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March 15, 2019

Brian Jankauskas, P.E.
New York State Department of Environmental Conservation
Division of Environmental Remediation, Remedial Bureau A
625 Broadway
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Albany, NY 12233-7015

Subject: **Response to October 2018 Comments and Issuance of the *Revised Remedy Optimization Report***
Former Ciba-Geigy Facility - Main Plant Site in Glens Falls, NY
NYSDEC Site No.: 557011

Dear Mr. Jankauskas:

On behalf of Ashland LLC ("Ashland") and BASF Corporation ("BASF"), EHS Support LLC ("EHS Support") is submitting this second response to comments provided by the New York State Department of Environmental Conservation (NYSDEC) in an email dated October 10, 2018, regarding the *Remedy Optimization Report* (ROR) for the former Ciba-Geigy facility Main Plant Site (MPS) in Glens Falls, New York (the Site). This letter also transmits the *Revised Remedy Optimization Report* (Revised ROR*)*, which incorporates the comments provided by the NYSDEC on February 13, 2018 [1] and October 10, 2018. As a matter of background, Ashland and BASF (referenced herein as the Parties) are respectively responding on behalf of the Permittees for the Site, Hercules Incorporated (previously acquired by Ashland) and Ciba Corporation (previously acquired by BASF).

Responses to the comments provided by the NYSDEC on October 10, 2018 are provided below in a question and answer format with each NYSDEC comment presented in italics followed by the Parties' response, in order to address the comments as clearly and concisely as possible.

1. ***NYSDEC - Comments 1, 11, 27**: The initial response indicates that a geologic discussion and Figure 1 will be included in subsequent routine monitoring reports. The Department highly recommends that this discussion and Figure 1 be included in this document since this information helps to clarify site conditions and limits confusion when reviewing the data. This information helps to addresses comments 11 and 27 regarding the deep bedrock. The large gap between horizons B and C does seem to reduce the vertical migration of site contamination, but increased post ROP concentrations at AW-C11 up to 5,400 ug/l (more than half of the initial value indicated on Figure 2) suggests a connection or movement of material through the 100-foot thick interval of low hydraulic conductivity rock is occurring. This increase seems to go against the concept in the ROP, which the Department agreed with, that site contamination within bedrock*

[1] The Ashland and BASF project teams attended a meeting at the NYSDEC offices in Albany on March 21, 2018, to discuss the February 13, 2018 NYSDEC comment letter, and a written response to comments was provided to the NYSDEC by the Parties on September 13, 2018.

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wells will reduce when the pumps are shutdown since the pumps would not be drawing the site contamination into the bedrock horizons.

Parties' Response: As requested by the NYSDEC, a geologic discussion and the cross section previously submitted to the NYSDEC on September 13, 2018 have been incorporated in the Revised ROR. A new subsection – Section 1.2 Environmental Setting – has been added to the Revised ROR. This subsection provides summaries of the Site geology and Site hydrogeology and includes the new *Hydro-Stratigraphic Units and Geologic Cross Section* as **Figure 1-3**.

The goals of the Remedy Optimization Plan (ROP) (EHS Support, 2016) remain unchanged and are consistent with the Conceptual Site Model (SCGCMEE Report, EHS Support, 2015). The bedrock groundwater horizon goals established in the ROP were focused on the shallow and intermediate bedrock, since there is no Site-wide hydraulic connection between Horizons A and B water-bearing units and the underlying Horizon C unit (where AW-C11 is screened), and because groundwater extraction implemented as part of Corrective Measures was not intended to remediate Horizon C. As stated in Subsection 7.2 of the ROP, *"in the Central Area, although it appears that much of the historical mass in-place has been removed, there is evidence that in some areas, recent bedrock impacts may have been caused by the GWES itself. In this case, continued bedrock pumping may be introducing impacts from the overburden into the shallow bedrock and further warrants an alternative strategy to reverse the recently observed trends*."

As detailed in the Parties' September 13, 2018 responses to NYSDEC Comments 11 and 27, Horizon B and Horizon C are separate isolated water-bearing units separated by a 100-foot thick low-hydraulic conductivity interval. The parties further acknowledged the increase in chromium concentrations observed at well AW-C11 after shutdown of the former Horizon A and Horizon B groundwater extraction wells in late 2016, with chromium concentrations at AW-C11 in 2017 and 2018 at a similar magnitude, but lower than the historical maximum concentration at this well. Migration of chromium through the 100-foot thick interval of low-hydraulic conductivity rock from the Horizons A/B water-bearing units to the Horizon C water-bearing unit is highly unlikely. The most plausible cause of the localized increase in chromium concentrations at well AW-C11 is a discrete anthropogenic feature (e.g., potential downward water seepage along casing of a deep well). Another possibility is a localized geologic feature, such as an open vertical/high-angle fracture or fault connecting the overburden/shallow bedrock and the Horizon C; however, the available hydrogeologic data, geologic data and the Conceptual Site Model indicate this is unlikely.

2. ***NYSDEC - Comments 5, 20:*** *As part of the remedy optimization process an assessment of the French drain should be evaluated to determine if any modifications can be performed to improve the performance of the system. Based on the responses the Department understands that no easy modifications to the existing French drain system can be made to improve the capture zone between Sump B and MH-4. The Department would like further evaluation to be performed to assess if any changes can be made near MH-4, which seems to be where the French drain has the least amount influence, Figures 2-1, 4-4 and 4-14.*

Parties' Response: As discussed with the NYSDEC in a conference call on December 14, 2018 [2] the Parties have performed further review of the geology and the saturated thickness of the overburden horizon in the vicinity of manhole MH-4 under pumping and non-pumping conditions. As part of this evaluation, the following figures were developed and submitted to the NYSDEC in advance of the conference call: [3]

- A new cross section with an orientation perpendicular to the river and to the French drain, to illustrate the hydrostratigraphy in this area
- An annotated version of ROR **Figure 4-14**, which summarized the further review of boring logs and the determination of clay occurrence and thicknesses in the area between manhole MH-4 and Sump B

As discussed with the NYSDEC on December 14, the additional evaluations support the Parties' previous determination that there is limited aquifer saturated thickness within the overburden horizon (approximately 3 feet) in the vicinity of manhole MH-4 during current Sump A and B pumping conditions; that any additional pumping in the vicinity of MH-4 could achieve only 1-foot of additional drawdown as compared to current groundwater levels; and that this would have a negligible effect on expanding the downgradient extent of the capture zone.

The additional review of the boring logs for borings installed in this area determined that the basal clay unit that separates the overburden from the bedrock is present in the majority of borings installed (in three borings, the presence or absence of the clay could not be confirmed due to borehole conditions and partial sample recovery; see notes on Figure 4-14), which supports a determination that the French Drain is substantially keyed into clay and that the clay unit is pervasive in this area.

On this basis and on the basis of previously-presented hydrogeologic evaluations that demonstrate full groundwater capture is achieved in the vicinity of manhole MH-4, the Parties are not planning to change the current overburden pumping approach in the vicinity of manhole MH-4. Adding pumping at manhole MH-4 is not necessary since the system is achieving the goal of capturing and controlling groundwater flow at MH-4.

As part of on-going operation and maintenance of the French Drain, the Parties will compare the pumping ranges obtained at Sump B to operational targets and the constructed manhole elevations to ensure that overburden groundwater is extracted at Sump B to the extent practicable. This information will be presented in the annual Operation and Maintenance Reports for the Site.

The new cross section that was developed as part of this evaluation has been added to the Revised ROR as **Figure H-2** in **Appendix H**, and the revised **Figure 4-14** has been inserted. Boring logs that were referenced for the refinement of **Figure 4-14** have also been added in **Appendix H**, along with a plan view figure that illustrates the location of each boring and the clay thickness that was documented (**Figure H-3**). Finally, a summary of the Parties' evaluations of this topic

[2] Conference call on December 14, 2018, with Brian Jankauskas, NYSDEC; Jim Vondracek, Hercules; Cassie Reuter and Jim Breza, EHS Support; and Bob O'Neill, Brown and Caldwell

[3] Email submitted to Brian Jankauskas, NYSDEC, by Cassie Reuter, EHS Support LLC, on December 14, 2018.

have been added to Sections 4.5 and 4.6 of the Revised ROR.

3. ***NYSDEC – Comment 6****: The Department agreed with the concept in the ROP, which thought that chromium contamination was migrating into the bedrock due to the pumping of the bedrock recovery wells and that site contamination within bedrock wells will reduce when the pumps are shutdown. Unfortunately, during the temporary shutdown of the bedrock wells, post-ROP chromium concentration appear to have increased at EW-B5 and AW-C11 when compared to pre-ROP results. The response to the Department's question included calculations regarding the amount of chromium removed from the environment for the system and EW-B5. These calculations identify that a significant portion of the chromium for the site was removed at EW-B5 during pre-ROP conditions. A source of material appears to be present that is causing the contamination at EW-B5. In 2015, attempts failed to identify the source of the contamination within the overburden. As indicated in Part 375, Section 2.8, the goal of the remedial program for a specific site is to restore that site to pre-disposal conditions to the extent feasible. At a minimum, the remedy selected shall eliminate or mitigate all significant threats to the public health and the environment presented by contaminants disposed at the site through proper application of scientific and engineering principles. Due to the significant contamination at EW-B5 and the presence of the extraction well pump and conveyance system it is necessary to continue to remove this contamination so the site can comply with Part 375 Section 2.8. As a result this supersedes the performance goal indicated in the ROP and the shutdown criteria in this response, which was based on the protection of the environment/Hudson River. If EW-B5 conditions improved then the ROP performance goal would have been appropriate. Continued operation of EW-B5 will be necessary and shutdown of the pump will be based on future assessments since other factors will determine when it is appropriate to shutdown the extraction well. This would change the bedrock performance goal indicated in Table 1-1.*

   Parties' Response: With the exception of extraction well EW-B5, two years of quarterly sampling has demonstrated stable chromium concentrations in the intermediate horizon bedrock wells on-Site. With respect to well EW-B5, this comment was addressed in a letter submitted by the Parties to the NYSDEC in November 2018. [4]

   As described in the letter submitted by the Parties to the NYSDEC on November 27, 2018,[5] in December 2018, groundwater extraction was reinitiated at Horizon B well EW-B5 (where the highest chromium concentrations are located on-Site). Chromium concentrations will continue to be monitored at wells EW-B5 and AW-C11 (and at other select locations) to establish trends under EW-B5 pumping conditions.

   The re-initiation of pumping at extraction well EW-B5 has been noted in the Revised ROR (Executive Summary, Section 2.0, Subsection 2.1 and Section 6.0 [Summary and Conclusions]).

4. ***NYSDEC Comments 16 and 46:*** *Request that Figure be included in the report and referenced in Section 4.5 as the cause of the fluctuations was a point of confusion for the Department.*

[4] EW-B5 Operations and Main Plant Site Groundwater and Surface Water Sampling Program. Letter Submitted by the Parties to the NYSDEC on November 27, 2018.
[5] EW-B5 Operations and Main Plant Site Groundwater and Surface Water Sampling Program (EHS Support, LLC; November 27, 2018)

Parties' Response: As requested, the figure entitled Diurnal Hydraulic Head Fluctuations Observed in the Hudson River and Site Groundwater has been incorporated into Section 4.5 of the Revised ROR. Diurnal influence on the hydraulic system is briefly discussed in Section 4.5 and the new figure included as **Figure H-1** in **Appendix H**.

5. ***NYSDEC Comment 21:*** *Not sure why this information was presented if not incorporated into the discussion since a significant drawdown was observed at EW-B3 (45 feet). This information could potentially be used to further assess the competency of the bedrock since EW-A11 (7 feet) had less of a drawdown within the shallow bedrock horizon. I am not sure on the pumping conditions, but you may have additional records that provide supplemental information to complete an assessment.*

   Parties' Response: As described in the Parties' response to comments submitted on September 13, 2018, there is insufficient data to conduct a meaningful interpretation of the head recoveries observed in extraction wells EW-A11 and EW-B3. Additional records are not available; therefore, additional analysis and discussion of the data has not been added to the ROR regarding these wells.

6. ***NYSDEC Comment 25****: The discussion appears to be limited as it relies on conductivity readings from Sump B to conclude that the main cause for decreased conductivity in Sump B is seepage along the Weir Brook corridor. I understand that you do not wish to do a site wide assessment regarding the feeder canal, but inclusion of some groundwater data seems warranted to support the conclusion indicated. If higher groundwater conductivity is discussed than a conclusion that canal water is migrating along the Weir Brook corridor would be a via conclusion. The present discussion does not remove the possibility that leaks within portions of the very old canal is influencing the groundwater conditions at the site, which are captured by the french drain/Sump B. A simple indication regarding groundwater conditions is not sufficient to connect the dots.*

   Parties' Response: The intent of Section 4.8 was to present an observation revealed in our evaluation of Sumps A and B transducer specific conductance and temperature data and how the data may relate to the former Weir Brook corridor impact on local groundwater conditions via a "short-circuiting" of water inflow in the vicinity of Sump B trench system. This data interpretation is focused wholly on the possible water contribution by the former Weir Brook corridor on the Sump B French Drain system. This section is not intended to provide a Site-wide discussion of the influence the Feeder Canal on the entire site. No further clarification or enhancement to Section 4.8 is warranted in the context of the ROR.

7. ***NYSDEC Comment 49****: In Table B of Figure 4-22 indicates AW-10A, which I believe is AW-A10.*

   Parties' Response: This correction has been made and the updated version is provided in the Revised ROR.

8. ***NYSDEC Comment 50****: A similar comment was provided for comment 48 since readings were also obtained from various dates. The Department does not agree with the use of this information to assess vertical gradients, but if you are going to present it a similar note as indicated in response to comment 48 should be included*.

Parties' Response: The Parties will present the vertical gradients as shown in **Figure 4-23**. However, the following notation has been added to **Figure 4-23** to clarify the use of the data.

> "Note 3. There is limited pre-bedrock recovery well system shutdown groundwater elevation data available for monitoring wells AW-A14, AW-B4, and AW-C11 for use to conduct a hydraulic head comparison. Same day measurements for each location do exist for post-bedrock recovery well system shutdown. The closest available measurement dates for the pre-bedrock recovery well system shutdown was used to calculate the vertical hydraulic gradients. The calculated vertical hydraulic gradients are considered estimated."

A revised **Figure 4-23** to include this note is provided in the Revised ROR.

Closing

We look forward to receiving approval of the *Revised Remedy Optimization Report*. Please contact Cassie Reuter at (608) 558-6795 regarding any questions or further discussion.

Sincerely,

Jim Breza

Cassie R. Reuter

James Breza
Senior Hydrogeologist

Cassie R. Reuter
Project Manager

Enclosure

cc: Eamonn O'Neill, New York State Department of Health
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Revised Remedy Optimization Report
Former Ciba-Geigy Facility
Glens Falls, NY

Prepared for:
Hercules Incorporated

Prepared by:

EHS Support
consider it done

March 2019

I, Kristin A. VanLandingham, P.E., certify that I am currently a NYS-registered professional engineer and that this *Revised Remedy Optimization Report* dated March 2019 for the Former Ciba-Geigy Facility located in Queensbury Township, Glens Falls, New York was prepared in accordance with all applicable statutes and regulations, and in conformance with the DER Technical Guidance for Site Investigation and Remediation (DER- I 0).

STATE OF NEW YORK
KRISTIN A. VanLANDINGHAM
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LICENSED PROFESSIONAL ENGINEER

Kristin A. VanLandingham, P.E.
NYS License No. 089610

03/15/2019
Date

I, James Breza, P.G., certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this *Revised Remedy Optimization Report* dated March 2019 for the Former Ciba-Geigy Facility located in Queensbury Township, Glens Falls, New York was prepared in accordance with all applicable statutes and regulations, and in conformance with the DER Technical Guidance for Site Investigation and Remediation (DER- I 0).

James Breza, P.G.
FL License No. PG1439

03/15/2019
Date

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ACRONYMS

µg/L	micrograms per liter
µs/cm	microSiemens
cfs	cubic feet per second
CGW	Groundwater Concentration Performance Criteria
COC	constituent of concern
CSM	Conceptual Site Model
DCB	dichlorobenzene
DER	Division of Environmental Remediation
DMR	discharge monitoring report
EPS	Effluent Pumping Station
ft	feet or foot
ft bgs	feet below ground surface
ft/d	foot per day
ft^3/d	cubic feet per day
ft msl	feet above mean sea level
GPD	gallons per day
GPM	gallons per minute
GSMP	Groundwater-Surface Water Monitoring Plan
GSMRS	groundwater-surface water monitoring reports
GWES	groundwater extraction system
HDPE	high-density polyethylene
HP	horsepower
HWM	Hazardous Waste Management
lb/day	pounds per day
mg/L	milligram per liter
MPS/Site	Main Plant Site
NYSDEC	New York State Department of Environmental Conservation
POTW	publicly owned treatment works
ROP	Remedy Optimization Plan
ROR	Remedy Optimization Report
SCGCMEE	Site Conceptualization and Groundwater Corrective Measures Effectiveness Evaluation
SWQC	surface water quality criteria
TOGS	Technical and Operations Guidance Series
USEPA	United State Environmental Protection Agency
USGS	United States Geological Survey

EXECUTIVE SUMMARY

EHS Support LLC ("EHS Support") has prepared this *Revised Remedy Optimization Report* (Revised ROR) on behalf of Hercules and Ciba-Geigy Corporation ("CIBA") for the groundwater extraction system (GWES) at the former CIBA pigments manufacturing facility located at 89 Lower Warren Street in Queensbury Township, NY. The GWES was installed as part of the Corrective Measures implemented for the Main Plant Site area (referred to herein as the MPS or the Site) and fully commissioned by 2003. Operations are conducted under the 2015 Site Hazardous Waste Management (HWM) Post Closure Permit issued by the New York State Department of Environmental Conservation (NYSDEC; Site No. 557011). Hercules and CIBA are the Site permittees and share responsibility for environmental activities.

The GWES included an approximately 2,100-foot (ft) long French Drain system, designed to collect groundwater from the overburden groundwater zone, and 20 groundwater extraction wells screened in the shallow bedrock and intermediate bedrock zones. Site groundwater conditions changed after the commencement of GWES operations, including a substantial decrease in constituent of concern (COC) concentrations, and additional subsequent investigations and modeling expanded the understanding of leachable fractions, fate and transport, and potential flux of COCs. The findings indicated that remediation activities should be focused on the overburden groundwater horizon in the Central Area of the Site. In response, EHS Support prepared and submitted a Remedy Optimization Plan (ROP) to the NYSDEC in 2016 (EHS Support, 2016). Following approval by the NYSDEC, the ROP was implemented in November 2016.

The ROP included the following modifications to system operations, infrastructure, and monitoring:

- Modifying the French drain system operation by suspending pumping at Sump C, which is one of the three sumps within the system. This reduced the length of the operational French Drain system by 500 feet (1,600 feet remain in operation, with water collected from Sumps A and B).
- Suspending pumping at the 20 bedrock extraction wells.
- Installing and commissioning an updated telemetry system to monitor water levels and system flow rates in French Drain Sumps A and B which remain in operation.
- Increasing the frequency of groundwater and surface monitoring to quarterly, for a period of two years after implementation of the ROP, and comparing results to site-specific GWES performance goals developed for surface water protection.
- Installing transducers and performing a hydraulic assessment for the French Drain system in the Central Area of the Site (located between Sumps A and B) for up to 12 months following ROP implementation, to document the extent of hydraulic influence and the monitoring of hydraulic head and gradients.
- Assessing the change in hydraulic gradients within the bedrock groundwater horizons, following the cessation of pumping, to validate the Conceptual Site Model and assess trends over time.

A summary of the status and findings from each component of the ROP is as follows:

System Optimization

Groundwater extraction continues from French Drain Sumps A and B at the Site. The overall average extraction rate since implementation of the ROP was 50,000 gallons per day (GPD), varying seasonally and with precipitation. The reduction in groundwater extraction rates (from historical average of 68,000 GPD) is consistent with the expected reduction after implementation of the ROP. The newly updated telemetry system has been operational since December 2016, with programming optimization and system notification updates conducted through Spring 2017. The system now provides pump status and flow rate data at 15-minute intervals and daily totalizer values. Alarms have been integrated into the system to provide notification of power outages and higher than anticipated water levels within the sumps. GWES downtime has been minimal since integration of these systems, and the extraction of groundwater from Sumps A and B has been optimized.

Following an evaluation of groundwater chemistry data from the period of 2016 through 2018, groundwater extraction was reinitiated at EW-B5 in December 2018.

French Drain System Hydraulics

Groundwater capture extent of the French Drain were defined based on a controlled shutdown of the pumping at the French Drain and recording the recovery responses at various monitoring point. It was shown that down-gradient capture extents from the French Drain are variable as evidenced by hydraulic head changes measured at wells AP-6 (inside capture extent), MW-OB30 (inside capture extent), MW-OB31 (inside capture extent), MW-OB33 (inside capture extent) and at wells MW-OB32 (outside capture extent) and MW-OB34 (outside capture extent). In short, the French Drain captures overburden groundwater flowing towards the Hudson River and creates a downgradient capture zone that extends up to 60 feet from the trench toward the river. Other characteristics of the French Drain's influence on the overburden groundwater flow regime are:

- Groundwater contours induced by pumping are generally centered around the French Drain.
- Groundwater from upgradient regions are intercepted by the French Drain.
- Based on the groundwater heads and relationships observed in the continuous data records, it is shown that downgradient capture areas are spatially variable.
- The groundwater capture characteristics are relatively precise as evidenced by multiple synoptic events at different dates under relatively wet and dry conditions.

Bedrock Hydraulics

The interpretation of the data for the bedrock wells was made from a similar basis as the overburden wells. Of note are the small but measurable recovery trends at the shallow bedrock wells AW-A14, AW-A10, and AW-A11. These wells are located very close to the French Drain. The head recoveries infer that groundwater in the shallow bedrock near the French Drain are influenced by pumping at Sumps A and B. Additionally, the groundwater heads at these shallow bedrock wells were higher than at the French Drain. This relationship infers that the net groundwater flow in the shallow bedrock in this general region is upward and likely captured by pumping at the French Drain – where the bedrock hydraulic head is greater than the pumping water level at Sump A and associated perforated piping.

Groundwater in the intermediate and deep bedrock wells generally did not respond to the sump pump shutdown in the French Drain. The exception is at well EW-B3 which is located adjacent to Sump A in the French Drain. The measurable groundwater recovery from pump shutdown and higher water levels compared to Sump A (during pumping) indicate that intermediate bedrock groundwater in this localized area may be captured by the French Drain.

Groundwater Chemistry Trends

Site-wide, groundwater quality characteristics have been consistent with past results before the ROP implementation. As anticipated based on the Conceptual Site Model (CSM) and past monitoring results, concentrations were higher in the Central Area than to the east or west.

- Concentrations of dissolved chromium, hexavalent chromium and total cyanide in overburden groundwater at certain locations in the vicinity of former Buildings 8 and 56 (the Central Area) and in the Western Area of the Site exceeded GA standards. Overburden groundwater extraction at Sumps A and B is ongoing in these areas and therefore, local impacts in the overburden are being remediated. This includes the mitigation of groundwater in the vicinity of well MW-OB30 that exhibited elevated hexavalent chromium since the ROP implementation.
- Groundwater quality characteristics in the bedrock have also been consistent with past results before the ROP implementation. Based on the changed hydraulic setting, it is anticipated water quality trends will evolve to new groundwater flow conditions. On this basis, in the shallow bedrock, it is anticipated that local impacts will be mitigated by the French Drain operation as an upward vertical flow was facilitated by significant head recoveries observed in the shallow bedrock. This includes the mitigation of groundwater in the vicinity of well AW-A11 that exhibited elevated hexavalent chromium since the ROP implementation.
- In the intermediate bedrock, the groundwater heads recovered with significant reductions in the vertical hydraulic gradients. This phenomenon alone minimizes potential vertical drag-down of overlying impacts. The reestablished groundwater flow regime indicates transport pathways that include upward flow towards the French Drain; discharge to the Hudson River and under-flowing the Hudson River. Of the local impacts observed in the intermediate bedrock, during 2016-2018, groundwater at well EW-B5 generally had higher hexavalent chromium concentrations than during pumping conditions prior to 2016. While the groundwater head at well EW-B5, which is lower than the river, indicates that impacted water will not discharge to the Hudson River at the Site, groundwater extraction was reinitiated at EW-B5 in December 2018.

The data collected since November 2016 demonstrates that the goals of the ROP have been achieved. EHS Support recommends that French Drain operations continue in the present mode – with groundwater extraction continued at French Drain Sumps A and B for the collection of overburden groundwater from the Central Area of the Site. Pumping at intermediate horizon well EW-B5 will be conducted in 2019, while performing an evaluation of chromium concentration trends at well EW-B5 under pumping conditions. Operational data and groundwater monitoring results will be reported to the NYSDEC as part of regular Site reporting.

The approximate length of active French drain piping (i.e., the sections of the French drain that flow to Sumps A and B) is 1,600 feet. As described in the ROP, the continued operation of Sumps A and B targets overburden groundwater within the 750-feet stretch of French Drain located between these two sumps (i.e., the Central Area of the Site) with the highest potential for contaminant flux. Under the existing French Drain construction, an additional 850 feet of piping is also active, including the 600-feet length of French Drain extending west of Sump A and the 250-feet length between Sump B and Manhole 5. COC concentrations in these areas are low and collection of groundwater is no longer considered to be required. In the future, modification of the French Drain design may be considered to cease collection of groundwater from these sections.

1.0 INTRODUCTION

This *Remedy Optimization Report* (ROR) provides documentation for optimization of the groundwater extraction system (GWES) and associated evaluations completed in 2016-2017 at the former Ciba-Geigy Corporation ("CIBA") pigments manufacturing facility (the Site) located at 89 Lower Warren Street in the Town of Queensbury, NY **(Figure 1-1).** GWES operations are conducted in the historical manufacturing area of the Site (referred to as the Main Plant Site or MPS), under a New York State Department of Environmental Conservation (NYSDEC) Hazardous Waste Management Post Closure Permit (NYSDEC Site No. 557011).

EHS Support LLC ("EHS Support") is submitting this report to the NYSDEC on behalf of Hercules, an affiliate of Ashland, and CIBA (previously acquired by BASF Corporation ["BASF"]). Hercules and CIBA are the Site permittees and share responsibility for on-going environmental activities.

1.1 Background

The GWES went into full operation in 2003, and includes an approximately 2,100- foot (ft) long French Drain system, designed to collect groundwater from the overburden groundwater zone parallel to the downgradient Site boundary and the Hudson River, as well as 20 groundwater extraction wells screened in shallow and intermediate depths within the bedrock. Over the past 14 years, the GWES has been successful in extracting hundreds of millions of gallons of groundwater, as well as hundreds of kilograms of COC identified in groundwater at the Site. In 2015, EHS Support submitted a *Site Conceptualization and Groundwater Corrective Measures Effectiveness Evaluation (SCGCMEE) Report* to NYSDEC for this Site (EHS Support, 2015). The report provided a compilation of data collected at the Site; a demonstration that concentrations of Site COCs have declined significantly over time; an updated CSM; and the recommendation that groundwater remediation activities be focused in the Central Area of the Site (GWES target area).

In 2016, EHS Support submitted a *Remedy Optimization Plan* ([ROP]; EHS Support, 2016), which was approved by the NYSDEC in an e-mail on November 8, 2016 (NYSDEC, 2016a), and in a letter dated November 29, 2016 (NYSDEC, 2016b). Following receipt of NYSDEC approval, the recommended optimization measures were implemented in November 2016.

The ROP document outlined measures for optimizing GWES operations at the Site including: suspending pumping from one of three sumps in the French drain system (Sump C, located in the Eastern Area of the Site) and discontinuing pumping activities from the 20 bedrock extraction wells (**Figure 1-2**). The ROP further outlined an enhanced monitoring program, including hydraulic monitoring for the Central Area of the Site, where French Drain Sumps A and B remain in operation.

The frequency of regular water quality monitoring at the MPS was also increased as part of the ROP, from semi-annually to quarterly for a period of two years, to provide data for the evaluation of trends after the implementation of the ROP. Quarterly groundwater monitoring was initiated in December 2016. A revised telemetry system was also installed and commissioned to provide continuous data for water levels within Sumps A and B and for system flow rates.

1.2 Environmental Setting

The following is a summary of the geologic and hydrogeologic setting at the Site. In-depth review and evaluation of the Site's geologic and hydrogeologic setting were presented in the *SCGCMEE Report* (EHS Support, 2015). An illustration of the Site's stratigraphic and hydrogeologic units is shown in cross-sectional view on **Figure 1-3**.

1.2.1 Site Geology

The Site lies on the bank of the Hudson River. The unconsolidated and consolidated lithologies beneath the Site consist of glaciolacustrine and fluvial sediments (overburden) and underlying limestone bedrock. The overburden is a combination of industrial fill and fluvial/glaciofluvial sediments (i.e., sand, some silt, and clay), with glaciolacustrine clay at its base.

The bedrock is primarily limestone comprising three geologic formations: Glens Falls Limestone, Isle La Motte Limestone, and Fort Ann Formation Limestone (**Figure 1-3**).The limestone bedrock can be characterized as massive, with limited to no intergranular porosity and groundwater movement concentrated in fractured secondary porosity.

The historical structural forces that have acted upon the regional geology in the study area have created an enhanced secondary porosity of the limestone rock in the form of joints and fractures. The structural fractures formed parallel to bedding planes. The sub-horizontal bedding plane fractures are typically the main contributor to active groundwater flow through secondary porosity development. The more continuous these features the greater the influence they have on groundwater flow direction. Sub-vertical fractures may influence localized groundwater flow. High-angle joints, which formed almost 90 degrees to the bedding planes, also occur and are mostly mineralized; and hydraulic conductivity associated with these features is likely to be low. Relief of lithostatic load due to erosion during uplift (including isostatic uplift following glaciation) is likely to have been a significant contributor to the opening of horizontal or low-angle bedding fractures to form the water-bearing zones.

1.2.2 Site Hydrogeology

Four groundwater units have been characterized at the Site, with groundwater flow in the limestone bedrock controlled primarily by three zones of open, sub-horizontal, bedding-parallel fracture networks. The four groundwater units are listed below, from shallow to deep, and are shown on **Figure 1-3**:

- Overburden – unconsolidated sediments
- Horizon A (shallow) – limestone
- Horizon B (intermediate) – limestone
- Horizon C (deep) – limestone

The typical depth of the groundwater unit's fracture zones for the western part of the site is shown on **Figure 1-3**. In summary, Horizon A fracture zone occurs approximately 40 feet below ground surface (bgs), Horizon B fracture zone occurs approximately 60 feet bgs, and Horizon C fracture zone occurs approximately 160 feet bgs. Note, the bedding plane fracture zones generally become shallower toward the east, with Horizons A and B intersecting the top of bedrock surface (subcropping) in the Central and Eastern areas of the Site, respectively.

The groundwater flow within the four units is described as follows.

- *Overburden*: Groundwater flow in the overburden is to the south towards the Hudson River, with groundwater likely to discharge to the river under natural conditions (i.e., in the absence of the French drain). The overburden material (native lacustrine sediments, till, and fill) is variably saturated. The Overburden water-bearing zone includes the saturated portions of the fill and lacustrine sands and silts situated above the lacustrine clay unit (and local underlying till) or, where the clay unit is absent, above the bedrock surface. The water-bearing zone is locally thin and discontinuous, with unsaturated areas occurring near the Hudson River. The extent and/or existence of these areas varies with seasonal fluctuations in the groundwater table elevation.

- *Horizon A (shallow)*: Groundwater flow within Horizon A is generally in a southerly direction towards the Hudson River.
- *Horizon B (intermediate)*: Groundwater flow within Horizon B is generally in a southerly direction, with groundwater elevations below the elevation of the Hudson River.
- *Horizon C (deep)*: Horizon C groundwater elevations are below the elevation of the Hudson River, with groundwater flow generally to the west-southwest across the Site. There is a possibility that local dewatering of a quarry located southwest of the Site (on the south side of the Hudson River) may influence the direction of groundwater flow within Horizon C.

1.3 Refined Objectives and Performance Goals for GWES Operation

In the ROP document, refined objectives and monitoring approaches were established for groundwater in the overburden, and shallow and intermediate bedrock horizons. GWES performance goals were also established for the ongoing extraction of groundwater in the overburden horizon in the Central Area of the Site. These objectives, performance goals, and monitoring approaches, as established in the ROP, are provided in **Table 1-1**.

As further detailed in the ROP, the key anticipated benefits of GWES optimization included:

1. Concentrating groundwater flow and associated flushing in the Central Area of the Site that contains persistently elevated hexavalent chromium and cyanide concentrations.
2. Mitigating pumping-induced vertical migration of hexavalent chromium from the overburden into the bedrock.
3. Minimizing pumping of bedrock groundwater, influx of surface water, and associated potential dissolution of calcite within bedrock fracture planes. This dissolution has the potential to exacerbate flux of constituents to the river, enhancing hydraulic communication between groundwater and surface water and limiting time for complexation and precipitation of metals within the bedrock fracture system.

1.4 Key Questions

Monitoring activities that were performed since implementation of the ROP were designed to address several key questions. The key questions and overall conclusions based on evaluation of the monitoring data are summarized below, and are detailed in the following sections of this report:

- **Section 2 –** Did the ROP achieve the refined performance goals for overburden groundwater: "Extract overburden groundwater to the extent practicable, while managing hydraulic head to mitigate vertical migration of impacted overburden groundwater into the underlying bedrock unit?"
  - Yes – French Drain operations and monitoring have been optimized, and hydraulic data demonstrate extraction of overburden groundwater in the target area mitigating flux to the river and recovery of bedrock water levels following cessation of bedrock groundwater extraction, reducing the potential vertical migration of COCs from overburden into bedrock.
- **Section 3 –** Did the ROP achieve the refined objectives for overburden groundwater: "For areas where concentrations in overburden groundwater exceed Groundwater Concentration Performance Criteria (CGW) [site-specific groundwater concentrations protective of surface water, EHS Support, 2016], maintain groundwater collection in areas of high constituent flux to the Hudson River, and manage the flux of constituents to the river to maintain surface water quality adjacent to the Site below regulatory criteria?"
  - Yes – no changes to surface water quality resulted with changes to GWES operations initiated in November 2016; surface water quality adjacent to the Site is compliant with regulatory criteria.

- **Section 4 –** Did the ROP achieve its goal related to groundwater hydraulic conditions: "Continue water level monitoring in the vicinity of the French Drain to document the extent of hydraulic influence and the management of hydraulic head and gradients?"
    - Yes – Monitoring data demonstrate the area of French Drain influences hydraulic gradients between groundwater overburden and bedrock horizons during pumping and non-pumping conditions.
- **Section 5 –** Did the ROP achieve its goals related to groundwater quality: "Continue groundwater sampling to confirm that groundwater does not exceed concentrations that are protective of surface water in the Hudson River, and that concentrations are stable to declining?"
    - Groundwater concentrations outside the GWES target area are below CGW, and monitoring data collected to date indicate concentrations are below groundwater GA standards and stable or declining, verifying that no further groundwater remedial action is required in these areas.
    - Within the GWES target area hexavalent chromium exceeds the CGW at overburden well MW-OB30 and intermediate bedrock well EW-B5. Hydraulic data demonstrate that groundwater in the area of well MW-OB30 is within the capture zone of the French Drain, inhibiting potential flux to the river.

Discussion of the optimized GWES operations, surface water and groundwater quality, and detailed analysis of hydraulic conditions are provided in **Sections 2** through **5** of this report. Section 6 presents conclusions and recommendations regarding optimized GWES operations and further monitoring required for the Site.

2.0 DOCUMENTATION OF GWES OPTIMIZATION

GWES operations were modified in November 2016 as specified in the ROP, including the suspension of pumping from Sump C in the overburden French Drain and the 20 bedrock groundwater extraction wells. Enhanced system monitoring controls were put in place, including installation of pressure transducers in Sumps A and B to enhance pump control to maintain water levels within the design elevation range, and enhanced telemetry to monitor water levels and flow rates from Sumps A and B on a continuous basis. Monitoring data demonstrate that French Drain Sumps A and B are being operated to extract overburden groundwater to the extent achievable, and that the area of elevated overburden groundwater concentrations (targeted high flux area) is within the capture zone of the French Drain extraction (as discussed in **Sections 4** and **5**).

Following evaluation of groundwater chemistry data from the period of 2016 through 2018, groundwater extraction was reinitiated at EW-B5 in December 2018.

This section details the GWES optimization activities and operating conditions during the time period since ROP implementation (November 2016 through December 2018).

2.1 Pumping Modifications

Following the receipt of approval from the NYSDEC for the ROP on November 10, 2016, pumping was suspended from French Drain Sump C and from the 20 bedrock extraction wells, EW-A1 through EW-A14 and EW-B1 through EW-B6 (**Figure 1-2**). The pump in extraction well EW-B5 was removed to facilitate groundwater sampling and the placement of a transducer in this well. The pumps in the remaining wells and in Sump C were ‘winterized’ and left in-place.

In December 2018, the pump was reinstalled at extraction well EW-B5 and pumping was reinitiated at this well, in order to allow for additional evaluation of concentration trends under pumping conditions.

2.2 Post-ROP Pumping Configuration – French Drain

Pumping continues from Sumps A and B in the French Drain system, along an approximately 1,600-foot-long section parallel to the downgradient Site boundary. Sumps A and B are positioned at low points in the drain system, with the sumps extending 2–3 feet below the base of the French Drain, to the approximate average surface level of the Hudson River. The base elevation of the French Drain system is generally below the base of the overburden horizon, keyed into the underlying lacustrine clay horizon. The system was designed so that the perforated piping in the base of the drain slopes downward toward a sump, resulting in flow of collected groundwater toward the sump for extraction by pumping. The elevation of the perforated drain piping varies along the length of the system, between approximately 228 to 209 feet above mean sea level (ft msl), which is 10 to 26 feet below ground surface (ft bgs). The inlet piping to Sump A is located at 210 ft msl, and the inlet piping to Sump B is located at 209 ft msl **(Figure 2-1)**.

Groundwater extracted from Sump A is pumped through a 2-inch diameter high-density polyethylene (HDPE) force main (transfer pipeline), to a lift station, and then to the Effluent Pumping Station (EPS) located on the northeast area of the MPS (**Figure 1-2**). Groundwater extracted from Sump B is pumped through a 4-inch diameter HDPE force main to the EPS. At the EPS, the extracted groundwater discharges to a 500,000-gallon equalization tank, and is then discharged from the EPS to the City of Glens Falls publicly owned treatment works (POTW) in accordance with City of Glens Falls Industrial User Permit No. 002E. The City of Glens Falls renewed the discharge permit in April 2017; the permit requires discharge sampling and Discharge Monitoring Reports on a quarterly basis. (**Appendix A**).

The pumps in Sumps A and B continue to operate at the Site. Sump A contains a 1 horsepower (HP) submersible pump, and Sump B contains a 5 HP submersible pump. Sumps A and B are 4-ft by 4-ft concrete sump manholes with pipe inlets on each side connected to the French Drain perforated piping, which discharges groundwater collected in the trench to the sump via gravity flow.

There are two manholes located within the operating section of the French Drain alignment between Sumps A and B (MH-3 and MH-4; **Figure 2-1**), which are similar in construction to Sumps A and B except they are located at high points in the French Drain system and do not contain pumps. These manholes are the endpoints of the segments of the French Drain that drain to Sumps A and B (high points from which groundwater flows away toward the low point sumps), and provide access points in the French Drain for monitoring and maintenance. In the Central Area, MH-3 is the high point draining to the west toward Sump A and to the east toward Sump B.

2.3 Telemetry System and Pump Control Upgrades

During 2014, telemetry data transmission between extraction well vaults and sumps and the EPS became intermittent, and ultimately the data ceased being recorded.

To support the ROP, in December 2016 the Site telemetry system for the GWES instrumentation was repaired and upgraded for Sumps A and B to provide continuous telemetry data, including pump status, pumping rate (when active), and water levels within each sump. The level-float switches in each sump were replaced with transducer control to more accurately control water levels (via pumping) in the sumps. Diagrams illustrating the upgraded control and telemetry systems are provided in **Appendix B**.

In April and May of 2017, the pumping level set points in Sumps A and B were refined to achieve maximum drawdown within the sumps (i.e., optimize water extraction), while ensuring pump intakes remain submerged to avoid overheating/damage to the pumps. The pump operations are optimized to maintain water levels in the French Drain at or below base of the overburden horizon to the extent practicable. In Sump A, the transducer controlling the pump was calibrated to initiate pumping at a water level elevation of 211.2 ft msl and continue pumping until the water level reaches 209.7 ft msl (**Appendix B**). For reference, the overburden base elevation in the vicinity of Sump A is 215 ft msl or higher, and the invert of the French Drain inlet pipe at Sump A is at 210.2 ft msl (**Figure 2-1**). In Sump B, the transducer controlling the pump was calibrated to initiate pumping at a water level elevation of 214.0 ft msl and continue pumping until the water level reaches 211.5 ft msl (**Appendix B**). For reference, the overburden base elevation in the vicinity of Sump B is 217 ft msl or higher, and the invert of the French Drain inlet pipe at Sump B is at 209.2 ft msl (**Figure 2-1**).

2.4 GWES Discharge Monitoring

Optimized GWES operations discharged groundwater extracted from French Drain Sumps A and B. During operations, discharged water was monitored in accordance with the POTW permit (**Appendix A**). All monitored parameters were in compliance with the limits set forth in the permit, including the following permit limits for flow, chromium, and cyanide:

- Total Flow: 175,000 GPD (monthly average)
- Total Flow: 350,000 GPD (instantaneous maximum)
- Total Chromium: 3.1 pounds per day (lb/day) (maximum monthly discharge, based on monthly sample result and monthly average flow)
- Total Cyanide: 3.0 milligrams per liter (mg/L) (maximum, based on monthly sample result)

The GWES discharge flow volume is recorded daily at the permittees' dedicated flow meter, located at the southern end of the Preliminary Treatment Building at the Glens Falls POTW. The GWES discharge stream is sampled using a composite sampler at the south end of the POTW.

Discharge monitoring included analysis for total chromium by United States Environmental Protection Agency (USEPA) Method 200.8 and total cyanide by USEPA Method 335.4. The 2016 and 2017 discharge monitoring results for these parameters (representative of pre- and post- ROP implementation) are summarized in **Table 2-1**. All monitoring results were within the applicable permit limits. The chromium permit limit is a daily mass limit, so the concentration measured in the composite discharge sample is converted to an average daily mass using the monthly average flow.

For example:

$$Total\ chromium\colon \left(0.39\ \frac{mg}{L}\right)\left(\frac{g}{10^3\ mg}\right)\left(\frac{lb}{453.59\ g}\right)\left(\frac{1\ L}{0.2642\ gal}\right)\left(\frac{57{,}226\ gal}{day}\right) = 0.19\ \frac{lb}{day}$$

Additional parameters analyzed under the POTW permit include pH (continuous monitoring); lead, mercury and total phenols (monthly); total suspended solids (bimonthly); and annual sampling for 23 additional analytes, chemical oxygen demand, and oil and grease (monitoring frequencies and limits are provided in **Appendix A**). Discharge monitoring reports (DMRs) for the period from January through September of 2017 are provided in **Appendix C**. DMRs for 2016 were provided in the 2016 Operations and Monitoring Report (EHS Support, 2017c).

Based on the discharge monitoring data, cyanide concentrations increased after ROP implementation. This is consistent with cyanide concentrations in groundwater being highest in overburden groundwater, and an absence of dilution effects that likely resulted with extraction of bedrock groundwater. Chromium concentrations in discharged groundwater decreased following ROP implementation, which may be attributable to the absence of water extraction from EW-B5 where elevated chromium persists.

Average system flow rates were lower after ROP implementation compared to historical averages, as expected in response to suspension of pumping from the bedrock extraction wells and Sump C. As detailed in the ROP, flow contributions from Sump C and the bedrock extraction wells contributed up to 35 percent of the system flow prior to ROP implementation. The average year-to-date flow rate in 2017 was 50,000 GPD, as compared to the historical average of 68,000 GPD (**Figure 2-2**).

Flow totalizers are in place for both Sump A and Sump B, and readings were manually recorded on an approximately weekly basis throughout 2017 (**Appendix D**), as well as on a daily basis through the telemetry system beginning in May 2017. Consistent with historical data reviewed for development of the ROP, Sump B had a considerably higher average discharge rate than Sump A. When considering the combined discharge from these two sumps, on the order of 70 to 90 percent of the flow (average of 83 percent) was contributed by Sump B.

After telemetry upgrades were completed for Sumps A and B, continual (15-minute interval) operational data including pump status (on/off) and flow rate were available for each location. The data show that pumping typically occurred at Sump A every 2 days for approximately 5 hours, with a pumping rate averaging approximately 14 gallons per minute (GPM) when the pump was active. At Sump B, pumping typically occurred 3 times a day, for approximately 1.5 to 2-hour intervals. When active, Sump B pumping rates averaged approximately 90 GPM.

3.0 SURFACE WATER AND GROUNDWATER QUALITY SUMMARY

Semi-annual groundwater and surface water monitoring reports (GSMRs) were submitted to the NYSDEC in February 2017 (EHS Support, 2017a) and in September 2017 (EHS Support, 2017b), which provided the results of surface water and groundwater sampling conducted at the Site under the ROP monitoring program (in November and December of 2016, and in January, February, and July of 2017). This section provides a summary of surface water and groundwater quality based on these monitoring results and with consideration of historical Site conditions. In addition, surface water and groundwater quality criteria used in evaluating water quality are identified, and an overview of the CGW values developed in the ROP for use in evaluating groundwater conditions with consideration of optimized GWES operation goals. These CGW values represent conservative groundwater concentrations protective of surface water with groundwater discharge to the Hudson River, and were calculated using conservatively estimated flux areas and dilution attenuation factors.

A discussion of concentration trends in groundwater observed at key locations is presented in **Section 5**.

3.1 Water Quality Standards and GWES Performance Criteria

3.1.1 Water Quality Standards

Surface water and groundwater quality standards and guidance values for comparison to groundwater and surface water data are derived from New York State Code, Rules and Regulations (6 NYCRR 703.5 Table 1) and NYSDEC Technical and Operations Guidance Series (TOGS 1.1.1) (NYSDEC, 1998). Available water quality standards/guidance values (also referred to herein as criteria) for each analyte were provided in the Groundwater-Surface Water Monitoring Plan (GSMP) (EHS Support, 2016). The water quality criteria selected for comparison with the Site monitoring data comprise the following:

- Class GA groundwater quality standards protective of fresh groundwater for drinking water sources. The GA standards are included in **Table 3-1**.
- Surface water quality criteria (SWQC) for Class C waters, selected based on New York's classification of the Hudson River in the Site vicinity as "Class C" water. The available criteria for screening include standards/guidance values for protection of human health with fish consumption [designated as H(FC)] and/or protection of aquatic life from chronic and acute effects [designated as A(C) and A(A), respectively]. The available aquatic protection values (lowest surface water criteria available for fresh Class C waters) were used for screening and are included in **Tables 3-1 (**for hexavalent chromium, cyanide and vanadium**) and 3-2** (chromium criteria derived based on site-specific hardness measurements).

It is noted that comparison of groundwater data to GA standards is for reference only. Groundwater on-site is not used, and use of groundwater for any purpose is precluded (pursuant to the Deed Notice filed with Warren County).

3.1.2 GWES Groundwater Concentration Performance Criteria

GWES performance criteria were developed and presented in the ROP (groundwater concentrations [CGW] values in ROP Table 4-2; EHS Support, 2016c). The CGW values are important because they present an objective basis for determining potential risk to the receptor of interest (Hudson River) in a conservative scenario when impacted groundwater discharges to the river. For instance, the potential for this scenario to occur is anticipated during lapses in the operation of the GWES (i.e. unscheduled and unanticipated shutdown of pumping at the French Drain due to power failures, pump failures, etc.) or scheduled maintenance. The CGW values were calculated based on an assessment of streamflow characteristics of the

Hudson River, including the 7Q10 and 30Q10 critical low flows to facilitate an evaluation of the attenuative capacity of the river to naturally mitigate affected groundwater seepage and achieve surface water quality standards. This effort was based on NYSDEC's surface water mixing zone implementation guidance for total daily maximum loads and water quality-based effluent limits (NYSDEC, 1996). These CGW values are provided in **Table 3-4** along with the dilution attenuation values used to derive the CGW. The values represent conservative groundwater concentrations for the protection of surface water in the adjacent Hudson River, as calculated using dilution attenuation factors. Details of the derivation of these values is provided in the ROP. The CGW values include:

- Hexavalent Chromium: 2,838 micrograms per Liter (µg/L) for overburden; 80,828 µg/L for bedrock
- Free Cyanide: 1,602 µg/L for overburden; 69,586 µg/L for bedrock
- Vanadium: 2,954 µg/L for overburden; 157,542 µg/L for bedrock

The ROP included a contingency plan with triggers for further evaluation/response if monitoring results exceeded 90 percent of a CGW value (**Appendix E**). Contingency response sampling outlined in the ROP has been conducted for wells MW-OB30 and EW-B5, where hexavalent chromium concentrations above the CGW were detected during some sampling events. These data were previously provided to NYSDEC (EHS Support, 2017a; 2017b) and were considered in the discussions presented below.

3.2 Surface Water Results

Surface water monitoring provides surface water quality data at four locations in the Hudson River, including upstream, mid-stream, and downstream locations relative to the Site historical operations and groundwater impacts (SW-01 through SW-04; **Figure 1-2**). All surface water sample results collected from July 2015 through July 2017 (pre- and post-GWES optimization) were below surface water quality standards. The analytical results for this monitoring period are summarized in **Table 3-3.**

No free cyanide or vanadium was detected in surface water. Dissolved chromium results ranged from non-detect to an estimated concentration of 2.5 µg/L, demonstrating that concentrations are below the most conservative surface water standards based on fish propagation (ranging from of 13-38 µg/L for chromium, depending on measured surface water hardness; 11 µg/L for hexavalent chromium).

3.3 Groundwater Results

The analytical results for chromium, cyanide and vanadium in groundwater samples collected between 2015 and 2017 are tabulated in **Appendix F** (EHS Support, 2017b). The GA groundwater standards are also provided in the data table in **Appendix F** (Table F-1) and values exceeding a GA standard are noted in bold text. Figures summarizing chromium, cyanide and vanadium concentrations detected in groundwater during the period of February through July of 2017 are also provided in **Appendix F**. On each figure, well location markers are color-coded to indicate which horizon the well is screened in (i.e., overburden, and shallow, intermediate and deep bedrock horizons), and results that exceed the groundwater GA standards are denoted by orange text. During quarterly sampling conducted at the Site since implementation of the ROP in November 2016, concentrations at most locations at or near the downgradient property boundary, adjacent to the river, were below the calculated CGW values. Exceptions were hexavalent chromium concentrations at overburden well MW-OB30 and intermediate bedrock well EW-B5, which was used as an intermediate bedrock groundwater extraction well. Additionally, the vanadium concentration at overburden well MW-OB31 exceeded the CGW in January and March 2017, but was below the CGW during subsequent events. The hexavalent chromium concentration at MW-OB33 exceeded the CGW in June 2017, but was below the CGW during the subsequent sampling event in July 2017.

As noted in **Section 3.2**, groundwater is not in use at the Site and is precluded. As outlined in the CSM and in the ROP, the groundwater remedy was developed to mitigate risk associated with potential flux of COCs in groundwater that may discharge to surface water. The CGW values presented in the ROP were derived to be protective of surface water.

3.3.1 Overburden Groundwater

Consistent with past results, during the monitoring period between November 2016 and July 2017, concentrations of dissolved chromium, hexavalent chromium and total cyanide in overburden groundwater at certain locations in the vicinity of former Buildings 8 and 56 (the Central Area) and in the Western Area of the Site exceeded GA standards. Overburden groundwater extraction at Sumps A and B is ongoing in these areas. As anticipated based on the CSM and past monitoring results, concentrations were higher in the Central Area than to the east or west.

At well MW-OB30, concentrations exceeded CGW for hexavalent chromium between March and July of 2017. Based on the monitoring data, all chromium detected is in hexavalent form. No hexavalent chromium was detected in surface water samples collected from the river adjacent to this well (SW-03) or downstream (SW-02), and data collected during supplemental sampling conducted pursuant to the ROP contingency plan indicate the area of elevated (above CGW) impact is limited to the immediate vicinity of MW-OB30 (**Figure F-1 in Appendix F**).

Considering the attenuation processes occurring between the Site and the river, and within the hyporheic zone prior to discharge to the river, the potential flux of constituents in overburden groundwater at well MW-OB30 would not be sufficient to result in an exceedance of surface water quality standards. Sample results from adjacent wells AP-6 and MW-OB31 are below the CGW, indicating that the area of hexavalent chromium impact above CGW is localized and limited to the immediate area around well MW-OB30. This adds a factor of safety because the CGW value was calculated assuming a longer discharge transect. An additional factor of safety is provided by the assumed drought conditions (estimated 7Q10 river flow of 1,590 cubic feet per second [cfs]) used for calculation of CGW. A 7Q10 flow is the lowest average discharge over a period of one week with a recurrence interval of 10 years. Average daily river flows ranged from 4,000 to 20,000 cfs during the months of March 2017 through July 2017.

Well MW-OB30 is within the optimized GWES operation target area, and based on detailed hydraulic assessment and capture zone analysis, well MW-OB30 is within the capture zone of the French Drain, such that typical French Drain operating conditions result in groundwater at MW-OB30 flowing back toward the French Drain system, rather than discharging toward the river. Supporting data and analysis of groundwater levels and French Drain hydraulics for this location are provided in **Section 4**.

3.3.2 Shallow Bedrock

Shallow bedrock monitoring data indicate concentrations are below the CGW values developed in the ROP in all areas monitored. In the Western Area, wells AW-A2, AW-A15 and MW-28 are consistent with past results, with concentrations below GA standards (**Appendix F**).

In the Central Area, consistent with past results, concentrations at three wells in a localized area in the vicinity of former Building 56 (AW-A11, AW-A10 and AW-A14) were above GA standards for hexavalent chromium (AW-A11) or cyanide (AW-A10 and AW-A14). At well AW-A11, hexavalent chromium exceeded the GA standard of 50 µg/L, ranging from 390 to 1,200 µg/L between December 2016 and July 2017 (post-remedy optimization), and were higher during this period than during 2015 and previous 2016 sampling events. Hexavalent chromium concentrations in other shallow bedrock wells were below GA standards (generally not-detected or were near reporting limits). Consistent with the CSM, chromium detected in groundwater was all/nearly all in the form of hexavalent chromium.

Cyanide was detected above the GA standard of 200 µg/L at wells AW-A10 and AW-A14 prior to GWES optimization. Concentrations have been steadily declining over time, and were below or near the GA standard in June 2017 (maximum of 210 µg/L detected). Further discussion of shallow bedrock hydraulic conditions and groundwater concentrations trends is provided in **Sections 4** and **5**.

3.3.3 Intermediate Bedrock

Based on the monitoring data, COC concentrations in intermediate bedrock are below the CGW values developed in the ROP except for hexavalent chromium at well EW-B5. Similarly, as in the shallow bedrock groundwater horizon, chromium detected in intermediate bedrock was all/nearly all in hexavalent form.

In the Western Area of the Site (AW-B2, AW-B11, AW-B18 and MW-25D), hexavalent chromium was below GA standards (either not-detected or reported at estimated concentrations below the laboratory reporting limit). Vanadium concentrations were generally low (below or near reporting limits) and cyanide was below the GA standard except at inland well AW-B18 where concentrations ranged between 200 and 450 µg/L (**Appendix F**).

In the East Area of the Site (AW-B17 just east of Building 8) concentrations are below GA standards, with chromium and vanadium concentrations below or near detection limits and cyanide concentrations on the order of 20 to 35 µg/L.

In the Central Area, consistent with past results, groundwater concentrations at four intermediate bedrock wells in the vicinity of former Buildings 8 and 56 were above GA standards for either hexavalent chromium and cyanide (AW-B4, AW-B20, and EW-B5) or cyanide only (AW-B18). Cyanide concentrations ranged between 81 and 650 µg/L with the highest concentrations detected at EW-B5, while concentrations at inland well AW-B20 were slightly higher than downgradient well AW-B4. Hexavalent chromium at inland well AW-B20 has declined over time and was below the GA standard in June 2017. Concentrations at downgradient well AW-B4 were generally below or near detection limits, but was detected at 110-120 µg/L between November 2016 and March 2017, and subsequently below detection (less than 10 µg/L) in June 2017. Hexavalent chromium at well EW-B5 is significantly elevated compared to any concentrations detected elsewhere on the Site and in overlying units. Concentrations increased (by approximately 40%) following cessation of pumping, with a maximum concentration of 140,000 µg/L detected in June and July of 2017

At well EW-B5, hexavalent chromium concentrations exceed the CGW value of 80,828 µg/L. As further detailed in **Sections 4** and **5**, vertical gradients were significantly increased during historical bedrock pumping at this former intermediate bedrock extraction well. Hexavalent chromium concentrations increased following the cessation of pumping in November 2016, and monitoring data shows significant fluctuation in concentrations with July 2016 and March 2017 results being an order of magnitude lower than results for December 2016 and June and July of 2017, and in January 2017 an apparently anomalous concentration was reported (at 61 µg/L). Groundwater monitoring is continuing on a quarterly basis under the ROP, with the data to be used to assess when equilibrated conditions are reached and the post-bedrock extraction water quality trend at this location.

3.3.4 Deep Bedrock

Chromium concentrations above GA standards were detected in the deep bedrock well AW-C11, located in the Central Area of the Site, following cessation of bedrock groundwater pumping with concentrations of ranging between 2,500 and 6,000 µg/L (**Appendix F**). Chromium concentrations at well AW-C2 in the Western Area of the site are below the GA standard. Cyanide and vanadium concentrations in deep bedrock groundwater (in the Central and West Areas) are generally low and cyanide is below the GA standard. Further discussion of the hydraulic and groundwater quality in deep bedrock is provided in **Sections 4 and 5**.

4.0 HYDRAULIC EVALUATION

A hydraulics evaluation was performed to monitor water level elevations prior to and after the ROP implementation to support assessment of groundwater recovery post-bedrock pumping, hydraulic influence of the French Drain operations, and hydraulic context for concurrent water quality monitoring evaluations. The hydraulic assessment included the collection of continuous groundwater level, temperature and specific conductance measurements using in-well pressure transducers and data loggers placed in select overburden, shallow bedrock, intermediate bedrock, and deep bedrock wells, as well as within Sumps A and B in the French Drain. The Hudson River was manually gauged.

Hydraulic monitoring data collected through January 2017 under the ROP monitoring plan was provided to the NYSDEC in the semi-annual groundwater and surface water monitoring reports previously submitted (EHS Support, 2017a and 2017b). The full hydraulic monitoring dataset collected from November 2016 through August 2017 is included in this report, along with a discussion of the data and results of the hydraulic assessment.

4.1 Scope

4.1.1 Monitoring Points

In accordance with the hydraulic monitoring program presented in the ROP, continuous monitoring of groundwater elevations was conducted for six locations (Sump A, Sump B, MH-4, MW-OB33, MW-OB34 and EW-B5). An additional 18 well locations were added to the hydraulic monitoring program in 2017 to expand the program to include monitoring of the shallow and deep bedrock horizons as well as increase the spatial coverage within the overburden and intermediate bedrock. The Hudson River was gauged manually. The 24 locations monitored for groundwater data in this study are listed in **Table 4-1**. The locations of these wells are shown on **Figure 4-1**. Plots illustrating the hydrograph, temperature and specific conductivity data are included in **Appendix G** (Figures A through W).

4.1.2 Data Loggers for Groundwater Water Level, Temperature and Specific Conductance

The data loggers used in this study were Aqua TROLL 200, Rugged TROLL 200, and Level TROLL 700 electronic data loggers manufactured by In-Situ Inc. Depending upon the instruments' design the following parameters were measured: water level/pressure, temperature, and/or specific conductivity. The data loggers were programmed to measure water level elevation, water temperature, and water specific conductivity on 15-minute intervals (96 measurements per day). The data collected by the data loggers were typically downloaded on a weekly basis. The water level elevations measured by the electronic data loggers were periodically field verified with manual measurements.

4.1.3 Data Processing

Manual water level measurements were made at each monitoring point, typically on a weekly basis, to calibrate and verify the data logger water level elevation data. In addition, manual groundwater temperature and specific conductivity measurements were recorded during well purging/sampling activities. In most cases, the electronic data agreed with the manual field measurements.

The transducer data were reviewed for hydraulic head, temperature, and specific conductivity changes due to groundwater sampling activities or removal of the transducer from the well to download the electronic measurement data. The hydraulic head, temperature, and specific conductivity changes related to these activities were removed from the data set prior to data interpretation and presentation.

4.1.4 Precipitation Data

The precipitation data were obtained from the weather station located at the Floyd Bennett Memorial Airport, Queensbury, New York. The Floyd Bennett Memorial Airport is located approximately 2 miles north of the Site.

4.1.5 Hudson River Flow Data

The Hudson River daily mean flows were obtained from river stage gauge station United States Geological Survey (USGS) 0132770 located at Fort Edward, New York. The gauge station is located approximately 3.5 miles downstream of the Site.

4.1.6 Controlled French Drain System Shutdown

The French Drain system pumps in Sump A and Sump B were intentionally turned off to monitor the hydraulic responses (hydraulic head recovery phase) in the overburden, shallow bedrock and intermediate bedrock and deep bedrock. This control shutdown study (pulse test) was conducted from August 10, 2017 through August 14, 2017. The objective of this test was to provide additional characteristics of the hydraulic relationships between overburden, shallow bedrock, intermediate bedrock and deep bedrock within the Sump A and Sump B regions. Zero to negligible precipitation occurred 5 days prior to and during the control shutdown test; a dry period was intentionally selected to factor out potential effects of short term precipitation and the associated recharge. The 24 locations monitored in the ROP hydraulic study were observed during this test.

4.2 Objectives

The primary objective of the hydraulic evaluation was to ascertain the effectiveness of the GWES operation based on changes to historical GWES operational practices. Changes in the GWES operations included the reduction of pumping sumps (from three to two pumping sumps) in the French Drain of the overburden and the cessation of all bedrock pumping. The rationale for these changes were based on the longevity of continuous GWES operation (at least 13 years); Site-wide decreases in COC concentrations over time; and the concern of potential increase of vertical migration of COCs from the overburden by bedrock pumping and thereby, perpetuating bedrock impacts. On this basis, the following sections present data and discussions on the following areas:

- Seasonal conditions during the study duration to date. Discusses the general hydrologic setting based on the rainfall and relationship to Hudson River flow (**Section 4.3**);
- Site-wide groundwater flow regime (**Section 4.4**);
- Groundwater responses in the water-bearing zones from pumping at the overburden French Drain sumps and termination of bedrock pumping. Discusses the hydraulic relationships to pumping at the French Drain and the characteristics that are used to delineate groundwater capture areas in the vicinity of the GWES and the Hudson River (**Section 4.5**);
- Groundwater capture characteristics of the overburden from GWES pumping (**Section 4.5**);
- Groundwater responses in the bedrock after cessation of bedrock pumping. Focuses on the relative changes in the groundwater recovery and vertical gradients between the bedrock and the overburden (**Section 4.6**).
- Weir Brook Influences. Supplemental discussion on hydrologic influences from the Weir Brook in the vicinity of the GWES and its effect on pumping at the French Drain (**Section 4.6**).

4.3 Seasonal Conditions

Both precipitation and river conditions observed during this study duration (November 2016 to August 2017) are important to compare with the long-term conditions because both factors affect groundwater at the Site. On this basis, the seasonal conditions during the study duration were summarized by comparing the monthly total precipitation to historical monthly precipitation based on a 29-year average (**Figure 4-2)**. The precipitation records were measured at Floyd Bennett Memorial airport which is located about 2 miles north of the Site (station KGFL).

As shown, the monthly total precipitation was generally slightly lower or about the same as the long-term averages during most of the study duration with the exception of the month of July (especially wet) and August (especially dry) in 2017. The dry condition in August was relatively important for this study as it presented an opportunity to evaluate hydrologic conditions when the attenuative capacity of the Hudson River was especially low – similar to the conservative setting used to determine nonpoint source impacts using 7Q10 and 30Q10 flow conditions.

Figure 4-3 displays the monthly total precipitation and the daily mean river flows at the USGS gauge located near Fort Edward (gauge 01327750). The relationship between precipitation and the river flows is not well correlated unlike natural riverine systems. The primary reason is that the river is mostly controlled by flow structures (dams), which is characterized by the "stair-stepped" trends of the river flows as pool levels are maintained according to water needs. Outside of peak flows (as shown during the spring months), river flows generally ranged from approximately 2,000 cfs to 5,000 cfs. Based on long-term records, the lower flow (2,000 cfs) approximates baseflow at the 90-percentile exceedance probability and the upper flow (5,000 cfs) represents normal flows at the 50-percentile exceedance probability. This means that the Hudson River flow conditions observed during this study were generally consistent with the long-term flow records.

4.4 Site-Wide Groundwater Flow Regime

Figures 4-4 to **4-7** present the groundwater flow regimes at Site-wide scale for the overburden, the shallow bedrock, intermediate bedrock, and the deep bedrock. The time period (June 2017) represents the groundwater setting when all former bedrock extraction wells were shut down for at least 8 months, and the French Drain was being pumped at Sump A and B only.

In the overburden (**Figure 4-4**), groundwater flow was generally similar to past observations before the bedrock well shutdown – that is overburden flow is towards the French Drain where it is intercepted by the drain and flows within the drain to the pumping sumps. The extent of the capture areas is not detailed at this scale – especially related to down-gradient extent of the capture induced by pumping at the French Drain. These details are discussed in subsequent sections of this report.

Groundwater in the shallow bedrock and intermediate bedrock flows south towards the river (**Figures 4-5** and **4-6**, respectively). However, the flow characteristics are variable depending on the hydraulic head relationship to the river; pumping at the French Drain in the overburden; and the presence of the clay confining unit between the overburden and the shallow bedrock. For instance, with the bedrock water levels that recovered significantly in this area (due to bedrock extraction well shutdown), there is evidence that localized vertical groundwater flow in the shallow bedrock to the overburden is facilitated in the vicinity of the French Drain – particularly in areas where the sump pumping levels and associated piping are below the shallow bedrock water levels. The evidence that supports this observation is presented in detail in **Section 4.7** (Bedrock Recovery Characteristics). In summary, the hydraulic head data collected from shallow bedrock wells AW-A10 and AW-A11 located along Sump A French Drain system and shallow bedrock wells AW-A13 and AW-A14 located along Sump B French Drain system indicate that groundwater flow is upwards and possibly flows into the overburden water-bearing unit. The vertical upward groundwater flow is facilitated by local open vertical fractures and / or areas where the lacustrine clay unit is absent, which is intercepted (captured) by Sump A and Sump B pumping influences at those locations. As illustrated in the figures presented in **Section 4.7**, post bedrock pumping conditions show the net vertical hydraulic head change (upward) from the shallow bedrock wells to the French Drain system are approximately 2 feet at AW-A10, 3 feet at AW-A11, 8 feet at AW-A13, and 7 feet at AW-A14. However, the hydraulic conditions in the intermediate bedrock following recovery of water levels after shutdown of the bedrock pumping appear to be very similar to the pre-GWES groundwater setting. In a number of intermediate bedrock wells (MW-27D, MW-30D, AW-B11 and EW-B5) monitored with continuous data-logging pressure transducers or manually measured (**Figure 4-6**), the groundwater heads in areas proximal to the Hudson River were lower than the Hudson River stage. For example, based on the groundwater elevations presented on **Figure 4-6**, the hydraulic head differences between the river stage and the intermediate bedrock groundwater elevations, as measured feet below the river stage, are: MW-27D (1.6 feet), MW-30D (2.1 feet), AW-B11 (0.7 feet) and EW-B5 (5.3 feet).

Groundwater in the deep bedrock (**Figure 4-7**) generally follows similar flow trends observed before the bedrock well shutdown. The groundwater head recovery was inconclusive, and with heads that are significantly lower than the Hudson River, the groundwater flow-paths follow a trend that indicates potential influences from a large quarry across the Hudson River as characterized in the conceptual site model (EHS Support, 2015). It is noted that the scope of the GWES system design and operations historically focused on groundwater management of the overburden, shallow bedrock and the intermediate bedrock. Currently, the GWES is focused on the management of overburden groundwater. No remedial action was required for deep bedrock groundwater; however, the deep bedrock groundwater characteristics (heads and water quality) are monitored as part of the routine groundwater monitoring, and were evaluated in the SCGCMEE report (EHS Support, 2015) to support assessment of Site conditions.

4.5 Groundwater Responses to Changes in the GWES Pumping Scheme

Continuous data-logging pressure transducers were installed in selective monitoring wells and pumping sumps to gather continuous hydrologic data. These data provided valuable insights to the groundwater setting primarily pertaining to the dynamics of groundwater head recovery in the bedrock upon cessation of pumping from the bedrock extraction wells and capture of groundwater in the overburden by the operating segments of the French Drain.

Figures 4-8 to **4-11** provide the continuous water level data at the French Drain and the overburden/bedrock water-bearing zones during the entire study duration (November 2016 to August 2017). These figures were generally developed to be self-explanatory – with notes that are pertinent to data interpretation. This discussion summarizes important highlights that are applicable to phenomena contributing to groundwater capture and explaining the fate and transport of groundwater constituents discussed later in this report.

Figure 4-8 displays the continuous water level data at the pumping sumps in the French Drain. Daily total precipitation and the Hudson River stages (manually measured) are also presented. It is shown that pumping at the sumps was relatively continuous throughout the study except at discrete short-term events when the pumps were shut down for maintenance, calibration and controlled study (e.g., pulse test) purposes. The average discharge rate in Sump A was about 1.45 GPM (over a 24-hour period) with a pumping rate averaging approximately 14 GPM when the pump was active.. Sump B discharge rate averaged approximately 29 GPM. As shown in the figure, the pumping water levels between Sumps A and B were relatively similar considering the large discrepancy in the discharge rates. This discrepancy is potentially attributed to influences from leakage at the Weir Brook corridor (i.e., remaining pipes from the former Weir Brook system and associated pipe bedding) that seems to influence Sump B more than Sump A. Further discussion to this phenomenon is provided in **Section 4.6**. Another factor that can influence the flow of groundwater to Sumps A and B is the variable composition of the overburden material (fill, silt, fine sand, fine to medium) that controls the transmissivity of the overburden and its ability to yield water to the French Drain system.

Figure 4-9 presents groundwater heads in the overburden wells that were monitored. The following characteristics are highlighted:

- Well MW-OB34 is located downgradient of the segment of the French Drain that drains to Sump B, and the head in this well is below the head in Sump B. The water levels and trends in this well are closely similar to the Hudson River stages and trends. The low head level relative to the French Drain and the close relationship between groundwater heads at well MW-OB34 and surface water trends at the river infer that this vicinity is likely outside the capture influences of the French Drain.
- The groundwater heads in monitoring wells MW-OB30, MW-OB31 and MW-OB33 are distinctly higher although all three wells are generally located between the French Drain and the river. These traits generally imply the extent of capture influences from pumping at the upgradient French Drain. Supporting evidence is further provided by the controlled shutdown of Sumps A and B on August 10, 2017 (4-day shutdown) at the French Drain to record the hydraulic responses in the surrounding monitoring points. As shown in **Figure 4-9** and **Figure 4-19**, the head recoveries were variable. For instance, at well MW-OB30, the head recovery following shutdown (August 10, 2017) was relatively significant (>0.5 ft) compared to well MW-OB34 (<0 ft) where recovery was not noticeable from background trends. These characteristics contribute to insights to the lateral extent of the drawdowns induced by pumping at the French Drain.
- Similarly, additional insights are presented by the groundwater head responses when Sump A and B were shut down for a short period in August 2017. The purpose of this shutdown was to ascertain the head recoveries in the monitoring wells due to cessation of pumping in the French Drain without influences from precipitation events and the associated recharge events. Therefore, head recoveries observed in the monitoring wells are directly attributed to the cessation of pumping – inferring reversibly similar drawdowns induced by pumping. Therefore, these characteristics are indicative of the relative extent of pumping influences and potential capture.
- On this basis, it is shown that a number of wells in the overburden responded to the controlled shutdown of Sumps A and B conducted from August 10, 2017, through August 14, 2017. Of particular interest were the monitoring wells/piezometers that are located downgradient from the French Drain that exhibited relatively measurable head recoveries including wells AP-6, MW-OB30, MW-OB31, and MW-OB33. Conversely, heads at well MW-OB32 did not respond in the recovery phase similar to well MW-OB34. Based on this relationship, it is likely that these wells (MW-OB32 and MW-OB34) are outside the influence of downgradient capture.

The interpretation of the data for the bedrock wells from the shutdown test was made from a similar basis as the overburden wells. Of note are the small but measurable and instantaneous recovery trends at shallow bedrock wells AW-A14, AW-A10, and AW-A11 (**Figure 4-10**). These wells are located very close to the French Drain. The head recoveries infer that groundwater in the shallow bedrock near the French Drain are influenced by pumping at Sumps A and B. This phenomenon is direct evidence of vertical hydraulic connectivity between the overburden and the shallow bedrock. Additionally, the groundwater heads at these shallow bedrock wells were higher than at the French Drain – specifically in the water levels measured at the sump itself (see pumping levels at Sump A in **Figure 4-8**). This relationship infers that local upward vertical groundwater flow in the shallow bedrock is facilitated by hydraulic pressure alone and where it occurs can likely be captured by pumping at the French Drain either at the sumps or the perforated piping that are below the bedrock heads. In addition to the hydraulic head evidence, the clay confining unit that underlies the overburden is locally not contiguous. There are areas at the Site, within the French Drain and between the French Drain and the river, where the clay confining layer is absent or very thin. This is displayed in **Figure 4-14** and **Figure 4-15** (see boring logs to MW-OB30, MW-OB31, and MW-OB32). These localized areas are potential regions for upwelling of shallow bedrock groundwater to the overburden as it responds to areas of induced drawdowns from the pumping at the French Drain that support upward flow.

Groundwater in the intermediate and deep bedrock wells generally did not respond to the sump pump shutdown in the French Drain (**Figure 4-11**). The exception is at well EW-B3 which is located adjacent to Sump A in the French Drain. The measurable groundwater recovery from pump shutdown and higher water levels compared to Sump A (during pumping) indicate that intermediate bedrock groundwater in this localized area may be captured by the French Drain. The rationale is based solely on the head relationship between well EW-B3 and Sump A water level (and the elevation of the discharge water piping in the vicinity of Sump A).

Figures 4-12 and **4-13** display continuous groundwater heads during the time-frame of the controlled study (pulse test) when Sumps A and B were deliberately shutdown (August 10, 2017 through August 14, 2017). These figures provide more detailed characteristics of the hydraulic relationships within the Sump A and Sump B regions as discussed above. It is noted that rainfall was negligible during the recovery phase of the study from pump shutdown.

One point of interest is the groundwater heads at well EW-B5 as shown in **Figure 4-13**. Compared to the other intermediate bedrock well monitored (AW-B4), the water levels at EW-B5 were significantly lower than the Hudson River stages (at least 4 feet). This difference was relatively consistent during the duration of the monitoring. This means that groundwater in the vicinity of EW-B5 does not discharge to the Hudson River and likely flows beneath it. This observation is important because water quality sampling at the well indicate relatively high concentrations of hexavalent chromium, which was a concern to potential impacts to the Hudson River.

As discussed, insights to groundwater capture were based on a controlled shutdown of the pumping at the French Drain and recording the recovery responses at various monitoring points. It was shown that down-gradient capture extents from the French Drain are variable as evidenced by heads at well MW-OB34 (outside capture extent) and well MW-OB30 (inside capture extent) (**Figure 4-9**). As an independent check to the potential extent of the down-gradient capture from the French Drain, the distance to the stagnation point of the capture area was estimated for well MW-OB30. This area was selected because well MW-OB30 has shown elevated concentrations of hexavalent chromium during this study; is approximately 40 feet down-gradient from the French Drain; and groundwater is influenced by a relatively lower pumping rate at Sump A (average ~1.45 GPM). A simple solution for estimating the stagnation point from a pumping well is expressed by the following equation (Fileccia, 2015; EPA, 1987). Note that this solution applies to a homogenous aquifer setting and therefore presents limitations. The stagnation point extent is primarily based on the geologic setting between the pumping center (Sump A) and down-gradient area of interest. This area is predominantly characterized by sediments ranging from silt to fine sand and therefore, the transmissivity applied is representative of geologic media of higher hydraulic conductivity, which is conservative – the higher the transmissivity, the shorter the distance to the stagnation point:

$Xs = Q / (2\pi TI)$

Where:

Xs = Distance from pumping center to the down-gradient stagnation point

Q = Discharge rate at Sump A (1.45 GPM; 2,088 GPD)

T = Transmissivity (~ 30 cubic feet per day [ft^2/d])

I = Static hydraulic gradient (0.1 ft/ft)

The aquifer transmissivity was based on an estimated hydraulic conductivity of 1 foot per day (ft/d) and a saturated thickness of about 30 feet. The rationale is provided in **Figures 4-14** and **4-15**. **Figure 4-14** presents a generalized profile of the French Drain between Sumps A, B and C. As shown, the pumping water table at near-steady state condition is primarily within the clay and silty clay unit that underlies the permeable regions of the overburden. The pumping water table also demonstrates that much of the French Drain is unsaturated and most of the water being discharged within the French Drain is occurring within this clay unit and the base of the porous sediments overlying the clay. In the general vicinity of Sump A, the clay is less than 10 feet thick. Considering that the shallow bedrock is likely contributing some groundwater to the pumping center, an additional 20 feet of saturated thickness was applied to estimate a total thickness of 30 feet. **Figure 4-15** presents the boring logs to the monitoring wells installed adjacent to the Hudson River. The boring logs indicate the relatively large heterogeneity of the overburden geology along this river reach and some of the variable geology is likely attributed to historical industrial fill. Near Sump A, the boring log to well MW-OB30 indicates that the saturated sediments is primarily silt to fine sand. Therefore, considering the low permeability characteristics of clay and silty clay at the French Drain and silt to fine sand near the river, a relatively conservative hydraulic conductivity of 1 ft/d was applied which is more weighed towards the silt range. The static hydraulic gradient was based on the short-duration non-pumping water levels measured during the control test (pulse test) when Sump A and B were shutdown (August 10 through August 14, 2017). This value is generally within the range of pre-development gradients measured in this general area before the installment of the French Drain.

By applying these values to the equation stated above, the estimated distance to the stagnation point is about 110 feet. This distance is beyond well MW-OB30 from the French Drain and generally conforms to the current conceptualization of the capture extent in the area.

As noted on **Figures 4-9** through **4-11**, diurnal hydraulic head fluctuations were observed in several wells during the hydraulic evaluation. A similar pattern of dirunal hydraulic head fluctuation is apparent in the well EW-B5 hydrograph (**Figure 4-13**). The observed diurnal head fluctuations are caused by stage fluctuations in the Hudson River, due to daily water releases from the power plants/dam structures located upstream from the Site, which provides water to the river and feeder canals. Based on Darcy's Law, river effects will influence groundwater – including heads. Bank storage effects from storm events is one example of this phenomenon.

This interpretation is supported by multiple lines of empirical evidence showing direct correlation with the diurnal water level fluctuations measured in the Hudson River to the diurnal water level fluctuations observed in the Site's groundwater units (overburden, shallow bedrock, intermediate bedrock, and deep bedrock). **Figure H-1** in **Appendix H** presents two data sets that support this interpretation:

1) The peaks and troughs of the diurnal river stage fluctuations measured at USGS station 01327750 at Fort Edward, New York aligns exactly with the diurnal fluctuations measured at intermediated bedrock well EW-B5 (**Figure H-1**, Inset A). In addition, the data collected from the other ROR study wells monitored with a transducer that exhibit the hydraulic head fluctuations were compared to the river stage data, and it's been confirmed that the diurnal fluctuations observed in this data correlates with the river stage data; and

2) In 1992, Eckenfelder Inc. conducted a hydraulic study using transducers to collect continuous hydraulic head elevations of the Hudson River and the Site's groundwater system (Eckenfelder, 1993). The transducer data shows the peaks and troughs of the diurnal river stage fluctuations aligning exactly with the diurnal fluctuations measured in the groundwater. **Figure H-1**, Inset B presents three hydrographs examples of the overburden, shallow bedrock and intermediate bedrock wells.

4.6 Groundwater Capture

The groundwater capture characteristics near the French Drain are shown by a series of groundwater potentiometric surface contour maps in **Figures 4-16** to **4-20**. The development of the contours was based on synoptic water surveys at discrete times and by applying concepts derived from the interpretations of the continuous hydraulic data. The potentiometric surface contour maps are relatively self-explanatory:

- Groundwater contours induced by pumping are generally centered around the French Drain.
- Groundwater from up-gradient regions are intercepted by the French Drain at segments where groundwater flows to Sumps A and B
- The extent of the capture zone is relatively precise as evidenced by multiple synoptic events at different dates under relatively wet and dry conditions (June 12, 2017 representing relatively wet conditions, **Figure 4-16;** August 10, 2017 representing relatively dry conditions, **Figure 4-17**; and August 21, 2017, **Figure 4-20**). Of note is the relative change in the groundwater heads between pumping and non-pumping surveys as displayed in **Figure 4-19**. The head differential conforms to the contours that show where groundwater is being captured – within the area south of the French Drain.
- Based on the groundwater heads and relationships observed in the continuous data records, it is shown that down-gradient capture areas are spatially variable. As expected, the lateral influence of the French Drain is widest near the pumping sumps (Sumps A and B) and most narrow at the ends of the lateral lines (e.g., MH-4).
- The hydraulic evaluation shows that the French Drain system is effective in intercepting groundwater at MH-4 and preventing groundwater flow across the trench. Groundwater from upgradient regions are intercepted by the French Drain. Although the downgradient capture zone at manhole MH-4 is limited (approximately 10 feet based on the **Figure 4-17** potentiometric surface interpretation), the trench system is effective and is achieving the goal of capturing and preventing upgradient groundwater from flowing across the trench and discharging into the river. Based on the following evaluation, the Parties are not planning to change the current overburden pumping approach in the vicinity of manhole MH-4.
    - **Current Groundwater Capture** - Based on multiple synoptic groundwater elevation measurement events at different dates under various wet and dry conditions, the potentiometric surface contours show that Site groundwater is captured by the French Drain system in the area of manhole MH-4 (**Figures 4-16, 4-17 and 4-20**). This is further illustrated on **Figure H-2** in **Appendix H**. The potentiometric surface interpretations were verified by the continuous hydraulic data (transducer data) that measured the hydraulic responses in downgradient monitoring wells caused by pumping the French Drain. This data was used to confirm the structure/interpretation of the potentiometric surface at manhole MH-4 and to determine the downgradient lateral influence of pumping the French Drain system. The head differentials between pumping and non-pumping water level surveys aligns with the potentiometric contours that show where groundwater is being captured as displayed on **Figure 4-19**; within the area south of the French Drain.
    - **Natural Structural Feature -** In conjunction with the hydraulic capture induced by the French Drain at MH-4, a natural structural feature also influences groundwater flow at the mid-point between Sumps A and B. This natural structure is a clay pinnacle (mound) where the clay extends from the top of bedrock (base of overburden) to 4 to 8 feet above the overburden static water table. It is estimated that this clay pinnacle is approximately 200 feet wide along the French Drain (east - west). The clay pinnacle is composed of low permeable lacustrine clay and facilitates limiting groundwater flow across the French Drain as well as possibly influences local groundwater flow such that it deflects flow to the east and west of the clay pinnacle; the deflected flow would be captured by the trench. The location of the clay pinnacle is shown on **Figure 4-14**.

- **Basal Clay Unit -** An additional review of the boring logs for borings installed along the alignment of French drain between MH-4 and Sump B determined that the basal clay unit that separates the overburden from the bedrock is present in the majority of borings installed, which supports a determination that the French Drain is substantially keyed into clay and that the clay unit is pervasive in this area (limited overburden to bedrock contact). The interpreted clay surface is illustrated on **Figure 4-14**, and supporting documentation is provided in **Appendix H** (i.e., boring logs and a plan view figure illustrating the boring locations and clay thicknesses [**Figure H-3**]).
- **Limited Saturated Thickness -** There is limited saturated thickness within the overburden horizon (approximately 3 feet) above the clay unit in the vicinity of manhole MH-4 during current Sump A and B pumping conditions (see **Figure H-2** in **Appendix H**). The water column in manhole MH-4 at current pumping conditions is approximately 5.6 feet. If a pump was installed in MH-4, the pump would occupy the lower 2.7 feet of the water column (pump length 2.2 feet, pump base 0.5 feet), which would then provide 2.9 feet of water above the pump. The low-level pump shut off switch would need to be placed 1 foot above the pump for pump protection, allowing for only 1 foot of water to be pumped/dewatered. Based on two analytical solutions that estimate extent of downgradient capture/stagnation point (Keely and Tsang, 1983 and Fileccia, 2015), lowering the water table one foot at manhole MH-4 would only extend the downgradient capture zone by approximately 6 feet. These lines of evidence support that dewatering the overburden by 1 foot at MH-4 would have negligible effect on expanding the downgradient capture zone (i.e., additional 6 feet).

4.7 Bedrock Recovery Characteristics

One of the primary goals of the study was to ascertain the recovery characteristics of bedrock groundwater when bedrock pumping was shutdown. It was conceptualized that continued bedrock pumping perpetuated bedrock impacts via the increased downward vertical hydraulic gradients created by pumping and the associated potential increase in the vertical migration of COCs from the overburden to the shallow bedrock. It was anticipated that by shutting down bedrock pumping, the vertical hydraulic gradients will re-establish to new hydraulic conditions induced by pumping in the French Drain at Sumps A and B. The hydraulic trends and extent of this recovery are presented in **Figures 4-21** to **4-23**.

Figure 4-21 displays monitoring points (both overburden and bedrock) in this study. As a comparative analysis of the change in vertical hydraulic gradients, five well clusters were selected – some representing hydraulic conditions in the overburden and the bedrock; and others between shallower and deeper bedrock.

Figure 4-22 presents the groundwater head trends of both overburden and bedrock wells localized in the vicinity of Sump A. Changes in the vertical hydraulic gradients within the applicable well clusters in this region (Clusters A to C) are also shown in the embedded table in the figure (also in **Table 4-2**). It is shown that the vertical gradients within each well cluster analyzed were reduced significantly since the cessation of bedrock pumping (see pre-and post-bedrock pumping gradients for each well cluster). In the case of well cluster B, the trend was reversed.

According to the hydrographs, bedrock groundwater heads prior to November 2016 were drawn down due to bedrock pumping. As anticipated, all heads in the monitored wells in the shallow and intermediate bedrock recovered significantly after the cessation of bedrock pumping. The heads at the shallow bedrock wells AW-A10 and AW-A11 and the intermediate well EW-B3 following recovery were significantly greater than the Sump A pumping water levels. Based on their proximity to the French Drain, it is anticipated that the net groundwater flow is upwards to the overburden and intercepted by Sump A pumping influences in this local area. The recovered heads at the intermediate bedrock wells AW-B11 and AW-B12 were slightly lower than the Sump A water levels. Based on the river stages and the upgradient locations of these wells, it is likely groundwater in this general region of the intermediate bedrock may not discharge to the river.

Similar characteristics can be observed in **Figure 4-23,** which displays the hydrographs of wells in the vicinity of Sump B and vertical hydraulic gradients estimated in well clusters D and E (shown in the embedded table in **Figure 4-23** and **Table 4-3**). Similar to previous observations made, groundwater recovery occurred in the intermediate bedrock wells AW-B4 and EW-B5. The head following recovery; however, is below the pumping levels at Sump B. In the vicinity of well AW-B4, it appears groundwater discharge to the Hudson River is variable, and seepage to the river may be intermittent depending on river flows. Although the head recovery was relatively large at well EW-B5, the stabilized groundwater heads were significantly lower than the Hudson River stage inferring flow below the river.

The final figure (**Figure 4-24**) for this discussion presents the groundwater hydrographs at the overburden wells MW-OB30 to MW-OB34 and associated trends to the Hudson River stages. In some of these wells such as wells MW-OB30 and MW-OB31 (and to a small extent, at MW-OB32), the groundwater heads do not track back to the original heads (pre-bedrock recovery well system shutdown; prior to November 10, 2016) when the river stages were relatively low. This phenomenon can be viewed by comparing groundwater heads to the river stages in the earlier records and the latest trends when the river stage decreased during the dry August month. As observed, the groundwater heads do not follow this trend. Although preliminary, it is conceptualized that the sustained higher heads may be contributed by shallow bedrock groundwater upwelling into the overburden. The additional flux of bedrock groundwater could elevate heads in the overburden – considering that the clay confining unit in these wells are absent or very thin (**Figure 4-15**)

4.8 Supplemental Analysis of the Weir Brook Contribution to the GWES Operation

One of the historical and continuing investigative questions is the influence of leakage at the Weir Brook corridor from contribution of source water in the Glens Falls Feeder Canal and the Sliver Quarry. This phenomenon was pertinent to possibly explaining the large discrepancy in Sump B pumping rates relative to Sump A. The hydrologic premise and supporting field data were reported in a technical memorandum by Brown and Caldwell (2001).

As part of this study, groundwater specific conductances and temperature were also collected at the continuous data acquisition sites. **Figure 4-25** exhibits these field parameters and other applicable data for Sumps A and B. As displayed, there is a significant difference between the specific conductances of Sump A and Sump B.

In Sump A, the specific conductances were relatively flat throughout the study duration – mostly within the 800 microSiemens (µS/cm) to 900 µS/cm range. On the contrary, the specific conductances at Sump B groundwater ranged between about 400 µS/cm to as high as 1,500 µS/cm. Additionally, this large change occurs within the time period when the Glens Falls Feeder canal was drained (sluice gate to Weir Brook open) in early December 2016 and refilled (sluice gate to Weir Brook closed) in April 2017.

This unique characteristic could be explained by dilution effects from the depletion or introduction of water to the groundwater system. **Figure 4-26** presents a more detailed view of this relationship. For instance, when the Feeder Canal is drained, the source water is either minimized or temporarily mitigated. Hence, with less water entering the groundwater system near Sump B (reduced leakage from the Weir Brook corridor), the resulting specific conductances become elevated – likely because these higher values are more representative of groundwater being pumped at Sump B versus water derived to a large degree from the

Feeder Canal. However, with the refilling of the Feeder Canal, the additional leakage into the groundwater system via the Weir Brook corridor that extends through the Sump B French Drain system, contributes to the dilution of groundwater captured by Sump B.

Aside from the addition of water that contributes to greater discharge rates at Sump B (therefore affecting the pumping efficiency), the overall effect to the fate and transport of groundwater constituents has not changed since the inception of the GWES program; up-gradient groundwater is being captured by the French Drain pumping.

5.0 GROUNDWATER CHEMISTRY TRENDS

Groundwater quality monitoring was conducted Site-wide, at wells screened in the overburden, shallow bedrock, intermediate bedrock, and deep bedrock. Consistent with the CSM (EHS Support, 2015) and the GSMP approved by the NYSDEC as part of the ROP (EHS Support, 2016), the scope of groundwater monitoring activities included sampling for key Site constituents - dissolved chromium and hexavalent chromium, dissolved vanadium, and cyanide - to assess trends in concentrations. Samples from two wells were also analyzed for dichlorobenzene (DCB), to monitor and verify concentration trends.

The CSM identified hexavalent chromium as the main COC at the Site, based on mobility and toxicity (EHS Support, 2015). The CSM provided a focused assessment of the distribution and temporal patterns of hexavalent chromium, as well as cyanide in groundwater and demonstrated that there have been major declines in these constituent concentrations over the majority of the Site since commencement of the full operation of the GWES in 2003. The CSM further identified discrete areas onsite where elevated concentrations of hexavalent chromium and cyanide persist in both the overburden and bedrock groundwater, based on the Site hydrogeology and groundwater quality and hydrogeochemical evaluations. The findings of the CSM and geochemical modeling presented were subsequently verified through supplemental groundwater and soil sampling completed in focused areas of the Site in 2015, which formed the basis for focusing groundwater extraction on the overburden horizon in the Central Area of the Site (EHS Support, 2016).

A summary of groundwater quality at the Site was provided in **Section 3** of this report, as demonstrated by sampling events conducted between November 2016 and September 2018. That summary includes discussion hexavalent chromium, vanadium and cyanide concentrations in the Western, Central, and Eastern Site areas as delineated in the ROP (EHS Support, 2016). This Section provides an initial assessment of trends observed to date in the evolving groundwater quality after implementation of the ROP.

5.1 Assessment of Trends in COC Concentrations

The groundwater quality is evolving because the hydrologic setting was altered by changing the GWES operations. Specific details of the revised GWES operation and observed hydrologic responses are presented in **Section 4** of this report.

Solute transport timeframes are orders of magnitude slower than groundwater flow. This phenomenon is further affected by the relatively low permeability of the sediments that comprise the overburden and the bedrock where typical hydraulic conductivities are less than 10 ft/d (EHS Support, 2015). On this basis alone, the interpretation of plume dynamics based on short-term concentration trends is at best, preliminary as anticipated plume break-through characteristics evolve with the new groundwater flow setting over time.

COC concentration trends are different from point to point – exhibiting increasing, decreasing and stable trends. All trend characteristics are influenced by the spatial nature of individual plume(s) after 13 years of groundwater pumping; bias from dilution effects prior to bedrock pump shutdown; induced leakage from competing pumping centers between the French Drain and the bedrock; and proximity to historical source regions. These factors influenced the water quality setting that is slowly responding to the new groundwater flow regime. The following discussion highlights the unique trend characteristics of selected wells of interest located in **Figure 5-1**. **Figures 5-2** and **5-3** present the hexavalent chromium trends prior to and during the ROP study. Groundwater head trends and the Hudson River stages are displayed as supplementary information.

5.1.1 Vicinity of Former Building 56

At overburden groundwater monitoring well MW-OB30, hexavalent chromium concentrations were higher in samples collected after November 2016 than in samples collected in the previous year (following well installation in November 2015; **Figure 5-2**), with concentrations ranging from 8,900 µg/L to 17,000 µg/L in samples collected between March 2017 and July 2017.

Multiple rounds of sampling have demonstrated that this magnitude of hexavalent chromium concentrations is limited to the discrete location of MW-OB30, with samples at locations along the riverbank to the west (AP-6) and to the east (MW-OB31) ranging from non-detect to slightly higher than the GA standard of 50 µg/L (**Appendix F**).

There was a corresponding increase in groundwater elevations at MW-OB30 during this same timeframe, with groundwater elevation measurements prior to the ROP implementation on the order of 211-212 ft. msl and after implementation of the ROP on the order of 216-218 ft msl (**Figure 5-2**). The source of the localized elevated chromium concentrations is likely dissolution of chromium-impacted soil, which had previously been unsaturated. Given the localized nature of this phenomenon, the highly conservative nature of the calculations used to derive the GWES performance CGW values (see **Section 3**), and the demonstration that MW-OB30 is within the capture zone of the French Drain (see **Section 4**), no modifications to the pumping scheme are warranted to address the increased concentration observed at MW-OB30.

An increasing trend in hexavalent chromium concentration was observed at shallow bedrock well AW-A11 after the cessation of bedrock pumping (**Figure 5-2**). AW-A11 is located near and upgradient of the French Drain and near MW-OB30. At AW-A11, concentrations were on the order of 200 µg/L prior to ROP implementation and on the order of 900 to 1,200 µg/L during sampling events conducted in 2017. With cessation of bedrock pumping at nearby bedrock groundwater extraction wells in November 2016, groundwater heads recovered about 15 ft to 20 ft in this well. As discussed in **Section 4**, this recovery level is above the elevation of the French Drain indicating an upward vertical hydraulic gradient in this local area.

As with MW-OB30, it is possible that the rise in bedrock groundwater heads promoted dissolution from chromium-impacted soil contributing to the increased concentrations observed since the shutdown of bedrock pumping. Alternatively, the increased concentrations in the bedrock – especially near former pumping areas is the result of the absence of additional groundwater that contributed to dilution effects in the past when bedrock was pumped. Typically, solute concentrations near pumping centers are suppressed (diluted) primarily from non-impacted water flowing to the pumping well. In the bedrock setting, the zone of groundwater contribution to a pumping well is truly three-dimensional because groundwater fluxes include the pumping plane (zone of lateral contribution to pumping center) as well as both the overlying and underlying regions. In the absence of pumping, groundwater concentrations "rebound" and more accurately represent the plume without the contributing effects of dilution attributed to surrounding non-impacted groundwater. It is believed that this phenomenon could apply to some of the concentration trends observed in the bedrock including at well AW-A11.

As discussed in **Section 4**, it is also demonstrated that the head recovery at well AW-A11 has changed the vertical groundwater flow direction since the cessation of nearby bedrock pumping. Therefore, some of the mass that is present at this location is subject to capture by the overburden French Drain system.

In **Figure 5-3**, an increasing trend in hexavalent chromium concentration was observed at deep bedrock well AW-C11 in the timeframe since ROP implementation (shutdown of bedrock pumping in November

2016). However, groundwater heads remained relatively steady at this location prior to and after ROP implementation **-** indicating former pumping in the overlying intermediate bedrock may have had minimal hydraulic effect in the deep bedrock.

Groundwater impacts at AW-C11 do not pose a risk to the adjacent Hudson River as groundwater flow in the deeper bedrock is uniquely different from the overlying water-bearing zones. Flow directions are governed by a different hydrologic boundary separate from the overlying Hudson River such as the quarry that was identified across the river as a possible influencing boundary condition. In this context, the fate and transport characteristics of the deep bedrock has not changed with ROP implementation.

As shown in **Figure 5-3**, the groundwater head trend in the shallow bedrock well AW-A14 exhibited minimal recovery throughout the study duration. This indicates that the influences of bedrock pumping prior to the ROP implementation was spatially limited in this area. The groundwater head (approximately 220 ft msl) is about 8 ft higher than pumping water levels near Sump B (~212 ft msl). Therefore, it is anticipated that some groundwater in the shallow bedrock is intercepted by the pumping influences of the French Drain via leakage through the relatively thinner confining unit in this region compared to the vicinity surrounding Sump A.

The groundwater heads at the intermediate bedrock well AW-B4 have recovered at least 5 ft since bedrock pumping shutdown. Based on the limited data, the recovered heads appear to closely track the Hudson River trend. Since the heads at well AW-B4 are generally below pumping water levels in the Sump B vicinity, it is anticipated that the intermediate bedrock groundwater may discharge to the river or flow beneath it depending on the river flow conditions. Hexavalent chromium trends, as shown, were relatively low with short-term increases following the shutdown of bedrock pumping and the latest result exhibiting non-detection (10U µg/L).

The decreasing hexavalent chromium trends at the overburden well MW-OB25 indicates plume mitigation from pumping at the French Drain. The boring log and well screen interval for well MW-OB25 is presented on **Figure 5-3a**. It is also noted that groundwater in all water-bearing horizons (with the exception of the deep bedrock) is influenced by the Hudson River. This correlation can be observed in a number of the hydrographs presented in **Section 4 (Figures 4-9** through **4-11)**. This is important because the shutdown of the bedrock pumping in November 2016 also coincided with a general rise in the river stage. Therefore, interpretation of groundwater heads that rose during this period is either from influences of bedrock pumping shutdown, a rise in the river stage that was coincided with this event or contribution from both phenomena. This was one of the primary reasons that a controlled shutdown of the sumps in the French Drain was conducted to minimize other influencing factors. In the case of the overburden in the vicinity of MW-OB25, we conceptualize that the head rise that coincided with the bedrock shutdown period was due to the river influence.

5.1.2 Vicinity of Former Building 8

As displayed in **Figure 5-4**, the hexavalent chromium concentrations at the intermediate bedrock groundwater well EW-B5 ranged from 40,000 µg/L to 140,000 µg/L in samples collected between March 2017 and July 2017. In comparison, historical concentrations have typically been on the order of 50,000 µg/L at this well (i.e., concentrations of 43,000 µg/L and 56,000 µg/L in 2013 and 2014, respectively).

With cessation of bedrock pumping in November 2016, there was a corresponding 15- to 20-foot head recovery at EW-B5. The cause of the chromium increases is unclear to date (as previous concentrations during pumping are attributed to dilution effects), and it is anticipated that the trend will continue to evolve over time.

The water level at EW-B5 is below the elevation of the river bottom, indicating that groundwater from this location is not discharging to the Hudson River, which is consistent with conclusions made in the CSM (EHS Support, 2015).

As noted earlier in **Section 4**, groundwater at well MW-OB34 is likely outside the capture zone from the French Drain (**Figure 5-4**). Additionally, the hydraulic relationship between groundwater heads and the Hudson River stage is practically identical. Under normal hydrologic conditions, groundwater will discharge to the river although it also appears bank storage effects during higher flow conditions may reverse this relationship. With the exception of a single event when hexavalent chromium reached 120 µg/L, the water quality trend at this well has been mostly non-detection.

The water quality and groundwater trends at well MW-OB26 (**Figure 5-4**) were similar to conditions observed at well MW-OB25 (**Figure 5-3**) as both overburden wells are located upgradient and subject to the hydraulic capture from the French Drain.

6.0 SUMMARY AND CONCLUSIONS

The following findings are based on the results of groundwater and surface water sampling and hydraulic monitoring completed after implementation of the ROP in November 2016 and comparison with available historical investigation data.

- Precipitation and river flows observed during this study indicate generally average hydrologic conditions that are representative of historical long-term conditions. Therefore, it is anticipated that the groundwater/hydrologic study results to date and interpretations also apply to similar hydrologic conditions into the foreseeable future.
- With the revised GWES operation which includes pumping at Sumps A and B in the French Drain (shutdown of Sump C) and cessation of all bedrock pumping, the study results show and support the capture of upgradient overburden groundwater at the segments of the French Drain that flow to Sumps A and B.
- Based on potentiometric surface analysis from multiple surveys, the capture of the overburden groundwater extends downgradient from the French Drain. The capture extent is variable – depending on the permeability of the saturated sediments. Where the overburden material is fine-grained, the distance to the stagnation point is greater from the French Drain and closer to the Hudson River. When the overburden material is relatively coarse-grained, the stagnation point is closer to the French Drain. The downgradient capture extent is relatively narrow near the mid-point of Sump A and Sump B where pumping exerts minimal drawdowns within the French Drain. Groundwater in the shallow and the intermediate bedrock that were previously lowered by bedrock pumping have recovered significantly. The head recoveries have significantly reduced or reversed the vertical hydraulic gradients from the overburden to the bedrock water-bearing zones. It is anticipated this phenomenon alone will also reduce and/or mitigate the vertical mass flux of groundwater COCs over time.
- In the shallow bedrock, most of the monitoring points indicate vertical hydraulic heads (reversed groundwater flow) where groundwater is either flowing to the overburden and/or being captured by the French Drain (the French Drain is installed in the overburden) – where the bedrock head is greater than pumping water level at Sump A and associated perforated piping. Note that vertical upward groundwater flow into the overburden maybe facilitated by local open vertical fractures and/or areas where the lacustrine clay unit is absent. In the intermediate bedrock, groundwater flow is relatively variable. Groundwater may flow to the overburden, discharge into the Hudson River or flow beneath it.
- The deep bedrock is outside the scope of the GWES operation; however, discussion has been included in order to complete the characterization of the groundwater flow regime in the bedrock setting. Based on the data collected to-date, the flow regime has been consistent before and after the ROP implementation.
- The specific conductances observed at Sump B validate the premise of leakage at the Weir Brook corridor (i.e., remaining pipes from the former Weir Brook system and associated pipe bedding) contributing additional water to the French Drain derived from leakage from the Feeder Canal and the Sliver Quarry). It appears that the peak flow in the Weir Brook corridor occurs approximately for a seven-month period from May through November. The influence of leakage appears to be localized to the Sump B vicinity only with no or minimal influences to Sump A pumping.
- Overall, groundwater COC concentrations on-Site have declined over time (since the GWES was implemented in 2003)
- Site-wide, groundwater quality characteristics have been consistent with past results before the ROP implementation. As anticipated based on the CSM and past monitoring results, concentrations were higher in the Central Area than to the east or west. Concentrations of dissolved chromium, hexavalent chromium and total cyanide in overburden groundwater at certain locations in the vicinity of former Buildings 8 and 56 (the Central Area) and in the Western Area of the Site exceeded GA standards. Overburden groundwater extraction at Sumps A and B is ongoing in these

areas; therefore, local impacts in the overburden are being remediated. This includes the mitigation of groundwater in the vicinity of well MW-OB30 that exhibited elevated hexavalent chromium since the ROP implementation.

- Groundwater quality characteristics have also been consistent with past results before the ROP implementation in the bedrock. Based on the changed hydraulic setting, it is anticipated water quality trends will evolve to new groundwater flow conditions. On this basis, in the shallow bedrock, it is anticipated that local impacts will be mitigated to some degree by the French Drain operation as an upward vertical flow was facilitated by significant head recoveries observed in the shallow bedrock. This includes the mitigation of groundwater in the vicinity of well AW-A11 that exhibited elevated hexavalent chromium since the ROP implementation.
- In the intermediate bedrock, the groundwater heads have recovered with significant reductions in the vertical hydraulic gradients. This phenomenon alone minimizes potential vertical drag-down of overlying impacts. The reestablished groundwater flow regime indicates transport pathways that include upward flow towards the French Drain; discharge to the Hudson River and under-flowing the Hudson River. Of the local impacts observed in the intermediate bedrock, groundwater at well EW-B5 was observed with elevated hexavalent chromium trends since the ROP implementation. However, the groundwater head at well EW-B5, which is lower than the river, indicate that impacted water will not discharge to the Hudson River at the Site. Pumping at intermediate horizon well EW-B5 will be conducted in 2019, while performing an evaluation of chromium concentration trends under pumping conditions. Operational data and groundwater monitoring results will be reported to the NYSDEC as part of regular Site reporting.

7.0 REFERENCES

Brown and Caldwell. (2001). Old Weir Brook Evaluation, Ciba Site, Glens Falls, New York: Technical Memorandum, by Brown and Caldwell, October 24, 2001.

Eckenfelder Engineering Inc. (1993). Resource Conservation and Recovery Act (RCRA) Facility Investigation Report for Groundwater Ciba-Geigy Site, Glens Falls, New York. March 1993.

EHS Support LLC. (2015). Site Conceptualization and Groundwater Corrective Measures Effectiveness Evaluation Report, Former Ciba-Geigy Facility, Glens Falls, NY. January 2015.

EHS Support LLC. (2016). Remedy Optimization Plan. Former Ciba-Geigy Facility, Glens Falls, NY. August 2016. *Revised November 2016.*

EHS Support LLC (2017a). Groundwater and Surface Water Monitoring Report - Main Plant Site - July 2016 to January 2017. Former Ciba-Geigy Facility, Glens Falls, NY. February 2017.

EHS Support LLC (2017b). Groundwater and Surface Water Monitoring Report - Main Plant Site - February 2017 – July 2017. Former Ciba-Geigy Facility, Glens Falls, NY. September 2017.

EHS Support LLC. (2017c). 2016 Operations and Maintenance Report - Ciba-Geigy Facility. February 28, 2017.EPA. (1987). Guidelines for Delineation of Wellhead Protection Areas: U.S. Environmental Protection Agency, 440/6-87-010.

Fileccia, Alessio. (2015). Some Simple Procedures for the Calculation of the Influence Radius and Wellhead Protection Areas (Theoretical Approach and a Field Case for a Water Table Aquifer in an Alluvial Plain): Italian Journal of Groundwater, ASI4065: 007-023.

Keely and Tsang (1983). Velocity plots and capture zone of pumping centers for ground-water investigations: Ground Water, v. 21, no. 6, p. 701-714.

NYSDEC. (1996). Total maximum daily loads and water quality-based effluent limitations memorandum: New York Department of Environmental Conservation.

NYSDEC. (1998). Technical and Operational Guidance Series (TOGS) 1.1.1, Ambient Water Quality and Guidance Values (October 22, 1993, Reissue Date June 1998, as modified and supplemented by the January 1999 Errata Sheet and the April 2000 and June 2004 Addenda).

NYSDEC. (2010). DER-10 Technical Guidance for Site Investigation and Remediation. New York State Department of Environmental Conservation. May 2010. Accessed at http://www.dec.ny.gov/regulations/67386.html.

NYSDEC. (2016a). E-mail communication from Brian Jankauskas at NYSDEC to Cassie Reuter at EHS Support LLC. November 8, 2016.

NYSDEC. (2016b). Letter from Brian Jankauskas at NYSDEC to James Vondracek at Ashland LLC, and Stephen Havlik at BASF Corporation. November 29, 2016.

TABLES

Table 1-1
GWES Refined Objectives, Performance Goals, and Monitoring Approaches
Former Ciba-Geigy Site
Glens Falls, New York

Refined Objective	Refined Performance Goals	Monitoring Approaches
1. Overburden – For areas where Constituent of Concern (COC) concentrations in overburden groundwater exceed CGW (site-specific groundwater concentrations protective of surface water with discharge of groundwater to Hudson River), maintain groundwater collection in areas of high constituent flux to the Hudson River, and manage the flux of constituents to the river to maintain surface water quality adjacent to the site below regulatory criteria.[1]	**Central Area** – Extract overburden groundwater to the extent practicable, while managing hydraulic head to mitigate vertical migration of impacted overburden groundwater into the underlying bedrock unit.	**Central Area** – Continue groundwater sampling to confirm that overburden groundwater does not exceed concentrations that are protective of surface water for discharge to the Hudson River. Continue water level monitoring in the vicinity of the French Drain to document the extent of hydraulic influence and the management of hydraulic head and gradients.
	Eastern & Western Areas – Performance goal for overburden groundwater extraction is unnecessary at this time. At the site boundary with the Hudson River, COCs no longer exceed GA standards or CGW protective of surface water discharge.	**Eastern & Western Areas** – Continue groundwater sampling to confirm that groundwater does not exceed CGW protective of surface water and to confirm stable to declining trends on-site.
2. Shallow & Intermediate Bedrock – Manage the flux of constituents to the river to maintain surface water quality adjacent to the site below regulatory criteria. (Note: institutional controls prevent the use of on-site groundwater above the state's groundwater GA classification, as specified separately in the HWM Permit).[2]	For groundwater that may discharge to the Hudson River, maintain concentrations below CGW protective of surface water discharge. For well EW-B5, which does not discharge to the Hudson River, achieve stable to declining concentrations of hexavalent chromium.	Continue groundwater sampling to confirm that groundwater in shallow bedrock and intermediate bedrock does not exceed CGW protective of surface water and to confirm stable to declining trends on-site.

[1] 6 CRR-NY 703.5. Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations. May 31, 2016.
[2] New York State Department of Environmental Conservation (NYSDEC), 2015. Hazardous Waste Management (HWM) Permit Post Closure. Ciba Corporation & Hercules Incorporated. 6 NYCRR Part 373. NYSDEC Permit #5-5234-00008/00096. EPA RCRA# NYD002069748. Effective March 6, 2015, expiration March 5, 2025.

Table 2-1
Comparison of Measured Values to Permit Limits (Flow, Cyanide, Chromium)
Former Ciba-Geigy Site
Glens Falls, New York

	Flow (GPD, Max. Daily)	Flow (GPD, Monthly Ave.)	Sample Date	Total Cyanide (mg/L)	Total Chromium (mg/L)	Total Chromium (lb/day)
Permit Limits	**350,000**	**175,000**		**3.0**	**--**	**3.1**
January 2016	71,000	57,226	1/5/16	0.50	0.39	0.19
February 2016	72,000	51,966	2/1/16	0.57	0.43	0.19
March 2016	64,000	55,194	3/3/16	0.50	0.36	0.17
April 2016	61,000	56,467	4/5/16	0.29	0.48	0.23
May 2016	57,000	50,677	5/2/16	0.29	0.35	0.15
June 2016	82,000	41,467	6/2/16	0.33	0.60	0.21
July 2016	62,000	53,065	7/5/16	0.22	0.42	0.19
August 2016	86,000	63,000	8/2/16	0.37	0.26	0.14
September 2016	94,000	59,733	9/1/16	0.40	0.37	0.18
October 2016	61,000	52,710	10/5/16	0.43	0.38	0.17
November 2016	59,000	42,600	11/2/16	0.41	0.50	0.18
Average		**53,100**		**0.39**	**0.41**	**0.18**
Maximum		**63,000**		**0.57**	**0.60**	**0.23**
Minimum		**41,467**		**0.22**	**0.26**	**0.14**
Pumping from Bedrock GWES and Sump C Suspended on November 10, 2016						
December 2016	61,000	31,161	12/12/16	1.5	0.24	0.06
January 2017	52,000	41,258	1/4/2017	0.69	0.21	0.07
February 2017	56,000	44,857	2/1/2017	0.90	0.21	0.08
March 2017	74,000	44,355	3/2/2017	0.70	0.29	0.11
April 2017	103,000	62,400	4/10/2017	0.71	0.32	0.17
May 2017	86,000	56,355	5/2/2017	0.52	0.27	0.13
June 2017	93,000	54,100	6/6/2017	0.68	0.25	0.11
July 2017	117,000	65,806	7/3/2017	0.91	0.24	0.13
August 2017	91,000	46,484	8/1/2017	0.80	0.11	0.04
September 2017	57,000	48,467	9/5/2017	0.96	0.20	0.08
Average		**49,524**		**0.84**	**0.23**	**0.10**
Maximum		**65,806**		**1.50**	**0.32**	**0.17**
Minimum		**31,161**		**0.52**	**0.11**	**0.04**

Table 3-1
New York State Water Quality Standards – Groundwater and Class C Surface Water (1)
Former Ciba-Geigy Site
Glens Falls, New York

Water Classes	Standard (µg/L)	Type (5)	Basis Code
Hexavalent Chromium			
GA	50	H(WS)	F
A, A-S, AA, AA-S, B, C	11 (2)	A(C)	
A, A-S, AA, AA-S, B, C, D	16 (2)	A(A)	
Cyanide			
GA	200	H(WS)	H
A, A-S, AA-S, B, C, D	9,000	H(FC)	B
A, A-S, AA, AA-S, B, C	5.2 (3)	A(C)	
A, A-S, AA, AA-S, B, C, D	22 (3)	A(A)	
Vanadium			
A, A-S, AA, AA-S, B, C	14 (4)	A(C)	

Notes:

(1) NYSDEC 6 CRR-NY 703, Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations. Most restrictive standards indicated in bold.
(2) Applies to dissolved form
(3) As free cyanide: the sum of HCN and CN- expressed as CN.
(4) Applies to acid-soluble form.
(5) H(WS) = Source of Drinking Water (groundwater); A(C) = Fish Propagation (chronic); A(A) = Fish Survival (acute); H(FC) = Human Consumption of Fish

Basis Codes:

B = Non-oncogenic, Human Health
F = Former Groundwater Regulations, 6 NYCRR 703.5(a)(3), Human Health or Aesthetics
H = Former Use of or Reference to 10 NYCRR Part 170, Human Health or Aesthetics

Table 3-2
Calculated Surface Water Quality Criteria for Chromium
Former Ciba-Geigy Site
Glens Falls, New York

Location	Sample ID	Date	Hardness (As CaCO3)	Total Dissolved Solids (Residue, Filterable)	Calculated Chromium (dissolved) WQS	
Surface Water Quality Criteria (SWQC)[1]			µg/l	µg/l	A(C)	A(A)
SW-01	SW-01-20151208	12/08/15	35300	79000 J	32	243
SW-01	SW-01_20160726	07/25/16	38000	65000	34	258
SW-01	DUP1_20161201	12/01/16	32000	81000	29	224
SW-01	SW-01_20161201	12/01/16	28000	85000	26	201
SW-01	SW01_20170227	02/27/17	16000	42000	17	127
SW-01	SW-01_20170622	06/22/17	24000	40000	23	177
SW-01	SW-01_20170724	07/24/17	41000	44000	36	275
SW-02	SW-02-20151208	12/08/15	37600	81000 J	33	256
SW-02	SW-02_20160726	07/25/16	34000	74000	31	235
SW-02	SW-02_20161201	12/01/16	32000	81000	29	224
SW-02	SW02_20170227	02/27/17	20000	58000	20	152
SW-02	SW-02_20170622	06/22/17	28000	49000	26	201
SW-02	SW-02_20170724	07/24/17	33000	24000	30	230
SW-03	SW-03-20151208	12/08/15	27500	82000 J	26	198
SW-03	SW-03_20160725	07/25/16	34000	56000	31	235
SW-03	DUP-20160726	07/26/16	--	--	--	--
SW-03	SW-03_20161201	12/01/16	44000	69000	38	291
SW-03	SW-03_20170118	01/18/17	26000	57000	25	189
SW-03	SW03_20170227	02/27/17	16000	57000	17	127
SW-03	DUP01_20170227	02/27/17	12000	42000	13	100
SW-03	SW-03_20170425	04/25/17	16000	49000	17	127
SW-03	DUP_20170622	06/22/17	28000	40000	26	201
SW-03	SW-03_20170622	06/22/17	20000	44000	20	152
SW-03	SW-03_20170724	07/24/17	32000	16000	29	224
SW-04	SW-04-20151208	12/08/15	33700	85000 J	30	234
SW-04	SW-04_20160725	07/25/16	30000	64000	28	213
SW-04	SW-04_20161201	12/01/16	32000	79000	29	224
SW-04	SW-04_20170622	06/22/17	44000	47000	38	291

Notes:
1) Surface water quality criteria (SWQC) from Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations from NYS Division of Water TOGS 1.1.1. Hudson River is classified as Class C waters in site vicinity.

Surface water quality criteria shown are applicable for Class C, fresh water (chloride concentrations less than 250 mg/L or total dissolved solids less than 1,000 mg/L).
A(C) - protective of fish propogation in fresh waters - applicable to dissolved phases only (or acid soluble phase for vanadium).
A(A) - protective of fish survival in fresh waters - applicable to dissolved phases only (acid soluble phase for vanadium).
Calculated values based on hardness (per TOGS 1.1.1):
Chromium A(C) = (0.86) exp(0.819 [ln (ppm hardness)] + 0.6848)
Chromium A(A) = (0.316) exp(0.819 [ln (ppm hardness)] + 3.7256)
Chromium aquatic standard applies to dissolved form and does not include hexavalent chromium.
Vanadium aquatic standard applies to acid soluble form.
n/a - indicates no standard available
µg/L - micrograms per liter
J - indicates value is estimated

Table 3-3
Surface Water - Chromium, Cyanide and Vandium Analytical Results
Former Ciba-Geigy Site
Glens Falls, New York

Location ID	Sample Name	Sample Date	Dissolved Chromium, Hexavalent µg/l	Dissolved Chromium µg/l	Cyanide, Free µg/l	Cyanide, µg/l	Dissolved Vanadium µg/l	Hardness (As CaCO3) µg/l	Total Dissolved Solids µg/l
SW-01	SW-01_20150729	7/29/2015	10 UJ	2 U	2 UJ	10 UJ	2 U	37000	79000 J
SW-01	SW-01-20151208	12/8/2015	10 UJ	2 UJ	2 U	10 U	--	35300	55000
SW-01	SW-01_20160726	7/26/2016	10 U	2.5	2 U	10 UJ	--	38000	65000
SW-01	DUP1_20161201	12/1/2016	5.8 J	1.5 U	2 U	3.2 J	4 U	32000	81000
SW-01	SW-01_20161201	12/1/2016	10 U	1.5 U	2 U	10 U	4 U	28000	85000
SW-01	SW01_20170227	2/27/2017	10 U	1.5 U	2 U	10 U	4 U	16000	42000 J
SW-01	SW-01_20170622	6/22/2017	10 U	1.5 U	2 U	4 J	4 U	24000 J	40000
SW-01	SW-01_20170724	7/24/2017	10 U	1.4 J	--	--	4 U	41000	44000
SW-02	SW-02_20150729	7/29/2015	10 UJ	2 U	2 UJ	10 UJ	2 U	41000	81000 J
SW-02	DUP-M3_20150729	7/29/2015	10 UJ	2 U	2 UJ	10 UJ	2 U	35000	82000 J
SW-02	SW-02-20151208	12/8/2015	10 U	2 UJ	2 U	10 U	--	37600	62000
SW-02	SW-02_20160726	7/26/2016	8.9 J	1.6	2 U	10 UJ	--	34000	74000
SW-02	SW-02_20161201	12/1/2016	5 J	1.5 U	2 U	10 U	4 U	32000	81000
SW-02	SW02_20170227	2/27/2017	10 U	0.47 J	2 U	10 U	4 U	20000	58000 J
SW-02	SW-02_20170622	6/22/2017	10 U	1.5 U	2 U	10 U	4 U	28000 J	49000
SW-02	SW-02_20170724	7/24/2017	10 U	0.62 J	--	--	4 U	33000	24000
SW-03	SW-03_20150729	7/29/2015	10 UJ	2 U	2 UJ	10 UJ	2 U	34000	85000 J
SW-03	SW-03-20151208	12/8/2015	10 UJ	2 UJ	2 U	10 U	--	27500	54000
SW-03	DUP-20151208	12/8/2015	10 UJ	2 UJ	2 U	10 U	--	27800	53000
SW-03	SW-03_20160726	7/26/2016	10 U	1 J	2 U	10 UJ	--	34000	56000
SW-03	DUP-20160726	7/26/2016	8.9 J	0.49 J	2 U	10 UJ	--	--	--
SW-03	SW-03_20161201	12/1/2016	10 U	1.5 U	2 U	10 U	4 U	44000	69000
SW-03	SW-03_20170118	1/18/2017	--	--	--	--	4 U	26000	57000
SW-03	SW03_20170227	2/27/2017	10 U	1.5 U	2 U	10 U	4 U	16000	57000 J
SW-03-DUP	DUP01_20170227	2/27/2017	10 U	1.5 U	2 U	10 U	4 U	12000	42000 J
SW-03	SW-03_20170425	4/25/2017	10 U	1.5 UJ	2 U	10 U	4 U	16000	49000
SW-03-DUP	DUP_20170622	6/22/2017	10 U	1.5 U	2 U	10 U	4 U	28000 J	40000
SW-03	SW-03_20170622	6/22/2017	10 U	1.5 U	2 U	3.1 J	4 U	20000 J	44000
SW-03	SW-03_20170724	7/24/2017	10 U	0.44 J	--	--	4 U	32000	16000
SW-04	SW-04_20150729	7/29/2015	10 UJ	2 U	2 UJ	10 UJ	2 U	33000	83000 J
SW-04	SW-04-20151208	12/8/2015	10 UJ	2 UJ	2 U	10 U	--	33700	53000
SW-04	SW-04_20160726	7/26/2016	9.8 J	0.43 J	2 U	10 UJ	--	30000	64000
SW-04	SW-04_20161201	12/1/2016	10 U	1.5 U	2 U	10 U	4 U	32000	79000
SW-04	SW-04_20170622	6/22/2017	10 U	1.5 U	2 U	10 U	4 U	44000 J	47000

Notes:
µg/L - micrograms per liter
" - " indicates not available/not analyzed
U - indicates analyte was not detected above reporting limit shown
J - indicates value is estimated
n/a - indicates no standard available
1) Surface Water Quality Criteria (SWQC) are aquatic values, A(C) and A(A), from NYS Division of Water Technical and Operations Guidance Series *(TOGS 1.1.1), Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.*
Hudson River is classified as Class C waters in site vicinity.
SWQC shown are applicable for Class C, fresh water (chloride concentrations less than 250 mg/L or total dissolved solids less than 1,000 mg/L)
A(C) - protective of fish propogation in fresh waters - applicable to dissolved phases only (or acid soluble phase for vanadium)
A(A) - protective of fish survival in fresh waters - applicable to dissolved phases only (acid soluble phase for vanadium)
Calculated values based on hardness (per TOGS 1.1.1):
Chromium A(C) = (0.86) exp(0.819 [ln (ppm hardness)] + 0.6848)
Chromium A(A) = (0.316) exp(0.819 [ln (ppm hardness)] + 3.7256)
Chromium aquatic standard applies to dissolved form and does not include hexavalent chromium.
Vanadium aquatic standard applies to acid soluble form.

Table 3-4
Groundwater Criteria for Surface Water Protection Using Dilution Attenuation Factors
Former Ciba-Geigy Site
Glens Falls, New York

Hexavalent Chromium						
Horizon	**CWQSh (µg/L) Most Conservative - A(C)**	**DAF Most Conservative - 7Q10, 1992 Conditions**	**CGW (µg/L)**	**Max. Concentration Measured On-Site in 2015 (µg/L)**	**Location**	**Sample Date**
Overburden	11	258	2,838	7,580	MW-OB14	08/05/15
				1,190	MW-OB33	12/08/15
Shallow Bedrock (Zone A)	11	7,348	80,828	835	EW-A9	08/04/15
				147	AW-A11	12/09/15
Intermediate Bedrock (Zone B)[1]	11	7,348	80,828	587	AW-B20	08/05/15
				10 U	All sampled wells	Dec. 2015

Free Cyanide						
Horizon	**CWQSh (µg/L) Most Conservative - A(C)**	**DAF Most Conservative - 7Q10, 1992 Conditions**	**CGW (µg/L)**	**Max. Concentration Measured On-Site in 2015 (µg/L)**	**Location**	**Sample Date**
Overburden	5.2	308	1,602	13	MW-OB13	7/31/2015
				94	MW-OB32	12/08/15
Shallow Bedrock (Zone A)	5.2	13,382	69,586	2.4	AW-A16	8/6/2015
				6	AW-A10	12/08/15
Intermediate Bedrock (Zone B)	5.2	13,382	69,586	13	AW-B13	8/3/2015
				8.9	MW-25D	12/10/15

Vanadium (Dissolved)						
Horizon	**CWQSh (µg/L) Most Conservative - A(C)**	**DAF Most Conservative - 7Q10, 1992 Conditions**	**CGW (µg/L)**	**Max. Concentration Measured On-Site in 2015 (µg/L)**	**Location**	**Sample Date**
Overburden	14	211	2,954	2,400	MW-OB14	08/05/15
				1,600	MW-OB30	12/10/15
Shallow Bedrock (Zone A)	14	11,253	157,542	230	AW-A10	07/29/15
				NS	NS	NS
Intermediate Bedrock (Zone B)	14	11,253	157,542	85	AW-B5	08/05/15
				NS	NS	NS

Notes:
1. An intermediate Zone B bedrock extraction well -EW-B5 -was sampled in 2013 and 2014, with hexavalent chromium detected at 43,000 ug/L and 56,000 ug/L, respectively.

CWQSh = NYSDEC Water Quality Standard (Class C Water). Ambient Water Quality Standards from NYS Division of Water TOGS 1.1.1.
A(C) = Surface water criteria for the protection of fish propagation (fresh water). Applicable to dissolved phases only (or acid soluble phase for vanadium).
DAF = Dilution attenuation factor in acute mix setting
CGW = Groundwater concentration (discharge level) to prevent aquatic life and/or human health impacts.
A shaded value indicates a concentration above the calculated CGW.
CGW = CBKG + (CWQSh - CBKG)(DAF); CBKG = Background concentration upstream (assumed zero as conservative assumption)
U = Concentration below reporting limit
NS = Not Sampled

Table 4-1
Hydraulic Assessment Program Monitoring Wells
Former Ciba-Geigy / Hercules Site
Glens Falls, New York

Well ID	Transducer Type	Monitoring Parameters			Data Collection Frequency (minutes)	Date Data Collected	ROP Scope of Work
		Water Level	Temperature	Specific Conductivity			
Overburden							
MW-OB25	Rugged Troll 200	X	X	X	15	3-30-17 to 8-28-17	Added
MW-OB30	Aqua Troll 200	X	X	X	15	3-29-17 to 8-28-17	Added
MW-OB31	Rugged Troll 200	X	X		15	7-14-17 to 8-28-17	Added
MW-OB32	Rugged Troll 200	X	X		15	7-14-17 to 8-28-17	Added
MW-OB33	Aqua Troll 200	X	X	X	15	11-2-16 to 8-28-17	Original
MW-OB34	Aqua Troll 200	X	X	X	15	11-2-16 to 8-28-17	Original
MH-4	Aqua Troll 200	X	X	X	15	11-2-16 to 8-28-17	Original
Sump A	Aqua Troll 200	X	X	X	15	11-2-16 to 8-28-17	Original
Sump B	Aqua Troll 200	X	X	X	15	11-2-16 to 8-28-17	Original
AP-1	Level Troll 700	X	X		15	7-18-17 to 8-21-17	Added
AP-2	Level Troll 700	X	X		15	7-18-17 to 8-21-17	Added
AP-3	Level Troll 700	X	X		15	7-18-17 to 8-21-17	Added
AP-5	Level Troll 700	X	X		15	7-18-17 to 8-21-17	Added
AP-6	Level Troll 700	X	X		15	7-18-17 to 8-21-17	Added
Shallow Bedrock							
AW-A10	Rugged Troll 200	X	X		15	7-14-17 to 8-22-17	Added
AW-A11	Rugged Troll 200	X	X	X	15	7-14-17 to 8-21-17	Added
AW-A14	Rugged Troll 200	X	X	X	15	3-29-17 to 8-28-17	Added
EW-A11	Rugged Troll 200	X	X		15	7-14-17 to 8-22-17	Added
Intermediate Bedrock							
AW-B4	Rugged Troll 200	X	X	X	15	3-30-17 to 8-28-17	Added
AW-B11	Rugged Troll 200	X	X		15	7-14-17 to 8-22-17	Added
AW-B12	Rugged Troll 200	X	X		15	7-14-17 to 8-22-17	Added
EW-B3	Rugged Troll 200	X	X	X	15	7-14-17 to 8-21-17	Added
EW-B5	Rugged Troll 200	X	X	X	15	11-10-17 to 8-28-17	Original
Deep Bedrock							
AW-C11	Rugged Troll 200	X	X	X	15	3-30-17 to 8-28-17	Added

Notes:
1. Transducers manufactured by In-Situ Inc.
2. ROP = Remedy Optimization Plan

Table 4-2
French Drain System Sump A: Vertical Hydraulic Gradient
Former Ciba-Geigy / Hercules
Glens Falls, New York

Well ID	Hydrogeologic Horizon	Date	Hydraulic Head Elevation (feet msl)	Well Screen Mid-Point Elevation (feet msl)	Hydraulic Head Difference Between Wells (feet)	Distance Between Well Screen Mid-Points (feet) (note 1)	Vertical Hydraulic Gradient (feet/feet) (note 2)
Cluster A (see Figure 4-21)							
Pre Bedrock Recovery Well System Shutdown							
AW-10A	Shallow Bedrock	July 28, 2016	204.10	200.05	12.06	16.40	0.74
AW-B11	Intermediate Bedrock	July 28, 2016	192.04	183.65			
Post Bedrock Recovery Well System Shutdown							
AW-10A	Shallow Bedrock	August 21, 2017	212.65	200.05	4.20	16.40	0.26
AW-B11	Intermediate Bedrock	August 21, 2017	208.45	183.65			
Cluster B (see Figure 4-21)							
Pre Bedrock Recovery Well System Shutdown							
Sump A	Overburden	November 30, 2016	215.30	210.00	19.10	21.40	0.89 (note 3)
AW-A11	Shallow Bedrock	July 28, 2016	196.20	188.60			
Post Bedrock Recovery Well System Shutdown							
Sump A	Overburden	August 21, 2017	213.69	210.00	-0.14	21.40	-0.01
AW-A11	Shallow Bedrock	August 21, 2017	213.83	188.60			
Pre Bedrock Recovery Well System Shutdown							
Sump A	Overburden	November 30, 2016	215.30	210.00	47.06	39.66	1.19 (note 3)
EW-B3	Intermediate Bedrock	March 2015	168.24	170.34			
Post Bedrock Recovery Well System Shutdown							
Sump A	Overburden	August 21, 2017	213.69	210.00	0.31	39.66	0.01
EW-B3	Intermediate Bedrock	August 21, 2017	213.38	170.34			
Cluster C (see Figure 4-21)							
Pre Bedrock Recovery Well System Shutdown							
EW-A11	Shallow Bedrock	March 2015	202.45	201.15	2.60	16.23	0.16
AW-B12	Intermediate Bedrock	March 2015	199.85	184.92			
Post Bedrock Recovery Well System Shutdown							
EW-A11	Shallow Bedrock	August 21, 2017	209.42	201.15	0.71	16.23	0.04
AW-B12	Intermediate Bedrock	August 21, 2017	208.71	184.92			

Notes:
1. The sump lateral trench pipe invert elevation was used as the "well screen mid-point elevation."
2. Positive vertical hydraulic gradient represents downward groundwater flow direction.
3. There is limited pre-bedrock recovery well system shutdown groundwater elevation data available for Sump A, monitoring well AW-A11, and extraction well EW-B3 for use to conduct a hydraulic head comparison. Same day measurements for each location does not exist. The closest available measurement dates were used to calculate the vertical hydraulic gradients between Sump A and well AW-A11, and between Sump A and well EW-B5. The calculated vertical hydraulic gradients are considered estimated.

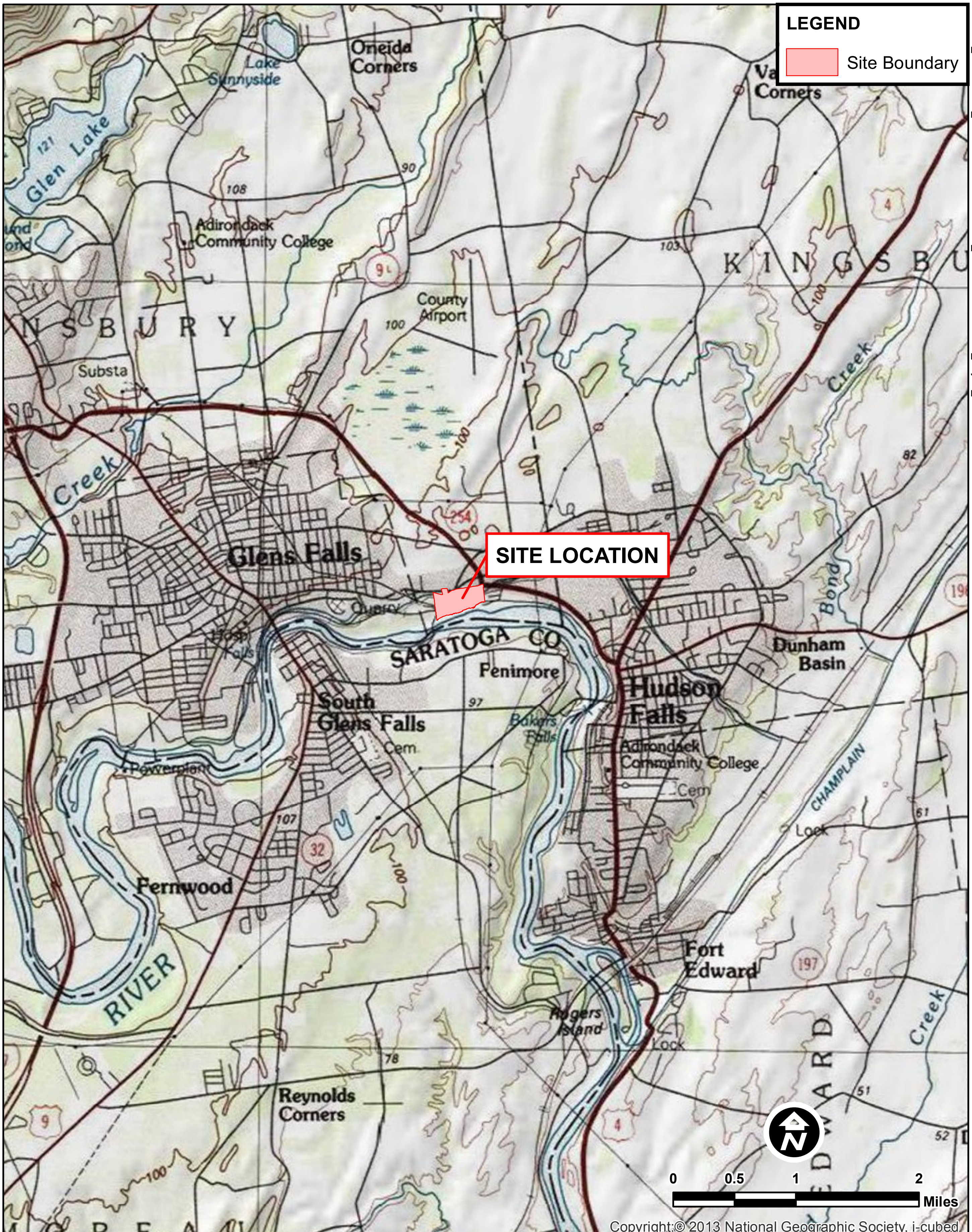
Table 4-3
French Drain System Sump B: Vertical Hydraulic Gradients
Former Ciba-Geigy / Hercules
Glens Falls, New York

Well ID	Hydrogeologic Horizon	Date	Hydraulic Head Elevation (feet msl)	Well Screen Mid-Point Elevation (feet msl)	Hydraulic Head Difference Between Wells (feet)	Distance Between Well Screen Mid-Points (feet)	Vertical Hydraulic Gradient (feet/feet)
Cluster D (see Figure 4-21)							
Pre Bedrock Recovery Well System Shutdown							
AW-A14	Shallow Bedrock	July 27, 2016	218.34	206.32	13.83	10.57	1.31
AW-B4	Intermediate Bedrock	July 29, 2016	204.51	195.75			
Post Bedrock Recovery Well System Shutdown							
AW-A14	Shallow Bedrock	August 21, 2017	219.89	206.32	10.87	10.57	1.03
AW-B4	Intermediate Bedrock	August 21, 2017	209.02	195.75			
Pre Bedrock Recovery Well System Shutdown							
AW-A14	Shallow Bedrock	July 27, 2016	218.34	206.32	23.82	118.37	0.20
AW-C11	Deep Bedrock	July 28, 2016	194.52	87.95			
Post Bedrock Recovery Well System Shutdown							
AW-A14	Shallow Bedrock	August 21, 2017	219.89	206.32	24.68	118.37	0.21
AW-C11	Deep Bedrock	August 21, 2017	195.21	87.95			
Cluster E (See Figure 4-21)							
Pre Bedrock Recovery Well System Shutdown							
MW-OB26	Overburden	July 28, 2016	226.77	224.45	34.43	35.10	0.98
EW-B5	Intermediate Bedrock	July 26, 2016	192.34	189.35			
Post Bedrock Recovery Well System Shutdown							
MW-OB26	Overburden	August 28, 2017	227.50	224.45	24.05	35.10	0.69
EW-B5	Intermediate Bedrock	August 21, 2017	203.45	189.35			

Notes:

1. The sump lateral trench pipe invert elevation was used as the "well screen mid-point elevation."
2. Positive vertical hydraulic gradient represents downward groundwater flow direction.

FIGURES



EHS Support consider it done	ASHLAND FORMER CIBA-GEIGY / HERCULES SITE GLENS FALLS, NY	**SITE LOCATION**	**FIGURE 1-1**

D:\EHS_GIS\C16262_GlensFallsHudsonRiver01_ANALYSIS\20160913_July16_GW\FIGURE 1 Site Location.mxd

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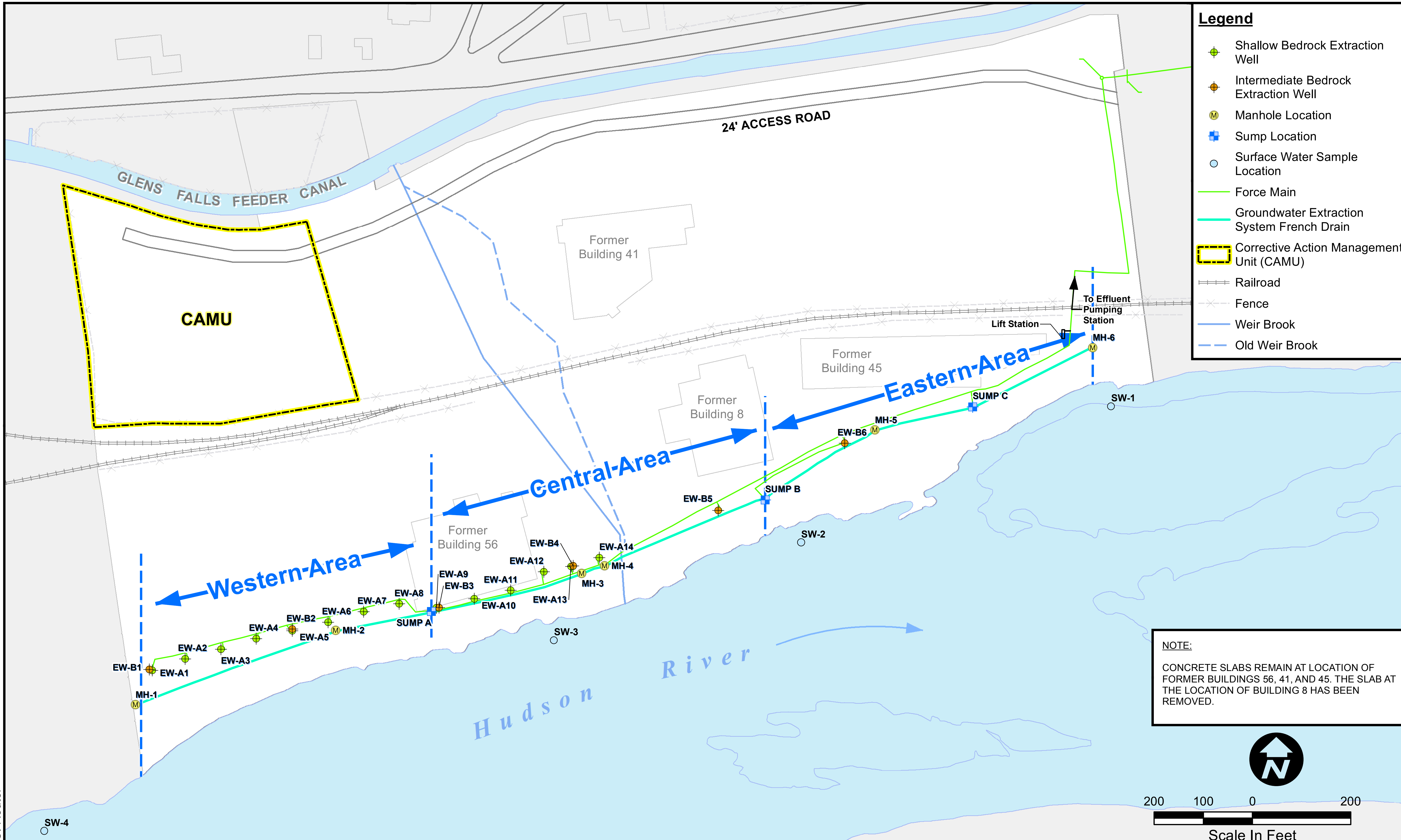

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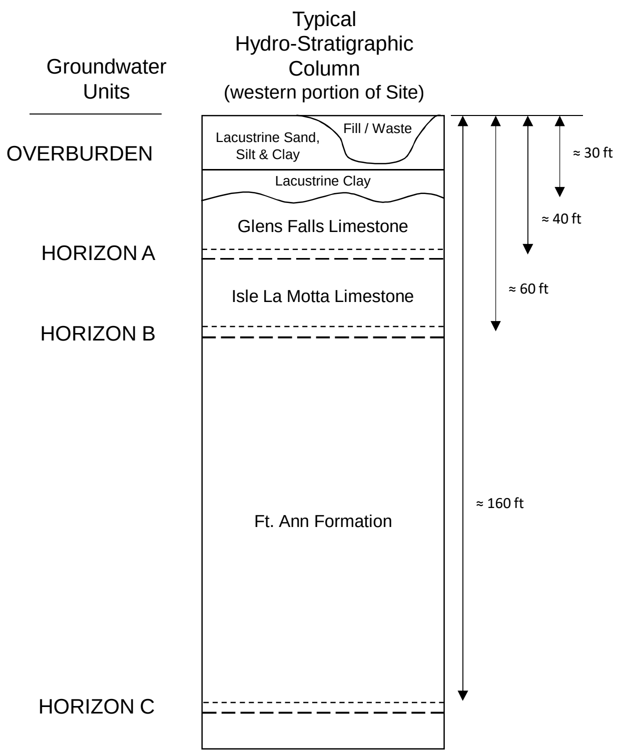
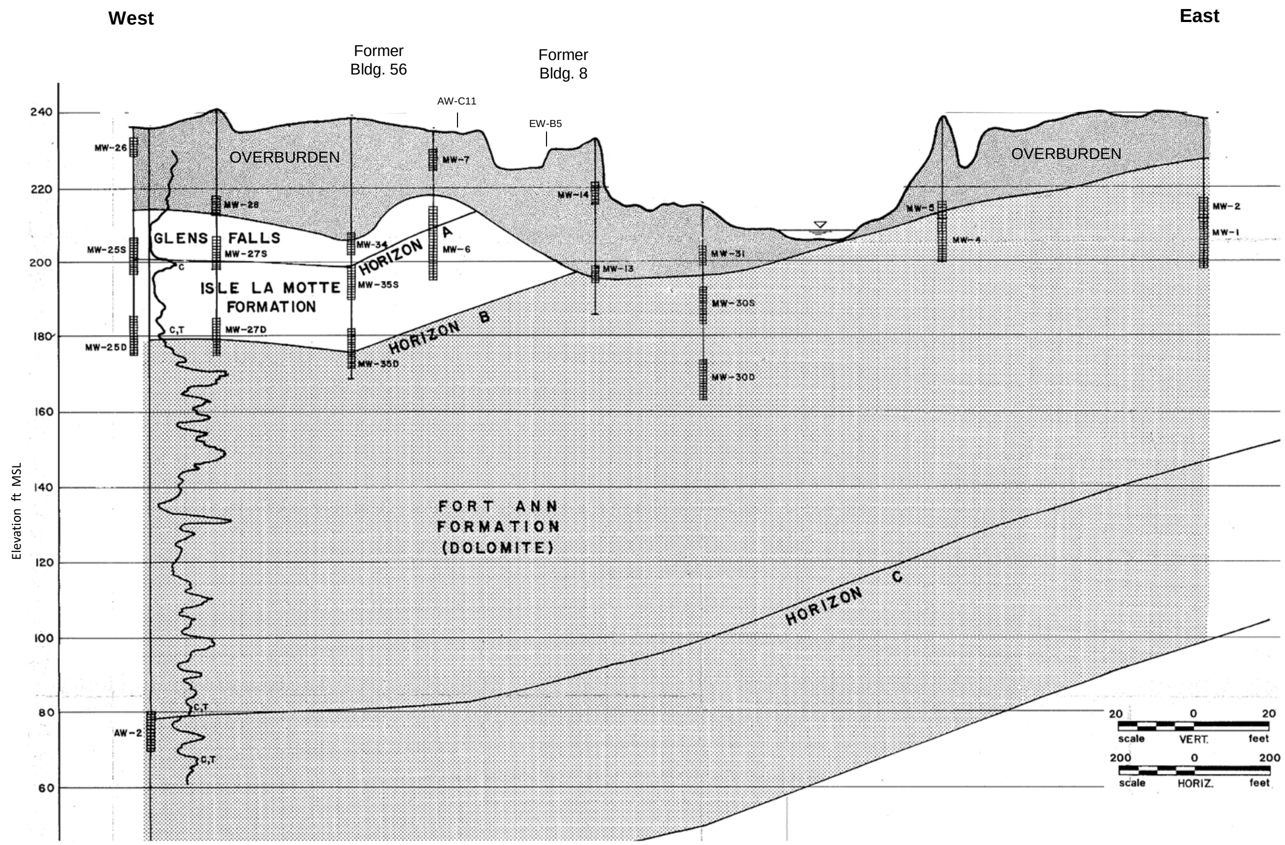
ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

GROUNDWATER EXTRACTION SYSTEM COMPONENTS AND SURFACE WATER SAMPLING LOCATIONS

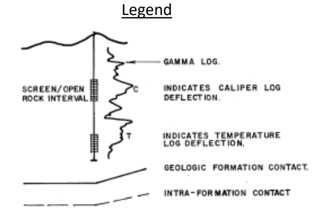
FIGURE 1-2





Map Source: AWARE Incorporated, January 1989. Hydrostratigraphic Cross Section D-D'.
Cross section placed along the northern banks of the Hudson River.

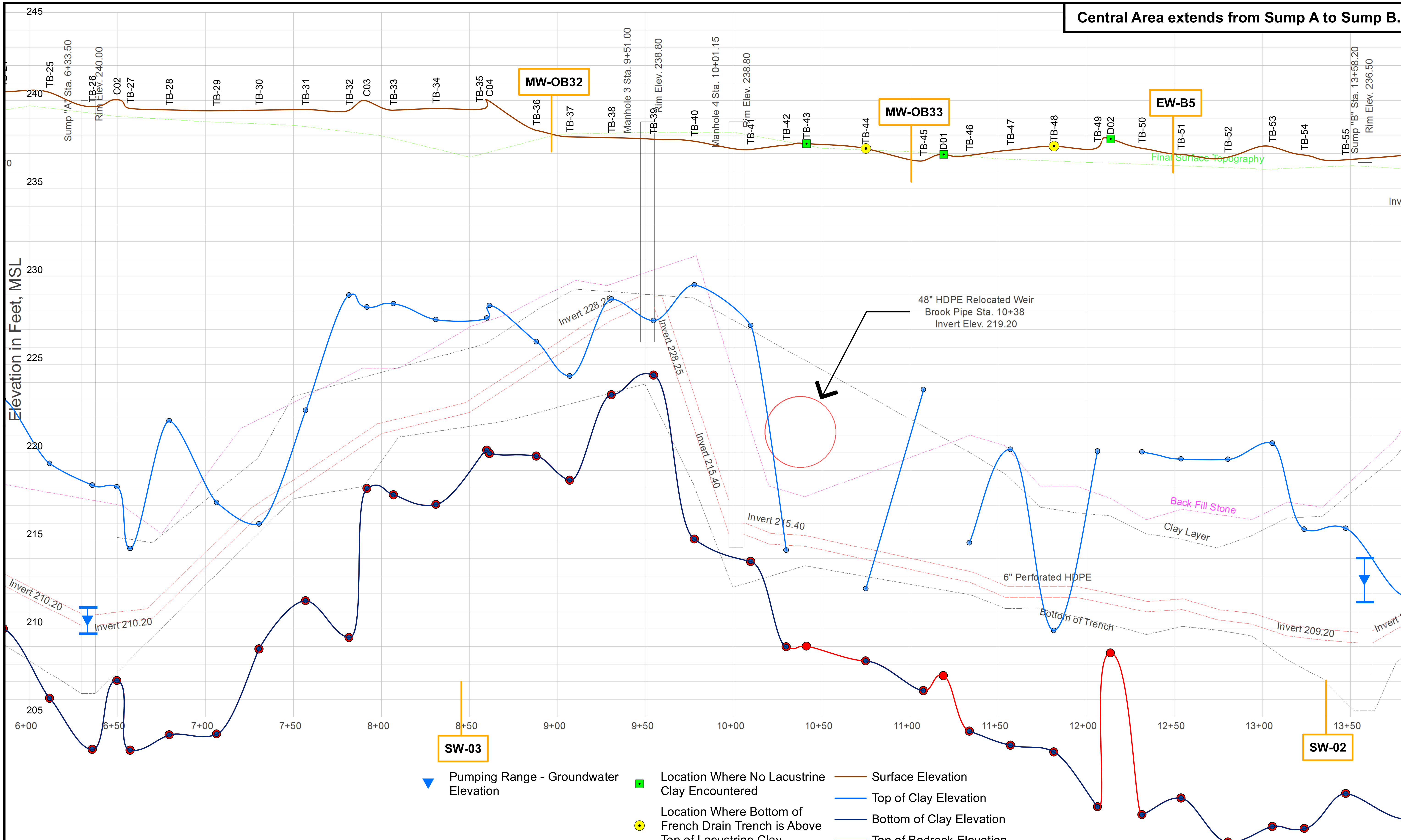
Legend



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support January 2019

Hydro-Stratigraphic Units and Geologic Cross Section

Figure 1-3



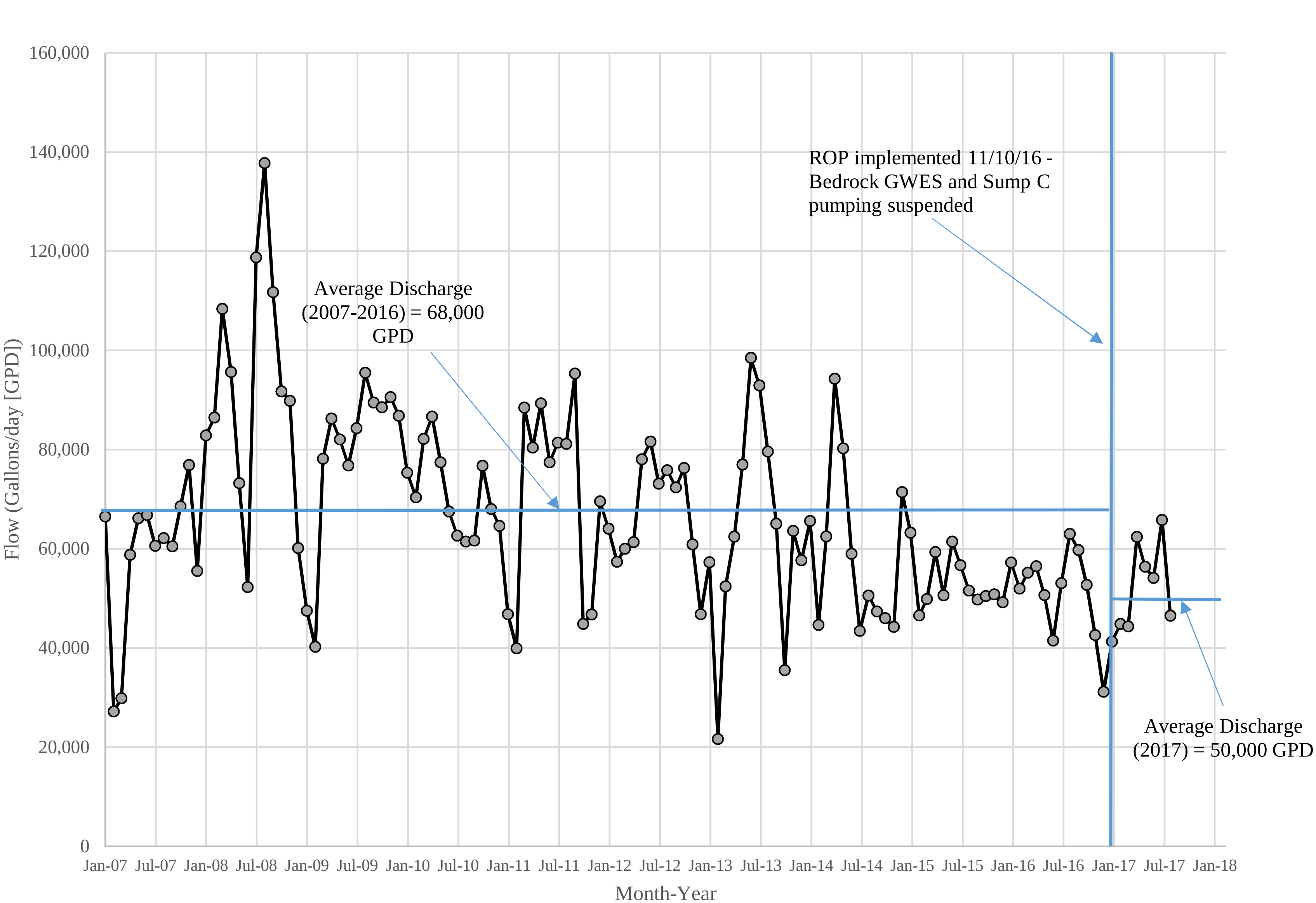
EHS Support *consider it done*

ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

FRENCH DRAIN CROSS SECTION - CENTRAL AREA

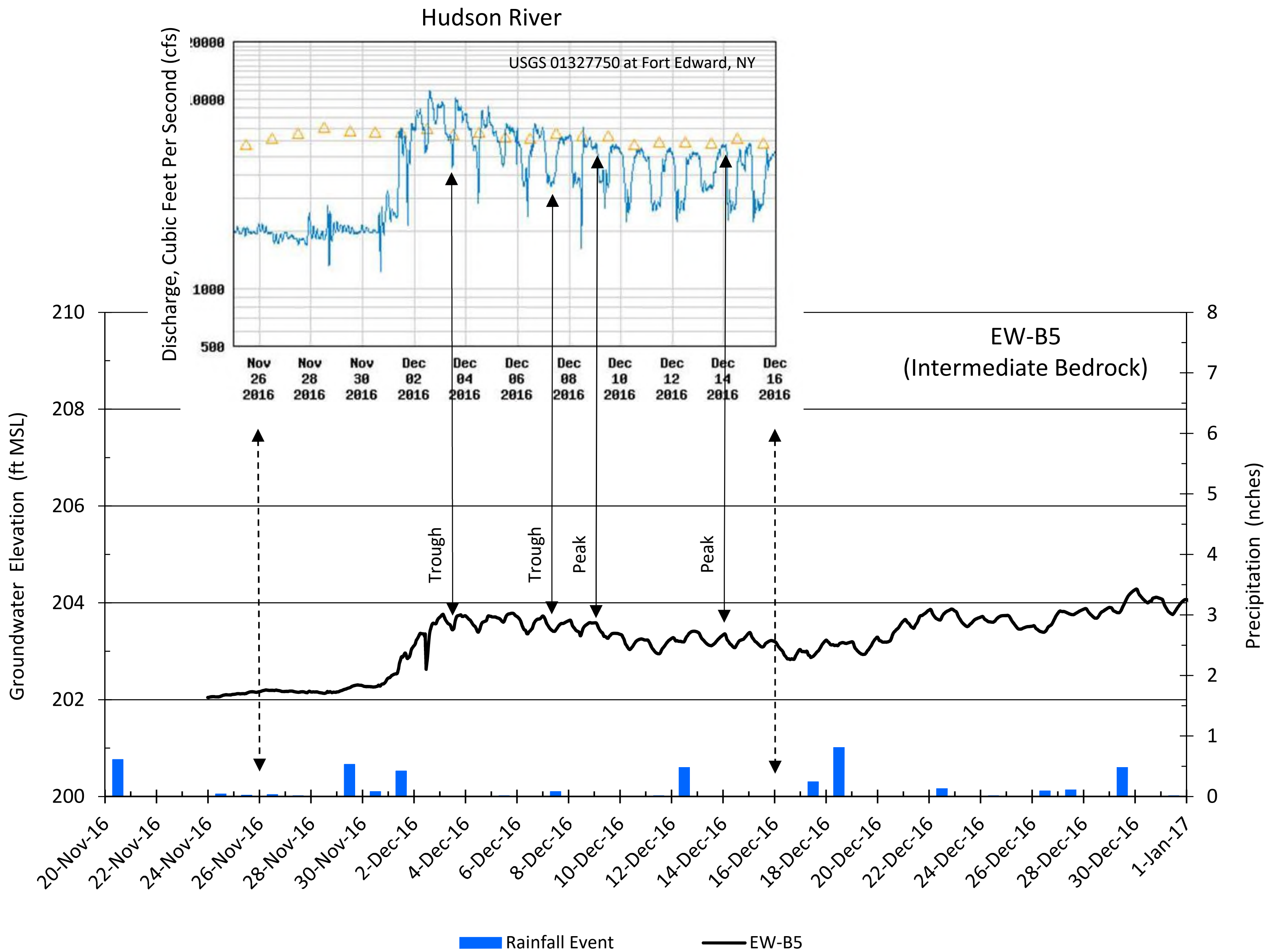
FIGURE 2-1

Figure 2-2
GWES Monthly Discharge Rates (2007 to 2017)

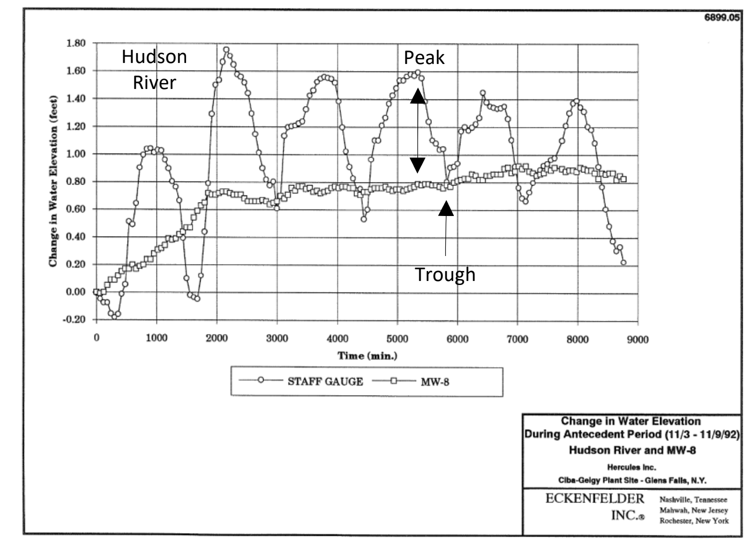


Inset B: Hudson River Stage Compared to Wells MW-8, AW-A4 and MW-27D Hydraulic Heads (Nov. 1992)

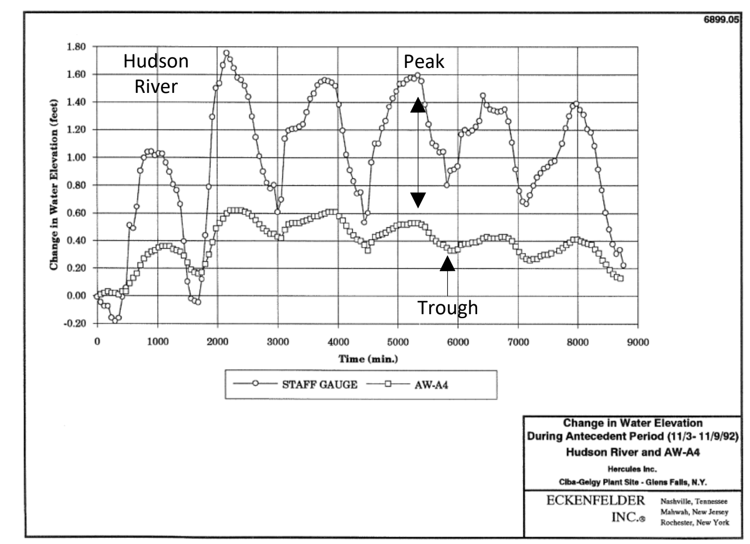
Inset A: Hudson River Stage Compared to Well EW-B5 Hydraulic Head (Dec. 2016)



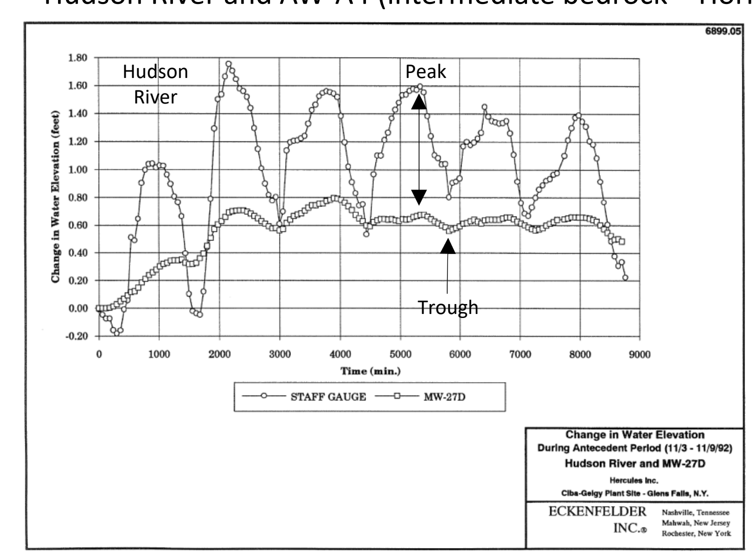
Hudson River and MW-8 (shallow bedrock – Horizon A)



Hudson River and AW-A4 (shallow bedrock – Horizon A)



Hudson River and AW-A4 (intermediate bedrock – Horizon B)



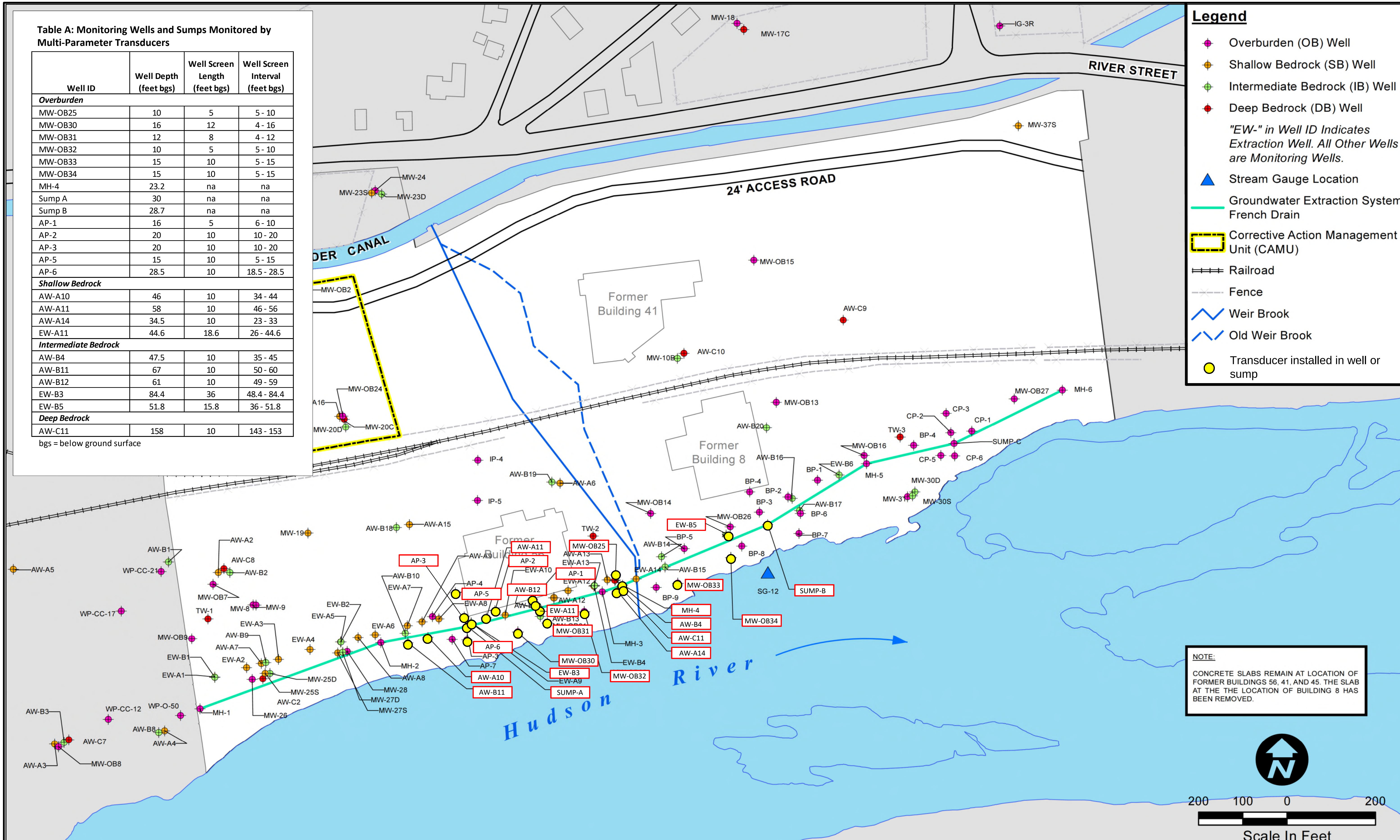
Explanation:

- The diurnal hydraulic head fluctuations observed in the monitoring well transducer data presented in Inset A and Inset B are caused by the Hudson River stage fluctuations due to daily water releases from the power plants/dam structures located upstream from the Site; which provides water to the river and feeder canals. This interpretation is supported by:
  1. The peaks and troughs of the diurnal river stage fluctuations measured at USGS station 01327750 at Fort Edward, New York aligns exactly with the diurnal fluctuations measured at intermediated bedrock well EW-B5 (Inset A). In addition, the data collected from the other Remedy Optimization Report (ROR) study wells (EHS Support, 2017) monitored with a transducer that exhibit the hydraulic head fluctuations were compared to the river stage data and it's been confirmed that the diurnal fluctuations observed in this data correlates with the river stage data; and
  2. In 1992, Eckenfelder Inc. conducted a hydraulic study using transducers to collect continuous hydraulic head elevations of the Hudson River and the Site's groundwater system. The transducer data shows the peaks and troughs of the diurnal river stage fluctuations aligning with the diurnal fluctuations measured in the groundwater. Inset B presents three hydrographs examples showing the correlation of the Hudson River stage fluctuations with the shallow bedrock and intermediated bedrock wells hydraulic head fluctuations.
- The source of the data presented in Inset B is from the RCRA Facility Investigation Report for Groundwater Ciba-Geigy Site, Glens Falls, New York, by Eckenfelder Engineering dated March 1993.

Table A: Monitoring Wells and Sumps Monitored by Multi-Parameter Transducers

Well ID	Well Depth (feet bgs)	Well Screen Length (feet bgs)	Well Screen Interval (feet bgs)
Overburden			
MW-OB25	10	5	5 - 10
MW-OB30	16	12	4 - 16
MW-OB31	12	8	4 - 12
MW-OB32	10	5	5 - 10
MW-OB33	15	10	5 - 15
MW-OB34	15	10	5 - 15
MH-4	23.2	na	na
Sump A	30	na	na
Sump B	28.7	na	na
AP-1	16	5	6 - 10
AP-2	20	10	10 - 20
AP-3	20	10	10 - 20
AP-5	15	10	5 - 15
AP-6	28.5	10	18.5 - 28.5
Shallow Bedrock			
AW-A10	46	10	34 - 44
AW-A11	58	10	46 - 56
AW-A14	34.5	10	23 - 33
EW-A11	44.6	18.6	26 - 44.6
Intermediate Bedrock			
AW-B4	47.5	10	35 - 45
AW-B11	67	10	50 - 60
AW-B12	61	10	49 - 59
EW-B3	84.4	36	48.4 - 84.4
EW-B5	51.8	15.8	36 - 51.8
Deep Bedrock			
AW-C11	158	10	143 - 153

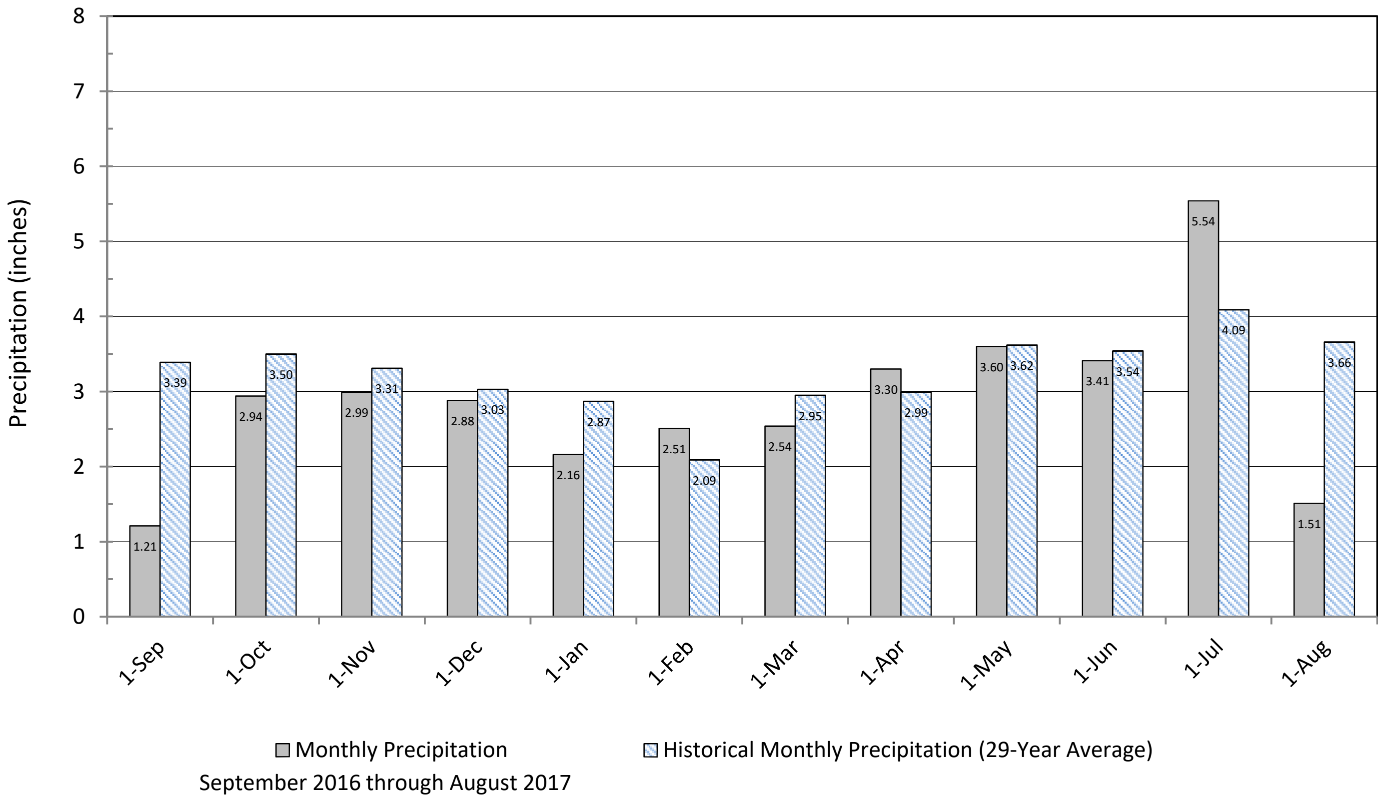
bgs = below ground surface



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support August 2018

Hydraulic Assessment Program Monitoring Well and Sump Locations

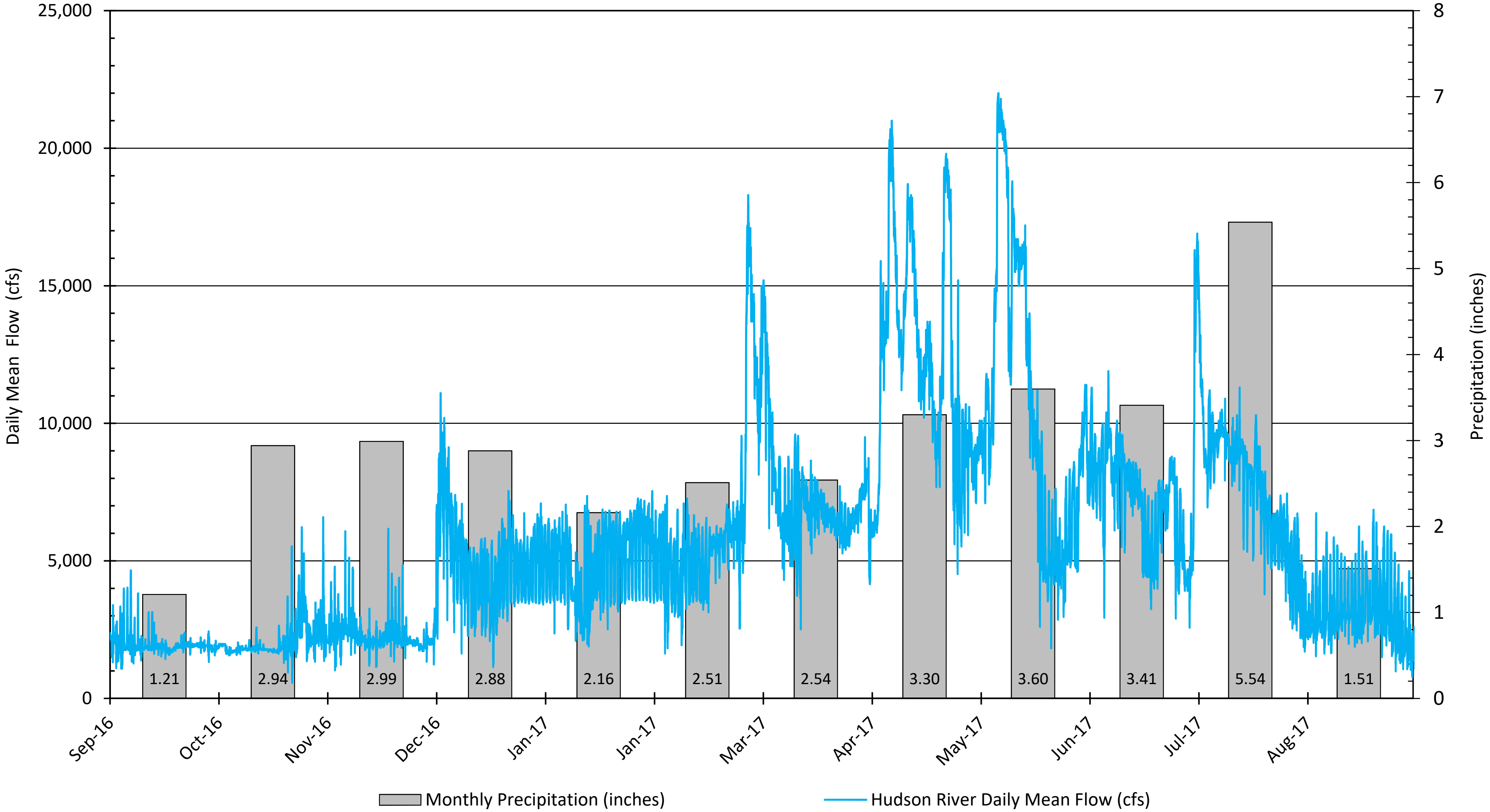
Figure 4-1



Notes:

1. Precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Monthly average precipitation calculated from rainfall data measured from 1981 through 2010 (29 years).

Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support October 2017	**Monthly Precipitation and Historical Monthly Precipitation**	**Figure 4-2**

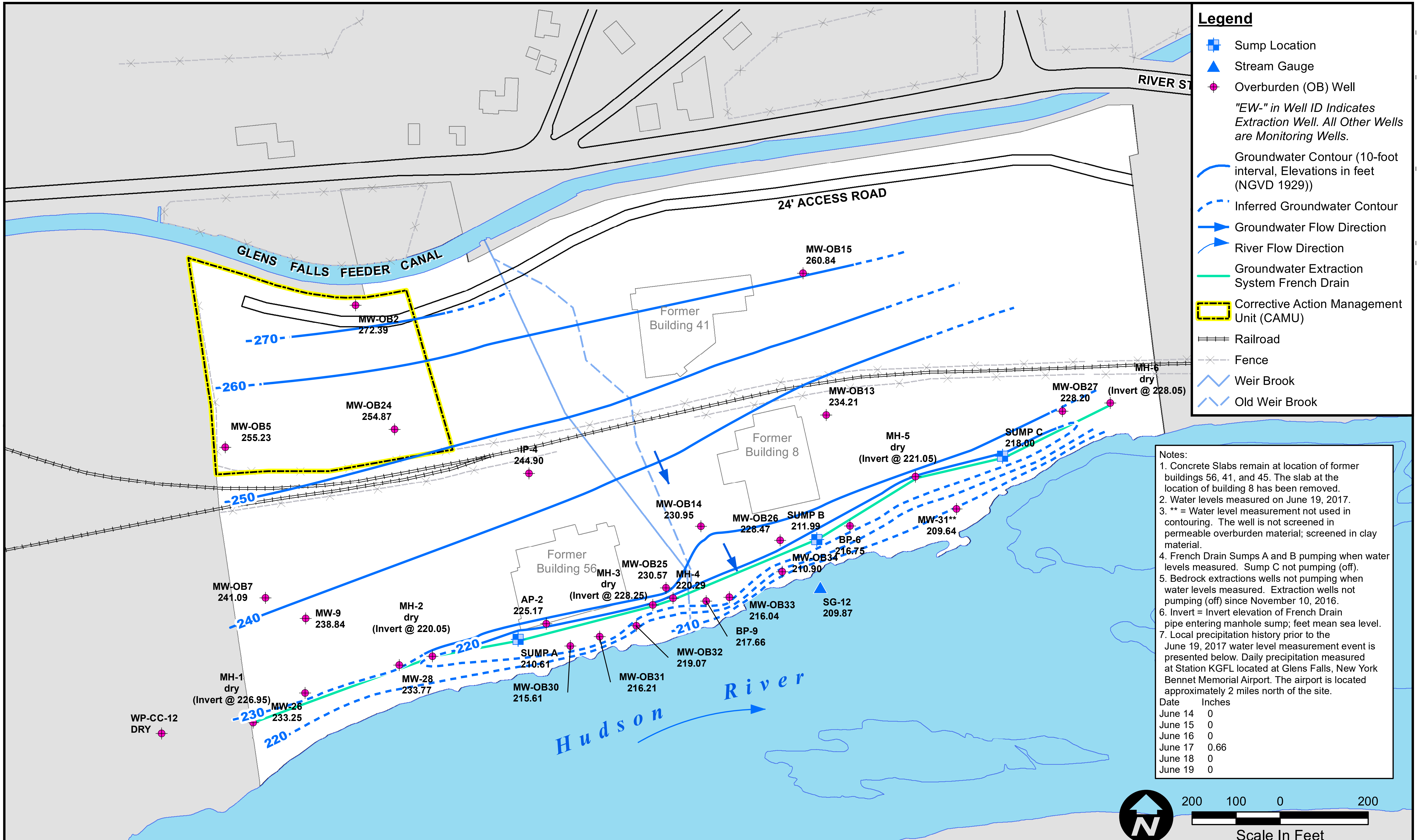


September 2016 through August 2017

Notes:

1. Precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. The Hudson River stage gauge station is USGS 01327750 located at Fort Edward, New York

Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support October 2017	**Monthly Precipitation and Hudson River Daily Mean Flows**	**Figure 4-3**



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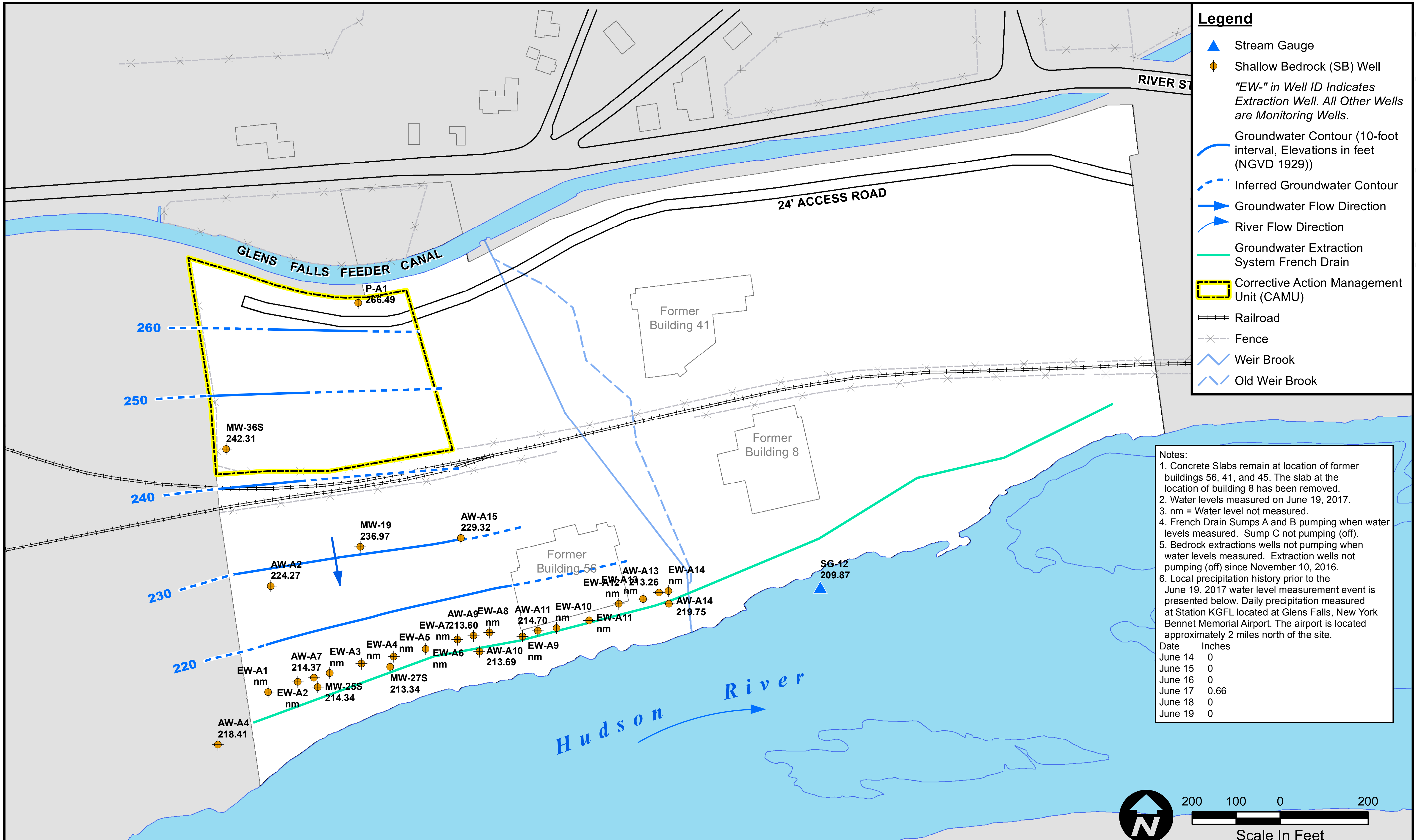
ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

OVERBURDEN POTENTIOMETRIC SURFACE: JUNE 2017

Figure 4-4



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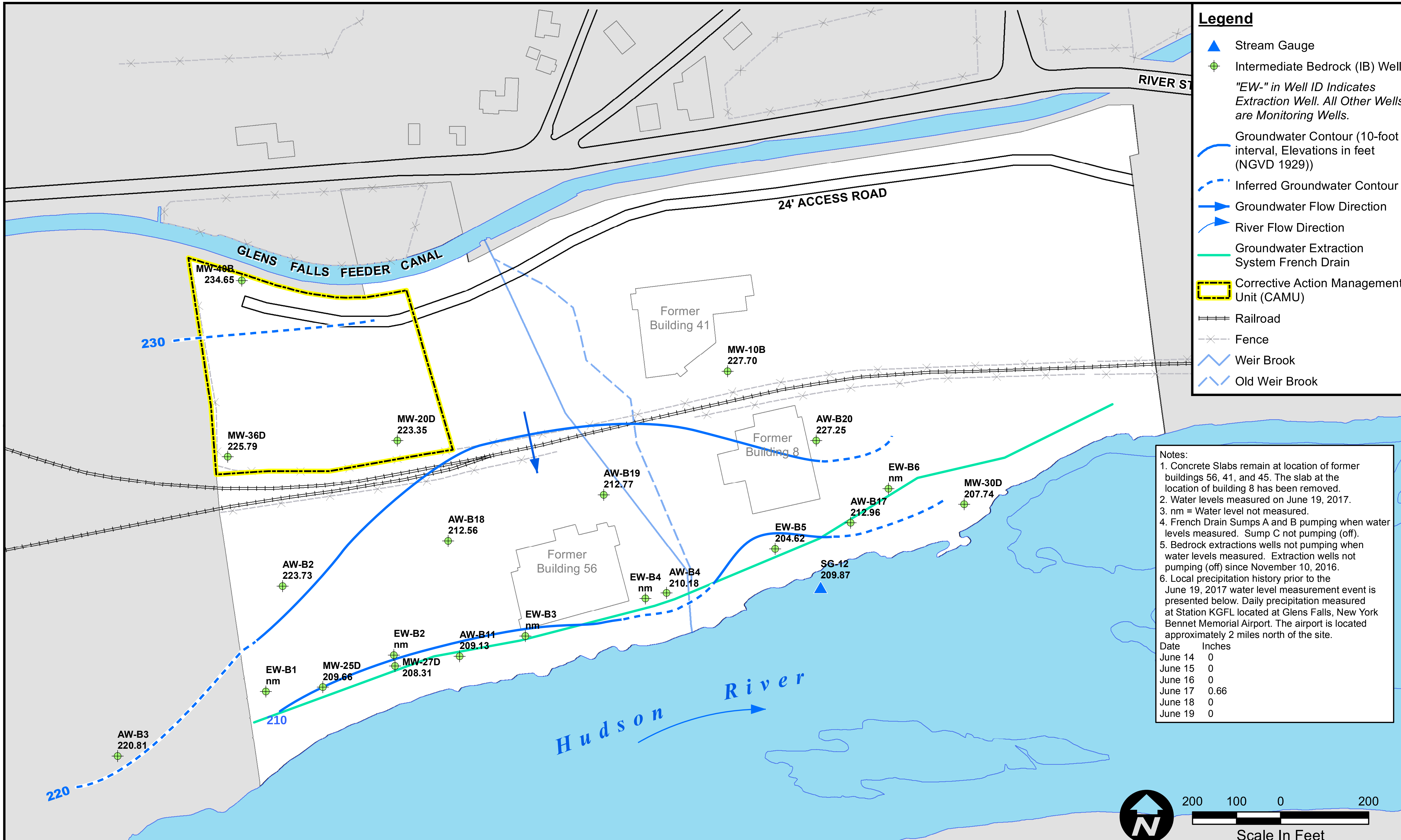
ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

SHALLOW BEDROCK POTENTIOMETRIC SURFACE: JUNE 2017

Figure 4-5



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ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

INTERMEDIATE BEDROCK POTENTIOMETRIC SURFACE: JUNE 2017

Figure 4-6

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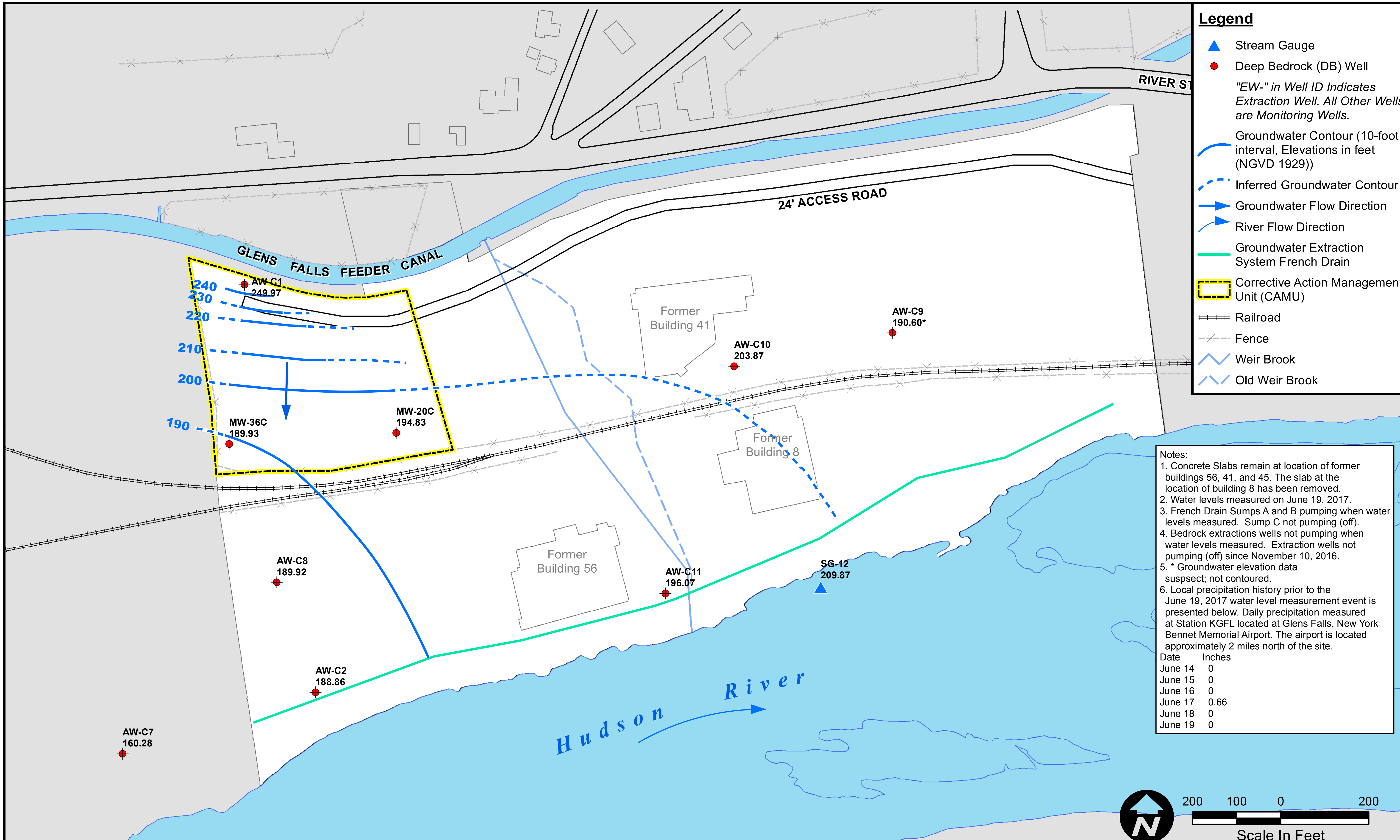

EHS Support *consider it done*

ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

DEEP BEDROCK POTENTIOMETRIC SURFACE: JUNE 2017

Figure 4-7

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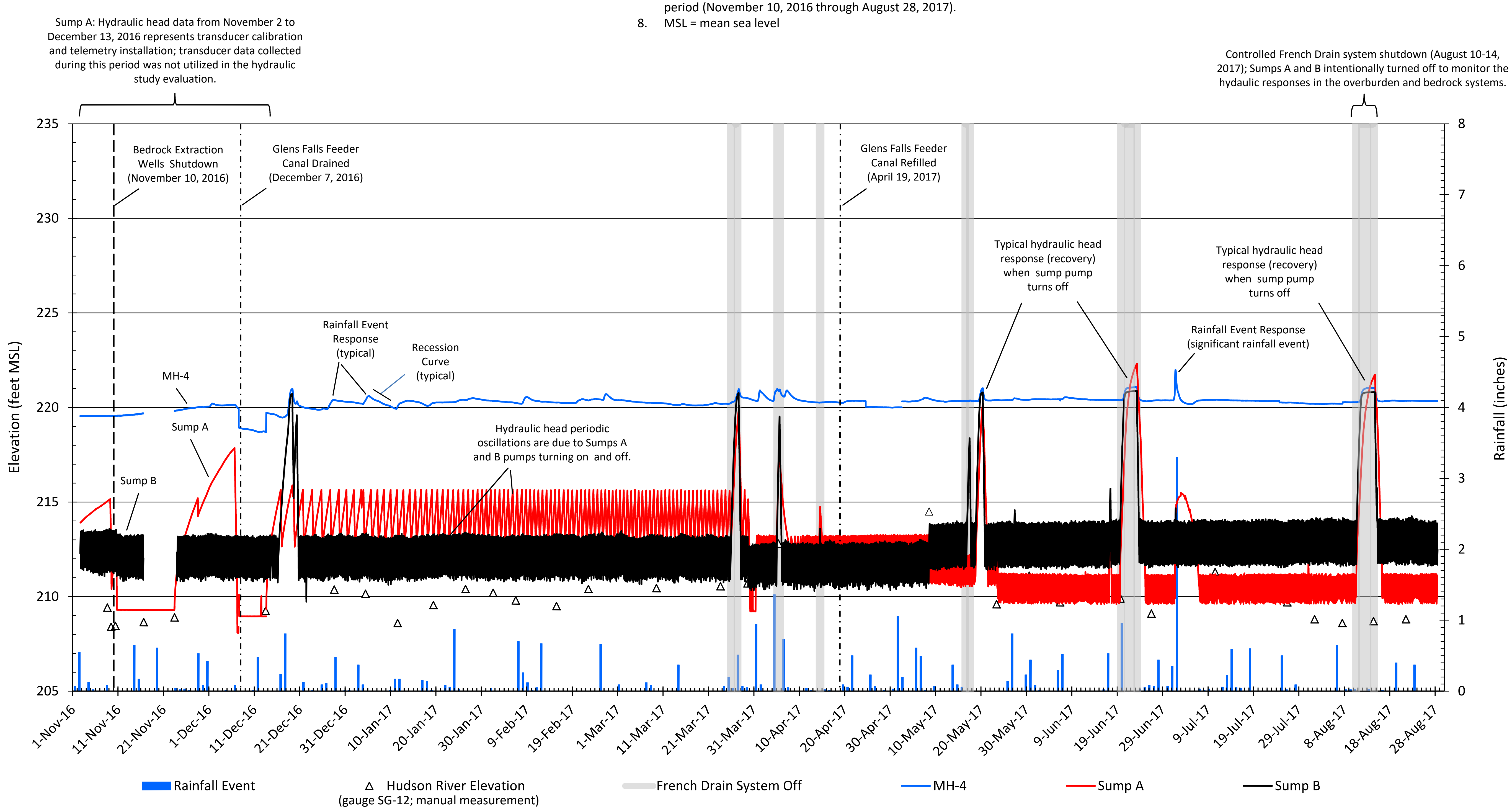
Notes:
1. Daily precipitation data source: precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Blue bar graph includes wet precipitation, snowfall, and other frozen/winter precipitation types. The melted liquid equivalent of the snowfall or other frozen/winter precipitation types is included in the daily total.
3. Hydraulic head elevation data measured by a data logger; data logger measurement frequency at 15 minutes intervals.
4. Data points identified on the graph as "manual" are periodic manual field measurements of the Hudson River surface water elevation.
5. Sumps A and B were pumping throughout the duration of the monitoring period, except during the noted system down times (no pumping).
6. Bedrock extraction wells were pumping during the first 9 days of the monitoring period (November 2 through November 10, 2016).
7. Bedrock extraction wells stopped pumping (were shut down) on November 10, 2016, and continued to be off during the entire monitoring period (November 10, 2016 through August 28, 2017).
8. MSL = mean sea level



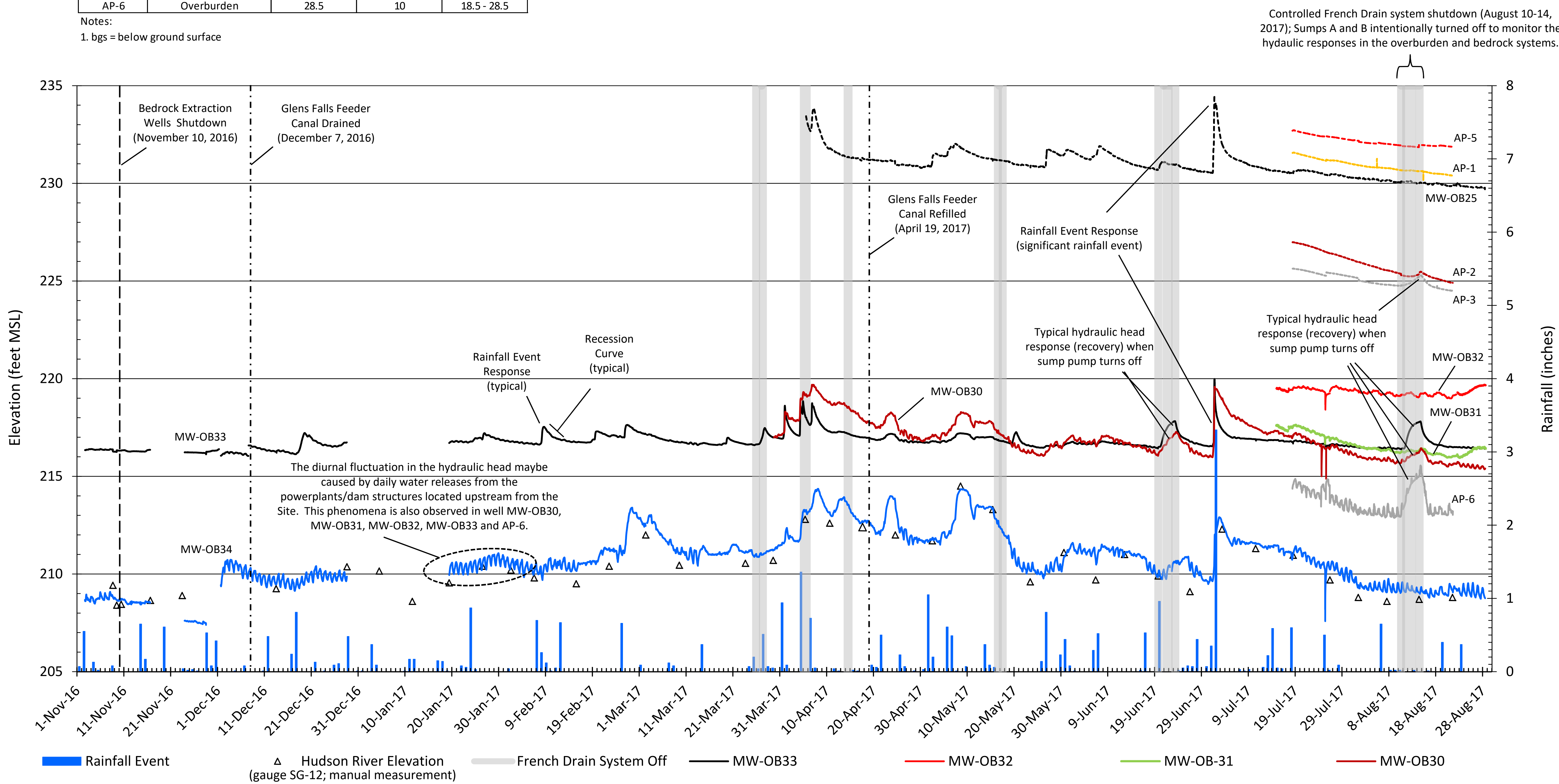
Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2018	**Long-Duration Groundwater Hydrograph Plots: French Drain System**	**Figure 4-8**

Table A: Well Construction Details

Well ID	Hydrogeologic Unit	Well Depth (feet bgs)	Well Screen Length (feet bgs)	Well Screen Interval (feet bgs)
MW-OB25	Overburden	10	5	5 - 10
MW-OB30	Overburden	16	12	4 - 16
MW-OB31	Overburden	12	8	4 - 12
MW-OB32	Overburden	10	5	5 - 10
MW-OB33	Overburden	15	10	5 - 15
MW-OB34	Overburden	15	10	5 - 15
AP-1	Overburden	16	5	6 - 10
AP-2	Overburden	20	10	10 - 20
AP-3	Overburden	20	10	10 - 20
AP-5	Overburden	15	10	5 - 15
AP-6	Overburden	28.5	10	18.5 - 28.5

Notes:
1. bgs = below ground surface

Notes:
1. Daily precipitation data source: precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Blue bar graph includes wet precipitation, snowfall, and other frozen/winter precipitation types. The melted liquid equivalent of the snowfall or other frozen/winter precipitation types is included in the daily total.
3. Hydraulic head elevation data measured by a data logger; data logger measurement frequency at 15 minutes intervals.
4. Data points identified on the graph as "manual" are periodic manual field measurements of the Hudson River surface water elevation.
5. Sumps A and B were pumping throughout the duration of the monitoring period, except during the noted system down times (no pumping).
6. Bedrock extraction wells were pumping during the first 9 days of the monitoring period (November 2 through November 10, 2016).
7. Bedrock extraction wells stopped pumping (were shut down) on November 10, 2016, and continued to be off during the entire monitoring period (November 10, 2016 through August 28, 2017).
8. MSL = mean sea level



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support August 2018

Long-Duration Groundwater Hydrograph Plots: Overburden Wells

Figure 4-9

Table A: Well Construction Details

Well ID	Hydrogeologic Unit	Well Depth (feet bgs)	Well Screen Length (feet bgs)	Well Screen Interval (feet bgs)
AW-A10	Shallow Bedrock	46	10	34 - 44
AW-A11	Shallow Bedrock	58	10	46 - 56
AW-A14	Shallow Bedrock	34.5	10	23 - 33
EW-A11	Shallow Bedrock	44.6	18.6	26 - 44.6

Notes:
1. bgs = below ground surface

Notes:
1. Daily precipitation data source: precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Blue bar graph includes wet precipitation, snowfall, and other frozen/winter precipitation types. The melted liquid equivalent of the snowfall or other frozen/winter precipitation types is included in the daily total.
3. Hydraulic head elevation data measured by a data logger; data logger measurement frequency at 15 minutes intervals.
4. Data points identified on the graph as "manual" are periodic manual field measurements of the Hudson River surface water elevation.
5. Sumps A and B were pumping throughout the duration of the monitoring period, except during the noted system down times (no pumping).
6. Bedrock extraction wells were pumping during the first 9 days of the monitoring period (November 2 through November 10, 2016).
7. Bedrock extraction wells stopped pumping (were shut down) on November 10, 2016, and continued to be off during the entire monitoring period (November 10, 2016 through August 28, 2017).
8. MSL = mean sea level

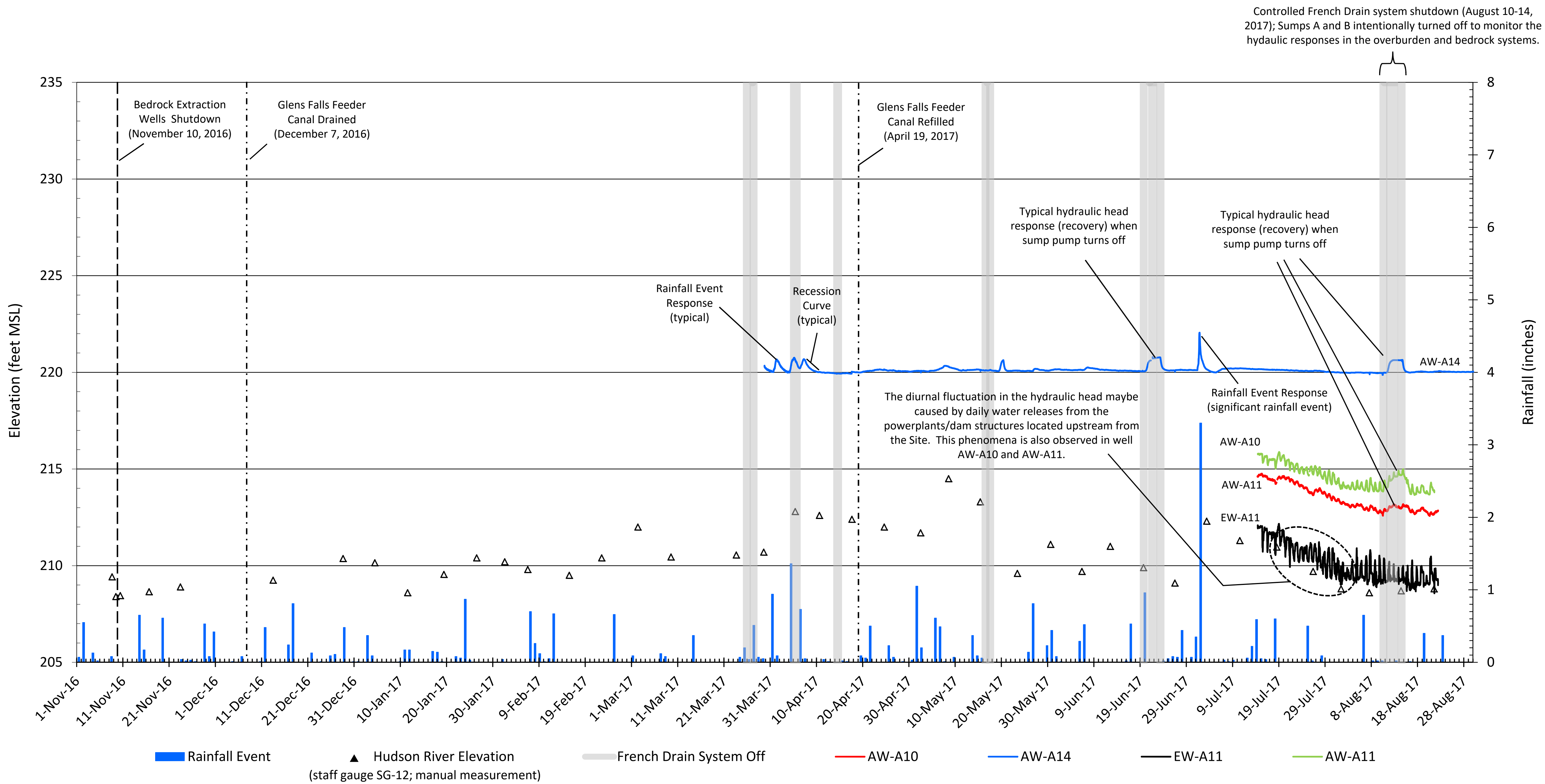
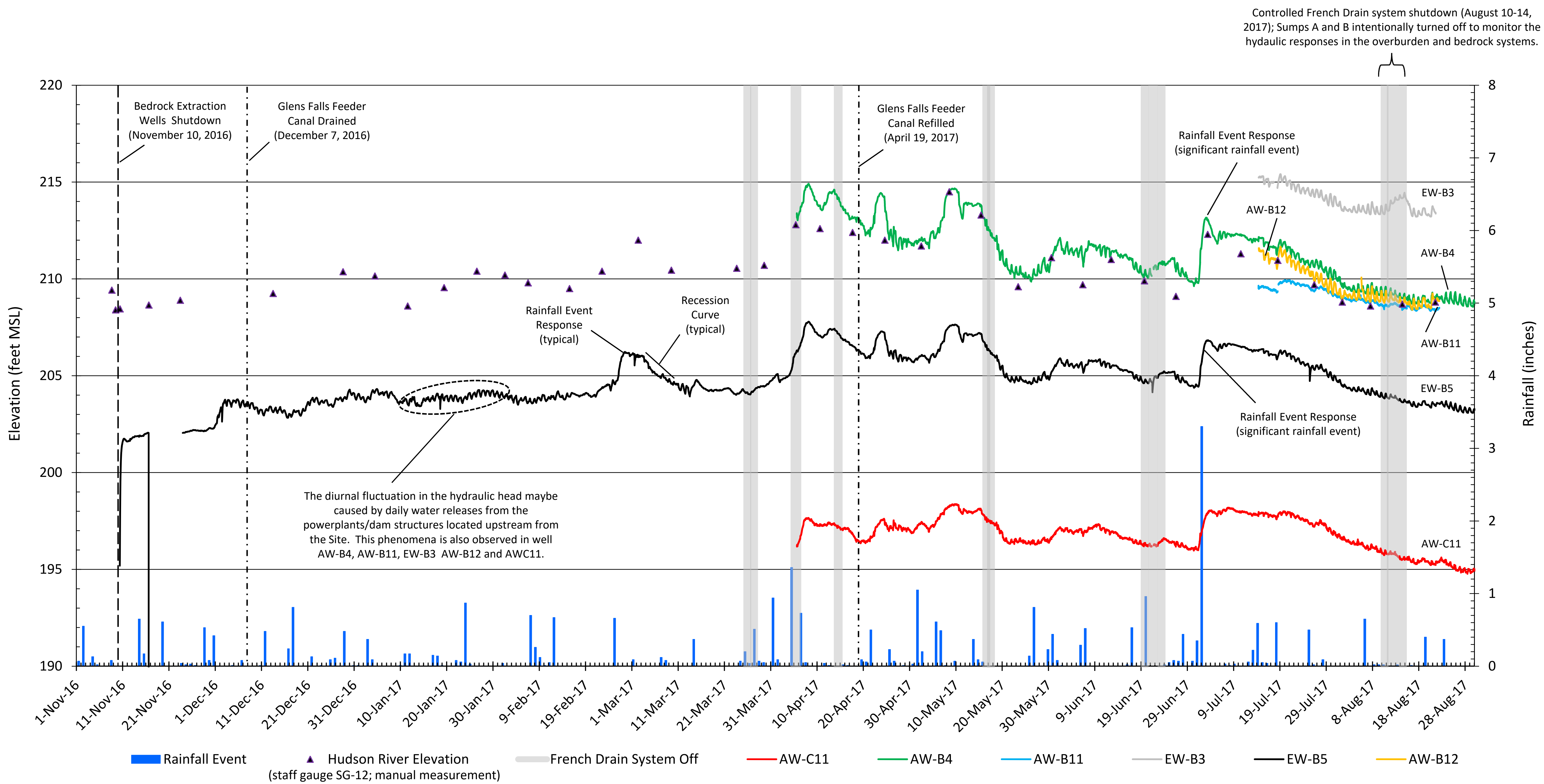


Table A: Well Construction Details

Well ID	Hydrogeologic Unit	Well Depth (feet bgs)	Well Screen Length (feet bgs)	Well Screen Interval (feet bgs)
AW-B4	Intermediate Bedrock	47.5	10	35 - 45
AW-B11	Intermediate Bedrock	67	10	50 - 60
AW-B12	Intermediate Bedrock	61	10	49 - 59
EW-B3	Intermediate Bedrock	84.4	36	48.4 - 84.4
EW-B5	Intermediate Bedrock	51.8	15.8	36 - 51.8
AW-C11	Deep Bedrock	158	10	143 - 153

Notes:
1. bgs = below ground surface

Notes:
1. Daily precipitation data source: precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Blue bar graph includes wet precipitation, snowfall, and other frozen/winter precipitation types. The melted liquid equivalent of the snowfall or other frozen/winter precipitation types is included in the daily total.
3. Hydraulic head elevation data measured by a data logger; data logger measurement frequency at 15 minutes intervals.
4. Data points identified on the graph as "manual" are periodic manual field measurements of the Hudson River surface water elevation.
5. Sumps A and B were pumping throughout the duration of the monitoring period, except during the noted system down times (no pumping).
6. Bedrock extraction wells were pumping during the first 9 days of the monitoring period (November 2 through November 10, 2016).
7. Bedrock extraction wells stopped pumping (were shut down) on November 10, 2016, and continued to be off during the entire monitoring period (November 10, 2016 through August 28, 2017).
8. MSL = mean sea level

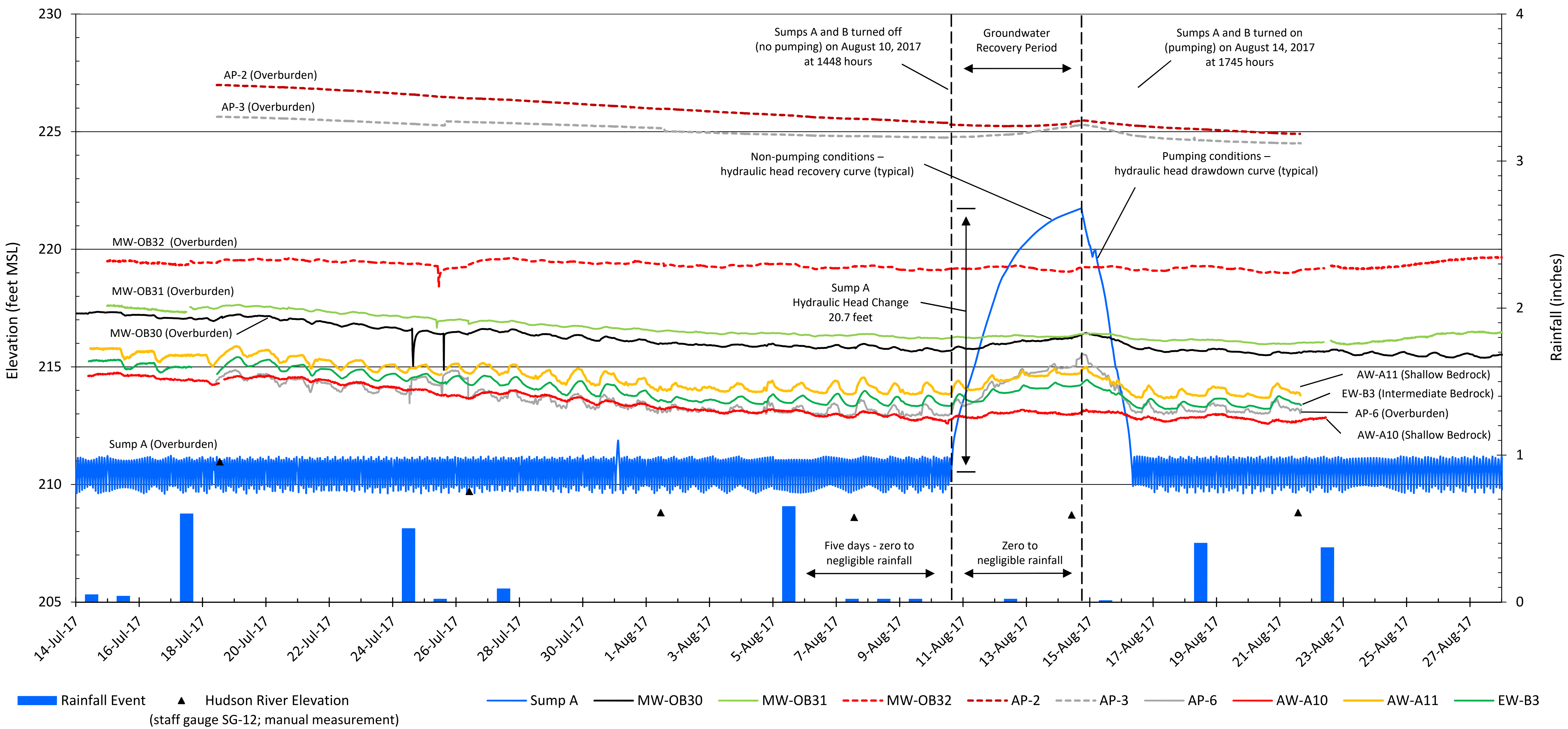


Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2017	**Long-Duration Groundwater Hydrograph Plots: Intermediate and Deep Bedrock Wells**	Figure 4-11

Table A: Hydraulic Head Differential Between Pumping and Non-Pumping Conditions

Well ID	French Drain System On (pumping conditions) (note 7) Date	Groundwater Elevation (feet msl)	French Drain System Off (non-pumping conditions) (note 8) Date	Groundwater Elevation (feet msl)	Hydraulic Head Differential Between Pumping and Non-Pumping Conditions: Head Differential (feet)	Well Location Relative to French Drain System
Overburden						
AP-2	8/10/17	225.33	8/14/17	225.34	0.01	upgradient
AP-3	8/10/17	224.66	8/14/17	225.12	0.46	upgradient
AP-6	8/10/17	212.92	8/14/17	214.94	2.02	downgradient
MW-OB30	8/10/17	215.15	8/14/17	215.7	0.55	downgradient
MW-OB31	8/10/17	215.91	8/14/17	215.99	0.08	downgradient
MW-OB32	8/10/17	218.87	8/14/17	218.79	-0.08	downgradient
Sump A	8/10/17	210.9	8/14/17	231.59	20.69	trench
Shallow Bedrock						
AW-A10	8/10/17	212.75	8/14/17	212.96	0.21	downgradient
AW-A11	8/10/17	213.77	8/14/17	214.58	0.81	upgradient
Intermediate Bedrock						
EW-B5	8/10/17	203.84	8/14/17	203.61	-0.23	upgradient

Notes:
1. Daily precipitation data source: precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Blue bar graph includes wet precipitation, snowfall, and other frozen/winter precipitation types. The melted liquid equivalent of the snowfall or other frozen/winter precipitation types is included in the daily total.
3. Hydraulic head elevation data measured by a data logger; data logger measurement frequency at 15 minutes intervals.
4. Data points identified on the graph as "manual" are periodic manual field measurements of the Hudson River surface water elevation.
5. Sumps A and B were pumping before and after the French Drain System pulse test.
6. Bedrock extraction wells stopped pumping (were shut down) on November 10, 2016.
7. Hydraulic head was measured several hours prior to turning sump pump off.
8. Hydraulic head was measured again four days after sump pump turned off (static conditions).
9. Positive hydraulic head differential in Table A represents a rise (increase) in hydraulic head (highlighted in yellow).
10. MSL = mean sea level

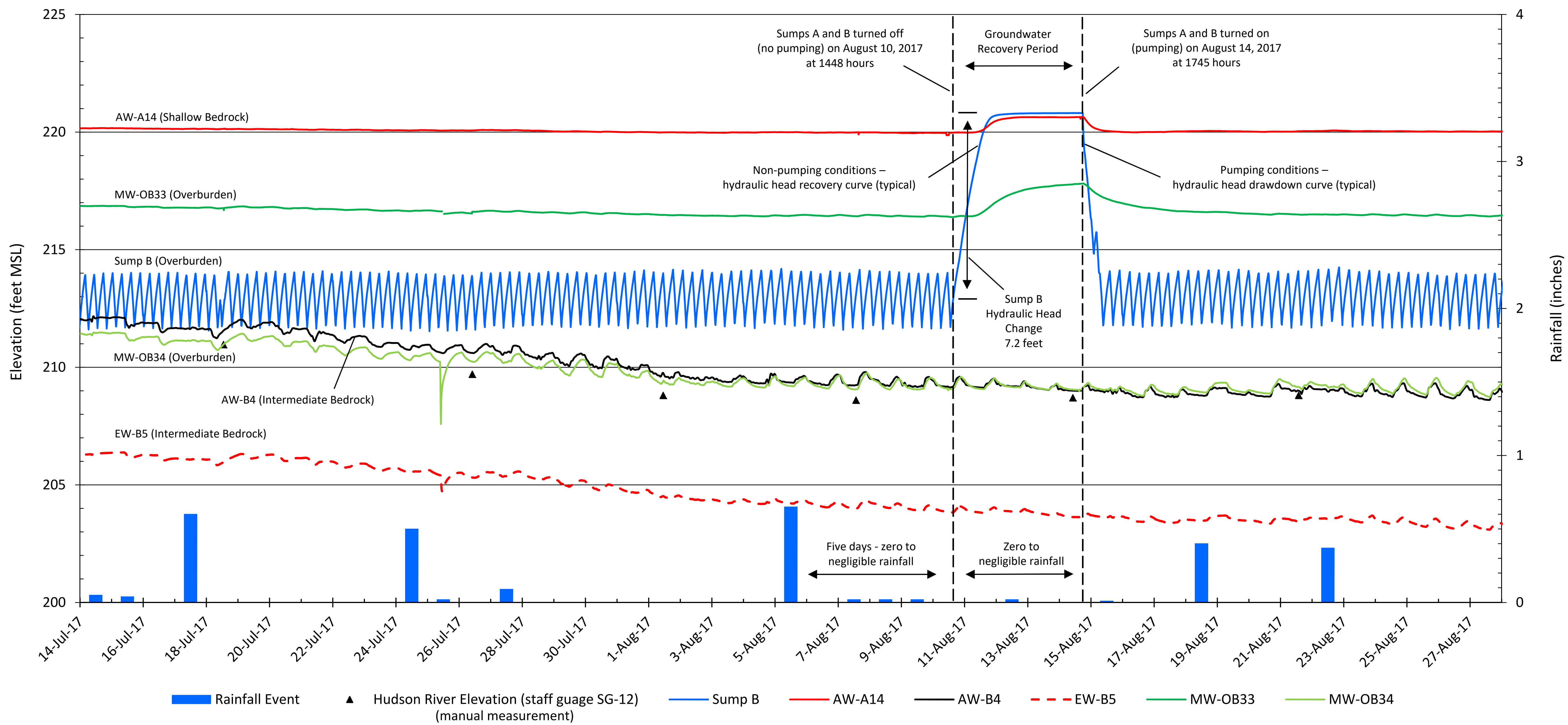


Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2017	French Drain System Pulse Test Hydrographs: Sump A Segment	Figure 4-12

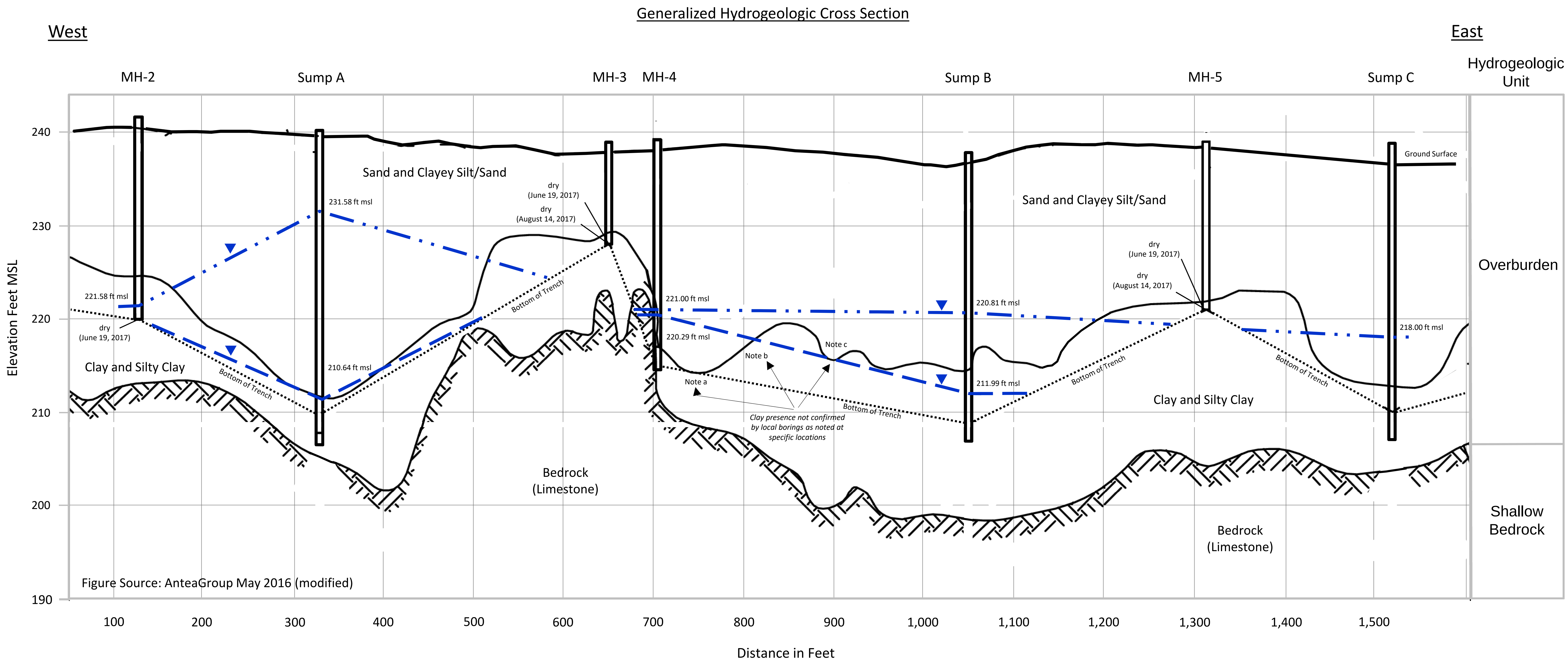
Table A: Hydraulic Head Differential Between Pumping and Non-Pumping Conditions

Well ID	French Drain System On (pumping conditions) (note 7) Date	Groundwater Elevation (feet msl)	French Drain System Off (non-pumping conditions) (note 8) Date	Groundwater Elevation (feet msl)	Hydraulic Head Differential Between Pumping and Non-Pumping Conditions: Head Differential (feet)	Well Location Relative to French Drain System
Overburden						
MW-OB33	8/10/17	214.34	8/14/17	217.74	3.4	downgradient
MW-OB34	8/10/17	209.02	8/14/17	208.99	-0.03	downgradient
Sump B	8/10/17	213.58	8/14/17	220.81	7.23	trench
Shallow Bedrock						
AW-A14	8/10/17	211.49	8/14/17	220.49	9	downgradient
Intermediate Bedrock						
AW-B4	8/10/17	209.15	8/14/17	209.01	-0.14	upgradient
EW-B5	8/10/17	203.84	8/14/17	203.61	-0.23	upgradient

Notes:
1. Daily precipitation data source: precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Blue bar graph includes wet precipitation, snowfall, and other frozen/winter precipitation types. The melted liquid equivalent of the snowfall or other frozen/winter precipitation types is included in the daily total.
3. Hydraulic head elevation data measured by a data logger; data logger measurement frequency at 15 minutes intervals.
4. Data points identified on the graph as "manual" are periodic manual field measurements of the Hudson River surface water elevation.
5. Sumps A and B were pumping before and after the French Drain System pulse test.
6. Bedrock extraction wells stopped pumping (were shut down) on November 10, 2016.
7. Hydraulic head was measured several hours prior to turning sump pump off.
8. Hydraulic head was measured again four days after sump pump turned off (static conditions).
9. Positive hydraulic head differential in Table A represents a rise (increase) in hydraulic head (highlighted in yellow).
10. MSL = mean seal level



Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2017	French Drain System Pulse Test Hydrographs: Sump B Segment	Figure 4-13



Legend:

- Groundwater elevation during non-pumping conditions (groundwater not fully recovered to static condtions)
- Groundwater elevation during pumping conditions

Pumping Conditions (June 19, 2017):

1. Groundwater elevations measured on June 19, 2017.
2. Sumps A and B were pumping when the water levels were measured.
3. Bedrock extraction wells were not puming when the water levels were measuered; wells turned off on November 10, 2016.

Non-Pumping Conditions (August 14, 2017):

1. Groundwater elevations measured on August 14, 2017.
2. Sumps A and B were off when water levels were measured. Pumps off for four days prior to measuring water levels.
3. Groundwater not in steady state; not fully recovered to static conditions.
4. Bedrock extraction wells were not puming when the water levels were measuered; wells turned off on November 10, 2016.

Notes:

a. Boring TB-43 used to construct the cross section is located north of french drain. Borings located directly west (TB-42), southeast (10+50), and east (TB-44) encountered clay. To the north, there is an area where the clay has been noted to be absent.

b. B. Boring D01 used to construct the cross section. Nearby borings TB45, TB46, and MW-OB33 encountered clay. Possible issues with boring D01 due to partial recovery or borehole sloughing preventing the detection of clay.

c. C. Boring D02 used to construct the cross section. Nearby borings TB49, TB50, 12+00, and IS-19 encountered clay. Possible issues with boring D02 due to partial recovery or borehole sloughing preventing the detection of clay.

Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support August 2017

Cross Section View Along the French Drain System Showing Overburden Groundwater Elevations: Pumping and Non-Pumping Conditions

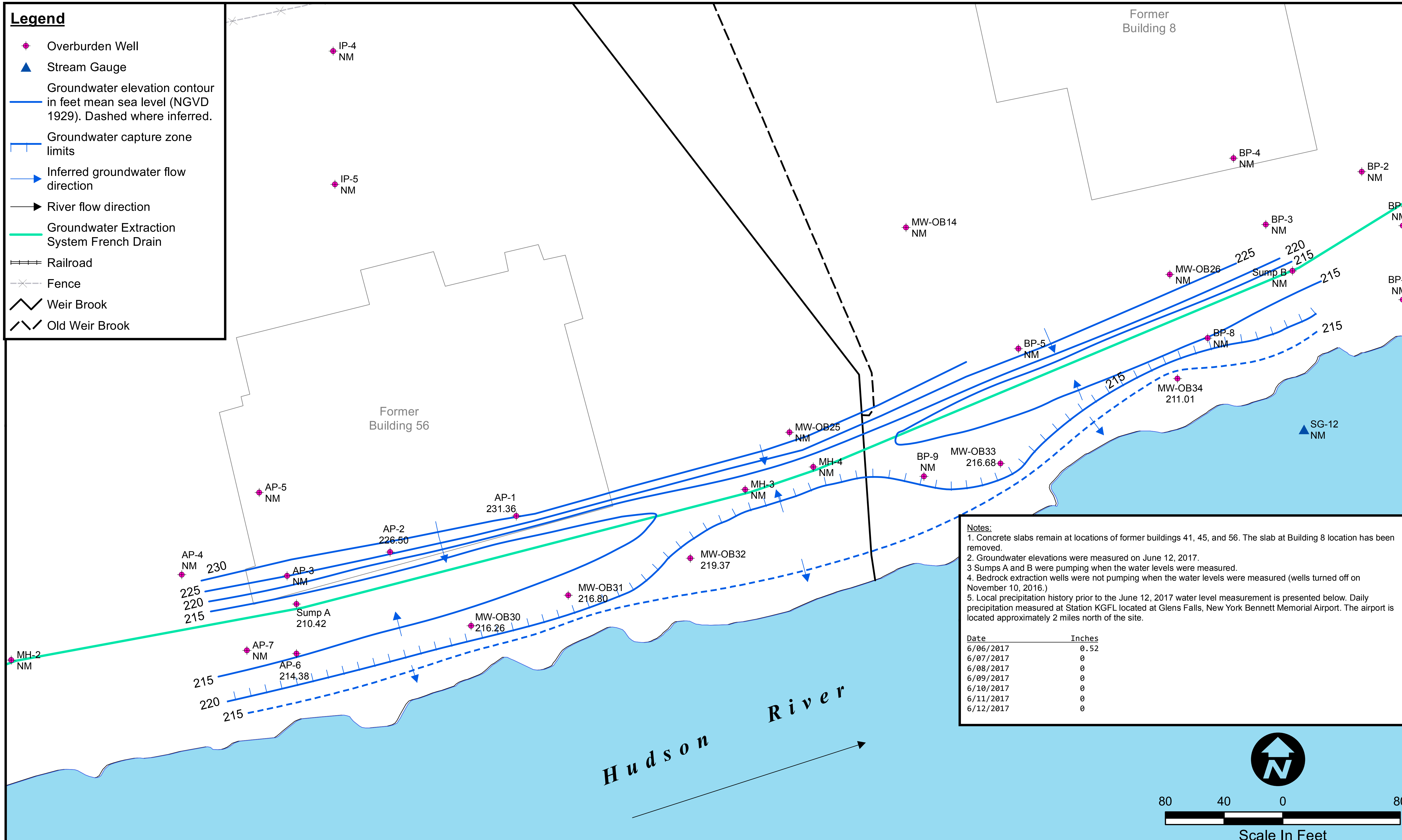
Figure 4-14

Davis Superfund Site
Smithfield, RI

EHS Support October 2017

Overburden Heterogeneity and the Range of Groundwater Heads between the French Drain and the Hudson River

FIGURE 4-15



Notes:
1. Concrete slabs remain at locations of former buildings 41, 45, and 56. The slab at Building 8 location has been removed.
2. Groundwater elevations were measured on June 12, 2017.
3 Sumps A and B were pumping when the water levels were measured.
4. Bedrock extraction wells were not pumping when the water levels were measured (wells turned off on November 10, 2016.)
5. Local precipitation history prior to the June 12, 2017 water level measurement is presented below. Daily precipitation measured at Station KGFL located at Glens Falls, New York Bennett Memorial Airport. The airport is located approximately 2 miles north of the site.

Date	Inches
6/06/2017	0.52
6/07/2017	0
6/08/2017	0
6/09/2017	0
6/10/2017	0
6/11/2017	0
6/12/2017	0

EHS Support consider it done

ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

Overburden Potentiometric Surface: Pumping Conditions (June 12, 2017)

Figure 4-16

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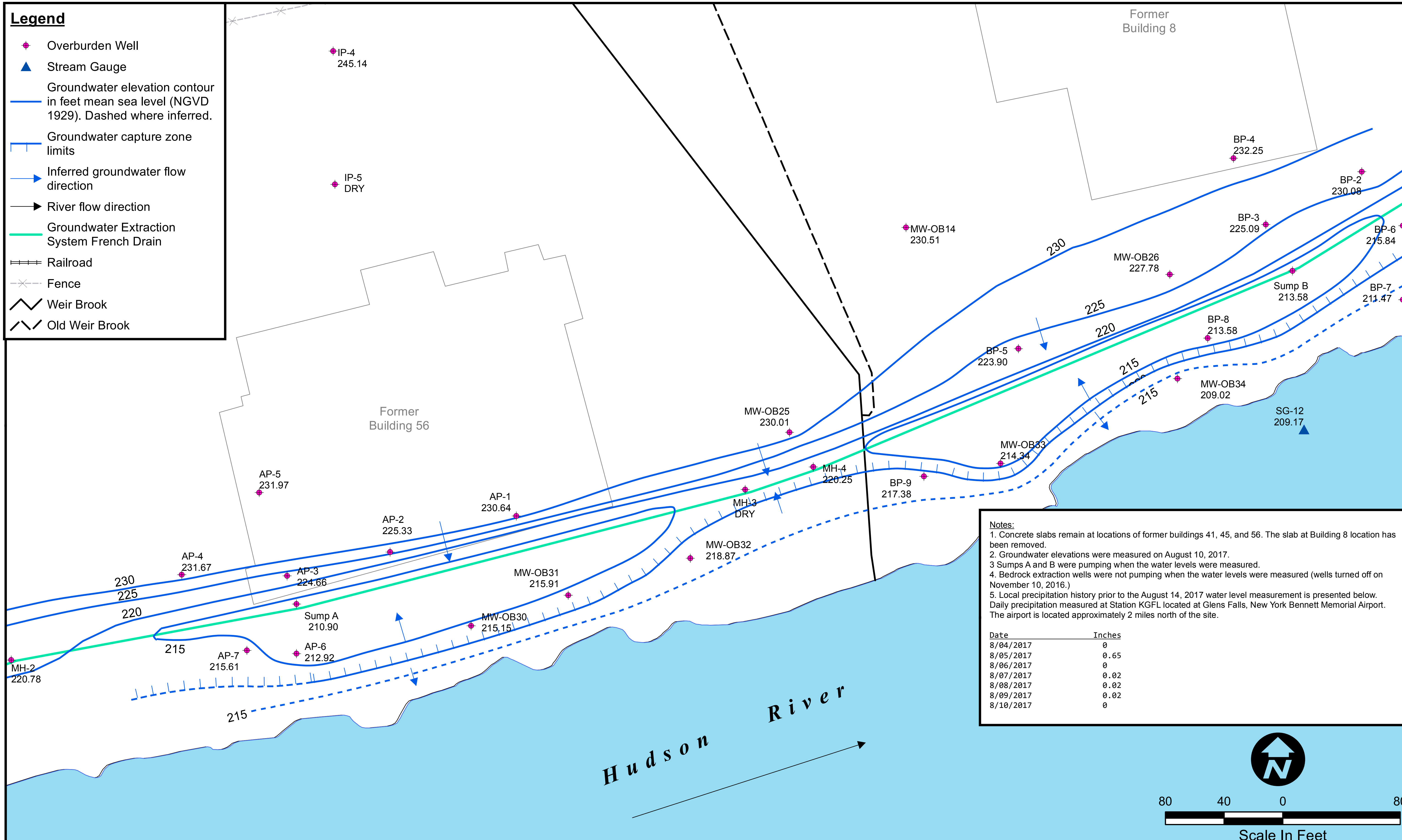

Notes:
1. Concrete slabs remain at locations of former buildings 41, 45, and 56. The slab at Building 8 location has been removed.
2. Groundwater elevations were measured on August 10, 2017.
3 Sumps A and B were pumping when the water levels were measured.
4. Bedrock extraction wells were not pumping when the water levels were measured (wells turned off on November 10, 2016.)
5. Local precipitation history prior to the August 14, 2017 water level measurement is presented below. Daily precipitation measured at Station KGFL located at Glens Falls, New York Bennett Memorial Airport. The airport is located approximately 2 miles north of the site.

Date	Inches
8/04/2017	0
8/05/2017	0.65
8/06/2017	0
8/07/2017	0.02
8/08/2017	0.02
8/09/2017	0.02
8/10/2017	0

EHS Support consider it done

ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

Overburden Potentiometric Surface: Pumping Conditions Prior to French Drain System Shutdown (August 10, 2017)

Figure 4-17

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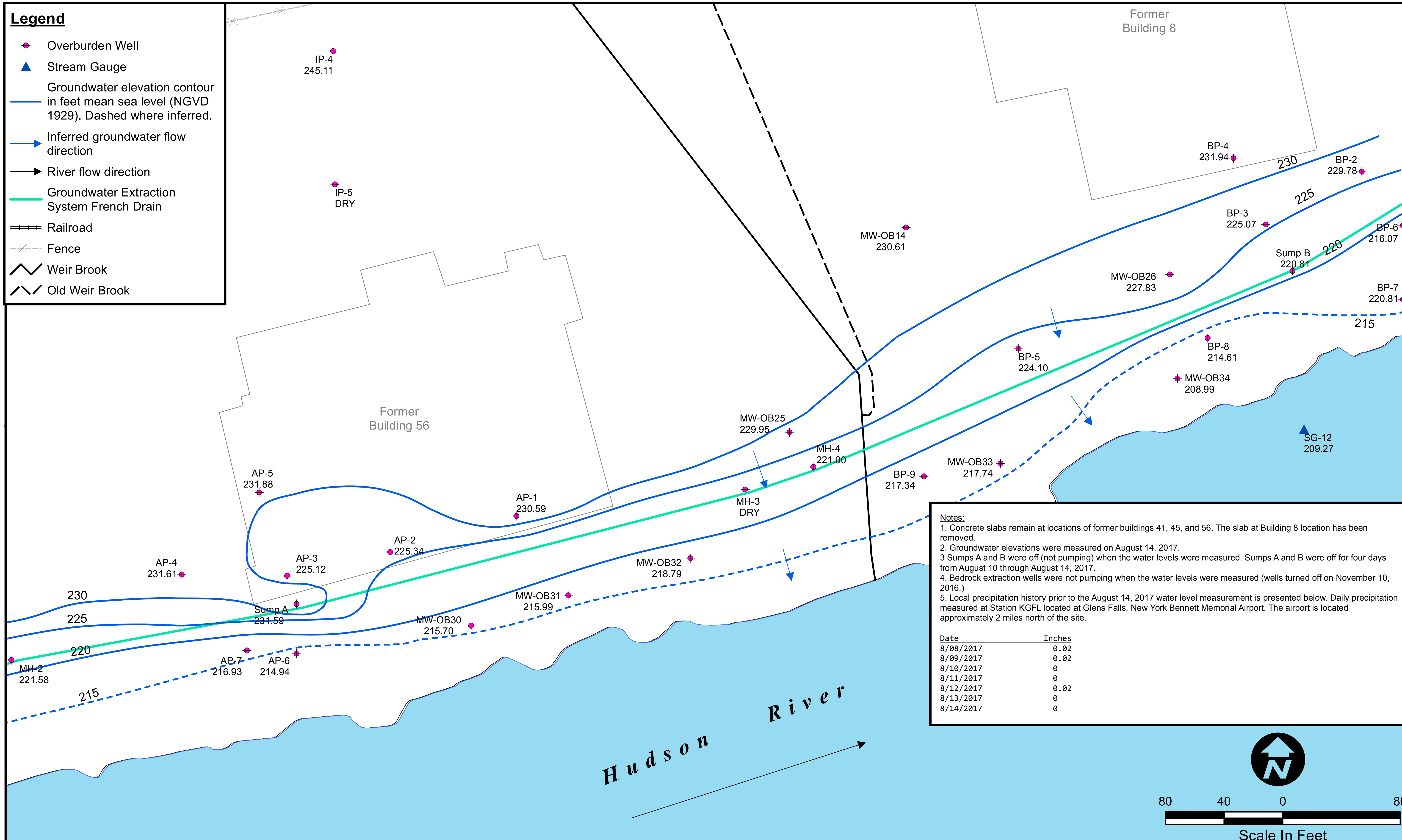

Notes:
1. Concrete slabs remain at locations of former buildings 41, 45, and 56. The slab at Building 8 location has been removed.
2. Groundwater elevations were measured on August 14, 2017.
3 Sumps A and B were off (not pumping) when the water levels were measured. Sumps A and B were off for four days from August 10 through August 14, 2017.
4. Bedrock extraction wells were not pumping when the water levels were measured (wells turned off on November 10, 2016.)
5. Local precipitation history prior to the August 14, 2017 water level measurement is presented below. Daily precipitation measured at Station KGFL located at Glens Falls, New York Bennett Memorial Airport. The airport is located approximately 2 miles north of the site.

Date	Inches
8/08/2017	0.02
8/09/2017	0.02
8/10/2017	0
8/11/2017	0
8/12/2017	0.02
8/13/2017	0
8/14/2017	0

EHS Support consider it done

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FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

Overburden Potentiometric Surface: Static Conditions Four Days After French Drain System Shutdown (August 14, 2017)

Figure 4-18

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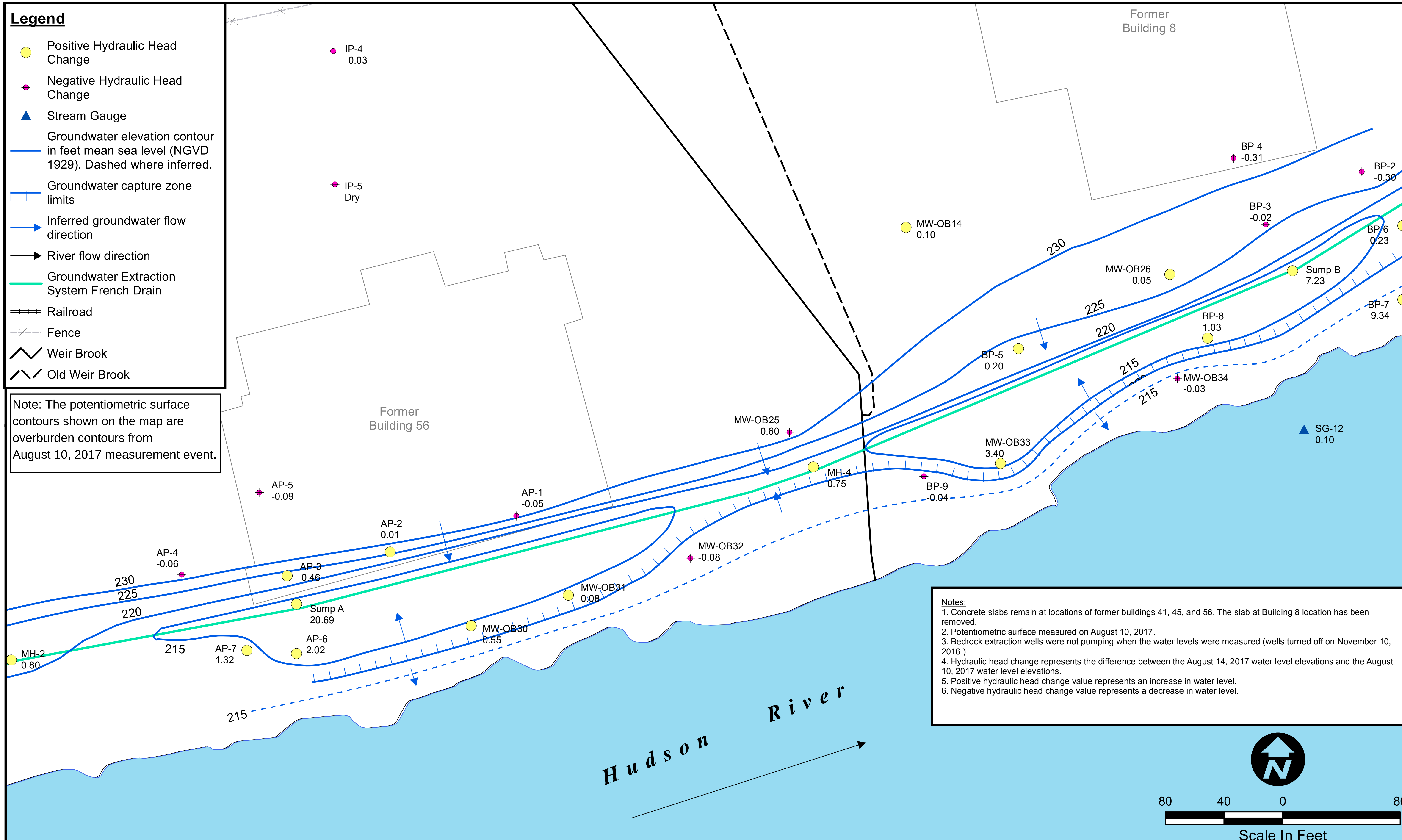
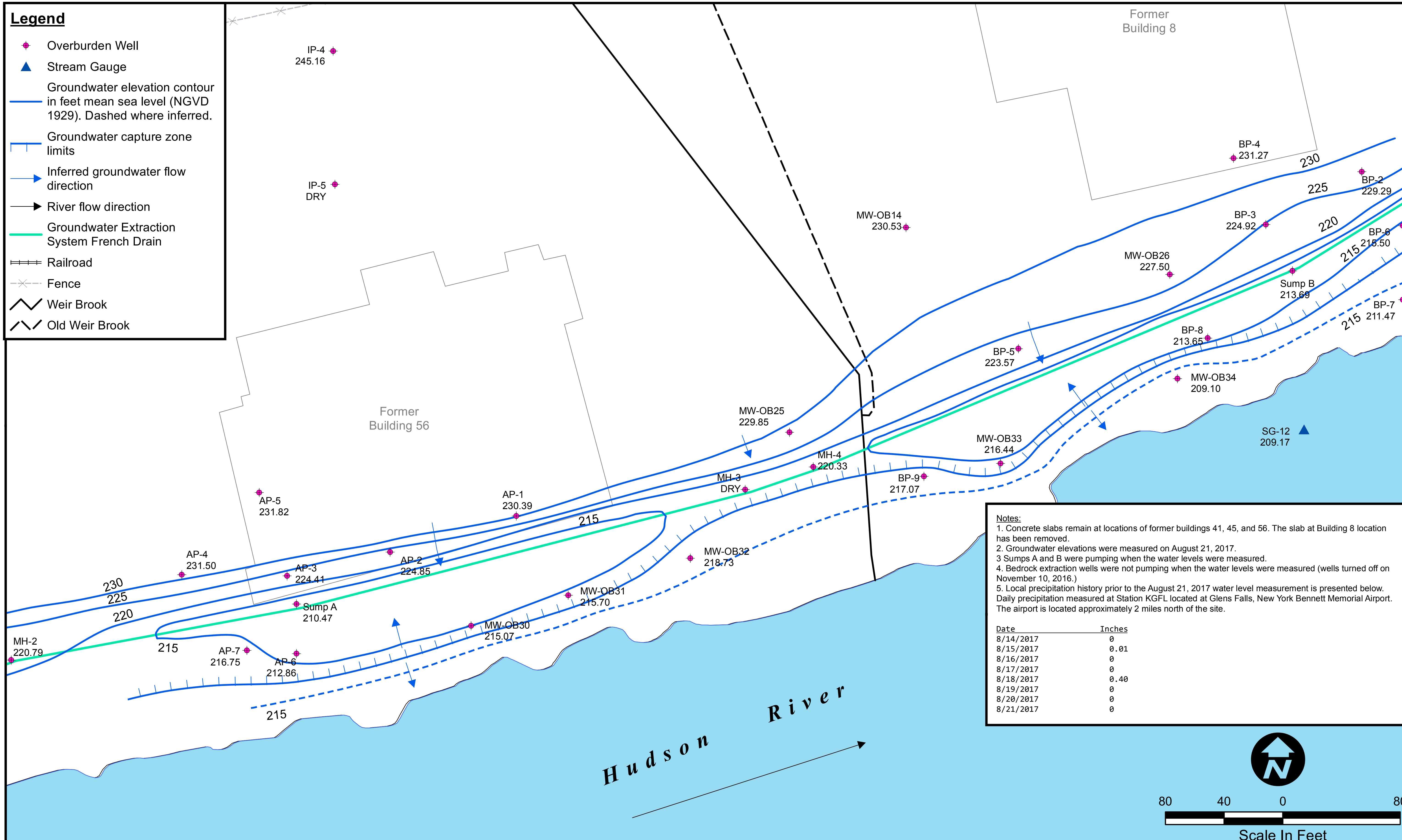


EHS Support consider it done

ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

Hydraulic Head Change Between Pumping (August 10, 2017) and Non-Pumping Conditions (August 14, 2017)

Figure 4-19



Notes:
1. Concrete slabs remain at locations of former buildings 41, 45, and 56. The slab at Building 8 location has been removed.
2. Groundwater elevations were measured on August 21, 2017.
3 Sumps A and B were pumping when the water levels were measured.
4. Bedrock extraction wells were not pumping when the water levels were measured (wells turned off on November 10, 2016.)
5. Local precipitation history prior to the August 21, 2017 water level measurement is presented below. Daily precipitation measured at Station KGFL located at Glens Falls, New York Bennett Memorial Airport. The airport is located approximately 2 miles north of the site.

Date	Inches
8/14/2017	0
8/15/2017	0.01
8/16/2017	0
8/17/2017	0
8/18/2017	0.40
8/19/2017	0
8/20/2017	0
8/21/2017	0

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EHS Support consider it done

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FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

Overburden Potentiometric Surface: Pumping Conditions Seven Days After French Drain System Startup (August 21, 2017)

Figure 4-20

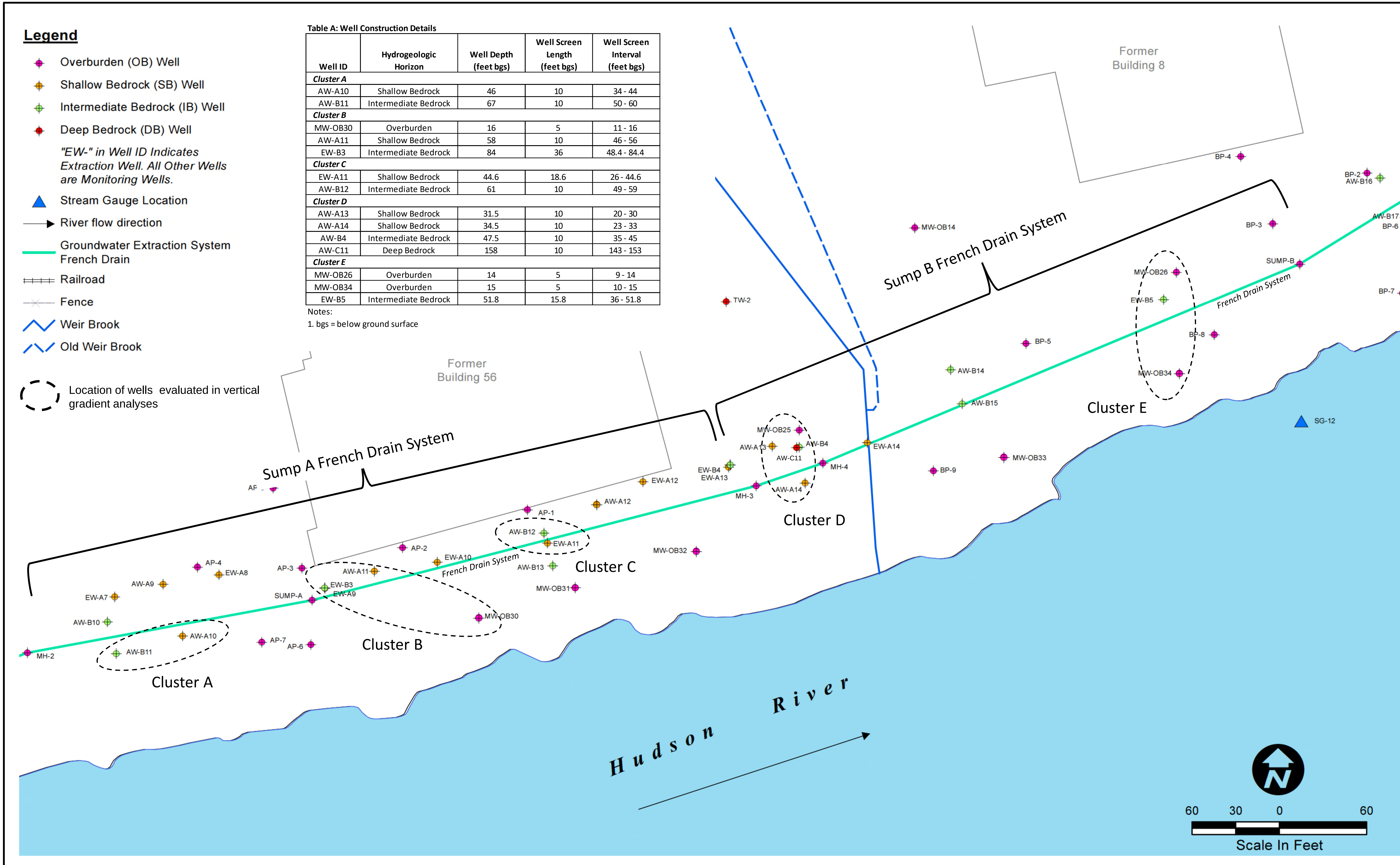


Table A: Well Construction Details

Well ID	Hydrogeologic Horizon	Well Depth (feet bgs)	Well Screen Length (feet bgs)	Well Screen Interval (feet bgs)
Cluster A				
AW-A10	Shallow Bedrock	46	10	34 - 44
AW-B11	Intermediate Bedrock	67	10	50 - 60
Cluster B				
MW-OB30	Overburden	16	5	11 - 16
AW-A11	Shallow Bedrock	58	10	46 - 56
EW-B3	Intermediate Bedrock	84	36	48.4 - 84.4
Cluster C				
EW-A11	Shallow Bedrock	44.6	18.6	26 - 44.6
AW-B12	Intermediate Bedrock	61	10	49 - 59
Cluster D				
AW-A13	Shallow Bedrock	31.5	10	20 - 30
AW-A14	Shallow Bedrock	34.5	10	23 - 33
AW-B4	Intermediate Bedrock	47.5	10	35 - 45
AW-C11	Deep Bedrock	158	10	143 - 153
Cluster E				
MW-OB26	Overburden	14	5	9 - 14
MW-OB34	Overburden	15	5	10 - 15
EW-B5	Intermediate Bedrock	51.8	15.8	36 - 51.8

Notes:
1. bgs = below ground surface

Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support October 2017

Vertical Gradient Analyses Hydrograph Plots - Monitoring Wells, Extraction Wells and Sumps Locations

Figure 4-21

Table A: Hydraulic Head Comparision

Well ID	Hydraulic Head Elevation Prior to Shutdown of Bedrock Extraction Wells		Hydraulic Head Elevation Nine Months After Shutdown of Bedrock Extraction Wells		Change in Hydraulic Head Nine Months After Shutdown of Bedrock Extraction Wells (note 1) (feet)
	Date	Hydraulic Head Elevation (feet msl)	Date	Hydraulic Head Elevation (feet msl)	
Overburden					
MW-OB30	July 27, 2016	211.09	August 28, 2017	215.35	4.26
Shallow Bedrock					
AW-A10	July 28, 2016	204.10	August 21, 2017	212.65	8.55
AW-A11	July 28, 2016	196.20	August 21, 2017	213.83	17.63
EW-A11	March 2015	202.45	August 21, 2017	209.42	6.97
Intermediate Bedrock					
EW-B3	March 2015	168.24	August 21, 2017	213.38	45.14
AW-B11	July 28, 2016	192.04	August 21, 2017	208.45	16.41
AW-B12	March 2015	199.85	August 21, 2017	208.71	8.86

Notes:
1. Positive number represents an increase in hydraulic head elevation after bedrock extraction well system shutdown.
2. msl = mean sea level

Table B: Vertical Hydraulic Gradients (pre and post bedrock extraction well system shutdown)

Well ID	Hydrogeologic Unit	Date	Hydraulic Gradient (feet/feet) (note 1)
Cluster A (see Figure 4-21)			
Pre Bedrock Recovery Well System Shutdown			
AW-A10	Shallow Bedrock	July 28, 2016	0.74
AW-B11	Intermediate Bedrock	July 28, 2016	
Post Bedrock Recovery Well System Shutdown			
AW-10A	Shallow Bedrock	August 21, 2017	0.26
AW-B11	Intermediate Bedrock	August 21, 2017	

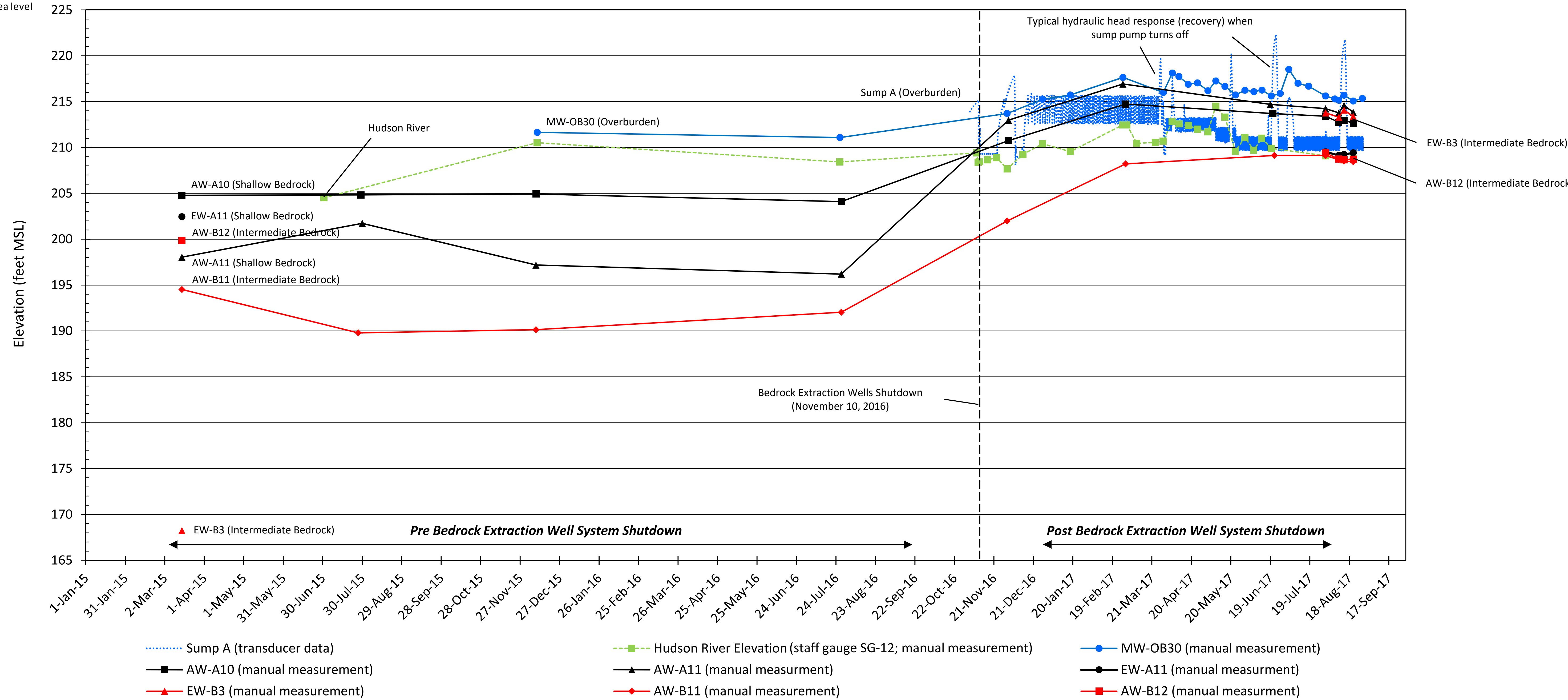
Notes:
1. Positive vertical hydraulic gradient represents downward groundwater flow.
2. The sump lateral trench pipe invert elevation was used as the "well screen mid-point elevation."

Well ID	Hydrogeologic Unit	Date	Hydraulic Gradient (feet/feet) (note 1)
Cluster B (see Figure 4-21)			
Pre Bedrock Recovery Well System Shutdown			
Sump A	Overburden	November 30, 2016	0.89 (note 2)
AW-A11	Shallow Bedrock	July 28, 2016	
Post Bedrock Recovery Well System Shutdown			
Sump A	Overburden	August 21, 2017	-0.01
AW-A11	Shallow Bedrock	August 21, 2017	

Pre Bedrock Recovery Well System Shutdown			
Sump A	Overburden	November 30, 2016	1.19 (note 2)
EW-B3	Intermediate Bedrock	March 2015	
Post Bedrock Recovery Well System Shutdown			
Sump A	Overburden	August 21, 2017	0.01
EW-B3	Intermediate Bedrock	August 21, 2017	

Well ID	Hydrogeologic Unit	Date	Hydraulic Gradient (feet/feet) (note 1)
Cluster C (see Figure 4-21)			
Pre Bedrock Recovery Well System Shutdown			
EW-A11	Shallow Bedrock	March 2015	0.16
AW-B12	Intermediate Bedrock	March 2015	
Post Bedrock Recovery Well System Shutdown			
EW-A11	Shallow Bedrock	August 21, 2017	0.04
AW-B12	Intermediate Bedrock	August 21, 2017	

Notes:
3. There is limited pre-bedrock recovery well system shutdown groundwater elevation data available for Sump A, monitoring well AW-A11, and extraction well EW-B3 for use to conduct a hydraulic head comparison. Same day measurements for each location do exist for post-bedrock recovery well system shutdown. The closest available measurement dates for the pre-bedrock recovery well system shutdown were used to calculate the vertical hydraulic gradients. The calculated vertical hydraulic gradients are considered estimated.



Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2018	**Composite Hydrographs Showing Vertical Gradients Between Water-bearing Horizons: Sump A French Drain System**	**Figure 4-22**

Table A: Hydraulic Head Comparision

Well ID	Hydraulic Head Elevation Prior to Shutdown of Bedrock Extraction Wells: Date	Hydraulic Head Elevation (feet msl)	Hydraulic Head Elevation Nine Months After Shutdown of Bedrock Extraction Wells: Date	Hydraulic Head Elevation (feet msl)	Change in Hydraulic Head Nine Months After Shutdown of Bedrock Extraction Wells (note 1) (feet)
Overburden					
MW-OB26	July 28, 2016	226.77	August 28, 2017	227.50	0.73
MW-OB34	July 26, 2016	208.59	August 28, 2017	208.69	0.10
Shallow Bedrock					
AW-A13	nd	nd	August 21, 2017	220.74	nd
AW-A14	July 27, 2016	218.34	August 21, 2017	219.89	1.55
Intermediate Bedrock					
AW-B4	July 29, 2016	204.51	August 21, 2017	209.02	4.51
EW-B5	July 26, 2016	192.34	August 21, 2017	203.45	11.11
Deep Bedrock					
AW-C11	July 28, 2016	194.52	August 21, 2017	195.21	0.69

1. Positive number represents an increase in hydraulic head elevation after bedrock 2. msl = mean sea level 3. nd = no data available

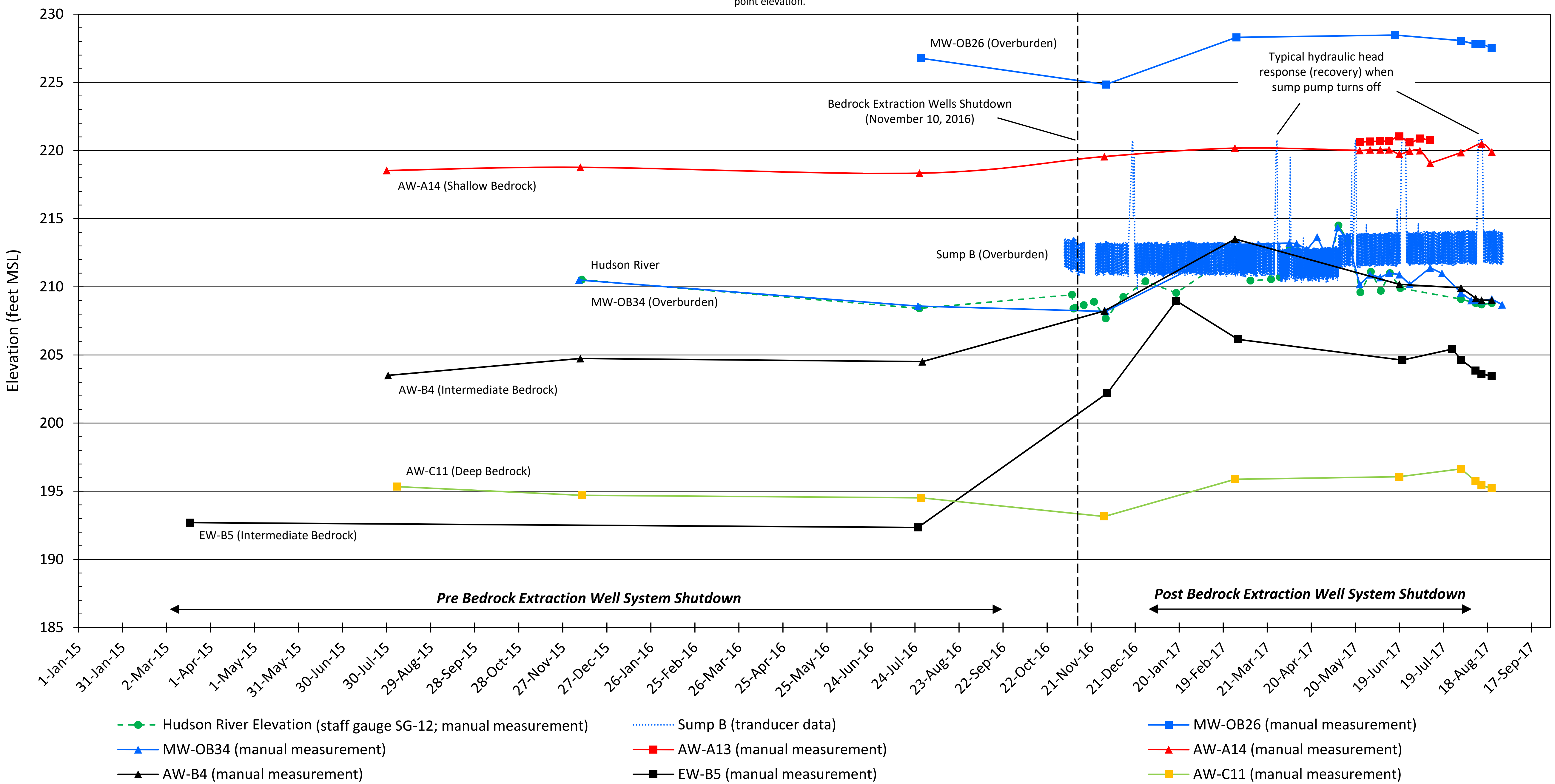
Table B: Vertical Hydraulic Gradients (pre and post bedrock extraction well system shutdown)

Well ID	Hydrogeologic Unit	Date	Vertical Hydraulic Gradient (feet/feet)
Cluster D (see Figure 4-21)			
Pre Bedrock Recovery Well System Shutdown			
AW-A14	Shallow Bedrock	July 27, 2016	1.31
AW-B4	Intermediate Bedrock	July 29, 2016	
Post Bedrock Recovery Well System Shutdown			
AW-A14	Shallow Bedrock	August 21, 2017	1.03
AW-B4	Intermediate Bedrock	August 21, 2017	
Pre Bedrock Recovery Well System Shutdown			
AW-A14	Shallow Bedrock	July 27, 2016	0.20
AW-C11	Deep Bedrock	July 28, 2016	
Post Bedrock Recovery Well System Shutdown			
AW-A14	Shallow Bedrock	August 21, 2017	0.21
AW-C11	Deep Bedrock	August 21, 2017	

Notes:
1. The sump lateral trench pipe invert elevation was used as the "well screen mid-point elevation."

Well ID	Hydrogeologic Unit	Date	Vertical Hydraulic Gradient (feet/feet)
Cluster E (See Figure 4-21)			
Pre Bedrock Recovery Well System Shutdown			
MW-OB26	Overburden	July 28, 2016	0.98
EW-B5	Intermediate Bedrock	July 26, 2016	
Post Bedrock Recovery Well System Shutdown			
MW-OB26	Overburden	August 28, 2017	0.69
EW-B5	Intermediate Bedrock	August 21, 2017	

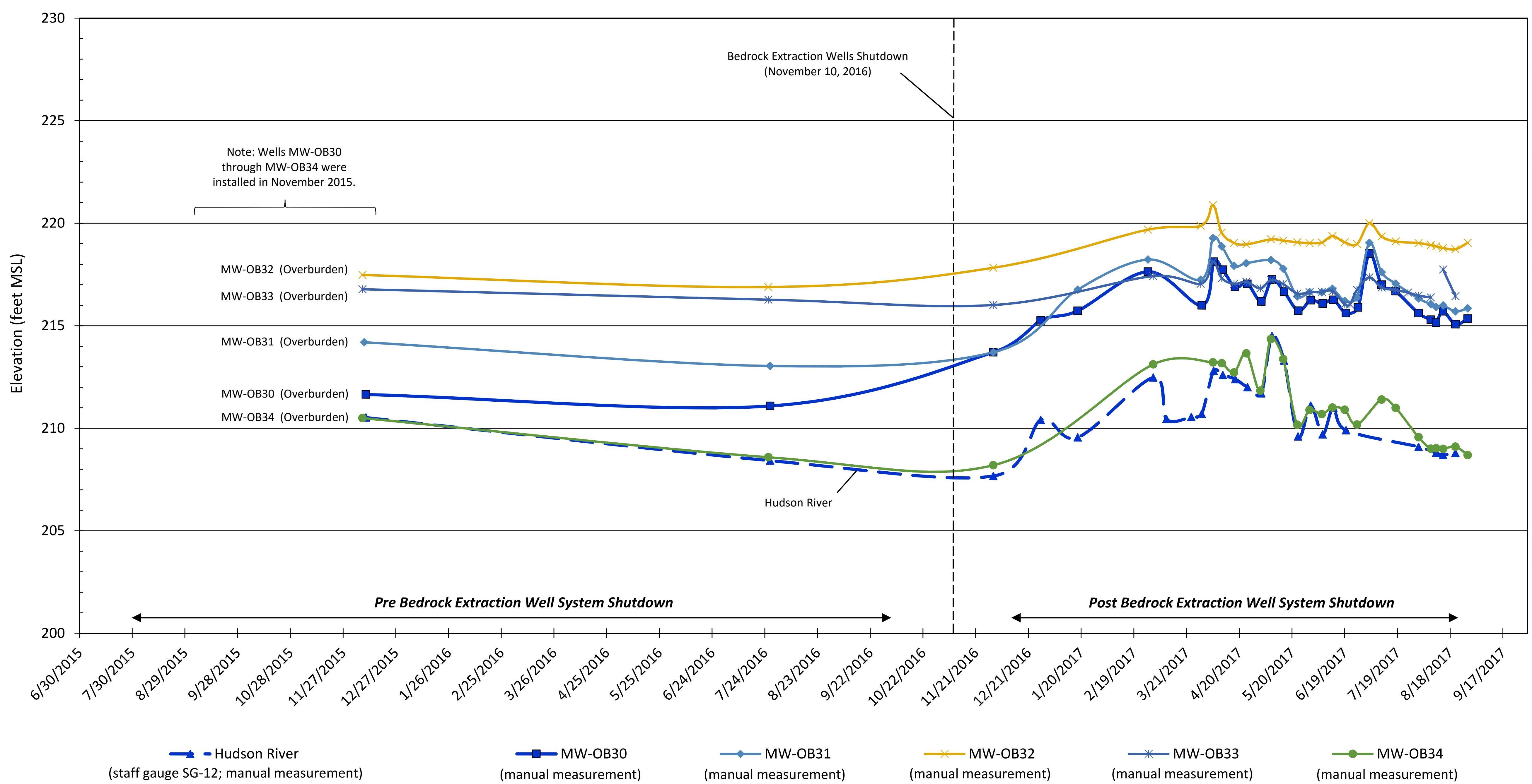
Notes:
2. Positive vertical hydraulic gradient represents downward goundwater flow direction.
3. There is limited pre-bedrock recovery well system shutdown groundwater elevation data available for monitoring wells AW-A14, AW-B4, and AW-C11 for use to conduct a hydraulic head comparison. Same day measurements for each location do exist for post-bedrock recovery well system shutdown. The closest available measurement dates for the pre-bedrock recovery well system shutdown were used to calculate the vertical hydraulic gradients. The calculated vertical hydraulic gradients are considered estimated.



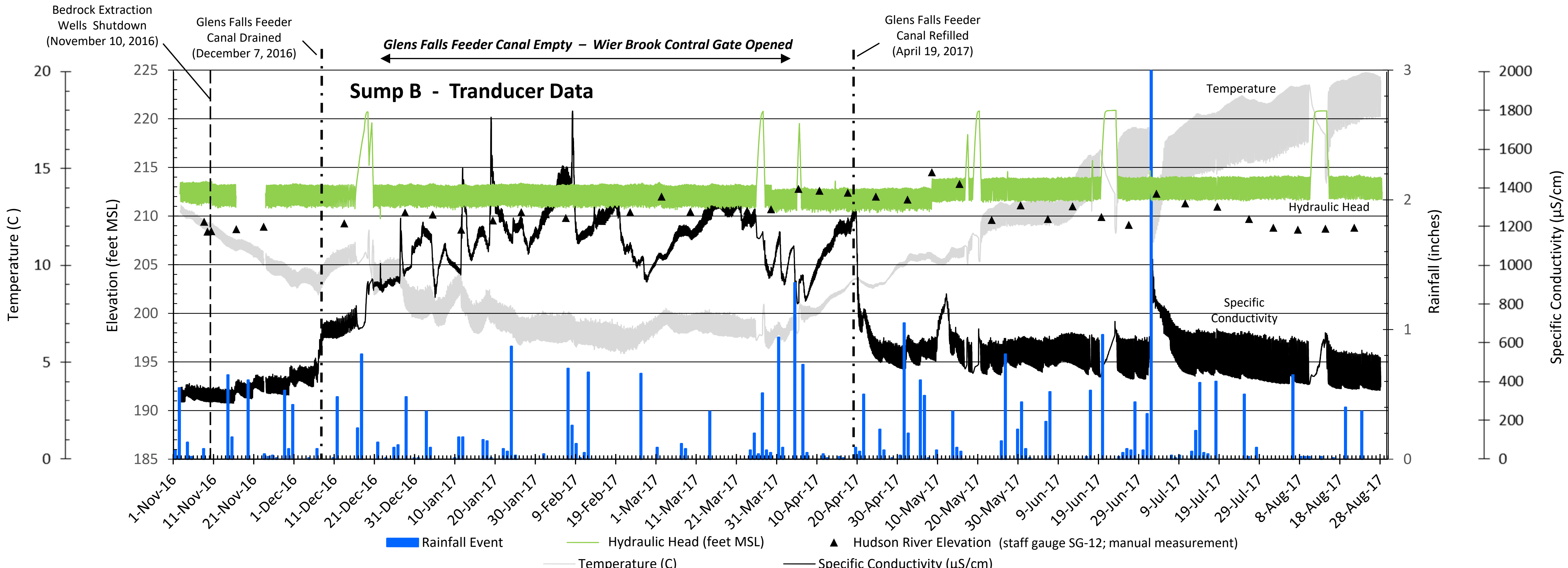
Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support October 2017

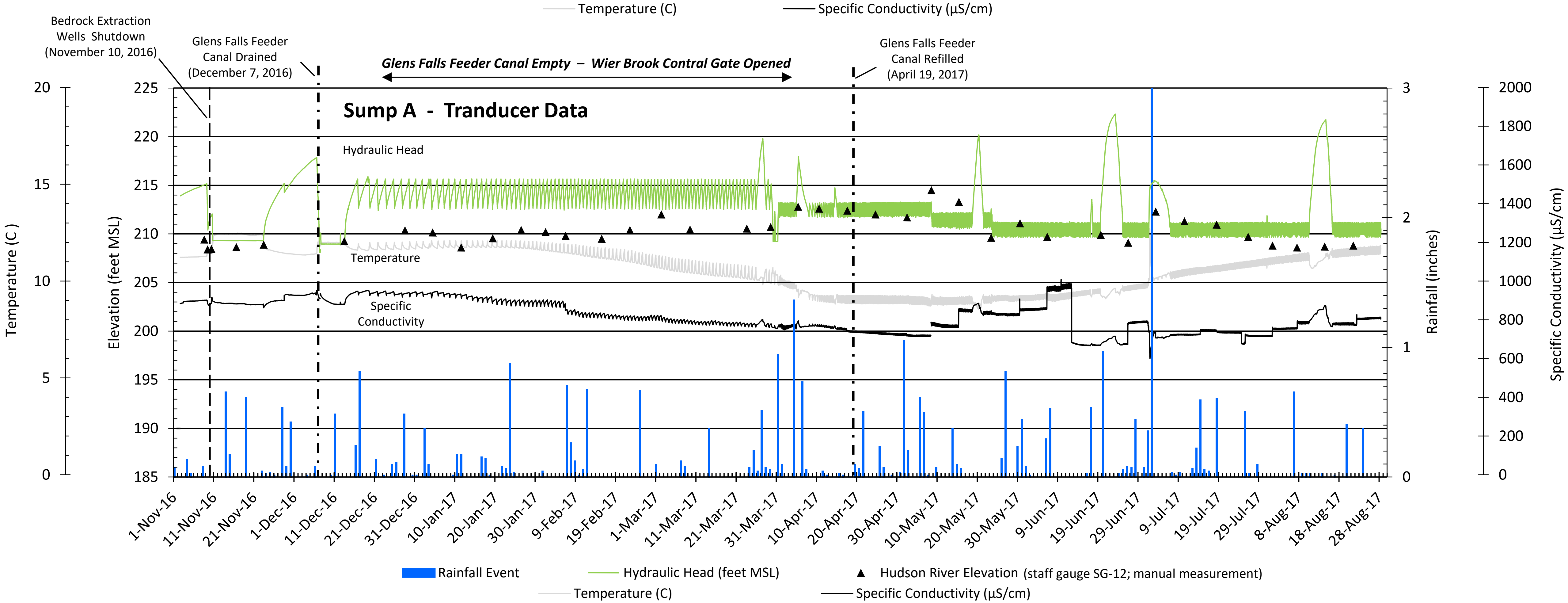
Composite Hydrographs Showing Vertical Gradients Between Water-bearing Horizons: Sump B French Drain System

Figure 4-23



Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2018	**Groundwater Head Trends at River Monitoring Wells MW-OB30 through MW-OB34 Showing Potential Contribution from Bedrock Groundwater Recovery**	**Figure 4-24**





Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support February 2018	Groundwater Hydraulic Head, Specific Conductivity and Temperature Trends Measured in Sump A and Sump B	Figure 4-25

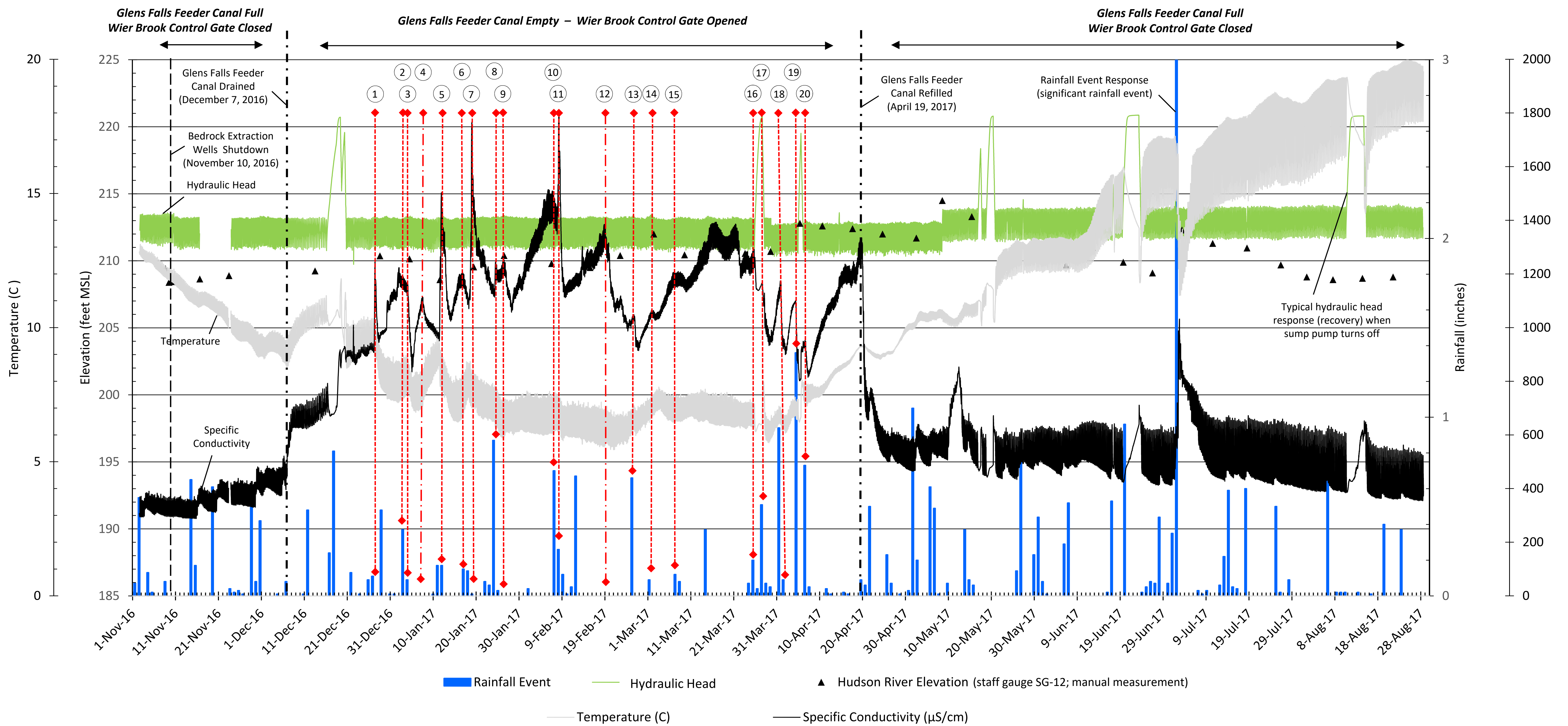
Table A: Specific Conductivity Events - Observed Rapid Decrease in Specific Conductivity

Specific Conductivity Event	Date	Trigger Event (Precipitation)	Type
1	12/27/2106	0.11 (12/27/17)	rain
2	1/3/2017	0.37 (1/3/17)	rain
3	1/4/2017	0.09 (1/4/17)	rain and snow
4	1/7/2017	unknown	rain and snow
5	1/12/2017	0.17 (1/12/17)	rain
6	1/17/2017	0.15 ((1/17/17)	rain and snow
7	1/19/2017	0.14 (1/18/17)	rain and snow
8	1/25/2017	0.87 (1/24/17)	rain and snow
9	1/26/2017	0.87 (1/24/17)	rain and snow
10	2/7/2017	0.70 (2/7/17)	rain and snow

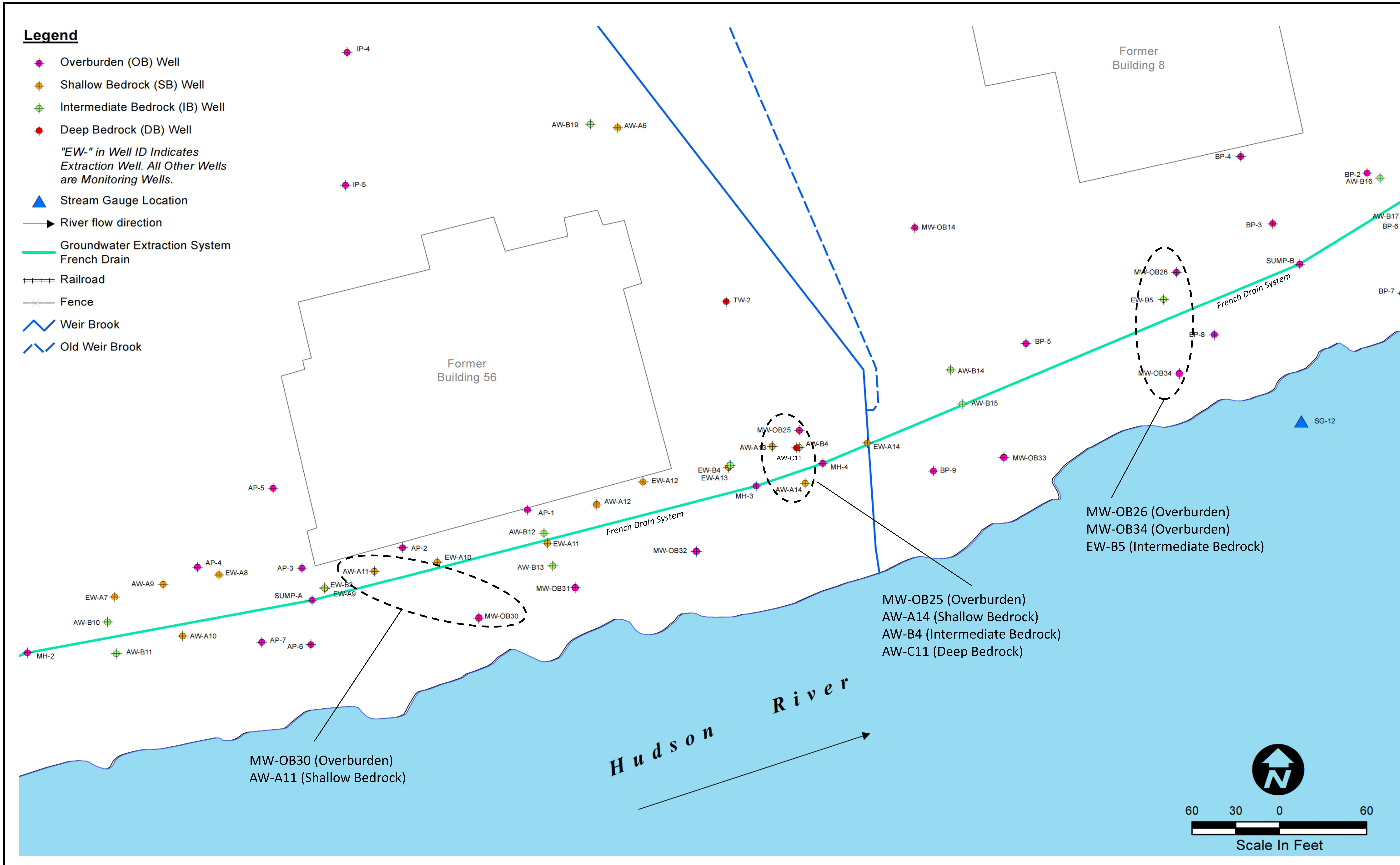
Specific Conductivity Event	Date	Trigger Event (Precipitation)	Type
11	2/8/2017	0.26 (2/8/17)	rain and snow
12	2/19/2017	unknown	rain
13	2/25/2017	0.66 (2/25/17)	rain
14	3/1/2017	0.09 (3/1/17)	rain
15	3/7/2017	0.12 (3/7/17)	rain
16	3/25/2017	0.20 (3/25/17)	rain and snow
17	3/27/2017	0.51 (3/27/17)	rain
18	4/1/2017	0.94 (3/31/17)	rain and snow
19	4/4/2017	1.36 (4/4/17)	rain
20	4/6/2017	0.73 (4/6/17)	rain

Notes:

1. Daily precipitation data source: precipitation measured at station KGFL located at Glens Falls, New York Bennett Memorial airport. The airport is located approximately 2 miles north of the site.
2. Blue bar graph includes wet precipitation, snowfall, and other frozen/winter precipitation types. The melted liquid equivalent of the snowfall or other frozen/winter precipitation types is included in the daily total.
3. Groundwater hydraulic head elevation, groundwater temperature, and groundwater specific conductivity data measured by a data logger; data logger measurement frequency at 15 minutes intervals.
4. Data points identified on the graph as "manual" are periodic manual field measurements of the Hudson River surface water elevation.
5. Sumps A and B were pumping throughout the duration of the monitoring period (note, some system down time occurred during the monitoring period).
6. Bedrock extraction wells were pumping during the first 9 days of the monitoring period (November 2 through November 10, 2016).
7. Bedrock extraction wells stopped pumping (were shut down) on November 10, 2016, and continued to be off during the entire monitoring period (November 10, 2016 through August 28, 2017).
8. MSL = mean sea level
9. 1 = ID number for specific conductivity event



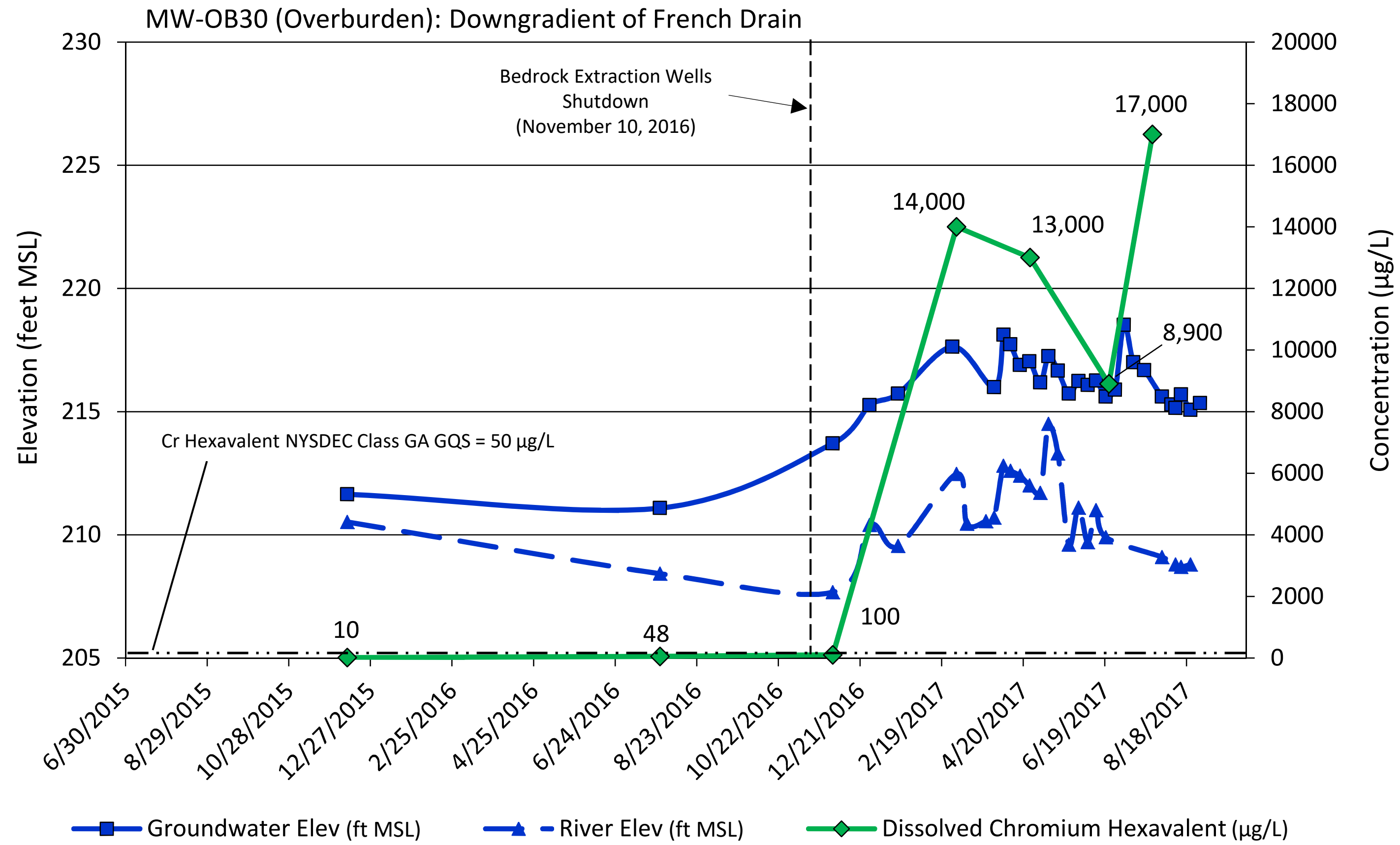
Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support October 2017	**Groundwater Specific Conductivity Trends Measured in Sump B Groundwater as it Relates to the Operation of Wier Brook**	**Figure 4-26**

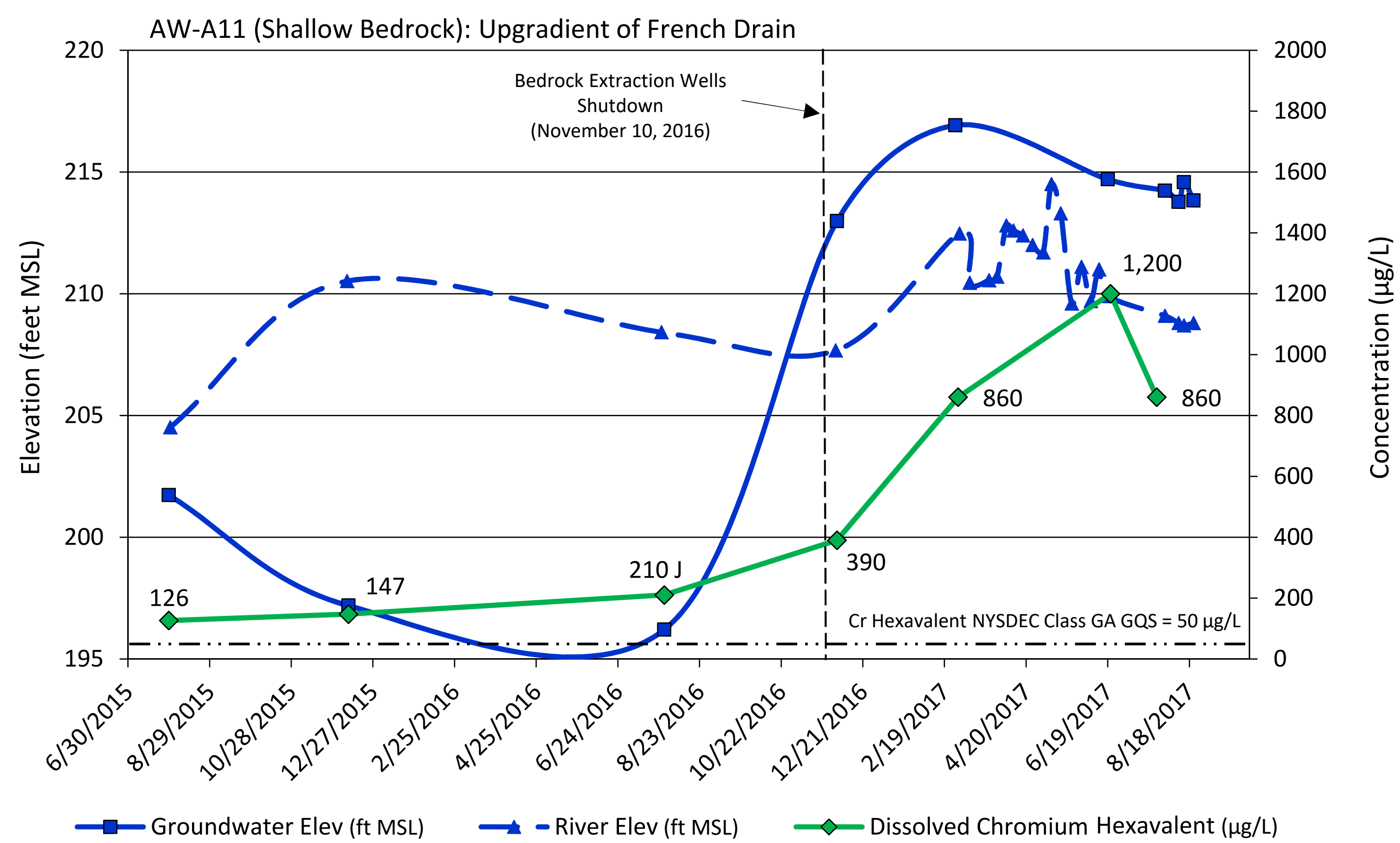


Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support October 2017

Monitoring Well Locations: MW-OB25, MW-OB26, MW-OB30, MW-OB34, AW-A11, AW-A14, AW-B4, EW-B5, and AW-C11

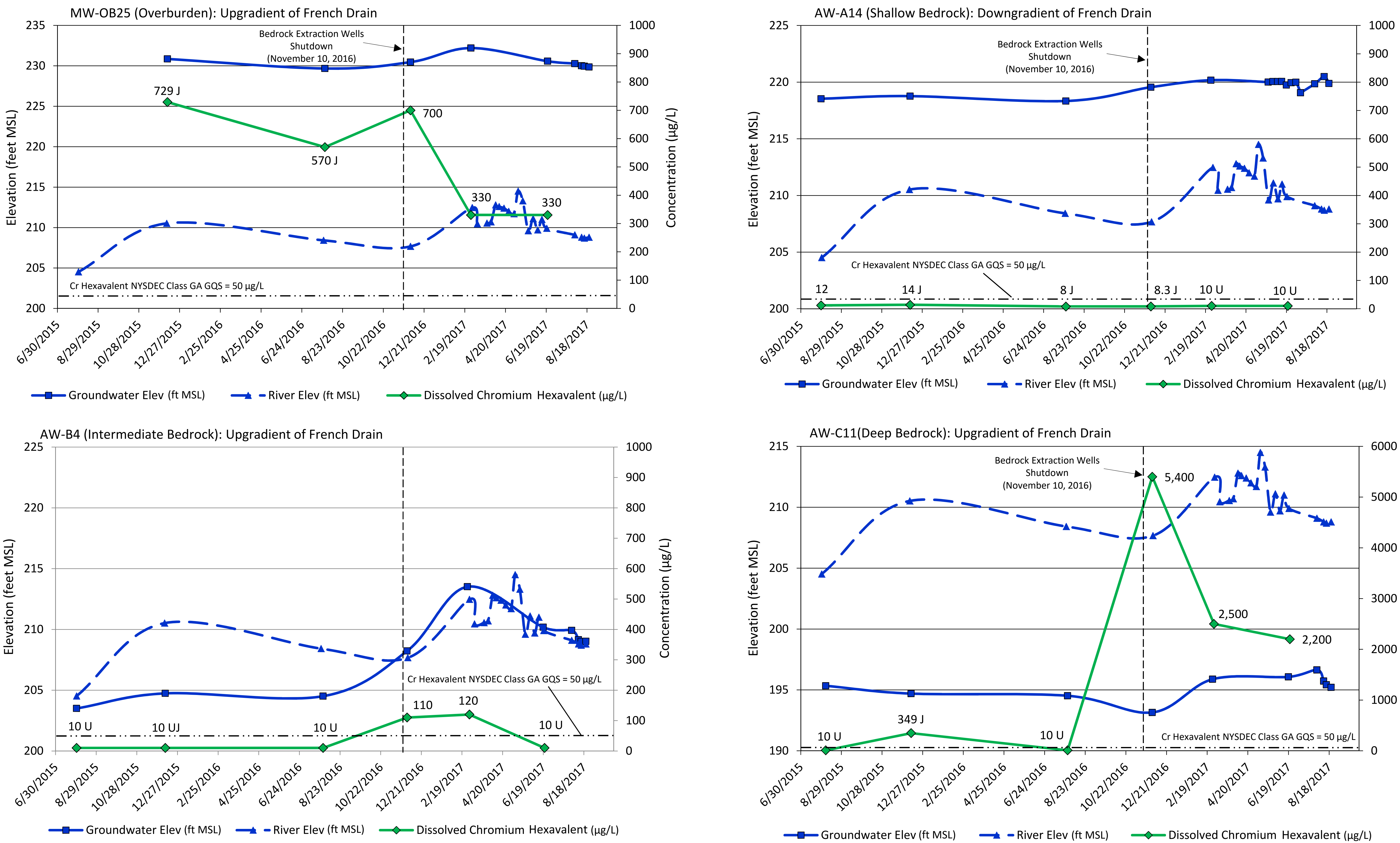
Figure 5-1





Notes:
1. Groundwater (monitoring well) and surface water (Hudson River) hydraulic data points plotted on the graph are manual field measurements.
2. NYSDEC Class GA groundwater quality standard (GQS) from 6 NYCRR 703.5, Table 1 Water Quality Standards and Water Quality Guidance Values from NYS Division of Water TOGS 1.1.1.
3. U = indicates analyte was not detected above reporting limit shown
4. J = indicates value is estimated
5. µg/L - micrograms per liter
6. ft = feet
7. MSL = mean sea level

Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2018	**Chromium Concentration Plots for Monitoring Wells Located Downgradient of Building 56: MW-OB30 (Overburden) and AW-A11 (Shallow Bedrock)**	**Figure 5-2**



Notes:

1. Groundwater (monitoring well) and surface water (Hudson River) hydraulic data points plotted on the graph are manual field measurements.
2. NYSDEC Class GA groundwater quality standard (GQS) from 6 NYCRR 703.5, Table 1 Water Quality Standards and Water Quality Guidance Values from NYS Division of Water TOGS 1.1.1
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6. ft = feet
7. MSL = mean sea level

Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support August 2018

Chromium Concentration Plots for Monitoring Wells Located Side Gradient to the Weir Brook: MW-OB25 (Overburden), AW-A14 (Shallow Bedrock), AW-B4 (Intermediate Bedrock), and AW-C11 (Deep Bedrock)

Figure 5-3

BROWN AND CALDWELL	Subsurface Boring Log	Well Name/Location: MW-OB25 Page 1 of 1
Project: *CM Construction, Ciba Site, Glens Falls, NY*	Project No.: *21089.001*	Start Date: *5/11/01* Finish Date: *5/11/01*
Client: *Hercules Incorporated*		

DRILLING DATA

Inspector: *JLM*
Contractor: *Layne Christiensen*
Equipment: *Auger Rig*
Method: *4.25" Hollow Stem Auger*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2"*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*Sch. 40 PVC*	*0.010" slot PVC*
Diameter (ID):	*2 inch*	*2 inch*
Coupling:	*Flush-threaded*	*Flush-threaded*

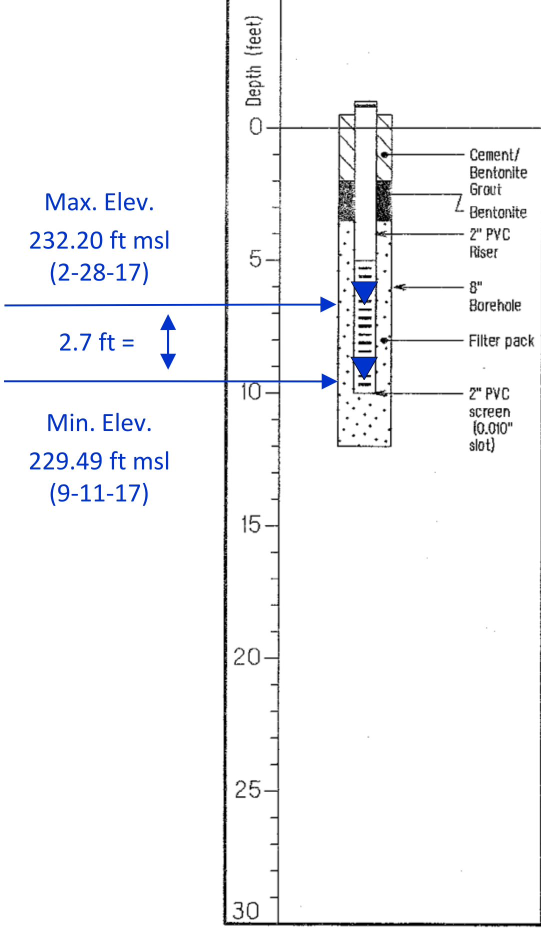
WELL DEVELOPMENT

Method: *Surge/Bail*
Duration: *1.5 hours*
Gals. Purged: *0.5*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NGVD

Grade: *NA*
TWC: *NA*
TPC: *NA*
North: *NA*
East: *NA*

Geophysical Log: ☐ yes ☒ no
Comments:



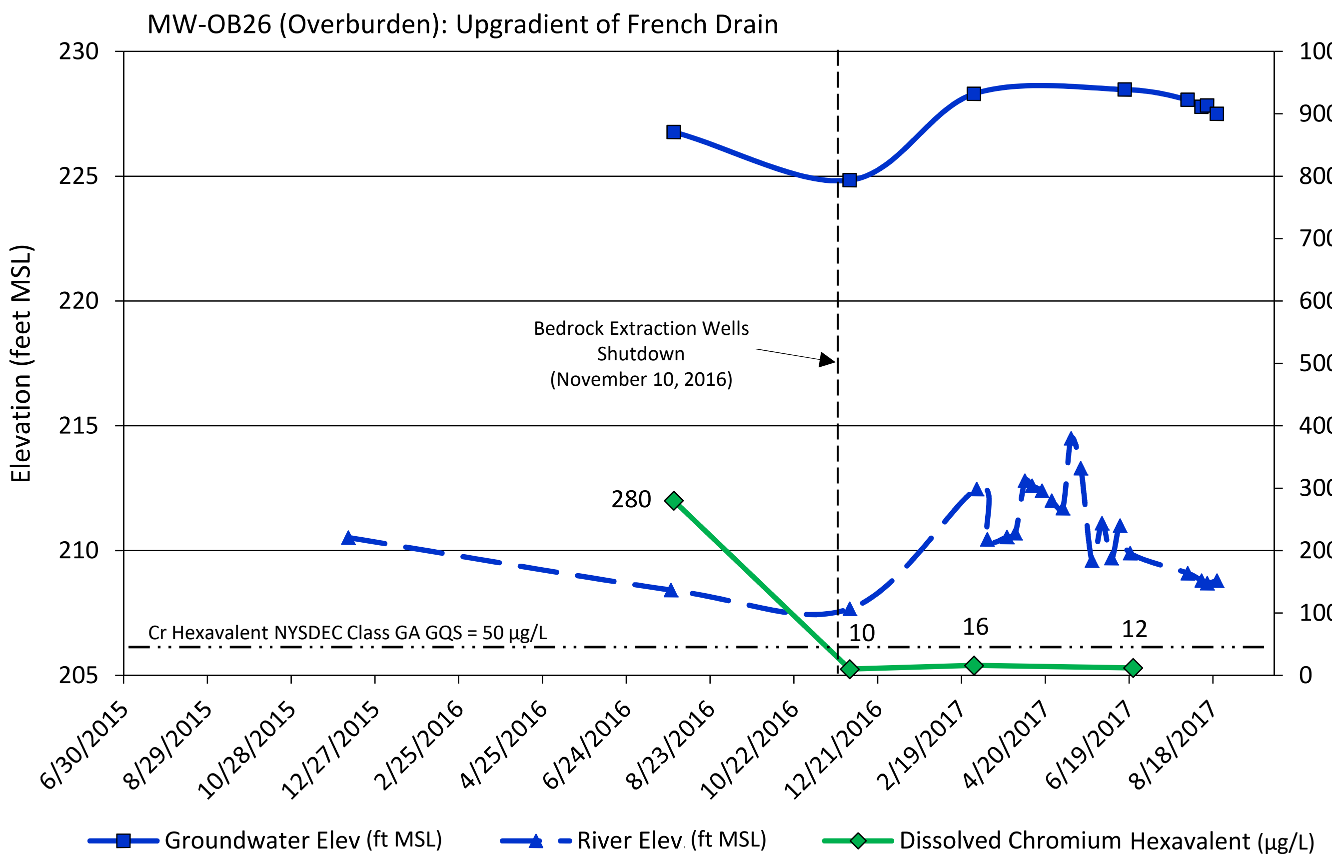
SAMPLE DATA (soil / rock)

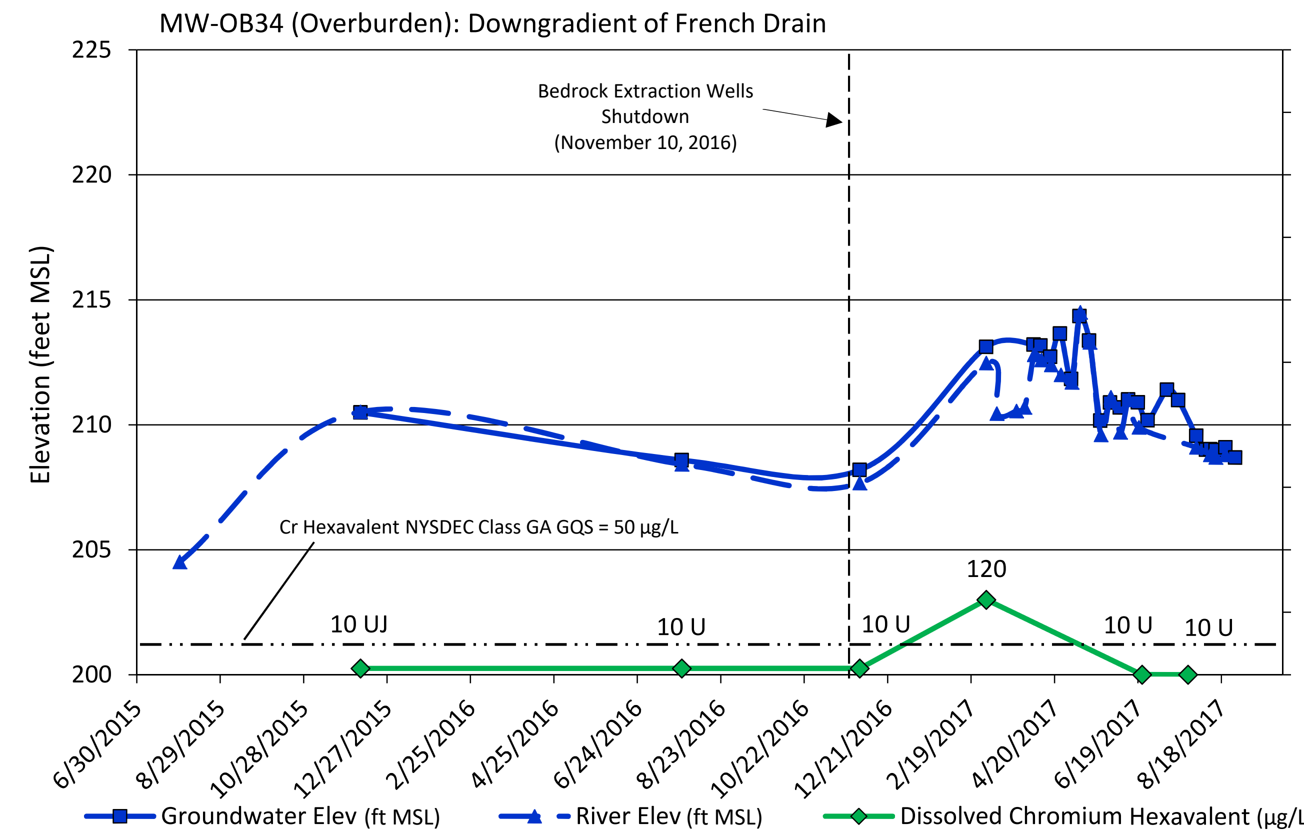
Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
S-1	1-1-1-2	1.0'		
S-2	5-4-3-3	1.4'		
S-3	5-1-7-9	1.0'		
S-4	7-3-4-3	1.0'		
S-5	4-4-4-5	2.0'		
S-6	2-3-4-5	2.0'		

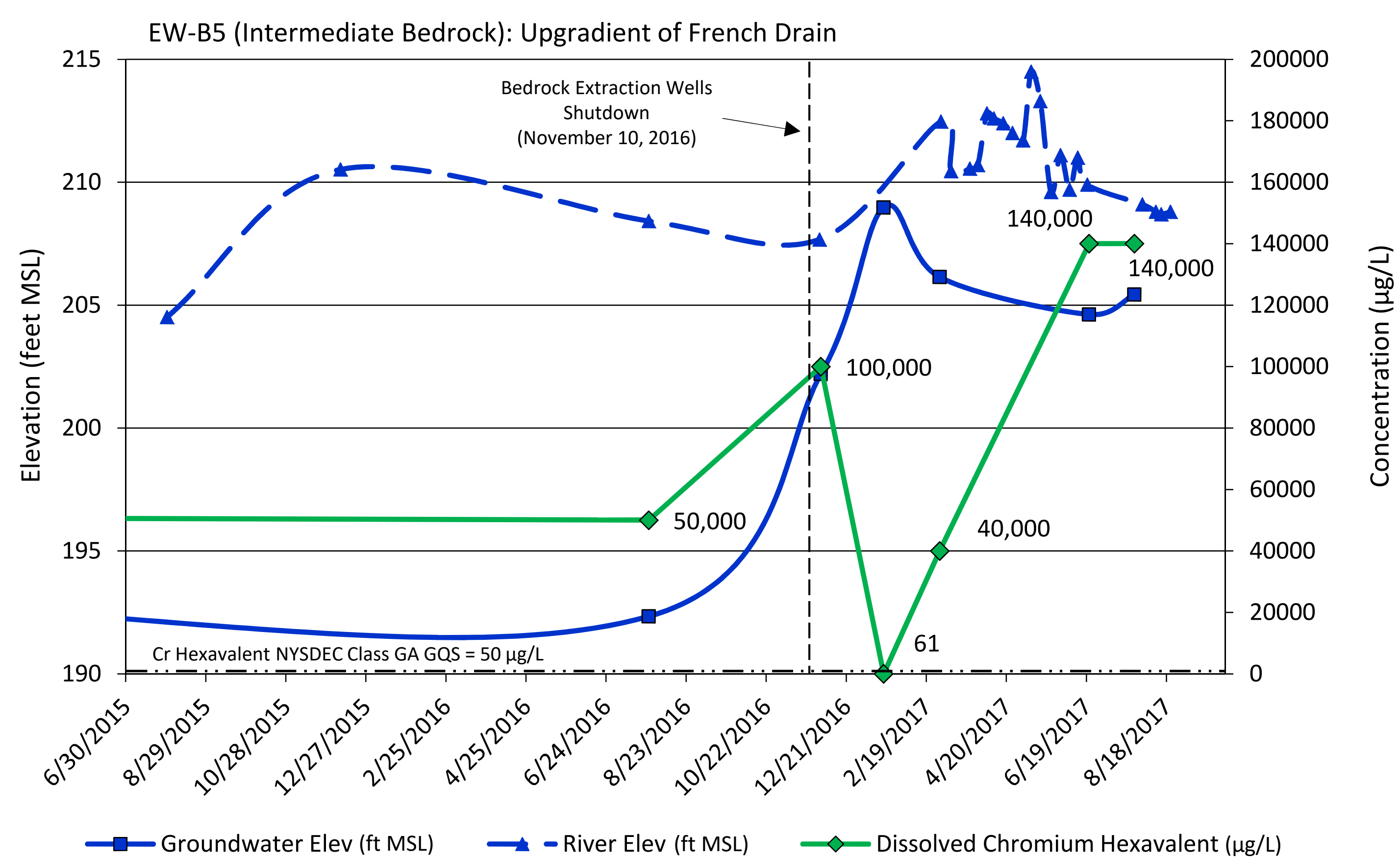
VISUAL CLASSIFICATION	REMARKS
Fill	
Brwn, m-c SAND, trace Gravel, becomes Dk Brwn f-m SAND, trace Gravel. Dry	
Brwn, m-c SAND, trace Gravel. Damp	
Lacustrine Deposits	
Dk Brwn clayey SILT, little f-m Sand. Moist	
Gray SILT, some f-m Sand, trace Gravel, grading to light Gray SILT, some f Sand. Wet	
Red/Brwn silty CLAY, little f Sand. Wet	Clay unit located @ 10.0
Lacustrine Clay	
Red/Brwn silty CLAY, becomes Gray silty CLAY. Wet	
End of Boring @ 12'	

Notes:
1. Maximum and minimum groundwater elevations measured during the time period between December 2015 through September 2017.

Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support August 2018	**Boring Log , Well Screen Interval, and Range of Groundwater Heads for Well MW-OB25**	**Figure 5-3a**







Notes:

1. Groundwater (monitoring well) and surface water (Hudson River) hydraulic data points plotted on the graph are manual field measurements.
2. NYSDEC Class GA groundwater quality standard (GQS) from 6 NYCRR 703.5, Table 1 Water Quality Standards and Water Quality Guidance Values from NYS Division of Water TOGS 1.1.1.
3. U = indicates analyte was not detected above reporting limit shown
4. J = indicates value is estimated
5. µg/L - micrograms per liter
6. ft = feet
7. MSL = mean sea level

Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support August 2018

Chromium Concentration Plots for Monitoring Wells Located Downgradient of Building 8: MW-OB26 (Overburden), MW-OB34 (Overburden), and EW-B5 (Intermediate Bedrock)

Figure 5-4

Appendix A
City of Glens Falls Industrial User Permit No. 002F (April 2017)

April 22, 2017

Hercules LLC, a wholly owned subsidiary of
Ashland Inc.
5200 Blazer Parkway
Dublin, Ohio 43017

Dear James E. Vondracek,

Please find your renewed Industrial User Permit. Check for any typographical or factual errors. Contact me with any questions or concerns regarding the permit language or sampling/reporting requirements so they can be resolved as soon as possible.

Sincerely,

Lawrence Glasheen

Lawrence Glasheen, Chief Operator
Glens Falls WWTP
2 Shermantown Road
Glens Falls 12801
Telephone: (518) 761-3850 ext 112
Telefax: (518) 761-3862
Email: lglasheen@cityofglensfalls.com

City of Glens Falls Water and Sewer Board of Commissioners

2 Shermantown Road
Glens Falls, NY 12801
Telephone: (518) 761-3850
Fax: (518) 761-3862

Permit No. 002F

INDUSTRIAL USER PERMIT

In accordance with the provisions of Chapter 177 of the Code of the City of Glens Falls

Hercules LLC , a wholly owned subsidiary of Ashland Inc. 5200 Blazer Parkway Dublin, Ohio 43017	and	BASF Corporation 227 Oak Ridge Parkway Toms River, NJ 08754-0071

Are hereby authorized to discharge industrial wastewater from the above identified facility and through the outfall identified herein into the City of Glens Falls sewer system in accordance with the conditions set forth in this permit. Compliance with this permit does not relieve the permittee of its obligation to comply with any or all applicable pretreatment regulations, standards or requirements under local, State, and Federal laws, including any such regulations, standards, requirements, or laws that may become effective during the term of this permit.

Noncompliance with any term or condition of this permit shall constitute a violation of Chapter 177 of the Code of the City of Glens Falls.

This permit shall become effective on April 24, 2017 and shall expire at midnight on April 23, 2022.
If the permittee wishes to continue to discharge after the expiration date of this permit, an application must be filed for a renewal permit in accordance with the requirements of Chapter 177 of the Code of the City of Glens Falls, a minimum of 180 days prior to the expiration date.

CITY OF GLENS FALLS

By: Steve Gurzler

Steven Gurzler, Water & Sewer Superintendent

Issued this 21st day of April, 2017

PART 1 - EFFLUENT LIMITATIONS

A. During the period of April 24, 2017 through midnight April 23, 2022, the permittees is authorized to discharge process wastewater to the City of Glens Falls sewer system from the outfalls listed below.

Description of outfalls:

Outfall	Descriptions
001	The flow from manhole number 5 located at the Glens Falls WWTP to a dedicated conveyance channel where metering and sampling takes place prior to combining with GFWWTP primary effluent. Said discharge is conveyed by a dedicated pipeline from the permittee's effluent pumping station located on Lower Warren Street.

B. During the period commencing April 24, 2017 through midnight April 23, 2022, the discharge from the process wastewater shall not exceed the following effluent limitations. Effluent at this location consists of the discharge from the permittees' effluent pumping station treating groundwater from the Lower Warren Street site that was formerly used by Hercules, Inc. and Ciba-Geigy Inc. for the manufacture of dyes and related chemicals.

EFFLUENT LIMITATIONS

Parameter	Instantaneous Maximum (mg/1)	Quarterly Average (mg/l unless otherwise noted)
Antimony	10	--
Ammonia	40	--
Arsenic	0.25	--
Benzene	0.1	--
Boron	5.0	--
Cadmium	0.25	--
Calcium	500	--
Chloroform	1.0	--
Chromium, total	see note below *	3.1 lb/day
Copper	1.0	--
Cyanide, total	3.0	--
Ethylbenzene	0.1	--
Iron	50	--
Lead	0.8**	--
Manganese	5.0	--
Mercury	0.025***	0.005
Methylene Chloride	1.0	--
Napthalene	1.0	--
Nickel	2.3	--
Oil & Grease	50	--
pH	6.5-8.5	--
Phenols	5.0	--
Silver	0.2	--
Toluene	0.1	--
1,1,1 - Trichloroethane	1.0	--
Xylene	0.1	--
Zinc	1.5	--
Flow (gallons per day)	350,000	175,000

*The discharge for total chromium is 3.1 lb/day and will be based on the average of chromium sampling data and the quarterly average flow. This limit is based on mass balance calculations as well as the 1999 Wastewater Headworks Analysis Report.

**0.8 mg/l Lead recommended as a local limit in the 1999 Wastewater Headworks Analysis Report.

***Variance for Mercury granted by the Water and Sewer Board at the public hearing held June 24, 1991.

C. All discharges shall comply with all other applicable laws, regulations, standards, and requirements contained in Chapter 177 of the Code of the City of Glens Falls and any applicable State and Federal pretreatment laws, regulations, standards, and requirements including any such laws, regulations, standards, or requirements that may become effective during the term of this permit.

PART 2 - MONITORING REQUIREMENTS

A. From the period beginning on the effective date of the permit until the expiration date, the permittee shall monitor outfall 001 for the following parameters, at the indicated frequency:

Sample Parameter (units)	Sample Location	Frequency	Sample Type
Flow (gpd)	See note 2	Continuous	Meter
BOD (mg/l)	See note 1,3	1/Year	Grab
TSS (mg/1)	See note 1,3	1/Year	Grab
Ammonia (mg/1)	See note 1,3	1/Year	Grab
Antimony (mg/l)	See note 1,3	1/Year	Grab
Arsenic (mg/1)	See note 1,3	1/Year	Grab
Benzene (mg/l)	See note 1,4	1/Year	Grab
Boron (mg/l)	See note 1,3	1/Year	Grab
Cadmium (mg/1)	See note 1,3	1/Year	Grab
Calcium (mg/l)	See note 1,3	1/Year	Grab
Chloroform (mg/l)	See note 1,4	1/Year	Grab
Chromium (mg/1)	See note 1,3	Quarterly	Grab
Copper (mg/1)	See note 1,3	1/Year	Grab
Cyanide (mg/1)	See note 1,3	Quarterly	Grab
Ethylbenzene (mg/l)	See note 1,4	1/Year	Grab
Iron (mg/l)	See note 1,3	1/Year	Grab
Lead (mg/1)	See note 1,3	Quarterly	Grab
Manganese (mg/l)	See note 1,3	1/Year	Grab
Mercury (mg/1)	See note 1,3	Quarterly	Grab
Methylene Chloride (mg/l)	See note 1,4	1/Year	Grab
Napthalene	See note 1,3	1/Year	Grab
Nickel (mg/1)	See note 1,3	1/Year	Grab

Sample Parameter (units)	Sample Location	Frequency	Sample Type
Zinc (mg/1)	See note 1,3	1/Year	Grab
Trichlorophenol (mg/1)	See note 1,4	1/Year	Grab
Pentachlorophenol (mg/l)	See note 1,4	1/Year	Grab
Oil and Grease (mg/l)	See note 1,4	1/Year	Grab
Phenols, Total (mg/l)	See note 1,3	Quarterly	Grab
pH	See note 5	Continuous	Meter
Silver (mg/l)	See note 1,3	1/Year	Grab
Toluene (mg/l)	See note 1,4	1/Year	Grab
1,1,1-Trichloroethane	See note 1,4	1/Year	Grab
Xylene (mg/l)	See note 1,4	1/Year	Grab

Notes

1. Composite sampler is located at the Southern end of the Preliminary Treatment Building at the WWTP.
2. Daily flows are to be recorded from the permittee's flow meter at the Southern end of the Preliminary Treatment Building at the WWTP
3. Composite samples shall be taken at the frequency specified above and tested by a State certified laboratory. Permittee's samples shall be 24 hour time composites except as noted above.;
4. Grab samples shall be taken from the effluent wet well at the Southern end of the Preliminary Treatment Building at the WWTP at the frequency specified above and tested by a State certified laboratory.
5. pH shall be monitored at the Southern end of the Preliminary Treatment Building at the WWTP.

B. All handling and preservation of collected samples and laboratory analyses of samples shall be performed in accordance with 40 CFR Part 136 and amendments thereto unless specified otherwise in the monitoring conditions of this permit.

PART 3 - REPORTING REQUIREMENTS

A. Monitoring Reports

Monitoring results obtained shall be summarized and reported on an Industrial User Monitoring Report Form once per quarter. The reports are due on the 28th day of the following month. The report shall indicate the nature and concentration of all pollutants in the effluent for which sampling and analyses were performed including measured maximum and average daily flows.

B. If the permittee monitors any pollutant more frequently than required by this permit, using test procedures prescribed in 40 CFR Part 136 or amendments thereto, or otherwise approved by EPA or as specified in this permit, the results of such monitoring shall be included in any calculations of actual daily maximum or monthly average pollutant discharge and results shall be reported in the monthly report submitted to the City of Glens Falls. Such increased monitoring frequency shall also be indicated in the monthly report.

C. Automatic Resampling

If the results of the permittee's wastewater analysis indicate that a violation of this permit has occurred, the permittee must:

1. Inform the City of Glens Falls of the violation within 24 hours; and

2. Repeat the sampling and pollutant analysis and submit, in writing, the results of this second analysis within 30 days of the first violation.

D. Accidental Discharge Report

1. The permittee shall notify the City of Glens Falls immediately upon the occurrence of an accidental discharge of substances prohibited by Chapter 177 of the Code of the City of Glens Falls or any slug loads or spills that may enter the public sewer. The City of Glens Falls should be notified by telephone at (518) 761-3850. The notification shall include location of discharge, date and time thereof, type of waste, including concentration and volume, and corrective actions taken. The permittee's notification of accidental releases in accordance with this section does not relieve it of other reporting requirements that arise under local, State, or Federal laws.

Within five days following an accidental discharge, the permittee shall submit to the City of Glens Falls a detailed written report. The report shall specify:

a. Description and cause of the upset, slug load or accidental discharge, the cause thereof, and the impact on the permittee's compliance status. The description should also include location of discharge, type, concentration and volume of waste.

b. Duration of noncompliance, including exact dates and times of noncompliance and, if the noncompliance is continuing, the time by which compliance is reasonably expected to occur.

c. All steps taken or to be taken to reduce, eliminate, and/or prevent recurrence of such an upset, slug load, accidental discharge, or other conditions of noncompliance.

E. All reports required by this permit shall be submitted to the City of Glens Falls at the following address:

City of Glens Falls
Attn.: Pretreatment Coordinator
2 Shermantown Rd.
Glens Falls, NY 12801

PART 4 - SPECIAL CONDITIONS

SECTION 1 - <u>ADDITIONAL/SPECIAL MONITORING REQUIREMENTS</u>.

A. No Special Monitoring Requirements are applicable at this time.

SECTION 2 - REOPENER CLAUSE

A. This permit may be reopened and modified to incorporate any new or revised requirements contained in a National Categorical Pretreatment Standard.

B. This permit may be reopened and modified to incorporate any new or revised requirements resulting from the City of Glens Falls' reevaluation of its local limits.

C. This permit may be reopened and modified to incorporate any new or revised requirements developed by the City of Glens Falls as are necessary to ensure POTW compliance with any and all regulatory standards.

PART 5 - STANDARD CONDITIONS

SECTION A. GENERAL CONDITIONS AND DEFINITIONS

1. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

2. Duty to comply

The permittee must comply with all conditions of this permit. Failure to comply with the requirements of this permit may be grounds for administrative action, or enforcement proceedings including civil or criminal penalties, injunctive relief, and summary abatements.

3. Duty to mitigate

The permittee shall take all reasonable steps to minimize or correct any adverse impact to the public treatment plant or the environment resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Permit Modification

This permit may be modified for good causes including, but not limited to, the following:

a. To incorporate any new or revised Federal, State, or local pretreatment standards or requirements.

b. Material or substantial alterations or additions to the discharger's operation processes, or discharge volume or character which were not considered in drafting the effective permit.

c. A change in any condition in either the industrial user or the POTW that requires either a temporary or permanent reduction or elimination of the authorized discharge.

d. Information indicating that the permitted discharge poses a threat to the Control Authority's collection and treatment systems, POTW personnel or the receiving waters.

e. Violation of any terms or conditions of the permit.

f. Misrepresentation or failure to disclose fully all relevant facts in the permit application or in any required reporting.

g. Revision of or a grant of variance from such categorical standards pursuant to 40 CFR 403.13.

h. To correct typographical or other errors in the permit.

i. To reflect transfer of the facility ownership and/or operation to a new/operator.

j. Upon request of the permittee, provided such request does not create a violation of any applicable requirements, standards, laws, or rules and regulations.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

5. Permit Termination

This permit may be terminated for the following reasons:

a. Falsifying self-monitoring reports

b. Tampering with monitoring equipment

c. Refusing to allow timely access to the facility premises and records

d. Failure to meet effluent limitations

e. Failure to pay fines

f. Failure to pay sewer charges

g. Failure to meet compliance schedules

6. Permit Appeals

The permittee may petition to appeal the terms of this permit within thirty (30) days of the notice.

The petition must be in writing; failure to submit a petition for review shall be deemed to be a waiver of the appeal. In its petition, the permittee must indicate the permit provisions objected to, the reasons for this objection, and the alternative condition, if any, it seeks to be placed in the permit.

7. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any violation of Federal, State, or local laws or regulations.

8. Limitation on Permit Transfer

Permits may be reassigned or transferred to a new owner and/or operator with prior approval of the City of Glens Falls:

a. The permittee must give at least thirty (30) days advance notice to the City of Glens Falls

b. The notice must include a written certification by the new owner which:

(i) States that the new owner has no immediate intent to change the facility's operations and processes

(ii) Identifies the specific date on which the transfer is to occur

(iii) Acknowledges full responsibility for complying with the existing permit.

9. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must submit an application for a new permit at least 180 days before the expiration date of this permit.

10. Continuation of Expired Permits

An expired permit will continue to be effective and enforceable until the permit is reissued if:

a) The permittee has submitted a complete permit application at least 180 days prior to the expiration date of the user's existing permit.

b) The failure to reissue the permit, prior to expiration of the previous permit, is not due to any act or failure to act on the part of the permittee.

11. Dilution

The permittee shall not increase the use of potable or process water or, in any way, attempt to dilute an effluent as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in this permit.

12. Definitions

a) Daily Maximum – The maximum allowable discharge of pollutant during a calendar day. Where daily maximum limitations are expressed in units of mass, the daily discharge is the total mass discharged over the course of the day. Where daily maximum limitations are expressed in terms of a concentration, the daily discharge is the arithmetic average measurement of the pollutant concentration derived from all measurements taken that day.

b) Composite Sample – A sample that is collected over time, formed either by continuous sampling or by mixing discrete samples. The sample may be composited either as a time composite sample: composed of discrete sample aliquots collected in one container at constant time intervals providing representative samples irrespective of stream flow; or as a flow proportional composite sample: collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increases while maintaining a constant time interval between the aliquots.

c) Grab Sample – An individual sample collected in less than 15 minutes, without regard for flow or time.

d) Instantaneous Maximum Concentration – The maximum concentration allowed in any single grab sample.

e) Cooling Water –

(1) Uncontaminated: Water used for cooling purposes only which has no direct contact with any raw material, intermediate, or final product and which does not contain a level of contaminants detectably higher than that of the intake water.

(2) Contaminated: Water used for cooling purposes only which may become contaminated either through the use of water treatment chemicals used for corrosion inhibitors or biocides, or by direct contact with process materials and/or wastewater.

f) Monthly Average – The arithmetic mean of the values for effluent samples collected during a calendar month .

g) Weekly Average – The arithmetic mean of the values for effluent samples collected over a period of seven consecutive days.

h) Bi-Weekly – Once every other week.

i) Bi- Monthly – Once every other month

j) Quarterly – The arithmetic mean of the values for effluent samples collected during a calendar quarter.

k) Upset – Means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee, excluding such factors as operational error, improperly designed or inadequate treatment facilities, or improper operation and maintenance or lack thereof.

l) Bypass – Means the intentional diversion of wastes from any portion of a treatment facility.

13. General Prohibitive Standards

The permittee shall comply with all the general prohibitive discharge standards in Chapter 177 of the Code of the City of Glens Falls. No user shall contribute or cause to be contributed, directly or indirectly, any pollutant, wastewater, or other material which will inhibit or interfere with the operation or performance of the POTW or the use or disposal of the sludge generated by the POTW or pass through the POTW without adequate treatment in violation of any applicable federal, state, or local environmental regulation into the receiving waters of the Hudson River or into the sludge by-product of the POTW. These general prohibitions apply to all such users of a POTW, whether or not the user is subject to National Categorical Pretreatment Standards or any other national, state, or local pretreatment standards or requirements. Namely, the industrial user shall not discharge wastewater to the sewer system:

a) Containing any liquid, solid, or gas which, by reason of its nature or quantity, is sufficient, either alone or by interaction with other substances, to cause fire or explosion or be injurious in any way to the POTW or to the operation of the POTW. At no time shall two successive readings on an explosion-hazard meter at the point of discharge in the system or at any point in the system, be more than 5% nor any single reading over 10% of the lower explosive limits (LEL) of the meter. Materials prohibited under this subsection include but are not limited to substance(s) which the Board, the DEC or the EPA has notified a user poses a fire or explosion hazard to the POTW;

b) Containing solid or viscous substances which may cause obstruction to the flow in a sewer or other interference with the operation of the wastewater treatment facilities, such as but not limited to grease, oil or fat in concentrations exceeding 100 parts per million by weight, garbage with particles greater than ½ inch in any dimension, animal guts or tissues, paunch manure, bones, hair, hides or fleshings, entrails, whole blood, feathers, ashes, cinders, sand, spent lime, stone or marble dust, metal, glass, straw, shavings, grass clippings, rags, spent grains, spent hops, wastepaper, wood, plastics, gas, tar, asphalt residues, residues from refining or processing of fuel or lubricating oil, mud or glass grindings or polishing wastes;

c) Having a pH less than six point five (6.5) or higher than eight point five (8.5) or having any other corrosive property capable of causing damage or hazard to structures, equipment or personnel of the POTW;

d) Containing any toxic pollutants in sufficient quantity, either singly or by interaction with other pollutants, so as to potentially inhibit or interfere with the operation or performance of the POTW, constitute a hazard to humans or animals, create a toxic effect in the receiving waters of the POTW or exceed a limitation set forth in a National Categorical Pretreatment Standard. A "toxic pollutant" shall include but not be limited to any pollutant identified pursuant to Section 307 (a) of the Federal Act.

e) Containing any wastes which either singly or by interaction with other wastes, are sufficient to create a public nuisance or hazard to life or are sufficient to prevent entry into the sewer for its maintenance and repair.

f) Containing any substance which may cause the POTW's effluent or any other product of the POTW, such as residues, sludges or scums, to be unsuitable for reclamation and reuse or to interfere with the reclamation process. In no case shall a substance discharged to the POTW cause the POTW to be in noncompliance with the sludge use or disposal criteria, guidelines or regulations developed under Section 405 of the Act; any criteria, guidelines or regulations affecting sludge use or disposal developed pursuant to the Solid Waste Disposal Act, the Clean Air Act or the Toxic Substances Control Act; or state criteria applicable to the sludge management method being used.

g) Containing any substance which may cause the POTW to violate its State Pollution Discharge Pollution Discharge Elimination System Permit or receiving water quality standard.

h) Containing any objectionable color not removed in the treatment process, such as but not limited to dye wastes and vegetable tanning solutions.

i) Having a temperature which may inhibit biological activity in the POTW treatment plant resulting in interference, but in no case wastewater with a temperature at the introduction into the POTW which exceeds forty degrees centigrade (40 degrees C.) [one hundred four degrees Fahrenheit (104 degrees F.)]

j) Containing any pollutants, including oxygen-demanding pollutants (BOD, etc.), released at a flow rate and/or pollutant concentration which will cause interference to the POTW. In no case shall a slug load have a flow rate or contain concentrations or qualities of pollutants that exceed, for any time period longer than fifteen (15) minutes, more than five (5) times the average twenty-four hour concentration quantities or flow during normal operation.

k) Containing any radioactive waste or isotopes of such half-life or concentration as may exceed limits established by the Board in compliance with applicable state or federal regulatons or limits set forth in any applicable federal, state, or local pollutant discharge regulation.

l) Containing suspended solids of such character and quantity that unusual attention or expense is required to handle such materials at the sewage treatment plant.

m) Containing any substance which exceeds a national categorical pretreatment standsrd promulgated by the EPA or any other applicable federal, state or local pollutant discharge regulation.

n) Containing any medical or infectious wastes;

o) Containing any gasoline, benzene, naptha, fuel oil or other flammable or explosive liquids, solids or gases; and in no case pollutants with a closed cup flashpoint of less than one hundred forty (140) degrees Fahrenheit (60 degrees C), or pollutants which cause an exceedance of 10 percent of the Lower Explosive Limit (LEL) at any point within the POTW.

14. Compliance with Applicable Pretreatment Standards and Requirements

Compliance with this permit does not relieve the permittee from its obligations regarding compliance with any and all applicable local, State and Federal pretreatment standards and requirements including any such standards or requirements that may become effective during the term of this permit.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes but is not limited to: effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

2. Duty to Halt or Reduce Activity

Upon reduction of efficiency of operation, or loss or failure of all or part of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control its production or discharges (or both) until operation of the treatment facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power of the treatment facility fails or is reduced. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Bypass of Treatment Facilities

a) Bypass is prohibited unless it is unavoidable to prevent loss of life, personal injury, or severe property damage or no feasible alternatives exist.

b) The permittee may allow bypass to occur which does not cause effluent limitations to be exceeded, but only if it is also for essential maintenance to assure efficient operation.

c) Notification of bypass:

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior written notice, at least ten days before the date of the bypass, to the City of Glens Falls

(2) Unanticipated bypass. The permittee shall immediately notify the City of Glens Falls and submit a written notice to the POTW within 5 days. This report shall specify:

(i) A description of the bypass, and its cause, including its duration;

(ii) Whether the bypass has been corrected; and

(iii) The steps being taken or to be taken to reduce, eliminate and prevent a reoccurrence of the bypass.

4. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in accordance with section 405 of the Clean Water Act and Subtitles C and D of the Resource Conservation and Recovery Act or in accordance with the latest appropriate State and/or Federal requirements.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water or substance. All equipment used for sampling and analysis must be routinely calibrated, inspected and maintained to ensure their accuracy. Monitoring points shall not be changed without notification to and the approval of the City of Glens Falls.

2. Flow Measurements

If flow measurement is required by this permit, the appropriate flow measurement devices and methods consistent with approved scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10 percent from true discharge rates throughout the range of expected discharge volumes.

3. Analytical Methods to Demonstrate Continued Compliance

All sampling and analysis required by this permit shall be performed in accordance with the techniques prescribed in 40 CFR Part 136 and amendments thereto, otherwise approved by EPA, or as specified in this permit.

4. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures identified in Section C.3, the results of this monitoring shall be included in the permittee's self-monitoring reports.

5. Inspection and Entry

The permittee shall allow the City of Glens Falls, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit;

d) Sample or monitor, for the purposes of assuring permit compliance, any substances or parameters at any location; and

e) Inspect any production, manufacturing, fabricating, or storage are where pollutants, regulated under the permit, could originate, be stored, or be discharged to the sewer system.

6. Retention of Records

a) The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurements, report or application.

   This period may be extended by request of the City of Glens Falls at any time.

b) All records that pertain to matters that are the subject of special orders or any other enforcement or litigation activities brought by the City of Glens Falls shall be retained and preserved by the permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

7. Record Contents

Records of sampling and analyses shall include:

a) The date, exact place, time, and methods of sampling or measurements, and sample preservation techniques or procedures;

b) Who performed the sampling or measurements;

c) The date(s) analyses were performed;

d) Who performed the analyses;

e) The analytical techniques or methods used; and

f) The results of such analyses.

8. Falsifying Information

Knowingly making any false statement on any report or other document required by this permit or knowingly rendering any monitoring device or method inaccurate, is a crime and may result in the imposition of criminal sanctions and/or civil penalties.

SECTION D. ADDITIONAL REPORTING REQUIRMENTS

1. Planned Changes

The permittee shall give notice to the City of Glens Falls 90 days prior to any facility expansion, production increase, or process modifications which results in new or substantially increased discharges or a change in the nature of the discharge.

2. Anticipated Noncompliance

The permittee shall give advance notice to the City of Glens Falls of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Automatic Resampling

If the results of the permittee's wastewater analysis indicates a violation has occurred, the permittee must notify the City of Glens Falls within 24 hours of becoming aware of the violation and repeat the sampling and pollutant analysis and submit, in writing, the results of this repeat analysis within 30 days after becoming aware of the violation.

4. Duty to Provide Information

The permittee shall furnish to the City of Glens Falls within 10 days any information which the City of Glens Falls may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also, upon request, furnish to the City of Glens Falls within 10 days copies of any records required to be kept by this permit.

5. Signatory Requirements

All applications, reports, or information submitted to the City of Glens Falls must contain the following certification statement and be signed as required in Sections (a), (b), (c) or (d) below:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

a) By a responsible corporate officer, if the Industrial User submitting the reports is a corporation. For the purpose of this paragraph, a responsible corporate officer means:

(i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or;

(ii) the manager of one or more manufacturing, production, or operation facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million, if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

b) By a general partner or proprietor if the Industrial User submitting the reports is a partnership or sole proprietorship respectively.

c) The principal executive officer or director having responsibility for the overall operation of the discharging facility if the Industrial User submitting the reports is a Federal, State, or local governmental entity, or their agents.

d) By a duly authorized representative of the individual designated in paragraph (a), (b), or (c);

(i) the authorization is made in writing by the individual described in paragraph (a), (b), or (c);

(ii) the authorization specifies either an individual or a position having responsibility for the overall operation of the facility from which the Industrial Discharge originates, such as the position of plant manager, operator of a well, or a well field superintendent, or a position of equivalent responsibility, or having overall responsibility for environmental matters for the company; and

(iii) the written authorization is submitted to the City.

e) If an authorization under paragraph (d) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, or overall responsibility for the environmental matters for the company, a new authorization satisfying the requirements of paragraph (d) of this section must be submitted to the City of Glens Falls prior to or together with any reports to be signed by an authorized representative.

6. <u>Operating Upsets</u>

Any permittee that experiences an upset in operations that places the permittee in a temporary state of noncompliance with the provision of either this permit or with any section of Chapter 177 of the Code of the City of Glens Falls, shall inform the City of Glens Falls within 24 hours of becoming aware of the upset at (518) 761-3850.

A written follow-up report of the upset shall be filed by the permittee with the City of Glens Falls within five days. The report shall specify:

a) Description of the upset, the cause(s) thereof and the upset's impact on the permittee's compliance status;

b) Duration of noncompliance, including exact dates and times of noncompliance, and if not corrected, the anticipated time the noncompliance is expected to continue; and

c) All steps taken or to be taken to reduce, eliminate and prevent recurrence of such an upset.

The report must also demonstrate that the treatment facility was being operating in an appropriate manner.

A documented and verified operating upset shall be an affirmative defense to any enforcement action brought against the permittee for violations attributable to the upset event.

7. Annual Publication

A list of all industrial users which were subject to enforcement proceedings during the twelve (12) previous months shall be annually published by the City of Glens Falls in the largest daily newspaper within its service area. Accordingly, the permittee is apprised that noncompliance with this permit may lead to an enforcement action and may result in publication of its name in an appropriate newspaper in accordance with this section.

8. Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil and/or criminal penalties for noncompliance under Chapter 177 of the Code of the City of Glens Falls or State or Federal laws or regulations.

9. Penalties for Violations of Permit Conditions

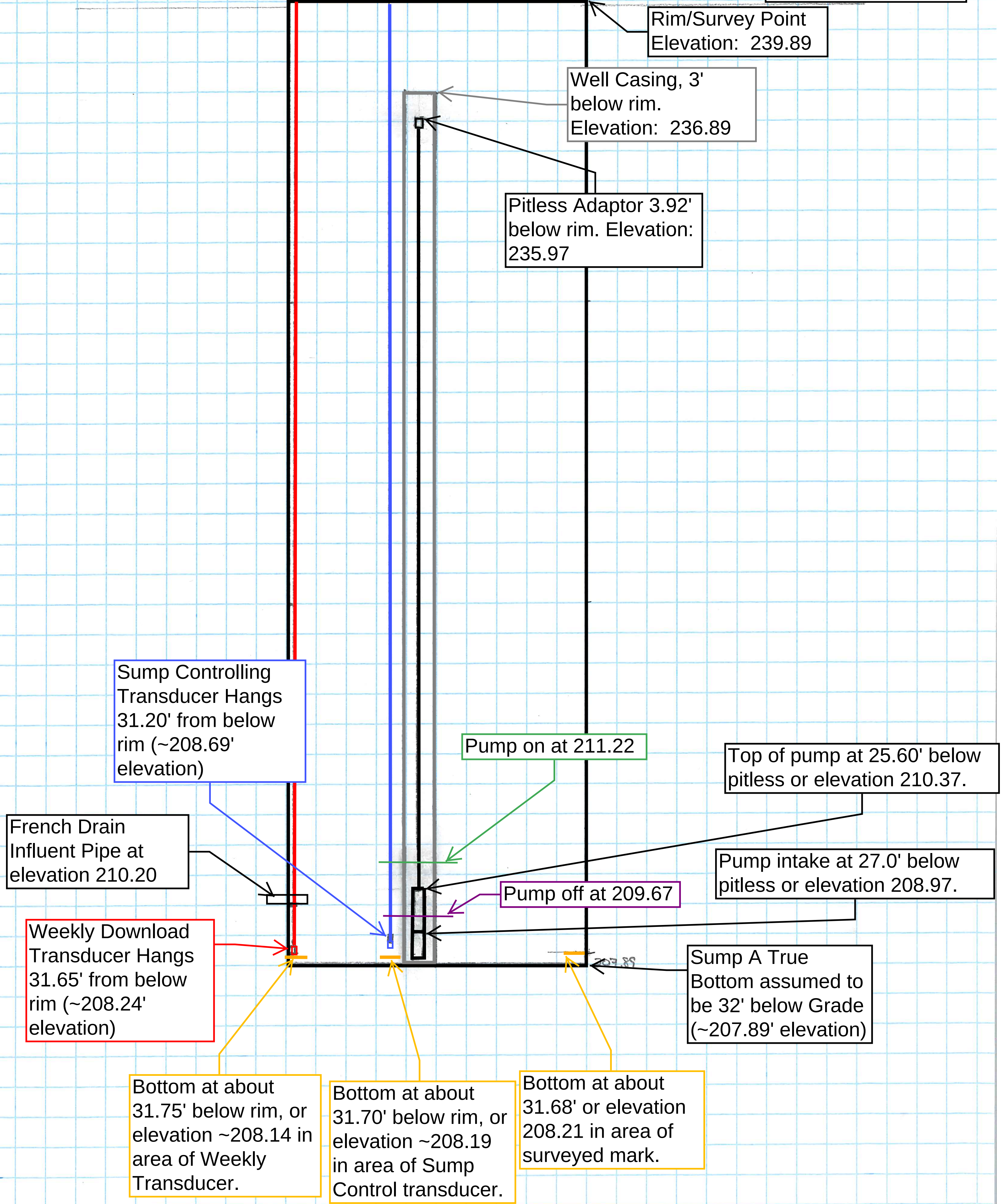
The City of Glens Falls provides that any person who violates a permit condition is subject to administrative penalties of up to $5000 per violation per day and civil penalties of up to $5000 per violation per day. Any person who willfully or negligently violates permit conditions is subject to criminal penalties of $5000 per violation per day, or imprisonment for six months, or both. The permittee may also be subject to sanctions under State and/or Federal law.

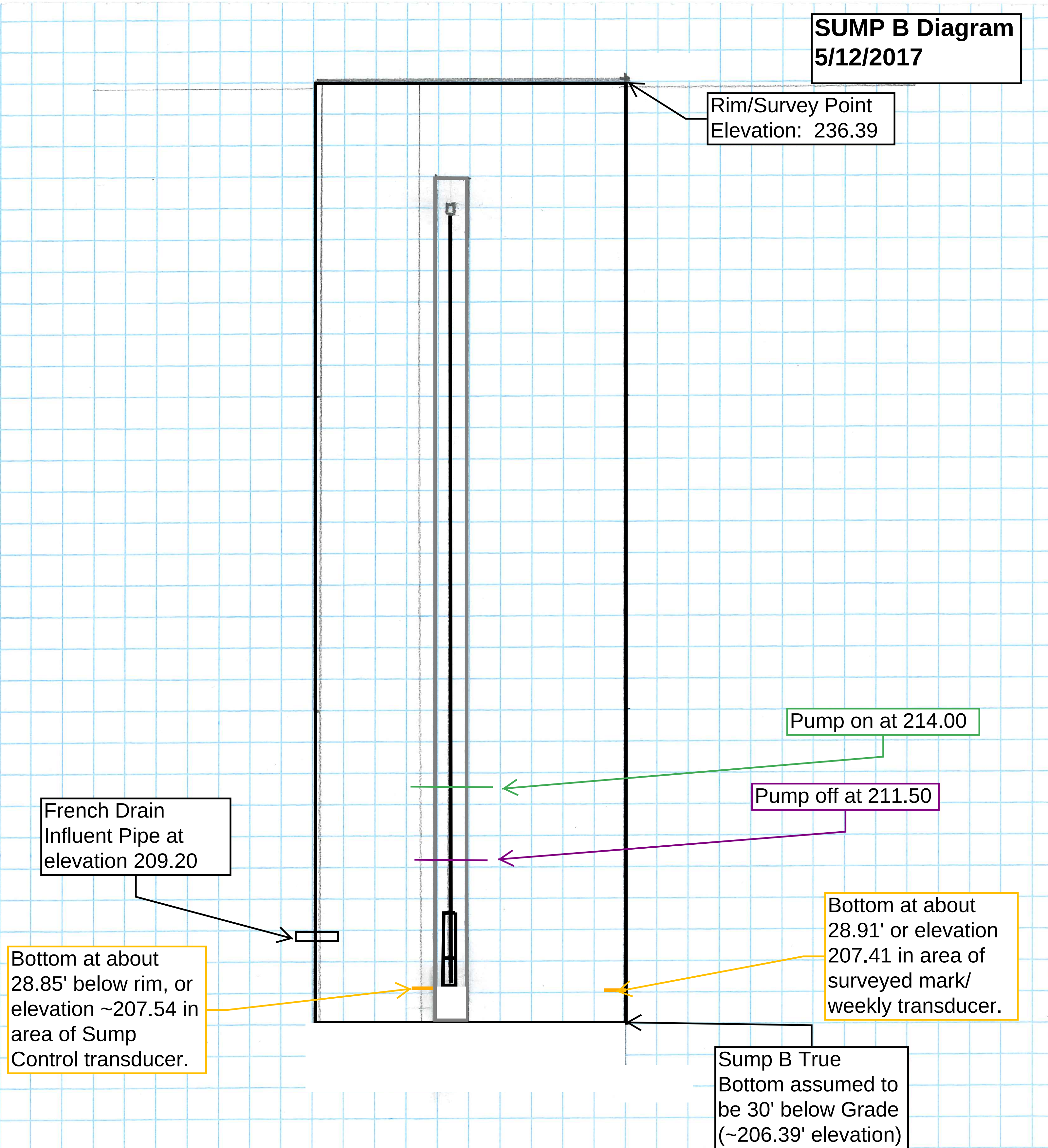
10. Recovery of Costs Incurred

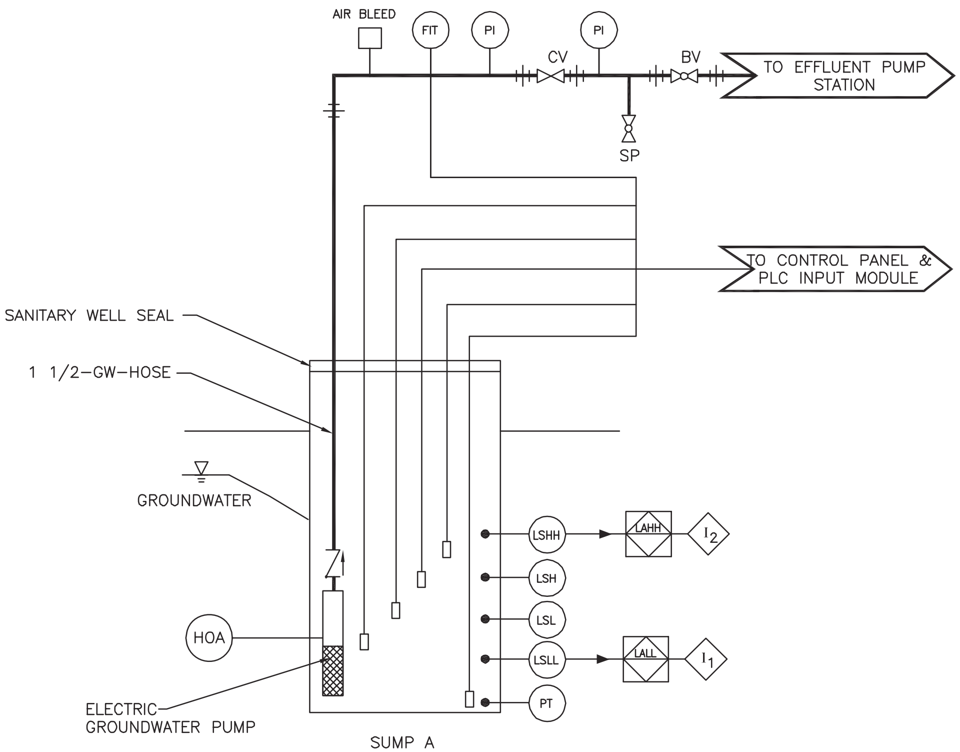
In addition to civil and criminal liability, the permittee violating any of the provisions of this permit or Chapter 177 of the Code of the City of Glens Falls or causing damage to or otherwise inhibiting the City of Glens Falls wastewater disposal system shall be liable to the City of Glens Falls for any expense, loss, or damage caused by such violation or discharge. The City of Glens Falls shall bill the permittee for the costs incurred by the City of Glens Falls for any cleaning, repair, or replacement work caused by the violation or discharge. Refusal to pay the assessed costs shall constitute a separate violation of Chapter 177 of the Code of the City of Glens Falls.

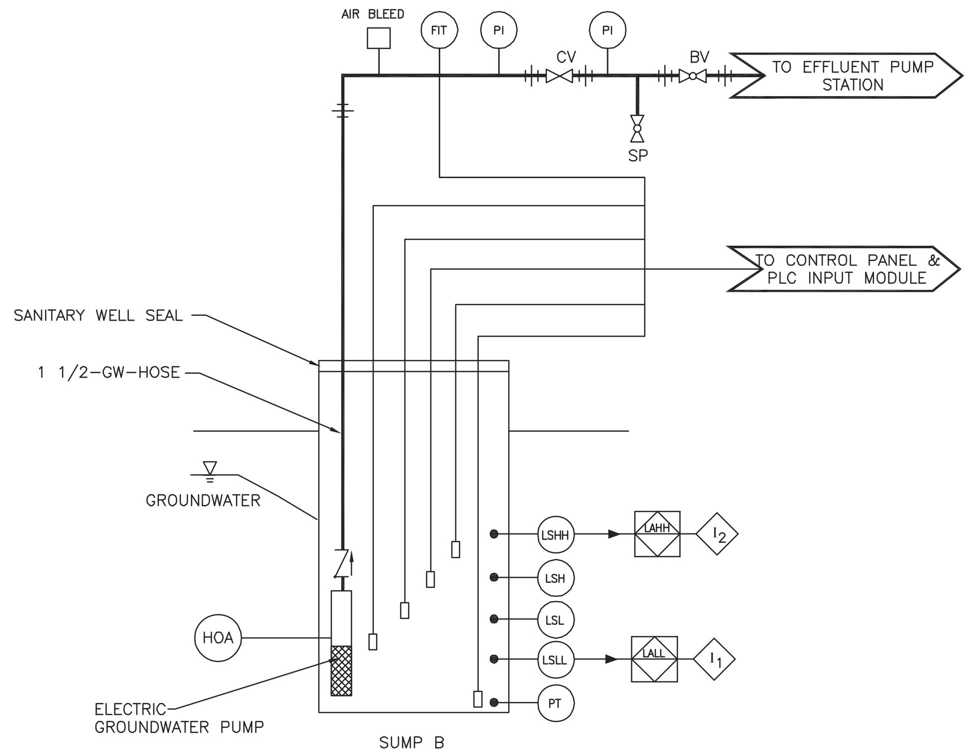
Appendix B
Sump Diagrams and Telemetry System Diagrams

SUMP A Diagram
5/12/2017




SUMP B Diagram
5/12/2017
Rim/Survey Point
Elevation: 236.39
Pump on at 214.00
Pump off at 211.50
French Drain
Influent Pipe at
elevation 209.20
Bottom at about
28.91' or elevation
207.41 in area of
surveyed mark/
weekly transducer.
Bottom at about
28.85' below rim, or
elevation ~207.54 in
area of Sump
Control transducer.
Sump B True
Bottom assumed to
be 30' below Grade
(~206.39' elevation)





ITEM	DESCRIPTION	TYPE	FUNCTION
LSLL & LSHH	LEVEL SENSOR/RELAY	115 VAC	WELL LEVEL SENSING/ALARM
FT/FI	FLOW TRANSMITTER	PADDLE WHEEL/4-20 MA	WELL FLOW MEASUREMENT
AI	ANALOG INPUT	4-20 MA	FLOW MEASURE WELL LEVEL
DI	DIGITAL INPUT	115 VAC	HI, LO, PUMP RUNNING
PUMP	PUMP/MOTOR STARTER	240 VAC	WELL PUMP
PI	PRESSURE INDICATOR	0-120 PSI	LINE PRESSURE

PIPING & INSTRUMENTATION DIAGRAM

FORMER CIBA-GEIGY/HERCULES SITE
QUEENSBURY, NEW YORK

PROJECT NO.	PREPARED BY	DRAWN BY
GLENS FALLS	HM	LKO
DATE	REVIEWED BY	FILE NAME
9/05/2016	HM	9-2016 PID.DWG

anteagroup

ANTEA Ashland Glens Falls Site CONTROL UPGRADE PROJECT
PROCESS & INSTRUMENTATION DIAGRAM

PROGRAMMABLE LOGIC CONTROLLERS

PLC 1 IS CENTRAL CONTROL, (IN PUMP HOUSE)
PLC 2 (SUMP A) & PLC 3 (SUMP B) ARE SLAVED
TO PLC 1 VIA 900 MHz DSS DATA RADIOS MODBUS
PLC 4 (LIFT STATION) IS STANDALONE
ALL PLC's ARE CLICK PLATFORM by KOYO
HMI / WEBSERVER/ DATALOGGER = C-MORE by KOYO

PUMPHOUSE PUMP CTRL VIA LEGACY RELAY PANEL

INSTRUMENT LEGEND

OR SENSOR

OR SWITCH

OR PLC DISCRETE INPUT

OR PLC DISCRETE OUTPUT

OR VFD / MOTOR STARTER

ELEMENTS IN COLOR CONNECT WITH CENTRAL CONTROL. ELEMENTS IN WHITE ARE LOCALLY CONNECTED ONLY.

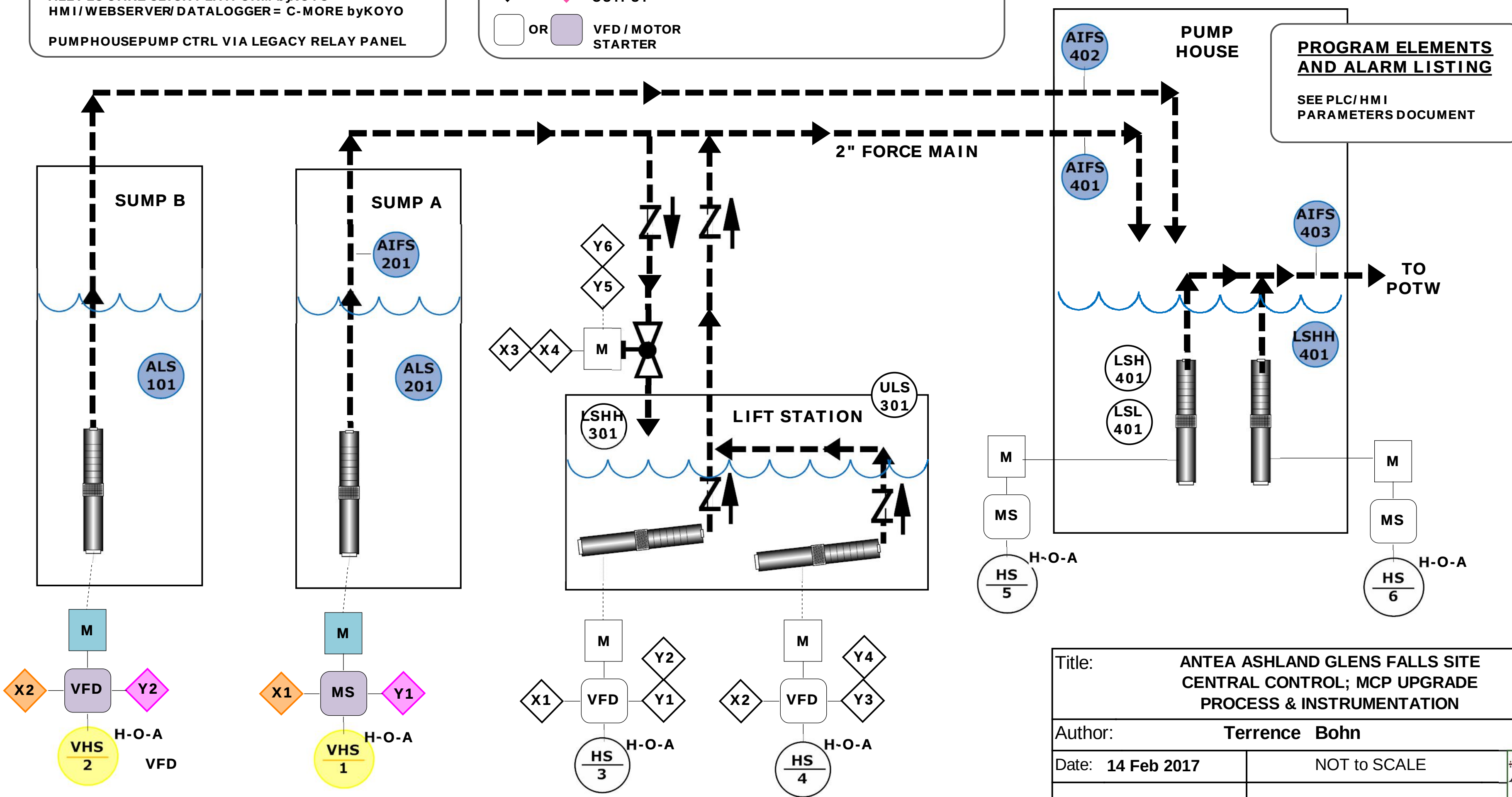
100 SERIES LOCATED @ SUMP B
200 SERIES LOCATED @ SUMP A
300 SERIES LOCATED @ LIFT STA.
400 SERIES LOCATED @ PUMP HOUSE

ABBREVIATION KEY

ALS --- ANALOG LEVEL SENSOR
AIFS --- ANALOG INDICATING FLOW SENSOR
HS --- HAND SWITCH
LSHH - LVL SENSOR HI-HI
LSH - LVL SENSOR HI
LSL - LVL SENSOR LO
M --- MOTOR
MS --- MOTOR STARTER
ULS--- ULTRASONIC LVL SENSOR
VFD --- VARIABLE FREQ DRIVE
VHS---VIRTUAL HAND SWITCH
X ---- CONTROLLER INPUT
Y ---- CONTROLLER OUTPUT

PROGRAM ELEMENTS AND ALARM LISTING

SEE PLC / HMI PARAMETERS DOCUMENT



Title:	ANTEA ASHLAND GLENS FALLS SITE CENTRAL CONTROL; MCP UPGRADE PROCESS & INSTRUMENTATION
Author:	Terrence Bohn
Date: 14 Feb 2017	NOT to SCALE
Revision: IV	Aztech Technologies, Inc.

ANTEA Ashland GF 161223 **PLC/HMI PROGRAM ELEMENTS**

C1-C90: OPERATIONAL COILS/HMI DISPLAY/DATA RADIO MONITORING/MEM. LOC'S FOR REMOTE SLAVES					
C1	1 SEC COIL	C31	SP_A_Y1_PUMP_GO_COMAND	C61	SP_B_Y1_VFD_RUN_CMD
C2	2 SEC COIL	C32	SP_A_Y002	C62	SP_B_Y2_VFD_RST_CMD
C3	3 SEC COIL	C33	SP_A_Y003	C63	SP_B_Y003
C4	4 SEC COIL	C34	SP_A_Y004	C64	SP_B_Y004
C5		C35		C65	
C6		C36		C66	PROGRAM DEVELOP COIL
C7	CALL_SW_MODE_SELECT_HMI	C37		C67	
C8	SW_MODE_SELECT_COIL_HMI	C38		C68	
C9		C39		C69	
C10	100 MSEC COIL	C40	MODBUS INTERLOCK	C70	
C11	DISPLAY_SP_A_FLOW	C41	RECEIVING_SP_A_DIG	C71	RECEIVING_SP_B_DIG
C12	DISPLAY_SP_B_FLOW	C42	REC_SUCCESS_SP_A_DIG	C72	REC_SUCCESS_SP_B_DIG
C13	DISPLAY_2IN_FM_FLOW	C43	REC_FAIL_SP_A_DIG	C73	REC_FAIL_SP_B_DIG
C14	DISPLAY_POTW_FLOW	C44	RECEIVING_SP_A_ANA	C74	RECEIVING_SP_B_ANA
C15	DISPLAY_SP_A_FLOARO2	C45	REC_SUCCESS_SP_A_ANA	C75	REC_SUCCESS_SP_B_ANA
C16	DISPLAY_SP_B_FLOARO2	C46	REC_FAIL_SP_A_ANA	C76	REC_FAIL_SP_B_ANA
C17	DISPLAY_POTW_FLOARO2	C47	SENDING_DATA_SP_A	C77	SENDING_DATA_SP_B
C18		C48	SEND_SUCCESS_SP_A	C78	SEND_SUCCESS_SP_B
C19		C49	SEND_FAIL_ SP_A	C79	SEND_FAIL_ SP_B
C20	DATALOG_NOW_HMI	C50		C80	
C21	SP_A X001	C51	SP_B_ X1_RESET_SW	C81	
C22	SP_A X002	C52	SP_B_ X2_AC MONITOR	C82	
C23	SP_A X3_CONTACTOR_IN	C53	SP_B_ X3_VFD NOW RUNNING	C83	
C24	SP_A X004	C54	SP_B_ X4_ESTOP_NOT_PUSH	C84	
C25		C55		C85	
C26		C56		C86	
C27		C57		C87	
C28		C58		C88	
C29		C59		C89	
C30	SP_A_IN_PUMP_RANGE	C60	SP_B_ IN_PUMP_RANGE	C90	

CONTROL COILS C91- C180

C91-C151: OPERATIONAL COILS/VIRTUAL HOA LOCATIONS/ALARMS/					
C91	PH_AC_POWER_ON_MSG	C121	SP_B_LL_LVL_ALARM_BIT	C151	PH_PMP2_SW_IS_OFF
C92		C122	SP_B_HH_LVL_ALARM_BIT	C152	PH_PMP2_SW_IN_AUTO
C93		C113	SP_B_VFD_ALARM_BIT	C153	LS_PMP1_SW_IN_HAND
C94		C124	SP_B_AC_FAIL_ALARM_BIT	C154	LS_PMP1_SW_IS_OFF
C95	SP_A_E_STOP_PUSHED_ALM	C125	SP_B_DATA_RADIO_ALM_BIT	C155	LS_PMP1_SW_IN_AUTO
C96	SP_B_E_STOP_PUSHED_ALM	C126		C156	LS_PMP2_SW_IN_HAND
C97	LS_E_STOP_PUSHED_ALM	C127		C157	LS_PMP2_SW_IS_OFF
C98	PH_E_STOP_PUSHED_ALM	C128		C158	LS_PMP2_SW_IN_AUTO
C99	FATAL_ALARM_COIL	C129		C159	
C100		C130		C160	
C101	PH_SUMP_HH_LVL_ALARM_BIT	C131		C161	PUMP SWITCH IN HAND
C102	SP_B_LL_FLO_ALARM_BIT	C132		C162	
C103	SP_B_HH_FLO_ALARM_BIT	C133		C163	
C104	2IN_FORCE_LL_FLO_ALM_BIT	C134		C164	
C105	2IN_FORCE_HH_FLO_ALM_BIT	C135		C165	
C106	POTW_LL_FLOW_ALARM_BIT	C136		C166	
C107	POTW_HH_FLOW_ALARM_BIT	C137		C167	
C108	PH_AC_FAIL_ALARM_BIT	C138		C168	
C109	PH_DATA_RADIO_ALARM_BIT	C139		C169	
C110	DATALOG_NOW_HMI	C140		C170	
C111	SP_A_LL_LVL_ALARM_BIT	C141	SP_A_PMP_SW_IN_HAND	C171	
C112	SP_A_HH_LVL_ALARM_BIT	C142	SP_A_PMP_SW_IS_OFF	C172	
C113	SP_A_PMP_CTR_ALARM_BIT	C143	SP_A_PMP_SW_IN_AUTO	C173	
C114	SP_A_LL_FLOW_ALARM_BIT	C144	SP_B_PMP_SW_IN_HAND	C174	
C115	SP_A_HH_FLOW_ALARM_BIT	C145	SP_B_PMP_SW_IS_OFF	C175	
C116	SP_A_DATA_RADIO_ALM_BIT	C146	SP_B_PMP_SW_IN_AUTO	C176	
C117		C147	PH_PMP1_SW_IN_HAND	C177	
C118		C148	PH_PMP1_SW_IS_OFF	C178	
C119		C149	PH_PMP1_SW_IN_AUTO	C179	
C120		C150	PH_PMP2_SW_IN_HAND	C180	

DF: FLOATING DECIMAL

DF1-DF10: LOCAL ANALOG I/O; DF11-DF60: MEM LOC'S FOR REMOTE SLAVES ANALOG DATA; MATH RESULT STORAGE			
DF1	SUMP B FLOW_GF SIGNET (Raw)	DF31	SP_B DF1_LEVEL RAW
DF2	2IN FORCE FLOW_YOKOGAWA (Raw)	DF32	SP_B DF2_CPU_AI2
DF3	FLOW TO POTW_ROSEMOUNT (Raw)	DF33	SP_B DF3_CPU_A01
DF4		DF34	SP_B DF4_CPU_A02
DF5		DF35	
DF6		DF36	SP_B LEVEL SMOOTHED1
DF7		DF37	SP_B LEVEL LOG
DF8		DF38	
DF9		DF39	
DF10		DF40	
DF11	SUMP B FLOW SMOOTHED 1	DF41	SP_A_PMP_ON_LVL_MIN_VAL
DF12	SUMP B FLOW LOG	DF42	SP_A_PMP_ON_LVL_SETTING
DF13	2IN FORCE FLOW SMOOTHED 1	DF43	SP_A_PMP_ON_LVL_MAX_VAL
DF14	2IN FORCEMAIN FLOW LOG	DF44	
DF15	FLOW TO POTW SMOOTHED 1	DF45	SP_A_PMP_OFF_LVL_MIN_VAL
DF16	FLOW TO POTW LOG	DF46	SP_A_PMP_OFF_LVL_SETTING
DF17		DF47	SP_A_PMP_OFF_LVL_MAX_VAL
DF18		DF48	
DF19		DF49	
DF20		DF50	
DF21	SP_A DF1_LEVEL RAW	DF51	SP_B_PMP_ON_LVL_MIN_VAL
DF22	SP_A DF2_FLOW RAW	DF52	SP_B_PMP_ON_LVL_SETTING
DF23	SP_A DF3_CPU_A01	DF53	SP_B_PMP_ON_LVL_MAX_VAL
DF24	SP_A DF4_CPU_A02	DF54	
DF25		DF55	SP_B_PMP_OFF_LVL_MIN_VAL
DF26	SP_A LEVEL SMOOTHED1	DF56	SP_B_PMP_OFF_LVL_SETTING
DF27	SP_A LEVEL LOG	DF57	SP_B_PMP_OFF_LVL_MAX_VAL
DF28	SP_A FLOW SMOOTHED1	DF58	
DF29	SP_A FLOW LOG	DF59	
DF30		DF60	

DD: DOUBLE WORD INTEGER

DD1-DD60: INTEGER STORAGE; REMOTE SLAVES MATH RESULT STORAGE			
DD1		DD31	SP_B DF1_LEVEL RAW
DD2		DD32	SP_B DF2_CPU_AI2
DD3	SP_A_LEVEL_INTEGER	DD33	SP_B DF3_CPU_A01
DD4	SP_B_LEVEL_INTEGER	DD34	SP_B DF4_CPU_A02
DD5		DD35	
DD6	SP_A_FLOW_INTEGER	DD36	SP_B LEVEL SMOOTHED1
DD7	SP_B_FLOW_INTEGER	DD37	SP_B LEVEL LOG
DD8	FM_FLOW_INTEGER	DD38	
DD9	POTW_FLOW_INTEGER	DD39	
DD10		DD40	
DD11	SP_A_ANIMATE_VAL	DD41	
DD12	SP_B_ANIMATE_VAL	DD42	
DD13	POTW_ANIMATE_VAL	DD43	
DD14	2IN_FM_ANIMATE_VAL	DD44	
DD15		DD45	
DD16		DD46	
DD17		DD47	
DD18		DD48	
DD19		DD49	
DD20		DD50	
DD21	SP_A DF1_LEVEL RAW	DD51	
DD22	SP_A DF2_FLOW RAW	DD52	
DD23	SP_A DF3_CPU_A01	DD53	
DD24	SP_A DF4_CPU_A02	DD54	
DD25		DD55	
DD26	SP_A LEVEL SMOOTHED1	DD56	
DD27	SP_A LEVEL LOG	DD57	
DD28	SP_A FLOW SMOOTHED1	DD58	
DD29	SP_A FLOW LOG	DD59	
DD30		DD60	

PUMP HOUSE REAL I/O: X001-X008 & Y001-Y006

C0-11DRE-D (ENET, no native analog @ CPU)			
X1	RESET PUSHBUTTON	Y1	(CPU BI)
X2	ESTOP NOT PUSHED	Y2	(CPU BI)
X3	AC POWER FAILURE	Y3	(CPU BI)
X4	PH SUMP HH LVL FLOAT SWITCH	Y4	(CPU BI)
X5	(FUTURE?) SUMP B FLOW INCREMENT PULSE	Y5	(CPU BI)
X6	(FUTURE?) 2IN FM FLOW INCREMENT PULSE	Y6	(CPU BI) RED ALARM LED: (SEE SCREEN)
X7	(FUTURE?) POTW FLOW INCREMENT PULSE		
X8			
X101		Y101	
X102		Y102	
X103		Y103	
X104		Y104	
X105		Y105	
X106		Y106	
X107		Y107	
X108		Y108	

SUMP A REAL I/O: X001-X008 & Y001-Y006

C0-02DR-D (4) 24VDC IN, (4) RELAY OUT, (2) ANALOG IN, (2) ANALOG OUT			
X1	(CPU BI)	Y1	(CPU BI) WELL PUMP RUN COMMAND
X2	(CPU BI)	Y2	(CPU BI)
X3	(CPU BI) PUMP CONTACTOR PULLED IN	Y3	(CPU BI)
X4	(CPU BI)	Y4	(CPU BI)
X101		Y101	
X102		Y102	
X103		Y103	
X104		Y104	

SUMP B REAL I/O: X001-X008 & Y001-Y006

C0-02DR-D (4) 24VDC IN, (4) RELAY OUT, (2) ANALOG IN, (2) ANALOG OUT			
X1	(CPU BI) RESET SWITCH	Y1	(CPU BI) WELL PUMP RUN COMMAND
X2	(CPU BI) AC POWER MONITOR RELAY SIGNAL	Y2	(CPU BI)
X3	(CPU BI) VFD NOW RUNNING SIGNAL	Y3	(CPU BI)
X4	(CPU BI) ESTOP NOT PUSHED RELAY	Y4	(CPU BI)
X101		Y101	
X102		Y102	
X103		Y103	
X104		Y104	

TIMER LOCATIONS

T1-T60: SIGNAL DEBOUNCE/BUFFERS/PERSISTENCE PROVERS			
T1		T31	SP_B PUMP_START_DELAY
T2		T32	SP_B PUMP_STOP_DELAY
T3		T33	SP_B_VFD_ALARM_DELAY
T4		T34	SP_B_LL_LVL_ALARM_DELAY
T5		T35	SP_B_HH_LVL_ALARM_DELAY
T6		T36	SP_B_VFD_RESET_DELAY
T7		T37	SP_B_AC_ALARM_DELAY
T8		T38	
T9		T39	
T10		T40	
T11	PH_SMP_HH_LVL_ALM_DELAY	T41	SP_A_FLOW_DISP_DELAY
T12	PH_SMP_LL_FLO_ALM_DELAY	T42	SP_B_FLOW_DISP_DELAY
T13	PH_SMP_HH_FLO_ALM_DELAY	T43	FM_FLOW_DISP_DELAY
T14	2IN_FORCE_LL_FLO_ALM_DELAY	T44	POTW_FLOW_DISP_DELAY
T15	2IN_FORCE_HH_FLO_ALM_DELAY	T45	
T16	POTW_LL_FLO_ALM_DELAY	T46	
T17	POTW_HH_FLO_ALM_DELAY	T47	
T18	PH_AC_FAIL_ALARM_DELAY	T48	
T19		T49	
T20		T50	
T21	SP_A PUMP START DELAY	T51	
T22	SP_A PUMP STOP DELAY	T52	
T23	SP_A PMP_CTR_ALRM_DELAY	T53	
T24	SP_A_LL_LVL_ALARM_DELAY	T54	
T25	SP_A_HH_LVL_ALARM_DELAY	T55	
T26		T56	
T27		T57	
T28		T58	
T29		T59	
T30		T60	

COUNTER LOCATIONS

CT1-CT60: OPERATIONAL COUNTERS/TALLIES/HMI ANIMATORS/			
CT1	1 SEC COUNTER	CT31	SP_B_MINS_RUNNING
CT2	2 SEC COUNTER	CT32	SP_B_HRS_RUNNING
CT3	3 SEC COUNTER	CT33	SP_B_SECS_SINCE_RAN
CT4	4 SEC COUNTER	CT34	SP_B_MINS_SINCE_RAN
CT5		CT35	SP_B_HRS_SINCE_RAN
CT6		CT36	
CT7	TEST FLOW PULSE	CT37	
CT8		CT38	
CT9		CT39	
CT10	100 MSEC COUNTER	CT40	
CT11	SP_A_HMI_FLO_ANIMATOR	CT41	
CT12	SP_B_HMI_FLO_ANIMATOR	CT42	
CT13	POTW_HMI_FLO_ANIMATOR	CT43	
CT14	2IN_FM_FLO_ANIMATOR	CT44	
CT15		CT45	
CT16		CT46	
CT17		CT47	
CT18		CT48	
CT19		CT49	
CT20	SP_A_SECS_RUNNING	CT50	
CT21	SP_A_MINS_RUNNING	CT51	
CT22	SP_A_HRS_RUNNING	CT52	
CT23	SP_A_SECS_SINCE_RAN	CT53	
CT24	SP_A_MINS_SINCE_RAN	CT54	
CT25	SP_A_HRS_SINCE_RAN	CT55	
CT26		CT56	
CT27		CT57	
CT28		CT58	
CT29		CT59	
CT30	SP_B_SECS_RUNNING	CT60	

Appendix C
January – September 2017 Discharge Monitoring Report Summary Tables

Hercules LLC
a wholly owned subsidiary of
Ashland, LLC
Ashland LLC. - EH&S - DS4
5200 Blazer Parkway
Dublin, Ohio 43017

February 8, 2017

Mr. Larry Glasheen
Glens Falls Wastewater Treatment Plant
Water and Sewer Department
2 Shermantown Road
Glens Falls, New York 12801

RE: Discharge Monitoring Report for January 2017
Industrial Wastewater - Discharge Permit No. 002E

Dear Mr. Glasheen:

Attached is the January 2017 Discharge Monitoring Report for the Hercules/Ciba site. The monthly wastewater sample was collected on January 4, 2017. All parameters meet the limits of the wastewater discharge permit, effective April 23, 2007 and renewed April 2012.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

If you have any questions, please contact me at (614) 790-6146.

Sincerely,

James E. Vondracek, P.E.
Principal Remediation Engineer

Attachments

cc: Stephen K. Havlik, BASF Corporation, Toms River, NJ

ATTACHMENT 1

DISCHARGE DATA

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA 2/8/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
In Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min.	0.21	0.00	0.00	0.69	0.00	6.9	30,000
Monthly ave.	0.21	0.00	0.00	0.69	0.00	7.2	41,258
Monthly max.	0.21	0.00	0.00	0.69	0.00	7.4	52,000
Data points	1	1	1	1	1	31	31
Date:							
01/01/17						7.1	40,000
01/02/17						7.0	38,000
01/03/17						7.1	42,000
01/04/17	0.210	ND	ND	0.69	ND	7.2	30,000
01/05/17						7.3	52,000
01/06/17						7.2	48,000
01/07/17						7.2	37,000
01/08/17						7.1	44,000
01/09/17						7.3	38,000
01/10/17						7.2	31,000
01/11/17						7.3	36,000
01/12/17						7.3	31,000
01/13/17						7.3	38,000
01/14/17						7.3	50,000
01/15/17						7.3	41,000
01/16/17						7.2	41,000
01/17/17						7.2	41,000
01/18/17						7.2	33,000
01/19/17						7.3	39,000
01/20/17						6.9	42,000
01/21/17						7.2	42,000
01/22/17						7.2	42,000
01/23/17						7.2	41,000
01/24/17						7.4	41,000
01/25/17						7.3	42,000
01/26/17						7.2	45,000
01/27/17						7.3	45,000
01/28/17						7.2	46,000
01/29/17						7.2	45,000
01/30/17						7.1	50,000
01/31/17						7.4	48,000

Monthly Average for Chromium	
Concentration	0.21 mg/L
Ave. Flow	41,258 gpd
Ave. Load	0.07 #/day
PERMIT	3.10 #/day

Notes:

ND = Non-Detect. Value reported to be below the laboratory Reporting Limit.
The laboratory Reporting Limit for Lead is 0.0025 mg/L.
The laboratory Reporting Limit for Mercury is 0.00020 mg/L.
The laboratory Reporting Limit for Phenols is 0.050 mg/L.

Hercules LLC
A wholly owned subsidiary of
Ashland, LLC
Ashland LLC. - EH&S - DS4
5200 Blazer Parkway
Dublin, Ohio 43017

March 24, 2017

Mr. Larry Glasheen
Glens Falls Wastewater Treatment Plant
Water and Sewer Department
2 Shermantown Road
Glens Falls, New York 12801

RE: Discharge Monitoring Report for February 2017
Industrial Wastewater - Discharge Permit No. 002E

Dear Mr. Glasheen:

Attached is the February 2017 Discharge Monitoring Report for the Hercules/Ciba site. The monthly wastewater sample was collected on February 1, 2017. All parameters meet the limits of the wastewater discharge permit, effective April 23, 2007 and renewed April 2012.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

If you have any questions, please contact me at (614) 790-6146.

Sincerely,

James E. Vondracek, P.E.
Principal Remediation Engineer

Attachments

cc: Stephen K. Havlik, BASF Corporation, Toms River, NJ

ATTACHMENT 1

DISCHARGE DATA

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA 3/10/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.21	0.00	0.00	0.90	0.03	6.7	38,000
Monthly ave	0.21	0.00	0.00	0.90	0.03	7.2	44,857
Monthly max	0.21	0.00	0.00	0.90	0.03	7.3	56,000
Data points	1	1	1	1	1	28	28
Date:							
02/01/17	0.210	ND	ND	0.90	0.033	7.2	44,000
02/02/17						7.3	42,000
02/03/17						7.3	43,000
02/04/17						7.2	46,000
02/05/17						7.2	43,000
02/06/17						7.1	41,000
02/07/17						7.3	40,000
02/08/17						7.2	39,000
02/09/17						7.3	47,000
02/10/17						7.1	45,000
02/11/17						7.2	51,000
02/12/17						7.2	48,000
02/13/17						7.2	41,000
02/14/17						7.2	43,000
02/15/17						7.3	42,000
02/16/17						7.2	42,000
02/17/17						6.7	43,000
02/18/17						7.2	40,000
02/19/17						7.2	38,000
02/20/17						7.2	41,000
02/21/17						7.3	44,000
02/22/17						7.1	43,000
02/23/17						7.2	49,000
02/24/17						7.2	55,000
02/25/17						7.2	51,000
02/26/17						7.0	48,000
02/27/17						7.0	56,000
02/28/17						7.0	51,000

Monthly Average for Chromium		
Concentration	0.21	mg/L
Ave. Flow	44,857	gpd
Ave. Load	0.08	#/day
PERMIT	3.10	#/day

Notes:

ND = Non-Detect. Value reported to be below the laboratory Reporting Limit.

The laboratory Reporting Limit for Lead is 0.0025 mg/L.

The laboratory Reporting Limit for Mercury is 0.00020 mg/L.

Hercules LLC
A wholly owned subsidiary of
Ashland, LLC
Ashland LLC. - EH&S - DS4
5200 Blazer Parkway
Dublin, Ohio 43017

April 21, 2017

Mr. Larry Glasheen
Glens Falls Wastewater Treatment Plant
Water and Sewer Department
2 Shermantown Road
Glens Falls, New York 12801

RE: Discharge Monitoring Report for March 2017
Industrial Wastewater - Discharge Permit No. 002E

Dear Mr. Glasheen:

Attached is the March 2017 Discharge Monitoring Report for the Hercules/Ciba site. The monthly wastewater sample was collected on March 2, 2017. All parameters meet the limits of the wastewater discharge permit, effective April 23, 2007 and renewed April 2012.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

If you have any questions, please contact me at (614) 790-6146.

Sincerely,

James E. Vondracek, P.E.
Principal Remediation Engineer

Attachments

cc: Stephen K. Havlik, BASF Corporation, Toms River, NJ

ATTACHMENT 1

DISCHARGE DATA

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA

4/14/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.29	0.00	0.00	0.70	0.04	7.0	0
Monthly ave	0.29	0.00	0.00	0.70	0.04	7.1	44,355
Monthly max	0.29	0.00	0.00	0.70	0.04	7.2	74,000
Data points	1.00	1.00	1.00	1.00	1.00	31	31
Date:							
03/01/17						7.2	58,000
03/02/17	0.290	ND	ND	0.70	0.035	7.1	57,000
03/03/17						7.0	49,000
03/04/17						7.2	45,000
03/05/17						7.0	55,000
03/06/17						7.0	46,000
03/07/17						7.0	53,000
03/08/17						7.1	44,000
03/09/17						7.2	45,000
03/10/17						7.0	47,000
03/11/17						7.2	46,000
03/12/17						7.0	42,000
03/13/17						7.0	39,000
03/14/17						7.0	39,000
03/15/17						7.1	41,000
03/16/17						7.0	42,000
03/17/17						7.0	40,000
03/18/17						7.0	41,000
03/19/17						7.0	39,000
03/20/17						7.0	34,000
03/21/17						7.0	35,000
03/22/17						7.2	40,000
03/23/17						7.2	40,000
03/24/17						7.1	39,000
03/25/17						7.2	40,000
03/26/17						7.0	42,000
03/27/17						7.1	0
03/28/17						7.2	46,000
03/29/17						7.2	74,000
03/30/17						7.2	61,000
03/31/17						7.2	56,000

Monthly Average for Chromium		
Concentration	0.29	mg/L
Ave. Flow	44,355	gpd
Ave. Load	0.11	#/day
PERMIT	3.10	#/day

Notes:

ND = Non-Detect. Value reported to be below the laboratory Reporting Limit.

The laboratory Reporting Limit for Lead is 0.0025 mg/L.

The laboratory Reporting Limit for Mercury is 0.00020 mg/L.

Hercules LLC
A wholly owned subsidiary of
Ashland, LLC
Ashland LLC. - EH&S - DS4
5200 Blazer Parkway
Dublin, Ohio 43017

July 18, 2017

Mr. Larry Glasheen
Glens Falls Wastewater Treatment Plant
Water and Sewer Department
2 Shermantown Road
Glens Falls, New York 12801

RE: Discharge Monitoring Report for 2nd Quarter 2017
Industrial Wastewater - Discharge Permit No. 002F

Dear Mr. Glasheen:

Attached is the 2nd Quarter 2017 Discharge Monitoring Report for the Hercules/Ciba site. Monthly wastewater samples were collected on the following dates:

- April 10, 2017
- May 2, 2017
- June 6, 2017

All parameters meet the limits of the wastewater discharge permit effective April 23, 2007 which was subsequently renewed in April 2012 and April 2017.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

If you have any questions, please contact me at (614) 790-6146.

Sincerely,

James E. Vondracek, P.E.
Principal Remediation Engineer

Attachments
cc: Stephen K. Havlik, BASF Corporation, Toms River, NJ

ATTACHMENT 1

DISCHARGE DATA

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA 5/11/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.32	0.00	0.00	0.71	0.00	6.9	48,000
Monthly ave	0.32	0.00	0.00	0.71	0.00	7.1	62,400
Monthly max	0.32	0.00	0.00	0.71	0.00	7.3	103,000
Data points	1	1	1	1	1	30	30
Date:							
04/01/17						7.2	52,000
04/02/17						7.3	66,000
04/03/17						7.0	65,000
04/04/17						7.0	63,000
04/05/17						7.0	66,000
04/06/17						7.1	60,000
04/07/17						7.1	103,000
04/08/17						7.1	89,000
04/09/17						7.3	87,000
04/10/17	0.320	ND	ND	0.71	ND	7.2	73,000
04/11/17						7.1	67,000
04/12/17						7.1	66,000
04/13/17						7.1	64,000
04/14/17						7.1	48,000
04/15/17						7.0	68,000
04/16/17						7.1	59,000
04/17/17						7.0	55,000
04/18/17						7.1	59,000
04/19/17						7.0	51,000
04/20/17						7.0	51,000
04/21/17						6.9	61,000
04/22/17						7.0	54,000
04/23/17						7.1	57,000
04/24/17						7.0	57,000
04/25/17						7.0	58,000
04/26/17						7.0	55,000
04/27/17						6.9	55,000
04/28/17						7.0	59,000
04/29/17						6.9	53,000
04/30/17						7.0	51,000

Monthly Average for Chromium		
Concentration	0.32	mg/L
Ave. Flow	62,400	gpd
Ave. Load	0.17	#/day
PERMIT	3.10	#/day

Notes:

ND = Non-Detect. Value reported to be below the laboratory Reporting Limit.
NS: No Standard. No instantaneous maximum for Total Chromium.
The laboratory Reporting Limit for Lead is 0.0025 mg/L.
The laboratory Reporting Limit for Mercury is 0.00020 mg/L.
The laboratory Reporting Limit for Phenols is 0.050 mg/L.

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA 7/13/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.27	0.00	0.00	0.52	0.00	6.7	0
Monthly ave	0.27	0.00	0.00	0.52	0.00	7.0	56,355
Monthly max	0.27	0.00	0.00	0.52	0.00	9.0	86,000
Data points	1	1	1	1	1	31	31
Date:							
05/01/17						7.0	54,000
05/02/17	0.270	ND	0.001	0.52	ND	7.0	55,000
05/03/17						7.1	55,000
05/04/17						7.0	54,000
05/05/17						7.0	59,000
05/06/17						7.0	52,000
05/07/17						9.0	59,000
05/08/17						7.0	65,000
05/09/17						7.1	55,000
05/10/17						7.0	68,000
05/11/17						7.0	55,000
05/12/17						7.0	60,000
05/13/17						7.0	48,000
05/14/17						7.0	66,000
05/15/17						7.0	50,000
05/16/17						7.1	65,000
05/17/17						6.9	50,000
05/18/17						6.9	60,000
05/19/17						6.9	50,000
05/20/17						6.8	0
05/21/17						6.9	86,000
05/22/17						6.8	59,000
05/23/17						7.0	61,000
05/24/17						6.8	59,000
05/25/17						6.9	50,000
05/26/17						6.9	59,000
05/27/17						6.9	59,000
05/28/17						7.0	59,000
05/29/17						7.1	58,000
05/30/17						7.0	61,000
05/31/17						6.7	56,000

Monthly Average for Chromium		
Concentration	0.27	mg/L
Ave. Flow	56,355	gpd
Ave. Load	0.13	#/day
PERMIT	3.10	#/day

Notes:

ND = Non-Detect. Value reported to be below the laboratory Reporting Limit.
NS: No Standard. No instantaneous maximum for Total Chromium.
The laboratory Reporting Limit for Lead is 0.0025 mg/L.
The laboratory Reporting Limit for Phenols is 0.05 mg/L.

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA 7/13/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.25	0.00	0.00	0.68	0.00	6.8	0
Monthly ave	0.25	0.00	0.00	0.68	0.00	7.0	54,100
Monthly max	0.25	0.00	0.00	0.68	0.00	7.2	93,000
Data points	1	1	1	1	1	30	30
Date:							
06/01/17						6.8	63,000
06/02/17						7.0	60,000
06/03/17						6.9	60,000
06/04/17						7.0	58,000
06/05/17						7.0	59,000
06/06/17	0.250	ND	ND	0.680	ND	7.2	64,000
06/07/17						7.0	55,000
06/08/17						7.0	70,000
06/09/17						6.9	59,000
06/10/17						7.0	66,000
06/11/17						7.0	56,000
06/12/17						7.0	64,000
06/13/17						7.0	51,000
06/14/17						7.0	65,000
06/15/17						7.0	52,000
06/16/17						6.9	59,000
06/17/17						6.9	57,000
06/18/17						6.9	52,000
06/19/17						6.8	61,000
06/20/17						6.9	34,000
06/21/17						6.9	0
06/22/17						6.9	0
06/23/17						6.9	0
06/24/17						7.0	93,000
06/25/17						6.9	68,000
06/26/17						7.0	65,000
06/27/17						6.9	52,000
06/28/17						7.0	64,000
06/29/17						6.9	52,000
06/30/17						7.0	64,000

Monthly Average for Chromium		
Concentration	0.25	mg/L
Ave. Flow	54,100	gpd
Ave. Load	0.11	#/day
PERMIT	3.10	#/day

Notes:

ND = Non-Detect. Value reported to be below the laboratory Reporting Limit.
NS: No Standard. No instantaneous maximum for Total Chromium.
The laboratory Reporting Limit for Lead is 0.0025 mg/L.
The laboratory Reporting Limit for Mercury is 0.00020 mg/L.
The laboratory Reporting Limit for Phenols is 0.050 mg/L.

HERCULES

Hercules LLC
A wholly owned subsidiary of
Ashland, LLC
Ashland LLC. - EH&S - DS4
5200 Blazer Parkway
Dublin, Ohio 43017

October 12, 2017

Mr. Larry Glasheen
Glens Falls Wastewater Treatment Plant
Water and Sewer Department
2 Shermantown Road
Glens Falls, New York 12801

RE: Discharge Monitoring Report for 3rd Quarter 2017
<u>Industrial Wastewater - Discharge Permit No. 002F</u>

Dear Mr. Glasheen:

Attached is the 3rd Quarter 2017 Discharge Monitoring Report for the Hercules/Ciba site. Monthly wastewater samples were collected on the following dates:

- July 3, 2017
- August 1, 2017
- September 5, 2017

All parameters meet the limits of the wastewater discharge permit effective April 23, 2007 which was subsequently renewed in April 2012 and April 2017.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

If you have any questions, please contact me at (614) 790-6146.

Sincerely,

James E. Vondracek, P.E.
Principal Remediation Engineer

Attachments
cc: Stephen K. Havlik, BASF Corporation, Toms River, NJ

ATTACHMENT 1

DISCHARGE DATA

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA

10/12/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.24	0.00	0.00	#N/A	#N/A	6.7	52,000
Monthly ave	0.24	0.00	0.00	0.91	0.00	6.9	65,968
Monthly max	0.24	0.00	0.00	0.91	0.00	7.1	117,000
Data points	1	1	1	1	1	31	31
Date:							
07/01/17						6.8	62,000
07/02/17						7.1	117,000
07/03/17	0.240	ND	ND	0.91	ND	7.0	102,000
07/04/17						7.0	92,000
07/05/17						6.9	76,000
07/06/17						6.9	71,000
07/07/17						7.0	72,000
07/08/17						6.9	69,000
07/09/17						6.9	66,000
07/10/17						7.0	66,000
07/11/17						6.9	65,000
07/12/17						6.8	62,000
07/13/17						6.8	63,000
07/14/17						6.9	64,000
07/15/17						6.9	61,000
07/16/17						6.9	65,000
07/17/17						6.9	54,000
07/18/17						6.9	63,000
07/19/17						6.9	59,000
07/20/17						7.0	63,000
07/21/17						6.9	54,000
07/22/17						6.9	62,000
07/23/17						6.8	60,000
07/24/17						6.9	54,000
07/25/17						7.0	62,000
07/26/17						7.0	56,000
07/27/17						6.8	57,000
07/28/17						6.7	63,000
07/29/17						6.8	53,000
07/30/17						6.8	52,000
07/31/17						6.9	60,000

Monthly Average for Chromium	
Concentration	0.24 mg/L
Ave. Flow	65,968 gpd
Ave. Load	0.13 #/day
PERMIT	3.10 #/day

Notes:

ND = Non-Detect. Value reported to be below the Laboratory Reporting Limit.
NS: No Standard. No instantaneous maximum for Total Chromium.
The laboratory Reporting Limit for Lead is 0.0025 mg/L.
The laboratory Reporting Limit for Mercury is 0.00020 mg/L.
The laboratory Reporting Limit for Phenols is 0.050 mg/L.

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA 10/12/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.11	0.00	0.00	0.80	0.00	6.6	0
Monthly ave	0.11	0.00	0.00	0.80	0.00	6.8	46,129
Monthly max	0.11	0.00	0.00	0.80	0.00	7.0	91,000
Data points	1	1	1	1	1	31	31
Date:							
08/01/17	0.110	ND	ND	0.80	ND	6.9	55,000
08/02/17						6.9	51,000
08/03/17						6.8	53,000
08/04/17						6.8	55,000
08/05/17						6.6	58,000
08/06/17						6.9	50,000
08/07/17						6.9	50,000
08/08/17						7.0	52,000
08/09/17						6.9	56,000
08/10/17						6.8	36,000
08/11/17						6.8	0
08/12/17						6.8	0
08/13/17						6.8	0
08/14/17						6.8	28,000
08/15/17						6.8	91,000
08/16/17						6.8	67,000
08/17/17						6.8	46,000
08/18/17						6.7	47,000
08/19/17						6.7	48,000
08/20/17						6.8	48,000
08/21/17						6.8	49,000
08/22/17						6.9	55,000
08/23/17						6.7	47,000
08/24/17						6.8	49,000
08/25/17						6.8	44,000
08/26/17						6.9	52,000
08/27/17						7.0	52,000
08/28/17						6.9	46,000
08/29/17						6.9	46,000
08/30/17						6.8	50,000
08/31/17						6.8	49,000

Monthly Average for Chromium	
Concentration	0.11 mg/L
Ave. Flow	46,129 gpd
Ave. Load	0.04 #/day
PERMIT	3.10 #/day

Notes:

ND = Non-Detect. Value reported to be below the Laboratory Reporting Limit.
NS: No Standard. No instantaneous maximum for Total Chromium.
The laboratory Reporting Limit for Lead is 0.0025 mg/L.
The laboratory Reporting Limit for Mercury is 0.00020 mg/L.
The laboratory Reporting Limit for Phenols is 0.050 mg/L.

GLENS FALLS PRETREATED DISCHARGE TO POTW QUALITY DATA 10/12/2017

LOCATION:	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW-CG Sampler	POTW Meter	POTW Meter
ANALYZED BY:	Test America	Test America	Test America	Test America	Test America		
LAB METHOD:	EPA 200.8	EPA 200.8	EPA 245.1	MCAWW 335.4	MCAWW 420.1		
PRESERVED:	Acid Chilled	Acid Chilled	Acid Chilled	NaOH Chilled	Chilled		
	Total Chromium	**Total Lead**	**Total Mercury**	**Total Cyanide**	**Total Phenols**	**Compliance Point**	**Compliance Point**
Units:	mg/l	mg/l	mg/l	mg/l	mg/l	pH	gpd
POTW Permit or min						5.0	
Daily max.	NS	0.8	0.025	3.0	5.0	9.0	350,000
Monthly ave.			0.005				175,000
Compliance	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Monthly min	0.20	0.00	0.00	0.96	0.00	6.6	40,000
Monthly ave	0.20	0.00	0.00	0.96	0.00	6.9	48,467
Monthly max	0.20	0.00	0.00	0.96	0.00	7.1	57,000
Data points	1	1	1	1	1	30	30
Date:							
09/01/17						6.8	53,000
09/02/17						6.8	43,000
09/03/17						6.6	46,000
09/04/17						7.0	46,000
09/05/17	0.200	ND	ND	0.96	ND	7.0	48,000
09/06/17						6.8	53,000
09/07/17						6.8	50,000
09/08/17						7.0	46,000
09/09/17						6.9	48,000
09/10/17						6.9	52,000
09/11/17						7.1	47,000
09/12/17						7.1	45,000
09/13/17						6.8	50,000
09/14/17						6.9	56,000
09/15/17						6.8	46,000
09/16/17						6.7	45,000
09/17/17						6.8	54,000
09/18/17						6.9	51,000
09/19/17						7.0	46,000
09/20/17						6.8	45,000
09/21/17						7.0	49,000
09/22/17						7.0	57,000
09/23/17						6.8	43,000
09/24/17						6.8	40,000
09/25/17						6.7	57,000
09/26/17						6.8	49,000
09/27/17						6.9	50,000
09/28/17						7.0	47,000
09/29/17						7.0	44,000
09/30/17						6.8	48,000

Monthly Average for Chromium	
Concentration	0.20 mg/L
Ave. Flow	48,467 gpd
Ave. Load	0.08 #/day
PERMIT	3.10 #/day

Notes:

ND = Non-Detect. Value reported to be below the Laboratory Reporting Limit.

NS: No Standard. No instantaneous maximum for Total Chromium.

The laboratory Reporting Limit for Lead is 0.0025 mg/L.

The laboratory Reporting Limit for Mercury is 0.00020 mg/L.

The laboratory Reporting Limit for Phenols is 0.050 mg/L.

Appendix D
January – September 2017 Sump A and B Totalizer Measurements

Appendix D – Sump A and B Totalizer Measurements – January to September 2017

Date	Days	Sump A				Sump B				Ave. Total Sump A + Sump B Flow Since Previous Reading (Gal/Day)
		Totalizer Reading (Gal)	Since Previous Reading			Totalizer Reading (Gal)	Since Previous Reading			
			Gallons Pumped	Ave. Gal/Day	% of Sump A + Sump B Flow		Gallons Pumped	Ave. Gal/Day	% of Sump A + Sump B Flow	
1/3/2017	--	1,358,566	--	--	--	45,629,961	--	--	--	--
1/11/2017	8	1,386,993	28,427	3,553	9	45,914,995	285,034	35,629	91	39,183
1/19/2017	8	1,422,138	35,145	4,393	11	46,194,352	279,357	34,920	89	39,313
1/26/2017	7	1,455,141	33,003	4,715	11	46,464,755	270,403	38,629	89	43,344
2/1/2017	6	1,489,358	34,218	5,703	12	46,707,699	242,944	40,491	88	46,194
2/6/2017	5	1,518,502	29,144	5,829	13	46,895,336	187,637	37,527	87	43,356
2/15/2017	9	1,577,066	58,564	6,507	19	47,138,280	242,944	26,994	81	33,501
2/22/2017	7	1,619,183	42,117	6,017	11	47,491,838	353,558	50,508	89	56,525
3/9/2017	15	1,740,941	121,758	8,117	31	47,759,041	267,203	17,814	69	25,931
3/13/2017	4	1,771,480	30,539	7,635	18	47,900,261	141,220	35,305	82	42,940
3/23/2017	10	1,840,279	68,799	6,880	17	48,227,651	327,390	32,739	83	39,619
3/29/2017	6	1,882,898	42,619	7,103	17	48,429,912	202,261	33,710	83	40,813
4/5/2017	7	1,957,573	74,676	10,668	19	48,738,481	308,569	44,081	81	54,749
4/10/2017	5	2,052,473	94,900	18,980	23	49,053,723	315,242	63,048	77	82,028
4/17/2017	7	2,156,450	103,978	14,854	26	49,350,878	297,155	42,451	74	57,305
4/24/2017	7	2,242,147	85,697	12,242	22	49,648,899	298,021	42,574	78	54,817
5/2/2017	8	2,324,103	81,956	10,244	19	49,989,570	340,671	42,584	81	52,828
5/8/2017	6	2,385,868	61,765	10,294	18	50,264,937	275,367	45,895	82	56,189
5/15/2017	7	2,462,704	76,836	10,977	20	50,571,131	306,194	43,742	80	54,719
5/23/2017	8	2,539,931	77,227	9,653	19	50,899,821	328,690	41,086	81	50,740
5/30/2017	7	2,605,945	66,014	9,431	17	51,222,364	322,543	46,078	83	55,508
6/6/2017	7	2,675,777	69,832	9,976	17	51,557,333	334,969	47,853	83	57,829
6/12/2017	6	2,738,016	62,239	10,373	18	51,837,153	279,820	46,637	82	57,010
6/23/2017	11	2,807,660	69,644	6,331	18	52,161,336	324,183	29,471	82	35,802

Appendix D – Sump A and B Totalizer Measurements – January to September 2017

Date	Days	Sump A				Sump B				Ave. Total Sump A + Sump B Flow Since Previous Reading (Gal/Day)
			Since Previous Reading				Since Previous Reading			
		Totalizer Reading (Gal)	Gallons Pumped	Ave. Gal/Day	% of Sump A + Sump B Flow	Totalizer Reading (Gal)	Gallons Pumped	Ave. Gal/Day	% of Sump A + Sump B Flow	
6/26/2017	3	2,857,078	49,418	16,473	20	52,353,537	192,201	64,067	80	80,540
7/3/2017	7	2,939,902	82,824	11,832	18	52,721,184	367,647	52,521	82	64,353
7/10/2017	7	3,061,909	122,007	17,430	23	53,120,683	399,499	57,071	77	74,501
7/18/2017	8	3,163,056	101,147	12,643	21	53,501,996	381,313	47,664	79	60,307
7/26/2017	8	3,248,583	85,528	10,691	19	53,861,275	359,279	44,910	81	55,601
8/1/2017	6	3,305,829	57,246	9,541	17	54,131,891	270,616	45,103	83	54,644
8/8/2017	7	3,364,907	59,078	8,440	16	54,445,807	313,916	44,845	84	53,285
8/15/2017	7	3,394,602	29,695	4,242	15	54,612,780	166,973	23,853	85	28,095
8/22/2017	7	3,456,392	61,790	8,827	17	54,906,466	293,686	41,955	83	50,782
8/28/2017	6	3,493,718	37,326	6,221	13	55,160,780	254,314	42,386	87	48,607
9/5/2017	8	3,539,411	45,693	5,712	12	55,495,243	334,463	41,808	88	47,520
9/15/2017	10	3,594,056	54,645	5,465	12	55,912,740	417,497	41,750	88	47,214
			Maximum	18,980	31			64,067	91	
			Minimum	3,553	9			17,814	69	

Appendix E
Contingency Action Triggers and Steps (EHS Support, 2016)

Table E-1
Contingency Action Trigger and Steps
Former Ciby-Geigy Site
Glens Falls, New York

No.	Activity or Trigger	Contingency Steps
1	**Overburden Groundwater in Western Area** - Groundwater COC Concentration in a Well Directly Upgradient of the French Drain (MW-26 or MW-28) Increases to 90-percent of the Relevant Discharge Threshold Protective of Surface Water Quality[1]	1) Repeat COC sampling on the subject well and adjacent wells (MW-26, MW-28, and inland well MW-OB7).
		2) Concurrently, measure water levels in the area (e.g., MW-26 and MW-28; inland wells MW-OB7 and MW-9; and French Drain locations MH-1, MH-2 and Sump A). Assess water levels within the French Drain System west of Sump A to confirm the extent of hydraulic influence.
		3) Revisit surface water discharge threshold evaluations to assess potential risk to the river.
		4) If the COC concentration at MW-26 or MW-28 presents a potential risk to the river, meet with the NYSDEC to establish a plan for improving overburden groundwater capture in the area contributing to the higher-than-anticipated COC concentration.
2	**Overburden Groundwater in Eastern Area** - Groundwater COC Concentration in the Well Near the River (MW-31) Increases to 90-percent of the Relevant Discharge Threshold Protective of Surface Water Quality[1]	1) Repeat COC sampling at MW-31, and sample the upgradient well MW-OB16 and the adjacent surface water location SW-1 concurrently.
		2) If the COC concentration at MW-31 remains at 90-percent of the surface water threshold or above, reinitiate pumping at Sump C.
		3) Measure water levels at MW-31 and in the vicinity (e.g., inland wells MW-OB16 and MW-OB27, and French Drain locations MH-5, MH-6 and Sump C). Assess water levels within the French Drain System in the Sump C collection area to confirm the extent of hydraulic capture.
		4) Revisit surface water discharge threshold evaluations to assess potential risk to the river.
		5) Repeat COC sampling at MW-31 and sample the upgradient well MW-OB16 and the adjacent surface water location SW-1 concurrently. If the COC concentration presents a potential risk to the river, meet with the NYSDEC to establish a plan for improving overburden groundwater capture in the area contributing to the higher-than-anticipated COC concentration.
3	**Overburden Groundwater in Central Area** - Groundwater COC Concentration in a Well Along the Riverbank (MW-OB30, MW-OB31, MW-OB32, MW-OB33, or MW-OB34) Increases to 90-percent of the Relevant Discharge Threshold Protective of Surface Water Quality[1]	1) Repeat COC sampling at the subject well, 2 adjacent wells along the river, and at nearby inland wells (e.g., MW-OB14, MW-OB25, and/or MW-OB26), and the surface water sampling locations SW-2 and SW-3. Concurrently measure water levels at the affected well; at the sampled adjacent and inland wells; and within the Central Area of the French Drain (i.e., Sump A, MW-3, MH-4, and Sump B).
		2) Utilize the discrete water level measurements, as well as available water level data from transducers installed as part of the ROP implementation, to assess performance of the French Drain System in the area of the affected well.
		3) Revisit surface water discharge threshold evaluations to assess potential risk to the river.
		4) If the COC concentration at the subject well presents a potential risk to the river, meet with the NYSDEC to establish a plan for improving overburden groundwater capture in the area contributing to the higher-than-anticipated COC concentration.
4	**A-Zone and B-Zone Bedrock Groundwater -** Groundwater COC Concentration at an A-Zone or B-Zone Bedrock Monitoring Well Near the River Increases to 90-percent of the Relevant Discharge Threshold Protective of Surface Water Quality[2]	1) Repeat COC sampling at the subject well to confirm findings.
		2) Revisit surface water discharge threshold evaluations to assess potential risk to the river.
		3) If the COC concentration at the subject well presents a potential risk to the river, meet with the NYSDEC to present findings and discuss response actions, such as reinitiating groundwater extraction at the subject location.
5	**Hudson River Surface Water Adjacent to the Site** - COCs are Detected Adjacent to the Main Plant Site at Concentrations Near NYSDEC Surface Water Criteria	1) Repeat sampling at the affected surface water location to confirm findings.
		2) Revisit surface water discharge threshold evaluations to assess potential risk to the river.
		3) Meet with the NYSDEC to present findings and discuss response actions, such as reinitiating groundwater extraction at adjacent areas on-site.
5	**POTW Permit Requirements -** GWES Flow Rate and/or Discharge Concentration Increases to Level Near Permitted Threshold	1) Repeat discharge sampling for COC of interest and review daily system flow rates.
		2) If the issue is related to an elevated COC concentration in the combined POTW discharge, assess contribution sources of the COC to the system based on site monitoring data, and temporarily adjust system operations accordingly to decrease the concentration. Examples include increasing pumping rate at lower-concentration locations and/or reinitiating pumping in an area of lower concentration (e.g., Sump C) in order to reduce the combined discharge concentration.
		3) If the issue is related to a higher-than-anticipated GWES flow rate, which causes the system to approach either a permit mass limit (i.e., chromium mass per day) or the daily or monthly permitted flow rates, temporarily reduce pumping rates at Sump A and/or Sump B to accommodate the greater-than-design flow rate.
		4) Assess long-term options to minimize the likelihood of another similar occurrence, and meet with the NYSDEC and City of Glens Falls POTW to discuss recommendations and implementation.

Notes:
1. As provided in Section 4 of this report, the most conservative calculated surface water protection criteria (i.e., CGW, discharge levels) for the overburden groundwater zone include: 2,838 µg/L for hexavalent chromium; 2,954 µg/L for vanadium; and 1,602 µg/L for free cyanide.
2. As provided in Section 4 of this report, the most conservative calculated surface water protection criteria (i.e., CGW, discharge levels) for the bedrock groundwater zones include: 80,828 µg/L for hexavalent chromium; 157,542 µg/L for vanadium; and 69,586 µg/L for free cyanide.

Appendix F
2015-2017 Groundwater Monitoring Results (EHS Support, 2017b)

Table F-1
Groundwater - Chromium, Cyanide and Vanadium Analytical Results
Remedy Optimization Report
Main Plant Site - Glens Falls, NY

Location ID	Sample Name	Sample Date	Dissolved Chromium, Hexavalent µg/l	Dissolved Total Chromium µg/l	Cyanide, Free µg/l	Cyanide, Total µg/l	Dissolved Vanadium µg/l	Water Elevation NGVD29
NYSDEC Class GA Groundwater Quality Standards (µg/l)			50	50	-	200	-	-
Overburden								
AP-6	AP-6_20170118	1/18/2017	--	--	--	--	2.9 J	213.64
AP-6	AP-6_20170425	4/25/2017	10 U	8.5 UJ	2.6 U	170	15 J	215.08
AP-6	AP-6_20170725	7/25/2017	10 U	30 J	--	--	15 J	213.68
IP-4	IP-4_20150723	7/23/2015	10 U	8.1	2.2 J	**1380**	76	245.13
IP-4	IP-4-20151209	12/9/2015	10 UJ	3.3 U	8.6	**843**	--	244.80
IP-4	IP-4_20160727	7/27/2016	10 U	3.9	2.8 J	**710**	--	245.10
IP-4	IP-4_20161129	11/29/2016	10 U	2	2 U	**760**	18	244.82
IP-4	IP-4_20170301	3/1/2017	10 U	3.9	3	**640**	21	245.03
IP-4	IP-4_20170621	6/21/2017	19 U	7.4	4.3	**1200**	48	244.90
MW-26	MW-26_20150727	7/27/2015	10 U	7.8	2 UJ	74	59	231.40
MW-26	MW-26-20151208	12/8/2015	10 U	7.1	2 U	68	--	231.00
MW-26	MW-26_20160727	7/27/2016	10 U	3.2	2 UJ	77	--	231.37
MW-26-DUP	DUP1_20160727	7/27/2016	10 UJ	3.4	2 UJ	71	--	231.37
MW-26	MW-26_20161129	11/29/2016	10 U	3.1	2 U	81	54	230.69
MW-26	MW-26_20170228	2/28/2017	5.1 J	7.3	2 U	94	240	233.10
MW-26	MW-26_20170620	6/20/2017	10 U	8.4	2 U	63	150	233.25
MW-28	MW-28_20160727	7/27/2016	10 U	24	2 UJ	9.1 J	--	237.65
MW-28	MW-28_20170228	2/28/2017	10 U	17	2 U	**350**	100	229.93
MW-31	MW-31_20150805	8/5/2015	10 U	11	2 U	74	4	208.23
MW-31	MW-31-20151209	12/9/2015	10 UJ	5.3	2 U	80	--	210.49
MW-31	MW-31_20160727	7/27/2016	10 U	11	2 U	130	--	211.43
MW-31	MW-31_20161201	12/1/2016	10 U	8.8	2 U	160	3.5 J	208.36
MW-31	MW-31_20170301	3/1/2017	10 U	9	2 U	190	3.4 J	202.88
MW-31	MW-31_20170622	6/22/2017	10 U	10	2 U	95	4.1	209.64
MW-OB7	MW-OB7_20150723	7/23/2015	**5260**	**4400**	2 UJ	71	1100	237.72
MW-OB7	MW-OB7-20151209	12/9/2015	**3150** J	**2750** J	2 U	51	--	239.09
MW-OB7	MW-OB7_20160728	7/28/2016	10 U	44	2 UJ	40	--	237.28
MW-OB7	MW-OB7_20161130	11/30/2016	11 U	**580**	2.8	180	1400	235.56
MW-OB7	MW-OB7_20170301	3/1/2017	**98**	**150**	2 U	22	310	241.71
MW-OB7	MW-OB7_20170620	6/20/2017	10 U	1.7	2 U	4 J	5.9	241.09
MW-OB14	MW-OB14_20150805	8/5/2015	**7540**	**6300**	2 U	**860**	1900	230.18
MW-OB14	MW-OB14A_A(1.0)-20150805 Diss	8/5/2015	**6870**	**6300**	--	--	1900	230.18
MW-OB14	MW-OB14B_B(0.1)-20150805 Diss	8/5/2015	**7580**	**6700**	8.3	--	2400	230.18
MW-OB14	MW-OB14_20160727	7/27/2016	**2300**	**2900**	2 UJ	**430**	--	230.40
MW-OB14	MW-OB14_20161129	11/29/2016	**5300**	**8800**	2 U	**650**	3700	230.26
MW-OB14	MW-OB14_20170228	2/28/2017	**950**	**1000**	2 U	**310**	240	231.65
MW-OB14	MW-OB14_20170621	6/21/2017	**1300**	**1300**	2 U	**230**	290	230.95
MW-OB25	MW-OB25-20151209	12/9/2015	**729** J	**608** J	2 U	58	--	230.85
MW-OB25	MW-OB25_20160728	7/28/2016	**570** J	**570**	3.2	120	--	229.67
MW-OB25	MW-OB25_20161201	12/1/2016	**700**	**720**	2.6	110	4.3	230.46
MW-OB25	MW-OB25_20170228	2/28/2017	**330**	**350**	2 U	18 U	4.1	232.20
MW-OB25	MW-OB25_20170621	6/21/2017	**330**	**330**	2.6	61	15	230.57
MW-OB26	MW-OB26_20160728	7/28/2016	**280**	**270**	3.7	**250**	--	226.77
MW-OB26	MW-OB26_20161201	12/1/2016	10 U	22	4	**300**	25	224.84
MW-OB26	MW-OB26_20170228	2/28/2017	16	30	2 U	**390**	16	228.30
MW-OB26	MW-OB26_20170622	6/22/2017	12	9.7	5.6	180	5.2	228.47

Table F-1
Groundwater - Chromium, Cyanide and Vanadium Analytical Results
Remedy Optimization Report
Main Plant Site - Glens Falls, NY

Location ID	Sample Name	Sample Date	Dissolved Chromium, Hexavalent µg/l	Dissolved Total Chromium µg/l	Cyanide, Free µg/l	Cyanide, Total µg/l	Dissolved Vanadium µg/l	Water Elevation NGVD29
NYSDEC Class GA Groundwater Quality Standards (µg/l)			50	50	-	200	-	-
MW-OB30	MW-OB30-20151209	12/9/2015	--	--	22	**897**	--	211.65
MW-OB30	MW-OB30-20151209A(1.0)	12/9/2015	10 UJ	--	--	--	1500	211.65
MW-OB30	MW-OB30-20151209B(0.1)	12/9/2015	10 UJ	--	--	--	--	211.65
MW-OB30	MW-OB30-20151209B(0.1)-2	12/10/2015	--	22	--	--	1600	211.65
MW-OB30	MW-OB30-20151209F	12/10/2015	10 UJ	21	--	--	1600	211.65
MW-OB30	MW-OB30_20160727	7/27/2016	48	48	25 J	**650**	--	211.09
MW-OB30	MW-OB30_20161201	12/1/2016	**100**	**170**	2 U	**400**	3500	213.71
MW-OB30	MW-OB30_20161228	12/28/2016	--	--	--	--	7000	-
MW-OB30	MW-OB30_20170118	1/18/2017	--	--	--	--	2500	215.73
MW-OB30	DUP_20170118	1/18/2017	--	--	--	--	2400	215.73
MW-OB30	MW-OB30_20170302	3/2/2017	**14000**	**15000**	4.3	**370**	1700	217.64
MW-OB30	MW-OB30_20170425	4/25/2017	**13000** J	**13000** J	3.4 U	**440**	1400 J	216.46
MW-OB30	DUP_20170425	4/25/2017	**14000**	**14000** J	3.3 U	**420**	1400 J	216.46
MW-OB30	MW-OB30_20170622	6/22/2017	**8900**	**8500**	2.2	**330**	1800	216.37
MW-OB30	MW-OB30_20170724	7/24/2017	**17000**	**16000**	--	--	2300	216.15
MW-OB31	MW-OB31-20151209	12/9/2015	--	--	3.2	117	--	214.20
MW-OB31	MW-OB31-20151209A(1.0)	12/9/2015	10 UJ	--	--	--	--	214.20
MW-OB31	MW-OB31-20151209B(0.1)	12/9/2015	10 UJ	--	--	--	--	214.20
MW-OB31	MW-OB31-20151209F	12/9/2015	10 UJ	**200**	--	--	300	214.20
MW-OB31	MW-OB31-20151209A(1.0)-2	12/10/2015	--	**84**	--	--	210	214.20
MW-OB31	MW-OB31-20151209B(0.1)-2	12/10/2015	--	46	--	--	63	214.20
MW-OB31	MW-OB31_20160727	7/27/2016	8.9 J	**250**	2 U	67	--	213.04
MW-OB31	MW-OB31_20161201	12/1/2016	10 U	6.1	2.3	70	120	213.71
MW-OB31	MW-OB31_20170118	1/18/2017	--	--	--	--	5400	216.76
MW-OB31	MW-OB31_20170302	3/2/2017	**82**	**320**	2.6	**420**	4200	218.23
MW-OB31	MW-OB31_20170425	4/25/2017	10	**600** J	4.2 U	180	2400 J	217.35
MW-OB31	MW-OB31_20170622	6/22/2017	10 U	**310**	2 U	100	1800	216.21
MW-OB31	MW-OB31_20170725	7/25/2017	17	**610**	--	--	800 J	216.51
MW-OB32	MW-OB32-20151208	12/8/2015	--	--	94	**2190**	--	217.48
MW-OB32	MW-OB32-20151208-A(1.0)	12/8/2015	15	32	--	--	18	217.48
MW-OB32	MW-OB32-20151208-B(0.1)	12/8/2015	14	**68**	--	--	25	217.48
MW-OB32	MW-OB32-20151208F	12/8/2015	10 U	34	--	--	15 J	217.48
MW-OB32	MW-OB32_20160726	7/26/2016	10 U	5.6	11 J	**1700**	--	216.89
MW-OB32	MW-OB32_20161201	12/1/2016	10 U	24	6	**1000**	12	217.83
MW-OB32	MW-OB32_20170302	3/2/2017	**510**	**480**	7.4	**890**	16	219.69
MW-OB32	MW-OB32_20170425	4/25/2017	**170**	**210** J	9.7	**1400**	26 J	218.84
MW-OB32	MW-OB32_20170622	6/22/2017	**95**	**140**	16	**2000**	33	219.07
MW-OB32	MW-OB32_20170725	7/25/2017	16	**90**	--	--	35 J	218.90
MW-OB33	MW-OB33-20151208	12/8/2015	--	--	2 U	**214**	--	216.78
MW-OB33	MW-OB33-20151208A(1.0)	12/8/2015	**1190** J	**1000** J	--	--	15	216.78
MW-OB33	MW-OB33-20151208B(0.1)	12/8/2015	**1170** J	**1100**	--	--	15	216.78
MW-OB33	MW-OB33-20151208F	12/8/2015	**1160** J	**1100**	--	--	14	216.78
MW-OB33-DUP	DUP-20151208-2	12/8/2015	**1170** J	--	2 U	**213**	--	216.78
MW-OB33-DUP	DUP-20151208-2F	12/8/2015	**1180** J	**1100**	--	--	17	216.78
MW-OB33	MW-OB33_20160726	7/26/2016	**1700**	**1900**	2 U	190	--	216.27
MW-OB33	MW-OB33_20161201	12/1/2016	**1800**	**2000**	2 U	180	6.7	216.01
MW-OB33	MW-OB33_20170302	3/2/2017	**1900**	**2000**	6.2	**560**	19	217.42
MW-OB33	MW-OB33_20170622	6/22/2017	**3900**	**3500**	4	**540**	48	216.04
MW-OB33	MW-OB33_20170725	7/25/2017	**1700**	**2200** J	--	--	34 J	216.62
MW-OB34	MW-OB34-20151208	12/8/2015	--	--	2 U	**913**	--	210.50
MW-OB34	MW-OB34-20151208A(1.0)	12/8/2015	10 U	**270**	--	--	14	210.50
MW-OB34	MW-OB34-20151208B(0.1)	12/8/2015	10 UJ	**300**	--	--	14	210.50
MW-OB34	MW-OB34-20151208F	12/8/2015	10 U	**310**	--	--	15 J	210.50
MW-OB34	QC-MW-OB34-20151208	12/8/2015	--	--	0.83 U	--	--	210.50
MW-OB34	MW-OB34_20160726	7/26/2016	10 U	**170**	4.9 J	**740**	--	208.59
MW-OB34	MW-OB34_20161201	12/1/2016	10 U	**200**	2 U	**720**	3.6 J	208.20
MW-OB34	MW-OB34_20170302	3/2/2017	**120**	**170**	9.6	**600**	4 U	213.12
MW-OB34	MW-OB34_20170622	6/22/2017	10 U	**53**	4.3	**570**	2 J	210.90
MW-OB34	MW-OB34_20170725	7/25/2017	10 U	**62** J	--	--	1.6 J	210.22

Table F-1
Groundwater - Chromium, Cyanide and Vanadium Analytical Results
Remedy Optimization Report
Main Plant Site - Glens Falls, NY

Location ID	Sample Name	Sample Date	Dissolved Chromium, Hexavalent µg/l	Dissolved Total Chromium µg/l	Cyanide, Free µg/l	Cyanide, Total µg/l	Dissolved Vanadium µg/l	Water Elevation NGVD29
NYSDEC Class GA Groundwater Quality Standards (µg/l)			50	50	-	200	-	-
SUMP A	Sump_A_20160726	7/26/2016	**81**	**90**	8	**780** J	--	--
SUMP A	Sump A_20161130	11/30/2016	**130**	**140**	2 U	**760**	59	219.29
SUMP A	SUMPA_20170228	2/28/2017	**500**	**660**	28	**1900**	30	216.39
SUMP A	SUMP A_20170425	4/25/2017	**420**	**470** J	7.4 U	**580**	35 J	213.08
SUMP A	SumpA_20170621	6/21/2017	**1100**	**1100**	29	**2200**	23	210.61
SUMP A	SUMPA_20170724	7/24/2017	**590**	**550**	--	--	23	210.17
SUMP B	Sump_B_20160726	7/26/2016	**83**	**95**	49	**620** J	--	--
SUMP B	Sump B_20161130	11/30/2016	**110**	**110**	2 U	**530**	56	211.64
SUMP B	SUMPB_20170228	2/28/2017	**190**	**190**	5.3	**940**	49	212.67
SUMP B	SumpB_20170621	6/21/2017	**190**	**180**	9	**450**	65	211.99
SUMP B	SUMPB_20170724	7/24/2017	**140**	**150**	--	--	61	213.21
Shallow Bedrock								
AW-A2	AW-A2-20151209	12/9/2015	10 U	2 U	2 U	28	--	219.49
AW-A2	AW-A2_20160728	7/28/2016	10 U	1.5 U	2 U	21	--	219.95
AW-A2	AW-A2_20161129	11/29/2016	10 U	1.5	2 U	39	4 U	222.30
AW-A2	AW-A2_20170228	2/28/2017	10 U	1.5 U	2 U	19 U	1.2 J	223.99
AW-A2	AW-A2_20170620	6/20/2017	10 U	1.8	2 U	38	4 U	224.27
AW-A10	AW-A10_20150729	7/29/2015	10 UJ	15	2 UJ	**578** J	230	204.83
AW-A10	AW-A10-20151209	12/9/2015	10 UJ	9.9	6	**550**	--	204.93
AW-A10	AW-A10_20160728	7/28/2016	10 U	14	2 U	**730**	--	204.10
AW-A10	AW-A10_20161202	12/2/2016	7.9 J	8.1	2 U	**440**	88	210.74
AW-A10	AW-A10_20170301	3/1/2017	10 U	4.4	2 U	**260**	39	214.74
AW-A10	AW-A10_20170621	6/21/2017	10 U	4.6	2 U	**210**	66	213.69
AW-A11	AW-A11_20150730	7/30/2015	**126**	**140**	2 UJ	**129**	120	201.74
AW-A11	AW-A11-20151209	12/9/2015	**147**	**139** J	2 U	149	--	197.19
AW-A11	AW-A11_20160728	7/28/2016	**210** J	**250**	2 U	140	--	196.20
AW-A11	AW-A11_20161202	12/2/2016	**390**	**420**	2 U	81	79	212.98
AW-A11	AW-A11_20170301	3/1/2017	**860**	**890**	2 U	97	83	216.92
AW-A11	AW-A11_20170621	6/21/2017	**1200**	**1200**	2 U	63	85	214.70
AW-A11	AW-A11_20170725	7/25/2017	**860**	**870**	--	--	54 J	214.67
AW-A14	AW-A14_20150730	7/30/2015	12	27	2 UJ	**455**	6.2	218.97
AW-A14	AW-A14-20151209	12/9/2015	14 J	20.1	2 U	**460**	--	218.77
AW-A14	AW-A14_20160727	7/27/2016	8 J	11	2 UJ	**250**	--	218.34
AW-A14	AW-A14_20161130	11/30/2016	8.3 J	6.7	2 U	**270**	4	219.56
AW-A14	AW-A14_20170228	2/28/2017	10 U	8	2 U	**240**	5	220.18
AW-A14	AW-A14_20170621	6/21/2017	10 U	3.6	2 U	120	3.3 J	219.75
AW-A15	AW-A15_20150724	7/24/2015	10 U	5.6	2 UJ	42	1.2 J	228.08
AW-A15	AW-A15-20151209	12/9/2015	10 U	2 U	2 U	43	--	228.20
AW-A15	AW-A15_20160728	7/28/2016	10 UJ	1.5 U	2 U	39	--	228.55
AW-A15	AW-A15_20161130	11/30/2016	10 U	1.5 U	2 U	28	4 U	228.62
AW-A15	AW-A15_20170301	3/1/2017	10 U	0.81 J	2 U	45	4 U	230.37
AW-A15	AW-A15_20170620	6/20/2017	10 U	0.6 J	2 U	34	4 U	229.32
MW-25S	MW-25S_20150728	7/28/2015	10 U	6.6	2 UJ	90	28	203.13
MW-25S	MW-25S-20151210	12/10/2015	10 U	4.7 J	2 U	89	--	203.24
MW-25S	MW-25S_20160728	7/28/2016	10 U	3.9	2 U	66	--	203.00
MW-25S	MW-25S_20161129	11/29/2016	10 U	3.3	2 U	58	12	212.64
MW-25S	MW-25S_20170301	3/1/2017	10 U	7.3	2.4	84	18	214.81
MW-25S	MW-25S_20170620	6/20/2017	10 U	8.6	2 U	130	27	214.34
Intermediate Bedrock								
AW-B2	AW-B2_20150723	7/23/2015	10 U	2.9	2 UJ	36	0.81 J	218.28
AW-B2-DUP	DUP-M1_20150723	7/23/2015	10 U	2.9	2 UJ	38	0.68 J	218.28
AW-B2	AW-B2-20151210	12/10/2015	10 U	2 U	2 U	44	--	209.39
AW-B2	AW-B2_20160728	7/28/2016	10 U	1.5 U	2 U	10 U	--	218.27
AW-B2	AW-B2_20161129	11/29/2016	10 U	1.5 U	2 U	7.7 J	4 U	220.64
AW-B2	AW-B2_20170228	2/28/2017	5.1 J	1.5 U	2 U	10 U	4 U	222.03
AW-B2	AW-B2_20170621	6/21/2017	10 U	1.5 U	2 U	10 U	4 U	223.73

Table F-1
Groundwater - Chromium, Cyanide and Vanadium Analytical Results
Remedy Optimization Report
Main Plant Site - Glens Falls, NY

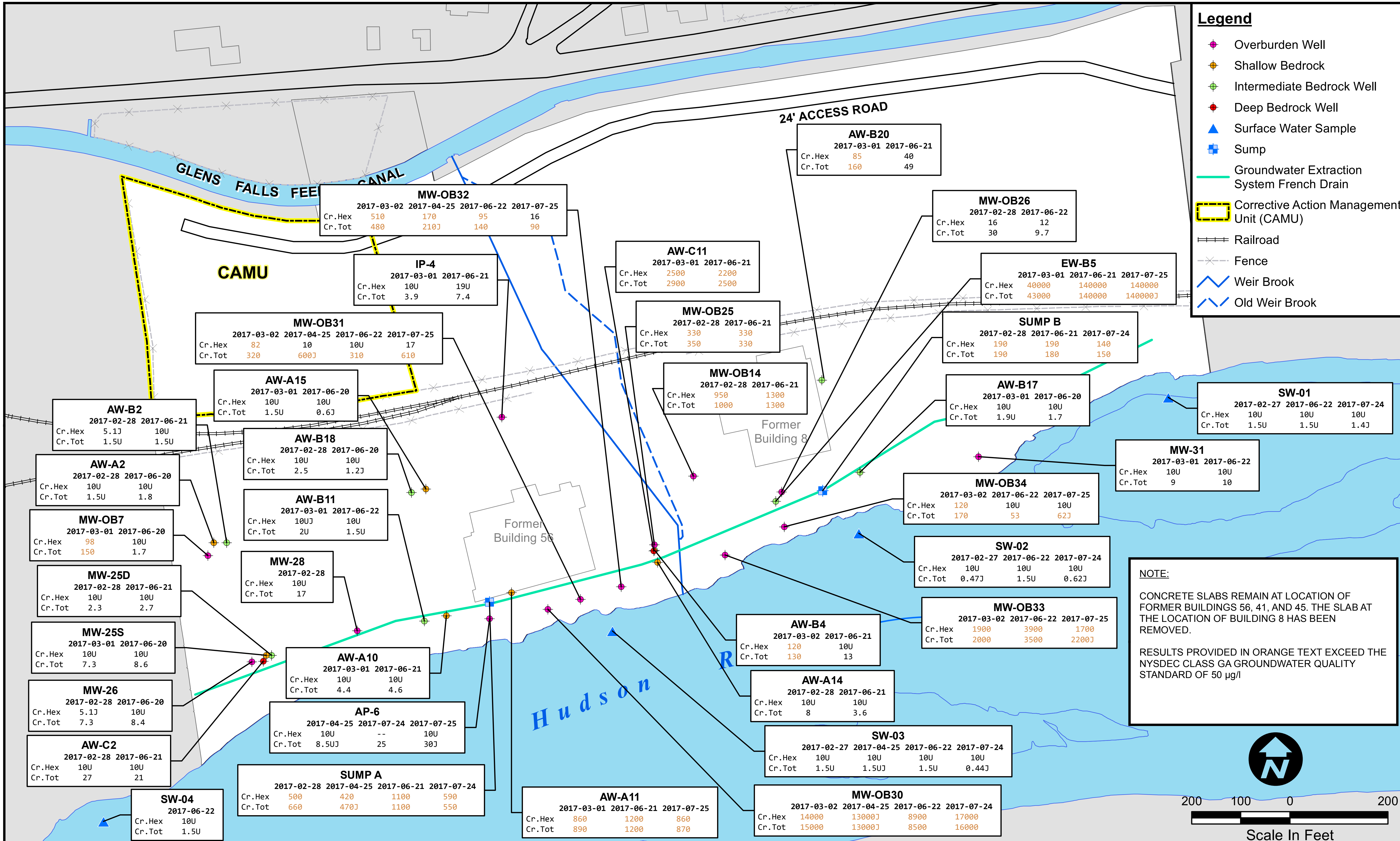
Location ID	Sample Name	Sample Date	Dissolved Chromium, Hexavalent µg/l	Dissolved Total Chromium µg/l	Cyanide, Free µg/l	Cyanide, Total µg/l	Dissolved Vanadium µg/l	Water Elevation NGVD29
NYSDEC Class GA Groundwater Quality Standards (µg/l)			**50**	**50**	**-**	**200**	**-**	**-**
AW-B4	AW-B4_20150731	7/31/2015	10 U	5.4	--	10 U	5.3	203.70
AW-B4	AW-B4A_A(1.0)-20150731 Diss	7/31/2015	10 U	5.9	--	--	5.3	203.70
AW-B4	AW-B4B_B(0.1)-20150731 Diss	7/31/2015	10 U	5.7	--	--	4.7	203.70
AW-B4	AW-B4-20151209	12/9/2015	10 UJ	7.3	2 U	81	--	204.74
AW-B4	AW-B4_20160729	7/29/2016	10 U	17	8.2	**230**	--	204.51
AW-B4	AW-B4_20161130	11/30/2016	**110**	**130**	2 U	**190**	7.3	208.23
AW-B4	AW-B4_20170302	3/2/2017	**120**	**130**	2 U	170	6.6	213.51
AW-B4	AW-B4_20170621	6/21/2017	10 U	13	2.3	**220**	4	210.18
AW-B11	AW-B11_20150727	7/27/2015	10 U	5.1	2 UJ	51	1.4 J	189.79
AW-B11	AW-B11-20151209	12/9/2015	10 U	2.4 U	2 U	32	--	190.14
AW-B11	AW-B11_20160728	7/28/2016	10 U	4.4	2 UJ	19	--	192.04
AW-B11	AW-B11_20161201	12/1/2016	7.5 J	2.7	2	25	3.5 J	201.99
AW-B11	AW-B11_20170301	3/1/2017	10 UJ	2	2 U	30	1.3 J	208.21
AW-B11	AW-B11_20170622	6/22/2017	10 U	1.5 U	2 U	21	4 U	209.13
AW-B17	AW-B17_20150806	8/6/2015	10 U	5.1	2 U	29	1.3 J	213.88
AW-B17	AW-B17-20151209	12/9/2015	10 UJ	2.1 U	2 U	31	--	211.77
AW-B17	AW-B17_20160727	7/27/2016	10 U	3	2 UJ	22	--	210.90
AW-B17	AW-B17_20161130	11/30/2016	10 U	2.3	2 U	26	4 U	211.37
AW-B17	AW-B17_20170301	3/1/2017	10 U	1.9	2 U	35	4 U	214.86
AW-B17	AW-B17_20170620	6/20/2017	10 U	1.7	2 U	26	4 U	212.96
AW-B18	AW-B18_20150724	7/24/2015	10 U	4.4	2 UJ	**206**	1.5 J	208.51
AW-B18	AW-B18-20151207	12/7/2015	--	--	2 U	**214**	--	208.75
AW-B18	AW-B18-20151207F	12/7/2015	10 U	2.1 U	--	--	--	208.75
AW-B18	AW-B18_20160726	7/26/2016	10 U	1.8 U	2 U	**270**	--	208.20
AW-B18	AW-B18_20161130	11/30/2016	10 UJ	2.7	2 U	**450**	1.6 J	209.62
AW-B18	AW-B18_20170228	2/28/2017	10 U	2.5	2 U	**200**	1.3 J	215.00
AW-B18	AW-B18_20170620	6/20/2017	10 U	1.2 J	2 U	**270**	4 U	212.56
AW-B20	AW-B20_20150805	8/5/2015	**578**	**510**	2 U	**274**	85	225.44
AW-B20	AW-B20A_A(1.0)-20150805 Diss	8/5/2015	**587**	**520**	--	--	85	225.44
AW-B20	AW-B20B_B(0.1)-20150805 Diss	8/5/2015	**584**	**570**	2 U	--	90	225.44
AW-B20	AW-B20_20161130	11/30/2016	**110** J	**91** J	2 U	250	41	226.20
AW-B20	AW-B20_20170301	3/1/2017	**85**	**160**	2 U	**310**	57	227.42
AW-B20	AW-B20_20170621	6/21/2017	40	49	2 U	**240**	45	227.25
EW-B5	EW-B5_20160726	7/26/2016	**50000**	**57000**	2 U	10 UJ	--	192.34
EW-B5	EW-B5_20161202	12/2/2016	**100000**	**120000**	3	**490**	800 U	202.20
EW-B5	EW-B5_20170118	1/18/2017	**61**	**130000**	--	**--**	--	208.97
EW-B5	EW-B5_20170301	3/1/2017	**40000**	**43000**	3.6	**300**	400 U	206.14
EW-B5	EW-B5_20170621	6/21/2017	**140000**	**140000**	2 U	**650**	4000 U	204.62
EW-B5	DUP_20170621	6/21/2017	**130000**	**140000**	2 U	**600**	4000 U	204.62
EW-B5	EW-B5_20170725	7/25/2017	**140000**	**140000** J	--	**--**	8000 U	205.43
EW-B5	DUP_20170725	7/25/2017	**140000**	**130000**	--	**--**	8000 U	205.43
MW-25D	MW-25D_20150728	7/28/2015	10 U	4.8	2 U	72	5.8	204.53
MW-25D	MW-25D-20151210	12/10/2015	10 UJ	3.1 J	8.9	148	--	204.32
MW-25D-DUP	DUP-20151210	12/10/2015	10 UJ	3.1 J	9.4	146	--	204.32
MW-25D	MW-25D_20160728	7/28/2016	10 UJ	3.9	2 U	160	--	203.26
MW-25D	MW-25D_20161129	11/29/2016	10 U	2.8	2 U	140	3.4 J	201.60
MW-25D	MW-25D_20170228	2/28/2017	10 U	2.3	2 U	180	2.8 J	210.63
MW-25D	MW-25D_20170621	6/21/2017	10 U	2.7	2 U	140	3.1 J	209.66
Deep Bedrock								
AW-C2	AW-C2_20150806	8/6/2015	10 U	19	2 U	19	5.1	189.47
AW-C2	AW-C2-20151210	12/10/2015	10 U	**73.9**	2 U	22	--	185.65
AW-C2	AW-C2_20160728	7/28/2016	10 U	13	2 U	10	--	187.74
AW-C2	AW-C2_20161129	11/29/2016	10 U	13	2 U	23	2.1 J	184.89
AW-C2	AW-C2_20170228	2/28/2017	10 U	27	2 U	42	3.9 J	187.50
AW-C2	AW-C2_20170621	6/21/2017	10 U	21	2 U	18	2.2 J	188.86

Table F-1
Groundwater - Chromium, Cyanide and Vanadium Analytical Results
Remedy Optimization Report
Main Plant Site - Glens Falls, NY

Location ID	Sample Name	Sample Date	Dissolved Chromium, Hexavalent µg/l	Dissolved Total Chromium µg/l	Cyanide, Free µg/l	Cyanide, Total µg/l	Dissolved Vanadium µg/l	Water Elevation NGVD29
NYSDEC Class GA Groundwater Quality Standards (µg/l)			**50**	**50**	**-**	**200**	**-**	**-**
AW-C11	AW-C11_20150806	8/6/2015	10 U	**120**	2 U	53	52	195.34
AW-C11	AW-C11A_A(1.0)-20150806 Diss	8/6/2015	10 U	**100**	--	--	53	195.34
AW-C11	AW-C11B_B(0.1)-20150806 Diss	8/6/2015	27	**82**	2 U	--	52	195.34
AW-C11	AW-C11-20151210	12/10/2015	**349** J	**479**	2 U	50	--	194.70
AW-C11	AW-C11_20160728	7/28/2016	10 U	**460**	2 UJ	28	--	194.52
AW-C11	AW-C11_20161130	11/30/2016	**5400**	**6000**	2 U	110	33 J	193.15
AW-C11-DUP	DUP2_20161130	11/30/2016	**5300**	**6300**	2 U	110	34 J	193.15
AW-C11	AW-C11_20170301	3/1/2017	**2500**	**2900**	2 U	86	40 U	195.88
AW-C11-DUP	DUP_20170301	3/1/2017	**2500**	**2900**	2 U	89	40 U	195.88
AW-C11	AW-C11_20170621	6/21/2017	**2200**	**2500**	2 U	67	4 U	196.07
Equipment Blanks								
--	EB_20160725	7/25/2016	--	--	2 U	10 U	--	
	EB_20160726	7/26/2016	8.9 J	0.53 J	2 U	10 U	--	
--	EB_20160727	7/27/2016	10 U	0.45 J	2 U	10 U	--	
--	EB_20160728	7/28/2016	7.2 J	0.59 J	2 U	10 U	--	
--	EB_20160729	7/29/2016	10 U	1.5 U	2 U	10 U	--	
--	EB_20161129	11/29/2016	5 J	1.5 U	2 U	10 U	4 U	
--	EB_20161130	11/30/2016	5.8 J	0.42 J	2 U	10 U	4 U	
--	EB_20161201	12/1/2016	10 U	1.5 U	2 U	10 U	4 U	
--	EB_20161202	12/2/2016	10 U	0.99 J	2 U	10 U	4 U	
--	EB_20170227	2/27/2017	10 U	1.5 U	2 U	10 U	--	
--	EB_20170228	2/28/2017	10 U	0.39 BJ	2 U	4 J	4 U	
--	EB_20170301	3/1/2017	10 U	0.6 BJ	2 U	10 U	4 U	
--	EB_20170302	3/2/2017	10 U	1.5 U	2 U	2.7 J	4 U	
--	EB_20170620	6/20/2017	10 U	1.5 U	2 U	10 U	4 U	
--	EB_20170621	6/21/2017	7.5 J	1.5 U	2 U	3 J	4 U	
--	EB_20170622	6/22/2017	10 U	1.5 U	2 U	10 U	4 U	
--	EB_20170724	7/24/2017	10 U	0.43 J	--	--	4 U	
	EB_20170725	7/25/2017	10 U	1.5 U	--	--	4 U	

Notes:
1) Sample ID nomenclature indicates the following:
"F" in sample ID indicates sample was field filtered using 0.45 micrometer filter
A(1.0) in sample ID indicates sample was field filtered using 1.0 micrometer filter
B(0.1) in sample ID indicates sample was field filtered using 0.1 micrometer filter
2) Groundwater GA Standard from 6 NYCRR 703.5, Table 1 Water Quality Standards (or Water Quality Guidance Values from NYS Division of Water TOGS 1.1.1). GA standards are for protective of fresh groundwaters for drinking water source.

µg/L - micrograms per liter
BOLD value indicates concentration above GA standard
" - " indicates not available/not analyzed
U - indicates analyte was not detected above reporting limit shown
J - indicates value is estimated



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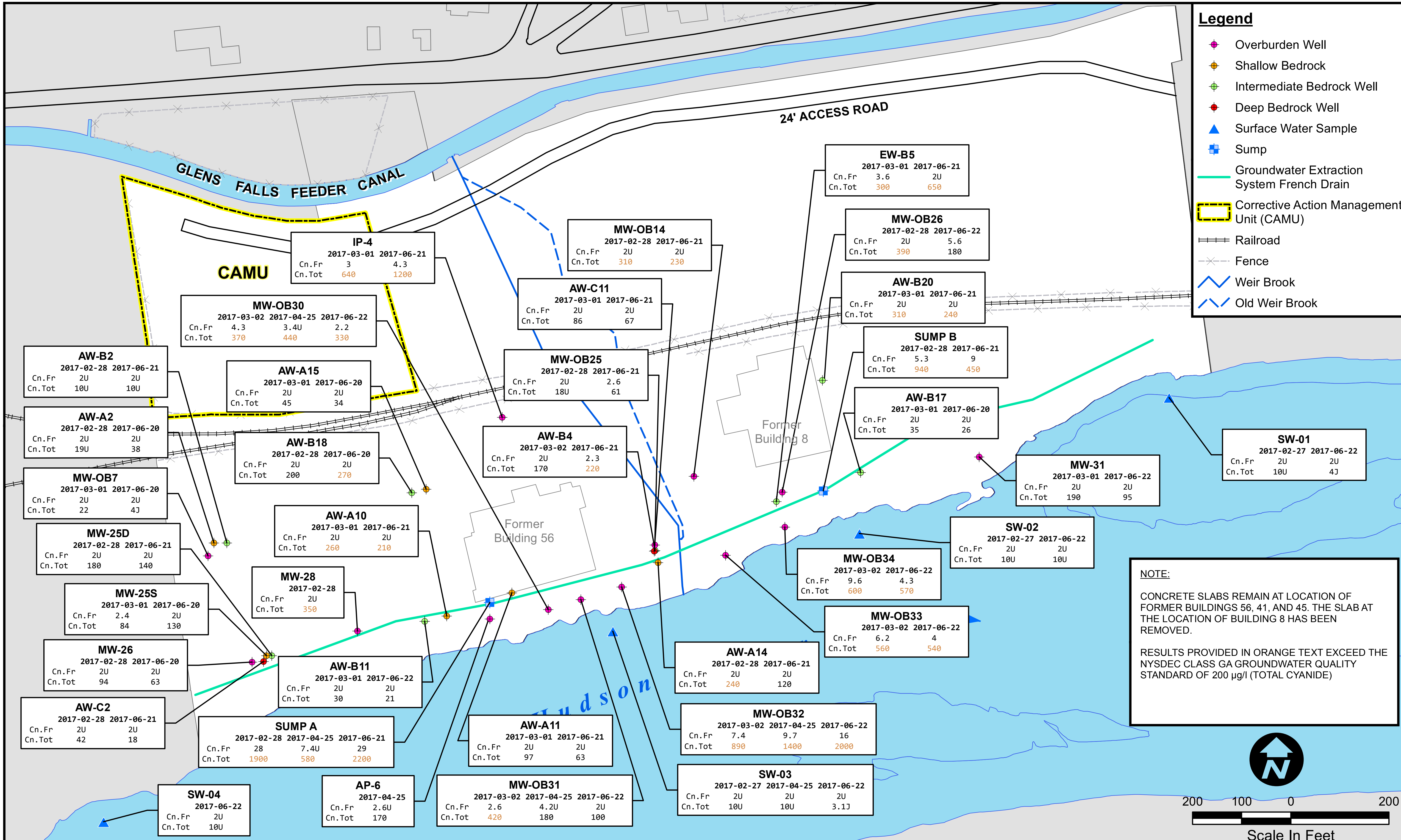
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

CHROMIUM RESULTS - FEBRUARY THROUGH JULY 2017

FIGURE F-1



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ASHLAND
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GLENS FALLS, NY

CYANIDE RESULTS - FEBRUARY THROUGH JULY 2017

FIGURE F-2

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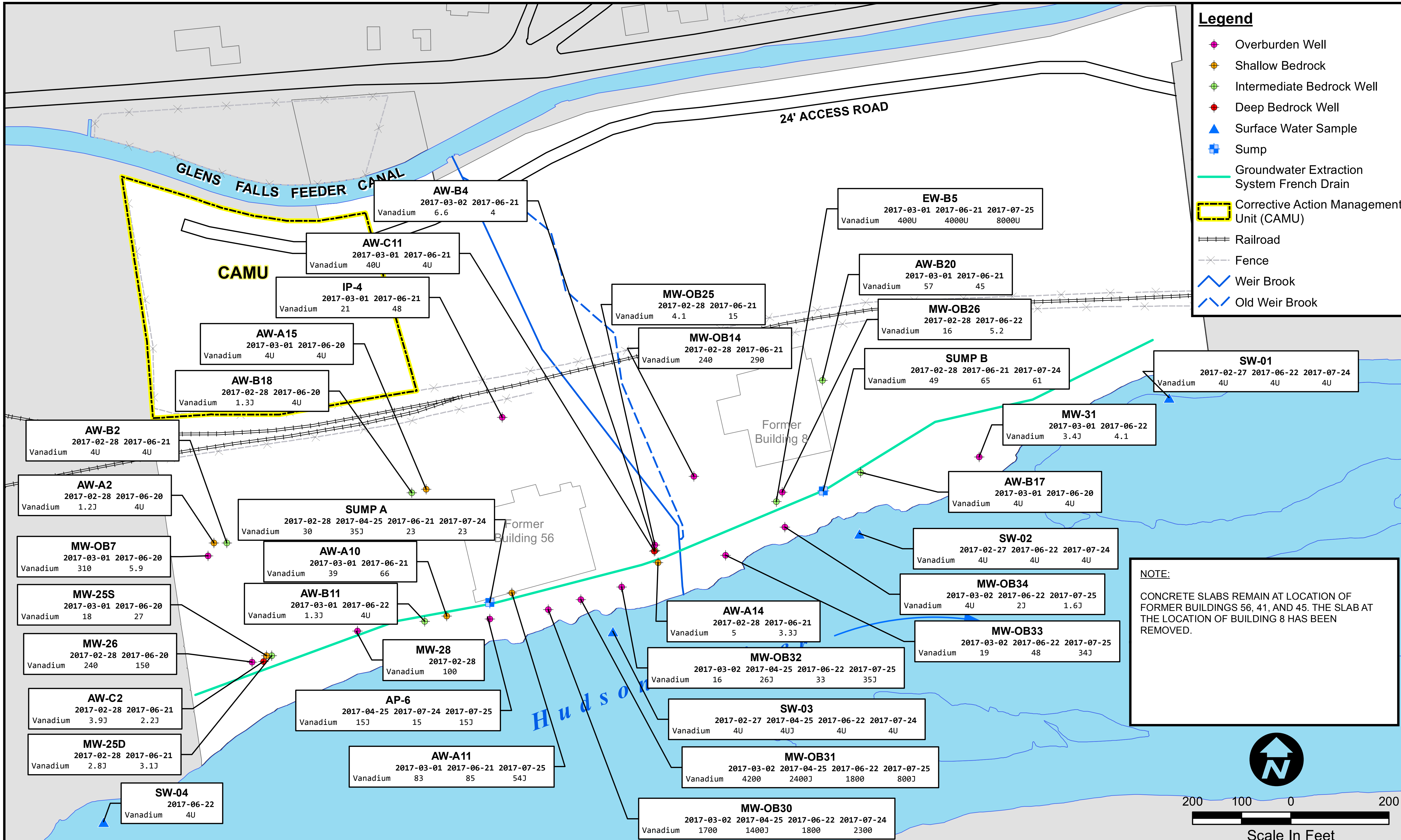

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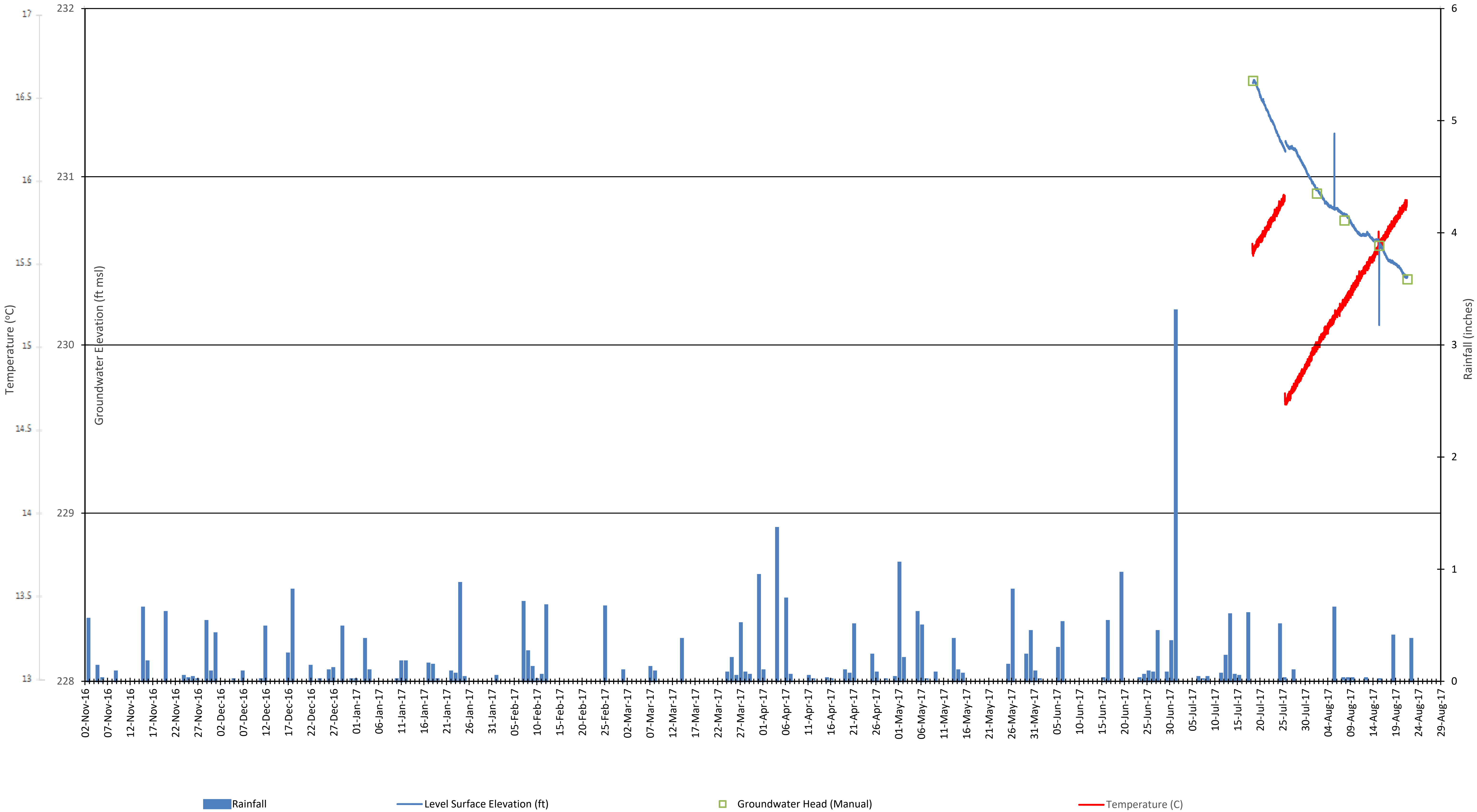
GLENS FALLS, NY

VANADIUM RESULTS - FEBRUARY THROUGH JULY 2017

FIGURE F-3

Appendix G
Monitoring Well Hydrographs, Temperature, and Specific Conductivity Plots

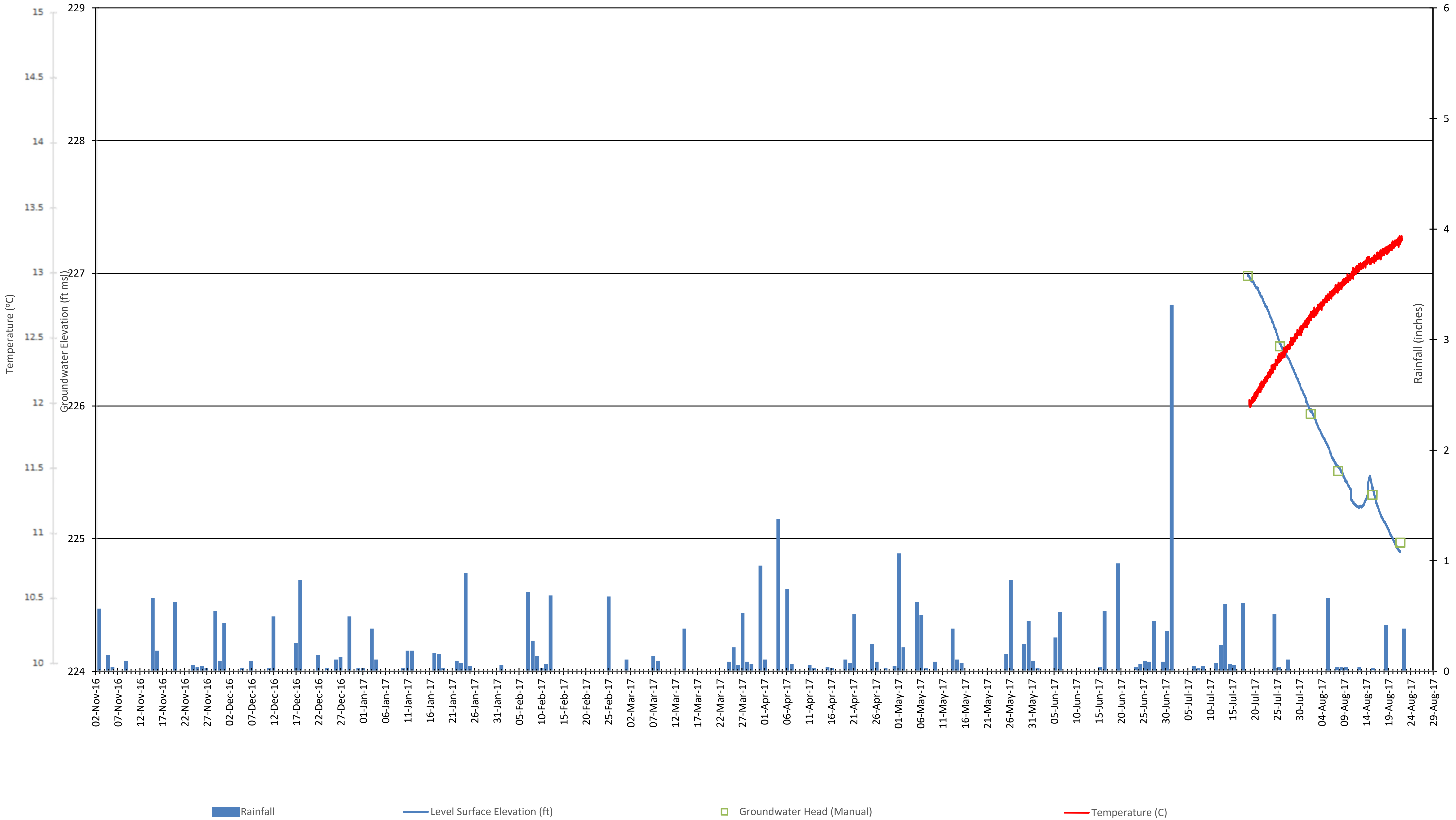


Former Ciba-Geigy / Hercules
Glens Falls, NY

EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AP-1 (Overburden)

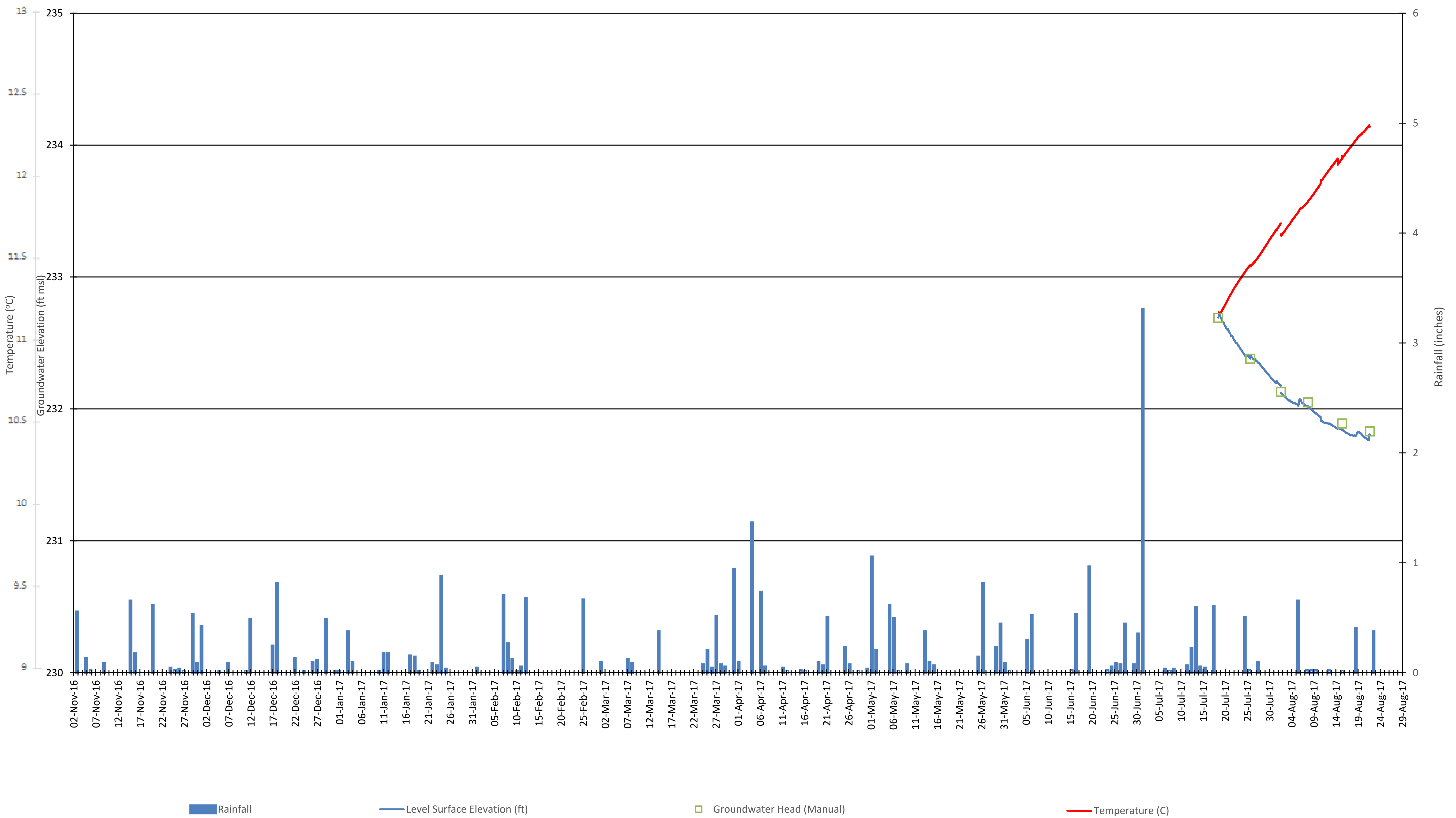
Figure A



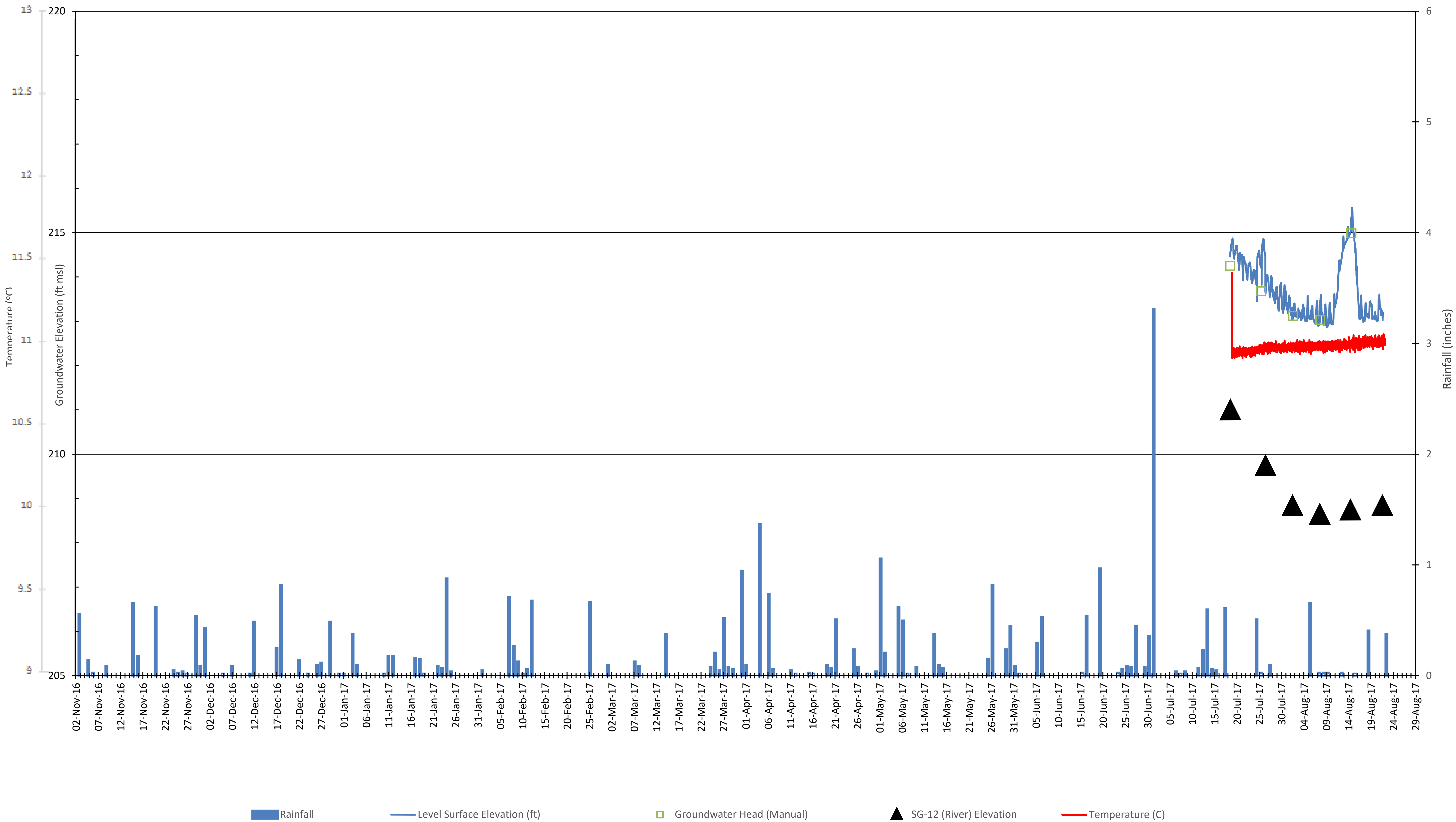
Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AP-2 (Overburden)

Figure B



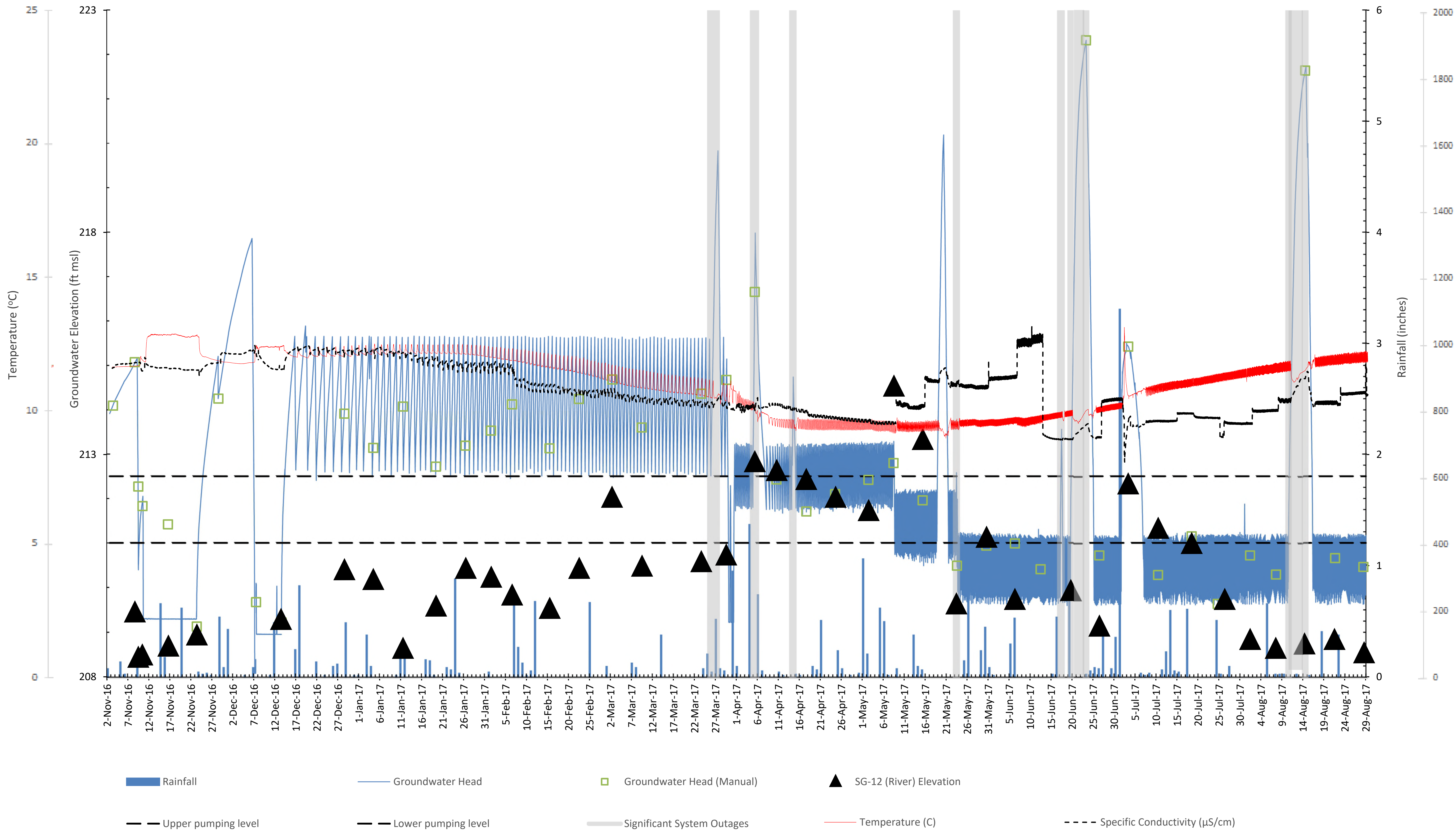
Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support September 2017	Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AP-5 (Overburden)	Figure C



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AP-6 (Overburden)

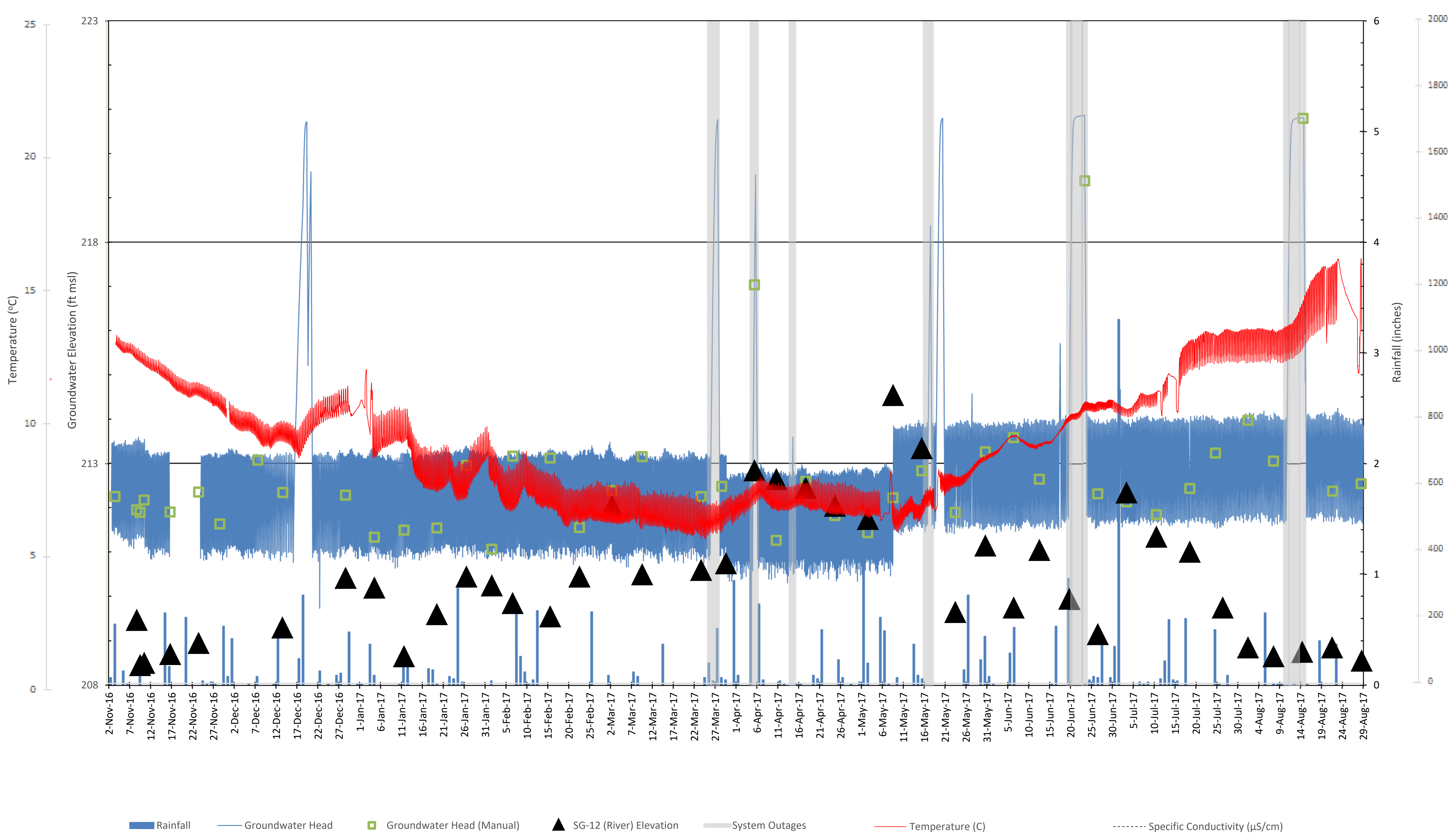
Figure
D



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Sump A (Overburden)

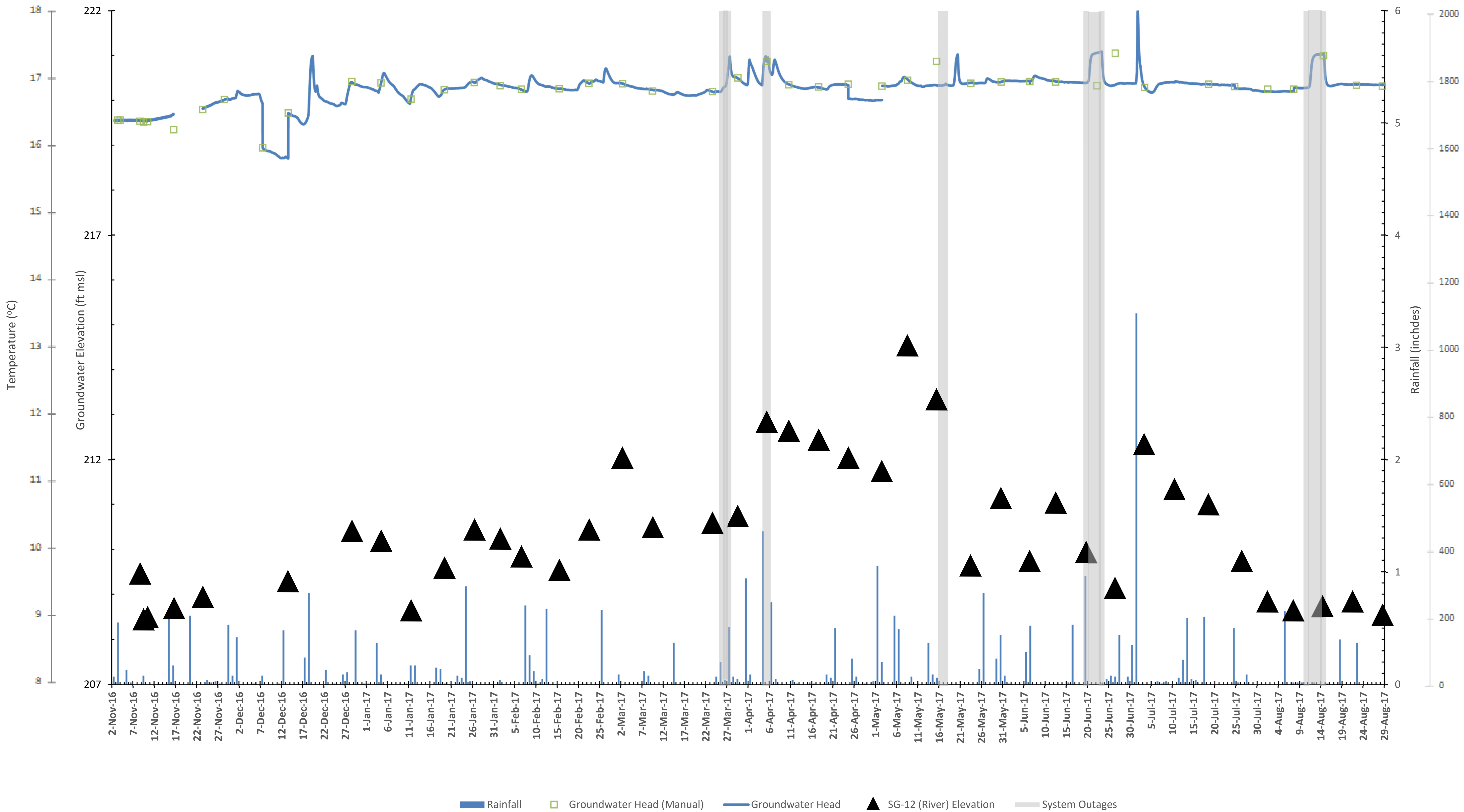
Figure E



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Sump B (Overburden)

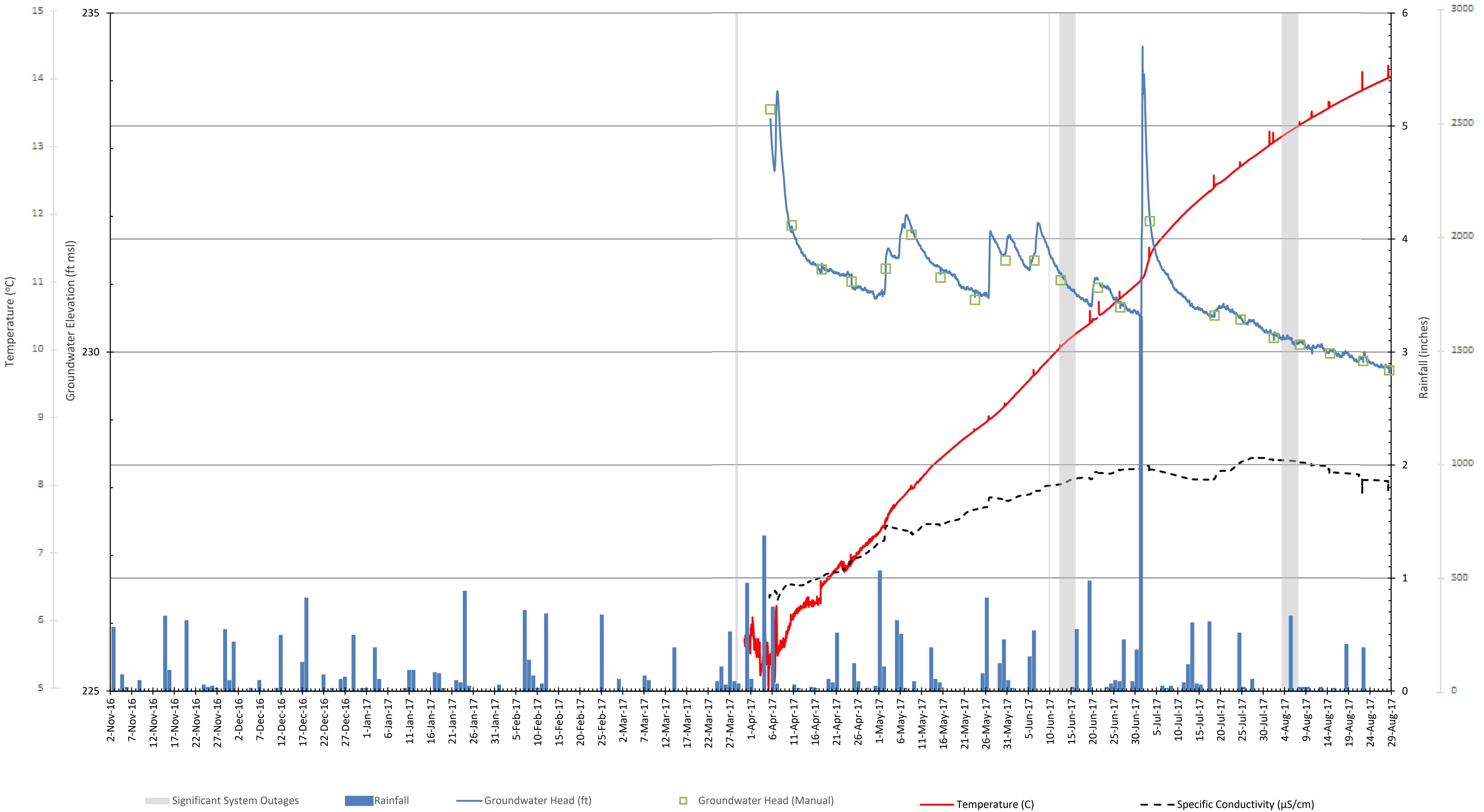
Figure
F



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well MH-4 (Overburden)

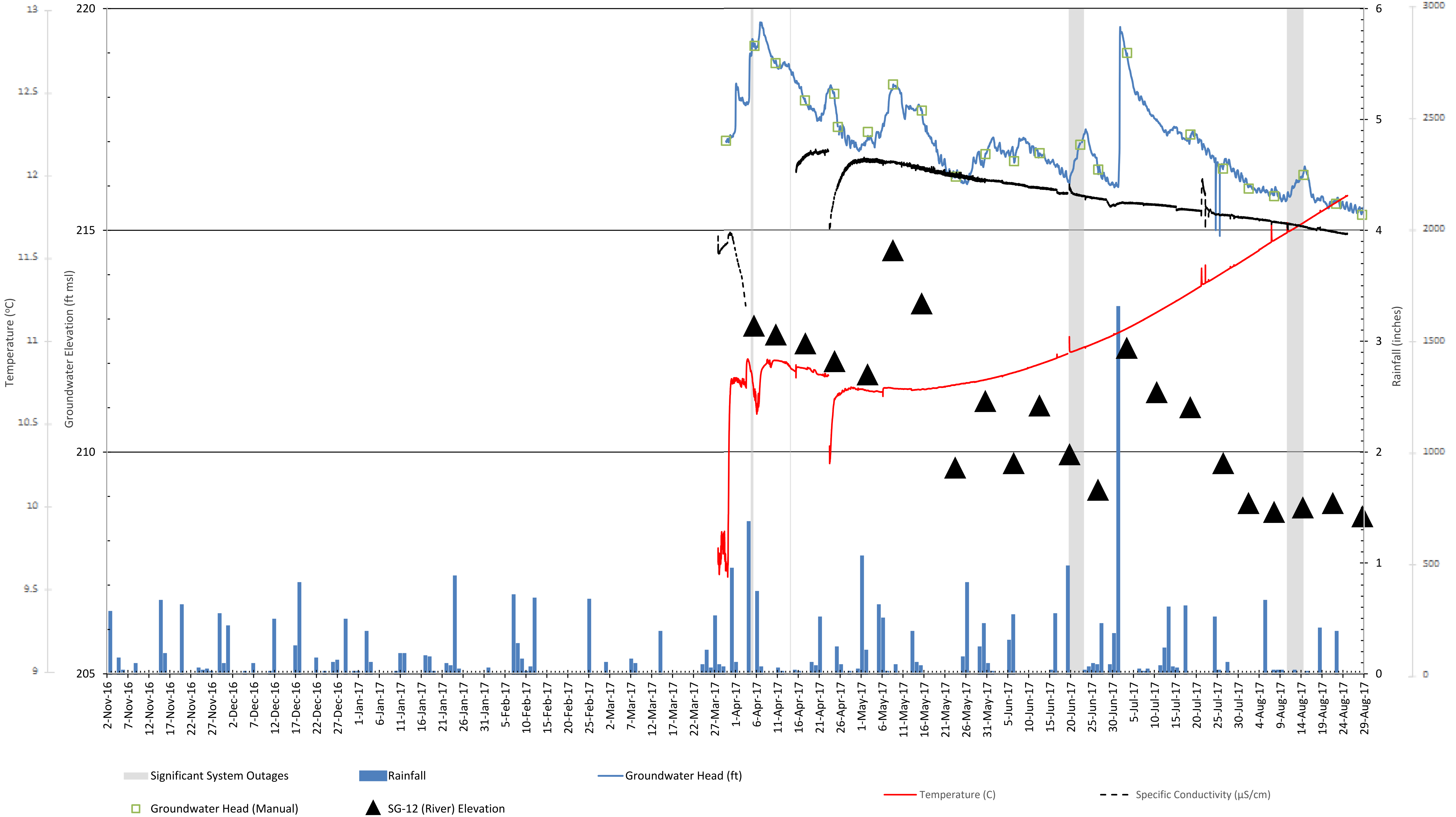
Figure G



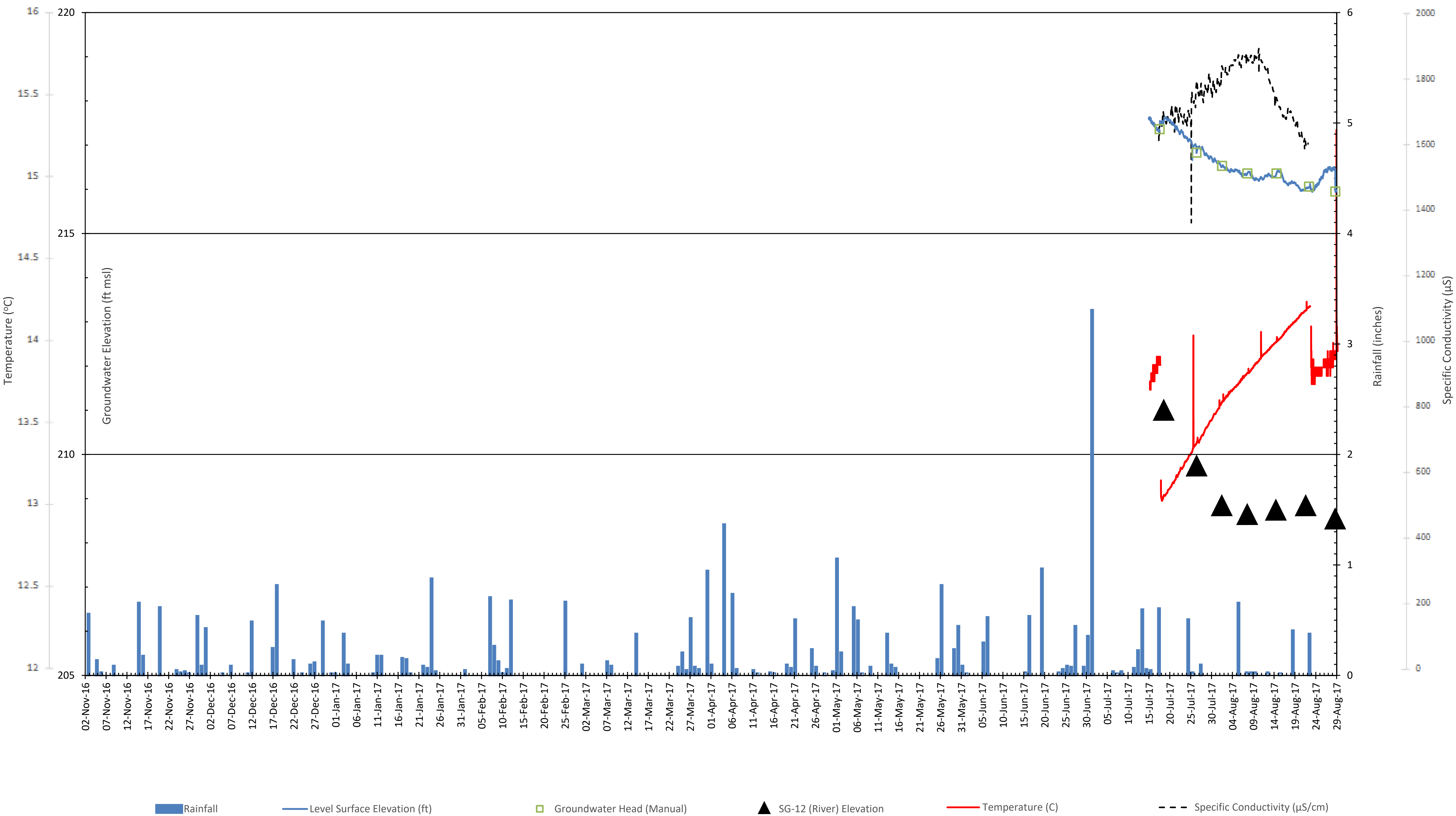
Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: MW-OB25 (Overburden)

Figure H



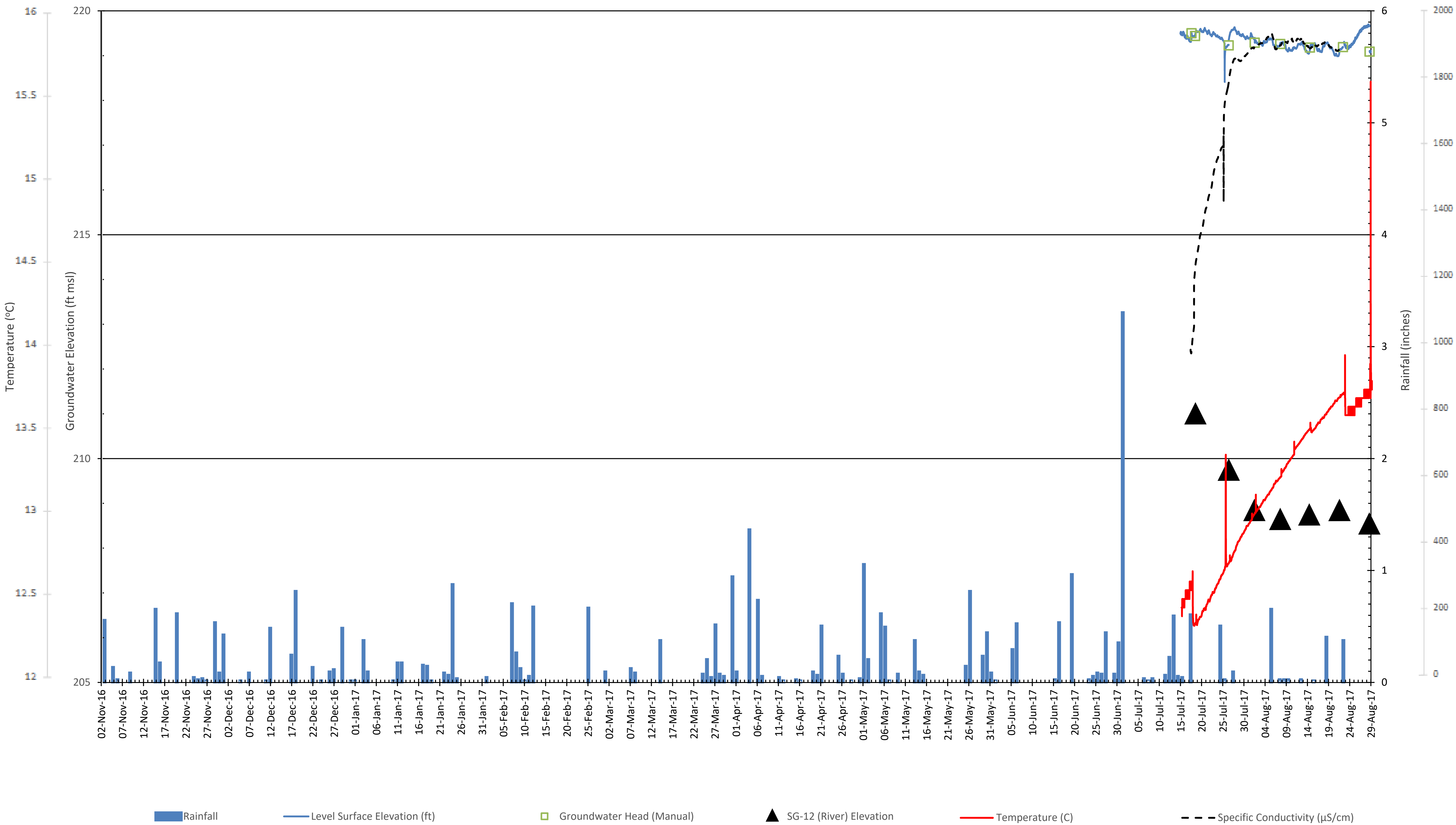
Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support September 2017	Groundwater Hydrograph , Temperature, and Specific Conductivity Plots: MW-OB30 (Overburden)	Figure I



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well MW-OB31 (Overburden)

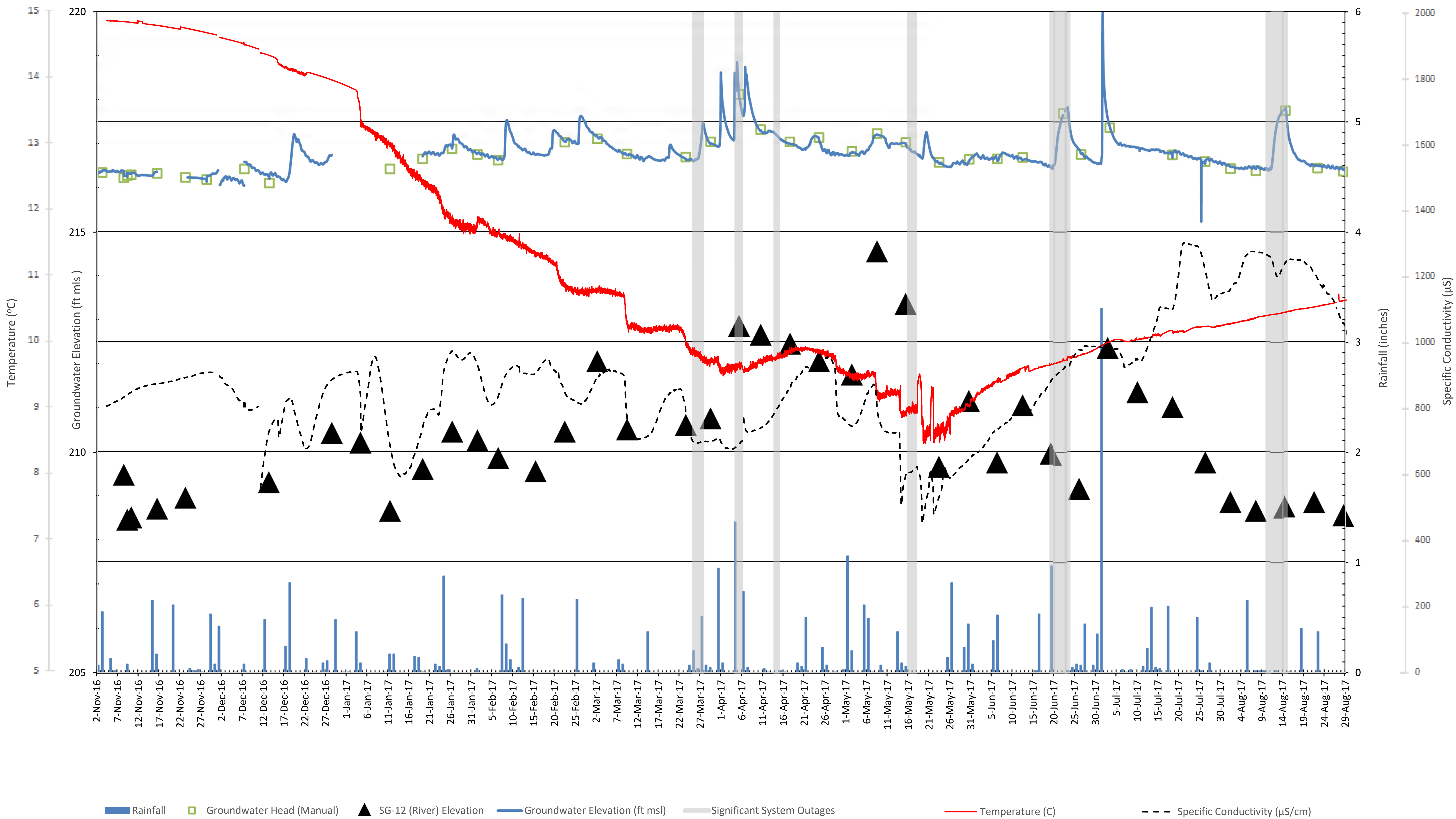
Figure J



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well MW-OB32 (Overburden)

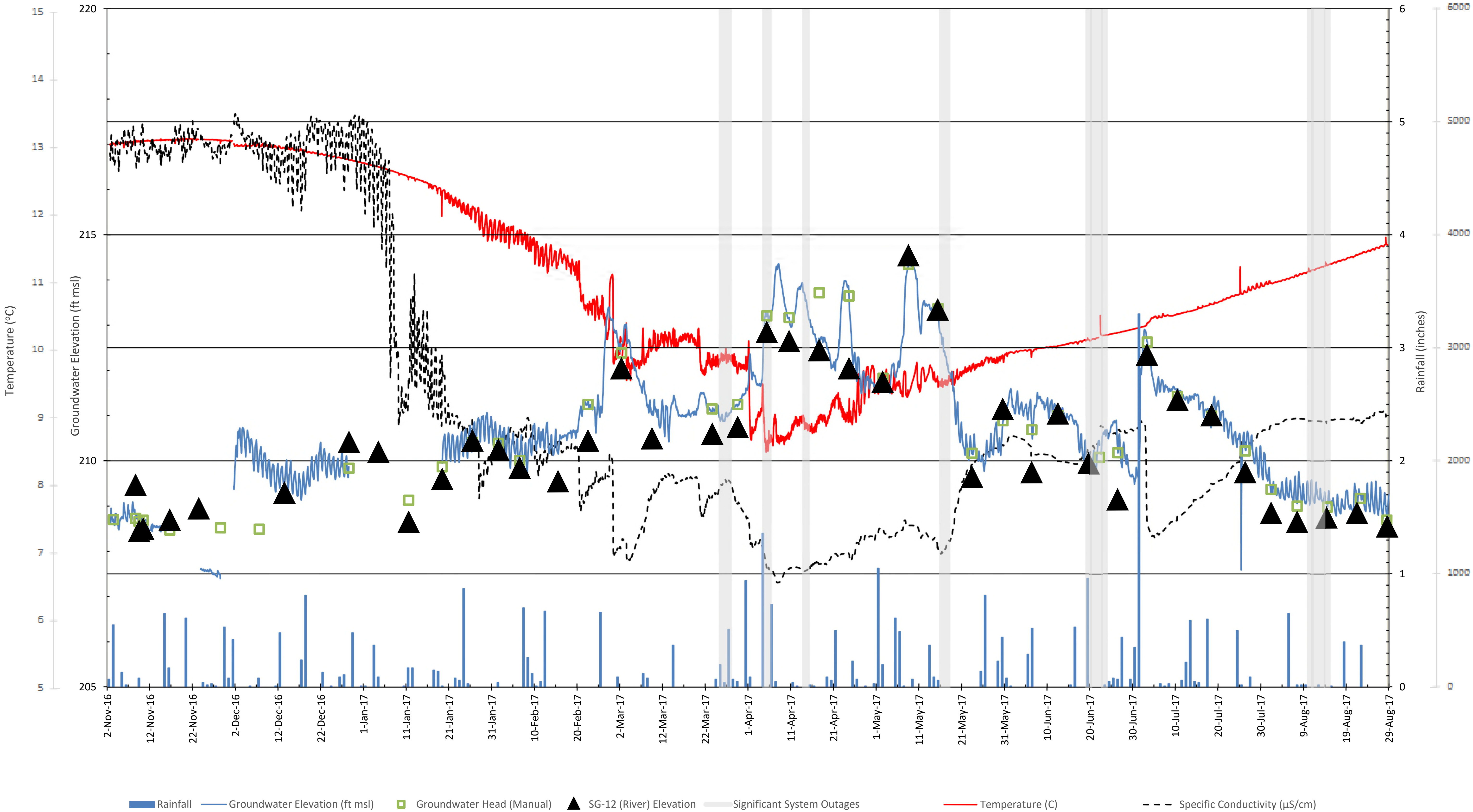
Figure
K



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well MW-OB33 (Overburden)

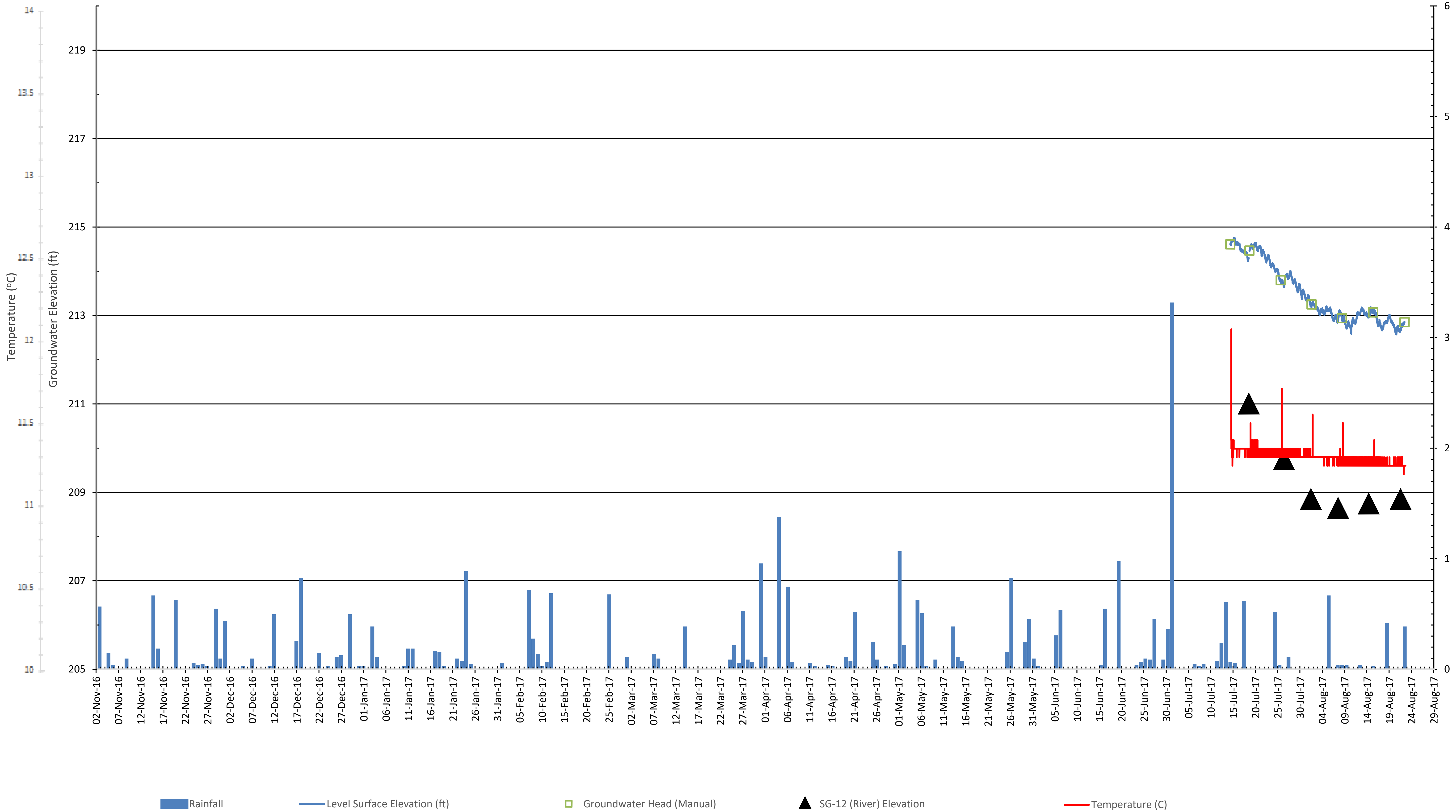
Figure L



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: MW-OB34 (Overburden)

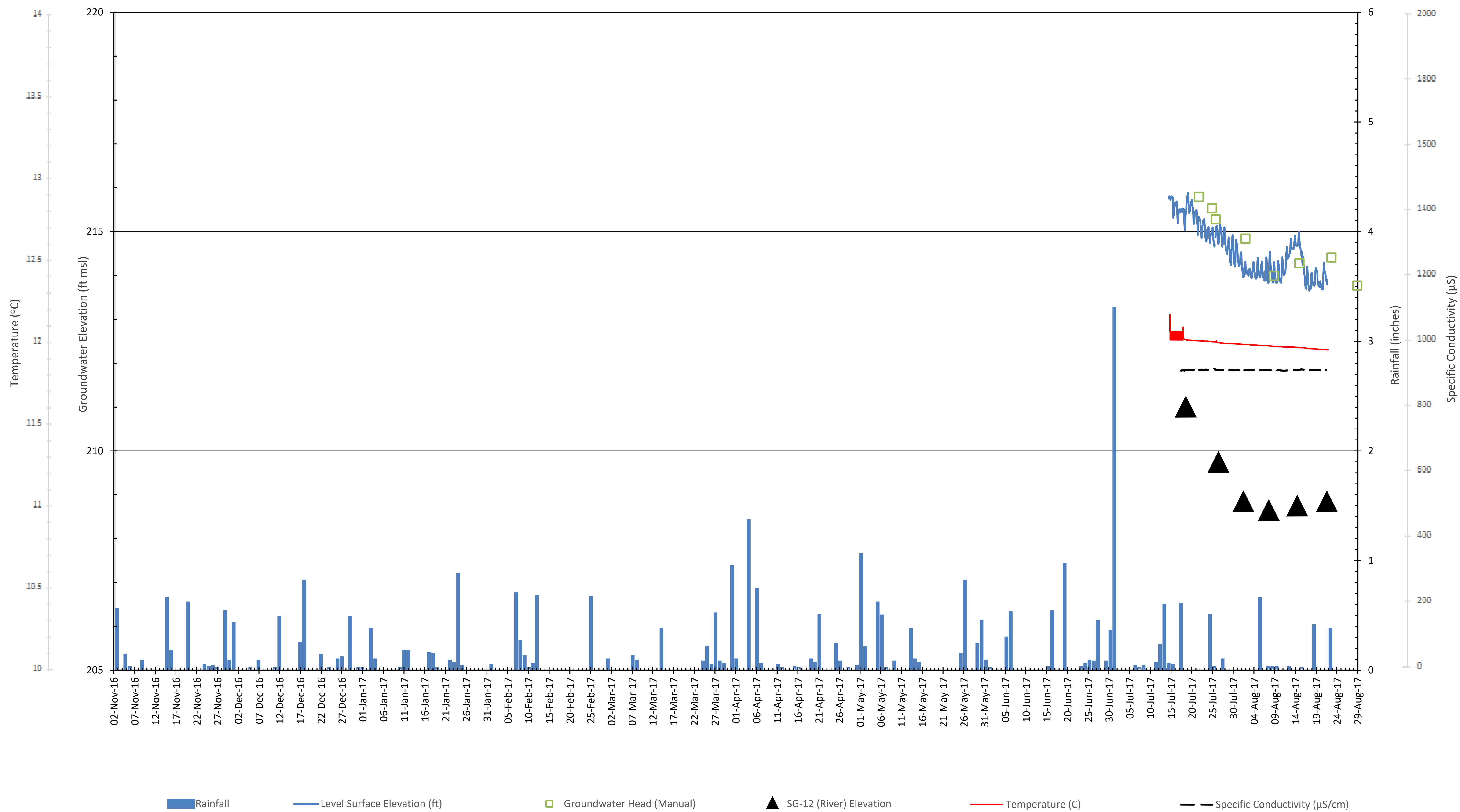
Figure M



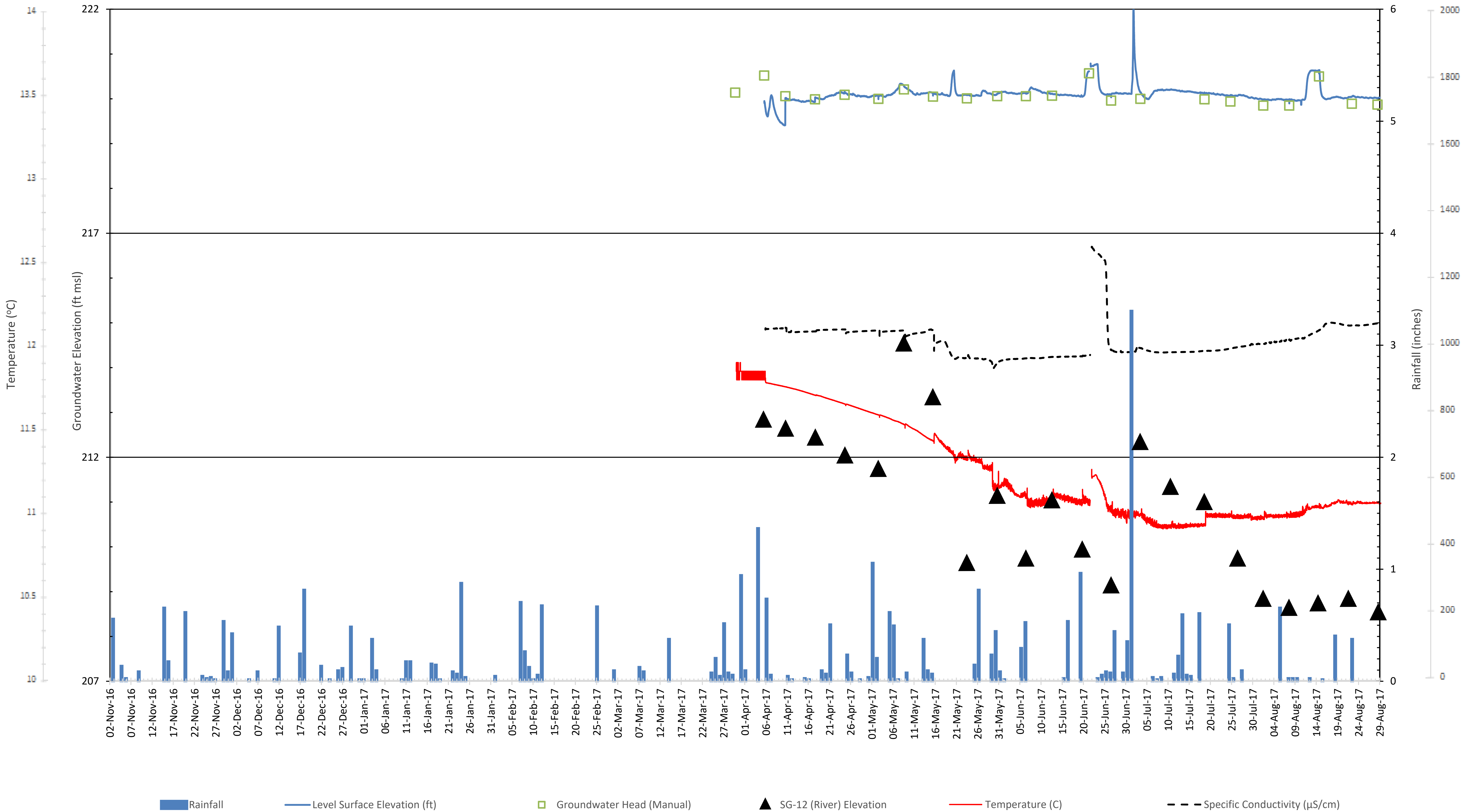
Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AW-A10 (Shallow Bedrock)

Figure
N



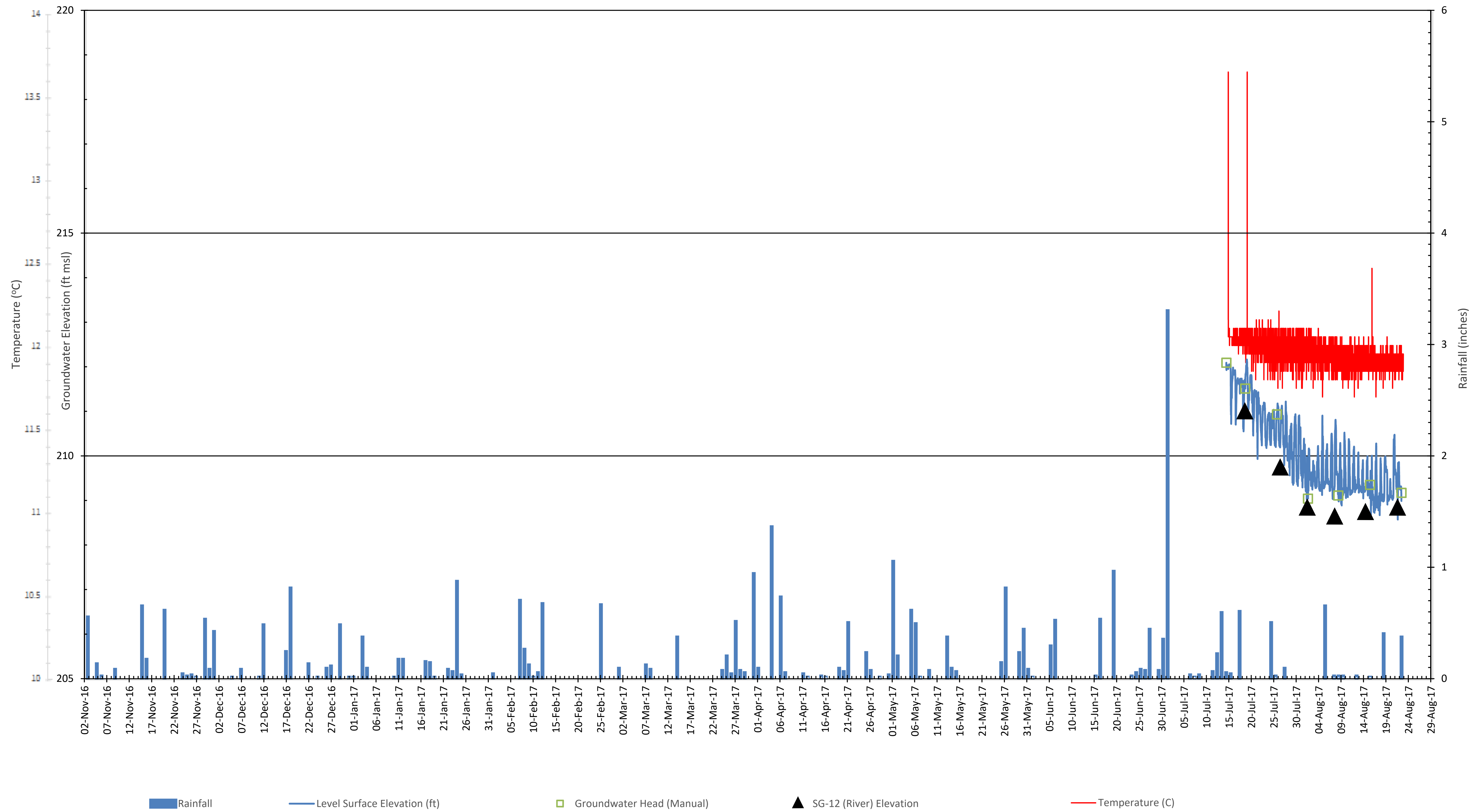
Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support September 2017	**Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AW-A11 (Shallow Bedrock)**	**Figure** **O**



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AW-A14 (Shallow Bedrock)

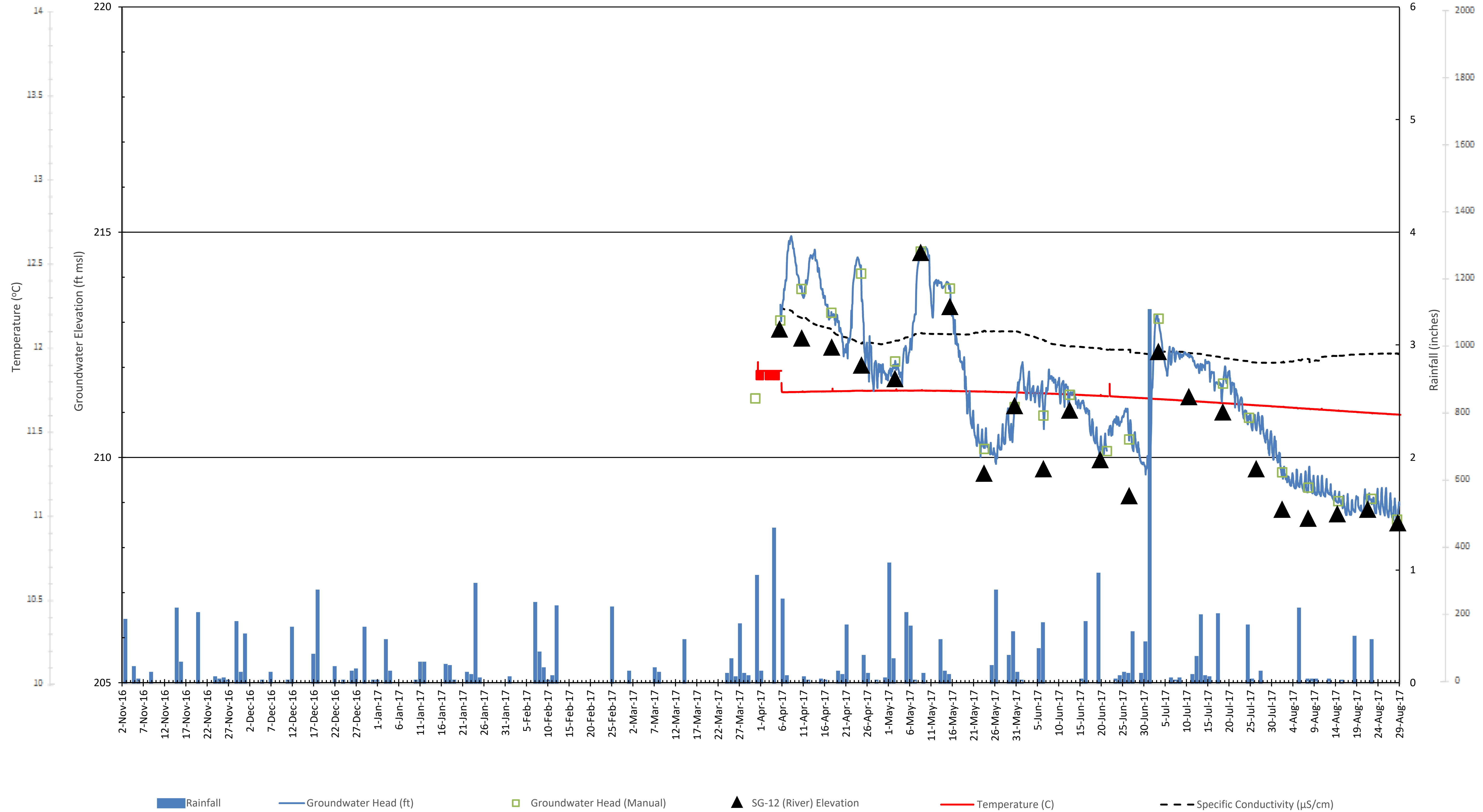
Figure
P



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well EW-A11 (Shallow Bedrock)

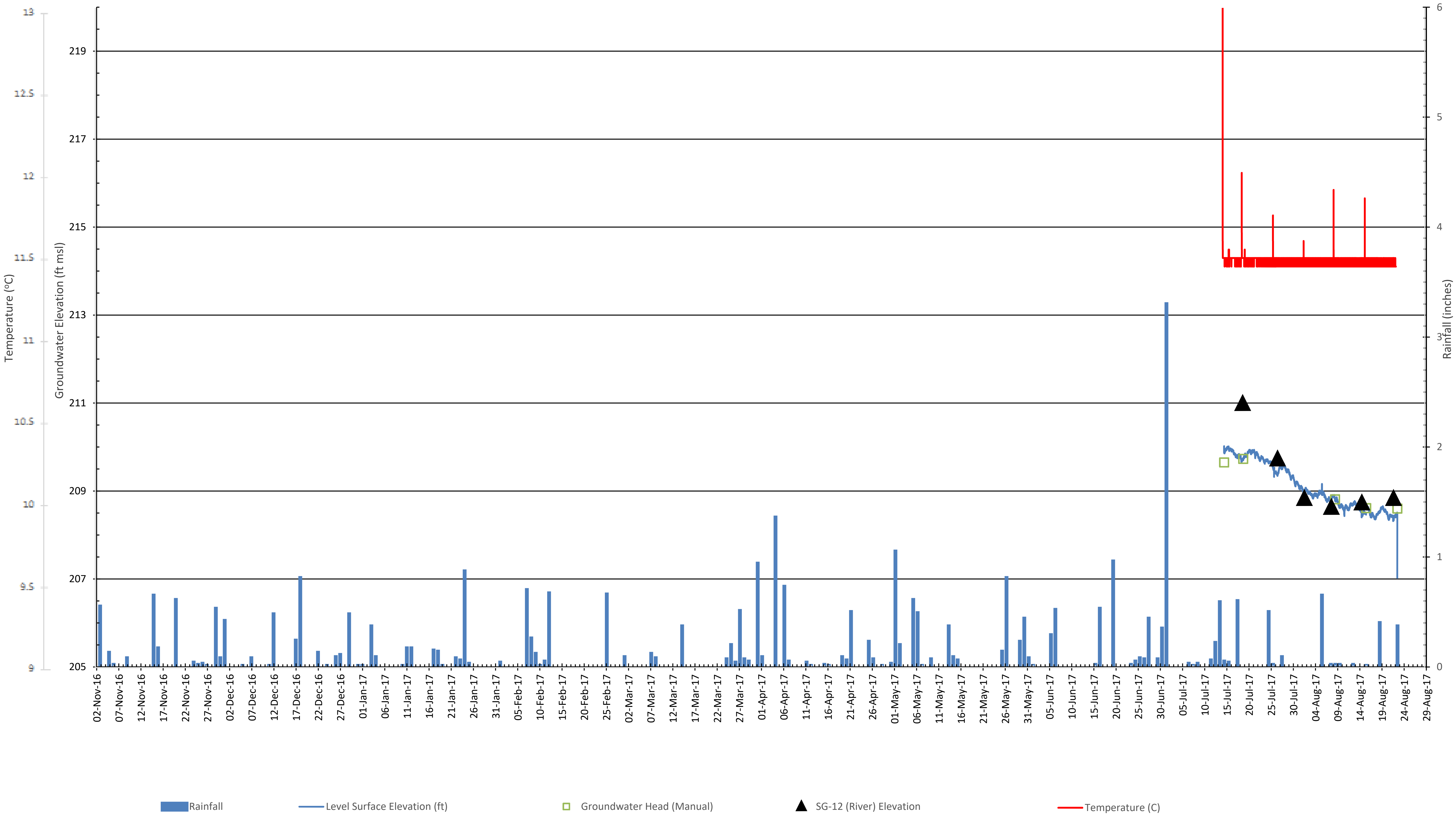
Figure Q



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AW-B4 (Intermediate Bedrock)

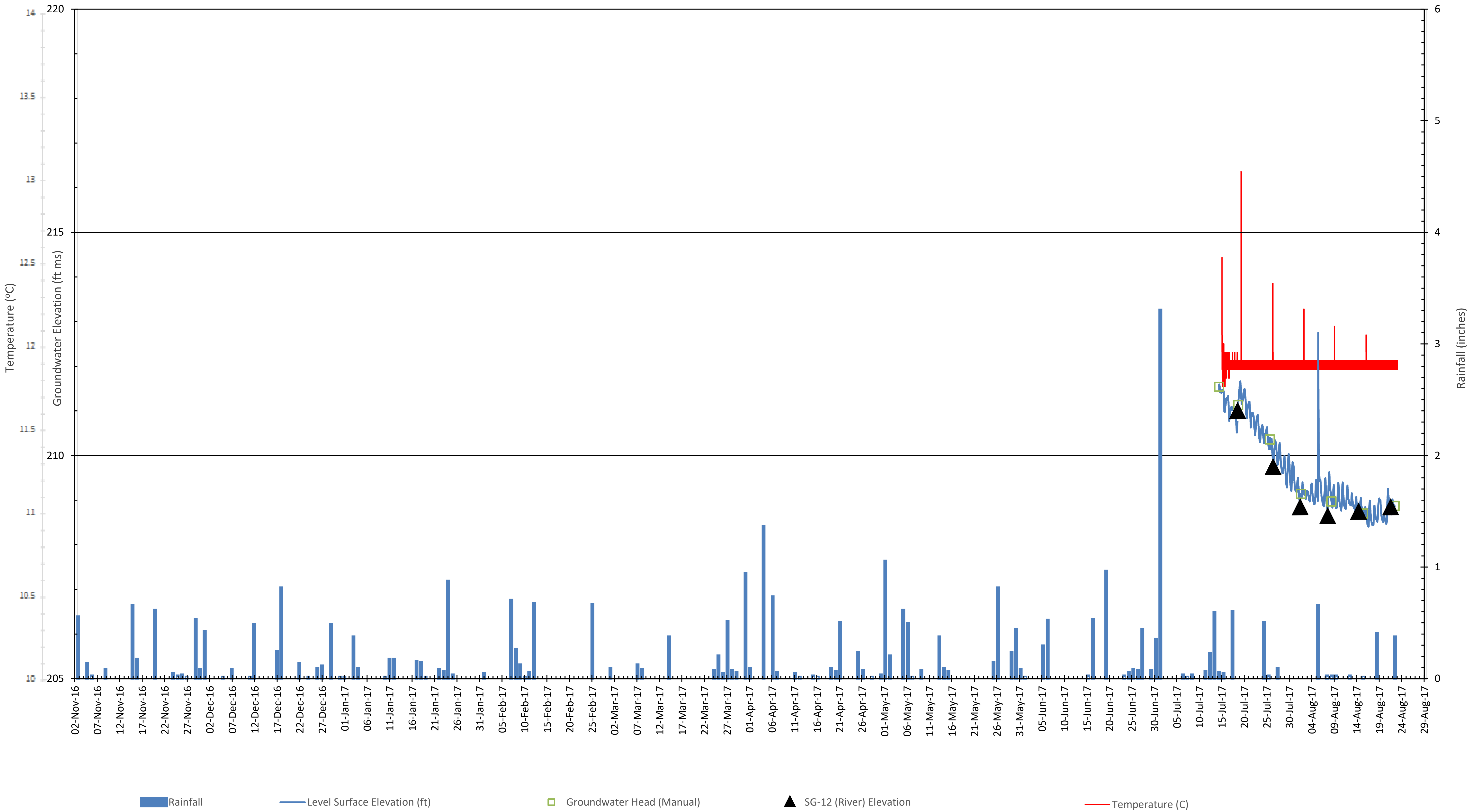
Figure R



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AW-B11 (Intermediate Bedrock)

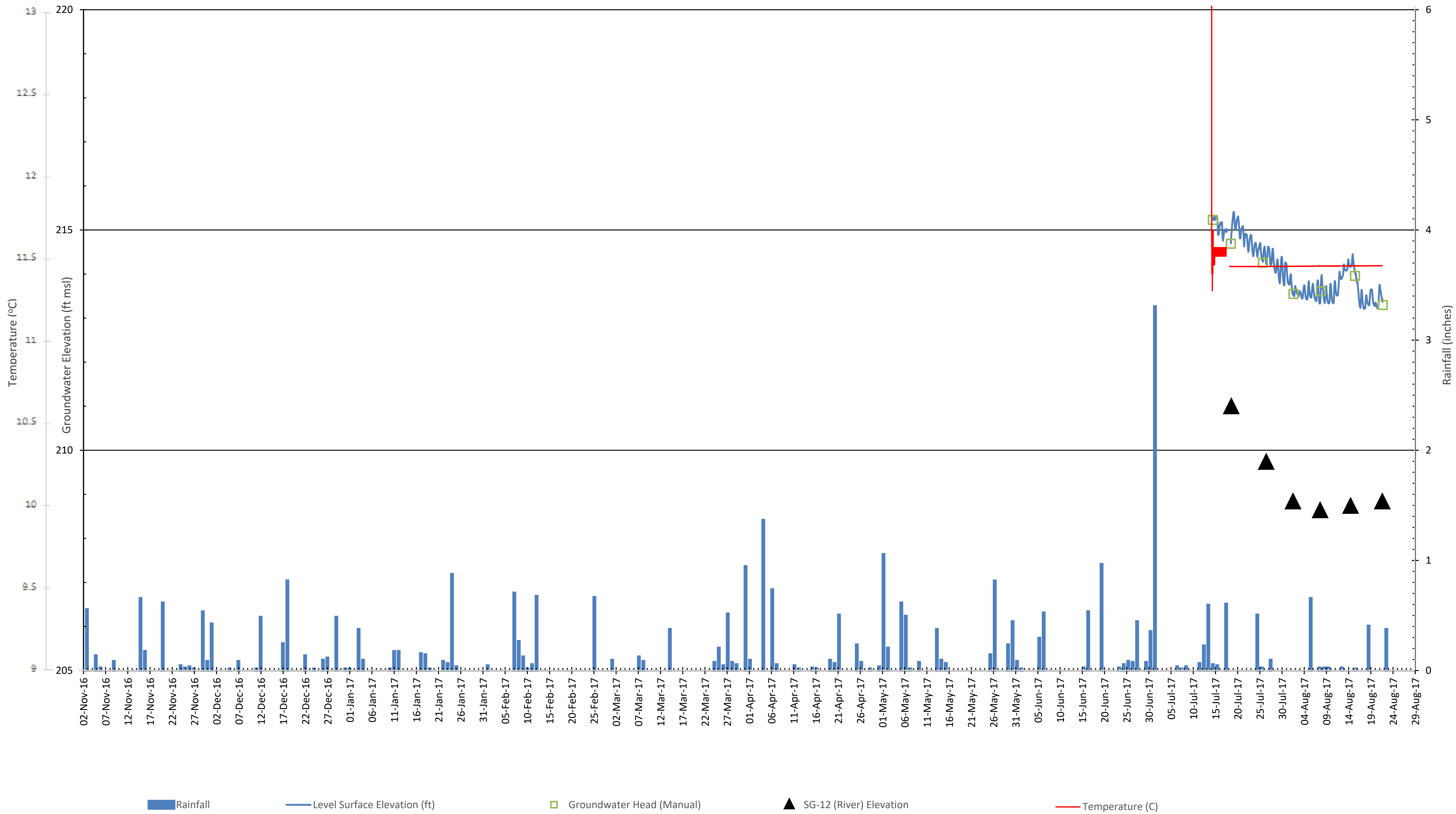
Figure S



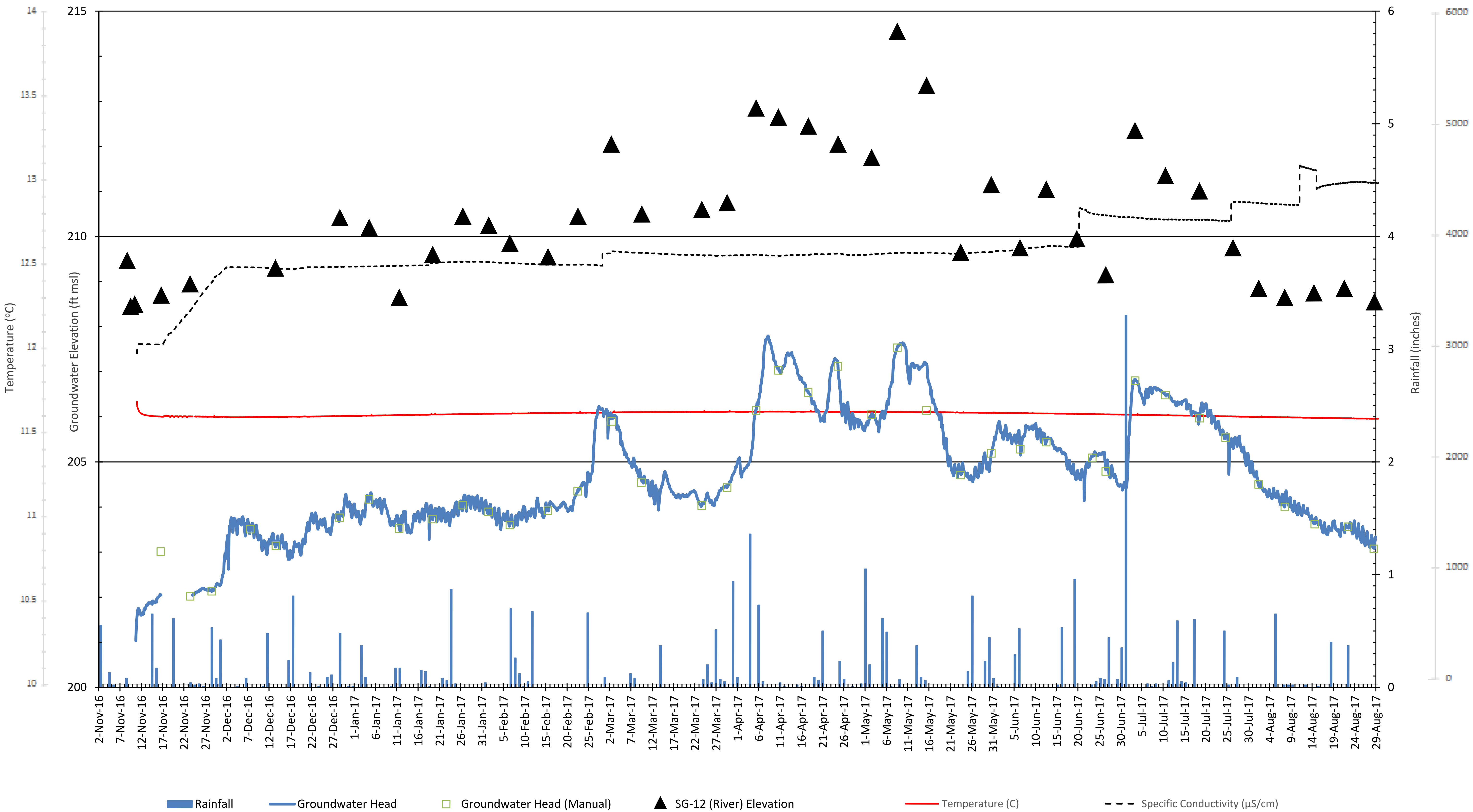
Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well AW-B12 (Intermediate Bedrock)

Figure
T



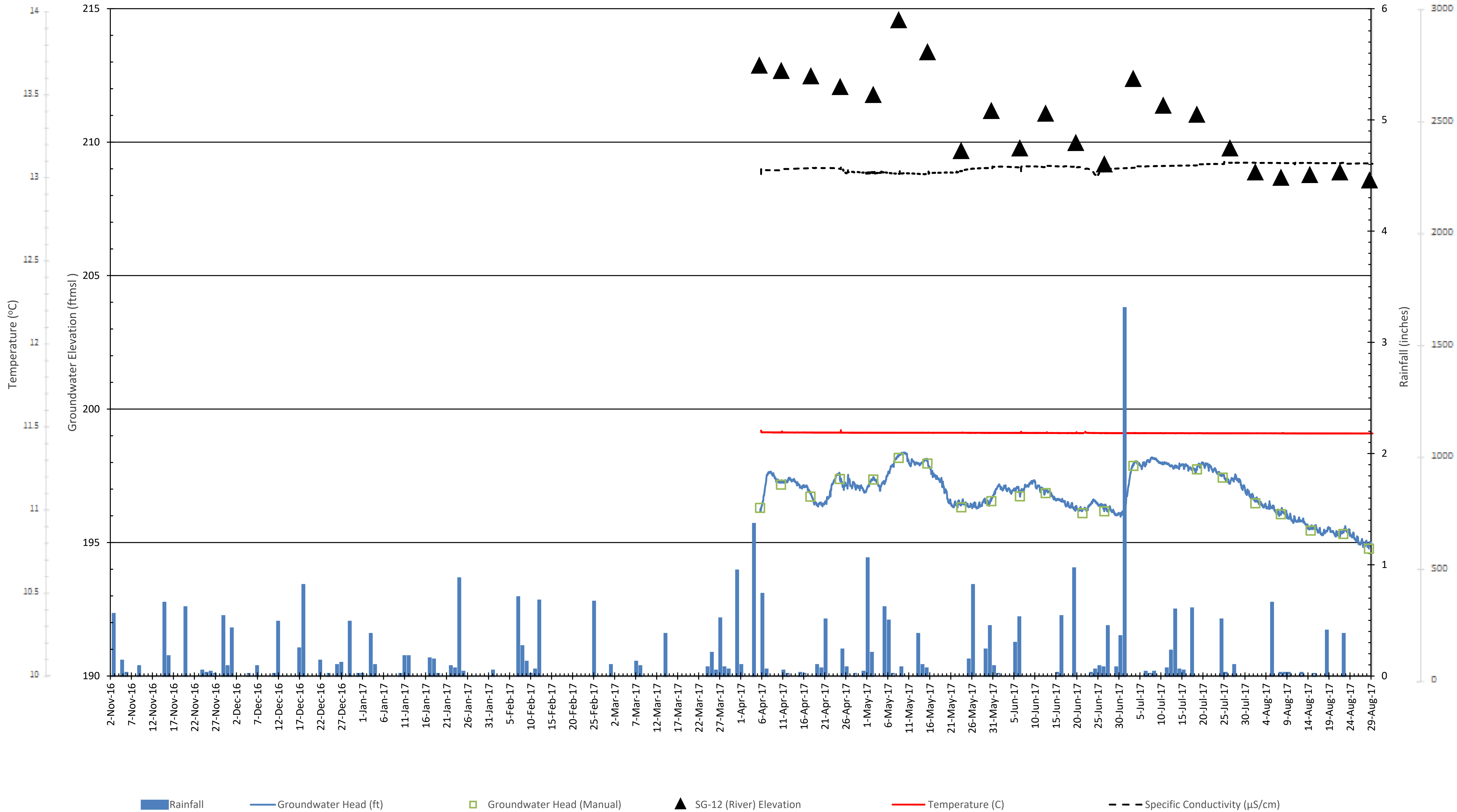
Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support September 2017	**Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: Well EW-B3 (Intermediate Bedrock)**	**Figure U**



Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: EW-B5 (Intermediate Bedrock)

Figure V



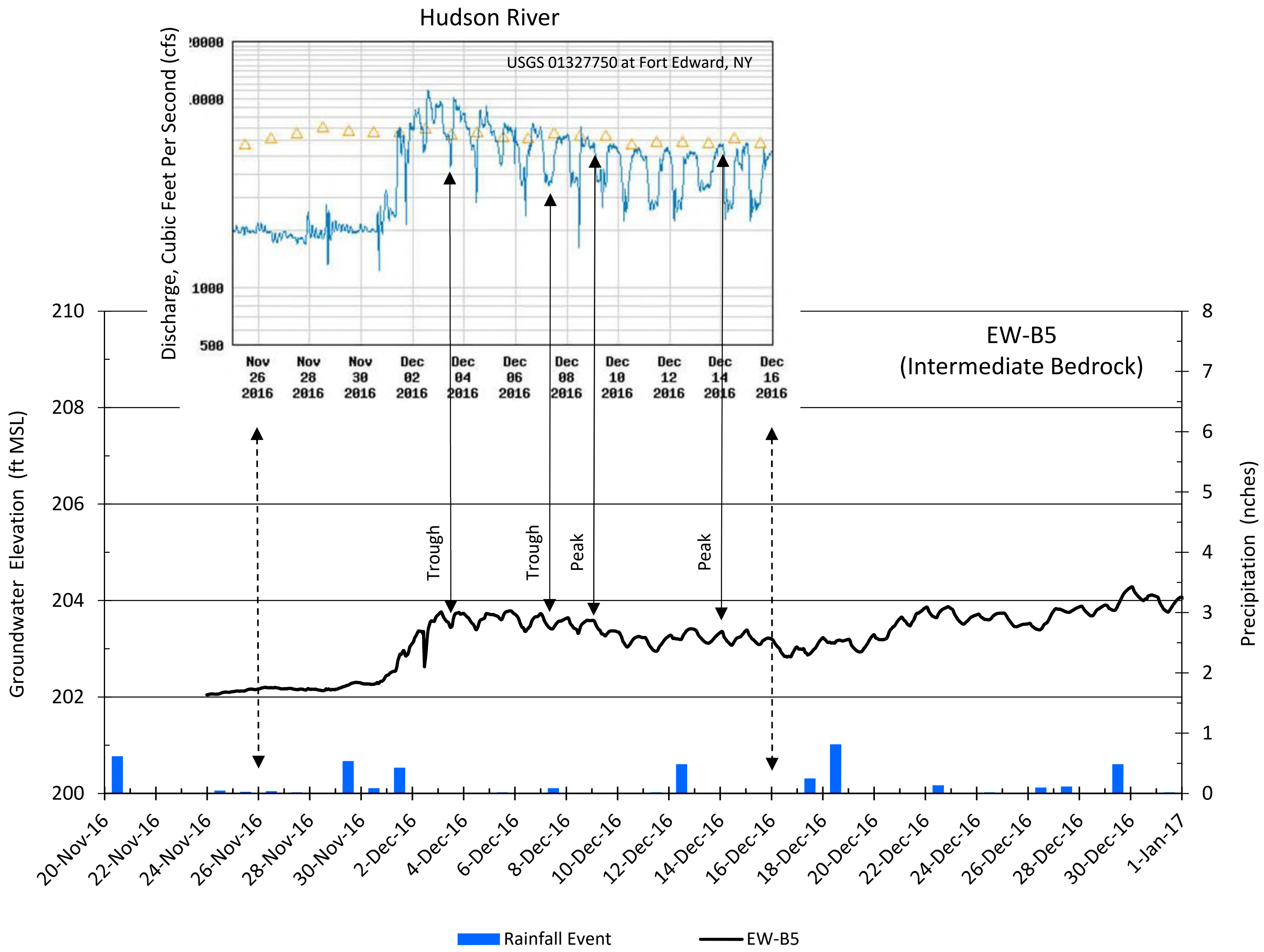
Former Ciba-Geigy / Hercules
Glens Falls, NY
EHS Support September 2017

Groundwater Hydrograph, Temperature, and Specific Conductivity Plots: AW-C11 (Deep Bedrock)

Figure W

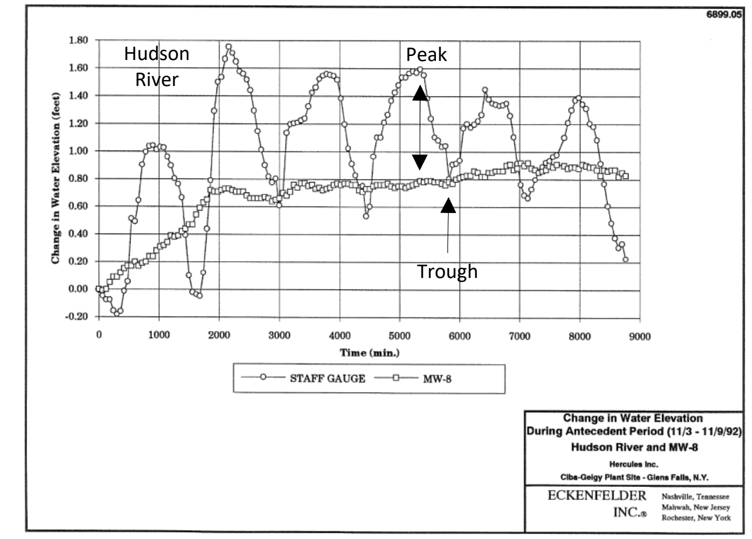
Appendix H
Supplemental Evaluations by EHS Support in 2018

Inset A: Hudson River Stage Compared to Well EW-B5 Hydraulic Head (Dec. 2016)

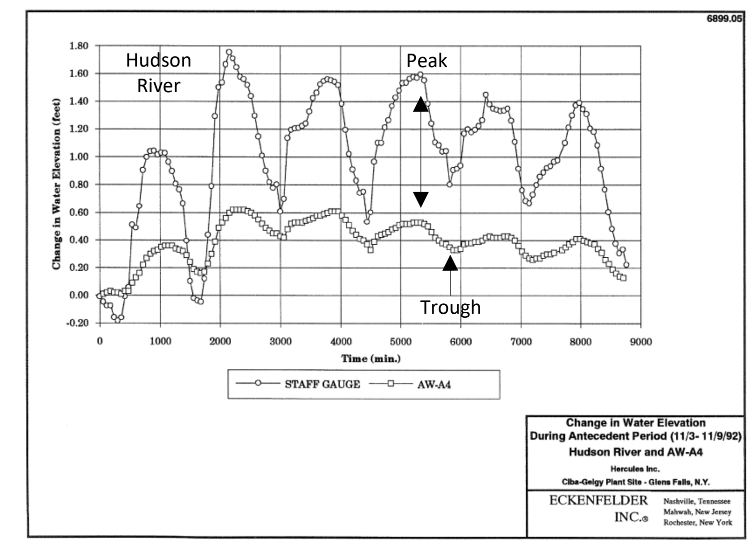


Inset B: Hudson River Stage Compared to Wells MW-8, AW-A4 and MW-27D Hydraulic Heads (Nov. 1992)

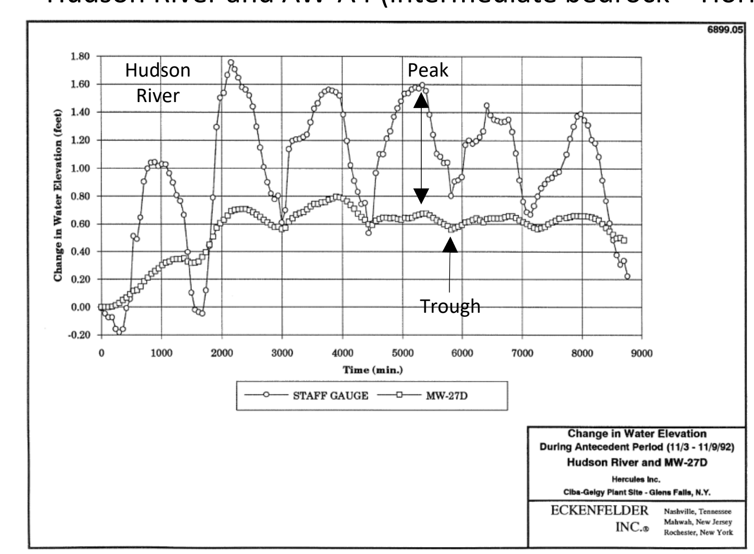
Hudson River and MW-8 (shallow bedrock – Horizon A)



Hudson River and AW-A4 (shallow bedrock – Horizon A)

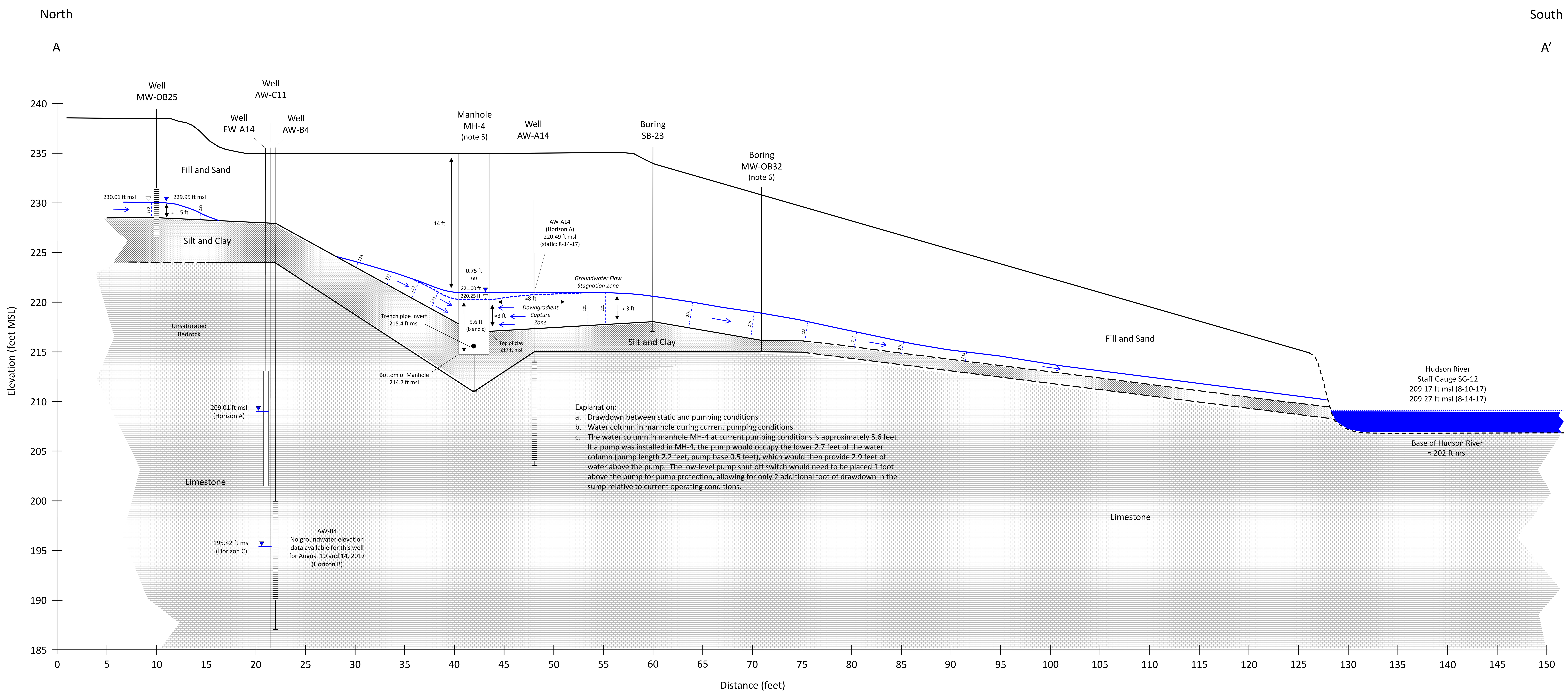


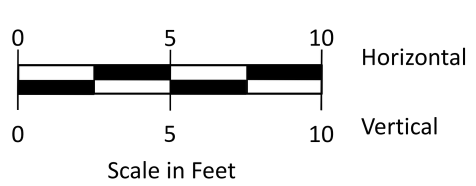
Hudson River and AW-A4 (intermediate bedrock – Horizon B)



Explanation:

- The diurnal hydraulic head fluctuations observed in the monitoring well transducer data presented in Inset A and Inset B are caused by the Hudson River stage fluctuations due to daily water releases from the power plants/dam structures located upstream from the Site; which provides water to the river and feeder canals. This interpretation is supported by:
  1. The peaks and troughs of the diurnal river stage fluctuations measured at USGS station 01327750 at Fort Edward, New York aligns exactly with the diurnal fluctuations measured at intermediated bedrock well EW-B5 (Inset A). In addition, the data collected from the other Remedy Optimization Report (ROR) study wells (EHS Support, 2017) monitored with a transducer that exhibit the hydraulic head fluctuations were compared to the river stage data and it's been confirmed that the diurnal fluctuations observed in this data correlates with the river stage data; and
  2. In 1992, Eckenfelder Inc. conducted a hydraulic study using transducers to collect continuous hydraulic head elevations of the Hudson River and the Site's groundwater system. The transducer data shows the peaks and troughs of the diurnal river stage fluctuations aligning with the diurnal fluctuations measured in the groundwater. Inset B presents three hydrographs examples showing the correlation of the Hudson River stage fluctuations with the shallow bedrock and intermediated bedrock wells hydraulic head fluctuations.
- The source of the data presented in Inset B is from the RCRA Facility Investigation Report for Groundwater Ciba-Geigy Site, Glens Falls, New York, by Eckenfelder Engineering dated March 1993.





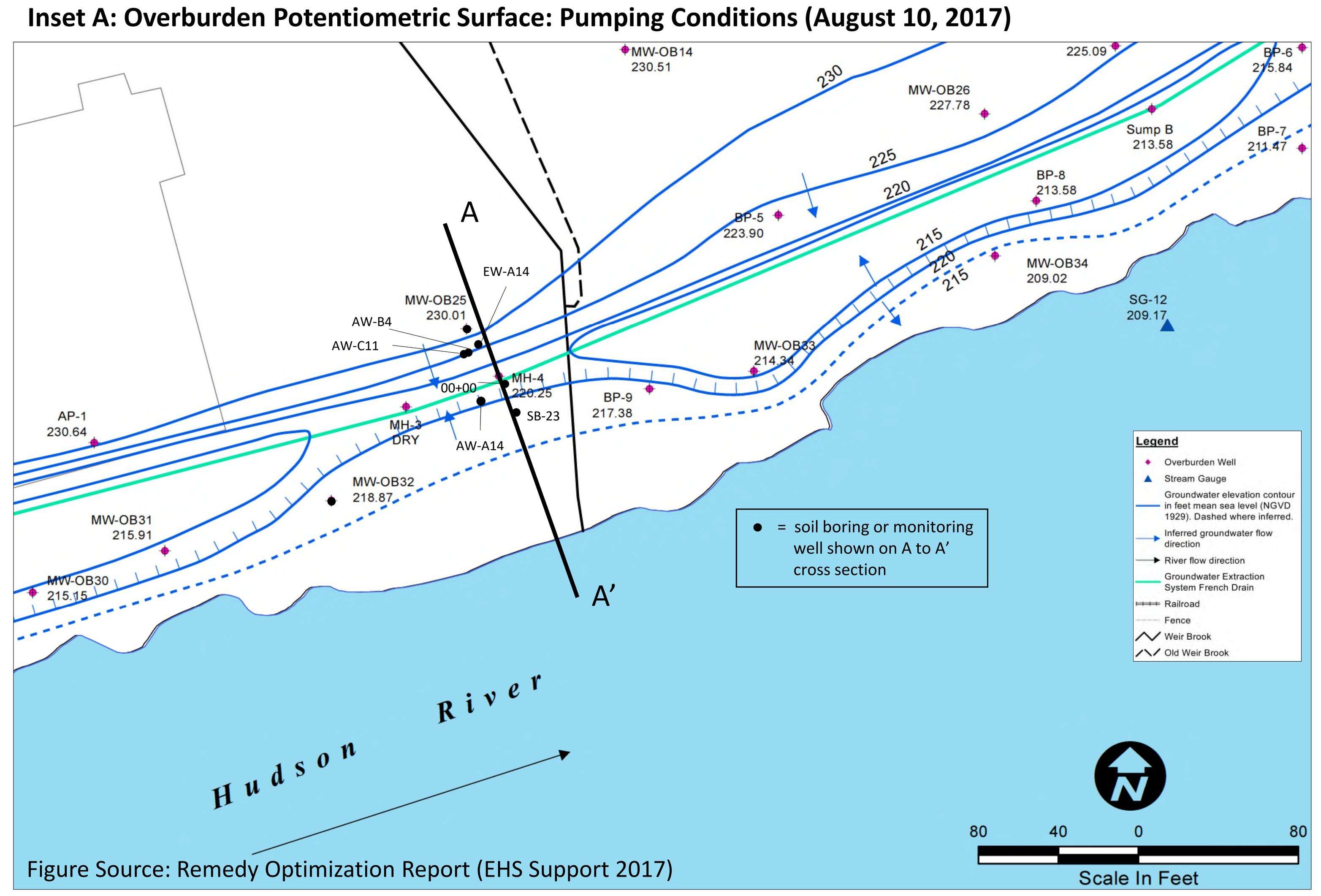
Notes:

1. Cross-section A to A' is a match point cross section along profile present on Insets A and B.
2. Pumping conditions: groundwater elevations measured on August 10, 2017
3. Static groundwater conditions: groundwater elevations measured on August 14, 2017
4. Groundwater elevation in feet above mean sea level (ft msl)
5. Lithology at Manhole MH-4 based on soil boring 10-10
6. Lithology at MW-OB32 in cross-section A to A' based on extrapolation of boring MW-OB32 (see Inset A and Inset B for actual location of boring MW-OB32).

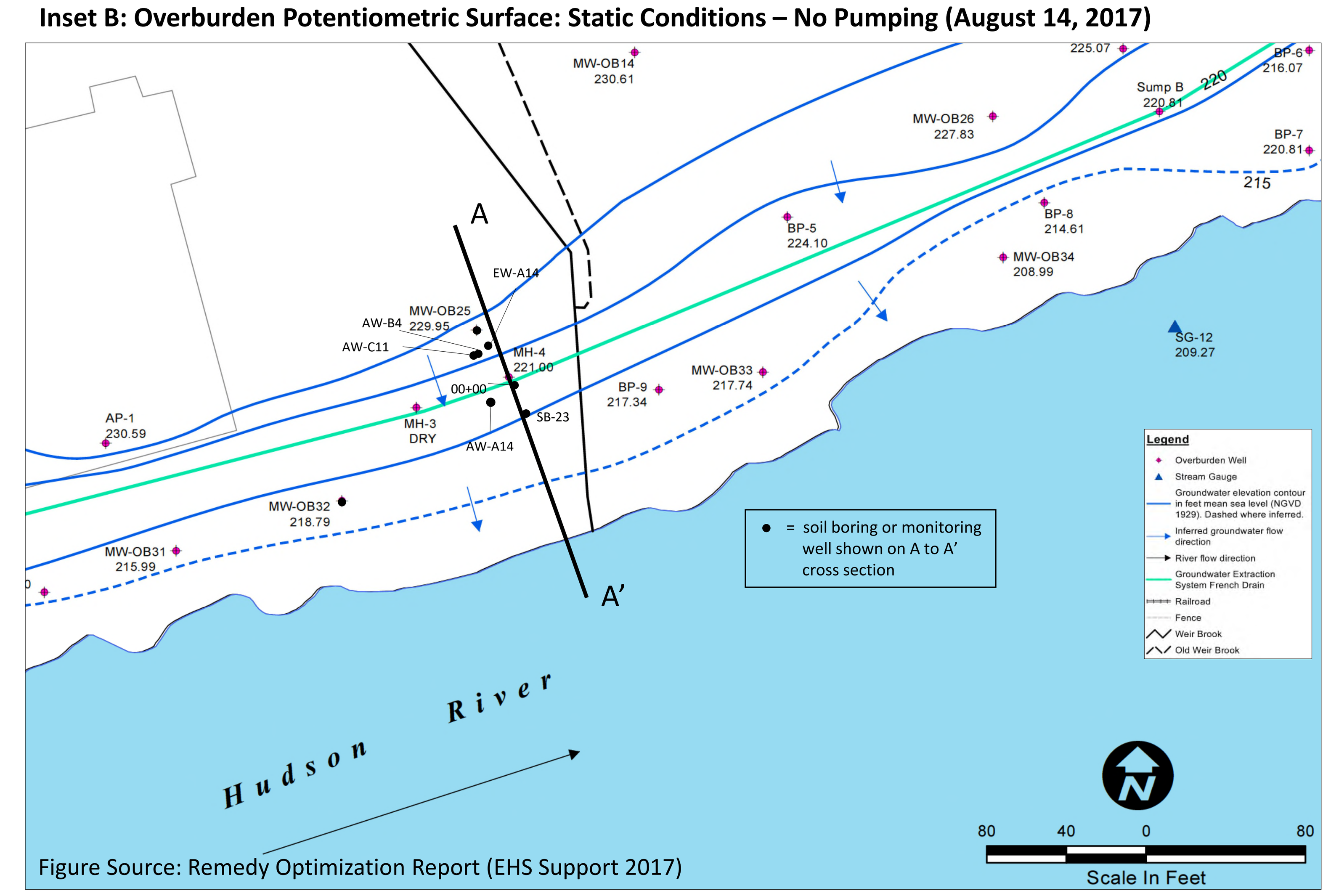
Legend

- Well screen interval
- Well open borehole interval
- ▽ Pumping conditions: groundwater elevation August 10, 2017
- Pumping conditions: groundwter elevation, August 10, 2017
- ▼ Static conditions: groundwater elevation, August 14, 2017
- Static conditions: groundwater elevation, August 14, 2017
- → Groundwater flow direction during pumping conditions, August 10, 2017
- 229 Groundwater equipotential during pumping conditions, August 10, 2017. Equipotential lines in one foot contours, ft msl

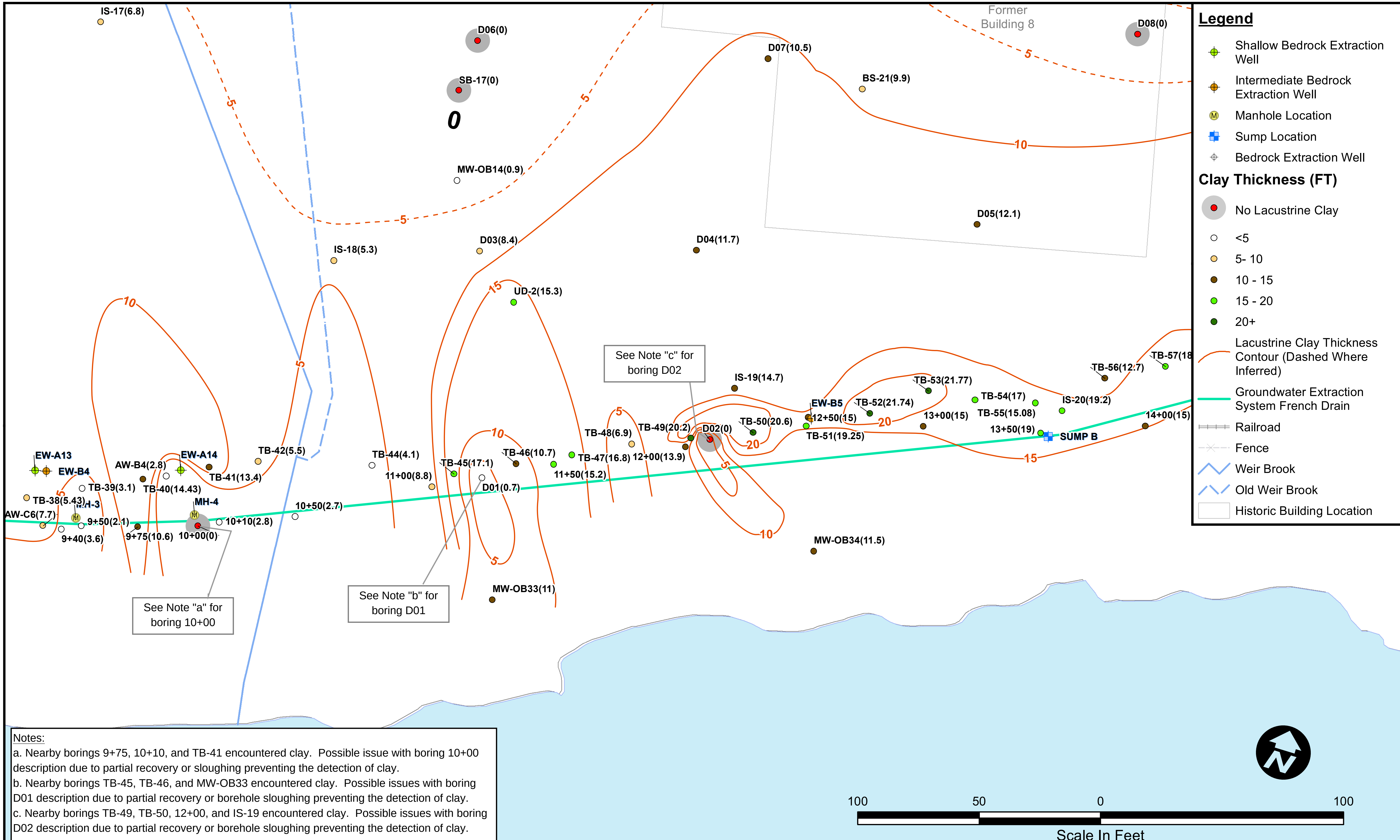
Inset A: Overburden Potentiometric Surface: Pumping Conditions (August 10, 2017)



Inset B: Overburden Potentiometric Surface: Static Conditions – No Pumping (August 14, 2017)



Former Ciba-Geigy / Hercules Glens Falls, NY EHS Support January 2019	**Hydrogeologic Cross Section at Manhole MH-4 (A to A')**	**Figure H-2**



Notes:

a. Nearby borings 9+75, 10+10, and TB-41 encountered clay. Possible issue with boring 10+00 description due to partial recovery or sloughing preventing the detection of clay.

b. Nearby borings TB-45, TB-46, and MW-OB33 encountered clay. Possible issues with boring D01 description due to partial recovery or borehole sloughing preventing the detection of clay.

c. Nearby borings TB-49, TB-50, 12+00, and IS-19 encountered clay. Possible issues with boring D02 description due to partial recovery or borehole sloughing preventing the detection of clay.

EHS Support *consider it done*

ASHLAND
FORMER CIBA-GEIGY / HERCULES SITE
GLENS FALLS, NY

CLAY THICKNESSES BETWEEN MH-4 AND SUMP B

Figure H-3

J:\EHSS_GIS\C16262_GlensFallsHudsonRiver\01_ANALYSIS\20160509_RemOpRpt\ClayThicknessAreas_SumpB.mxd

Printed 1/23/2019 9:50:28 AM by Alex.Smith

EHS Support consider it done

Well ID: MWOB-33

Project / Site: Glens Falls NY	
Location / Address: 89 Lower Warren St., Queensbury, NY 12804	
Date Started: 11/18/2015	Date Finished: 11/18/2015
Ground Surface Elevation (ft msl): 221.28	Top of Casing Elevation (ft msl): 224.026
Easting: 73.61036591	Northing: 43.30771435 / Total Depth (ft): 26
Drilling Method: Direct Push/Hollow Stem Auger	Borehole Diameter (in): 8"
Rig Type: Geoprobe 3230 DT	Casing Diameter (in) / Type: 6 1/4" Earth Auger Bit
Drilling Co.: Aztech Technologies, Inc.	Sampler Dia. / Type: 1.75" Macro-core (5') (AS)
Drilled by: Bob Gannon	Logged by: C. Gebhard

Sketch Map

Client: Ashland Inc.
Project Number: C16262_2016-3070
EHS Support PM: Arlene Lillie

Elevation (ft msl)	Depth (ft)	Lithologic Column	Lithologic Description	Sample Number	Sampler Type	Recovery (ft)	PID ppm (Headspace)	Well Diagram	Notes
	0–0.5		Olive tan to gray CLAY (CL), little silt, stiff, dry, high plasticity, cohesive	1	5' AS	2.2	0 (0.5)		Boring originally advanced with 2" macrocore barrel and over drilled with 4 1/4" hollow stem augers
	0.5–2.2		Orangish brown fine to medium SAND (SP), little silt, moderately loose, dry, non-plastic, non-cohesive				0 (1.5)		Brick fragments identified from 2.0 to 2.1 ft. bgs Green staining identified at 2.2 ft. bgs
	2.2–5		No Recovery				0 (2.5), 0 (3.5), 0 (4.5)		
	5–6.5		Yellowish brown fine to coarse SAND (SW), trace fine gravel and silt, loose, moist, non-plastic, non-cohesive	2	5' AS	1.5	0 (5.5), 0 (6.5)		
	6.5–10		No Recovery				0 (7.5), 0 (8.5), 0 (9.5)		
	10–10.6		Yellowish brown fine to coarse SAND (SW), trace fine gravel and silt, loose, moist, non-plastic, non-cohesive	3	5' AS	0.6	0 (10.5)		
	10.6–15		No Recovery				0 (11.5), 0 (12.5), 0 (13.5), 0 (14.5)		
	15–16		Gray CLAY (CL), moderately stiff, wet, high plasticity, cohesive				0 (15.5)		

WELL CONSTRUCTION

Concrete	Sand
Bentonite	Riser
Grout	Screen

Sch. 40 PVC 2-inch ID
Screen 0.006-inch slotted

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): 10.0
Depth to water in borehole after drilling (ft bTOC): 7.75

Boring: MWOB-33

EHS Support consider it done

Elevation (ft msl)	Depth (ft)	Lithologic Column	Lithologic Description	Sample Number	Sampler Type	Recovery (ft)	PID ppm (Headspace)	Well Diagram	Notes
	16–25.5		Gray CLAY (CL), moderately stiff, wet, high plasticity, cohesive	4	5' AS	5	0, 0, 0, 0		
				5	5' AS	5	0, 0, 0, 0, 0		Boring converted into 2" monitoring well MWOB-33
	25.5–26		Black LIMESTONE	6	5' AS	1	0		Geoprobe encountered refusal due to bedrock at 26 ft. bgs

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to Water in borehole during drilling (ft bgs): 10.0

Depth to Water in borehole after drilling (ft bTOC): 7.75

Boring: MWOB-33

EHS Support consider it done

SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.:	Drilling Location:	Project/Client:	Project No.:
TB-42	French Drain Borings	Ashland / Glens Falls, NY	2430805419
		Site Contact:	

Contractor:	Aztech Technologies, Inc.	Site Location:	PID Backgr.(ppm): 0.0
Crew:	Date: 10/25/13	89 Lower Warren Street, Queensbury, NY	PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Bryan Reles	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
1	0-5	40	0.0				Topsoil	0.75'
			0.0	1.0			Brown f-m SAND	
								1.4'
				2.0			Brown f-m SAND with cobbles	
				3.0				
				4.0				
			0.0	5.0				5.0'
2	5-10	50	0.0				Dark brown f-m SAND some silt f-c gravel	
				6.0				
				7.0				7.0'
							Light brown f-c SAND little silt little gravel, moist	
				8.0				
				9.0				
			0.0	10.0				
3	10-15	0						
				11.0				
				12.0				
				13.0				
				14.0				
				15.0				15.0'
4	15-20	15	0.0				Red SILT	15.3'
			0.0	16.0			Brown f-m SAND and SILT and CLAY little f-m gravel	
				17.0				
				18.0				
				19.0				
			0.0	20.0				

Monitoring Well Construction	Soil Characterization
Concrete	Topsoil
Well Casing	Primarily Sand
Screen (0.01 slotted)	Primarily Silt
Sand Pack (quartz)	Primarily Clay
Bentonite	Bedrock
Grout	Heterogeneous Mixture
Static Water Level	Fill Material
	Saturated Soil Depth

Well Construction Detail:

Boring Depth:	28.5'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

anteagroup
5788 Widewaters Pkwy., Syracuse, NY 13214
phone: (800) 477-7411 Fax: (315) 445-0793

SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-42	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/25/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Bryan Reles	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
5	20-25	80	0.0				Black f SAND and SILT	
				21.0				
				22.0				
								22.5'
			0.0	23.0			Grey f-m SAND and SILT and CLAY	23.0'
							Grey CLAY	
			0.0	24.0				
				25.0				
				26.0				
				27.0				
				28.0				
								28.5'
				29.0			Bedrock encountered at 28.5' bgs	
				30.0				
				31.0				
				32.0				
				33.0				
				34.0				
				35.0				
				36.0				
				37.0				
				38.0				
				39.0				
				40.0				

Monitoring Well Construction

- Concrete
- Well Casing
- Screen (0.01 slotted)
- Sand Pack (quartz)
- Bentonite
- Grout
- Static Water Level

Soil Characterization

- Topsoil
- Primarily Sand
- Primarily Silt
- Primarily Clay
- Bedrock
- Heterogeneous Mixture
- Fill Material
- Saturated Soil Depth

Well Construction Detail:

Boring Depth:	28.5'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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phone: (800) 477-7411 Fax: (315) 445-0793

SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-43	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/25/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Bryan Reles	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
1	0-5	100	0.0				Topsoil	0.75'
			0.0	1.0			Brown f-m SAND	
								1.4'
				2.0			Brown f-m SAND and SILT, pieces of brick and concrete	2.2'
							Brown f-m SAND	
				3.0				
				4.0				
								4.9'
			0.0	5.0			Dark brown f-m SAND some f-m gravel	5.0'
2	5-10	60	0.0				Brown transitioning to black f-m SAND some silt and clay little f-m	
				6.0			gravel, red dye deposits	
				7.0				
				8.0				
				9.0				
			0.0	10.0				10.0'
3	10-15	40	0.0				Black brown SAND, red dye deposits	
				11.0				
				12.0				
				13.0				
				14.0				
			0.0	15.0				15.0'
4	15-20	60	0.0				Red orange SILT, red dye deposits and pieces of concrete and brick	
				16.0				
				17.0				
				18.0				
			0.0					
				19.0				
				20.0				

Monitoring Well Construction
- Concrete
- Well Casing
- Screen (0.01 slotted)
- Sand Pack (quartz)
- Bentonite
- Grout
- Static Water Level

Soil Characterization
- Topsoil
- Primarily Sand
- Primarily Silt
- Primarily Clay
- Bedrock
- Heterogeneous Mixture
- Fill Material
- Saturated Soil Depth

Well Construction Detail:

Boring Depth:	28.55'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-43	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/25/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Bryan Reles	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
5	20-25	70	0.0				Grey brown f-c SAND and CLAY, saturated	
				21.0				
				22.0				
								22.5'
				23.0			Black f SAND	
				24.0				
			0.0	25.0				
6	25-30	65	0.0					
				26.0				
				27.0				
				28.0				
			0.0					28.55'
				29.0			Refusal encountered at 28.55' bgs	
				30.0				
				31.0				
				32.0				
				33.0				
				34.0				
				35.0				
				36.0				
				37.0				
				38.0				
				39.0				
				40.0				

Monitoring Well Construction

- Concrete
- Well Casing
- Screen (0.01 slotted)
- Sand Pack (quartz)
- Bentonite
- Grout
- Static Water Level

Soil Characterization

- Topsoil
- Primarily Sand
- Primarily Silt
- Primarily Clay
- Bedrock
- Heterogeneous Mixture
- Fill Material
- Saturated Soil Depth

Well Construction Detail:

Boring Depth:	28.55'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-44	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
1	0-5	60	0.0				Topsoil	0.7'
			0.0	1.0			Brown f-m SAND, pieces of brick and concrete	
				2.0				
				3.0				3.0'
							Brown f-m SAND some grey clay some cobbles	3.1'
				4.0				
			0.0	5.0				5.0'
2	5-10	50	0.0				Dark brown f-m SAND some silt, moist, pieces of brick and concrete	
				6.0				
				7.0				
				8.0				
				9.0				
			0.0	10.0				
3	10-15	80	0.0					10.5'
				11.0			Light brown f-c SAND little silt some clay and gravel, pieces of brick and concrete	11.5'
				12.0			Brown f-c SAND some clay and gravel, saturated	
				13.0				
				14.0				
			0.0	15.0				15.0'
4	15-20	80	0.0				Brown f-c SAND some clay and gravel, saturated	15.1'
				16.0			Brown f-m SAND some clay, red dye desposits	
				17.0				
				18.0				
				19.0				
			0.0	20.0				

Monitoring Well Construction	Soil Characterization
Concrete	Topsoil
Well Casing	Primarily Sand
Screen (0.01 slotted)	Primarily Silt
Sand Pack (quartz)	Primarily Clay
Bentonite	Bedrock
Grout	Heterogeneous Mixture
Static Water Level	Fill Material
	Saturated Soil Depth

Well Construction Detail:

Boring Depth:	29.1'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-44	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
5	20-25	70	0.0				Brown f-m SAND some clay, red dye deposits	
				21.0				20.75'
							Dark brown to black f-m SAND, saturated	
				22.0				
								22.5'
				23.0			Dark brown to black f-m SAND with clay, saturated	
				24.0				
			0.0	25.0				25.0'
6	25-30	100	0.0				Dark grey CLAY	
				26.0				
				27.0				
				28.0				
				29.0				29.1'
							Bedrock encountered at 29.1' bgs	
				30.0				
				31.0				
				32.0				
				33.0				
				34.0				
				35.0				
				36.0				
				37.0				
				38.0				
				39.0				
				40.0				

Monitoring Well Construction
- Concrete
- Well Casing
- Screen (0.01 slotted)
- Sand Pack (quartz)
- Bentonite
- Grout
- Static Water Level

Soil Characterization
- Topsoil
- Primarily Sand
- Primarily Silt
- Primarily Clay
- Bedrock
- Heterogeneous Mixture
- Fill Material
- Saturated Soil Depth

Well Construction Detail:

Boring Depth:	29.1'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-45	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
1	0-5	50	0.0				Topsoil	0.6'
			0.0	1.0			Brown f-c SAND, pieces of brick and concrete	
				2.0				
				3.0				
				4.0				
			0.0	5.0				5.0'
2	5-10	50	0.0				Brown f-c SAND some gravel and clay, pieces of concrete	5.3'
				6.0			Blackish brown f-m SAND some gravel little silt, saturated, pieces of concrete	
				7.0				
				8.0				
				9.0				
			0.0	10.0				
3	10-15	80	0.0					
				11.0				
				12.0				
			0.0	13.0				13.0'
			0.0				Brown CLAY	
				14.0				
			0.0	15.0				15.0'
4	15-20	60	0.0				Brown to grey CLAY, saturated	
				16.0				
				17.0				
				18.0				
				19.0				
			0.0	20.0				

Monitoring Well Construction	Soil Characterization
Concrete	Topsoil
Well Casing	Primarily Sand
Screen (0.01 slotted)	Primarily Silt
Sand Pack (quartz)	Primarily Clay
Bentonite	Bedrock
Grout	Heterogeneous Mixture
Static Water Level	Fill Material
	Saturated Soil Depth

Well Construction Detail:

Boring Depth:	30.1'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-45	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
5	20-25	20	0.0				Brown to grey CLAY, saturated	
				21.0				
				22.0				
				23.0				
				24.0				
			0.0	25.0				
6	25-30	100	0.0					
				26.0				
				27.0				
				28.0				
				29.0				
			0.0	30.0				30.1'
							Refusal encountered at 30.1' bgs	
				31.0				
				32.0				
				33.0				
				34.0				
				35.0				
				36.0				
				37.0				
				38.0				
				39.0				
				40.0				

Monitoring Well Construction	Soil Characterization
Concrete	Topsoil
Well Casing	Primarily Sand
Screen (0.01 slotted)	Primarily Silt
Sand Pack (quartz)	Primarily Clay
Bentonite	Bedrock
Grout	Heterogeneous Mixture
Static Water Level	Fill Material
	Saturated Soil Depth

Well Construction Detail:

Boring Depth:	30.1'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-46	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
1	0-5	60	0.0		Topsoil		Topsoil	0.75'
			0.0	1.0	Primarily Sand		Brown f-c SAND, pieces of concrete and brick	
				2.0				
				3.0				
				4.0				
			0.0	5.0			Moist at 5'	
2	5-10	50	0.0					
				6.0				
				7.0				
				8.0				
				9.0				
			0.0	10.0				
3	10-15	100	0.0					10.1'
				11.0			Light brown f-c SAND little gravel, moist	10.9'
							Dark brown f-m SAND some gravel little silt	
				12.0				
							~saturated at 12.6'	
				13.0				
				14.0				
			0.0	15.0				15.0'
4	15-20	100	0.0				Dark brown transitioning to brown f-m SAND some gravel little silt, saturated	
				16.0				
				17.0				
				18.0				
				19.0				
			0.0	20.0				

Monitoring Well Construction
- Concrete
- Well Casing
- Screen (0.01 slotted)
- Sand Pack (quartz)
- Bentonite
- Grout
- Static Water Level

Soil Characterization
- Topsoil
- Primarily Sand
- Primarily Silt
- Primarily Clay
- Bedrock
- Heterogeneous Mixture
- Fill Material
- Saturated Soil Depth

Well Construction Detail:

Boring Depth:	32.7'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-46	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY Site Contact:	Project No.: 2430805419

Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY		PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13			PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point):	NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point):	NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)		
Sample Submission: NA		Drill rig: Geoprobe Static water depth: NA		

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Sample Description	Ending Depth
5	20-25	100	0.0			
				21.0		
			0.0	22.0		22.0'
			0.0		Grey CLAY	
				23.0		
				24.0		
			0.0	25.0		
6	25-30	0				
				26.0		
				27.0		
				28.0		
				29.0		
				30.0		
7	30-35	0				
				31.0		
				32.0		
				33.0		32.7'
					Refusal encountered at 32.7' bgs	
				34.0		
				35.0		
				36.0		
				37.0		
				38.0		
				39.0		
				40.0		

Monitoring Well Construction: Concrete; Well Casing; Screen (0.01 slotted); Sand Pack (quartz); Bentonite; Grout; Static Water Level

Soil Characterization: Topsoil; Primarily Sand; Primarily Silt; Primarily Clay; Bedrock; Heterogeneous Mixture; Fill Material; Saturated Soil Depth

Well Construction Detail:

Boring Depth:	32.7'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-49	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
1	0-5	60	0.0				Topsoil	
			0.0	1.0				0.9'
							Brown f-c SAND some cobbles	
				2.0				
				3.0				
				4.0				
			0.0	5.0				
2	5-10	80	0.0					
				6.0				6.0'
							Dark brown f-c SAND some gravel, moist, pieces of brick	
				7.0				
				8.0				
								8.5'
				9.0			Brown Gravel	
			0.0	10.0				
3	10-15	75	0.0					10.5'
				11.0			Light brown f-c SAND, pieces of wood debris	11.0'
							Dark brown to black f-c SAND some silt and gravel, multi-colored	
				12.0			dye deposits, pieces of concrete	
				13.0				
				14.0				
			0.0	15.0			Moist at 15'	
4	15-20	80	0.0					
				16.0				
				17.0				17.2'
							Grey CLAY, saturated	
				18.0				
				19.0				
			0.0	20.0				

Monitoring Well Construction	Soil Characterization
Concrete	Topsoil
Well Casing	Primarily Sand
Screen (0.01 slotted)	Primarily Silt
Sand Pack (quartz)	Primarily Clay
Bentonite	Bedrock
Grout	Heterogeneous Mixture
Static Water Level	Fill Material
	Saturated Soil Depth

Well Construction Detail:

Boring Depth:	37.45'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-49	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	

Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/28/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
5	20-25	10	0.0				Grey CLAY, saturated	
				21.0				
				22.0				
				23.0				
				24.0				
			0.0	25.0				
6	25-30	5	0.0					
				26.0				
				27.0				
				28.0				
				29.0				
			0.0	30.0				
7	30-35	0	0.0					
				31.0				
				32.0				
				33.0				
				34.0				
			0.0	35.0				
8	35-40	5	0.0					
				36.0				
				37.0				
			0.0					37.45'
				38.0			Bedrock encountered at 37.45' bgs	
				39.0				
				40.0				

Monitoring Well Construction
- Concrete
- Well Casing
- Screen (0.01 slotted)
- Sand Pack (quartz)
- Bentonite
- Grout
- Static Water Level

Soil Characterization
- Topsoil
- Primarily Sand
- Primarily Silt
- Primarily Clay
- Bedrock
- Heterogeneous Mixture
- Fill Material
- Saturated Soil Depth

Well Construction Detail:

Boring Depth:	37.45'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.:	Drilling Location:	Project/Client:	Project No.:
TB-50	French Drain Borings	Ashland / Glens Falls, NY	2430805419
		Site Contact:	

Contractor:	Aztech Technologies, Inc.	Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/31/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
1	0-5	100	0.0		Topsoil		Topsoil	
			0.0	1.0				0.9'
					Primarily Sand		Brown f-c SAND some cobbles	
				2.0				
				3.0				
				4.0				
			0.0	5.0				5.0'
2	5-10	60	0.0		Primarily Sand		Brown to black f-c SAND little gravel, red dye deposits, pieces of brick	
				6.0				
				7.0				6.9'
					Fill Material		Grey CLAY	
				8.0				
				9.0				
			0.0	10.0				10.0'
3	10-15	50	0.0		Primarily Sand		Dark brown to black f-c SAND with gravel little silt, moist, pieces of brick and concrete	
				11.0				
				12.0				
				13.0				
				14.0				
			0.0	15.0				
4	15-20	90	0.0					
				16.0				
				17.0				17.2'
					Primarily Clay		Brownish grey CLAY, saturated	
				18.0				
				19.0				
			0.0	20.0				

Monitoring Well Construction
- Concrete
- Well Casing
- Screen (0.01 slotted)
- Sand Pack (quartz)
- Bentonite
- Grout
- Static Water Level

Soil Characterization
- Topsoil
- Primarily Sand
- Primarily Silt
- Primarily Clay
- Bedrock
- Heterogeneous Mixture
- Fill Material
- Saturated Soil Depth

Well Construction Detail:

Boring Depth:	37.85'	Well Dia. (ID/OD):		Sand Pack:	NA
Well Depth:	NA	Well Material:		Sand Type:	NA
Screen Depth:	NA	Protective cover:		Bentonite (chips):	NA
Riser Depth:	NA	Riser Height:		Grout:	NA
Screen Type:	NA	Locked:		Grout type:	NA

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5788 Widewaters Pkwy., Syracuse, NY 13214
phone: (800) 477-7411 Fax: (315) 445-0793

SOIL BORING / WELL CONSTRUCTION LOG

MW / SB No.: TB-50	Drilling Location: French Drain Borings	Project/Client: Ashland / Glens Falls, NY	Project No.: 2430805419
		Site Contact:	
Contractor: Aztech Technologies, Inc.		Site Location: 89 Lower Warren Street, Queensbury, NY	PID Backgr.(ppm): 0.0
Crew:	Date: 10/31/13		PID Lamp (eV): 10.6
	Time Start: NA	Weather: NA	Surface Elevation (ft above ref. point): NA
Drill Method: Geoprobe	Time End: NA	Logged By: Luke Gladue	TOC Elevation (ft above ref. point): NA
Sample Method: Macro Core		Notes (Surface Condition, Soil Sample Numbers, Soil Drums, etc)	
Sample Submission: NA		Drill rig: Geoprobe	
		Static water depth: NA	

Sample No.	Depth (feet)	Recovery (%)	PID/FID (ppm)	Depth (feet)	Soil Details	Well Details	Sample Description:	Ending Depth:
5	20-25	40	0.0				Brownish grey CLAY, saturated	
				21.0				
				22.0				
				23.0				
				24.0				
			0.0	25.0				
6	25-30	0	0.0					
				26.0				
				27.0				
				28.0				
				29.0				
			0.0	30.0				
7	30-35	0						
				31.0				
				32.0				
				33.0				
				34.0				
				35.0				
8	35-40	0						
				36.0				
				37.0				
				38.0				37.85'
							Bedrock encountered at 37.85' bgs	
				39.0				
				40.0				

Monitoring Well Construction: Concrete; Well Casing; Screen (0.01 slotted); Sand Pack (quartz); Bentonite; Grout; Static Water Level

Soil Characterization: Topsoil; Primarily Sand; Primarily Silt; Primarily Clay; Bedrock; Heterogeneous Mixture; Fill Material; Saturated Soil Depth

Well Construction Detail:

Boring Depth: 37.85'	Well Dia. (ID/OD):	Sand Pack:	NA
Well Depth: NA	Well Material:	Sand Type:	NA
Screen Depth: NA	Protective cover:	Bentonite (chips):	NA
Riser Depth: NA	Riser Height:	Grout:	NA
Screen Type: NA	Locked:	Grout type:	NA

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ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: 10+50

Project: *French Drain Pilot Borings,Ciba Site,Glen Falls,NY* Project No.: *60415.001*

Client: *Hercules Incorporated*

Start Date: *8/10/98*
Finish Date: *8/10/98*

DRILLING DATA
Inspector: *J.Robinson*
Contractor: *Maxim/ John Leonhardt*
Equipment: *CME 850 Track-Mounted Rig*
Method: *3 1/4" ID HS Augers*

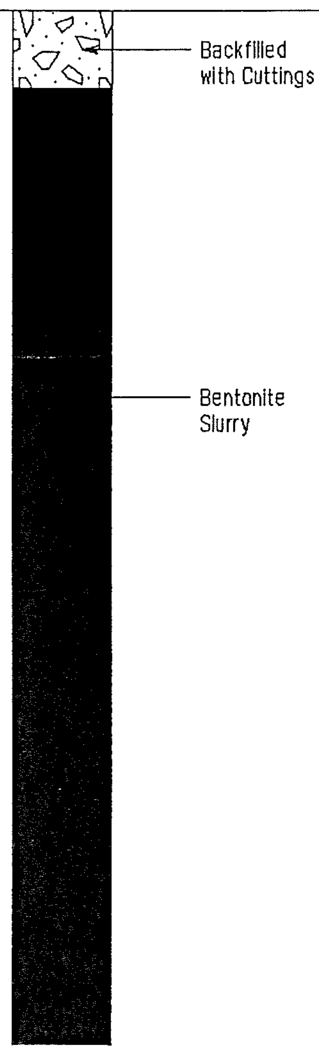
SAMPLING METHODS	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2" ID*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT
Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA DATUM: NGVD 1929, ft
Grade: *235.31*
TWC: *NA*
TPC: *NA*
North: *1206056.9492*
East: *692237.5599*

Geophysical Log: ☐ yes ☒ no
Comments: *NA*



Depth (feet)	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
0	1	1-2-6-5	0.8	GW		FILL Crushed stone. Tan cmf-SAND (0.8)	
	2	4-3-3-4	0.6	NA		Dark red-brown, red, rusty WASTE @ 3.8'-4.0' wet	
5	3	1-2-3-2	1.4	NA			
	4	2-2-3-2	1.6	NA		@ 6'-8' wet	
	5	1-4-2-4	1.7	NA			
10	6	1-2-3-2	2.0	NA		@ 10'-12' some layering	
	7	1-1-3-3	2.0	NA		@ 14' blue layer	
15	8	1-1-1-1	2.0	NA			
	9	1-2-2-1	2.0	NA		(17.3)	
	10	WH-WH-1-1	2.0	SW-SM		LACUSTRINE DEPOSITS Brown mf-SAND, little (-) Silt	
20	11	1-4-5-2	1.8	SW-SM		@ 20' wood (almost lignite) (21.3)	
	12	1-2-6-4	2.0	CL		Gray Silty CLAY (24.0)	
25	13	6-10-12-14	2.0	ML-GM		TILL Gray SILT and GRAVEL (26.7)	
	14	16-100/0.2	1.5			Bedrock at 26.7 feet.	
30							

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: 12+00

Page 1 of

Project: *French Drain Pilot Borings, Ciba Site, Glen Falls, NY*
Project No.: *60415.001*
Client: *Hercules Incorporated*
Start Date: *8/6/98*
Finish Date: *8/6/98*

DRILLING DATA

Inspector: *J.Robinson*
Contractor: *Maxim/ John Leonhardt*
Equipment: *CME 850 Track-Mounted Rig*
Method: *3 1/4" ID HS Augers*

SAMPLING METHODS

	Sampler	Tube	Core
Type:	*Split Spoon*	*NA*	*NA*
Diameter:	*2" ID*	*NA*	*NA*
Other:	*NA*	*NA*	*NA*

WELL CONSTRUCTION

	Riser	Screen
Material:	*NA*	*NA*
Diameter (ID):	*NA*	*NA*
Coupling:	*NA*	*NA*

WELL DEVELOPMENT

Method: *NA*
Duration: *NA*
Gals. Purged: *NA*
Slug Test: *NA* (cm/sec)

SURVEY DATA

DATUM: NGVD 1929, ft
Grade: *233.74*
TWC: *NA*
TPC: *NA*
North: *1206131.2321*
East: *692382.8331*

Geophysical Log: ☐ yes ☒ no
Comments: *NA*

WELL CONSTRUCTION / SAMPLE DATA

Well construction: Backfilled with Cuttings (0–2 ft); Bentonite Slurry (2–30 ft)

Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)
1	15-8-8-6	0.4	GW / SW	
2	6-5-4-3	0.5	SW	
3	2-2-1-2	0.6	SW	
4	3-9-100/0.3	1.8	SW	
5	2-1-2-2	2.0	SM-SC	
6	2-4-2-2	2.0	SM-SC	
7	4-4-3-4	1.8	SM-SC	
8	2-3-2-4	2.0	SM-SC	
9	2-3-3-2	2.0	SM/CL	
10	WH-1-2-3	2.0	CL	
11	2-1-1-2	NA	CL	
12	1-2-2-2	NA	CL	
13	1-2-2-3	NA	CL	
14	3-3-3-4	NA	CL	
15	1-1-2-2	NA	CL	

Depth (feet): 0, 5, 10, 15, 20, 25, 30

VISUAL CLASSIFICATION

FILL
Crushed stone (0–0.5)
Brown, tan cmf-SAND (0.5–7.8)
Concrete (7.8–8.0)
LACUSTRINE DEPOSITS
Interbedded fm-Sand, Silt and Clay:
@ 8.0'-8.9' Brown mf-SAND, little (+) Silt
@ 8.9'-14.2' Brown Clayey SILT with f-Sand and Clay interbeds. saturated
Dark gray CLAY with f-Sand interbeds (0.2' thick)
16.0
Brown f-SAND, some Silt with 0.3' to 0.5' thick Silty Clay interbeds
18.1
Gray CLAY with thin Silt interbeds

REMARKS

@ 7.8' Refusal on concrete. Abandoned hole, shifted location a few feet and started sampling at 8 feet.

ECKENFELDER INC.

Subsurface Boring Log

Well Name/Location: 12+00

Project: *French Drain Pilot Borings,Ciba Site,Glen Falls,NY* Project No.: *60415.001*

Client: *Hercules Incorporated*

Start Date: *8/6/98*

Finish Date: *8/6/98*

(CONTINUATION)

Depth (feet)	WELL CONSTRUCTION	Samp. No. / Run No.	Blows/ 6 in. / Hydraul. Cond. cm/sec	Rec. (ft.)	USCS / RQD	HNU (ppm)	VISUAL CLASSIFICATION	REMARKS
30		16	1-9-8-9	NA	CL		32.0	
		17	9-9-12-100/0.4	NA	ML-GM		TILL Gray SILT and GRAVEL 33.9	
35							Bedrock at 33.9 feet.	
40								
45								
50								
55								
60								
65								
70								

Well ID: D01

Project / Site: Glens Falls NY	
Location / Address: 89 Lower Warren St., Queensbury, NY 12804	
Date Started: 10/29/05	Date Finished: 10/29/05
Ground Surface Elevation (ft msl):	Top of Casing Elevation (ft msl):
Easting:	Northing: / Total Depth (ft): 29.6
Drilling Method: Direct Push	Borehole Diameter (in): 2
Rig Type: GeoProbe 6610	Casing Diameter (in) / Type: Cutting Shoe
Drilling Co.: Aztech Drilling	Sampler Dia. / Type: 5' Acetate Sleeve
Drilled by: Ray Hammond	Logged by: Dani Gugliemotto

Sketch Map

Client: Ashland Inc.

Project Number: C15262

EHS Support PM: Arlene Lillie

Elevation (ft msl)	Depth (ft)	Lithologic Column	Lithologic Description	Sample Number	Sampler Type	Recovery (ft)	PID ppm (Headspace)	Well Diagram	Notes
	0		Grayish brown (10YR 4/3) CLAY (CL), moderately stiff, moderately plastic	1	AS	2.6	0		
	1		Dark yellowish brown (10YR 4/6) fine SAND (SP), trace silt, moderately loose, moist						Trace colorful waste (red) encountered from 0.9 to 2.6 feet bgs
	2		Dark brown (10YR 3/2) fine to medium SAND (SP), trace silt, trace fine gravel, moist						
	3		Very dark gray (10YR 3/1) CLAY (CL), trace fine sand, moderately stiff						
	4		No Recovery						Collected composite soil sample D01(01.6-06.2) from 01.6 to 06.2 feet bgs
	5		Very dark gray (10YR 3/1) CLAY (CL), trace fine sand, moderately soft	2	AS	3	0		
	6		Yellow fine SAND lens						
			Very dark gray (10YR 3/1) CLAY (CL), some silt, trace fine sand, moderately soft						
	7		Black (10YR 2/1) fine to coarse GRAVELLY fine to medium SAND (SW), trace coarse sand, trace silt, moist						
	8		Black (10YR 2/1) fine to coarse GRAVELLY fine SAND (SW), little silt, trace medium to coarse sand, moist						
	9		No Recovery						
	10		Black (10YR 2/1) fine to coarse GRAVELLY fine SAND (SW), little silt, trace medium to coarse sand, moist	3	AS	3	0		
	11		Very dark brown (10YR 2/2) fine to medium SAND (SP), little silt, little fine to coarse gravel, wet						
	12								
	13		No Recovery						
	14								
	15		Very dark brown (10YR 2/2) fine to medium SAND (SP), little silt, little fine to coarse gravel, wet	4	AS	5			
	16								

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): 10.0

Depth to water in borehole after drilling (ft bTOC): ______

Boring: D01

Elevation (ft msl)	Depth (ft)	Lithologic Column	Lithologic Description	Sample Number	Sampler Type	Recovery (ft)	PID ppm (Headspace)	Well Diagram	Notes
	16		Very dark brown (10YR 2/2) fine to medium SAND (SP), little silt, little fine to coarse gravel, wet	4	AS	5	0		
	17–20		Very dark brown (10YR 2/2) fine to medium SAND (SP), some fine to coarse gravel, little silt, trace clay, wet						
	20–22		No Recovery	5	AS	3	0		
	22–23.7		Dark brown (10YR 3/2) fine to medium SAND (SP), trace silt, trace fine gravel, wet						
	24		Very dark brown (10YR 2/2) fine to medium SAND (SP), some fine to coarse gravel, little silt, trace clay, wet						Trace colorful waste (red) encountered from 23.7 to 24.3 feet bgs
	25		Dark gray (10YR 4/1) CLAY (CL), cohesive, plastic						
	25–26		Very dark brown (10YR 2/2) fine to medium SAND (SP), little silt, little fine to coarse gravel, loose, wet	6	AS	4	0		
	26–29.6		Very dark grayish brown (10YR 3/2) fine to medium SAND, wet						Boring backfilled using bentonite chips Geoprobe encountered refusal due to bedrock at 29.6 feet bgs

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to Water in borehole during drilling (ft bgs): 10.0

Depth to Water in borehole after drilling (ft bgs): _______

Boring: D01

EHS Support consider it done

EHS Support consider it done

Well ID: D02

Sketch Map

Project / Site: Glens Falls NY	
Location / Address: 89 Lower Warren St., Queensbury, NY 12804	
Date Started: 10/29/15	Date Finished: 10/29/15
Ground Surface Elevation (ft msl):	Top of Casing Elevation (ft msl):
Easting:	Northing: / Total Depth (ft): 29.2
Drilling Method: Direct Push	Borehole Diameter (in): 2
Rig Type: GeoProbe 6610	Casing Diameter (in) / Type: Cutting Shoe
Drilling Co.: Aztech Drilling	Sampler Dia. / Type: 5' Acetate Sleeve
Drilled by: Ray Hammond	Logged by: Dani Gugliemotto

Client: Ashland Inc.
Project Number: C15262
EHS Support PM: Arlene Lillie

Elevation (ft msl)	Depth (ft)	Lithologic Column	Lithologic Description	Sample Number	Sampler Type	Recovery (ft)	PID ppm (Headspace)	Well Diagram	Notes
	0		Grayish brown (10YR 4/3) CLAY (CL), moderately stiff, moderately plastic	1	AS	3.4	0		
	1		Dark yellowish brown (10YR 4/6) fine SAND (SP), trace silt, moderately loose, noncohesive, moist						Initial boring encountered refusal at 9.6 feet bgs, second boring was located 5 feet east of initial boring
	2		Very dark grayish brown (10YR 3/2) fine to coarse SAND (SW), trace fine to medium gravel, noncohesive, moist						
	3		CONCRETE fragments						Trace colorful waste (red, dark red) encountered from 2.7 to 3.4 feet bgs
			Black (10YR 2/1) SILT (ML), little fine sand, trace fine to coarse gravel, moderately soft, moist						
	4		No Recovery						Collected composite soil sample D02 (02.5-05.7) from 02.5 to 05.7 feet bgs Collected composite soil sample D02 (COMP) from 22-22.7 and 26.7-29.2 feet bgs
	5		Black (10YR 2/1) with olive brown (2.5Y 4/3) SILT (ML), little fine sand, little coarse to fine gravel, moderately soft, moist	2	AS	2.8	0		
	6		Dark yellowish brown (10YR 4/6) fine SAND (SP), trace silt, moderately loose, noncohesive, moist						
	7		Black (10YR 2/1) SILT (ML), little fine sand, trace fine to coarse gravel, moderately soft, moist						Concrete fragments encountered from 6.2 to 7.4 feet bgs
	8		Black (2.5Y 2.5/1) CLAY (CL), trace fine sand, moderately soft						
	9		No Recovery						
	10		Black (10YR 2/1) SILT (ML), little medium to coarse sand, trace clay, trace fine to medium gravel, moist	3	AS	1.7	0		
	11		Very dark grayish brown (10YR 3/2) SILT (ML), some clay, moist						Concrete fragments encountered from 10.0 to 11.7 feet bgs
	12		No Recovery						
	13								
	14								
	15		Very dark brown (10YR 2/2) fine to coarse SAND (SW), little silt, little clay, little fine to coarse gravel, loose, noncohesive, wet	4	AS	5			
	16								

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to water in borehole during drilling (ft bgs): 15.0

Depth to water in borehole after drilling (ft bTOC): ______

Boring: D02

EHS Support consider it done

Elevation (ft msl)	Depth (ft)	Lithologic Column	Lithologic Description	Sample Number	Sampler Type	Recovery (ft)	PID ppm (Headspace)	Well Diagram	Notes
	16–22		Very dark brown (10YR 2/2) fine to coarse SAND (SW), little silt, little clay, little fine to coarse gravel, loose, noncohesive, wet	4	AS	5	0		
	22–23		Dark grayish brown (10YR 4/2) SILT (ML), little fine sand, moderately soft, moderately cohesive, low plasticity, wet	5	AS	2.6	0		
	23–25		No Recovery						
	25–26.7		Very dark brown (10YR 2/2) fine to coarse SAND (SW), little silt, little clay, little fine to coarse gravel, loose, noncohesive, wet	6	AS	4.2	0		Boring backfilled using bentonite chips Geoprobe encountered refusal due to bedrock at 29.2 feet bgs
	26.7–29.2		Dark grayish brown (10YR 4/2) SILT (ML), little fine sand, moderately soft, moderately cohesive, low plasticity, wet						

Notes:
Soil classification based on the Unified Soil Classification System (USCS)

Depth to Water in borehole during drilling (ft bgs): 15.0

Depth to Water in borehole after drilling (ft bgs): _______

Boring: D02

Page: 2 of 2

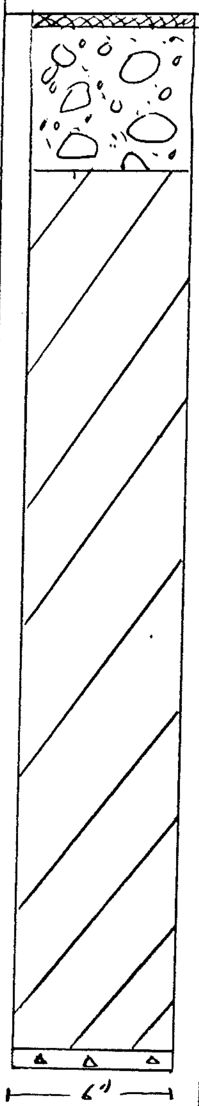
EHS Support consider it done

ECKENFELDER INC.	TEST BORING LOG	NO. IS-19

PROJECT: SOIL SAMPLING	SHEET NO. 1 of 1
CLIENT: CIBA-GEIGY CORPORATION	PROJECT NO. 6703

DRILLING DATA		SAMPLING METHODS			
			SAMPLER	TUBE	CORE
CONTRACTOR:	EAST COAST DRILLING	TYPE	SPLIT SPOON		
DRILLER:	PETER PLACE	DIAMETER	3"		
EQUIPMENT:	DIEDRICH D-50/140 lbs HAMMER	OTHER			
METHOD:	6" HOLLOW STEM AUGER				

WELL CONSTRUCTION	RISER	INTAKE	WELL DEVELOPMENT		GROUND	WELL	PROT CSG.
			METHOD:	ELEV	234.82		
MATERIAL			DURATION:	DATE STARTED: 5-3-90			
DIAMETER			YIELD:	DATE COMPLETED: 5-3-90			
COUPLING			OTHER:	INSPECTOR:			



DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION (AFTER BURMISTER, 1959)	REMARKS	U.S.C.S.
0	1	SS	11-14 / 12-12	FILL DARK BROWN CMF SAND, LITTLE SILT, LITTLE CRUSHED STONE		SP
	2	SS	18-23 / 16-21	@0.6'		
5	3	SS	12-14 / 21-21	LACUSTRINE MEDIUM BROWN FM SAND, TRACE TO LITTLE SILT, WELL-SORTED, STRATIFIED	SATURATED @ 6.5'	SW
	4	SS	8-11 / 15-21	@2.6'		
	5	SS	11-18 / 18-21	MEDIUM BROWN TO MEDIUM GREY SILT AND F SAND, WELL-SORTED, STRATIFIED; INTERLAYERED WITH MEDIUM BROWN TO MEDIUM GREY SILTY CLAY, VARVED, COHESIVE, DENSE. SAND AND SILT DIMINISHING DOWNWARD		SM
10	6	SS	11-12 / 12-15			
	7	SS	7-9 / 10-9			
15	8	SS	R-2 / 2-3			
	9	SS	5-5 / 8-9	@18.0'		
	10	SS	9-9 / 12-11	MEDIUM GREY SILTY CLAY, COHESIVE, DENSE, VARVED	*R: WEIGHT OF RODS	CH
20						
25						
30				@32.7'		
35				END OF BORING @ BEDROCK		
40						

6"

LEGEND:

- CONCRETE
- DRILL-CUTTINGS
- BENTONITE/CEMENT GROUT
- BENTONITE PELLETS