensive Environmental Response, Compensation and Liability Act

CGWA – Controlled Groundwater Area

CMS – Corrective Measures Study

Custodial Trust – Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust

CWA – Clean Water Act

DNRC – Montana Department of Natural Resources and Conservation

ET – Evapotranspiration

Facility – All former ASARCO-owned East Helena properties now owned by the Custodial Trust including the Former Smelter site

Former Smelter - The former ASARCO East Helena Lead Smelter Plant Site

HHS – Human Health Standard

IC – Institutional Controls

ICS – Interim Cover System

IM – Interim Measures

MCA – Montana Code Annotated

MCL – Maximum Contaminant Level

MDEQ – Montana Department of Environmental Quality

PPC – Prickly Pear Creek

RCRA – Resource Conservation and Recovery Act

RFI – RCRA Facility Investigation

SPHC – South Plant Hydraulic Control

TAG – Technical Advisory Group

TPA – Tito Park Area

UOSA – Upper Ore Storage Area

USEPA – United States Environmental Protection Agency

EXECUTIVE SUMMARY

This petition is being submitted to the Montana Department of Natural Resources and Conservation (DNRC) to request the designation of a Controlled Ground Water Area (CGWA) encompassing approximately 3,290 acres in the eastern portion of the Helena Valley near the City of East Helena, in Lewis and Clark County, Montana. The overall objective of the CGWA is to restrict future groundwater withdrawals and use in order to prevent exposure to certain contaminants (arsenic and selenium) that could result in unacceptable risk to human health or the environment, and to prevent possible pumping-induced spreading of groundwater contaminants. The East Valley CGWA is being requested in accordance with applicable laws and regulations included in Montana Code Annotated 85-2-500, and related groundwater rules and regulations.

Groundwater quality in the area of the proposed CGWA has been impacted by contaminants migrating from the former East Helena lead smelter (former smelter) as well as other sources, possibly including naturally occurring or "background" contaminant sources. Groundwater contaminants of concern include arsenic and selenium that have been identified in separate contaminant plumes that extend from the former smelter northward (up to three miles in the case of the selenium plume) within the Helena Valley alluvial aquifer. Concentrations of arsenic and/or selenium exceed applicable groundwater quality standards including State of Montana groundwater Human Health Standards (MDEQ, 2012) and the United States Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) established for protection of human health. The CGWA is requested because: arsenic and selenium concentrations in the area are above drinking water standards and therefore ingestion of such water could pose a public health risk; the groundwater is unsuitable for certain designated beneficial uses, including public and private drinking water supplies, and culinary and food processing purposes; and additional pumping of groundwater could cause spreading of the contaminant plumes.

The proposed East Valley CGWA includes 3,290 acres (5.1 square miles) within Lewis and Clark County in the southeastern portion of the Helena Valley. The CGWA boundaries (Figure 1-1) include the former smelter plant site; portions of the City of East Helena including the main downtown area and Manlove Addition; Seaver Park; and surrounding agricultural, industrial, residential and open lands. The CGWA includes all of Sections 23, 25, 26, 35, 36 and a portion of Section 24 in Township 10 North, Range 3 West. 1,120 of the total 3,290 acres included in the proposed CGWA are owned by the Montana Environmental Trust Group, Trustee of the Montana Environmental Custodial Trust (the Custodial Trust), where groundwater usage restrictions can readily be applied as appropriate. An additional 1,270 acres are situated within East Helena where a moratorium on new wells currently exists. The remaining 900 acres of the CGWA include various agricultural, industrial and residential properties.

The CGWA includes two subareas or zones with differing groundwater usage provisions, plus an adjacent Temporary CGWA. Subarea 1 includes those portions of the aquifer where concentrations of arsenic and/or selenium exceed human health standards and a small buffer zone around the edge of the plumes to account for uncertainty in the precise exceedance boundary and potential future shifts in the plume boundary. The CGWA proposes a total ban on drilling new wells and groundwater appropriations within the 1,190 acres (or 1.9 square miles) of Subarea 1. Existing wells would not be affected. Subarea 2 includes those portions of the aquifer outside of Subarea 1 where, based on currently available data, arsenic and/or selenium concentrations do not currently exceed applicable human health standards, but exceedances of human health standards may occur due to future groundwater withdrawals or other changes in the hydrologic system. The CGWA proposes to require issuance of a permit by a designated East Valley CGWA technical advisory group for any new wells and groundwater appropriations within the 734 acres (1.2 square miles) of Subarea 2. The proposed East Valley CGWA also includes a Temporary CGWA (1366 acres/2.0 square miles) to the south and west of the "permanent" CGWA where "background" sources of arsenic unrelated to the former smelter are believed to affect groundwater quality. Designation of a temporary CGWA will allow the occurrence and source(s) of arsenic in this area to be further evaluated, and the area converted to a permanent CGWA in the future, if warranted.

Data collected through CERCLA and RCRA cleanup activities performed under the oversight of the US Environmental Protection Agency (EPA), initially focusing on ASARCO's operations, have shown that the former smelter is the primary source of arsenic and selenium contamination to groundwater within the proposed CGWA. The Custodial Trust assumed responsibility for the former smelter cleanup as a result of the ASARCO bankruptcy settlement, with EPA as the designated lead regulatory agency. Cleanup of the former smelter is proceeding under the RCRA Corrective Action Program with the remediation and protection of groundwater being a primary objective. Remedy identification and evaluations are currently underway as part of a RCRA Corrective Measures Study, and cleanup actions are being performed as Interim Measures (IMs) to address contaminant loading to groundwater while final remedy evaluations are completed. Remedial activities scheduled to be implemented as IMs over the next few years include lowering of groundwater levels on the former plant site to reduce contaminant leaching from soils, removal of certain contaminated soils, and placement of a soil cap over the former smelter plant site. Groundwater monitoring will be conducted to monitor the effectiveness of implemented cleanup activities and the potential need for additional remedial actions in the future. The monitoring program will also serve to track groundwater quality within the CGWA so that adjustments to the CGWA boundaries and/or groundwater usage provisions can be made, as appropriate. Cleanup activities are designed to reduce downgradient groundwater contamination from the former smelter that will enable reductions in the CGWA boundaries and/or provisions, although the process may take several years.

SUPPORTING INFORMATION FOR THE
EAST VALLEY CONTROLLED GROUNDWATER AREA PETITION
LEWIS AND CLARK COUNTY, MONTANA

1.0 INTRODUCTION

This document provides information in support of a petition to establish and maintain a controlled groundwater area (CGWA) near the City of East Helena in Lewis and Clark County, Montana. Groundwater quality in the area is impacted by multiple sources, including the former East Helena lead smelter (former smelter), apparent natural or background sources, and other possible sources. Concentrations of certain constituents in groundwater, primarily arsenic, selenium, and some trace metals, exceed applicable water quality standards (State of Montana Human Health Standards (MDEQ, 2012) and U.S. Environmental Protection Agency Maximum Contaminant Levels[1]), rendering portions of the aquifer unsuitable for certain designated beneficial uses. Designation of the East Valley CGWA is being requested to prevent exposure to specific contaminants in groundwater where Human Health Standards (HHS) are exceeded, and to prevent groundwater withdrawals that may alter or induce contaminant migration. Specific objectives of this petition include:

- Establishing a CGWA encompassing portions of the Helena Valley alluvial aquifer and adjacent foothills where observed contaminant concentrations exceed State of Montana HHSs for protection of human health. For purposes of the CGWA, primary contaminants of concern (COCs) include arsenic and selenium since these are the primary COCs in groundwater originating from the former lead smelter; and
- Establishing appropriate groundwater usage restrictions to prevent unacceptable human exposure to groundwater contaminants or pumping-induced spreading of contaminants.

This CGWA petition is being submitted to the Montana Department of Natural Resources and Conservation (DNRC) by the Lewis and Clark City-County Board of Health and Water

[1] Applicable groundwater quality standards for protection of human health include State of Montana Human Health Standards (HHS) and U.S. EPA Maximum Contaminant Levels (MCLs). For the contaminants of concern (arsenic and selenium), the HHS and MCLs are identical. To avoid redundancy, the HHS standards are used in this document when referring to applicable groundwater quality standards.

Quality Protection District Board and has been prepared in accordance with applicable laws and regulations included in Montana Code Annotated (MCA) 85-2-500, and related groundwater rules and regulations as referenced below.

1.1 CGWA DESCRIPTION AND BACKGROUND

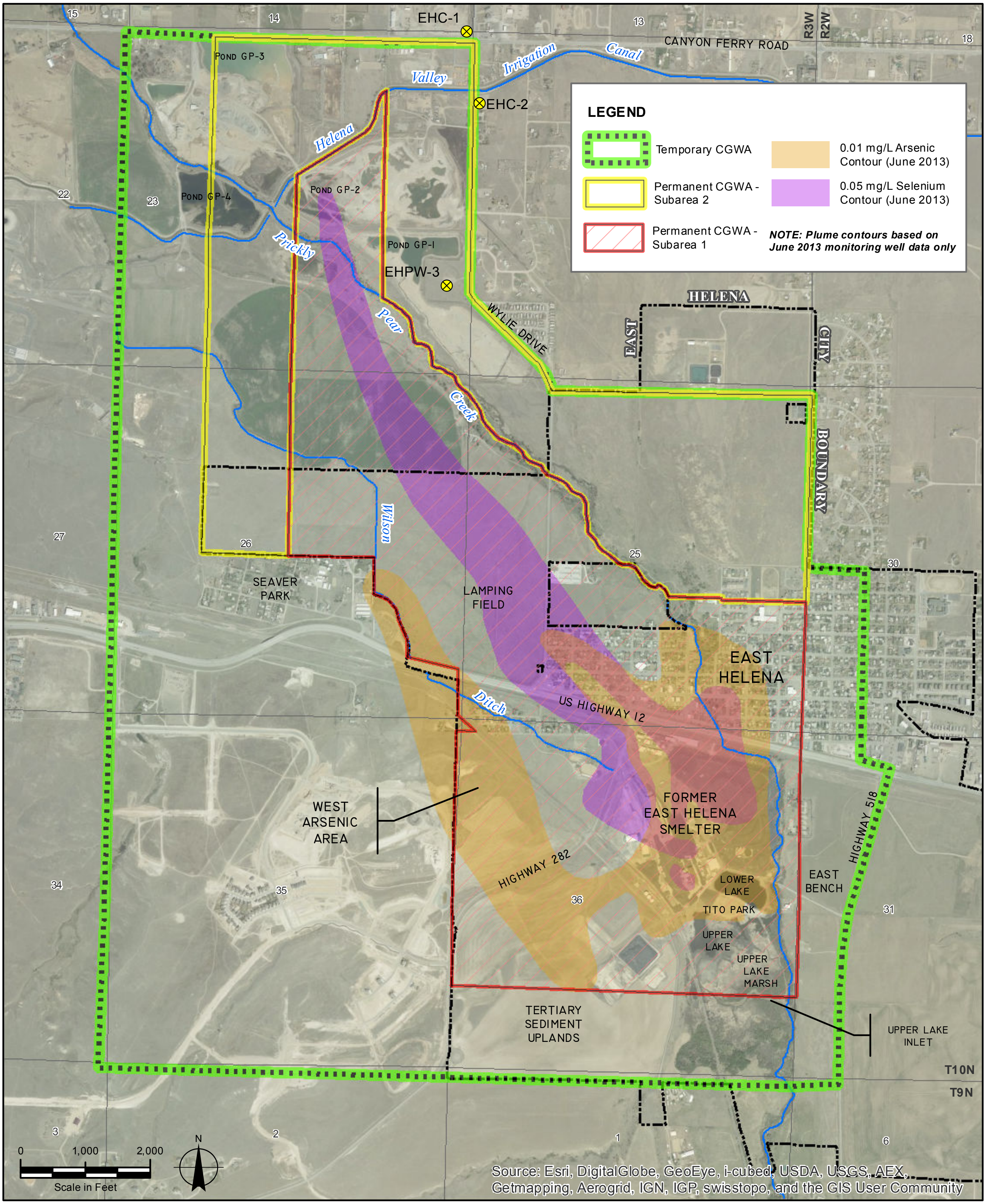
For the purposes of this petition, the project area (or proposed CGWA) includes those portions of the Helena Valley alluvial aquifer and adjacent southern foothills with elevated concentrations of arsenic, selenium, and/or trace metal concentrations attributable to the former smelter as well as other sources of contaminants of concern in the area. As described in Section 4, the proposed CGWA boundaries are based on the current areal extent of contaminants exceeding applicable state Human Health Standards (10 micrograms per liter (µg/L) for arsenic and 50 µg/L for selenium), plus buffer zones around the contaminant plumes where water quality exceedances could occur due to future changes in contaminant migration or pumping-induced changes to the plume boundaries. The areal extent of exceedances has been defined based on groundwater quality data collected by the Custodial Trust as part of the RCRA Corrective Action work being performed at the former East Helena Facility[2]. Figure 1-1 shows the general project area with key physical and geographical features identified.

The proposed CGWA encompasses approximately 3,290 acres (5.1 square miles) including all or portions of Sections 23, 24, 25, 26, 35 and 36 in Township 10 North, Range 3 West (Figure 1-1). Key features in the area, in terms of relevance to the CGWA, include the former smelter site, the Tertiary sediment foothills or uplands around the former smelter site, the City of East Helena (East Helena), Prickly Pear Creek, Lamping Field, and Seaver Park (Figure 1-1). Following is a description of aspects of these key site features relevant to the CGWA petition.

1.1.1 Former Smelter Site

ASARCO began smelting operations at the former smelter in 1888, producing lead bullion from a variety of foreign and domestic concentrates, ores, fluxes, and other non-ferrous metal bearing materials. In addition to lead bullion, the smelter produced copper by-products and food-grade sulfuric acid. Smelter operations were terminated in 2001, and in 2005 ASARCO filed for Chapter 11 bankruptcy. In December 2009, as part of the ASARCO bankruptcy settlement agreement, ownership of and cleanup responsibility for the former smelter site and associated ASARCO-owned properties (collectively referred to as the Facility) were transferred from ASARCO to the Custodial Trust.

[2] The terms smelter or former smelter refer to the former smelter plant site while Facility refers to all properties formerly owned by ASARCO and transferred to the Custodial Trust, including the former smelter site.



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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

SITE FEATURES NEAR THE PROPOSED EAST VALLEY CONTROLLED GROUNDWATER AREA

FIGURE

1-1

The former smelter plant site, where actual smelting operations occurred, occupies approximately 142 acres in the northeast quarter of Section 36, Township 10N, Range 3 West (Figure 1-1). The former smelter site is bounded to the south by a lake/marsh complex (Upper Lake and Marsh) and to the east and northeast by Prickly Pear Creek. Uplands or foothills comprised of tertiary-age sediments border the smelter on the west and southwest, and U.S. Highway 12 and the American Chemet plant (a manufacturer and marketer of metals-based chemicals) border the smelter to the north. The City of East Helena business district and major residential areas are located north of Highway 12 and the former smelter (Figure 1-1). Based on data collected over a period of twenty-five years, the smelter and surrounding soils and groundwater contain elevated concentrations of certain metals, including cadmium, copper, lead and zinc, as well as arsenic and selenium. Groundwater monitoring on and downgradient of the smelter has also identified a groundwater arsenic plume and a groundwater selenium plume originating from the former smelter site and extending to the north/northwest into the Helena Valley (Figure 1-1). This environmental data has confirmed that the former smelter site is a primary source of contaminant loading to groundwater in the proposed CGWA.

The extreme southern portion of the former smelter site is occupied by a lake/marsh complex referred to as Upper Lake and Upper Lake Marsh. The marsh is associated with the Prickly Pear Creek riparian area, while Upper Lake is primarily a manmade feature constructed by ASARCO to provide water for smelting operations. Historically, leakage from Upper Lake was a significant source of recharge to the local groundwater system. Starting in November of 2011, the Custodial Trust began draining Upper Lake to assess the effect on groundwater elevations and flow rates on the former smelter site, and ultimately the effect on contaminant leaching and migration from plant site soils (see Upper Lake Drawdown Test Technical Memorandum, Appendix A). Other surface water features on or near the former smelter site include Lower Lake, another manmade process water storage pond, Prickly Pear Creek which flows from south to north along the eastern smelter boundary, and Wilson Ditch, an irrigation ditch historically fed by Upper Lake and extending from the western smelter boundary northward into the Helena Valley (Figure 1-1). Wilson Ditch has not been used to deliver irrigation and/or stock water to the Prickly Pear Simmental (Burnham) Ranch since the end of the 2011 irrigation season. Since then, use of the ditch to deliver Prickly Pear Creek water has been discontinued and the Prickly Pear Simmental Ranch has permanently relinquished all interest in Wilson Ditch. Future use of some or all of Wilson Ditch, if any, will be consistent with the East Valley CGWA requirements and restrictions.

Cleanup of the former smelter and the surrounding areas was initiated under EPA's CERCLA program and, since 1998, has been managed under EPA's RCRA Corrective Action Program (USEPA, 1994) pursuant to a 1998 Consent Decree entered into by EPA and ASARCO. The Consent Decree was modified by EPA and the Custodial Trust and the First

Modification to the Consent Decree (the First Modification), (US District Court, 2012) was entered in Federal District Court in 2012. The First Modification specifies requirements for cleanup of the Facility under the RCRA Corrective Action program, with EPA as the lead regulatory agency. Pursuant to the First Modification, the Custodial Trust is preparing a Corrective Measures Study (CMS) to identify and evaluate remedies that are protective of human health and the environment. The cleanup and control of contaminated groundwater migrating from the former smelter site is a primary objective of the CMS. Remedies being evaluated include addressing source areas as well as both engineering controls and institutional controls. The CGWA is a critical institutional control and interim measure to prevent exposure to groundwater with contaminant concentrations exceeding State of Montana HHSs. The Custodial Trust is also implementing additional Interim Measures (IMs) intended to reduce contaminant mass loading to groundwater and migration of contaminated groundwater from the former smelter site while final remedy evaluations are being completed. Implementation of the IMs (described in more detail in Section 6 of this document) is also consistent with provisions within the First Modification specifying the use of IMs to address the spread of and potential exposure to contaminants associated with the Facility.

1.1.2 City of East Helena

East Helena is located north of the smelter with much of the main business and residential areas overlying the groundwater plumes (Figure 1-1). The majority of residences within city limits are served by the municipal water system. In 2003, the city adopted an ordinance (City Code 8-3-7) prohibiting drilling of private water wells, and reactivation of existing inactive private water wells within the city water service area. Under East Helena Code 8-3-6, the East Helena water service area is defined as including all areas within the city boundaries as well as some areas outside the city boundaries that are served by the municipal water system. In November of 2009, prior to the creation of the Custodial Trust, all ASARCO-owned property in the vicinity of East Helena was annexed into the city. Therefore, the Custodial Trust property is subject to all East Helena municipal Codes, including city codes 8-3-7 and 8-3-6. A significant portion of the proposed CGWA north of the former smelter site is subject to the East Helena well moratorium, thus restricting future groundwater usage in these areas. A limited number of "grandfathered" private wells do still exist within the East Helena well ban area. Although most of these private wells are used for lawn irrigation, a few are still used for potable water. The Custodial Trust regularly samples many of these private wells (where owner permission has been granted) and provides sampling results to the well owners. The Custodial Trust's residential well sampling program and results, and their relevance to the CGWA petition, are discussed in various sections of this document.

The three municipal wells serving the East Helena municipal water system are shown on Figure 1-1. All three wells are located outside of the arsenic and selenium plumes. Regular sampling by city personnel and the Custodial Trust confirm that these public water supply wells are not impacted by the former smelter site groundwater plumes. One of the municipal wells (EHPW-3) is located inside the proposed CGWA boundaries to protect against potential future plume encroachment towards the well due to future groundwater development in the area.

1.1.3 Surface Water Features

Primary surface water features within the proposed CGWA include Prickly Pear Creek, the Helena Valley Irrigation Canal, and a number of gravel pit ponds northwest of the Facility (Figure 1-1). A number of active and inactive irrigation ditches are also located in the proposed CGWA. Prickly Pear Creek flows northwestward from the smelter through East Helena and towards the Helena Valley. The creek is a losing stream through most of this reach, meaning it leaks water to the underlying groundwater system. Leakage from the creek results in groundwater mounding beneath the creek, which in turn influences groundwater flow patterns and contaminant plume migration north of the former smelter site. The Helena Valley Irrigation Canal (HVIC) flows from east to west across the northern portion of the project area (Figure 1-1). Previous studies have documented average HVIC leakage rates of approximately 280 gallons per minute (gpm) per mile along the entire canal length (Briar and Madison, 1992). The effects of leakage from the creek and canal on local groundwater flow and plume migration patterns are discussed further in Section 2.2.2.

A number of gravel pit ponds are present near the intersection of the HVIC and Prickly Pear Creek. The ponds are fed primarily by groundwater with the pond water levels dictated in part by past gravel mining operations. Water levels within the gravel pit ponds are believed to have a direct influence on the horizontal and vertical migration of the selenium plume in this area, and are further addressed in Section 2.2.3.

Wilson Ditch, an irrigation ditch extending from Upper Lake into the Helena Valley, borders the west side of Lamping Field. Historically, leakage from the ditch resulted in groundwater mounding along its course, affecting groundwater flow and contaminant plume migration patterns. As noted above, Wilson Ditch has not been used to convey water since late 2011. This change in the local groundwater flow regime has been factored into development of the CGWA boundaries as described in this petition.

1.1.4 Other Relevant Features

In addition to the primary features described above, other relevant features in the area include the Tertiary sediment foothills or uplands in the southwestern portion of the CGWA, Lamping Field, and Seaver Park. As described in Section 2, the Tertiary sediment uplands west and southwest of the former smelter influence both the regional groundwater flow and chemistry. The Tertiary sediments are believed to contribute to elevated groundwater arsenic levels in the area, and therefore are relevant to the CGWA petition.

Lamping Field is a large area of vacant land northwest of the former smelter. The Lamping Field property is owned by the Custodial Trust and has been annexed into the City of East Helena. Although the East Helena municipal water and sewer system does not currently service this area, future property development will require hook ups to the municipal water system. Besides serving as a locational reference throughout this document, Lamping Field is relevant to the East Valley CGWA petition since the groundwater contaminant plumes pass directly beneath the property and it therefore represents a significant portion of the proposed CGWA.

Seaver Park is a residential subdivision located north of Highway 12 and west of Lamping Field (Figure 1-1). Seaver Park has been included in the proposed CGWA because past sampling has shown a number of wells in the subdivision exceed the State of Montana HHS for arsenic. There are approximately 50 residences in Seaver Park with all residences serviced by individual private water supply wells. ASARCO and/or the Custodial Trust sampled the majority of Seaver Park wells in 2009 and/or 2010 as part of the Facility groundwater monitoring program. Sampling results showed 19 of the wells exhibited arsenic concentrations at or above the 10 µg/L human health standard[3]. Based on evaluations to date, as described further in Section 2 and Appendix B, the elevated arsenic concentrations in the Seaver Park wells are believed to be attributable, at least in part, to source(s) other than the former smelter. Nevertheless, because of the number of private wells and the presence of elevated arsenic in groundwater, and its proximity to the former smelter, this petition includes the Seaver Park subdivision as a Temporary CGWA to allow for additional evaluation of the occurrence and source(s) of arsenic in this area. Pending the evaluation results, the area would be converted to a permanent CGWA in the future, if warranted, or deleted entirely from the East Valley CGWA.

The preceding sections provide a brief overview of the former smelter site and surrounding area. Detailed discussions of the former smelter operations, environmental conditions and past remediation activities are provided in a number of documents including Hydrometrics, 1990 and 1999, ASARCO Consulting, Inc. (ACI), 2005, as well as documents and reports prepared by the Custodial Trust and submitted to EPA including interim measures work plans (CH2MHill, 2013a, 2013b), Phase II RFI Work Plan (Hydrometrics, 2010), Phase II RFI Report (METG, 2011), annual water resources monitoring plans (Hydrometrics, 2013), and groundwater modeling activities (Newfields, 2014). Additional detail on the history and physical characteristics of the smelter and surrounding area, as relevant to the CGWA

[3] Although elevated arsenic is known to occur in portions of Seaver Park, the June 2013 arsenic plume on Figure 1-1 does not encompass Seaver Park since there is no groundwater data available for Seaver Park private wells for that time period.

petition, are presented in Section 2 and Appendix B of this document. Key components of the proposed East Valley CGWA and information required for or relevant to the petitioning process are described in subsequent sections.

2.0 HYDROGEOLOGIC SETTING

The hydrogeology or groundwater characteristics of the area are relevant to the East Valley CGWA petition since these factors control the current extent of the contaminant plumes, and ultimately the appropriate horizontal and vertical boundaries of the CGWA. The hydrogeology of the former smelter site and the Helena Valley has been described in numerous reports. Groundwater flow and chemistry on and around the former smelter site have been investigated as part of, and prior to, the RCRA Corrective Action program currently being conducted by the Custodial Trust. The results of these studies are best described in the Current Conditions/Release Assessment (CC/RA) Report (Hydrometrics, 1999), the Phase I RCRA Facility Investigation (RFI) report (ASARCO Consulting, Inc., 2005), the Phase II RFI Work Plan (Hydrometrics, 2010), and the Phase II RFI report (METG, 2011). The East Helena Facility cleanup program includes extensive groundwater and surface water monitoring on a seasonal basis. For instance, the 2013 monitoring program including groundwater level and/or groundwater quality sampling at 200 monitoring wells and piezometers (Hydrometrics, 2013). The East Helena Facility monitoring well network is shown in Exhibit 1.

The hydrogeology of the general Helena Valley area has been described in a number of previous reports including Briar and Madison (1992), Thamke (2000), and Swierc (2013). Previous studies have differentiated between the Helena Valley "valley-fill" aquifer, comprised of unconsolidated sands, gravels, silts and other granular material, and the underlying bedrock aquifer. The East Valley CGWA petition is applicable to the valley-fill aquifer only, where the presence of arsenic and selenium plumes have been documented. Following is a general description of the hydrogeology and groundwater quality of the Helena valley-fill aquifer (also referred to as the Helena Valley alluvial aquifer) and a more detailed discussion of the hydrogeology of the area proposed for inclusion in the CGWA.

2.1 REGIONAL HYDROGEOLOGY

The Helena valley-fill aquifer covers an area of approximately eight square miles within the Helena Valley basin. The valley-fill aquifer is comprised of Tertiary and Quaternary-age unconsolidated granular material ranging in size from cobble and boulder down to silt and clay. The unconsolidated valley-fill overlies bedrock at depth, with the valley-fill aquifer reaching 6,000 feet or more in thickness in the northeast portion of the Valley (Briar and Madison, 1992). The majority of valley fill is comprised of Tertiary age sediments with the upper 100 feet or more comprised of younger alluvium (Briar and Madison, 1992). The valley-fill aquifer serves as a drinking water source for the majority of Helena Valley residents through individual domestic wells, community wells, and public water supply wells.

Recharge to the valley-fill aquifer occurs from streamflow infiltration, leakage from irrigation ditches and canals, infiltration of excess irrigation water, inflow from the surrounding and underlying bedrock aquifer, and, to a lesser extent, direct precipitation. Inflow from the surrounding bedrock aquifer is the greatest source of recharge to the valley-fill aquifer basin-wide, with bedrock recharge accounting for about 46% of annual recharge (Briar and Madison, 1992). Recharge from irrigated fields accounts for about 31% of annual recharge, with stream leakage and irrigation canal/ditch leakage accounting for 15% and 8%, respectively.

Groundwater flow directions in the valley-fill aquifer are generally from the north, west and south valley margins, towards Lake Helena, the regional groundwater drain in the northeast portion of the valley. As a result, the valley-fill potentiometric surface, or contour map of groundwater potential head, forms a more or less concentric pattern with the low point centered on Lake Helena. A generalized potentiometric map of the valley-fill aquifer, with the former smelter and approximate East Valley CGWA shown for reference, is included in Figure 2-1.

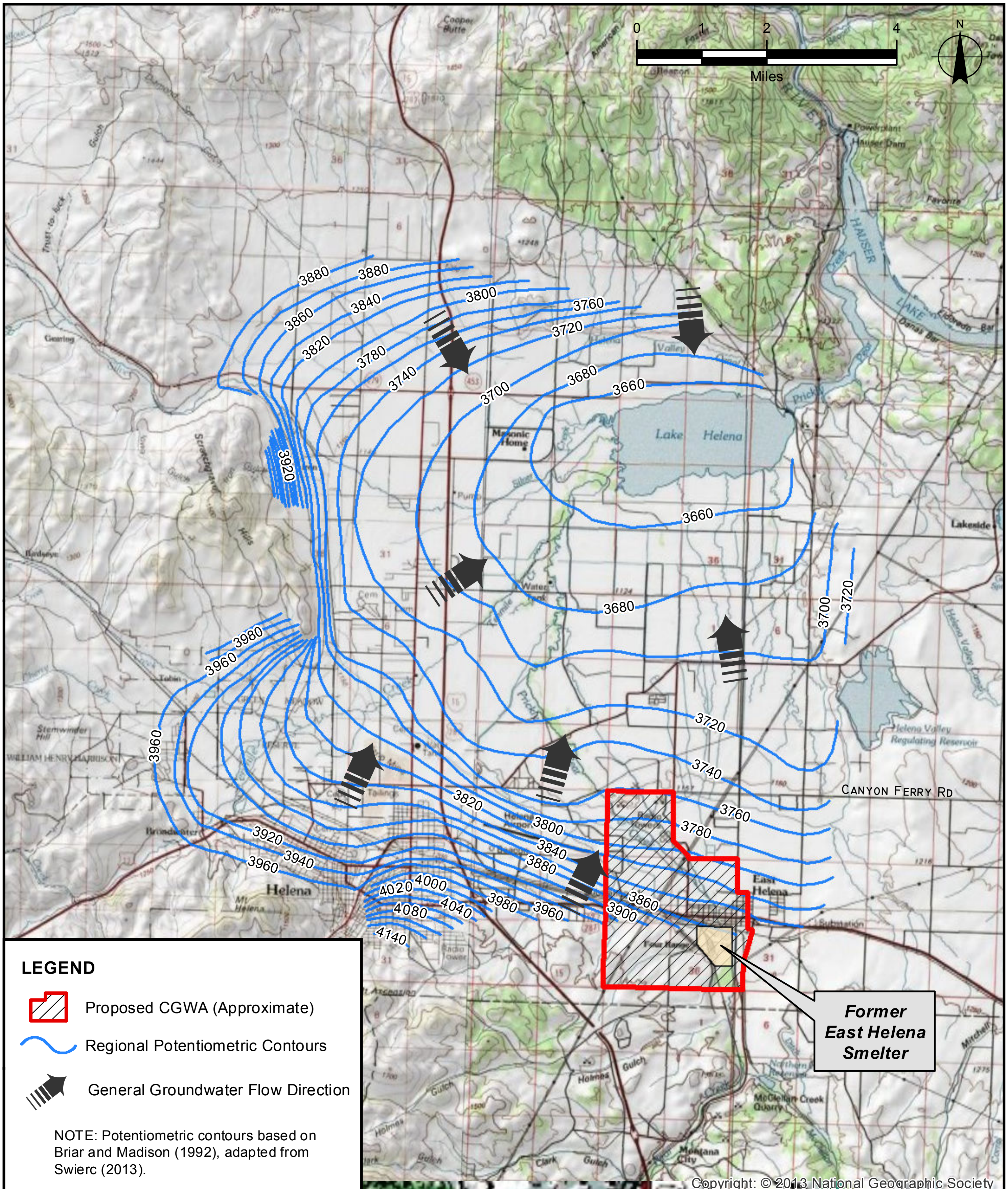
The valley-fill material generally consists of relatively permeable sands, gravel, and cobbles, with interlayered zones of less permeable silt and clay. The silt/clay layers are relatively thin (a few feet to 10 feet in thickness) and are laterally discontinuous. As such, the silt/clay layers inhibit but do not prevent vertical flow between the more extensive and more permeable coarser-grained water-bearing zones. This general stratigraphic pattern, which has been documented near and north of the former smelter site through the Facility investigations, directly influences contaminant plume migration and the proposed CGWA boundaries.

2.2 LOCAL HYDROGEOLOGY

Within the proposed CGWA, groundwater conditions are generally similar to the regional conditions described above. On and north of the former smelter (the primary contaminant source within the proposed CGWA), the valley-fill stratigraphy and hydrogeology have been documented through logging of more than 200 monitoring wells, piezometers, and soil borings as well as by reviewing available well completion logs from private and public water supply wells. The area of interest and key features for the local hydrogeology discussion (and the CGWA petition) are shown in Figure 1-1.

2.2.1 Geology and Hydrostratigraphy

The local geology, both surficial and subsurface, has a strong influence on groundwater flow and contaminant plume migration. Important features of the local geology include: exposed metasedimentary Spokane formation bedrock (Ys) in the southwest portion of the CGWA; a large area of alluvium (Qa) extending along Prickly Pear Creek from the former smelter site



LEGEND

Proposed CGWA (Approximate)

Regional Potentiometric Contours

General Groundwater Flow Direction

NOTE: Potentiometric contours based on Briar and Madison (1992), adapted from Swierc (2013).

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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

REGIONAL POTENTIOMETRIC MAP

FIGURE 2-1

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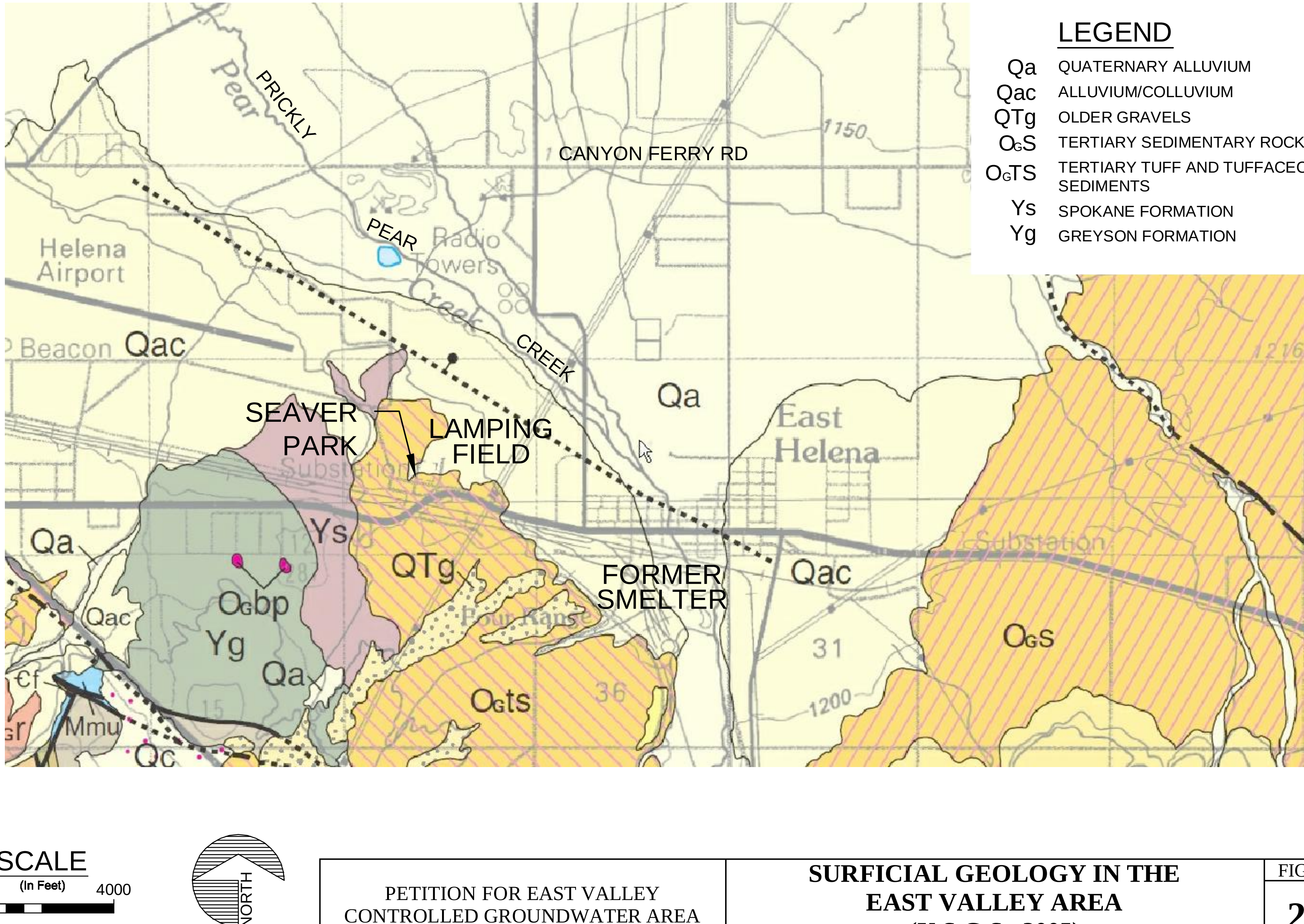
northward into the Helena Valley; the uplands or foothills comprised of fine-grained Tertiary sediments south, east (OgS) and west (OgtS) of East Helena; and commingled alluvium and colluvium (Qac) intermediate to the Tertiary uplands and alluvium along the Prickly Pear Creek corridor. The surficial geology of the immediate area is shown in Figure 2-2. Following is a summary of the CGWA geology and hydrostratigraphy. Additional detail is provided in Appendix B.

<u>Younger (Quaternary) Alluvium and Mixed Alluvium/Colluvium:</u> Much of the CGWA including the former smelter site is situated on recent unconsolidated alluvial/colluvial sediments that extend northward from the southern basin margin into the valley. The alluvium (Qa in Figure 2-2) represents relatively recent sediment deposition from Prickly Pear Creek and forms in part the primary groundwater-bearing unit within the CGWA. The thickness of the alluvium, where present, ranges from about 20 feet in the south portion of the CGWA, to 100 feet or more in the northern portion.

Distal from Prickly Pear Creek the alluvium grades to a heterogeneous mixture of alluvium and colluvium (Qac). The alluvium/colluvium contains a higher percentage of fine-grained silt and fine sand than the alluvium. Fine sediment content increases with distance from the creek, resulting in a lower permeability. This difference in permeability influences groundwater flow and plume migration in the CGWA.

<u>Older Quaternary/Tertiary Alluvium:</u> Older alluvium of early Quaternary and late Tertiary age underlies the more recent alluvium. Based on data obtained through drilling within the proposed CGWA, these sediments are weakly consolidated sand, silty sand and gravel with discontinuous silt layers. The thickness of this unit ranges up to about 30 feet on the former smelter site, and increases to 100 feet or more at the north end of the CGWA near Canyon Ferry Road (Figure 1-1). Overall, the older alluvium contains more fine-grained sediment and is more highly cemented with secondary mineral precipitates than the younger alluvium, but still serves as a primary water-bearing unit in the valley-fill aquifer.

<u>Tertiary Sediments:</u> Tertiary-age sediments (OgS) consisting primarily of fine-grained sediments (silt/fine sand) form the foothills south of East Helena and in the southwest portion of the CGWA (Figure 2-2). In the southwest area, the Tertiary sediments contain significant volcanic ash and tuff beds (OgtS) partially or completely altered to clay. A laterally extensive weathered ash/clay unit within the Tertiary sediments underlies a substantial portion of the former smelter and surrounding area. As discussed below (and in Appendix B), the ash/clay unit plays an important role in groundwater flow while the volcaniclastic sediments affect the regional groundwater chemistry and distribution of arsenic in the proposed CGWA.



PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

SURFICIAL GEOLOGY IN THE EAST VALLEY AREA (U.S.G.S., 2005)

FIGURE 2-2

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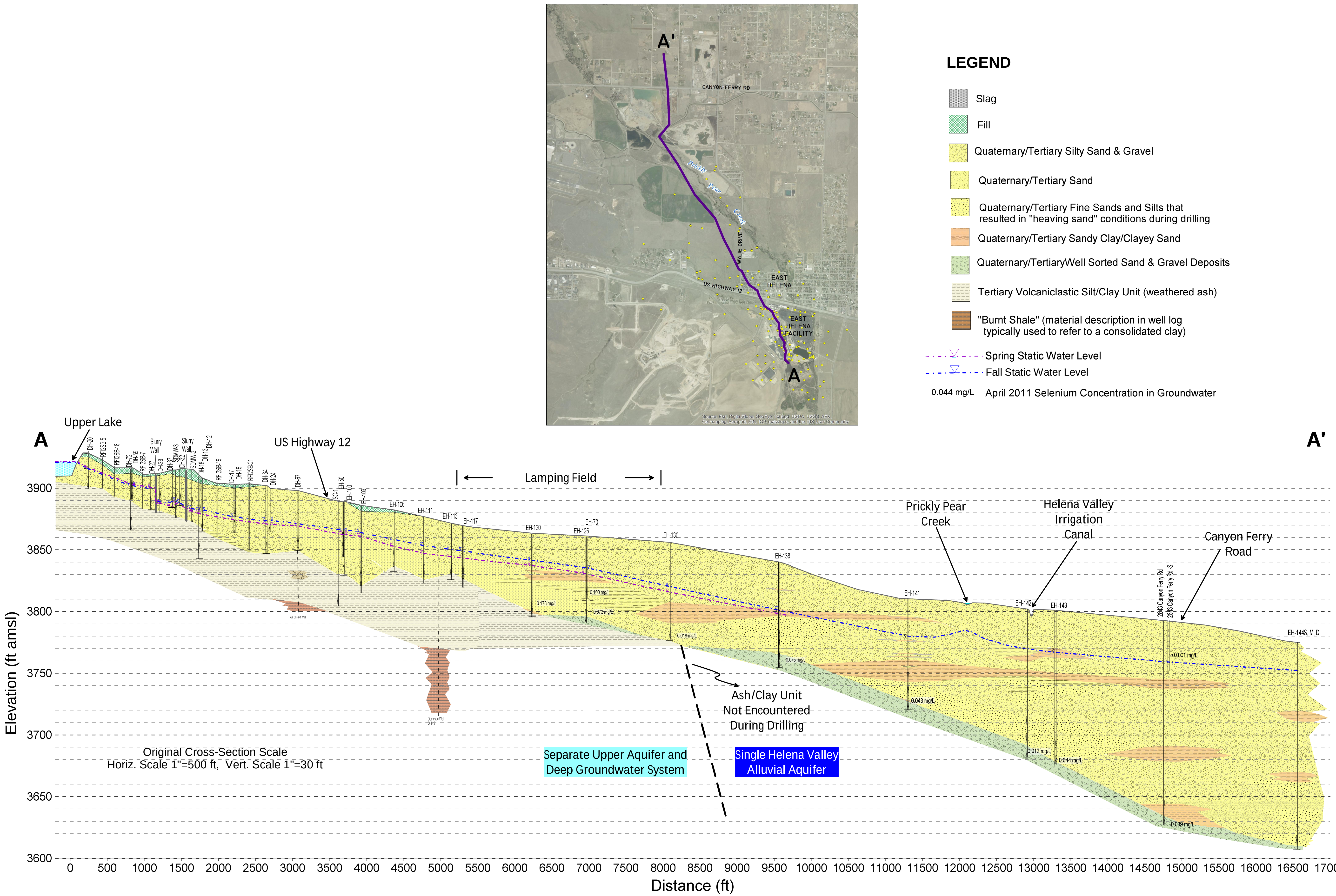
A hydrostratigraphic unit is one or more stratigraphic units with similar hydrologic characteristics allowing for grouping into a single unit for purposes of describing groundwater occurrence and flow. Based on the local geology and stratigraphy, the following hydrostratigraphic units have been identified within the proposed CGWA.

Upper Aquifer: The Upper Aquifer is comprised of unconsolidated granular fill and alluvial/colluvial sediments extending from ground surface down to the top of the weathered Tertiary ash/clay layer. The Upper Aquifer hydrostratigraphic unit extends from Upper Lake on the south end of the former smelter site, northward through the East Helena area and into the Helena Valley.

Tertiary Ash/Clay Confining Unit: Underlying the Upper Aquifer in the southern portion of the CGWA is a clay-rich low permeability unit inhibiting vertical groundwater flow. This confining unit, or aquitard, is comprised of the weathered Tertiary volcaniclastic sediments described above. Based on extrapolation of well log data throughout the CGWA, the low permeability clay unit appears to be continuous from south of the former smelter site northward through Lamping Field, with depths ranging from about 20 feet below ground surface at the south end of the smelter, to 50 feet bgs at the north end, and 80 feet bgs north of Lamping Field. The ash/clay unit has not been identified in monitoring wells completed to depths of 175 feet in the vicinity of Canyon Ferry Road. Figure 2-3 shows the cross sectional relationship between the Upper Aquifer and the ash/clay aquitard from the smelter on the south, extending northward approximately three miles into the Helena Valley.

Deeper Groundwater System: Besides the Upper Aquifer, groundwater in the southern portion of the CGWA, including the former smelter site, occurs at depths below the ash/clay confining layer. Unlike the Upper Aquifer, which occurs as one continuous saturated unit, the deeper groundwater occurs as multiple coarser-grained layers interspersed within and beneath the ash/clay unit. Because the deeper water bearing zones may have limited interconnectivity, they are referred to as the deep groundwater system as opposed to a single aquifer. These deeper water-bearing zones are present within different materials at various depths.

In the northern portion of the CGWA (north of Lamping Feld), the hydrostratigraphy changes due to the apparent absence of the ash/clay aquitard. As shown in Figure 2-3, the ash/clay layer has not been detected during monitoring well drilling or through review of private well completion logs in the northern portion of the CGWA (north of Section 26, Figure 1-1). Therefore, groundwater within the Upper Aquifer and deeper groundwater systems present in the southern portion of the CGWA apparently merges into a single, vertically continuous aquifer (the Helena Valley alluvial or valley fill aquifer) north of Lamping Field.



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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA	GEOLOGIC CROSS SECTION	FIGURE 2-3

2.2.2 Groundwater Recharge/Discharge

The primary documented sources of groundwater recharge within the CGWA include leakage of surface water to groundwater and possibly inflow from the surrounding Tertiary sediment and bedrock uplands (Briar and Madison, 1992). Until recently, leakage from Upper Lake was a significant source of recharge to the Upper Aquifer at the former smelter site, with the Upper Lake seepage water flowing north-northwest through the smelter towards the Helena Valley. Historic releases of contaminants from former smelter operations, and ongoing leaching of contaminants to groundwater from the plant site soils, are primary mechanisms for contaminant transport and plume migration leading to this petition. As part of implementation of IMs, in the fall of 2011 the Custodial Trust began dewatering Upper Lake to determine if reducing recharge from the surface water bodies would lower groundwater elevations (Appendix A). Extensive monitoring of groundwater levels following dewatering of Upper Lake, and installation of a temporary bypass for Prickly Pear Creek in October 2013, shows that groundwater elevations have declined in response to these activities. Therefore, Upper Lake is to remain dewatered indefinitely to lower groundwater elevations and reduce groundwater flow through the contaminated former smelter site on a permanent basis.

Of the primary sources of groundwater recharge, leakage from area surface waters to the valley fill aquifer has the greatest influence on groundwater flow and contaminant migration patterns within the proposed CGWA. June 2013 streamflow monitoring on Prickly Pear Creek by Hydrometrics (Table 2-1, Figure 2-4) shows a decrease in creek flow from 90 to 55 cfs between the Highway 12 bridge in East Helena (site PPC-7) to Canyon Ferry Road (site SG-16), a distance of roughly 3 miles. This represents a loss of about 35 cfs or 15,700 gpm, the majority of which likely recharges the underlying groundwater system. In September 2013, the measured streamflow loss was approximately 11 cfs across the same reach, or about 5,000 gpm (Table 2-1). Similar results have been obtained by Lewis and Clark County through streamflow monitoring within this reach of Prickly Pear Creek (Appendix B).

As discussed below, leakage and associated groundwater mounding beneath the creek imparts a strong influence on groundwater flow and contaminant plume migration patterns in the CGWA. As such, future changes in Prickly Pear Creek streamflow and leakage rates could affect future groundwater flow and plume migration patterns. Potential changes in creek flow and leakage rates could result from changes to in-stream leasing agreements currently in effect on Prickly Pear Creek, modifications to the creek channel as part of the Custodial Trust's proposed South Plant Hydraulic Control IM, and/or future drought or other climatic conditions. All of these potential influences, some acting to increase and some decrease future streamflow, have the potential to influence future groundwater flow and plume migration patterns, and have been considered in development of the proposed CGWA boundaries (Section 4).

Hydrometrics, Inc. Consulting Scientists and Engineers Date Saved: 4/10/2014 1:57:41 PM	PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA	SYNOPTIC STREAMFLOW MONITORING LOCATIONS	FIGURE 2-4

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TABLE 2-1. PRICKLY PEAR CREEK
SYNOPTIC STREAMFLOW MEASUREMENTS

Site ID	Location	Flow - cfs	
		6/11/13	9/16/13
PPC-3A	Upstream near Kleffner Ranch	86.5	17
PPC-22	Near Upper Lake Diversion	89.1	17.3
PPC-5	Below Smelter Dam	92.7	15.2
PPC-23	East of Slag Pile	82.9	15.8
PPC-7	Upstream of Highway 12 Bridge	89.9	16.3
PPC-36A	Upstream of Wylie Drive	70	16.1
PPC-10	Near Wylie Drive Gravel Pit	61.7	10.3
SG-16	At Canyon Ferry Road	54.9	5.2
Total Leakage PPC-7 to SG-16		**35.0 cfs**	**11.1 cfs**

Notes: Locations shown on Figure 2-4.

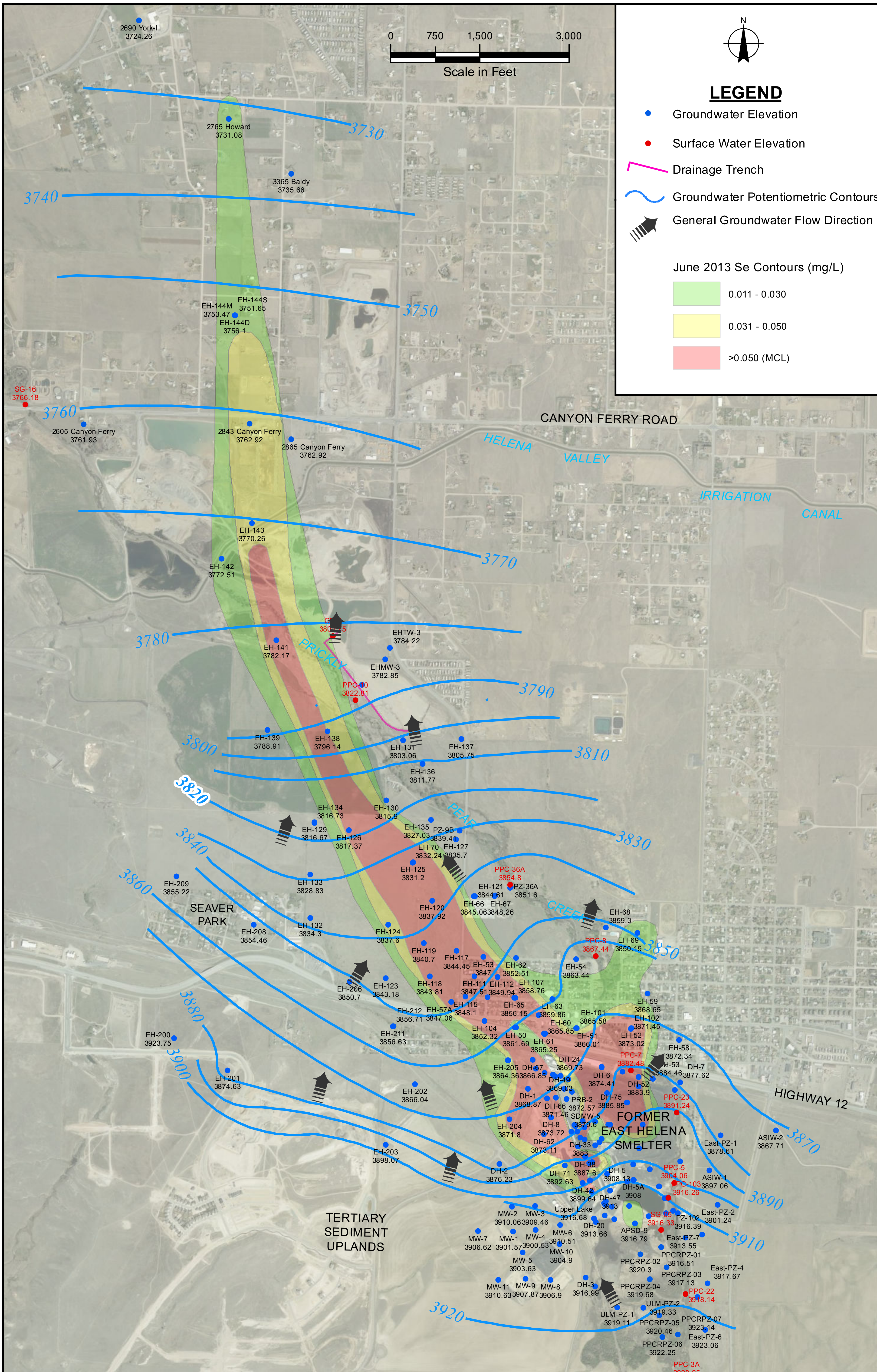
Wilson Ditch is an unlined irrigation ditch which previously conveyed irrigation water from Upper Lake northwestward to the Burnham Ranch in the Helena Valley (Figure 2-4). Historically, leakage from Wilson Ditch recharged groundwater west of the former smelter and along the west side of Lamping Field. In conjunction with the Upper Lake dewatering program (Appendix A), Wilson Ditch has not been operational since the end of the 2011 irrigation season, and use of the ditch to deliver Prickly Pear Creek water has been discontinued. Similar to Prickly Pear Creek, leakage from Wilson Ditch (Appendix A) resulted in seasonal groundwater mounding along the west side of the smelter and Lamping Field, limiting the westward migration of the groundwater plumes in this area. The effects of the discontinued use of Wilson Ditch on future groundwater flow and plume migration patterns has been evaluated through various hydrologic analyses and groundwater flow modeling, and has been accounted for in establishing the proposed CGWA boundaries (Section 4).

As shown in Figure 2-4, the Helena Valley Irrigation Canal is located about two miles north of the former smelter and within the area of the groundwater plumes. Briar and Madison (1992) estimated an average leakage rate of 0.63 cfs (280 gpm) per mile for the Helena Valley Irrigation Canal based on synoptic streamflow measurements collected along the entire canal length. Hydrometrics collected synoptic streamflow measurements on the segment of canal crossing the groundwater plumes (Figure 2-4) to better define canal leakage, and possible effects on groundwater flow and contaminant migration in the downgradient plume area. Differences in the upstream and downstream flow measurements were largely within the flow measurement margin of error (+/-10%), meaning the canal leakage rate (and associated groundwater recharge) in the vicinity of the plumes could not be quantified. However, the section of canal crossing the plume area is partially lined with asphaltic membrane, which likely reduces the actual leakage rate in this area to less than the 0.63 cfs/mile estimated for the entire 53-mile length of the canal.

2.2.3 Groundwater Flow Patterns

Figure 2-5 shows a map of the valley-fill aquifer potentiometric surface within the proposed CGWA. The map was produced from groundwater level measurements collected from the more than 200 monitoring wells and piezometers included in the East Helena Facility groundwater monitoring program, as wells as from surveyed stage elevations along Prickly Pear Creek. Consistent with the regional potentiometric surface and groundwater flow patterns (Figure 2-1), the local groundwater flow direction is generally from the valley margin on the south, northward towards the Helena Valley and ultimately towards Lake Helena, which receives regional groundwater drainage. Primary points of interest in the local potentiometric map (Figure 2-5) include the following:

- The effect of leakage from Prickly Pear Creek on the potentiometric surface is evident from the map. The northward bulge in the potentiometric surface extending from the smelter northward through Lamping Field (to about the 3820 potentiometric contour) represents groundwater mounding due to leakage from the creek. This northwestward-oriented groundwater mound or ridge influences groundwater flow directions along the west side of the creek, and is responsible in part for the northwestward groundwater plume trajectory.
- North of the 3820 potentiometric contour, groundwater mounding is greatly reduced. The reduced mounding is believed to primarily result from groundwater drainage associated with a nearby gravel pit. As shown on Figure 2-5, a perimeter drain is located along the gravel pit floor, presumably to lower the adjacent water table to support prior mining operations (the pit is no longer active). Based on field measurements, the perimeter drain flow rate varied from 2 to 3 cfs (900 to 1350 gpm) in 2012 and 2013. Groundwater drainage through the perimeter trench is believed to be responsible, at least in part, for dissipation of the groundwater mound in this area, which in turn imparts controls on the selenium plume orientation. Dissipation of the groundwater mound causes the groundwater flow direction (and the selenium plume) to veer northward at this location crossing beneath the creek. As a consequence, future changes in the gravel pit groundwater drain system may have implications for future plume migration patterns, and has been considered in development of the proposed CGWA boundaries (Section 4).



PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

LOCAL GROUNDWATER POTENTIOMETRIC MAP FOR JUNE 2013

FIGURE 2-5

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- As shown on both the local potentiometric map (Figure 2-5) and the regional Helena Valley potentiometric map (Figure 2-1), groundwater west and southwest of the former smelter site flows in a northeasterly direction. This influx of groundwater from the southwest acts to buttress groundwater flow on and north of the former smelter (i.e., in Lamping Field), limiting westward groundwater flow and plume migration, even in the absence of Wilson Ditch leakage. The groundwater flow from the southwest is also believed to contribute to the elevated arsenic concentrations in the vicinity of the proposed CGWA as discussed below and in Appendix B.

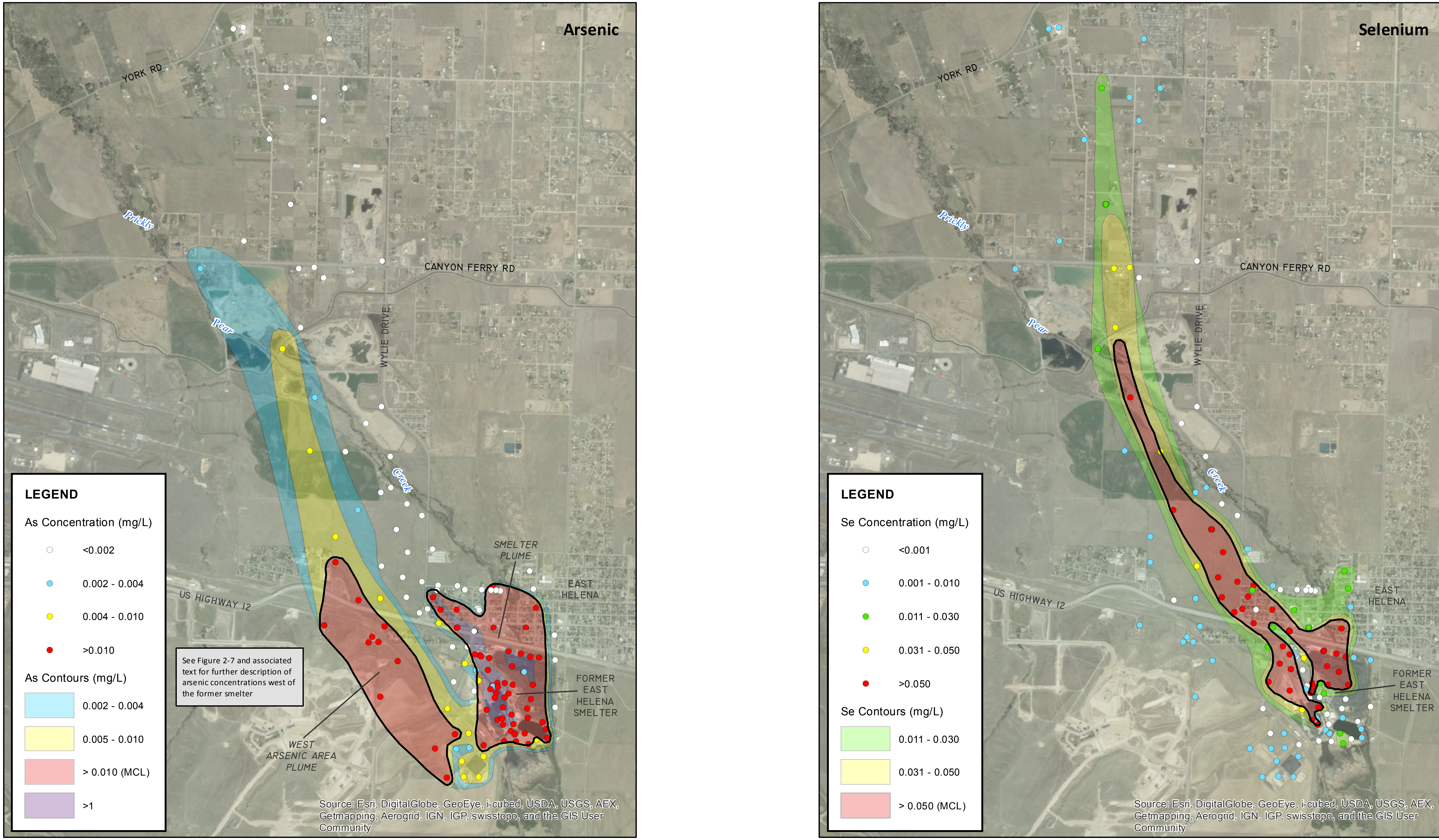
The area hydrogeology as described above, coupled with the groundwater chemistry and plume information presented below, forms the framework for the East Valley CGWA boundaries and provisions outlined in the following sections.

2.3 FORMER SMELTER SITE GROUNDWATER PLUMES

Two groundwater contaminant plumes, one containing elevated concentrations of arsenic and the other selenium, originate from the former smelter site and extend north-northwest towards the Helena Valley (Figure 2-6). As previously mentioned, historic smelter operations released contaminants to the environment over many decades. Although smelter operations ceased in 2001, the leaching of contaminants (i.e., arsenic and selenium) from soils, slag, and/or smelter debris is ongoing. Once partitioned from soil to groundwater, the contaminants migrate with groundwater following the general direction of groundwater flow.

The rate and spatial extent of contaminant migration (i.e., spatial extent of plumes), is based on source mass, source status (historic or current), groundwater flow rates, patterns and mixing with other groundwater sources (dilution/dispersion), and the chemical behavior of the contaminants (attenuation). Generally, arsenic is considered to be a "non-conservative" contaminant, meaning it readily adsorbs to soil or precipitates out of solution as a secondary mineral, whereas selenium is more conservative and tends not to adsorb or precipitate from solution. These distinctive geochemical characteristics explain the relatively limited extent of the smelter arsenic plume, extending approximately 1,500 feet north of Highway 12, as compared to the selenium plume which extends more than three miles northwest of Highway 12 (Figure 2-6).

The groundwater plume patterns, particularly the larger selenium plume, closely mimic the general groundwater flow patterns. As shown in Figure 2-6, the selenium plume is relatively long and narrow, extending about 15,000 feet north of Highway 12 and only 1,500 feet wide at its maximum. The plume extends to the north-northwest through Lamping Field, paralleling Prickly Pear Creek for most of its length, before turning due north and crossing under the creek. The plume migration pattern through and north of Lamping Field is largely



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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

JUNE 2013 ARSENIC AND SELENIUM GROUNDWATER CONCENTRATIONS FORMER EAST HELENA SMELTER

FIGURE **2-6**

controlled by leakage from and associated groundwater mounding beneath Prickly Pear Creek. Near the Wylie Drive gravel pits, the groundwater mound beneath the creek dissipates, due at least in part to groundwater drainage associated with the gravel pits (Figure 2-5). Dissipation of the groundwater mound in this area allows the groundwater to flow in a more northerly direction (towards the Lake Helena regional groundwater drain) resulting in the northward turn in the selenium plume.

Also shown on Figure 2-6 is an additional area of elevated arsenic west of the former smelter referred to as the west arsenic area or plume. As discussed in Section 2.4 and Appendix B, the "west arsenic plume" is believed to be attributable, at least in part, to source(s) other than the former smelter. Based on currently available information, the most likely source appears to be naturally occurring "background" arsenic originating from the Tertiary volcano-clastic sediments, with possible contributions, either current or historic, from the former smelter site and related facilities. The west arsenic area is proposed as a temporary CGWA acknowledging the need for additional evaluation of the occurrence and source(s) of arsenic in this area.

2.3.1 Plume Status

Of primary interest to the East Valley CGWA petition, as well as the East Helena Facility RCRA Corrective Action program, is the current status of the plumes in terms of their stability (i.e., are the plumes advancing, receding or in equilibrium). The groundwater arsenic plume originating from the former smelter site was identified in site investigations dating back to the early 1980s. Since then, groundwater sampling has been conducted under various CERCLA, RCRA and State programs, typically at a minimum frequency of semiannually, with additional monitoring wells installed to track and monitor changes in the arsenic plume. As a result, an extensive database for groundwater arsenic concentrations has been established and the arsenic plume is well-defined. While the plume has expanded into East Helena over time and concentrations in some East Helena area monitoring wells have increased, the current extent as defined by the 10 µg/L HHS contour on Figure 2-6 has remained relatively stable for the past eight to ten years. The primary (highest concentration) arsenic plume extending into the northwest corner of East Helena (Figure 2-6) is characterized by substantial decreases in groundwater arsenic concentration over very short distance. Near the leading edge of the plume, arsenic concentrations currently decrease from nearly 5 mg/L to less than 0.002 mg/L over a distance of approximately 500 feet. This behavior is likely due to strong attenuation of arsenic through adsorption and/or co-precipitation reactions with aquifer material, which has been identified as a key control on arsenic fate and transport at the site through adsorption and leach testing, as well as through examination of arsenic trends and spatial distribution in groundwater. Although some expansion of the groundwater arsenic plume may occur in the future, and trends within the plume likely will vary, existing data and historical trends suggest that the overall extent of the plume should be constrained as a result of geochemical attenuation.

The groundwater selenium plume originating at the former smelter site was identified more recently than the arsenic plume, with extensive testing for selenium in groundwater starting in 2006. As a result, much of the recent site investigation activities have been focused on characterizing the nature and extent of selenium concentrations in groundwater. In contrast with arsenic, selenium is relatively mobile in groundwater, with limited attenuation except under reducing conditions. The long, narrow selenium plume extending more than 1.5 miles from the former smelter site to the northwest (Figure 2-6) demonstrates the mobility of selenium in groundwater. Data collected over the last five to seven years has helped define the spatial extent of the groundwater selenium plume and confirm that the area where concentrations exceed the 50 µg/L HHS has remained relatively stable during that timeframe. However, because data on groundwater selenium concentrations near the leading edge of the plume is limited to the past three years, there is greater uncertainty regarding the selenium plume status. In addition, data from monitoring wells installed in various locations within the selenium plume (both closer to the former smelter site and further downgradient) have shown significant seasonal variability in selenium concentrations, likely due to slight shifts in plume direction related to seasonal water level fluctuations. Given the overall mobility demonstrated by selenium in the groundwater system, additional plume expansion is possible. As previously mentioned and further outlined in Section 6, addressing these two groundwater plumes is a primary focus of the remedy evaluations (both interim and final corrective measures) being conducted as part of the Custodial Trust's CMS.

2.4 CONTAMINANT SOURCES

As noted in Section 1, the primary contaminants of concern for the East Valley CGWA are arsenic and selenium with the contaminated soils at the former smelter being the primary contaminant source. As noted above, an additional source of arsenic loading to groundwater has been identified west of the smelter site and is believed to be related, at least in part, to naturally occurring arsenic in the Tertiary sediment uplands. Conversely, the former smelter as the only identified source of selenium within the East Valley CGWA, although the presence of other unidentified sources is possible. Following is a summary of smelter and non-smelter related contaminant sources affecting water quality within the CGWA.

2.4.1 Former Smelter-Related Contaminant Sources

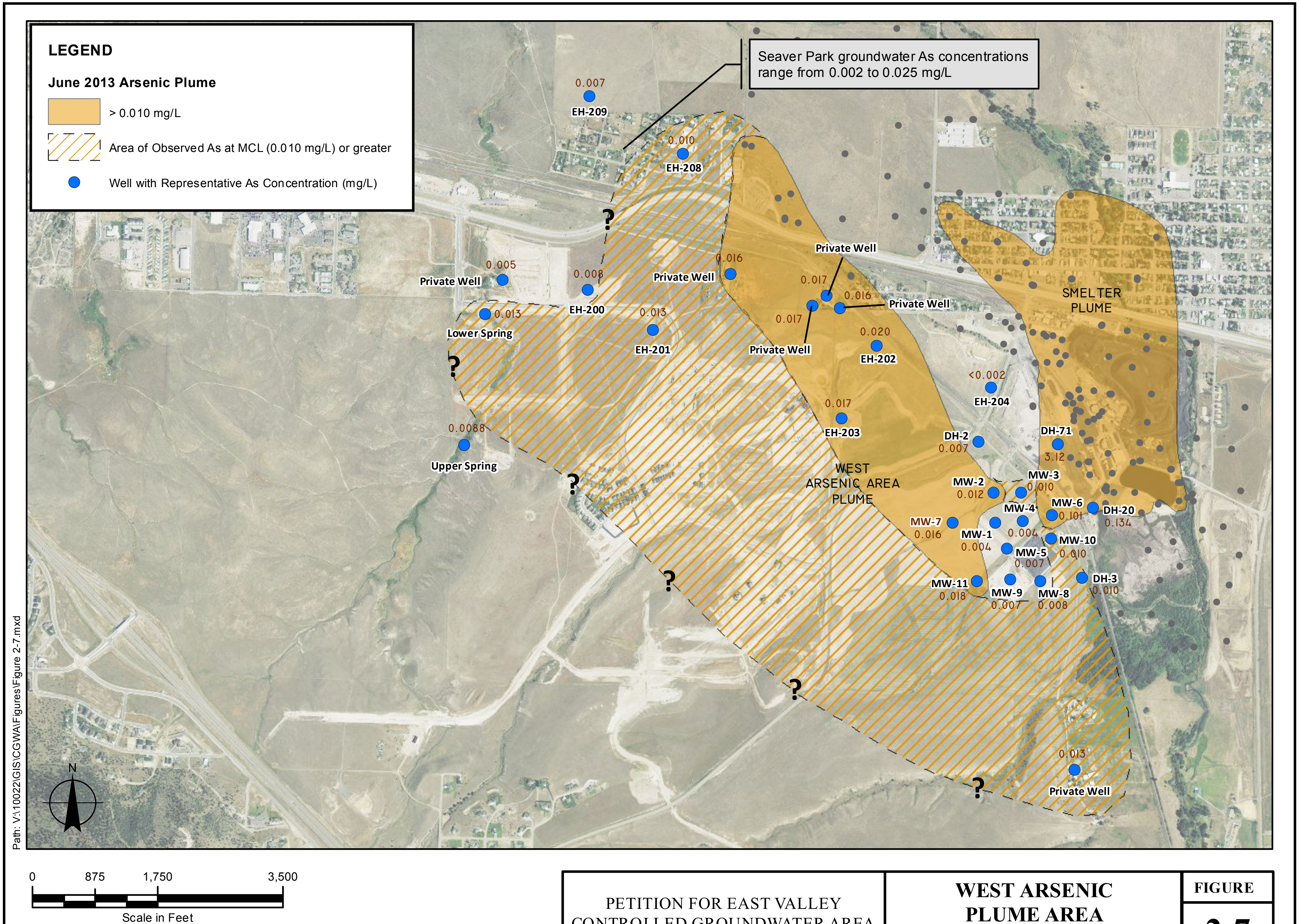
The relationship between the downgradient groundwater plumes and source areas on the former smelter site is well documented, and is the focus of the current East Helena Facility CMS remedy evaluations and current and planned interim measures. The groundwater plume maps (Figure 2-6), along with the groundwater potentiometric map and flow patterns (Figure 2-5) clearly demonstrate the relationship between the main groundwater plumes and the former smelter plant site. Groundwater originating on and south of the site flows north/northwestward through the contaminated plant site soils, releasing contaminants from soils to groundwater. Contaminant source areas on the smelter have been characterized through a number of studies including the Comprehensive RI/FS (Hydrometrics, 1990), the Phase I RFI (ACI, 2005), and the Phase II RFI (METG, 2011). Documented groundwater contaminant source areas on the former smelter property, either current or historic, include: acid plant area soils; speiss/dross area soils; and the south plant area including Tito Park and the Acid Plant sediment drying area (METG, 2011). Other potential contaminant source areas include the west plant site where the highest selenium groundwater concentrations (up to 7 mg/L) have been observed within the CGWA, and the slag pile, although the magnitude of and/or mechanisms for contaminant loading from these source areas is not well defined. Once released to groundwater, the contaminants travel with groundwater to the north/northwest, resulting in the current arsenic and selenium smelter plume configurations shown in Figure 2-6.

2.4.2 Additional Contaminant Sources

An area of elevated groundwater arsenic concentrations west of the former smelter site (west arsenic plume or area, Figure 2-6) was identified as part of the groundwater evaluations being conducted under the RCRA Corrective Action program. Despite its proximity to the former smelter site, evaluations to date indicate that the elevated arsenic concentrations west of the smelter are believed to be related, at least in part, to other sources. Figure 2-7 focuses on the west arsenic plume area as delineated by the June 2013 groundwater sampling data, as well as a number of additional data points collected at different times from the area. As shown in the figure, elevated arsenic concentrations near or above the 10 µg/L HHS have been documented hydrologically upgradient of the former smelter, including to the south and southwest. Examples include:

- Arsenic concentrations in samples from a private water well located on Smelter Road south of the smelter range from 9 to 16 µg/L from 2011 through 2013. Groundwater elevations at this well are 3920 to 3925 feet AMSL, or 5 to 10 feet higher than the smelter property groundwater levels.
- The R&D spring located southwest of the smelter site was sampled once in 2010 with an arsenic concentration of 9 µg/L. The elevation of the spring is about 4010 feet AMSL, or about 100 feet higher in elevation than the smelter site groundwater. A second sampling site further downstream on the spring drainage, approximate elevation 3945 AMSL, or 25 to 30 feet higher than the south plant site groundwater, had an arsenic concentration of 13 µg/L.

Although the presence of elevated arsenic concentrations in groundwater hydrologically upgradient of the former smelter indicates a separate source, it does not rule out the



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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

WEST ARSENIC PLUME AREA CONCENTRATIONS

FIGURE **2-7**

possibility that groundwater from the former smelter site may contribute to portions of the west arsenic area plume. In order to evaluate the potential for smelter groundwater to contribute to the west arsenic plume, an evaluation of the potential hydrologic connection between the two areas was conducted by the Custodial Trust. The evaluation included a review of groundwater flow patterns and water level trends, a review of groundwater chemistry, and a groundwater flow particle tracking analysis using the East Helena Facility numerical groundwater flow model. Results of these evaluations are presented in Appendix B. In summary, these studies and analyses suggest the following:

- Groundwater levels in most monitoring wells west of the former smelter site exhibit little or no correlation in water level trends with smelter site monitoring wells, suggesting a lack of or limited groundwater interaction between these areas. Elevated arsenic concentrations in these wells, generally between 10 and 20 µg/L, suggest an arsenic source other than the smelter.
- The general groundwater chemistry in the west area monitoring wells is variable, with some wells showing an alluvial groundwater signature, some a Tertiary sediment signature, and others a bedrock (Spokane Formation) signature (see Appendix B and Exhibit 3). Groundwater throughout most of the former smelter property exhibits unique chemical signatures associated with elevated sodium, chloride, and/or sulfate. The presence of elevated arsenic concentrations in the west area wells with varying chemical signatures suggest a source of arsenic (and groundwater) that is different than the smelter.
- The East Helena Facility groundwater model was used to simulate groundwater flow southwest of the smelter site including the west arsenic area. Based on reverse particle tracking simulations, groundwater flow west of the smelter, including all west area wells with elevated arsenic concentrations, originates from the southwest and not from the smelter. The modeling results are included in Appendix C.

In summary, elevated arsenic concentrations hydrologically upgradient of the former smelter site indicate a distinct source of arsenic other than the former smelter, most likely derived from the Tertiary volcano-clastic sediments to the southwest. Based on a review of available groundwater level and chemistry data, and particle tracking using the numerical groundwater flow model (Appendix C), current contributions from the smelter site to the west arsenic area plume appear to be limited, although commingling of "background" contaminants and smelter-derived contaminants, either from current or historic smelter sources, cannot be ruled out. As outlined in the following sections, this petition for the East Valley CGWA addresses all arsenic and selenium groundwater contamination in the vicinity of the former smelter, regardless of source.

3.0 CRITERIA FOR CGWA PETITION

Montana code 85-2-506 MCA defines specific criteria that must be satisfied for implementation of a CGWA. According to the statute, a CGWA may be designated by rule if one or more conditions or specific criteria are met. The criteria include various water quality and/or quantity issues that do, or may, jeopardize the designated beneficial uses of water or the ability to exercise permitted water right withdrawals. In the case of the East Valley CGWA petition, applicable criteria include:

- *85-2-506 (5)(c): current or projected ground water withdrawals from the aquifer or aquifers in the proposed controlled ground water area have induced or altered or will induce or alter contaminant migration exceeding relevant water quality standards.*
- *85-2-506 (5)(e): ground water within the proposed controlled ground water area is not suited for beneficial use.*
- *85-2-506 (5)(f): Public health, safety, or welfare is or will become at risk.*

Water quality standards for groundwaters in Montana are specified in the Administrative Rules of Montana (ARMs). ARM 17.30.1006 lists various groundwater classifications and associated intended beneficial uses. Groundwaters are classified by their natural specific conductance, with Class I groundwater having a natural specific conductance (SC) equal to or less than 1,000 microsiemens/centimeter (µs/cm) at 25° C, Class II groundwater having an SC between 1,000 and 2,500 µs/cm, Class III between 2,500 and 15,000 µs/cm, and Class IV groundwater greater than 15,000 µs/cm. With few exceptions, groundwater in the East Helena area, including the former smelter, is less than 1,000 µs/cm. Those portions of the smelter where the groundwater exceeds 1,000 µs/cm are impacted by historic smelter activities and likely had a natural SC of less than 1,000. Therefore, groundwater in the East Helena area is designated Class I groundwater.

ARM 17.30.1006 defines beneficial uses of Class I groundwater, with minimal or no treatment, as:

1. Public and private water supplies;
2. Culinary and food processing purposes;
3. Irrigation; Livestock and wildlife consumption; and
4. Commercial and industrial purposes.

A water body's ability to meet a designated beneficial use is based in part on the quality of that water body. In the case of potable use of groundwater (beneficial uses 1 and 2), the State of Montana human health water quality standards from Circular DEQ-7 (MDEQ, 2012), typically the same as federally promulgated MCLs, are used to assess the suitability of a source. As established in Circular DEQ-7, the human health standards for arsenic and selenium are 10 and 50 µg/L, respectively.

Based on extensive groundwater sampling and testing over the past several years, arsenic and selenium concentrations in groundwater near and downgradient (north) of the former Smelter site consistently exceed the applicable human health standards. Table 3-1 includes a statistical summary of arsenic and selenium concentrations at select wells within and peripheral to the contaminant plumes. The statistical summary is based on recent water quality data (2010 through June 2013), reflecting current water quality conditions. The summary includes the number of samples, minimum, maximum and mean concentrations for each well, and the number and percentage of HHS exceedances. Monitoring wells included in the statistical summary are shown on Figure 3-1. As shown in Table 3-1, HHS exceedances for arsenic at representative wells are consistent (exceedance rates of 86% to 100%) within the currently defined 10 µg/L arsenic contour, while concentrations outside the contour are consistently below the arsenic HHS (exceedance rates of 0%). For selenium, HHS exceedance rates are also consistent for wells on the former Smelter site, near source areas and near the centroid of the downgradient plume (exceedance rates of 91% to 100% in Table 3-1). Lower exceedance rates for some wells near the 50 µg/L selenium plume margins (19% to 38%, see Figure 3-1 and Table 3-1) illustrate that selenium concentrations fluctuate seasonally, and may exceed the HHS only during certain times of the year or under certain groundwater flow conditions. Overall, this information confirms that groundwater quality within and downgradient of the former smelter site does not meet applicable groundwater quality standards, may present a health risk if exposures are not properly controlled, and therefore is not suitable for all intended beneficial uses.

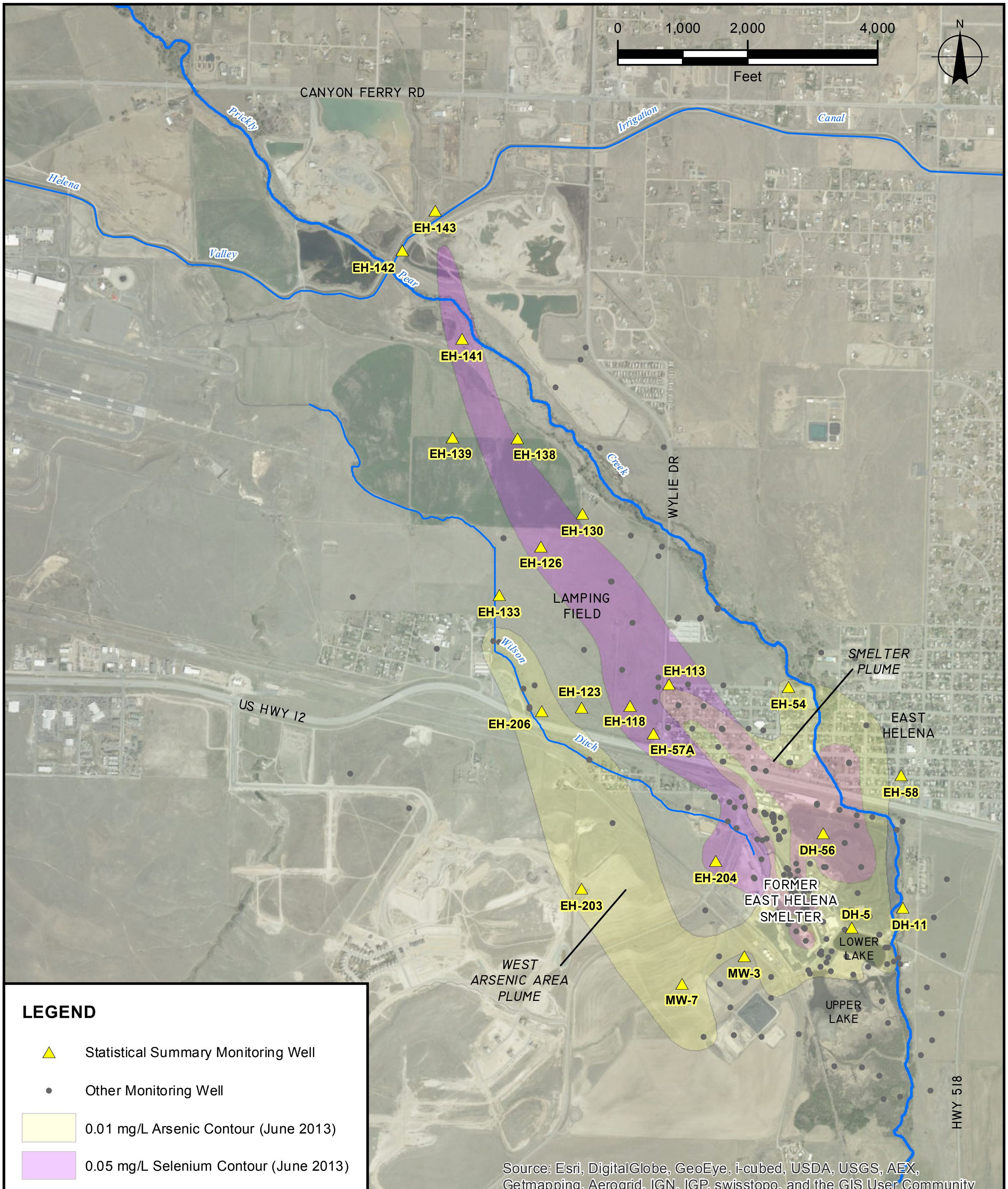
Furthermore, development of new pumping wells peripheral to the groundwater plumes has the potential to lower groundwater levels, alter groundwater flow patterns, and thus cause the groundwater plumes and associated contaminants to migrate into currently unaffected areas. This potential indicates that the criteria presented in 85-2-506 (5)(c) MCA should also be considered in the designation process.

Based on the above information, groundwater quality on and north of the former smelter is not suitable for all intended beneficial uses and exceeds Montana groundwater HHSs, meeting the CGWA petitioning criteria listed in MCA 85-2-506 (5)(c), (5)(e), and 5(f). The full East Helena Facility monitoring well water quality database is included on CD in Appendix D. All well locations are shown on Exhibit 1.

TABLE 3-1. STATISTICAL SUMMARY OF ARSENIC AND SELENIUM CONCENTRATIONS AT SELECT MONITORING WELLS NEAR THE EAST VALLEY GROUNDWATER PLUMES

Well ID	Arsenic Concentrations mg/L					Selenium Concentrations mg/L				
	N	Min	Max	Mean	Number (%) Exceedances	N	Min	Max	Mean	Number (%) Exceedances
MW-7	12	0.013	0.018	0.015	12 (100%)	12	0.001	0.001	0.001	0 (0%)
MW-3	13	0.008	0.01	0.01	0 (0%)	13	0.002	0.009	0.007	0 (0%)
DH-5	7	0.077	0.413	0.23	7 (100%)	7	0.001	0.002	0.001	0 (0%)
DH-11	7	0.002	0.002	0.002	0 (0%)	7	0.001	0.003	0.001	0 (0%)
EH-203	7	0.005	0.017	0.014	6 (86%)	7	0.002	0.002	0.002	0 (0%)
EH-204	10	0.002	0.002	0.002	0 (0%)	10	0.07	0.115	0.096	10 (100%)
DH-56	17	0.778	4.13	1.91	17 (100%)	17	0.514	2.02	0.8	17 (100%)
EH-58	7	0.002	0.002	0.002	0 (0%)	7	0.001	0.004	0.002	0 (0%)
EH-206	9	0.02	0.031	0.025	9 (100%)	8	0.001	0.012	0.003	0 (0%)
EH-123	10	0.007	0.008	0.007	0 (0%)	9	0.002	0.003	0.002	0 (0%)
EH-57A	8	0.002	0.002	0.002	0 (0%)	8	0.003	1.06	0.273	3 (38%)
EH-54	10	0.009	0.029	0.021	9 (90%)	10	0.001	0.001	0.001	0 (0%)
EH-118	8	0.002	0.002	0.002	0 (0%)	8	0.005	0.74	0.165	2 (25%)
EH-113	2	0.002	0.003	0.003	0 (0%)	2	0.10	0.12	0.11	2 (100%)
EH-133	8	0.007	0.008	0.008	0 (0%)	8	0.001	0.002	0.001	0 (0%)
EH-126	16	0.002	0.005	0.004	0 (0%)	16	0.005	0.089	0.027	3 (19%)
EH-130	16	0.002	0.005	0.002	0 (0%)	16	0.003	0.033	0.013	0 (0%)
EH-138	10	0.002	0.002	0.002	0 (0%)	11	0.049	0.082	0.063	10 (91%)
EH-139	9	0.002	0.006	0.005	0 (0%)	9	0.001	0.002	0.002	0 (0%)
EH-141	10	0.002	0.005	0.003	0 (0%)	10	0.023	0.07	0.046	3 (30%)
EH-142	10	0.004	0.005	0.005	0 (0%)	10	0.009	0.018	0.013	0 (0%)
EH-143	10	0.002	0.002	0.002	0 (0%)	10	0.024	0.044	0.037	0 (0%)

N-Number of Results
Number of exceedances includes results greater than 0.010 mg/L arsenic or 0.050 mg/L selenium.
Well Locations shown on Figure 3-1.



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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

STATISTICAL SUMMARY WELL LOCATIONS

FIGURE

3-1

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4.0 CONTROLLED GROUNDWATER AREA BOUNDARIES AND PROPERTY OWNERSHIP

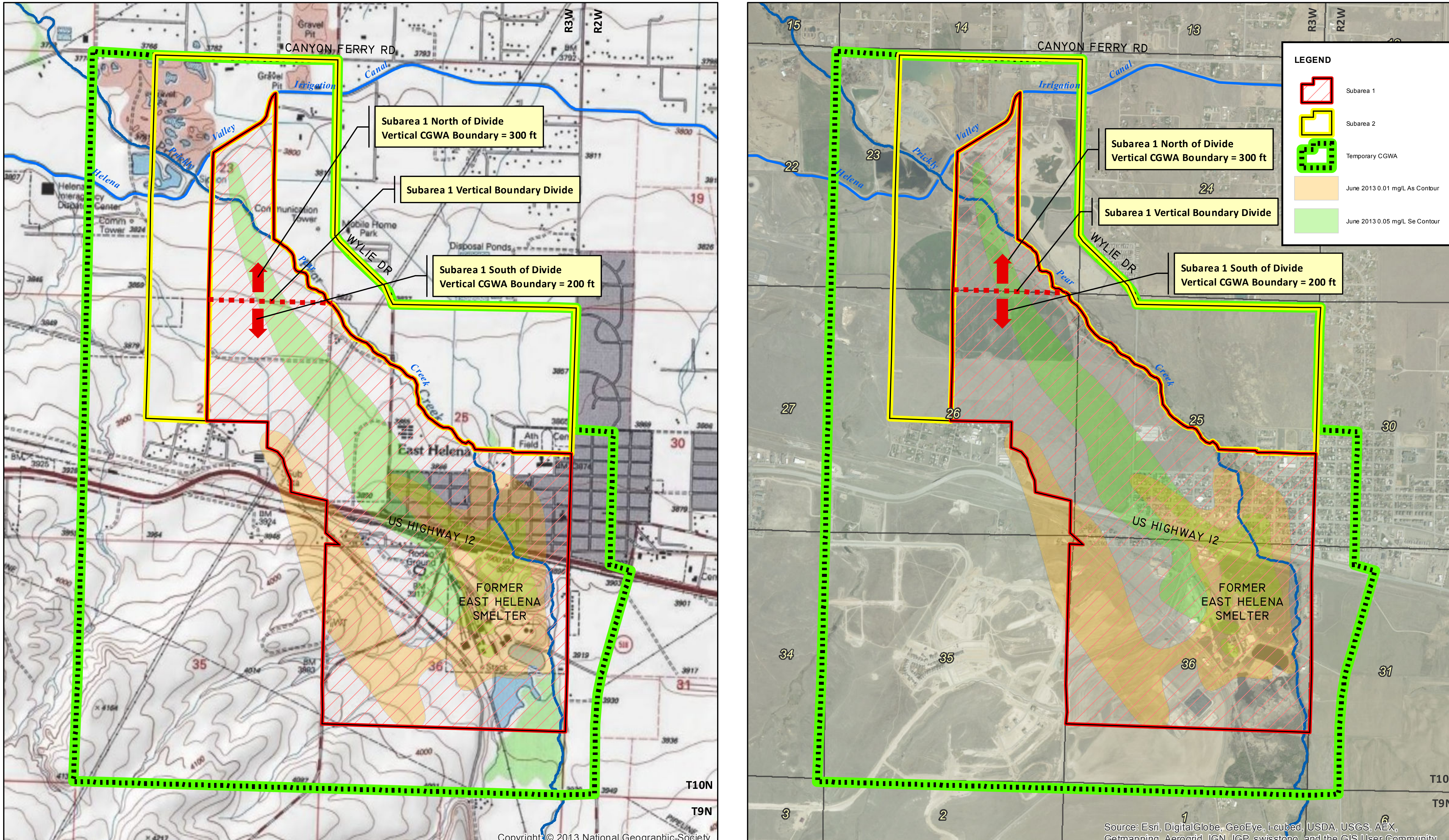
The East Valley CGWA boundaries are based on the distribution of contaminants in the groundwater plumes, and potential future changes in groundwater flow and plume migration patterns. Where possible, the boundaries are located to coincide with physical features, such as roads, or legal boundaries such as parcel boundaries or section lines to facilitate physical interpretation of boundary locations. The boundaries are consistent with the CGWA objectives of preventing unacceptable exposure to groundwater-borne contaminants (i.e., arsenic and selenium) or spreading of the groundwater plumes due to groundwater pumping, while minimizing the impacts of groundwater usage restrictions on property owners to the extent practicable.

The proposed East Valley CGWA lies entirely within Lewis and Clark County in the southeastern portion of the Helena Valley. The CGWA includes both a temporary and permanent[4] CGWA component, with the overall boundaries encompassing the former smelter site, portions of the City of East Helena (including the main downtown area and Manlove Addition), Seaver Park, and surrounding agricultural, industrial, residential and open lands. The CGWA includes all of Sections 23, 25, 26, 35, 36 and a portion of Section 24 in Township 10 North, Range 3 West (Figure 4-1). The CGWA covers a total of 3,290 acres or about 5.1 square miles. A total of 1,120 acres within the CGWA is owned by the Custodial Trust where groundwater usage controls are already in place and 1,360 acres lies within the East Helena city boundaries where a moratorium on new wells currently exists (Table 4-1).

TABLE 4-1. EAST VALLEY CONTROLLED GROUNDWATER AREA

	Area (Acres/Square Miles)	Custodial Trust Owned Property	Area within City of East Helena
Subarea 1	1,190/1.9	693 acres	910 acres
Subarea 2	734/1.2	257 acres	280 acres
Temporary CGWA	1,366/2.0	170 acres	170 acres
Total	**3,290/5.1**	**1,120 acres**	**1,360 acres**

[4] The statutes refer to two types of CGWAs; permanent and temporary. The designations refer primarily to groundwater usage controls and not the duration of the CGWA. Use of the term "permanent" does not imply that the CGWA will be in effect for perpetuity.



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N

0 1,000 2,000 4,000
Scale in Feet

PETITION FOR EAST VALLEY
CONTROLLED GROUNDWATER AREA

EAST VALLEY CGWA BOUNDARIES

FIGURE
4-1

4.1 CGWA BOUNDARIES

As noted above, the proposed East Valley CGWA includes a primary or permanent CGWA component and a temporary CGWA component. The primary difference between the two components is that groundwater usage restriction can be applied within a permanent CGWA while usage restrictions cannot be applied in a temporary CGWA. Each of the components is described below.

4.1.1 Permanent Controlled Groundwater Area

The proposed permanent CGWA encompasses approximately 1,924 acres (3.1 square miles) in area. As allowed by statute (85-2-506 MCA), the permanent CGWA is divided into two subareas based on proximity to the HHS-defined plume boundaries. Subarea 1 is the smaller of the two and conforms more closely to the plume boundaries, while the Subarea 2 boundaries lie outside of, or in some places are coincident with, the Subarea 1 boundaries. The two subareas are included to allow for application of different groundwater usage restrictions based on proximity to the plumes. The two subareas are shown on Figure 4-1 and are described below.

Subarea 1 includes those areas with arsenic and/or selenium concentrations that exceed groundwater HHSs due to conditions at the former smelter and includes: the former smelter site and Custodial Trust owned properties immediately to the west; the majority of the City of East Helena main residential/business districts and the Manlove Addition residential area; the majority of Lamping Field; and privately owned properties to the north. In addition to the areas of observed groundwater HHS exceedances, the Subarea 1 boundaries include a buffer zone to account for uncertainty in the precise HHS boundary locations, and possible near-term changes in groundwater flow directions and plume migration patterns. As noted above, the boundaries also coincide with physical or legal boundaries, where possible, to facilitate on-the-ground interpretation of CGWA boundaries. Subarea 1 is approximately 1,190 acres (1.9 square miles) in area (Table 4-1).

Subarea 2 includes those areas in the vicinity of the groundwater plumes where elevated arsenic and selenium concentrations persist but, based on currently available data, at concentrations below the HHSs. Subarea 2 is intended to address areas where there may be insufficient data to conclusively identify the extent of groundwater contamination related to the former smelter, where excessive groundwater pumping could cause plumes to migrate into currently unimpacted areas, or where other changes in the hydrologic system (such as reduced leakage from Prickly Pear Creek due to changes in local water management practices or climatic conditions) could cause changes in the groundwater plume migration patterns in the future. Groundwater usage restrictions are less stringent in Subarea 2 (Section 5). Subarea 2 is approximately 734 acres (1.2 square miles) in area, excluding Subarea 1 (Table 4-1).

4.1.2 Temporary Controlled Groundwater Area

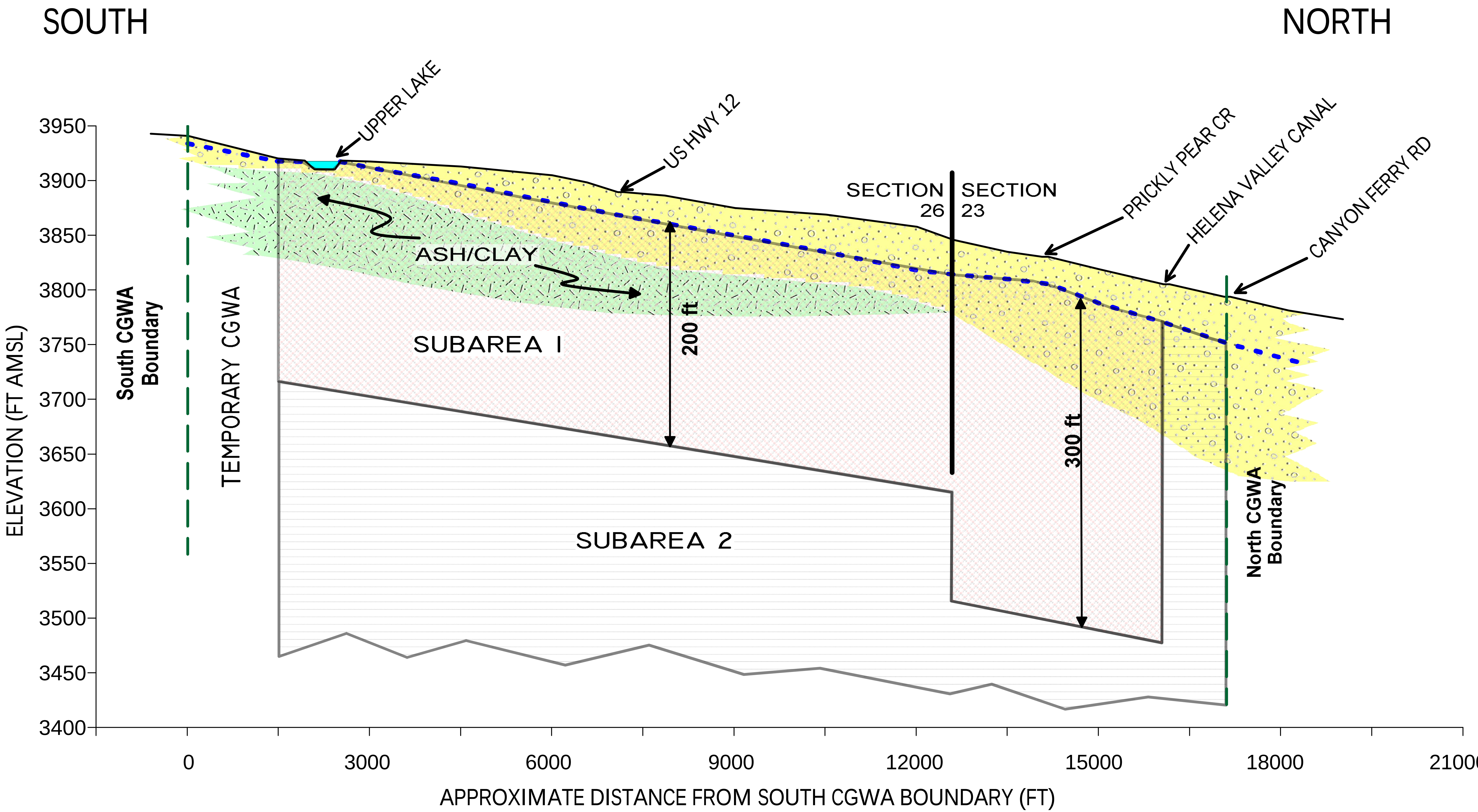
As provided for in statute (MCA 85-2-506(6)): "If the department finds that sufficient facts are not available to designate a permanent controlled ground water area, it may designate by rule a temporary controlled ground water area to allow studies to obtain the facts needed to determine whether or not it is appropriate to designate a permanent controlled ground water area." For the East Valley CGWA, a temporary CGWA is proposed for the areas south and west of the permanent CGWA where exceedances of the 10 µg/L arsenic HHS are known to occur, but the distribution, concentrations and source(s) of arsenic in groundwater are less well defined. Designation of a temporary CGWA is intended to allow for study of the area and cannot include any groundwater usage restrictions, other than measurement, water quality testing, and reporting requirements. The purpose of the East Valley temporary CGWA would be to allow for additional evaluation of water quality conditions and contaminant sources in the area (Section 6), in order to determine if the area warrants designation as a permanent CGWA.

As proposed, the temporary CGWA encompasses 1,366 acres (2.0 square miles), including areas south and west of the former smelter site and the Seaver Park subdivision. A four year duration is proposed for the temporary CGWA, after which time a determination would be made to either convert the area to a permanent CGWA, remove the area from the CGWA, or extend the duration of the temporary CGWA. According to statute, a temporary CGWA can be extended by the department up to a total duration of six years.

4.2 VERTICAL BOUNDARIES

In addition to the lateral boundaries shown in Figure 4-1, vertical boundaries must also be defined for the permanent CGWA to meet the CGWA objectives (Figure 4-2). The upper boundary is proposed to coincide with the top of the saturated zone, or groundwater table, throughout the entire CGWA. The depth to the saturated zone varies from ten feet or less in the south part of the former smelter and along Prickly Pear Creek to the north, to approximately 50 to 60 feet in the northwestern portion of Lamping Field. Groundwater depths then decrease to between 20 and 30 feet further north near Canyon Ferry Road. Information on groundwater depths in the southwest portion (south half of Section 35) is limited, but based on water level data in the north half of Section 35, groundwater depths in this area likely reach 100 feet or more.

The proposed lower CGWA boundary varies by subarea and location. For Subarea 1, where contaminant concentrations approach or exceed the HHSs and the stratigraphy and hydrogeology is relatively well defined, the proposed lower boundary ranges from 200 to 300 feet. For the majority of Subarea 1 (within Section 25, 26 and 36), the boundary is proposed



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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA	EAST VALLEY CGWA VERTICAL BOUNDARIES	FIGURE 4-2

to be set at 200 feet below ground surface. The 200-foot limit recognizes the presence of the low permeability silt/clay layer at depth in this area to establish a base for the Upper Aquifer and the groundwater plumes (Figure 2-4, Appendix B). The 200-foot depth also recognizes that some monitoring wells located on and around the smelter site and completed beneath the top of the silt/clay layer (to depths of 75 feet), have shown exceedances of arsenic and/or selenium HHSs. Thus, the 200-foot depth boundary is intended to prevent usage of potentially contaminated groundwater, and avoid vertical spreading of the contaminant plumes due to pumping at depth.

North of Section 26, the proposed Subarea 1 lower CGWA boundary steps down to 300 feet. The lower boundary is deeper to the north due to the absence of the low permeability silt/clay layer and the increasing depth of the selenium plume in this area. Based on groundwater quality sampling in this area, and particle tracking analyses completed with the groundwater flow model (see groundwater modeling tech memo, Appendix C), the highest selenium concentrations in this area occur at depths of 150 to 200 feet. Establishing the lower boundary at 300 feet accounts for uncertainty in selenium concentrations with depth, and possible future downward migration of the plume due to either natural conditions or excessive groundwater withdrawals at depth. The depth of the lower boundary may be modified in the future if warranted based on additional information on the vertical distribution of the groundwater plumes.

Because the groundwater usage controls are less restrictive for Subarea 2 (see Section 5), no lower vertical boundary is specified. All new wells in Subarea 2 would require a permit before drilling to assure the proposed well completion details, pumping rates and water usage are protective of human health and consistent with the CGWA objectives. The Subarea 2 provisions (permit requirements) would also apply at depths below the Subarea 1 vertical boundary within the Subarea 1 lateral boundaries. Vertical boundaries do not apply to the temporary CGWA.

4.3 BASIS FOR CGWA BOUNDARIES

As noted above, the CGWA boundaries have been proposed with consideration to the designation criteria, based primarily on the distribution and concentrations of the contaminants of concern (arsenic and selenium), and the potential for withdrawals to induce spreading of contaminants. The boundaries are also defined on the basis of other factors, including: current knowledge of groundwater flow and contaminant transport processes responsible for the current plume patterns; potential stresses or changes in the hydrologic system that could affect these mechanisms, and existing property boundaries. Each of these factors is described below.

1. As noted in Appendix A, dewatering of Upper Lake and Wilson Ditch since late 2011 has lowered groundwater levels on the west side of the former smelter and the west side of Lamping Field. This has resulted in a westward shift in groundwater flow and plume migration patterns on and north of the smelter. The 3-D numerical groundwater flow model was used to predict the extent of westward migration of the plumes in the future using forward particle tracking. Based on the predictive modeling results, the groundwater plumes originating from the former smelter site are expected to migrate to the west as much as 1500 feet in the future. The CGWA boundaries proposed in this petition are intended to account for this potential westward shift in the plumes.

2. The CGWA Subarea 1 and Subarea 2 boundaries also address the potential for groundwater pumping to cause the plumes to migrate into currently unaffected areas. Using the numerical groundwater flow model (Appendix C), the capture zone radius, or lateral distance from which a pumping well will draw in surrounding groundwater was estimated for various pumping scenarios. To simulate the effects of a private residential water supply well, the groundwater capture zone was calculated based on one year of continuous pumping at 6.2 gpm. Private residential wells (i.e., exempt wells) are limited to a maximum pumping rate of 35 gpm or a total volume of 10 acre-feet/year (an average annual rate of 6.2 gpm). Additional capture zone simulations were run with pumping rates up to 350 gpm to simulate effects of large scale irrigation or other production wells. The simulation results show that new residential wells should not be completed within 250 feet and higher capacity (350 gpm) productions wells within 700 feet of the HHS-exceeding portions of the plumes. Subarea 2 is intended, in part, to place controls on future development of wells outside of Subarea 1 that have the potential to cause problematic spreading of the groundwater plumes.

3. Other factors accounted for in establishing the CGWA boundaries include future changes in leakage rates from Prickly Pear Creek, or water management practices at the Section 23 gravel pit ponds (Figure 1-1). As noted in Section 2.2, both of these factors have the potential to alter future groundwater flow and contaminant migration patterns. Groundwater drainage at the gravel pits is believed to lower the groundwater table in Section 23 thus allowing groundwater flow and the groundwater plumes to pass northward beneath the creek near the ponds. Termination of the groundwater drainage could cause groundwater levels beneath the creek to rise and the selenium plume to track to the northwest instead of the north. Also noted in Section 2.2 is the effect of leakage from Prickly Pear Creek and associated groundwater mounding on groundwater flow and contaminant migration. A reduction in leakage from the creek, due to natural causes or water management practices, could cause the plumes to spread eastward beneath the creek further south than they currently do. Alternatively, an increase in creek leakage and groundwater

mounding would force the plumes further to the west. The potential for future plume spreading due to one or both of these factors has been accounted for in the proposed CGWA boundaries, and will be evaluated further in 2014 through use of the updated groundwater flow model.

4.4 PROPERTY OWNERSHIP WITHIN THE EAST VALLEY CGWA

Exhibit 4 shows property ownership within the East Valley CGWA as well as the groundwater plumes and CGWA boundaries. The properties shown on Exhibit 4 are tabulated in Appendix E, which shows parcel identification numbers for properties within the CGWA boundaries along with other relevant information. The majority of the CGWA falls under two primary property owners: the Montana Custodial Trust and the Prickly Pear Simmental Ranch. Custodial Trust property holdings within the CGWA include approximately 1,120 acres and represent 34% of the total CGWA acreage, including 693 acres or 58% of the more restrictive Subarea 1 property. In addition to the smelter property itself and surrounding acreage, the Custodial Trust owns all of Lamping Field within the CGWA. The second largest landowner, Prickly Pear Simmental Ranch, owns approximately 375 acres within the CGWA. Other landowners with property within the CGWA include Helena Sand and Gravel, Inc. (180 acres), the Helena Regional Airport (206 acres), and numerous smaller private property owners.

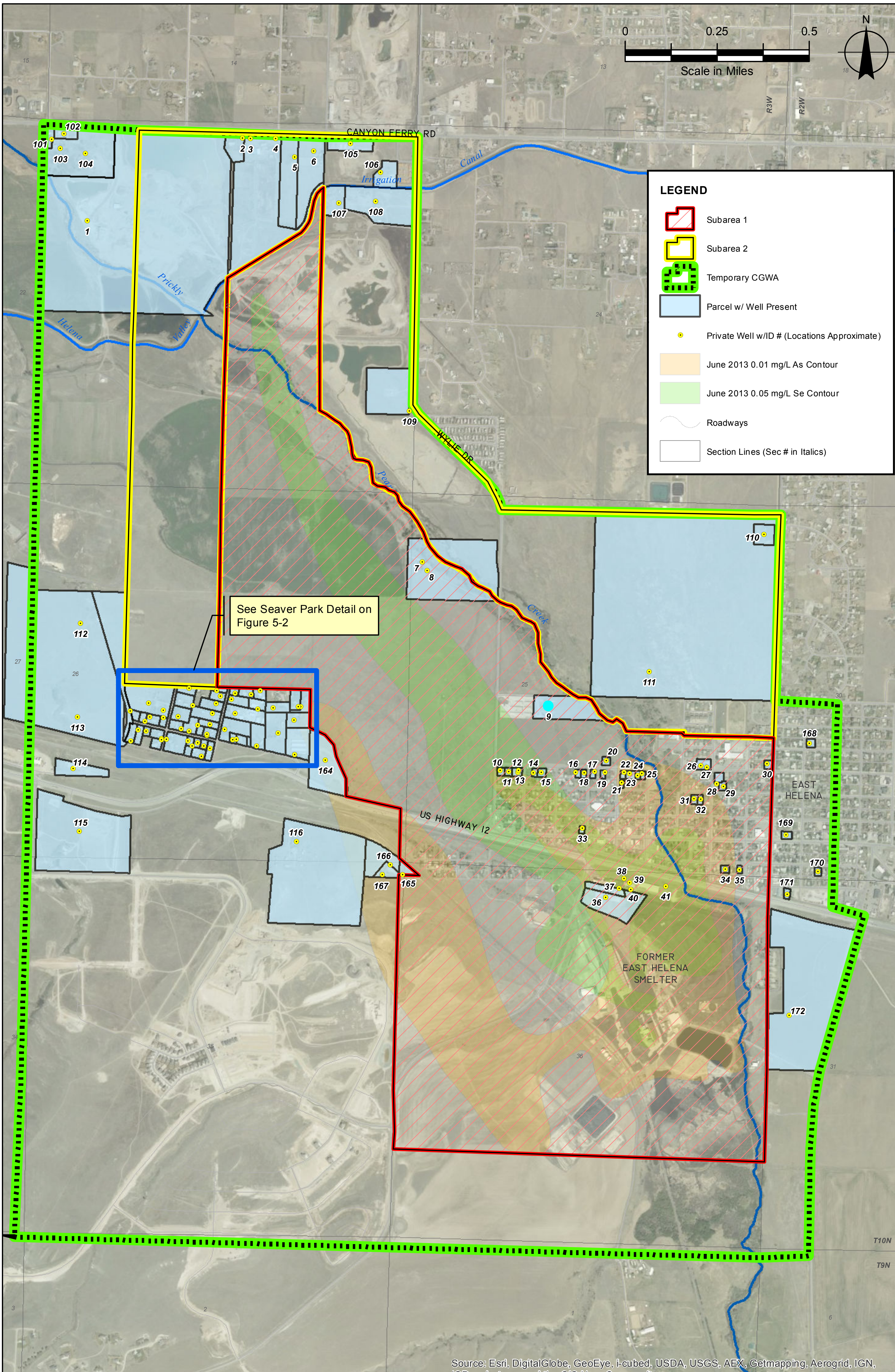
5.0 PROPOSED GROUNDWATER USAGE RESTRICTIONS

The following groundwater usage restrictions are recommended for the East Valley CGWA. These restrictions are designed to ensure compliance with the CGWA objectives of preventing unacceptable exposure to contaminants in groundwater and pumping-induced migration of contaminant plumes, while endeavoring to minimize adverse effects of the restrictions on the local community to the extent possible. The restrictions vary by subarea and are described below and summarized in Table 5-1.

5.1 SUBAREA 1 RESTRICTIONS

Subarea 1 includes those portions of the groundwater plumes where contaminant concentrations currently exceed State of Montana HHSs or where exceedances could occur with minor changes in the plume boundaries. Groundwater usage restrictions within Subarea 1 include a complete moratorium on all new water supply wells, including but not limited to: private, community or municipal water supply wells, irrigation wells and industrial use wells. These restrictions would apply within the lateral and vertical boundaries of Subarea 1 (Section 4). Groundwater monitoring wells, test wells and remediation wells associated with the East Helena Facility remediation program or other government administered hydrogeologic investigations would be allowed within Subarea 1, provided the proposed well(s) would not cause unacceptable contaminant exposure or contaminant migration.

Continued use of existing wells within Subarea 1 would be allowed, but only for their current uses and currently permitted usage rates (35 gpm or 10 acre-feet/year). Based on currently available information, a total of 35 private wells currently exist with the Subarea 1 boundaries, with 33 of these wells located within the City of East Helena boundaries. The majority of private wells located within East Helena are used for lawn irrigation only, although some are used for potable purposes including drinking water (see residential well sampling discussion, Section 1.2.3). Figures 5-1 and 5-2 show all private wells located within the CGWA and Table 5-2 lists the well use and water quality data where available. Existing wells would be subject to water quality monitoring requirements as described in Section 6. Replacement wells may be allowed in Subarea 1 if the replacement well is located in close proximity to, is completed within the same depth interval, and the proposed pumping rate and water usage is the same as the original well. Completion of replacement wells would be subject to approval by a technical advisory group (TAG) as described in Section 5.2, and would also require compliance with all local, state or other applicable rules, regulations, ordinances or statutes.



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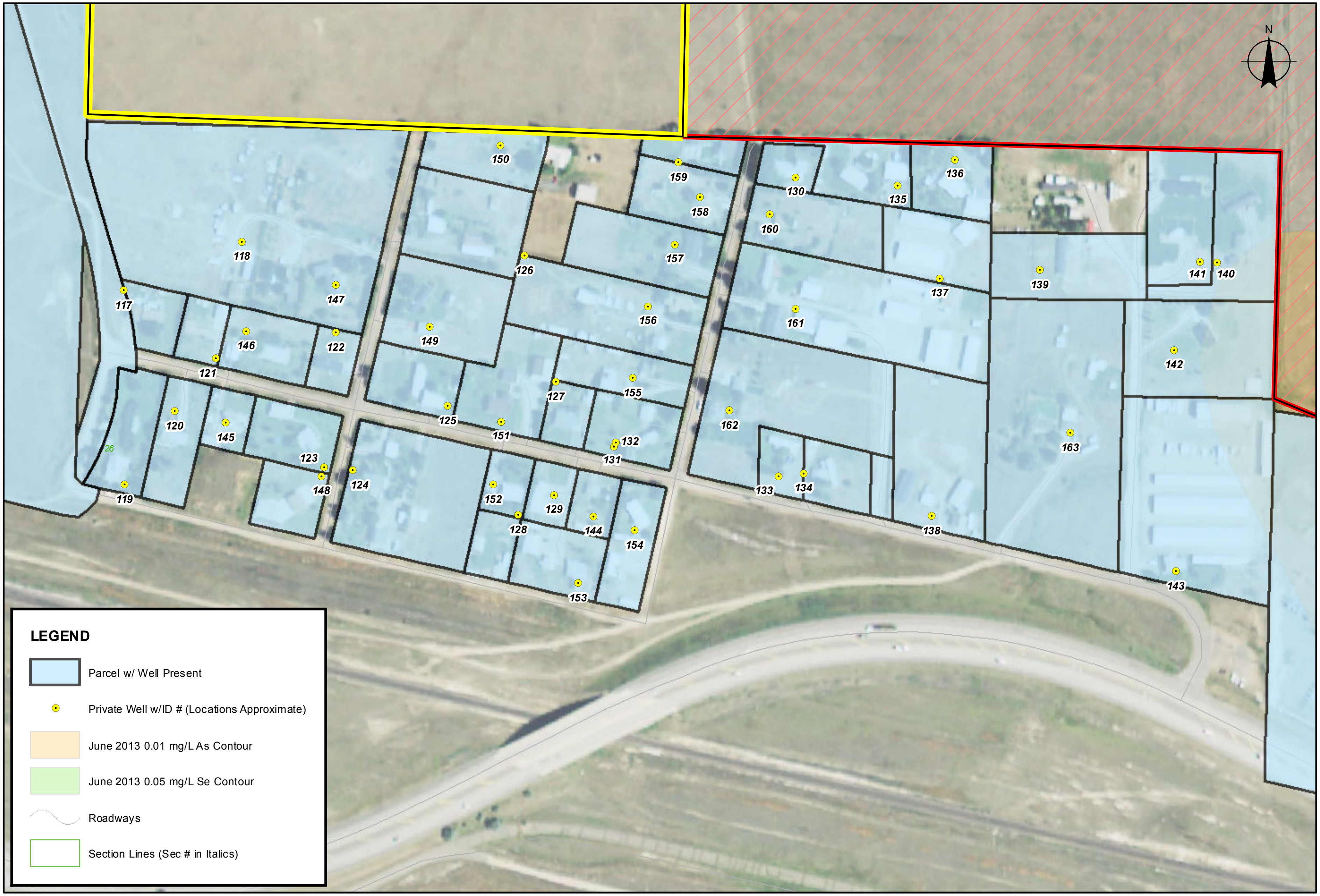
PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA	EXISTING WATER SUPPLY WELLS WITHIN CGWA BOUNDARIES	FIGURE 5-1



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PETITION FOR EAST VALLEY CONTROLLED GROUNDWATER AREA

EXISTING WATER SUPPLY WELLS WITHIN CGWA BOUNDARIES SEAVER PARK DETAIL

FIGURE **5-2**

TABLE 5-1. PROPOSED GROUNDWATER USAGE RESTRICTIONS FOR EAST VALLEY CGWA

CGWA Component	Proposed Restrictions[1]	Notes
Permanent CGWA Subarea 1	No new wells allowed. Existing wells not affected. Replacement wells (exempt and non-exempt) allowed if general location, depth, pumping rate and use same as original well.	All replacement wells require approval of TAG and DNRC[1]. Non-exempt wells also subject to DNRC water rights permitting requirements[2].
Permanent CGWA Subarea 2	New wells (exempt[2] and non-exempt) allowed if approved by TAG. Existing wells not affected. Replacement wells (exempt[2] and non-exempt) allowed if approved by TAG.	Non-exempt new or replacement wells approved by TAG also subject to DNRC water rights permitting requirements.
Temporary CGWA	No restrictions on new wells or groundwater usage.	No restrictions allowed per CGWA regulations.

1. All new wells or replacement wells approved by the TAG are subject to all local state or federal regulations, laws and ordinances.
2. Exempt wells must meet requirements of MT Water Use Act; MCA 85-2-306 and 85-2-500.

TAG - Technical Advisory Group.

5.2 SUBAREA 2 RESTRICTIONS

Subarea 2 includes those areas outside of Subarea 1 where future shifts in the plume boundaries, due to groundwater pumping, changes in irrigation or other water usage practices, and/or East Helena Facility remediation activities, could change groundwater quality and would therefore require groundwater usage restrictions in the future. Construction of new wells would not be prohibited in Subarea 2, but would be subject to review and approval by a CGWA technical advisory group (TAG) and would also require compliance with all local, state or other applicable rules, regulations, ordinances or statutes.

Groundwater monitoring wells, test wells and remediation wells associated with the East Helena Facility remediation program or other government administered hydrogeologic investigations would not be subject to the CGWA permitting process, provided the proposed well(s) would not cause unacceptable contaminant exposure or plume spreading, but would still be subject to other well drilling and groundwater usage permitting requirements

TABLE 5-2. WATER QUALITY DATA FROM EXISTING WATER SUPPLY WELLS WITHIN CGWA BOUNDARIES

Well ID		Arsenic Concentrations (mg/L) - 2006-2013						Selenium Concentrations (mg/L) - 2006-2013					
(see Figure 5-1)	Well Use	N	Min	Max	Avg	Exceedances #	Exceedances %	N	Min	Max	Avg	Exceedances #	Exceedances %
1	Industrial	3	0.003	0.003	0.003	0	0%	3	<0.001	<0.001	NA	0	0%
2	Domestic	9	<0.002	<0.002	NA	0	0%	9	0.035	0.043	0.039	0	0%
3	Unknown	3	<0.002	<0.002	NA	0	0%	3	<0.001	<0.001	NA	0	0%
4	Domestic	8	<0.002	<0.002	NA	0	0%	8	0.026	0.037	0.031	0	0%
5	Domestic	5	<0.002	<0.002	NA	0	0%	5	<0.001	<0.001	NA	0	0%
6	Domestic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7	Out of Service	10	<0.002	<0.002	NA	0	0%	10	0.005	0.040	0.013	0	0%
8	Domestic	31	<0.002	<0.002	NA	0	0%	31	0.002	0.037	0.004	0	0%
9	Domestic	2	<0.002	<0.002	NA	0	0%	2	<0.001	<0.005	NA	0	0%
10	Out of Service	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	Out of Service	1	0.002	0.002	0.002	0	0%	1	0.007	0.007	0.007	0	0%
12	Out of Service	1	<0.002	<0.002	NA	0	0%	1	0.014	0.014	0.014	0	0%
13	Domestic	64	<0.002	0.005	0.002	0	0%	55	<0.005	0.029	0.019	0	0%
14	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
15	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
16	Domestic	60	<0.002	<0.002	NA	0	0%	52	<0.001	<0.005	0.001	0	0%
17	Irrigation	28	<0.002	<0.002	NA	0	0%	25	<0.001	<0.005	0.003	0	0%
18	Irrigation (No Pump)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
19	Domestic	12	<0.002	0.004	0.002	0	0%	10	<0.001	<0.005	NA	0	0%
20	Domestic	1	<0.002	<0.002	NA	0	0%	1	<0.005	<0.005	NA	0	0%
21	Domestic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
22	Domestic	11	<0.002	<0.002	NA	0	0%	10	<0.001	<0.005	NA	0	0%
23	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
24	Domestic	11	<0.002	0.003	0.002	0	0%	10	<0.001	<0.005	0.002	0	0%
25	Domestic	11	<0.002	<0.002	NA	0	0%	10	<0.001	<0.005	NA	0	0%
26	Domestic	11	<0.002	<0.002	NA	0	0%	10	0.003	0.012	0.008	0	0%
27	Out of Service	3	<0.002	<0.002	NA	0	0%	2	0.009	0.013	0.011	0	0%
28	Domestic	6	<0.002	<0.002	NA	0	0%	5	0.004	0.011	0.007	0	0%
29	Irrigation	6	<0.002	<0.002	NA	0	0%	5	0.006	0.013	0.010	0	0%
30	Irrigation	3	<0.002	<0.002	NA	0	0%	2	<0.005	<0.005	NA	0	0%
31	Irrigation	4	0.031	0.093	0.055	4	100%	3	0.011	0.019	0.015	0	0%
32	Out of Service	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
33	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
34	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
35	Out of Service	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
36	Industrial	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
37	Industrial	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
38	Industrial	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2. WATER QUALITY DATA FROM EXISTING WATER SUPPLY WELLS WITHIN CGWA BOUNDARIES

Well ID		Arsenic Concentrations (mg/L) - 2006-2013						Selenium Concentrations (mg/L) - 2006-2013					
(see Figure 5-1)						Exceedances						Exceedances	
	Well Use	N	Min	Max	Avg	#	%	N	Min	Max	Avg	#	%
39	Industrial	6	<0.002	0.002	0.002	0	0%	5	<0.001	<0.005	0.004	0	0%
40	Industrial	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
41	Industrial	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
101	Domestic	8	0.002	0.002	0.002	0	0%	8	0.003	0.006	0.004	0	0%
102	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
103	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
104	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
105	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
106	Domestic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
107	Domestic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
108	Domestic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
109	Public Water Supply	13	<0.002	<0.002	<0.002	0	0%	13	<0.001	<0.005	NA	0	0%
110	Public Water Supply	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
111	Out of Use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
112	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
113	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
114	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
115	Domestic	2	0.004	0.005	0.005	0	0%	2	<0.001	0.001	0.001	0	0%
116	Domestic	8	0.014	0.017	0.016	8	100%	8	0.002	0.003	0.003	0	0%
117	Domestic	3	0.009	0.010	0.009	0	0%	3	0.003	0.004	0.003	0	0%
118	Domestic	2	0.005	0.005	0.005	0	0%	2	0.003	0.003	0.003	0	0%
119	Domestic	4	0.009	0.010	0.010	0	0%	3	0.003	0.004	0.004	0	0%
120	Domestic	2	0.008	0.009	0.009	0	0%	2	0.003	0.004	0.004	0	0%
121	Domestic	2	0.007	0.008	0.008	0	0%	2	0.004	0.004	0.004	0	0%
122	Domestic	2	0.008	0.009	0.009	0	0%	2	0.004	0.004	0.004	0	0%
123	Domestic	2	0.009	0.009	0.009	0	0%	2	0.002	0.002	0.002	0	0%
124	Domestic	2	0.008	0.009	0.009	0	0%	2	0.003	0.004	0.004	0	0%
125	Domestic	2	0.013	0.013	0.013	2	100%	2	0.002	0.002	0.002	0	0%
126	Domestic	2	0.009	0.009	0.009	0	0%	2	0.003	0.004	0.004	0	0%
127	Irrigation	2	0.010	0.010	0.010	0	0%	2	0.004	0.005	0.005	0	0%
	Domestic	1	<0.002	<0.002	<0.002	0	0%	1	<0.001	<0.001	<0.001	0	0%
128	Domestic	3	0.008	0.013	0.011	2	67%	3	0.003	0.004	0.003	0	0%
129	Domestic	2	0.004	0.005	0.005	0	0%	2	0.005	0.007	0.006	0	0%
130	Domestic	2	0.006	0.007	0.007	0	0%	2	0.007	0.008	0.008	0	0%
131	Domestic	2	0.010	0.010	0.010	0	0%	2	0.004	0.004	0.004	0	0%
132	Domestic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
133	Irrigation	1	0.013	0.013	0.013	1	100%	1	0.003	0.003	0.003	0	0%
	Domestic	1	<0.002	<0.002	<0.002	0	0%	1	<0.001	<0.001	<0.001	0	0%
134	Domestic	5	0.016	0.019	0.017	5	100%	5	0.002	0.003	0.002	0	0%

TABLE 5-2. WATER QUALITY DATA FROM EXISTING WATER SUPPLY WELLS WITHIN CGWA BOUNDARIES

Well ID		Arsenic Concentrations (mg/L) - 2006-2013						Selenium Concentrations (mg/L) - 2006-2013					
(see Figure 5-1)						Exceedances						Exceedances	
	Well Use	N	Min	Max	Avg	#	%	N	Min	Max	Avg	#	%
135	Domestic	2	0.007	0.007	0.007	0	0%	2	0.004	0.005	0.005	0	0%
136	Domestic	2	0.007	0.008	0.008	0	0%	2	0.002	0.002	0.002	0	0%
137	Domestic	2	0.007	0.008	0.008	0	0%	2	0.005	0.006	0.006	0	0%
138	Domestic	4	0.024	0.025	0.024	4	100%	3	0.002	0.003	0.003	0	0%
139	Domestic	4	0.006	0.007	0.007	0	0%	4	0.003	0.004	0.003	0	0%
140	Domestic	5	0.002	0.002	0.002	0	0%	5	<0.001	0.001	0.001	0	0%
141	Domestic	2	0.004	0.004	0.004	0	0%	2	0.002	0.002	0.002	0	0%
142	Domestic	6	0.006	0.006	0.006	0	0%	5	0.003	0.003	0.003	0	0%
143	Domestic	7	0.014	0.017	0.015	7	100%	6	0.005	0.010	0.007	0	0%
144	Domestic	1	0.009	0.009	0.009	0	0%	1	0.004	0.004	0.004	0	0%
145	Domestic	2	0.005	0.006	0.006	0	0%	2	0.002	0.004	0.003	0	0%
146	Domestic	2	0.007	0.008	0.008	0	0%	2	0.003	0.003	0.003	0	0%
147	Domestic	1	0.008	0.008	0.008	0	0%	1	0.003	0.003	0.003	0	0%
148	Domestic	2	0.006	0.007	0.007	0	0%	2	0.002	0.004	0.003	0	0%
149	Domestic	2	0.009	0.010	0.010	0	0%	2	0.003	0.003	0.003	0	0%
150	Domestic	4	0.009	0.010	0.010	0	0%	3	0.003	0.004	0.003	0	0%
151	Domestic	3	0.011	0.012	0.012	3	100%	3	0.002	0.003	0.002	0	0%
152	Domestic	3	0.009	0.010	0.009	0	0%	2	0.004	0.004	0.004	0	0%
153	Domestic	2	0.007	0.009	0.008	0	0%	2	0.006	0.006	0.006	0	0%
154	Domestic	2	0.011	0.011	0.011	2	100%	2	0.003	0.003	0.003	0	0%
155	Domestic	2	0.009	0.011	0.010	1	50%	2	0.004	0.005	0.005	0	0%
156	Domestic	2	0.009	0.010	0.010	0	0%	2	0.003	0.003	0.003	0	0%
157	Domestic	2	0.013	0.017	0.015	2	100%	2	0.003	0.004	0.004	0	0%
158	Irrigation	3	0.019	0.024	0.022	3	100%	2	0.005	0.006	0.006	0	0%
	Domestic	1	<0.002	<0.002	<0.002	0	0%	1	<0.001	<0.001	<0.001	0	0%
159	Domestic	2	0.010	0.010	0.010	0	0%	2	0.003	0.003	0.003	0	0%
160	Domestic	1	0.010	0.010	0.010	0	0%	1	0.013	0.013	0.013	0	0%
161	Domestic	3	0.010	0.011	0.010	1	33%	3	0.005	0.006	0.006	0	0%
162	Domestic	2	0.012	0.014	0.013	2	100%	2	0.002	0.003	0.003	0	0%
163	Domestic	2	0.009	0.009	0.009	0	0%	2	0.007	0.007	0.007	0	0%
164	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
165	Domestic	11	0.012	0.017	0.015	11	100%	9	0.001	0.005	0.002	0	0%
166	Domestic	8	0.013	0.017	0.015	8	100%	8	0.002	<0.005	0.003	0	0%
167	Domestic	10	0.015	0.018	0.017	10	100%	10	<0.001	<0.005	0.002	0	0%
168	Unknown	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
169	Domestic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
170	Inactive	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
171	Domestic	8	<0.002	0.003	0.002	0	0	5	0.006	0.012	0.009	0	0%
172	Inactive	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

administered by DNRC. Wells drilled for the purposes of investigation or remediation will continue to be tracked in a project database and abandoned per State regulations (ARM 17.50.1312) when no longer needed.

Permit applications for new wells will be reviewed and approved by a CGWA TAG. The TAG membership will include appointees from the Lewis and Clark City-County Board of Health and WQPD, the EPA, and MDEQ/DNRC. Potential permittees will complete an application containing, at a minimum, the proposed well location, depth of completion, well construction details, proposed groundwater use, and proposed pumping rate and schedule. Information in the application will be reviewed by the TAG to determine whether the well poses a threat in terms of exposure to unacceptable levels of contaminants, or to spreading of contaminants. If approved, the permittee would be required to provide detailed lithologic and well completion logs recorded by a hydrogeologist, professional engineer, or other agreed upon qualified individual, provide physical means to obtain well water level measurements, allow access for collection of water level data and/or water quality sampling. Both exempt wells (wells with appropriations of 35 gpm or less and 10 acre-feet/year or less; MCA 85-2-306(3)) and non-exempt wells would require approval from the TAG and compliance with the Montana Water Use Act (MCA 85-2-306), with non-exempt wells subject to all water rights permitting requirements administered by the DNRC. All new wells in the CGWA will have to be completed in accordance with State of Montana well drilling and construction regulations provided in ARM 36.21.600.

As required by statute no groundwater usage restrictions or provisions would apply within the temporary CGWA boundaries, other than providing allowances for possible water level measurement, water quality testing and reporting requirements.

The groundwater usage restrictions outlined above are consistent with current rules regarding appropriation of groundwater within a controlled groundwater area as outlined in 85-2-506, 85-2-508 and 85-2-306 MCA. Additional details on the permit application, review and approval process for new wells in Subarea 2, and monitoring and reporting requirements within the Temporary CGWA, will be developed by project stakeholders external to the CGWA petitioning process.

6.0 MITIGATION OF APPLICABLE PETITIONING CRITERIA AND CGWA MONITORING

As noted in Section 1 and detailed in the referenced documents, extensive work has been completed to date to reduce environmental impacts from the former smelter and associated properties (the Facility), with additional remedial actions being implemented and/or planned to address groundwater contamination. The Custodial Trust is performing these remedial activities under the EPA-led RCRA Corrective Action program, as mandated by the First Modification to the Consent Decree (see Section 1.1.1). Various remedial actions are currently being evaluated for effectiveness at controlling contaminant sources and meeting remedy performance standards, which include achieving appropriate media cleanup standards in groundwater and reducing ongoing contaminant loading to groundwater from the former smelter site, to the extent practicable. These evaluations are being conducted as part of the Corrective Measures Study process and development/implementation of Interim Measures.

The Lewis and Clark City-County Board of Health administers an Institutional Control Program within the East Helena CERCLA site. The proposed CGWA will be included as a component of this program and is critical for preventing unacceptable exposure to contaminated groundwater and/or potential contaminant migration resulting from additional groundwater withdrawals, while the interim and final remedies are being implemented. Given the presence of additional contaminant source materials on the former smelter site, it is expected that the remedy performance phase of the project will extend for a number of years. However, the remedial action objectives include not only preventing further spreading of the groundwater plumes beyond their current boundaries, but also reducing the areal extent, duration, and/or usage restrictions associated with the CGWA in the future. Remedial activities completed to date and activities proposed in the next few years are summarized below along with applicable references where additional detail is provided. Consistent with the past few years (Hydrometrics, 2013), and as discussed below, groundwater monitoring will be implemented in the coming years to assess the effectiveness of remedial activities on downgradient groundwater quality, and to evaluate the need for additional groundwater remedies and/or modifications to the CGWA boundaries and/or provisions.

6.1 FORMER SMELTER REMEDIAL PROGRAM

ASARCO initiated remediation activities at the former smelter in the late 1980s when the smelter was still in operation. Initial actions focused on the process water circuit, including removal of leaking process water ponds and sumps, and removal of some of the associated contaminated soils. After the plant was shut down in 2001, remedial activities were performed pursuant to two interim measures work plans that included demolition and placement of material and debris in one of two RCRA Corrective Action Management Units (CAMUs), and construction of two slurry walls to isolate highly contaminated soils from groundwater, thereby reducing contaminant leaching to groundwater. Since it was established four years ago, the Custodial Trust has planned and implemented numerous investigations and corrective actions aimed at addressing remaining groundwater contamination related to the former smelter site. Studies that have been completed or are currently underway include: a Phase II RCRA Facility Investigation (RFI) (METG, 2011); development of a groundwater flow model (Newfields, 2014); completion of a baseline ecological risk assessment and a screening level human health risk assessment; continued delineation and characterization of the groundwater plumes; initiation of the Upper Lake Drawdown Test (Appendix A); preparation of a Corrective Measures Study work plan (CH2MHill, 2014); and additional technical studies, evaluations and activities. All work completed to date by the Custodial Trust is intended to support design, permitting and construction of interim and final corrective measures aimed at reducing the migration of contaminants in groundwater from the site.

In addition to the actions cited above, three interdependent Interim Measures (IMs) are currently being implemented by the Custodial Trust at the former smelter site, with additional measures to be implemented as warranted. The primary purpose of the IMs is to reduce the migration of contaminants in groundwater from the former smelter site in order to protect public health and the environment. The three IMs are being implemented in phases and are summarized as follows:

1. <u>South Plant Hydraulic Control</u>: The South Plant Hydraulic Control IM (SPHC IM) is intended to reduce the migration of inorganic contaminants in groundwater by reducing groundwater elevations and flux rates through the south portion of the former smelter. Lowering groundwater levels will reduce the interaction of the groundwater with contaminated plant site soils, and leaching of contaminants to groundwater.

2. <u>Source Removal IM</u>: The Source Removal IM is intended to reduce the mass loading of contaminants to groundwater by eliminating certain soils currently acting as contaminant sources to groundwater. Source removal is being considered in areas where contaminated soils are accessible for removal, source area volumes and depths are conducive to removal, and source removal is deemed cost effective, from a cost/benefit perspective, as determined by currently available information.

3. <u>Evapotranspiration Site Cover</u>: The Evapotranspiration (ET) Cover System IM is intended to minimize precipitation infiltration on the former smelter site and associated leaching of contaminants from unsaturated soils to the groundwater table. Boundaries for the ET Cover System are intended to encompass the former plant site where the majority of smelting and related activities occurred, and the most highly contaminated soils exist. The ET Cover System IM will also eliminate human and

ecological receptor exposure to, and stormwater runoff contact with, contaminated soil.

Following is a schedule of completed and planned activities.

Activities completed in **2012 and 2013** include:

- ET Cover System IM Preparation: Phase 1 and Phase 2 demolition of the buildings and infrastructure on the former smelter site was required to prepare the site for future construction of the ET Cover System. Phase 1 demolition was completed in July 2013 and Phase 2 demolition was completed in October 2013.
- SPHC IM: Relocation of utilities and infrastructure to accommodate construction of a Temporary Bypass for Prickly Pear Creek (PPC) (PPC Temporary Bypass): Construction of the PPC Temporary Bypass was required to route PPC flow around Smelter Dam, thereby dewatering the South Plant area and enabling demolition of Smelter Dam, removal of Tito Park Area (TPA) soils (see discussion below), and reconstruct the PPC channel in mostly dry conditions. Construction of the PPC Temporary Bypass began in July 2013 and was completed in October 2013.

Activities being completed in **2014** include:

- Tito Park Area Soil Removal IM: This work will remove contaminated soil from the TPA, consisting of Tito Park, Upper Ore Storage Area (UOSA), Acid Plant Sediment Drying Area (APSD Area), and Lower Lake. Excavated soils are being consolidated within the onsite Area of Contamination (AOC) in accordance with the IM Work Plan 2012. The earthwork will remove contaminated soil from an area that is susceptible to inundation and erosion due to potential future PPC flooding. In addition, removal of materials from the TPA is necessary to meet the functional needs of the PPC Realignment, support the development of wetland habitat in the PPC floodplain, and reduce the overall footprint of the final ET Cover System.
- ET Cover System IM, Interim Cover System (ICS) Construction: An interim soil cover will be placed over a portion of the former smelter plant site in 2014 in conjunction with the TPA Removal IM. The ICS will serve as a foundation layer for the final ET Cover System, as well as a temporary cover for the TPA excavated soils to be placed within the onsite AOC. Engineered fill placed for the ICS will establish grade for the ET Cover System and will protectively manage soil and sediment removed from the TPA and East Bench areas consolidated within the AOC. The ICS will be capped with native soil to prevent storm water from contacting contaminated soil and to enable runoff to be shed offsite to perimeter drainages. The ICS will be constructed in two phases, with ICS 1 occurring in 2014 and ICS 2 in 2015.

Work planned for future years includes ongoing groundwater monitoring as well as the following:

2015

- Demolition/abandonment of remaining site facilities and infrastructure to accommodate placement of the ET Cover system.
- Construction of Phase I of the ET Soil Cover System over the Interim Cover System.
- Begin construction of the realigned Prickly Pear Creek channel. The realigned channel will be the final phase of the South Plant Hydraulic Control IM, and is intended to permanently lower plant site groundwater levels thereby reducing the interaction of groundwater with contaminated soils, and provide a more naturally functioning stream/riparian system.
- Performance monitoring of IMs implemented to date, which will include evaluations of downgradient groundwater quality.

2016

- Complete construction of realigned Prickly Pear Creek channel.
- Complete construction of the subgrade and ET Cover over the former smelter plant site.
- Performance monitoring of IMs implemented to date, which will include evaluations of downgradient groundwater quality.

In summary, the Interim Measures outlined above are designed to reduce contaminant loading to groundwater and the downgradient migration of groundwater-borne contaminants. Although the full effect of these activities is difficult to predict with certainty, evaluations are currently underway to estimate the effects on downgradient groundwater quality, and groundwater monitoring will be conducted to provide actual performance data. The effectiveness of the Interim Measures as well as the need for additional corrective measures will continue to be evaluated, with 2014 activities to include development of a groundwater geochemical fate and transport model to predict the groundwater quality response to the proposed corrective measures and guide future corrective measures planning and design. As discussed below, annual groundwater quality monitoring will also be conducted throughout the proposed CGWA to document the effectiveness of the IM/CM activities, assess the need for additional corrective measures, and to determine if changes to the East Valley CGWA boundaries or provisions are warranted.

6.2 CGWA MONITORING PROGRAM

As described above, the primary objective of the former smelter cleanup program is to protect human health and the environment, with corrective measures being evaluated and implemented to address the continued migration of contaminants, primarily arsenic, selenium and trace metals, through groundwater from the former smelter. The Custodial Trust has been implementing an extensive groundwater characterization and monitoring program since 2010, with the monitoring program components outlined in annual monitoring plans (Hydrometrics, 2013). Primary components of the monitoring program from 2010 to 2013 included:

- Further delineation and characterization of the groundwater plumes emanating from the plant site into the East Valley area;
- Contaminant source delineation and characterization; and
- Tracking water quality in residential and public water supply wells in the East Valley area (and the proposed CGWA).

In 2014 and future years, the focus of the groundwater monitoring program will be to obtain data necessary to confirm the protection of human health, evaluate the effectiveness of ongoing interim remedial measures, and determine if additional interim and final corrective measures are necessary.

The current groundwater monitoring program includes seasonal monitoring at approximately 140 monitoring wells, with the monitoring well network extending from south of the former smelter to north of Canyon Ferry Road (Exhibit 1). Groundwater monitoring includes field measurements of groundwater levels, water temperature, specific conductance, pH, dissolved oxygen, turbidity and oxygen/reduction potential at each well. Groundwater samples are also collected at each well for laboratory analyses of the parameters shown in Table 6-1. All samples are collected and sampling results are reviewed in accordance with a rigorous QA/QC program as outlined in the project quality assurance project plan (Hydrometrics, 2011a) and data management plan (Hydrometrics, 2011b). Field measurements and laboratory analytical results are entered into a project database.

Groundwater monitoring associated with the cleanup activities being conducted under the First Modification to the Consent Decree and the EPA-led RCRA program will continue until all remedial action objectives have been satisfied. Given the scale of groundwater contamination at and downgradient of the former smelter site, it is expected that monitoring will be required for several years. Once the CGWA is designated, the monitoring program will also be designed to support implementation and administration of the CGWA, with the groundwater quality data incorporated into the project database (Appendix D), for use by the

Table 6-1. 2014 Groundwater Sample Analytical Parameter List -- East Helena Facility

Parameter	Analytical Method [1]	Project Required Detection Limit (mg/L)
Physical Parameters		
pH	150.2/SM 4500H-B	0.1 s.u.
Specific Conductance	120.1/SM 2510B	1 µmhos/cm
TDS	SM 2540C	10
TSS	SM 2540D	10
Common Ions		
Alkalinity	SM 2320B	1
Bicarbonate	SM 2320B	1
Sulfate	300	1
Chloride	300.0/SM 4500CL-B	1
Calcium	215.1/200.7	5
Magnesium	242.1/200.7	5
Sodium	273.1/200.7	5
Potassium	258.1/200.7	5
Trace Constituents (Total and/or Dissolved) [2][3]		
Antimony (Sb)	200.7/200.8	0.003
Arsenic (As)	200.8/SM 3114B	0.002
Beryllium (Be)	200.7/200.8	0.001
Cadmium (Cd)	200.7/200.8	0.001
Chromium (Cr)	200.7/200.8	0.001
Copper (Cu)	200.7/200.8	0.001
Iron (Fe)	200.7/200.8	0.02
Lead (Pb)	200.7/200.8	0.005
Manganese (Mn)	200.7/200.8	0.01
Mercury (Hg)	245.2/245.1/200.8/SM 3112B	0.001
Nickel (Ni)	200.7/200.8	0.01
Selenium (Se)	200.7/200.8/SM 3114B	0.001
Thallium (Tl)	200.7/200.8	0.001
Zinc (Zn)	200.7/200.8	0.01
Metal Speciation (Dissolved) [3][4]		
Arsenic (As)	E 1632A Mod	0.002
Selenium (Se)	A 3114 B Mod	0.001
Field Parameters [5]		
Static Water Level	HF-SOP-10	0.01 ft
Water Temperature	HF-SOP-20	0.1 °C
Dissolved Oxygen (DO)	HF-SOP-22	0.01 mg/L
pH	HF-SOP-20	0.01 pH standard unit
Turbidity		0.1 NTU
ORP/Eh	HF-SOP-23	1 mV
Specific Conductance (SC)	HF-SOP-79	1 µmhos/cm

Notes:

(1) Analytical methods are from *Standard Methods for the Examination of Water and Wastewater* (SM) or EPA's *Methods for Chemical Analysis of Water and Waste* (1983).

(2) Private/residential well samples will be analyzed for both total and dissolved trace constituents; monitoring well samples will be analyzed for dissolved metals only

(3) Samples to be analyzed for dissolved constituents will be field-filtered through a 0.45 µm filter.

(4) Arsenic and selenium speciation will be analyzed at the monitoring wells scheduled for monthly monitoring.

(5) Field parameters should be measured in a flow cell in accordance with project SOPs.

technical advisory group in evaluating applications for new wells in Subarea 2 (or replacement wells in Subarea 1). The groundwater monitoring data will also be used for periodic reviews of the CGWA program, including the suitability of the CGWA boundaries and restrictions, so that changes can be made in response to changing groundwater conditions. Formal reviews of the CGWA program should occur at least every three years, with an appropriate schedule to be determined by the TAG in conjunction with the DNRC and other stakeholders.

6.3 TEMPORARY CGWA EVALUATION PROGRAM

As noted in Section 4, the primary purpose of the temporary component of the East Valley CGWA is to facilitate further study of potential sources of arsenic in the west arsenic area west of the former smelter (Figure 1-1). The Custodial Trust and Lewis and Clark County will jointly perform the necessary field investigations and data evaluations to further delineate the sources of arsenic to groundwater in this area and make recommendations regarding future management of the temporary CGWA. If arsenic in the west arsenic area is determined to be derived primarily from natural background sources (i.e., tertiary volcanoclastic sediments as is suggested by data collected to date), the recommendation would be to terminate the temporary portion of the CGWA. If it is determined that the former smelter is the primary source of arsenic to the area, then the recommendation would be to convert all or a portion of the temporary CGWA to a permanent CGWA.

The temporary CGWA evaluation will be implemented in phases to allow relevant existing information to be compiled and incorporated, and to accommodate potential funding mechanisms. The phases will include:

1. **Compile and Review Existing Information and Make Initial Determination:** Some groundwater data has previously been collected in the west arsenic area by the Custodial Trust and other entities (see Section 2.4.2). In addition, numerous studies have been conducted regarding the occurrence of naturally occurring arsenic in groundwater around the Helena Valley, as well as other similar intermontane basins in Montana and the interior west. As an initial step, all information and data relevant to the west arsenic area evaluation will be compiled and reviewed. Limited additional data collection will be performed as necessary in conjunction with the groundwater monitoring program outlined in Section 6.2. The west arsenic area information will be summarized in a technical memorandum, with conclusions on the source(s) of arsenic and recommendations for the temporary CGWA presented as warranted. If the existing information is not adequate for final determination of the arsenic source(s), additional data needs will be identified and recommendations for further evaluations made. Phase 1 of the evaluation will be funded by the Custodial Trust.

2. **Pursue Additional Funding for Further Evaluations if Necessary**: If additional evaluation is necessary, the Lewis and Clark County WQPD will pursue funding though the DNRC Resource Recovery Grant Program (RRGP). The County, in conjunction with the Custodial Trust, will develop a work plan for the additional source evaluations for use in the grant application. The grant application will be submitted by May 15, 2016, the next RRGP cycle.

3. **Conduct Additional Field Investigation/Evaluations if Necessary**: Utilizing the RRGP funds, additional field studies and other investigations will be conducted. The scope of the investigations will be dependent on the findings of the Phase 1 evaluation, but may include completion of additional test wells, groundwater testing and analyses to further define groundwater flow and chemical properties, geologic mapping and soil testing. Specialized testing would likely include groundwater isotopic analyses to delineate groundwater sources and flowpaths and for groundwater age dating. The evaluations may also include additional groundwater modeling using the calibrated groundwater flow and contaminant transport model developed for the proposed CGWA.

A preliminary schedule for the temporary CGWA evaluations is presented in Table 6-2. The schedule assumes that designation of the East Valley CGWA occurs by mid-2015, and is based in part on the RRGP grant schedule, with the next opportunity to submit grant applications being May 15, 2016. Based on this schedule, an initial duration of four years is requested for the temporary CGWA, with the option to extend the duration up to two additional years if necessary.

TABLE 6-2. PRELIMNARY SCHEDULE FOR EVALUATION OF TEMPORARY CONTROLLED GROUNDWATER AREA

MILESTONE	DATE(S)	NOTES
East Valley CGWA Designation	June 1, 2015	Estimated start date
Phase 1-Existing Data Compilation and Review	June 2015 – December 2015	May include additional data collection as necessary. Funded by Custodial Trust.
Preliminary Assessment/ Recommendations on Temporary CGWA	February 28, 2016	If possible, recommend discontinuing temporary CGWA, extending temporary CGWA for up to two more years, or converting to permanent CGWA. Otherwise, prepare work plan for additional investigation/evaluation.
Submit RRGP Grant Application	By May 15, 2016	If approved, grant funds available after July 1, 2017.
Conduct additional Evaluations	August 2017 – December 2018	Funded by RRGP grant.
Final Recommendations/ Determination on Temporary CGWA	March 2019	Recommend discontinuing temporary CGWA, extending temporary CGWA for up to two more years, or converting to permanent CGWA.

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APPENDIX A

UPPER LAKE DRAWDOWN TEST
TECHNICAL MEMORANDUM

APPENDIX B

CONTROLLED GROUNDWATER AREA HYDROGEOLOGY

APPENDIX C

NUMERICAL GROUNDWATER FLOW MODEL EVALUATIONS

APPENDIX D

EAST HELENA FACILITY PROJECT
WATER QUALITY DATABASE
(LOCATED ON CD)

APPENDIX E

PROPERTY OWNERSHIP WITHIN
THE EAST VALLEY CGWA BOUNDARIES