# 2017 WATER RESOURCES MONITORING REPORT

# EAST HELENA FACILITY

Prepared for:

**Montana Environmental Trust Group, LLC**
**Trustee of the Montana Environmental Custodial Trust**
P.O. Box 1230
East Helena, MT 59635

Prepared by:

**Hydrometrics, Inc.**
3020 Bozeman Avenue
Helena, MT 59601

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## TABLE OF CONTENTS

LIST OF TABLES ..... iii
LIST OF FIGURES ..... v
LIST OF APPENDICES ..... vi
LIST OF EXHIBITS ..... vi
LIST OF ACRONYMS AND ABBREVIATIONS ..... vii
1.0 INTRODUCTION ..... 1-1
1.1 PROJECT BACKGROUND ..... 1-1
1.2 CORRECTIVE MEASURES STUDY PROGRAM ..... 1-4
1.3 CORRECTIVE ACTION MONITORING PROGRAM ..... 1-5
2.0 2017 CAMP MONITORING ACTIVITIES ..... 2-1
2.1 2017 SURFACE WATER MONITORING ..... 2-1
2.1.1 Surface Water Monitoring Network and Schedule ..... 2-1
2.1.2 Surface Water Sampling Methodology ..... 2-1
2.1.3 Surface Water Field Measurements and Analytical Parameters ..... 2-5
2.2 2017 GROUNDWATER MONITORING ..... 2-5
2.2.1 Groundwater Monitoring Network and Schedule ..... 2-5
2.2.1.1 Groundwater Level Monitoring ..... 2-5
2.2.1.2 Groundwater Quality Monitoring ..... 2-7
2.2.2 Groundwater Sampling Methodology ..... 2-7
2.2.3 Groundwater Field Measurements and Analytical Parameters ..... 2-15
2.3 2017 DATA MANAGEMENT AND QUALITY CONTROL ..... 2-15
3.0 2017 WATER RESOURCES MONITORING RESULTS ..... 3-1
3.1 SURFACE WATER MONITORING RESULTS ..... 3-1
3.1.1 Surface Water Elevation and Flow ..... 3-1
3.1.2 Surface Water Quality Results ..... 3-5
3.2 GROUNDWATER MONITORING RESULTS ..... 3-5
3.2.1 Groundwater Level Data ..... 3-5
3.2.2 Groundwater Quality Monitoring Results ..... 3-11
3.2.2.1 Monitoring Well Sampling Results ..... 3-11

3.2.2.2 Residential/Public Water Supply Sampling Results .....3-15
3.2.2.3 2017 Low Flow Purge Method Assessment .....3-17
4.0 GROUNDWATER DATA ANALYSIS AND PLUME STATUS EVALUATION 4-1
4.1 GENERAL GROUNDWATER CONDITIONS .....4-1
4.2 GROUNDWATER LEVEL AND CONCENTRATION TRENDS .....4-4
4.2.1 Groundwater Level Trends .....4-4
4.2.2 Groundwater Concentration Trends.....4-6
4.3 CONTAMINANT PLUME STABILITY.....4-20
4.3.1 Arsenic Plume Stability Results.....4-22
4.3.2 Selenium Plume Stability Results.....4-25
4.3.3 Plant Site Arsenic and Selenium Plume Stability Results .....4-25
5.0 REFERENCES .....5-1

## LIST OF TABLES

TABLE 2-1. 2017 SURFACE WATER MONITORING LOCATIONS-EAST HELENA FACILITY.....2-2
TABLE 2-2. SURFACE WATER MONITORING SCHEDULE - EAST HELENA FACILITY.....2-4
TABLE 2-3. 2017 SURFACE WATER SAMPLE ANALYTICAL PARAMETER LIST - EAST HELENA FACILITY.....2-6
TABLE 2-4. 2017 MONITORING WELL NETWORK AND SAMPLING SCHEDULE.....2-8
TABLE 2-5. EAST HELENA PROJECT TRANSDUCER-INSTRUMENTED WELLS.....2-11
TABLE 2-6. 2017 RESIDENTIAL/PUBLIC WATER SUPPLY WELL SEMIANNUAL SAMPLING SCHEDULE – EAST HELENA FACILITY.....2-13
TABLE 2-7. 2017 GROUNDWATER SAMPLE ANALYTICAL PARAMETER LIST - EAST HELENA FACILITY .....2-16

TABLE 3-1. 2017 PRICKLY PEAR CREEK SEASONAL STREAMFLOW MEASUREMENTS ....3-3
TABLE 3-2. SUMMARY OF 2017 SURFACE WATER ELEVATION SURVEYS – EAST HELENA FACILITY ....3-4
TABLE 3-3. JUNE 2017 SURFACE WATER QUALITY MONITORING RESULTS – EAST HELENA FACILITY ....3-6
TABLE 3-4. OCTOBER 2017 SURFACE WATER QUALITY MONITORING RESULTS – EAST HELENA FACILITY ....3-7
TABLE 3-5. SUMMARY OF 2017 MONITORING WELL WATER QUALITY DATA FOR SELECT PARAMETERS – EAST HELENA FACILITY ....3-13
TABLE 3-6. SUMMARY OF 2017 RESIDENTIAL/PUBLIC WATER SUPPLY WELL WATER QUALITY DATA – EAST HELENA FACILITY ...3-16
TABLE 3-7. 2017 WELL PURGE METHOD COMPARISON RESULTS ....3-18
TABLE 4-1. 2017 PERFORMANCE EVALUATION TREND ANALYSIS MONITORING WELLS – EAST HELENA FACILITY ....4-8
TABLE 4-2. 2017 PERFORMANCE EVALUATION PLUME STABILITY ANALYSIS MONITORING WELLS – EAST HELENA FACILITY 4-23

## LIST OF FIGURES

FIGURE 1-1. EAST HELENA FACILITY LOCATION MAP.....1-2
FIGURE 1-2. PROJECT AREA FEATURES AND LANDMARKS.....1-3
FIGURE 2-1. 2017 SURFACE WATER MONITORING LOCATIONS .....2-3
FIGURE 3-1. 2017 PRICKLY PEAR CREEK SURFACE WATER FLOW MEASUREMENTS .....3-2
FIGURE 3-2. 2016-2017 GROUNDWATER ARSENIC PLUMES AND POTENTIOMETRIC CONTOURS – EAST HELENA FACILITY ...3-8
FIGURE 3-3. 2016-2017 GROUNDWATER SELENIUM PLUMES AND POTENTIOMETRIC CONTOURS – EAST HELENA FACILITY ...3-9
FIGURE 3-4. 2016-2017 GROUNDWATER SULFATE PLUMES AND POTENTIOMETRIC CONTOURS – EAST HELENA FACILITY ...3-10
FIGURE 3-5. AVERAGE ARSENIC AND SELENIUM CONCENTRATIONS 2002-2011, 2015, 2016, AND 2017.....3-14
FIGURE 4-1. CURRENT AND HISTORIC GROUNDWATER CONTAMINANT SOURCE AREAS .....4-3
FIGURE 4-2. GROUNDWATER LEVEL CHANGES THROUGHOUT PROJECT AREA .....4-5
FIGURE 4-3. GROUNDWATER LEVEL HYDROGRAPHS FROM FACILITY SOURCE AREA MONITORING WELLS .....4-7
FIGURE 4-4. 2017 PERFORMANCE EVALUATION TREND ANALYSIS MONITORING WELLS.....4-9
FIGURE 4-5. ACID PLANT AND SOUTH PLANT AREA GROUNDWATER QUALITY TRENDS.....4-11
FIGURE 4-6. SLAG PILE AREA GROUNDWATER QUALITY TRENDS .....4-12
FIGURE 4-7. WEST SELENIUM AREA GROUNDWATER QUALITY TRENDS .....4-13
FIGURE 4-8. NORTH PLANT ARSENIC AREA GROUNDWATER QUALITY TRENDS .....4-15

FIGURE 4-9. DOWNGRADIENT ARSENIC PLUME AREA GROUNDWATER QUALITY TRENDS....4-16
FIGURE 4-10. DOWNGRADIENT SELENIUM PLUME AREA GROUNDWATER QUALITY TRENDS....4-18
FIGURE 4-11. 2017 PERFORMANCE EVALUATION PLUME STABILITY EVALUATION MONITORING WELLS....4-21
FIGURE 4-12. ARSENIC PLUME STABILITY EVALUATION RESULTS....4-24
FIGURE 4-13. SELENIUM PLUME STABILITY EVALUATION RESULTS....4-26
FIGURE 4-14. PLANT SITE PLUME STABILITY EVALUATION RESULTS....4-27

## LIST OF APPENDICES

APPENDIX A 2017 SURFACE WATER AND GROUNDWATER DATABASE
APPENDIX B MONITORING WELL COMPLETION DETAILS
APPENDIX C 2017 SURFACE WATER AND GROUNDWATER ELEVATION DATA
APPENDIX D SITE-WIDE GROUNDWATER CONCENTRATION TREND GRAPHS

## LIST OF EXHIBITS

EXHIBIT 1 2017 CAMP MONITORING WELL AND RESIDENTIAL / MUNICIPAL WATER SUPPLY WELL MONITORING NETWORK
EXHIBIT 2 GROUNDWATER STIFF DIAGRAM COMPARISON FOR SELECTED WELLS

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| bgs | Below Ground Surface |
| CAMP | Corrective Action Monitoring Plan |
| CAMU | Corrective Action Management Unit |
| cfs | Cubic Feet Per Second |
| CM | Corrective Measure |
| CMI | Corrective Measures Implementation |
| CMS | Corrective Measures Study |
| COC | Constituents of Concern |
| COEH | City of East Helena |
| Custodial Trust | Montana Environmental Custodial Trust |
| °C | Degrees Centigrade |
| DI | Deionized |
| DMP | Data Management Plan |
| DO | Dissolved Oxygen |
| EI | Environmental Indicator |
| ET | Evapotranspiration |
| gpm | Gallons Per Minute |
| HDPE | High Density Polyethylene Tubing |
| HHS | Human Health Standard |
| IM | Interim Measures |
| METG | Montana Environmental Trust Group |
| mg/L | milligrams/liter |
| ORP | Oxidation-Reduction Potential |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RCRA | Resource Conservation and Recovery Act |
| RFI | RCRA Facility Investigation |
| RPD | Relative Percent Difference |
| SAI | Source Area Investigations |
| SC | Specific Conductance |
| SOPs | Standard Operating Procedures |
| SPHC | South Plant Hydraulic Control |
| SWL | Static Water Level |
| TDS | Total Dissolved Solids |
| TMDL | Total Maximum Daily Load |
| µm | micrometer |
| USEPA | United States Environmental Protection Agency |
| WRM | Water Resources Monitoring |

# 2017 WATER RESOURCES MONITORING REPORT
# EAST HELENA FACILITY

## 1.0 INTRODUCTION

This report presents a summary of water resources monitoring (WRM) activities conducted in 2017 for the former East Helena Smelter remediation project. For purposes of this WRM report, the project area includes the former East Helena smelter site or Facility[1], and the surrounding area encompassing two groundwater plumes and the project groundwater monitoring network. The WRM program has been implemented by the Montana Environmental Trust Group (METG), Trustee of the Montana Environmental Custodial Trust (the Custodial Trust). The 2017 monitoring activities were conducted as a key component of the Corrective Measures Study (CMS) implemented by the Custodial Trust to identify and address groundwater contamination originating from the Facility, under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. This report summarizes the WRM activities and associated data collected in 2017 as outlined in the 2017 Corrective Action Monitoring Plan (CAMP). Information provided in this report will also serve as a foundation for planning and implementation of future long-term WRM activities, along with ongoing remedial measure evaluations and other CMS-related activities.

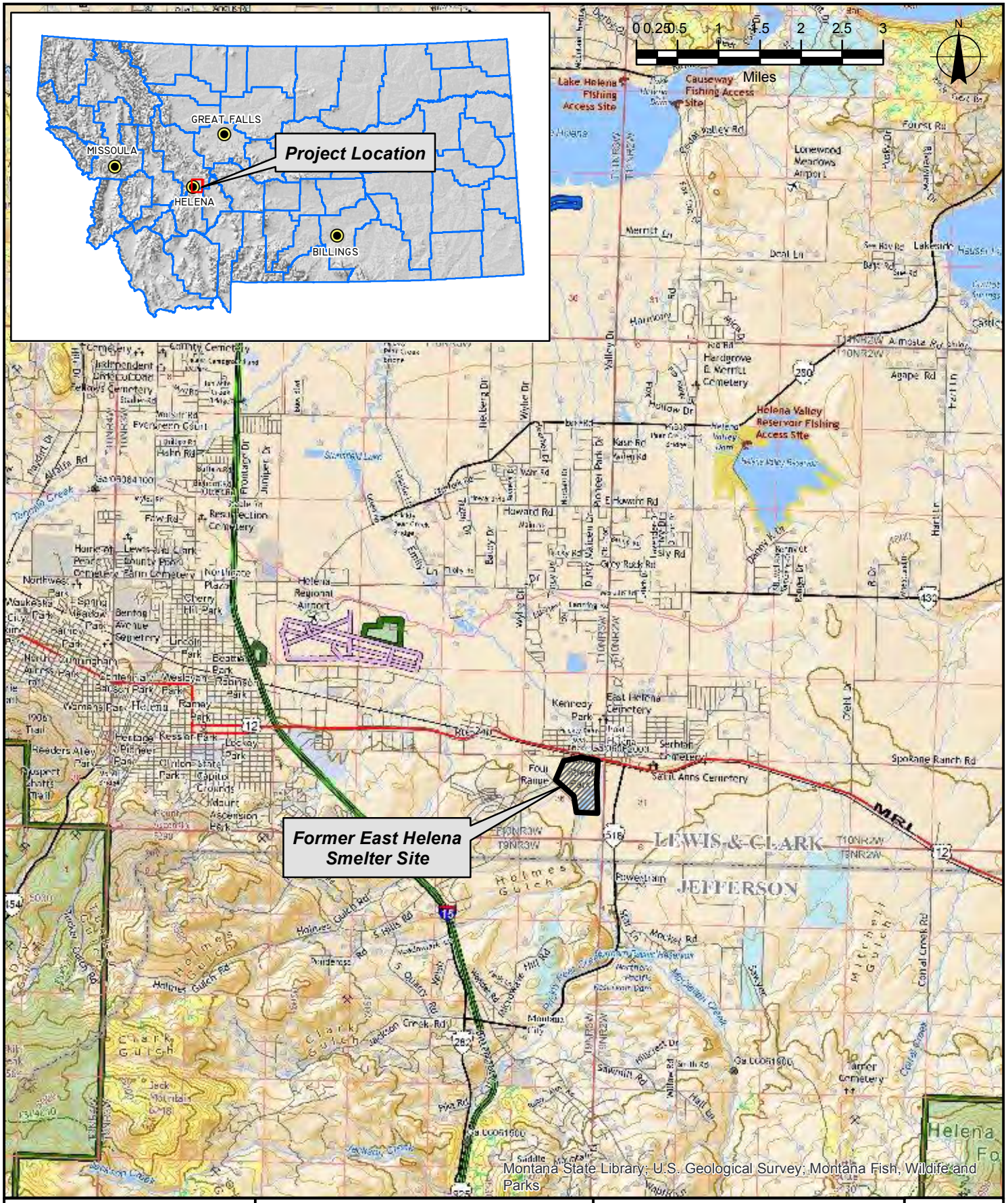
### 1.1 PROJECT BACKGROUND

The former East Helena Smelter was a custom lead smelter located in Lewis and Clark County, Montana (Figure 1-1). The former smelter began operations in 1888 and produced lead bullion from smelting of a variety of foreign and domestic concentrates, ores, fluxes, and other non-ferrous metal bearing materials. In addition to lead bullion, the Facility produced copper by-products and food-grade sulfuric acid. The Facility ceased operation in April 2001.

The Facility covers approximately 142 acres located primarily on the Prickly Pear Creek alluvial plain. The Facility is bounded to the east and northeast by Prickly Pear Creek; to the west and southwest by uplands or foothills comprised of tertiary-age sediments; and to the north by U.S. Highway 12 and the American Chemet plant (a manufacturer of copper and zinc-based chemicals). The City of East Helena (COEH) business district and residential areas are located immediately north of Highway 12 (Figure 1-2). Prior to 2014, the Facility was bordered to the south by Upper Lake, a large lake/marsh complex. Upper Lake has since been eliminated and the Prickly Pear Creek channel and floodplain lowered to reduce groundwater levels and groundwater interaction with contaminated soils (Section 1.2). The site background and history of the former smelter is described further in numerous reports including Hydrometrics (1999, 2010, 2017a) and GSI (2014).

Soils and non-native fill material (i.e., slag, ore, concentrates, demolition debris) located on the Facility contain elevated concentrations of a number of contaminants, primarily arsenic, selenium,

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

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**EAST HELENA FACILITY LOCATION MAP**

FIGURE
**1-1**

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**PROJECT AREA**
**FEATURES AND LANDMARKS**

FIGURE
**1-2**

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and certain trace metals. Contaminants within site soils and fill 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 plant process water. The contaminated soil/fill represents the primary historic source of contaminant loading to groundwater. Loading of contaminants to groundwater has resulted in the generation and migration of groundwater plumes (arsenic and selenium) from the Facility to the north and northwest. The Custodial Trust has implemented a number of interim corrective measures concurrent with the CMS, including the South Plant Hydraulic Control, contaminant source removal, and plant site capping Interim Measures (IMs) (CH2M, 2018). The primary purpose of the IMs completed to date by the Custodial Trust is to reduce contaminant mass loading to groundwater and downgradient migration of contaminants from the Facility in order to protect public health and the environment.

## 1.2 CORRECTIVE MEASURES STUDY PROGRAM

The Custodial Trust is currently conducting a CMS for the East Helena Facility, under the oversight of the United States Environmental Protection Agency (USEPA). The CMS is one of the RCRA Corrective Actions being conducted at the Facility pursuant to the First Modification to the 1998 RCRA Consent Decree (U.S. District Court, 2012), and has involved the completion of several site investigations designed to delineate groundwater contaminant source areas and aid in selection of groundwater contaminant corrective measures. Concurrent with the CMS program, the Custodial Trust has implemented a number of IMs intended to address ongoing groundwater contaminant loading. The three IMs completed to date include:

1. The South Plant Hydraulic Control (SPHC) IM: The SPHC IM is a multicomponent remedial action intended to lower groundwater levels across the Facility. Since the primary source of contaminant loading to groundwater is groundwater flow through contaminated soils on the Facility and associated contaminant leaching, lowering the water table has reduced the volume of contaminated soil in contact with groundwater and associated contaminant leaching. Components of the SPHC include: dewatering of former Upper Lake immediately south of the Facility, previously a major source of recharge to the Facility groundwater system; removal of the Smelter Dam from Prickly Pear Creek thereby lowering the creek stage by up to 15 feet and reducing leakage from the creek to the shallow groundwater system; and reconstructing Prickly Pear Creek upstream of and adjacent to the Facility to further reduce the creek stage and leakage to groundwater.
2. Plant Site Evapotranspiration Cover IM: The evapotranspiration (ET) Cover IM included placement of an engineered soil cover over approximately 57 acres of the western portion of the Facility where smelting operations and associated activities occurred (the Former Plant Site). The ET Cover is designed to store precipitation infiltration in the engineered soil cap for subsequent evapotranspiration during the growing season. The purpose of the ET Cover IM is to minimize deep percolation of incident precipitation and snowmelt water through contaminated vadose zone soils and associated leaching of contaminants to the shallow groundwater system.
3. Contaminant Source Removal IM: Source removal actions were performed on the Facility to remove areas of localized, higher contaminant concentration soils from below the

groundwater table where accessible. Source removal actions were completed in the southern portion of the Facility (South Plant Area), including the former Tito Park and Upper Ore Storage areas, and in the Former Acid Plant Area. The excavated soils were placed beneath the ET Cover and the excavations backfilled with clean soil.

Additional information on the completed IMs is available in the CMS Report (CH2M, 2018). Evaluation of the IM effectiveness in terms of the groundwater system response is a primary focus of the East Helena Project CAMP.

## 1.3 CORRECTIVE ACTION MONITORING PROGRAM

The groundwater and surface water monitoring activities performed in 2017 for the East Helena Project were conducted in accordance with the 2017 CAMP (Hydrometrics, 2017b). As described in the CAMP, the overall objective of the 2017 monitoring program was 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. Similar to previous years, the 2017 monitoring program focused on performance monitoring appropriate to the CMS phase of a RCRA Corrective Action remediation project. The following performance evaluation-specific monitoring objectives were established for 2017:

[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 downgradient edge of the selenium plume; and
[3] Evaluate downgradient arsenic and selenium plume stability, in terms of plume area, average plume concentrations, and location of plume centroids.

Additional 2017 monitoring objectives included:

[4] Collect ongoing data on residential/public water supply well water quality in the vicinity of former smelter to track groundwater use and provide information to water users;
[5] Evaluate surface water quality and potential interactions with the groundwater plumes, specifically any effects of surface water recharge on groundwater flow and plume migration, and surface water quality and flow in the Prickly Pear Creek realignment area; and
[6] Monitor current groundwater chemistry in Corrective Action Management Plan (CAMU) area wells.

This 2017 WRM Report presents a summary of groundwater and surface water monitoring activities and resulting data for the East Helena Facility in 2017. The scope of monitoring activities is presented in Section 2 and monitoring results presented in Section 3. Discussion and interpretation of the monitoring results and current groundwater and surface water conditions is provided in Section 4.

# 2.0 2017 CAMP MONITORING ACTIVITIES

The 2017 CAMP program included seasonal monitoring at an extensive network of groundwater and surface water locations spanning the project area. Following is a summary of 2017 WRM activities.

## 2.1 2017 SURFACE WATER MONITORING

Surface water monitoring under the CAMP includes surface water elevation or stage measurements, streamflow measurements and water quality sampling and analysis.

### 2.1.1 Surface Water Monitoring Network and Schedule

A total of 18 surface water sites were monitored in 2017 with monitoring sites listed and described in Table 2-1 and shown on Figure 2-1. Nine of the sites are located on Prickly Pear Creek with coverage extending from upstream of the Facility to the Canyon Ferry Road crossing approximately three miles downstream (northwest) of the site. Six of the sites (GP-1 through GP-5A) are ponds within active or inactive gravel pits located two to three miles north of the Facility. The remaining three sites (Trib-1, Trib-1B, Trib-1D) are on a Prickly Pear Creek tributary drainage that flows from the southwest through the former Upper and Lower Lake areas on the south end of the Facility (Figure 2-1).

Surface water elevations were measured in June, August, and October 2017 at all sites using a survey grade GPS. Although the 2017 CAMP schedule (Hydrometrics, 2017b) included surface water elevation monitoring in June and October 2017 only, an August 2017 event was added to provide concurrent surface water elevation data coinciding with the August 2017 groundwater static water level (SWL) measurement event (Section 2.2.1.1). The three 2017 surface water elevation surveys were conducted concurrently with site-wide groundwater static water level measurements to allow development of site-wide potentiometric maps incorporating groundwater and surface water elevation data. Besides documenting groundwater flow directions and gradients, the resulting data was used to assess potential gaining and losing reaches of Prickly Pear Creek. The surface water monitoring schedule is in Table 2-2.

Streamflow and water quality monitoring was conducted at select surface water sites during high flow (June) and low flow (October) conditions (Table 2-2). The timing of the surface water monitoring events was coordinated with semiannual groundwater monitoring events to obtain a more complete picture of seasonal groundwater and surface water quality conditions in the project area.

### 2.1.2 Surface Water Sampling Methodology

Instantaneous flow measurements were obtained using current velocity meters and the cross-section method, or (for smaller flows) portable flumes or volumetric methods as described in the 2017 CAMP (Hydrometrics, 2017b). Field parameter and streamflow measurements were recorded at the time of water sample collection, with all monitoring events completed within one day to minimize possible temporal variability.

## Table 2-1. 2017 Surface Water Monitoring Locations -- East Helena Facility

| Site ID | Northing | Easting | Description |
|---|---|---|---|
| PPC-3A | 856283.87 | 1361694.37 | Prickly Pear Creek upstream of former smelter site |
| PPC-4A | 858437.51 | 1361223.39 | Prickly Pear Creek realigned channel upstream of former smelter dam, in former Upper Lake area |
| Trib-1 | 858008.43 | 1360249.85 | Spring fed tributary to Prickly Pear Creek originating southwest of former smelter site |
| Trib-1B | 858479.08 | 1360187.35 | Spring feature downstream of Trib-1, at head of small pond upstream of access road |
| Trib-1D | 859392.30 | 1361402.33 | Discharge point of Trib-1 and former Lower Lake area wetlands to Prickly Pear Creek |
| PPC-5A | 859568.08 | 1361450.05 | Prickly Pear Creek realigned channel downstream of former smelter dam; near historic site PPC-5 |
| PPC-7 | 861473.74 | 1360743.50 | Prickly Pear Creek channel upstream of Highway 12 bridge; between slag pile and Highway 12 |
| PPC-8 | 863372.55 | 1360137.99 | Prickly Pear Creek at West Gail Street in East Helena |
| PPC-36A | 864556.11 | 1358753.31 | Prickly Pear Creek approximately 3,500 feet (0.67 miles) downstream of former smelter site |
| PPC-9A | 865555.92 | 1357841.22 | Prickly Pear Creek approximately 5,250 feet (1.0 miles) downstream of former smelter site |
| PPC-10 | 867712.58 | 1356117.83 | Prickly Pear Creek approximately 8,000 feet (1.5 miles) downstream of former smelter site |
| SG-16 | 872677.17 | 1350559.96 | Prickly Pear Creek downstream of Canyon Ferry Road bridge |
| GP-1 | 869382.84 | 1355642.76 | Gravel pit pond south of Canyon Ferry Road |
| GP-2 | 870307.35 | 1354223.32 | Gravel pit pond south of Canyon Ferry Road |
| GP-3 | 872295.33 | 1352636.82 | Gravel pit pond south of Canyon Ferry Road |
| GP-4 | 869942.71 | 1352286.21 | Gravel pit pond south of Canyon Ferry Road |
| GP-5 | 868811.08 | 1355741.50 | Gravel pit pond south of Canyon Ferry Road |
| GP-5A | 867206.54 | 1357125.85 | Gravel pit pond south of Canyon Ferry Road |

Site locations shown on Figure 2-1.
Sites listed in upstream to downstream order.

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**2017 SURFACE WATER MONITORING LOCATIONS**

FIGURE

**2-1**

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## Table 2-2. Surface Water Monitoring Schedule -- East Helena Facility

| Monitoring Location | 2017 | | |
|---|---|---|---|
| | Water Elevation Measurements | Instantaneous Flow Measurements | Water Quality Monitoring |
| | June / August / October | Semiannual (June and October) | Semiannual (June and October) |
| PPC-3A | X | X | X |
| PPC-4A | X | X | X |
| Trib-1 | X[1] | X | X |
| Trib-1B | X[2] | X[2] | X[2] |
| Trib-1D | X | X | X |
| PPC-5A | X | X | X |
| PPC-7 | X | X | X |
| PPC-8 | X | | |
| PPC-36A | X | X | X |
| PPC-9A | X | | |
| PPC-10 | X | X | X |
| SG-16 | X | X | X |
| GP-1 | X | | |
| GP-2 | X[3] | | |
| GP-3 | X | | |
| GP-4 | X | | |
| GP-5 | X | X | |
| GP-5A | X | | |

NOTES: Site locations shown on Figure 2-1 and described in Table 2-1.
Sites listed in upstream to downstream order.
[1]Site dry in August 2017
[2]Site dry in August and October 2017
[3]No elevation surveyed in June 2017 due to instrument malfunction

When wading, surface water samples were collected across the area of flow upstream of the sampler; during unsafe wading conditions, samples were collected from the stream bank. Samples were preserved as appropriate for the intended analysis and stored in ice filled coolers or refrigerated at ≤6°C prior to delivery to the laboratory. Water sample container and preservation requirements for surface water samples are specified in the project Quality Assurance Project Plan (QAPP) (Hydrometrics, 2015a) and 2017 CAMP (Hydrometrics, 2017b). All surface water sampling information, including sample sites, sample identification numbers, date and time of sample collection, sampling personnel, field parameter measurements, flow measurements and other notes and observations, was documented in project field books and on standard field forms. Field quality control (QC) samples included deionized (DI) water blanks and field duplicate samples, both collected at a minimum frequency of 1 per 20 samples or 1 per day (whichever was greater). All surface water sampling procedures were consistent with the methodology and Standard Operating Procedures (SOPs) presented in the 2017 CAMP and the project QAPP (Hydrometrics, 2015a).

### 2.1.3 Surface Water Field Measurements and Analytical Parameters

Surface water samples were analyzed for the parameters shown in Table 2-3, including field analysis of pH, specific conductance (SC), dissolved oxygen (DO), and water temperature, and laboratory analysis of common constituents and total recoverable metals. Laboratory analysis was conducted by Energy Laboratories in Helena, Montana. All of the 2017 CAMP surface water stage, flow, and water quality results have been entered into the project database and validated for data quality and usability. The 2017 validated database is included in Appendix A.

## 2.2 2017 GROUNDWATER MONITORING

### 2.2.1 Groundwater Monitoring Network and Schedule

The 2017 groundwater monitoring program included groundwater level and water quality monitoring at a wide network of monitoring wells and residential/public water supply wells. The current monitoring well network includes more than 180 monitoring wells with well coverage extending from south (upgradient) of the Facility northward approximately four miles beyond Canyon Ferry Road. Monitoring well depths range from less than 10 feet for some wells located near Prickly Pear Creek, to 247 feet (EH-145D) north of Canyon Ferry Road. The groundwater monitoring network is shown on Exhibit 1 with a complete list of monitoring wells and completion details included in Appendix B. Following is a description of the various groundwater monitoring program components.

#### 2.2.1.1 <u>Groundwater Level Monitoring</u>

Groundwater level monitoring has been a key component of the monitoring program during recent years due to its relevance to the groundwater remediation program. As described in Section 1, the objective of the SPHC IM is to lower groundwater levels on the Facility thereby reducing groundwater interaction with, and contaminant leaching from, contaminated plant site soils. The groundwater level data also provides information on changing hydraulic gradients and groundwater (and contaminant) flow directions, and provides for development of project-area groundwater potentiometric maps.

## Table 2-3. 2017 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 |
| Cadmium (Cd) | 200.7/200.8 | 0.00003 |
| 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 |
| 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).

Groundwater levels were measured at approximately 186 wells in May, June, August, and October and 38 wells in December 2017. All water levels were measured manually with electronic meters with depths to water from the top of the well casing recorded to the nearest 0.01 foot. The depth to water measurements were converted to elevations (relative to mean sea level) using surveyed casing elevations for each well. The water level monitoring events were all completed in a single day to provide a snapshot of seasonal groundwater elevation and flow conditions, and were coordinated with the surface water elevation surveys (Section 2.1) to provide more comprehensive water level datasets for the project area. The 2017 water level monitoring schedule is included in Table 2-4 with results presented in Section 3.2.

In addition to the manual measurements, approximately 40 wells are instrumented with pressure sensitive transducers and dataloggers for continuous water level (and water temperature) monitoring, with the list of instrumented wells varying over time in response to project activities and data needs. Table 2-5 includes a list of instrumented wells and the water level recording intervals.

#### 2.2.1.2 Groundwater Quality Monitoring

In addition to the water level monitoring events outlined above, the 2017 groundwater monitoring program included groundwater quality sampling at 81 monitoring wells in June and October, and one-time sampling at an additional 11 CAMU monitoring wells in October (Table 2-4). In addition, residential and public water supply well sampling was conducted in June and October to monitor the quality of local drinking water sources at 20 residential/public water supply wells (Table 2-6, Exhibit 1). The residential/public water supply well sampling program includes measurement of water levels (where well access permits) and collection of groundwater samples for water quality analyses, with the water quality data provided to the well owners. The COEH public water supply wells (numbers R18, R19, and R20, Table 2-6 and Exhibit 1) are included in each semi-annual sampling event.

### 2.2.2 Groundwater Sampling Methodology

As outlined in the 2017 CAMP (Hydrometrics, 2017b) and the project QAPP (Hydrometrics, 2015b), monitoring well sampling consisted of three main steps:

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

Before collection of samples or introduction of any equipment into the well, the SWL was measured and recorded on the sampling field forms. Next, the well was purged and sampled with a submersible pump.

**Table 2-4. 2017 Monitoring Well Network and Sampling Schedule**

**East Helena Facility**

| Well ID | MP Elevation | Water Levels | Water Quality Monitoring | |
|---|---|---|---|---|
| | | May / June / August / October | Semiannual (June / October) | Annual (October) |
| 2843 Canyon Ferry | Unknown | X | X | |
| 2853 Canyon Ferry | Unknown | X | X | |
| Amchem Injection | Unknown | | X[1] | |
| Amchem4 | Unknown | | X[1] | |
| ASIW-1 | 3913.75 | X | | |
| ASIW-2 | 3909.13 | X | | |
| DH-1 | 3910.89 | X | X | |
| DH-10A | 3886.97 | X | | |
| DH-13 | 3909.66 | X | | |
| DH-14 | 3916.06 | X | | |
| DH-15 | 3889.82 | X | X | |
| DH-17 | 3904.84 | X | X | |
| DH-18 | 3910.21 | X | | |
| DH-2 | 3936.91 | X | | |
| DH-20 | 3930.89 | X | X | |
| DH-22 | 3930.08 | X | | |
| DH-23 | 3915.93 | X | | |
| DH-24 | 3899.59 | X | | |
| DH-27 | 3912.70 | X | | |
| DH-3 | 3947.48 | X | | |
| DH-30 | 3914.23 | X | | |
| DH-36 | 3907.98 | X | | |
| DH-4 | 3917.26 | X | | |
| DH-42 | 3931.61 | X | X[2] | |
| DH-47 | 3922.33 | X | X[2] | |
| DH-48 | 3905.96 | X | | |
| DH-5 | 3921.18 | X | | |
| DH-50 | 3904.76 | X | | |
| DH-51 | 3904.34 | X | | |
| DH-52 | 3889.18 | X | X | |
| DH-53 | 3892.87 | X | | |
| DH-54 | 3890.27 | X | | |
| DH-55 | 3972.76 | X | X | |
| DH-56 | 3958.17 | X | X | |
| DH-57 | 3915.26 | X | | |
| DH-58 | 3899.64 | X | | |
| DH-59 | 3917.74 | X | X | |
| DH-5A | 3921.92 | X | | |
| DH-6 | 3889.85 | X | X | |
| DH-61 | 3919.62 | X | | |
| DH-62 | 3919.40 | X | | |
| DH-63 | 3905.37 | X | | |
| DH-64 | 3904.02 | X | X | |
| DH-65 | 3945.85 | X | | |
| DH-66 | 3913.43 | X | X | |
| DH-67 | 3899.77 | X | X | |
| DH-68 | 3943.28 | X | X[3] | |
| DH-69 | 3934.40 | X | X[4] | |
| DH-7 | 3898.66 | X | X | |
| DH-70 | 3918.94 | X | | |
| DH-71 | 3925.12 | X | | |
| DH-72 | 3918.51 | X | | |
| DH-73 | 3899.82 | X | | |
| DH-74 | 4001.49 | X | | |
| DH-75 | 4001.55 | X | | |
| DH-76 | 3994.28 | X | | |
| DH-77 | 3930.04 | X | | |
| DH-78 | 3918.86 | X | X[5] | |
| DH-79 | 3916.04 | X | X[6] | |
| DH-8 | 3916.83 | X | X | |
| DH-80 | 3919.52 | X | X | |
| DH-82 | 3908.18 | X | X | |
| DH-83 | 3918.83 | X | | |
| DH-9 | 3896.56 | X | | |
| East-PZ-1 | 3911.93 | X | | |
| East-PZ-2 | 3924.58 | X | | |
| East-PZ-4 | 3935.66 | X | | |
| East-PZ-6 | 3943.83 | X | | |

**Table 2-4. 2017 Monitoring Well Network and Sampling Schedule**

**East Helena Facility**

| Well ID | MP Elevation | Water Levels | Water Quality Monitoring | |
|---|---|---|---|---|
| | | May / June / August / October | Semiannual (June / October) | Annual (October) |
| East-PZ-7 | 3928.83 | X | | |
| EH-100 | 3889.83 | X | X | |
| EH-101 | 3879.95 | X | X | |
| EH-102 | 3880.45 | X | X | |
| EH-103 | 3890.54 | X | X | |
| EH-104 | 3887.83 | X | X | |
| EH-106 | 3882.07 | X | X | |
| EH-107 | 3880.15 | X | X | |
| EH-109 | 3885.67 | X | | |
| EH-110 | 3884.05 | X | X | |
| EH-111 | 3876.50 | X | X | |
| EH-112 | 3875.78 | X | | |
| EH-113 | 3871.34 | X | | |
| EH-114 | 3878.07 | X | X | |
| EH-115 | 3883.29 | X | X | |
| EH-116 | 3874.52 | X | | |
| EH-117 | 3871.33 | X | X | |
| EH-118 | 3879.95 | X | X | |
| EH-119 | 3873.75 | X | X | |
| EH-120 | 3865.78 | X | X | |
| EH-121 | 3869.49 | X | X | |
| EH-122 | 3868.08 | X | | |
| EH-123 | 3885.71 | X | X | |
| EH-124 | 3874.46 | X | X | |
| EH-125 | 3863.22 | X | X | |
| EH-126 | 3870.00 | X | X | |
| EH-127 | 3860.75 | X | | |
| EH-128 | 3892.17 | X | | |
| EH-129 | 3870.21 | X | X | |
| EH-130 | 3858.55 | X | X | |
| EH-131 | 3834.44 | X | | |
| EH-132 | 3893.90 | X | X | |
| EH-133 | 3884.36 | X | | |
| EH-134 | 3870.21 | X | X | |
| EH-135 | 3852.25 | X | X | |
| EH-136 | 3838.59 | X | | |
| EH-137 | 3839.66 | X | | |
| EH-138 | 3839.70 | X | X[7] | |
| EH-139 | 3839.78 | X | X[7] | |
| EH-140 | 3812.08 | X | X | |
| EH-141 | 3813.32 | X | X | |
| EH-142 | 3804.68 | X | X | |
| EH-143 | 3803.37 | X | X | |
| EH-144D | 3778.86 | X | X | |
| EH-144M | 3778.95 | X | X | |
| EH-144S | 3778.70 | X | X | |
| EH-145D | 3789.60 | X | X | |
| EH-145S | 3790.09 | X | X | |
| EH-200 | 3953.33 | X | | |
| EH-201 | 3973.48 | X | | |
| EH-202 | 3930.56 | X | | |
| EH-203 | 4003.92 | X | | |
| EH-204 | 3925.69 | X | X | |
| EH-205 | 3900.66 | X | | |
| EH-206 | 3898.10 | X | X | |
| EH-208 | 3910.58 | X | | |
| EH-209 | 3898.34 | X | | |
| EH-210 | 3901.19 | X | | |
| EH-211 | 3905.75 | X | | |
| EH-212 | 3905.90 | X | | |
| EH-50 | 3889.39 | X | X | |
| EH-51 | 3880.09 | X | X | |
| EH-52 | 3880.50 | X | X | |
| EH-53 | 3872.82 | X | X | |
| EH-54 | 3869.66 | X | X | |
| EH-57 | 3885.05 | X | | |
| EH-57A | 3885.45 | X | X[2] | |
| EH-58 | 3888.15 | X | X | |

**Table 2-4. 2017 Monitoring Well Network and Sampling Schedule**

**East Helena Facility**

| Well ID | MP Elevation | Water Levels | Water Quality Monitoring | |
|---|---|---|---|---|
| | | May / June / August / October | Semiannual (June / October) | Annual (October) |
| EH-59 | 3876.57 | X | X | |
| EH-60 | 3888.46 | X | X | |
| EH-61 | 3889.77 | X | X | |
| EH-62 | 3875.07 | X | X | |
| EH-63 | 3878.32 | X | X | |
| EH-64 | 3882.67 | X | | |
| EH-65 | 3879.96 | X | X | |
| EH-66 | 3869.48 | X | X | |
| EH-67 | 3869.46 | X | | |
| EH-68 | 3867.60 | X | | |
| EH-69 | 3869.10 | X | X | |
| EH-70 | 3863.48 | X | X | |
| EHMW-3 | 3825.45 | X | | |
| EHTW-3 | 3827.66 | X | | |
| IW-01 | 3888.28 | X | | |
| IW-02 | 3871.08 | X | | |
| MW-1 | 3953.05 | X | | X |
| MW-10 | 3946.28 | X | | X |
| MW-11 | 3973.33 | X | | X |
| MW-2 | 3945.97 | X | | X |
| MW-3 | 3940.95 | X | | X |
| MW-4 | 3947.06 | X | | X |
| MW-5 | 3956.18 | X | | X |
| MW-6 | 3938.14 | X | | X |
| MW-7 | 3963.67 | X | | X[5] |
| MW-8 | 3958.65 | X | | X |
| MW-9 | 3965.36 | X | | X |
| PBTW-1 | 3907.85 | X | | |
| PBTW-2 | 3906.73 | X | | |
| PPCRPZ-02 | 3923.17 | X | | |
| PRB-1 | 3910.83 | X | | |
| PRB-2 | 3905.34 | X | | |
| PRB-3 | 3912.96 | X | | |
| PZ-36A | 3858.96 | X | | |
| PZ-36B | 3858.75 | X | | |
| PZ-36C | 3859.60 | X | | |
| PZ-9A | 3850.70 | X | | |
| PZ-9B | 3849.43 | X | | |
| SC-1 | 3890.42 | X | | |
| SDMW-1 | 3914.28 | X | | |
| SDMW-2 | 3914.17 | X | X | |
| SDMW-3 | 3918.07 | X | | |
| SDMW-4 | 3917.66 | X | | |
| SDMW-5 | 3921.29 | X | | |
| SP-3 | 3905.91 | X | | |
| SP-4 | 3908.16 | X | | |
| SP-5 | 3903.52 | X | | |
| TW-1 | 3918.26 | X | | |
| TW-2 | 3931.43 | X | | |
| ULM-PZ-1 | 3924.24 | X | | |
| ULTP-1 | 3919.63 | X | | |
| ULTP-2 | 3921.23 | X | | |
| **Total Scheduled Per Monitoring Event** | | **186** | **81** | **11** |

**NOTES:** (1) Added to monitoring schedule in October 2017 at EPA request
(2) Sampled in June 2017 only; well dry in October 2017
(3) Added to monitoring schedule in June and October 2017
(4) Sampled in October 2017 only; no access due to broken casing in June 2017
(5) Well dry during 2017 monitoring events; no samples collected
(6) Added to monitoring schedule in October 2017
(7) Monitored in July 2017 instead of June at landowner request

## Table 2-5. East Helena Project Transducer-Instrumented Wells

| Site ID | Location | Transducer Schedule | |
|---|---|---|---|
| | | Installed | Removed |
| **SURFACE WATER** | | | |
| SG-16 | PPC at Canyon Ferry Rd Bridge | 6/3/2011 | 8/23/2012 |
| Smelter Dam | PPC at Smelter Dam | 4/5/2012 | 10/30/2013 |
| Lower Lake | South Plant Site | 10/20/2011 | 7/8/2014 |
| Upper Lake | South Plant Site | 8/5/2011 | 12/17/2013 |
| **GROUNDWATER** | | | |
| ***Upper Lake Marsh*** | | | |
| PPCRPZ-02 | South Marsh | 9/5/2013 | 7/5/2016 |
| PPCRPZ-05 | South Marsh | 9/6/2013 | 4/8/2015 |
| PPCRPZ-06 | South Marsh | 9/6/2013 | 4/8/2015 |
| PPCRPZ-07 | South Marsh | 9/5/2013 | 3/16/2015 |
| ***South Plant*** | | | |
| APSD-7 | East of Lower Lake | 4/7/2010 | 7/8/2014 |
| APSD-8 | East of Lower Lake | 4/7/2010 | 4/15/2011 |
| APSD-9 | Tito Park | 10/20/2011 | 7/8/2014 |
| APSD-10 | Tito Park | 4/15/2011 | 3/19/2014 |
| APSD-12 | Tito Park | 4/15/2011 | 7/8/2014 |
| APSD-16 | Tito Park | 4/15/2011 | 7/8/2014 |
| DH-4 | North of Lower Lake | 2/10/2016 | Currently Installed |
| DH-5 | North of Lower Lake | 4/22/2011 | 7/27/2017 |
| DH-14 | North of Lower Lake | 9/5/2013 | Currently Installed |
| DH-19R | West of Lower Lake | 2/10/2016 | 5/1/2016 |
| DH-47 | West of Lower Lake | 2/10/2016 | Currently Installed |
| DH-68 | West of Lower Lake | 2/10/2016 | Currently Installed |
| ***East Bench*** | | | |
| DH-11 | East of PPC | 4/21/2011 | 7/15/2015 |
| East-PZ-2 | East of PPC | 9/5/2013 | Currently Installed |
| East-PZ-4 | East of PPC | 9/5/2013 | 10/18/2016 |
| East-PZ-6 | East of PPC | 9/5/2013 | Currently Installed |
| East-PZ-7 | East of PPC | 9/5/2013 | Currently Installed |
| Air Liquide North | East of PPC | 9/5/2013 | 7/15/2015 |
| ***East Plant / Slag Pile*** | | | |
| DH-74 | Slag Pile | 10/20/2011 | Currently Installed |
| DH-75 | Slag Pile | 10/20/2011 | Currently Installed |
| DH-76 | South end of Slag Pile | 10/20/2011 | Currently Installed |
| DH-55 | Slag Pile | 7/5/2016 | Currently Installed |
| DH-56 | Slag Pile | 7/5/2016 | Currently Installed |
| DH-65 | Slag Pile | 7/5/2016 | Currently Installed |
| IP-102A/B | East of Lower Lake | 4/7/2010 & 7/19/10 | 12/3/2010 |
| IP-103A/B | East of Lower Lake | 4/8/2010 & 7/16/10, 4/22/11 | 1/24/2012 |
| PZ-33A | NE Plant Site, near PPC | 4/22/2011 | 10/23/2012 |
| PZ-33B | NE Plant Site, near PPC | 4/22/2011 | 9/12/2014 |
| PZ-102 | East of Lower Lake | 4/7/2010 | 4/22/2011 |
| PZ-103 | East of Lower Lake | 4/7/2010, 2/28/13 | 11/26/2013 |
| ***Central Plant*** | | | |
| DH-8 | NW of Ore Storage Building | 10/20/2011 | 4/12/2016 |
| DH-12 | Plant Site | 4/22/2011 | 8/23/2012 |
| DH-13 | Plant Site | 4/7/2010 | 4/12/2016 |
| DH-18 | Plant Site | 4/7/2010 | 4/12/2016 |
| DH-20 | Upper Ore Storage Area | 10/20/2011 | 7/29/2014 |
| | | 3/2/2016 | Currently Installed |
| DH-23 | Plant Site | 10/23/2014 | Currently Installed |
| DH-29 | Plant Site | 4/15/2011 | 7/29/2014 |
| DH-30 | Plant Site | 4/15/2011 | 11/18/2015 |
| DH-31 | Plant Site | 7/22/2015 | 3/16/2016 |
| DH-33 | Plant Site | 5/24/2011 | 9/12/2014 |

## Table 2-5. East Helena Project Transducer-Instrumented Wells

| Site ID | Location | Transducer Schedule | |
|---|---|---|---|
| | | Installed | Removed |
| DH-34 | Plant Site | 12/8/2015 | 3/28/2016 |
| DH-59 | N of former AP Settling Pond | 10/20/2011 | Currently Installed |
| DH-17 | North Plant Site | 5/16/2016 | Currently Installed |
| DH-42 | Plant Site | 5/16/2016 | 7/5/2016 |
| DH-80 | Plant Site | 5/16/2016 | 7/5/2016 |
| DH-62 | Lower Ore Storage Area | 10/20/2011 | Currently Installed |
| DH-66 | Plant Site | 10/2/2012 | Currently Installed |
| DH-70 | Central Plant Site | 10/20/2011 | 4/7/2016 |
| DH-72 | N of former AP Settling Pond | 10/20/2011 | Currently Installed |
| DH-81 | Plant Site | 2/10/2016 | 4/27/2016 |
| ***CAMU / West of Plant*** | | | |
| MW-4 | CAMU monitoring well | 2/10/2016 | Currently Installed |
| MW-6 | CAMU monitoring well | 10/20/2011 | Currently Installed |
| MW-8 | CAMU monitoring well | 10/20/2011 | Currently Installed |
| MW-11 | CAMU monitoring well | 10/20/2011 | Currently Installed |
| DH-3 | West of Upper Lake | 4/8/2010 | 12/3/2010 |
| | | 10/20/2011 | Currently Installed |
| ***North of Plant*** | | | |
| DH-6 | North of Plant near Am Chemet | 7/5/2016 | Currently Installed |
| DH-10A | North of Plant near PPC | 4/21/2011 | Currently Installed |
| DH-52 | North of Plant near PPC | 7/5/2016 | Currently Installed |
| DH-53 | North of Plant near PPC | 7/5/2016 | 12/4/2017 |
| EH-52 | East Helena | 7/6/2016 | Currently Installed |
| EH-58 | East Helena | 7/6/2016 | Currently Installed |
| EH-60 | East Helena | 4/7/2010 | 12/4/2017 |
| EH-61 | East Helena | 4/21/2011 | 7/5/2016 |
| EH-101 | East Helena | 7/6/2016 | Currently Installed |
| EH-102 | East Helena | 7/6/2016 | Currently Installed |
| EH-103 | East Helena | 4/7/2010 | Currently Installed |
| EH-126 | Lamping Field | 4/7/2010 | 4/21/2011 |
| EH-127 | Lamping Field | 4/21/2011 | 7/5/2016 |
| EH-128 | SW Lamping Field | 4/7/2010 | 10/20/2011 |
| EH-130 | Lamping Field | 4/7/2010 | 4/21/2011 |
| EH-132 | SW Lamping Field | 4/7/2010 | 10/20/2011 |
| EH-134 | NW Lamping Field | 10/9/2010 | 4/21/2011 |
| EH-141 | South of Irr. Canal | 4/22/2011 | Currently Installed |
| EH-142 | South of Irr. Canal | 4/22/2011 | Currently Installed |
| EH-205 | N of Wilson Ditch, S of Manlove Ave. | 10/9/2010 | 8/23/2012 |
| EH-208 | Seaver Park | 6/18/2010 | 4/21/2011 |
| EH-210 | N of Wilson Ditch, S of Manlove Ave. | 10/9/2010 | 7/5/2016 |
| EH-211 | Manlove Subdivision | 4/22/2011 | 2/10/2016 |
| EH-212 | Manlove Subdivision | 4/22/2011 | 2/10/2016 |
| 2840 Winslow | Seaver Park | 7/2/2010 | 4/21/2011 |
| SP-4 | N of Wilson Ditch, N of Manlove Ave. | 10/9/2010 | 10/20/2011 |

**Table 2-6. 2017 Residential/Public Water Supply Well Semiannual Sampling Schedule East Helena Facility**

| Map Key (see Exhibit 1) | Northing | Easting |
|---|---|---|
| R1 | 863425.39 | 1359501.01 |
| R2 | 863266.68 | 1359337.84 |
| R3 | 863296.03 | 1360955.74 |
| R4 | 863053.71 | 1361184.11 |
| R5 | 864206.53 | 1358674.56 |
| R6 | 866156.57 | 1356934.48 |
| R7 | 872346.42 | 1354330.00 |
| R8 | 872391.53 | 1354773.24 |
| R9 | 872086.41 | 1355030.70 |
| R10 | 863376.30 | 1361815.27 |
| R11 | 863255.39 | 1358240.44 |
| R12 | 861502.42 | 1362101.41 |
| R13 | 855347.37 | 1359909.48 |
| R14 | 863233.58 | 1359840.14 |
| R15 | 861784.41 | 1356574.41 |
| R16 | 861925.29 | 1356400.09 |
| R17 | 861781.59 | 1356290.54 |
| R18 | 872558.37 | 1356681.06 |
| R19 | 871444.75 | 1356882.84 |
| R20 | 868437.60 | 1356673.10 |

Well locations shown on Exhibit 1.

and dedicated high density polyethylene (HDPE) tubing installed in each monitoring well. Purging was conducted using the standard purge method of removing three to five well volumes while routinely monitoring field parameters (pH, DO, temperature, SC, turbidity, and oxidation-reduction potential (ORP)) using a flow-through cell. Following removal of the first well volume, field measurements were 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 were collected during well purging to monitor stabilization of field parameters.

Samples for laboratory analysis were collected after one of the following purge conditions was met:

- A minimum of three well volumes has been removed, and three successive field parameter measurements agree to within the stability criteria specified in the CAMP.
- At least five well volumes have been removed although field parameter stabilization criteria have not been 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.

Following well purging, final field parameter measurements were collected and recorded, and groundwater quality samples were obtained by filling sample bottles directly from a sampling port upstream of the flow-through cell. Samples for dissolved metals analyses (including trace metals and the common cations calcium, magnesium, sodium, and potassium) were filtered through a 0.45-micrometer (µm) filter before preservation. Samples for common anions (sulfate, chloride, bicarbonate) and other constituents were not filtered. Collection of water samples from residential / public water supply wells followed the same general sequence as that for monitoring wells, although these wells are equipped with permanent pumps. Following sample collection, samples were preserved as appropriate, and placed on ice in coolers at ≤6°C for storage and transport. Groundwater sampling equipment reused between monitoring locations (flow-through cell, sampling pumps, non-dedicated tubing) was thoroughly decontaminated between uses per the project QAPP and CAMP.

Field QC samples collected as part of groundwater monitoring program included DI blanks, equipment rinsate blanks (to evaluate the effectiveness of the decontamination procedure), and field duplicate samples, all collected at a minimum frequency of 1 per 20 field samples or 1 per day (whichever was greater) for monitoring wells, and 1 per 20 total samples for residential wells. DI blanks consisted of DI water placed directly from storage containers into sample containers and preserved. Equipment rinsate blanks consisted of DI water processed through decontaminated sampling equipment (including filtration equipment as appropriate), collected into sample bottles and preserved. Field duplicate samples consisted of replicate samples from a single sampling location submitted to the laboratory for the same set of analyses.

### 2.2.3 Groundwater Field Measurements and Analytical Parameters

Groundwater quality samples were analyzed for the parameters shown in Table 2-7, including field analysis of pH, SC, DO, turbidity, ORP, and water temperature, and laboratory analysis of common constituents and dissolved metals at all sites. Laboratory analysis was conducted by Energy Laboratories in Helena, Montana. All groundwater data collected under the 2017 CAMP has been entered into the project database and validated for data quality and usability. The validated database is included in Appendix A.

## 2.3 2017 DATA MANAGEMENT AND QUALITY CONTROL

Procedures for data review, validation, and reporting are presented and discussed in the East Helena QAPP (Hydrometrics, 2015b), the Data Management Plan (DMP) (Hydrometrics, 2011), and the 2017 CAMP. Included in these documents are 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 procedures. 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). All data collected under the 2017 WRM program has been reviewed and validated in accordance with these procedures and entered into the East Helena Project water quality database (Appendix A).

## Table 2-7. 2017 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 | 0.05 | NA |
| Calcium | 215.1/200.7 | 1 | NA |
| Magnesium | 242.1/200.7 | 1 | NA |
| Sodium | 273.1/200.7 | 1 | NA |
| Potassium | 258.1/200.7 | 1 | 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 |
| Cadmium (Cd) | 200.7/200.8 | 0.001 | 0.005 |
| 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 |
| 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 (May 2017 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.

# 3.0 2017 WATER RESOURCES MONITORING RESULTS

The 2017 CAMP monitoring results are presented below. Discussion and interpretation of the 2017 groundwater data, with emphasis on the performance evaluation metrics outlined in the 2017 CAMP, is presented in Section 4.

## 3.1 SURFACE WATER MONITORING RESULTS

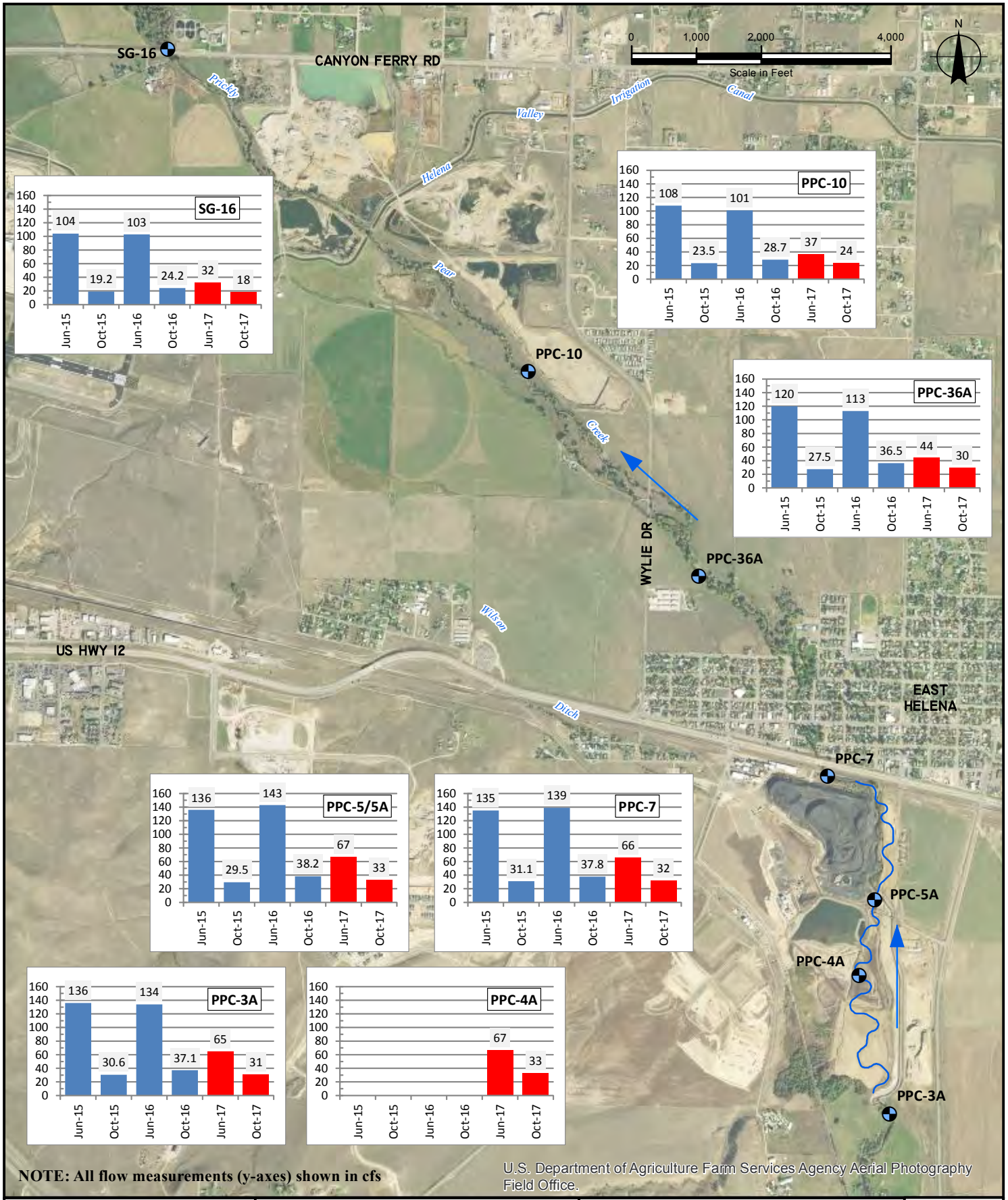
The 2017 surface water monitoring programs included measurement of surface water elevations, streamflow rates, and surface water quality sampling (Section 2.1). The surface water elevation data (Appendix C) was used in conjunction with concurrent groundwater elevation data to develop site-wide groundwater potentiometric maps and evaluate groundwater flow directions and groundwater / surface water interactions (Section 3.2). The streamflow and surface water quality data was used to delineate gaining and losing segments of Prickly Pear Creek, and document current water quality conditions in the project area.

### 3.1.1 Surface Water Elevation and Flow

The June and October 2017 Prickly Pear Creek streamflow data is shown on Figure 3-1 and in Table 3-1. Figure 3-1 also shows June and October flow measurement data collected during 2015 and 2016 for comparison with the 2017 results. June streamflows in Prickly Pear Creek in 2015 and 2016 were significantly higher than those measured in June 2017 while the October flows were similar in 2015 and 2016 and 2017 (Figure 3-1).

Similar to past years, the 2017 data indicates that Prickly Pear Creek flow adjacent to the Facility (PPC-3A to PPC-7) is relatively constant in both June and October (Table 3-1). The 2017 results are consistent with previous flow data (GSI, 2014), suggesting there is minimal net interaction between Prickly Pear Creek and the local groundwater system adjacent to the Facility. The 2017 flow measurements in this reach included two locations (PPC-4A and PPC-5A) on the reconstructed portion of the creek; these results therefore suggest that the realignment project, completed as part of the SPHC IM, has maintained the historic condition of no significant flow gains or losses adjacent to the Facility. Downstream of the Facility, however, the 2017 and previous flow data shows flow rates consistently decrease in a downstream direction indicating leakage from the creek to groundwater. For example, accounting for irrigation diversions, streamflow decreased by about 21 cubic feet per second (cfs) in June 2017 and 14 cfs in October 2017 between Highway 12 and Canyon Ferry Road (sites PPC-7 and SG-16, Figure 3-1). This equate to about 9,400 and 6,300 gallons per minute (gpm) of leakage to the subsurface over a distance of approximately three miles.

Surface water elevations, or stage, were surveyed in June, August, and October 2017 using a survey grade GPS instrument (Section 2.1). The seasonal range in stage at each site is summarized in Table 3-2, with the complete dataset included in Appendix C. The surface water stage data was used in conjunction with monthly groundwater level data (Section 2.2) to produce site-wide potentiometric maps of the project area (Section 3.2).




NOTE: All flow measurements (y-axes) shown in cfs

U.S. Department of Agriculture Farm Services Agency Aerial Photography Field Office.

Hydrometrics, Inc.
Consulting Scientists and Engineers

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2017 WATER RESOURCES MONITORING REPORT
EAST HELENA FACILITY

**2017 PRICKLY PEAR CREEK SURFACE WATER FLOW MEASUREMENTS**

FIGURE

**3-1**

Path: V:\10022\GIS\2017 GW Report\Fig3-1_SWFlows.mxd

## Table 3-1. 2017 Prickly Pear Creek Seasonal Streamflow Measurements

<table>
<tr><th rowspan="2">Monitoring Site</th><th rowspan="2">Location</th><th colspan="3">June 19, 2017 Flows - cfs</th><th colspan="3">October 2, 2017 Flows - cfs</th></tr>
<tr><th>Flow</th><th colspan="2">Stream Leakage</th><th>Flow</th><th colspan="2">Stream Leakage</th></tr>
<tr><td>PPC-3A</td><td>Upstream of Facility</td><td>65</td><td rowspan="3">2</td><td rowspan="3"></td><td>31</td><td rowspan="3">1</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>PPC-4A</td><td>Adjacent to Facility</td><td>67</td><td>33</td></tr>
<tr><td>PPC-5A</td><td>Adjacent to Facility</td><td>67</td><td>33</td></tr>
<tr><td>PPC-7</td><td>Downstream Facility Boundary</td><td>67</td><td rowspan="5">-16.0</td><td rowspan="6">-21.0</td><td>32</td><td rowspan="5"></td><td rowspan="5">-8</td><td rowspan="6">-14</td></tr>
<tr><td>Company Ditch</td><td>0.6 miles downstream of Facility</td><td>-10.8</td><td rowspan="5"></td><td>0</td></tr>
<tr><td>PPC-36A</td><td>0.7 miles downstream of Facility</td><td>44</td><td>30</td></tr>
<tr><td>Browns Ditch</td><td>1.2 miles downstream of Facility</td><td>-3.2</td><td>0</td></tr>
<tr><td>PPC-10</td><td>1.5 miles downstream of Facility</td><td>37</td><td>24</td></tr>
<tr><td>SG-16</td><td>2.9 miles downstream of Facility</td><td>32</td><td></td><td>18</td><td></td></tr>
</table>

cfs - cubic feet per second.

Sites listed in upstream to downstream order; locations shown on Figure 2-1.

Ditch sites are diversion points.

## Table 3-2. Summary of 2017 Surface Water Elevation Surveys -- East Helena Facility

| Site | Description | 2017 Stage Measurements | | | |
|---|---|---|---|---|---|
| | | n | Min | Max | Mean |
| PPC-3A | Prickly Pear Creek | 3 | 3926.83 | 3927.32 | 3927.10 |
| PPC-4A | Prickly Pear Creek | 3 | 3910.04 | 3910.35 | 3910.22 |
| Trib-1 | Spring fed tributary to PP Creek | 2 | 3917.78 | 3917.89 | 3917.84 |
| Trib-1B | Spring fed tributary to PP Creek | 1 | 3914.93 | 3914.93 | 3914.93 |
| Trib-1D | Spring fed tributary to PP Creek | 3 | 3903.82 | 3905.1 | 3904.39 |
| PPC-5A | Prickly Pear Creek | 3 | 3900.42 | 3902.31 | 3901.61 |
| PPC-7 | Prickly Pear Creek | 3 | 3881.63 | 3882.32 | 3881.97 |
| PPC-8 | Prickly Pear Creek | 3 | 3866.95 | 3868 | 3867.44 |
| PPC-36A | Prickly Pear Creek | 3 | 3854.47 | 3854.81 | 3854.63 |
| PPC-9A | Prickly Pear Creek | 3 | 3845.14 | 3845.5 | 3845.33 |
| PPC-10 | Prickly Pear Creek | 3 | 3817.4 | 3817.83 | 3817.64 |
| SG-16 | Prickly Pear Creek | 3 | 3765.47 | 3765.99 | 3765.73 |
| GP-1 | Gravel Pit north of former smelter | 3 | 3791.59 | 3794.78 | 3792.67 |
| GP-2 | Gravel Pit north of former smelter | 2 | 3788.46 | 3788.62 | 3788.54 |
| GP-3 | Gravel Pit north of former smelter | 3 | 3761.23 | 3761.73 | 3761.54 |
| GP-4 | Gravel Pit north of former smelter | 3 | 3783.42 | 3788.48 | 3786.11 |
| GP-5 | Gravel Pit north of former smelter | 3 | 3799.98 | 3800.2 | 3800.06 |
| GP-5A | Gravel Pit north of former smelter | 3 | 3806.42 | 3815.67 | 3812.40 |

n = number of measurements
Site locations shown on Figure 2-1.
Prickly Pear Creek sites shown in upstream to downstream order.
Complete data included in Appendix C.

### 3.1.2 Surface Water Quality Results

The 2017 semi-annual surface water quality data is presented in Tables 3-3 (June) and 3-4 (October). The seasonal data shows Prickly Pear Creek water to be a calcium-bicarbonate type water with slightly alkaline pH and total dissolved solids (TDS) concentrations ranging from approximately 100 to 200 mg/L seasonally. Major ion constituent concentrations are very consistent from upstream of the smelter site (site PPC-3A) to downstream site SG-16 near Canyon Ferry Road. For example, calcium concentrations in this reach ranged from 21 to 22 mg/L in June 2017, and from 28 to 29 mg/L in October 2017, and sulfate concentration ranges were 23 to 24 mg/L in June 2017, and 45 to 47 mg/L in October 2017.

Total recoverable trace metal concentrations are also relatively low and consistent throughout the sampled reach of Prickly Pear Creek (Tables 3-3 and 3-4). A number of trace metals including antimony, mercury, selenium, and thallium were below the laboratory reporting limits in all 2017 samples. Water quality criterion exceedances (DEQ-7 surface water standards) observed in Prickly Pear Creek samples in 2017 were limited to total recoverable lead, which exceeded the hardness-dependent chronic aquatic life criteria in June 2017 at all eight sites (Table 3-3). The water quality exceedances for lead occurred both upstream and downstream of the Facility, indicating the contaminant sources responsible for the exceedances are located upstream. The occurrence of elevated metals concentrations far upstream of the Facility has been noted in numerous studies, including the watershed total maximum daily load (TMDL) document (USEPA, 2004b), and is attributed to historic mining activities.

## 3.2 GROUNDWATER MONITORING RESULTS

The 2017 groundwater monitoring program included groundwater level and water quality monitoring (Section 2.2). Monitoring results are presented below.

### 3.2.1 Groundwater Level Data

The 2017 groundwater level monitoring program included manual measurements at 186 monitoring wells in May, June, August, and October, and continuous water level data collected at approximately 40 sites using pressure transducers and dataloggers. The wells included in the monthly measurement program are identified in Table 2-4 and shown on Exhibit 1, with the water level data included in Appendix C. As previously noted, groundwater levels on the Facility are of particular interest since groundwater flow through contaminated soils is the principal mechanism for contaminant loading to groundwater, and the SPHC IM is intended to lower groundwater levels and reduce contaminant leaching from soils. The water level data collection program provides a comprehensive accounting of water level trends on and around the Facility.

Overall, 2017 depths to groundwater in the project area range from less than 10 feet below ground surface (bgs) in the southern portion of the Facility and near Prickly Pear Creek, to as much as 50 feet bgs near and north of Canyon Ferry Road. The 2017 water level data was used to develop seasonal groundwater potentiometric maps for the local alluvial/colluvial aquifer. Figures 3-2, 3-3, and 3-4 show the June and October 2016 and 2017 potentiometric maps for the project area, the surficial

## Table 3-3. June 2017 Surface Water Quality Monitoring Results -- East Helena Facility

| | | | Field Parameters | | | | | General Chemistry | | | | | Major Ions | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Water Elevation (ft)** | **pH (s.u.)** | **SC (µmhos/cm)** | **Diss $O_2$ (mg/L)** | **Water Temp (°C)** | **Flow (cfs)** | **Lab pH (s.u.)** | **Lab SC (µmhos/cm)** | **Total Alkalinity as CaCO3** | **Total Suspended Solids** | **Total Dissolved Solids** | **Calcium** | **Magnesium** | **Sodium** | **Potassium** | **Bicarbonate** | **Chloride** | **Sulfate** |
| **Prickly Pear Creek Mainstem Sites** | | | | | | | | | | | | | | | | | | | |
| PPC-3A | 6/19/2017 | 3927.32 | 8.07 | 187 | 10.71 | 16.8 | 65 | 8.2 | 194 | 60 | < 10 | 125 | 21 | 5 | 8 | 2 | 73 | 3.0 | 24 |
| PPC-4A | 6/19/2017 | 3910.35 | 8.17 | 186 | 10.55 | 16.5 | 67 | 8.2 | 194 | 61 | < 10 | 123 | 21 | 5 | 8 | 2 | 74 | 3.0 | 24 |
| PPC-4A (Dup) | 6/19/2017 | 3910.35 | 8.17 | 185 | 10.54 | 16.5 | 67 | 8.2 | 193 | 60 | < 10 | 120 | 22 | 5 | 8 | 2 | 73 | 2.9 | 24 |
| PPC-5A | 6/19/2017 | 3900.42 | 8.13 | 187 | 10.76 | 15.7 | 67 | 8.2 | 194 | 61 | < 10 | 123 | 21 | 5 | 8 | 2 | 73 | 2.9 | 24 |
| PPC-7 | 6/19/2017 | 3882.32 | 8.14 | 188 | 11.05 | 14.8 | 66 | 8.2 | 195 | 61 | < 10 | 122 | 21 | 5 | 8 | 2 | 74 | 3.0 | 24 |
| PPC-36A | 6/19/2017 | 3854.81 | 8.09 | 186 | 10.32 | 13.8 | 44 | 8.2 | 195 | 62 | < 10 | 130 | 22 | 5 | 9 | 2 | 75 | 3.0 | 24 |
| PPC-10 | 6/19/2017 | 3817.83 | 8.19 | 188 | 11.68 | 13.1 | 37 | 8.2 | 197 | 61 | < 10 | 122 | 22 | 5 | 9 | 2 | 74 | 3.3 | 23 |
| SG-16 | 6/19/2017 | 3775.14 | 8.25 | 188 | 10.83 | 12.6 | 32 | 8.2 | 197 | 62 | < 10 | 122 | 22 | 5 | 9 | 2 | 75 | 3.3 | 24 |
| **Other Surface Water Sites** | | | | | | | | | | | | | | | | | | | |
| Trib-1 | 6/19/2017 | 3917.89 | 7.40 | 437 | 4.12 | 22.5 | 0.05 | 7.6 | 442 | 160 | 13 | 265 | 47 | 11 | 22 | 3 | 200 | 5.8 | 48 |
| Trib-1B | 6/19/2017 | 3914.93 | 8.31 | 632 | 9.80 | 30.5 | NM | 8.5 | 631 | 170 | 17 | 406 | 80 | 17 | 26 | 5 | 200 | 5.5 | 140 |
| Trib-1D | 6/19/2017 | 3903.82 | 8.49 | 717 | 10.47 | 26.9 | 0.015 | 8.6 | 736 | 100 | 27 | 510 | 89 | 22 | 27 | 5 | 120 | 8.1 | 250 |
| GP-5 | 6/19/2017 | 3800.20 | No Water Quality Sample Collected | | | | 0.97 | No Water Quality Sample Collected | | | | | | | | | | | |

| | | Total Recoverable Metals | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Antimony** | **Arsenic** | **Cadmium** | **Copper** | **Iron** | **Lead** | **Manganese** | **Mercury** | **Selenium** | **Thallium** | **Zinc** |
| **Prickly Pear Creek Mainstem Sites** | | | | | | | | | | | | |
| PPC-3A | 6/19/2017 | < 0.0005 | 0.004 | 0.00014 | 0.003 | 0.2 | 0.0029 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.032 |
| PPC-4A | 6/19/2017 | < 0.0005 | 0.004 | 0.00014 | 0.003 | 0.22 | 0.0027 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.033 |
| PPC-4A (Dup) | 6/19/2017 | < 0.0005 | 0.004 | 0.00014 | 0.003 | 0.21 | 0.0028 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.032 |
| PPC-5A | 6/19/2017 | < 0.0005 | 0.004 | 0.00014 | 0.003 | 0.23 | 0.003 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.034 |
| PPC-7 | 6/19/2017 | < 0.0005 | 0.005 | 0.00015 | 0.003 | 0.24 | 0.0031 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.034 |
| PPC-36A | 6/19/2017 | < 0.0005 | 0.005 | 0.00016 | 0.003 | 0.24 | 0.0034 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.036 |
| PPC-10 | 6/19/2017 | < 0.0005 | 0.005 | 0.0002 | 0.004 | 0.34 | 0.0044 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.037 |
| SG-16 | 6/19/2017 | < 0.0005 | 0.005 | 0.00014 | 0.003 | 0.19 | 0.0033 | 0.03 | < 0.000005 | < 0.001 | < 0.0002 | 0.032 |
| **Other Surface Water Sites** | | | | | | | | | | | | |
| Trib-1 | 6/19/2017 | 0.0025 | 0.017 | 0.00033 | 0.002 | 0.44 | 0.0258 | 0.08 | 0.000037 | 0.001 | < 0.0002 | < 0.008 |
| Trib-1B | 6/19/2017 | 0.0033 | 0.022 | 0.0186 | 0.024 | 0.91 | 0.0332 | 0.32 | 0.000122 | < 0.001 | 0.0008 | 0.959 |
| Trib-1D | 6/19/2017 | 0.0016 | 0.011 | 0.00079 | 0.011 | 1.11 | 0.012 | 0.21 | 0.000039 | < 0.001 | < 0.0002 | 0.041 |
| GP-5 | 6/19/2017 | No Water Quality Sample Collected | | | | | | | | | | |

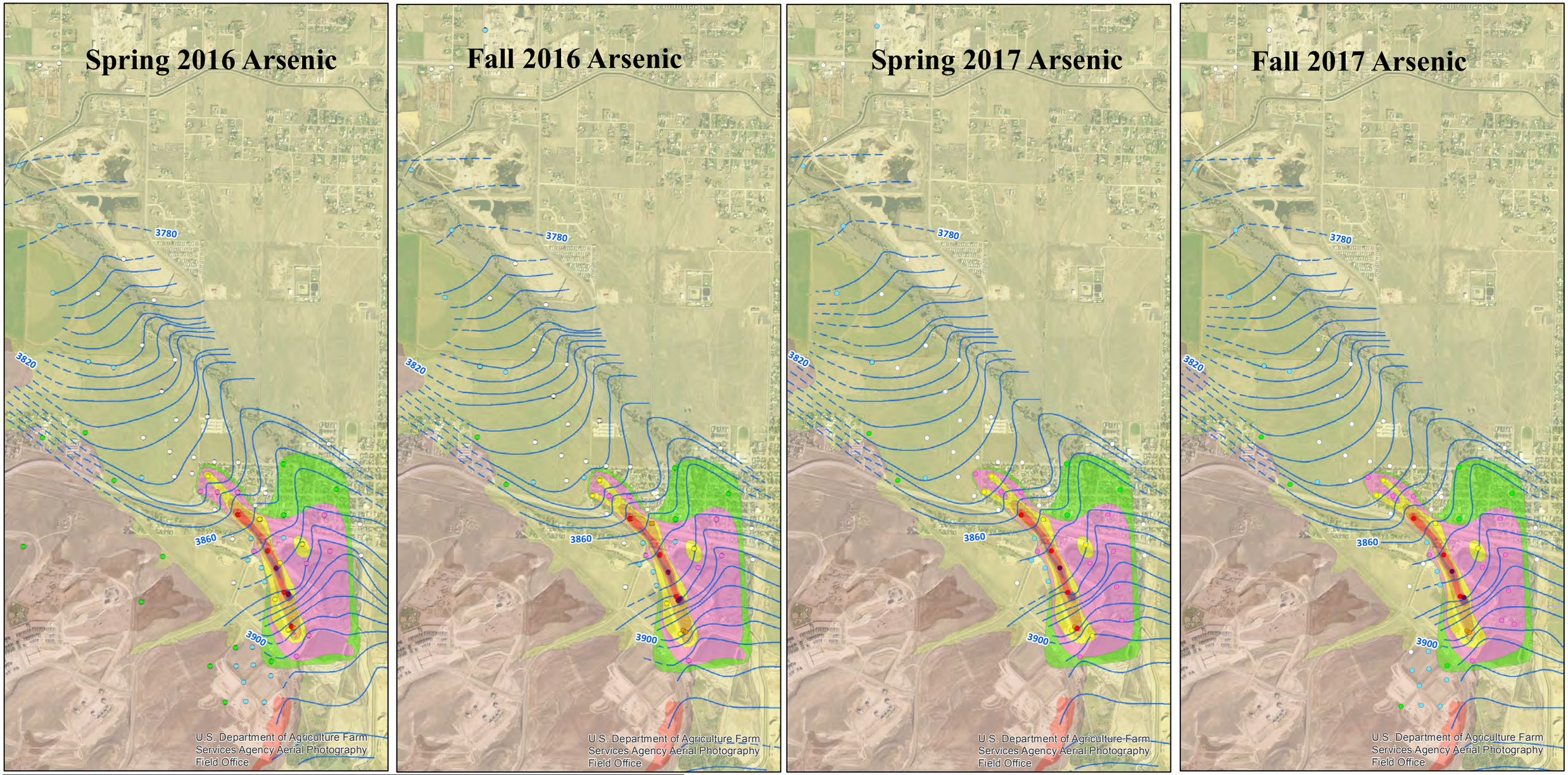
NOTES: All concentrations in mg/L except as indicated.
Value exceeds DEQ-7 water quality criterion.

## Table 3-4. October 2017 Surface Water Quality Monitoring Results -- East Helena Facility

| | | | Field Parameters | | | | | General Chemistry | | | | | Major Ions | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Water Elevation (ft)** | **pH (s.u.)** | **SC (µmhos/cm)** | **Diss $O_2$ (mg/L)** | **Water Temp (°C)** | **Flow (cfs)** | **Lab pH (s.u.)** | **Lab SC (µmhos/cm)** | **Total Alkalinity as CaCO3** | **Total Suspended Solids** | **Total Dissolved Solids** | **Calcium** | **Magnesium** | **Sodium** | **Potassium** | **Bicarbonate** | **Chloride** | **Sulfate** |
| **Prickly Pear Creek Mainstem Sites** | | | | | | | | | | | | | | | | | | | |
| PPC-3A | 10/2/2017 | 3927.16 | 8.17 | 272 | 13.17 | 7.7 | 31 | 8.1 | 283 | 81 | < 10 | 182 | 28 | 6 | 14 | 2 | 98 | 6.0 | 46 |
| PPC-4A | 10/2/2017 | 3910.27 | 8.35 | 275 | 13.76 | 7.7 | 33 | 8.2 | 284 | 81 | < 10 | 188 | 29 | 7 | 15 | 3 | 98 | 6.0 | 47 |
| PPC-4A (Dup) | 10/2/2017 | 3910.27 | 8.35 | 275 | 13.76 | 7.7 | 33 | 8.2 | 284 | 81 | < 10 | 187 | 29 | 7 | 15 | 3 | 98 | 6.0 | 47 |
| PPC-5A | 10/2/2017 | 3902.31 | 8.32 | 273 | 14.30 | 7.7 | 33 | 8.2 | 283 | 82 | < 10 | 186 | 29 | 7 | 15 | 3 | 99 | 6.0 | 47 |
| PPC-7 | 10/2/2017 | 3881.96 | 8.49 | 273 | 14.93 | 7.3 | 32 | 8.4 | 285 | 81 | < 10 | 187 | 28 | 6 | 15 | 3 | 99 | 6.0 | 47 |
| PPC-36A | 10/2/2017 | 3854.62 | 8.37 | 275 | 14.47 | 7.0 | 30 | 8.4 | 284 | 82 | < 10 | 187 | 28 | 7 | 14 | 2 | 99 | 6.0 | 47 |
| PPC-10 | 10/2/2017 | 3817.68 | 8.28 | 275 | 14.38 | 6.8 | 24 | 8.2 | 284 | 79 | < 10 | 187 | 29 | 7 | 14 | 3 | 96 | 6.0 | 47 |
| SG-16 | 10/2/2017 | 3765.74 | 8.24 | 276 | 14.24 | 6.9 | 18 | 8.2 | 284 | 83 | < 10 | 185 | 29 | 7 | 14 | 3 | 100 | 6.0 | 45 |
| **Other Surface Water Sites** | | | | | | | | | | | | | | | | | | | |
| Trib-1 | 10/2/2017 | 3917.78 | 7.51 | 755 | 9.2 | 5.6 | 0.0076 | 7.4 | 784 | 140 | 10 | 549 | 102 | 18 | 27 | 5 | 170 | 9.0 | 253 |
| Trib-1B | 10/2/2017 | Site Dry - No Sample | | | | | | | | | | | | | | | | | |
| Trib-1D | 10/2/2017 | 3904.24 | 9.2 | 621 | 16.25 | 7.7 | 0.033 | 9.1 | 668 | 73 | < 10 | 474 | 71 | 22 | 27 | 5 | 71 | 7 | 260 |
| GP-5 | 10/2/2017 | 3800.00 | No Water Quality Sample Collected | | | | 0.574 | No Water Quality Sample Collected | | | | | | | | | | | |

| | | Total Recoverable Metals | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Antimony** | **Arsenic** | **Cadmium** | **Copper** | **Iron** | **Lead** | **Manganese** | **Mercury** | **Selenium** | **Thallium** | **Zinc** |
| **Prickly Pear Creek Mainstem Sites** | | | | | | | | | | | | |
| PPC-3A | 10/2/2017 | < 0.0005 | 0.004 | 0.00014 | < 0.002 | 0.13 | 0.0013 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.038 |
| PPC-4A | 10/2/2017 | < 0.0005 | 0.004 | 0.00014 | < 0.002 | 0.15 | 0.0013 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.037 |
| PPC-4A (Dup) | 10/2/2017 | < 0.0005 | 0.004 | 0.00013 | < 0.002 | 0.15 | 0.0014 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.038 |
| PPC-5A | 10/2/2017 | < 0.0005 | 0.004 | 0.00010 | < 0.002 | 0.16 | 0.0014 | 0.05 | < 0.000005 | < 0.001 | < 0.0002 | 0.036 |
| PPC-7 | 10/2/2017 | < 0.0005 | 0.004 | 0.00010 | < 0.002 | 0.16 | 0.0016 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.034 |
| PPC-36A | 10/2/2017 | < 0.0005 | 0.004 | 0.00010 | < 0.002 | 0.18 | 0.0020 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.033 |
| PPC-10 | 10/2/2017 | < 0.0005 | 0.004 | 0.00011 | 0.003 | 0.19 | 0.0024 | 0.04 | < 0.000005 | < 0.001 | < 0.0002 | 0.033 |
| SG-16 | 10/2/2017 | < 0.0005 | 0.006 | 0.00011 | 0.002 | 0.15 | 0.0020 | 0.02 | < 0.000005 | < 0.001 | < 0.0002 | 0.030 |
| **Other Surface Water Sites** | | | | | | | | | | | | |
| Trib-1 | 10/2/2017 | 0.0012 | 0.007 | 0.0354 | 0.008 | 0.71 | 0.0355 | 0.37 | 0.000035 | < 0.001 | 0.0004 | 0.619 |
| Trib-1B | 10/2/2017 | Site Dry - No Sample | | | | | | | | | | |
| Trib-1D | 10/2/2017 | 0.0020 | 0.020 | 0.00014 | 0.004 | 0.22 | 0.0031 | 0.02 | 0.0000072 | < 0.001 | < 0.0002 | < 0.008 |
| GP-5 | 10/2/2017 | No Water Quality Sample Collected | | | | | | | | | | |

NOTES: All concentrations in mg/L except as indicated.
Value exceeds DEQ-7 water quality criterion.




**Legend**

| As Contours | As Conc (mg/L) | Surficial Geology | Groundwater Potentiometric Contour |
|---|---|---|---|
| 0.011 - 0.100 mg/L | <0.002 | Qac - Alluvium/Colluvium | 5-foot Contour |
| 0.101 - 1.00 mg/L | 0.002 - 0.010 | Qa - Alluvium | 5-foot Contour (Inferred) |
| 1.01 - 5.00 mg/L | 0.011 - 0.100 | Qt - Terrace Gravel | |
| 5.01 - 10.0 mg/L | 0.101 - 1.0 | QTg - Older Gravel | |
| 10.1 - 20.0 mg/L | 1.01 - 5.0 | OGts - Tuff and Tuffaceous Sediment | |
| > 20.0 mg/L | 5.01 - 10.0 | Ys - Spokane Formation | |
| | 10.01 - 20.0 | | |
| | > 20.0 | | |

N

0 0.5 1

Scale in Miles

| | | |
|---|---|---|
| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | **2016-2017 GROUNDWATER ARSENIC PLUMES AND POTENTIOMETRIC CONTOURS EAST HELENA FACILITY** | **FIGURE** **3-2** |

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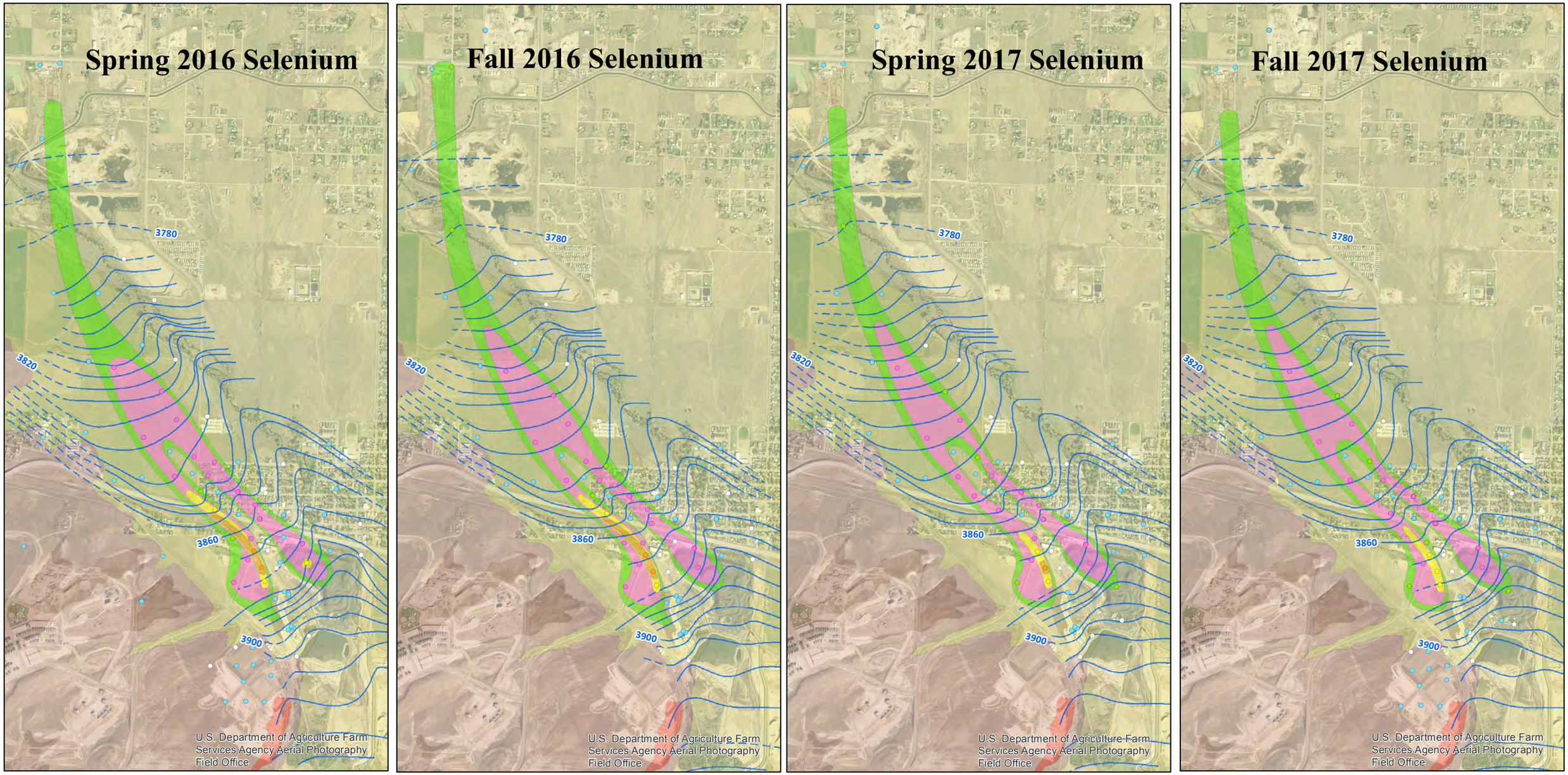


**Legend**

**Se Contours**
- 0.051 - 0.100 mg/L
- 0.101 - 0.500 mg/L
- 0.501 - 1.0 mg/L
- 1.01 - 3.0 mg/L
- > 3.0 mg/L

**Se Conc (mg/L)**
- <0.001
- 0.001-0.050
- 0.051-0.100
- 0.101-0.500
- 0.501-1.0
- 1.01-3.0
- >3.0

**Surficial Geology**
- Qac - Alluvium/Colluvium
- Qa - Alluvium
- Qt - Terrace Gravel
- QTg - Older Gravel
- OGts - Tuff and Tuffaceous Sediment
- Ys - Spokane Formation

**Groundwater Potentiometric Contours**
- 5-foot Contour
- 5-foot Contour (Inferred)

N

0 0.5 1
Scale in Miles

| | | |
|---|---|---|
| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | **2016-2017 GROUNDWATER SELENIUM PLUMES AND POTENTIOMETRIC CONTOURS EAST HELENA FACILITY** | **FIGURE** **3-3** |

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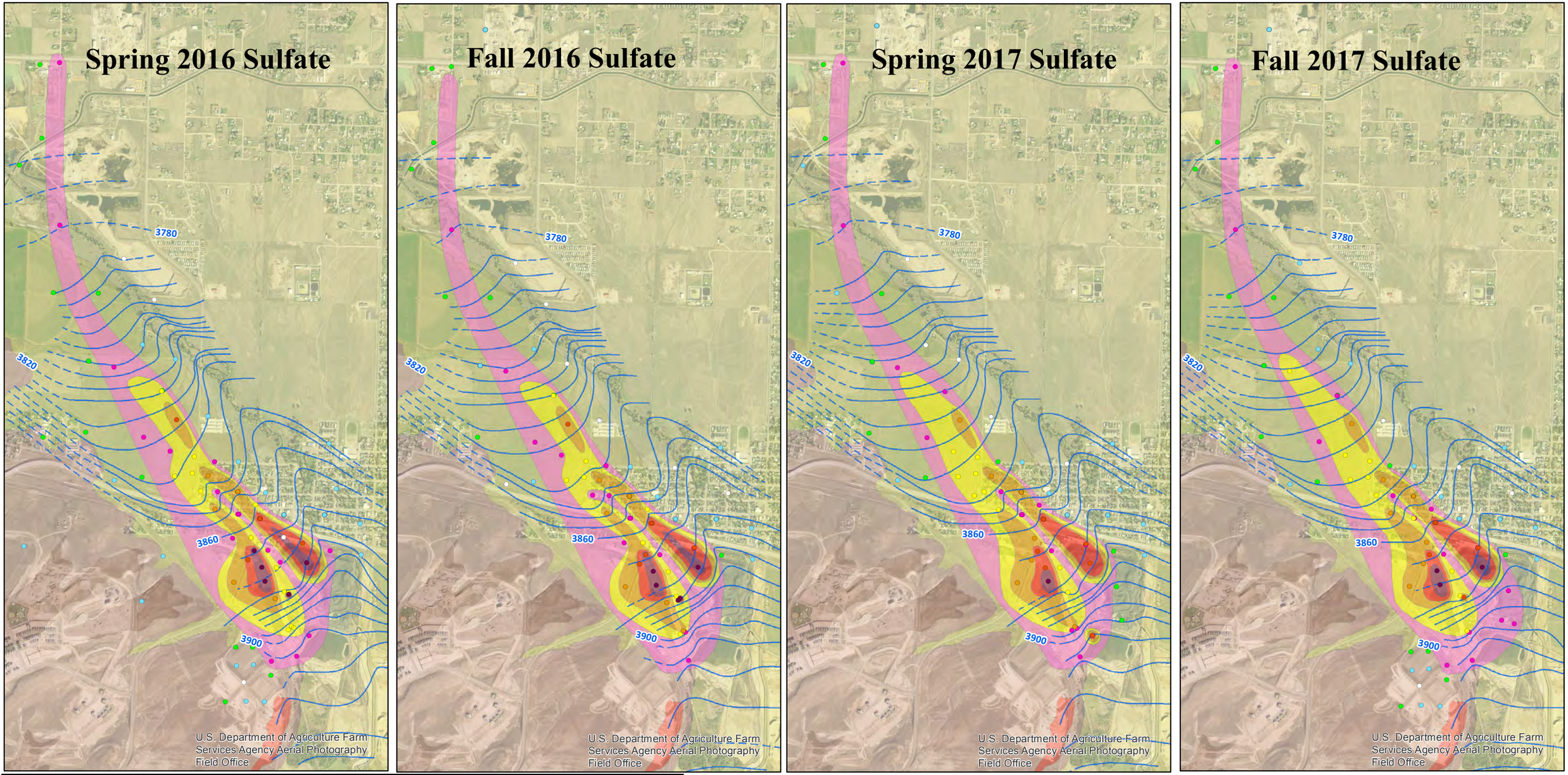


**Legend**

| SO4 Contours | SO4 Conc (mg/L) | Surficial Geology | Groundwater Potentiometric Contours |
|---|---|---|---|
| 201 - 350 mg/L | < 50 | Qac - Alluvium/Colluvium | 5-foot Contour |
| 351 - 500 mg/L | 51 - 100 | Qa - Alluvium | 5-foot Contour (Inferred) |
| 501 - 750 mg/L | 101 - 200 | Qt - Terrace Gravel | |
| 751 - 1000 mg/L | 201 - 350 | QTg - Older Gravel | |
| > 1000 mg/L | 351 - 500 | OGts - Tuff and Tuffaceous Sediment | |
| | 501 - 750 | Ys - Spokane Formation | |
| | 751 - 1000 | | |
| | > 1000 | | |

N

0 0.5 1

Scale in Miles

| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | **2016-2017 GROUNDWATER SULFATE PLUMES AND POTENTIOMETRIC CONTOURS EAST HELENA FACILITY** | **FIGURE** **3-4** |
|---|---|---|

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geology, and the groundwater arsenic, selenium, and sulfate plumes. As shown on the figures, groundwater flow through the Facility and surrounding area is generally from the south through the Facility to the north/northwest. The strong influence of Prickly Pear Creek on groundwater flow is evident from the elevated groundwater ridge (groundwater divide) beneath the creek, and the groundwater flow direction paralleling the creek. Figures 3-3 and 3-4 also show the influence of leakage from Prickly Pear Creek and the associated groundwater divide on selenium and sulfate transport through the alluvial aquifer, with the plumes paralleling the creek north of the Facility.

### 3.2.2 Groundwater Quality Monitoring Results

Groundwater quality monitoring in 2017 included semi-annual monitoring well and residential/public water supply well sampling. The monitoring results are presented below with data evaluation and interpretation included in Section 4.

#### 3.2.2.1 Monitoring Well Sampling Results

The groundwater chemistry in the vicinity of the former smelter is influenced by the local geology as well as former smelter operations, and possibly other anthropogenic influences downgradient (north) of the former smelter. Exhibit 2 includes Stiff diagrams summarizing representative groundwater chemistry throughout the project area for both pre-IM conditions (2010/2011 or earlier) and 2017. Stiff diagrams provide a graphical representation of general groundwater chemistry or groundwater type, based on relative concentrations of the major cations sodium, potassium, calcium and magnesium, and anions chloride, carbonate, bicarbonate, and sulfate. Based on groundwater chemistry data upgradient (south) of the Facility and in East Helena east of Prickly Pear Creek, background groundwater in the alluvial/colluvial aquifer underlying the Facility is a calcium bicarbonate type (light green symbols on Exhibit 2), typical of most alluvial groundwater systems in the region. The groundwater chemistry changes beneath the Facility due to impacts from various smelter operations, with the groundwater chemistry transitioning to a calcium-sulfate type with significant chloride contribution (dark green) on the western Plant site portion of the Facility, and a sodium or potassium-sulfate type (blue) in the central and eastern portions beneath the historic Speiss/Dross area and the slag pile. These geochemical fingerprints are useful in helping to identify various groundwater contaminant sources in downgradient groundwater. For example, high sodium, potassium, and sulfate concentrations may indicate a slag pile source, and high calcium, chloride, and sulfate concentrations may indicate a Plant Site source.

West of the Facility in the area referred to as the West Bench (Figure 1-2), groundwater chemistry is variable with a primary calcium-bicarbonate signature and varying concentrations of other major ions. Tan colored Stiff diagrams in this area indicate slightly higher sulfate signatures, and red Stiff diagrams indicate higher sodium and sulfate signatures (Exhibit 2). Groundwater chemistry in the two western-most CAMU wells show strong sodium bicarbonate (MW-7, light blue Stiff diagram) and sodium sulfate (MW-11, darker blue Stiff diagram) signatures, likely influenced by the Tertiary sediments comprising the foothills around the Helena Valley. In addition to affecting the general chemistry, the Tertiary volcanoclastic sediments are also responsible for the occurrence of a background arsenic signature in the Tertiary sediment groundwater, with background arsenic

concentrations west of the Facility generally ranging from 0.01 to 0.02 mg/L (Hydrometrics, 2014), compared to the human health standard (HHS) of 0.01 mg/L (MDEQ, 2017).

A third general groundwater type in the project area is a magnesium-bicarbonate type detected in a few monitoring wells west and northwest of the Facility (purple Stiff diagrams on Exhibit 2). This groundwater chemistry is attributed to local bedrock influences, specifically groundwater originating from the Spokane Formation argillite. As shown on Exhibit 2, the Spokane Formation outcrops to the west of the Facility and extends northward along the west margin of Lamping Field. The magnesium-bicarbonate type groundwater follows the trace of bedrock outcrops northward to monitoring well EH-139 north of Lamping Field. This pattern is consistent with the groundwater potentiometric maps (Figures 3-2, 3-3, and 3-4) which show groundwater flow from the southwest foothills toward the alluvial/colluvial aquifer north of the Facility. This groundwater flow pattern is important in constraining the western extent of the alluvial/colluvial flow system and the groundwater selenium plume.

Exhibit 2 also shows areas of groundwater chemistry changes from 2010/2011 to 2017, spanning the IM implementation period. Based on the comparison of 2010/2011 (pre-IM) to 2017 (post-IM) Stiff diagrams, the groundwater general chemistry has remained relatively constant throughout much of the project area. The groundwater chemistry has changed, however, at some well locations north of the Facility, such as EH-50 and EH-100 in East Helena, and EH-114 and EH-124 in Lamping Field. These changes generally reflect a westward shift in groundwater flow north of the Facility resulting from the loss of recharge from Wilson Ditch following decommissioning of the ditch. Further downgradient, north of Lamping Field, wells EH-138 and EH-139 show slight changes in Stiff diagram patterns from 2010 to 2017, with EH-138 showing a slight decrease in sulfate signature (along with a significant decrease in TDS) and EH-139 showing a slight increase in sodium and sulfate signature. These changes are consistent with the groundwater level and flow pattern changes noted north of the Facility in response to decommissioning of Wilson Ditch.

*Groundwater Quality*

A statistical summary of the 2017 water quality monitoring results for arsenic, selenium and key indicator parameters is provided in Table 3-5, with the complete validated database included in Appendix A. The 2017 water quality data in Table 3-5 is presented by area, with summary statistics for the post-operational/pre-IM period (2002-2011) and for 2015 and 2016 for comparison. Monitoring wells are all shown on Exhibit 1 and have been grouped into the following areas (shown on Figure 3-5) for calculation of summary statistics:

- Former Smelter – Plant Site Area (9 wells in the central and western portions of the Facility where smelting and associated operations occurred, along with historic process water releases that introduced contaminants into groundwater);
- Former Smelter – Slag Pile Area (11 wells in the eastern portion of the Facility completed beneath and immediately north of the slag pile);
- East Helena Area (23 wells in the City of East Helena);
- Lamping Field (16 wells in Lamping Field);

**Table 3-5. Summary of 2017 Monitoring Well Water Quality Data for Select Parameters-- East Helena Facility**

| Area / Time Period | Arsenic (Dissolved) | | | | Selenium (Dissolved) | | | | Sulfate | | | | Chloride | | | | Calcium | | | | Sodium | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | Min | Max | Mean | *n* | Min | Max | Mean | *n* | Min | Max | Mean | *n* | Min | Max | Mean | *n* | Min | Max | Mean | *n* | Min | Max | Mean |
| **Former Smelter Site** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Plant Site Area** | | | | | | | | | | | | | | | | | | | | | | | | |
| **2002-2011 Average** | *190* | <0.002 | 53.2 | **14.4** | *99* | <0.001 | 7.78 | **0.642** | *184* | <1 | 1900 | **657** | *184* | <1 | 720 | **137** | *184* | 10 | 838 | **178** | *184* | 14 | 803 | **211** |
| **2015** | *35* | <0.002 | 33.1 | **9.79** | *35* | <0.001 | 4.31 | **0.615** | *35* | 186 | 1860 | **729** | *35* | 7 | 618 | **141** | *35* | 11 | 875 | **253** | *35* | 24 | 296 | **158** |
| **2016** | *28* | <0.002 | 30.4 | **9.39** | *28* | <0.001 | 1.43 | **0.299** | *28* | 261 | 1990 | **691** | *28* | 7 | 604 | **125** | *28* | 12 | 913 | **217** | *28* | 27 | 323 | **152** |
| **2017** | *16* | 0.003 | 26.4 | **7.47** | *16* | <0.001 | 1.16 | **0.208** | *16* | 243 | 1730 | **640** | *16* | 8 | 460 | **97** | *16* | 17 | 787 | **218** | *16* | 25 | 256 | **123** |
| ***Percent Reduction 2002-2011 to 2017*** | | | | ***48%*** | | | | ***68%*** | | | | ***3%*** | | | | ***29%*** | | | | ***-22%*** | | | | ***42%*** |
| **Slag Pile Area** | | | | | | | | | | | | | | | | | | | | | | | | |
| **2002-2011 Average** | *135* | <0.002 | 4.13 | **0.8030** | *89* | <0.001 | 2.02 | **0.250** | *131* | <1 | 2800 | **701** | *131* | 5 | 170 | **39** | *131* | 16 | 313 | **110** | *131* | 19 | 1000 | **211** |
| **2015** | *23* | <0.002 | 2.04 | **0.6990** | *23* | <0.001 | 0.604 | **0.211** | *23* | 73 | 1410 | **594** | *23* | 4 | 32 | **14** | *23* | 17 | 241 | **78** | *23* | 39 | 495 | **191** |
| **2016** | *25* | <0.002 | 1.82 | **0.6260** | *25* | <0.001 | 0.978 | **0.253** | *25* | 47 | 1940 | **706** | *25* | 3 | 33 | **15** | *25* | 19 | 243 | **98** | *25* | 39 | 590 | **206** |
| **2017** | *13* | <0.002 | 1.83 | **0.6024** | *13* | <0.001 | 0.35 | **0.127** | *13* | 120 | 1070 | **445** | *13* | 6 | 24 | **12** | *13* | 19 | 242 | **76** | *13* | 54 | 353 | **139** |
| ***Percent Reduction 2002-2011 to 2017*** | | | | ***25%*** | | | | ***49%*** | | | | ***37%*** | | | | ***69%*** | | | | ***31%*** | | | | ***34%*** |
| **East Helena Area** | | | | | | | | | | | | | | | | | | | | | | | | |
| **2002-2011 Average** | *641* | <0.002 | 16.58 | **1.29** | *387* | <0.001 | 1.2 | **0.120** | *617* | 22 | 1220 | **419** | *617* | <1 | 169 | **53** | *617* | 22 | 277 | **107** | *617* | 11 | 375 | **123** |
| **2015** | *61* | <0.002 | 19.1 | **2.25** | *61* | <0.001 | 1.04 | **0.125** | *61* | 17 | 932 | **337** | *61* | 2 | 75 | **24** | *61* | 17 | 240 | **81** | *61* | 10 | 236 | **115** |
| **2016** | *48* | <0.002 | 17.5 | **1.83** | *48* | <0.001 | 0.94 | **0.118** | *48* | 26 | 934 | **320** | *48* | 2 | 70 | **21** | *48* | 17 | 233 | **75** | *48* | 11 | 248 | **107** |
| **2017** | *46* | <0.002 | 14.1 | **1.27** | *46* | <0.001 | 0.385 | **0.077** | *46* | 36 | 900 | **310** | *46* | 3.7 | 85 | **25** | *46* | 19 | 206 | **73** | *46* | 14 | 247 | **108** |
| ***Percent Reduction 2002-2011 to 2017*** | | | | ***2%*** | | | | ***36%*** | | | | ***26%*** | | | | ***52%*** | | | | ***32%*** | | | | ***13%*** |
| **Lamping Field** | | | | | | | | | | | | | | | | | | | | | | | | |
| **2002-2011 Average** | *207* | <0.002 | 0.030 | **0.0051** | *178* | <0.001 | 0.408 | **0.072** | *191* | 34 | 850 | **256** | *191* | 3 | 119 | **36** | *199* | 21 | 268 | **84** | *199* | 12 | 198 | **66** |
| **2015** | *40* | <0.002 | 0.031 | **0.0040** | *40* | <0.001 | 0.977 | **0.175** | *40* | 43 | 801 | **303** | *40* | 4 | 93 | **35** | *40* | 31 | 244 | **107** | *40* | 14 | 151 | **70** |
| **2016** | *33* | <0.002 | 0.032 | **0.0050** | *33* | <0.001 | 0.396 | **0.117** | *33* | 43 | 885 | **276** | *33* | 4 | 53 | **25** | *33* | 30 | 241 | **90** | *33* | 13 | 155 | **68** |
| **2017** | *31* | <0.002 | 0.261 | **0.0168** | *31* | <0.001 | 0.397 | **0.084** | *31* | 49 | 740 | **262** | *31* | 5 | 83 | **27** | *31* | 30 | 195 | **85** | *31* | 13 | 153 | **65** |
| ***Percent Reduction 2002-2011 to 2017*** | | | | ***-227%*** | | | | ***-17%*** | | | | ***-2%*** | | | | ***24%*** | | | | ***-1%*** | | | | ***1%*** |
| **North of Lamping Field** | | | | | | | | | | | | | | | | | | | | | | | | |
| **2002-2011 Average** | *45* | <0.002 | 0.005 | **0.0020** | *46* | <0.001 | 0.082 | **0.027** | *44* | 41 | 370 | **140** | *44* | 4 | 41 | **15** | *45* | 28 | 129 | **61** | *45* | 17 | 58 | **30** |
| **2015** | *32* | <0.002 | 0.005 | **0.0020** | *32* | <0.001 | 0.073 | **0.030** | *32* | 45 | 244 | **144** | *32* | 4 | 25 | **14** | *32* | 30 | 99 | **65** | *32* | 15 | 48 | **31** |
| **2016** | *35* | <0.002 | 0.005 | **0.0020** | *35* | <0.001 | 0.078 | **0.032** | *35* | 43 | 244 | **147** | *35* | 4 | 24 | **14** | *35* | 30 | 98 | **66** | *35* | 15 | 48 | **31** |
| **2017** | *24* | <0.002 | 0.004 | **0.0016** | *24* | <0.001 | 0.069 | **0.022** | *24* | 48 | 250 | **128** | *24* | 4.6 | 23 | **13** | *24* | 30 | 103 | **59** | *24* | 14 | 48 | **29** |
| ***Percent Reduction 2002-2011 to 2017*** | | | | ***21%*** | | | | ***20%*** | | | | ***9%*** | | | | ***14%*** | | | | ***3%*** | | | | ***4%*** |
| **CAMU Wells** | | | | | | | | | | | | | | | | | | | | | | | | |
| **2002-2011 Average** | *246* | <0.005 | 0.200 | **0.0160** | *186* | <0.001 | 0.012 | **0.003** | *246* | 8 | 210 | **72** | *246* | 1 | 80 | **12** | *246* | 15 | 142 | **62** | *246* | 17 | 60 | **27** |
| **2015** | *22* | 0.003 | 0.051 | **0.0120** | *22* | <0.001 | 0.009 | **0.003** | *22* | 25 | 193 | **98** | *22* | 1 | 44 | **18** | *22* | 19 | 122 | **69** | *22* | 19 | 61 | **30** |
| **2016** | *11* | 0.003 | 0.055 | **0.0130** | *11* | <0.001 | 0.012 | **0.003** | *11* | 30 | 212 | **109** | *11* | 1 | 42 | **18** | *11* | 20 | 127 | **68** | *11* | 19 | 57 | **29** |
| **2017** | *10* | <0.002 | 0.072 | **0.0134** | *10* | <0.001 | 0.010 | **0.002** | *10* | 35 | 222 | **115** | *10* | 6 | 39 | **20** | *10* | 35 | 124 | **70** | *10* | 24 | 59 | **31** |
| ***Percent Reduction 2002-2011 to 2017*** | | | | ***16%*** | | | | ***18%*** | | | | ***-60%*** | | | | ***-70%*** | | | | ***-13%*** | | | | ***-14%*** |

Plant Site wells include: DH-8, DH-17, DH-20, DH-42, DH-47, DH-59, DH-64, DH-66, SDMW-2

Slag Pile Area wells include: DH-6, DH-15, DH-52, DH-53, DH-55, DH-56, DH-68, DH-69, DH-74, DH-75, DH-76 (DH-53, DH-74, DH-75, and DH-76 were not sampled in 2017)

East Helena Area wells include: EH-50, EH-51, EH-52, EH-53, EH-54, EH-58, EH-59, EH-60, EH-61, EH-62, EH-63, EH-65, EH-69, EH-100, EH-101, EH-102, EH-103, EH-104, EH-106, EH-107, EH-110, EH-111, EH-115

Lamping Field wells include: EH-57A, EH-70, EH-114, EH-117, EH-118, EH-119, EH-120, EH-123, EH-124, EH-125, EH-126, EH-129, EH-132, EH-134, EH-135, EH-206

North of Lamping Field wells include: EH-130, EH-138, EH-139, EH-140, EH-141, EH-142, EH-143, EH-144S, EH-144M, EH-144D, 2843 Canyon Ferry, 2853 Canyon Ferry

CAMU Wells include: MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11 (MW-7 was not sampled in 2017)

2002-2011 Average represents post smelter shutdown to pre-IM period

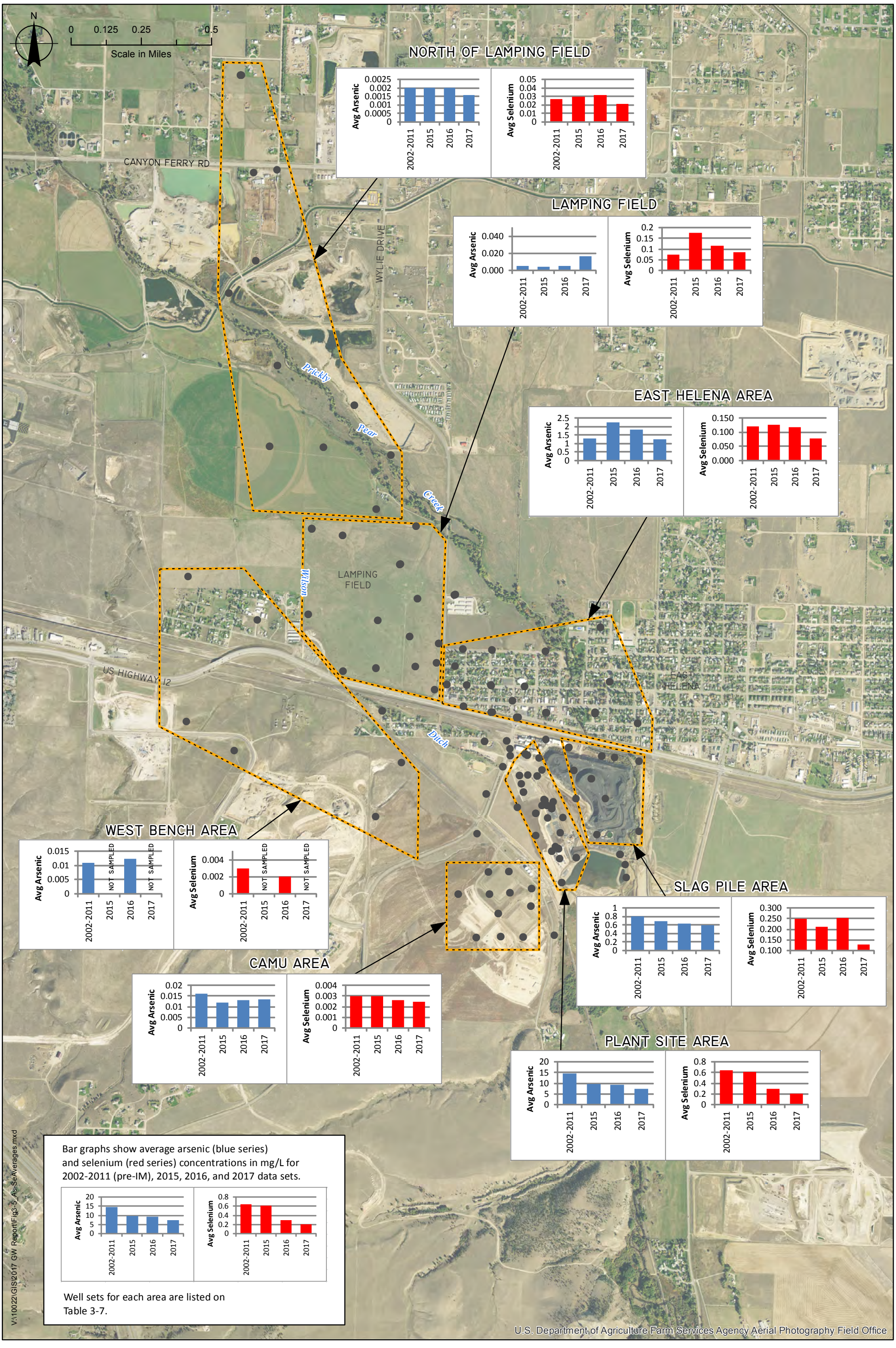
All concentrations in mg/L. Below detect values replaced with 1/2 detection limit for calculation of mean.

n = number of samples; quality control samples (splits and duplicates) not included in statistics.

ND = no data for indicated period.

Well locations shown on Exhibit 1.

Complete 2017 water quality data included in Appendix A.




| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | AVERAGE ARSENIC AND SELENIUM CONCENTRATIONS 2002-2011, 2015, 2016, AND 2017 | FIGURE 3-5 |
|---|---|---|

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- North of Lamping Field (12 wells north of Lamping Field, from the irrigated agricultural fields south of Prickly Pear Creek to the furthest northern set of monitoring wells north of Canyon Ferry Road); and
- CAMU Wells (11 wells associated with the Phase I and Phase II CAMUs southwest of the Facility).

The highest average concentrations of arsenic and selenium occur on the former Plant Site, reflecting ongoing loading of contaminants to groundwater from historic releases and secondary sources. Average concentrations have decreased from the 2002-2011 pre-IM period to 2017, however, with average arsenic concentrations decreasing from 14.4 mg/L to 7.47 mg/L, or 48%, and average selenium concentrations decreasing from 0.642 mg/L to 0.208 mg/L or 68% (Table 3-5, Figure 3-5). In the slag pile area, average arsenic concentrations have also decreased from 0.803 mg/L in 2002-2011 to 0.602 mg/L in 2017 (25%), and average selenium concentrations have decreased from 0.250 mg/L to 0.127 mg/L (49%). These results indicate that, although current concentrations remain well above background levels in portions of the Facility, implementation of IMs beginning in 2011 has reduced overall average groundwater contaminant concentrations beneath the Facility.

Downgradient of the Facility, average arsenic and selenium concentrations in East Helena have fluctuated from the 2002-2011 pre-IM period through 2016 before decreasing in 2017. For example, arsenic concentrations increased from 1.29 mg/L to 2.25 mg/L before decreasing to 1.27 mg/L in 2017 (a net 2% decrease) while selenium concentrations in the East Helena area groundwater have decreased from 0.120 to 0.077 mg/L over this same period or 36% (Table 3-5). Further downgradient in Lamping Field, average arsenic and selenium concentrations have increased since the 2002-2011 pre-IM period (Table 3-5). The variability in average contaminant concentrations in these near downgradient areas is attributed to a westward shift in the downgradient plumes and the elimination of dilution from ditch leakage associated with the decommissioning of Wilson Ditch in 2011.

North of Lamping Field, arsenic and selenium concentrations show measureable net decreases as of 2017, with concentrations of both contaminants decreasing about 20% (and both contaminants below the applicable drinking water standards). Average arsenic and selenium concentrations in CAMU area wells have also shown modest decreases of less than 20% during this period (Table 3-5). 2017 arsenic concentrations in the CAMU wells (ranging from <0.002 to 0.072 mg/L) are influenced by natural background arsenic concentrations associated with Tertiary volcanoclastic sediments west of the Facility.

#### 3.2.2.2 Residential/Public Water Supply Sampling Results

The 2017 residential/public water supply well sampling schedule is included in Table 2-6 with the water quality data summarized in Table 3-6. Complete water supply well analytical results for 2017 are included in Appendix A. Residential well locations are shown on Exhibit 1.

Table 3-6 includes a statistical summary of the 2017 arsenic and selenium concentrations along with an exceedance summary of State of Montana HHSs for groundwater (MDEQ, 2017). As shown in the table, no water supply wells exhibited HHS exceedances for selenium in 2017, while four of the twenty wells sampled showed HHS exceedances for arsenic, consistent with previous results for these

## Table 3-6. Summary of 2017 Residential/Public Water Supply Well Water Quality Data -- East Helena Facility

| Map Key (see Exhibit 1) | Use | # of 2017 Samples | Dissolved Arsenic (mg/L) | | | | | Dissolved Selenium (mg/L) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Concentration | | | HHS Exceedances | | Concentration | | | HHS Exceedances | |
| | | | Min | Max | Mean | No. | % | Min | Max | Mean | No. | % |
| R1 | Drinking/Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R2 | Irrigation | 3 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.002 | 0.002 | 0.002 | 0 | 0% |
| R3 | Drinking | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.001 | 0.003 | 0.002 | 0 | 0% |
| R4 | Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.004 | 0.004 | 0.004 | 0 | 0% |
| R5 | Drinking/Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R6 | Drinking/Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.002 | 0.003 | 0.0025 | 0 | 0% |
| R7 | Drinking/Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.002 | 0.002 | 0.002 | 0 | 0% |
| R8 | Drinking/Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R9 | Drinking/Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R10 | Irrigation | 1 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.002 | 0.002 | 0.002 | 0 | 0% |
| R11 | Drinking/Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.036 | 0.038 | 0.037 | 0 | 0% |
| R12 | Drinking/Irrigation | 3 | <0.002 | <0.002 | <0.002 | 0 | 0% | 0.002 | 0.003 | 0.0027 | 0 | 0% |
| R13 | Drinking/Irrigation | 2 | 0.013 | 0.013 | 0.013 | 2 | 100% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R14 | Irrigation | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R15 | Drinking/Irrigation | 2 | 0.015 | 0.016 | 0.0155 | 2 | 100% | 0.002 | 0.002 | 0.002 | 0 | 0% |
| R16 | Drinking/Irrigation | 2 | 0.016 | 0.016 | 0.016 | 2 | 100% | 0.002 | 0.002 | 0.002 | 0 | 0% |
| R17 | Drinking/Irrigation | 2 | 0.016 | 0.017 | 0.0165 | 2 | 100% | 0.002 | 0.002 | 0.002 | 0 | 0% |
| R18 | Public Water Supply | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R19 | Public Water Supply | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |
| R20 | Public Water Supply | 2 | <0.002 | <0.002 | <0.002 | 0 | 0% | <0.001 | <0.001 | <0.001 | 0 | 0% |

All concentrations are dissolved fraction.

HHS - Human Health Standard from MDEQ, 2017: arsenic =0.010 mg/L, selenium 0.050 mg/L

wells. There were no exceedances recorded in 2017 or in previous years at the three COEH municipal water supply wells located north of the Facility (Well IDs R18, R19, and R20 in Table 3-6).

#### 3.2.2.3 2017 Low Flow Purge Method Assessment

Groundwater monitoring activities generate purge water that must be appropriately managed. Past practice consisted of containing all purge water and discharging it to the Facility water treatment facility. With the decommissioning of the plant in 2016, alternative purge water handling and disposal methods have been explored. The current approach includes: (1) discharge of purge water from wells not exceeding water quality standards, and not located within the City of East Helena or on the Facility, onto the ground near the well; and (2) containing purge water from other wells and transferring it to the million-gallon water tanks at the south end of the slag pile, for storage and eventual off-site disposal.

The Custodial Trust is also evaluating the option of minimizing the amount of purge water generated during future sampling by transitioning from standard well purge methods (which typically remove 3 to 5 well volumes of water prior to sampling) to low-flow or low-stress well purge methods (which typically remove 1 to 3 gallons of water prior to sampling, and are based on stabilization of both water level drawdown and field parameter measurements). One of the primary concerns when transitioning from standard purge to low-flow purge groundwater sampling methods is ensuring that the different purge methods yield similar and representative groundwater samples, and thus that the data obtained using the two different methods is comparable. To assess the applicability of low-flow sampling to the East Helena groundwater monitoring program, comparisons of standard and low-flow sampling have been conducted during multiple East Helena monitoring events, including: three wells during the August 2016 monitoring event; 12 wells during the October 2016 monitoring event; and eight wells during the June 2017 monitoring event. These data are intended to provide information to evaluate the potential advantages and/or disadvantages of transitioning to low flow sampling for all future groundwater sampling.

Groundwater samples using both low-flow and standard purge methods were collected at suites of monitoring wells selected to cover a range of groundwater arsenic and selenium concentrations, as well as a range of standard purge volumes. Low-flow samples were collected first, followed by standard purge samples. The wells sampled using both low-flow and standard purge methods in June 2017 included DH-64, EH-65, EH-70, EH-107, EH-111, EH-115, EH-125, and EH-126 (see Exhibit 1). The results for samples collected using the two purge methods at each well are summarized in Table 3-7, including total purge volumes, final field parameter measurements, and laboratory analytical results. Consistent with the 2016 results, the 2017 results indicate that the low-flow and standard purge methods yielded very similar results for the majority of field and laboratory parameters. The difference in purge volumes between the two methods is considerable, with June 2017 low-flow purge volumes ranging from 1.3 to 5.3 gallons (total 24 gallons), and standard purge volumes ranging from 5 to 30 gallons (total 114 gallons). The low-flow purge method therefore generated approximately 79% less purge water in June 2017; previous results (Hydrometrics, 2017a) showed that the low-flow purge method generated 94% less purge water in August 2016 and 86% less purge water in October 2016.

## Table 3-7. 2017 Well Purge Method Comparison Results

| | | | Field Parameters | | | | | | | General Chemistry | | | | | Major Ions | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station ID | Sample Date | Total Purge Volume (gal) | pH (s.u.) | SC (µmhos/cm) | Diss O2 (mg/L) | ORP (mV) | EH (mV) | Turbidity (NTU) | Water Temp (°C) | Lab pH (s.u.) | Lab SC (µmhos/cm) | Total Alkalinity as CaCO3 | Total Suspended Solids | Total Dissolved Solids | Calcium | Magnesium | Sodium | Potassium | Bicarbonate | Chloride | Sulfate |
| DH-64 (Low Flow) | 6/21/2017 | 2 | 6.86 | 1091 | 0.75 | -18 | 192 | 2.7 | 15.6 | 7 | 1170 | 220 | 10 U | 767 | 50 | 16 | 170 | 13 | 270 | 17 | 310 |
| DH-64 (Standard) | 6/21/2017 | 15 | 6.85 | 1087 | 0.22 | -19 | 194 | 1.7 | 12.7 | 7 | 1170 | 220 | 10 U | 772 | 50 | 16 | 169 | 13 | 270 | 17 | 300 |
| **RPD** | | | **0.1%** | **0.4%** | **109.3%** | **5.4%** | **1.0%** | **45.5%** | **20.5%** | **0.0%** | **0.0%** | **0.0%** | **NC** | **0.6%** | **0.0%** | **0.0%** | **0.6%** | **0.0%** | **0.0%** | **0.0%** | **3.3%** |
| EH-107 (Low Flow) | 6/28/2017 | 1.3 | 6.73 | 1603 | 0.7 | 169 | 382 | 1.4 | 13.3 | 6.9 | 1690 | 180 | 10 U | 1200 | 158 | 35 | 172 | 7 | 220 | 36 | 620 |
| EH-107 (Standard) | 6/28/2017 | 30 | 6.7 | 1630 | 0.11 | 127 | 341 | 0.9 | 12.2 | 6.9 | 1700 | 180 | 12 | 1250 | 160 | 35 | 174 | 7 | 220 | 36 | 620 |
| **RPD** | | | **0.4%** | **1.7%** | **145.7%** | **28.4%** | **11.3%** | **43.5%** | **8.6%** | **0.0%** | **0.6%** | **0.0%** | **NC** | **4.1%** | **1.3%** | **0.0%** | **1.2%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** |
| EH-111 (Low Flow) | 6/28/2017 | 1.3 | 6.51 | 1610 | 0.23 | 116 | 328 | 4.9 | 14.2 | 6.7 | 1630 | 150 | 32 | 1170 | 101 | 28 | 211 | 10 | 180 | 30 | 600 |
| EH-111 (Standard) | 6/28/2017 | 10 | 6.47 | 1516 | 0.1 | 125 | 340 | 1.1 | 11.9 | 6.7 | 1560 | 150 | 10 U | 1110 | 98 | 26 | 206 | 9 | 180 | 29 | 570 |
| **RPD** | | | **0.6%** | **6.0%** | **78.8%** | **7.5%** | **3.6%** | **126.7%** | **17.6%** | **0.0%** | **4.4%** | **0.0%** | **NC** | **5.3%** | **3.0%** | **7.4%** | **2.4%** | **10.5%** | **0.0%** | **3.4%** | **5.1%** |
| EH-115 (Low Flow) | 6/23/2017 | 3.3 | 6.51 | 1117 | 0.82 | 103 | 314 | 3.9 | 15.5 | 6.6 | 1100 | 180 | 21 | 803 | 81 | 22 | 130 | 6 | 220 | 28 | 370 |
| EH-115 (Standard) | 6/23/2017 | 10 | 6.49 | 1116 | 0.41 | 127 | 342 | 1 | 12 | 6.6 | 1100 | 180 | 10 U | 808 | 80 | 22 | 131 | 6 | 220 | 26 | 380 |
| **RPD** | | | **0.3%** | **0.1%** | **66.7%** | **20.9%** | **8.5%** | **118.4%** | **25.5%** | **0.0%** | **0.0%** | **0.0%** | **NC** | **0.6%** | **1.2%** | **0.0%** | **0.8%** | **0.0%** | **0.0%** | **7.4%** | **2.7%** |
| EH-125 (Low Flow) | 6/23/2017 | 3.3 | 7.01 | 515 | 4.77 | 98 | 312 | 1.4 | 11.9 | 7.1 | 530 | 110 | 10 | 344 | 34 | 9 | 56 | 3 | 140 | 9.9 | 140 |
| EH-125 (Standard) | 6/23/2017 | 22 | 7.01 | 420 | 4.69 | 119 | 335 | 1.1 | 10.7 | 7.1 | 430 | 100 | 10 U | 275 | 31 | 8 | 42 | 3 | 120 | 8.2 | 99 |
| **RPD** | | | **0.0%** | **20.3%** | **1.7%** | **19.4%** | **7.1%** | **24.0%** | **10.6%** | **0.0%** | **20.8%** | **9.5%** | **NC** | **22.3%** | **9.2%** | **11.8%** | **28.6%** | **±RL** | **15.4%** | **18.8%** | **34.3%** |
| EH-126 (Low Flow) | 6/22/2017 | 4 | 7.25 | 1044 | 7.24 | 81 | 293 | 4.8 | 13.4 | 7.4 | 1080 | 200 | 76 | 773 | 112 | 53 | 45 | 4 | 240 | 41 | 300 |
| EH-126 (Standard) | 6/22/2017 | 11 | 7.16 | 1103 | 5.69 | 105 | 320 | 1.3 | 11 | 7.4 | 1130 | 200 | 10 U | 818 | 118 | 49 | 52 | 4 | 240 | 39 | 330 |
| **RPD** | | | **1.2%** | **5.5%** | **24.0%** | **25.8%** | **8.8%** | **114.8%** | **19.7%** | **0.0%** | **4.5%** | **0.0%** | **NC** | **5.7%** | **5.2%** | **7.8%** | **14.4%** | **±RL** | **0.0%** | **5.0%** | **9.5%** |
| EH-65 (Low Flow) | 6/23/2017 | 5.3 | 6.48 | 1631 | 0.3 | 144 | 354 | 6.7 | 15.5 | 6.6 | 1700 | 170 | 14 | 1200 | 117 | 31 | 196 | 10 | 210 | 60 | 630 |
| EH-65 (Standard) | 6/23/2017 | 5 | 6.46 | 1616 | 0.41 | 153 | 367 | 1.4 | 12.3 | 6.6 | 1600 | 170 | 10 U | 1190 | 114 | 30 | 197 | 10 | 200 | 61 | 630 |
| **RPD** | | | **0.3%** | **0.9%** | **31.0%** | **6.1%** | **3.6%** | **130.9%** | **23.0%** | **0.0%** | **6.1%** | **0.0%** | **NC** | **0.8%** | **2.6%** | **3.3%** | **0.5%** | **0.0%** | **4.9%** | **1.7%** | **0.0%** |
| EH-70 (Low Flow) | 6/23/2017 | 4 | 6.96 | 869 | 6.93 | 138 | 352 | 3.6 | 12.6 | 7.1 | 870 | 140 | 13 | 581 | 62 | 21 | 85 | 4 | 170 | 18 | 280 |
| EH-70 (Standard) | 6/23/2017 | 11 | 6.96 | 858 | 6.97 | 149 | 365 | 2.1 | 10.8 | 7.1 | 880 | 140 | 10 U | 582 | 63 | 21 | 85 | 4 | 170 | 18 | 290 |
| **RPD** | | | **0.0%** | **1.3%** | **0.6%** | **7.7%** | **3.6%** | **52.6%** | **15.4%** | **0.0%** | **1.1%** | **0.0%** | **NC** | **0.2%** | **1.6%** | **0.0%** | **0.0%** | **±RL** | **0.0%** | **0.0%** | **3.5%** |

NOTES: (1) RPD = relative percent difference, calculated as [(|result 1 - result 2|)/(average of result 1 and result 2)] x 100

NC = not calculated - RPD value not calculated when one or both results are less than the reporting limit.

±RL = results agree to within ± the laboratory reporting limit; comparison used when one or both results are less than or equal to 5x the laboratory reporting limit.

Bold red font indicates RPD values >20%.

## Table 3-7. 2017 Well Purge Method Comparison Results

| Station ID | Sample Date | Total Purge Volume (gal) | Bromide | Dissolved (D) Metals | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sb (D) | As (D) | Cd (D) | Cu (D) | Fe (D) | Pb (D) | Mn (D) | Hg (D) | Se (D) | Tl (D) | Zn (D) |
| DH-64 (Low Flow) | 6/21/2017 | 2 | 1.6 | 0.003 U | 12.9 | 0.013 | 0.001 | 0.67 | 0.005 U | 2.92 | 0.001 U | 0.001 U | 0.001 U | 0.18 |
| DH-64 (Standard) | 6/21/2017 | 15 | 1.6 | 0.003 U | 12.7 | 0.013 | 0.002 | 0.65 | 0.005 U | 2.9 | 0.001 U | 0.001 U | 0.001 U | 0.18 |
| **RPD** | | | **0.0%** | **NC** | **1.6%** | **0.0%** | **±RL** | **3.0%** | **NC** | **0.7%** | **NC** | **NC** | **NC** | **0.0%** |
| EH-107 (Low Flow) | 6/28/2017 | 1.3 | 1.1 | 0.003 U | 0.002 U | 0.001 U | 0.001 U | 0.08 | 0.005 U | 0.07 | 0.001 U | 0.238 | 0.001 U | 0.01 U |
| EH-107 (Standard) | 6/28/2017 | 30 | 1.1 | 0.003 U | 0.002 U | 0.001 U | 0.001 U | 0.02 U | 0.005 U | 0.07 | 0.001 U | 0.257 | 0.001 U | 0.01 U |
| **RPD** | | | **0.0%** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **0.0%** | **NC** | **7.7%** | **NC** | **NC** |
| EH-111 (Low Flow) | 6/28/2017 | 1.3 | 1.8 | 0.003 U | 1.94 | 0.001 U | 0.003 | 0.13 | 0.005 U | 8.53 | 0.001 U | 0.136 | 0.001 U | 0.01 U |
| EH-111 (Standard) | 6/28/2017 | 10 | 1.8 | 0.003 U | 1.71 | 0.001 U | 0.001 | 0.02 U | 0.005 U | 6.08 | 0.001 U | 0.122 | 0.001 U | 0.01 U |
| **RPD** | | | **0.0%** | **NC** | **12.6%** | **NC** | **>±RL** | **NC** | **NC** | **33.5%** | **NC** | **10.9%** | **NC** | **NC** |
| EH-115 (Low Flow) | 6/23/2017 | 3.3 | 1.6 | 0.003 U | 1.29 | 0.001 U | 0.002 | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.019 | 0.001 U | 0.01 U |
| EH-115 (Standard) | 6/23/2017 | 10 | 1.7 | 0.003 U | 1.55 | 0.001 U | 0.002 | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.012 | 0.001 U | 0.01 U |
| **RPD** | | | **6.1%** | **NC** | **18.3%** | **NC** | **±RL** | **NC** | **NC** | **NC** | **NC** | **45.2%** | **NC** | **NC** |
| EH-125 (Low Flow) | 6/23/2017 | 3.3 | 0.1 | 0.003 U | 0.002 U | 0.001 U | 0.001 U | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.396 | 0.001 U | 0.01 U |
| EH-125 (Standard) | 6/23/2017 | 22 | 0.068 | 0.003 U | 0.002 U | 0.001 U | 0.001 U | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.391 | 0.001 U | 0.01 U |
| **RPD** | | | **±RL** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **1.3%** | **NC** | **NC** |
| EH-126 (Low Flow) | 6/22/2017 | 4 | 1.7 | 0.003 U | 0.003 | 0.001 U | 0.001 U | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.163 | 0.001 U | 0.01 U |
| EH-126 (Standard) | 6/22/2017 | 11 | 1.8 | 0.003 U | 0.002 | 0.001 U | 0.001 U | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.154 | 0.001 U | 0.01 U |
| **RPD** | | | **5.7%** | **NC** | **±RL** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **5.7%** | **NC** | **NC** |
| EH-65 (Low Flow) | 6/23/2017 | 5.3 | 1.2 | 0.003 U | 0.271 | 0.001 U | 0.002 | 0.02 U | 0.005 U | 2.21 | 0.001 U | 0.158 | 0.001 U | 0.01 U |
| EH-65 (Standard) | 6/23/2017 | 5 | 1.2 | 0.003 U | 0.285 | 0.001 U | 0.002 | 0.02 U | 0.005 U | 2.09 | 0.001 U | 0.154 | 0.001 U | 0.01 U |
| **RPD** | | | **0.0%** | **NC** | **5.0%** | **NC** | **±RL** | **NC** | **NC** | **5.6%** | **NC** | **2.6%** | **NC** | **NC** |
| EH-70 (Low Flow) | 6/23/2017 | 4 | 0.41 | 0.003 U | 0.002 U | 0.001 U | 0.001 U | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.057 | 0.001 U | 0.01 U |
| EH-70 (Standard) | 6/23/2017 | 11 | 0.42 | 0.003 U | 0.002 U | 0.001 U | 0.001 U | 0.02 U | 0.005 U | 0.01 U | 0.001 U | 0.058 | 0.001 U | 0.01 U |
| **RPD** | | | **2.4%** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **1.7%** | **NC** | **NC** |

NOTES: (1) RPD = relative percent difference, calculated as [(|result 1 - result 2|)/(average of result 1 and result 2)] x 100

NC = not calculated - RPD value not calculated when one or both results are less than the reporting limit.

±RL = results agree to within ± the laboratory reporting limit; comparison used when one or both results are less than or equal to 5x the laboratory reporting limit.

Bold red font indicates RPD values >20%.

As a quantitative measure of data comparability, relative percent difference (RPD) values were calculated for the field and laboratory results obtained using the two different purge methods. RPD values are typically used as part of data validation procedures to compare replicate samples (sample-duplicate pair results) for evaluating data precision (reproducibility). For low concentration data, when analytical results are within five times the laboratory reporting limit, RPD values are not calculated; instead, the difference between replicate results is compared directly with the reporting limit. USEPA guidelines for comparing replicate samples specify control limits of <20% RPD for sample results greater than five times the laboratory reporting limit, and ± the reporting limit for sample results less than or equal to five times the laboratory reporting limit.

Direct comparison of analytical results, along with the RPD and reporting limit comparisons for the low-flow and standard purge results shows generally good comparability between the purge methods for most wells.

For 2017 general chemistry parameters, 38 out of 40 total comparisons were within the criteria; for major ions, 62 out of 64 total comparisons were within the criteria; and for dissolved metals, 85 out of 88 total comparisons were within the criteria (see Table 3-7; note that most dissolved metals concentrations were below reporting limits). Combining the 2017 results reported in Table 3-7 with the 2016 purge method comparison results (Hydrometrics, 2017a), the complete purge method comparison results indicate that 96% of the general chemistry comparisons, 96% of the major ion comparisons, and 97% of the dissolved metals comparisons were within the comparison criteria. These results indicate that the differences between the low-flow and standard purge groundwater samples in terms of laboratory analytical results were minimal at most wells. For field parameters, comparison of the low-flow and standard purge samples showed a higher degree of variability for some parameters compared with the laboratory results (Table 3-7). Field pH, SC, and Eh values were similar between the two methods; DO, ORP, turbidity, and water temperature values showed more variability.

Specific wells that have exhibited a higher degree of variability between the purge method results include: well EH-111 (arsenic RPD of 43.1% and manganese RPD of 51.5% in October 2016, manganese RPD of 33.5% in June 2017), well EH-125 (major ion RPDs of 13.3% to 72.2% and selenium RPD of 49.5% in October 2016, major ion RPDs of 9.2% to 34.3% in June 2017), and well EH-115 (arsenic RPD of 18.3% and selenium RPD of 45.2% in June 2017). At EH-111 and EH-125, lower concentrations were obtained from the standard purge samples compared with the low-flow purge samples, and at EH-115 higher concentrations were obtained from the standard purge samples (Table 3-7). The observed differences may be due to the effects of (1) drawing in greater volumes of either more dilute or higher concentration groundwater under standard purge conditions, and/or (2) local variability in plume width or thickness, or greater vertical variability in contaminant concentrations at certain wells.

Overall, the 2016 and 2017 purge method comparison indicated good comparability for the majority of constituents and wells. The differences observed for critical parameters such as arsenic and selenium at several wells, however, suggest that method comparability may need further evaluation before a transition to exclusively low-flow techniques (or other purge volume minimization methods)

for groundwater sampling on the East Helena Project is considered. As the refinement of the performance monitoring program continues and the scope of monitoring is narrowed to a smaller subset of monitoring points, a well-by-well comparison of purge methods may be warranted to support such a transition. Additional comparisons would be desirable to ensure data comparability with the established data set, and the accurate tracking of groundwater quality responses to remedial measures.

# 4.0 GROUNDWATER DATA ANALYSIS AND PLUME STATUS EVALUATION

This section presents a summary of the current groundwater quality conditions and trends, and the status of the groundwater arsenic and selenium plumes. With completion of the scheduled IMs in 2016, the CAMP program has transitioned from a contaminant source area characterization and plume delineation program, to a remedy performance monitoring program appropriate to the remediation and CMS phase of a RCRA Corrective Action remediation project (Hydrometrics, 2017b). In their *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action* (USEPA, 2004a), USEPA 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 USEPA guidance on groundwater remediation completion strategies (USEPA, 2013, 2014a, 2014b) includes a discussion of recommended remedy evaluation (performance monitoring) strategies. Based on these guidance documents, and goals and objectives specific to the East Helena Project, the performance monitoring program outlined in 2017 included two components:

(1) Groundwater level and contaminant concentration trend analyses at selected wells in Facility contaminant source areas, and near the leading edge of the selenium plume; and
(2) Contaminant plume stability analyses.

Following is a summary of current groundwater conditions in the Project area, followed by discussions of the two performance monitoring components.

## 4.1 GENERAL GROUNDWATER CONDITIONS

The hydrogeology and geochemistry of the East Helena Facility and Project Area has been described in several documents including Hydrometrics, 2010, 2015a, and 2016b; GSI, 2014; and CH2MHill 2012. The alluvial aquifer on the Facility, referred to as the Upper Aquifer, extends from the top of the saturated zone or water table, downward to a low permeability tertiary ash/clay basal layer. On the Facility, the depth to groundwater varies from less than 10 feet bgs in the south and near Prickly Pear Creek, to about 50 feet bgs in the northwest portion of the Facility. The base of the aquifer (the ash/clay layer) varies in depth from about 20 feet bgs in the southwest portion of the Facility, to more than 70 feet in the northeast portion. As a result, the saturated thickness of the alluvial aquifer ranges from about 10 feet in the south, to about 20 feet in the north of the Facility. A deeper groundwater system also occurs beneath the Facility with the deeper system comprised of isolated to poorly interconnected sandy lenses or zones within the Tertiary ash/clay layer. The contaminated soils and fill and groundwater plumes are restricted to the upper alluvial aquifer.

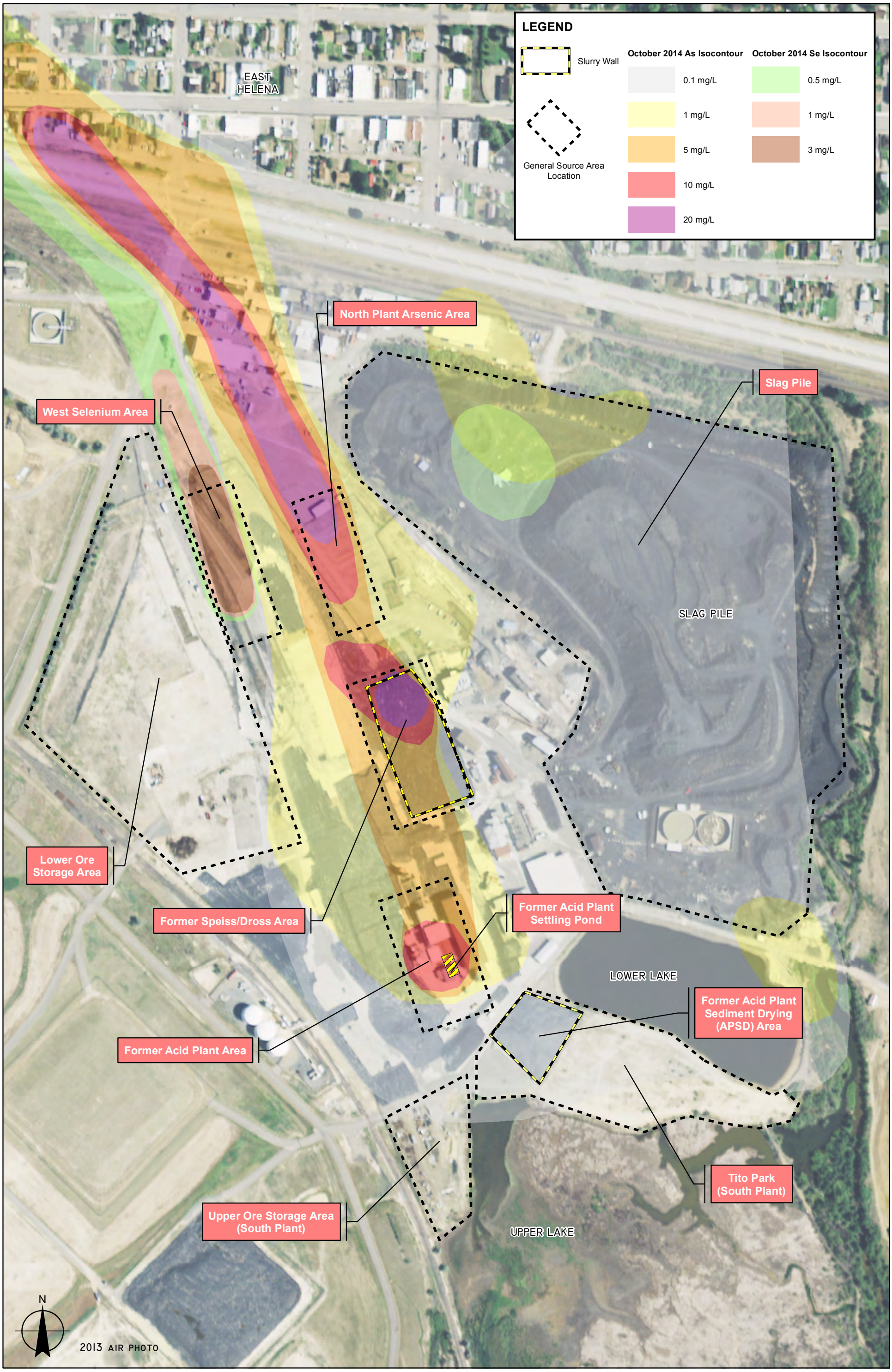
As previously noted, the primary groundwater constituents of concern (COCs) are arsenic and selenium, both of which exceed applicable HHSs in groundwater beneath and downgradient of the Facility. Secondary COCs exceeding HHSs in localized portions of the Facility, and rarely if ever in downgradient groundwater, include antimony, and cadmium (GSI, 2014). The 2017 arsenic and selenium groundwater plumes are shown on Figures 3-2 and 3-3, respectively.

Groundwater contaminant source areas have been delineated through a number of studies dating back more than two decades, with the two most recent investigations presented in Hydrometrics 2015b and

2016a. Based on results of prior investigations, confirmed or suspected historic groundwater contaminant sources include the South Plant Area (Tito Park and Upper Ore Storage Area), the former Acid Plant Area, former Speiss/Dross Area and former Lower Ore Storage Area (Figure 4-1). Some of the historic source areas have been addressed through remedial actions such as construction of slurry walls around the Speiss/Dross Area and the Acid Plant sediment drying area. Based on the 2014 and 2015 Source Area Investigations (SAIs), primary contaminant source areas as of 2014 included portions of the South Plant Area, the former Acid Plant settling pond area, the West Selenium Source Area and the North Plant Arsenic Source Area. The West Selenium and North Plant Arsenic source areas are secondary sources, where contaminants have accumulated on the aquifer matrix and are now desorbing or resolubilizing into groundwater, possibly due to post-operational changes in groundwater redox and/or pH conditions. The SPHC and ET Cover IMs are intended to address these source areas. The Acid Plant and South Plant source areas were targeted through the localized source removal IMs. Based on more recent analyses (Hydrometrics, 2016b), portions of the slag pile have also been identified as a current groundwater contaminant source area, particularly for selenium. The Draft CMS Report (CH2M, 2018) identifies an engineered control in the form of a cover over (at a minimum) the unfumed slag portion of the slag pile as one of the final corrective measures for the Facility. Conceptual designs are presented in the CMS Report, with the final design of the cover to be developed during Corrective Measures Implementation (CMI).

The configuration and geometry of the current arsenic plume (Figure 3-2) indicates that the primary plant site plume extends approximately 0.5 miles northwest of the Facility into the City of East Helena, with a more diffuse (lower concentration) plume extending north from the slag pile. Maximum concentrations near 100 mg/L arsenic occur isolated within the Speiss/Dross slurry wall, with maximum concentrations outside of the slurry wall currently in the 20 to 35 mg/L range in the North Plant Site Source Area (Figure 4-1). The downgradient boundary of the arsenic plume as defined by the 0.01 mg/L (HHS) concentration contour is located along the north and west edges of East Helena, and has remained relatively stable since at least 2001 when the Facility was shutdown. An area of groundwater HHS exceedances to the south and west of the former smelter (the "west arsenic area"), typically showing arsenic concentrations in the 0.005 to 0.025 mg/L range, is believed to be derived from groundwater interactions with naturally-occurring arsenic-bearing Tertiary-age volcanoclastic sediments.

The selenium plume (Figure 3-3) extends offsite significantly further than the arsenic plume, due to a lower rate of geochemical attenuation (adsorption or coprecipitation) and relatively conservative transport behavior of selenium. The conservative nature of selenium migration in groundwater is highlighted by the similarity of the selenium plume configuration to that of the sulfate plume (Figure 3-4), as sulfate generally exhibits limited retardation in groundwater. The 0.05 mg/L (HHS) selenium plume extends approximately 2.75 miles northwest of the Facility to Canyon Ferry Road. Lower selenium concentrations (below than the 0.05 mg/L groundwater HHS) extend north of Canyon Ferry Road, with concentrations of 0.023 to 0.029 mg/L observed at one of the northernmost monitoring wells (EH-144D) about three miles north of the Facility. The primary current groundwater selenium sources are the West Selenium Source Area (west lobe), and the slag pile (east lobe) (Figure 4-1).

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2017 WATER RESOURCES MONITORING REPORT
EAST HELENA FACILITY

**CURRENT AND HISTORIC GROUNDWATER CONTAMINANT SOURCE AREAS**

FIGURE

**4-1**

Current information indicates that the primary source of selenium in the slag pile is an area of unfumed slag generated following shutdown of the zinc plant in the early 1980s (Hydrometrics, 2016b). Current maximum selenium concentrations in the project area are 0.5 to 1 mg/L in the West Selenium Source Area and about 0.35 mg/L immediately downgradient of the slag pile. The plumes emanating from these areas merge in Lamping Field approximately 0.5 miles downgradient (northwest) of the Facility (Figure 3-3).

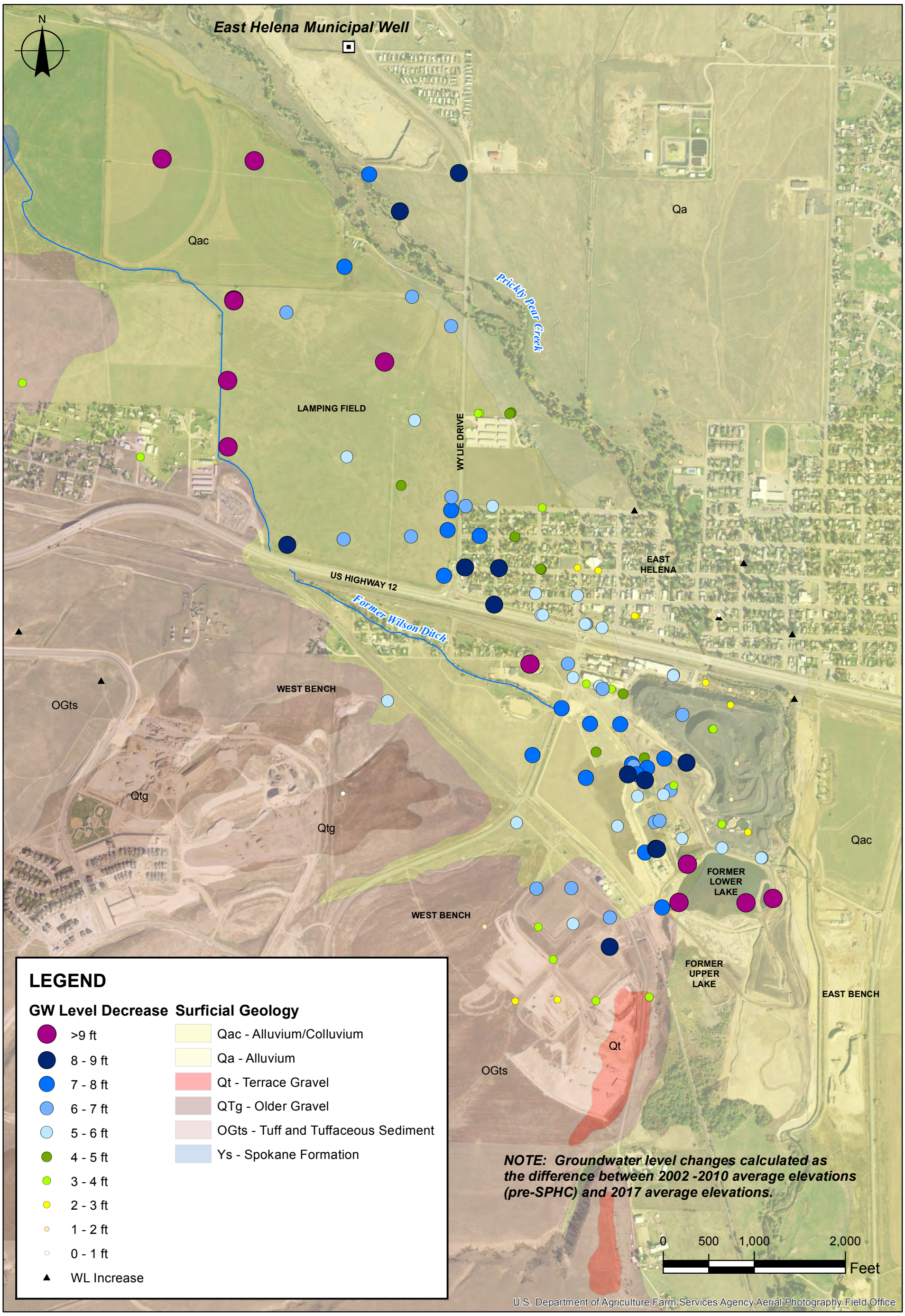
## 4.2 GROUNDWATER LEVEL AND CONCENTRATION TRENDS

### 4.2.1 Groundwater Level Trends

Groundwater level trends on the Facility are of particular interest since reducing groundwater levels is a large component of the corrective measures program. As previously noted the main objective of the SPHC IM is to reduce groundwater levels on the Facility, thereby reducing groundwater interaction with contaminated soils and associated contaminant leaching to groundwater. By reducing contaminant leaching to groundwater, groundwater contaminant loads and concentrations are expected to decrease, first in the source areas on the Facility, followed by reductions in downgradient portions of the groundwater plumes.

Figure 4-2 shows the magnitude of groundwater level changes throughout the project area since inception of the SPHC IM in November 2011. As shown in the figure, groundwater levels have declined most in the southern portion of the Facility and northwest of the Facility near Wilson Ditch. Notable water level changes illustrated on Figure 4-2 include:

- Groundwater levels have declined by 10 feet or more in the South Plant Area in response to the SPHC IM. Water levels in the former Lower Lake area have declined from about 3918 feet prior to 2011, to current levels of about 3905 feet.
- Water levels in the central portion of the Plant Site including the former Acid Plant and Speiss/Dross areas have declined by 5 to 9 feet, desaturating some of the most highly contaminated soils on the Facility.
- Groundwater levels beneath the slag pile have declined from 1 to 7 feet with the lower declines occurring beneath the east half of the pile. This illustrates the controlling influence of Prickly Pear Creek on groundwater levels in the far eastern portion of the Facility as compared to the western portion where groundwater levels were more influenced by recharge from former Upper Lake.
- Besides the South Plant Site, groundwater level declines were greatest northwest of the Facility near Highway 12 and Wylie Drive, and along the west side of Lamping Field adjacent to former Wilson Ditch (wells EH-132, EH-133, EH-134, Figure 4-2). The larger water level declines in this area are due to decommissioning of Wilson Ditch in 2012 and elimination of groundwater recharge from ditch leakage.

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| Hydrometrics, Inc. Consulting Scientists and Engineers<br>Date Saved: 4/30/2018 4:25:25 PM | 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | GROUNDWATER LEVEL CHANGES THROUGHOUT PROJECT AREA | FIGURE<br>4-2 |

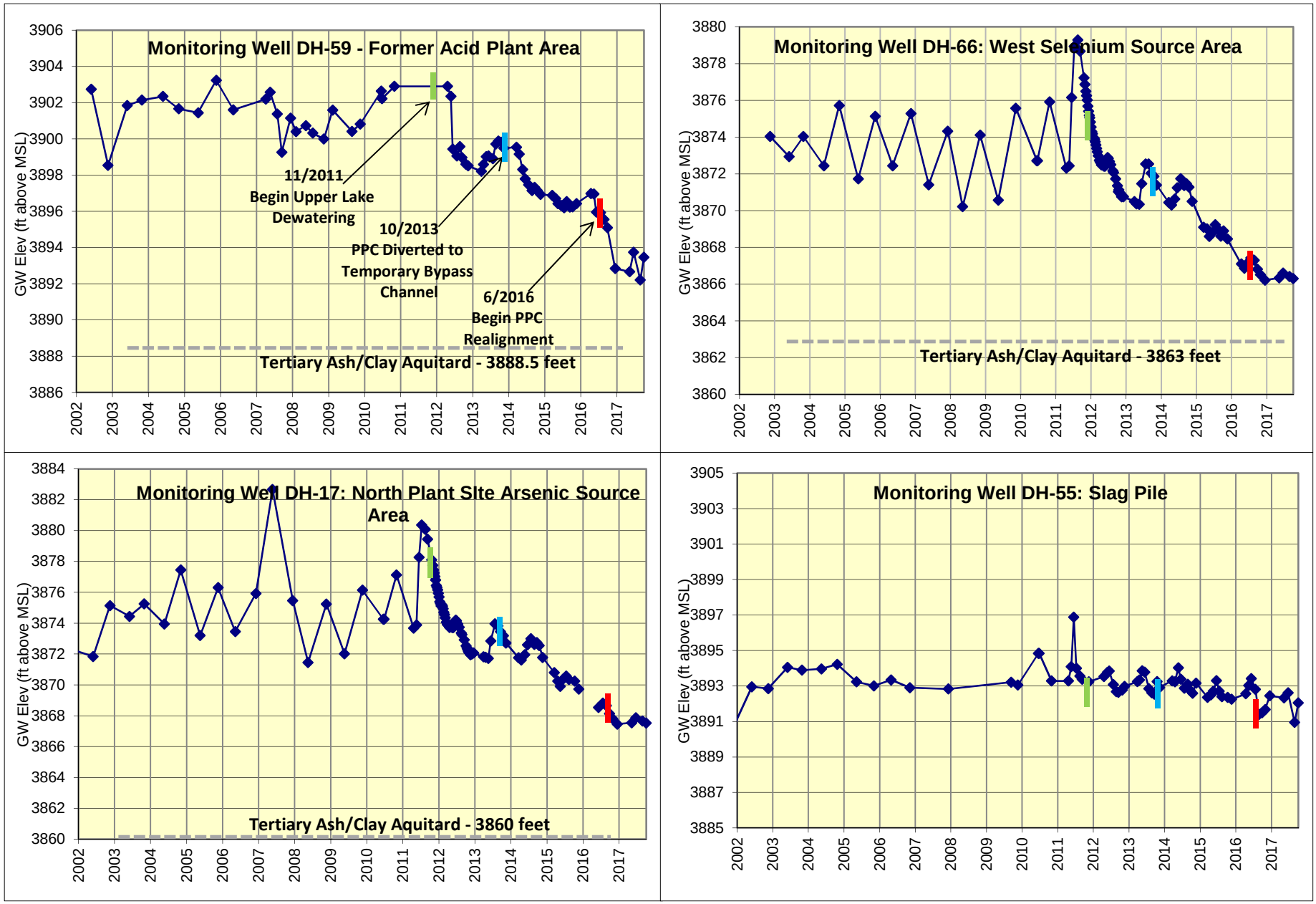
- Groundwater levels on the Facility generally decreased by one to two feet from 2016 to 2017 presumably due to further dewatering and excavation of the former Lower Lake area, and realignment of Prickly Creek in 2017. Groundwater levels north of the Facility (in and north of East Helena and Lamping Field) increased one to two feet from 2016 levels, most likely due to influences unrelated to the Facility such as precipitation, creek flows, and irrigation/water usage practices.

Figure 4-3 includes groundwater level hydrographs further illustrating groundwater level trends for various portions of the Facility. As shown in Figure 4-3, groundwater levels on the Facility have decreased in response to the various SPHC IM components and other IM-related activities. Water levels in the Acid Plant Area, illustrated by the well DH-59 hydrograph, have declined by close to 10 feet through 2017, desaturating some of the highest contaminant concentration soils on the Facility. The saturated thickness of the Upper Aquifer at this site, as measured from the top of the Tertiary ash/clay aquitard, has decreased from about 10 to 15 feet pre-SPHC to 4 to 5 feet. The hydrograph from Well DH-66 shows that water levels in the West Selenium Source Area have declined by 6 to 8 feet since inception of the SPHC IM, reducing the saturated thickness from 10 feet to about 3 feet. In the North Plant Site Arsenic Source Area (well DH-17), water levels have declined 6 to 8 feet reducing the saturated thickness from approximately 15 feet to 8 feet. Beneath the slag pile (well DH-55), groundwater levels have decreased by about two feet with the majority of decline occurring since June 2016 in response to the Prickly Pear Creek realignment component of the SPHC IM.

### 4.2.2 Groundwater Concentration Trends

The 2017 CAMP specified trend analysis for both the primary COCs at the Facility (arsenic and selenium), as well as the indicator geochemical parameters sulfate and chloride. Remediation phase performance trend analyses currently focus on wells in three primary areas of interest: (1) the Facility source areas, including the Acid Plant area, slag pile area, West Selenium area, and North Plant Site Arsenic area; (2) wells defining the downgradient extent of the arsenic plume, and (3) wells defining the downgradient extent of the selenium plume. Wells selected for remediation phase concentration trend analysis under the performance evaluation program are listed in Table 4-1 and are shown on Figure 4-4. The parameter trends shown on the summary figures have been segregated into the two periods prior to and following the initial implementation of IMs in late 2011:

1. RCRA Facility Investigation (RFI) period (2002-October 2011); and
2. RCRA Interim Measure/Corrective Measure (IM/CM) implementation period (November 2011-2017).

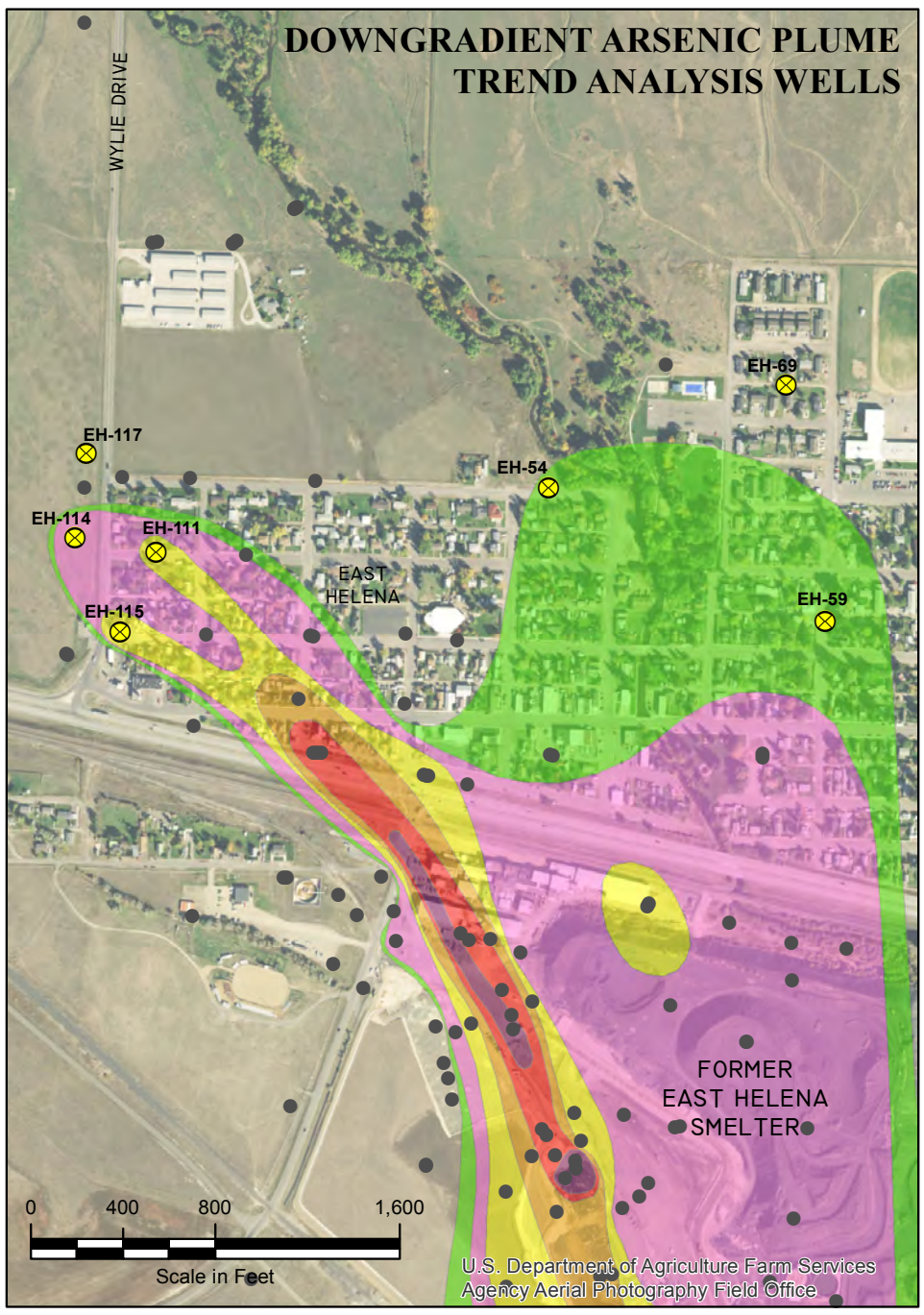



**2017 WATER RESOURCES MONITORING REPORT**
**EAST HELENA FACILITY**

**FIGURE 4-3.GROUNDWATER LEVEL HYDROGRAPHS FROM FACILITY SOURCE AREA MONITORING WELLS**

**Table 4-1. 2017 Performance Evaluation Trend Analysis Monitoring Wells -- East Helena Facility**

| Well | Northing | Easting | Target Area |
|---|---|---|---|
| DH-20 | 858989.37 | 1360128.45 | South Plant |
| DH-47 | 859460.02 | 1360402.02 | South Plant |
| 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-138 | 867179.05 | 1355646.47 | Downgradient Selenium Plume |
| EH-139 | 867197.45 | 1354635.30 | Downgradient Selenium Plume |
| EH-140 | 867962.26 | 1356224.79 | 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 |
| EH-54 | 863345.39 | 1359822.33 | Downgradient Arsenic Plume |
| EH-59 | 862766.01 | 1361023.24 | Downgradient Arsenic Plume |
| EH-69 | 863791.12 | 1360852.61 | Downgradient Arsenic Plume |
| EH-111 | 863063.82 | 1358121.67 | Downgradient Arsenic Plume |
| EH-114 | 863127.75 | 1357769.76 | Downgradient Arsenic Plume |
| EH-115 | 862717.81 | 1357963.04 | Downgradient Arsenic Plume |
| EH-117 | 863491.19 | 1357815.10 | Downgradient Arsenic 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-82 | 861377.16 | 1359161.97 | West Selenium |
| DH-8 | 860693.17 | 1359404.72 | West Selenium |



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| 2017 WATER RESOURCES<br>MONITORING REPORT<br>EAST HELENA FACILITY | **2017 PERFORMANCE EVALUATION<br>TREND ANALYSIS<br>MONITORING WELLS** | **FIGURE**<br>**4-4** |

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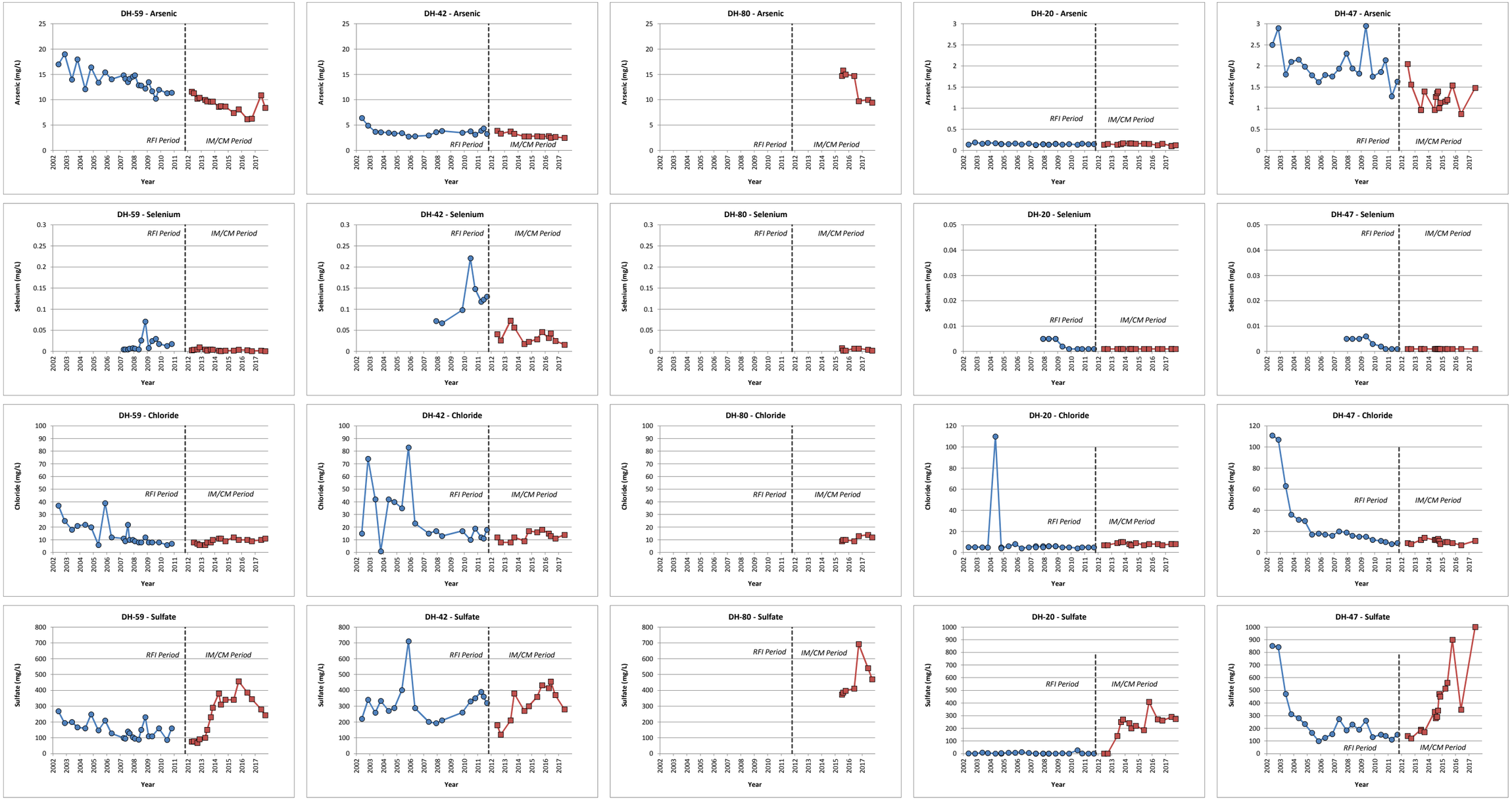
Parameter trend plots for Acid Plant area wells DH-42, DH-59, and DH-80 and South Plant area wells DH-20 and DH-47 are shown on Figure 4-5. Note that wells DH-42 and DH-47 both were dry in October 2017, precluding groundwater sample collection. Arsenic concentrations have decreased overall at wells DH-42, DH-47, DH-59, and DH-80 during the IM/CM period, while concentrations at DH-20 have remained consistently in the 0.1 to 0.2 mg/L range from 2002 through 2017. The arsenic concentration at well DH-80 decreased by about 35% from 15.1 mg/L to 9.72 mg/L following the 2016 Acid Plant source removal, and remained in the 9 to 10 mg/L range in 2017. Selenium concentrations in the Acid Plant and South Plant area have historically been relatively low, with a maximum concentration of 0.22 mg/L observed at well DH-42 during the RFI period (Figure 4-5) and concentrations near or below reporting limits at South Plant wells DH-20 and DH-47. Selenium concentrations observed during the post-2011 IM/CM period have been lower than pre-2011 concentrations at Acid Plant area wells DH-42 and DH-59, and selenium concentrations at all five wells in the Acid Plant/South Plant area are currently less than the 0.05 mg/L groundwater standard.

Concentration trends for slag pile area wells DH-6, DH-15, DH-52, and DH-56 are shown on Figure 4-6. Concentrations for the slag pile area wells during the IM/CM period show generally decreasing trends for the performance evaluation constituents at well DH-6; decreasing or stable trends at wells DH-15 and DH-52; and variable trends at well DH-56, although concentrations of both arsenic and selenium at well DH-56 have decreased overall, and in 2017 reached the minimum values observed since 2002. Current arsenic concentrations in these slag pile wells as of October 2017 range from <0.002 mg/L at DH-15 to 1.69 mg/L at DH-6, and selenium concentrations range from 0.017 mg/L at DH-52 to 0.35 mg/L at DH-15. Although well DH-56 has historically shown the highest COC concentrations within the slag pile, with arsenic concentrations as high as 4 mg/L and selenium concentrations as high as 2 mg/L (Figure 4-6), post-IM decreases have resulted in concentrations now lower than downgradient paired wells DH-6 (for arsenic) and DH-15 (for selenium).

West Selenium area concentration trends for wells DH-66, DH-8, DH-82, and DH-78 are shown on Figure 4-7. Note that well DH-78 went dry after the October 2015 monitoring event, so the trends shown for well DH-78 are through 2015. Arsenic concentrations in West Selenium area wells DH-66, DH-8, and DH-78 have historically been relatively low (0.1 mg/L or lower), and decreased to near or below the groundwater standard of 0.01 mg/L after 2011. Well DH-82, installed about 400 feet downgradient of well DH-66 in 2015, has shown stable arsenic concentrations in the 0.15 to 0.20 mg/L range through 2017. Selenium concentrations at wells DH-8 and DH-66 were highly variable historically, ranging from about 1 to nearly 8 mg/L. After IM implementation began in 2011, selenium concentrations increased consistently at DH-66 through 2014, and have since decreased to near historic minimum levels (0.938 mg/L in October 2017). At DH-8, seasonally variable selenium concentrations continued to be observed through 2014, but are also currently at historically low concentrations (0.57 mg/L in October 2017). Selenium concentrations at well DH-82 have decreased from 3.75 mg/L in July 2015 to 0.836 mg/L in October 2017, paralleling the decrease observed at DH-66. Chloride and sulfate concentrations are also currently near the lower end of the historically observed range at DH-66 and have shown slight decreases at DH-82, but DH-8 has not shown a decreasing trend (Figure 4-7).

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| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | ACID PLANT AND SOUTH PLANT AREA GROUNDWATER QUALITY TRENDS | FIGURE 4-5 |
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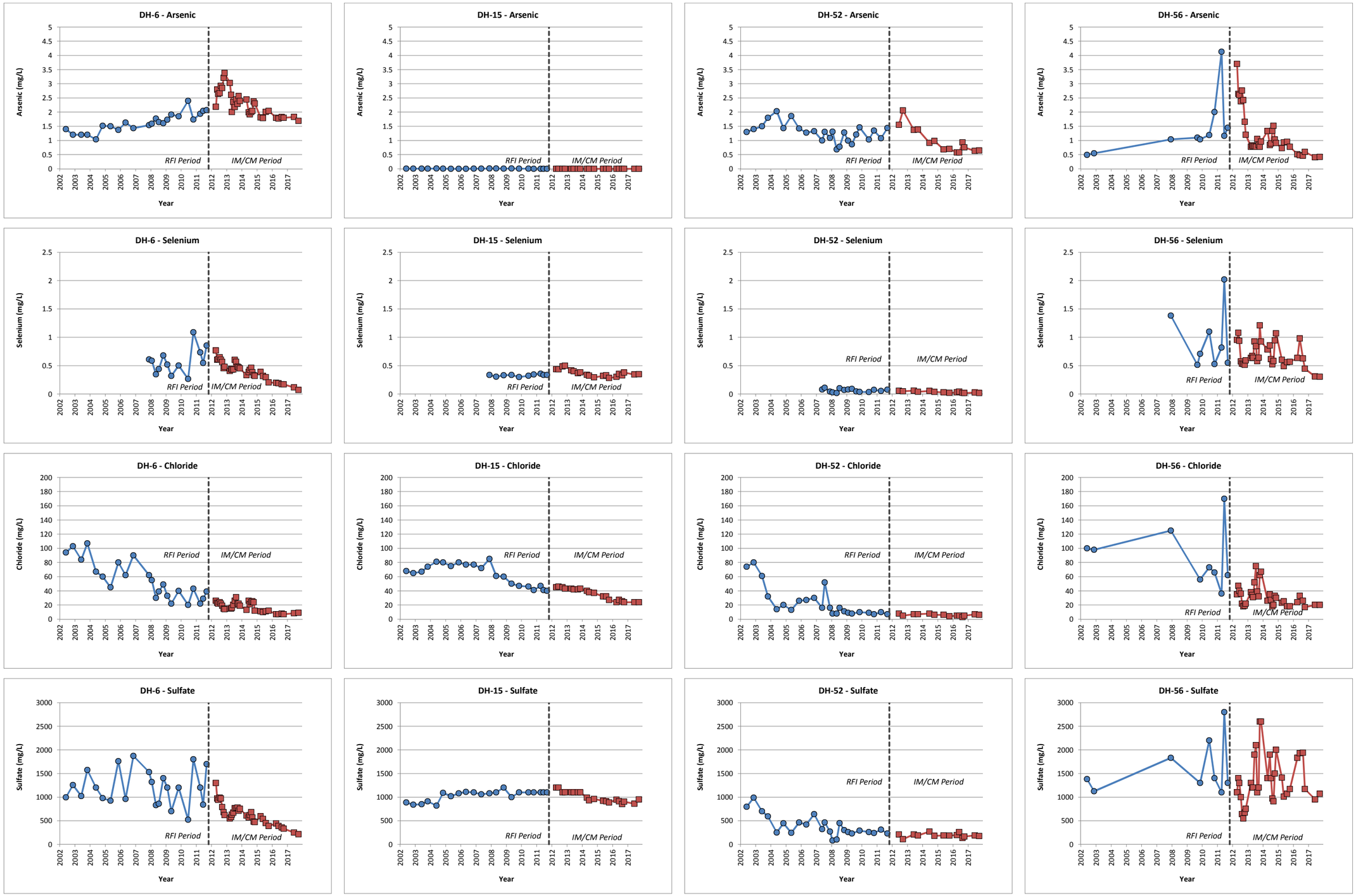


2017 WATER RESOURCES MONITORING REPORT
EAST HELENA FACILITY

**SLAG PILE AREA GROUNDWATER QUALITY TRENDS**

FIGURE **4-6**

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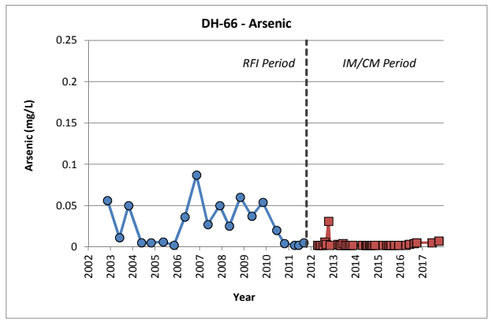


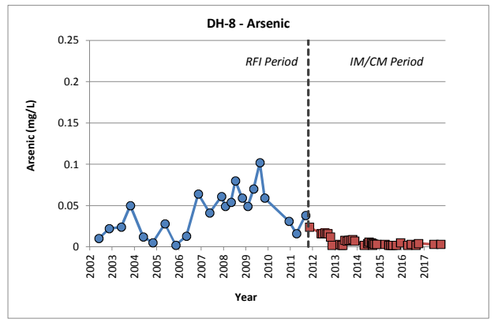


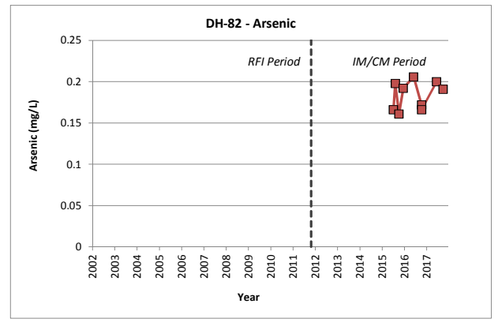


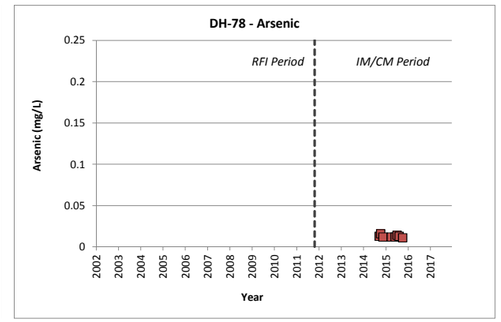


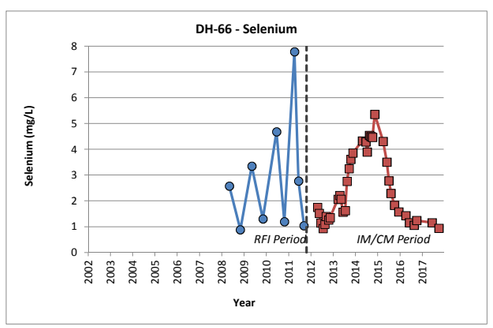


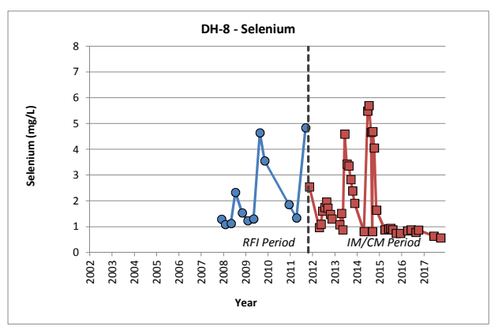


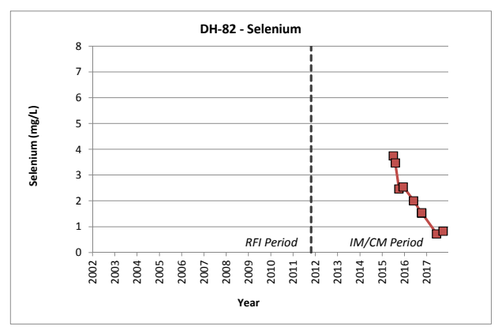


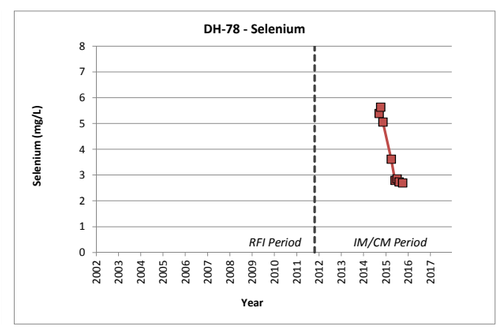


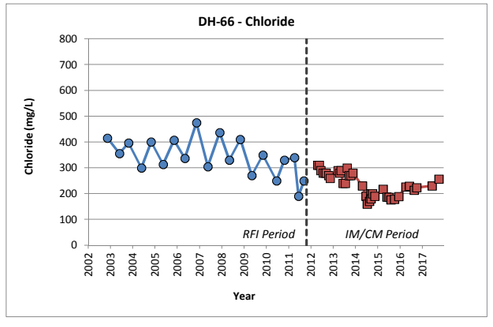


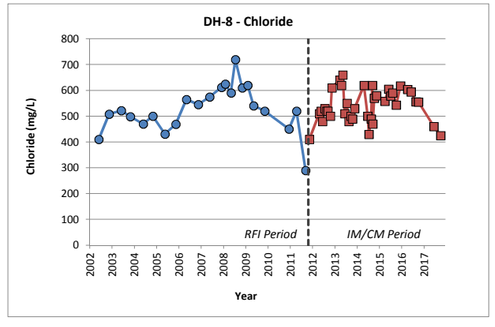


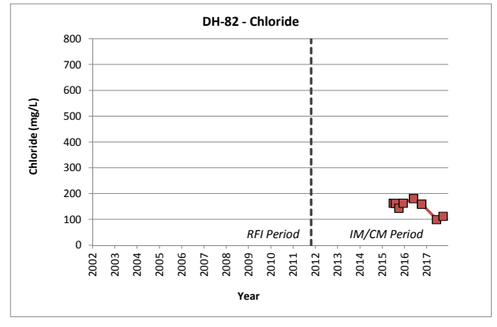


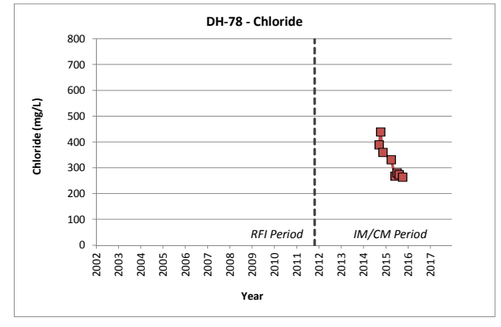


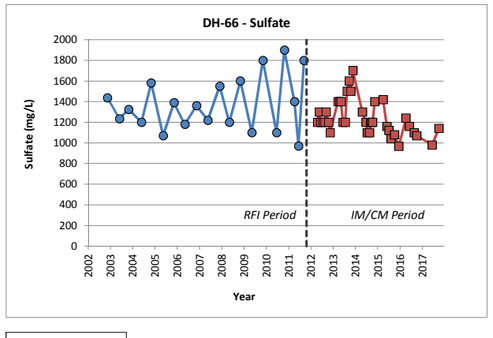


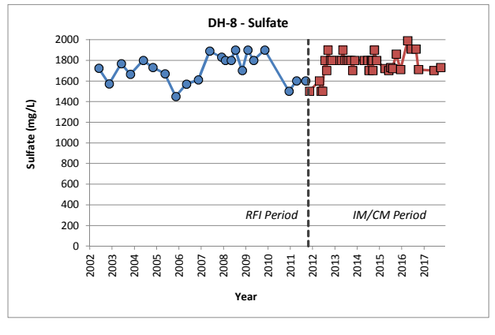


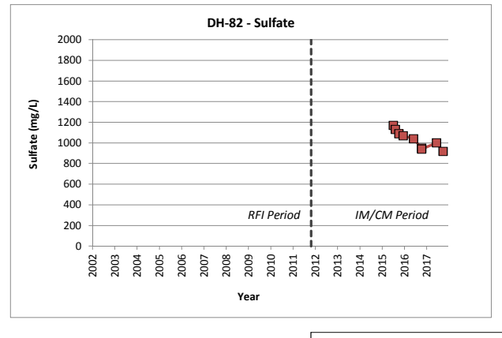


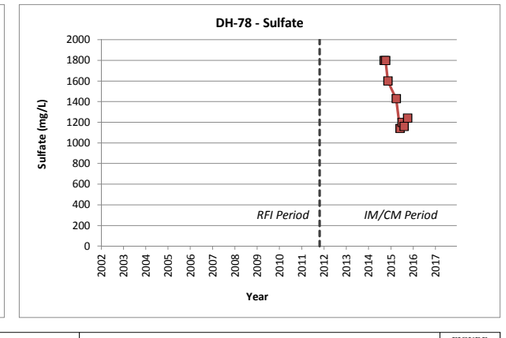


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| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | WEST SELENIUM AREA GROUNDWATER QUALITY TRENDS | FIGURE 4-7 |
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Arsenic, selenium, sulfate, and chloride concentration trends for North Plant area wells DH-17, DH-64, and SDMW-2 are shown on Figure 4-8. Strongly decreasing post-2011 arsenic trends are apparent at DH-17 and DH-64. At SDMW-2, the rapid decrease in arsenic in 2008 and 2009 from over 50 mg/L to about 10 mg/L corresponds to the installation of the Speiss/Dross slurry wall in late 2007 and the isolation of high arsenic concentration soils within the wall; since 2011, arsenic concentrations at this well have shown a slight decreasing trend, but remain near 10 mg/L. Arsenic concentrations at wells DH-17 and DH-64 have decreased from pre-IM average concentrations of 42.9 mg/L at DH-17 and 32.6 mg/L at DH-64, to 22.8 mg/L at DH-17, and 10.1 mg/L at DH-64 in October 2017. Selenium concentrations in North Plant area wells have been below the 0.05 mg/L groundwater standard throughout the post operational period, and currently remain at or below the 0.001 mg/L selenium reporting limit (Figure 4-8).

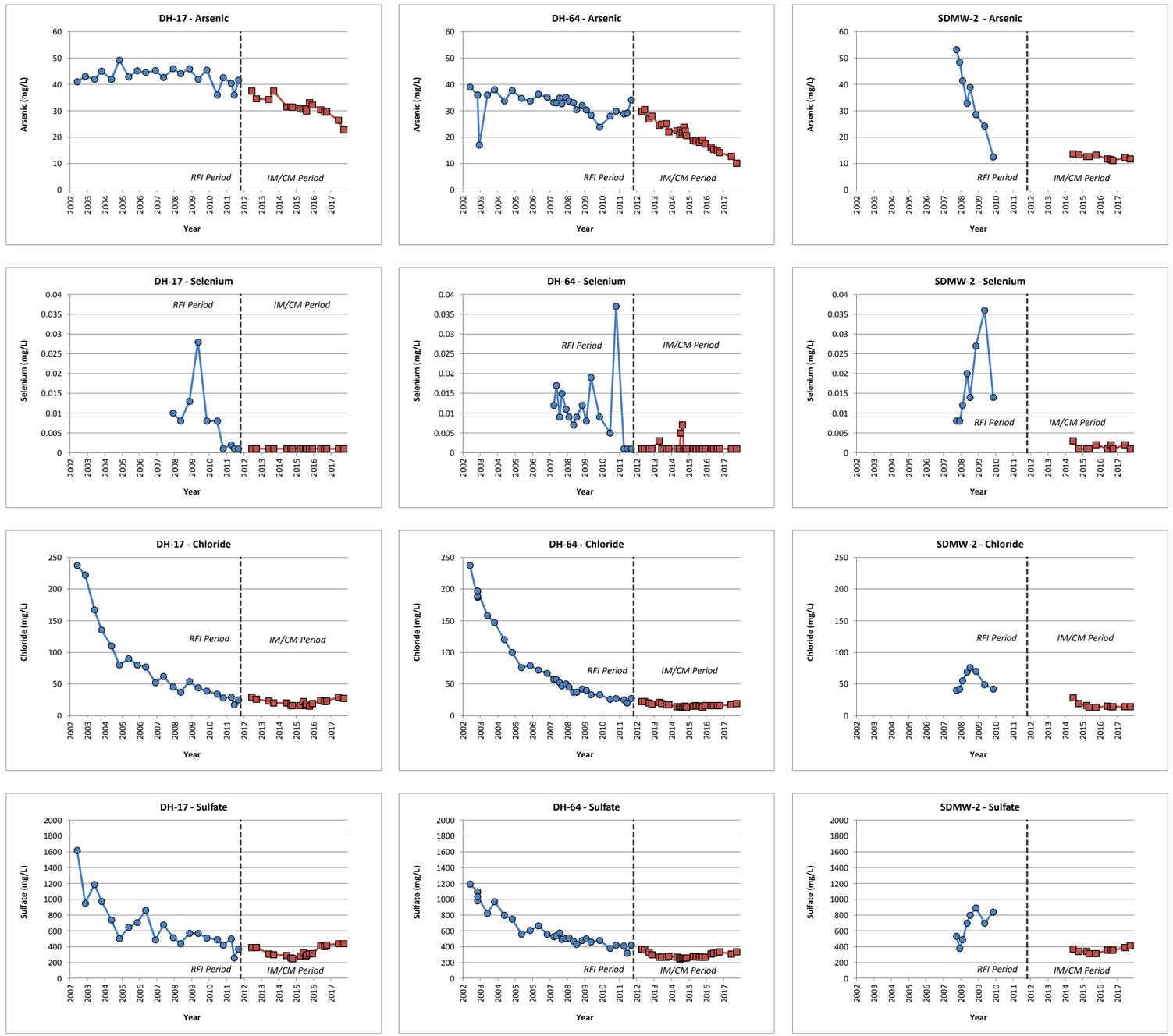
Figures 4-9a and 4-9b show concentration trends for wells along the downgradient end of the arsenic plume, including EH-111, EH-114, EH-115, and EH-117 in the higher concentration western portion of the plume, and EH-54, EH-59, and EH-69 in the lower concentration eastern portion of the plume (refer to Figure 4-4). Well EH-111, which has historically represented the furthest downgradient extent of arsenic concentrations greater than 1 mg/L, has shown a significant decrease from 2015 through 2017. The current arsenic concentration at EH-111 (1.35 mg/L in October 2017) is the lowest concentration observed since 2004. Concentrations of other constituents at EH-111 have shown variable trends (Figure 4-9a): selenium concentrations initially increased in the post-2011 period but have since stabilized at about 0.15 mg/L.

Water quality trends at wells EH-114 and EH-115 (south and west of EH-111; Figure 4-4) show the impacts of the westward plume shift observed in the IM/CM period. Prior to 2011, arsenic concentrations were below detect and selenium, sulfate, and chloride concentrations were highly variable as these wells received seasonal influxes of water from the West Selenium source area, with low arsenic concentrations and elevated selenium concentrations. In the last several years, arsenic concentrations have increased at both wells and selenium concentrations have decreased (Figure 4-9a). These trends are attributable to the lack of seasonal recharge and altered flow direction due to the decommissioning of Wilson Ditch in 2012.

In the eastern, lower concentration portion of the arsenic plume (Figure 4-9b), arsenic concentrations are currently near 0.015 mg/L at EH-54 and EH-59, and below reporting limits (<0.002 mg/L) at EH-69, similar to pre-IM/CM concentrations. Selenium and sulfate concentrations at EH-59 and EH-69 have both decreased during the IM/CM period, while groundwater quality at EH-54 has remained relatively consistent.

Concentration trends for wells near the downgradient end of the selenium plume (including former residential wells 2843 and 2853 Canyon Ferry Road, EH-138, EH-139, EH-140, EH-141, EH-142, and EH-143) are shown on Figures 4-10a and 4-10b. Available data for the pre-IM period before 2011 is limited to three to four samples for this well set, so trends prior to 2011 are not discernable. The downgradient well trend plots in Figures 4-10a and 4-10b show the following:

- Arsenic – concentrations in the downgradient area are low, ranging from <0.001 to 0.006 mg/L, and showing no trends over time.




| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | NORTH PLANT ARSENIC AREA GROUNDWATER QUALITY TRENDS | FIGURE 4-8 |
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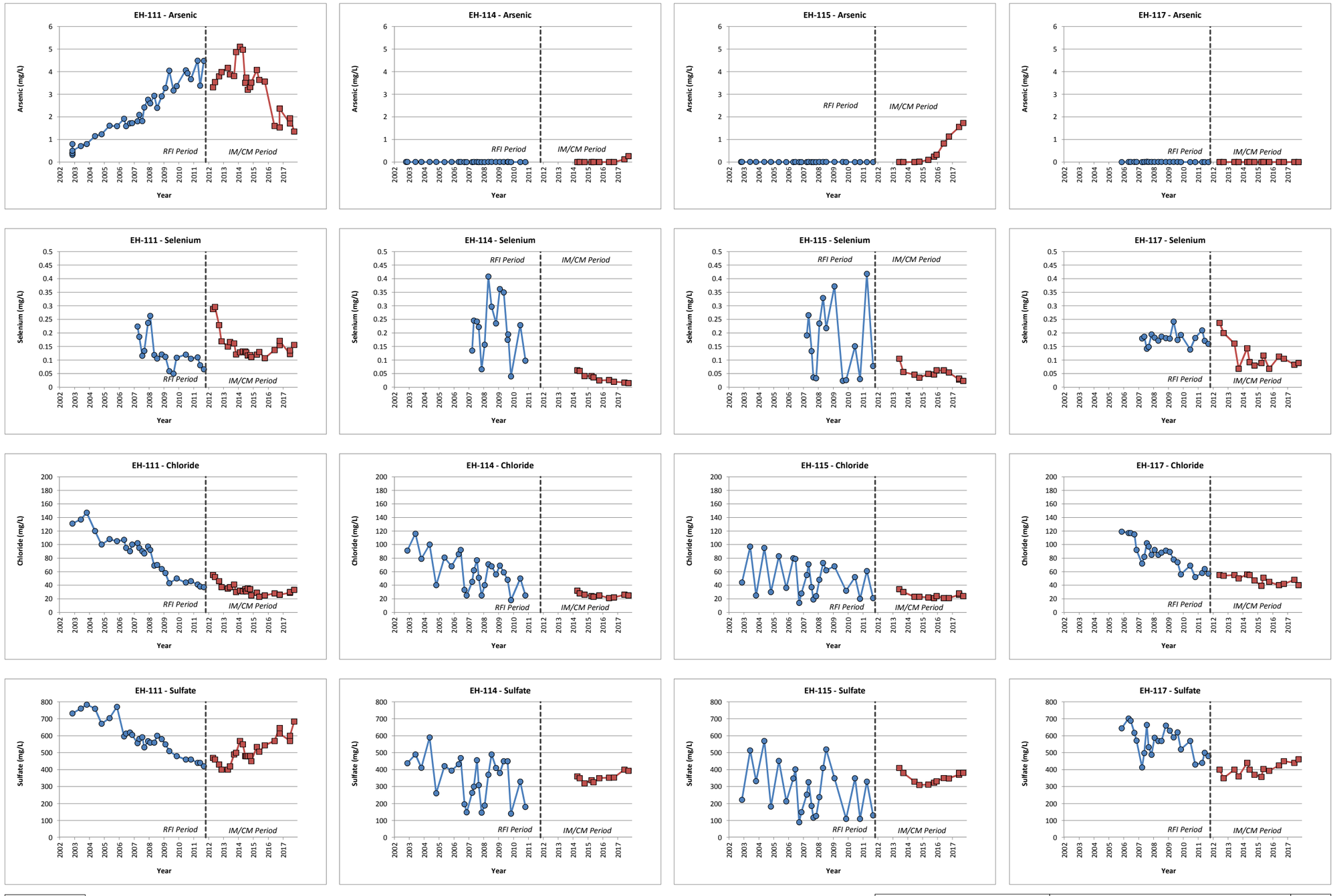


| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | DOWNGRADIENT ARSENIC PLUME AREA (WEST) GROUNDWATER QUALITY TRENDS | FIGURE 4-9a |
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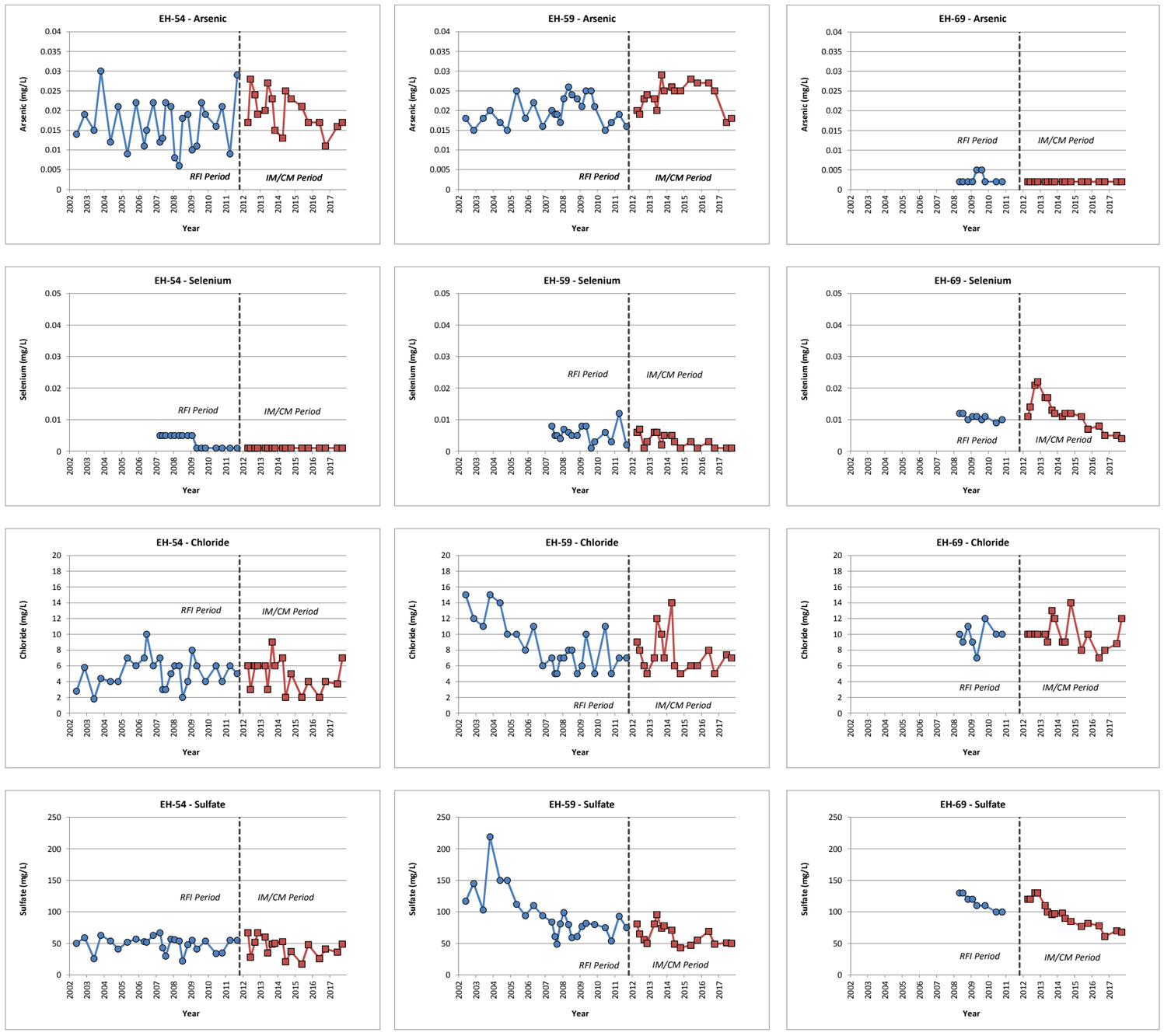


Hydrometrix, Inc.

| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | DOWNGRADIENT ARSENIC PLUME AREA (EAST) GROUNDWATER QUALITY TRENDS | FIGURE 4-9b |
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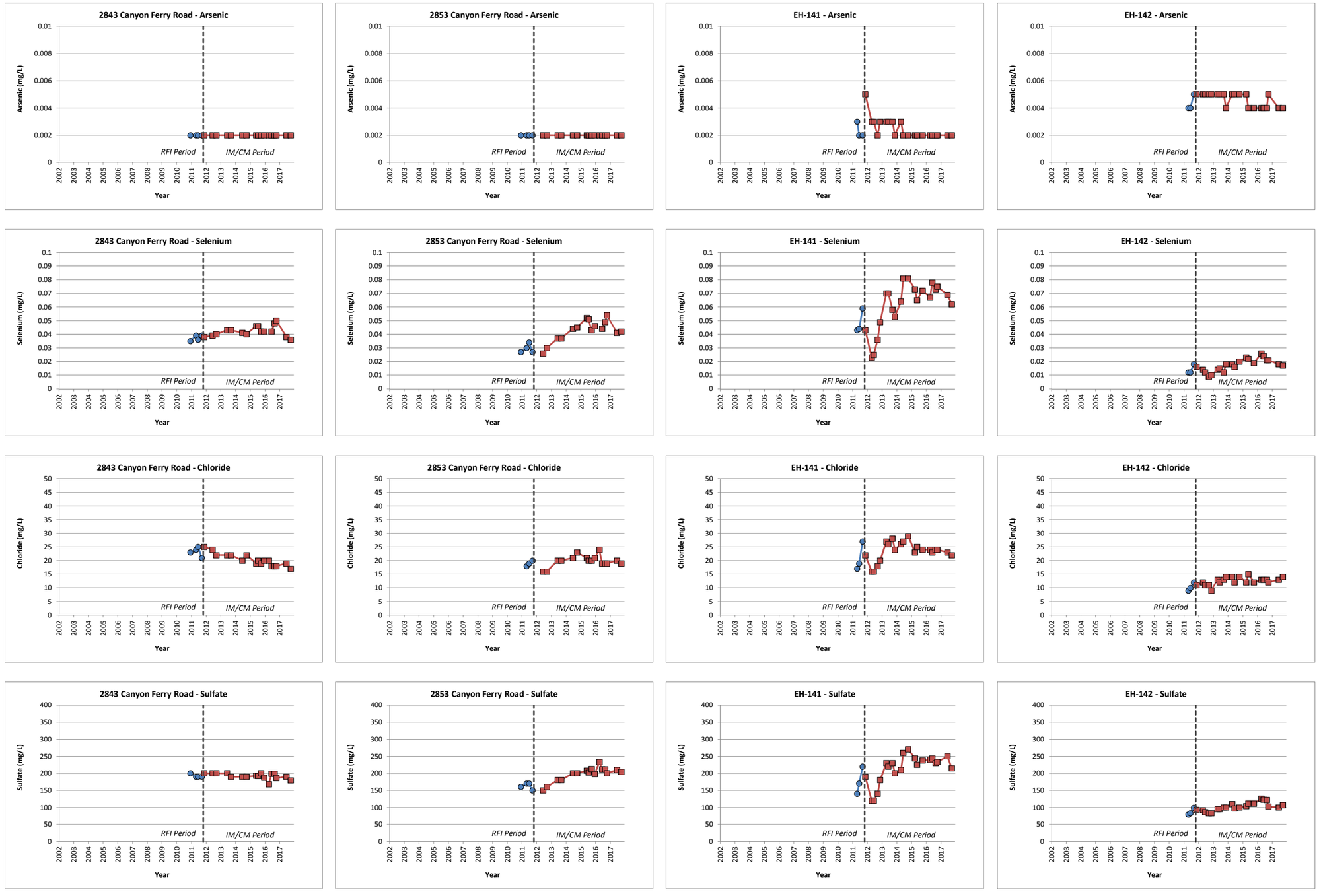


| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | DOWNGRADIENT SELENIUM PLUME AREA GROUNDWATER QUALITY TRENDS | FIGURE 4-10a |
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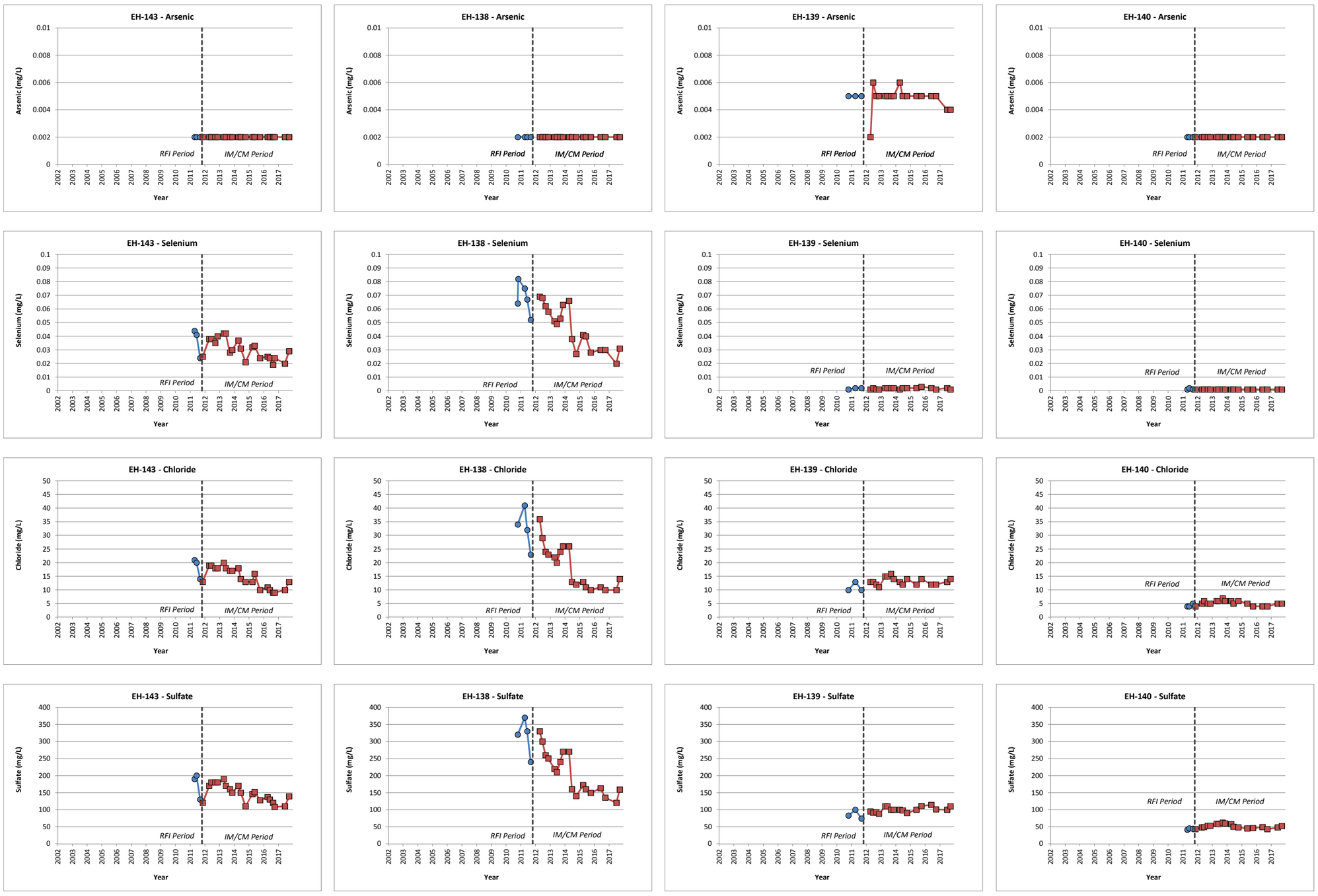


Hydrometrics, Inc.

| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | DOWNGRADIENT SELENIUM PLUME AREA GROUNDWATER QUALITY TRENDS | FIGURE 4-10b |
|---|---|---|

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- Selenium – concentrations at well EH-140 (north of Prickly Pear Creek between the selenium plume and the East Helena city water supply well on Wylie Drive) remain below the reporting limit (<0.001 mg/L). At EH-139 on the west side of the plume, the selenium concentration has remained near the reporting limit (0.001 to 0.003 mg/L) throughout the period of record. At the other wells defining the downgradient selenium plume, selenium trends during the IM/CM period either show decreasing trends (EH-138, EH-143) or slightly increasing trends followed by stable concentrations or recent slight decreases (2843 and 2853 Canyon Ferry Road wells, EH-141 and EH-142). As of October 2017, the selenium concentration exceeded the 0.05 mg/L groundwater standard in only one downgradient well (EH-141, at 0.062 mg/L).
- Chloride and Sulfate – concentrations of these indicator parameters generally show trends similar to selenium, with recent trends either stable or decreasing.

Downgradient wells have exhibited a mixture of increasing, decreasing, and stable water quality trends for selenium, sulfate, and chloride in the IM/CM period, although recent concentration trends are either stable or decreasing. The relationship of these trends to pre-IM trends is unknown, due to a lack of pre-IM data at these wells.

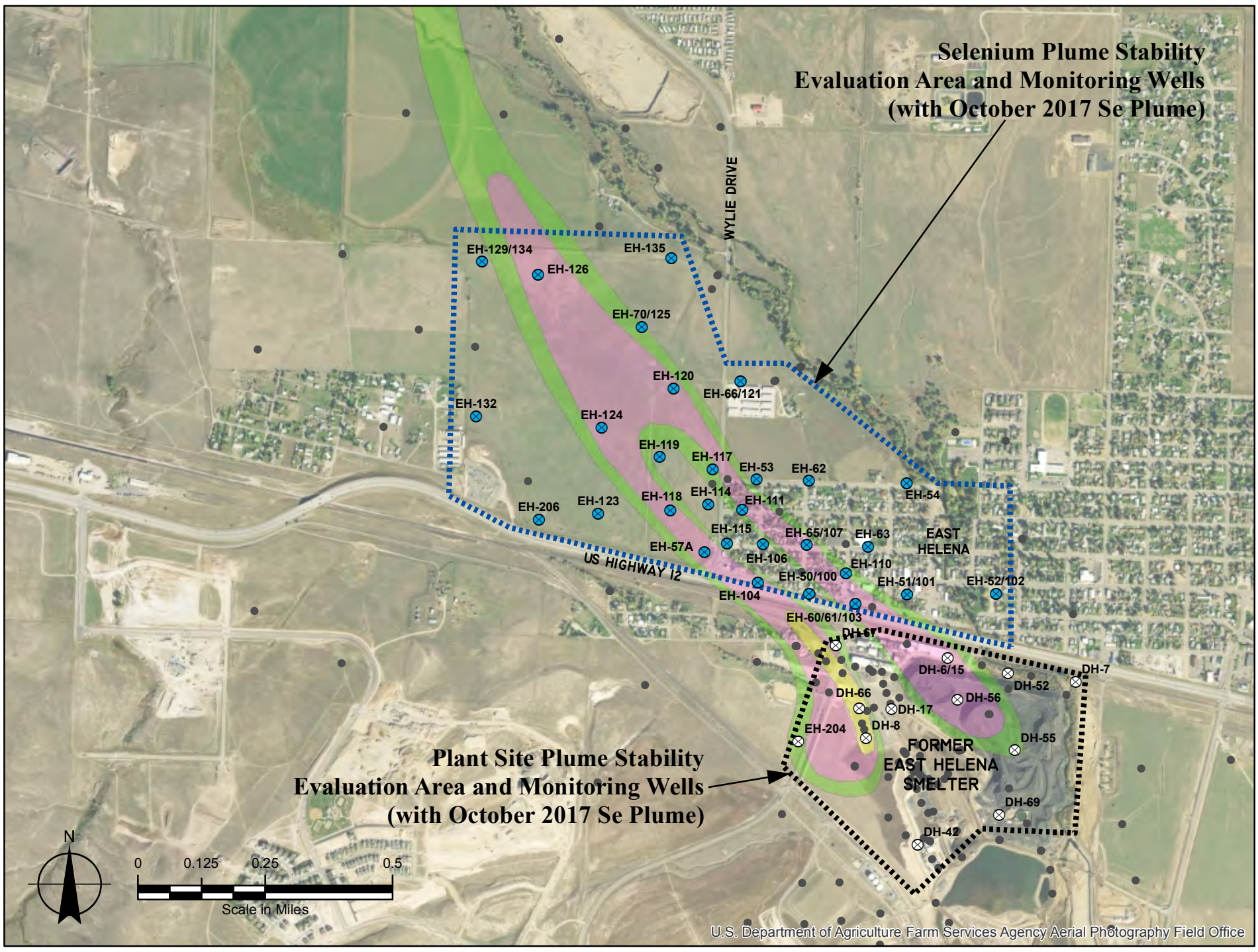
In addition to the remediation phase performance monitoring trend analysis discussed above, temporal trends for the primary groundwater COCs arsenic and selenium for other monitoring wells in the semi-annual sampling program have been compiled and are included in Appendix D.

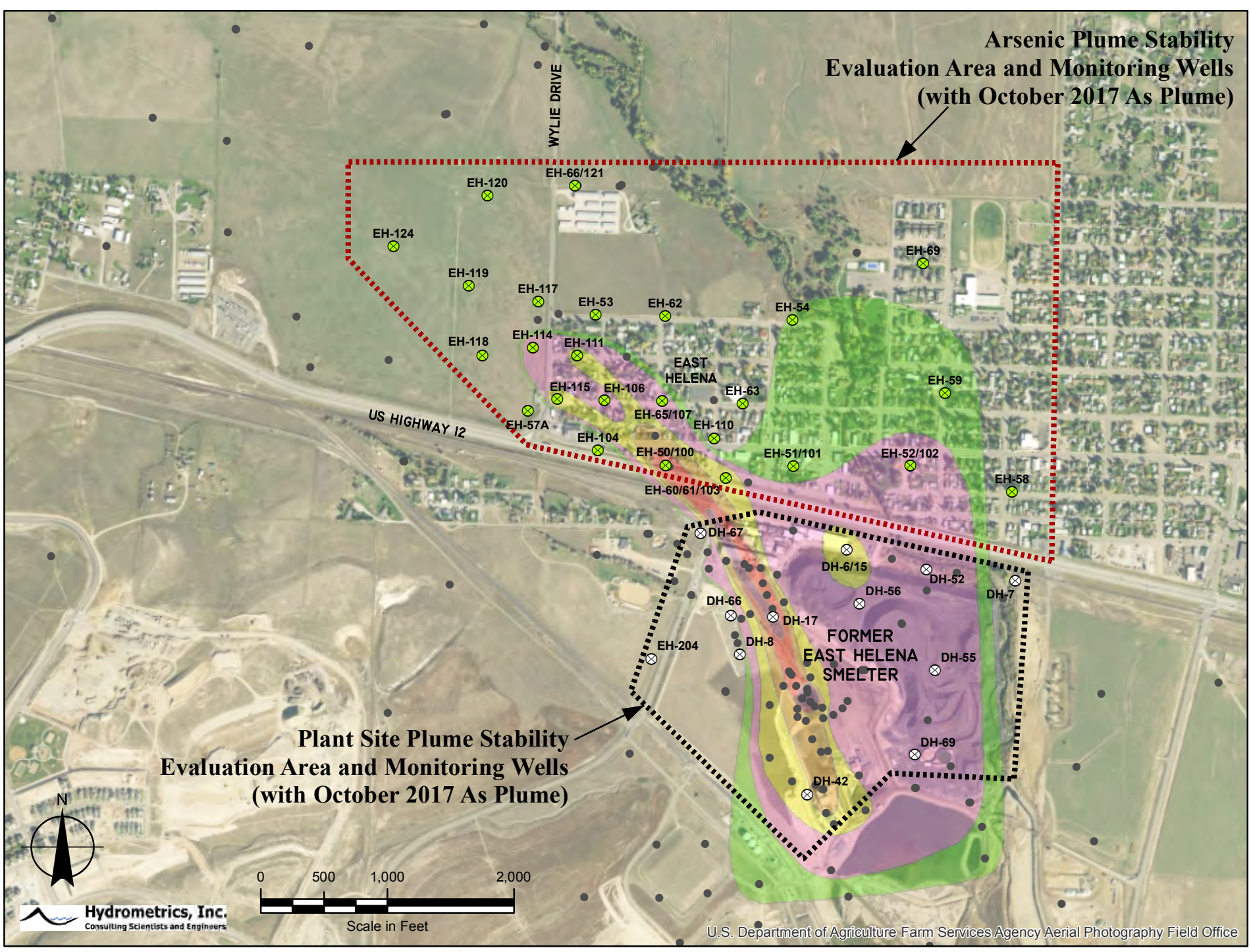
## 4.3 CONTAMINANT PLUME STABILITY

Another component of the East Helena groundwater remedy performance evaluation is 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 Facility may show varying trends (increasing or decreasing), particularly during the remediation phase of remedy monitoring, evaluation of plume stability allows an additional comprehensive assessment of plume characteristics in the area directly downgradient of the Facility, including any changes over time in metrics such as total plume area, average plume concentration, and plume concentration centroid location.

The calculation methods for arsenic and selenium plume stability are based on methods outlined in Ricker (2008). This method was originally developed as a tool to evaluate the stabilization of contaminated groundwater migration, in accordance with the requirements of Government Performance and Results Act Environmental Indicator (EI) RCRIS Code CA 750 (Migration of Contaminated Groundwater Under Control). The evaluation 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 described in the 2017 CAMP, arsenic and selenium plume areas on the former smelter site ("plant site plume stability"), and in the near downgradient areas in the City of East Helena and in Lamping Field were 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 4-11.

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| | | |
|---|---|---|
| 2017 WATER RESOURCES<br>MONITORING REPORT<br>EAST HELENA FACILITY | **2017 PERFORMANCE EVALUATION<br>PLUME STABILITY EVALUATION<br>MONITORING WELLS** | **FIGURE**<br>**4-11** |

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 plume stability analyses are shown on Figure 4-11 and are summarized in Table 4-2. Note that the selected off-site well set for selenium covers a greater area than the off-site well set for arsenic, since the plume configurations are different.
3. For each well, calculate an annual average concentration of the COC. Below detect values were replaced with the detection limit for calculation of averages.
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 suggested in Ricker (2008), grid files were 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.

Calculated values are then compared over time to determine any trends in total plume area or average plume concentration. 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 evaluated.

Based on the available groundwater data for the plume stability well sets shown in Table 4-2, off-site arsenic and selenium plume stability metrics were calculated for monitoring years 2010 (representing conditions prior to implementation of IMs), 2014, 2015, 2016, and 2017 (representing conditions during ongoing implementation of IMs). Due to variable monitoring frequencies for some plant site wells and the potential effects on plume stability calculations, plant site plume stability metrics have been calculated for monitoring years 2010 (prior to IM implementation), 2016, and 2017 (during IM implementation).

### 4.3.1 Arsenic Plume Stability Results

The arsenic plume stability analysis results are summarized on Figure 4-12, including software-generated arsenic contours, a table summarizing plume areas and average concentrations, and a map showing the locations of the calculated plume centroids for 2010, 2014, 2015, 2016, and 2017. The overall plume area with arsenic concentrations above the 0.01 mg/L groundwater standard has not changed appreciably from 2010 (66 acres) to 2014 (68 acres), 2015 (68 acres), 2016 (64 acres), and 2017 (65 acres). Average arsenic concentrations within the 0.01 mg/L contour area have shown a

## Table 4-2. 2017 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 |

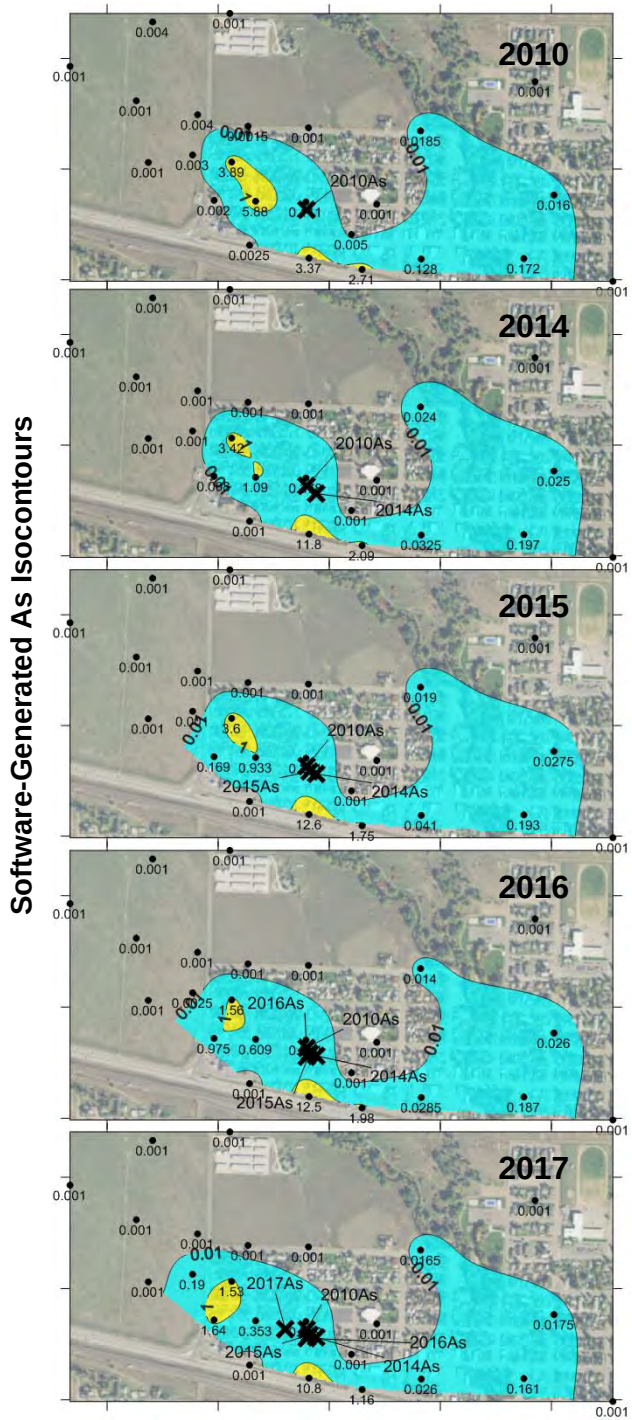
**Selenium Plume Stability Analysis Wells**

| 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 |

**Plant Site Plume Stability Analysis Wells**

| Well/Well Set* | X | Y |
|---|---|---|
| DH-6/15 | 1360252.419 | 861527.0799 |
| DH-7 | 1361580.684 | 861281.5224 |
| DH-8 | 1359404.724 | 860693.1656 |
| DH-17 | 1359668.631 | 860997.414 |
| DH-42 | 1359938.798 | 859587.2008 |
| DH-52 | 1360876.159 | 861372.1393 |
| DH-55 | 1360945.555 | 860568.8169 |
| DH-56 | 1360350.744 | 861098.4318 |
| DH-66 | 1359333.409 | 861005.14 |
| DH-67 | 1359095.512 | 861657.6447 |
| DH-69 | 1360783.894 | 859899.5982 |
| EH-204 | 1358703.601 | 860660.9927 |

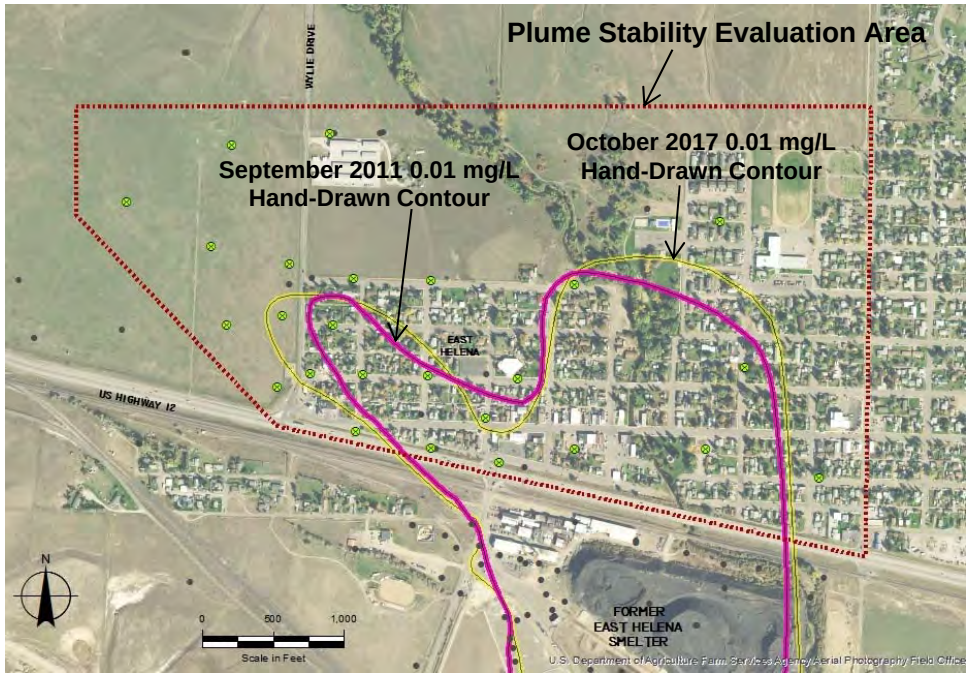
*NOTE: Data from well sets (paired wells) will be combined to yield a single overall average concentration for a given monitoring year for plume stability calculations.




× = plume centroid for given year

Plume stability metrics calculated Using method of Ricker (2008)

| Year | Planar Area (acres) | Avg Conc (mg/L) |
|---|---|---|
| 2010 | 66 | 0.203 |
| 2014 | 68 | 0.167 |
| 2015 | 68 | 0.175 |
| 2016 | 64 | 0.167 |
| **2017** | **65** | **0.173** |

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| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | **Arsenic Plume Stability Evaluation Results** | FIGURE **4-12** |
|---|---|---|

modest decline from 0.203 mg/L in 2010 to 0.173 mg/L in 2017. The locations of the calculated plume centroids for 2010, 2014, 2015, and 2016 are in approximately the same location, with a slight centroid shift to the west observed in 2017 (Figure 4-12).

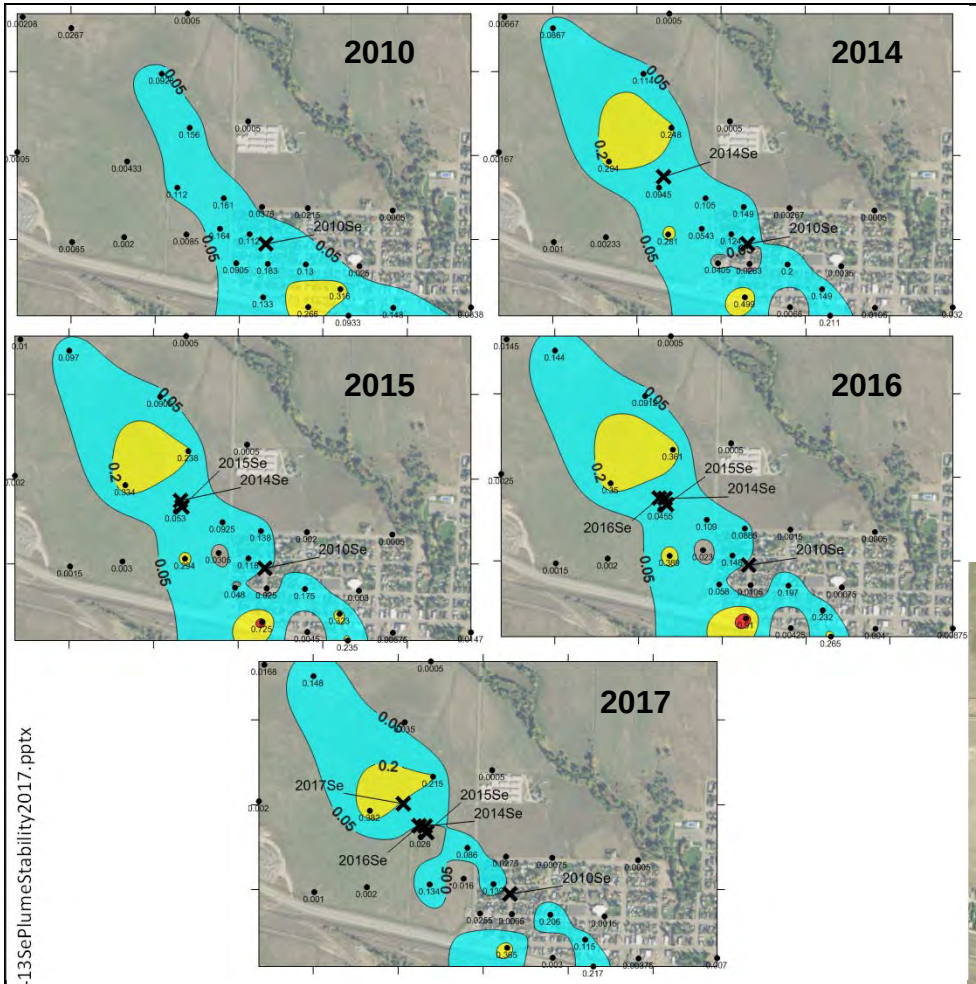
Overall, the plume area and average concentration metrics suggest that the arsenic plume is relatively stable; a slight westward shift in the arsenic plume centroid in 2017 is attributable to the concentration increases previously discussed at two wells on the western margin of the arsenic plume. The plume stability results are generally consistent with observations based on preparation of hand-drawn arsenic isocontour maps. The Fall 2011 and Fall 2017 0.01 mg/L hand-drawn arsenic contours shown on Figure 4-12 illustrate the stability in overall plume area, along with the recent shift to the west in the western portion of the arsenic plume.

### 4.3.2 Selenium Plume Stability Results

Selenium plume stability analysis results are summarized on Figure 4-13. In contrast to arsenic, the overall plume area with selenium concentration above the 0.05 mg/L groundwater standard increased from 2010 (74 acres) to 2014 (111 acres); this total area remained stable in 2015 (112 acres) and 2016 (114 acres), before decreasing again in 2017 to 79 acres. Average selenium concentrations showed an overall increase from 2010 (0.112 mg/L) to 2016 (0.136 mg/L), before decreasing in 2017 to 0.108 mg/L (Figure 4-13). Finally, the plume centroid location for selenium shifted to the west and north between 2010 and 2014, remained relatively stable in 2015, 2016 and 2017 (Figure 4-13). Also apparent in Figure 4-13, particularly in the 2017 computer generated plume map, is the apparent fragmentation of the plume between the Facility and Lamping Field. This is attributable to the significant decreases observed in the upgradient West Selenium source area in the past two years and should propagate downgradient with time.

### 4.3.3 Plant Site Arsenic and Selenium Plume Stability Results

Plume stability metrics for pre-IM (2010) and post-IM (2016 and 2017) conditions were also calculated for arsenic and selenium, based on data from 13 Facility (source area) wells. The plant site plume stability results are summarized on Figure 4-14. Plume stability results for 2010, 2016, and 2017 show a reduction in overall selenium plume area from 67 to 35 acres, and a relatively stable arsenic plume area (82 to 77 acres). Average plume concentrations have decreased by nearly 50% from 2010 to 2017 for both selenium (from 0.45 to 0.23 mg/L) and arsenic (from 2.25 to 1.19 mg/L), reflecting the generally decreasing concentration trends for arsenic and selenium observed in the plant site source areas (Section 4.2.2). The locations of the calculated arsenic and selenium plume centroids showed virtually no changes from 2010 to 2017. As source area contaminant concentrations of both arsenic and selenium continue to decrease over time, average plant site plume concentrations should also continue to decrease.

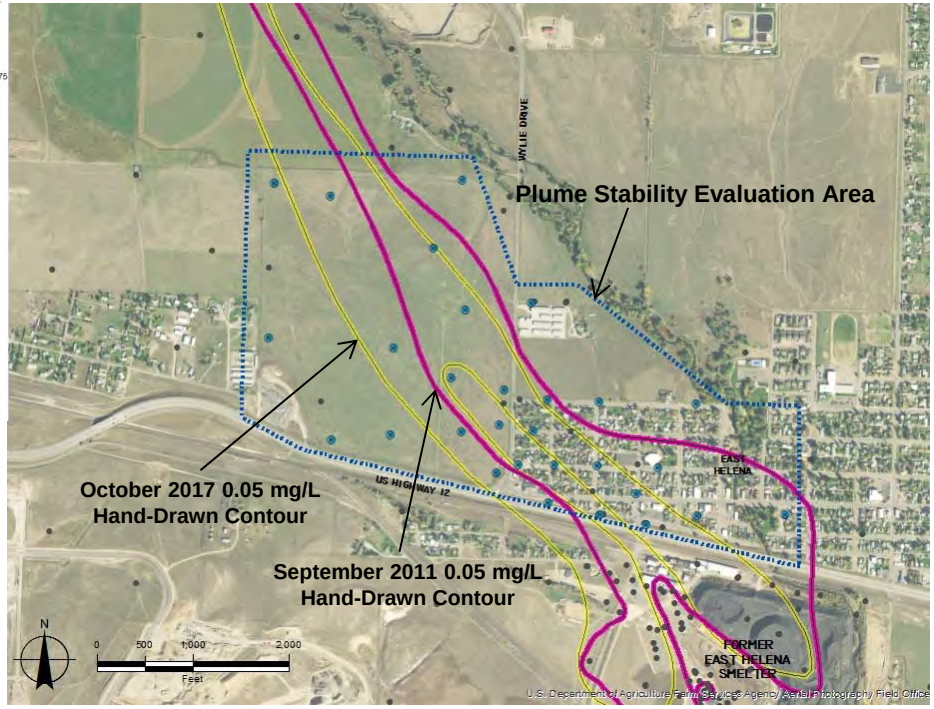



**Software-Generated Se Isocontours**

× = plume centroid for given year

Plume stability metrics calculated
Using method of Ricker (2008)

| Year | Planar Area (acres) | Avg Conc (mg/L) |
|---|---|---|
| 2010 | 74 | 0.112 |
| 2014 | 111 | 0.123 |
| 2015 | 112 | 0.121 |
| 2016 | 114 | 0.136 |
| **2017** | **79** | **0.108** |

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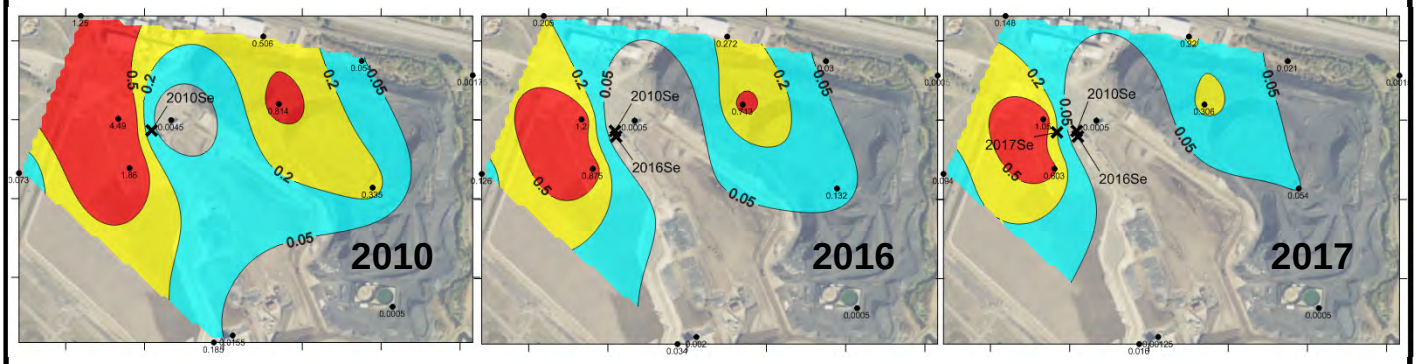
| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | **Selenium Plume Stability Evaluation Results** | **FIGURE** **4-13** |
|---|---|---|

## Selenium

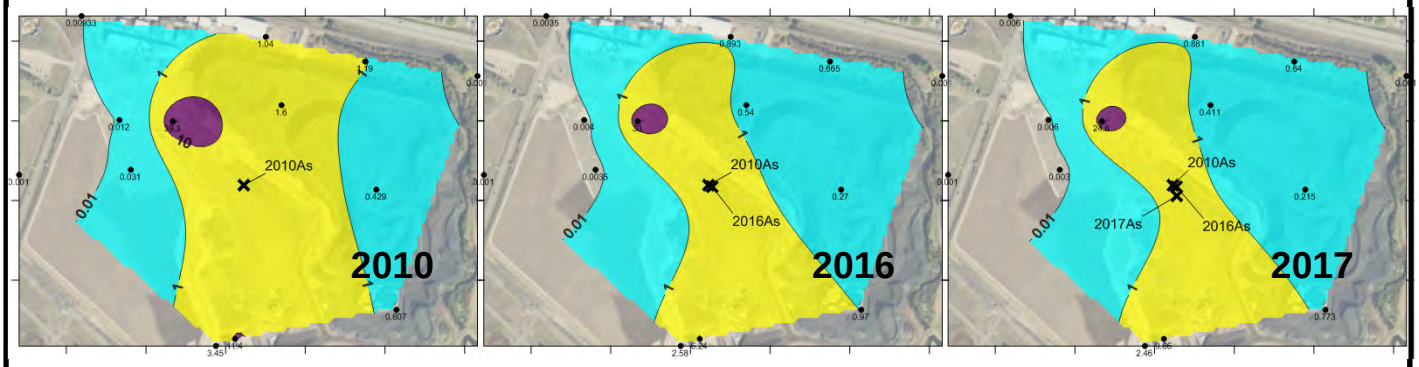



| Year | Parameter | Planar Area (acres) | Avg Conc (mg/L) |
|---|---|---|---|
| 2010 | Se | 67 | 0.45 |
| 2016 | | 48 | 0.27 |
| 2017 | | 35 | 0.23 |
| 2010 | As | 82 | 2.25 |
| 2016 | | 77 | 1.29 |
| 2017 | | 77 | 1.19 |

× = plume centroid for given year

Plume stability metrics calculated Using method of Ricker (2008)

## Arsenic




| 2017 WATER RESOURCES MONITORING REPORT EAST HELENA FACILITY | **Plant Site Plume Stability Evaluation Results** | FIGURE **4-14** |
|---|---|---|

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# 5.0 REFERENCES


CH2MHill, 2012. Former ASARCO East Helena Facility Interim Measures Work Plan—Conceptual Overview of Proposed Interim Measures and Details of 2012 Activities - Final. Prepared for Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust. September 2012.

CH2MHill, 2018. Former ASARCO East Helena Facility Corrective Measures Study Report. Public Review Draft. Prepared for Montana Environmental Trust Group, LLC, Trustee of the Montana Environmental Custodial Trust. March 2018.

GSI Water Solutions, Inc. (GSI), 2014. *Phase II RCRA Facility Investigation*, *East Helena Facility*. April 29.

Hydrometrics, Inc. 1999. Current Conditions/Release Assessment, East Helena Facility. September 1998; Revised January 1999.

Hydrometrics, Inc., 2010. Phase II RCRA Facility Investigation Site Characterization Work Plan. May 2010.

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., 2014. Supporting Information for the East Valley Controlled Groundwater Area Petition – Lewis and Clark County, Montana. Prepared for Montana Environmental Trust Group, LLC. August 2014.

Hydrometrics, Inc., 2015a. Quality Assurance Project Plan for Environmental Data Collection Activities, East Helena Facility (Draft). Prepared for Montana Environmental Trust Group, LLC. Revised August 2011.

Hydrometrics, Inc., 2015b. 2014 Supplemental Contaminant Source Area Investigation at the Former East Helena Smelter. Prepared for Montana Environmental Trust Group, LLC. February 2015.

Hydrometrics, Inc., 2016a. 2015 Supplemental Contaminant Source Area Investigation at the Former East Helena Smelter. Prepared for Montana Environmental Trust Group, LLC. March 2016.

Hydrometrics, Inc., 2016b. Technical Memorandum, Existing Information and Data Compilation for the Former East Helena Smelter Slag Pile Area. May 23, 2016.

Hydrometrics, Inc., 2017a. 2015/2016 Water Resources Monitoring Report, East Helena Facility. Prepared for Montana Environmental Trust Group, LLC. December 2017.

Hydrometrics, Inc., 2017b. 2017 Groundwater and Surface Water Corrective Action Monitoring Plan, East Helena Facility. Prepared for Montana Environmental Trust Group, LLC. July 2017.

MDEQ, 2017. Circular DEQ-7, Montana Numeric Water Quality Standards. Prepared by: Water Quality Planning Bureau, Water Quality Standards Section, Helena, Montana. May 2017.

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

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.

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

USEPA, 2004b. Water Quality Restoration Plan and Total Maximum Daily Loads for the Lake Helena Watershed Planning Area: V1 Watershed Characterization and Water Quality Status Review. December 30, 2004.

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

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

USEPA, 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.

# APPENDIX A

# 2017 SURFACE WATER AND GROUNDWATER DATABASE

# APPENDIX A1

# 2017 MONITORING WELL WATER QUALITY DATABASE

| | | | Field Parameters | | | | | | | General Chemistry | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Depth To Water (ft)** | **pH (s.u.)** | **SC (µmhos/cm)** | **Diss $O_2$ (mg/L)** | **ORP (mV)** | **$E_H$ (mV)** | **Turbidity (NTU)** | **Water Temp (°C)** | **Lab pH (s.u.)** | **Lab SC (µmhos/cm)** | **Total Alkalinity as CaCO3** | **Total Suspended Solids** | **Total Dissolved Solids** |
| 2843 Canyon Ferry Rd | 6/27/2017 | 28.60 | 7.17 | 684 | 5.47 | 31 | 247 | 10.3 | 10.3 | 7.3 | 705 | 140 | < 10 | 469 |
| 2843 Canyon Ferry Rd | 10/12/2017 | 29.89 | 7.20 | 673 | 5.50 | 80 | 297 | 0 | 10.3 | 7.3 | 669 | 130 | < 10 | 457 |
| 2853 Canyon Ferry Rd | 6/27/2017 | 29.88 | 7.11 | 718 | 5.05 | 27 | 244 | 10.5 | 10.2 | 7.3 | 741 | 140 | < 10 | 495 |
| 2853 Canyon Ferry Rd | 10/12/2017 | 31.31 | 7.08 | 727 | 5.12 | 105 | 322 | 0 | 9.8 | 7.2 | 725 | 140 | < 10 | 491 |
| Amchem Injection | 10/12/2017 | | 7.16 | 372 | 1.53 | 26 | 203 | 12.1 | 43.3 | 7.4 | 336 | 110 | < 10 | 251 |
| Amchem4 | 10/12/2017 | 54.13 | 7.20 | 367 | 1.91 | 63 | 276 | 9.8 | 13.4 | 7.2 | 338 | 110 | < 10 | 248 |
| DH-1 | 6/22/2017 | 44.87 | 7.38 | 1706 | 9.93 | 139 | 353 | 1.9 | 12.2 | 7.5 | 1790 | 240 | < 10 | 1370 |
| DH-1 | 10/6/2017 | 45.53 | 7.44 | 1757 | 7.56 | 68 | 282 | 2.6 | 12.1 | 7.6 | 1870 | 240 | < 10 UJ | 1410 |
| DH-15 | 6/21/2017 | 19.52 | 6.95 | 1863 | 0.15 | 150 | 366 | 0.7 | 10.7 | 7.1 | 2020 | 160 | < 10 | 1670 |
| DH-15 | 10/6/2017 | 19.96 | 6.96 | 1942 | 0.04 | 127 | 344 | 0.5 | 10.2 | 7.1 | 2040 | 160 | < 10 | 1610 |
| DH-17 | 6/22/2017 | 49.68 | 7.22 | 1538 | 0.26 | -41 | 172 | 2.7 | 13.1 | 7.4 | 1580 | 300 | < 10 | 1020 |
| DH-17 | 10/11/2017 | 49.97 | 7.25 | 1467 | 0.18 | -64 | 150 | 24.6 | 12.5 | 7.3 | 1490 | 280 | 30 J | 1010 |
| DH-20 | 6/22/2017 | 18.45 | 7.07 | 969 | 0.25 | -114 | 104 | 0.6 | 8.4 | 7.1 | 964 | 220 | 21 | 694 |
| DH-20 (Dup) | 6/22/2017 | 18.45 | 7.07 | 967 | 0.24 | -114 | 104 | 0.6 | 8.4 | 7.1 | 967 | 220 | 20 | 692 |
| DH-20 | 10/10/2017 | 18.83 | 7.07 | 928 | 0.05 | -136 | 78 | 0.9 | 12.6 | 7.1 | 964 | 220 | 17 | 663 |
| DH-42 | 6/20/2017 | 49.03 | 6.64 | 976 | 0.61 | 204 | 415 | 0.7 | 14.4 | 6.8 | 984 | 200 | < 10 | 679 |
| DH-42 (Dup) | 6/20/2017 | 49.03 | 6.64 | 970 | 0.60 | 203 | 415 | 0.7 | 14.5 | 6.8 | 984 | 200 | < 10 | 691 |
| DH-47 | 6/28/2017 | 21.33 | 7.20 | 2132 | 1.26 | -87 | 125 | 1000 J- | 14.1 | 7.2 | 2220 | 440 | 15400 | 1840 |
| DH-52 | 6/20/2017 | 6.70 | 7.42 | 720 | 0.65 | 206 | 422 | 3.5 | 10.4 | 7.5 | 723 | 130 | < 10 | 469 |
| DH-52 | 10/6/2017 | 7.35 | 7.47 | 671 | 0.26 | 113 | 328 | 1.2 | 11.6 | 7.6 | 700 | 130 | < 10 | 445 |
| DH-55 | 6/20/2017 | 80.20 | 7.22 | 705 | 1.04 | 77 | 294 | 1.7 | 9.5 | 7.6 | 711 | 110 | < 10 | 447 |
| DH-55 | 10/10/2017 | 80.70 | 7.58 | 833 | 0.72 | 24 | 241 | 2.5 | 9.4 | 7.6 | 867 | 130 | < 10 | 567 |
| DH-56 | 6/20/2017 | 83.95 | 7.56 | 2597 | 2.54 | 43 | 260 | 19.6 | 9.9 | 7.6 | 2620 | 240 | 88 | 1800 |
| DH-56 (Dup) | 6/20/2017 | 83.95 | 7.54 | 2597 | 2.56 | 44 | 260 | 19.6 | 9.9 | 7.6 | 2620 | 240 | 84 | 1800 |
| DH-56 | 10/10/2017 | 84.55 | 7.65 | 2718 | 2.84 | 36 | 252 | 4.5 | 10.9 | 7.6 | 2840 | 210 | < 10 | 1940 |
| DH-59 | 6/21/2017 | 43.98 | 6.41 | 918 | 0.46 | 60 | 272 | 2.4 | 14.6 | 6.7 | 941 | 160 | < 10 | 663 |
| DH-59 | 10/11/2017 | 44.32 | 6.66 | 812 | 0.41 | 25 | 237 | 1.3 | 14.0 | 6.7 | 822 | 160 | 14 J | 575 |
| DH-6 | 6/21/2017 | 19.52 | 7.62 | 900 | 2.39 | 131 | 349 | 0.6 | 9.2 | 7.7 | 968 | 150 | < 10 | 629 |
| DH-6 | 10/6/2017 | 20.01 | 7.62 | 835 | 1.33 | 110 | 326 | 0.1 | 10.3 | 7.7 | 870 | 150 | < 10 | 548 |
| DH-64 (Low Flow) | 6/21/2017 | 38.35 | 6.86 | 1091 | 0.75 | -18 | 192 | 2.7 | 15.6 | 7 | 1170 | 220 | < 10 | 772 |
| DH-64 (Standard) | 6/21/2017 | 38.35 | 6.85 | 1087 | 0.22 | -19 | 194 | 1.7 | 12.7 | 7 | 1170 | 220 | < 10 | 767 |
| DH-64 | 10/11/2017 | 38.61 | 6.82 | 1142 | 0.20 | -17 | 197 | 1.7 | 12.1 | 6.9 | 1160 | 220 | < 10 UJ | 779 |
| DH-66 | 6/21/2017 | 52.65 | 6.57 | 2852 | 2.90 | 161 | 374 | 8.1 | 13.5 | 6.7 | 2950 | 220 | 13 | 2440 |
| DH-66 (Dup) | 6/21/2017 | 52.65 | 6.57 | 2858 | 2.87 | 162 | 375 | 8.1 | 13.5 | 6.8 | 2960 | 230 | 18 | 2370 |
| DH-66 | 10/11/2017 | 52.92 | 6.62 | 2740 | 1.95 | 114 | 328 | 5.2 | 12.4 | 6.7 | 2910 | 210 | 10 J | 2530 |
| DH-67 | 6/22/2017 | 36.56 | 6.27 | 1455 | 1.15 | 180 | 394 | 2.6 | 12.2 | 6.5 | 1500 | 150 | < 10 | 1170 |
| DH-67 | 10/6/2017 | 36.87 | 6.36 | 1303 | 0.71 | 80 | 294 | 4.7 | 12.2 | 6.5 | 1370 | 150 | 10 J | 1040 |
| DH-68 | 6/21/2017 | 44.38 | 6.68 | 817 | 0.19 | -106 | 110 | 6.6 | 11.1 | 7.1 | 786 | 260 | 39 | 527 |
| DH-68 | 10/10/2017 | 44.75 | 7.17 | 916 | 0.12 | -129 | 86 | 35.1 | 11.6 | 7.1 | 939 | 220 | 59 | 598 |
| DH-69 | 10/10/2017 | 36.12 | 7.09 | 1051 | 0.14 | -95 | 120 | 23 | 11.3 | 7.1 | 1080 | 180 | 35 | 716 |
| DH-7 | 6/22/2017 | 15.76 | 6.69 | 294 | 4.71 | 181 | 399 | 0.7 | 9.1 | 7.1 | 307 | 80 | < 10 | 179 |
| DH-7 | 10/4/2017 | 15.56 | 6.96 | 285 | 1.57 | 139 | 355 | 0.2 | 10.6 | 7 | 304 | 84 | < 10 | 206 |
| DH-79 | 10/11/2017 | 55.10 | 7.90 | 1827 | 7.37 | -90 | 123 | 70.5 | 13.7 | 7.8 | 2360 | 360 | 444 | 1660 |
| DH-8 | 6/22/2017 | 51.92 | 7.19 | 4312 | 3.71 | 220 | 433 | 1 | 13.1 | 7.3 | 4500 | 300 | < 10 | 4190 |
| DH-8 | 10/11/2017 | 52.16 | 7.23 | 4021 | 3.77 | 108 | 323 | 5.6 | 11.4 | 7.2 | 4220 | 280 | 10 J | 3970 |
| DH-80 | 6/21/2017 | 49.35 | 4.33 | 1062 | 0.34 | 124 | 335 | 8.9 | 14.4 | 4.6 | 1090 | 4 UJ | 82 | 842 |
| DH-80 | 10/11/2017 | 49.71 | 4.56 | 957 | 0.65 | 199 | 411 | 11.1 | 13.4 | 4.6 | 978 | < 1 | 23 J | 742 |
| DH-80 (Dup) | 10/11/2017 | 49.71 | 4.55 | 956 | 0.69 | 199 | 412 | 11.1 | 13.5 | 4.6 | 977 | < 1 | 41 J | 750 |
| DH-82 | 6/22/2017 | 43.63 | 7.05 | 2537 | 8.27 | 160 | 375 | 17.5 | 12.1 | 7.2 | 2610 | 300 | 39 | 2160 |
| DH-82 | 10/6/2017 | 43.91 | 7.03 | 2408 | 5.21 | 61 | 275 | 22.2 | 12.3 | 7.2 | 2480 | 290 | 48 J | 1960 |
| EH-100 | 6/28/2017 | 31.33 | 6.57 | 1195 | 0.01 | 121 | 335 | 0.7 | 12.7 | 6.8 | 1240 | 180 | < 10 | 806 |
| EH-100 (Dup) | 6/28/2017 | 31.33 | 6.57 | 1195 | 0.01 | 121 | 335 | 0.7 | 12.7 | 6.8 | 1240 | 180 | < 10 | 823 |
| EH-100 | 10/6/2017 | 31.84 | 6.62 | 1241 | 0.26 | 155 | 369 | 0.4 | 12.0 | 6.8 | 1300 | 180 | < 10 | 852 |
| EH-101 | 6/27/2017 | 17.19 | 7.03 | 336 | 7.35 | 195 | 411 | 0.5 | 10.4 | 7.2 | 343 | 79 | < 10 | 219 |
| EH-101 | 10/5/2017 | 17.44 | 7.05 | 324 | 4.46 | 123 | 340 | 0.7 | 9.8 | 7.2 | 336 | 80 | < 10 | 198 |
| EH-102 | 6/27/2017 | 9.14 | 7.03 | 390 | 1.73 | 205 | 422 | 0.9 | 9.5 | 7.1 | 399 | 98 | < 10 | 259 |
| EH-102 | 10/5/2017 | 9.05 | 7.04 | 395 | 1.12 | 116 | 333 | 0.2 | 10.0 | 7.2 | 411 | 98 | < 10 | 242 |
| EH-103 | 6/27/2017 | 28.60 | 6.85 | 1903 | 0.30 | 156 | 371 | 0.7 | 12.1 | 7 | 1940 | 170 | < 10 | 1500 |
| EH-103 | 10/6/2017 | 28.96 | 6.90 | 1862 | 0.18 | 184 | 399 | 1.8 | 11.5 | 7.1 | 1950 | 170 | 13 | 1500 |
| EH-104 | 6/27/2017 | 38.55 | 6.72 | 1519 | 7.00 | 193 | 408 | 0.7 | 11.8 | 6.9 | 1540 | 220 | < 10 | 1180 |
| EH-104 (Dup) | 6/27/2017 | 38.55 | 6.72 | 1519 | 6.94 | 192 | 407 | 0.7 | 11.8 | 6.8 | 1550 | 220 | < 10 | 1210 |
| EH-104 | 10/6/2017 | 39.64 | 6.80 | 1545 | 6.53 | 74 | 289 | 0.4 | 11.9 | 7 | 1640 | 210 | < 10 UJ | 1210 |
| EH-106 | 6/27/2017 | 32.22 | 6.55 | 1000 | 2.28 | 186 | 400 | 3 | 12.1 | 6.7 | 1000 | 170 | 12 | 714 |
| EH-106 | 10/6/2017 | 32.96 | 6.57 | 984 | 1.25 | 70 | 284 | 7 | 12.1 | 6.8 | 1050 | 160 | 56 J | 713 |
| EH-106 (Dup) | 10/6/2017 | 32.96 | 6.57 | 985 | 1.24 | 70 | 284 | 7 | 12.1 | 6.7 | 1040 | 160 | 25 J | 700 |
| EH-107 (Low Flow) | 6/28/2017 | 25.39 | 6.73 | 1603 | 0.70 | 169 | 382 | 1.4 | 13.3 | 6.9 | 1690 | 180 | 12 | 1200 |
| EH-107 (Standard) | 6/28/2017 | 25.39 | 6.70 | 1630 | 0.11 | 127 | 341 | 0.9 | 12.2 | 6.9 | 1700 | 180 | < 10 | 1250 |
| EH-107 | 10/10/2017 | 24.90 | 6.76 | 1588 | 0.11 | 60 | 274 | 3.2 | 12.3 | 6.9 | 1650 | 170 | 18 | 1190 |
| EH-110 | 6/26/2017 | 23.91 | 7.06 | 1060 | 0.09 | 121 | 335 | 0.9 | 12.2 | 7.4 | 1080 | 160 | < 10 | 723 |
| EH-110 | 10/5/2017 | 24.33 | 7.11 | 974 | 0.11 | 45 | 259 | 2.1 | 12.2 | 7.2 | 998 | 160 | < 10 | 654 |
| EH-111 (Low Flow) | 6/28/2017 | 32.64 | 6.51 | 1610 | 0.23 | 116 | 328 | 4.9 | 14.2 | 6.7 | 1630 | 150 | 32 | 1170 |
| EH-111 (Standard) | 6/28/2017 | 32.64 | 6.47 | 1516 | 0.10 | 125 | 340 | 1.1 | 11.9 | 6.7 | 1560 | 150 | < 10 | 1110 |
| EH-111 | 10/10/2017 | 34.07 | 6.57 | 1658 | 0.09 | 70 | 285 | 3.7 | 11.8 | 6.6 | 1730 | 150 | 14 | 1230 |
| EH-111 (Dup) | 10/10/2017 | 34.07 | 6.57 | 1655 | 0.10 | 70 | 284 | 3.7 | 11.8 | 6.7 | 1740 | 140 | 11 | 1230 |
| EH-114 | 6/26/2017 | 35.91 | 6.58 | 1158 | 0.56 | 190 | 405 | 1.5 | 11.4 | 6.8 | 1180 | 170 | < 10 | 814 |
| EH-114 (Dup) | 6/26/2017 | 35.91 | 6.58 | 1157 | 0.56 | 189 | 405 | 1.5 | 11.4 | 6.8 | 1190 | 170 | < 10 | 837 |

| | | | Field Parameters | | | | | | | General Chemistry | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Depth To Water (ft)** | **pH (s.u.)** | **SC (µmhos/cm)** | **Diss $O_2$ (mg/L)** | **ORP (mV)** | **$E_H$ (mV)** | **Turbidity (NTU)** | **Water Temp (°C)** | **Lab pH (s.u.)** | **Lab SC (µmhos/cm)** | **Total Alkalinity as CaCO3** | **Total Suspended Solids** | **Total Dissolved Solids** |
| EH-114 | 10/3/2017 | 37.41 | 6.70 | 1173 | 0.43 | 70 | 285 | 7.4 | 11.6 | 6.7 | 1170 | 170 | 22 | 820 |
| EH-115 (Low Flow) | 6/23/2017 | 38.44 | 6.51 | 1117 | 0.82 | 103 | 314 | 3.9 | 15.5 | 6.6 | 1100 | 180 | 21 | 803 |
| EH-115 (Standard) | 6/23/2017 | 38.44 | 6.49 | 1116 | 0.41 | 127 | 342 | 1 | 12.0 | 6.6 | 1100 | 180 | < 10 | 808 |
| EH-115 | 10/6/2017 | 39.74 | 6.53 | 1121 | 0.29 | 67 | 281 | 1.8 | 12.3 | 6.7 | 1180 | 170 | < 10 J | 837 |
| EH-117 | 6/26/2017 | 30.87 | 6.72 | 1316 | 6.41 | 154 | 369 | 2.1 | 10.8 | 6.9 | 1360 | 180 | 12 | 964 |
| EH-117 | 10/5/2017 | 32.65 | 6.71 | 1310 | 2.73 | 70 | 285 | 6.4 | 11.3 | 6.9 | 1350 | 170 | 58 | 921 |
| EH-118 | 6/26/2017 | 39.57 | 6.76 | 1172 | 2.44 | 152 | 367 | 16.7 | 11.3 | 7 | 1210 | 220 | 51 | 882 |
| EH-118 | 10/5/2017 | 40.97 | 6.74 | 1164 | 2.36 | 65 | 280 | 47 | 11.5 | 6.9 | 1200 | 220 | 78 | 841 |
| EH-119 | 6/22/2017 | 36.25 | 6.63 | 1105 | 0.32 | 154 | 370 | 1 | 10.9 | 6.9 | 1120 | 180 | < 10 | 808 |
| EH-119 | 10/5/2017 | 37.78 | 6.69 | 1108 | 0.27 | 78 | 293 | 1.2 | 11.1 | 6.9 | 1140 | 180 | < 10 | 777 |
| EH-120 | 6/26/2017 | 32.83 | 6.67 | 1432 | 1.77 | 140 | 355 | 1.7 | 11.6 | 6.9 | 1460 | 150 | 11 | 1160 |
| EH-120 | 10/5/2017 | 34.18 | 6.66 | 1656 | 1.00 | 64 | 279 | 3.5 | 11.7 | 6.8 | 1690 | 160 | 18 | 1300 |
| EH-121 | 6/22/2017 | 30.97 | 6.97 | 277 | 3.79 | 204 | 421 | 0.6 | 9.6 | 7.2 | 283 | 78 | < 10 | 166 |
| EH-121 | 10/4/2017 | 31.82 | 7.12 | 265 | 4.33 | 146 | 364 | 0.2 | 8.8 | 7.2 | 275 | 77 | < 10 | 192 |
| EH-123 | 6/22/2017 | 45.92 | 7.11 | 607 | 7.11 | 177 | 391 | 1 | 12.4 | 7.3 | 619 | 160 | < 10 | 409 |
| EH-123 | 10/3/2017 | 47.37 | 7.27 | 597 | 6.87 | 60 | 274 | 6.8 | 12.4 | 7.3 | 596 | 160 | 12 | 403 |
| EH-124 | 6/26/2017 | 39.58 | 7.23 | 1187 | 3.73 | 142 | 357 | 2.4 | 10.9 | 7.4 | 1220 | 240 | 15 | 871 |
| EH-124 | 10/5/2017 | 40.97 | 7.24 | 1063 | 5.23 | 56 | 271 | 2.9 | 11.1 | 7.4 | 1090 | 210 | < 10 | 740 |
| EH-125 (Low Flow) | 6/23/2017 | 37.59 | 7.01 | 515 | 4.77 | 98 | 312 | 1.4 | 11.9 | 7.1 | 530 | 110 | 10 | 344 |
| EH-125 (Standard) | 6/23/2017 | 37.59 | 7.01 | 420 | 4.69 | 119 | 335 | 1.1 | 10.7 | 7.1 | 430 | 100 | < 10 | 275 |
| EH-125 | 10/5/2017 | 38.91 | 7.03 | 467 | 4.86 | 62 | 277 | 4.6 | 10.9 | 7.2 | 473 | 100 | 10 | 295 |
| EH-126 (Low Flow) | 6/22/2017 | 57.58 | 7.25 | 1044 | 7.24 | 81 | 293 | 4.8 | 13.4 | 7.4 | 1080 | 200 | 76 | 773 |
| EH-126 (Standard) | 6/22/2017 | 57.58 | 7.16 | 1103 | 5.69 | 105 | 320 | 1.3 | 11.0 | 7.4 | 1130 | 200 | < 10 | 818 |
| EH-126 | 10/5/2017 | 59.40 | 7.20 | 1159 | 4.49 | 55 | 270 | 4.9 | 11.4 | 7.3 | 1190 | 200 | 10 | 851 |
| EH-126 (Dup) | 10/5/2017 | 59.40 | 7.20 | 1158 | 4.42 | 55 | 270 | 4.9 | 11.4 | 7.4 | 1190 | 200 | < 10 | 857 |
| EH-129 | 6/22/2017 | 58.48 | 7.29 | 607 | 7.77 | 132 | 347 | 5 | 11.9 | 7.5 | 615 | 160 | 13 | 403 |
| EH-129 | 10/3/2017 | 60.75 | 7.45 | 588 | 6.96 | 58 | 272 | 4.3 | 12.2 | 7.4 | 588 | 160 | < 10 | 399 |
| EH-130 | 6/21/2017 | 47.77 | 7.06 | 274 | 4.73 | 142 | 358 | 1.3 | 10.6 | 7.2 | 297 | 82 | < 10 | 189 |
| EH-130 | 10/4/2017 | 48.92 | 7.09 | 283 | 4.40 | 114 | 330 | 5.1 | 9.9 | 7.2 | 295 | 81 | 17 | 205 |
| EH-132 | 6/22/2017 | 61.87 | 7.26 | 646 | 5.30 | 171 | 383 | 2.1 | 14.0 | 7.5 | 642 | 130 | < 10 | 443 |
| EH-132 (Dup) | 6/22/2017 | 61.87 | 7.26 | 645 | 5.30 | 171 | 383 | 2.1 | 14.0 | 7.5 | 642 | 130 | < 10 | 437 |
| EH-132 | 10/3/2017 | 63.55 | 7.40 | 629 | 6.38 | 54 | 266 | 16.9 | 14.1 | 7.4 | 628 | 130 | 23 | 438 |
| EH-134 | 6/22/2017 | 58.48 | 7.43 | 440 | 7.62 | 163 | 376 | 1.9 | 12.7 | 7.6 | 447 | 140 | < 10 | 293 |
| EH-134 | 10/3/2017 | 60.41 | 7.56 | 444 | 7.64 | 55 | 268 | 2.8 | 13.1 | 7.6 | 445 | 140 | 10 | 303 |
| EH-135 | 6/22/2017 | 31.89 | 6.98 | 283 | 7.05 | 166 | 384 | 1 | 9.2 | 7.2 | 290 | 78 | < 10 | 168 |
| EH-135 | 10/5/2017 | 32.00 | 7.11 | 274 | 5.35 | 114 | 333 | 3 | 8.1 | 7.2 | 289 | 78 | < 10 | 186 |
| EH-138 | 7/11/2017 | 46.83 | 7.29 | 509 | 7.69 | 164 | 381 | 1 | 9.8 | 7.3 | 526 | 120 | < 10 | 338 |
| EH-138 | 10/4/2017 | 48.26 | 7.22 | 592 | 6.35 | 116 | 334 | 2.5 | 9.4 | 7.2 | 610 | 130 | < 10 | 416 |
| EH-139 | 7/11/2017 | 52.07 | 7.36 | 599 | 10.27 | 134 | 349 | 0.8 | 11.4 | 7.5 | 619 | 180 | < 10 | 415 |
| EH-139 (Dup) | 7/11/2017 | 52.07 | 7.36 | 599 | 10.26 | 134 | 349 | 0.8 | 11.4 | 7.5 | 618 | 180 | < 10 | 421 |
| EH-139 | 10/4/2017 | 54.06 | 7.42 | 581 | 7.84 | 81 | 297 | 0.7 | 10.8 | 7.4 | 597 | 180 | < 10 | 416 |
| EH-139 (Dup) | 10/4/2017 | 54.06 | 7.42 | 581 | 7.83 | 81 | 296 | 0.7 | 10.8 | 7.4 | 596 | 180 | < 10 | 414 |
| EH-140 | 6/20/2017 | 24.44 | 6.68 | 285 | 6.67 | 143 | 361 | 0.9 | 8.5 | 7.2 | 291 | 83 | < 10 | 177 |
| EH-140 | 10/4/2017 | 26.47 | 7.11 | 285 | 6.29 | 151 | 369 | 1.5 | 8.9 | 7.2 | 295 | 83 | < 10 | 205 |
| EH-141 | 6/21/2017 | 31.73 | 7.25 | 821 | 4.59 | 127 | 343 | 1.1 | 10.7 | 7.4 | 893 | 170 | < 10 | 609 |
| EH-141 (Dup) | 6/21/2017 | 31.73 | 7.25 | 821 | 4.59 | 126 | 343 | 1.1 | 10.7 | 7.4 | 893 | 170 | < 10 | 628 |
| EH-141 | 10/5/2017 | 33.73 | 7.27 | 789 | 5.38 | 156 | 372 | 0.5 | 10.4 | 7.4 | 821 | 160 | < 10 | 546 |
| EH-141 (Dup) | 10/5/2017 | 33.73 | 7.27 | 789 | 5.38 | 155 | 371 | 0.5 | 10.4 | 7.4 | 818 | 170 | < 10 | 540 |
| EH-142 | 6/21/2017 | 32.10 | 7.41 | 535 | 7.09 | 126 | 341 | 2 | 11.6 | 7.5 | 582 | 160 | < 10 | 378 |
| EH-142 | 10/4/2017 | 33.86 | 7.44 | 560 | 6.59 | 100 | 315 | 3.2 | 11.2 | 7.6 | 578 | 170 | 14 | 401 |
| EH-143 | 6/21/2017 | 33.08 | 7.28 | 467 | 5.77 | 113 | 329 | 1.2 | 10.4 | 7.4 | 506 | 120 | < 10 | 333 |
| EH-143 | 10/4/2017 | 34.88 | 7.29 | 538 | 5.42 | 111 | 328 | 1.8 | 9.7 | 7.3 | 558 | 120 | < 10 | 390 |
| EH-144D | 6/20/2017 | 22.17 | 7.09 | 598 | 5.91 | 106 | 323 | 8 | 10.1 | 7.3 | 608 | 120 | 31 | 390 |
| EH-144D | 10/3/2017 | 22.97 | 7.19 | 589 | 5.34 | 126 | 343 | 0.5 | 10.1 | 7.2 | 605 | 120 | < 10 | 396 |
| EH-144D (Dup) | 10/3/2017 | 22.97 | 7.19 | 589 | 5.35 | 126 | 343 | 0.5 | 10.1 | 7.2 | 603 | 120 | < 10 | 397 |
| EH-144M | 6/20/2017 | 24.93 | 7.00 | 480 | 6.33 | 120 | 337 | 1.2 | 9.8 | 7.3 | 489 | 110 | < 10 | 318 |
| EH-144M | 10/3/2017 | 25.47 | 7.19 | 471 | 5.71 | 118 | 335 | 1 | 10.1 | 7.2 | 483 | 110 | < 10 | 316 |
| EH-144S | 6/20/2017 | 26.42 | 7.15 | 390 | 5.65 | 113 | 330 | 1 | 9.9 | 7.3 | 398 | 100 | < 10 | 247 |
| EH-144S | 10/3/2017 | 26.83 | 7.22 | 384 | 5.16 | 120 | 337 | 0.4 | 10.1 | 7.3 | 395 | 99 | < 10 | 243 |
| EH-145D | 6/21/2017 | 29.83 | 7.12 | 390 | 4.56 | 100 | 316 | 6 | 10.6 | 7.2 | 420 | 100 | < 10 | 281 |
| EH-145D | 10/3/2017 | 30.90 | 7.16 | 404 | 4.39 | 108 | 325 | 1.4 | 10.1 | 7.2 | 417 | 100 | < 10 | 272 |
| EH-145S | 6/21/2017 | 30.85 | 7.06 | 388 | 4.35 | 102 | 318 | 8 | 10.5 | 7.2 | 420 | 100 | 10 | 274 |
| EH-145S | 10/3/2017 | 31.88 | 7.09 | 402 | 4.44 | 111 | 328 | 5.5 | 9.8 | 7.2 | 415 | 100 | < 10 | 264 |
| EH-204 | 6/22/2017 | 57.74 | 7.11 | 1899 | 3.84 | 82 | 297 | 11.1 | 11.6 | 7.3 | 1960 | 260 | 21 | 1550 |
| EH-204 | 10/6/2017 | 58.16 | 7.13 | 1887 | 2.99 | 72 | 287 | 7 | 11.4 | 7.4 | 1990 | 260 | 12 J | 1550 |
| EH-206 | 6/22/2017 | 51.28 | 7.47 | 533 | 5.79 | 178 | 391 | 6.6 | 13.2 | 7.7 | 542 | 180 | 17 | 345 |
| EH-206 | 10/3/2017 | 52.16 | 7.57 | 515 | 6.15 | 53 | 266 | 15.4 | 13.2 | 7.6 | 512 | 170 | 73 | 343 |
| EH-50 | 6/28/2017 | 30.81 | 6.49 | 1066 | 0.77 | 138 | 353 | 0.8 | 12.3 | 6.7 | 1100 | 170 | < 10 | 742 |
| EH-50 | 10/6/2017 | 31.29 | 6.56 | 1099 | 1.18 | 205 | 420 | 1.4 | 11.7 | 6.7 | 1150 | 170 | < 10 | 778 |
| EH-50 (Dup) | 10/6/2017 | 31.29 | 6.56 | 1099 | 1.18 | 205 | 420 | 1.4 | 11.7 | 6.7 | 1150 | 170 | < 10 | 773 |
| EH-51 | 6/27/2017 | 16.90 | 7.05 | 354 | 7.97 | 194 | 411 | 1.1 | 9.9 | 7.2 | 362 | 86 | < 10 | 236 |
| EH-51 | 10/5/2017 | 17.17 | 7.09 | 346 | 4.90 | 126 | 343 | 0.4 | 10.3 | 7.2 | 362 | 87 | < 10 | 212 |
| EH-52 | 6/27/2017 | 7.70 | 6.81 | 340 | 3.52 | 194 | 409 | 0.8 | 11.2 | 7 | 354 | 95 | < 10 | 232 |
| EH-52 | 10/5/2017 | 7.86 | 6.79 | 377 | 1.96 | 125 | 337 | 0.3 | 13.7 | 6.9 | 393 | 110 | < 10 | 230 |
| EH-53 | 6/23/2017 | 30.22 | 6.70 | 656 | 8.87 | 202 | 417 | 0.3 | 11.9 | 7.1 | 680 | 140 | < 10 | 434 |
| EH-53 (Dup) | 6/23/2017 | 30.22 | 6.70 | 657 | 8.89 | 202 | 417 | 0.3 | 11.9 | 7.1 | 680 | 140 | < 10 | 430 |

| | | | Field Parameters | | | | | | | General Chemistry | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Depth To Water (ft)** | **pH (s.u.)** | **SC (µmhos/cm)** | **Diss $O_2$ (mg/L)** | **ORP (mV)** | **$E_H$ (mV)** | **Turbidity (NTU)** | **Water Temp (°C)** | **Lab pH (s.u.)** | **Lab SC (µmhos/cm)** | **Total Alkalinity as CaCO3** | **Total Suspended Solids** | **Total Dissolved Solids** |
| EH-53 | 10/5/2017 | 32.23 | 7.01 | 613 | 6.63 | 138 | 353 | 0.4 | 11.0 | 7.1 | 638 | 150 | < 10 | 403 |
| EH-54 | 6/23/2017 | 8.43 | 6.69 | 269 | 5.42 | 201 | 421 | 3.2 | 7.6 | 7.2 | 280 | 98 | < 10 | 168 |
| EH-54 | 10/5/2017 | 8.18 | 6.94 | 332 | 2.80 | 139 | 352 | 1.4 | 13.5 | 7.1 | 347 | 110 | < 10 | 212 |
| EH-57A | 6/26/2017 | 41.72 | 6.85 | 1473 | 3.57 | 170 | 384 | 0.9 | 11.9 | 7.1 | 1510 | 260 | < 10 | 1070 |
| EH-58 | 6/23/2017 | 13.65 | 6.55 | 416 | 2.18 | 215 | 432 | 0.5 | 10.1 | 7 | 440 | 120 | < 10 | 291 |
| EH-58 | 10/3/2017 | 13.50 | 6.85 | 422 | 1.83 | 28 | 243 | 3.4 | 11.7 | 6.9 | 425 | 110 | < 10 | 270 |
| EH-58 (Dup) | 10/3/2017 | 13.50 | 6.85 | 419 | 1.85 | 28 | 243 | 3.4 | 11.7 | 6.8 | 431 | 120 | < 10 | 274 |
| EH-59 | 6/23/2017 | 8.03 | 6.49 | 296 | 2.19 | 189 | 405 | 1 | 11.1 | 7 | 310 | 86 | < 10 | 188 |
| EH-59 | 10/5/2017 | 7.97 | 6.80 | 351 | 1.26 | 80 | 293 | 0.6 | 12.8 | 7 | 366 | 110 | < 10 | 212 |
| EH-60 | 6/27/2017 | 26.31 | 6.72 | 1871 | 6.82 | 166 | 379 | | 13.7 | 6.7 | 1660 | 250 | < 10 | 1150 |
| EH-60 | 10/6/2017 | 26.69 | 6.90 | 1714 | 3.93 | 220 | 433 | 2.8 | 12.9 | 6.8 | 1760 | 260 | < 10 | 1200 |
| EH-61 | 6/27/2017 | 27.99 | 6.87 | 1972 | 0.01 | 151 | 365 | 0.9 | 12.6 | 7 | 1990 | 180 | 10 | 1560 |
| EH-61 | 10/6/2017 | 28.39 | 6.93 | 1954 | 0.33 | 185 | 400 | 0.9 | 11.3 | 7.1 | 2060 | 180 | < 10 | 1510 |
| EH-62 | 6/23/2017 | 27.50 | 6.78 | 335 | 6.59 | 198 | 414 | 0.8 | 10.8 | 7.2 | 350 | 100 | < 10 | 224 |
| EH-62 | 10/5/2017 | 28.26 | 7.07 | 344 | 5.10 | 63 | 278 | 0.6 | 11.1 | 7.2 | 355 | 100 | < 10 | 224 |
| EH-63 | 6/26/2017 | 22.14 | 6.98 | 351 | 4.42 | 123 | 339 | 1.1 | 10.2 | 7.2 | 359 | 99 | < 10 | 240 |
| EH-63 | 10/5/2017 | 22.40 | 7.00 | 356 | 5.69 | 66 | 282 | 1.7 | 10.9 | 7.1 | 369 | 99 | < 10 | 223 |
| EH-65 (Low Flow) | 6/23/2017 | 27.77 | 6.48 | 1631 | 0.30 | 144 | 354 | 6.7 | 15.5 | 6.6 | 1700 | 170 | 14 | 1200 |
| EH-65 (Low Flow Dup) | 6/23/2017 | 27.77 | 6.48 | 1631 | 0.30 | 144 | 354 | 6.7 | 15.5 | 6.6 | 1700 | 170 | 16 | 1210 |
| EH-65 (Standard) | 6/23/2017 | 27.77 | 6.46 | 1616 | 0.41 | 153 | 367 | 1.4 | 12.3 | 6.6 | 1600 | 170 | < 10 | 1190 |
| EH-65 | 10/10/2017 | 28.83 | 6.50 | 1666 | 0.24 | 112 | 327 | 1.1 | 11.8 | 6.6 | 1760 | 170 | < 10 | 1230 |
| EH-66 | 6/22/2017 | 30.66 | 7.23 | 325 | 9.37 | 209 | 426 | 7 | 9.4 | 7.5 | 328 | 99 | 24 | 189 |
| EH-66 | 10/4/2017 | 31.62 | 7.12 | 268 | 7.34 | 118 | 336 | 14.8 | 8.9 | 7.2 | 280 | 78 | 41 | 194 |
| EH-69 | 6/23/2017 | 20.48 | 6.60 | 388 | 5.82 | 208 | 424 | 7.7 | 10.8 | 7 | 400 | 110 | 71 | 266 |
| EH-69 | 10/3/2017 | 20.02 | 6.96 | 411 | 5.13 | 68 | 283 | 6.7 | 11.5 | 7 | 412 | 110 | 28 | 259 |
| EH-70 (Low Flow) | 6/23/2017 | 36.91 | 6.96 | 869 | 6.93 | 138 | 352 | 3.6 | 12.6 | 7.1 | 870 | 140 | 13 | 581 |
| EH-70 (Standard) | 6/23/2017 | 36.91 | 6.96 | 858 | 6.97 | 149 | 365 | 2.1 | 10.8 | 7.1 | 880 | 140 | < 10 | 582 |
| EH-70 | 10/5/2017 | 38.35 | 6.98 | 815 | 5.35 | 64 | 280 | 1.7 | 11.1 | 7.1 | 833 | 140 | < 10 | 558 |
| MW-1 | 10/4/2017 | 54.56 | 7.47 | 443 | 9.67 | 58 | 273 | 6.7 | 11.9 | 7.5 | 452 | 120 | < 10 | 329 |
| MW-10 | 10/4/2017 | 48.75 | 7.36 | 731 | 4.25 | 55 | 271 | 3 | 11.1 | 7.4 | 746 | 240 | < 10 | 511 |
| MW-10 (Dup) | 10/4/2017 | 48.75 | 7.35 | 729 | 4.16 | 55 | 271 | 3 | 11.1 | 7.4 | 742 | 240 | < 10 | 519 |
| MW-11 | 10/4/2017 | 64.56 | 7.70 | 630 | 9.80 | 66 | 280 | 2.7 | 11.8 | 7.7 | 643 | 120 | < 10 | 459 |
| MW-2 | 10/4/2017 | 40.93 | 7.04 | 800 | 0.17 | 31 | 247 | 0.2 | 10.9 | 7.1 | 816 | 220 | < 10 | 575 |
| MW-3 | 10/4/2017 | 36.29 | 7.03 | 820 | 0.16 | 50 | 266 | 0.2 | 10.7 | 7.1 | 838 | 240 | < 10 | 586 |
| MW-4 | 10/4/2017 | 50.83 | 7.43 | 501 | 9.36 | 62 | 278 | 12.6 | 11.0 | 7.5 | 515 | 170 | 18 | 363 |
| MW-5 | 10/4/2017 | 55.73 | 7.79 | 358 | 9.52 | 52 | 266 | 10.3 | 12.5 | 7.8 | 361 | 140 | 48 | 264 |
| MW-6 | 10/4/2017 | 32.85 | 7.14 | 932 | 0.14 | 39 | 254 | 1.6 | 10.8 | 7.2 | 965 | 250 | < 10 | 693 |
| MW-8 | 10/4/2017 | 54.52 | 7.38 | 468 | 7.20 | 57 | 272 | 5.1 | 11.9 | 7.4 | 478 | 160 | 22 | 339 |
| MW-9 | 10/4/2017 | 53.14 | 7.54 | 436 | 9.00 | 54 | 266 | 3.6 | 14.0 | 7.6 | 446 | 150 | 395 | 315 |
| SDMW-2 | 6/21/2017 | 54.10 | 6.29 | 1268 | 0.46 | 16 | 228 | 6.9 | 13.9 | 6.6 | 1290 | 170 | 10 | 825 |
| SDMW-2 | 10/11/2017 | 54.42 | 6.60 | 1242 | 0.25 | -19 | 195 | 2.2 | 12.8 | 6.6 | 1260 | 160 | < 10 UJ | 803 |

NOTES: All concentrations in mg/L except as indicated.
U = below laboratory reporting limit (associated value)
A = anomalous data point (historical inconsistency)
R = data point rejected during validation procedure
J = QC criterion exceeded; + = potential high bias

| | | Major Ions | | | | | | | | Dissolved (D) Metals | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Calcium** | **Magnesium** | **Sodium** | **Potassium** | **Bicarbonate** | **Chloride** | **Sulfate** | **Bromide** | **Sb (D)** | **As (D)** | **Cd (D)** | **Cu (D)** | **Fe (D)** | **Pb (D)** | **Mn (D)** | **Hg (D)** | **Se (D)** | **Tl (D)** | **Zn (D)** |
| 2843 Canyon Ferry Rd | 6/27/2017 | 80 | 18 | 31 | 5 | 170 | 19 | 190 | 0.81 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | 1.26 | < 0.005 | 0.02 | < 0.001 | 0.038 | < 0.001 | < 0.01 |
| 2843 Canyon Ferry Rd | 10/12/2017 | 81 | 18 | 30 | 4 | 160 | 17 | 179 | 0.7 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | 0.07 | < 0.005 | 0.01 | < 0.001 | 0.036 | < 0.001 | < 0.01 |
| 2853 Canyon Ferry Rd | 6/27/2017 | 87 | 19 | 32 | 5 | 170 | 20 | 210 | 0.9 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | 0.03 | < 0.005 | < 0.01 | < 0.001 | 0.041 | < 0.001 | < 0.01 |
| 2853 Canyon Ferry Rd | 10/12/2017 | 89 | 20 | 30 | 4 | 160 | 19 | 204 | 0.84 | < 0.003 | < 0.002 | < 0.001 | 0.002 | 0.05 | < 0.005 | < 0.01 | < 0.001 | 0.042 | < 0.001 | 0.01 |
| Amchem Injection | 10/12/2017 | 35 | 8 | 16 | 4 | 130 | 5 | 46 | 0.21 | < 0.003 | 0.004 | < 0.001 | 0.004 | 0.05 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| Amchem4 | 10/12/2017 | 35 | 8 | 16 | 4 | 140 | 5 | 46 | 0.21 | < 0.003 | 0.004 | < 0.001 | 0.007 | 0.03 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | 0.01 |
| DH-1 | 6/22/2017 | 181 | 43 | 136 | 12 | 290 | 49 | 630 | 2.5 | < 0.003 | 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.168 | < 0.001 | < 0.01 |
| DH-1 | 10/6/2017 | 189 | 45 | 155 | 12 | 290 | 51 | 676 | 2.86 | < 0.003 | < 0.002 UJ | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 UJ | < 0.001 | 0.181 | < 0.001 | < 0.01 |
| DH-15 | 6/21/2017 | 242 | 53 | 167 | 8 | 200 | 24 | 860 | 1.7 | < 0.003 | < 0.002 | < 0.001 | 0.003 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.343 | < 0.001 | < 0.01 |
| DH-15 | 10/6/2017 | 234 | 52 | 174 | 8 | 200 | 24 | 951 | 1.6 | < 0.003 | < 0.002 | < 0.001 | 0.003 | < 0.02 | < 0.005 | 0.02 | < 0.001 | 0.35 | < 0.001 | < 0.01 |
| DH-17 | 6/22/2017 | 45 | 15 | 256 | 13 | 370 | 29 | 440 | 2.5 | < 0.003 | 26.4 | < 0.001 | < 0.001 | 0.22 | < 0.005 | 1.35 | < 0.001 | < 0.001 | < 0.001 | 0.09 |
| DH-17 | 10/11/2017 | 52 | 15 | 243 | 14 | 340 | 27 | 440 | 2.59 | < 0.003 | 22.8 | < 0.001 | < 0.001 | 0.25 | < 0.005 | 1.51 | < 0.001 | < 0.001 | < 0.001 | 0.09 |
| DH-20 | 6/22/2017 | 138 | 30 | 25 | 5 | 270 | 8.1 | 290 | 0.05 | < 0.003 | 0.106 | < 0.001 | < 0.001 | 10.8 | < 0.005 | 7.89 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| DH-20 (Dup) | 6/22/2017 | 129 | 28 | 25 | 5 | 270 | 8 | 290 | 0.055 | < 0.003 | 0.105 | < 0.001 | < 0.001 | 10.1 | < 0.005 | 7.47 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| DH-20 | 10/10/2017 | 123 | 25 | 27 | 6 | 260 | 8 | 274 | < 0.05 | < 0.003 | 0.124 | < 0.001 | < 0.001 | 9.2 | < 0.005 | 7.27 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| DH-42 | 6/20/2017 | 114 | 30 | 32 | 8 | 240 | 14 | 280 | 0.97 | 0.003 | 2.46 | 5.01 | 0.004 | < 0.02 | < 0.005 | 7.51 | < 0.001 | 0.016 | 0.005 | 2.72 |
| DH-42 (Dup) | 6/20/2017 | 116 | 31 | 33 | 8 | 240 | 14 | 280 | 0.96 | 0.003 | 2.51 | 5.14 | 0.004 | < 0.02 | < 0.005 | 7.63 | < 0.001 | 0.016 | 0.004 | 2.76 |
| DH-47 | 6/28/2017 | 340 | 54 | 110 | 20 | 540 | 11 | 1000 | 0.53 | 0.036 | 1.48 | < 0.001 | < 0.001 | 8.66 | < 0.005 | 10.8 | < 0.001 | < 0.001 | < 0.001 | 0.04 |
| DH-52 | 6/20/2017 | 42 | 7 | 57 | 60 | 160 | 6.7 | 190 | 0.16 | 0.031 | 0.634 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.025 | < 0.001 | < 0.01 |
| DH-52 | 10/6/2017 | 38 | 7 | 60 | 61 | 160 | 6 | 175 | 0.17 | 0.03 | 0.646 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.017 | < 0.001 | < 0.01 |
| DH-55 | 6/20/2017 | 31 | 6 | 54 | 75 | 140 | 6.2 | 200 | 0.09 | 0.036 | 0.227 | < 0.001 | 0.003 | < 0.02 | < 0.005 | 0.01 | < 0.001 | 0.056 | 0.005 | < 0.01 |
| DH-55 | 10/10/2017 | 45 | 9 | 62 | 79 | 150 | 7 | 252 | 0.2 | 0.034 | 0.202 | < 0.001 | 0.003 | < 0.02 | < 0.005 | 0.02 | < 0.001 | 0.052 | 0.007 | 0.06 |
| DH-56 | 6/20/2017 | 59 | 11 | 331 | 251 | 290 | 20 | 950 | 1 | 0.024 | 0.406 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.307 | < 0.001 | < 0.01 |
| DH-56 (Dup) | 6/20/2017 | 58 | 11 | 326 | 247 | 290 | 20 | 950 | 1.1 | 0.024 | 0.412 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.308 | < 0.001 | < 0.01 |
| DH-56 | 10/10/2017 | 60 | 11 | 353 | 262 | 260 | 20 | 1070 | 0.9 | 0.025 | 0.416 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.306 | < 0.001 | < 0.01 |
| DH-59 | 6/21/2017 | 107 | 19 | 49 | 17 | 200 | 11 | 280 | 0.32 | < 0.003 | 10.9 | 0.057 | < 0.001 | 0.57 | < 0.005 | 5.59 | < 0.001 | 0.002 | 0.115 | 0.08 |
| DH-59 | 10/11/2017 | 91 | 17 | 42 | 15 | 190 | 10 | 243 | 0.25 | < 0.003 | 8.41 | 0.031 | < 0.001 | 0.56 | < 0.005 | 4.72 | < 0.001 | < 0.001 | 0.097 | 0.06 |
| DH-6 | 6/21/2017 | 22 | 3 | 128 | 83 | 180 | 8.3 | 250 | 0.17 | 0.059 | 1.83 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.115 | < 0.001 | < 0.01 |
| DH-6 | 10/6/2017 | 19 | < 5 | 116 | 73 | 180 | 9 | 215 | 0.15 | 0.061 | 1.69 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.072 | < 0.001 | < 0.01 |
| DH-64 (Low Flow) | 6/21/2017 | 50 | 16 | 169 | 13 | 270 | 17 | 300 | 1.6 | < 0.003 | 12.9 | 0.013 | 0.002 | 0.65 | < 0.005 | 2.9 | < 0.001 | < 0.001 | < 0.001 | 0.18 |
| DH-64 (Standard) | 6/21/2017 | 50 | 16 | 170 | 13 | 270 | 17 | 310 | 1.6 | < 0.003 | 12.7 | 0.013 | 0.001 | 0.67 | < 0.005 | 2.92 | < 0.001 | < 0.001 | < 0.001 | 0.18 |
| DH-64 | 10/11/2017 | 59 | 19 | 158 | 13 | 270 | 19 | 337 | 1.83 | < 0.003 | 10.1 | 0.013 | 0.002 | 0.72 | < 0.005 | 3.22 | < 0.001 | < 0.001 | < 0.001 | 0.18 |
| DH-66 | 6/21/2017 | 401 | 133 | 104 | 11 | 270 | 230 | 980 | 16 | < 0.003 | 0.005 | 0.288 | 0.004 | < 0.02 | < 0.005 | < 0.01 | 0.002 | 1.16 | < 0.001 | 0.17 |
| DH-66 (Dup) | 6/21/2017 | 402 | 133 | 103 | 11 | 270 | 230 | 990 | 16 | < 0.003 | 0.005 | 0.287 | 0.004 | < 0.02 | < 0.005 | < 0.01 | 0.002 | 1.16 | < 0.001 | 0.17 |
| DH-66 | 10/11/2017 | 413 | 135 | 90 | 10 | 260 | 257 | 1140 | 19.5 | < 0.003 | 0.007 J+ | 0.275 | 0.003 | < 0.02 | < 0.005 | < 0.01 | 0.002 | 0.938 | < 0.001 | 0.14 |
| DH-67 | 6/22/2017 | 155 | 54 | 91 | 7 | 180 | 48 | 560 | 2.5 | < 0.003 | 0.006 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.202 | < 0.001 | < 0.01 |
| DH-67 | 10/6/2017 | 132 | 44 | 94 | 7 | 180 | 36 | 511 | 1.92 | < 0.003 | 0.006 J | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 UJ | < 0.001 | 0.093 | < 0.001 | < 0.01 |
| DH-68 | 6/21/2017 | 45 | 8 | 109 | 5 | 310 | 8.8 | 120 | 0.45 | < 0.003 | 0.839 | < 0.001 | < 0.001 | 14.4 | < 0.005 | 4.61 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| DH-68 | 10/10/2017 | 65 | 9 | 95 | 23 | 270 | 9 | 218 | 0.48 | 0.007 | 0.707 | < 0.001 | < 0.001 | 9.53 | < 0.005 | 4.12 | < 0.001 | < 0.001 | < 0.001 | 0.13 |
| DH-69 | 10/10/2017 | 85 | 10 | 98 | 38 | 220 | 9 | 328 | 0.27 | 0.003 | 0.232 | < 0.001 | 0.004 | 7.4 | < 0.005 | 3.1 | < 0.001 | 0.002 | 0.002 | 0.87 |
| DH-7 | 6/22/2017 | 32 | 7 | 15 | 3 | 97 | 5.6 | 57 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| DH-7 | 10/4/2017 | 30 | 6 | 16 | < 5 | 100 | 5 | 56 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| DH-79 | 10/11/2017 | 42 | 18 | 430 | 21 | 440 | 54 | 769 | 2.2 | < 0.003 | 33.1 | 0.004 | < 0.001 | 0.22 | < 0.005 | 1.89 | < 0.001 | 0.007 | < 0.001 | 0.02 |
| DH-8 | 6/22/2017 | 787 | 195 | 96 | 18 | 370 | 460 | 1700 | 26 | 0.003 | 0.003 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | 0.002 | 0.637 | 0.002 | < 0.01 |
| DH-8 | 10/11/2017 | 729 | 163 | 98 | 17 | 340 | 425 | 1730 | 27.8 | < 0.003 | 0.003 J+ | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | 0.003 | 0.57 | 0.002 | < 0.01 |
| DH-80 | 6/21/2017 | 101 | 24 | 47 | 11 | 4 | 14 | 540 | 0.39 | < 0.003 | 10 | 5.82 | 0.001 | 16.5 | < 0.005 | 4.34 | < 0.001 | 0.004 | 0.274 | 9.39 |
| DH-80 | 10/11/2017 | 85 | 21 | 43 | 10 | < 1 | 12 | 470 | 0.33 | < 0.003 | 9.43 | 3.8 | < 0.001 | 14 | < 0.005 | 3.79 | < 0.001 | 0.002 | 0.246 | 7.46 |
| DH-80 (Dup) | 10/11/2017 | 85 | 21 | 44 | 10 | < 1 | 12 | 471 | 0.33 | < 0.003 | 9.12 | 3.85 | < 0.001 | 13.9 | < 0.005 | 3.78 | < 0.001 | 0.002 | 0.241 | 7.18 |
| DH-82 | 6/22/2017 | 318 | 94 | 151 | 9 | 360 | 100 | 1000 | 3.6 | < 0.003 | 0.2 | < 0.001 | 0.004 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.725 | < 0.001 | < 0.01 |
| DH-82 | 10/6/2017 | 287 | 81 | 177 | 8 | 360 | 113 | 917 | 5.9 | < 0.003 | 0.191 J | < 0.001 | 0.004 | < 0.02 | < 0.005 | < 0.01 UJ | < 0.001 | 0.836 | < 0.001 | < 0.01 |
| EH-100 | 6/28/2017 | 38 | 13 | 216 | 8 | 220 | 19 | 350 | 1.6 | < 0.003 | 14.1 | 0.002 | 0.004 | < 0.02 | < 0.005 | 3.68 | < 0.001 | 0.003 | < 0.001 | 0.23 |
| EH-100 (Dup) | 6/28/2017 | 37 | 13 | 211 | 8 | 220 | 19 | 350 | 1.6 | < 0.003 | 13.9 | 0.002 | 0.003 | < 0.02 | < 0.005 | 3.69 | < 0.001 | 0.003 | < 0.001 | 0.22 |
| EH-100 | 10/6/2017 | 42 | 15 | 205 | 8 | 220 | 20 | 397 | 1.69 | < 0.003 | 13.9 | 0.002 | 0.003 | < 0.02 | < 0.005 | 4.01 | < 0.001 | 0.003 | < 0.001 | 0.2 |
| EH-101 | 6/27/2017 | 21 | 4 | 33 | 14 | 96 | 11 | 61 | < 0.05 | < 0.003 | 0.003 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.004 | < 0.001 | < 0.01 |
| EH-101 | 10/5/2017 | 21 | < 5 | 30 | 14 | 98 | 8 | 61 | < 0.05 | < 0.003 | 0.003 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.003 | < 0.001 | < 0.01 |
| EH-102 | 6/27/2017 | 25 | 5 | 46 | 6 | 120 | 8.2 | 80 | 0.082 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.008 | < 0.001 | < 0.01 |
| EH-102 | 10/5/2017 | 26 | 5 | 44 | 6 | 120 | 10 | 80 | 0.13 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.008 | < 0.001 | < 0.01 |
| EH-103 | 6/27/2017 | 206 | 42 | 174 | 11 | 210 | 32 | 890 | 2 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.23 | < 0.001 | 0.329 | < 0.001 | < 0.01 |
| EH-103 | 10/6/2017 | 198 | 40 | 186 | 11 | 200 | 31 | 847 | 2.18 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.23 | < 0.001 | 0.312 | < 0.001 | < 0.01 |
| EH-104 | 6/27/2017 | 164 | 41 | 114 | 7 | 260 | 71 | 500 | 3 | < 0.003 | < 0.002 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.346 | < 0.001 | < 0.01 |
| EH-104 (Dup) | 6/27/2017 | 166 | 42 | 114 | 7 | 260 | 72 | 500 | 3.1 | < 0.003 | < 0.002 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.354 | < 0.001 | < 0.01 |
| EH-104 | 10/6/2017 | 177 | 45 | 116 | 7 | 260 | 72 | 534 | 3.4 | < 0.003 | < 0.002 UJ | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 UJ | < 0.001 | 0.385 | < 0.001 | < 0.01 |
| EH-106 | 6/27/2017 | 73 | 17 | 116 | 5 | 200 | 39 | 280 | 1.2 | < 0.003 | 0.358 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.06 | < 0.001 | 0.007 | < 0.001 | < 0.01 |
| EH-106 | 10/6/2017 | 71 | 17 | 123 | 5 | 190 | 33 | 303 | 1.25 | < 0.003 | 0.348 J | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.05 J | < 0.001 | 0.006 | < 0.001 | < 0.01 |
| EH-106 (Dup) | 10/6/2017 | 72 | 17 | 125 | 5 | 190 | 34 | 300 | 1.23 | < 0.003 | 0.482 J | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.03 J | < 0.001 | 0.007 | < 0.001 | < 0.01 |
| EH-107 (Low Flow) | 6/28/2017 | 158 | 35 | 172 | 7 | 220 | 36 | 620 | 1.1 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | 0.08 | < 0.005 | 0.07 | < 0.001 | 0.238 | < 0.001 | < 0.01 |
| EH-107 (Standard) | 6/28/2017 | 160 | 35 | 174 | 7 | 220 | 36 | 620 | 1.1 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.07 | < 0.001 | 0.257 | < 0.001 | < 0.01 |
| EH-107 | 10/10/2017 | 149 | 33 | 168 | 7 | 210 | 33 | 638 | 0.94 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.06 | < 0.001 | 0.242 | < 0.001 | < 0.01 |
| EH-110 | 6/26/2017 | 54 | 11 | 161 | 7 | 200 | 18 | 350 | 0.23 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.03 | < 0.001 | 0.13 | < 0.001 | < 0.01 |
| EH-110 | 10/5/2017 | 51 | 10 | 140 | 6 | 190 | 17 | 306 | 0.19 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.01 | < 0.001 | 0.099 | < 0.001 | < 0.01 |
| EH-111 (Low Flow) | 6/28/2017 | 101 | 28 | 211 | 10 | 180 | 29 | 600 | 1.8 | < 0.003 | 1.94 | < 0.001 | 0.003 | 0.13 | < 0.005 | 8.53 | < 0.001 | 0.136 | < 0.001 | < 0.01 |
| EH-111 (Standard) | 6/28/2017 | 98 | 26 | 206 | 9 | 180 | 30 | 570 | 1.8 | < 0.003 | 1.71 | < 0.001 | 0.001 | < 0.02 | < 0.005 | 6.08 | < 0.001 | 0.122 | < 0.001 | < 0.01 |
| EH-111 | 10/10/2017 | 107 | 28 | 230 | 10 | 180 | 33 | 684 | 1.9 | < 0.003 | 1.35 | < 0.001 | 0.002 | < 0.02 | < 0.005 | 5.92 | < 0.001 | 0.156 | < 0.001 | < 0.01 |
| EH-111 (Dup) | 10/10/2017 | 102 | 27 | 227 | 9 | 180 | 33 | 688 | 1.9 | < 0.003 | 1.27 | < 0.001 | 0.001 | < 0.02 | < 0.005 | 5.46 | < 0.001 | 0.16 | < 0.001 | < 0.01 |
| EH-114 | 6/26/2017 | 81 | 22 | 145 | 6 | 200 | 26 | 400 | 1.8 | < 0.003 | 0.118 | < 0.001 | 0.002 J+ | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.017 | < 0.001 | < 0.01 |
| EH-114 (Dup) | 6/26/2017 | 79 | 22 | 147 | 6 | 210 | 26 | 400 | 1.8 | < 0.003 | 0.111 | < 0.001 | 0.002 J+ | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.015 | < 0.001 | < 0.01 |

| | | Major Ions | | | | | | | | Dissolved (D) Metals | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Calcium** | **Magnesium** | **Sodium** | **Potassium** | **Bicarbonate** | **Chloride** | **Sulfate** | **Bromide** | **Sb (D)** | **As (D)** | **Cd (D)** | **Cu (D)** | **Fe (D)** | **Pb (D)** | **Mn (D)** | **Hg (D)** | **Se (D)** | **Tl (D)** | **Zn (D)** |
| EH-114 | 10/3/2017 | 80 | 21 | 141 | 6 | 200 | 25 | 393 | 1.79 | < 0.003 | 0.261 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.015 | < 0.001 | < 0.01 |
| EH-115 (Low Flow) | 6/23/2017 | 81 | 22 | 130 | 6 | 220 | 28 | 370 | 1.6 | < 0.003 | 1.29 | < 0.001 | 0.002 J+ | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.032 | < 0.001 | < 0.01 |
| EH-115 (Standard) | 6/23/2017 | 80 | 22 | 131 | 6 | 220 | 26 | 380 | 1.7 | < 0.003 | 1.55 | < 0.001 | 0.002 J+ | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.028 | < 0.001 | < 0.01 |
| EH-115 | 10/6/2017 | 84 | 23 | 139 | 6 | 210 | 24 | 381 | 1.59 | < 0.003 | 1.73 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 UJ | < 0.001 | 0.023 | < 0.001 | < 0.01 |
| EH-117 | 6/26/2017 | 100 | 27 | 153 | 6 | 220 | 48 | 440 | 2 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.083 | < 0.001 | < 0.01 |
| EH-117 | 10/5/2017 | 101 | 26 | 146 | 6 | 210 | 40 | 461 | 2.03 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.089 | < 0.001 | < 0.01 |
| EH-118 | 6/26/2017 | 117 | 38 | 85 | 6 | 270 | 36 | 370 | 1.6 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.132 | < 0.001 | < 0.01 |
| EH-118 | 10/5/2017 | 122 | 39 | 79 | 6 | 270 | 39 | 359 | 1.65 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | 0.03 | < 0.005 | < 0.01 | < 0.001 | 0.136 | < 0.001 | < 0.01 |
| EH-119 | 6/22/2017 | 100 | 31 | 91 | 5 | 220 | 26 | 360 | 1.7 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.028 | < 0.001 | < 0.01 |
| EH-119 | 10/5/2017 | 95 | 28 | 95 | < 5 | 220 | 25 | 380 | 1.77 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.024 | < 0.001 | < 0.01 |
| EH-120 | 6/26/2017 | 155 | 35 | 117 | 6 | 180 | 33 | 600 | 1.8 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.192 | < 0.001 | < 0.01 |
| EH-120 | 10/5/2017 | 195 | 42 | 117 | 6 | 190 | 36 | 740 | 2.23 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.237 | < 0.001 | < 0.01 |
| EH-121 | 6/22/2017 | 31 | 7 | 13 | 2 | 95 | 4.3 | 47 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-121 | 10/4/2017 | 28 | 6 | 14 | < 5 | 94 | 5 | 48 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-123 | 6/22/2017 | 64 | 18 | 32 | 7 | 190 | 25 | 110 | 0.16 | < 0.003 | 0.005 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-123 | 10/3/2017 | 60 | 16 | 34 | 7 | 190 | 24 | 105 | 0.17 | < 0.003 | 0.006 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-124 | 6/26/2017 | 142 | 39 | 51 | 7 | 290 | 50 | 340 | 2 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.367 | < 0.001 | < 0.01 |
| EH-124 | 10/5/2017 | 134 | 36 | 45 | 6 | 260 | 47 | 294 | 1.78 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.397 | < 0.001 | < 0.01 |
| EH-125 (Low Flow) | 6/23/2017 | 34 | 9 | 56 | 3 | 140 | 9.9 | 140 | 0.1 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.019 | < 0.001 | < 0.01 |
| EH-125 (Standard) | 6/23/2017 | 31 | 8 | 42 | 3 | 120 | 8.2 | 99 | 0.068 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.012 | < 0.001 | < 0.01 |
| EH-125 | 10/5/2017 | 37 | 10 | 42 | < 5 | 130 | 9 | 109 | 0.09 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.015 | < 0.001 | < 0.01 |
| EH-126 (Low Flow) | 6/22/2017 | 112 | 53 | 45 | 4 | 240 | 41 | 300 | 1.7 | < 0.003 | 0.003 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.163 | < 0.001 | < 0.01 |
| EH-126 (Standard) | 6/22/2017 | 118 | 49 | 52 | 4 | 240 | 39 | 330 | 1.8 | < 0.003 | 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.154 | < 0.001 | < 0.01 |
| EH-126 | 10/5/2017 | 122 | 47 | 62 | < 5 | 240 | 38 | 384 | 2.03 | < 0.003 | 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.143 | < 0.001 | < 0.01 |
| EH-126 (Dup) | 10/5/2017 | 123 | 47 | 62 | < 5 | 240 | 38 | 385 | 2.03 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.142 | < 0.001 | < 0.01 |
| EH-129 | 6/22/2017 | 60 | 21 | 31 | 6 | 200 | 19 | 120 | 0.37 | < 0.003 | 0.004 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.033 | < 0.001 | < 0.01 |
| EH-129 | 10/3/2017 | 56 | 19 | 31 | 6 | 190 | 17 | 111 | 0.35 | < 0.003 | 0.005 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.032 | < 0.001 | < 0.01 |
| EH-130 | 6/21/2017 | 32 | 8 | 16 | 2 | 100 | 4.6 | 48 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-130 | 10/4/2017 | 30 | 7 | 16 | < 5 | 98 | 5 | 54 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-132 | 6/22/2017 | 63 | 21 | 32 | 9 | 160 | 21 | 150 | 0.36 | < 0.003 | 0.02 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-132 (Dup) | 6/22/2017 | 63 | 21 | 32 | 8 | 160 | 20 | 150 | 0.35 | < 0.003 | 0.02 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-132 | 10/3/2017 | 59 | 19 | 33 | 8 | 160 | 21 | 147 | 0.38 | < 0.003 | 0.02 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-134 | 6/22/2017 | 46 | 14 | 20 | 6 | 170 | 9 | 63 | 0.074 | < 0.003 | 0.005 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-134 | 10/3/2017 | 45 | 13 | 22 | 6 | 170 | 9 | 66 | 0.07 | < 0.003 | 0.005 | < 0.001 | < 0.001 | 0.04 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-135 | 6/22/2017 | 32 | 7 | 13 | 2 | 95 | 5.5 | 49 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-135 | 10/5/2017 | 30 | 7 | 13 | < 5 | 95 | 5 | 51 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-138 | 7/11/2017 | 45 | 12 | 41 | 3 | 140 | 10 | 120 | 0.2 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.02 | < 0.001 | < 0.01 |
| EH-138 | 10/4/2017 | 54 | 14 | 47 | < 5 | 150 | 14 | 159 | 0.33 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.031 | < 0.001 | < 0.01 |
| EH-139 | 7/11/2017 | 52 | 22 | 37 | 8 | 220 | 13 | 100 | 0.073 | < 0.003 | 0.004 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-139 (Dup) | 7/11/2017 | 52 | 23 | 37 | 8 | 220 | 13 | 100 | 0.072 | < 0.003 | 0.005 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-139 | 10/4/2017 | 50 | 21 | 37 | 8 | 220 | 14 | 110 | 0.07 | < 0.003 | 0.004 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-139 (Dup) | 10/4/2017 | 51 | 22 | 36 | 8 | 210 | 14 | 110 | 0.07 | < 0.003 | 0.004 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-140 | 6/20/2017 | 32 | 7 | 14 | 3 | 100 | 5 | 48 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-140 | 10/4/2017 | 30 | 7 | 15 | < 5 | 100 | 5 | 52 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-141 | 6/21/2017 | 103 | 27 | 48 | 7 | 200 | 23 | 250 | 1 | < 0.003 | 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.069 | < 0.001 | < 0.01 |
| EH-141 (Dup) | 6/21/2017 | 102 | 27 | 49 | 7 | 210 | 23 | 230 | 1 | < 0.003 | 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.074 | < 0.001 | < 0.01 |
| EH-141 | 10/5/2017 | 89 | 23 | 44 | 6 | 200 | 22 | 215 | 0.92 | < 0.003 | 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.062 | < 0.001 | < 0.01 |
| EH-141 (Dup) | 10/5/2017 | 85 | 22 | 44 | 7 | 200 | 22 | 215 | 0.92 | < 0.003 | 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.06 | < 0.001 | < 0.01 |
| EH-142 | 6/21/2017 | 61 | 23 | 27 | 6 | 190 | 13 | 100 | 0.32 | < 0.003 | 0.004 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.018 | < 0.001 | < 0.01 |
| EH-142 | 10/4/2017 | 56 | 22 | 27 | 6 | 200 | 14 | 107 | 0.3 | < 0.003 | 0.004 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.017 | < 0.001 | < 0.01 |
| EH-143 | 6/21/2017 | 54 | 13 | 30 | 4 | 140 | 10 | 110 | 0.3 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.02 | < 0.001 | < 0.01 |
| EH-143 | 10/4/2017 | 59 | 14 | 30 | < 5 | 150 | 13 | 139 | 0.46 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.029 | < 0.001 | < 0.01 |
| EH-144D | 6/20/2017 | 73 | 16 | 27 | 4 | 150 | 16 | 150 | 0.81 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.025 | < 0.001 | < 0.01 |
| EH-144D | 10/3/2017 | 68 | 15 | 27 | < 5 | 150 | 16 | 152 | 0.85 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.026 | < 0.001 | < 0.01 |
| EH-144D (Dup) | 10/3/2017 | 69 | 15 | 27 | < 5 | 150 | 16 | 152 | 0.84 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.026 | < 0.001 | < 0.01 |
| EH-144M | 6/20/2017 | 55 | 12 | 25 | 3 | 140 | 11 | 110 | 0.5 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.012 | < 0.001 | < 0.01 |
| EH-144M | 10/3/2017 | 52 | 12 | 25 | < 5 | 140 | 11 | 107 | 0.5 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.013 | < 0.001 | < 0.01 |
| EH-144S | 6/20/2017 | 46 | 10 | 18 | 3 | 120 | 8 | 79 | 0.19 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.007 | < 0.001 | < 0.01 |
| EH-144S | 10/3/2017 | 42 | 10 | 19 | < 5 | 120 | 8 | 80 | 0.19 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.007 | < 0.001 | < 0.01 |
| EH-145D | 6/21/2017 | 49 | 11 | 21 | 4 | 120 | 7.3 | 83 | 0.27 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.006 | < 0.001 | < 0.01 |
| EH-145D | 10/3/2017 | 44 | 10 | 19 | < 5 | 120 | 8 | 88 | 0.3 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.007 | < 0.001 | < 0.01 |
| EH-145S | 6/21/2017 | 48 | 11 | 22 | 3 | 130 | 7 | 83 | 0.2 | < 0.003 | 0.003 | < 0.001 | < 0.001 | 0.09 | < 0.005 | < 0.01 | < 0.001 | 0.005 | < 0.001 | < 0.01 |
| EH-145S | 10/3/2017 | 45 | 10 | 21 | < 5 | 120 | 7 | 88 | 0.23 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.005 | < 0.001 | < 0.01 |
| EH-204 | 6/22/2017 | 274 | 66 | 70 | 12 | 320 | 95 | 670 | 4.1 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.1 | < 0.001 | < 0.01 |
| EH-204 | 10/6/2017 | 271 | 64 | 79 | 12 | 320 | 98 | 708 | 4.52 | < 0.003 | < 0.002 UJ | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 UJ | < 0.001 | 0.088 | < 0.001 | < 0.01 |
| EH-206 | 6/22/2017 | 66 | 16 | 17 | 9 | 220 | 24 | 51 | 0.076 | < 0.003 | 0.025 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-206 | 10/3/2017 | 59 | 14 | 18 | 9 | 210 | 21 | 52 | 0.08 | < 0.003 | 0.025 | < 0.001 | < 0.001 | 0.07 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-50 | 6/28/2017 | 58 | 18 | 159 | 6 | 210 | 32 | 290 | 1.3 | < 0.003 | 7.43 | < 0.001 | 0.002 | < 0.02 | < 0.005 | 0.01 | < 0.001 | 0.003 | < 0.001 | < 0.01 |
| EH-50 | 10/6/2017 | 58 | 18 | 163 | 6 | 210 | 38 | 316 | 1.32 | < 0.003 | 7.61 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.003 | < 0.001 | < 0.01 |
| EH-50 (Dup) | 10/6/2017 | 58 | 18 | 161 | 6 | 210 | 38 | 316 | 1.32 | < 0.003 | 7.27 | < 0.001 | 0.002 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.003 | < 0.001 | < 0.01 |
| EH-51 | 6/27/2017 | 19 | 4 | 38 | 17 | 100 | 12 | 62 | < 0.05 | < 0.003 | 0.048 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.004 | < 0.001 | < 0.01 |
| EH-51 | 10/5/2017 | 19 | < 5 | 35 | 17 | 110 | 9 | 63 | < 0.05 | < 0.003 | 0.05 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.004 | < 0.001 | < 0.01 |
| EH-52 | 6/27/2017 | 27 | 6 | 20 | 25 | 120 | 8.9 | 54 | < 0.05 | 0.015 | 0.312 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.008 | < 0.001 | < 0.01 |
| EH-52 | 10/5/2017 | 31 | 6 | 20 | 26 | 130 | 8 | 60 | < 0.05 | 0.016 | 0.329 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.004 | < 0.001 | < 0.01 |
| EH-53 | 6/23/2017 | 34 | 10 | 91 | 4 | 170 | 24 | 150 | 0.14 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.031 | < 0.001 | < 0.01 |
| EH-53 (Dup) | 6/23/2017 | 35 | 11 | 91 | 4 | 170 | 24 | 150 | 0.14 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.031 | < 0.001 | < 0.01 |

| | | Major Ions | | | | | | | | Dissolved (D) Metals | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **Sample Date** | **Calcium** | **Magnesium** | **Sodium** | **Potassium** | **Bicarbonate** | **Chloride** | **Sulfate** | **Bromide** | **Sb (D)** | **As (D)** | **Cd (D)** | **Cu (D)** | **Fe (D)** | **Pb (D)** | **Mn (D)** | **Hg (D)** | **Se (D)** | **Tl (D)** | **Zn (D)** |
| EH-53 | 10/5/2017 | 34 | 10 | 80 | < 5 | 180 | 16 | 132 | 0.1 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.024 | < 0.001 | < 0.01 |
| EH-54 | 6/23/2017 | 29 | 7 | 15 | 2 | 120 | 3.7 | 36 | < 0.05 | < 0.003 | 0.016 | < 0.001 | 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-54 | 10/5/2017 | 38 | 8 | 17 | < 5 | 130 | 7 | 49 | < 0.05 | < 0.003 | 0.017 | < 0.001 | 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-57A | 6/26/2017 | 153 | 46 | 104 | 7 | 320 | 83 | 430 | 2.7 | < 0.003 | < 0.002 | < 0.001 | 0.001 J+ | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.372 | < 0.001 | < 0.01 |
| EH-58 | 6/23/2017 | 48 | 11 | 20 | 3 | 140 | 9.7 | 89 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-58 | 10/3/2017 | 45 | 11 | 20 | < 5 | 140 | 9 | 83 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.03 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-58 (Dup) | 10/3/2017 | 46 | 11 | 20 | < 5 | 140 | 9 | 85 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.03 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-59 | 6/23/2017 | 28 | 6 | 14 | 11 | 100 | 7.4 | 51 | < 0.05 | 0.007 | 0.017 | < 0.001 | 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-59 | 10/5/2017 | 37 | 8 | 16 | 13 | 140 | 7 | 50 | < 0.05 | 0.005 | 0.018 | < 0.001 | 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-60 | 6/27/2017 | 96 | 29 | 228 | 11 | 300 | 78 | 520 | 1.2 | < 0.003 | 3.86 | < 0.001 | 0.002 | 0.06 | < 0.005 | 13 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-60 | 10/6/2017 | 103 | 31 | 230 | 12 | 320 | 85 | 534 | 1.13 | < 0.003 | 3.09 | < 0.001 | 0.003 | < 0.02 | < 0.005 | 14.1 | < 0.001 | 0.005 | < 0.001 | < 0.01 |
| EH-61 | 6/27/2017 | 164 | 30 | 245 | 15 | 220 | 32 | 900 | 1.2 | < 0.003 | < 0.002 | < 0.001 | 0.001 | < 0.02 | < 0.005 | 1.06 | < 0.001 | 0.332 | < 0.001 | < 0.01 |
| EH-61 | 10/6/2017 | 160 | 29 | 247 | 15 | 210 | 30 | 853 | 1 | < 0.003 | < 0.002 | < 0.001 | 0.002 | < 0.02 | < 0.005 | 0.96 | < 0.001 | 0.323 | < 0.001 | < 0.01 |
| EH-62 | 6/23/2017 | 35 | 8 | 17 | 3 | 120 | 7 | 58 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-62 | 10/5/2017 | 38 | 9 | 17 | < 5 | 130 | 8 | 55 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-63 | 6/26/2017 | 35 | 8 | 20 | 4 | 120 | 12 | 52 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| EH-63 | 10/5/2017 | 38 | 8 | 18 | < 5 | 120 | 12 | 53 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| EH-65 (Low Flow) | 6/23/2017 | 117 | 31 | 196 | 10 | 210 | 60 | 630 | 1.2 | < 0.003 | 0.271 | < 0.001 | 0.002 J+ | < 0.02 | < 0.005 | 2.21 | < 0.001 | 0.158 | < 0.001 | < 0.01 |
| EH-65 (Low Flow Dup) | 6/23/2017 | 116 | 30 | 197 | 10 | 200 | 60 | 640 | 1.2 | < 0.003 | 0.273 | < 0.001 | 0.002 J+ | < 0.02 | < 0.005 | 2.22 | < 0.001 | 0.16 | < 0.001 | < 0.01 |
| EH-65 (Standard) | 6/23/2017 | 114 | 30 | 197 | 10 | 200 | 61 | 630 | 1.2 | < 0.003 | 0.285 | < 0.001 | 0.002 J+ | < 0.02 | < 0.005 | 2.09 | < 0.001 | 0.154 | < 0.001 | < 0.01 |
| EH-65 | 10/10/2017 | 129 | 33 | 207 | 11 | 210 | 55 | 651 | 1.14 | < 0.003 | 0.268 | < 0.001 | 0.002 | < 0.02 | < 0.005 | 1.68 | < 0.001 | 0.171 | < 0.001 | < 0.01 |
| EH-66 | 6/22/2017 | 37 | 9 | 13 | 2 | 120 | 4.2 | 47 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-66 | 10/4/2017 | 29 | 7 | 13 | < 5 | 95 | 5 | 48 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| EH-69 | 6/23/2017 | 35 | 8 | 32 | 4 | 140 | 8.8 | 70 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.005 | < 0.001 | < 0.01 |
| EH-69 | 10/3/2017 | 38 | 9 | 32 | < 5 | 130 | 12 | 68 | < 0.05 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.004 | < 0.001 | < 0.01 |
| EH-70 (Low Flow) | 6/23/2017 | 62 | 21 | 85 | 4 | 170 | 18 | 280 | 0.41 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.057 | < 0.001 | < 0.01 |
| EH-70 (Standard) | 6/23/2017 | 63 | 21 | 85 | 4 | 170 | 18 | 290 | 0.42 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.058 | < 0.001 | < 0.01 |
| EH-70 | 10/5/2017 | 57 | 17 | 81 | < 5 | 160 | 17 | 255 | 0.39 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.055 | < 0.001 | < 0.01 |
| MW-1 | 10/4/2017 | 45 | 10 | 26 | < 5 | 140 | 14 | 84 | 0.11 | < 0.003 | 0.004 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| MW-10 | 10/4/2017 | 84 | 21 | 37 | 7 | 290 | 16 | 136 | 0.1 | < 0.003 | 0.008 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| MW-10 (Dup) | 10/4/2017 | 84 | 21 | 36 | 7 | 290 | 16 | 136 | 0.1 | < 0.003 | 0.008 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.002 | < 0.001 | < 0.01 |
| MW-11 | 10/4/2017 | 47 | 11 | 59 | 10 | 140 | 26 | 159 | 0.18 | < 0.003 | 0.017 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.003 | < 0.001 | < 0.01 |
| MW-2 | 10/4/2017 | 103 | 23 | 25 | 6 | 270 | 39 | 153 | 0.22 | < 0.003 | < 0.002 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.01 |
| MW-3 | 10/4/2017 | 106 | 24 | 26 | 7 | 290 | 37 | 159 | 0.22 | < 0.003 | 0.009 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 0.03 | < 0.001 | 0.01 | < 0.001 | < 0.01 |
| MW-4 | 10/4/2017 | 52 | 11 | 30 | 6 | 210 | 10 | 80 | 0.06 | < 0.003 | 0.003 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| MW-5 | 10/4/2017 | 35 | 7 | 25 | < 5 | 170 | 6 | 35 | < 0.05 | < 0.003 | 0.007 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| MW-6 | 10/4/2017 | 124 | 27 | 31 | 6 | 310 | 37 | 222 | 0.19 | < 0.003 | 0.072 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | 2.93 | < 0.001 | 0.003 | < 0.001 | < 0.01 |
| MW-8 | 10/4/2017 | 54 | 11 | 24 | 6 | 190 | 10 | 69 | 0.06 | < 0.003 | 0.007 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | < 0.01 |
| MW-9 | 10/4/2017 | 48 | 10 | 25 | 5 | 190 | 9 | 57 | 0.05 | < 0.003 | 0.006 | < 0.001 | < 0.001 | < 0.02 | < 0.005 | < 0.01 | < 0.001 | 0.001 | < 0.001 | 0.01 |
| SDMW-2 | 6/21/2017 | 17 | 5 | 242 | 14 | 210 | 14 | 390 | 0.68 | < 0.003 | 12.3 | 0.001 | < 0.001 | 3.86 | < 0.005 | 1.69 | < 0.001 | 0.002 | 0.022 | 0.45 |
| SDMW-2 | 10/11/2017 | 17 | < 5 | 223 | 14 | 200 | 14 | 410 | 0.67 | < 0.003 | 11.7 | 0.004 | < 0.001 | 3.69 | < 0.005 | 1.62 | < 0.001 | 0.001 | 0.022 | 0.46 |

NOTES: All concentrations in mg/L except as indicated.
U = below laboratory reporting limit (associated value)
A = anomalous data point (historical inconsistency)
R = data point rejected during validation procedure
J = QC criterion exceeded; + = potential high bias

# APPENDIX A2

# 2017 RESIDENTIAL WELL WATER QUALITY DATABASE

| | | | Field Parameters | | | | | | | General Chemistry | | | | | Major Ions | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map Key (see Exhibit 1) | Sample Date | Depth To Water (ft) | pH (s.u.) | SC (µmhos/cm) | Diss $O_2$ (mg/L) | ORP (mV) | $E_H$ (mV) | Turbidity (NTU) | Water Temp (°C) | Lab pH (s.u.) | Lab SC (µmhos/cm) | Total Alkalinity as CaCO3 | Total Suspended Solids | Total Dissolved Solids | Calcium | Magnesium | Sodium | Potassium | Bicarbonate | Chloride | Sulfate | Bromide |
| R1 | 6/16/2017 | | 6.91 | 294 | 6.47 | 91 | 307 | 0.7 | 10.6 | 7.0 | 288 | 79 | < 10 | 186 | 33 | 7 | 13 | 3 | 96 | 6 | 47 | < 0.05 |
| R1 | 10/5/2017 | | 6.79 | 268 | 2.21 | 107 | 325 | 0.02 | 8.7 | 7.1 | 273 | 80 | < 10 | 166 | 30 | 7 | 12 | < 5 | 97 | 5 | 46 | < 0.05 |
| R2 | 6/16/2017 | | 7 | 309 | 3.41 | 153 | 369 | 0.6 | 10.3 | 7.2 | 300 | 85 | < 10 | 192 | 35 | 8 | 14 | 3 | 100 | 5.1 | 48 | < 0.05 |
| R2 | 6/16/2017 | | 7.0 | 309 | 3.41 | 153 | 369 | 0.6 | 10.3 | 7.2 | 299 | 86 | < 10 | 195 | 35 | 8 | 14 | 3 | 100 | 5.1 | 48 | < 0.05 |
| R2 | 10/4/2017 | | 6.88 | 301 | 5.08 | 123 | 340 | 0.02 | 9.7 | 7.2 | 310 | 85 | < 10 | 200 | 32 | 7 | 15 | 3 | 100 | 7 | 53 | < 0.05 |
| R3 | 6/20/2017 | | 6.69 | 387 | 4.73 | 132 | 347 | 0.8 | 11.5 | 7.4 | 386 | 94 | < 10 | 229 | 40 | 8 | 18 | 14 | 110 | 13 | 67 | < 0.05 |
| R3 | 10/4/2017 | | 6.69 | 356 | 3.01 | 119 | 330 | 0.02 | 15.3 | 7.4 | 364 | 110 | < 10 | 227 | 34 | 7 | 19 | 15 | 140 | 7 | 54 | < 0.05 |
| R4 | 6/21/2017 | | 6.9 | 416 | 2.3 | 92 | 307 | 1.1 | 10.6 | 7.2 | 428 | 99 | < 10 | 278 | 42 | 9 | 31 | 3 | 120 | 6.5 | 86 | 0.16 |
| R4 | 10/4/2017 | | 6.83 | 398 | 2.13 | 109 | 326 | 0.02 | 10.2 | 7.2 | 409 | 98 | < 10 | 264 | 37 | 8 | 30 | 3 | 120 | 7 | 92 | 0.17 |
| R5 | 6/15/2017 | | 7.09 | 220 J- | 5.06 | 110 | 327 | 0.3 | 9.1 | 7.2 | 280 | 77 | < 10 | 167 | 31 | 7 | 13 | 2 | 93 | 5.1 | 48 | 0.055 |
| R5 | 10/3/2017 | | 6.91 | 272 | 7.17 | 104 | 323 | 0.02 | 8.8 | 7.2 | 280 | 74 | < 10 | 181 | 29 | 7 | 14 | 2 | 90 | 5 | 50 | < 0.05 |
| R6 | 6/15/2017 | | 7.1 | 369 J- | 4.08 | 101 | 317 | 13.3 | 9.9 | 7.2 | 468 | 110 | < 10 | 312 | 58 | 13 | 17 | 5 | 140 | 6.5 | 100 | 0.22 |
| R6 | 10/4/2017 | | 7.06 | 461 | 2.39 | 113 | 327 | 0.02 | 12 | 7.3 | 472 | 120 | < 10 | 334 | 56 | 12 | 18 | 5 | 140 | 7 | 109 | 0.23 |
| R7 | 6/15/2017 | 29.74 | 7.21 | 267 J- | 5.01 | 124 | 340 | 2.2 | 10.9 | 7.3 | 328 | 92 | < 10 | 197 | 37 | 8 | 16 | 3 | 110 | 5.8 | 55 | 0.078 |
| R7 | 10/3/2017 | 31.15 | 7.08 | 310 | 5.62 | 116 | 332 | 0.02 | 11 | 7.3 | 320 | 90 | < 10 | 203 | 33 | 7 | 17 | 3 | 110 | 6 | 57 | < 0.05 |
| R8 | 6/15/2017 | 31.02 | 7.15 | 242 J- | 4.14 | 112 | 328 | 0.6 | 10.6 | 7.3 | 298 | 85 | < 10 | 180 | 34 | 8 | 14 | 3 | 100 | 5.2 | 47 | 0.061 |
| R8 | 10/3/2017 | 32.52 | 7.11 | 283 | 4.8 | 103 | 319 | 0.02 | 10.5 | 7.3 | 292 | 85 | < 10 | 191 | 30 | 7 | 15 | 3 | 100 | 5 | 49 | < 0.05 |
| R9 | 6/15/2017 | 33.21 | 7.15 | 249 J- | 3.2 | 150 | 364 | 0.6 | 11.9 | 7.3 | 296 | 87 | < 10 | 177 | 33 | 8 | 14 | 3 | 110 | 4.6 | 46 | 0.054 |
| R9 | 10/3/2017 | 35.06 | 7.11 | 276 | 4.16 | 100 | 315 | 0.02 | 11.6 | 7.3 | 284 | 87 | < 10 | 182 | 29 | 6 | 14 | 3 | 110 | 5 | 43 | < 0.05 |
| R10 | 6/20/2017 | | 6.81 | 355 | 3.56 | 102 | 317 | 0.6 | 11.4 | 7.2 | 354 | 96 | < 10 | 220 | 42 | 10 | 15 | 3 | 120 | 8.1 | 59 | < 0.05 |
| R11 | 6/21/2017 | | 6.86 | 808 | 1.85 | 99 | 314 | 0.9 | 11.8 | 7.1 | 839 | 130 | < 10 | 596 | 110 | 24 | 27 | 6 | 150 | 24 | 230 | 2.6 |
| R11 | 10/5/2017 | | 6.82 | 806 | 1.89 | 120 | 335 | 0.02 | 11.6 | 7.0 | 814 | 130 | < 10 | 570 | 104 | 23 | 26 | 6 | 160 | 26 | 265 | 2.96 |
| R12 | 6/20/2017 | 17.63 | 7.09 | 509 | 7.08 | 160 | 375 | 0.8 | 11.1 | 7.4 | 511 | 130 | < 10 | 326 | 64 | 15 | 19 | 3 | 160 | 8 | 110 | 0.29 |
| R12 | 10/4/2017 | 17.68 | 7.13 | 487 | 8.47 | 114 | 330 | 0.02 | 10.6 | 7.3 | 500 | 130 | < 10 | 331 | 57 | 13 | 21 | 3 | 160 | 7 | 111 | 0.23 |
| R12 | 10/4/2017 | 17.68 | 7.13 | 487 | 8.47 | 114 | 330 | 0.02 | 10.6 | 7.3 | 501 | 130 | < 10 | 327 | 58 | 13 | 20 | 3 | 160 | 7 | 111 | 0.23 |
| R13 | 6/20/2017 | 18.95 | 7.11 | 569 | 3.97 | 137 | 354 | 0.4 | 9.4 | 7.4 | 572 | 230 | < 10 | 345 | 66 | 13 | 32 | 6 | 280 | 11 | 51 | 0.06 |
| R13 | 10/5/2017 | 19.86 | 7.11 | 506 | 3.63 | 130 | 348 | 0.02 | 9 | 7.3 | 512 | 200 | < 10 | 308 | 61 | 13 | 27 | 6 | 250 | 9 | 50 | 0.05 |
| R14 | 6/20/2017 | 13.7 | 6.84 | 305 | 6.21 | 73 | 290 | 1.9 | 9.6 | 7.1 | 303 | 79 | < 10 | 179 | 34 | 8 | 13 | 3 | 96 | 7.3 | 52 | < 0.05 |
| R14 | 10/4/2017 | 13.13 | 6.81 | 275 | 2.48 | 111 | 329 | 0.02 | 8.9 | 7.1 | 283 | 87 | < 10 | 200 | 30 | 7 | 13 | 3 | 110 | 5 | 43 | < 0.05 |
| R15 | 6/21/2017 | | 7.55 | 697 | 8.55 | 117 | 331 | 0.2 | 12.3 | 7.7 | 719 | 190 | < 10 | 481 | 77 | 20 | 39 | 14 | 230 | 26 | 110 | 0.18 |
| R15 | 10/6/2017 | | 7.51 | 699 | 8.91 | 117 | 332 | 0.02 | 11.6 | 7.6 | 705 | 190 | < 10 | 481 | 73 | 19 | 36 | 13 | 230 | 28 | 116 | 0.19 |
| R16 | 6/21/2017 | | 7.58 | 707 | 9.7 | 49 | 264 | 3.9 | 11.5 | 7.8 | 727 | 170 | < 10 | 496 | 73 | 20 | 44 | 14 | 210 | 28 | 120 | 0.18 |
| R16 | 10/6/2017 | | 7.5 | 691 | 8.74 | 122 | 337 | 0.02 | 11.4 | 7.7 | 689 | 170 | < 10 | 466 | 67 | 18 | 40 | 13 | 210 | 29 | 125 | 0.19 |
| R17 | 6/21/2017 | 86.55 | 7.65 | 516 | 9.68 | 105 | 318 | 0.4 | 12.3 | 7.8 | 531 | 140 | < 10 | 361 | 50 | 14 | 35 | 12 | 170 | 17 | 85 | 0.13 |
| R17 | 10/6/2017 | 86.58 | 7.6 | 500 | 10.28 | 115 | 329 | 0.02 | 12.1 | 7.7 | 512 | 140 | < 10 | 355 | 46 | 12 | 31 | 11 | 170 | 17 | 89 | 0.13 |
| R18 | 6/16/2017 | | 7.15 | 279 | 5.58 | 128 | 342 | 0.3 | 12.3 | 7.3 | 275 | 87 | < 10 | 168 | 32 | 7 | 13 | 3 | 110 | 5.5 | 38 | < 0.05 |
| R18 | 10/5/2017 | | 7.04 | 285 | 4.46 | 113 | 328 | 0.02 | 11 | 7.2 | 292 | 92 | < 10 | 172 | 33 | 7 | 13 | < 5 | 110 | 6 | 43 | < 0.05 |
| R19 | 6/16/2017 | | 7.16 | 292 | 7.85 | 129 | 345 | 2 | 10 | 7.2 | 284 | 84 | < 10 | 180 | 34 | 8 | 12 | 3 | 100 | 5 | 41 | < 0.05 |
| R19 | 10/5/2017 | | 7.12 | 277 | 8.74 | 116 | 333 | 0.02 | 9.9 | 7.2 | 285 | 82 | < 10 | 173 | 32 | 7 | 12 | < 5 | 100 | 5 | 47 | < 0.05 |
| R20 | 6/16/2017 | | 7.09 | 296 | 7.49 | 148 | 365 | 99.3 | 9 | 7.1 | 287 | 80 | < 10 | 186 | 33 | 7 | 13 | 3 | 98 | 5.2 | 47 | < 0.05 |
| R20 | 10/5/2017 | | 7.03 | 279 | 7.85 | 120 | 338 | 32.5 | 8.8 | 7.1 | 285 | 81 | < 10 | 171 | 31 | 7 | 13 | < 5 | 98 | 5 | 51 | < 0.05 |

NOTES: All concentrations in mg/L except as indicated.

J = estimated value due to QC criterion exceedance; J- = possible low bias; J+ = possible high bias

UJ = estimated value; constituent detected in associated lab or field blank

Locations shown on Exhibit 1

| | | Dissolved (D) and Total (T) Metals | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Map Key (see Exhibit 1) | Sample Date | Sb (D) | Sb (T) | As (D) | As (T) | Be (T) | Cd (D) | Cd (T) | Cr (T) | Cu (D) | Cu (T) | Fe (D) | Fe (T) | Pb (D) | Pb (T) | Mn (D) | Mn (T) | Hg (D) | Hg (T) | Ni (T) | Se (D) | Se (T) | Tl (D) | Tl (T) | Zn (D) | Zn (T) |
| R1 | 6/16/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.006 | 0.007 J | 0.05 | 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R1 | 10/5/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.007 | 0.007 | 0.04 | 0.05 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R2 | 6/16/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.006 J | < 0.02 | 0.05 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | < 0.01 | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R2 | 6/16/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.001 J | < 0.02 | 0.04 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | < 0.01 | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | 0.01 |
| R2 | 10/4/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | < 0.001 | 0.001 | < 0.02 | 0.04 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R3 | 6/20/2017 | 0.003 J+ | 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.031 J+ | 0.026 | < 0.02 | 0.02 UJ | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.003 | 0.003 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R3 | 10/4/2017 | 0.004 | 0.004 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.035 | 0.015 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.001 | 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R4 | 6/21/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.02 | 0.08 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.004 | 0.004 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R4 | 10/4/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.02 | 0.03 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.004 | 0.004 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R5 | 6/15/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.001 | 0.002 | < 0.02 | 0.06 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.01 | 0.01 |
| R5 | 10/3/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.001 | 0.001 | < 0.02 | 0.03 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.01 | 0.01 |
| R6 | 6/15/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.001 | 0.003 | < 0.02 | 0.49 | < 0.005 | < 0.005 | < 0.01 | 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | 0.02 | 0.02 |
| R6 | 10/4/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.005 | 0.039 | 0.03 | 0.51 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.003 | 0.003 | < 0.001 | < 0.001 | 0.06 | 0.07 |
| R7 | 6/15/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.009 | 0.011 | < 0.02 | 0.13 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R7 | 10/3/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.011 | 0.011 | < 0.02 | 0.06 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R8 | 6/15/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.02 | 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R8 | 10/3/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.001 | 0.001 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R9 | 6/15/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.002 | 0.003 | < 0.02 | 0.13 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R9 | 10/3/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.003 | 0.003 | < 0.02 | 0.13 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R10 | 6/20/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.003 J+ | 0.003 | 0.02 | 0.05 UJ | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R11 | 6/21/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.001 | 0.002 | < 0.02 | 0.03 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.036 | 0.033 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R11 | 10/5/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.002 | 0.003 | < 0.02 | 0.09 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.038 | 0.037 | < 0.001 | < 0.001 | 0.02 | 0.02 |
| R12 | 6/20/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.023 J+ | 0.026 | < 0.02 | 0.03 UJ | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R12 | 10/4/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.027 | 0.029 | < 0.02 | 0.04 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.003 | 0.003 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R12 | 10/4/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.028 | 0.028 | < 0.02 | 0.04 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.003 | 0.003 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R13 | 6/20/2017 | < 0.003 | < 0.003 | 0.013 J+ | 0.013 | NM | < 0.001 | < 0.001 | NM | 0.015 J+ | 0.018 | < 0.02 | 0.06 UJ | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.02 J+ | 0.02 |
| R13 | 10/5/2017 | < 0.003 | < 0.003 | 0.013 | 0.012 | NM | < 0.001 | < 0.001 | NM | 0.008 | 0.008 | < 0.02 | 0.05 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R14 | 6/20/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.001 J+ | 0.002 | < 0.02 | 1.46 | < 0.005 | < 0.005 | < 0.01 | 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.02 J+ | 0.01 |
| R14 | 10/4/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | < 0.001 | 0.002 | < 0.02 | 1.82 | < 0.005 | < 0.005 | < 0.01 | 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.01 | 0.01 |
| R15 | 6/21/2017 | < 0.003 | < 0.003 | 0.016 | 0.015 | NM | < 0.001 | < 0.001 | NM | < 0.001 | 0.002 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R15 | 10/6/2017 | < 0.003 | < 0.003 | 0.015 | 0.014 | NM | < 0.001 | < 0.001 | NM | 0.001 | 0.001 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R16 | 6/21/2017 | < 0.003 | < 0.003 | 0.016 | 0.017 | NM | < 0.001 | < 0.001 | NM | < 0.001 | 0.002 | 0.03 | 0.64 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R16 | 10/6/2017 | < 0.003 | < 0.003 | 0.016 | 0.016 | NM | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | 0.03 | 0.13 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | 0.01 |
| R17 | 6/21/2017 | < 0.003 | < 0.003 | 0.017 | 0.016 | NM | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R17 | 10/6/2017 | < 0.003 | < 0.003 | 0.016 | 0.016 | NM | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | 0.002 | 0.002 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R18 | 6/16/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.002 J | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R18 | 10/5/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R19 | 6/16/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.001 J | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R19 | 10/5/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | 0.001 | 0.001 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R20 | 6/16/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | 0.001 J | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | < 0.01 | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | < 0.01 |
| R20 | 10/5/2017 | < 0.003 | < 0.003 | < 0.002 | < 0.002 | NM | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.02 | < 0.02 | < 0.005 | < 0.005 | < 0.01 | < 0.01 | < 0.001 | < 0.001 | NM | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.01 | 0.01 |

NOTES: All concentrations in mg/L except as indicated.

J = estimated value due to QC criterion exceedance; J- = possible low bias; J+ = possible high bias

UJ = estimated value; constituent detected in associated lab or field blank

Locations shown on Exhibit 1

# APPENDIX A3

# 2017 SURFACE WATER QUALITY DATABASE

**2017 Surface Water Quality Database -- East Helena Facility**

| Station ID | Sample Date | Field pH (s.u.) | Field SC (µmhos/cm) | Diss O2 (mg/L) | Water Temp (°C) | Flow (cfs) | Lab pH (s.u.) | Lab SC (µmhos/cm) | Total Alkalinity as CaCO3 | Total Dissolved Solids | Total Suspended Solids | Ca (D) | Ca (TR) | Mg (D) | Mg (TR) | Na (D) | Na (TR) | K (D) | K (TR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GP-5 | 6/19/2017 | NM | NM | NM | NM | 0.97 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| GP-5 | 10/2/2017 | NM | NM | NM | NM | 0.574 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| PPC-10 | 6/19/2017 | 8.19 | 188 | 11.68 | 13.1 | 37 | 8.2 | 197 | 61 | 122 | <10 | NM | 22 | NM | 5 | NM | 9 | NM | 2 |
| PPC-10 | 10/2/2017 | 8.28 | 275 | 14.38 | 6.8 | 23.9 | 8.2 | 284 | 79 | 187 | <10 | NM | 29 | NM | 7 | NM | 14 | NM | 3 |
| PPC-36A | 6/19/2017 | 8.09 | 186 | 10.32 | 13.8 | 44 | 8.2 | 195 | 62 | 130 | <10 | NM | 22 | NM | 5 | NM | 9 | NM | 2 |
| PPC-36A | 10/2/2017 | 8.37 | 275 | 14.47 | 7.0 | 30 | 8.4 | 284 | 82 | 187 | <10 | NM | 28 | NM | 7 | NM | 14 | NM | 2 |
| PPC-3A | 4/12/2017 | 7.75 | 243 | 10.70 | 6.5 | 38 | 8.1 | 268 | 73 | 174 | <10 | NM | 29 | NM | 7 | NM | 12 | NM | 2 |
| PPC-3A | 6/19/2017 | 8.07 | 187 | 10.71 | 16.8 | 65 | 8.2 | 194 | 60 | 125 | <10 | NM | 21 | NM | 5 | NM | 8 | NM | 2 |
| PPC-3A | 10/2/2017 | 8.17 | 272 | 13.17 | 7.7 | 30.8 | 8.1 | 283 | 81 | 182 | <10 | NM | 28 | NM | 6 | NM | 14 | NM | 2 |
| PPC-4A | 4/12/2017 | 7.58 | 259 | 11.17 | 5.9 | 40.4 | 8.2 | 271 | 74 | 171 | <10 | NM | 29 | NM | 7 | NM | 12 | NM | 2 |
| PPC-4A | 4/12/2017 | 7.58 | 259 | 11.17 | 5.9 | 40.4 | 8.2 | 271 | 74 | 169 | <10 | NM | 29 | NM | 7 | NM | 12 | NM | 2 |
| PPC-4A | 6/19/2017 | 8.17 | 186 | 10.55 | 16.5 | 67 | 8.2 | 194 | 61 | 123 | <10 | NM | 21 | NM | 5 | NM | 8 | NM | 2 |
| PPC-4A | 6/19/2017 | 8.17 | 185 | 10.54 | 16.5 | 67 | 8.2 | 193 | 60 | 120 | <10 | NM | 22 | NM | 5 | NM | 8 | NM | 2 |
| PPC-4A | 10/2/2017 | 8.35 | 275 | 13.76 | 7.7 | 33.3 | 8.2 | 284 | 81 | 188 | <10 | NM | 29 | NM | 7 | NM | 15 | NM | 3 |
| PPC-4A | 10/2/2017 | 8.35 | 275 | 13.76 | 7.7 | 33.3 | 8.2 | 284 | 81 | 187 | <10 | NM | 29 | NM | 7 | NM | 15 | NM | 3 |
| PPC-5A | 4/12/2017 | 6.43 | 270 | 10.92 | 5.4 | 40.4 | 8.0 | 276 | 74 | 174 | <10 | NM | 30 | NM | 7 | NM | 12 | NM | 2 |
| PPC-5A | 6/19/2017 | 8.13 | 187 | 10.76 | 15.7 | 67 | 8.2 | 194 | 61 | 123 | <10 | NM | 21 | NM | 5 | NM | 8 | NM | 2 |
| PPC-5A | 10/2/2017 | 8.32 | 273 | 14.30 | 7.7 | 33.1 | 8.2 | 283 | 82 | 186 | <10 | NM | 29 | NM | 7 | NM | 15 | NM | 3 |
| PPC-7 | 6/19/2017 | 8.14 | 188 | 11.05 | 14.8 | 66 | 8.2 | 195 | 61 | 122 | <10 | NM | 21 | NM | 5 | NM | 8 | NM | 2 |
| PPC-7 | 10/2/2017 | 8.49 | 273 | 14.93 | 7.3 | 31.8 | 8.4 | 285 | 81 | 187 | <10 | NM | 28 | NM | 6 | NM | 15 | NM | 3 |
| SG-16 | 6/19/2017 | 8.25 | 188 | 10.83 | 12.6 | 32 | 8.2 | 197 | 62 | 122 | <10 | NM | 22 | NM | 5 | NM | 9 | NM | 2 |
| SG-16 | 10/2/2017 | 8.24 | 276 | 14.24 | 6.9 | 18.2 | 8.2 | 284 | 83 | 185 | <10 | NM | 29 | NM | 7 | NM | 14 | NM | 3 |
| Trib-1 | 4/17/2017 | 7.24 | 450 | 7.61 | 6.9 | 0.15 | 7.6 | 460 | 150 | 292 | <10 | NM | 52 | NM | 12 | NM | 23 | NM | 4 |
| Trib-1 | 6/19/2017 | 7.4 | 437 | 4.12 | 22.5 | 0.05 | 7.6 | 442 | 160 | 265 | 13 | NM | 47 | NM | 11 | NM | 22 | NM | 3 |
| Trib-1 | 10/2/2017 | 7.51 | 755 | 9.20 | 5.6 | 0.0076 | 7.4 | 784 | 140 | 549 | 10 | NM | 102 | NM | 18 | NM | 27 | NM | 5 |
| Trib-1B | 4/17/2017 | 7.02 | 549 | 0.72 | 6.1 | NM | 6.8 | 593 | 120 | 397 | <10 | NM | 69 | NM | 16 | NM | 24 | NM | 4 |
| Trib-1B | 5/5/2017 | 6.68 | 488 | 0.62 | 7.8 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| Trib-1B | 6/19/2017 | 8.31 | 632 | 9.80 | 30.5 | NM | 8.5 | 631 | 170 | 406 | 17 | NM | 80 | NM | 17 | NM | 26 | NM | 5 |
| Trib-1D | 4/17/2017 | 8.09 | 581 | 9.93 | 7.4 | 0.069 | 8.5 | 634 | 91 | 424 | 27 | 74 | 76 | 19 | 19 | 24 | 24 | 4 | 4 |
| Trib-1D | 6/19/2017 | 8.49 | 717 | 10.47 | 26.9 | 0.015 | 8.6 | 736 | 100 | 510 | 27 | NM | 89 | NM | 22 | NM | 27 | NM | 5 |
| Trib-1D | 10/2/2017 | 9.2 | 621 | 16.25 | 7.7 | 0.033 | 9.1 | 668 | 73 | 474 | <10 | NM | 71 | NM | 22 | NM | 27 | NM | 5 |

NOTES: All concentrations in mg/L except as indicated

NM = not measured

(D) = dissolved; (TR) = total recoverable

| Station ID | Sample Date | HCO3 | Cl | SO4 | Br | Sb (D) | Sb (TR) | As (D) | As (TR) | Be (D) | Be (TR) | Cd (D) | Cd (TR) | Cr (D) | Cr (TR) | Cu (D) | Cu (TR) | Fe (D) | Fe (TR) | Pb (D) | Pb (TR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GP-5 | 6/19/2017 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| GP-5 | 10/2/2017 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| PPC-10 | 6/19/2017 | 74 | 3.3 | 23 | NM | NM | <0.0005 | NM | 0.005 | NM | NM | NM | 0.0002 | NM | NM | NM | 0.004 | NM | 0.34 | NM | 0.0044 |
| PPC-10 | 10/2/2017 | 96 | 6 | 47 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00011 | NM | NM | NM | 0.003 | NM | 0.19 | NM | 0.0024 |
| PPC-36A | 6/19/2017 | 75 | 3 | 24 | NM | NM | <0.0005 | NM | 0.005 | NM | NM | NM | 0.00016 | NM | NM | NM | 0.003 | NM | 0.24 | NM | 0.0034 |
| PPC-36A | 10/2/2017 | 99 | 6 | 47 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.0001 | NM | NM | NM | <0.002 | NM | 0.18 | NM | 0.002 |
| PPC-3A | 4/12/2017 | 88 | 5.1 | 44 | <0.05 | NM | <0.0005 | NM | 0.003 | NM | <0.0008 | NM | 0.00012 | NM | <0.01 | NM | <0.002 | NM | 0.18 | NM | 0.0015 |
| PPC-3A | 6/19/2017 | 73 | 3 | 24 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00014 | NM | NM | NM | 0.003 | NM | 0.2 | NM | 0.0029 |
| PPC-3A | 10/2/2017 | 98 | 6 | 46 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00014 | NM | NM | NM | <0.002 | NM | 0.13 | NM | 0.0013 |
| PPC-4A | 4/12/2017 | 90 | 5.1 | 44 | <0.05 | NM | <0.0005 | NM | 0.003 | NM | <0.0008 | NM | 0.00015 | NM | <0.01 | NM | 0.002 | NM | 0.21 | NM | 0.0019 |
| PPC-4A | 4/12/2017 | 90 | 5.1 | 44 | <0.05 | NM | <0.0005 | NM | 0.003 | NM | <0.0008 | NM | 0.00013 | NM | <0.01 | NM | 0.002 | NM | 0.19 | NM | 0.002 |
| PPC-4A | 6/19/2017 | 74 | 3 | 24 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00014 | NM | NM | NM | 0.003 | NM | 0.22 | NM | 0.0027 |
| PPC-4A | 6/19/2017 | 73 | 2.9 | 24 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00014 | NM | NM | NM | 0.003 | NM | 0.21 | NM | 0.0028 |
| PPC-4A | 10/2/2017 | 98 | 6 | 47 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00014 | NM | NM | NM | <0.002 | NM | 0.15 | NM | 0.0013 |
| PPC-4A | 10/2/2017 | 98 | 6 | 47 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00013 | NM | NM | NM | <0.002 | NM | 0.15 | NM | 0.0014 |
| PPC-5A | 4/12/2017 | 89 | 5.1 | 46 | <0.05 | NM | <0.0005 | NM | 0.004 | NM | <0.0008 | NM | 0.00016 | NM | <0.01 | NM | 0.002 | NM | 0.23 | NM | 0.0019 |
| PPC-5A | 6/19/2017 | 73 | 2.9 | 24 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.00014 | NM | NM | NM | 0.003 | NM | 0.23 | NM | 0.003 |
| PPC-5A | 10/2/2017 | 99 | 6 | 47 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.0001 | NM | NM | NM | <0.002 | NM | 0.16 | NM | 0.0014 |
| PPC-7 | 6/19/2017 | 74 | 3 | 24 | NM | NM | <0.0005 | NM | 0.005 | NM | NM | NM | 0.00015 | NM | NM | NM | 0.003 | NM | 0.24 | NM | 0.0031 |
| PPC-7 | 10/2/2017 | 99 | 6 | 47 | NM | NM | <0.0005 | NM | 0.004 | NM | NM | NM | 0.0001 | NM | NM | NM | <0.002 | NM | 0.16 | NM | 0.0016 |
| SG-16 | 6/19/2017 | 75 | 3.3 | 24 | NM | NM | <0.0005 | NM | 0.005 | NM | NM | NM | 0.00014 | NM | NM | NM | 0.003 | NM | 0.19 | NM | 0.0033 |
| SG-16 | 10/2/2017 | 100 | 6 | 45 | NM | NM | <0.0005 | NM | 0.006 | NM | NM | NM | 0.00011 | NM | NM | NM | 0.002 | NM | 0.15 | NM | 0.002 |
| Trib-1 | 4/17/2017 | 180 | 6.4 | 70 | 0.056 | NM | 0.0022 | NM | 0.012 | NM | <0.0008 | NM | 0.00063 | NM | <0.01 | NM | 0.003 | NM | 0.64 | NM | 0.038 |
| Trib-1 | 6/19/2017 | 200 | 5.8 | 48 | NM | NM | 0.0025 | NM | 0.017 | NM | NM | NM | 0.00033 | NM | NM | NM | 0.002 | NM | 0.44 | NM | 0.0258 |
| Trib-1 | 10/2/2017 | 170 | 9 | 253 | NM | NM | 0.0012 | NM | 0.007 | NM | NM | NM | 0.0354 | NM | NM | NM | 0.008 | NM | 0.71 | NM | 0.0355 |
| Trib-1B | 4/17/2017 | 140 | 6.9 | 160 | 0.059 | NM | 0.0037 | NM | 0.004 | NM | <0.0008 | NM | 0.071 | NM | <0.01 | NM | 0.021 | NM | 0.35 | NM | 0.0366 |
| Trib-1B | 5/5/2017 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| Trib-1B | 6/19/2017 | 200 | 5.5 | 140 | NM | NM | 0.0033 | NM | 0.022 | NM | NM | NM | 0.0186 | NM | NM | NM | 0.024 | NM | 0.91 | NM | 0.0332 |
| Trib-1D | 4/17/2017 | 110 | 7.5 | 210 | 0.075 | 0.0015 | 0.0018 | 0.005 | 0.017 | <0.0008 | <0.0008 | 0.00034 | 0.00259 | <0.01 | <0.01 | 0.003 | 0.008 | 0.18 | 3.57 | 0.0013 | 0.0228 |
| Trib-1D | 6/19/2017 | 120 | 8.1 | 250 | NM | NM | 0.0016 | NM | 0.011 | NM | NM | NM | 0.00079 | NM | NM | NM | 0.011 | NM | 1.11 | NM | 0.012 |
| Trib-1D | 10/2/2017 | 71 | 7 | 260 | NM | NM | 0.002 | NM | 0.02 | NM | NM | NM | 0.00014 | NM | NM | NM | 0.004 | NM | 0.22 | NM | 0.0031 |

NOTES: All concentrations in mg/L except as indicated

NM = not measured

(D) = dissolved; (TR) = total recoverable

| Station ID | Sample Date | Mn (D) | Mn (TR | Hg (D) | Hg (TR) | Ni (D) | Ni (TR) | Se (D) | Se (TR) | Tl (D) | Tl (TR) | Zn (D) | Zn (TR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GP-5 | 6/19/2017 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| GP-5 | 10/2/2017 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM |
| PPC-10 | 6/19/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.037 |
| PPC-10 | 10/2/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.033 |
| PPC-36A | 6/19/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.036 |
| PPC-36A | 10/2/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.033 |
| PPC-3A | 4/12/2017 | NM | 0.03 | NM | <0.000005 | NM | <0.002 | NM | <0.001 | NM | <0.0002 | NM | 0.039 |
| PPC-3A | 6/19/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.032 |
| PPC-3A | 10/2/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.038 |
| PPC-4A | 4/12/2017 | NM | 0.04 | NM | <0.000005 | NM | <0.002 | NM | <0.001 | NM | <0.0002 | NM | 0.041 |
| PPC-4A | 4/12/2017 | NM | 0.03 | NM | <0.000005 | NM | <0.002 | NM | <0.001 | NM | <0.0002 | NM | 0.039 |
| PPC-4A | 6/19/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.033 |
| PPC-4A | 6/19/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.032 |
| PPC-4A | 10/2/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.037 |
| PPC-4A | 10/2/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.038 |
| PPC-5A | 4/12/2017 | NM | 0.05 | NM | <0.000005 | NM | <0.002 | NM | <0.001 | NM | <0.0002 | NM | 0.043 |
| PPC-5A | 6/19/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.034 |
| PPC-5A | 10/2/2017 | NM | 0.05 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.036 |
| PPC-7 | 6/19/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.034 |
| PPC-7 | 10/2/2017 | NM | 0.04 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.034 |
| SG-16 | 6/19/2017 | NM | 0.03 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.032 |
| SG-16 | 10/2/2017 | NM | 0.02 | NM | <0.000005 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.03 |
| Trib-1 | 4/17/2017 | NM | 0.09 | NM | 0.000059 | NM | <0.002 | NM | <0.001 | NM | <0.0002 | NM | 0.014 |
| Trib-1 | 6/19/2017 | NM | 0.08 | NM | 0.000037 | NM | NM | NM | 0.001 | NM | <0.0002 | NM | <0.008 |
| Trib-1 | 10/2/2017 | NM | 0.37 | NM | 0.000035 | NM | NM | NM | <0.001 | NM | 0.0004 | NM | 0.619 |
| Trib-1B | 4/17/2017 | NM | 0.48 | NM | 0.00024 | NM | 0.012 | NM | <0.001 | NM | 0.0007 | NM | 5.36 |
| Trib-1B | 5/5/2017 | NM | NM | NM | NM | NM | NM | NM | NM | NM | NM | 3.84 | 3.94 |
| Trib-1B | 6/19/2017 | NM | 0.32 | NM | 0.000122 | NM | NM | NM | <0.001 | NM | 0.0008 | NM | 0.959 |
| Trib-1D | 4/17/2017 | 1.00 | 1.14 | <0.000005 | 0.000026 | <0.002 | <0.002 | <0.001 | <0.001 | <0.0002 | <0.0002 | 0.028 | 0.24 |
| Trib-1D | 6/19/2017 | NM | 0.21 | NM | 0.000039 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | 0.041 |
| Trib-1D | 10/2/2017 | NM | 0.02 | NM | 0.000007 | NM | NM | NM | <0.001 | NM | <0.0002 | NM | <0.008 |

NOTES: All concentrations in mg/L except as indicated

NM = not measured

(D) = dissolved; (TR) = total recoverable

# APPENDIX B

# MONITORING WELL COMPLETION DETAILS

## Table B-1. East Helena Project Monitoring Well Network

| Well Name | Status | Date Installed | Northing | Easting | Ground Surface Elevation ATD, MTSP NAD83 (ft) | Measuring Point Elev. (ft) | Total Depth Drilled (ft bgs) | Total Depth Cased (ft bgs) | Casing Size (ID) (in) | Screened Interval (ft bgs) | Extended / Lowered Due to Construction Date (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plant Site Monitoring Wells** | | | | | | | | | | | |
| PZ-102 | Abandoned (2015) | 2011 | 859121.83 | 1361453.08 | NA | 3922.21 | NA | NA | NA | NA | |
| PZ-102B | Abandoned (2015) | 2011 | NA | NA | NA | NA | NA | NA | NA | NA | |
| PZ-103 | Abandoned (2015) | 2011 | 859334.6 | 1361357.2 | NA | 3921.82 | NA | NA | NA | NA | |
| PZ-103B | Abandoned (2015) | 2011 | NA | NA | NA | NA | NA | NA | NA | NA | |
| APSD-1 | Abandoned (2014) | 8/20/91 | 859273.19 | 1360490.343 | 3922.40 | 3923.57 | 14 | 11.75 | 2" | 1.75-11.75 | |
| APSD PW-1 | Abandoned (11/19/14) | 3/27/2014 | 859203.144 | 1360398.007 | 3926.37 | 3927.69 | 35.4 | 35.4 | 6" | 10-30' | |
| APSD-2 | Abandoned (2014) | 8/20/1991 | 859192.229 | 1360432.673 | 3926.10 | 3927.99 | 18 | 18 | 2" | 8-18 | |
| APSD-3 | Abandoned (2014) | 8/21/1991 | 859109.471 | 1360408.311 | 3924.30 | 3926.32 | 12.5 | 12.5 | 2" | 2.5-12.5 | |
| APSD-4 | Abandoned (2014) | 8/21/1991 | 859040.353 | 1360311.457 | 3924.06 | 3925.36 | 14 | 14 | 2" | 4-14 | |
| APSD-7 | Abandoned (2015) | 10/12/1993 | 859331.745 | 1361320.577 | 3922.46 | 3924.04 | 16 | 16 | 2" | 8.5-16 | |
| APSD-8 | Abandoned (2015) | 10/13/1993 | 859084.578 | 1361342.543 | 3922.59 | 3923.93 | 15 | 15 | 2" | 5-15 | |
| APSD-9 | Abandoned (2014) | 10/13/1993 | 858914.119 | 1360818.026 | 3925.67 | 3927.12 | 16 | 16 | 2" | 6-16 | |
| APSD-10 | Abandoned (2014) | 10/13/1993 | 858976.362 | 1360471.312 | 3925.03 | 3926.57 | 16 | 16 | 2" | 6-16 | |
| APSD-11 | Abandoned (2014) | 10/14/1993 | 859035.383 | 1361048.295 | 3924.85 | 3926.84 | 16 | 16 | 2" | 6-16 | |
| APSD-12 | Abandoned (2014) | 10/14/1993 | 859202.123 | 1360718.496 | 3922.74 | 3924.24 | 16 | 15.5 | 2" | 5.5-15.5 | |
| APSD-13 | Abandoned (04/07) | 10/15/1993 | NA | NA | 3924.63 | NA | 23 | 23 | 2" | 13-23 | |
| APSD-14 | Abandoned (1995) | 10/15/1993 | NA | NA | 3921.00 | NA | 16 | 16 | 2" | 6-16 | |
| APSD-15 | Abandoned (2014) | 4/25/2007 | 859246.393 | 1360295.985 | 3920.95 | 3923.90 | 25 | 24.6 | 2" | 4.6-24.6 | |
| APSD-16 | Abandoned (2014) | 4/25/2007 | 859282.646 | 1360326.599 | 3919.14 | 3922.05 | 25 | 23.75 | 2" | 3.75-23.75 | |
| DH-1 | Active | 12/8/84 | 861173.254 | 1359024.208 | 3909.11 | 3910.89 | 50 | 50 | 4" | 40-50 | |
| DH-2 | Active | 12/9/84 | 859912.152 | 1358535.16 | 3935.28 | 3936.91 | 65.5 | 65.5 | 4" | 55.5-65.5 | |
| DH-3 | Active | 12/10/84 | 858004.288 | 1359987.938 | 3946.11 | 3947.48 | 55 | 54 | 4" | 44-54 | |
| DH-4 | Active | 12/14/84 | 859528.54 | 1361219.921 | 3916.58 | 3917.26 | 23.6 | 23 | 4" | 17-23 | |
| DH-5 | Active | 1/7/85 | 859643.098 | 1360795.54 | 3920.62 | 3921.18 | 17 | 17 | 4" | 9-17 | |
| DH-5A | Active | 1/4/1985 | 859641.404 | 1360788.989 | 3920.62 | 3921.92 | 19.5 | 18 | 4" | 8-18 | |
| DH-6 | Active | 12/13/84 | 861528.803 | 1360255.14 | 3890.16 | 3889.85 | 25 | 25 | 4" | 15-25 | |
| DH-7 | Active | 12/12/84 | 861283.245 | 1361583.407 | 3896.83 | 3898.66 | 28.5 | 28.5 | 4" | 18.5-28.5 | |
| DH-8 | Active | 1/5/85 | 860694.887 | 1359407.443 | 3916.19 | 3923.38 | 50 | 49 | 4" | 39-49 | 5/9/16 (2.8) |
| DH-9 | Active | 1/4/85 | 860572.404 | 1360373.328 | 3897.42 | 3918.08 | 17 | 11.5 | 4" | 6.5-11.5 | |
| DH-10 | Abandoned (1995) | 12/11/84 | NA | NA | NA | NA | 10 | 10 | 4" | 5-10 | |
| DH-10A | Active | 1995 | 861458.531 | 1360611.538 | 3886.18 | 3886.97 | 10 | 10 | 2" | 5-10 | |
| DH-12 | Abandoned (4/22/16) | 11/3/86 | 860549.965 | 1359807.53 | 3911.24 | 3916.69 | 30 | 30 | 4" | 20-30 | |
| DH-13 | Active | 11/3/86 | 860562.77 | 1359798.13 | 3909.90 | 3923.91 | 45 | 45 | 4" | 35-45 | 4/29/16 (8.3) |
| DH-14 | Active | 10/22/86 | 859529.595 | 1361227.836 | 3916.16 | 3916.06 | 46 | 46 | 4" | 34-46 | |
| DH-15 | Active | 11/1/86 | 861542.786 | 1360259.716 | 3888.75 | 3889.82 | 50 | 50 | 4" | 41.5-50 | |
| DH-16 | Abandoned (3/9/16) | 11/20/86 | 861010.539 | 1359681.601 | 3906.69 | 3905.77 | 30 | 28 | 4" | 23-28 | |
| DH-17 | Active | 11/25/86 | 860999.136 | 1359671.35 | 3904.60 | 3917.56 | 41 | 41 | 4" | 31-41 | 3/23/16 (11.8) |
| DH-18 | Active | 12/2/86 | 860537.014 | 1359817.553 | 3910.61 | 3924.93 | 68 | 63.5 | 4" | 55.5-63.5 | 4/29/16 (8.5) |
| DH-19 | Abandoned (5/00) | 4/22/87 | NA | NA | NA | NA | 30 | 30 | 4" | 20-30 | |
| DH-19R | Abandoned (5/18/16) | 5/24/2000 | 859444.855 | 1360089.238 | 3919.97 | 3919.67 | 25 | 25 | 2" | 15-25 | |
| DH-20 | Active | 4/24/87 | 858991.089 | 1360131.173 | 3930.13 | 3927.09 | 31 | 31 | 4" | 21-31 | 4/29/16 (7.1) |
| DH-21 | Abandoned (3/9/16) | 4/23/87 | 860288.609 | 1360000.161 | 3909.26 | 3916.98 | 30 | 29 | 4" | 19-29 | |
| DH-22 | Active | 4/27/87 | 859691.79 | 1359818.954 | 3930.57 | 3948.63 | 35 | 34 | 4" | 24-34 | 14-Aug |
| DH-23 | Active | 4/28/87 | 860271.937 | 1360220.21 | 3916.11 | 3931.82 | 20 | 20 | 4" | 10-20 | |
| DH-24 | Active | 4/30/87 | 861414.349 | 1359444.728 | 3899.44 | 3899.59 | 35 | 35 | 4" | 27-35 | |
| DH-26 | Abandoned (1989) | 4/29/87 | NA | NA | NA | NA | 35 | 35 | 4" | 25-35 | |

## Table B-1. East Helena Project Monitoring Well Network

| Well Name | Status | Date Installed | Northing | Easting | Ground Surface Elevation ATD, MTSP NAD83 (ft) | Measuring Point Elev. (ft) | Total Depth Drilled (ft bgs) | Total Depth Cased (ft bgs) | Casing Size (ID) (in) | Screened Interval (ft bgs) | Extended / Lowered Due to Construction Date (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DH-27 | Active | 5/1/87 | 859925.566 | 1360049.181 | 3912.41 | 3946.21 | 30 | 29 | 4" | 19-29 | 3/31/16 (20) |
| DH-28 | Abandoned (200?) | 12/14/87 | NA | NA | NA | NA | 36 | 36 | 4" | 26-36 | |
| DH-29 | Abandoned (2014) | 12/11/87 | 859222.097 | 1360322.896 | 3923.90 | 3925.33 | 14 | 17 | 2" | 1.75-11.75 | |
| DH-30 | Active | 11/20/1999 | 859936.907 | 1360102.276 | 3912.94 | 3943.24 | 22 | 22 | 2" | 12-22 | 3/31/16 (20) |
| DH-31 | Abandoned (3/9/16) | 10/26/1999 | 860191.513 | 1360066.461 | 3911.78 | 3919.16 | 28 | 28 | 2" | 18-28 | |
| DH-32 | Abandoned (3/10/16) | 10/22/1999 | 860270.699 | 1359864.633 | 3915.73 | 3918.23 | 30 | 30 | 2" | 20-30 | |
| DH-33 | Abandoned (3/10/16) | 11/5/1999 | 860351.057 | 1359903.625 | 3912.06 | 3918.81 | 35 | 30 | 2" | 20-30 | |
| DH-34 | Abandoned (3/9/16) | 10/4/1999 | 860324.49 | 1359965.548 | 3909.90 | 3916.55 | 30 | 30 | 2" | 20-30 | |
| DH-35 | Abandoned (3/9/16) | 10/25/1999 | 860277.593 | 1360060.911 | 3911.97 | 3918.37 | 30 | 29.5 | 2" | 19.5-29.5 | |
| DH-36 | Active | 10/11/1999 | 860633.221 | 1359939.058 | 3905.67 | 3920.66 | 32 | 31 | 2" | 21-31 | |
| DH-37 | Abandoned (3/9/16) | 11/21/1999 | 860172.243 | 1359930.432 | 3914.05 | 3916.71 | 30 | 30 | 2" | 20-30 | |
| DH-38 | Abandoned (3/10/16) | 10/23/1999 | 860025.943 | 1359979.632 | 3912.31 | 3918.86 | 32 | 25 | 2" | 15-25 | |
| DH-39 | Abandoned (04/07) | 11/16/1999 | NA | NA | NA | NA | 35 | 30 | 2" | 20-30 | |
| DH-40 | Abandoned (04/07) | 11/17/1999 | NA | NA | NA | NA | 25 | 20 | 2" | 15-20 | |
| DH-41 | Abandoned (04/07) | 11/9/1999 | NA | NA | NA | NA | 30 | 27 | 2" | 17-27 | |
| DH-42 | Active | 11/7/1999 | 859588.92 | 1359941.518 | 3926.86 | 3942.63 | 34 | 34 | 2" | 24-34 | 8/15/16 (11.3) |
| DH-43 | Abandoned (04/07) | 11/15/1999 | NA | NA | NA | NA | 40 | 36 | 2" | 26-36 | |
| DH-44 | Abandoned (04/07) | 11/18/1999 | NA | NA | NA | NA | 31.5 | 29.4 | 2" | 19.5-29.5 | |
| DH-45 | Abandoned (04/07) | 11/10/1999 | NA | NA | NA | NA | 17 | 15 | 2" | 7-15 | |
| DH-46 | Abandoned (04/07) | 11/23/1999 | NA | NA | NA | NA | 17 | 14 | 2" | 4-14 | |
| DH-47 | Active | 11/15/1999 | 859461.742 | 1360404.744 | 3919.90 | 3926.82 | 15 | 15 | 2" | 5-15 | 7/5/16 (4.4) |
| DH-48 | Active | 10/10/1999 | 861495.272 | 1358993.426 | 3903.59 | 3905.96 | 34 | 34 | 2" | 24-34 | |
| DH-49 | Abandoned (03/15/17) | 10/9/1999 | 861443.082 | 1359299.789 | 3901.57 | 3904.07 | 34 | 34 | 2" | 24-34 | |
| DH-50 | Active | 10/7/1999 | 861386.979 | 1359574.482 | 3902.17 | 3904.76 | 34 | 34 | 2" | 24-34 | |
| DH-51 | Active | 10/5/1999 | 861331.977 | 1359703.046 | 3902.21 | 3904.34 | 35 | 34 | 2" | 24-34 | |
| DH-52 | Active | 10/20/1999 | 861373.862 | 1360878.881 | 3886.70 | 3889.18 | 20 | 17 | 2" | 7-17 | |
| DH-53 | Active | 10/18/1999 | 861345.403 | 1361120.388 | 3890.27 | 3892.87 | 20 | 17 | 2" | 7-17 | |
| DH-54 | Active | 12/1/1999 | 862059.028 | 1359473.867 | 3888.11 | 3890.27 | 30 | 27 | 2" | 17-27 | |
| DH-55 | Active | 6/17/2001 | 860570.538 | 1360948.277 | 3970.13 | 3972.76 | 93 | 93 | 2" | 83-93 | |
| DH-56 | Active | 6/14/2001 | 861100.154 | 1360353.465 | 3955.62 | 3958.17 | 85 | 85 | 2" | 70-85 | |
| DH-57 | Active | 5/16/2001 | 860330.666 | 1360259.106 | 3912.95 | 3929.53 | 28 | 28 | 2" | 23-28 | |
| DH-58 | Active | 5/30/2001 | 860622.068 | 1360152.519 | 3897.48 | 3919.33 | 24 | 24 | 2" | 9-24 | |
| DH-59 | Active | 5/23/2001 | 859633.795 | 1360061.325 | 3916.34 | 3937.44 | 27 | 25 | 2" | 10-25 | 8/15/16 (20) |
| DH-60 | Abandoned (04/07) | 5/13/2001 | NA | NA | NA | NA | 35 | 35 | 2" | 20-35 | |
| DH-61 | Active | 5/9/2001 | 860403.577 | 1359295.65 | 3917.05 | 3926.84 | 32 | 30 | 2" | 20-30 | Aug-14 |
| DH-62 | Active | 5/11/2001 | 860408.456 | 1359294.189 | 3917.00 | 3926.95 | 75 | 75 | 2" | 65-75 | Aug-14 |
| DH-63 | Active | 5/31/2001 | 861508.883 | 1359152.552 | 3903.20 | 3905.37 | 39 | 39 | 2" | 24-39 | |
| DH-64 | Active | 5/22/2001 | 861384.47 | 1359478.976 | 3901.74 | 3904.02 | 55 | 55 | 2" | 45-55 | |
| DH-65 | Active | 6/15/2001 | 861208.922 | 1360882.127 | 3943.36 | 3945.85 | 70 | 70 | 2" | 60-70 | |
| DH-66 | Active | 7/23/2002 | 861006.862 | 1359336.128 | 3911.43 | 3919.28 | 52 | 48 | 2" | 38-48 | 5/9/16 (2.8) |
| DH-67 | Active | 8/11/2002 | 861659.368 | 1359098.23 | 3897.77 | 3899.77 | 48.5 | 46 | 2" | 36-46 | |
| DH-68 | Active | 4/2/2008 | 859815.882 | 1361074.918 | 3940.38 | 3943.28 | 50 | 50 | 2" | 40-50 | |
| DH-69 | Active | 4/1/2008 | 859901.318 | 1360786.616 | 3931.85 | 3934.40 | 40 | 40 | 2" | 30-40 | |
| DH-70 | Active | 3/27/2008 | 859740.324 | 1360349.535 | 3916.18 | 3933.91 | 30 | 30 | 2" | 24-30 | 4/4/16 (15.5) |
| DH-71 | Active | 3/28/2008 | 859878.406 | 1359643.263 | 3922.71 | 3944.88 | 34.5 | 34 | 2" | 25-34 | |
| DH-72 | Active | 8/25/2010 | 859629.267 | 1360071.922 | 3916.02 | 3939.67 | 50 | 50 | 2" | 40-50 | 8/15/16 (20) |
| DH-73 | Active | 8/21/2010 | 860575.499 | 1360397.122 | 3897.87 | 3918.08 | 48 | 48 | 2" | 38-48 | |

## Table B-1. East Helena Project Monitoring Well Network

| Well Name | Status | Date Installed | Northing | Easting | Ground Surface Elevation ATD, MTSP NAD83 (ft) | Measuring Point Elev. (ft) | Total Depth Drilled (ft bgs) | Total Depth Cased (ft bgs) | Casing Size (ID) (in) | Screened Interval (ft bgs) | Extended / Lowered Due to Construction Date (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DH-74 | Active | 8/24/2010 | 860944.183 | 1360682.187 | 3998.99 | 4001.49 | 128 | 128 | 2" | 118-128 | |
| DH-75 | Active | 8/23/2010 | 860943.818 | 1360687.835 | 3998.90 | 4001.55 | 146 | 146 | 2" | 136-146 | |
| DH-76 | Active | 8/19/2010 | 860175.348 | 1360889.78 | 3992.23 | 3994.28 | 136 | 124 | 2" | 104-124 | |
| DH-77 | Active | 9/8/2014 | 860292.48 | 1259639.25 | 3924.99 | 3932.20 | 52 | 48 | 2" | 38-48 | |
| DH-78 | Active | 9/17/2014 | 860849 | 1359368.35 | 3918.85 | 3921.12 | 47 | 45 | 2" | 35-45 | 5/9/16 (2.4) |
| DH-79 | Active | 6/25/2015 | 860422.215 | 1359937.191 | 3913.15 | 3928.80 | 45.5 | 42 | 2" | 32-42 | 3/31/16 (13.0) |
| DH-80 | Active | 6/24/2015 | 859665.447 | 1360005.892 | 3916.04 | 3942.36 | 32 | 30 | 2" | 20-30 | 8/15/16 (20) 8/23/16 |
| DH-81 | Abandoned (5/4/16) | 7/15/2015 | 859352.188 | 1360152.25 | 3924.23 | 3926.66 | 32 | 30 | 2" | 20-30 | |
| DH-82 | Active | 7/8/2015 | 861377.161 | 1359161.969 | 3905.01 | 3908.18 | 55 | 49 | 2" | 39-49 | |
| DH-83 | Active | 7/8/2015 | 860783.429 | 1359388.46 | 3916.00 | 3922.14 | 56 | 54.5 | 2" | 49.5-54.5 | 5/9/16 (3.4) |
| TW-1 | Active | 8/7/2006 | 860384.034 | 1359940.835 | 3912.22 | 3930.10 | 47 | 43 | 4" | 25-40 | 3/31/16 (11.7) |
| TW-2 | Active | NA | NA | NA | NA | 3931.44 | NA | NA | NA | NA | |
| **East Bench Wells/Piezometers** | | | | | | | | | | | |
| DH-11 | Abandoned (2015) | 1/5/85 | 859950.404 | 1361579.582 | 3910.23 | 3912.36 | 29 | 29 | 4" | 19-29 | |
| East-PZ-1 | Active | NA | NA | NA | NA | 3911.93 | NA | NA | NA | NA | |
| East-PZ-2 | Active | NA | NA | NA | NA | 3924.58 | NA | NA | NA | NA | |
| East-PZ-3 | Abandoned (2013) | NA | 858670.97 | 1361666.00 | NA | 3927.30 | NA | NA | NA | NA | |
| East-PZ-4 | Active | NA | NA | NA | NA | 3935.66 | NA | NA | NA | NA | |
| East-PZ-5 | Abandoned (2013) | NA | 857670.39 | 1361862.50 | NA | 3937.95 | NA | NA | NA | NA | |
| East-PZ-6 | Active | NA | NA | NA | NA | 3943.83 | NA | NA | NA | NA | |
| East-PZ-7 | Active | NA | NA | NA | NA | 3928.83 | NA | NA | NA | NA | |
| PZ-33A | Abandoned (2015) | NA | 861145.75 | 1361480.23 | NA | 3894.51 | NA | NA | NA | NA | |
| PZ-33B | Abandoned (2015) | NA | 861144.75 | 1361484.5 | NA | 3894.26 | NA | NA | NA | NA | |
| PZ-36A | Active | NA | NA | NA | NA | 3858.96 | NA | NA | NA | NA | |
| PZ-36B | Active | NA | NA | NA | NA | 3858.75 | NA | NA | NA | NA | |
| PZ-36C | Active | 4/14/2010 | 864554.645 | 1358718.763 | 3853.38 | 3859.60 | 25 | 25 | 2" | 20-25 | |
| PZ-9A | Active | NA | NA | NA | NA | 3850.70 | NA | NA | NA | NA | |
| PZ-9B | Active | NA | NA | NA | NA | 3849.43 | NA | NA | NA | NA | |
| ASIW-1 | Active | 8/20/1991 | 859803.157 | 1362121.493 | NA | 3915.99 | 73 | 73 | 4" | 53-73 | |
| ASIW-2 | Active | 5/6/1993 | 860471.83 | 1363184.587 | NA | 3909.13 | 95 | 95 | 4" | 10-95 | |
| Aire Liquide N | Abandoned (2015) | NA | 859173.55 | 1361517.37 | NA | 3920.62 | NA | NA | NA | NA | |
| Aire Liquide S | Abandoned (2015) | NA | 859080.24 | 1361533.47 | NA | 3922.05 | NA | NA | NA | NA | |
| **Upper Lake Marsh** | | | | | | | | | | | |
| ULM-PZ-1 | Active | NA | 857497.97 | 1360521.68 | NA | 3924.40 | NA | NA | NA | NA | |
| ULM-PZ-2 | Active | NA | 857491.57 | 1360953.39 | NA | 3925.41 | NA | NA | NA | NA | |
| PPCRPZ-1 | Abandoned (2015) | NA | 858505.66 | 1361257.86 | NA | 3923.92 | NA | NA | NA | NA | |
| PPCRPZ-2 | Active | NA | 858388.35 | 1360904.92 | NA | 3919.76 | NA | NA | NA | NA | |
| PPCRPZ-3 | Abandoned (2015) | NA | 858172.93 | 1361351.22 | NA | 3924.59 | NA | NA | NA | NA | |
| PPCRPZ-4 | Abandoned (2015) | NA | 857967.86 | 1361064.82 | NA | 3922.73 | NA | NA | NA | NA | |
| PPCRPZ-5 | Abandoned (2015) | NA | 857361.45 | 1361226.21 | NA | 3926.58 | NA | NA | NA | NA | |
| PPCRPZ-6 | Abandoned (2015) | NA | 857000.56 | 1361280.44 | NA | 3928.47 | NA | NA | NA | NA | |
| PPCRPZ-7 | Abandoned (2015) | NA | 857033.74 | 1361539.94 | NA | 3928.02 | NA | NA | NA | NA | |
| ULTP-1 | Active | NA | NA | NA | NA | 3919.63 | NA | NA | NA | NA | |
| ULTP-2 | Active | NA | NA | NA | NA | 3921.23 | NA | NA | NA | NA | |
| GPPZ-6 | Abandoned (2015) | NA | 858200.88 | 1361048.05 | NA | 3923.36 | NA | NA | NA | NA | |
| GPPZ-12 | Abandoned (2015) | NA | 857622.12 | 1360941.61 | NA | 3927.82 | NA | NA | NA | NA | |
| GPPZ-14 | Abandoned (2015) | NA | 857650.64 | 1361569.05 | NA | 3927.18 | NA | NA | NA | NA | |

## Table B-1. East Helena Project Monitoring Well Network

| Well Name | Status | Date Installed | Northing | Easting | Ground Surface Elevation ATD, MTSP NAD83 (ft) | Measuring Point Elev. (ft) | Total Depth Drilled (ft bgs) | Total Depth Cased (ft bgs) | Casing Size (ID) (in) | Screened Interval (ft bgs) | Extended / Lowered Due to Construction Date (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GPPZ-18 | Abandoned (2015) | NA | 857005.18 | 1360924.13 | NA | 3926.56 | NA | NA | NA | NA | |
| **East Helena Area Monitoring Wells** | | | | | | | | | | | |
| EH-50 | Active | 11/6/86 | 862197.417 | 1358820.717 | 3888.92 | 3889.39 | 45 | 45 | 4" | 25-45 | |
| EH-51 | Active | 10/24/86 | 862188.704 | 1359831.135 | 3879.02 | 3880.09 | 30 | 30 | 4" | 10-30 | |
| EH-52 | Active | 11/7/86 | 862193.38 | 1360755.059 | 3880.50 | 3880.50 | 13 | 13 | 4" | 5-13 | |
| EH-53 | Active | 11/11/86 | 863389.199 | 1358271.548 | 3871.74 | 3872.82 | 35 | 35 | 4" | 25-35 | |
| EH-54 | Active | 11/20/86 | 863347.116 | 1359825.052 | 3869.75 | 3869.66 | 18 | 18 | 4" | 8-18 | |
| EH-57 | Active | 5/4/87 | 862620.151 | 1357739.199 | 3884.98 | 3885.05 | 35 | 35 | 4" | 25-35 | |
| EH-57A | Active | 11/23/87 | 862627.623 | 1357733.753 | 3884.85 | 3885.45 | 45 | 45 | 4" | 35-45 | |
| EH-58 | Active | 11/23/87 | 861987.109 | 1361555.923 | 3886.85 | 3888.15 | 35 | 31 | 4" | 21-31 | |
| EH-59 | Active | 5/6/87 | 862767.731 | 1361025.966 | 3877.00 | 3876.57 | 18 | 18 | 4" | 8-18 | |
| EH-60 | Active | 12/1/87 | 862095.091 | 1359298.502 | 3888.84 | 3888.46 | 29 | 29 | 4" | 22-28 | |
| EH-61 | Active | 11/30/87 | 862097.583 | 1359284.816 | 3889.36 | 3889.77 | 45 | 45 | 4" | 36-45 | |
| EH-62 | Active | 11/20/87 | 863375.344 | 1358815.695 | 3870.79 | 3875.07 | 46.5 | 46.5 | 4" | 25-45 | |
| EH-63 | Active | 6/20/2001 | 862684.214 | 1359430.15 | 3878.81 | 3878.32 | 35 | 35 | 2" | 20-35 | |
| EH-64 | Active | 6/21/2001 | 862712.645 | 1359203.585 | 3880.26 | 3882.67 | 35 | 35 | 2" | 20-35 | |
| EH-65 | Active | 6/22/2001 | 862704.706 | 1358792.645 | 3880.20 | 3879.96 | 35 | 35 | 2" | 20-35 | |
| EH-66 | Active | 4/10/2008 | 864408.628 | 1358108.047 | 3866.53 | 3869.48 | 40 | 38.5 | 2" | 28.5-38.5 | |
| EH-67 | Active | 5/4/2008 | 864407.638 | 1358457.283 | 3866.58 | 3869.46 | 37 | 37 | 2" | 27-37 | |
| EH-68 | Active | 4/8/2008 | 863878.859 | 1360334.193 | 3868.14 | 3867.60 | 26.5 | 25 | 2" | 15-25 | |
| EH-69 | Active | 4/9/2008 | 863792.843 | 1360855.33 | 3869.44 | 3869.10 | 36.4 | 36 | 2" | 26-36 | |
| EH-70 | Active | 8/17/2010 | 864973.644 | 1357080.497 | 3860.95 | 3863.48 | 50 | 50 | 2" | 40-50 | |
| EH-100 | Active | 11/5/1986 | 862198.915 | 1358803.612 | 3889.09 | 3889.83 | 60 | 60 | 4" | 52-60 | |
| EH-101 | Active | 11/5/1987 | 862186.785 | 1359844.454 | 3878.84 | 3879.95 | 45 | 45 | 4" | 34-45 | |
| EH-102 | Active | 11/7/86 | 862176.255 | 1360753.823 | 3880.91 | 3880.45 | 35 | 35 | 4" | 25-35 | |
| EH-103 | Active | 7/25/2002 | 862097.057 | 1359305.836 | 3888.34 | 3890.54 | 74.5 | 74.5 | 2" | 59.5-74.5 | |
| EH-104 | Active | 7/27/2002 | 862314.386 | 1358285.239 | 3888.04 | 3887.83 | 52 | 48 | 2" | 38-48 | |
| EH-106 | Active | 9/11/2002 | 862711.659 | 1358339.836 | 3882.25 | 3882.07 | 50 | 46 | 2" | 31-46 | |
| EH-107 | Active | 8/9/2002 | 862702.22 | 1358804.709 | 3880.27 | 3880.15 | 82 | 78 | 2" | 68-78 | |
| EH-109 | Active | 8/21/2002 | 862430.518 | 1358741.015 | 3885.88 | 3885.67 | 71 | 65 | 2" | 50-65 | |
| EH-110 | Active | 8/12/2002 | 862410.664 | 1359202.453 | 3884.27 | 3884.05 | 59 | 55 | 2" | 40-55 | |
| EH-111 | Active | 9/14/2002 | 863065.551 | 1358124.387 | 3876.72 | 3876.50 | 54 | 49 | 2" | 39-49 | |
| EH-112 | Active | 9/12/2002 | 863055.289 | 1358512.351 | 3876.10 | 3875.78 | 52 | 41 | 2" | 31-41 | |
| EH-113 | Active | 10/24/2002 | 863391.933 | 1357975.088 | 3871.64 | 3871.34 | 46 | 44 | 2" | 34-44 | |
| EH-114 | Active | 10/10/2002 | 863129.475 | 1357772.473 | 3876.45 | 3878.07 | 55 | 52 | 2" | 42-52 | |
| EH-115 | Active | 10/22/2002 | 862719.54 | 1357965.751 | 3883.59 | 3883.29 | 53 | 49 | 2" | 39-49 | |
| EH-116 | Active | 11/8/2005 | 863346.313 | 1357813.694 | 3872.71 | 3874.52 | 50 | 48 | 2" | 38-48 | |
| EH-117 | Active | 11/9/2005 | 863492.921 | 1357817.818 | 3869.49 | 3871.33 | 50 | 43 | 2" | 33-43 | |
| EH-118 | Active | 4/30/2008 | 863061.633 | 1357373.685 | 3877.57 | 3879.95 | 57 | 50 | 2" | 40-50 | |
| EH-119 | Active | 4/24/2008 | 863619.351 | 1357265.802 | 3871.17 | 3873.75 | 70 | 68 | 2" | 58-68 | |
| EH-120 | Active | 5/1/2008 | 864331.969 | 1357412.648 | 3863.19 | 3865.78 | 67 | 65 | 2" | 55-65 | |
| EH-121 | Active | 4/21/2008 | 864411.865 | 1358130.539 | 3867.00 | 3869.49 | 71.5 | 69 | 2" | 59-69 | |
| EH-122 | Active | 5/3/2008 | 864417.039 | 1358472.365 | 3865.63 | 3868.08 | 67 | 65 | 2" | 60-65 | |
| EH-123 | Active | 4/7/2009 | 863029.072 | 1356634.019 | 3883.20 | 3885.71 | 68 | 60 | 2" | 50-60 | |
| EH-124 | Active | 4/7/2009 | 863930.121 | 1356669.205 | 3872.10 | 3874.46 | 75 | 74 | 2" | 64-74 | |
| EH-125 | Active | 4/6/2009 | 864980.173 | 1357092.684 | 3860.96 | 3863.22 | 70 | 69 | 2" | 59-69 | |
| EH-126 | Active | 4/6/2009 | 865517.528 | 1356005.51 | 3867.80 | 3870.00 | 85 | 73 | 2" | 63-73 | |

## Table B-1. East Helena Project Monitoring Well Network

| Well Name | Status | Date Installed | Northing | Easting | Ground Surface Elevation ATD, MTSP NAD83 (ft) | Measuring Point Elev. (ft) | Total Depth Drilled (ft bgs) | Total Depth Cased (ft bgs) | Casing Size (ID) (in) | Screened Interval (ft bgs) | Extended / Lowered Due to Construction Date (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EH-127 | Active | 4/7/2009 | 865363.286 | 1357812.997 | 3858.40 | 3860.75 | 73 | 73 | 2" | 63-73 | |
| EH-128 | Active | 6/3/2009 | 863373.274 | 1355906.353 | 3889.50 | 3892.17 | 50 | 44 | 2" | 34-44 | |
| EH-129 | Active | 6/1/2009 | 865651.422 | 1355427.799 | 3867.45 | 3870.21 | 90 | 90 | 2" | 80-90 | |
| EH-130 | Active | 6/11/2009 | 866019.744 | 1356643.922 | 3855.98 | 3858.55 | 79 | 78 | 2" | 68-78 | |
| EH-131 | Active | 6/10/2009 | 867034.375 | 1356914.735 | 3831.57 | 3834.44 | 86.5 | 84 | 2" | 74-84 | |
| EH-132 | Active | 6/3/2009 | 864042.081 | 1355363.119 | 3891.41 | 3893.90 | 80 | 80 | 2" | 70-80 | |
| EH-133 | Active | 6/2/2009 | 864767.997 | 1355357.545 | 3881.59 | 3884.36 | 95 | 95 | 2" | 85-95 | |
| EH-134 | Active | 6/1/2009 | 865645.213 | 1355428.256 | 3867.52 | 3870.21 | 64 | 64 | 2" | 54-64 | |
| EH-135 | Active | 6/2/2009 | 865690.326 | 1357387.691 | 3849.54 | 3852.25 | 65 | 65 | 2" | 55-65 | |
| EH-136 | Active | 6/10/2009 | 866627.617 | 1357251.616 | 3836.09 | 3838.59 | 79 | 74 | 2" | 64-74 | |
| EH-137 | Active | 6/11/2009 | 867049.515 | 1357898.383 | 3837.16 | 3839.66 | 89 | 85 | 2" | 75-85 | |
| EH-138 | Active | 10/20/2010 | 867180.7802 | 1355649.183 | 3840.10 | 3839.70 | 85 | 85 | 2" | 55-85 | |
| EH-139 | Active | 10/21/2010 | 867199.1877 | 1354638.014 | 3840.20 | 3839.78 | 65.5 | 57 | 2" | 47-57 | |
| EH-140 | Active | 4/19/2011 | 867962.262 | 1356224.787 | 3808.61 | 3812.08 | 95 | 86 | 2" | 56-86 | |
| EH-141 | Active | 4/20/2011 | 868713.295 | 1354782.704 | 3810.66 | 3813.32 | 90 | 90 | 2" | 60-90 | |
| EH-142 | Active | 4/17/2011 | 870077.471 | 1353868.600 | 3802.22 | 3804.68 | 120 | 120 | 2" | 80-120 | |
| EH-143 | Active | 4/16/2011 | 870683.749 | 1354372.763 | 3801.02 | 3803.37 | 125 | 125 | 2" | 100-125 | |
| EH-144D | Active | 11/30/2012 | 874170.144 | 1354086.122 | 3776.98 | 3778.86 | 169 | 169 | 2" | 143.5-168.5 | |
| EH-144S | Active | 12/3/2012 | 874170.357 | 1354091.18 | 3776.98 | 3778.70 | 103 | 103 | 2" | 83-103 | |
| EH-144M | Active | 12/5/2012 | 874170.205 | 1354096.294 | 3776.98 | 3778.95 | 128 | 128 | 2" | 118-128 | |
| EH-145D | Active | 9/26/2016 | 873225.38 | 1355535.01 | 3787.90 | 3789.60 | 247 | 241 | 2" | 211-241 | |
| EH-145S | Active | 9/28/2016 | 873230.40 | 1355543.75 | 3787.97 | 3790.09 | 187 | 187 | 2" | 167-187 | |
| EH-200 | Active | 4/12/2010 | 862019.981 | 1353067.956 | 3950.83 | 3953.33 | 100 | 51 | 2" | 38-48 | |
| EH-201 | Active | 4/13/2010 | 861477.627 | 1353970.9 | 3970.98 | 3973.48 | 119 | 119 | 2" | 99-119 | |
| EH-202 | Active | 4/13/2010 | 861252.398 | 1357116.45 | 3927.94 | 3930.56 | 90 | 90 | 2" | 70-90 | |
| EH-203 | Active | 6/9/2010 | 860235.578 | 1356625.924 | 4001.42 | 4003.92 | 150 | 145 | 2" | 125-145 | |
| EH-204 | Active | 6/9/2010 | 860662.714 | 1358706.318 | 3923.19 | 3925.69 | 65 | 65 | 2" | 55-65 | |
| EH-205 | Active | 6/10/2010 | 861654.247 | 1358689.779 | 3898.16 | 3900.66 | 36 | 34 | 2" | 24-34 | |
| EH-206 | Active | 6/8/2010 | 862971.127 | 1356015.496 | 3895.60 | 3898.10 | 53 | 53 | 2" | 33-53 | |
| EH-208 | Active | 6/11/2010 | 863932.222 | 1354404.282 | 3908.08 | 3910.58 | 85 | 85 | 2" | 60-85 | |
| EH-209 | Active | 6/12/2010 | 864743.929 | 1353104.707 | 3895.84 | 3898.34 | 116 | 116 | 2" | 96-116 | |
| EH-210 | Active | 8/19/2010 | 861655.326 | 1358677.396 | 3898.54 | 3901.19 | 60 | 60 | 2" | 50-60 | |
| EH-211 | Active | 4/21/2011 | 862223.936 | 1356747.917 | 3903.21 | 3905.75 | 50 | 50 | 2" | 40-50 | |
| EH-212 | Active | 4/20/2011 | 862222.628 | 1356753.360 | 3903.16 | 3905.90 | 75 | 72 | 2" | 57-72 | |
| **CAMU Monitoring Wells** | | | | | | | | | | | |
| MW-1 | Active | 6/26/97 | 858773.371 | 1358769.475 | 3951.62 | 3953.05 | 68 | 68 | 2" | 58-68 | |
| MW-2 | Active | 6/27/1997 | 859193.354 | 1358748.559 | 3944.21 | 3945.97 | 66 | 66 | 2" | 56.0-66.0 | |
| MW-3 | Active | 6/30/1997 | 859198.543 | 1359135.104 | 3939.44 | 3940.95 | 50 | 48 | 2" | 38.5-48.0 | |
| MW-4 | Active | 5/10/2000 | 858804.194 | 1359152.731 | 3944.62 | 3947.06 | 72 | 64 | 2" | 54-64 | |
| MW-5 | Active | 5/12/2000 | 858416.418 | 1358932.959 | 3953.29 | 3956.18 | 71 | 65 | 2" | 55-65 | |
| MW-6 | Active | 5/14/2000 | 858877.988 | 1359559.188 | 3935.52 | 3938.14 | 40 | 40 | 2" | 30-40 | |
| MW-7 | Active | 5/18/2000 | 858778.722 | 1358180.49 | 3961.37 | 3963.67 | 60 | 57 | 2" | 44-57 | |
| MW-8 | Active | 9/26/2006 | 857963.951 | 1359403.65 | 3956.50 | 3958.65 | 70 | 64.5 | 2" | 44.5-64.5 | |
| MW-9 | Active | 9/27/2006 | 857979.158 | 1358981.702 | 3962.59 | 3959.01 | 70 | 70 | 2" | 50-70 | 10/16 |
| MW-10 | Active | 9/28/2006 | 858555.918 | 1359551.985 | 3943.42 | 3946.28 | 70 | 62 | 2" | 42-62 | |
| MW-11 | Active | 5/3/2007 | 857961.186 | 1358519.466 | 3970.41 | 3973.33 | 70 | 69.6 | 2" | 49.5-69.5 | |
| **Sparge Pilot Test Wells** | | | | | | | | | | | |

## Table B-1. East Helena Project Monitoring Well Network

| Well Name | Status | Date Installed | Northing | Easting | Ground Surface Elevation ATD, MTSP NAD83 (ft) | Measuring Point Elev. (ft) | Total Depth Drilled (ft bgs) | Total Depth Cased (ft bgs) | Casing Size (ID) (in) | Screened Interval (ft bgs) | Extended / Lowered Due to Construction Date (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PBTW-1 | Active | 8/14/2001 | 861057.613 | 1359665.397 | 3905.46 | 3914.59 | 46 | 46 | 2" | 29-46 | 3/23/16 (7.2) |
| PBTW-2 | Active | 8/15/2001 | 861167.511 | 1359625.146 | 3904.27 | 3906.73 | 54 | 54 | 2" | 30-54 | |
| SPAR-1 | Abandoned (03/15/17) | 4/27/2000 | 861337.8 | 1359581.303 | 3902.38 | 3904.80 | 40 | 38.8 | 2" | 37-39 | |
| SPAR-2 | Abandoned (03/15/17) | 4/28/2000 | 861343.14 | 1359580.277 | 3901.79 | 3904.97 | 41 | 39 | 2" | 36-39 | |
| SPAR-3 | Abandoned (03/15/17) | 5/22/2000 | 861388.259 | 1359457.37 | 3901.59 | 3904.23 | 40 | 37 | 2" | 35-37 | |
| STW-1 | Abandoned (03/15/17) | 4/26/2000 | 861264.293 | 1359590.432 | 3903.14 | 3905.58 | 40 | 38 | 2" | 33-38 | |
| STW-2 | Abandoned (03/15/17) | 4/25/2000 | 861348.056 | 1359574.958 | 3901.69 | 3904.28 | 40 | 39 | 2" | 34-39 | |
| STW-3 | Abandoned (03/15/17) | 4/29/2000 | 861347.359 | 1359588.307 | 3902.13 | 3904.79 | 40 | 39.5 | 2" | 34.5-39.5 | |
| STW-4 | Abandoned (03/15/17) | 5/2/2000 | 861357.189 | 1359564.476 | 3901.57 | 3904.07 | 40 | 37 | 2" | 32-37 | |
| STW-5 | Abandoned (03/15/17) | 5/1/2000 | 861362.025 | 1359577.708 | 3901.11 | 3903.81 | 40 | 39 | 2" | 34-39 | |
| STW-6 | Abandoned (03/15/17) | 4/30/2000 | 861359.936 | 1359592.165 | 3901.52 | 3904.17 | 40 | 39 | 2" | 34-39 | |
| STW-7 | Abandoned (03/15/17) | 7/17/2001 | 861318.866 | 1359585.858 | 3903.25 | 3905.54 | 40 | 40 | 2" | 25-40 | |
| STW-8 | Abandoned (03/15/17) | 7/18/2001 | 861328.49 | 1359584.509 | 3902.93 | 3903.06 | 40 | 40 | 2" | 35-40 | |
| STW-9 | Abandoned (03/15/17) | 7/19/2001 | 861352.623 | 1359579.176 | 3901.80 | 3904.05 | 40 | 40 | 2" | 35-40 | |
| **Permeable Reactive Barrier Wells** | | | | | | | | | | | |
| PRB-1 | Active | 2006 | 861021.094 | 1359490.903 | 3908.33 | 3918.37 | 55 | 50 | 2" | 35-50 | 4/11/16 (7.4) |
| PRB-2 | Active | 2006 | 861116.532 | 1359756.318 | 3902.84 | 3905.34 | 55 | 52 | 2" | 37-52 | |
| PRB-3 | Active | 2006 | 860985.534 | 1359421.246 | 3910.46 | 3919.19 | 55 | 51 | 2" | 36-51 | 5/9/16 (3.0) |
| **Speiss/Dross Slurry Wall Wells** | | | | | | | | | | | |
| SDMW-1 | Active | 8/29/2007 | 860516.314 | 1359965.598 | 3914.74 | 3925.11 | 45 | 45.6 | 2" | 25.6-45.6 | 3/31/16 (11.2) |
| SDMW-2 | Active | 8/28/2007 | 860449.978 | 1359853.948 | 3914.86 | 3928.09 | 42 | 42.5 | 2" | 22.5-42.5 | 4/4/16 (14.2) |
| SDMW-3 | Active | 9/10/2007 | 860205.66 | 1359862.077 | 3914.60 | 3935.14 | 39.5 | 39 | 2" | 19-39 | 4/4/16 (10.3) |
| SDMW-4 | Active | 8/24/2007 | 860219.838 | 1360147.66 | 3914.66 | 3936.10 | 43.5 | 39 | 2" | 19-39 | 5/9/16 (3.9) |
| SDMW-5 | Active | 9/5/2007 | 860448.42 | 1359753.028 | 3918.79 | 3929.86 | 49.5 | 49 | 2" | 29-49 | |
| **Stormwater Tank Wells** | | | | | | | | | | | |
| SP-3 (STP) | Active | 8/16/1991 | 861489.126 | 1358279.768 | 3905.912 | 3905.91 | 27 | 27 | 2" | 17-27 | |
| SP-4 (STP) | Active | 8/16/1991 | 861279.557 | 1358890.11 | 3908.162 | 3908.16 | 30 | 30 | 2" | 20-30 | |
| SP-5 (STP) | Active | 8/19/1991 | 861580.328 | 1358915.02 | 3903.523 | 3903.52 | 27 | 27 | 2" | 17-27 | |
| SC-1 | Active | 11/16/1987 | NA | NA | 3886.10 | 3890.42 | 85 | 85 | 2" | 75-85 | |
| IW-01 | Active | NA | NA | NA | 3888.28 | NA | NA | NA | NA | NA | |
| IW-02 | Active | NA | NA | NA | 3871.08 | NA | NA | NA | NA | NA | |
| **EPA Wells** | | | | | | | | | | | |
| EPA01 | Active | NA | 861046.3449 | 1359565.838 | NA | 3906.76 | NA | NA | NA | NA | 4/11/2016 (9.2) |
| EPA02 | Active | NA | 861040.0035 | 1359602.875 | NA | 3906.33 | NA | NA | NA | NA | 4/11/2016 (9.8) |
| EPA05 | Active | NA | 861103.4421 | 1359723.587 | NA | 3903.99 | NA | NA | NA | NA | 4/18/2016 (7.0) |
| EPA07 | Active | NA | 861085.5812 | 1359702.005 | NA | 3904.38 | NA | NA | NA | NA | 4/18/2016 (10.0) |
| EPA08 | Active | NA | 861041.6397 | 1359588.715 | NA | 3906.50 | NA | NA | NA | NA | 4/11/2016 (9.6) |
| EPA09 | Active | NA | 861051.6551 | 1359585.573 | NA | 3906.37 | NA | NA | NA | NA | 4/11/2016 (9.4) |
| T3A | Active | NA | 861048.4908 | 1359594.908 | NA | 3906.19 | NA | NA | NA | NA | 4/11/2016 (9.7) |
| T3B | Active | NA | 861049.3533 | 1359594.417 | NA | 3906.11 | NA | NA | NA | NA | 4/11/2016 (9.7) |
| T3C | Active | NA | 861050.4069 | 1359593.729 | NA | 3906.15 | NA | NA | NA | NA | 4/11/2016 (9.7) |

NA = not available

# APPENDIX C

# 2017 SURFACE WATER AND GROUNDWATER ELEVATION DATA

# APPENDIX C1

# 2017 SURFACE WATER ELEVATION SURVEY DATA

# 2017 Surface Water Elevation Database -- East Helena Facility

| Site ID | Sample Date | Parameter | Units | Value |
|---|---|---|---|---|
| GP-1 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3794.78 |
| GP-1 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3791.59 |
| GP-1 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3791.64 |
| GP-2 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3788.46 |
| GP-2 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3788.62 |
| GP-3 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3761.73 |
| GP-3 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3761.65 |
| GP-3 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3761.23 |
| GP-4 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3788.48 |
| GP-4 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3783.42 |
| GP-4 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3786.42 |
| GP-5 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3800.20 |
| GP-5 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3799.98 |
| GP-5 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3800.00 |
| GP-5A | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3815.12 |
| GP-5A | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3806.42 |
| GP-5A | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3815.67 |
| PPC-10 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3817.83 |
| PPC-10 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3817.40 |
| PPC-10 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3817.68 |
| PPC-36A | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3854.81 |
| PPC-36A | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3854.47 |
| PPC-36A | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3854.62 |
| PPC-3A | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3927.32 |
| PPC-3A | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3926.83 |
| PPC-3A | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3927.16 |
| PPC-4A | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3910.35 |
| PPC-4A | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3910.04 |
| PPC-4A | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3910.27 |
| PPC-5A | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3900.42 |
| PPC-5A | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3902.09 |
| PPC-5A | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3902.31 |
| PPC-7 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3882.32 |
| PPC-7 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3881.63 |
| PPC-7 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3881.96 |
| PPC-8 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3868.00 |
| PPC-8 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3866.95 |
| PPC-8 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3867.36 |
| PPC-9A | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3845.50 |
| PPC-9A | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3845.14 |
| PPC-9A | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3845.34 |
| SG-16 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3765.99 |
| SG-16 | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3765.47 |
| SG-16 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3765.74 |

## 2017 Surface Water Elevation Database -- East Helena Facility

| Site ID | Sample Date | Parameter | Units | Value |
|---|---|---|---|---|
| Trib-1 | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3917.89 |
| Trib-1 | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3917.78 |
| Trib-1B | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3914.93 |
| Trib-1D | 6/19/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3903.82 |
| Trib-1D | 8/25/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3905.10 |
| Trib-1D | 10/2/2017 | Water Elevation (ft) (Fld) | ft AMSL | 3904.24 |

# APPENDIX C2

# MANUAL GROUNDWATER LEVEL DATA

# 2017 SITE-WIDE MANUAL GROUNDWATER LEVEL MEASUREMENTS

| SiteID | MP Elevation | SWL | | | | | GWE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 |
| **EH-100** | 3889.83 | 31.49 | 31.31 | 31.69 | 31.79 | | 3858.34 | 3858.52 | 3858.14 | 3858.04 | |
| **EH-101** | 3879.95 | 17.10 | 17.02 | 17.84 | 17.46 | 19.41 | 3862.85 | 3862.93 | 3862.11 | 3862.49 | 3860.54 |
| **EH-102** | 3880.45 | 9.23 | 9.07 | 9.26 | 9.04 | 10.16 | 3871.22 | 3871.38 | 3871.19 | 3871.41 | 3870.29 |
| **EH-103** | 3890.54 | 28.84 | 28.56 | 28.91 | 28.92 | 29.48 | 3861.70 | 3861.98 | 3861.63 | 3861.62 | 3861.06 |
| **EH-104** | 3887.83 | 38.46 | 38.51 | 39.16 | 39.50 | | 3849.37 | 3849.32 | 3848.67 | 3848.33 | |
| **EH-106** | 3882.07 | 36.16 | 36.18 | 32.70 | 32.89 | | 3845.91 | 3845.89 | 3849.37 | 3849.18 | |
| **EH-107** | 3880.15 | 25.42 | 25.22 | 25.15 | 25.11 | | 3854.73 | 3854.93 | 3855.00 | 3855.04 | |
| **EH-109** | 3885.67 | 28.57 | 28.50 | 28.83 | 28.97 | | 3857.10 | 3857.17 | 3856.84 | 3856.70 | |
| **EH-110** | 3884.05 | 24.14 | 23.95 | 24.29 | 24.34 | | 3859.91 | 3860.10 | 3859.76 | 3859.71 | |
| **EH-111** | 3876.50 | 32.31 | 32.58 | 33.42 | 34.05 | | 3844.19 | 3843.92 | 3843.08 | 3842.45 | |
| **EH-112** | 3875.78 | 30.09 | 30.45 | No Access | No Access | | 3845.69 | 3845.33 | | | |
| **EH-113** | 3871.34 | 28.95 | 29.55 | 30.76 | 31.60 | | 3842.39 | 3841.79 | 3840.58 | 3839.74 | |
| **EH-114** | 3878.07 | 35.64 | 35.92 | 36.76 | 37.35 | | 3842.43 | 3842.15 | 3841.31 | 3840.72 | |
| **EH-115** | 3883.29 | 38.28 | 38.43 | 39.14 | 39.68 | | 3845.01 | 3844.86 | 3844.15 | 3843.61 | |
| **EH-116** | 3874.52 | 33.04 | 33.43 | 34.45 | 35.08 | | 3841.48 | 3841.09 | 3840.07 | 3839.44 | |
| **EH-117** | 3871.33 | 30.19 | 30.79 | 32.01 | 32.70 | | 3841.14 | 3840.54 | 3839.32 | 3838.63 | |
| **EH-118** | 3879.95 | 39.18 | 39.48 | 40.30 | 40.93 | | 3840.77 | 3840.47 | 3839.65 | 3839.02 | |
| **EH-119** | 3873.75 | 35.82 | 36.25 | 37.12 | 37.74 | | 3837.93 | 3837.50 | 3836.63 | 3836.01 | |
| **EH-120** | 3865.78 | 31.93 | 32.69 | 34.46 | 34.41 | | 3833.85 | 3833.09 | 3831.32 | 3831.37 | |
| **EH-121** | 3869.49 | 29.91 | 30.95 | 33.26 | 32.03 | | 3839.58 | 3838.54 | 3836.23 | 3837.46 | |
| **EH-122** | 3868.08 | 25.84 | 26.95 | 29.43 | 27.79 | | 3842.24 | 3841.13 | 3838.65 | 3840.29 | |
| **EH-123** | 3885.71 | 45.63 | 45.92 | 46.73 | 47.33 | | 3840.08 | 3839.79 | 3838.98 | 3838.38 | |
| **EH-124** | 3874.46 | 39.16 | 39.60 | 40.39 | 40.96 | | 3835.30 | 3834.86 | 3834.07 | 3833.50 | |
| **EH-125** | 3863.22 | 36.82 | 37.51 | 39.51 | 39.24 | | 3826.40 | 3825.71 | 3823.71 | 3823.98 | |
| **EH-126** | 3870.00 | 57.69 | 57.60 | 59.27 | 59.64 | | 3812.31 | 3812.40 | 3810.73 | 3810.36 | |
| **EH-127** | 3860.75 | 31.67 | 32.40 | 34.97 | 31.70 | | 3829.08 | 3828.35 | 3825.78 | 3829.05 | |
| **EH-128** | 3892.17 | Dry | Dry | Dry | Dry | | | | | | |
| **EH-129** | 3870.21 | 58.63 | 58.51 | 60.39 | 60.83 | | 3811.58 | 3811.70 | 3809.82 | 3809.38 | |
| **EH-130** | 3858.55 | 48.31 | 47.83 | 49.53 | 49.17 | | 3810.24 | 3810.72 | 3809.02 | 3809.38 | |
| **EH-131** | 3834.44 | 37.82 | 35.66 | 37.61 | 36.69 | | 3796.62 | 3798.78 | 3796.83 | 3797.75 | |
| **EH-132** | 3893.90 | 61.53 | 61.83 | 63.19 | 63.52 | | 3832.37 | 3832.07 | 3830.71 | 3830.38 | |
| **EH-133** | 3884.36 | 58.13 | 58.38 | 59.78 | 60.04 | | 3826.23 | 3825.98 | 3824.58 | 3824.32 | |
| **EH-134** | 3870.21 | 58.66 | 58.52 | 60.05 | 60.43 | | 3811.55 | 3811.69 | 3810.16 | 3809.78 | |
| **EH-135** | 3852.25 | 31.41 | 31.82 | 34.09 | 32.41 | | 3820.84 | 3820.43 | 3818.16 | 3819.84 | |
| **EH-136** | 3838.59 | 34.26 | 32.99 | 35.17 | 32.77 | | 3804.33 | 3805.60 | 3803.42 | 3805.82 | |
| **EH-137** | 3839.66 | 41.15 | 39.04 | 41.59 | 40.68 | | 3798.51 | 3800.62 | 3798.07 | 3798.98 | |

# 2017 SITE-WIDE MANUAL GROUNDWATER LEVEL MEASUREMENTS

| SiteID | MP Elevation | SWL | | | | | GWE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 |
| **EH-138** | 3839.70 | 49.16 | 46.42 | 48.09 | 48.43 | | 3790.54 | 3793.28 | 3791.61 | 3791.27 | |
| **EH-139** | 3839.78 | 55.29 | 52.64 | 53.08 | 54.11 | | 3784.49 | 3787.14 | 3786.70 | 3785.67 | |
| **EH-140** | 3812.08 | 28.25 | 24.55 | 26.53 | 26.68 | | 3783.83 | 3787.53 | 3785.55 | 3785.40 | |
| **EH-141** | 3813.32 | 35.46 | 31.91 | 33.53 | 33.94 | 34.44 | 3777.86 | 3781.41 | 3779.79 | 3779.38 | 3778.88 |
| **EH-142** | 3804.68 | 35.42 | 32.19 | 33.64 | 33.97 | 34.75 | 3769.26 | 3772.49 | 3771.04 | 3770.71 | 3769.93 |
| **EH-143** | 3803.37 | 36.26 | 33.17 | 34.58 | 34.93 | | 3767.11 | 3770.20 | 3768.79 | 3768.44 | |
| **EH-144D** | 3778.86 | 24.78 | 22.21 | 22.77 | 22.93 | | 3754.08 | 3756.65 | 3756.09 | 3755.93 | |
| **EH-144M** | 3778.95 | 27.33 | 24.89 | 25.34 | 25.44 | | 3751.62 | 3754.06 | 3753.61 | 3753.51 | |
| **EH-144S** | 3778.70 | 28.79 | 26.41 | 26.75 | 26.77 | | 3749.91 | 3752.29 | 3751.95 | 3751.93 | |
| **EH-145D** | 3789.60 | 32.52 | 29.79 | 30.70 | 30.87 | | 3757.08 | 3759.81 | 3758.90 | 3758.73 | |
| **EH-145S** | 3790.09 | 33.49 | 30.80 | 31.69 | 31.87 | | 3756.60 | 3759.29 | 3758.40 | 3758.22 | |
| **EH-206** | 3898.10 | 51.02 | 51.30 | 51.80 | 52.08 | | 3847.08 | 3846.80 | 3846.30 | 3846.02 | |
| **EH-208** | 3910.58 | 58.71 | 59.49 | 60.54 | 60.07 | | 3851.87 | 3851.09 | 3850.04 | 3850.51 | |
| **EH-209** | 3898.34 | 45.83 | 46.43 | 47.35 | 47.13 | | 3852.51 | 3851.91 | 3850.99 | 3851.21 | |
| **EH-50** | 3889.39 | 30.96 | 30.81 | 31.13 | 31.24 | | 3858.43 | 3858.58 | 3858.26 | 3858.15 | |
| **EH-51** | 3880.09 | 16.83 | 16.71 | 17.50 | 17.15 | 19.08 | 3863.26 | 3863.38 | 3862.59 | 3862.94 | 3861.01 |
| **EH-52** | 3880.50 | 7.71 | 7.61 | 8.01 | 7.88 | 8.52 | 3872.79 | 3872.89 | 3872.49 | 3872.62 | 3871.98 |
| **EH-53** | 3872.82 | 29.55 | 30.13 | 31.65 | 32.25 | | 3843.27 | 3842.69 | 3841.17 | 3840.57 | |
| **EH-54** | 3869.66 | 7.36 | 8.62 | 9.96 | 8.21 | | 3862.30 | 3861.04 | 3859.70 | 3861.45 | |
| **EH-57** | 3885.05 | Dry | Dry | Dry | Dry | | | | | | |
| **EH-57A** | 3885.45 | 41.54 | 41.68 | 42.53 | 43.03 | | 3843.91 | 3843.77 | 3842.92 | 3842.42 | |
| **EH-58** | 3888.15 | 14.02 | 13.49 | 13.75 | 13.45 | 14.41 | 3874.13 | 3874.66 | 3874.40 | 3874.70 | 3873.74 |
| **EH-59** | 3876.57 | 8.18 | 7.93 | 8.37 | 8.02 | | 3868.39 | 3868.64 | 3868.20 | 3868.55 | |
| **EH-60** | 3888.46 | 26.61 | 26.28 | 26.70 | 26.67 | 27.23 | 3861.85 | 3862.18 | 3861.76 | 3861.79 | 3861.23 |
| **EH-61** | 3889.77 | 28.27 | 28.00 | 28.37 | 28.36 | | 3861.50 | 3861.77 | 3861.40 | 3861.41 | |
| **EH-62** | 3875.07 | 26.63 | 27.40 | 29.26 | 28.54 | | 3848.44 | 3847.67 | 3845.81 | 3846.53 | |
| **EH-63** | 3878.32 | 21.70 | 21.98 | 23.29 | 22.40 | | 3856.62 | 3856.34 | 3855.03 | 3855.92 | |
| **EH-64** | 3882.67 | 27.77 | 28.06 | 29.61 | 28.88 | | 3854.90 | 3854.61 | 3853.06 | 3853.79 | |
| **EH-65** | 3879.96 | 27.38 | 27.71 | 29.14 | 28.92 | | 3852.58 | 3852.25 | 3850.82 | 3851.04 | |
| **EH-66** | 3869.48 | 29.56 | 30.81 | 32.94 | 31.83 | | 3839.92 | 3838.67 | 3836.54 | 3837.65 | |
| **EH-67** | 3869.46 | 26.71 | 27.80 | 30.24 | 28.89 | | 3842.75 | 3841.66 | 3839.22 | 3840.57 | |
| **EH-68** | 3867.60 | 9.97 | 10.11 | 11.15 | 9.84 | | 3857.63 | 3857.49 | 3856.45 | 3857.76 | |
| **EH-69** | 3869.10 | 20.74 | 20.39 | 20.65 | 20.00 | | 3848.36 | 3848.71 | 3848.45 | 3849.10 | |
| **EH-70** | 3863.48 | 36.05 | 36.81 | 38.77 | 38.70 | | 3827.43 | 3826.67 | 3824.71 | 3824.78 | |
| **EHMW-3** | 3825.45 | 47.25 | 41.34 | 43.29 | 43.57 | | 3778.20 | 3784.11 | 3782.16 | 3781.88 | |
| **EHTW-3** | 3827.66 | 48.25 | 43.91 | 45.80 | 46.34 | | 3779.41 | 3783.75 | 3781.86 | 3781.32 | |

# 2017 SITE-WIDE MANUAL GROUNDWATER LEVEL MEASUREMENTS

| SiteID | MP Elevation | SWL | | | | | GWE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 |
| **PZ-36A** | 3858.96 | 10.00 | Dry | 10.08 | 10.06 | | 3848.96 | | 3848.88 | 3848.90 | |
| **PZ-36B** | 3858.75 | 11.75 | 14.96 | 17.71 | 15.88 | | 3847.00 | 3843.79 | 3841.04 | 3842.87 | |
| **PZ-36C** | 3859.60 | 13.80 | Dry | Dry | Dry | | 3845.80 | | | | |
| **PZ-9A** | 3850.70 | Dry | Dry | Dry | Dry | | | | | | |
| **PZ-9B** | 3849.43 | 13.71 | 15.77 | 18.67 | 19.00 | | 3835.72 | 3833.66 | 3830.76 | 3830.43 | |
| **SC-1** | 3890.42 | 33.91 | 33.97 | 35.32 | 35.42 | | 3856.51 | 3856.45 | 3855.10 | 3855.00 | |
| **ASIW-1** | 3915.99 | 18.45 | 18.50 | 18.98 | 18.84 | | 3897.54 | 3897.49 | 3897.01 | 3897.15 | |
| **ASIW-2** | 3909.13 | 32.41 | 33.42 | 32.66 | 34.00 | | 3876.72 | 3875.71 | 3876.47 | 3875.13 | |
| **DH-1** | 3910.89 | 44.61 | 44.91 | 45.60 | 45.75 | | 3866.28 | 3865.98 | 3865.29 | 3865.14 | |
| **DH-10A** | 3886.97 | 8.83 | 8.61 | 9.68 | 9.65 | 10.37 | 3878.14 | 3878.36 | 3877.29 | 3877.32 | 3876.60 |
| **DH-13** | 3923.91 | 52.01 | 51.76 | 51.83 | 52.07 | | 3871.90 | 3872.15 | 3872.08 | 3871.84 | |
| **DH-14** | 3916.06 | 13.76 | 13.81 | 14.35 | 14.11 | 14.20 | 3902.30 | 3902.25 | 3901.71 | 3901.95 | 3901.86 |
| **DH-15** | 3889.82 | 20.11 | 19.54 | 20.00 | 19.98 | | 3869.71 | 3870.28 | 3869.82 | 3869.84 | |
| **DH-17** | 3917.56 | 50.02 | 49.69 | 49.90 | 50.03 | 50.50 | 3867.54 | 3867.87 | 3867.66 | 3867.53 | 3867.06 |
| **DH-18** | 3924.93 | 49.92 | 49.92 | 50.28 | 50.43 | | 3875.01 | 3875.01 | 3874.65 | 3874.50 | |
| **DH-2** | 3936.91 | 63.91 | 64.02 | Dry | Dry | | 3873.00 | 3872.89 | | | |
| **DH-20** | 3927.09 | 18.15 | 18.39 | 19.53 | 18.95 | 18.46 | 3908.94 | 3908.70 | 3907.56 | 3908.14 | 3908.63 |
| **DH-22** | 3948.63 | Dry | Dry | Dry | Dry | | | | | | |
| **DH-23** | 3931.82 | Dry | Dry | Dry | Dry | Dry | | | | | |
| **DH-24** | 3899.59 | Dry | 34.28 | Dry | Dry | | | 3865.31 | | | |
| **DH-27** | 3946.21 | 55.17 | 55.18 | 55.19 | 55.47 | | 3891.04 | 3891.03 | 3891.02 | 3890.74 | |
| **DH-3** | 3947.48 | 31.27 | 31.61 | 33.19 | 32.27 | 31.84 | 3916.21 | 3915.87 | 3914.29 | 3915.21 | 3915.64 |
| **DH-30** | 3943.24 | 51.75 | 51.38 | 51.33 | 51.58 | | 3891.49 | 3891.86 | 3891.91 | 3891.66 | |
| **DH-36** | 3920.66 | Dry | Dry | Dry | Dry | | | | | | |
| **DH-4** | 3917.26 | 14.85 | 14.88 | 15.42 | 15.17 | 15.19 | 3902.41 | 3902.38 | 3901.84 | 3902.09 | 3902.07 |
| **DH-42** | 3942.63 | 48.90 | 49.06 | 49.20 | Dry | | 3893.73 | 3893.57 | 3893.43 | | |
| **DH-47** | 3926.82 | 21.08 | 21.27 | 21.90 | Dry | 22.27 | 3905.74 | 3905.55 | 3904.92 | | 3904.55 |
| **DH-48** | 3905.96 | Dry | Dry | Dry | Dry | | | | | | |
| **DH-5** | 3921.18 | Dry | 17.85 | Dry | Dry | | | 3903.33 | | | |
| **DH-50** | 3904.76 | Dry | Dry | Dry | Dry | | | | | | |
| **DH-51** | 3904.34 | Dry | Dry | Dry | Dry | | | | | | |
| **DH-52** | 3889.18 | 6.72 | 6.72 | 7.53 | 7.39 | 7.79 | 3882.46 | 3882.46 | 3881.65 | 3881.79 | 3881.39 |
| **DH-53** | 3892.87 | 9.11 | 9.28 | 10.12 | 9.88 | 10.19 | 3883.76 | 3883.59 | 3882.75 | 3882.99 | 3882.68 |
| **DH-54** | 3890.27 | 27.54 | 27.07 | 27.44 | 27.43 | | 3862.73 | 3863.20 | 3862.83 | 3862.84 | |
| **DH-55** | 3972.76 | 80.42 | 80.14 | 81.81 | 80.70 | 80.98 | 3892.34 | 3892.62 | 3890.95 | 3892.06 | 3891.78 |
| **DH-56** | 3958.17 | 84.61 | 83.93 | 84.42 | 84.57 | 85.13 | 3873.56 | 3874.24 | 3873.75 | 3873.60 | 3873.04 |

# 2017 SITE-WIDE MANUAL GROUNDWATER LEVEL MEASUREMENTS

| SiteID | MP Elevation | SWL | | | | | GWE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 |
| **DH-57** | 3929.53 | Dry | Dry | Dry | Dry | | | | | | |
| **DH-58** | 3919.33 | 44.51 | 44.05 | 44.07 | 44.39 | | 3874.82 | 3875.28 | 3875.26 | 3874.94 | |
| **DH-59** | 3937.44 | 45.24 | 43.98 | 44.06 | 44.29 | 45.80 | 3892.20 | 3893.46 | 3893.38 | 3893.15 | 3891.64 |
| **DH-5A** | 3921.92 | 18.84 | 18.51 | Dry | Dry | | 3903.08 | 3903.41 | | | |
| **DH-6** | 3889.85 | 20.15 | 19.53 | 20.00 | 20.00 | 20.17 | 3869.70 | 3870.32 | 3869.85 | 3869.85 | 3869.68 |
| **DH-61** | 3926.84 | Dry | Dry | Dry | Dry | | | | | | |
| **DH-62** | 3926.95 | 57.49 | 57.52 | 58.12 | 58.19 | 58.30 | 3869.46 | 3869.43 | 3868.83 | 3868.76 | 3868.65 |
| **DH-63** | 3905.37 | Dry | 41.43 | Dry | Dry | | | 3863.94 | | | |
| **DH-64** | 3904.02 | 38.71 | 38.44 | 38.68 | 38.70 | | 3865.31 | 3865.58 | 3865.34 | 3865.32 | |
| **DH-65** | 3945.85 | 63.11 | 62.78 | 63.85 | 63.59 | 64.07 | 3882.74 | 3883.07 | 3882.00 | 3882.26 | 3881.78 |
| **DH-66** | 3919.28 | 52.95 | 52.68 | 52.87 | 52.98 | 53.43 | 3866.33 | 3866.60 | 3866.41 | 3866.30 | 3865.85 |
| **DH-67** | 3899.77 | 36.83 | 36.63 | 36.92 | 36.91 | | 3862.94 | 3863.14 | 3862.85 | 3862.86 | |
| **DH-68** | 3943.28 | 44.48 | 44.36 | 45.01 | 44.72 | 44.86 | 3898.80 | 3898.92 | 3898.27 | 3898.56 | 3898.42 |
| **DH-69** | 3934.40 | 35.89 | 35.80 | 36.38 | 36.14 | | 3898.51 | 3898.60 | 3898.02 | 3898.35 | |
| **DH-7** | 3898.66 | 15.74 | 15.53 | 15.95 | 15.58 | | 3882.92 | 3883.13 | 3882.71 | 3883.08 | |
| **DH-70** | 3933.91 | 33.90 | 33.95 | 34.41 | 34.26 | | 3900.01 | 3899.96 | 3899.50 | 3899.65 | |
| **DH-71** | 3944.88 | 53.81 | 56.38 | 56.40 | Dry | | 3891.07 | 3888.50 | 3888.48 | | |
| **DH-72** | 3939.67 | 43.98 | 44.08 | 44.31 | 44.40 | 44.45 | 3895.69 | 3895.59 | 3895.36 | 3895.27 | 3895.22 |
| **DH-73** | 3918.08 | 40.20 | 39.63 | 39.75 | 40.15 | | 3877.88 | 3878.45 | 3878.33 | 3877.93 | |
| **DH-74** | 4001.49 | 119.25 | 118.30 | 119.46 | 119.51 | 120.07 | 3882.24 | 3883.19 | 3882.03 | 3881.98 | 3881.42 |
| **DH-75** | 4001.55 | 119.43 | 118.86 | 119.90 | 119.98 | 120.47 | 3882.12 | 3882.69 | 3881.65 | 3881.57 | 3881.08 |
| **DH-76** | 3994.28 | 98.83 | 98.73 | 99.21 | 99.09 | 99.21 | 3895.45 | 3895.55 | 3895.07 | 3895.19 | 3895.07 |
| **DH-77** | 3932.20 | 53.82 | 53.82 | 53.85 | 53.92 | | 3878.38 | 3878.38 | 3878.35 | 3878.28 | |
| **DH-78** | 3921.12 | 53.38 | 53.28 | Dry | Dry | | 3867.74 | 3867.84 | | | |
| **DH-79** | 3928.80 | 55.13 | 54.87 | 54.83 | 55.10 | | 3873.67 | 3873.93 | 3873.97 | 3873.70 | |
| **DH-80** | 3942.36 | 49.23 | 49.35 | 49.45 | 49.68 | | 3893.13 | 3893.01 | 3892.91 | 3892.68 | |
| **DH-82** | 3908.18 | 43.95 | 43.72 | 43.98 | 43.96 | | 3864.23 | 3864.46 | 3864.20 | 3864.22 | |
| **DH-83** | 3922.14 | 52.73 | 52.68 | 52.87 | 53.00 | | 3869.41 | 3869.46 | 3869.27 | 3869.14 | |
| **DH-8** | 3923.38 | 51.87 | 51.90 | 52.12 | 52.23 | | 3871.51 | 3871.48 | 3871.26 | 3871.15 | |
| **DH-9** | 3918.08 | Dry | Dry | Dry | Dry | | | | | | |
| **East-PZ-1** | 3911.93 | 23.20 | 23.01 | 23.15 | 23.08 | | 3888.73 | 3888.92 | 3888.78 | 3888.85 | |
| **East-PZ-2** | 3924.58 | 23.91 | 23.99 | 24.33 | 24.20 | 24.51 | 3900.67 | 3900.59 | 3900.25 | 3900.38 | 3900.07 |
| **East-PZ-4** | 3935.66 | 20.54 | 20.62 | 20.77 | 20.64 | | 3915.12 | 3915.04 | 3914.89 | 3915.02 | |
| **East-PZ-6** | 3943.83 | 24.25 | 24.34 | 24.42 | 24.32 | 24.42 | 3919.58 | 3919.49 | 3919.41 | 3919.51 | 3919.41 |
| **East-PZ-7** | 3928.83 | 18.51 | 18.60 | 18.74 | 18.63 | 18.67 | 3910.32 | 3910.23 | 3910.09 | 3910.20 | 3910.16 |
| **EH-200** | 3953.33 | 29.10 | 28.78 | 28.81 | 28.58 | | 3924.23 | 3924.55 | 3924.52 | 3924.75 | |

# 2017 SITE-WIDE MANUAL GROUNDWATER LEVEL MEASUREMENTS

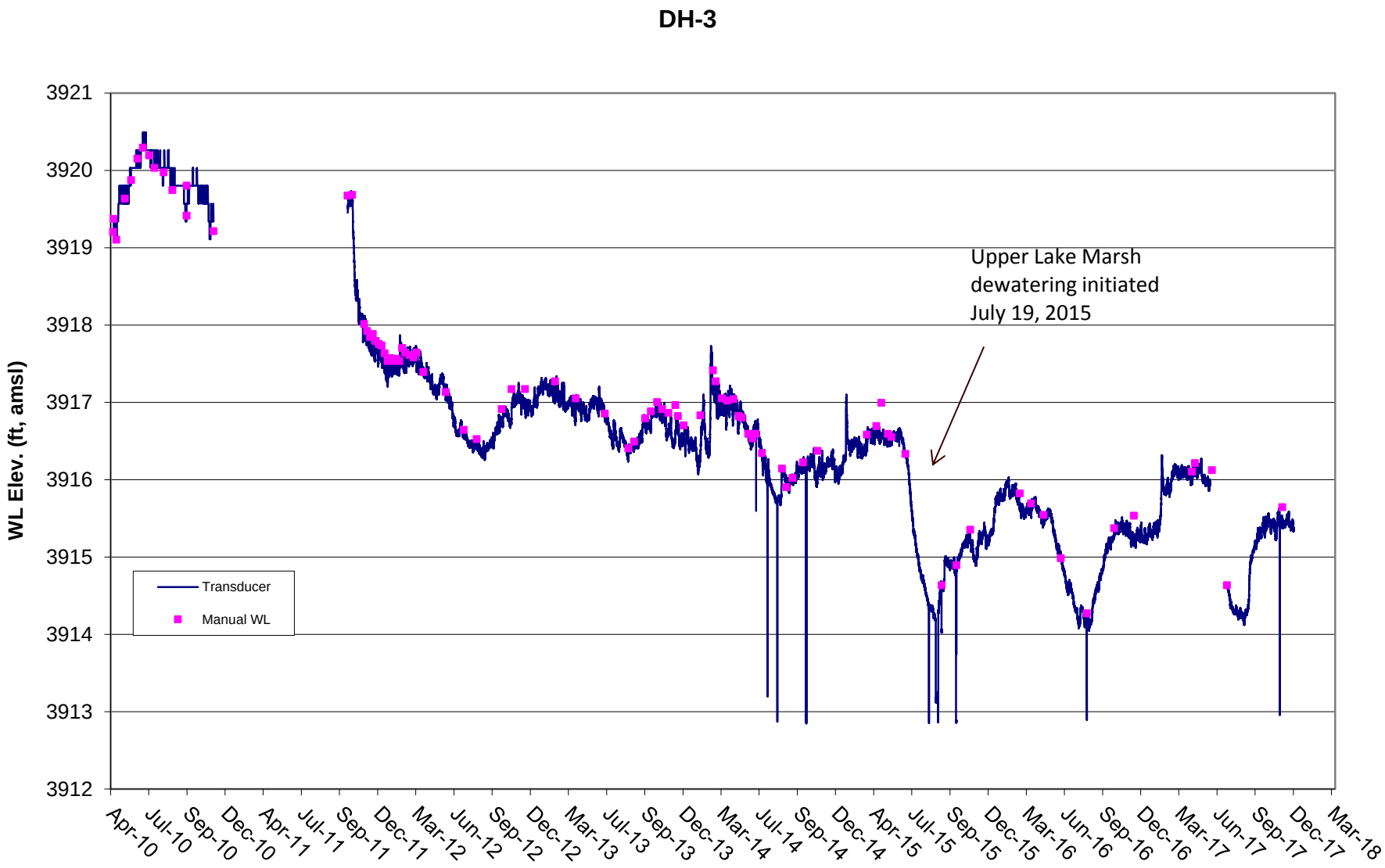
| SiteID | MP Elevation | SWL | | | | | GWE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 |
| **EH-201** | 3973.48 | 97.43 | 97.45 | 97.41 | 97.29 | | 3876.05 | 3876.03 | 3876.07 | 3876.19 | |
| **EH-202** | 3930.56 | 66.92 | 67.20 | 68.20 | 68.15 | | 3863.64 | 3863.36 | 3862.36 | 3862.41 | |
| **EH-203** | 4003.92 | 106.48 | 106.69 | 106.66 | 106.69 | | 3897.44 | 3897.23 | 3897.26 | 3897.23 | |
| **EH-204** | 3925.69 | 57.64 | 58.83 | 58.16 | 58.29 | | 3868.05 | 3866.86 | 3867.53 | 3867.40 | |
| **EH-205** | 3900.66 | Dry | 36.62 | Dry | Dry | | | 3864.04 | | | |
| **EH-210** | 3901.19 | 38.86 | 39.11 | 40.17 | 40.58 | | 3862.33 | 3862.08 | 3861.02 | 3860.61 | |
| **EH-211** | 3905.75 | 51.49 | 51.71 | 51.85 | 51.91 | | 3854.26 | 3854.04 | 3853.90 | 3853.84 | |
| **EH-212** | 3905.90 | 51.60 | 51.80 | 51.94 | 52.03 | | 3854.30 | 3854.10 | 3853.96 | 3853.87 | |
| **MW-1** | 3953.05 | 54.27 | 54.45 | 54.48 | 54.56 | | 3898.78 | 3898.60 | 3898.57 | 3898.49 | |
| **MW-10** | 3946.28 | 46.19 | 46.41 | 46.76 | 46.74 | | 3900.09 | 3899.87 | 3899.52 | 3899.54 | |
| **MW-11** | 3973.33 | 64.40 | 64.52 | 64.52 | 64.57 | 64.45 | 3908.93 | 3908.81 | 3908.81 | 3908.76 | 3908.88 |
| **MW-2** | 3945.97 | 40.50 | 40.73 | 41.13 | 40.97 | | 3905.47 | 3905.24 | 3904.84 | 3905.00 | |
| **MW-3** | 3940.95 | 35.78 | 36.02 | 36.42 | 36.32 | | 3905.17 | 3904.93 | 3904.53 | 3904.63 | |
| **MW-4** | 3947.06 | 50.56 | 50.73 | 50.83 | 50.88 | 51.14 | 3896.50 | 3896.33 | 3896.23 | 3896.18 | 3895.92 |
| **MW-5** | 3956.18 | 55.50 | 55.66 | 55.77 | 55.82 | | 3900.68 | 3900.52 | 3900.41 | 3900.36 | |
| **MW-6** | 3938.14 | 32.27 | 32.49 | 33.04 | 32.87 | 32.70 | 3905.87 | 3905.65 | 3905.10 | 3905.27 | 3905.44 |
| **MW-7** | 3963.67 | 58.15 | 58.32 | 58.30 | Dry | | 3905.52 | 3905.35 | 3905.37 | | |
| **MW-8** | 3958.65 | 54.01 | 54.28 | 54.44 | 54.53 | 54.63 | 3904.64 | 3904.37 | 3904.21 | 3904.12 | 3904.02 |
| **MW-9** | 3959.01 | 53.31 | 53.46 | 53.46 | 53.15 | | 3905.70 | 3905.55 | 3905.55 | 3905.86 | |
| **PBTW-1** | 3914.59 | 47.31 | 47.00 | 47.20 | 47.31 | | 3867.28 | 3867.59 | 3867.39 | 3867.28 | |
| **PBTW-2** | 3906.73 | 39.98 | 39.68 | 39.90 | 40.01 | | 3866.75 | 3867.05 | 3866.83 | 3866.72 | |
| **PRB-1** | 3918.37 | 51.42 | 51.15 | 51.37 | 51.49 | | 3866.95 | 3867.22 | 3867.00 | 3866.88 | |
| **PRB-2** | 3905.34 | 37.90 | 37.53 | 37.74 | NM | | 3867.44 | 3867.81 | 3867.60 | | |
| **PRB-3** | 3919.19 | 52.45 | 52.14 | 52.33 | 52.49 | | 3866.74 | 3867.05 | 3866.86 | 3866.70 | |
| **SDMW-1** | 3925.11 | 52.08 | 51.77 | 51.74 | 52.01 | | 3873.03 | 3873.34 | 3873.37 | 3873.10 | |
| **SDMW-2** | 3928.09 | 54.34 | 54.14 | 54.20 | 54.40 | | 3873.75 | 3873.95 | 3873.89 | 3873.69 | |
| **SDMW-3** | 3935.14 | 53.04 | 53.04 | 53.08 | 53.18 | | 3882.10 | 3882.10 | 3882.06 | 3881.96 | |
| **SDMW-4** | 3936.10 | 51.58 | 51.47 | 51.20 | 51.51 | | 3884.52 | 3884.63 | 3884.90 | 3884.59 | |
| **SDMW-5** | 3929.86 | 54.94 | 54.84 | 54.90 | 55.03 | | 3874.92 | 3875.02 | 3874.96 | 3874.83 | |
| **TW-1** | 3930.10 | 52.38 | 51.68 | 51.48 | 51.73 | | 3877.72 | 3878.42 | 3878.62 | 3878.37 | |
| **TW-2** | 3931.44 | 53.42 | 53.31 | 53.36 | 53.62 | | 3878.02 | 3878.13 | 3878.08 | 3877.82 | |
| **SP-3** | 3905.91 | Dry | Dry | Dry | Dry | | | | | | |
| **SP-4** | 3908.16 | Dry | Dry | Dry | Dry | | | | | | |
| **SP-5** | 3903.52 | Dry | Dry | Dry | Dry | | | | | | |
| **ULM-PZ-1** | 3924.40 | 5.49 | 5.88 | 7.06 | Dry | | 3918.91 | 3918.52 | 3917.34 | | |
| **PPCRPZ-02** | 3919.76 | 7.47 | 7.52 | 8.25 | 8.01 | | 3912.29 | 3912.24 | 3911.51 | 3911.75 | |

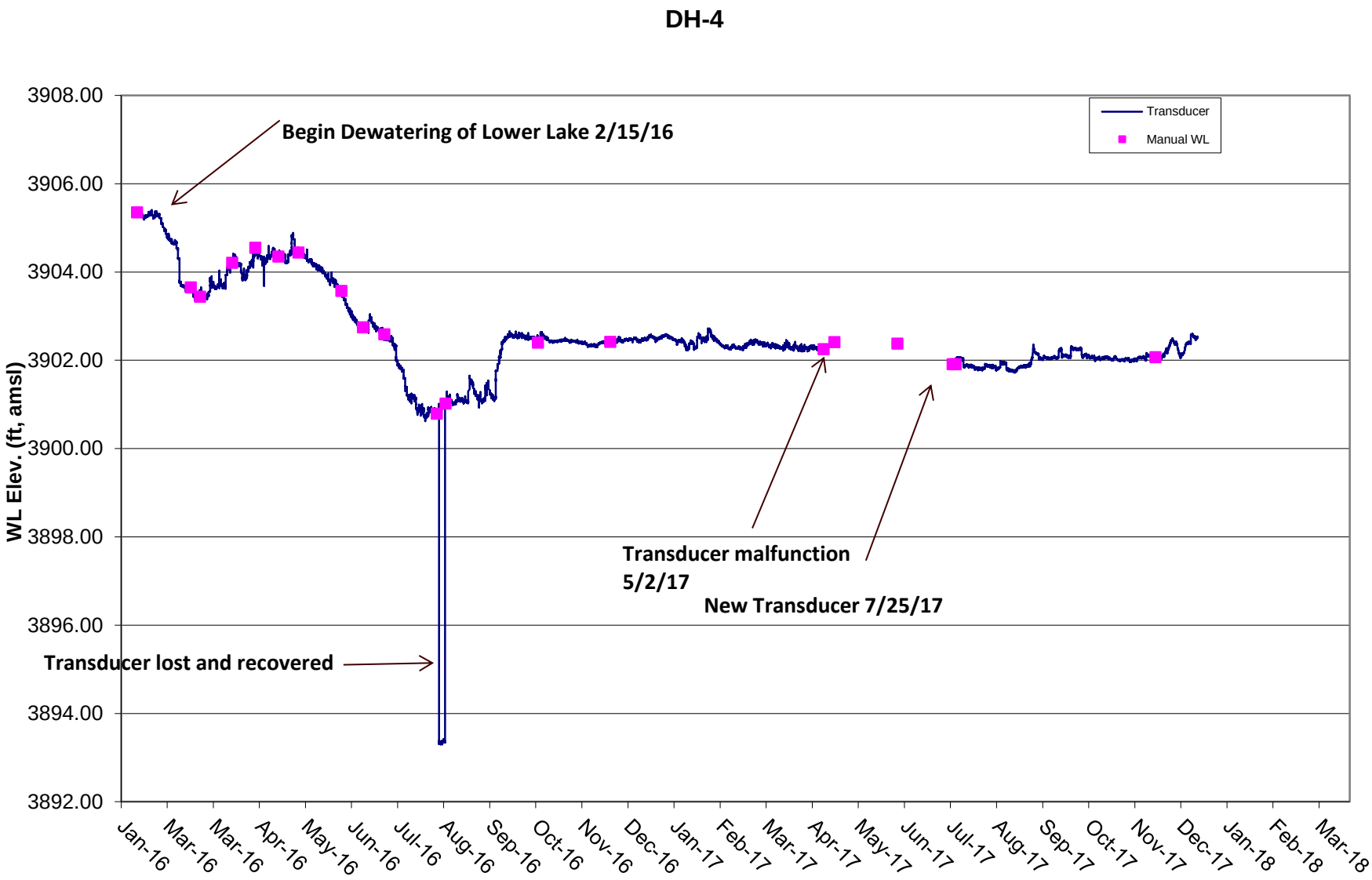
# 2017 SITE-WIDE MANUAL GROUNDWATER LEVEL MEASUREMENTS

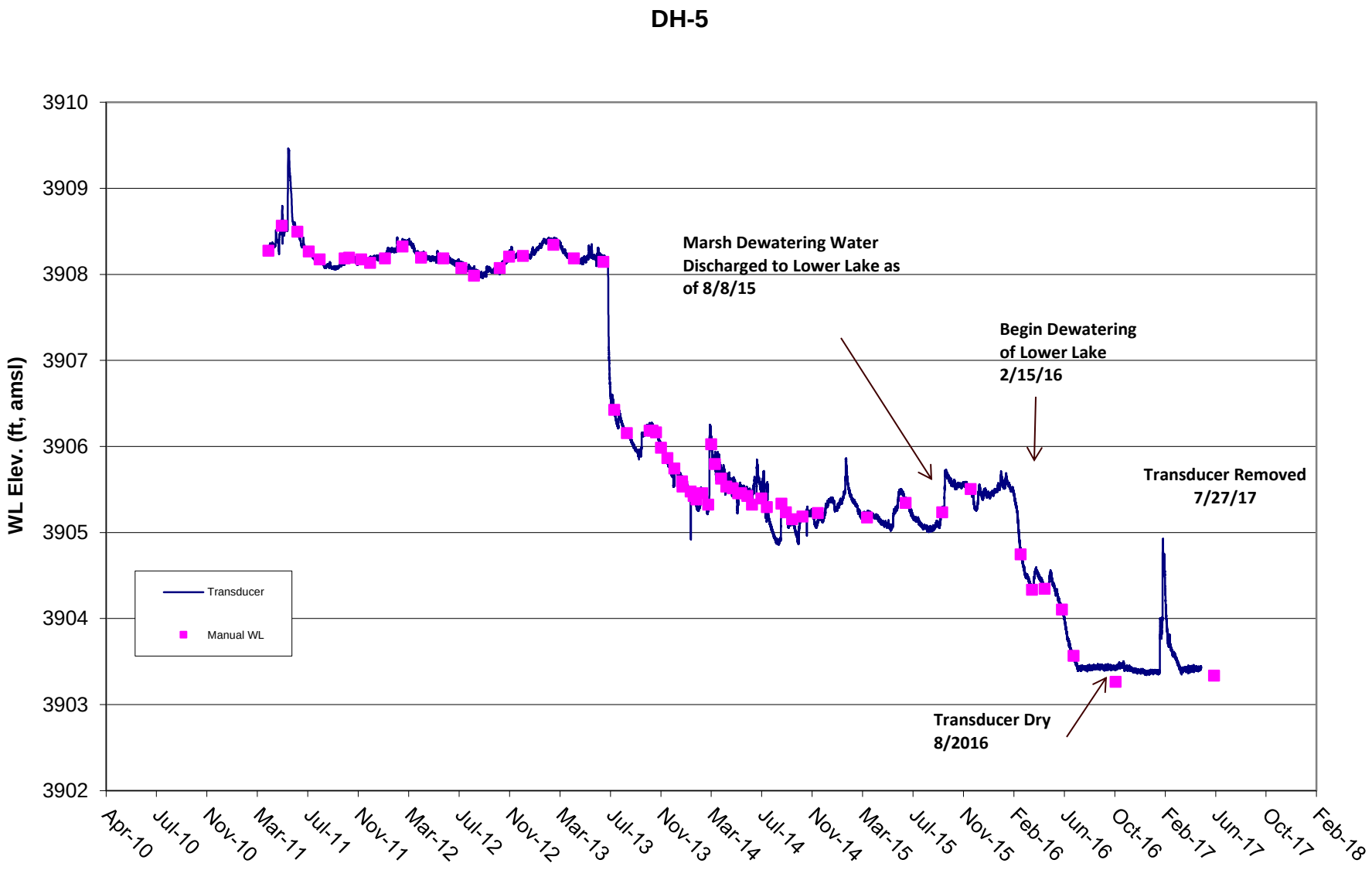
| SiteID | MP Elevation | SWL | | | | | GWE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 | May-17 | Jun-17 | Aug-17 | Oct-17 | Dec-17 |
| **ULTP-1** | 3919.63 | No Meas. | 4.99 | 6.44 | 5.74 | | | 3914.64 | 3913.19 | 3913.89 | |
| **ULTP-2** | 3921.23 | 6.75 | 7.14 | 9.06 | 8.15 | | 3914.48 | 3914.09 | 3912.17 | 3913.08 | |
| **PVC Piezo** | ? | 5.89 | 6.28 | Dry | Dry | | | | | | |
| **IW-01** | 3888.28 | 66.55 | 66.73 | 67.16 | 67.30 | | 3821.73 | 3821.55 | 3821.12 | 3820.98 | |
| **IW-02** | 3871.08 | 53.20 | 53.31 | 53.36 | 53.58 | | 3817.88 | 3817.77 | 3817.72 | 3817.50 | |

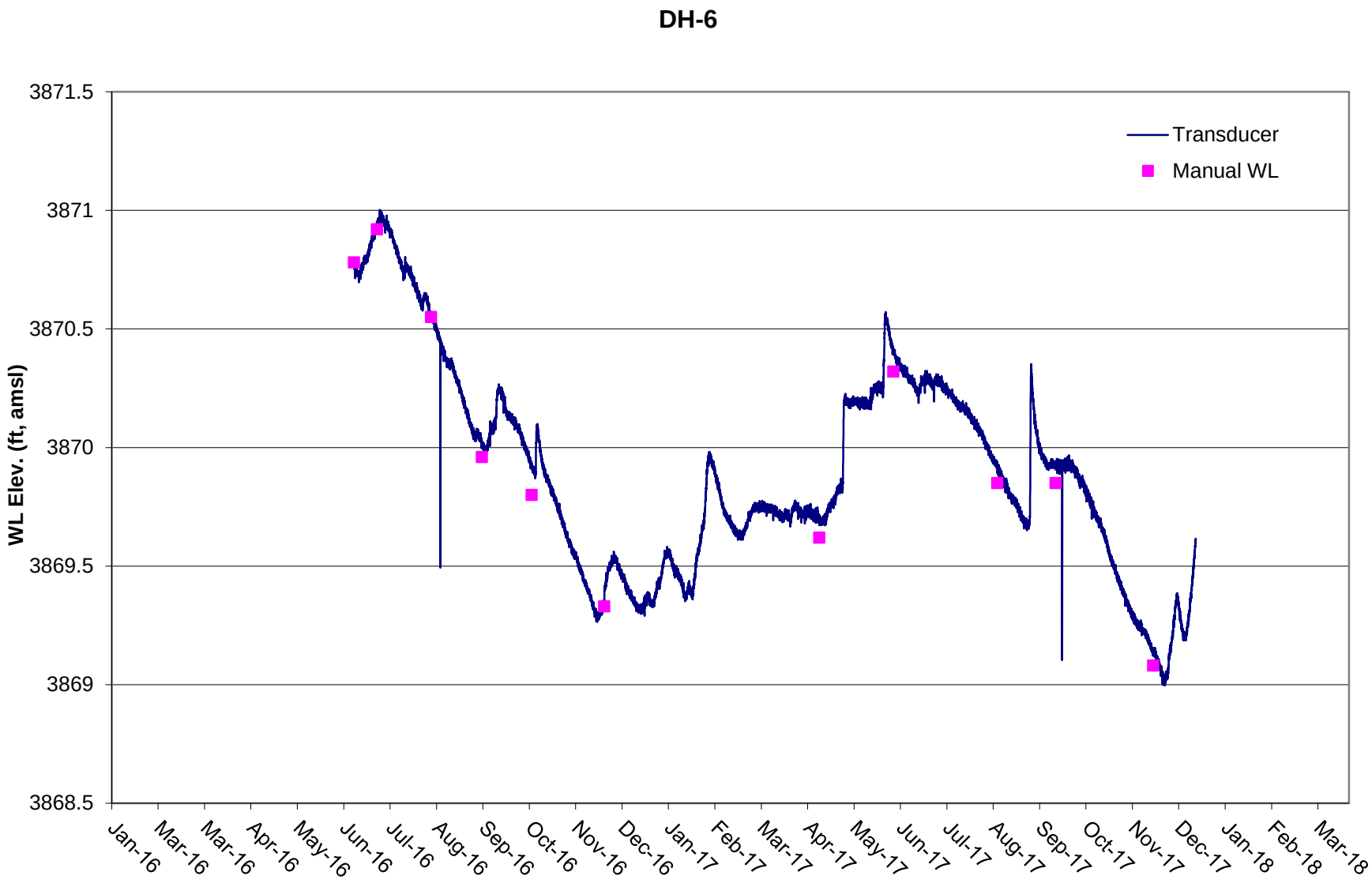
# APPENDIX C3

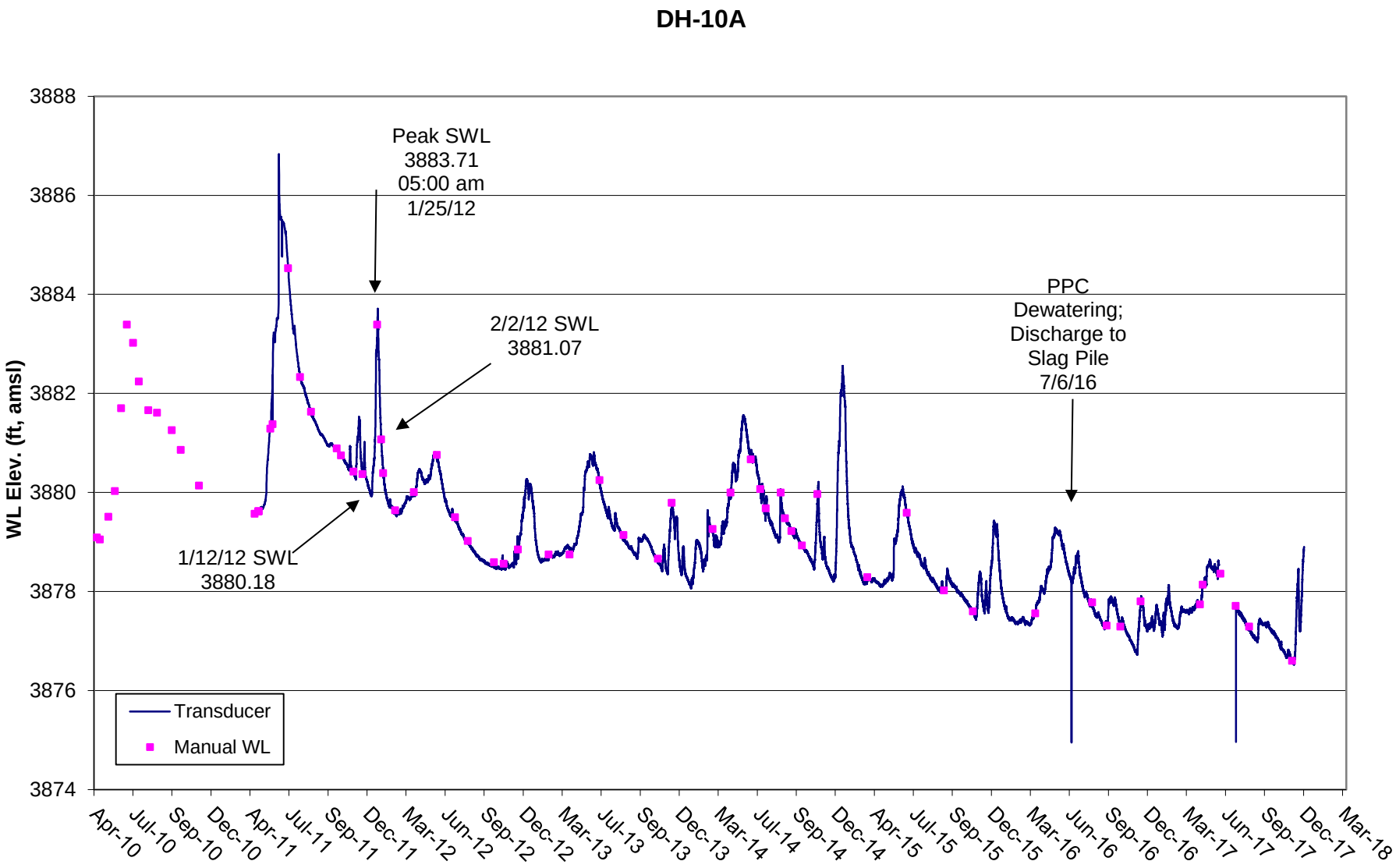
# CONTINUOUS GROUNDWATER LEVEL HYDROGRAPHS FROM TRANSDUCER-INSTRUMENTED WELLS

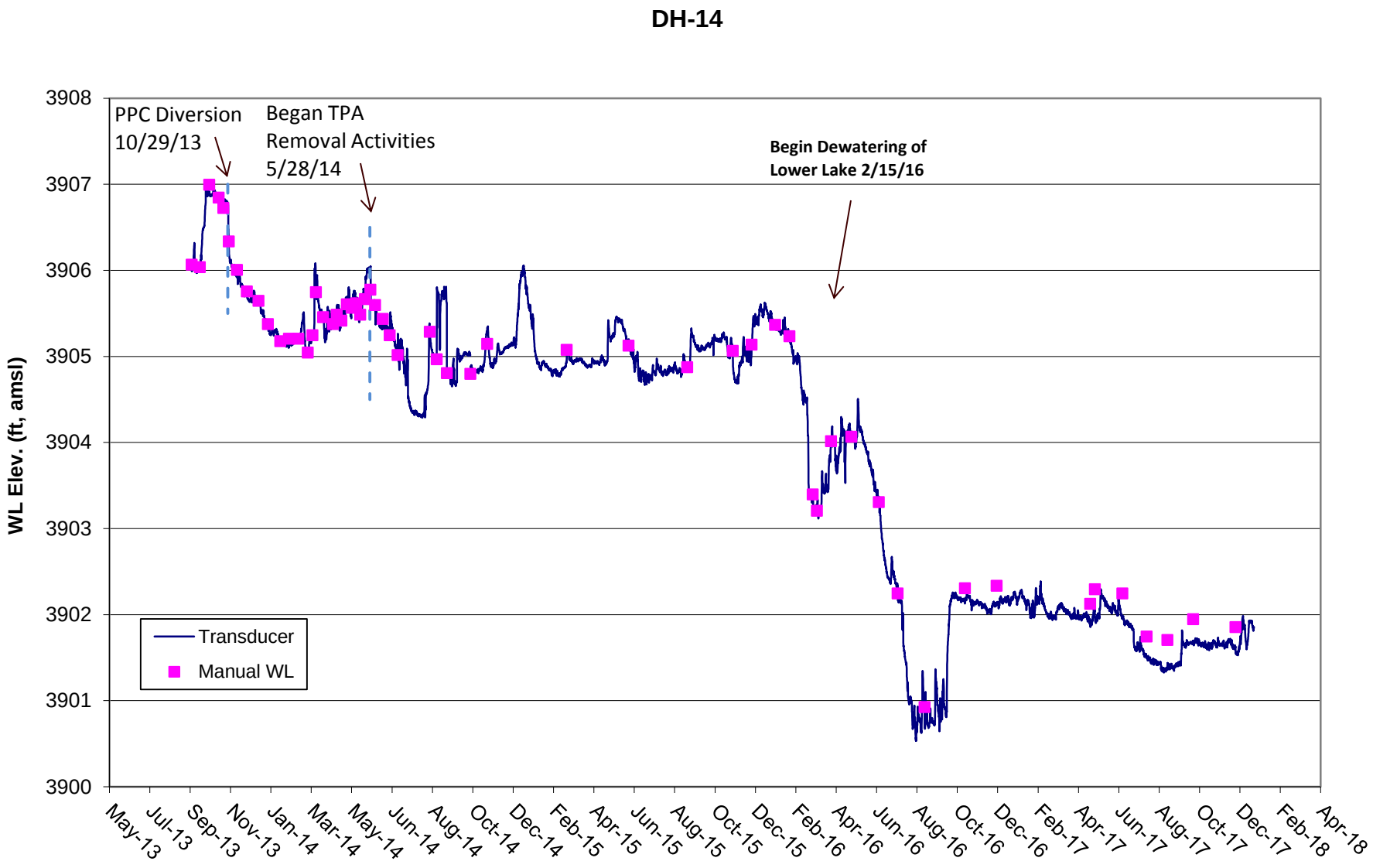

DH-3
WL Elev. (ft, amsl)
3921
3920
3919
3918
3917
3916
3915
3914
3913
3912
Apr-10
Jul-10
Sep-10
Dec-10
Apr-11
Jul-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jul-13
Sep-13
Dec-13
Mar-14
Jul-14
Sep-14
Dec-14
Apr-15
Jul-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Upper Lake Marsh
dewatering initiated
July 19, 2015
Transducer
Manual WL

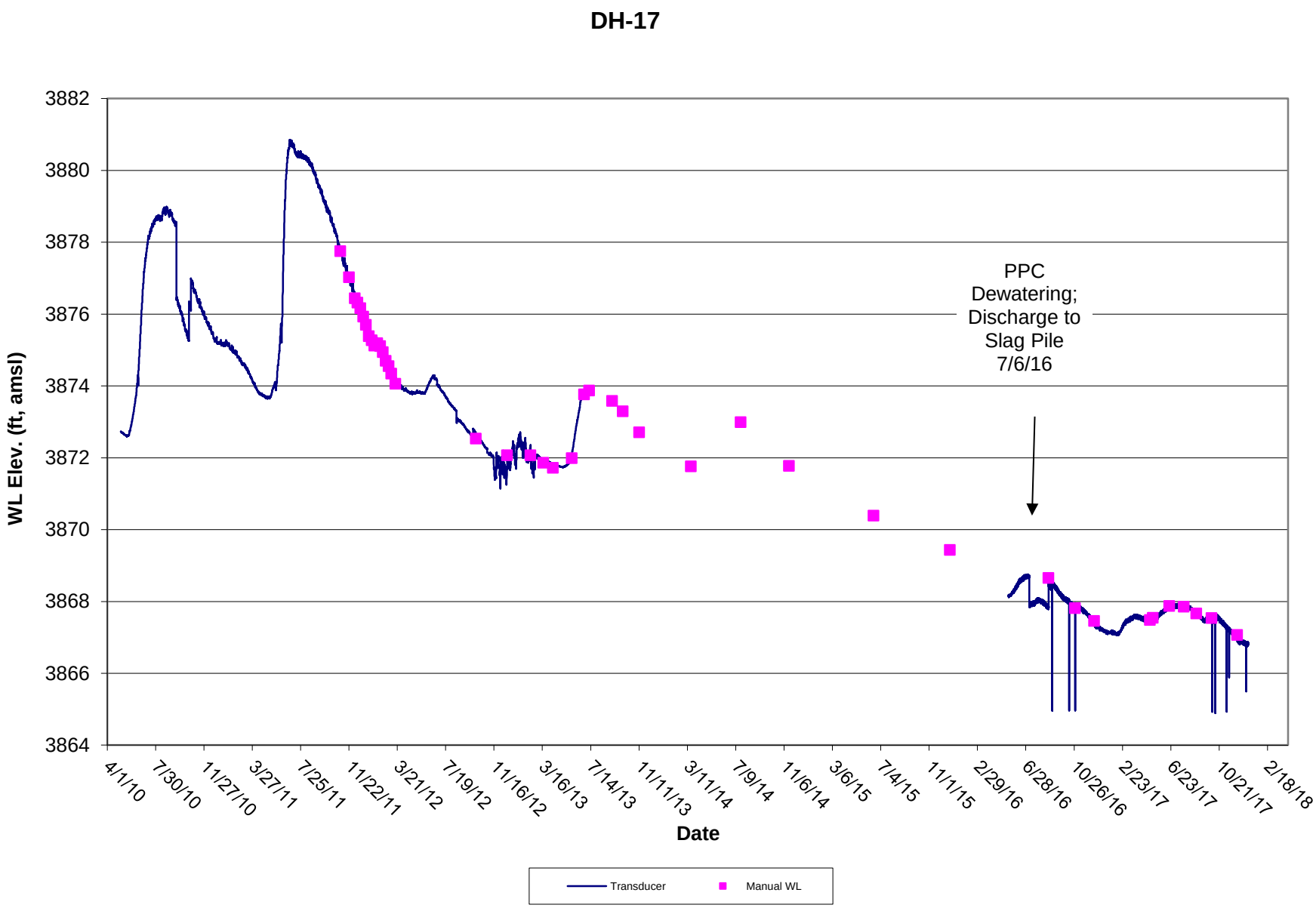

DH-4
Transducer
Manual WL
Begin Dewatering of Lower Lake 2/15/16
Transducer malfunction
5/2/17
New Transducer 7/25/17
Transducer lost and recovered
WL Elev. (ft, amsl)
3908.00
3906.00
3904.00
3902.00
3900.00
3898.00
3896.00
3894.00
3892.00
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

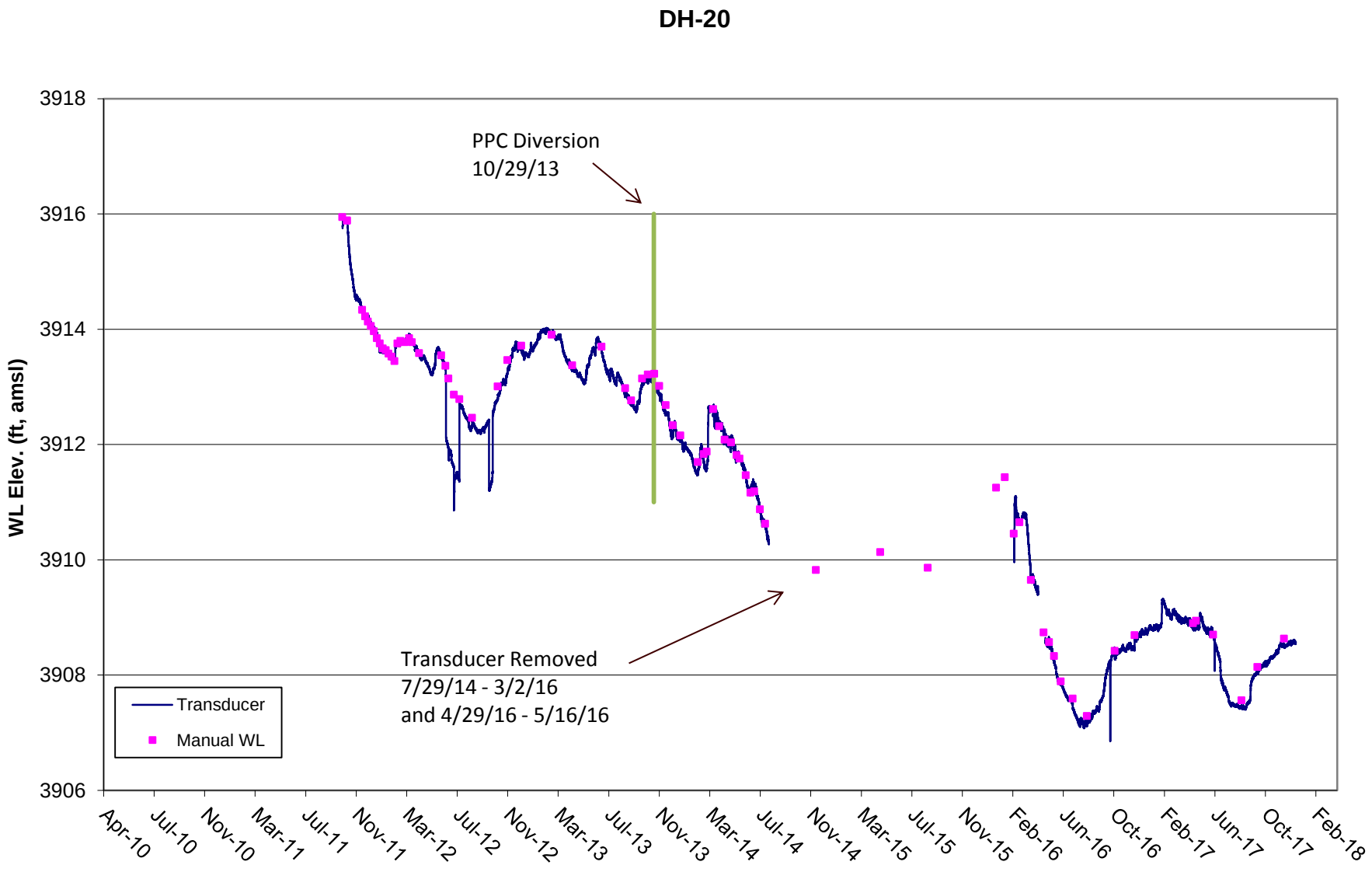

DH-5
WL Elev. (ft, amsl)
3910
3909
3908
3907
3906
3905
3904
3903
3902
Apr-10
Jul-10
Nov-10
Mar-11
Jul-11
Nov-11
Mar-12
Jul-12
Nov-12
Mar-13
Jul-13
Nov-13
Mar-14
Jul-14
Nov-14
Mar-15
Jul-15
Nov-15
Feb-16
Jun-16
Oct-16
Feb-17
Jun-17
Oct-17
Feb-18
Transducer
Manual WL
Marsh Dewatering Water Discharged to Lower Lake as of 8/8/15
Begin Dewatering of Lower Lake 2/15/16
Transducer Removed 7/27/17
Transducer Dry 8/2016

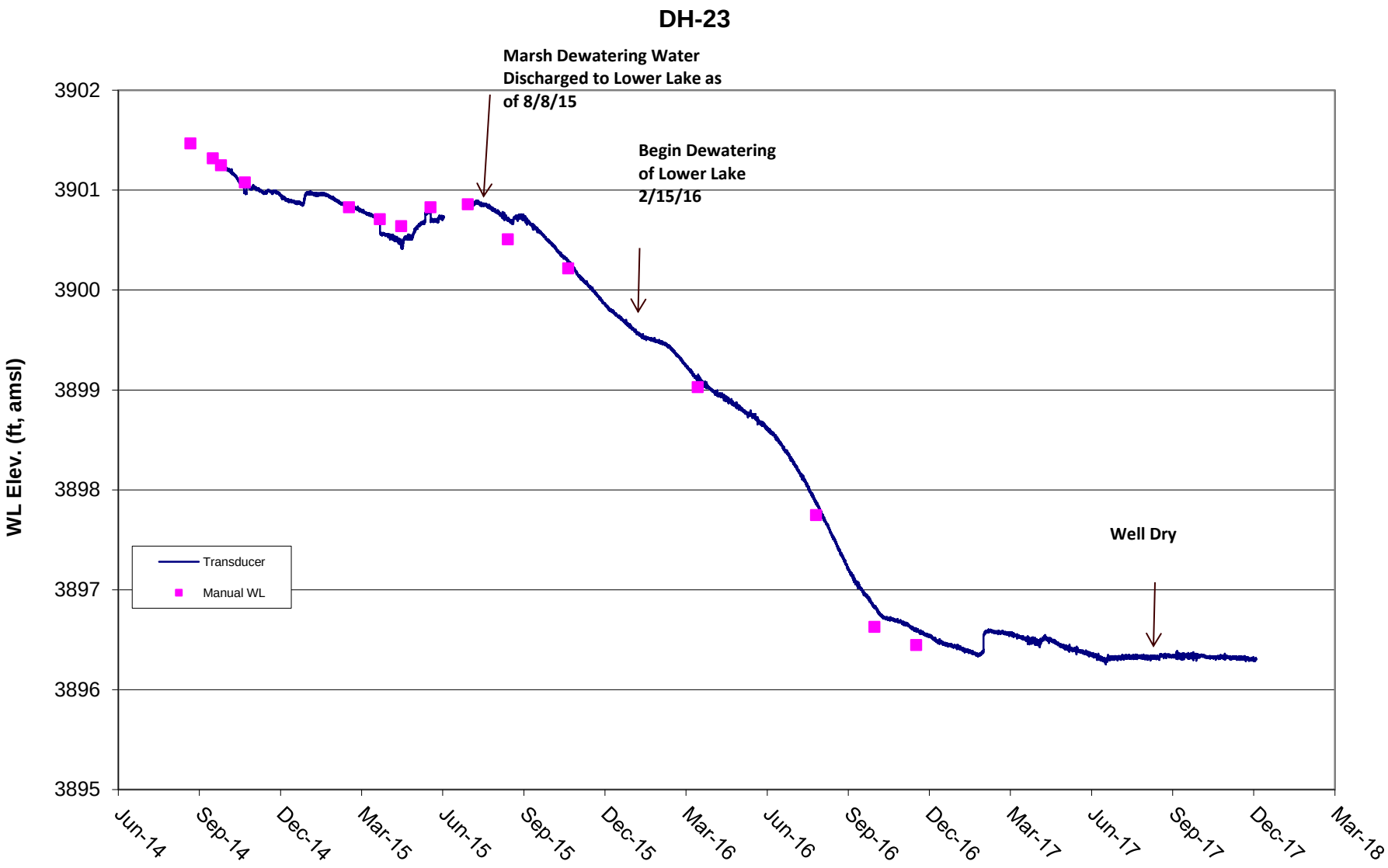

DH-6
Transducer
Manual WL
WL Elev. (ft, amsl)
3871.5
3871
3870.5
3870
3869.5
3869
3868.5
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18


DH-10A
WL Elev. (ft, amsl)
3888
3886
3884
3882
3880
3878
3876
3874
Peak SWL
3883.71
05:00 am
1/25/12
2/2/12 SWL
3881.07
PPC
Dewatering;
Discharge to
Slag Pile
7/6/16
1/12/12 SWL
3880.18
Transducer
Manual WL
Apr-10
Jul-10
Sep-10
Dec-10
Apr-11
Jul-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jul-13
Sep-13
Dec-13
Mar-14
Jul-14
Sep-14
Dec-14
Apr-15
Jul-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18

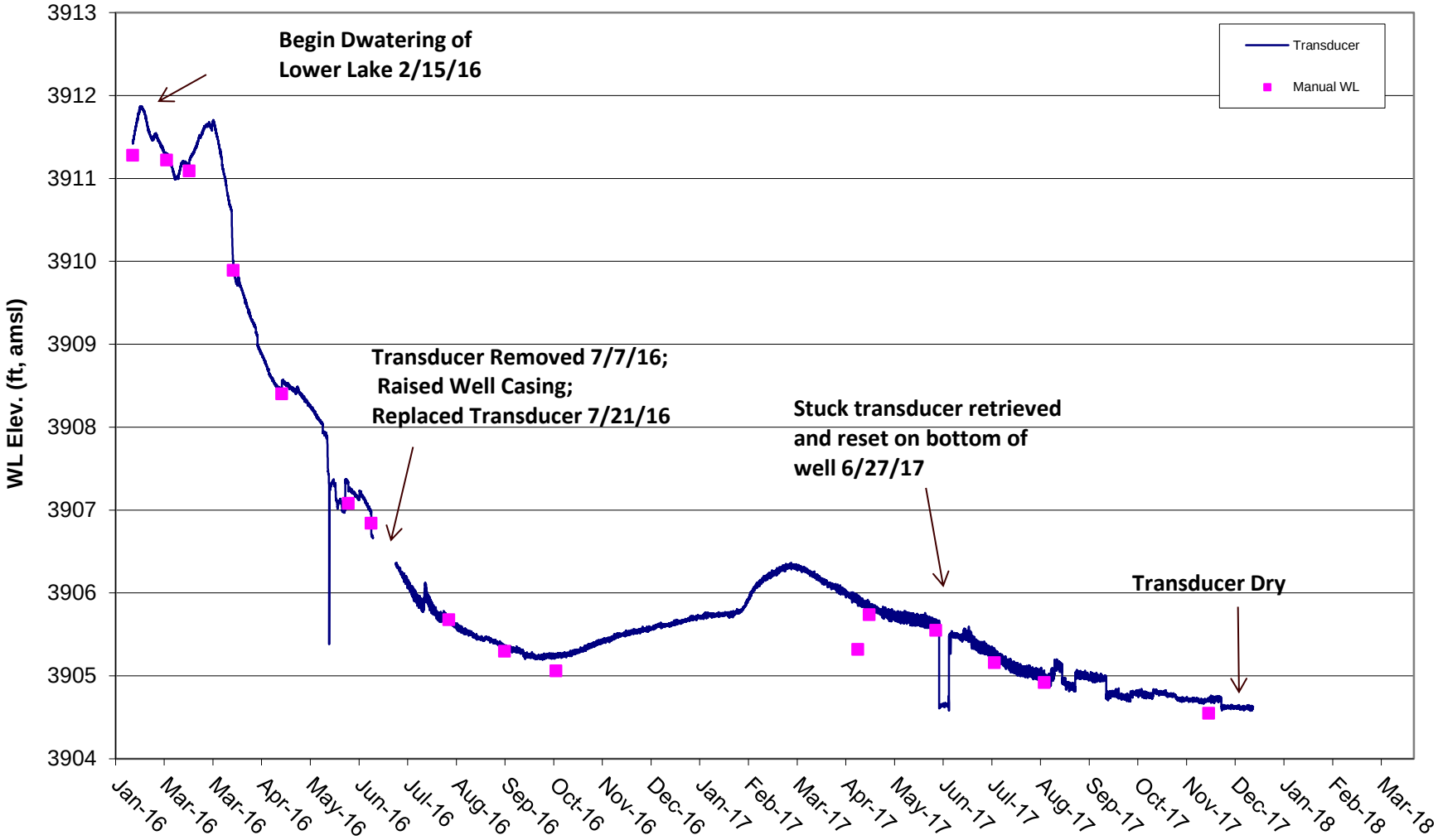

DH-14
PPC Diversion
10/29/13
Began TPA
Removal Activities
5/28/14
Begin Dewatering of
Lower Lake 2/15/16
Transducer
Manual WL
WL Elev. (ft, amsl)
3908
3907
3906
3905
3904
3903
3902
3901
3900
May-13
Jul-13
Sep-13
Nov-13
Jan-14
Mar-14
May-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18


DH-17
WL Elev. (ft, amsl)
3882
3880
3878
3876
3874
3872
3870
3868
3866
3864
4/1/10
7/30/10
11/27/10
3/27/11
7/25/11
11/22/11
3/21/12
7/19/12
11/16/12
3/16/13
7/14/13
11/11/13
3/11/14
7/9/14
11/6/14
3/6/15
7/4/15
11/1/15
2/29/16
6/28/16
10/26/16
2/23/17
6/23/17
10/21/17
2/18/18
Date
PPC Dewatering; Discharge to Slag Pile 7/6/16
Transducer
Manual WL


DH-20
WL Elev. (ft, amsl)
3918
3916
3914
3912
3910
3908
3906
PPC Diversion
10/29/13
Transducer Removed
7/29/14 - 3/2/16
and 4/29/16 - 5/16/16
Transducer
Manual WL
Apr-10
Jul-10
Nov-10
Mar-11
Jul-11
Nov-11
Mar-12
Jul-12
Nov-12
Mar-13
Jul-13
Nov-13
Mar-14
Jul-14
Nov-14
Mar-15
Jul-15
Nov-15
Feb-16
Jun-16
Oct-16
Feb-17
Jun-17
Oct-17
Feb-18


DH-23
Marsh Dewatering Water Discharged to Lower Lake as of 8/8/15
Begin Dewatering of Lower Lake 2/15/16
Well Dry
Transducer
Manual WL
WL Elev. (ft, amsl)
3902
3901
3900
3899
3898
3897
3896
3895
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18

# DH-47


Begin Dwatering of
Lower Lake 2/15/16
Transducer Removed 7/7/16;
Raised Well Casing;
Replaced Transducer 7/21/16
Stuck transducer retrieved
and reset on bottom of
well 6/27/17
Transducer Dry
Transducer
Manual WL
WL Elev. (ft, amsl)
3913
3912
3911
3910
3909
3908
3907
3906
3905
3904
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
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Jun-17
Jul-17
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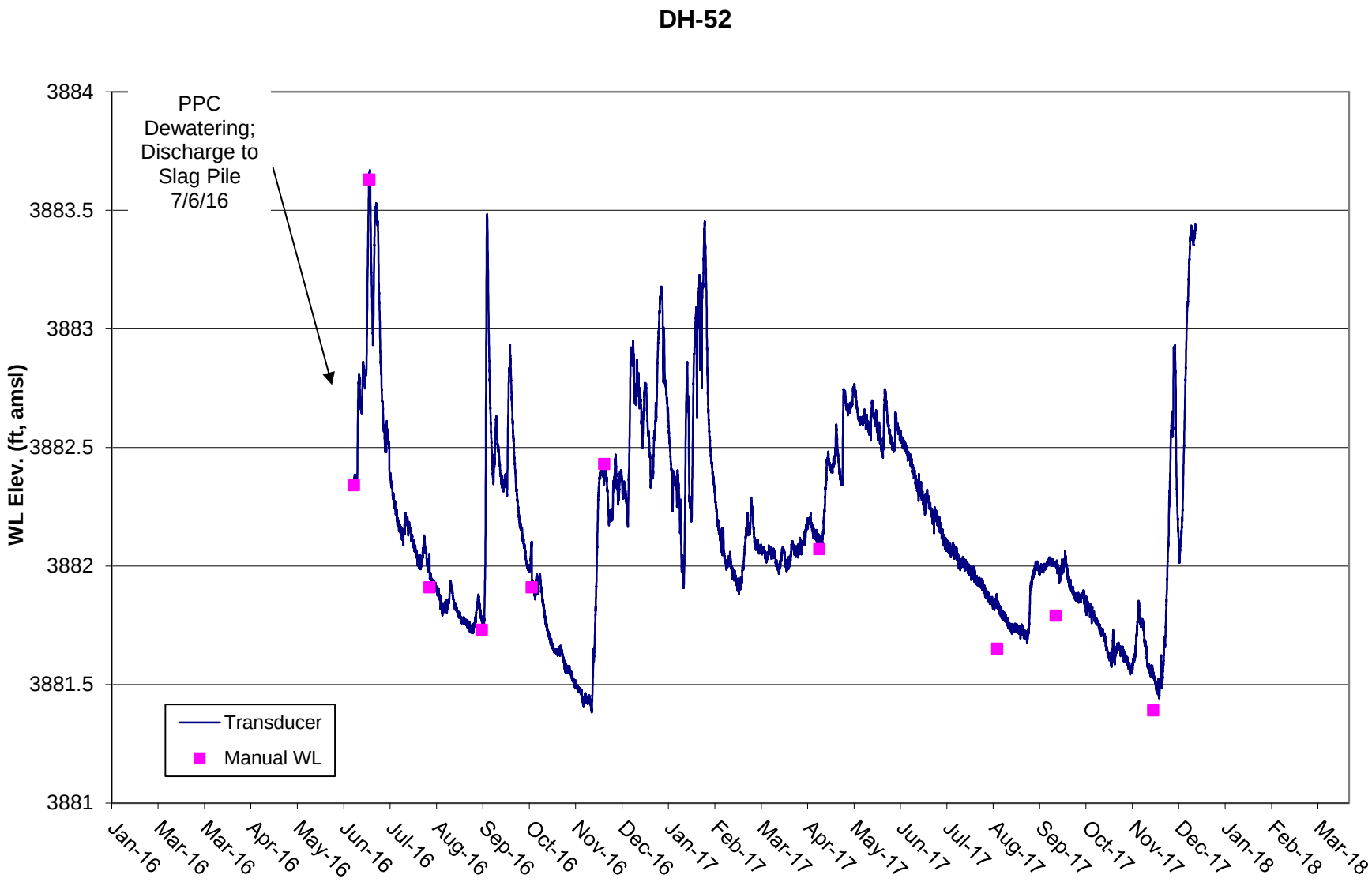
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18


DH-52
PPC Dewatering; Discharge to Slag Pile 7/6/16
WL Elev. (ft, amsl)
3884
3883.5
3883
3882.5
3882
3881.5
3881
Transducer
Manual WL
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
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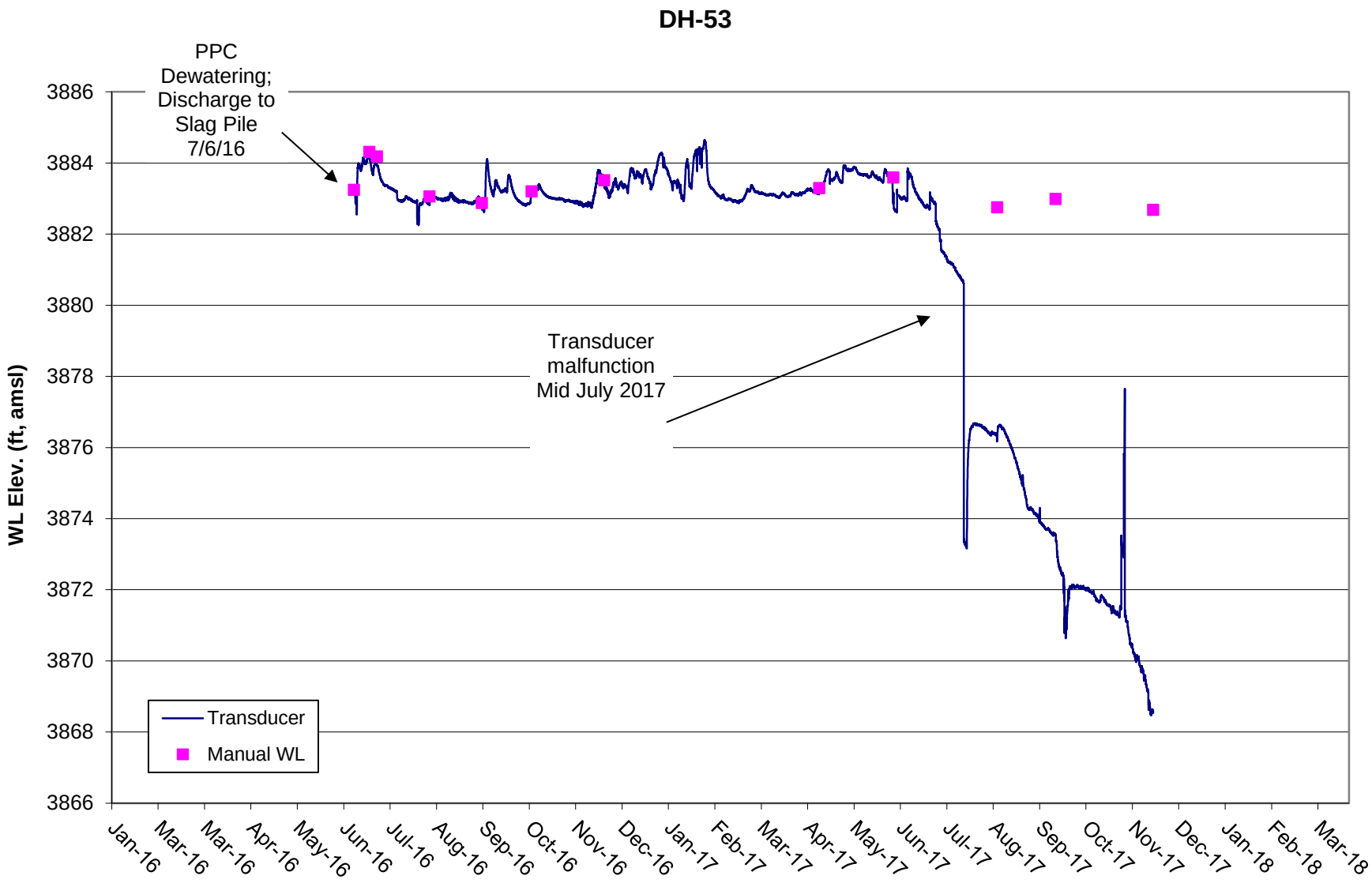
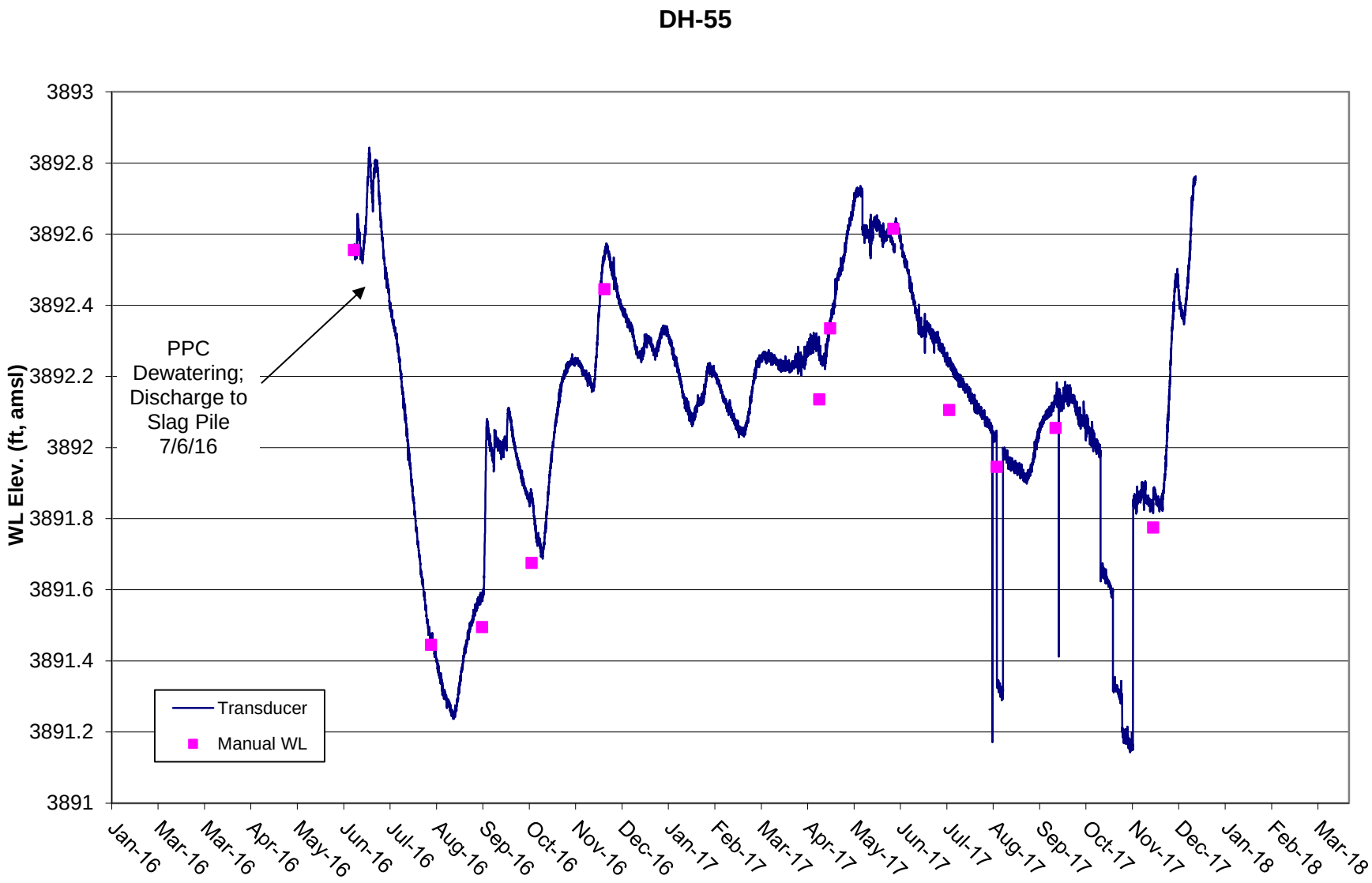
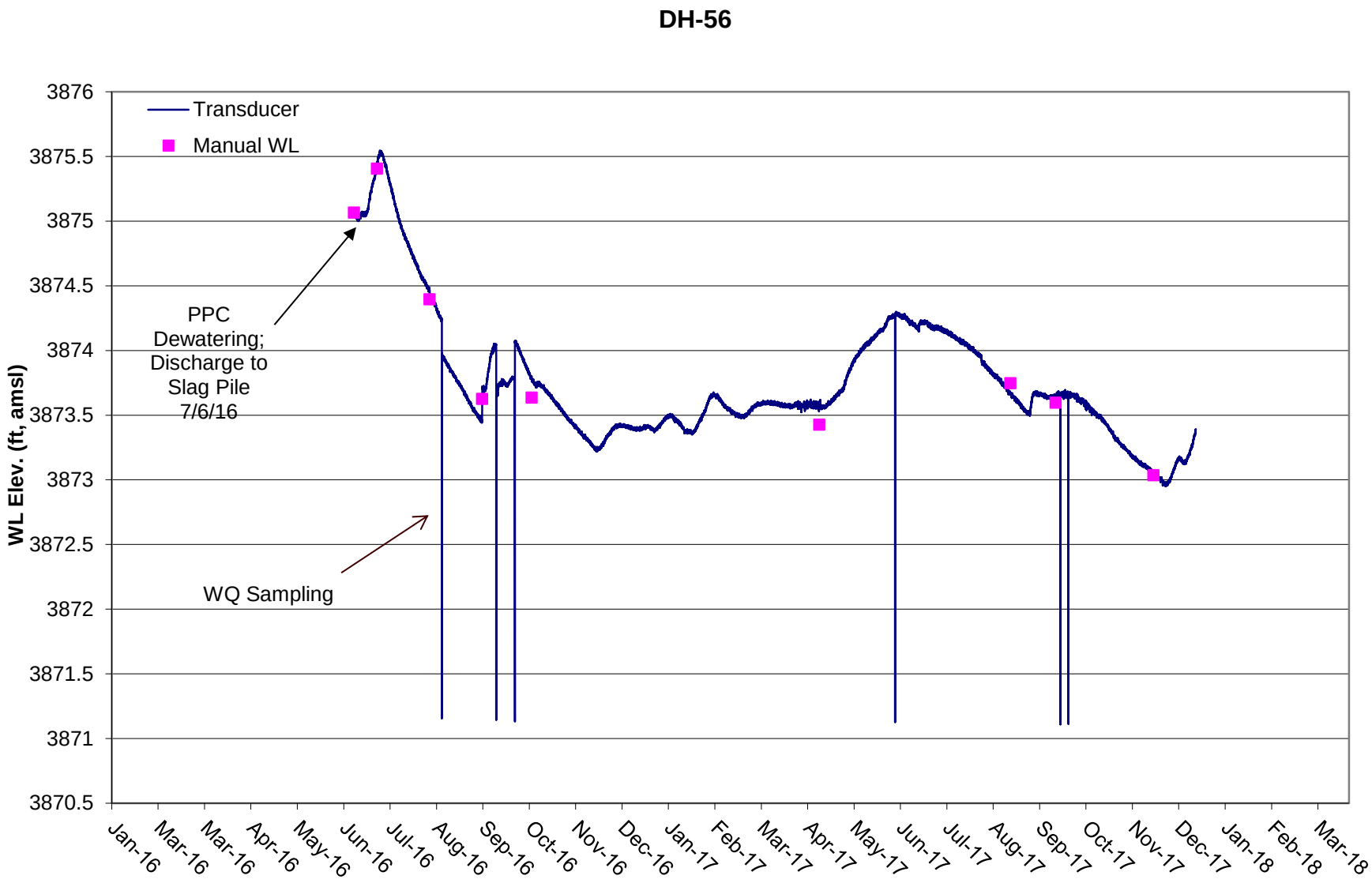
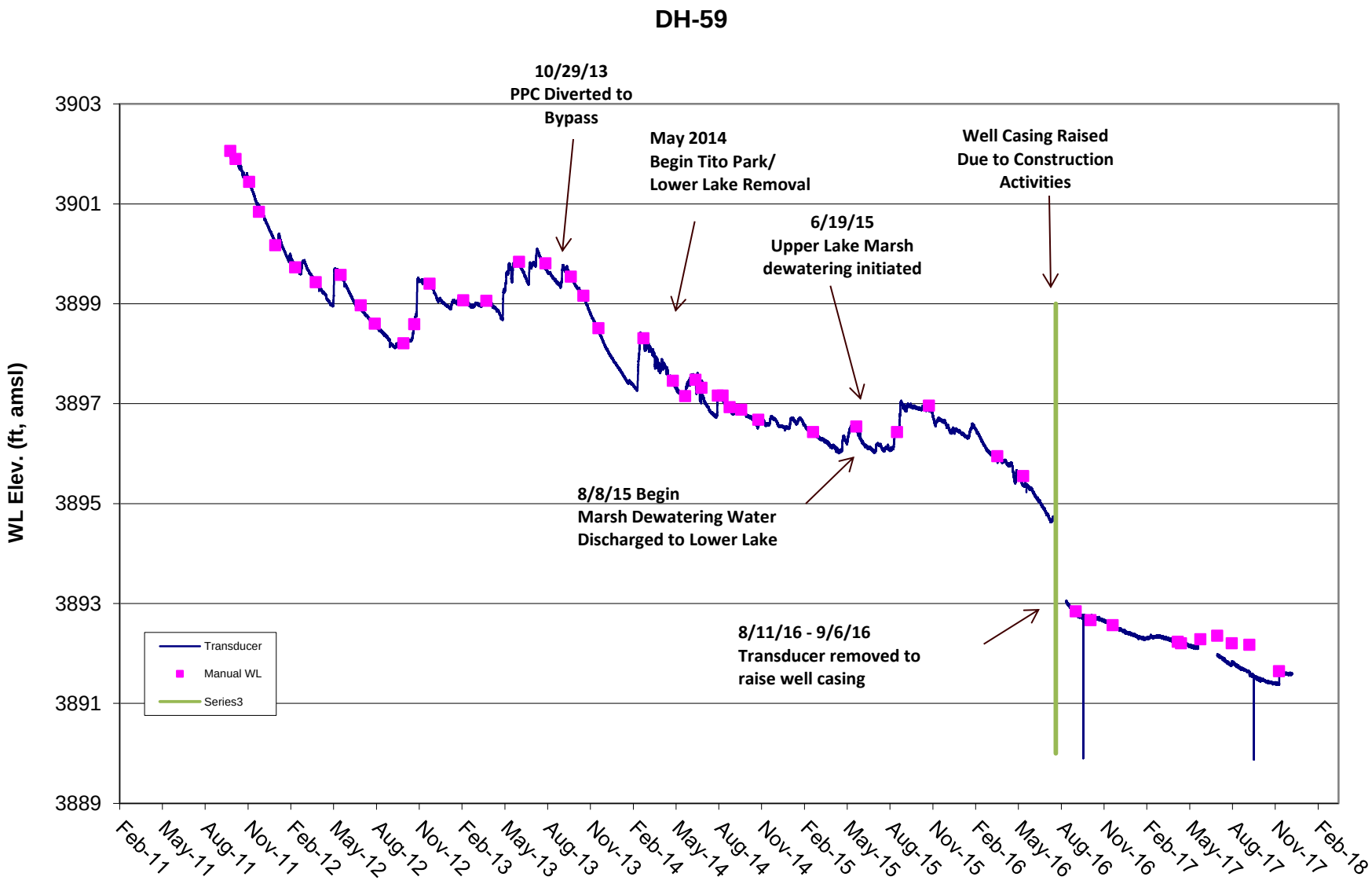
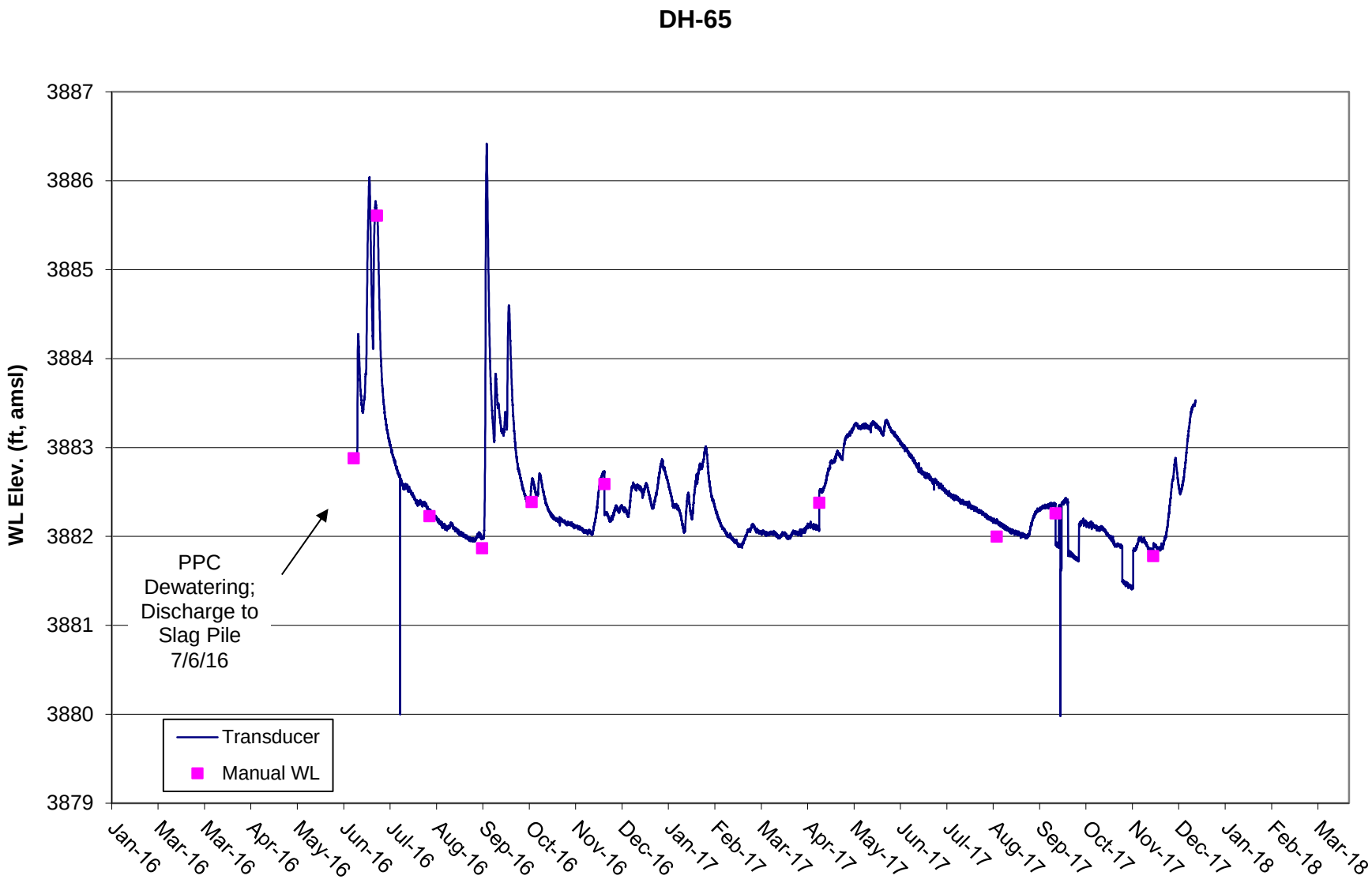
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

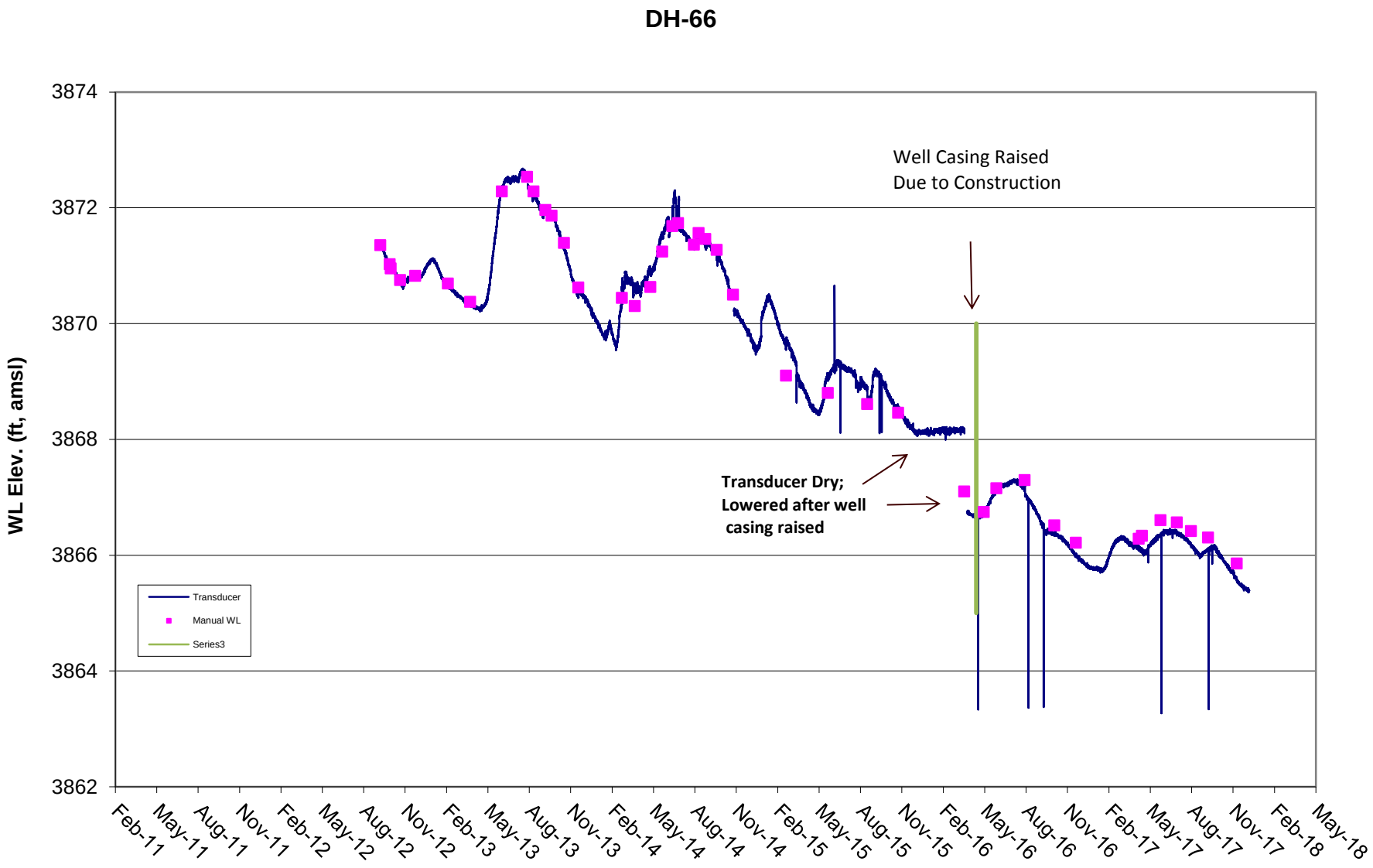

DH-53
PPC Dewatering; Discharge to Slag Pile 7/6/16
Transducer malfunction Mid July 2017
WL Elev. (ft, amsl)
3886
3884
3882
3880
3878
3876
3874
3872
3870
3868
3866
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Transducer
Manual WL

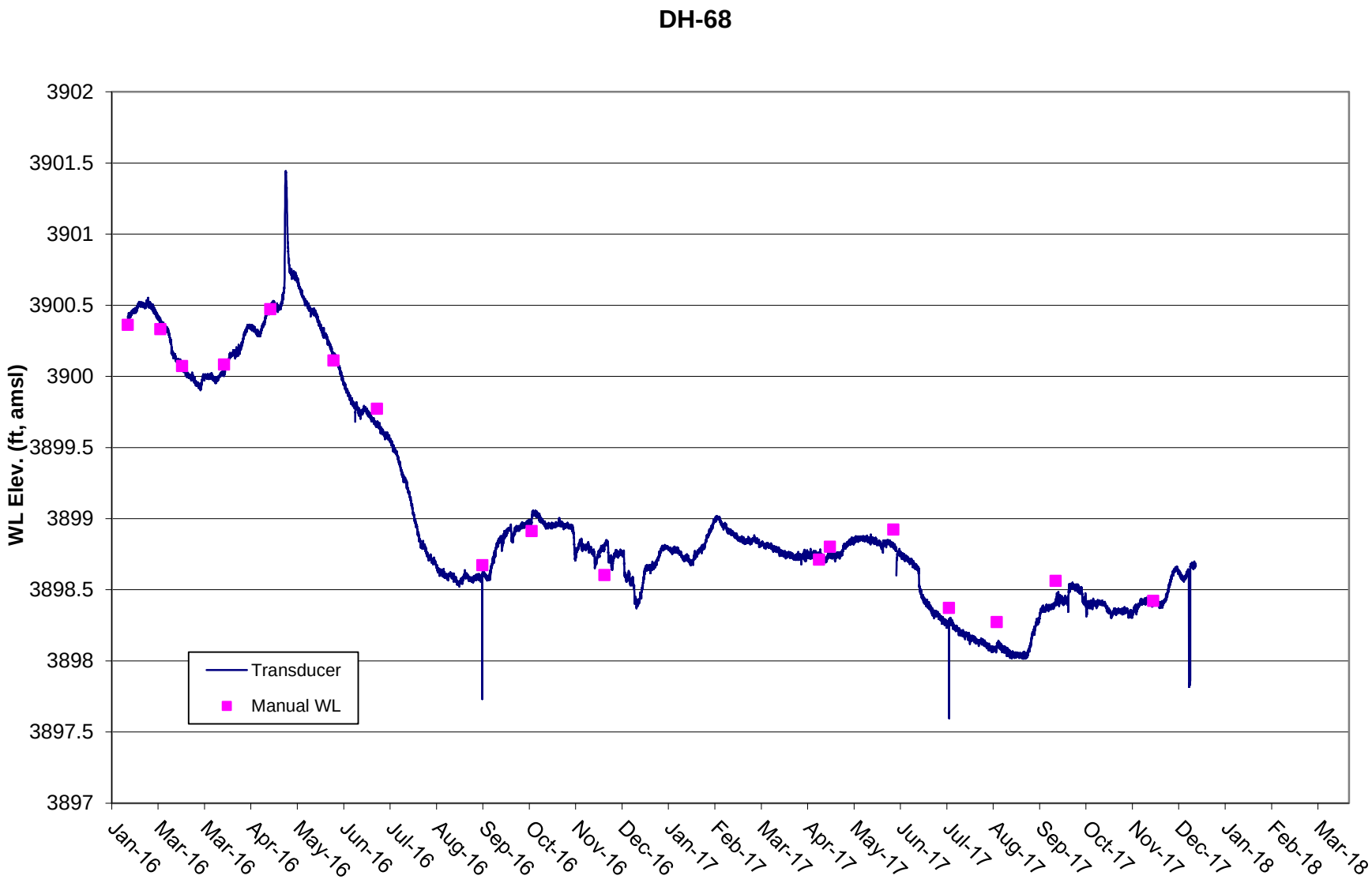

DH-55
WL Elev. (ft, amsl)
3893
3892.8
3892.6
3892.4
3892.2
3892
3891.8
3891.6
3891.4
3891.2
3891
PPC Dewatering; Discharge to Slag Pile 7/6/16
Transducer
Manual WL
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

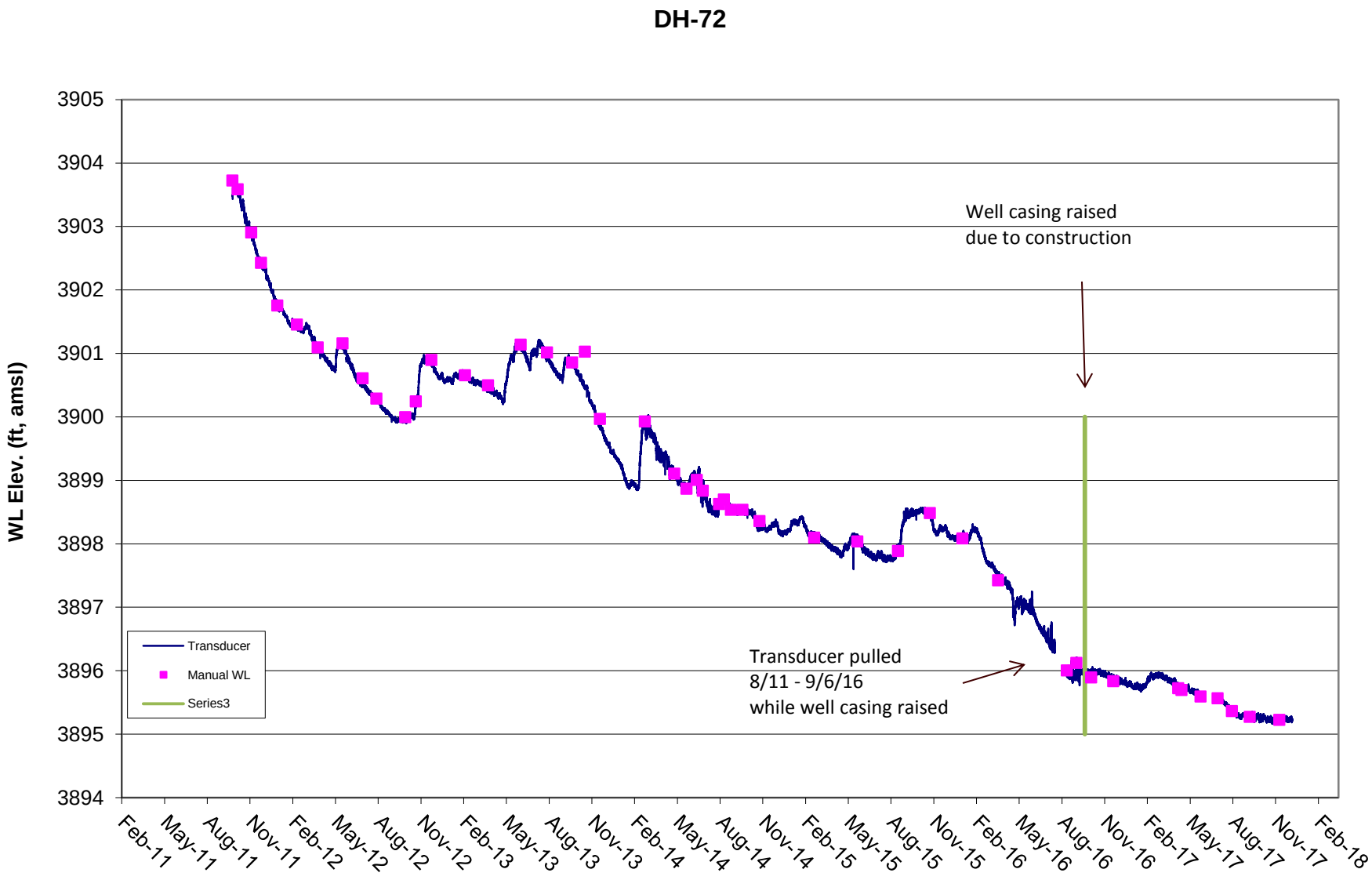

DH-56
Transducer
Manual WL
PPC Dewatering; Discharge to Slag Pile 7/6/16
WQ Sampling
WL Elev. (ft, amsl)
3876
3875.5
3875
3874.5
3874
3873.5
3873
3872.5
3872
3871.5
3871
3870.5
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

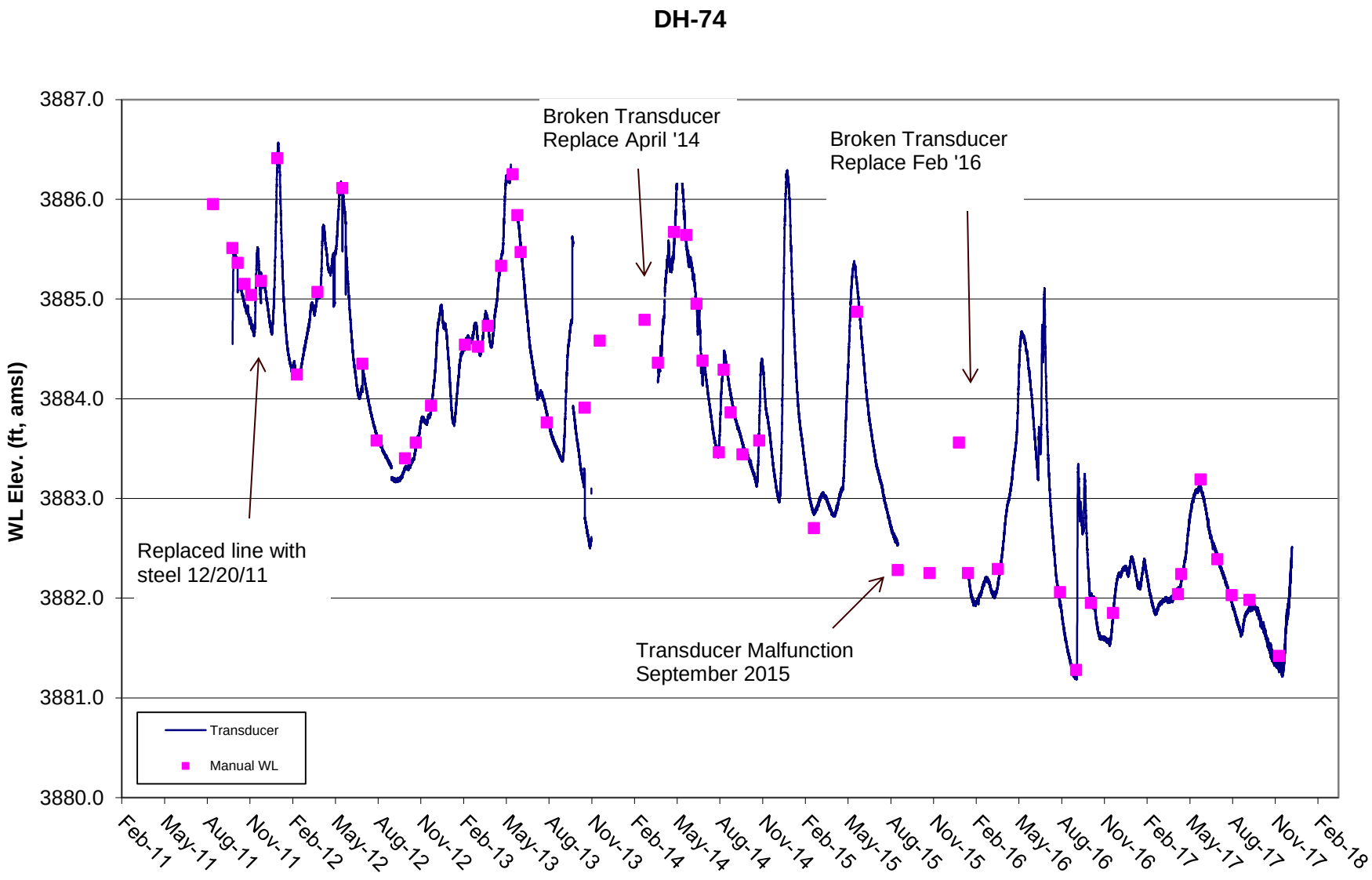

DH-59
10/29/13
PPC Diverted to
Bypass
May 2014
Begin Tito Park/
Lower Lake Removal
Well Casing Raised
Due to Construction
Activities
6/19/15
Upper Lake Marsh
dewatering initiated
8/8/15 Begin
Marsh Dewatering Water
Discharged to Lower Lake
8/11/16 - 9/6/16
Transducer removed to
raise well casing
Transducer
Manual WL
Series3
WL Elev. (ft, amsl)
3903
3901
3899
3897
3895
3893
3891
3889
Feb-11
May-11
Aug-11
Nov-11
Feb-12
May-12
Aug-12
Nov-12
Feb-13
May-13
Aug-13
Nov-13
Feb-14
May-14
Aug-14
Nov-14
Feb-15
May-15
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18

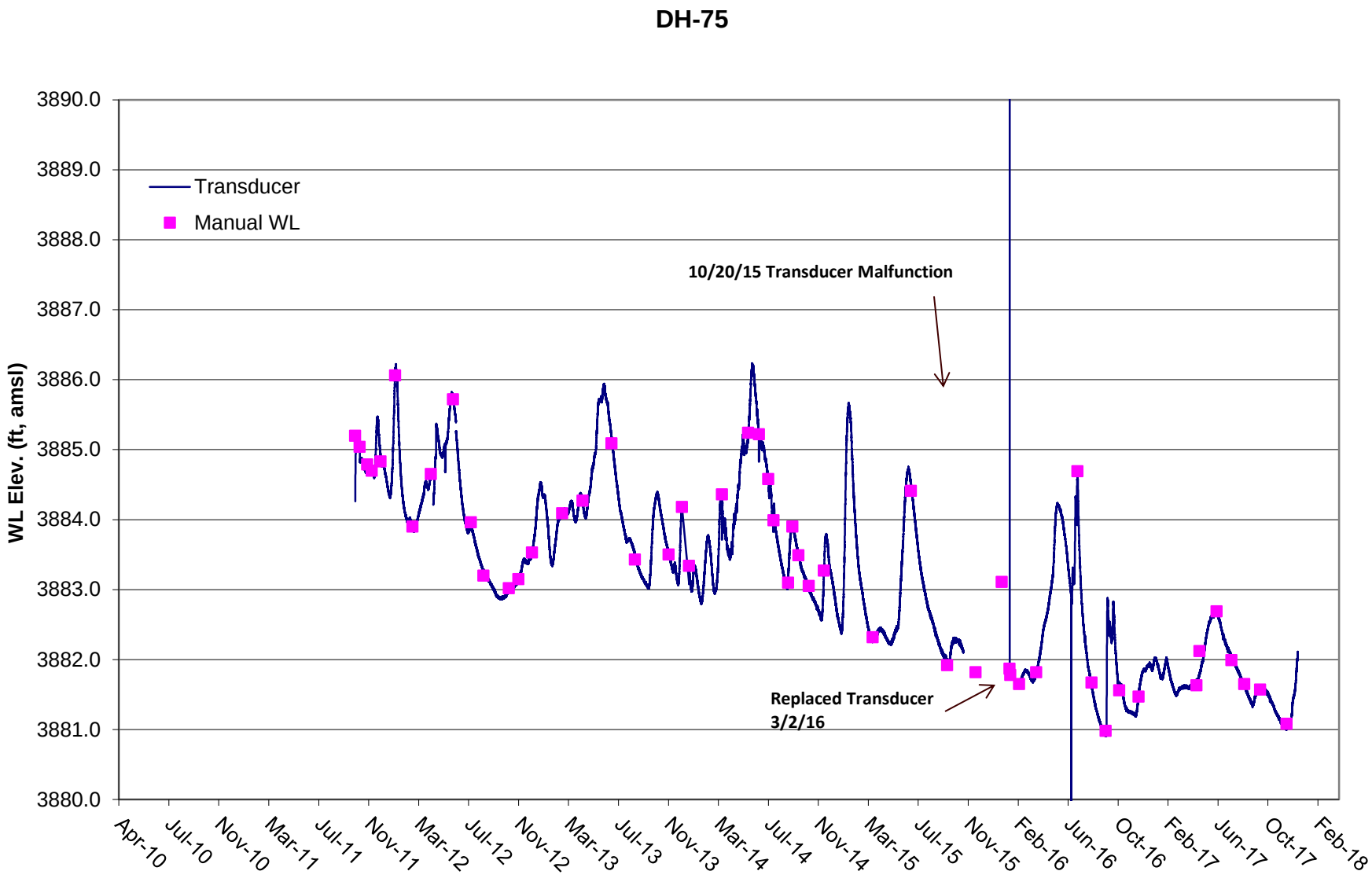

DH-65
WL Elev. (ft, amsl)
3887
3886
3885
3884
3883
3882
3881
3880
3879
PPC Dewatering; Discharge to Slag Pile 7/6/16
Transducer
Manual WL
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

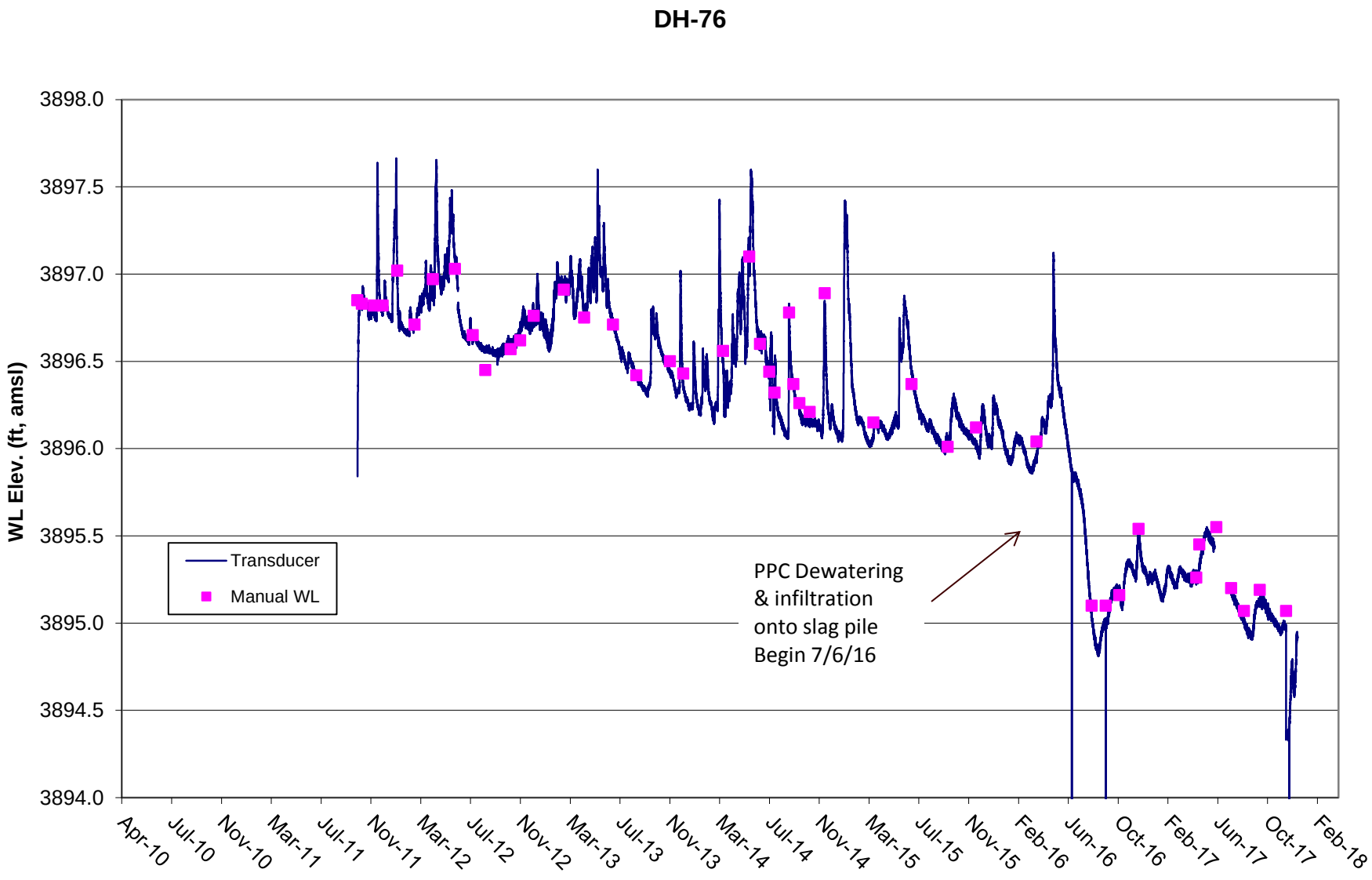

DH-66
WL Elev. (ft, amsl)
3874
3872
3870
3868
3866
3864
3862
Well Casing Raised
Due to Construction
Transducer Dry;
Lowered after well
casing raised
Transducer
Manual WL
Series3
Feb-11
May-11
Aug-11
Nov-11
Feb-12
May-12
Aug-12
Nov-12
Feb-13
May-13
Aug-13
Nov-13
Feb-14
May-14
Aug-14
Nov-14
Feb-15
May-15
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18
May-18

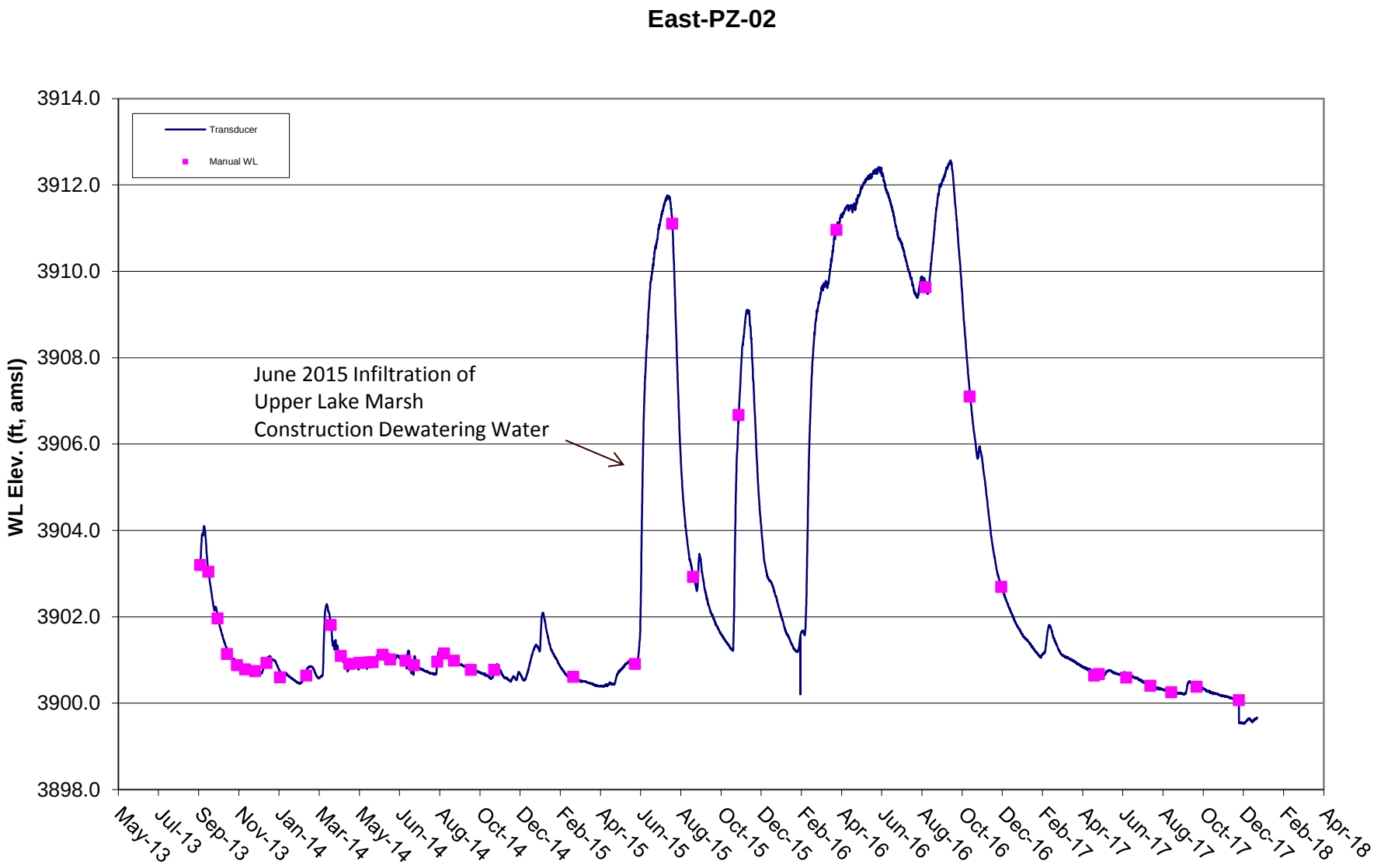

DH-68
WL Elev. (ft, amsl)
3902
3901.5
3901
3900.5
3900
3899.5
3899
3898.5
3898
3897.5
3897
Transducer
Manual WL
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

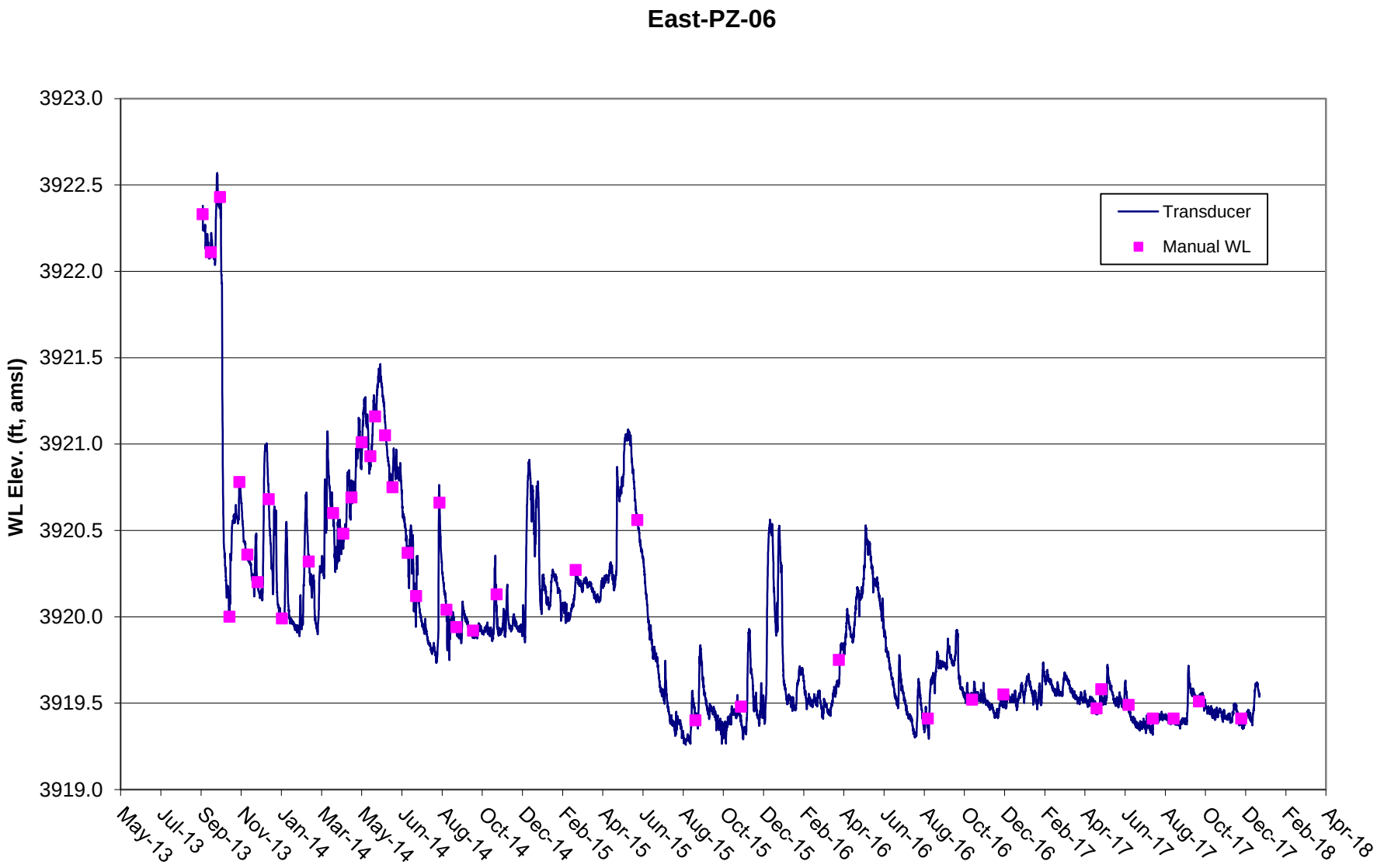

DH-72
WL Elev. (ft, amsl)
3905
3904
3903
3902
3901
3900
3899
3898
3897
3896
3895
3894
Feb-11
May-11
Aug-11
Nov-11
Feb-12
May-12
Aug-12
Nov-12
Feb-13
May-13
Aug-13
Nov-13
Feb-14
May-14
Aug-14
Nov-14
Feb-15
May-15
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18
Transducer
Manual WL
Series3
Well casing raised
due to construction
Transducer pulled
8/11 - 9/6/16
while well casing raised

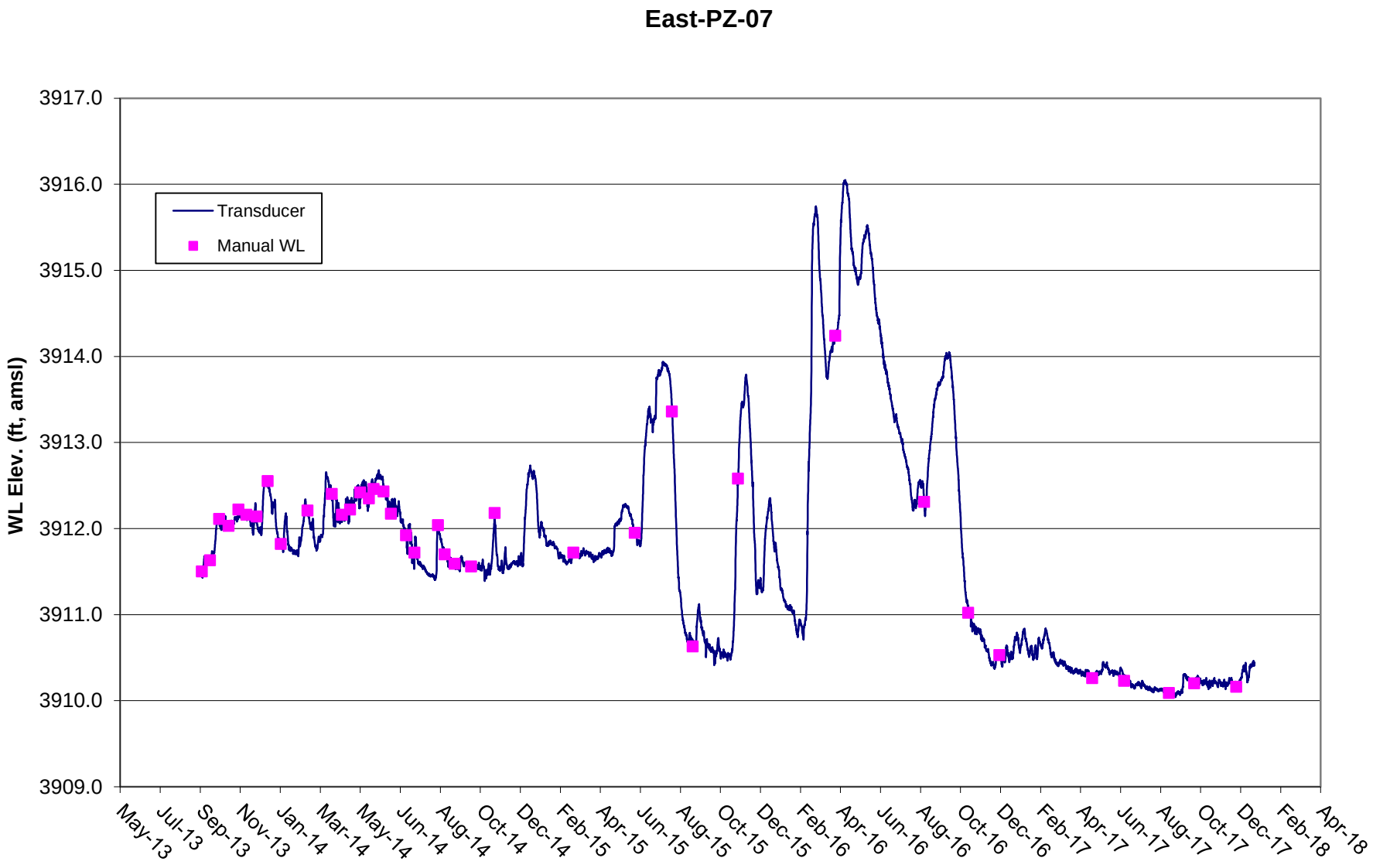

DH-74
WL Elev. (ft, amsl)
3887.0
3886.0
3885.0
3884.0
3883.0
3882.0
3881.0
3880.0
Broken Transducer
Replace April '14
Broken Transducer
Replace Feb '16
Replaced line with
steel 12/20/11
Transducer Malfunction
September 2015
Transducer
Manual WL
Feb-11
May-11
Aug-11
Nov-11
Feb-12
May-12
Aug-12
Nov-12
Feb-13
May-13
Aug-13
Nov-13
Feb-14
May-14
Aug-14
Nov-14
Feb-15
May-15
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18

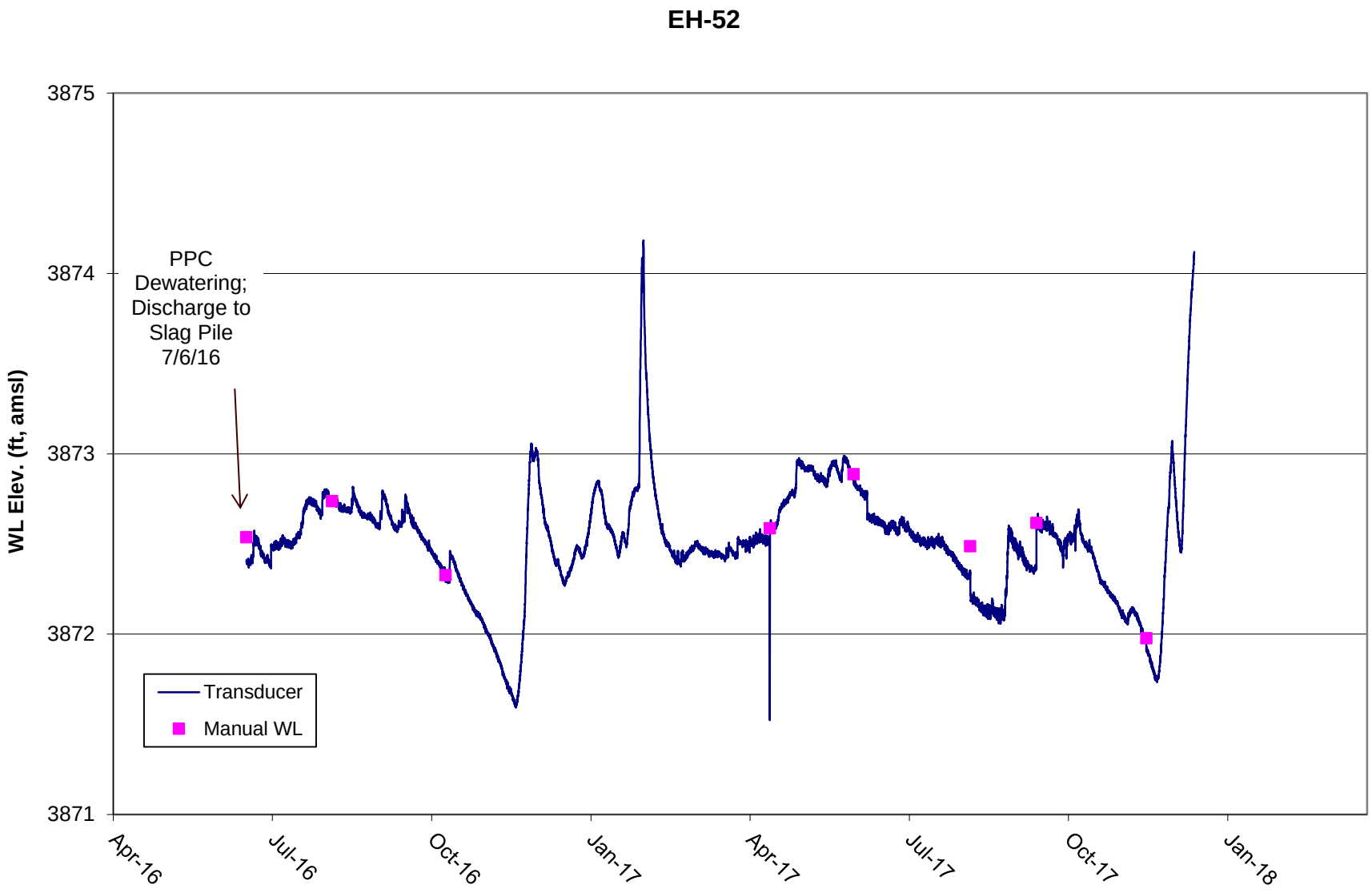

DH-75
Transducer
Manual WL
10/20/15 Transducer Malfunction
Replaced Transducer
3/2/16
WL Elev. (ft, amsl)
3890.0
3889.0
3888.0
3887.0
3886.0
3885.0
3884.0
3883.0
3882.0
3881.0
3880.0
Apr-10
Jul-10
Nov-10
Mar-11
Jul-11
Nov-11
Mar-12
Jul-12
Nov-12
Mar-13
Jul-13
Nov-13
Mar-14
Jul-14
Nov-14
Mar-15
Jul-15
Nov-15
Feb-16
Jun-16
Oct-16
Feb-17
Jun-17
Oct-17
Feb-18

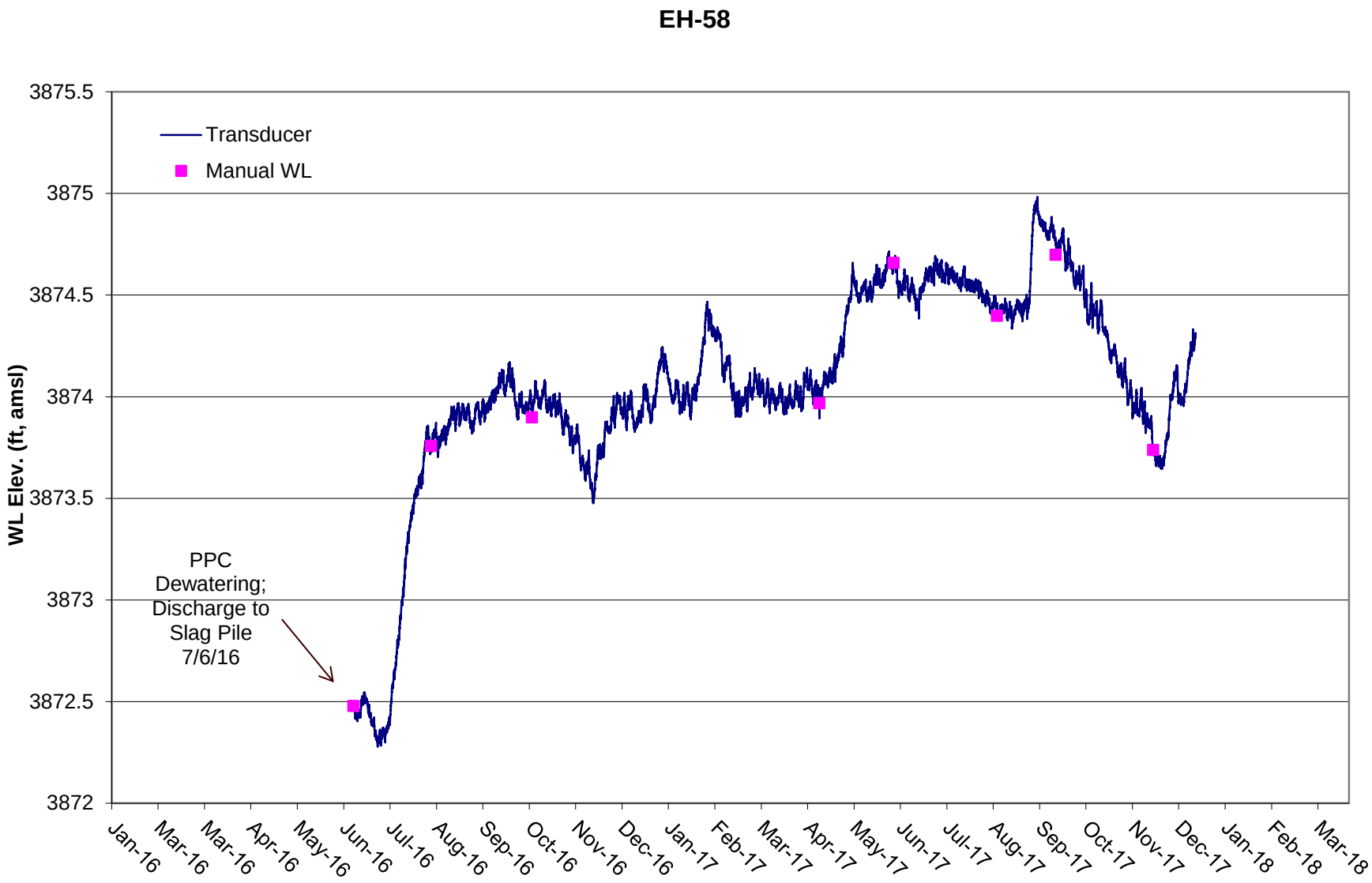

DH-76
WL Elev. (ft, amsl)
3898.0
3897.5
3897.0
3896.5
3896.0
3895.5
3895.0
3894.5
3894.0
Transducer
Manual WL
PPC Dewatering
& infiltration
onto slag pile
Begin 7/6/16
Apr-10
Jul-10
Nov-10
Mar-11
Jul-11
Nov-11
Mar-12
Jul-12
Nov-12
Mar-13
Jul-13
Nov-13
Mar-14
Jul-14
Nov-14
Mar-15
Jul-15
Nov-15
Feb-16
Jun-16
Oct-16
Feb-17
Jun-17
Oct-17
Feb-18

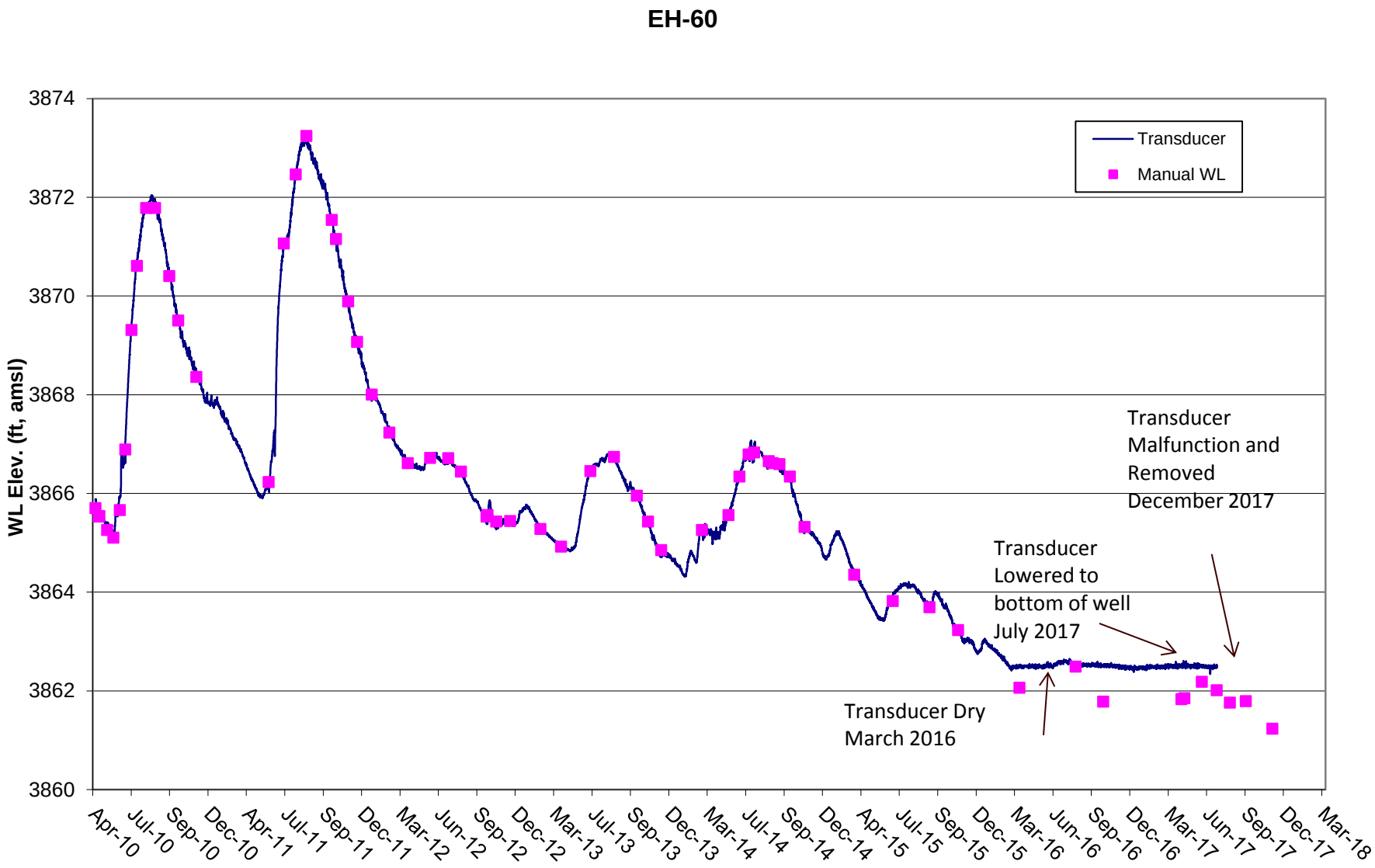

East-PZ-02
Transducer
Manual WL
June 2015 Infiltration of
Upper Lake Marsh
Construction Dewatering Water
WL Elev. (ft, amsl)
3914.0
3912.0
3910.0
3908.0
3906.0
3904.0
3902.0
3900.0
3898.0
May-13
Jul-13
Sep-13
Nov-13
Jan-14
Mar-14
May-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18

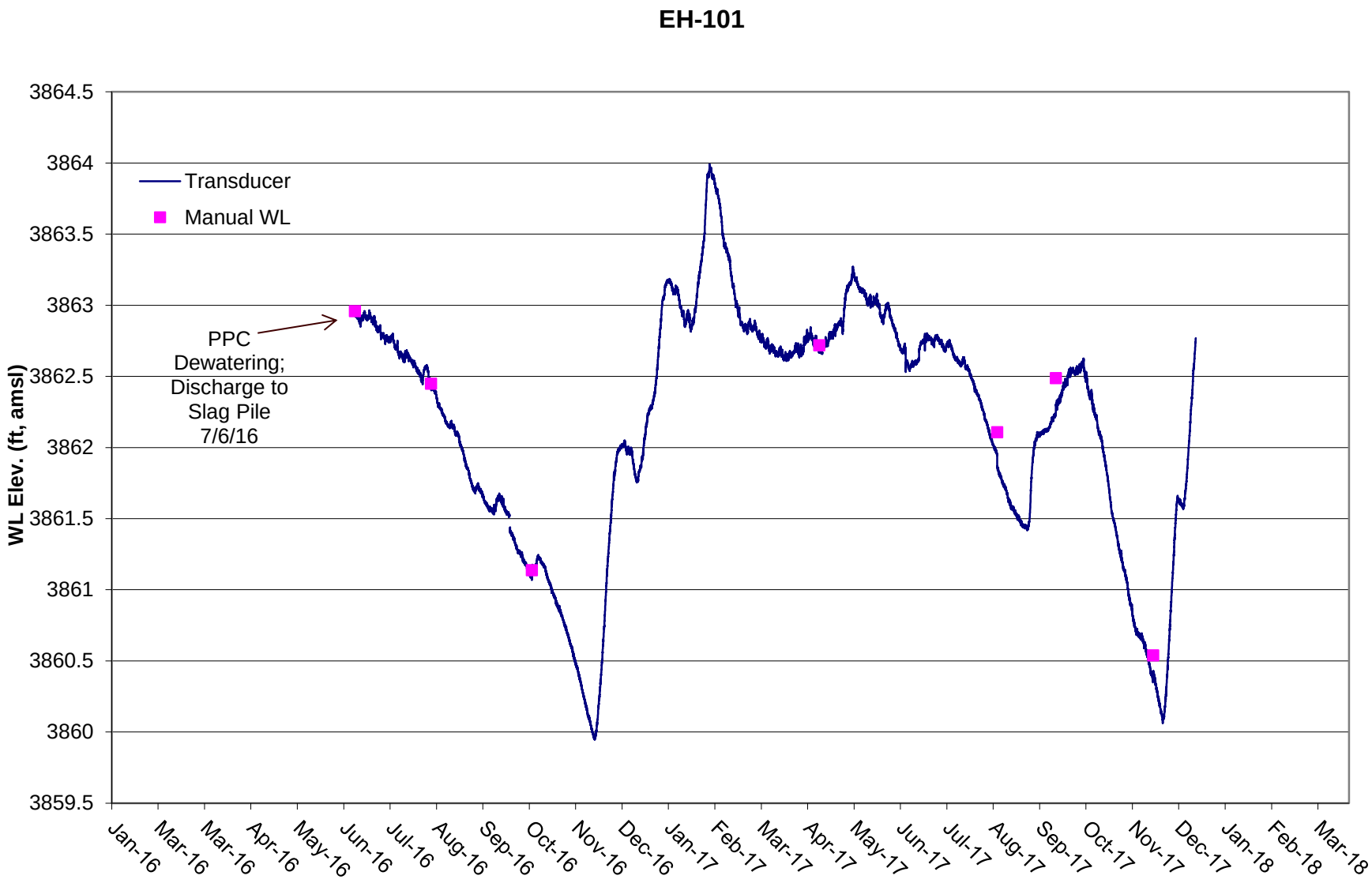

East-PZ-06
WL Elev. (ft, amsl)
3923.0
3922.5
3922.0
3921.5
3921.0
3920.5
3920.0
3919.5
3919.0
Transducer
Manual WL
May-13
Jul-13
Sep-13
Nov-13
Jan-14
Mar-14
May-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18

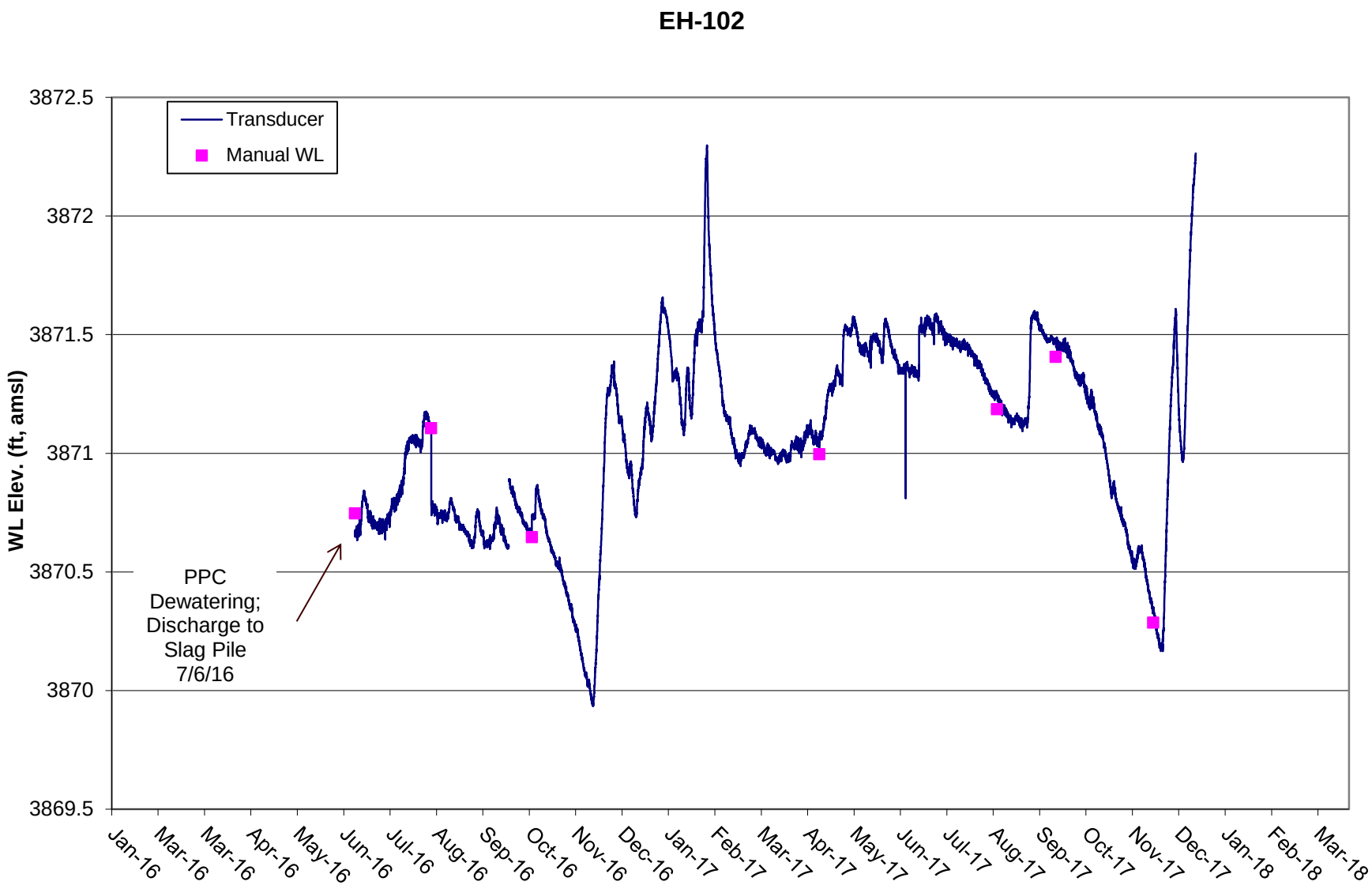

East-PZ-07
WL Elev. (ft, amsl)
3917.0
3916.0
3915.0
3914.0
3913.0
3912.0
3911.0
3910.0
3909.0
Transducer
Manual WL
May-13
Jul-13
Sep-13
Nov-13
Jan-14
Mar-14
May-14
Jun-14
Aug-14
Oct-14
Dec-14
Feb-15
Apr-15
Jun-15
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18

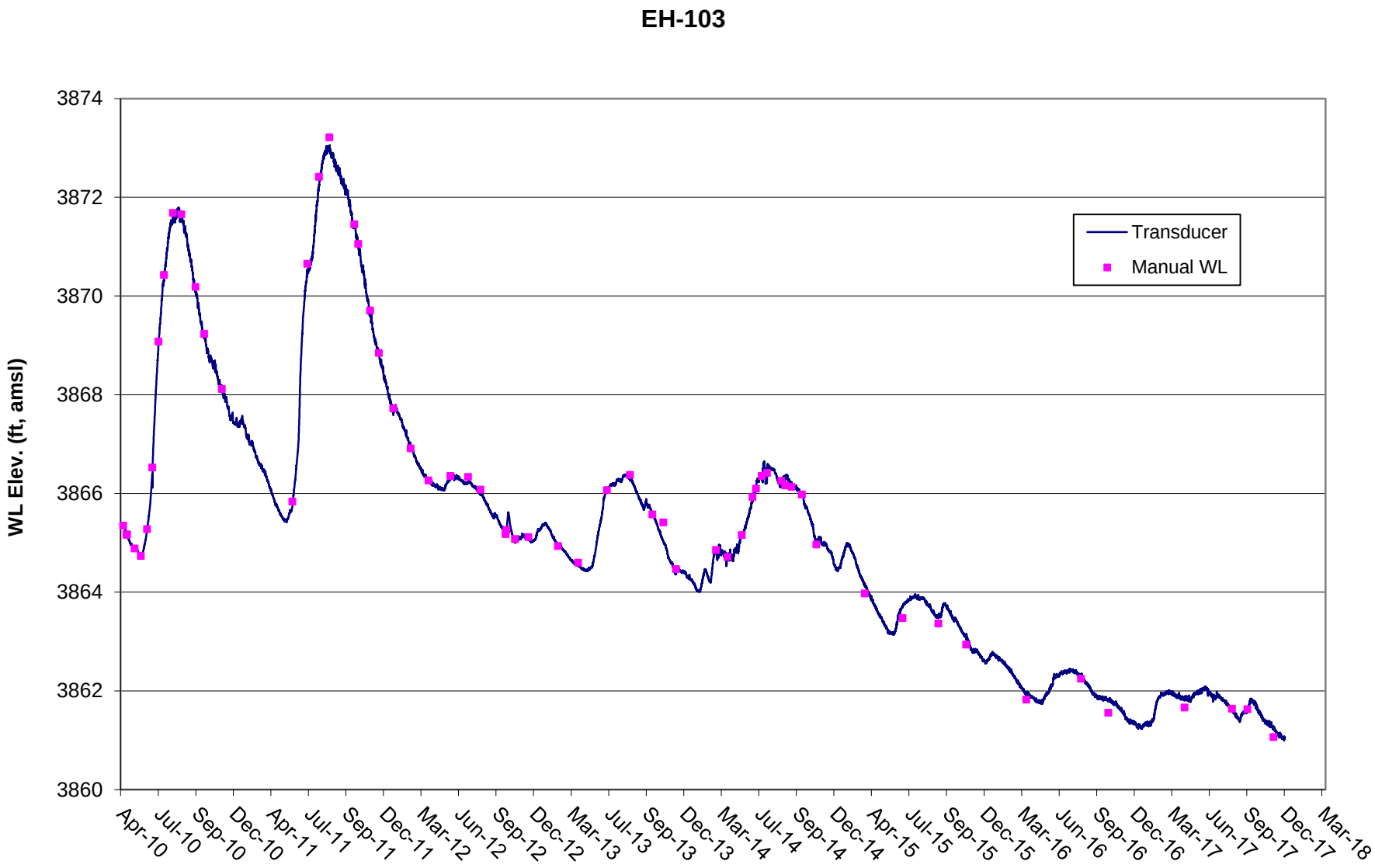

EH-52
WL Elev. (ft, amsl)
3875
3874
3873
3872
3871
PPC Dewatering; Discharge to Slag Pile 7/6/16
Transducer
Manual WL
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18

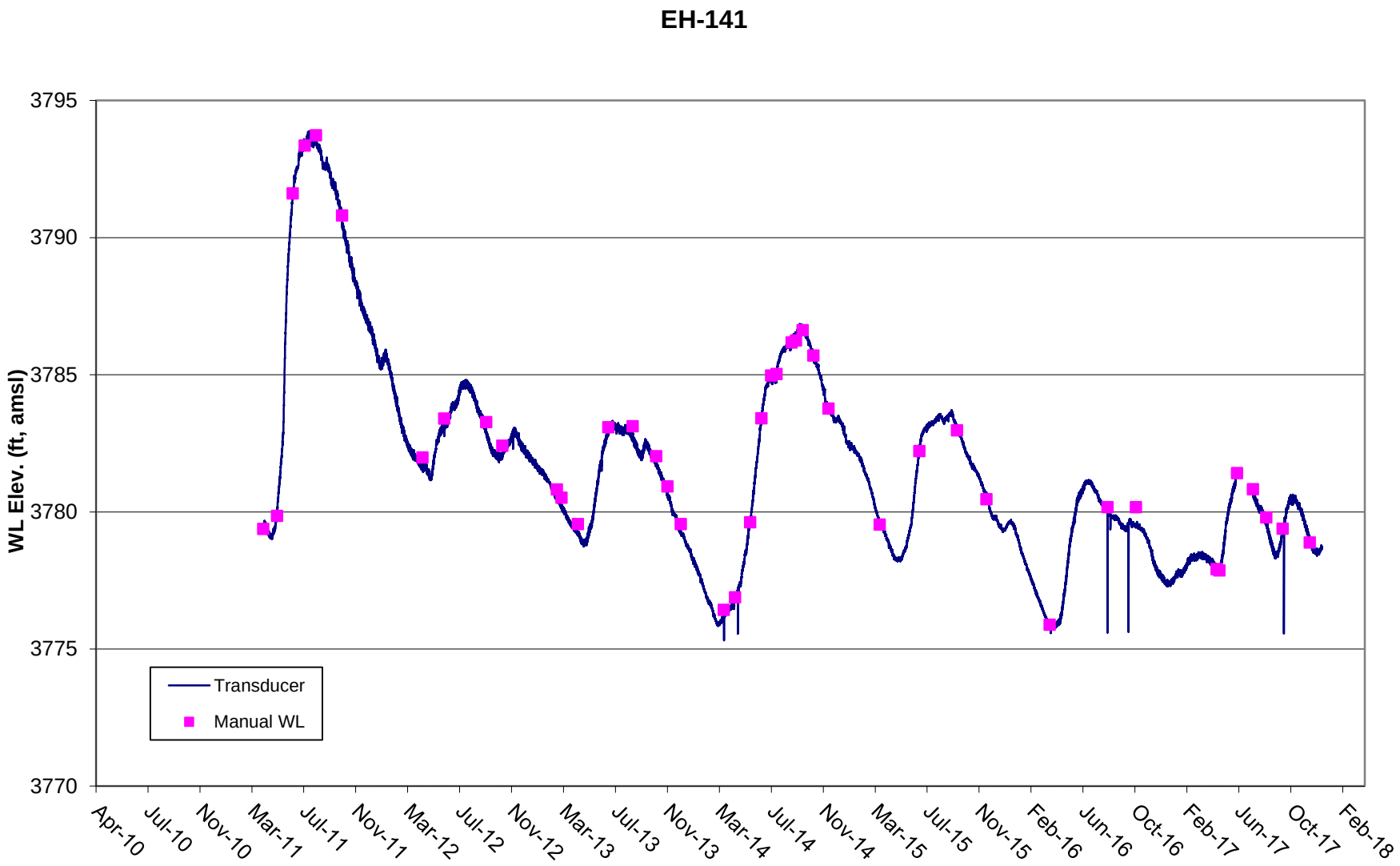

EH-58
Transducer
Manual WL
WL Elev. (ft, amsl)
3875.5
3875
3874.5
3874
3873.5
3873
3872.5
3872
PPC Dewatering; Discharge to Slag Pile 7/6/16
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18


EH-60
WL Elev. (ft, amsl)
3874
3872
3870
3868
3866
3864
3862
3860
Apr-10
Jul-10
Sep-10
Dec-10
Apr-11
Jul-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jul-13
Sep-13
Dec-13
Mar-14
Jul-14
Sep-14
Dec-14
Apr-15
Jul-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Transducer
Manual WL
Transducer Malfunction and Removed December 2017
Transducer Lowered to bottom of well July 2017
Transducer Dry March 2016

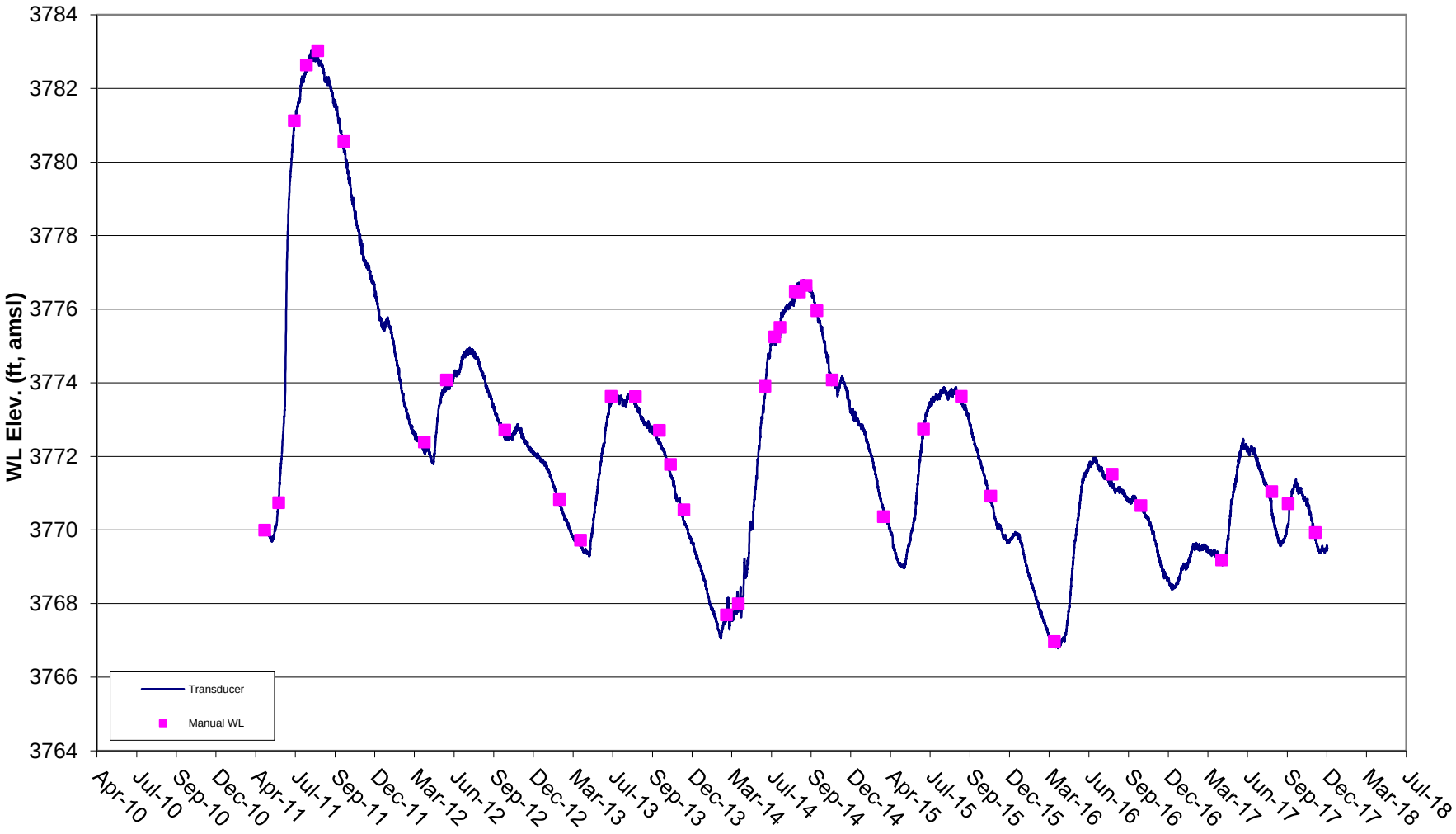

EH-101
WL Elev. (ft, amsl)
3864.5
3864
3863.5
3863
3862.5
3862
3861.5
3861
3860.5
3860
3859.5
Transducer
Manual WL
PPC Dewatering; Discharge to Slag Pile 7/6/16
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

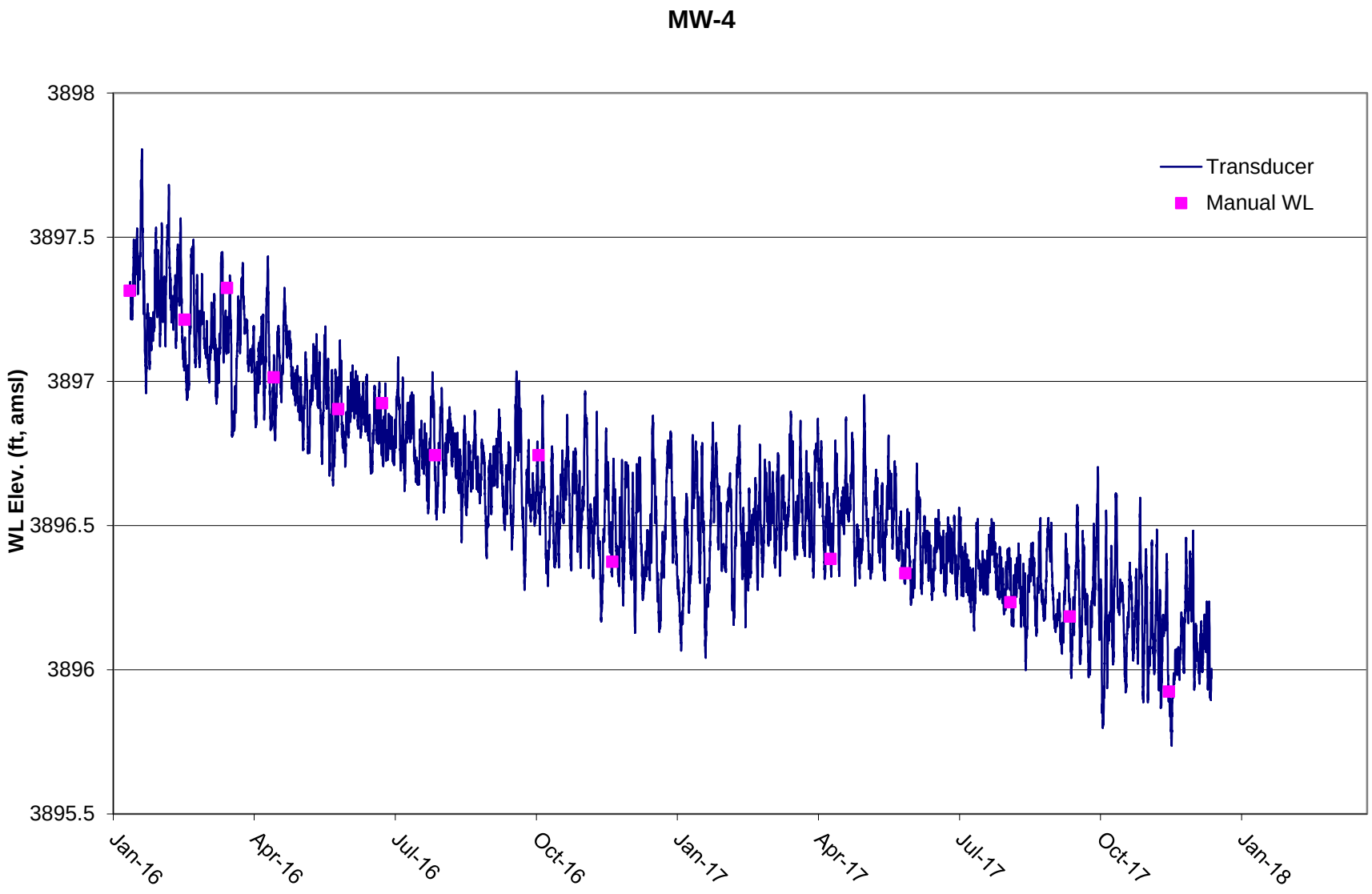

EH-102
Transducer
Manual WL
WL Elev. (ft, amsl)
3872.5
3872
3871.5
3871
3870.5
3870
3869.5
PPC Dewatering; Discharge to Slag Pile 7/6/16
Jan-16
Mar-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18

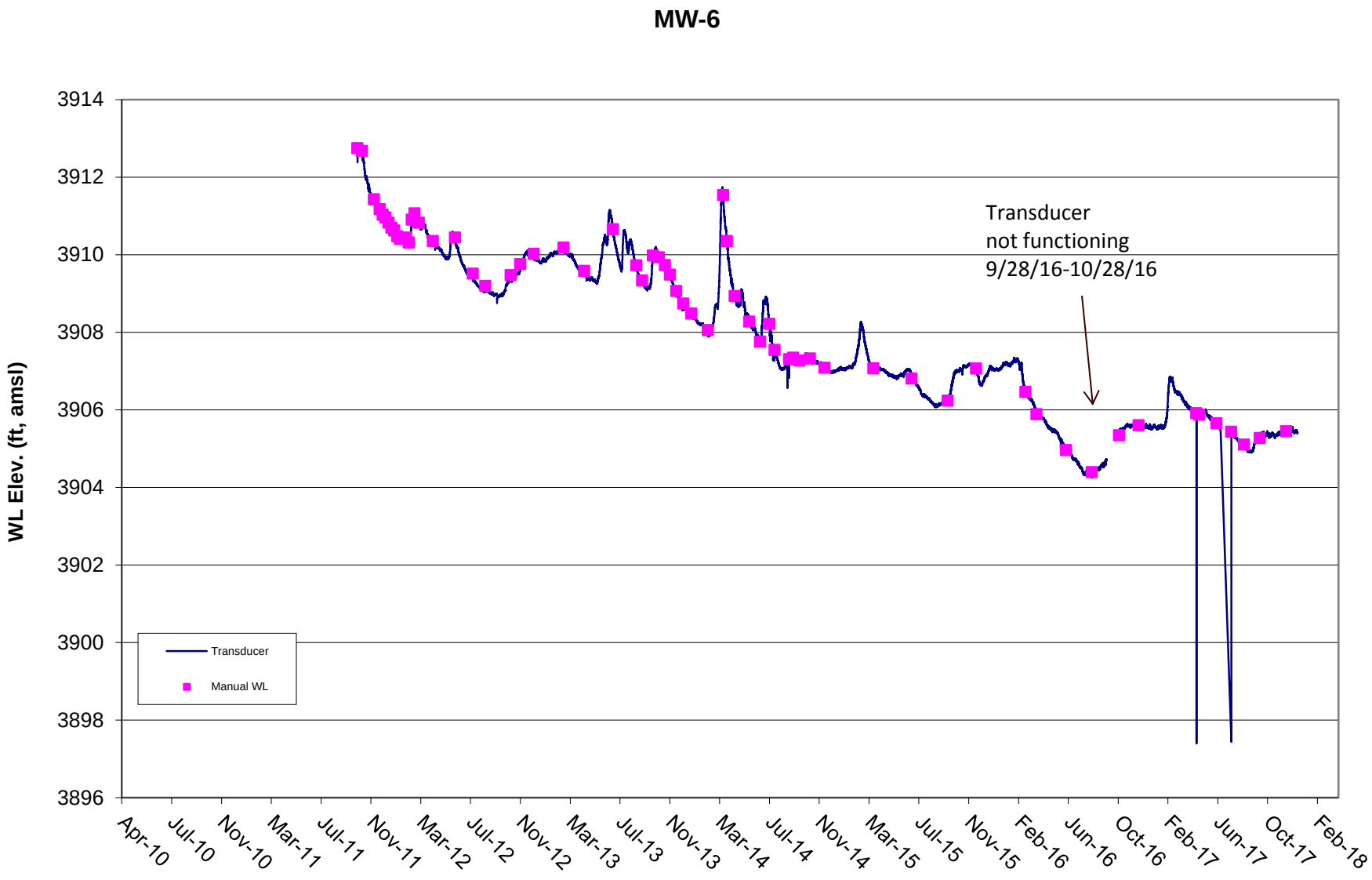

EH-103
WL Elev. (ft, amsl)
3874
3872
3870
3868
3866
3864
3862
3860
Transducer
Manual WL
Apr-10
Jul-10
Sep-10
Dec-10
Apr-11
Jul-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jul-13
Sep-13
Dec-13
Mar-14
Jul-14
Sep-14
Dec-14
Apr-15
Jul-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18

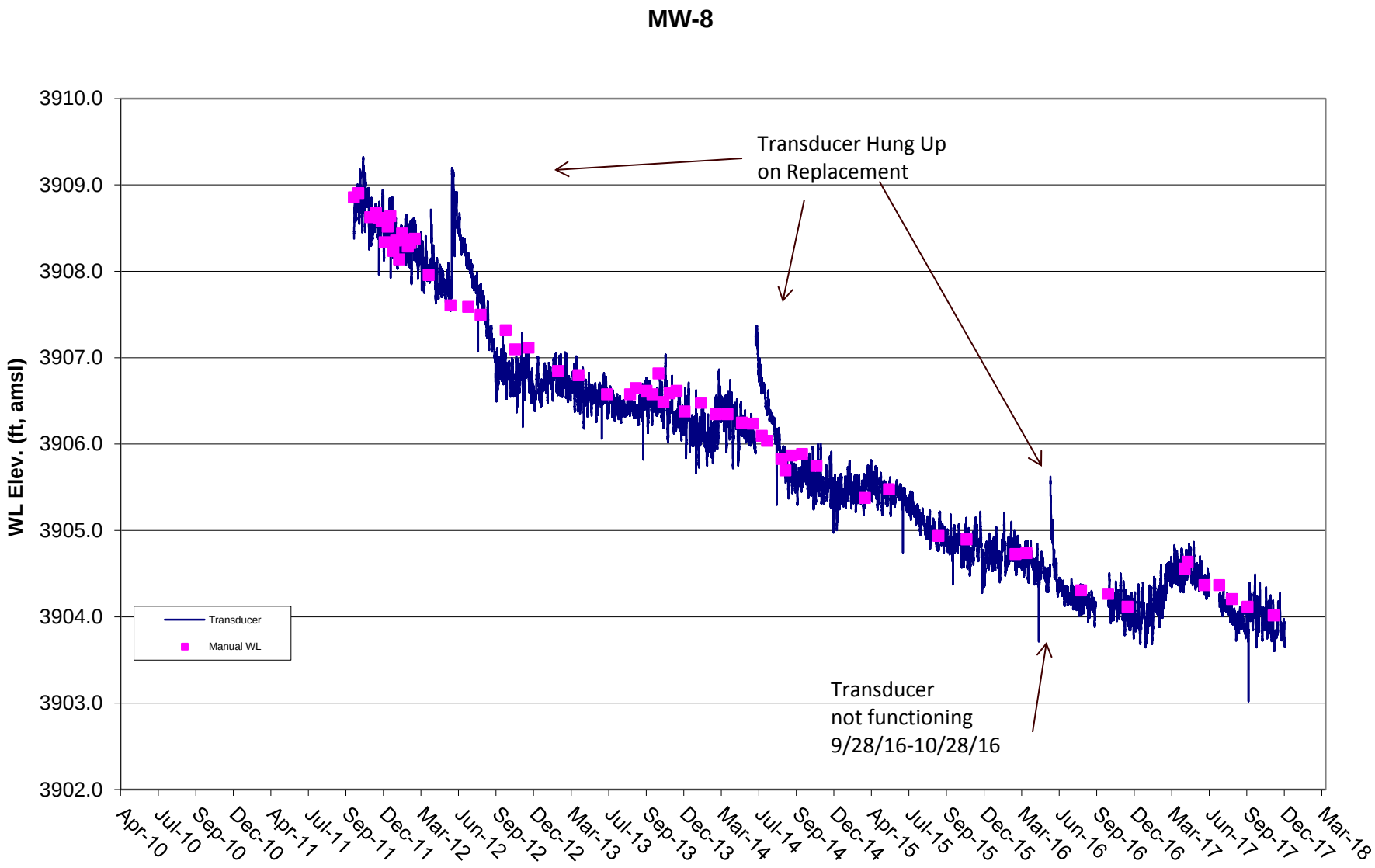

EH-141
WL Elev. (ft, amsl)
3795
3790
3785
3780
3775
3770
Transducer
Manual WL
Apr-10
Jul-10
Nov-10
Mar-11
Jul-11
Nov-11
Mar-12
Jul-12
Nov-12
Mar-13
Jul-13
Nov-13
Mar-14
Jul-14
Nov-14
Mar-15
Jul-15
Nov-15
Feb-16
Jun-16
Oct-16
Feb-17
Jun-17
Oct-17
Feb-18

# EH-142

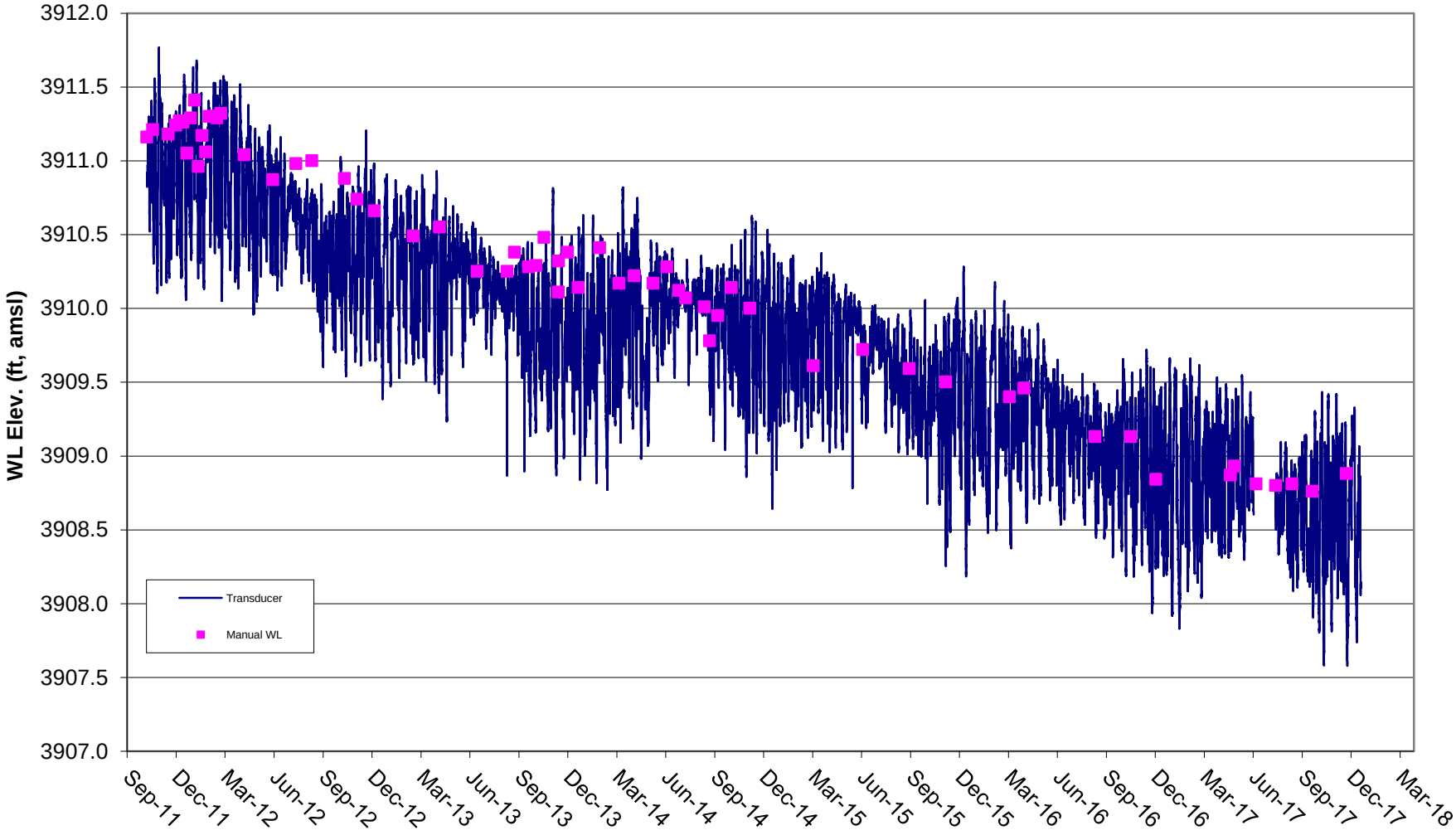

WL Elev. (ft, amsl)
3784
3782
3780
3778
3776
3774
3772
3770
3768
3766
3764
Apr-10
Jul-10
Sep-10
Dec-10
Apr-11
Jul-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jul-13
Sep-13
Dec-13
Mar-14
Jul-14
Sep-14
Dec-14
Apr-15
Jul-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jul-18
Transducer
Manual WL


MW-4
3898
3897.5
3897
3896.5
3896
3895.5
WL Elev. (ft, amsl)
Transducer
Manual WL
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18


MW-6
WL Elev. (ft, amsl)
3914
3912
3910
3908
3906
3904
3902
3900
3898
3896
Transducer
Manual WL
Transducer
not functioning
9/28/16-10/28/16
Apr-10
Jul-10
Nov-10
Mar-11
Jul-11
Nov-11
Mar-12
Jul-12
Nov-12
Mar-13
Jul-13
Nov-13
Mar-14
Jul-14
Nov-14
Mar-15
Jul-15
Nov-15
Feb-16
Jun-16
Oct-16
Feb-17
Jun-17
Oct-17
Feb-18

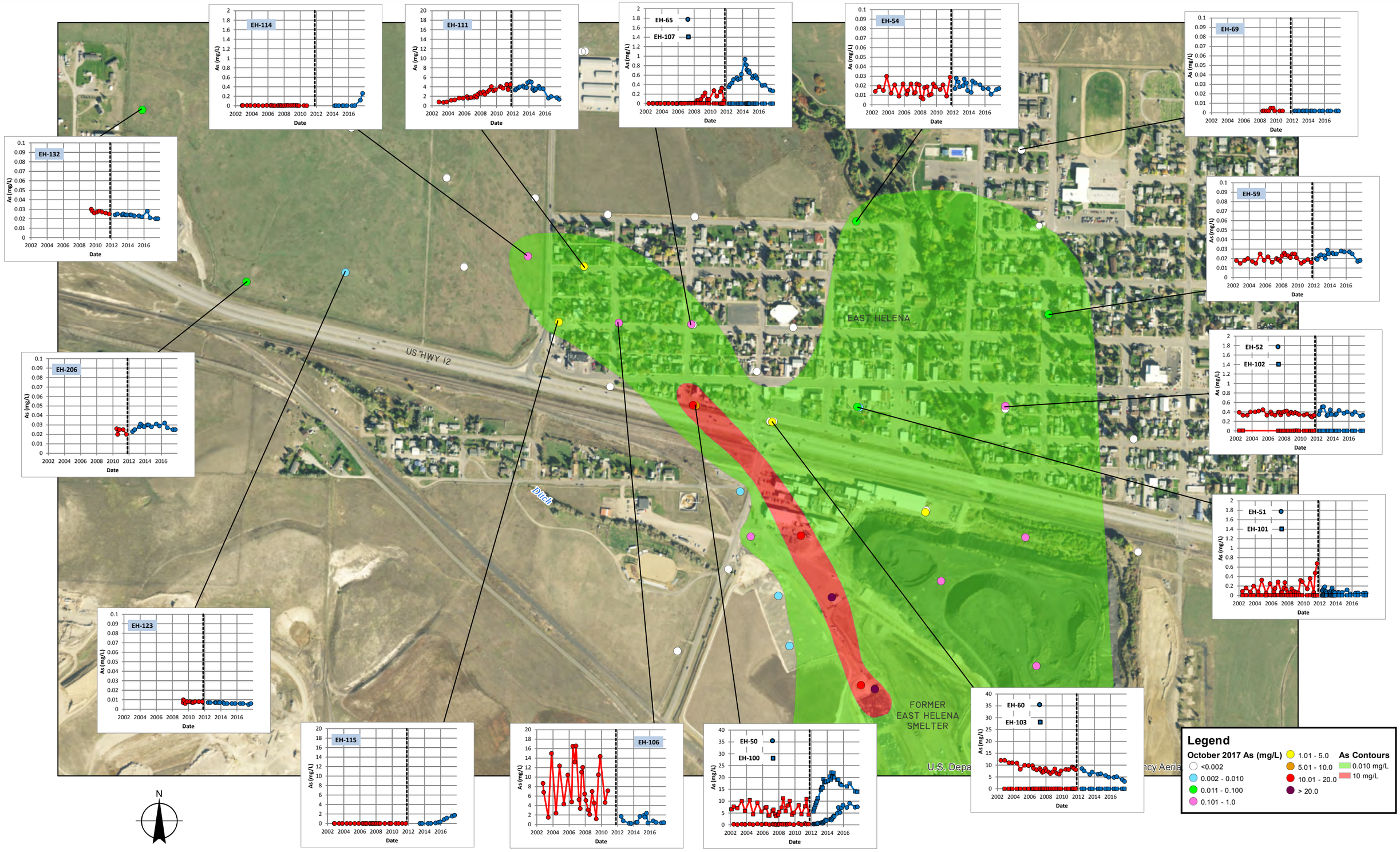

MW-8
WL Elev. (ft, amsl)
3910.0
3909.0
3908.0
3907.0
3906.0
3905.0
3904.0
3903.0
3902.0
Transducer Hung Up
on Replacement
Transducer
not functioning
9/28/16-10/28/16
Transducer
Manual WL
Apr-10
Jul-10
Sep-10
Dec-10
Apr-11
Jul-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jul-13
Sep-13
Dec-13
Mar-14
Jul-14
Sep-14
Dec-14
Apr-15
Jul-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18

# MW-11


WL Elev. (ft, amsl)
3912.0
3911.5
3911.0
3910.5
3910.0
3909.5
3909.0
3908.5
3908.0
3907.5
3907.0
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Transducer
Manual WL

# APPENDIX D

# SITE-WIDE GROUNDWATER CONCENTRATION TREND GRAPHS

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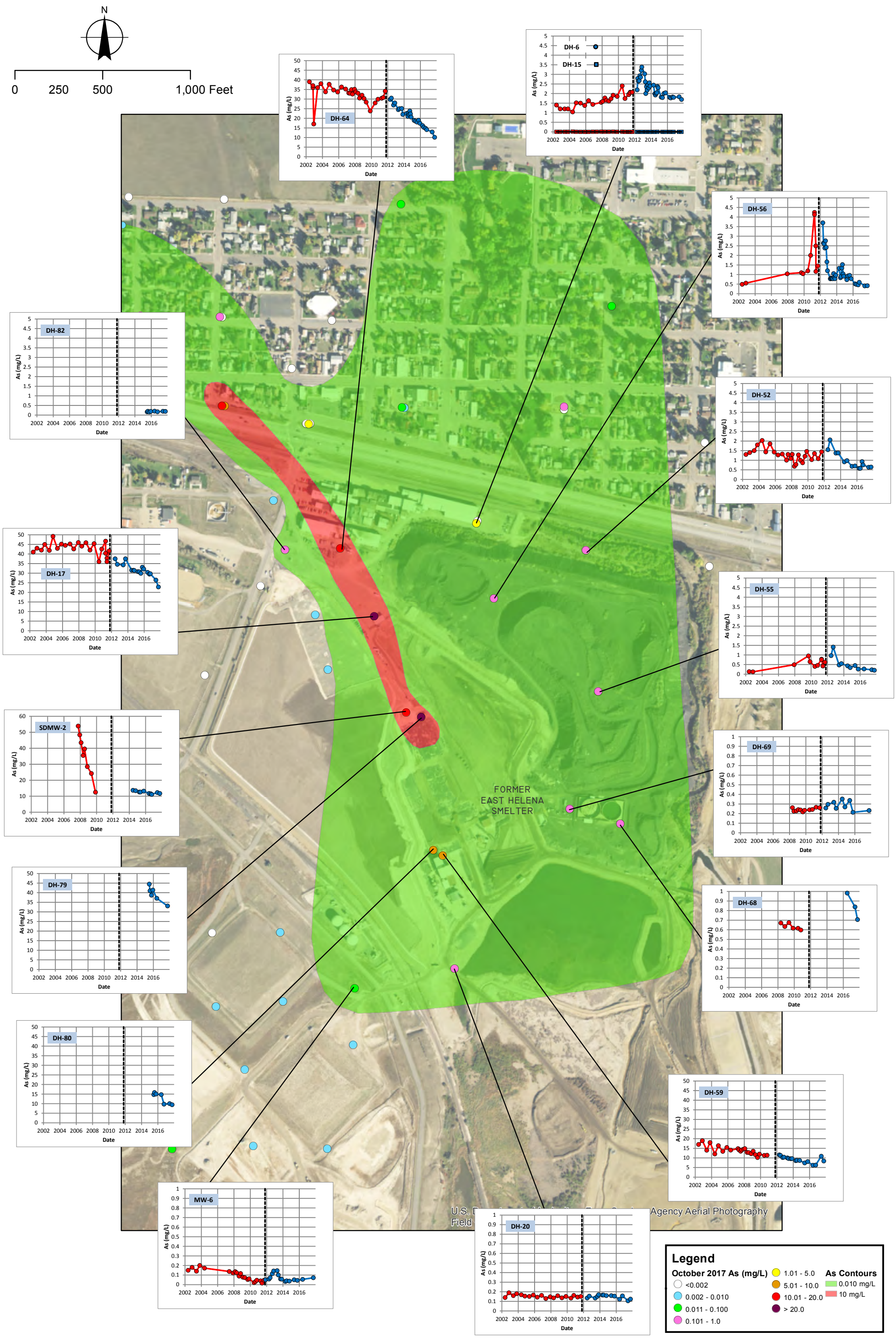
2017 WATER RESOURCES
MONITORING REPORT
EAST HELENA FACILITY

**ARSENIC TRENDS THROUGH OCTOBER 2017**
**FACILITY AREA WELLS**

FIGURE

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Consulting Scientists and Engineers

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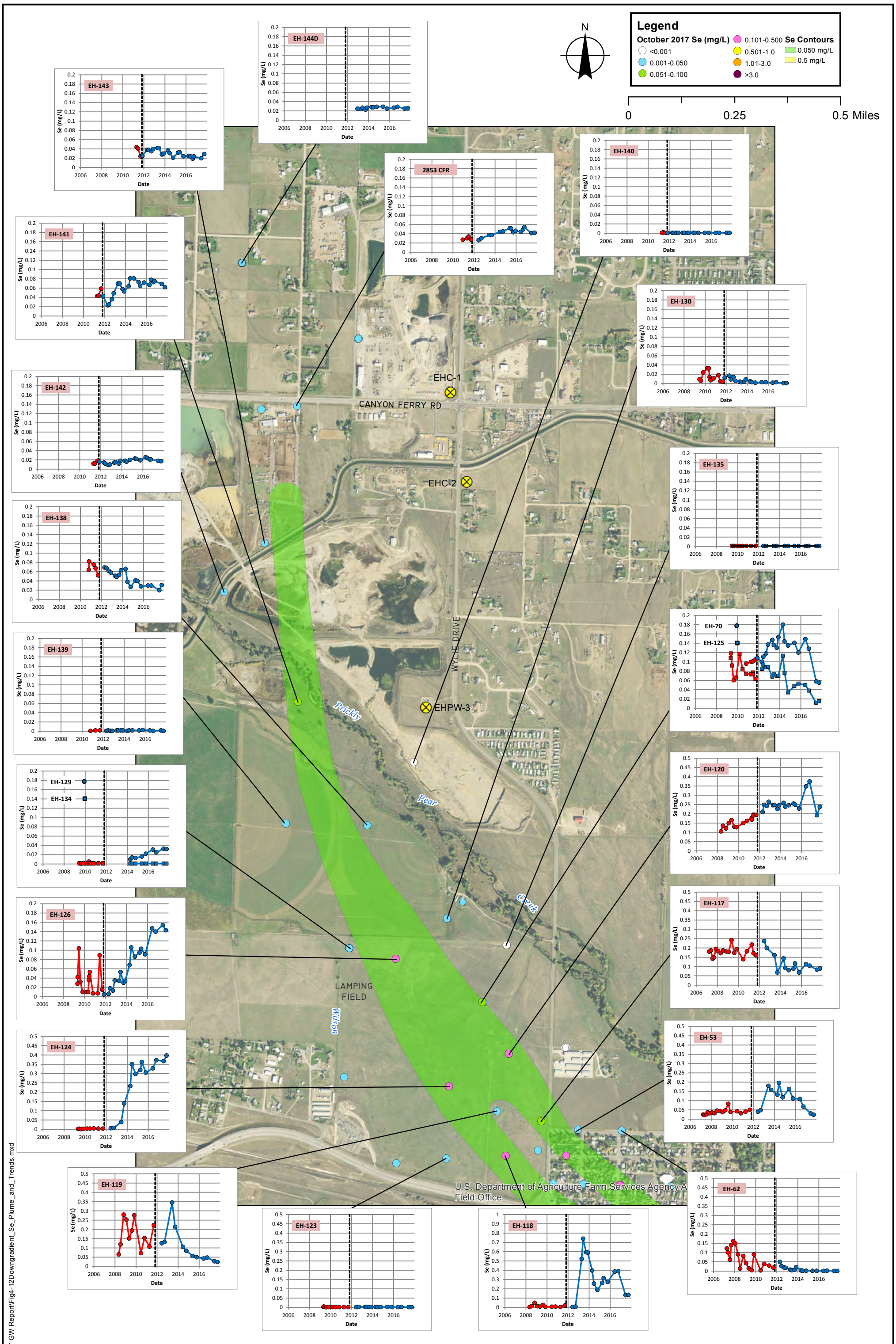
MONITORING REPORT
EAST HELENA FACILITY

**ARSENIC TRENDS THROUGH OCTOBER 2017**
**FACILITY AREA WELLS**

FIGURE

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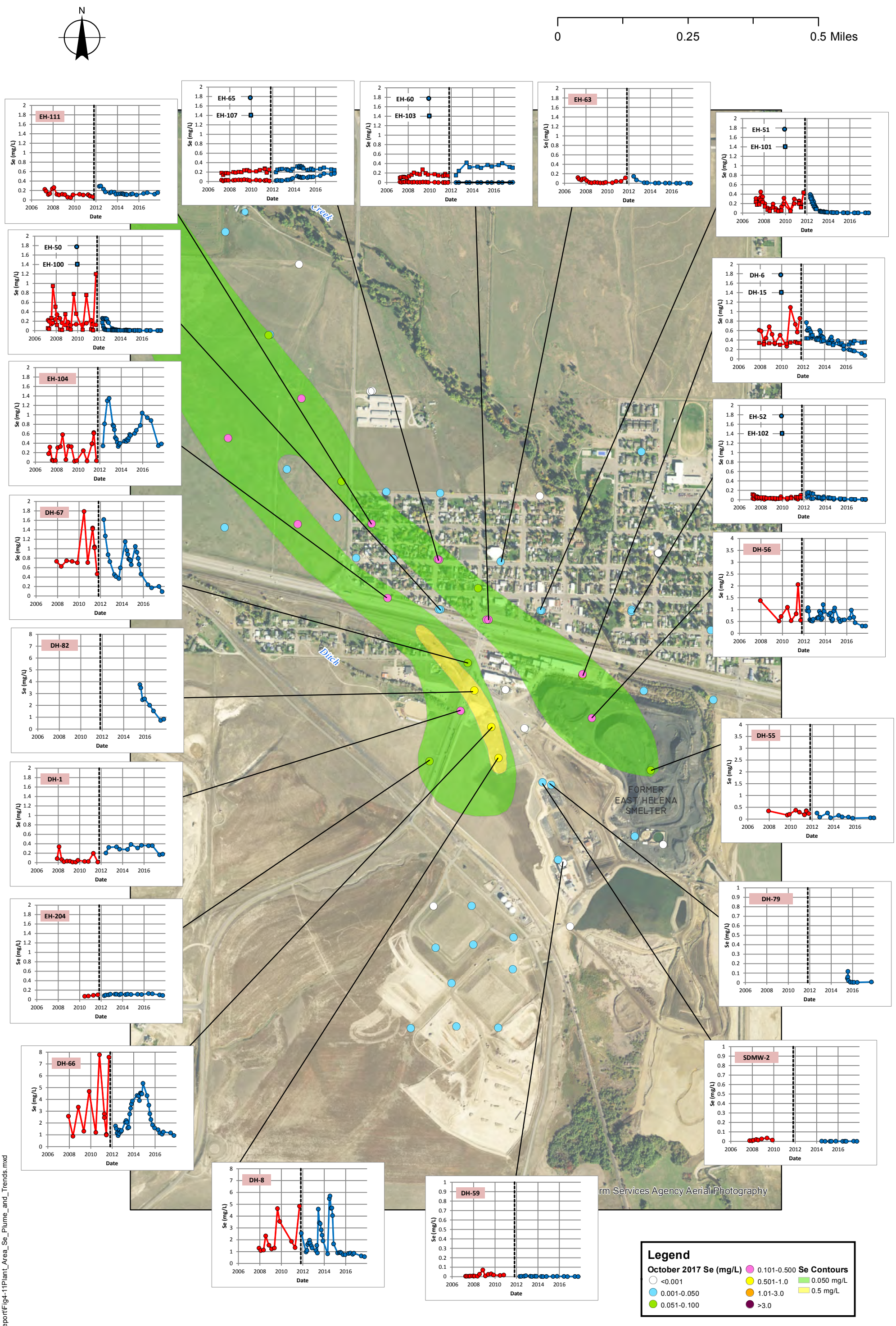
**SELENIUM TRENDS THROUGH OCTOBER 2017**
**DOWNGRADIENT AREA WELLS**

FIGURE

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EAST HELENA FACILITY

**SELENIUM TRENDS THROUGH OCTOBER 2017**
**FACILITY AREA WELLS**

FIGURE

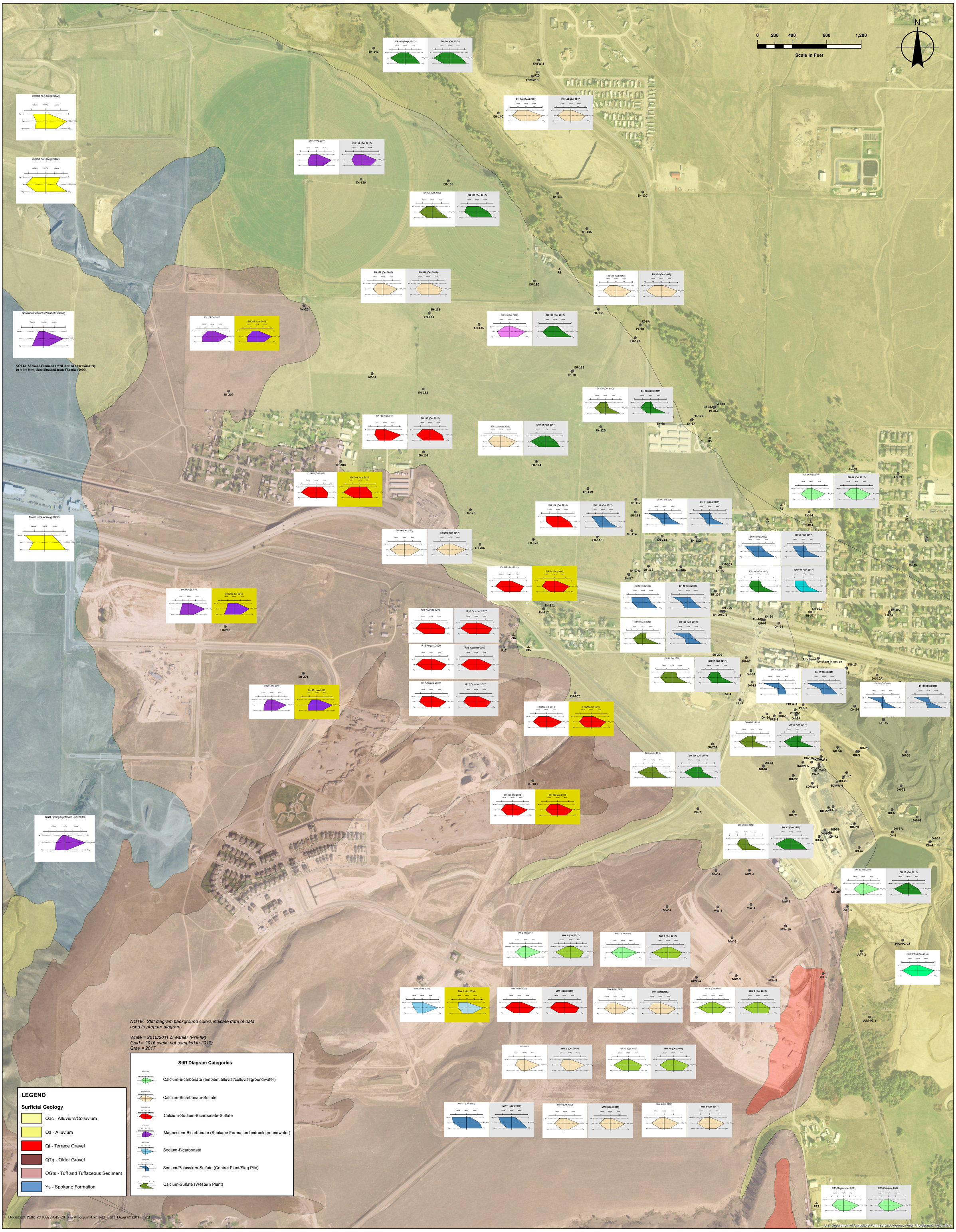
# EXHIBITS

2017 WATER RESOURCES MONITORING REPORT
EAST HELENA FACILITY

**2017 CAMP MONITORING WELL AND RESIDENTIAL / MUNICIPAL WATER SUPPLY WELL MONITORING NETWORK**

EXHIBIT

**1**

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2017 WATER RESOURCES MONITORING REPORT
EAST HELENA FACILITY

**GROUNDWATER STIFF DIAGRAM COMPARISON FOR SELECTED WELLS**

EXHIBIT
**2**