2016 GROUNDWATER AND SURFACE WATER CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY

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2016 GROUNDWATER AND SURFACE WATER CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY

1.0 INTRODUCTION

This Corrective Action Monitoring Plan (CAMP) summarizes the groundwater and surface water monitoring activities to be conducted in 2016 at the East Helena Facility[1] (the Facility) and surrounding areas, including the former ASARCO East Helena lead smelter site (former smelter)[2] (Figure 1-1). The primary objective of the 2016 CAMP is to provide for collection of adequate and appropriate groundwater and surface water monitoring data to evaluate the effectiveness of groundwater remedies (Interim Measures or IMs) implemented to date at the Facility, through a remediation phase performance monitoring data evaluation program. The IMs have been developed to reduce offsite migration of groundwater contaminants (primarily arsenic and selenium) and evaluation of IM performance is being done as part of the Corrective Measures Study (CMS). In addition to the performance monitoring component of the 2016 monitoring program, the CAMP also provides for data collection to meet other objectives, including monitoring of residential/water supply wells within the study area in order to ensure protection of groundwater users; supporting development of a final remedy performance monitoring program; evaluation of groundwater/surface water interactions and potential effects on groundwater contaminant plumes; and monitoring of groundwater chemistry in wells associated with the Corrective Action Management Units (CAMU) at the Facility and in the area west of the former smelter where elevated background arsenic concentrations have previously been observed (the "West Arsenic Area").

The 2016 CAMP describes the Facility-related groundwater and surface water monitoring activities; it identifies monitoring objectives and remediation phase performance evaluation data analysis techniques, and describes the number, type and location of samples to be collected to address objectives, as well as the sampling and analytical methodologies to be employed. The monitoring activities described in this plan are focused on providing comprehensive synoptic groundwater and surface water quality data, groundwater and

[1] East Helena Facility refers to the former ASARCO East Helena Lead Smelter and surrounding properties previously owned by ASARCO and currently owned by the Montana Environmental Custodial Trust (MECT).

[2] The former smelter refers to the approximately 142 acres previously occupied by the East Helena Lead Smelter.

surface water elevation measurements, and streamflow data targeting specific project objectives. The CAMP is intended to be utilized in association with other Facility planning and guidance documents, including the Quality Assurance Project Plan (QAPP) for Environmental Data Collection Activities (Hydrometrics, 2015a), and the Data Management Plan (DMP) for Environmental Data Collection Activities (Hydrometrics, 2011). These documents include detailed discussions of the project and Facility history and background, as well as requirements for data review, reporting, and management. Brief summaries are provided in this CAMP for context.

As CMS evaluations are being completed in 2016, implementation of IMs and further analyses of IM performance and other potential remedial actions will continue at the East Helena Facility and may require supplemental data in addition to that specified in this CAMP. If necessary, additional monitoring to be conducted at the Facility will be documented in supplemental, focused work plans.

1.1 PROJECT BACKGROUND

The Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust (Custodial Trust), is currently conducting a CMS for the East Helena Facility, under the oversight of the United States Environmental Protection Agency (EPA). The CMS is one of the Resource Conservation and Recovery Act (RCRA) Corrective Actions being conducted at the Facility pursuant to the First Modification to the 1998 RCRA Consent Decree (U.S. District Court, 2012).

Soils and non-native fill material (i.e., slag, ore, concentrates, demolition debris) located in the operating areas of the former smelter contain elevated concentrations of a number of contaminants, primarily arsenic, selenium, and certain trace metals. Contaminants within site soils and fill material are the result of more than a century of ore handling and processing; storage and disposal of smelting wastes and byproducts; and periodic releases of high contaminant-concentration plant process waters. The contaminated soils/fill represent the major current and/or historic sources of contaminant loading to groundwater. Loading of contaminants to groundwater has resulted in the generation and migration of groundwater plumes (primarily arsenic and selenium) from the former smelter to the north and northwest. The primary purpose of the IMs completed to date by the Custodial Trust under the CMS program is to reduce contaminant mass loading to, and the migration of, contaminants in groundwater from the former smelter in order to protect public health and the environment.

1.2 2016 MONITORING PROGRAM OBJECTIVES

The 2016 East Helena CAMP has been developed to guide the collection of information necessary to continue assessment of groundwater quality status and trends within and downgradient of the former smelter, and to evaluate the groundwater response to and effectiveness of interim and other remedial measures implemented at the Facility in terms of reducing the migration of groundwater contaminants. Compared with previous CAMP programs, which were more focused on source area characterization and plume delineation, the 2016 CAMP represents an increased emphasis on performance monitoring appropriate to the CMS phase of a RCRA Corrective Action remediation project (as described in Section 2). Therefore, the following performance evaluation-specific monitoring objectives have been established:

[1] Document and track groundwater level and flow trends across the project area;
[2] Document and track groundwater chemistry trends in former smelter contaminant source areas and at the leading downgradient edge of the selenium plume, where variable trends have recently been observed;
[3] Evaluate downgradient arsenic and selenium plume stability, in terms of plume area, average plume concentrations, and location of plume centroids; and
[4] Assess mass flux of arsenic and selenium in groundwater migrating off the former smelter site and at select downgradient locations.

Additional 2016 monitoring objectives include the following:

[5] Support development of a final remedy performance evaluation monitoring program (attainment phase monitoring);
[6] Provide ongoing data on residential/public water supply well water quality in the area of former smelter site impacts, and in rural residential areas peripheral to the main groundwater plumes (Seaver Park west of the former smelter, and the area north (downgradient) of the selenium plume), to provide protection of water users;
[7] Evaluate groundwater/surface water interaction, specifically effects of surface water recharge on groundwater flow and plume migration, and potential surface water quality or flow effects in the Prickly Pear Creek realignment area; and
[8] Monitor current groundwater chemistry in CAMU and West Arsenic Area wells.

As the CMS process continues and a final groundwater remedy is selected for the Facility, a final remedy performance monitoring program will be developed, with an optimized scope of monitoring and well network appropriate for the attainment phase of a RCRA Corrective Action project. It is anticipated that this attainment phase program will involve a reduction in the monitoring well network, compared with the 2016 and previous CAMPs; therefore, as noted above, a key objective of the 2016 CAMP is to collect information to support the future development of the final remedy performance monitoring program, in terms of selection of wells, monitoring objectives, and performance monitoring data evaluation techniques.

In addition to the objectives outlined above, data collected through the 2016 CAMP will also support additional data uses. For example, data collected through the 2016 CAMP will be used to update the conceptual and numerical groundwater models as needed and support implementation and administration of the East Valley Controlled Groundwater Area.

One of the principal tools that will be used to evaluate the effectiveness of the groundwater remedial measures implemented to date at the Facility will be a performance monitoring program consisting of three components: (1) water level trend analysis at wells throughout the monitoring well network, and contaminant concentration trend analysis at selected wells in contaminant source areas on the former smelter and near the leading edge of the selenium plume; (2) contaminant plume stability analysis in areas downgradient of the former smelter boundary; and (3) contaminant mass flux analysis using the calibrated numerical groundwater flow and fate and transport model. These analyses are intended to address CAMP Objectives [1] through [4] listed above, and will be conducted using groundwater data collected under this 2016 CAMP and in previous years. A detailed discussion of the performance monitoring data evaluation methods, including the monitoring wells selected for the performance monitoring, is presented in Section 2.

The multi-year CAMP Program is one component of the CMS currently being implemented at the Facility by the Custodial Trust. The 2016 CAMP details the CAMP Program objectives and monitoring activities for the current year, and fulfills requirements of the First Modification to the 1998 RCRA Consent Decree (U.S. District Court, 2012). The 2016 groundwater and surface water CAMP is structured as follows:

- Section 1.0 – Introduction;
- Section 2.0 – Remediation Phase Performance Monitoring Data Evaluation Program;
- Section 3.0 – Sampling Locations and Frequency;
- Section 4.0 – Sampling Methods;
- Section 5.0 – Sample Handling and Documentation;
- Section 6.0 – Laboratory Analytical Procedures and Reporting; and
- Section 7.0 – References.

2.0 REMEDIATION PHASE PERFORMANCE MONITORING DATA EVALUATION PROGRAM

In their *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action* (EPA, 2004), EPA defines performance monitoring as "the periodic measurement of physical and/or chemical parameters to evaluate whether a remedy is performing as expected." More recently published EPA guidance on groundwater remediation completion strategies (EPA, 2013, 2014a, 2014b) includes a discussion of recommended remedy evaluation (performance monitoring) strategies. EPA recommends evaluating groundwater data and information on a well-by-well basis to monitor remedial action effectiveness during two distinct phases of groundwater restoration activities (EPA, 2013), including:

1. The remediation phase, referring to the phase of the remedy where remedial activities are being actively implemented and groundwater data are used to monitor progress toward groundwater cleanup levels specified in a remedy decision document; and
2. The attainment monitoring phase, occurring after the remediation monitoring phase is complete.

The East Helena Facility is currently in the remediation phase. During this phase, groundwater data "typically are collected to evaluate contaminant migration and changes in COC concentration over time" (EPA, 2014a). Therefore, one of the primary objectives of the 2016 CAMP program is to provide sufficient data to evaluate progress toward groundwater cleanup levels specified in the CMS Work Plan for the Facility (CH2M Hill, 2015). Relevant questions regarding the performance of IMs implemented to date by the East Helena cleanup project, as well as the adequacy of the groundwater conceptual site model (CSM), are the following:

- Are there changes (trends) in groundwater contaminant of concern (COC) concentrations?
- Are groundwater elevations and flow directions as expected and have temporal, seasonal, and matrix diffusion influences been assessed and considered?
- Is there evidence of attenuation, degradation, and/or stabilization of COCs?
- Is the spatial (lateral and vertical) extent of contaminated groundwater changing?

The following three data evaluation methods will be used to address these IM performance questions, and to address the performance monitoring-specific objectives [1] through [4] in Section 1.2:

1. Groundwater elevation and Contaminant of Concern (COC) trend analysis (Section 2.1). Trend analysis of groundwater elevations (and associated flow directions)

throughout the project area, and contaminant trends in former smelter site source areas and at the downgradient end of the selenium plume will allow direct assessment of changes in concentration and groundwater elevations over time.

2. Plume Stability analysis (Section 2.2). Plume stability analyses will allow evaluation of any changes in the spatial extent of the arsenic and selenium plumes in the area downgradient of former smelter site source areas, as well as an integrated assessment of changes in concentrations averaged from multiple wells (as opposed to the individual well trend analysis).
3. Groundwater contaminant mass flux (Section 2.3). Mass loading rates (contaminant fluxes) of arsenic and selenium will be calculated at several locations, including the former smelter boundary and selected downgradient plume transects. Comparison of mass fluxes at multiple locations over time will allow evaluation of contaminant attenuation (e.g., arsenic adsorption/coprecipitation), degradation of sources (e.g., decreasing selenium loads as leachable sources are desaturated or leached out), and also will provide information regarding the relative impacts of changes in groundwater flux and changes in groundwater concentration on overall contaminant loads leaving the former smelter site and migrating downgradient. Although not directly comparable to water quality standards, contaminant mass loading rates will provide a direct measure of changes in contaminant leaching to groundwater minus the effects of changing recharge (dilution) that influence contaminant concentration trends.

As noted above, the 2016 performance monitoring program addresses the current remediation phase of performance monitoring. The remediation phase program relies on empirical, analytical, and statistical methods, as well as the numerical groundwater flow and contaminant fate and transport model developed for the site. The specific data evaluation techniques to be used as performance monitoring tools are described below. The 2016 performance monitoring results will be summarized in a 2016 Water Resources Monitoring Report. Program adjustments (for example, reduction in number of wells monitored and/or monitoring frequency, changes in data evaluation methods) will be made as appropriate in the future as the program transitions into the attainment phase. Groundwater data collected in 2016 will be utilized along with historic information in developing the final remedy performance monitoring program..

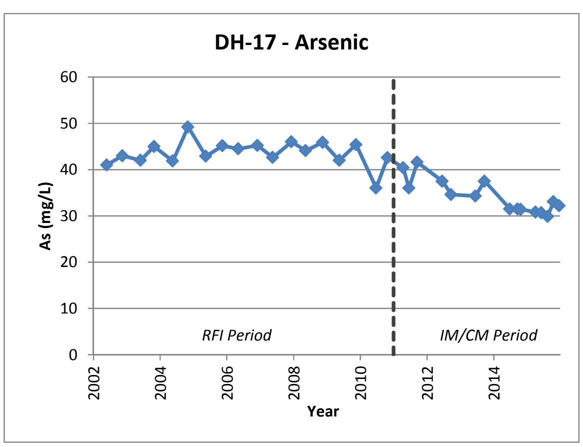
2.1 TREND ANALYSIS

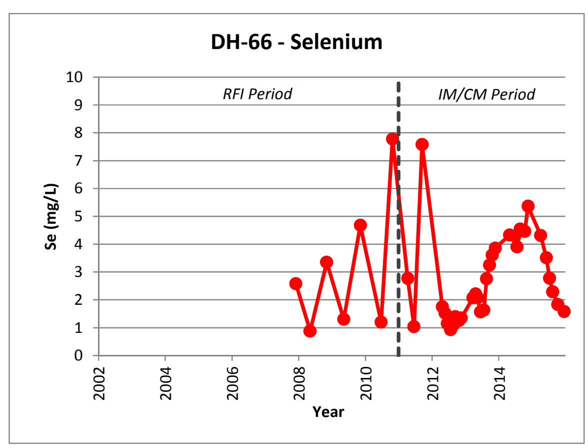
As recommended in EPA guidance (EPA, 2014a), trend analysis will be conducted at selected monitoring wells for the primary COCs at the Facility (arsenic and selenium), along with the indicator geochemical parameters sulfate and chloride (sulfate and chloride are relatively conservative indicators of historic smelter groundwater quality impacts). Groundwater elevation trends (hydrographs) comparing pre-IM and post-IM groundwater elevations will also be prepared to evaluate IM effectiveness in terms of reducing groundwater elevations. Remediation phase concentration trend analysis performance monitoring will focus on wells in two primary areas of interest: (1) the main former smelter site source areas, including the West Selenium area, North Plant Site Arsenic area, Slag Pile, and Acid Plant area; and (2) wells defining the downgradient end of the selenium plume where recently variable concentration trends have resulted in some uncertainty regarding the overall downgradient selenium plume extent. The set of wells selected for concentration trend analysis will be sampled quarterly during 2016, as described in Section 3.1.1. Quarterly monitoring of these wells will allow ongoing assessment of concentration trends at source area wells (where some concentration decreases have recently been observed), as well as additional information on the variable trends at the leading edge of the selenium plume. Wells selected for remediation phase concentration trend analysis under the performance evaluation program are listed in Table 2-1 and are shown on Figure 2-1. Groundwater elevation trend analysis will be based on data collected during the monthly water level monitoring events described in Section 3.1.3.

Temporal trend plots of arsenic, selenium, sulfate, and chloride concentrations, along with groundwater levels, will be prepared and updated as additional data are collected in 2016, to provide an ongoing delineation of contaminant concentration and water level trends. Trend analyses will be conducted for the post-operational data set (data collected in 2002 and subsequent years) at each well, including the following two periods:

1. RCRA Facility Investigation (RFI) period (2002-2011); and
2. RCRA Interim Measure/Corrective Measure implementation period (2011-present).

Example concentration trend plots for two of the wells selected for trend analysis are shown below:





In addition to the preparation and visual inspection of trend plots, statistical trend testing may be used to test for statistically significant water level, arsenic, selenium, sulfate, and/or chloride trends over time at selected wells, although based on recent trends visual analysis is expected to be sufficient for the remediation phase. If warranted based on visual examination of trends throughout 2016, nonparametric or parametric statistical tests for trend (e.g., Mann-Kendall tests or linear regression tests) may also be conducted as a more quantitative measure of trends. Appropriate statistical methods for evaluating trends in groundwater data, including Mann-Kendall and linear regression testing, are discussed in EPA's *Unified Guidance* (EPA, 2009). Software that would be used to conduct trend analysis may include EPA's ProUCL Version 5.0 (Singh and Maichle, 2013), Groundwater Statistics Tool (EPA, 2014c), the Mann-Kendall Toolkit (GSI, 2012) or similar calculation tools. Note that, during remediation phase performance monitoring, changes in concentration at individual wells are expected to be more visually apparent and may be variable as contaminant loading to groundwater from source areas decreases and the groundwater system adjusts to a new steady state condition. Statistical trend testing (or other statistical tests) will be more explicitly incorporated into the attainment phase performance monitoring program, in order to determine whether concentrations at individual monitoring wells meet remediation target levels.

2.2 PLUME STABILITY ANALYSIS

The second component of groundwater remedy performance evaluation will consist of a plume stability analysis for the primary groundwater COCs, arsenic, and selenium. While contaminant concentration trends at individual wells within and downgradient of the primary source areas on the former smelter site may show varying trends (increasing or decreasing), particularly during the remediation phase of remedy monitoring, evaluation of plume stability will allow an additional comprehensive assessment of plume characteristics in the area directly downgradient of the former smelter site, and any changes over time in metrics such as plume area, average plume concentration, and plume concentration centroid location.

The calculation methods for arsenic and selenium plume stability will be based on methods outlined in Ricker (2008). In general, the procedure involves the following steps:

1. Define the areas for which plume characteristics will be calculated. For the purposes of remediation phase performance evaluation monitoring, arsenic and selenium plume areas in the near downgradient area in the City of East Helena and in Lamping Field have been selected, to allow integration of results from multiple monitoring points into a single analytically-derived measure of plume characteristics. The arsenic and selenium plume stability evaluation areas are shown on Figure 2-2.
2. Select a representative set of monitoring wells from the monitoring well network with sufficient spatial distribution to define the extent of the contaminant plume within the

plume stability evaluation area over multiple years. The selected well sets for the arsenic and selenium plume stability analysis are shown on Figure 2-2 and are summarized in Table 2-2. Note that the selected well sets differ for the COCs, since the plume configurations are different for arsenic and selenium.

3. For each well, calculate an annual average concentration of the COC. A single average concentration will be calculated for paired or nested wells (see Table 2-2), in order to associate one average concentration at a given location.
4. Generate a grid file of interpolated concentration values within the given plume stability area for an individual monitoring year and contaminant, using spatial analysis software such as Surfer® by Golden Software. As noted in Ricker (2008), grid files are typically generated on log-transformed concentration data (for smoother interpolation), then transformed back to original concentration units prior to further calculations.
5. Use the grid file to calculate various average plume metrics for the monitoring year, including:
   a. Plume area;
   b. Average plume concentration; and
   c. Plume centroid of concentration.

As described in Ricker (2008), calculated values of these metrics may then be compared over time using trend testing techniques (such as those described above in Section 2.1) to determine the presence or absence of any trends in total plume area or average plume concentration. For example, the average arsenic concentration greater than 0.010 mg/L within the plume stability area, calculated on an annual average basis for a range of monitoring years, can be plotted and tested for trend to determine if there is a statistically significant trend. In addition, Ricker (2008) notes that for shrinking plumes, the plume centroid of concentration (or mass) should recede toward the source over time; if the plume is transient (migrating away from the source) or expanding, the centroid of concentration will show migration downgradient away from the source. Therefore, by calculating and plotting centroids of concentration over a number of years, plume stability (expanding, stable, shrinking or transient) can be further evaluated.

In combination with the individual well trend evaluations discussed above, the plume stability metrics offer an efficient and objective process for assessing the performance of remedial measures over time. Comparison of hand-drawn plume maps based on specific monitoring events allows for interpretation of broad overall trends in plume geometry and configuration when maps from different monitoring events are compared. The remediation phase plume stability calculations proposed in this CAMP, however, are intended to minimize potential bias and provide a more quantifiable comparison by using a consistent set of monitoring wells with suitable period of record, along with a consistent software-based gridding algorithm, and annual average concentrations to smooth out seasonal variability.

2.3 CONTAMINANT MASS FLUX ANALYSIS

The third component of groundwater remedy performance evaluation will consist of a contaminant mass flux analysis for the primary groundwater COCs, arsenic, and selenium. Mass flux can be defined as the mass discharge rate of a contaminant in a groundwater plume in units of mass per time passing across a plume transect. The mass flux analysis will complement the concentration trend and plume stability analyses discussed above. As noted previously, contaminant concentration trends at individual wells may vary (increasing or decreasing) during the remediation phase of remedy monitoring, and are affected by changes in groundwater recharge (dilution) and flux rates. Evaluation of mass flux changes over time, along with the plume stability analysis described above, will allow for a more comprehensive assessment of remedial progress in terms of the total contaminant mass migrating off the Facility and through downgradient areas.

Six transects established for arsenic and selenium mass flux calculations are shown on Figure 2-3. The mass fluxes of arsenic or selenium across these transects will be calculated using the calibrated numerical groundwater flow and contaminant fate and transport model for the East Helena Facility. The model incorporates detailed information on groundwater flow properties (hydraulic gradients, hydraulic conductivities, groundwater seepage velocities) and groundwater concentration distribution (based on calibration of the fate and transport model to empirical data sets), thus allowing calculation of the mass of contaminant migrating through a given transect over a given time period. Mass fluxes determined using the calibrated groundwater model based on 2016 concentration and water level data can be compared to similar simulations from other monitoring years, to evaluate changes in mass flux over time during the remediation phase of the project.

In summary, the remediation phase performance evaluation monitoring approach for the East Helena Facility outlined above includes three data evaluation methods. Trend analyses of water levels throughout the project area, and COCs and indicator geochemical parameters in former smelter site source areas and at the downgradient end of the selenium plume will allow direct assessment of changes in concentration and groundwater elevations over time. Plume stability analyses will allow evaluation of any fluctuations in the spatial extent of the arsenic and selenium plumes in the area downgradient of former smelter site sources and an integrated assessment of varying concentrations at multiple wells. Finally, groundwater contaminant mass fluxes will be calculated at selected plume transect locations using the calibrated groundwater model, to aid in determining changes in contaminant loading to groundwater and downgradient contaminant attenuation processes.

3.0 SAMPLING LOCATIONS AND FREQUENCY

This section of the CAMP describes the groundwater and surface water sampling locations and the frequency of sampling selected to allow evaluation of the remediation phase performance evaluation metrics specified in Section 2, and to meet the project objectives described in Section 1.2. Details on sampling methodologies, sample handling, and analytical requirements are presented in Sections 4, 5, and 6, respectively. The 2016 CAMP will be implemented in accordance with the QAPP and DMP prepared for the East Helena Facility (Hydrometrics, 2015a and 2011).

Based on the performance evaluation-specific objectives and additional objectives outlined above in Section 1.2, the scope of water resources monitoring under this CAMP includes periodic monitoring at a set of groundwater and surface water locations with sufficient spatial distribution to provide a synoptic evaluation of groundwater conditions utilizing groundwater and surface water hydrographs, surface water flow measurements, groundwater potentiometric maps, temporal trends, assessments of contaminant plume geometry and stability, and contaminant mass flux calculations. The 2016 groundwater monitoring well network includes a subset of monitoring wells on the former smelter site (on-site wells), as well as monitoring, residential, and municipal water supply wells in areas upgradient and downgradient of the former smelter (off-site wells). On-site sampling locations include selected wells located near identified contaminant sources (i.e., near or downgradient of former plant activities) and along historically-identified plume migration routes. Off-site sampling locations include monitoring wells located in East Helena, in and north of Lamping Field (west of East Helena), and residential and municipal water supply wells located south, west, and north of the Facility.

Note that, due to ongoing former smelter site construction activities and associated well modifications, some monitoring wells may be inaccessible during portions of 2016. Although efforts will be made to schedule 2016 CAMP monitoring activities to avoid issues with construction-related site or well access, it is likely that modifications to the proposed monitoring schedule will be required during 2016. Any modifications to the schedule proposed in this CAMP will be documented and discussed in the 2016 Groundwater Monitoring Report.

Monitoring well and semiannually-sampled residential / water supply well locations are shown on Exhibit 1. Residential / water supply wells selected for annual monitoring (Seaver Park, Canyon Ferry Road area) are shown on Figures 3-1 and 3-2. Surface water monitoring locations were selected to represent Lower Lake, Prickly Pear Creek, gravel pit ponds near Prickly Pear Creek, and drainage through the former Upper Lake area. Surface water monitoring locations selected for 2016 are shown on Figure 3-3. An overall summary schedule for the 2016 East Helena Facility groundwater and surface water monitoring is shown in Table 3-1. Table 3-1 presents the monthly schedule for various groundwater and surface water monitoring activities, along with the monitoring objectives addressed by each activity.

3.1 GROUNDWATER MONITORING

Specific wells selected for the 2016 groundwater monitoring program , and the monitoring frequencies assigned to each well, are summarized in Tables 3-2 (monitoring wells) and 3-3, 3-4, and 3-5 (residential and water supply wells). For the monitoring wells scheduled for groundwater quality sampling, Table 3-2 also presents a summary of the primary objective addressed by each monitoring well. The number of wells selected to address each of the groundwater-related CAMP objectives includes:

- Performance Evaluation-Specific Objectives
  - ✓ Water Level Trend Monitoring (Objective [1]): 193 wells.
  - ✓ Contaminant Trend Monitoring (Objective [2]): 18 wells sampled quarterly.
  - ✓ Plume Stability Monitoring (Objective [3]): 41 wells sampled semiannually.
  - ✓ Mass Flux / Plume Definition (Objective [4]): 19 wells sampled semiannually.

- Additional Monitoring Objectives
  - ✓ Support future development of final remedy performance monitoring program (Objective [5]): 78 wells (monitoring wells sampled on a quarterly, semiannual, or annual basis, including all wells sampled as part of performance evaluation trend monitoring, plume stability monitoring, and mass flux / plume definition monitoring).
  - ✓ Protection of water users (Objective [6]): 34 wells, sampled annually or semiannually.
  - ✓ Monitor groundwater chemistry in West Arsenic/CAMU areas (Objective [8]): 17 wells, sampled annually.

Groundwater quality sampling will be performed in accordance with applicable SOPs summarized in Sections 4 and 5 and provided in the project QAPP. Field parameters and static water levels will be recorded when water samples are collected. Samples will be analyzed for common ions, dissolved metals, and total metals (for residential and municipal water supply wells) as described in Section 6. Groundwater sampling and water level measurement activities will be performed in the shortest time period practical (1 day for comprehensive water level measurement events, 2 to 3 days for quarterly groundwater quality monitoring events, and 6 to 10 days for semiannual groundwater quality monitoring events) to provide a synoptic snapshot of hydrogeologic conditions. The sampling schedule for residential and municipal water supply wells will depend on coordination with well owners to arrange access; however, sampling and water level measurement activities will be performed in the shortest time period practical.

3.1.1 Performance Evaluation Groundwater Monitoring

3.1.1.1 Sitewide Water Level Monitoring

A Facility-wide set of monitoring wells and piezometers (193) is scheduled for measurement of groundwater levels in 2016 (Table 3-2). Measurement locations are shown on Exhibit 1. Water level data will be used to evaluate groundwater elevation trends as part of the performance monitoring trend analysis outlined as Objective [1] and described in Section 2. This data will also be used in combination with surface water flow and elevation data to provide information to develop groundwater potentiometric surface maps, to further evaluate groundwater/surface water interactions on a seasonal basis, to assess the potential impact of seasonal variability in flow direction and surface water gain/loss on contaminant plume geometry, and to refine future monitoring programs (CAMPs). Monitoring well static water level measurement will be supplemented by measurement of water levels in residential wells (subject to access limitations) during the residential well monitoring events described in Section 3.1.3.

Water level monitoring will be performed monthly between April and November 2016 (Table 3-2), to capture the effects of dynamic conditions (e.g., spring melt, wet season, plant site construction activities, and initiation of flow in irrigation ditches and canals). Manual measurements will be obtained at all locations to within 0.01 feet.

Water level measurements will be obtained in accordance with applicable SOPs summarized in Sections 4 and 5. During those months when semiannual groundwater quality sampling is scheduled (June and October-November 2016), a complete round of water level measurements will be obtained prior to initiation of the sampling event. Sitewide water level monitoring events will be conducted in coordination with the surface water elevation and flow measurement monitoring events described in Section 3.2, in order to provide a complete representation of groundwater and surface water elevations across the project area.

3.1.1.2 Performance Evaluation Trend Analysis Wells

A total of 18 monitoring wells have been scheduled for quarterly sampling during April, June, August, and October-November 2016. The quarterly monitoring program is primarily intended to provide information for remediation phase performance monitoring in former smelter site source areas (including the West Selenium Area, the North Plant Arsenic Area, the former Acid Plant area, and the Slag Pile), and at wells near the downgradient end of the selenium plume, through evaluation of the contaminant trend testing metrics outlined as Objective [2] and described in Section 2. The wells selected for quarterly monitoring to support performance evaluation trend testing in 2016 are listed in Table 3-2 and shown on Exhibit 1 and Figure 2-1.

3.1.1.3 <u>Performance Evaluation Plume Stability Analysis Wells</u>

A total of 60 monitoring wells have been scheduled for semiannual sampling during spring (June) and fall (October-November) 2016. Of these 60 wells, 41 wells have been selected primarily to provide information for remediation phase performance monitoring through evaluation of the contaminant plume stability metrics outlined as Objective [3] and described in Section 2. The wells selected for semiannual monitoring to support performance evaluation plume stability monitoring in 2016 are listed in Table 3-2 and are shown on Exhibit 1 and Figure 2-2.

3.1.1.4 <u>Performance Evaluation Mass Flux Analysis / Plume Definition Wells</u>

The remaining 19 of the 60 monitoring wells scheduled for semiannual sampling during spring (June) and fall (October-November) 2016 have been selected primarily to provide information for remediation phase performance monitoring (in combination with the other wells sampled on a semiannual or quarterly basis), through additional definition of the groundwater contaminant plumes originating on the former smelter and evaluation of the mass flux calculation metrics outlined in Objective [4] and described in Section 2. The wells selected for semiannual monitoring to support 2016 performance evaluation mass flux calculations via enhanced plume definition are listed in Table 3-2 and are shown on Exhibit 1.

3.1.2 West Arsenic and CAMU Area Monitoring

A total of 17 monitoring wells in the West Arsenic and CAMU areas are scheduled for annual sampling during June 2016. The annual monitoring program includes:

- Eleven wells (MW-1 through MW-11) in the vicinity of the Phase I and Phase II CAMU area, to monitor any groundwater quality trends over time in this area; and
- Six wells (EH-200, EH-201, EH-202, EH-203, EH-208, and EH-209) in the West Arsenic area (west of the former smelter), where arsenic concentrations exceeding groundwater standards have been previously observed, and are believed to be due at least in part to non-smelter sources.

Documented groundwater quality in the CAMU and West Arsenic areas has been relatively stable over time; therefore, annual sampling in 2016 is considered sufficient to allow continued tracking of groundwater quality, in accordance with Objective [8]. The wells selected for annual monitoring are listed in Table 3-2 and shown on Exhibit 1.

3.1.3 Residential / Water Supply Well Monitoring

Residential and public water supply wells are included in the 2016 groundwater monitoring program to address Objective [6], ensuring protection of groundwater users (i.e., nearby residents). As noted in the RCRA groundwater protection guidance (EPA, 2004), documenting and addressing potential human exposures is one of EPA's high priority short-term protection goals.

3.1.3.1 Semiannual Residential Monitoring

The residential and municipal water supply wells included in the 2016 semiannual water quality sampling program are listed in Table 3-3, and are shown on Exhibit 1. Monitoring is scheduled at 19 wells on a semiannual basis (June and October 2016). Note that, based on a well owner survey conducted in 2015 as part of the 2015 CAMP, a number of identified residential / water supply wells are not included on the 2016 sampling schedule, due to lack of access, inoperative pumps, or other reasons (see Table 3-3). In addition, a number of wells have been abandoned or are scheduled for abandonment as part of the residential well abandonment program being implemented by the Custodial Trust (Table 3-3). Although these wells are shown on Exhibit 1 and in Table 3-3 (shaded cells) for informational purposes, they are not included on the 2016 semiannual monitoring schedule.

3.1.3.2 Annual Residential / Water Supply Well Monitoring

In addition to the semiannual residential / water supply well sampling program outlined above, annual monitoring will be conducted in 2016 at a selected set of wells in two other residential areas: the area downgradient of the selenium plume ("Downgradient Se Area") and Seaver Park, west of the former smelter. Groundwater quality at residential wells in these areas was previously characterized as part of Facility-related monitoring programs that continued through the 2011-2012 monitoring season. Annual monitoring of selected wells in the Downgradient Se and Seaver Park areas is scheduled in 2016 to determine the current groundwater quality status in these areas and for comparison with historical data.

Wells selected for annual monitoring in 2016 in the Downgradient Se area are shown on Figure 3-1 and are listed in Table 3-4. Wells selected for annual monitoring in 2016 in Seaver Park are shown on Figure 3-2 and are listed in Table 3-5. The annual monitoring figures and tables also summarize recent arsenic and/or selenium concentrations observed at selected wells, and briefly describe the rationale for inclusion of each well in the monitoring program. The annual residential / water supply well monitoring is scheduled for May or June 2016.

3.2 SURFACE WATER MONITORING

This section describes the locations selected for monitoring water levels, water quality, and streamflow in surface water bodies near the Facility. Surface water sampling and measurement locations and frequencies are listed in Table 3-6 and shown on Figure 3-3. The surface water monitoring program has been designed to address Objective [7], evaluation of groundwater/surface water interactions, specifically effects of surface water recharge on groundwater flow and plume migration, and potential surface water quality or flow effects in the Prickly Pear Creek realignment area.

3.2.1 Elevation Monitoring

Surface water elevation measurements will be collected concurrently with sitewide groundwater level monitoring, from April through November 2016 (Table 3-6). Monthly monitoring is intended to capture dynamic conditions (e.g., spring melt, wet season, initiation of flow in irrigation ditches and canals), and to provide information on seasonal groundwater-surface water interactions. Water elevation measurements at stream, ditch, and pond locations will be obtained using a survey-grade global positioning system (GPS) instrument. Sites selected for elevation monitoring (19 sites) are listed in Table 3-6 and shown on Figure 3-3.

3.2.2 Surface Water Flow and Water Quality Sampling

Surface water flow measurements and water quality monitoring for 2016 will be conducted during high flow (June) and low flow (October-November) conditions. Locations selected for flow measurement and water quality sampling (10 sites) are listed in Table 3-6 and shown on Figure 3-3. The timing of the surface water quality monitoring events will be coordinated with the semiannual groundwater monitoring events to obtain a comprehensive synoptic understanding of groundwater and surface water conditions near the Facility.

Instantaneous flow measurements will be obtained using current velocity meters and the cross-section method, or (for smaller flows) flumes or volumetric methods. Flow measurement methods are further described in Section 4.2.2. Surface water quality sampling on flowing water bodies with more than one sampling location (Prickly Pear Creek) will be conducted from downstream to upstream in a single day, to provide information on streamflow gains and losses, potential interactions with groundwater, and in-stream parameter loading trends across various stream reaches, while minimizing the possibility of temporal variability.

The surface water quality sampling and flow measurements will be performed in accordance with applicable SOPs summarized in Sections 4 and 5. Field parameter measurements and streamflows will be recorded when samples are collected. Samples will be analyzed for common ions and total recoverable metals as described in Section 6.

4.0 SAMPLING METHODS

Groundwater and surface water sampling activities described in the 2016 CAMP will be conducted in accordance with the procedures described in the 2015 CAMP (Hydrometrics, 2015b), and consistent with the East Helena Facility QAPP (Hydrometrics, 2015a). Standard Operating Procedures (SOPs) for planned and anticipated field activities are listed in Table 4-1. The sampling methods outlined below for groundwater (Section 4.1) and surface water (Section 4.2) are consistent with methods described in previous CAMPs, which were derived from the SOPs and the QAPP. Collection of field quality control (QC) samples for groundwater and surface water is discussed in Section 4.3.

4.1 GROUNDWATER MONITORING

Groundwater samples will be collected from both monitoring wells and private (residential or water supply) wells in 2016. Procedures for collection of samples at these two types of wells differ, since private wells typically have dedicated pumps installed, and are pumped frequently in comparison to monitoring wells. Collection of samples from monitoring wells (Section 4.1.1) and private wells (Section 4.1.2) are discussed separately below.

4.1.1 Monitoring Well Samples

The collection of groundwater samples from site monitoring wells generally will consist of three steps:

1. Measurement of static water level;
2. Well purging and monitoring for field parameter stabilization; and
3. Water quality sample collection.

4.1.1.1 Static Water Level Measurement

Before collection of samples or removal/introduction of any equipment into the well, the static water level will be measured, to the nearest 0.01 foot, at each well using an electric water level probe to determine the depth of groundwater below a specified measuring point (typically the top of the polyvinyl chloride [PVC] well casing). Water level measurements and surveyed measuring point elevations will be used to compute groundwater elevations at each monitoring point. A complete set of static water level measurements will be obtained at all wells designated for water levels before initiating a quarterly or semiannual water quality sampling event. This procedure allows static water levels to be measured over a shorter time period (usually one day) than would be possible if measurements were collected concurrently with water quality sampling activities (i.e., days to weeks).

4.1.1.2 Well Purging, Field Parameter Measurement, and Water Quality Sample Collection

In general, groundwater sampling will proceed in order from "clean" wells (with lower concentrations of constituents of concern), to "dirty" wells based on previous data collected at the Facility, to reduce the potential for cross-contamination of water samples. Field personnel will determine the appropriate sampling order before conducting sampling in cooperation with the field team leader, the project manager, and METG.

Dedicated high-density polyethylene (HDPE) tubing is installed in all monitoring wells. Submersible pumps (either a 12-volt submersible pump for shallower wells, or a 2-inch Grundfos pump or equivalent for deeper wells) will be utilized for purging and sampling. Purging will be conducted using the "standard purge" method of removing three to five well volumes while routinely monitoring field parameters (pH, dissolved oxygen, temperature, specific conductance, turbidity, and ORP).

Following removal of the first well volume, field measurements will be collected at regular time intervals during purging of the second and third well volumes, based on the purge rate and required purge volume. A minimum of five sets of field parameter measurements will be collected during well purging to monitor stabilization of field parameters. Field parameters will be measured using a flow-through device to minimize potential effects from atmospheric exposure. Field meters will be calibrated daily according to factory instructions, with calibration results recorded on calibration forms. All purge water will be containerized and routed to the Facility water treatment system for disposal.

Samples for laboratory analysis will be collected only after one of the following purge conditions is met:

- A minimum of three well volumes has been removed, and three successive field parameter measurements agree to within the stability criteria given below.
- At least five well volumes have been removed although field parameter stabilization criteria are not yet met.
- The well has been pumped dry and allowed to recover sufficiently such that adequate sample volumes for rinsing equipment and collecting samples can be removed.

Criteria for field parameter stabilization are as follows:

Parameter (Units)	Stability Criteria
pH (standard units)	±0.1 pH unit
Water temperature (°C)	±0.2°C
Specific conductance (µmhos/cm)	±5% (SC ≤100 µmhos/cm) ±3% (SC >100 µmhos/cm)
Dissolved oxygen (mg/L)	±0.3 mg/L
Turbidity (NTU)	±10% (turbidity 10-100 NTU) or 3 consecutive readings <10 NTU

NOTES:

Stability criteria obtained from USGS *National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples* (September 1999). Turbidity criteria modified for low turbidity (<10 NTU) samples.

ORP measurements will be monitored during stabilization; however, given the inherent variability of ORP measurements, the USGS does not recommend its use as an indicator of stabilization, and it will not be included as a stabilization indicator during groundwater sampling under the 2016 East Helena CAMP.

Following well purging, final field parameter measurements will be collected and recorded, and groundwater quality samples will be obtained. Sample bottles will be filled directly from a sampling port, before the pumped water passes through the flow-through cell. Samples for dissolved metals analyses (including the common cations calcium, magnesium, sodium, and potassium) will be filtered through a 0.45-micrometer (µm) filter before preservation. Samples for common anions (sulfate, chloride, bicarbonate) will not be filtered.

Clean sample containers will be obtained from the analytical laboratory before sample collection. Following sample collection, samples will be preserved as appropriate, and stored on ice in coolers at ≤6°C during transport. Water quality sample container and preservation requirements are specified in the project QAPP (Hydrometrics, 2015a) and in Table 4-2.

All samples will be stored in coolers or refrigerated from the time of collection until delivery to the analytical laboratory. All water quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, flow measurements, and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook and on standard field forms.

Groundwater sampling equipment reused between monitoring locations (flow cell, 12-volt sampling pump and short piece of discharge line used to connect to the dedicated well tubing, Grundfos 2-inch pump system, and any non-dedicated tubing) will be thoroughly decontaminated between uses. Equipment decontamination will consist of the following steps:

- Rinse with soapy water (clean tap water plus Alconox or other non-phosphate detergent).
- Rinse thoroughly with clean tap water.
- Final rinse with deionized water.

The effectiveness of the decontamination procedure will be evaluated through the periodic collection of equipment rinsate and deionized water blanks, as outlined in Section 4.3, the East Helena Facility QAPP and SOPs.

4.1.2 Residential/Water Supply Well Samples

Collection of water samples from private wells will follow the same general sequence as that for monitoring wells:

1. Measurement of static water level.
2. Well purging and monitoring for field parameter stabilization.
3. Water quality sample collection.

An SOP for residential/private well monitoring was developed for 2011 FSAP monitoring (METG, 2011). This document (METG-SOP-001) is included in Table 3-1 and in Appendix A, and should be consulted as the guide for conducting private well sampling as part of this 2016 CAMP. A general description of the private well monitoring procedure is provided below.

Property access and a scheduled sampling time will be arranged with the well owner prior to visiting the site for sampling. Static water level measurements will be obtained prior to sampling, at those private wells where an access port is present.

Purging of private wells will be accomplished through a purge hose (as necessary), with water discharge directed away from the wellhead and any nearby buildings. Purge volumes will generally be based on an estimate of the total water present in the well casing, piping, and water storage system (i.e., pressure tank), and approximately three well volumes will be purged prior to sampling. Purge rates will be determined volumetrically using a five-gallon bucket. Field parameter measurements will be collected at the beginning, middle, and end of the purging cycle, using a flow cell or other system arranged to allow flow of purged water across field parameter sensors prior to contact with the atmosphere.

Purge rates will be reduced prior to collecting samples. If a purge hose was used, the hose should be removed and water samples collected directly from the faucet or spigot. Private well samples will be collected for analysis of common constituents, dissolved metals and total metals in accordance with Table 4-2. Following sample collection, samples will be preserved as appropriate, and stored on ice in coolers at ≤6°C during transport. All samples will be stored in coolers or refrigerated from the time of collection until delivery to the analytical laboratory. All water quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, flow measurements, and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook and on standard field forms. Prior to leaving the sampling location, the homeowner will be notified that sampling has been completed.

4.2 SURFACE WATER MONITORING

Surface water monitoring will consist of one or more of the following steps (depending on the monitoring schedule):

1. Measurement of water elevation;
2. Measurement of streamflow; and
3. Water quality sample collection.

4.2.1 Water Elevation Measurement

Water elevation measurements for ponds and flowing water sites will be collected using a survey-grade GPS instrument (Topcon Hiper+/Legacy E). Real-time kinematic (RTK) surveys will be conducted using a base station set up at a known East Helena control point (typically a monitoring well). Data collected will include horizontal coordinates (NAD83 Montana State Plane international feet) and elevations in feet above mean sea level (AMSL).

4.2.2 Streamflow Measurement

Surface water flow measurements at flowing water sites will be collected using a Marsh-McBirney current meter and wading rod (area-velocity method) or equivalent equipment following the appropriate project SOPs (see Table 4-1). If measurement conditions are unsafe because of high flows, the field sampling team will estimate the flow. Stage measurements (water surface elevations) also will be recorded at sites equipped with staff gages, or by measurement from established survey points.

Measurement of streamflow is performed in accordance with the area-velocity method developed by the U.S. Geological Survey (USGS) (Turnipseed and Sauer, 2010). In general, the entire stream width is divided into subsections and the stream velocity measured at the midpoint of each subsection and at a depth equivalent to six-tenths of the total subsection depth, or at two-tenths and eight-tenths if the water depth exceeds 2.5 feet. The velocity in each subsection is then multiplied by the cross-sectional area to obtain the flow volume through each subsection. The subsection flows are then summed to obtain the total streamflow rate. Streamflow measurements are typically collected in a stream reach that is as straight and free of obstructions as possible, to minimize potential measurement error introduced by converging or turbulent flow paths.

4.2.3 Field Parameters and Water Quality Sample Collection

Field parameters measured at surface water quality monitoring sites will include the following:

- pH;
- Specific conductance;
- Dissolved oxygen; and
- Water temperature.

Field meters will be calibrated daily according to factory instructions, with calibration results recorded in the field notebook and/or on calibration forms. Field parameter measurements will be obtained directly in the stream if possible; however, high-velocity areas should be avoided to limit possible pH measurement errors caused by streaming potentials. Alternatively, a clean container may be filled with sample water for parameter measurement. Results are recorded in the field notebook and on standard sample forms. Field meters are checked periodically throughout the day for drift by measuring standard solutions (pH buffers, specific conductivity solutions, etc.), and are recalibrated as necessary.

A water quality sample will be collected from each surface water monitoring location by passing an uncapped sample container across the area of flow. When wading, samples are collected across the area of flow upstream of the sampler; during unsafe wading conditions, samples are collected from the stream bank. Water quality sample container and preservation requirements for surface water sites are specified in the project QAPP (Hydrometrics, 2015a) and in Table 4-2.

Samples will be preserved as appropriate for the intended analysis (e.g., place samples for metals analysis in precleaned and prepreserved laboratory supplied containers containing nitric acid to acidify the sample to a pH <2), and stored on ice in coolers at $\leq 6°C$ for transport. Note that surface water samples will be analyzed for total recoverable metals concentrations (unfiltered samples).

All samples will be stored in coolers or refrigerated from the time of collection until delivery to the analytical laboratory. All water quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, flow measurements and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook and on standard field forms.

4.3 FIELD QUALITY CONTROL SAMPLES

Field QC samples will be collected and analyzed as part of the 2016 groundwater and surface water monitoring programs and in accordance with the project quality assurance program. Details for collection and submittal of quality assurance and quality control samples are also discussed in the QAPP (Hydrometrics, 2015a).

Required field QC sample types and frequencies for the groundwater and surface water monitoring programs will include the following:

- Equipment rinsate blanks (monitoring well sampling only).
- Deionized (DI) water blanks (groundwater and surface water sampling, including both monitoring and private wells).
- Field duplicate samples (groundwater and surface water sampling, including both monitoring and private wells).

4.3.1 Field Blanks (Rinsate Blanks and DI Blanks)

Equipment rinsate blanks consist of deionized water processed through decontaminated sampling equipment (including filtration equipment as appropriate), collected into sample bottles and preserved. DI blanks consist of deionized water placed directly from storage containers into sample containers and preserved. Rinsate and DI blanks for monitoring well groundwater samples, and DI blanks for surface water samples will be collected at a frequency of one per twenty samples (1/20) or one per day, whichever is greater. DI blanks for private/residential well groundwater samples will be collected at a frequency of one per twenty samples (1/20) over the course of the complete private well monitoring event. Deionized water for collection of field blanks will be obtained from the analytical laboratory.

Additional information regarding collection of rinsate blank samples is provided in the applicable SOP and in the project QAPP (Hydrometrics, 2015a).

4.3.2 Field Duplicates

Field duplicate samples are replicate samples from a single sampling location submitted to a laboratory for the same set of analyses. For the purposes of this project, field duplicates will be collected by filling two samples containers consecutively from the sampling location. Duplicates will be sent to the same laboratory, but will be identified with different sample numbers. Field duplicates for monitoring well groundwater samples and surface water samples will be collected at a minimum frequency of one per twenty (1/20) or one per day, whichever is greater. Field duplicates for private/residential well groundwater samples will be collected at a frequency of one per twenty samples (1/20) over the course of the complete private well monitoring event.

All field QC samples will be submitted blind to the laboratory (QC samples will be packaged and shipped in such a manner that the laboratory will not be aware of the nature of the samples). Additional information regarding collection of duplicate samples is provided in the applicable SOP and in the project QAPP (Hydrometrics, 2015a).

5.0 SAMPLE HANDLING AND DOCUMENTATION

All samples transferred to the laboratory for analysis will follow standard documentation, packing, and chain-of-custody procedures. Samples will be stored in iced coolers or refrigerated following collection, then hand-delivered to the laboratory in iced coolers to maintain sample temperatures of ≤6°C. The SOPs for sample labeling, documentation, and chain-of-custody procedures are listed in Table 4-1 and discussed further in the project QAPP (Hydrometrics, 2015a).

Sample custody (responsibility for the integrity of samples and prevention of tampering) will be the responsibility of sampling personnel until samples are shipped or delivered to the laboratory. Any containers used to ship samples via independent courier will be sealed with custody seals before shipping, and the receiving laboratory will record the condition of the seals upon arrival to ensure that the containers have not been opened during transport. Custody seals are not required for samples that are maintained under the direct custody of sampling personnel until being hand-delivered to the laboratory. Upon arrival at the laboratory, sample custody shifts to laboratory personnel, who are responsible for tracking individual samples through login, analysis and reporting. At the time of sample login, the laboratory will assign a unique laboratory sample number, which can be cross-referenced to the field sample number and used to track analytical results.

Documents generated during sample collection will consist of:

1. Sample collection field notes and forms;
2. Chain-of-custody forms; and
3. Shipping receipts in the event that samples are sent to a laboratory via independent courier.

Sampling activities will be recorded in a project-specific field notebook, and the appropriate water sample collection form will be completed. Each sample will be identified with a unique sample number, along with the date and time of collection, on adhesive labels attached to sample bottles. All labels will be completed using waterproof ink.

Field notebooks used to record pertinent sampling information will include, at a minimum, the following:

- Project name;
- Date and time;
- Sample location;
- Sample number;

- Sample depth (if applicable);
- Media type;
- Field meter calibration information;
- Sampling personnel present;
- Analyses requested;
- Sample preservation;
- Field parameter measurements;
- Weather observations; and
- Other relevant project-specific site or sample information.

Entries will be made in permanent ink. Corrections to field notebooks will be made by crossing out erroneous information with a single line and initialing the correction. Field books will be signed and dated at the bottom of each page by personnel making entries on that page.

Individual samples (including QC samples) will be assigned unique sample numbers according to the following sample numbering scheme:

AAA[A]-YYMM-XXX

where AAA[A] is a three- or four-character code denoting the project, YYMM is a four-digit code denoting the year and month (e.g., 1606 for June 2016), and XXX is a three-digit code incremented sequentially for each successive sample.

6.0 LABORATORY ANALYTICAL PROCEDURES AND REPORTING

Laboratory analysis will be conducted by Energy Laboratories' Helena, Montana branch. Energy Laboratories is certified by EPA Region 8 and the State of Montana under the Safe Drinking Water Act. Field parameters will be analyzed by field personnel using the procedures outlined in Section 4 above, and in the applicable SOPs (see Table 4-1). All laboratory analysis will be fully documented and conducted in accordance with EPA-approved and/or industry standard analytical methods.

6.1 GROUNDWATER ANALYSES

Required parameters, analytical methods, and project-required detection limits (PRDLs) for 2016 groundwater quality samples collected at the Facility are shown in Table 6-1. Groundwater samples will be analyzed for physical parameters, common constituents and a comprehensive suite of trace constituents. Trace constituents will be analyzed as dissolved for monitoring well samples, and as both dissolved and total for private well samples.

The PRDLs for individual parameters have been set at concentrations normally achievable by routine analytical testing in the absence of unusual matrix interference. These limits will support project objectives for trend analysis and contaminant plume characterization as well as comparison with regulatory standards for groundwater (shown in Table 6-1 for reference). It must be recognized that the PRDL is a detection limit goal, which may not be achieved in all samples because of sample matrix interference or other problems. If a PRDL is not met by the laboratory, the data will be reviewed to determine if any actions (e.g., sample reanalysis or selection of an alternative analytical method) are required.

6.2 SURFACE WATER ANALYSES

Required parameters, analytical methods, and project-required detection limits for surface water quality samples collected at the Facility are shown in Table 6-2. Similar to groundwater, surface water samples will be analyzed for physical parameters, common constituents, and a comprehensive suite of trace constituents. The PRDLs for individual parameters have been set at concentrations normally achievable by routine analytical testing in the absence of unusual matrix interference and are equivalent to the required reporting values (RRVs) published in the most recent version of Circular DEQ-7 (Montana Numeric Water Quality Standards). These limits will support project objectives for evaluation of groundwater/surface water interactions, as well as comparison with regulatory standards for surface water; therefore, PRDLs for a number of parameters are different in surface water compared to groundwater. It must be recognized that the PRDL is a detection limit goal, which may not be achieved in all samples because of sample matrix interference or other problems. If a PRDL is not met by the laboratory, the data will be reviewed to determine if any actions (e.g., sample reanalysis or selection of an alternative analytical method) are required.

6.3 DATA REVIEW AND REPORTING

Procedures for data review, validation, and reporting are presented and discussed in the Site QAPP (Hydrometrics, 2015a) and in the DMP (Hydrometrics, 2011), including control limits and criteria for specific types of field and laboratory QC samples, data validation and verification methods, potential corrective actions if criteria are not met, and database management issues. The DMP includes checklists for review of both field and laboratory documentation (prior to formal validation of laboratory data), and post-validation review and approval of the East Helena database (Hydrometrics, 2011). Both of these checklists will be completed for each monitoring event conducted during 2016.

All data deliverables containing analytical data and QC information will be reviewed for overall completeness of the data package. Completeness checks will be administered on all data to determine whether deliverables specified in the project planning documents (including this CAMP) are present. At a minimum, deliverables will include field notes and/or forms, transmittal information, sample chain-of-custody forms, analytical results, methods and practical quantification limits (PQL), and laboratory QC summaries. The reviewer will determine whether all required items are present and request copies of missing deliverables.

The number and type of samples collected will be compared to project specifications to ensure conformance with the sampling process design. Review of sample collection and handling procedures will include verification of the following:

- Completeness of submittal packages;
- Completeness of field documentation, including chain-of-custody documentation;
- Field equipment calibration and maintenance and/or quality of field measurements; and
- Adherence to proper sample collection procedures.

All data will be reviewed for completeness of deliverables, and adherence to the sampling and analytical protocols prescribed in this CAMP and the project QAPP (Hydrometrics, 2015a). Data validation will include a detailed review of all analytical results, including:

- Reporting limits (RL) and PQLs vs. PRDLs;
- Holding times;
- Analytical methods;

- Field QC sample results; and
- Laboratory QC sample results.

Data qualifiers will be applied to any analytical results associated with QC exceedances, as outlined in the QAPP.

All project data will be archived in hard copy format, and also will be imported to and stored in the electronic project database software, along with associated data qualifiers. The project Data Management and Validation Coordinator will be responsible for reviewing, organizing, revising, and certifying the integrity of the project database. Maintenance and use of the project database, including uploading of analytical results and downloading of data in various formats to support other Facility-related investigations are presented in detail in the DMP (Hydrometrics, 2011).

7.0 REFERENCES

CH2M HILL, 2015. *Former ASARCO East Helena Facility Corrective Measures Study Work Plan*. Prepared for The Montana Environmental Trust Group, LLC, and the Montana Environmental Custodial Trust. October 2015.

EPA, 1983. Methods for Chemical Analysis of Water and Wastes. EPA-600/14-79-020. Revised March 1983.

EPA, 2004. Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action. EPA 530-R-04-030. April 2004.

EPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530-R-09-007. March 2009.

EPA, 2013. Guidance for Evaluating Completion of Groundwater Restoration Remedial Actions. OSWER 9355.0-129. Office of Superfund Remediation and Technology Innovation. November 2013.

EPA, 2014a. Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well. OSWER 9283.1-44. August 2014.

EPA, 2014b. Groundwater Remedy Completion Strategy – Moving Forward With The End In Mind. OSWER Directive 9200.2-144. Office of Solid Waste and Emergency Response. May 2014.

EPA, 2014c. Groundwater Statistics Tool – User's Guide. OSWER 9283.1-46. . Office of Superfund Remediation and Technology Innovation. July 2014.

GSI, 2012. GSI Mann-Kendall Toolkit for Constituent Trend Analysis – User's Manual (Version 1.0). November 2012.

Hydrometrics, Inc., 2011. Data Management Plan for Environmental Data Collection Activities, East Helena Facility. Prepared for Montana Environmental Trust Group, LLC. Revised August 2011.

Hydrometrics, Inc., 2015a. Quality Assurance Project Plan Update 2015, East Helena Facility (Draft). Prepared for Montana Environmental Trust Group, LLC. Revised Draft July 2015.

Hydrometrics, Inc., 2015b. 2015 Groundwater and Surface Water Field Corrective Action Monitoring Plan, East Helena Facility. Prepared for Montana Environmental Trust Group, LLC. March 2015.

METG, 2011. 2011 Groundwater and Surface Water Field Sampling and Analysis Plan – East Helena Site. March 2011.

Ricker, J.A., 2008. A Practical Method to Evaluate Ground Water Contaminant Plume Stability. *Ground Water Monitoring & Remediation* 28(4): 85-94. Fall 2008.

Singh, A. and R. Maichle, 2013. ProUCL Version 5.0.00 User's Guide. Statistical Software for Environmental Applications for Datasets With and Without Nondetect Observations. EPA/600/R-07/041. September 2013.

Turnipseed, D.P., and Sauer, V.B., 2010. Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p. (also available at http://pubs.usgs.gov/tm/tm3-a8/.)

US District Court, 2012. First Modification to the 1998 Consent Decree. Civil Action No. CV 98-3-H-CCL. Case 6:98-cv-00003-CCL. Document 38. Filed January 17, 2012.

USGS, 1999. Techniques of Water Resources Investigations, Book 9 – Handbook for Water Resources Investigations, National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples. September 1999.

TABLES

Table 2-1. 2016 Performance Evaluation Trend Analysis Monitoring Wells -- East Helena Facility

Well	Northing	Easting	Target Area
DH-59	859632.08	1360058.60	Acid Plant
DH-42	859587.20	1359938.80	Acid Plant
DH-80	859665.45	1360005.89	Acid Plant
2843 Canyon Ferry Road	872346.42	1354330.00	Downgradient Selenium Plume
2853 Canyon Ferry Road	872391.53	1354773.24	Downgradient Selenium Plume
EH-141	868713.30	1354782.70	Downgradient Selenium Plume
EH-142	870077.47	1353868.60	Downgradient Selenium Plume
EH-143	870683.75	1354372.76	Downgradient Selenium Plume
DH-17	860997.41	1359668.63	North Plant Arsenic
DH-64	861382.75	1359476.26	North Plant Arsenic
SDMW-2	860448.26	1359851.23	North Plant Arsenic
DH-6	861527.08	1360252.42	Slag Pile
DH-15	861541.06	1360257.00	Slag Pile
DH-52	861372.14	1360876.16	Slag Pile
DH-56	861098.43	1360350.74	Slag Pile
DH-66	861005.14	1359333.41	West Selenium
DH-78	860848.96	1359368.22	West Selenium
DH-8	860693.17	1359404.72	West Selenium

Table 2-2. 2016 Performance Evaluation Plume Stability Analysis Monitoring Wells -- East Helena Facility

Arsenic Plume Stability Analysis Wells

Well/Well Set*	X	Y
EH-104	1358282.522	862312.6614
EH-106	1358337.119	862709.9336
EH-110	1359199.735	862408.9392
EH-111	1358121.671	863063.8249
EH-114	1357769.757	863127.7487
EH-115	1357963.035	862717.8146
EH-117	1357815.102	863491.194
EH-118	1357370.97	863059.9069
EH-119	1357263.087	863617.6238
EH-120	1357409.933	864330.2403
EH-124	1356666.492	863928.3931
EH-50/100	1358817.999	862195.6926
EH-51/101	1359828.415	862186.9796
EH-52/102	1360752.337	862191.6556
EH-53	1358268.831	863387.4722
EH-54	1359822.332	863345.3893
EH-57A	1357731.038	862625.8977
EH-58	1361553.2	861985.385
EH-59	1361023.244	862766.0055
EH-60/61/103	1359295.783	862093.3668
EH-62	1358812.977	863373.6172
EH-63	1359427.431	862682.4886
EH-65/107	1358789.927	862702.9806
EH-66/121	1358105.331	864406.8992
EH-69	1360852.608	863791.1154

Selenium Plume Stability Analysis Wells

Well/Well Set*	X	Y
EH-104	1358282.522	862312.6614
EH-106	1358337.119	862709.9336
EH-110	1359199.735	862408.9392
EH-111	1358121.671	863063.8249
EH-114	1357769.757	863127.7487
EH-115	1357963.035	862717.8146
EH-117	1357815.102	863491.194
EH-118	1357370.97	863059.9069
EH-119	1357263.087	863617.6238
EH-120	1357409.933	864330.2403
EH-123	1356631.306	863027.3459
EH-124	1356666.492	863928.3931
EH-126	1356002.798	865515.797
EH-129/134	1355425.088	865649.6907
EH-132	1355360.408	864040.3529
EH-135	1357384.976	865688.5946
EH-206	1356012.784	862969.4011
EH-50/100	1358817.999	862195.6926
EH-51/101	1359828.415	862186.9796
EH-52/102	1360752.337	862191.6556
EH-53	1358268.831	863387.4722
EH-54	1359822.332	863345.3893
EH-57A	1357731.038	862625.8977
EH-60/61/103	1359295.783	862093.3668
EH-62	1358812.977	863373.6172
EH-63	1359427.431	862682.4886
EH-65/107	1358789.927	862702.9806
EH-66/121	1358105.331	864406.8992
EH-70/125	1357077.783	864971.9141

*NOTE: Data from well sets (paired wells) will be combined to yield a single overall average concentration for a given monitoring year.

Table 3-1. East Helena Facility 2016 Water Resources Monitoring Schedule and Objectives

<table>
<tr><th colspan="2" rowspan="2">Month</th><th colspan="5">Groundwater Monitoring Activity</th><th colspan="3">Surface Water Monitoring Activity</th></tr>
<tr><th>Monthly Water Level Measurements</th><th>Residential / Water Supply Well Monitoring</th><th>Quarterly Monitoring Well Sampling Events</th><th>Semiannual Monitoring Well Sampling Events</th><th>Annual Monitoring Well Sampling Event</th><th>Elevation Monitoring</th><th>Flow Monitoring</th><th>Surface Water Quality Monitoring</th></tr>
<tr><td colspan="2">March</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">April</td><td>X</td><td></td><td>X</td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td colspan="2">May</td><td>X</td><td rowspan="2">X</td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td colspan="2">June</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td colspan="2">July</td><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td colspan="2">August</td><td>X</td><td></td><td>X</td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td colspan="2">September</td><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td colspan="2">October</td><td>X</td><td>X</td><td rowspan="2">X</td><td rowspan="2">X</td><td></td><td>X</td><td rowspan="2">X</td><td rowspan="2">X</td></tr>
<tr><td colspan="2">November</td><td>X</td><td></td><td></td><td>X</td></tr>
<tr><td rowspan="4">Performance Evaluation Objective Addressed</td><td>[1] Remediation Phase Groundwater Level Trend Analysis</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>[2] Remediation Phase Contaminant Trend Analysis</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>[3] Remediation Phase Plume Stability Analysis</td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>[4] Remediation Phase Mass Flux Analysis</td><td></td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Additional Monitoring Objective Addressed</td><td>[5] Support Future Development of Attainment Phase Performance Monitoring Program</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>[6] Protection of Groundwater Users</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>[7] Groundwater/Surface Water Interaction Assessment</td><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>[8] West Arsenic/CAMU Area Groundwater Chemistry</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td></tr>
</table>

Table 3-2. 2016 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Quarterly Monitoring Well Set	Semiannual Monitoring	Annual Monitoring	Primary Monitoring Objective Addressed			
				Monthly from April-November	4x (April, June, August, October-November)	2x (June, October-November)	1x (June)	*Performance Evaluation Trend Analysis*	*Peformance Evaluation Plume Stability*	*Performance Evaluation Mass Flux / Plume Definition*	*CAMU/West Arsenic Area Monitoring*
2843 Canyon Ferry	872346.42	1354330.00	Unknown	X	X			X			
2853 Canyon Ferry	872391.53	1354773.24	Unknown	X	X			X			
Amchem4	861678.84	1359828.04	Unknown	X		X				X	
APSD-7	859330.0263	1361317.854	3924.041	X							
APSD-8	859082.8598	1361339.82	3923.932	X							
ASIW-1	859803.75	1362064.52	3913.75	X							
ASIW-2	860471.83	1363184.587	3909.13	X							
DH-1	861171.5317	1359021.49	3910.89	X		X				X	
DH-10A	861456.8081	1360608.817	3886.965	X							
DH-12	860548.2439	1359804.81	3910.163	X							
DH-13	860561.0489	1359795.41	3909.662	X							
DH-14	859527.8759	1361225.114	3916.055	X							
DH-15	861541.0629	1360256.995	3889.816	X	X			X			
DH-16	861008.817	1359678.882	3905.766	X							
DH-17	860997.414	1359668.631	3904.839	X	X			X			
DH-18	860535.2929	1359814.833	3910.212	X							
DH-19R	859443.1361	1360086.518	3919.666	X							
DH-2	859910.4322	1358532.443	3936.913	X							
DH-20	858989.371	1360128.453	3930.893	X		X				X	
DH-22	859690.0706	1359816.234	3930.084	X							
DH-23	860270.2165	1360217.49	3915.928	X							
DH-24	861412.6262	1359442.009	3899.587	X							
DH-27	859923.8461	1360046.461	3912.703	X							
DH-3	858002.572	1359985.218	3947.481	X							
DH-30	859935.1871	1360099.556	3914.23	X							
DH-36	860631.4997	1359936.338	3907.979	X							
DH-4	859526.8209	1361217.199	3917.257	X							
DH-42	859587.2008	1359938.798	3931.613	X	X			X			
DH-47	859460.0231	1360402.023	3922.33	X		X				X	
DH-48	861493.549	1358990.708	3905.957	X							
DH-49	861441.3591	1359297.07	3904.072	X							
DH-5	859641.3787	1360792.818	3921.184	X							
DH-50	861385.2562	1359571.763	3904.756	X							
DH-51	861330.2543	1359700.327	3904.341	X		X				X	
DH-52	861372.1393	1360876.159	3889.18	X	X			X			
DH-53	861343.6803	1361117.666	3892.869	X							
DH-54	862057.3039	1359471.148	3890.269	X							
DH-55	860568.8169	1360945.555	3972.755	X							

Table 3-2. 2016 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Quarterly Monitoring Well Set	Semiannual Monitoring	Annual Monitoring	Primary Monitoring Objective Addressed			
				Monthly from April-November	4x (April, June, August, October-November)	2x (June, October-November)	1x (June)	*Performance Evaluation Trend Analysis*	*Peformance Evaluation Plume Stability*	*Performance Evaluation Mass Flux / Plume Definition*	*CAMU/West Arsenic Area Monitoring*
DH-56	861098.4318	1360350.744	3958.166	X	X			X			
DH-57	860328.9453	1360256.385	3915.262	X							
DH-58	860620.3468	1360149.799	3899.64	X							
DH-59	859632.0757	1360058.605	3917.739	X	X			X			
DH-5A	859639.6847	1360786.267	3921.919	X							
DH-6	861527.0799	1360252.419	3889.85	X	X			X			
DH-61	860401.8562	1359292.931	3919.622	X							
DH-62	860406.7352	1359291.47	3919.399	X							
DH-63	861507.16	1359149.834	3905.374	X							
DH-64	861382.7472	1359476.257	3904.024	X	X			X			
DH-65	861207.1996	1360879.405	3945.847	X							
DH-66	861005.14	1359333.409	3913.433	X	X			X			
DH-67	861657.6447	1359095.512	3899.765	X		X				X	
DH-68	859814.1624	1361072.196	3943.282	X							
DH-69	859899.5982	1360783.894	3934.404	X							
DH-7	861281.5224	1361580.684	3898.664	X		X				X	
DH-70	859738.6045	1360346.814	3918.941	X							
DH-71	859876.6862	1359640.544	3925.116	X							
DH-72	859627.5477	1360069.202	3918.505	X							
DH-73	860573.7778	1360394.401	3899.821	X							
DH-74	860942.4611	1360679.466	4001.491	X							
DH-75	860942.0961	1360685.114	4001.549	X							
DH-76	860173.6276	1360887.058	3994.28	X							
DH-77	860292.48	1359639.25	3930.04	X		X				X	
DH-78	860848.96	1359368.22	3918.86	X	X			X			
DH-79	860422.215	1359937.191	3916.04	X							
DH-8	860693.1656	1359404.724	3916.828	X	X			X			
DH-80	859665.447	1360005.892	3919.52	X	X			X			
DH-81	859352.188	1360152.25	3926.66	X							
DH-82	861377.161	1359161.969	3908.18	X		X				X	
DH-83	860783.429	1359388.46	3918.83	X							
DH-9	860570.6829	1360370.607	3896.559	X							
East-PZ-1	860384.383	1362260.694	3911.93	X							
East-PZ-2	859218.097	1362203.254	3924.58	X							
East-PZ-4	857903.643	1362039.588	3935.66	X							
East-PZ-6	857123.21	1362002.493	3943.83	X							
East-PZ-7	858720.489	1361949.299	3928.83	X							
EH-100	862197.1906	1358800.894	3889.825	X		X			X		

Table 3-2. 2016 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Quarterly Monitoring Well Set	Semiannual Monitoring	Annual Monitoring	Primary Monitoring Objective Addressed			
				Monthly from April-November	4x (April, June, August, October-November)	2x (June, October-November)	1x (June)	*Performance Evaluation Trend Analysis*	*Peformance Evaluation Plume Stability*	*Performance Evaluation Mass Flux / Plume Definition*	*CAMU/West Arsenic Area Monitoring*
EH-101	862185.0606	1359841.734	3879.947	X		X			X		
EH-102	862174.5306	1360751.101	3880.446	X		X			X		
EH-103	862095.3328	1359303.117	3890.541	X		X			X		
EH-104	862312.6614	1358282.522	3887.834	X		X			X		
EH-106	862709.9336	1358337.119	3882.069	X		X			X		
EH-107	862700.4946	1358801.991	3880.15	X		X			X		
EH-109	862428.7931	1358738.298	3885.669	X							
EH-110	862408.9392	1359199.735	3884.054	X		X			X		
EH-111	863063.8249	1358121.671	3876.502	X		X			X		
EH-112	863053.5629	1358509.634	3875.783	X							
EH-113	863390.2062	1357972.372	3871.343	X							
EH-114	863127.7487	1357769.757	3878.071	X		X			X		
EH-115	862717.8146	1357963.035	3883.29	X		X			X		
EH-116	863344.5863	1357810.978	3874.522	X							
EH-117	863491.194	1357815.102	3871.333	X		X			X		
EH-118	863059.9069	1357370.97	3879.949	X		X			X		
EH-119	863617.6238	1357263.087	3873.754	X		X			X		
EH-120	864330.2403	1357409.933	3865.781	X		X			X		
EH-121	864410.1362	1358127.823	3869.493	X		X			X		
EH-122	864415.3102	1358469.648	3868.084	X							
EH-123	863027.3459	1356631.306	3885.713	X		X			X		
EH-124	863928.3931	1356666.492	3874.455	X		X			X		
EH-125	864978.443	1357089.97	3863.222	X		X			X		
EH-126	865515.797	1356002.798	3870.001	X		X			X		
EH-127	865361.5553	1357810.281	3860.752	X							
EH-128	863371.5473	1355903.641	3892.165	X							
EH-129	865649.6907	1355425.088	3870.207	X		X			X		
EH-130	866018.012	1356641.209	3858.548	X		X				X	
EH-131	867032.6409	1356912.021	3834.444	X		X				X	
EH-132	864040.3529	1355360.408	3893.899	X		X			X		
EH-133	864766.2675	1355354.834	3884.364	X							
EH-134	865643.4817	1355425.545	3870.213	X		X			X		
EH-135	865688.5946	1357384.976	3852.245	X		X			X		
EH-136	866625.8837	1357248.902	3838.585	X							
EH-137	867047.7809	1357895.667	3839.655	X							
EH-138	867179.0458	1355646.472	3839.703133	X		X				X	
EH-139	867197.4533	1354635.304	3839.777133	X		X				X	
EH-140	867962.262	1356224.787	3812.08	X		X				X	

Table 3-2. 2016 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Quarterly Monitoring Well Set	Semiannual Monitoring	Annual Monitoring	Primary Monitoring Objective Addressed			
				Monthly from April-November	4x (April, June, August, October-November)	2x (June, October-November)	1x (June)	*Performance Evaluation Trend Analysis*	*Peformance Evaluation Plume Stability*	*Performance Evaluation Mass Flux / Plume Definition*	*CAMU/West Arsenic Area Monitoring*
EH-141	868713.295	1354782.704	3813.322	X	X			X			
EH-142	870077.471	1353868.6	3804.676	X	X			X			
EH-143	870683.749	1354372.763	3803.366	X	X			X			
EH-144D	874170.144	1354086.122	3778.86	X		X				X	
EH-144M	874170.205	1354096.294	3778.95	X		X				X	
EH-144S	874170.357	1354091.18	3778.7	X		X				X	
EH-200	862018.257	1353065.25	3953.333	X			X				X
EH-201	861475.904	1353968.192	3973.479	X			X				X
EH-202	861250.6755	1357113.736	3930.559	X			X				X
EH-203	860233.8575	1356623.211	4003.919	X			X				X
EH-204	860660.9927	1358703.601	3925.692	X		X				X	
EH-205	861652.5237	1358687.062	3900.658	X							
EH-206	862969.4011	1356012.784	3898.102	X		X			X		
EH-208	863930.4941	1354401.573	3910.582	X			X				X
EH-209	864742.1995	1353102.001	3898.337	X			X				X
EH-210	861653.6027	1358674.679	3901.19	X		X				X	
EH-211	862223.936	1356747.917	3905.754	X							
EH-212	862222.628	1356753.36	3905.899	X							
EH-50	862195.6926	1358817.999	3889.392	X		X			X		
EH-51	862186.9796	1359828.415	3880.087	X		X			X		
EH-52	862191.6556	1360752.337	3880.497	X		X			X		
EH-53	863387.4722	1358268.831	3872.817	X		X			X		
EH-54	863345.3893	1359822.332	3869.655	X		X			X		
EH-57	862618.4258	1357736.484	3885.054	X							
EH-57A	862625.8977	1357731.038	3885.451	X		X			X		
EH-58	861985.385	1361553.2	3888.148	X		X			X		
EH-59	862766.0055	1361023.244	3876.568	X		X			X		
EH-60	862093.3668	1359295.783	3888.46	X		X			X		
EH-61	862095.8588	1359282.097	3889.774	X		X			X		
EH-62	863373.6172	1358812.977	3875.065	X		X			X		
EH-63	862682.4886	1359427.431	3878.319	X		X			X		
EH-64	862710.9196	1359200.867	3882.669	X							
EH-65	862702.9806	1358789.927	3879.958	X		X			X		
EH-66	864406.8992	1358105.331	3869.475	X		X			X		
EH-67	864405.9092	1358454.566	3869.456	X							
EH-68	863877.1312	1360331.472	3867.596	X							
EH-69	863791.1154	1360852.608	3869.095	X		X			X		
EH-70	864971.9141	1357077.783	3863.48	X		X			X		

Table 3-2. 2016 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Quarterly Monitoring Well Set	Semiannual Monitoring	Annual Monitoring	Primary Monitoring Objective Addressed			
				Monthly from April-November	4x (April, June, August, October-November)	2x (June, October-November)	1x (June)	*Performance Evaluation Trend Analysis*	*Peformance Evaluation Plume Stability*	*Performance Evaluation Mass Flux / Plume Definition*	*CAMU/West Arsenic Area Monitoring*
EHMW-3	868386.9702	1356618.424	3825.447	X							
EHTW-3	868576.0698	1356692.192	3827.659	X							
IW-01	864945.874	1354765.643	3888.28	X							
IW-02	865731.883	1353973.511	3871.08	X							
MW-1	858771.6535	1358766.757	3953.046	X			X				X
MW-10	858554.2009	1359549.266	3946.28	X			X				X
MW-11	857959.4701	1358516.749	3973.331	X			X				X
MW-2	859191.6356	1358745.842	3945.967	X			X				X
MW-3	859196.8246	1359132.386	3940.951	X			X				X
MW-4	858802.4764	1359150.013	3947.064	X			X				X
MW-5	858414.7012	1358930.241	3956.184	X			X				X
MW-6	858876.2702	1359556.469	3938.143	X			X				X
MW-7	858777.0044	1358177.774	3963.674	X			X				X
MW-8	857962.2351	1359400.931	3958.646	X			X				X
MW-9	857977.442	1358978.984	3965.363	X			X				X
PBTW-1	861055.8909	1359662.678	3907.847	X							
PBTW-2	861165.7887	1359622.427	3906.733	X							
PPCRPZ-02	858388.3477	1360904.918	3923.1747	X							
PRB-1	861019.372	1359488.184	3910.834	X							
PRB-2	861114.8098	1359753.598	3905.335	X							
PRB-3	860983.812	1359418.527	3912.958	X							
PZ-33B	861144.751	1361484.498	3894.262	X							
PZ-36A	864560.517	1358731.291	3858.962	X							
PZ-36B	864557.572	1358724.518	3858.748	X							
PZ-36C	864554.645	1358718.763	3859.596	X							
PZ-9A	865510.378	1357868.389	3850.703	X							
PZ-9B	865507.227	1357867.095	3849.429	X							
SC-1	862196.3525	1358838.975	3890.4201	X							
SDMW-1	860514.593	1359962.878	3914.275	X							
SDMW-2	860448.2571	1359851.228	3914.169	X	X			X			
SDMW-3	860203.9396	1359859.357	3918.07	X							
SDMW-4	860218.1176	1360144.94	3917.662	X							
SDMW-5	860446.6991	1359750.308	3921.285	X							
SP-3	861487.403	1358277.051	3905.912	X							
SP-4	861277.8344	1358887.392	3908.162	X							
SP-5	861578.6048	1358912.302	3903.523	X							
STW-1	861262.5705	1359587.713	3905.582	X							
TW-1	860392.8781	1359940.799	3918.258	X							

Table 3-2. 2016 Monitoring Well Sampling Schedule -- East Helena Facility

Well ID	Northing	Easting	MP Elevation	Monthly Water Levels	Quarterly Monitoring Well Set	Semiannual Monitoring	Annual Monitoring	Primary Monitoring Objective Addressed			
				Monthly from April-November	4x (April, June, August, October-November)	2x (June, October-November)	1x (June)	*Performance Evaluation Trend Analysis*	*Peformance Evaluation Plume Stability*	*Performance Evaluation Mass Flux / Plume Definition*	*CAMU/West Arsenic Area Monitoring*
ULM-PZ-1	857498.249	1360521.727	3924.24	X							
ULTP-1	858779.0631	1360264.292	3919.6316	X							
ULTP-2	858262.1761	1360427.46	3921.2332	X							

	Monthly Water Levels	Quarterly Monitoring Well Set	Semiannual Monitoring	Annual Monitoring
Total # Wells Per Event	193	18	60	17
Total # Planned Samples for 2016	1544	209		

	Performance Evaluation Trend Analysis	Peformance Evaluation Plume Stability	Performance Evaluation Mass Flux / Plume Definition	CAMU/West Arsenic Area Monitoring
# Wells Addressing Primary Objective	18	41	19	17

NOTES: Monitoring Locations shown on Exhibit 1

Total number of planned groundwater quality samples does not include field quality control samples (Rinsate blank, DI blank, and duplicate samples each collected at frequency of 1 per 20 or 1 per day)

Table 3-3. 2016 Residential/Water Supply Well Semiannual Sampling Schedule -- East Helena Facility

Map Key (see Exhibit 1)	Site ID	Northing	Easting	Status
1	1 Gail Street	863237.91	1360019.06	Abandoned
2	105 Gail Street	863270.75	1359501.67	Abandoned
3	107 E Groschell	862873.52	1360767.10	Abandoned
4	108/110 Gail Street	863425.39	1359501.01	Active
5	109 Gail Street	863266.68	1359337.84	Active
6	111 E Groschell	862864.36	1360861.52	No Well Located
7	126 East Clinton-H	863296.03	1360955.74	Active
8	126 East Clinton-I	863327.86	1360948.64	Pump Inoperative
9	201 Gail Street	863250.07	1359185.43	Abandoned
10	202 W Main	862450.60	1359157.38	No Access
11	203 Gail Street	863263.27	1359031.01	Abandonment Pending
12	210 E Groschell	863053.71	1361184.11	Active
13	212 E Pacific	861861.51	1361212.16	No Access
14	224 E Pacific	861854.50	1361415.54	No Access
15	24 W Groschell	863109.81	1359725.42	No Well Located
16	2489 Wylie Dr	864206.53	1358674.56	Active
17	2540 Wylie	866156.57	1356934.48	Active
18	2843 Canyon Ferry-R	872346.42	1354330.00	Active
19	2853 Canyon Ferry-R	872391.53	1354773.24	Active
20	2865 Canyon Ferry	872086.41	1355030.70	Active
21	3 Gail Street	863256.45	1359904.15	Abandoned
22	303 Thurman	863069.96	1361069.38	No Access
23	305 Gail Street	863257.08	1358568.29	No Well Located
24	316 N. Montana	863376.30	1361815.27	Active
25	317 Gail Street	863250.07	1358456.08	Pump Inoperative
26	3885 US HWY 12	862259.92	1355055.07	No Access
27	401 Gail Street - S	863255.39	1358240.44	Active
28	405 Gail Street	863264.10	1358105.44	Pump Inoperative
29	407 E Porter	861502.42	1362101.41	Active
30	408 E Main	862355.37	1362082.87	No Access
31	409 Gail Street	863278.12	1357979.20	No Well Located
32	502 E King	863671.87	1362422.81	Pump Inoperative
33	513 E Clark	861830.00	1362540.24	No Access
34	690 Smelter Rd Yard	855347.37	1359909.48	Active
35	7 Gail Street	863233.58	1359840.14	Abandonment Pending
36	701 Manlove	861784.41	1356574.41	Active
37	800 Manlove	861925.29	1356400.09	Active
38	802 Manlove	861781.59	1356290.54	Active
39	9 Gail Street	863256.45	1359757.14	Abandonment Pending
40	EHC-1	872558.37	1356681.06	Active
41	EHC-2	871444.75	1356882.84	Active
42	EHPW-3	868437.60	1356673.10	Active

NOTES: Wells will be sampled semiannualy in June and October 2016.
Shaded cells indicate locations not scheduled for sampling in 2016.

Table 3-4. 2016 Downgradient Selenium Area Residential Well Monitoring Locations -- East Helena Facility

Location	2011 Se (mg/L)	Depth/Screen	Rationale
2765 Howard	0.010	99'/73-76'	Highest Se in downgradient area
3390 Baldy	0.006	100'/68-86'	Second highest Se in downgradient area
2685 Tuohy	0.002	168'/150-160'	Coverage to west; deeper well
3290 Tizer-H	<0.001	81'/45-60'	Coverage in west-central area
3320 Baldy	<0.001	81'/Open	Coverage in central area
3365 Baldy	0.004	70'/Open	Coverage in central area
3235 Baldy-H	<0.001	90'/NI	Well near Canyon Ferry Road and leading edge of plume
3120 Baldy	<0.001	72'/Open	Well near Canyon Ferry Road and leading edge of plume

NOTE: Wells will be sampled annually in 2016 (June).
Locations shown on Figure 3-1.

Table 3-5. 2016 Seaver Park Residential Well Monitoring Locations -- East Helena Facility

Location	As (mg/L)	Se (mg/L)	Rationale
2705 Winslow	0.010	0.004	Moderate As - SW Area, furthest west
2730 Winslow	0.008	0.003	Lower As - SW Area
2858 Winslow	0.024	0.003	Elevated As - Central Area
2746 Winslow	0.013	0.002	Moderate As - Central Area
3480 Weston Hydrant	0.023	0.006	Elevated As - Central Area
3425 Allied	0.017	0.006	Moderate As - NE Area, closest to former smelter and Wilson Ditch
3495 Allied	0.004	0.002	Lower As - NE Area

NOTE: Wells will be sampled annually in 2016 (June).
Locations shown on Figure 3-2.

Table 3-6. 2016 Surface Water Monitoring Schedule -- East Helena Facility

Site ID	Northing	Easting	Water Elevation Measurements (GPS Survey)	Instantaneous Flow Measurements	Water Quality Monitoring
			Monthly -April through November	Semiannual (June and Oct-Nov)	Semiannual (June and Oct-Nov)
PPC-3A	856283.87	1361694.37	X	X	X
PPCB-1	859199.48	1361720.04	X	X	X
Trib-1	858008.43	1360249.85	X	X	X
Lower Lake	859613.71	1360690.93	X		X
Former PPC-BD	859466.51	1361434.66	X	X	X
PPC-5	859954.78	1361478.38	X	X	X
PPC-7	861473.74	1360743.50	X	X	X
PPC-8	863372.55	1360137.99	X		
PPC-36A	864556.11	1358753.31	X	X	X
PPC-9A	865555.92	1357841.22	X		
PPC-10	867712.58	1356117.83	X	X	X
SG-16	872677.17	1350559.96	X	X	X
HVIC-1	870433.13	1354118.75	X		
GP-1	869382.84	1355642.76	X		
GP-2	870307.35	1354223.32	X		
GP-3	872295.33	1352636.82	X		
GP-4	869942.71	1352286.21	X		
GP-5	868811.08	1355741.50	X	X	
GP-5A	867206.54	1357125.85	X		

Total Measurements Per Monitoring Event	**19**	**10**	**10**
Total Monitoring Events	**8**	**2**	**2**
Total Measurements for 2016	**152**	**20**	**20**

Table 4-1. Standard Operating Procedures Applicable to East Helena Facility Water Resources Monitoring

SOP #[1]	Title
HSOP-2	Determination, Identification, and Description of Field Sampling Sites
HF-SOP-3	Preservation and Storage of Inorganic Water Samples
HSOP-4	Chain-of-Custody Procedures, Packing and Shipping Samples
HSOP-5	Global Positioning System (GPS) Equipment Operation
HSOP-7	Decontamination of Sampling Equipment
HF-SOP-9	Logging of Monitoring Wells - Geologic Conditions, Construction and Development
HF-SOP-10	Water Level Measurement with an Electric Probe
HF-SOP-11	Sampling Monitoring Wells for Inorganic Parameters
HSOP-13	Equipment Rinsate Blank Collection
HF-SOP-15	Measurement of Stream or Pond Stage
HF-SOP-17	Streamflow Measurement Using a Parshall Flume
HF-SOP-19	Obtaining Water Quality Samples from Streams
HF-SOP-20	Field Measurement of pH using a pH Meter
HF-SOP-22	Field Measurement of Dissolved Oxygen
HF-SOP-23	Field Measurement of Redox Potential (Eh)
HF-SOP-26	Streamflow Measurement Using a Flume
HF-SOP-27	Flow Estimation Method for Springs and Culverts
HSOP-29	Labeling and Documentation of Samples
HF-SOP-30	Decision Process for Field Variances and Nonconformances
HSOP-31	Field Notebooks
HF-SOP-37	Streamflow Measurement Using a Marsh-McBirney Water Current Meter
HF-SOP-44	Flow Measurements Using a Portable 90° V-Notch Cutthroat Flume
HF-SOP-46	Streamflow Measurement Using a Portable 3-inch Parshall Flume (Montana Flume)
HF-SOP-49	Use of a Flow Cell For Collecting Field Parameters
HF-SOP-50	Synoptic Runs on Streams
HSOP-58	Guidelines for Quality Assurance of Environmental Data Collection Activities: Data Quality Planning, Review, and Management
HF-SOP-71	Fluid Sampling With Peristaltic Pump
HF-SOP-73	Filtration of Water Samples
HF-SOP-79	Field Measurement of Specific Conductivity
HF-SOP-80	Water Level Monitoring With The Stevens Multilogger 9200
HF-SOP-81	Operation of The Stevens Type A/F Multilogger
HF-SOP-84	Field Measurement of Temperature
HF-SOP-102	Sampling of Municipal Wells
HSOP-105	Low Flow Sampling of Monitoring Wells for Inorganic Parameters
HSOP-106	Field Measurement of pH, Dissolved Oxygen, Conductivity, ORP, and Temperature Using a Multi-Meter
METG-SOP-001[2]	Residential Well Sampling for Inorganic Parameters

Notes:

(1) SOPs were prepared by Hydrometrics, Inc. and presented in various plans (e.g., QAPP; 2015a).

(2) SOP was prepared by METG and is presented in Appendix A.

Table 4-2. Sample Container and Preservation Requirements

Matrix	Parameters	Sample Container	Preservative
Groundwater	Field Parameters	None	None
	Common Constituents	1000 mL HDPE	Cool to ≤6°C
	Dissolved Metals(1)	250 mL HDPE	Filter samples (0.45 µm) HNO3 to pH <2 Cool to ≤6°C
	Total Metals (2)	250 mL HDPE	Unfiltered samples HNO3 to pH <2 Cool to ≤6°C
Surface Water	Field Parameters	None	None
	Common Constituents	1000 mL HDPE	Cool to ≤6°C
	Total Recoverable Metals	250 mL HDPE	Unfiltered samples HNO3 to pH <2 Cool to ≤6°C

Notes:

(1) Dissolved metals will be analyzed in both monitoring and private (residential/water supply) well samples.

(2) Total metals will be analyzed in private well samples only.

Table 6-1. 2016 Groundwater Sample Analytical Parameter List -- East Helena Facility

Parameter	Analytical Method [1]	Project Required Detection Limit (mg/L)	Montana Groundwater Human Health Standards (mg/L)[2]
Physical Parameters			
pH	150.2/SM 4500H-B	0.1 s.u.	NA
Specific Conductance	120.1/SM 2510B	1 μmhos/cm	NA
TDS	SM 2540C	10	NA
TSS	SM 2540D	10	NA
Common Ions			
Alkalinity	SM 2320B	1	NA
Bicarbonate	SM 2320B	1	NA
Sulfate	300.0	1	NA
Chloride	300.0/SM 4500CL-B	1	NA
Bromide	300.0	0.5	NA
Calcium	215.1/200.7	5	NA
Magnesium	242.1/200.7	5	NA
Sodium	273.1/200.7	5	NA
Potassium	258.1/200.7	5	NA
Trace Constituents (Total and/or Dissolved) [3][4]			
Antimony (Sb)	200.7/200.8	0.003	0.006
Arsenic (As)	200.8/SM 3114B	0.002	0.01
Beryllium (Be)	200.7/200.8	0.001	0.004
Cadmium (Cd)	200.7/200.8	0.001	0.005
Chromium (Cr)	200.7/200.8	0.001	0.1
Copper (Cu)	200.7/200.8	0.001	1.3
Iron (Fe)	200.7/200.8	0.02	NA
Lead (Pb)	200.7/200.8	0.005	0.015
Manganese (Mn)	200.7/200.8	0.01	NA
Mercury (Hg)	245.2/245.1/200.8/SM 3112B	0.001	0.002
Nickel (Ni)	200.7/200.8	0.01	0.1
Selenium (Se)	200.7/200.8/SM 3114B	0.001	0.05
Thallium (Tl)	200.7/200.8	0.001	0.002
Zinc (Zn)	200.7/200.8	0.01	2
Field Parameters [5]			
Static Water Level	HF-SOP-10	0.01 ft	NA
Water Temperature	HF-SOP-20	0.1 °C	NA
Dissolved Oxygen (DO)	HF-SOP-22	0.01 mg/L	NA
pH	HF-SOP-20	0.01 pH standard unit	NA
Turbidity		0.1 NTU	NA
ORP/Eh	HF-SOP-23	1 mV	NA
Specific Conductance (SC)	HF-SOP-79	1 μmhos/cm	NA

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) Standards from Montana Circular DEQ-7 (October4 2012 Version). NA = not applicable (no human health standard).

(3) Residential/water supply well samples will be analyzed for both total and dissolved trace constituents; monitoring well samples will be analyzed for dissolved metals only

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

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

Table 6-2. 2016 Surface Water 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	300.0	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 Recoverable)		
Antimony (Sb)	200.7/200.8	0.0005
Arsenic (As)	200.8/SM 3114B	0.001
Beryllium (Be)	200.7/200.8	0.0008
Cadmium (Cd)	200.7/200.8	0.00003
Chromium (Cr)	200.7/200.8	0.01
Copper (Cu)	200.7/200.8	0.002
Iron (Fe)	200.7/200.8	0.02
Lead (Pb)	200.7/200.8	0.0003
Manganese (Mn)	200.7/200.8	0.01
Mercury (Hg)	245.2/245.1/200.8/SM 3112B	0.000005
Nickel (Ni)	200.7/200.8	0.002
Selenium (Se)	200.7/200.8/SM 3114B	0.001
Thallium (Tl)	200.7/200.8	0.0002
Zinc (Zn)	200.7/200.8	0.008
Field Parameters		
Stream Flow	HF-SOP-37/-44/-46	NA
Water Temperature	HF-SOP-20	0.1 °C
Dissolved Oxygen (DO)	HF-SOP-22	0.01 mg/L
pH	HF-SOP-20	0.01 s.u.
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).

FIGURES

Hydrometrics, Inc. Consulting Scientists and Engineers Date Saved: 4/4/2016 2:32:51 PM	EAST HELENA FACILITY 2016 CORRECTIVE ACTION MONITORING PLAN	**GENERAL LOCATION MAP**	**FIGURE** **1-1**

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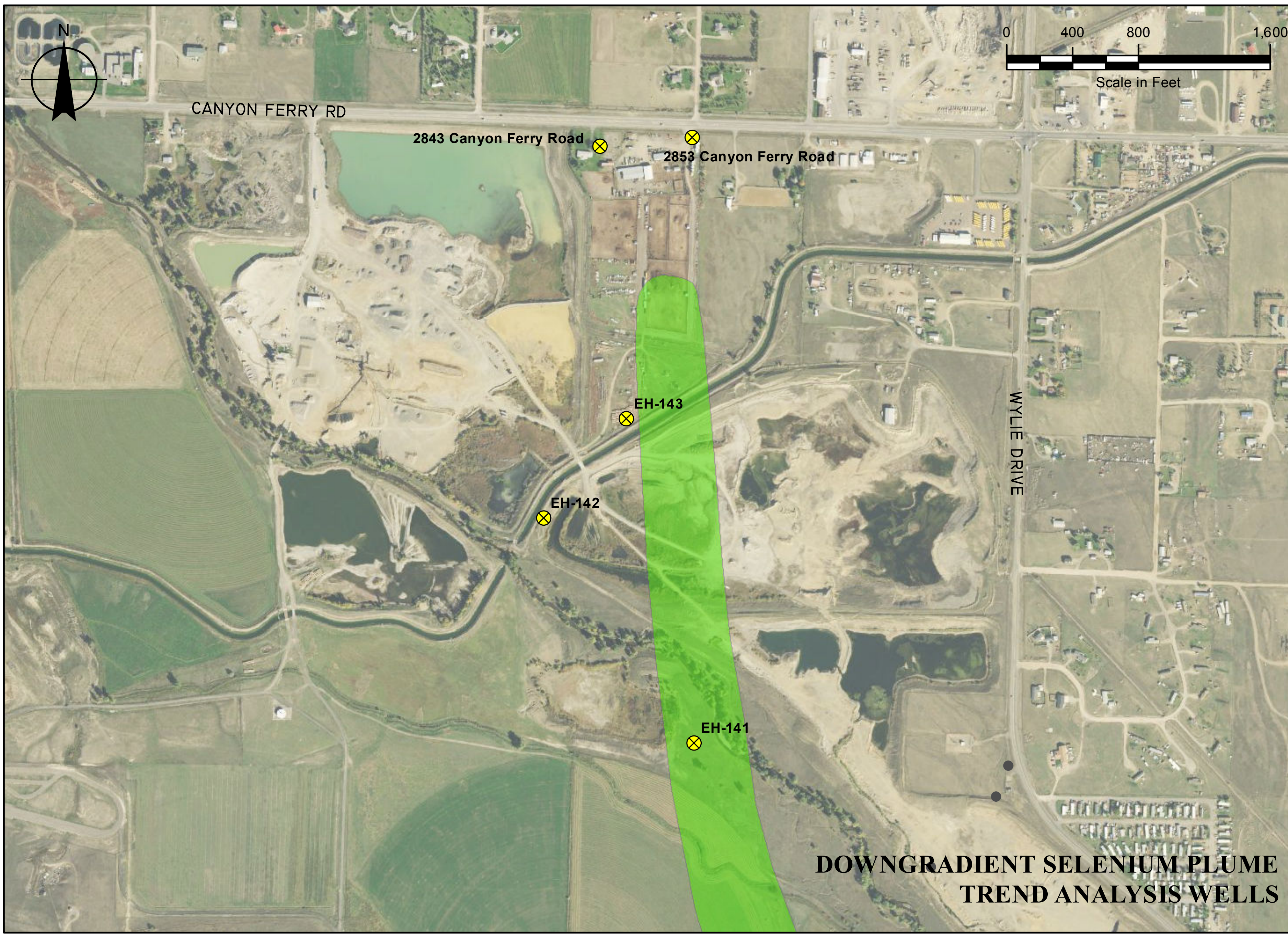

2016 CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY	**2016 PERFORMANCE EVALUATION TREND ANALYSIS MONITORING WELLS**	**FIGURE 2-1**

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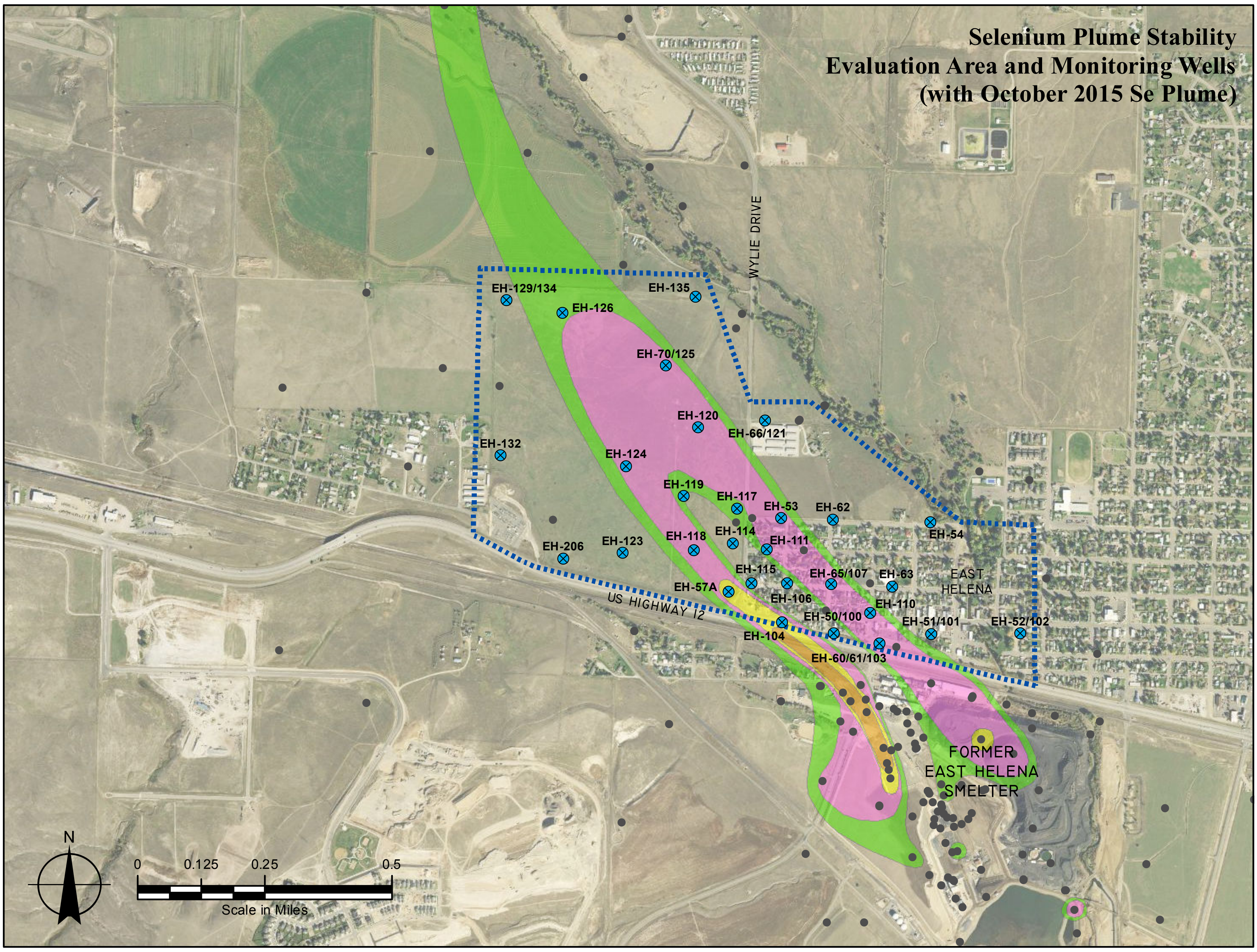

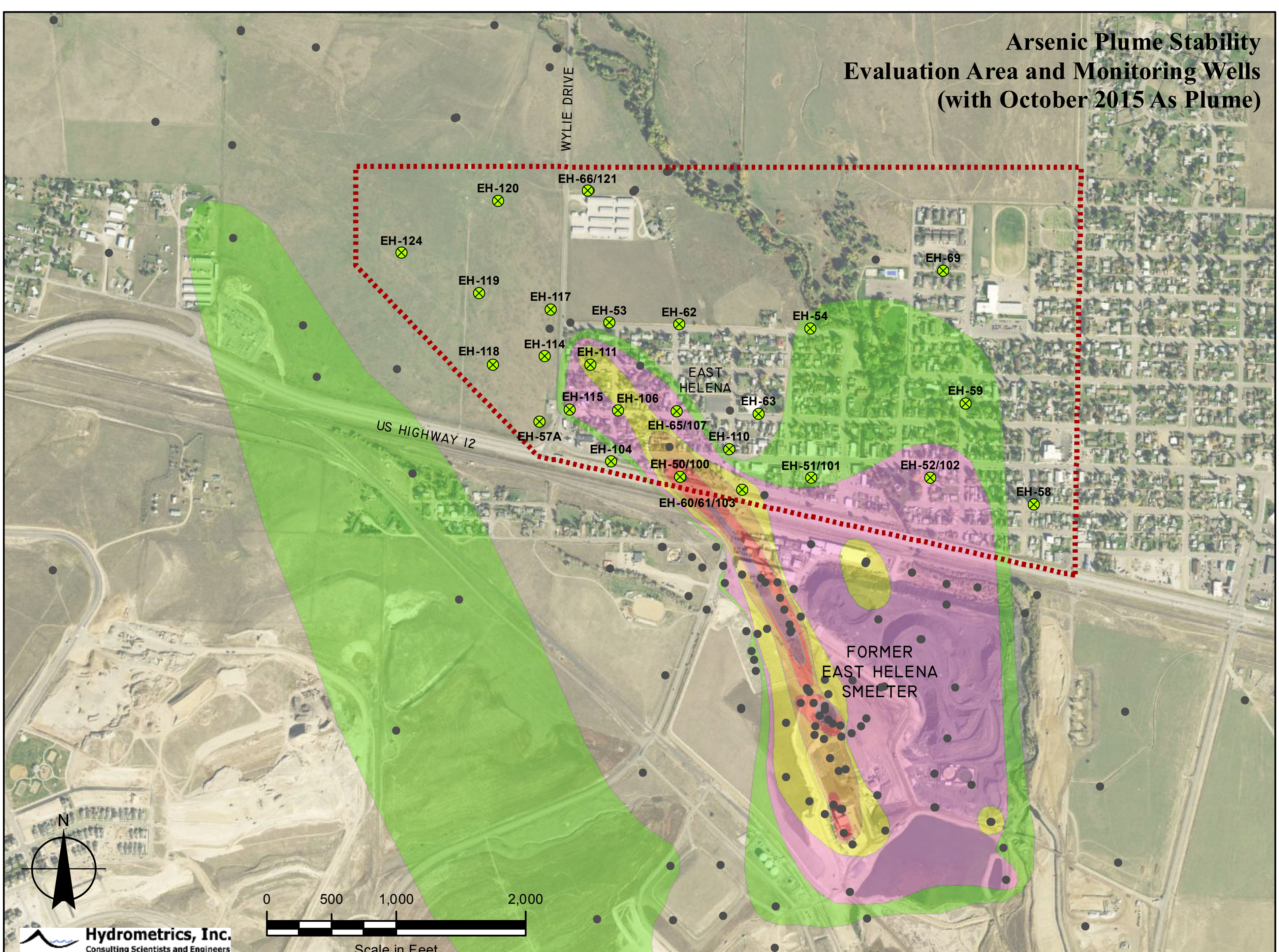

2016 CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY	**2016 PERFORMANCE EVALUATION PLUME STABILITY EVALUATION MONITORING WELLS**	**FIGURE** 2-2

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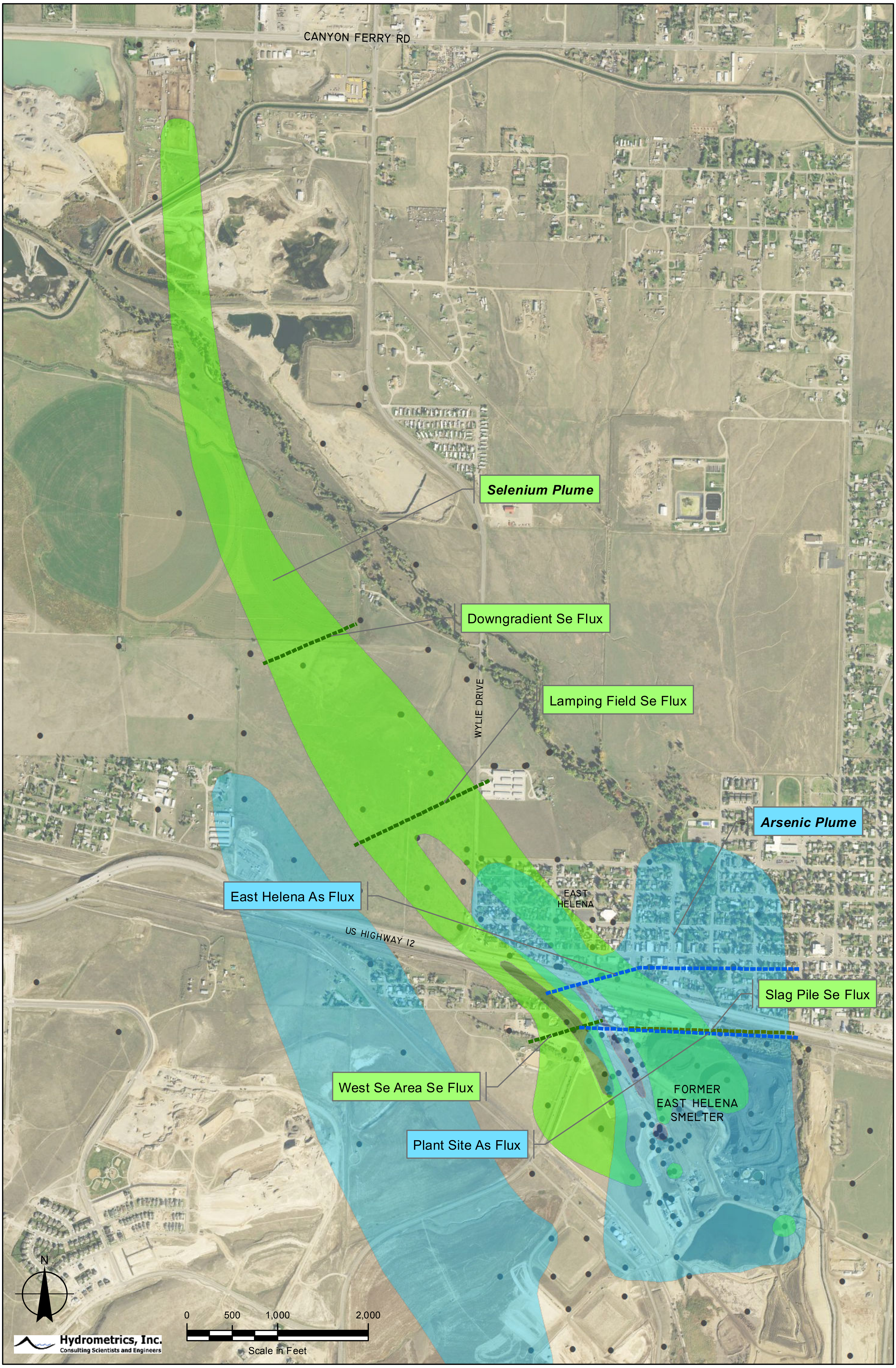

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2016 CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY	2016 PERFORMANCE EVALUATION CONTAMINANT MASS FLUX ANALYSIS TRANSECTS	FIGURE 2-3

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2015 Aerial Photo Source: http://gis.apfo.usda.gov/arcgis/services

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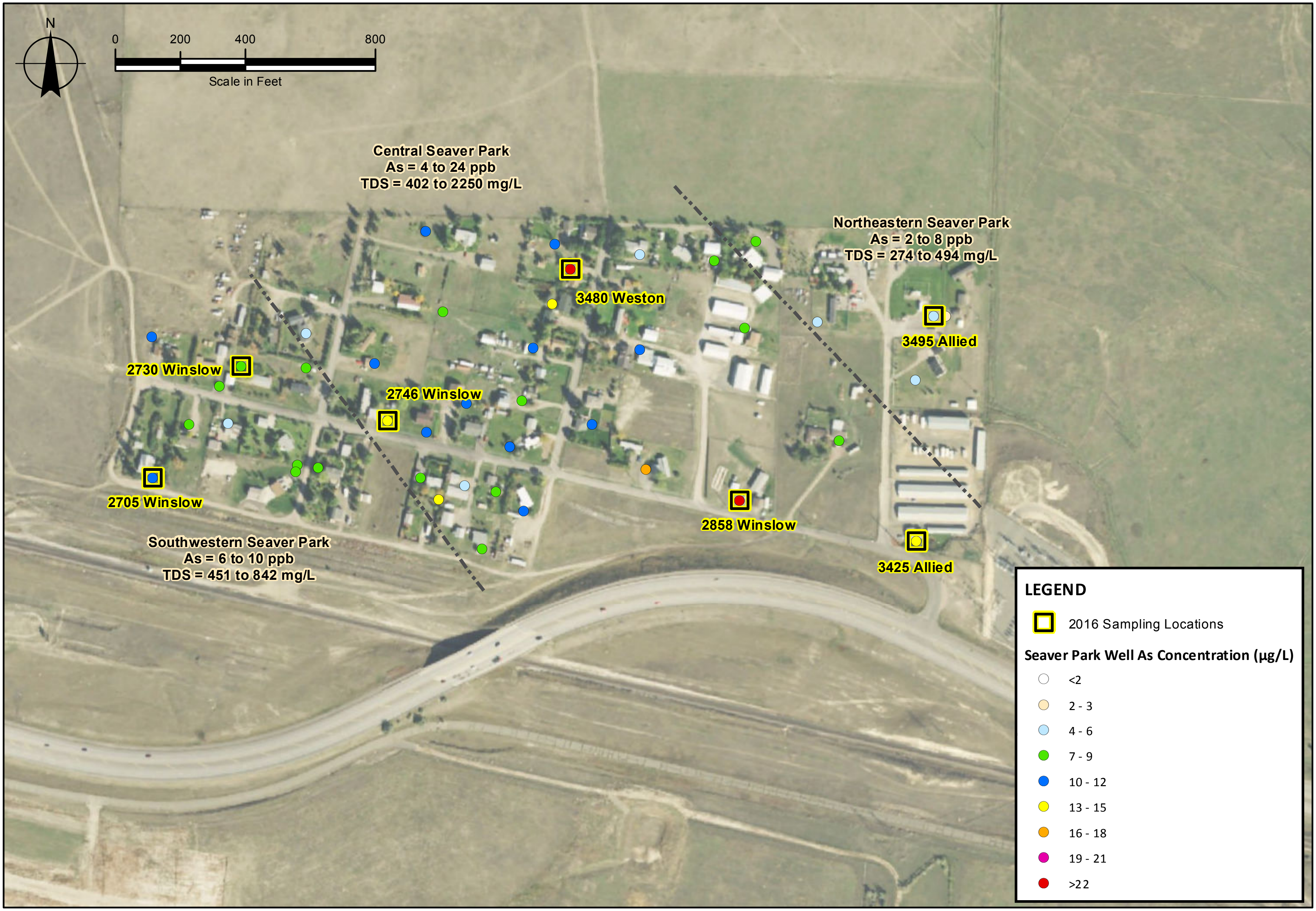
2016 CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY	2016 DOWNGRADIENT SELENIUM AREA RESIDENTIAL WELL MONITORING LOCATIONS	FIGURE 3-1



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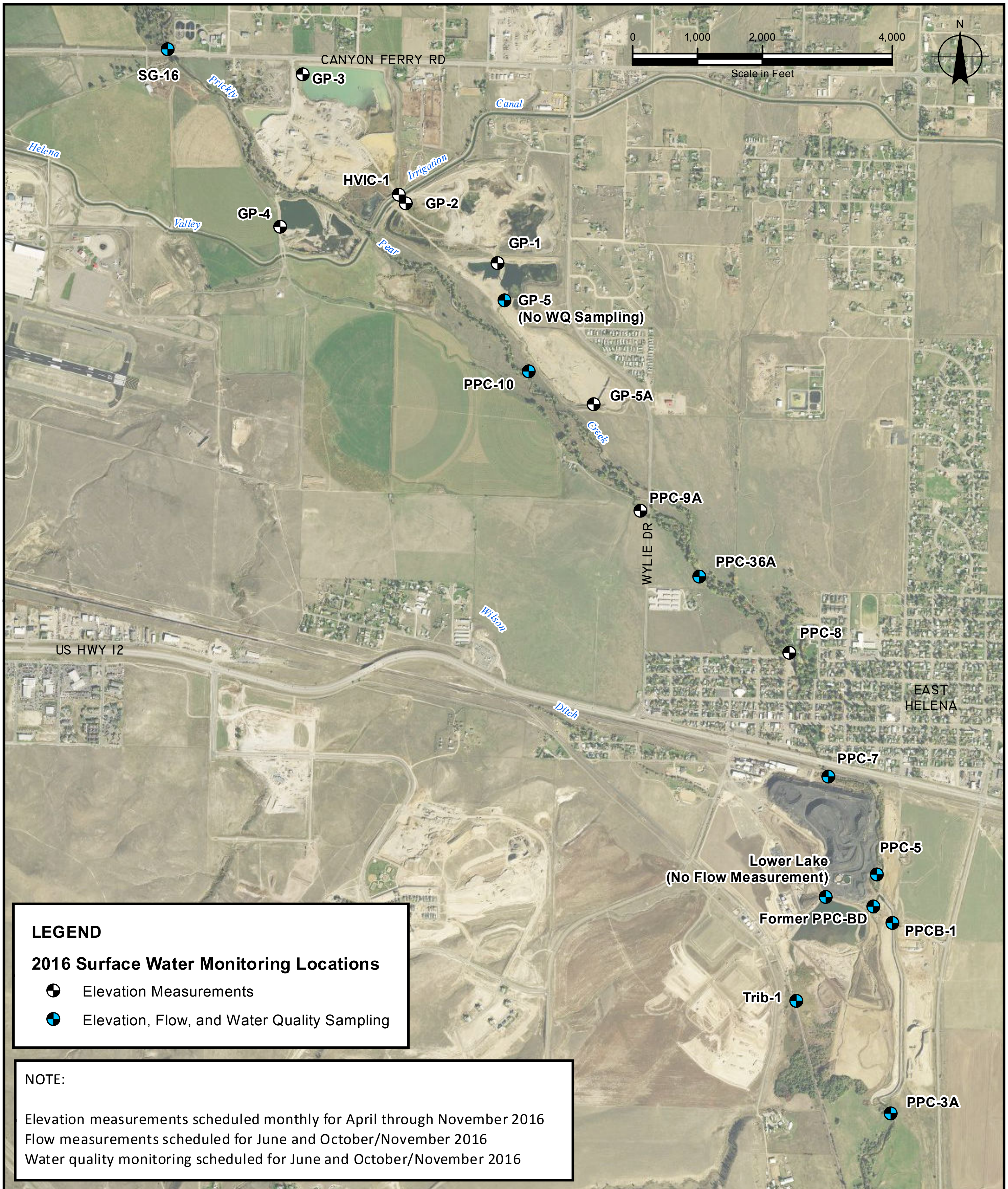
2016 CORRECTIVE ACTION MONITORING PLAN EAST HELENA FACILITY	2016 SEAVER PARK RESIDENTIAL WELL MONITORING LOCATIONS	FIGURE 3-2



Hydrometrics, Inc. Consulting Scientists and Engineers Date Saved: 4/5/2016 11:01:28 AM	EAST HELENA FACILITY 2016 CORRECTIVE ACTION MONITORING PLAN	**2016 SURFACE WATER MONITORING LOCATIONS**	FIGURE **3-3**

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APPENDIX A

METG-SOP-001
RESIDENTIAL WELL SAMPLING
FOR INORGANIC PARAMETERS

STANDARD OPERATING PROCEDURE

RESIDENTIAL WELL SAMPLING FOR INORGANIC PARAMETERS

METG-SOP-001

1.0 PURPOSE

This procedure describes the methods to be used in collection of groundwater samples from private residential wells. The purpose of this standard operating procedure (SOP) is to describe the general methodology for collecting representative groundwater samples from residential wells within the vicinity of the Montana Environmental Trust Group – East Helena Site. The procedure is designed for sampling residential wells where inorganic constituents are the contaminants of interest. This procedure is intended to serve as guidance for field crews collecting these samples – this SOP does not cover communication with residential well owners (e.g., obtaining access authorization, sampling notification). Methods presented in this SOP are based on recent USGS guidance (USGS, 2006).

2.0 SCOPE

This procedure applies to all METG personnel and any assigned contractors tasked with sampling residential wells. The scope of work includes the preparation, preservation, collection, and submittal of samples for analytical analysis.

3.0 GENERAL

This technical procedure has been established to standardize the sampling team preparation, collection, preservation, and submittal of residential well water samples to the analytical laboratory. Analyses conducted on these samples may include inorganic compounds (metals, sulfate, anions, cations, etc.) and must be conducted by a Montana certified laboratory. Procedures and methodologies may only be added or changed at the direction of the METG or its designated contractor. To ensure the sample collected is representative of the groundwater, the system must be purged prior to sample collection. This SOP will be used in conjunction with the East Helena QAPP (Hydrometrics, 2010 or its equivalent) and applicable field sampling and analyses plans (SAPs) to ensure the sampling event is properly performed, documented and yields quality results.

4.0 RESPONSIBILITIES

METG and assigned field staff shall ensure that:

- Property access has been obtained at each well to be sampled;
- Each property owner is notified and provided with the anticipated sample date and time before each sampling event;

- Residential well sampling schedules are coordinated to extent practical with other METG directed groundwater monitoring activities; and
- Representative residential drinking water well samples are obtained according to this procedure and other applicable QAPP or SAP requirements.

5.0 EQUIPMENT

Residential wells will be sampled using existing pumps installed in the wells by the property owners. Additional equipment needed to conduct sampling activities may include:

- Summary of addresses, well locations, preferred sampling location (inside, outside, spigot, faucet, etc.), estimated purge volumes (or calculator for determining purge volumes, holding tank volume), and other special instructions
- Distilled or deionized water
- 0.45 µm filter apparatus with inert filters
- Laboratory supplied pre-cleaned and preserved sample containers for analyses
- Stopwatch or watch with second hand
- Field logbook
- Sampling sheets
- Sample labels
- Chain-of-custody sheets
- Custody seals
- Chemical-free paper towels
- Waterproof pens (Sharpies)
- Paper towels
- Trash bags
- Nitrile gloves
- Garden hoses
- Buckets (5-gallon, 2-gallon)
- Pliers
- Standard connectors
- Sample coolers
- Extra-large zip-lock bags
- Ice for sample preservation
- Safety glasses
- Cell phone or two-way radio
- Water quality meters (Eh, pH, conductivity, ORP, temperature)

- Flow through cell
- Copies of Private Well Water Sampling Notice

6.0 PROCEDURES

6.1 Well Access

Upon arrive at the property, introduce yourself to the property owner/occupant and discuss the purpose of the sampling and the planned sampling protocols. Ask the property owner/occupant if they have been recently using the well and about the well's general usage. Record the answer.

If the information hasn't already been provided, the property owner should be questioned as to the well depth and pressure tank capacity, if known. Additionally, the owner should be asked if they have a water filtration or conditioning unit in their system. If a water filter is connected to the water system, permission should be asked to obtain the sample before the water passes through such systems. If the property owner is not home but has given permission to sample, consult the sampling instructions for the location of the outside spigot.

6.2 Well Purging

The purpose of purging the well is to remove any stagnant water within the system and to obtain a representative sample of the groundwater. The following steps should be followed to the extent practicable:

A. **Locate the well and sampling port**. Locate the sampling port nearest to the wellhead. The sampling port should be before the holding tank, pressure tank, water filtration, or water treatment system. If the sample port is outdoors, ask if the owner has a preference for where to discharge the purge water. It may be necessary to run a hose from the sampling port to an acceptable discharge location away from the house or other features.

B. **Obtain water level measurement** (see water level HF-SOP-010), if well has an access port. NOTE: electric water level probes are typically not recommended for sounding wells; instead, use a weighted measuring tape or other equipment. Measurements should not be made when the pump is operating.

C. **Prepare sampling port for purging.**

Houses with inside tap:

- If the faucet is fixed with an aerator (a small screen), remove the aerator carefully. If pliers are needed, place a nitrile glove or similar between the pliers and aerator to protect it.
- Establish a constant flow and determine the purge flow rate using a known volume container and timer.

Houses with outside spigot:

- If a hose is already connected, disconnect it.

- Attach the purge hose and direct end of hose so that water discharges away from the house, wellhead, etc.

D. **Determine the well purge volume.** This task can be done in advance and verified in the field, if information is obtained from the well owner before visiting the property. The volume of water to be purged before groundwater samples are collected will be calculated as follows:

- If the house has a holding tank and the volume is known, estimate length of piping to the well, and the well depth[1]. The total volume to purge the system is

  = tank volume[2] + well casing volume[3] + water line volume[4].

  The well casing volume, expressed in gallons (1 ft^3 = 7.48 gallons), is

  $$= \frac{\pi * d^2 * h}{77.01}$$

  Where:

  π = 3.14;
  d = Diameter of the well casing expressed in inches; and
  h = Total depth of the water column in the well in feet (well depth – static water level, see Static Water Level Determination HF-SOP-010).

- If the holding tank volume is unknown:
  - Assume a 35-gallon pressure tank.
  - Assume that ~ 5 gallons are contained in the water line.
  - Assume well volume ≈ 20 gallons.
  - Assume total purge volume = 60 gallons.

E. **Determine the purge time**

- Turn the spigot on and establish a constant flow. Determine the purge flowrate using a known volume container and a timer Time the filling of a 5-gallon bucket (outside) or a 2-liter beaker (inside).
- Calculate the purge time based on the purge rate in gallons per minute (gpm) and the total purge volume in gallons as follows:

[1] The well depth may be obtained from well logs, owners statements, or direct measurements – if wellhead is accessible.
[2] This value should include the volume of holding tank and/or pressure tank between the well and the sampling port. All samples should be obtained before any water filtration or water treatment systems.
[3] A minimum of one well casing volume should be purged prior to sampling if the well is actively used. If the well has been stagnant or infrequently used three to five well casing volumes should be purged.
[4] The water line volume can be calculated using the formula for the well casing volume by replacing d with the inside diameter of the pipe and h with the estimated length of the water line in feet.

$$= \frac{\text{Well Purge Volume (gallons)}}{\text{Purge Rate (gpm)}}$$

Where:

$$\text{Purge Rate} = \frac{\text{Volume of Container (gallons)}}{\text{Time to fill container (minutes)}}$$

Example:
Well Purge Volume calculated to be 60 gallons. If it takes 45 seconds to fill one 5-gallon bucket, the purge rate would be 6.8 gpm [5 gallons / 45 seconds (0.75 minutes)]. The estimated purge time would be about 9 minutes (60 gallons/6.8 gpm or 12 (# of bucket volumes in the system) x 45 (seconds) = 540 seconds or about 9 minutes.

F. **Purge the system**

- Let the water flow for the required purge time.
- Follow any homeowner instruction regarding where to direct the purge water. All reasonable efforts should be made to prevent water ponding near the residence.
- As the water system is purging:
  - Fill in the following information on the sample labels and apply them to the sample containers (see HSOP-29):
    - sample date;
    - sample time; and
    - samplers initials.
  - Complete entries in the Field Logbook (see Section 8 and HSOP-31)
  - Using a calibrated water quality measurement meters (YSI or equivalent)[5] and a low flow cell, record the following measurements at the beginning, middle and end of the purging period (see applicable SOP listed in Section 9):
    - dissolved oxygen;
    - oxygen reduction potential;
    - temperature;
    - pH;
    - specific conductance; and
    - turbidity (Hach Turbidometer or equivalent).

    Field parameters are considered "stable" when the variability between sequential measurements is as follows:

Parameter	Stability Criteria
pH	$\pm$0.1
Temperature (°C)	$\pm$0.2
SC (μmhos/cm)	$\pm$5% (SC $\leq$ 100) or $\pm$3% (SC > 100)

[5] Preference is that water quality parameters be measured using a low flow cell. Other measurement methods are acceptable, but should be documented.

Dissolved oxygen (mg/L)	±0.3
Turbidity (NTU)	±10% (NTU < 100)

Modifications of the standard purge procedure are allowable if site conditions, the project work plan, or study objectives dictate such modifications.

- Note and record any unusual color, turbidity or odor associated with the water as it is purging and during sampling.

6.3 Sample Collection

- Once purging is complete, sample collection can begin. If a hose was used to direct away the purge water, remove the hose before filling the sample bottles. To collect the sample:
  - Use a very low flow rate. Turn the faucet down to a flow of < 100 mL/min and allow the water to run a few seconds before collecting the sample.
  - Sample bottles may be filled directly from the tap for most analyses. For dissolved metal analyses water should be field filtered using 0.45 µm filter apparatus with inert filters (see HF-SOP-073).
  - Wear nitrile gloves to fill the sample bottles. This is to maintain the integrity of the sample and to protect your skin from any spillage of the preservative in the bottles.
  - Fill the bottles at arm’s length, pointing away from you. Wear safety glasses.
  - Sample bottles should be filled as directed by the Analytical Laboratory.
  - Do not allow bottles with preservative to overflow. If a preserved bottle overflows, discard it and sample again with a new bottle to avoid dilution of the preservative.
  - Preserve and store samples as appropriate for the intended laboratory analysis.
  - After the samples have been collected, they should immediately be placed in an ice filled cooler until relinquished or shipped to the appropriate contract laboratory (see HSOP-4).
  - Replace any faucet aerators, or reattach homeowner’s hose, if necessary.
  - Pick up and remove all waste and wipe up any water spillage.
  - If the owner is present, tell them you have completed the task and are leaving. If the owner is not present, place the “Private Well Water Sampling Notice” in the door or other convenient location (Note: do not place in mailbox).

7.0 DECONTAMINATION

Equipment that is shared between sampling locations (water level meters, water quality meters) should be decontaminated before leaving the property (see Decontamination of Sampling Equipment HSOP-7). Buckets and hoses should be emptied on site. If it is known that the residential well is contaminated, equipment should be thoroughly rinsed with potable water.

8.0 RECORDS

Accurate record keeping is necessary to demonstrate sampling methodologies and the validity of the samples. Field notes shall be kept in a bound field logbook as specified in the Field Notebook technical procedure (HSOP-31). Records shall be recorded using waterproof ink. Sampling records should include:

- Site Name/Number;
- Date and time of sampling;
- Names of Sampling Team members;
- Weather conditions;
- Location and address of residential well;
- Well use history;
- Location of sampling (inside or outside);
- Field sketch of property/structure showing where sample was collected;
- Photograph of well location and sampling port location;
- Description of sample port type (e.g., ¾” gate value, kitchen faucet with aerator)
- Calculations (e.g., calculation of purged volume);
- Data for purge volume calculation (e.g., well depth, SWL, casing diameter, etc.);
- Volume of water purged before sampling;
- Location of sample tap;
- Discharge rate of faucet;
- Starting field parameters;
- Progressive field parameters as a function of time;
- Demonstration of field parameter stabilization, (i.e., at least 3 consecutive stable measurements);
- Parameters (inorganic compounds, metals, etc.) for which sample is to be analyzed;
- Sample volume, number, and container types;
- Laboratory chain of custody form;
- Sample cooler shipping document number, if applicable;
- Sample preservation;

- QA/QC samples collected; and
- Irregularities or problems.

9.0 ASSOCIATED DOCUMENTS

A. Decontamination of Sampling Equipment **(HSOP-7)**

B. Water Level Measurement with an Electric Probe **(HF-SOP-010)**

C. Field Measurement of pH using a pH Meter **(HF-SOP-020)**

D. Field Measurement of Dissolved Oxygen **(HF-SOP-022)**

E. Field Measurement of Specific Conductivity **(HF-SOP-079)**

F. Field Measurement of Temperature **(HF-SOP-084)**

G. Filtration of Water Samples **(HF-SOP-073)**

H. Chain-of-Custody Procedures, Packing, and Shipping Samples **(HSOP-4)**

I. Labeling and Documentation of Samples **(HSOP-29)**

J. Field Notebooks **(HSOP-31)**

The following forms will be completed and retained in the project file:

A. Water Sampling Form;

B. Chain-of-Custody Form; and

C. Shipping receipts.

10.0 REFERENCES

USGS, 2006. *National Field Manual for the Collection of Water-Quality Data: Chapter A4, Collection of Water Samples.* USGS TWRI Book 9, September 1999; Revised 2006..

Hydrometrics, 2010. *Quality Assurance Project Plan for Environmental Data Collection Activities – East Helena Facility*. Prepared by Hydrometrics, Inc. for the Montana Environmental Trust Group. May 2010.

METG
Montana Environmental Trust Group

Date/Time: ________________________

Dear Neighbor:

Thank you for allowing us to sample your well today. We will be submitting the water sample for analytical testing. We anticipate the results of this testing will be available in approximately one month and will provide the results to you.

Please feel free to contact METG if you have any questions or concerns regarding this sampling by either:

Phone: (406) 227-3734 or
Email at lg@g-etg.com

You cooperation is greatly appreciated.

Sincerely,

Montana Environmental Trust Group, LLC
1000 Smelter Road, P.O. Box 1230
East Helena, MT 59635

METG
Montana Environmental Trust Group

Date/Time: ________________________

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Thank you for allowing us to sample your well today. We will be submitting the water sample for analytical testing. We anticipate the results of this testing will be available in approximately one month and will provide the results to you.

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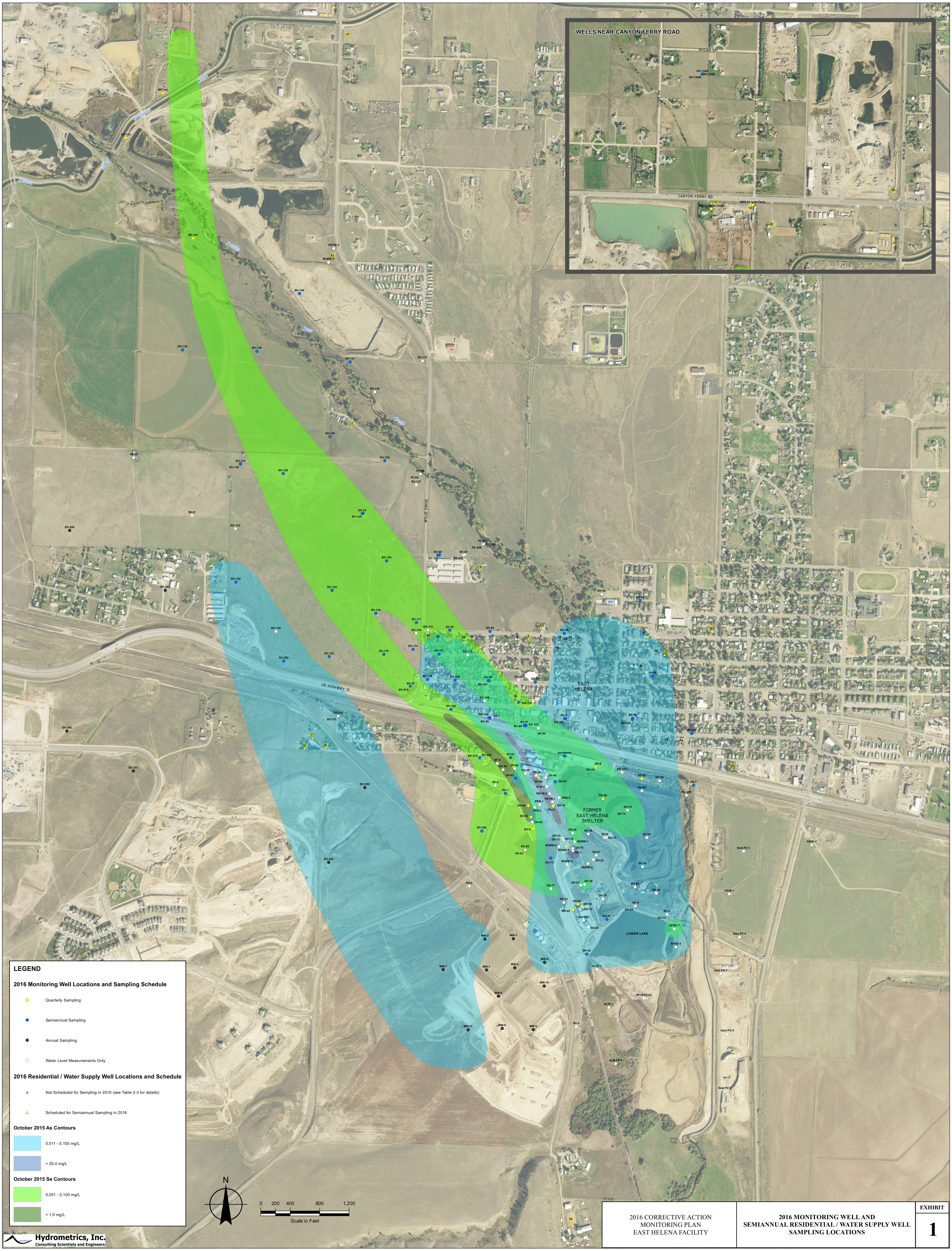
East Helena, MT 59635

EXHIBIT 1

2016 MONITORING WELL AND SEMIANNUAL RESIDENTIAL / WATER SUPPLY WELL SAMPLING LOCATIONS


WELLS NEAR CANYON FERRY ROAD
CANYON FERRY RD
EAST HELENA
FORMER
EAST HELENA
SMELTER
LOWER LAKE
US HIGHWAY 12
WYLIE DRIVE
N
0 200 400 800 1,200
Scale in Feet
LEGEND
2016 Monitoring Well Locations and Sampling Schedule
Quarterly Sampling
Semiannual Sampling
Annual Sampling
Water Level Measurements Only
2016 Residential / Water Supply Well Locations and Schedule
Not Scheduled for Sampling in 2016 (see Table 2-3 for details)
Scheduled for Semiannual Sampling in 2016
October 2015 As Contours
0.011 - 0.100 mg/L
> 20.0 mg/L
October 2015 Se Contours
0.051 - 0.100 mg/L
> 1.0 mg/L
Hydrometrics, Inc.
Consulting Scientists and Engineers
Date Saved: 4/5/2016 12:39:54 PM
Path: V:\10022\GIS\2016 CAMP\Exhibit1_2016_Wells.mxd
2016 CORRECTIVE ACTION
MONITORING PLAN
EAST HELENA FACILITY
2016 MONITORING WELL AND
SEMIANNUAL RESIDENTIAL / WATER SUPPLY WELL
SAMPLING LOCATIONS
EXHIBIT
1