UNFUMED SLAG PROCESSING AND REMOVAL
GROUNDWATER MONITORING PLAN
EAST HELENA FACILITY

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1.0 INTRODUCTION

This monitoring plan details groundwater monitoring activities to be conducted at the former East Helena smelter site or Facility[1] (the Facility) and surrounding area to assess potential groundwater quality impacts associated with the planned processing and removal of unfumed slag (UFS) from the Facility. The plan provides a scope, schedule, and strategy for collection and evaluation of groundwater quality data to assess potential changes in groundwater quality resulting from the UFS processing / removal (the UFS Project). The groundwater data collected and evaluated under this plan will be used to detect and mitigate any unacceptable groundwater quality impacts, as defined below.

The groundwater monitoring described in this plan is specific to the UFS Project, and will be conducted in addition to the comprehensive seasonal groundwater and surface water monitoring activities outlined in the 2021 Corrective Action Monitoring Plan (CAMP). This plan outlines the number, type and location of samples to be collected, as well as the sampling and analytical methodologies and data evaluation procedures to be employed. The field sampling and analytical methodologies specified in this plan are consistent with those utilized during previous Facility investigations and monitoring events.

1.1 UFS PROJECT BACKGROUND

The Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust (Custodial Trust), is currently conducting Resource Conservation and Recovery Act (RCRA) Corrective Actions at the Facility pursuant to the First Modification to the 1998 RCRA Consent Decree (U.S. District Court, 2012) for the East Helena Facility, under the oversight of the Environmental Protection Agency (EPA). RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS) evaluations have identified site soils, non-native fill, and the slag pile as containing elevated concentrations of a number of contaminants, primarily arsenic, selenium, and certain trace metals. Loading of contaminants from these sources, and historic releases of high contaminant-concentration plant process waters to groundwater, have resulted in the generation and migration of groundwater plumes (primarily arsenic and selenium) from the former smelter to the north and northwest. The East Helena Facility and associated features, including the slag pile, are shown on Figure 1-1 along with the current arsenic and selenium groundwater plumes based on data collected in 2020. The slag pile occupies approximately 45 acres in the northeast portion of the Facility and has been identified as a Facility-related source of arsenic and selenium to groundwater (CH2M Hill, 2018). Various Interim

[1] The former smelter site or Facility refers to the approximately 142 acres previously occupied by the East Helena Lead Smelter.

Corrective Measures (IMs) and associated Institutional Controls (ICs, including the East Valley Controlled Groundwater Area (EVCGWA)) have been implemented at the Facility to protect human health and the environment, by reducing mass loading of contaminants (primarily arsenic and selenium) to groundwater, decreasing offsite migration of contaminants, and reducing potential exposures to contaminated soil and groundwater. The EVCGWA boundaries are also shown on Figure 1-1.

The unfumed slag at the Facility contains economically recoverable amounts of zinc and other non-ferrous metals. MCC Non-Ferrous Trading, LLC (MCC) has contracted with the Custodial Trust to crush, stockpile, load, and ship UFS from the Facility to a location in Busan, South Korea for processing to recover metals. MCC has contracted with Helena Sand and Gravel (HSG) to perform the crushing, screening, and loading operations. Approximately 2 million metric tons (MT) of UFS is planned for removal from the Facility via rail, at an approximate average rate of 33,330 MT per month over a period of five years.

The slag processing and removal operation is described in a UFS Work Plan (MCC and HSG, 2021). As noted in the UFS Work Plan,

> "Continued protection of groundwater during the UFS removal process is of the utmost importance to the Custodial Trust and EPA. Impacts to groundwater quality could result from the movement and crushing of UFS, which will expose fresh UFS surfaces to the elements, and from the application of dust suppression water, both of which can increase contaminant leaching from the UFS to groundwater."

The UFS Work Plan also includes the following provision:

> "If groundwater monitoring shows unacceptable increases (i.e., potential water quality exceedances outside of the controlled groundwater area or at a residential well) in metals concentrations due to UFS processing, as determined by the Custodial Trust and/or EPA (including but not limited to, arsenic and selenium), MCC will move the Crushers to another location to be approved by the Custodial Trust. Groundwater monitoring details, which will include monitoring wells to be sampled, monitoring schedule, analytical parameters, and criteria for "unacceptable increases" are included in a separate monitoring plan to be prepared by the Custodial Trust and approved by EPA."

This groundwater monitoring plan is intended to fulfill the above groundwater monitoring provision of the UFS Work Plan. The plan outlines a tiered well sampling, sample analysis, and data evaluation procedure to monitor potential groundwater quality impacts and to prevent unacceptable increases in contaminant concentrations.

1.2 GROUNDWATER MONITORING OBJECTIVES

The primary objective of this groundwater monitoring plan is to provide for collection of groundwater data and establish data evaluation procedures to identify any UFS Project-related impacts to groundwater quality with the potential to cause unacceptable water quality impacts. Unacceptable water quality impacts are defined as impacts resulting in exceedances of one or more of the human health water quality standards listed in Circular DEQ-7 (MDEQ, 2019) in downgradient residential or public water supply wells. This monitoring plan objective and definition of unacceptable impacts recognizes and allows for potential short-term increases in some groundwater concentrations, including arsenic and selenium, in the immediate vicinity of the slag pile that pose no threat to human health or the environment. If potential short-term increases were to occur from the slag crushing and stockpiling activities, such increases would be transient, and offset by the contaminant loading reductions resulting from the unfumed slag removal in one to two years.

To achieve the monitoring program objective, this plan outlines groundwater sampling and data evaluation procedures that will facilitate:

(1) Assessment of groundwater quality concentrations and trends for key constituents (arsenic, selenium, and slag pile indicator parameters) at selected indicator and sentinel wells located within the UFS Project operational area and immediately downgradient of the slag pile.
(2) Supplemental sampling and analysis of additional downgradient monitoring and/or residential wells if warranted by observed trends/concentrations.
(3) Appropriate modifications of UFS Project operations, including Project shutdown if necessary, based on groundwater monitoring results, to prevent unacceptable impacts to downgradient residential water wells.

The groundwater monitoring plan is structured as follows:

- Section 1.0 – Introduction;
- Section 2.0 – Groundwater Monitoring and Evaluation Strategy;
- Section 3.0 – Groundwater Sampling Methods;
- Section 4.0 – Sample Handling and Documentation;
- Section 5.0 – Analytical Procedures, Data Review and Reporting; and
- Section 6.0 – References.

2.0 GROUNDWATER MONITORING AND EVALUATION STRATEGY

As noted above, due to the nature of the UFS Project (excavation, crushing, and transport of slag), some short-term impacts to groundwater may occur during operations due to enhanced contaminant leaching, although the project has been designed to minimize any such impacts. In addition, non-UFS Project-related short- and long-term variability in groundwater quality in the vicinity of the slag pile also occurs, due primarily to seasonal precipitation and infiltration patterns and to the ongoing effects of the IMs. The groundwater monitoring and evaluation outlined in this section is intended to track concentrations of key slag-related constituents, to rapidly identify any UFS Project-related groundwater quality changes in a timely manner, and to help assess the need for adjustment of UFS Project operations to ensure that unacceptable increases (Section 1.2) are prevented.

The principal components of the UFS Project groundwater monitoring and evaluation strategy will consist of the following:

- Biweekly water level measurements and groundwater sample collection at two indicator wells located within the slag pile near the slag processing operations, and six sentinel wells located immediately downgradient of the slag pile for the first two months of UFS Project Phase 2 (Section 2.1).
- Analysis of groundwater samples for field water quality parameters (water temperature, pH, specific conductance (SC), and dissolved oxygen (DO)), primary contaminants of concern (dissolved arsenic and selenium) and slag pile indicator parameters (potassium, magnesium, sulfate, and chloride) (Section 2.1).
- Visual evaluation of trends in water levels and water chemistry constituent concentrations, and comparison of observed concentrations with the upper limit of expected concentrations at each well, based on previous (2012-2020) sample results since IM implementation was initiated in late 2011 (Section 2.2).

If the trend and/or upper limit concentration comparisons suggest the occurrence or impending occurrence of significant UFS Project-related groundwater quality changes at downgradient wells, potential responses would include (1) increased monitoring frequency at selected wells, and/or (2) additional downgradient locations added to the groundwater monitoring network, and (3) review of UFS Project operations to consider potential modifications or termination to mitigate groundwater impacts.

2.1 SAMPLING LOCATIONS, FREQUENCY, AND ANALYTICAL PARAMETERS

The UFS Project monitoring network will include two indicator wells located within the slag pile, and six sentinel wells located immediately downgradient of the pile (Figure 2-1, Table 2-1). The indicator and sentinel wells will be sampled on a biweekly schedule for the first two months of the monitoring program due to their proximity to the slag crushing and processing activities. All groundwater samples will be analyzed for field parameters, including static water level, pH, SC, DO, and water temperature, with samples submitted to Energy Laboratories for analysis of dissolved constituents of concern (COCs) (arsenic and selenium), major cations (potassium and magnesium), and major anions (sulfate and chloride). Sulfate and potassium will serve as indicator parameters previously determined to be associated with the slag pile. Magnesium and chloride are included as indicators of infiltration through the slag (and potential leaching) to groundwater, due to the potential use of magnesium chloride as an aid for dust suppression as cited in the UFS Work Plan (MCC and HSG, 2021). The sampling methodology and sample handling and documentation procedures are outlined in Sections 3.0 and 4.0, and are identical to the methods and procedures used for long-term CAMP monitoring. Analytical methods and detection limits for the selected parameters and data review and reporting procedures are in Section 5.0, and are also consistent with those specified in annual CAMPs.

Data collected from the two indicator and six sentinel wells will be evaluated as it is received from the laboratory, according to the procedures outlined in Section 2.2. If warranted based on the concentrations and temporal trends observed at the sentinel wells, supplemental sampling will be initiated at one or more additional downgradient wells, as follows:

(1) Selected Tier 2 or Tier 3 monitoring wells located between the sentinel wells and active residential or public water supply wells (see Figure 2-1); and/or
(2) Active residential or public water supply wells downgradient of observed impacts

Specific additional downgradient wells designated for supplemental monitoring will be selected based on the nature and location of groundwater impacts observed in the sentinel wells, and on the general groundwater flow path(s) from the area(s) of impact. Tier 2 wells include EH-58, EH-52, EH-102, EH-51, EH-101, and EH-110; Tier 3 wells include EH-59, EH-63, EH-64, EH-65, and EH-107 (Figure 2-1). The intent of the supplemental monitoring will be to track the downgradient propagation of any observed groundwater quality changes at the sentinel wells, by adding Tier 2 and Tier 3 monitoring well locations. Based on the Tier 2 and Tier 3 monitoring well results, residential and public water supply wells located further downgradient would be added to the monitoring program as necessary to evaluate potential impacts. Figure 2-1 shows the location of Tier 2 and Tier 3 monitoring wells, along with residential and public water supply wells in the area downgradient of the sentinel wells, which could be added to the monitoring program as necessary. Any additional downgradient wells selected for supplemental sampling as part of the UFS Project groundwater monitoring program will be analyzed for the same constituents as the sentinel wells, with data to be evaluated using the procedure outlined below in Section 2.2. The monitoring frequency for supplemental downgradient wells will be determined based on the well location(s) and the type and magnitude of observed impacts.

Sampling locations, frequencies, and analytical parameters may be adjusted as data are collected and evaluated in accordance with the approach outlined in Section 2.2; however, biweekly sampling of indictor and sentinel wells will continue for a minimum of two months after the sampling program is initiated. Following the two month period, the monitoring frequency may be reduced to monthly, with stakeholder input, unless initial results warrant continued biweekly sampling.

2.2 DATA EVALUATION AND REPORTING

As outlined above, the objective of the UFS Project sampling program is to provide sufficient groundwater data to evaluate UFS Project-related changes in groundwater quality, in terms of the potential to cause human health standard (HHS) exceedances in downgradient residential and public water wells. In order to accomplish this objective, the data evaluation procedure must consider the following:

(1) Some change in groundwater quality in the vicinity of the project is possible, due to the movement and reprocessing (crushing) of slag, which could increase contaminant leaching from slag. Groundwater quality changes would only be considered “unacceptable” if they cause HHS exceedances in downgradient residential or public water supply wells. The tiered monitoring approach outlined in this monitoring plan is intended to provide multiple levels of data collection and review at indicator and sentinel wells and, if warranted, at additional downgradient monitoring, residential, or public water supply wells. Evaluation of these monitoring results will allow adjustments to UFS Project operating procedures as necessary.
(2) Groundwater quality in the vicinity of the slag pile exhibits elevated concentrations of the COCs arsenic and selenium, along with the indicator parameters sulfate and potassium. Variability in concentrations of these constituents at individual wells over time has been observed during past monitoring, due to seasonal variability in precipitation, infiltration, and leaching, and to the ongoing effects of IMs implemented at the site. Thus, the comparison of pre-UFS Project groundwater concentrations to the data collected under this plan needs to account for this background variability.

Concentration trend graphs of arsenic, selenium, sulfate, potassium, magnesium, and chloride at the eight indicator/sentinel wells since IM implementation began at the Facility in late 2011 are included in Attachment 1. For each well-constituent pair, the temporal trend from 2012-2020 is shown, along with “upper limit” concentrations based on the IM period (2012-2020, shown as dashed lines on the trend plots), The upper limits were calculated from the data for each well as upper simultaneous limits (USLs) with 95% confidence using ProUCL Version 5.1[2]. The USLs for each well and constituent are also shown in Table 2-2. The USL is one of the options recommended by the ProUCL Technical Guide for establishing background threshold values; in this case, the USLs presented in Attachment 1 represent the upper limit of “background” values that, based on the observed data set, future sample results should fall below with a 95% level of confidence (if changes are not occurring). Note that these are not “background” values in the sense of unimpacted concentrations, but rather a pre-UFS Project background to be used as a comparison level for data collected during implementation of the UFS Project.

The USLs for each well and constituent shown in Attachment 1 and Table 2-2 are representative of IM period conditions under which no groundwater human health standard exceedances have been observed at downgradient residential water supply wells. Therefore, maintaining groundwater concentrations below these limits should continue to be protective of human health and ensure compliance with the monitoring program objective (Section 1.2). The upper limits presented in Attachment 1 and Table 2-2 will be used in combination with trend analysis to evaluate the potential groundwater quality impacts of the UFS Project.

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[2] The USLs shown in Attachment 1 were calculated based on the data distribution as determined by ProUCL, utilizing calculations for a normal or gamma distribution, a nonparametric USL for data not fitting a normal or gamma distribution, or the maximum value when no calculations could be performed by ProUCL due to limited data (usually 1 or 2 available sample points).

The data evaluation procedure will be conducted as follows:

(1) Update trend plots for each of the wells sampled.
(2) Visually evaluate trends for arsenic, selenium, sulfate, potassium, chloride, and magnesium and compare concentrations to the USLs.
(3) If the trends appear stable or decreasing, continue the monitoring program without changes.
(4) If the trend is increasing (defined as 3 or more consecutive monitoring events with concentration increases equivalent to 20% or more of the last pre-UFS project concentration), responses may include increasing the monitoring frequency, adding one or more downgradient monitoring or residential/public water supply wells to the program, and review of UFS Project operations for potential modifications. Downgradient wells would be added in a sequential fashion (i.e., Tier 2 wells would be added based on the results of sentinel wells, Tier 3 wells would be added based on the results of Tier 2 wells, residential/public water supply wells would be added based on the results of Tier 2 or Tier 3 wells) to track any impacts along the groundwater flowpath.
(5) If the trend is increasing and the concentration exceeds the USL, responses may include increasing the monitoring frequency, adding one or more Tier 2 or Tier 3 monitoring wells or residential/public water supply wells to the monitoring program, and modification of UFS Project operations to mitigate groundwater impacts.

If downgradient wells are added to the program, USLs will be calculated and the data evaluations outlined above will be conducted for the downgradient wells. The tiered monitoring approach is intended to provide ongoing evaluation of groundwater quality across multiple well transects upgradient of residential/water supply wells, to allow appropriate project modifications prior to any impacts affecting water supply wells.

The results of the UFS Project groundwater sampling and data evaluation outlined in this section will be summarized in periodic data summary memorandums, to be prepared and submitted to the Custodial Trust on a monthly basis throughout the duration of the UFS Project. The frequency of data summary memorandum preparation may be reduced (i.e., to bimonthly, quarterly, etc.) if stakeholders agree that less frequent data reporting would fully support project objectives. These data summary memorandums will include, at a minimum:

- Updated temporal trend plots and summary data tables for all COC and indicator parameter analytical data received to date;
- Updated groundwater elevation trend plots;
- Comparisons of groundwater concentrations to the well-specific upper limits presented in Attachment 1;
- A review and discussion of any pertinent field observations noted during monitoring activities; and
- Recommendations for any changes to the groundwater monitoring program and/or the UFS Project operations.

3.0 GROUNDWATER SAMPLING METHODS

Groundwater sampling activities for the UFS project will be conducted in accordance with the procedures described in this section; these methods are consistent with those outlined in recent CAMP documents, including the 2021 CAMP (Hydrometrics, 2021). Standard Operating Procedures (SOPs) for planned field activities are listed in Table 3-1. Collection of field quality control (QC) samples is discussed in Section 3.2. Groundwater sampling methods are based on the procedures described in the SOPs and in the East Helena Quality Assurance Project Plan (QAPP) (Hydrometrics, 2015). Some of the procedures specified in this section may differ slightly from those outlined in the SOPs and/or the QAPP; in those circumstances, the procedures outlined in this document will be used to conduct sampling activities.

3.1 GROUNDWATER MONITORING

Samples will be collected predominantly from monitoring wells as part of the UFS Project groundwater monitoring; depending on observed results, samples may also be collected from residential or public water supply wells. Procedures for collection of samples at these two types of wells differ, since water supply wells typically have dedicated pumps installed, and are pumped frequently in comparison to monitoring wells. Collection of samples from monitoring wells is described in Section 3.1.1; samples collected from water supply wells (if necessary) would be conducted using the procedures outlined in the 2021 CAMP (Hydrometrics, 2021).

3.1.1 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.

3.1.1.1 Static Water Level Measurement

Before collection of samples or removal/introduction of any sampling equipment into or out of the well, the static water level will be measured to the nearest 0.01 foot 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 well location. Water level measurements will be recorded in field notebooks and on field sampling forms, as outlined in Section 4.0.

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

In general, groundwater sampling will proceed in order from wells with lower concentrations of constituents of concern to wells with higher concentrations, 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 or a 2-inch Grundfos submersible pump or equivalent) 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, DO, temperature, and SC).

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. Purge water and decontamination water generated during groundwater sampling activities will be handled in accordance with the following process:

EAST HELENA FACILITY GROUNDWATER SAMPLING PURGE WATER HANDLING PROCEDURE

1. Well purge and decontamination water from wells that do not exceed any water quality standards (based on the most recent data), and are not located within the City of East Helena or on the Facility, may be discharged to the ground near the well, where it will not cause a discharge to surface water.
2. Well purge and decontamination water generated at wells in the City of East Helena, on the former smelter site, or that do exceed one or more water quality standards (based on previous data) will be containerized and transferred to the leachate collection tanks near the Corrective Action Management Unit (CAMU) southwest of the Facility, for storage and eventual off-site 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. Pumping wells dry will be avoided if possible by reducing pumping rates.

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

NOTES:

Stability criteria obtained from USGS *National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples* (September 2006).

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 magnesium and potassium) will be filtered through a 0.45-micrometer (µm) filter before preservation. Samples for common anions (sulfate and chloride) 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, 2015) and in Table 3-2.

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, short piece of discharge line used to connect to the dedicated well tubing, submersible pump system, and short piece of non-dedicated tubing) will be thoroughly decontaminated between uses. Equipment decontamination will consist of the following steps:

- Rinse with approximately 2.5 gallons soapy water (clean tap water plus Alconox or other non-phosphate detergent).
- Rinse thoroughly with approximately 2.5 gallons clean tap water.
- Final rinse with approximately 2.5 gallons deionized water.

The effectiveness of the decontamination procedure will be evaluated through the periodic collection of equipment rinsate blanks, as outlined in Section 3.2, the East Helena Facility QAPP and SOPs.

3.2 FIELD QUALITY CONTROL SAMPLES

Field QC samples will be collected and analyzed as part of the UFS project groundwater monitoring program in accordance with the procedures outlined in this section. Required field QC sample types for the will include the following:

- Equipment rinsate blanks; and
- Field duplicate samples.

3.2.1 Equipment Rinsate Blanks

Equipment rinsate blanks consist of reagent grade (deionized) water processed through decontaminated sampling equipment, including filtration equipment as appropriate, collected into sample bottles and preserved. Equipment rinsate blanks for monitoring well sampling will be collected at a frequency of <u>one per monitoring event</u>. 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, 2015).

3.2.2 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 sets of sample 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 wells will be collected at a frequency of <u>one per monitoring event</u>.

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, 2015).

4.0 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 3-1 and are presented in the project QAPP (Hydrometrics, 2015).

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., 2107 for July 2021), and XXX is a three-digit code incremented sequentially for each successive sample.

5.0 ANALYTICAL PROCEDURES, DATA REVIEW 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 3.0 above, and in the applicable SOPs (see Table 3-1). All laboratory analysis will be fully documented and conducted in accordance with EPA-approved and/or industry standard analytical methods.

5.1 GROUNDWATER ANALYSES

Required parameters, analytical methods, and project-required detection limits (PRDLs) for UFS project groundwater quality samples are shown in Table 5-1. Static water level measurements will be collected prior to sampling as noted in Section 3.0, and groundwater samples will be analyzed for field parameters (pH, SC, DO, and water temperature), common anions (sulfate and chloride), common cations (potassium and magnesium), arsenic, and selenium. Arsenic, selenium, and common cations will be analyzed on field-filtered samples (dissolved) for monitoring 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, comparison to statistically determined upper limits, and comparison with regulatory standards for groundwater (shown in Table 5-1 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.

5.2 DATA REVIEW AND VALIDATION

Procedures for data review, validation, and reporting are presented and discussed in the Site QAPP (Hydrometrics, 2015) and in the Data Management Plan (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.

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 are present. At a minimum, deliverables will include field notes and/or forms, transmittal information, sample chain-of-custody forms, analytical results, methods and reporting limits, and laboratory QC summaries. Laboratory deliverables will include Adobe® portable document format (.pdf) versions of all laboratory reports, as well as electronic data deliverables (EDD) suitable for importing into the project EnviroData database. 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 monitoring plan and the project QAPP (Hydrometrics, 2015). Data qualifiers will be applied to any analytical results associated with QC exceedances, as outlined in the QAPP.

All project data will be archived (electronic and/or hard copy format), and also will be imported to and stored in the electronic project database software (EnviroData), 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).

5.3 DATA REPORTING

Preparation of data summary memorandums for the UFS Project groundwater monitoring is discussed above in Section 2.2. Data summary memorandums will be prepared on a periodic basis presenting the results of the groundwater monitoring activities outlined in this monitoring plan. Initially, monthly preparation of summary memorandums is anticipated. The frequency of memorandum preparation and submittal may be reduced if warranted (to bimonthly, quarterly, or some other frequency) based on observed results and stakeholder input. The data summary memorandums will include (at a minimum) updated trend plots for groundwater elevations and for analytical constituents; comparisons of groundwater concentrations to the well-specific upper limits presented in Attachment 1; review and discussion of any pertinent field observations noted during monitoring activities; and recommendations for any changes to the groundwater monitoring program and/or the UFS Project operations based on the observed results.

6.0 REFERENCES

CH2MHill Engineers, Inc., 2018. Former Asarco East Helena Facility Corrective Measures Study Report. Prepared for Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust. March.

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

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MCC and HSG, 2021. Unfumed Slag (UFS) Work Plan – Former Asarco Smelter, East Helena, Montana. Prepared by MCC Non-Ferrous Trading, LLC and Helena Sand & Gravel. January 22, 2021.

Montana Department of Environmental Quality, 2019. DEQ Circular-7, Montana Numeric Water Quality Standards. June 2019.

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, 2006. Collection of Water Samples (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9. Chap. A4, accessed June 7, 2018, from http://pubs.water.usgs.gov/twri9A. September 2006.

TABLES

Table 2-1. UFS Project Groundwater Sampling Schedule
East Helena Facility

Well ID	Northing	Easting	Measuring Point Elevation (ft AMSL)	Well Type	Monitoring Frequency(1)
DH-55	860568.8169	1360945.555	3972.76	Indicator	Biweekly
DH-56	861098.4318	1360350.744	3958.17	Indicator	Biweekly
DH-6	861527.0799	1360252.419	3889.85	Sentinel	Biweekly
DH-15	861541.0629	1360256.995	3889.82	Sentinel	Biweekly
DH-52	861372.1393	1360876.159	3889.18	Sentinel	Biweekly
DH-53	861343.6803	1361117.666	3892.87	Sentinel	Biweekly
EH-60	862093.3668	1359295.783	3888.46	Sentinel	Biweekly
EH-103	862095.3328	1359303.117	3890.54	Sentinel	Biweekly

NOTES: Well locations shown on Figure 2-1.
(1) Monitoring program will include biweekly monitoring of indicator wells and sentinel wells.
Changes to monitoring frequency and addition of supplemental downgradient wells to monitoring program will be evaluated in accordance with data evaluation procedures in Section 2.2.

Table 2-2. UFS Project Monitoring Well Upper Concentration Limits
East Helena Facility

Well ID	Analytical Constituent Upper Concentration Limits					
	Arsenic	Selenium	Sulfate	Potassium	Chloride	Magnesium
DH-6	3.81	0.885	1330	288	37	23
DH-15	0.003	0.530	1351	9	68	68
DH-52	2.19	0.090	474	87	11	15
DH-53	0.86	0.028	277	63	12	8
DH-55	1.48	0.316	1232	198	24	43
DH-56	3.70	1.75	3889	864	89	74
EH-60	9.85	0.005	674	15	212	45
EH-103	<0.002	0.484	1088	11	47	55

NOTES: Concentrations in mg/L
Upper concentration limits calculated from 2012-2021 data as Upper Simultaneous Limits (USLs) using ProUCL v. 5.1. See Section 2.2 for description and Attachment 1 for trend plots for each well and constituent.

Table 3-1. Standard Operating Procedures Applicable to UFS Project Groundwater Monitoring East Helena Facility

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-7	Decontamination of Sampling Equipment
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-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)
HSOP-29	Labeling and Documentation of Samples
HF-SOP-30	Decision Process for Field Variances and Nonconformances
HSOP-31	Field Notebooks
HF-SOP-49	Use of a Flow Cell For Collecting Field Parameters
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-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; Hydrometrics, 2015).

(2) SOP was prepared by METG and is included in annual CAMPs (e.g., Hydrometrics, 2021).

Table 3-2. UFS Project Groundwater Sample Container and Preservation Requirements
East Helena Facility

Matrix	Parameters	Sample Container	Preservative
Groundwater	Field Parameters	None	Field-Measured
	Common Anions (sulfate, chloride)	1000 mL HDPE	Cool to ≤6°C
	Dissolved Arsenic, Selenium, Potassium, Magnesium [1]	250 mL HDPE	Filter samples (0.45 µm)
			HNO3 to pH <2
			Cool to ≤6°C
	Total Arsenic, Selenium [2]	250 mL HDPE	Unfiltered samples
			HNO3 to pH <2
			Cool to ≤6°C

Notes:

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

(2) Total metals will be analyzed in residential/public water supply well samples only.

Table 5-1. UFS Project 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)
Common Ions			
Sulfate	300.0	1	NA
Chloride	300.0/SM 4500CL-B	1	NA
Magnesium	242.1/200.7	1	NA
Potassium	258.1/200.7	1	NA
Trace Constituents (Total and/or Dissolved) (3)(4)			
Arsenic (As)	200.8/SM 3114B	0.002	0.010
Selenium (Se)	200.7/200.8/SM 3114B	0.001	0.050
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
Specific Conductance (SC)	HF-SOP-79	1 µmhos/cm	NA

Notes:

(1) Analytical methods are from the most recent edition of *Standard Methods for the Examination of Water and Wastewater* (SM); *Methods for the Determination of Metals in Environmental Samples,* Supplement I, EPA/600/R-94/111 (May 1994); or *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).

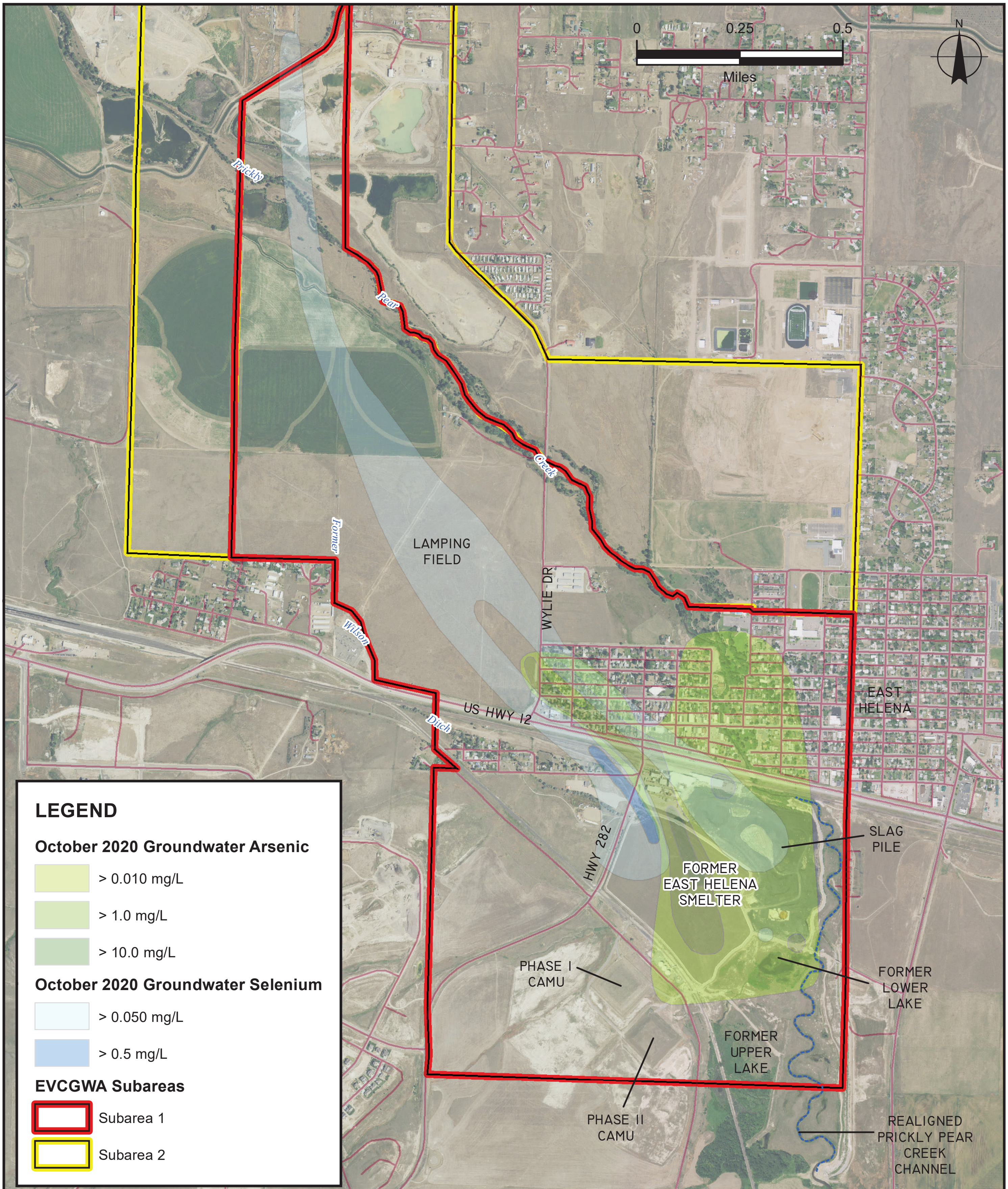
(2) Standards from Montana Circular DEQ-7 (June 2019 Version). NA = not applicable (no human health standard).

(3) If sampled, residential/public 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 will be measured in a flow cell in accordance with project SOPs.

FIGURES



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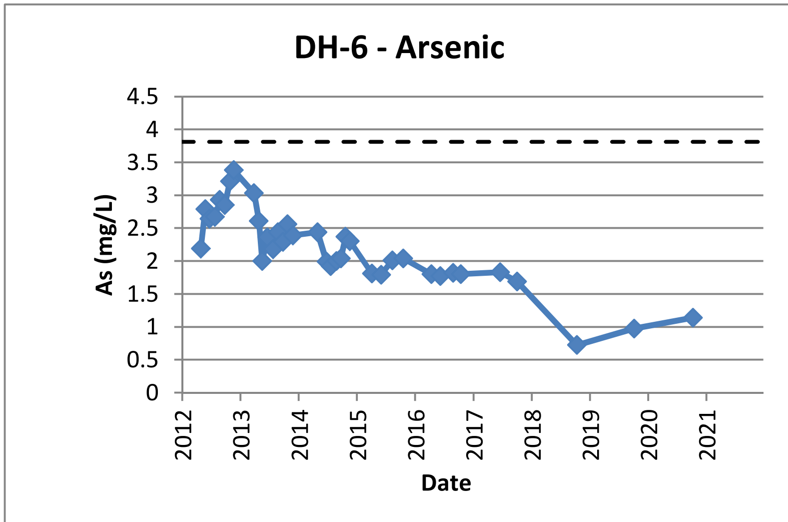
Path: V:\10022\GIS\Slag Pile\GWMon\Fig2-1_SlagWells.mxd

ATTACHMENT 1

UNFUMED SLAG INDICATOR AND SENTINEL WELL DATA TRENDS AND UPPER SIMULTANEOUS LIMITS



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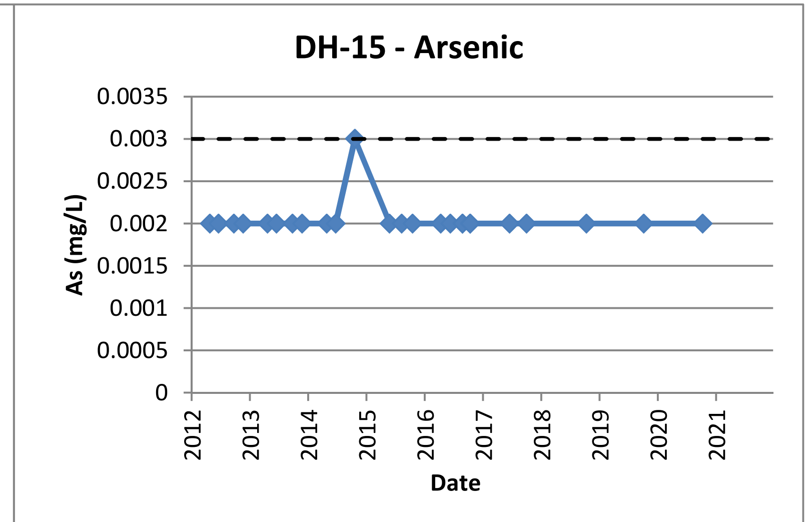

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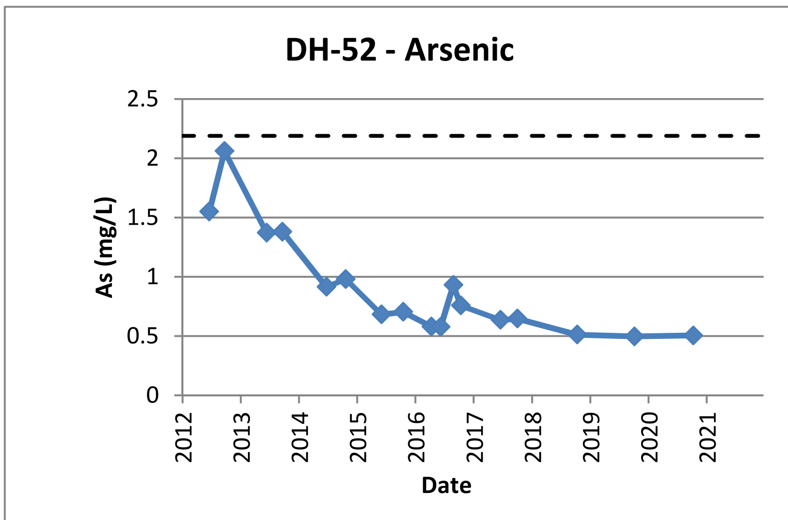

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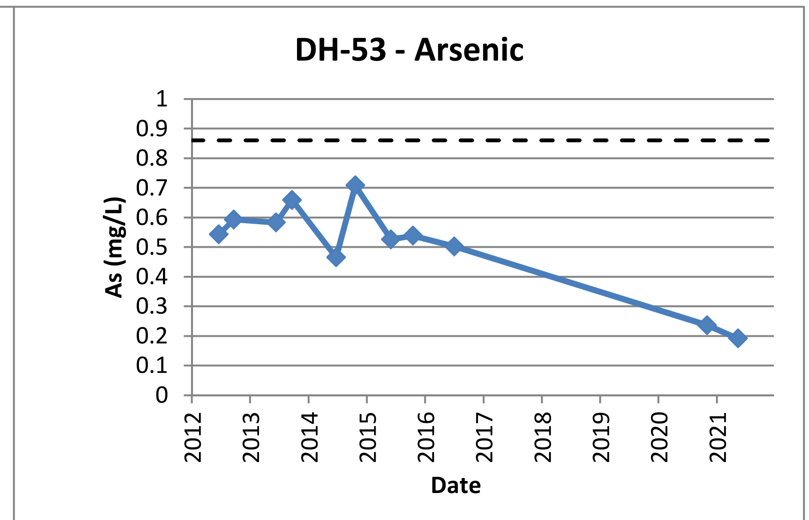

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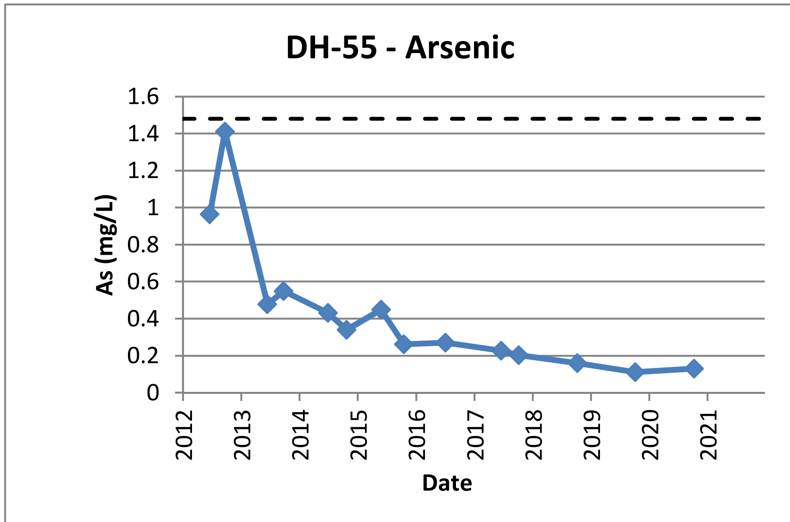

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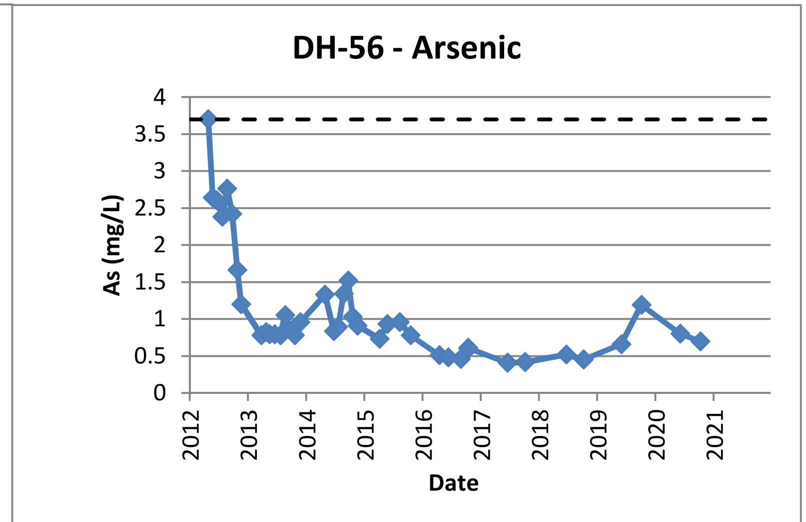

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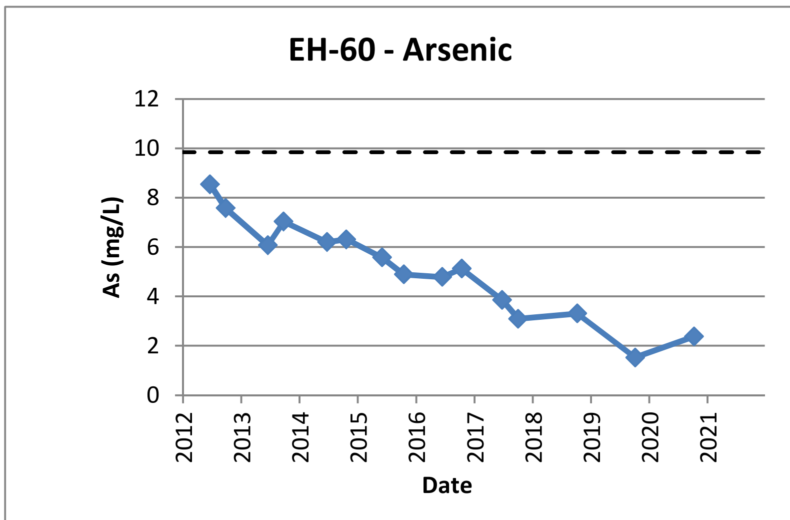

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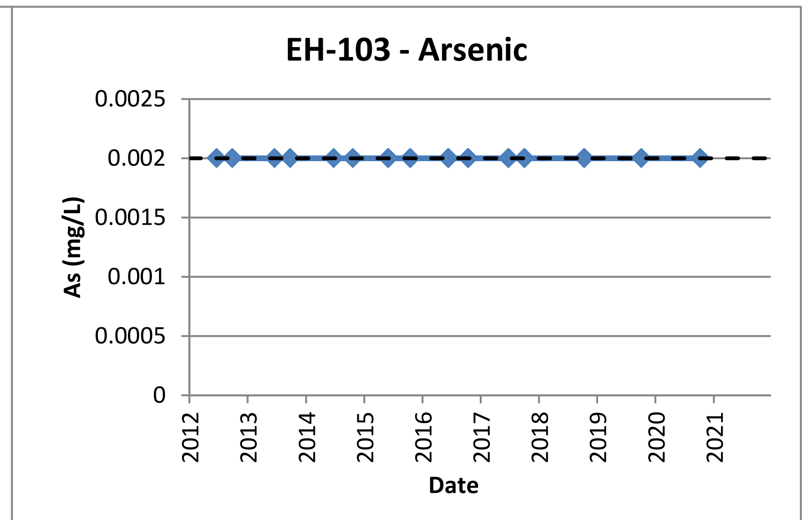

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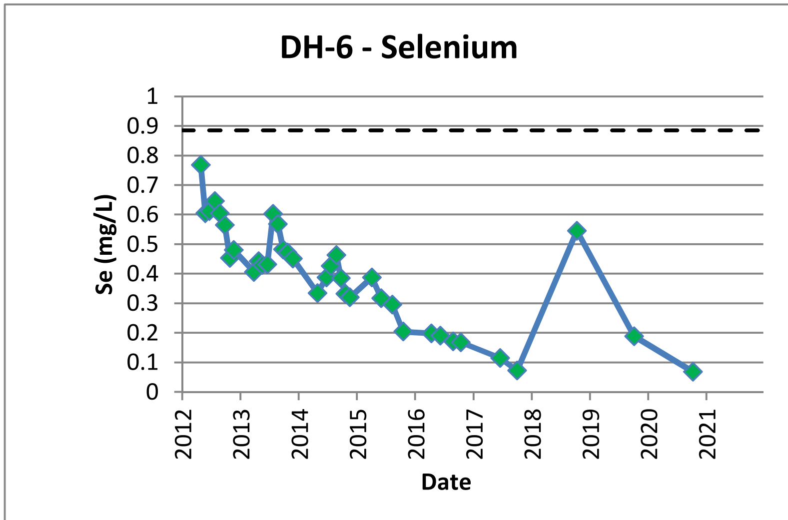

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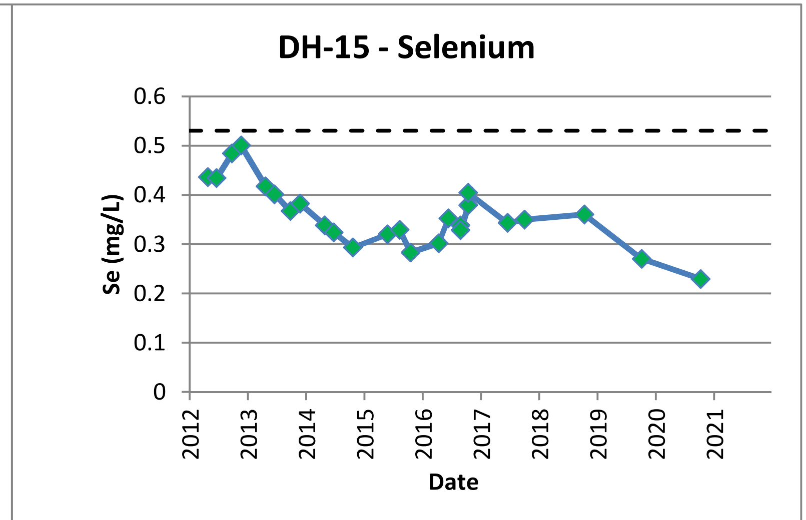

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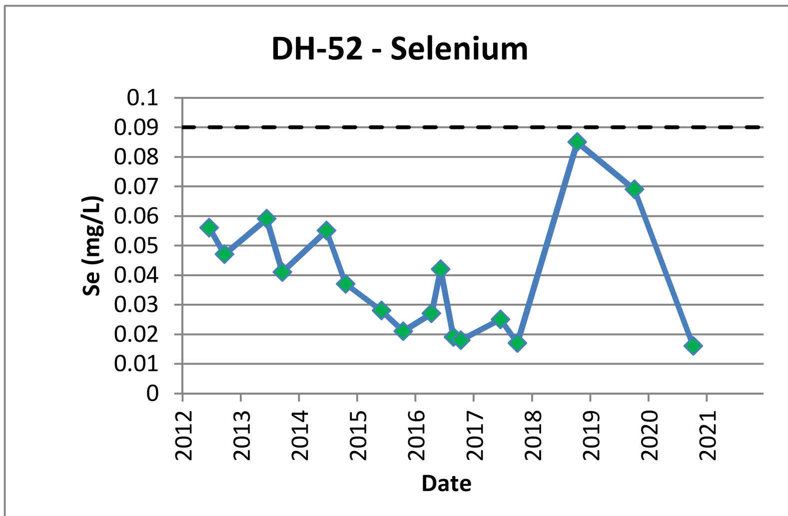

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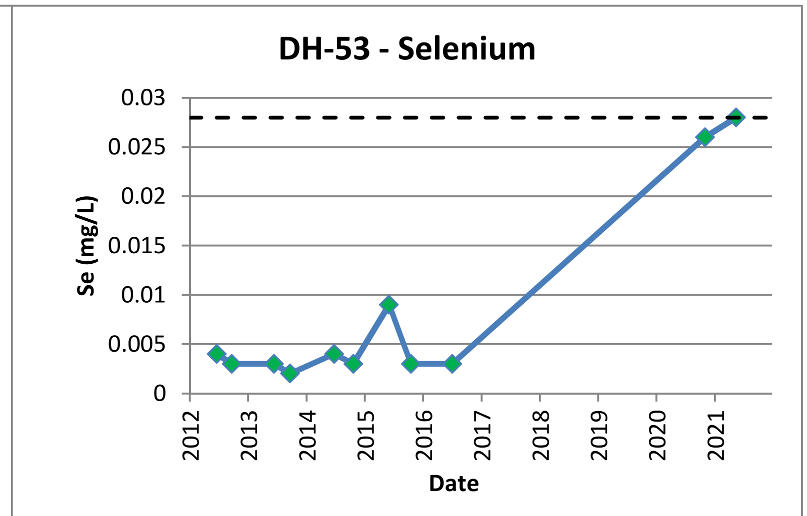

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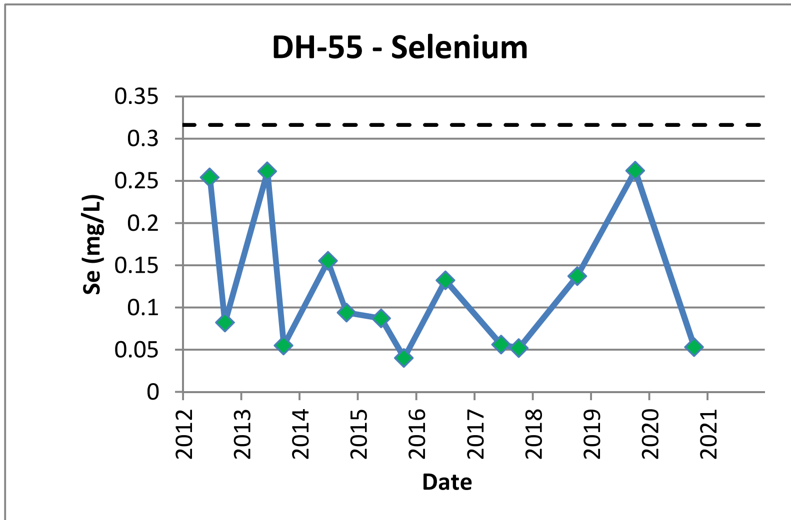

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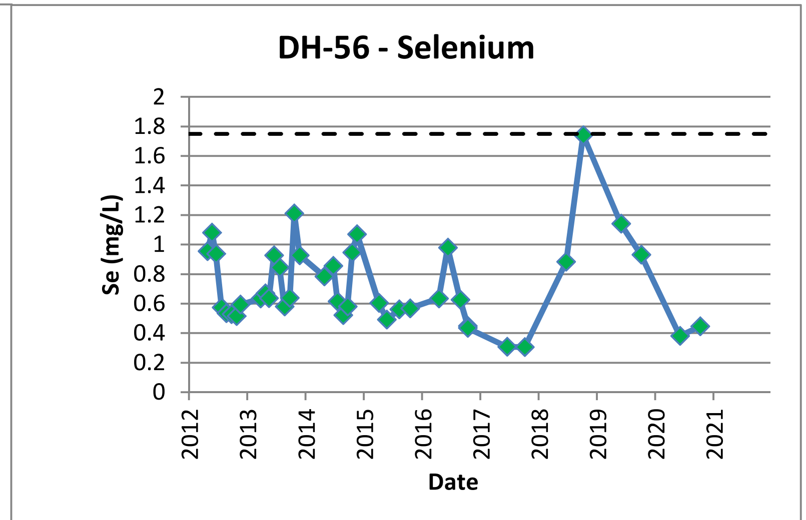

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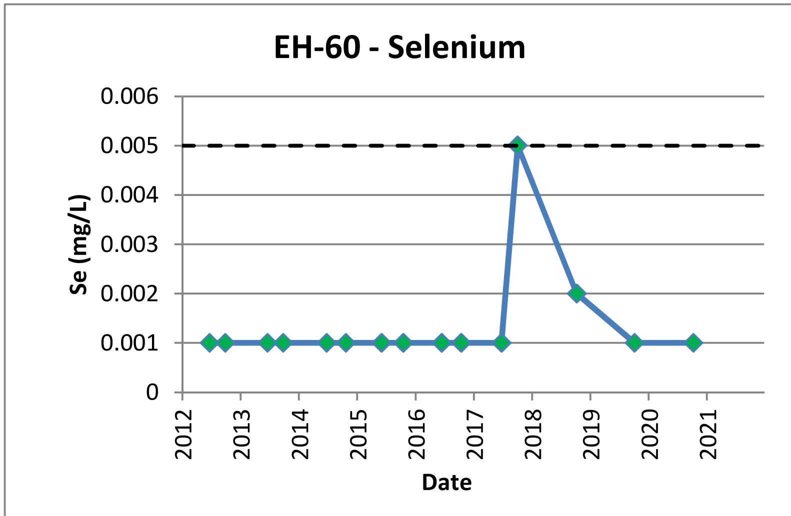

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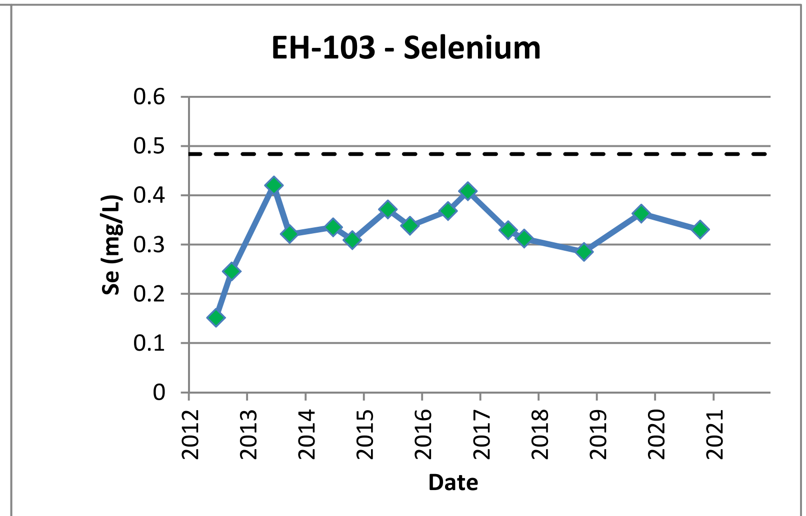

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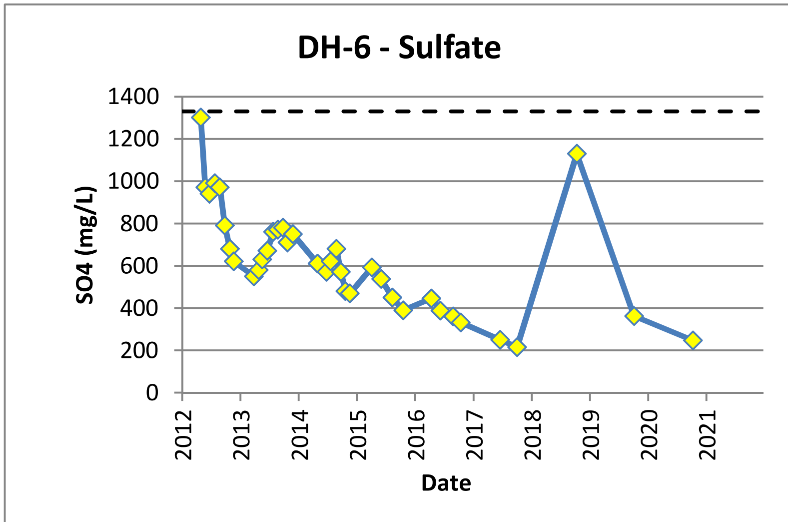

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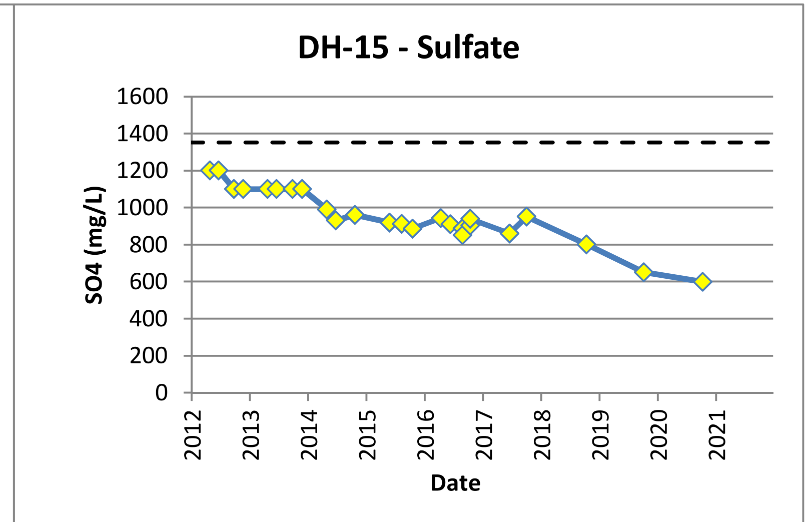

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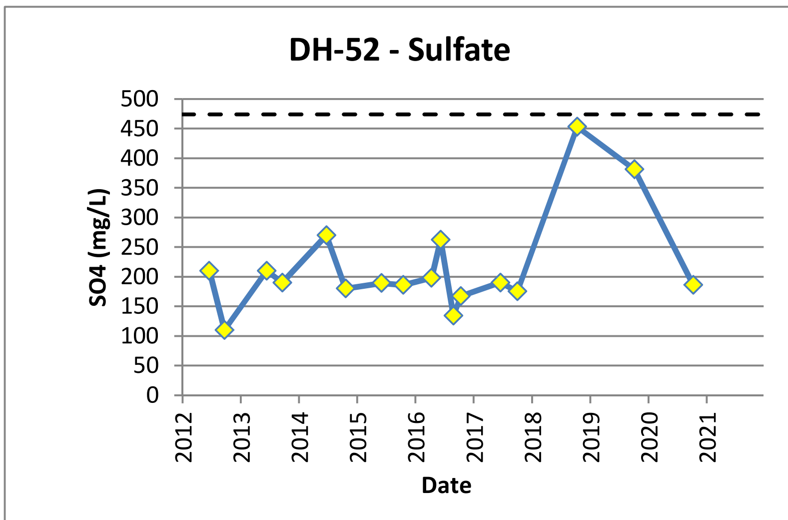

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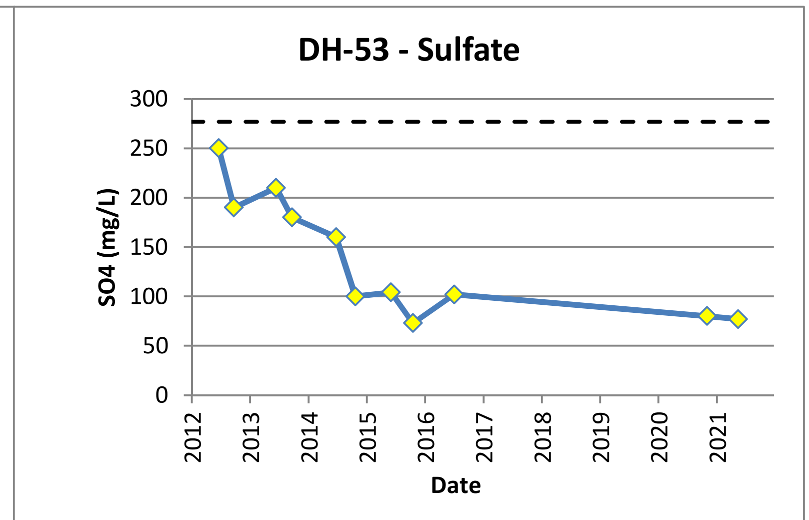

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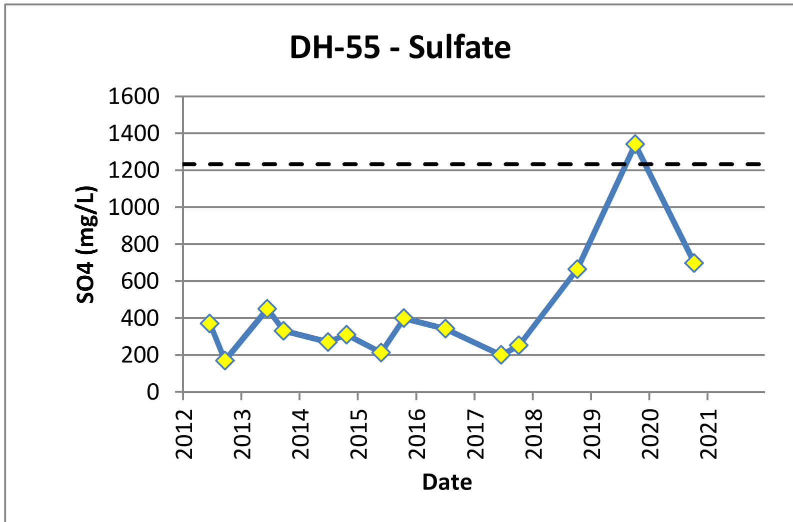

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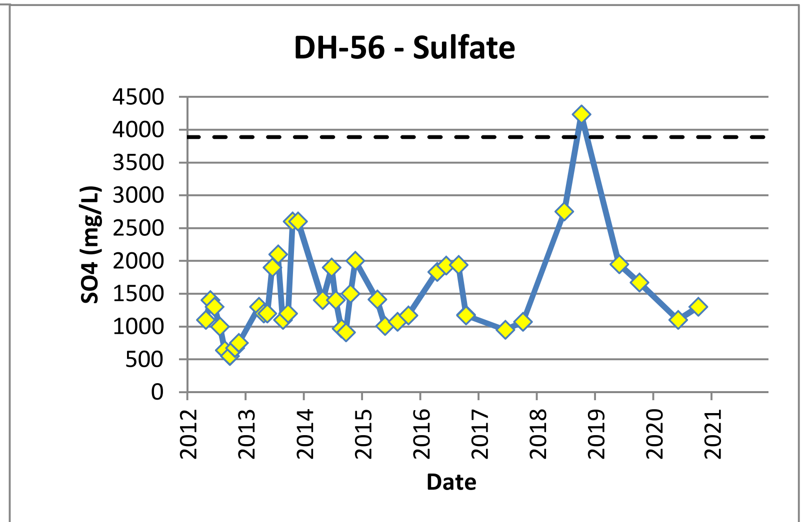

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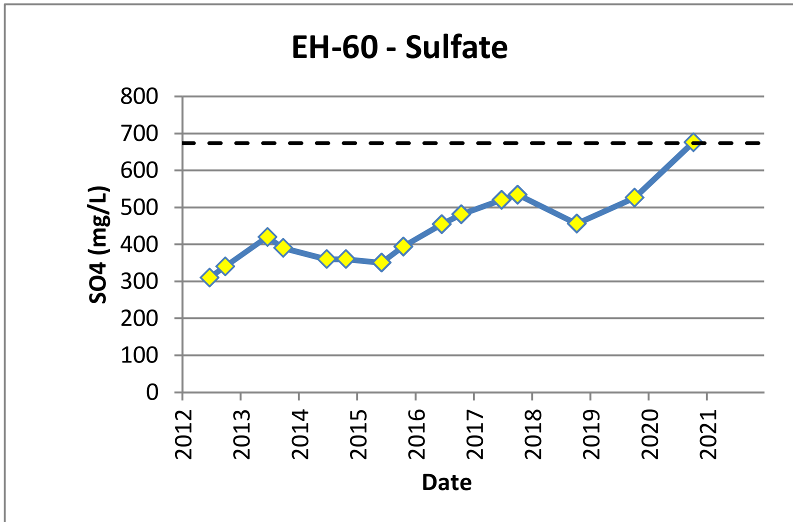

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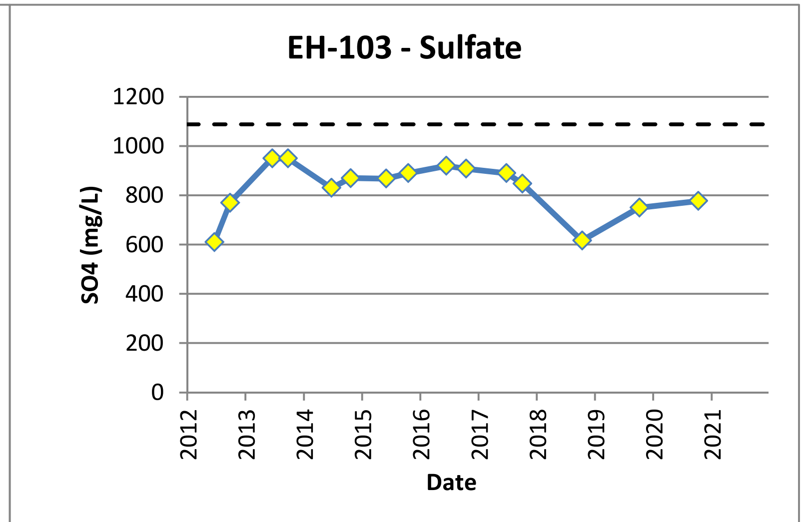

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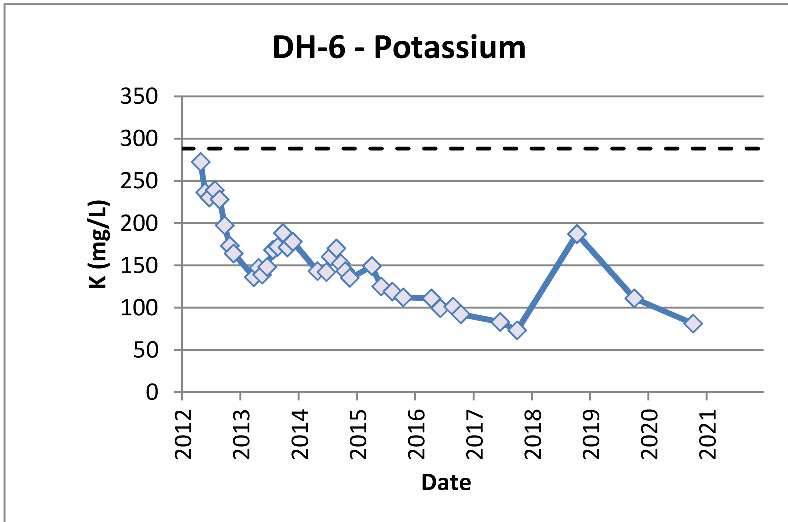

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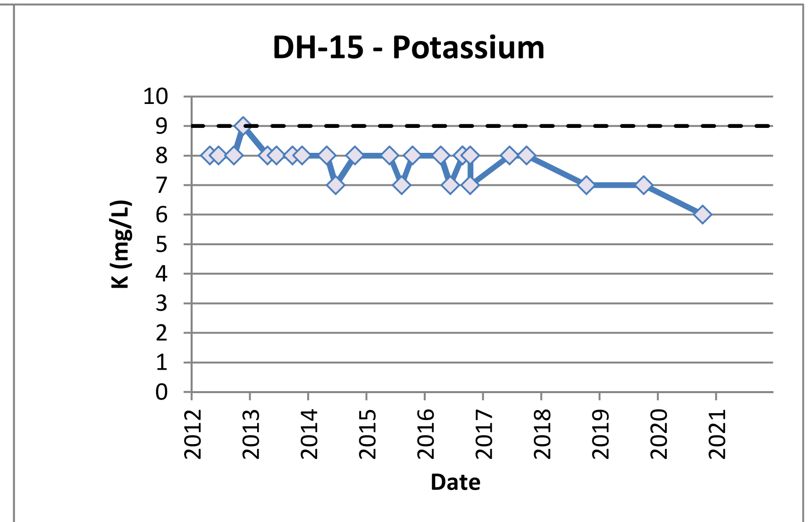

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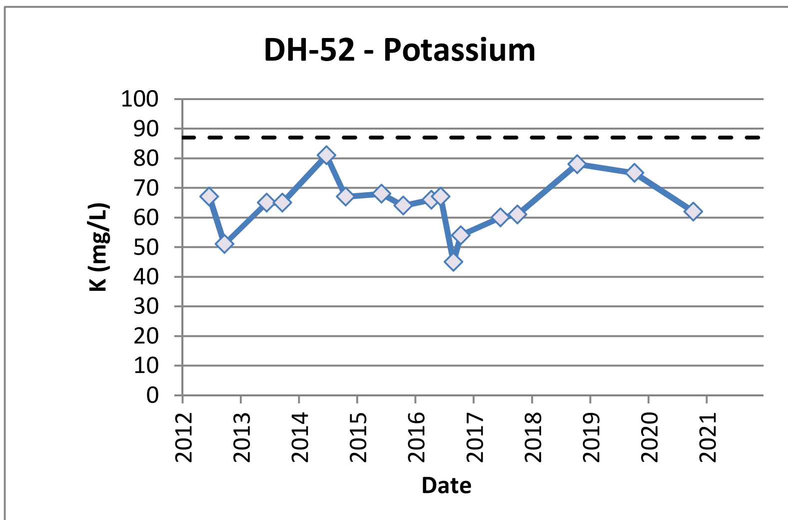

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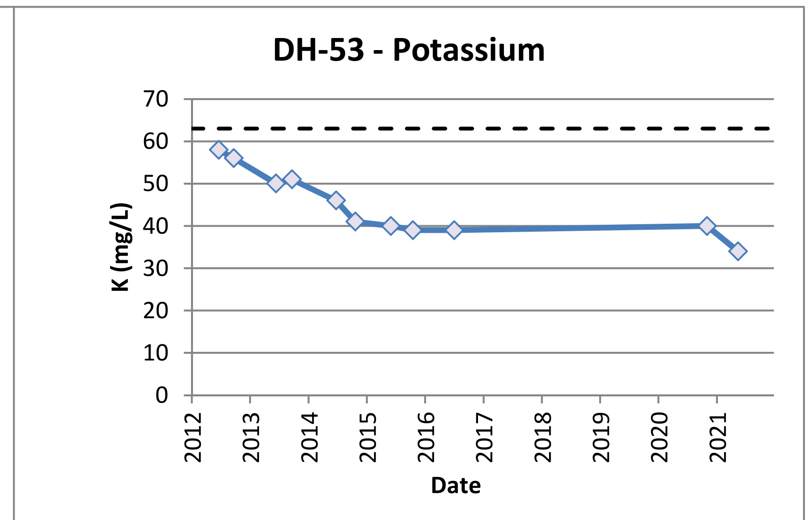

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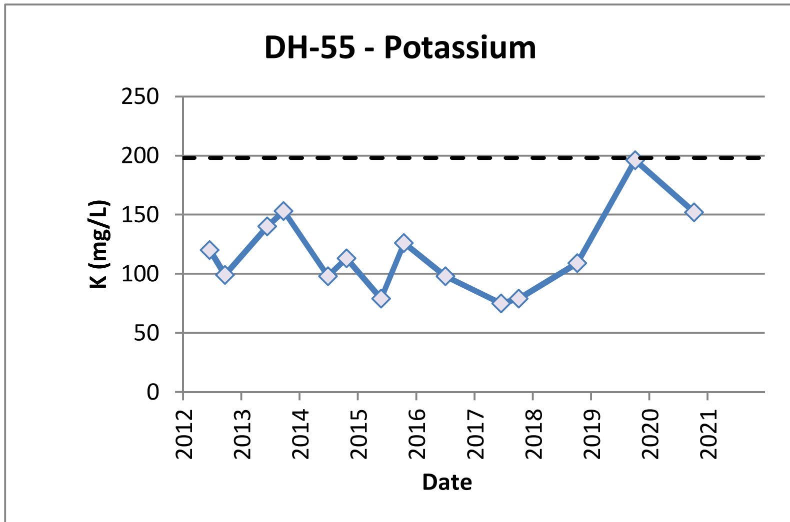

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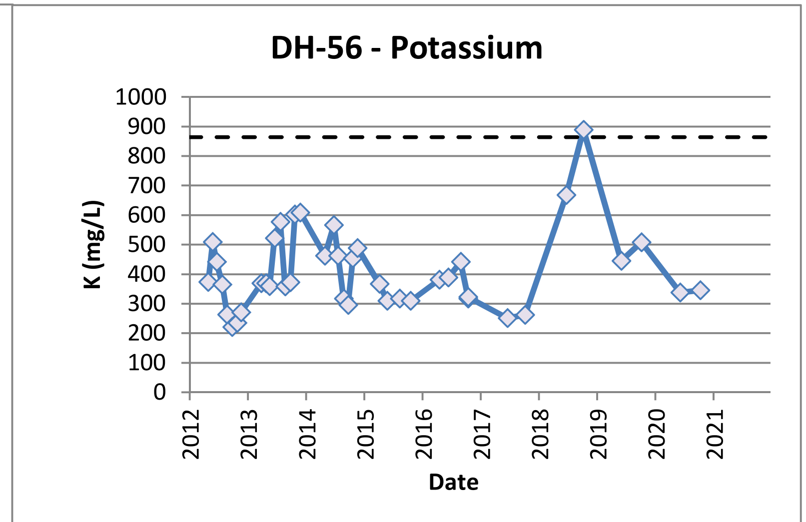

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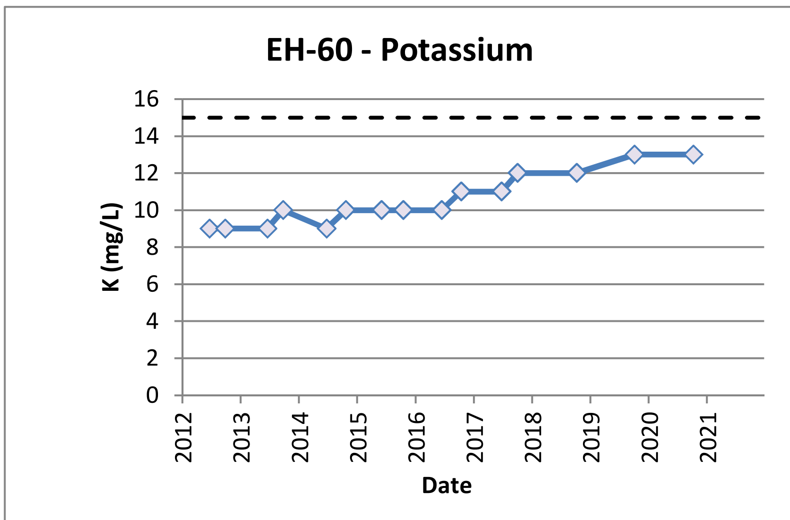

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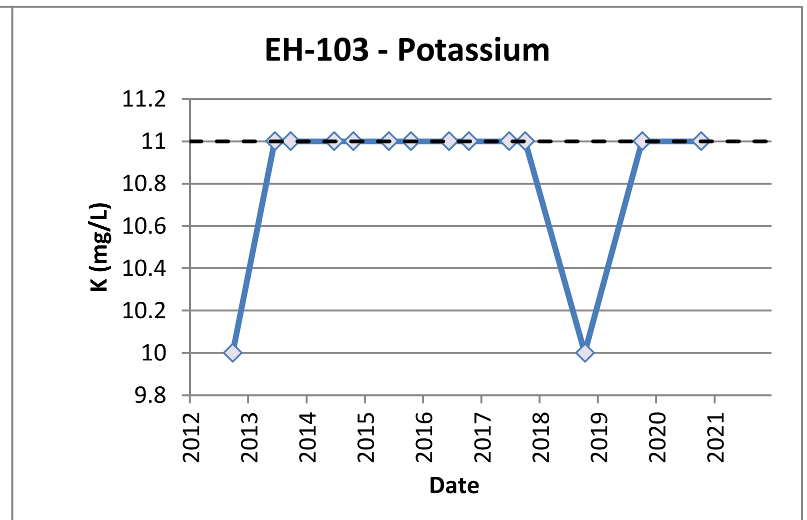

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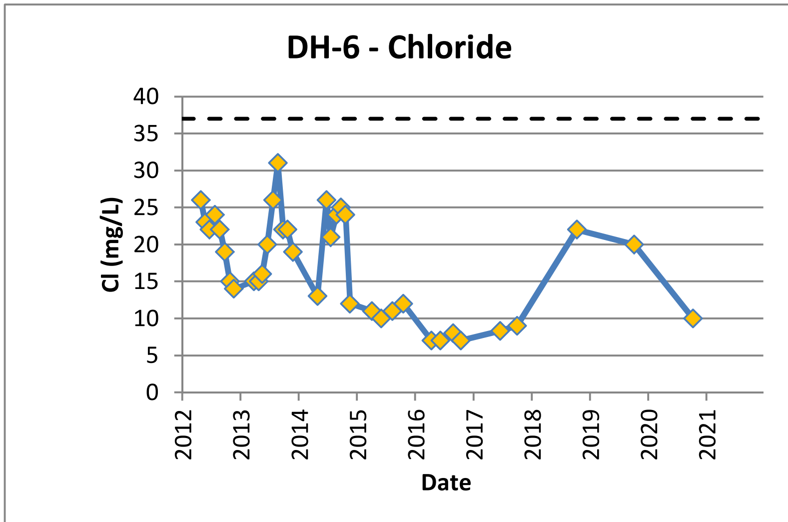

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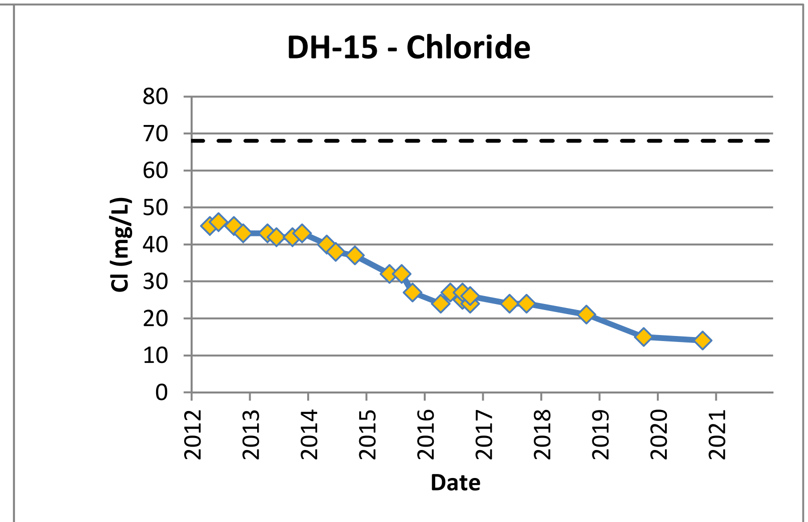

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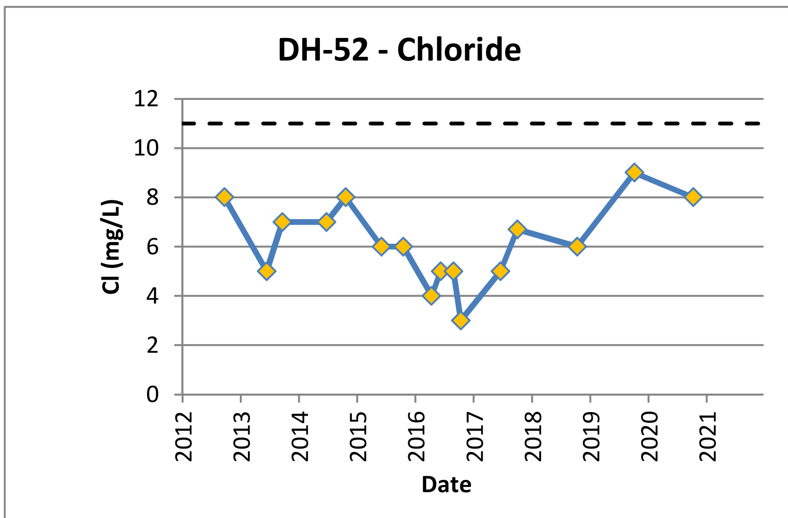

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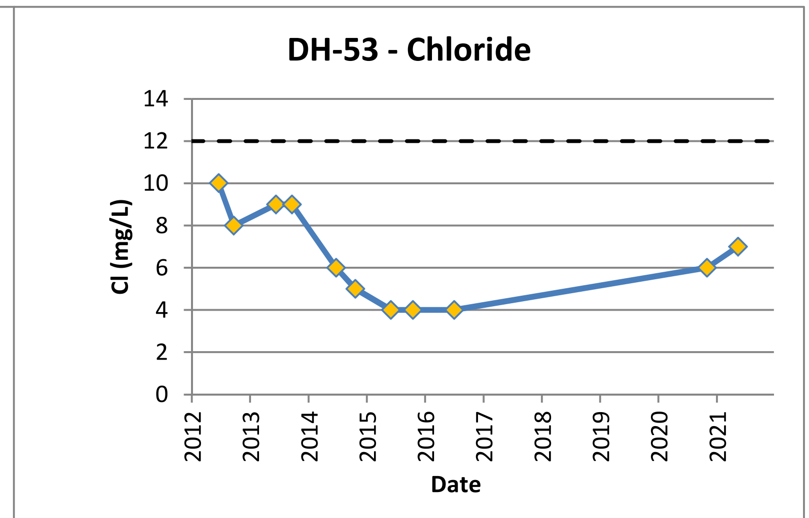

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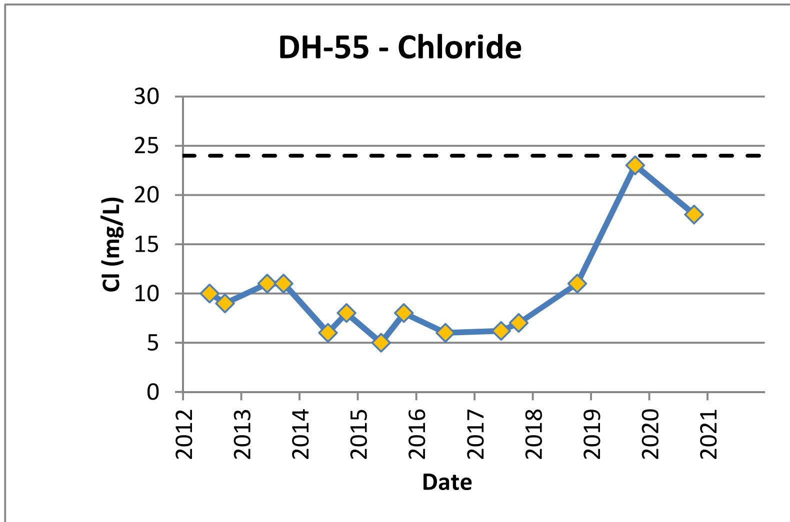

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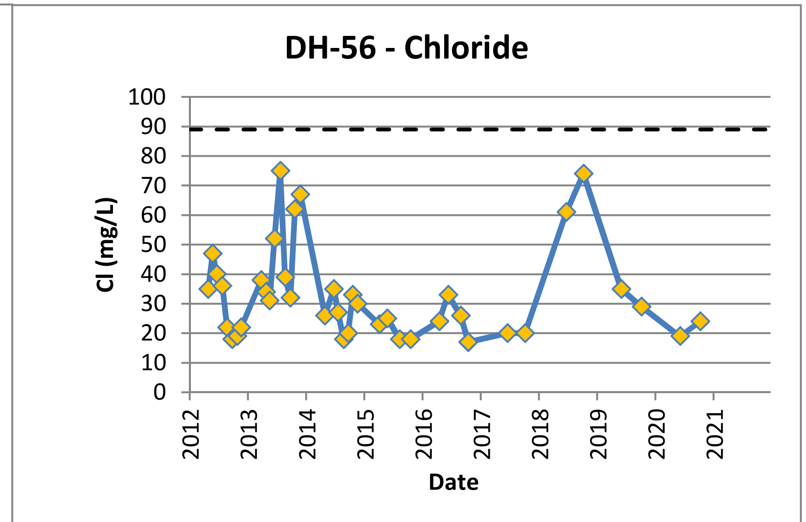

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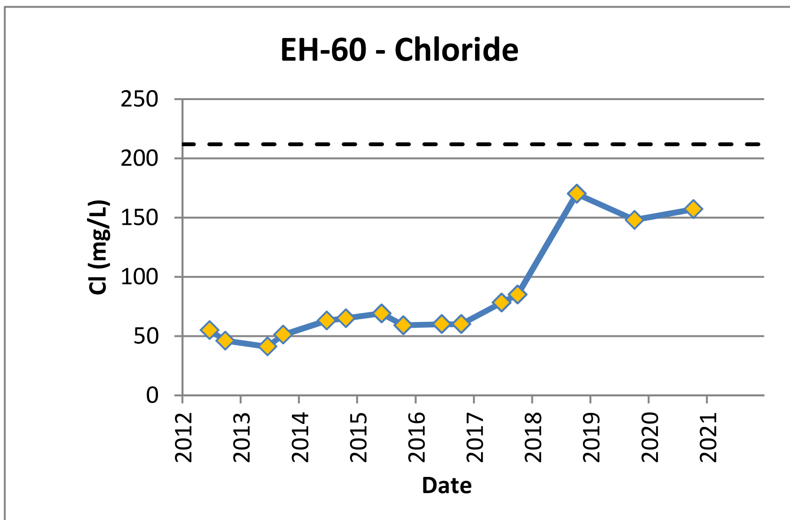

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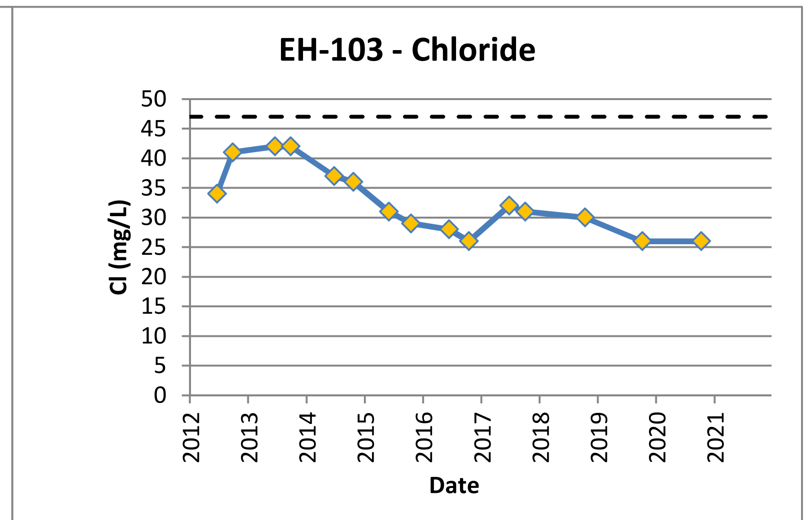

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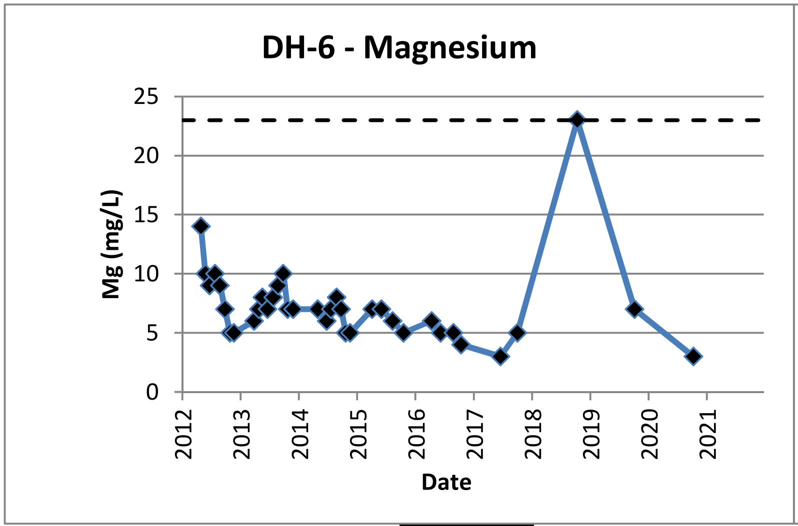

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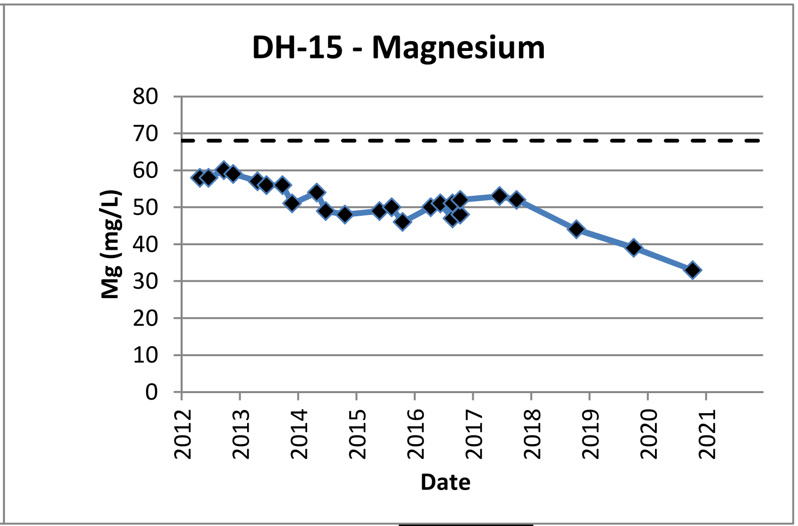

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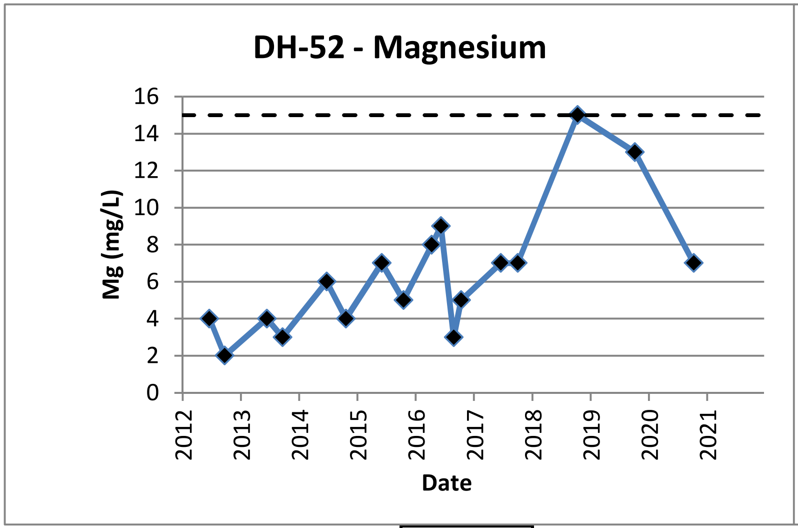

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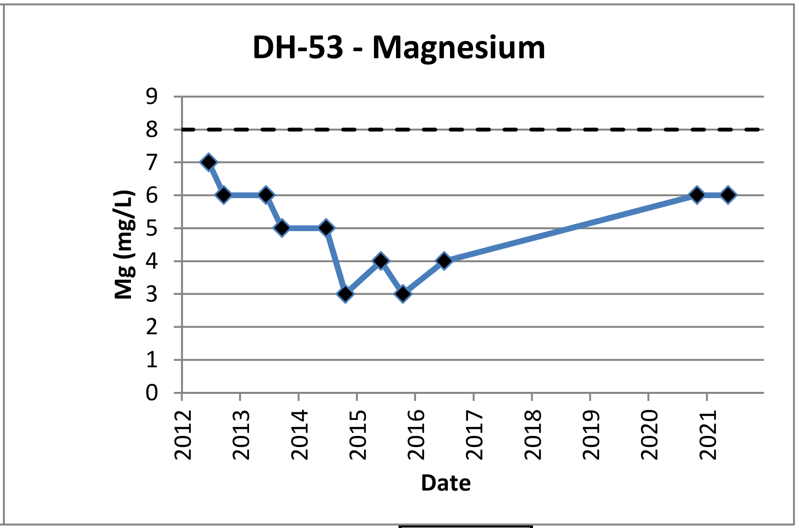

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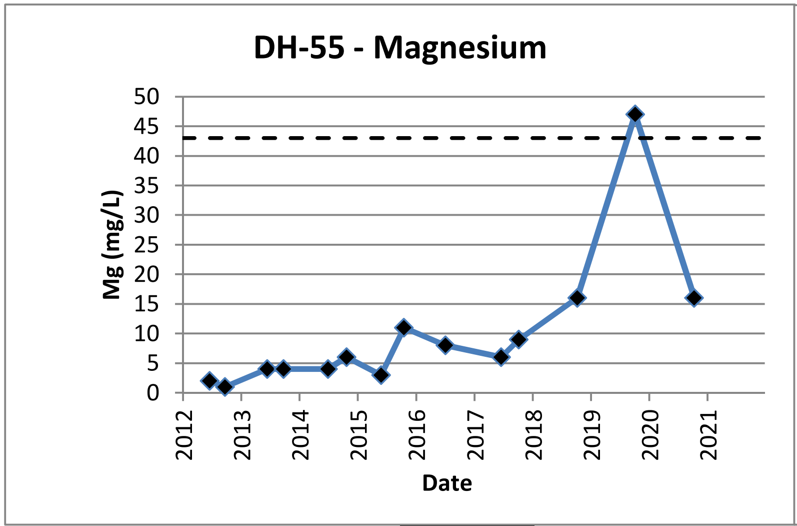

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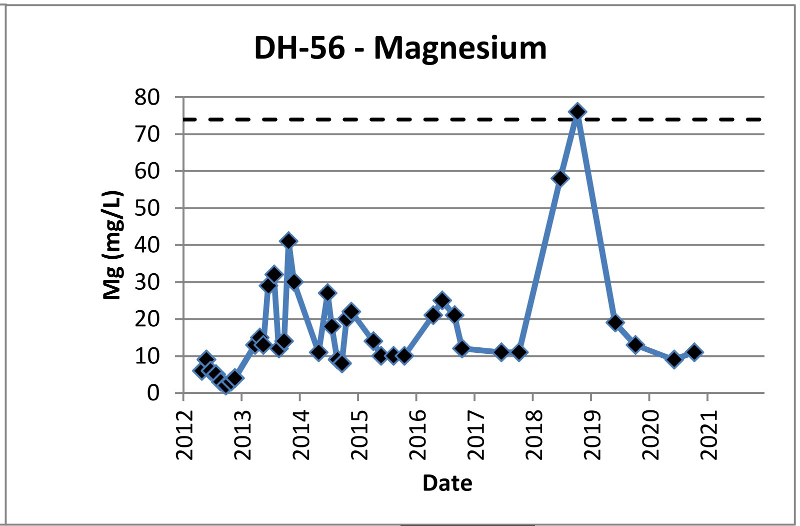
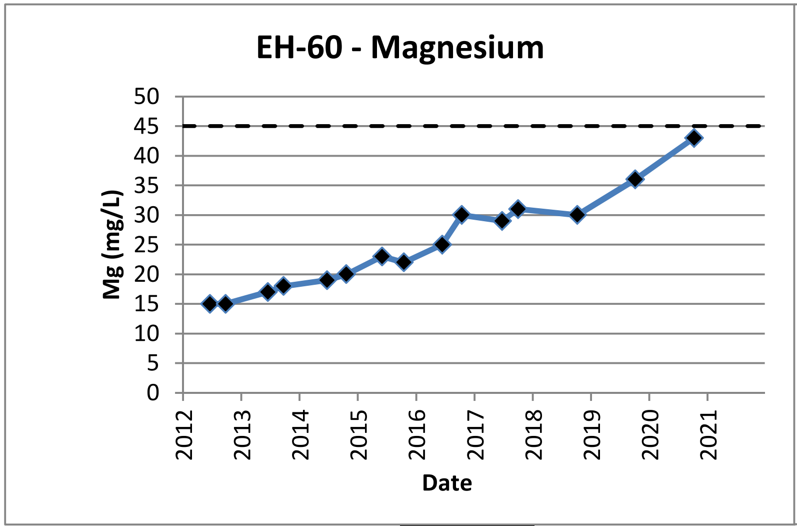
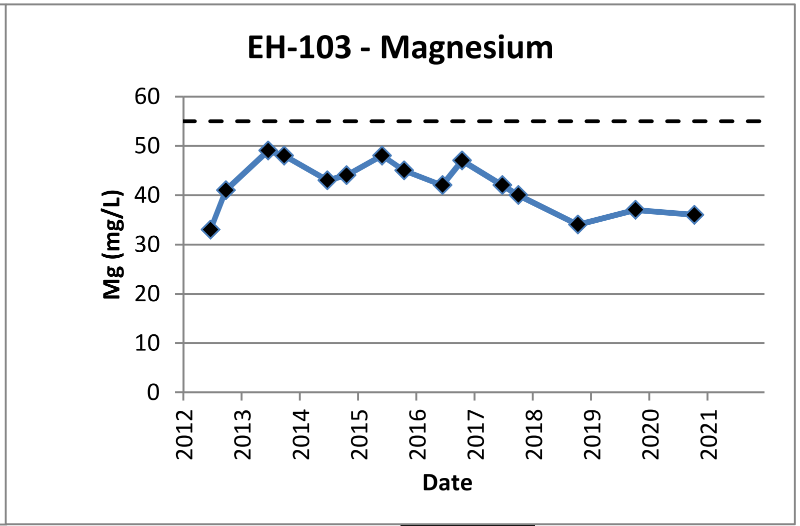


Upper Limit 74



Upper Limit 45



Upper Limit 55