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A Division of GZA

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November 1, 2021
File No. 16.0062961.01

Ms. Karen Vorce, Project Manager
Grand Rapids District Office
Remediation and Redevelopment Division
Michigan Department of Environment, Great Lakes, and Energy
350 Ottawa Avenue NW, Unit 10
Grand Rapids, MI 49503

Re: Wolverine World Wide, Inc. Consent Decree Court Case No. 1:18-cv-00039
Revised Tannery Interceptor System Response Activity Plan

Dear Ms. Vorce:

On behalf of Wolverine World Wide, Inc. (Wolverine), Rose & Westra, a Division of GZA GeoEnvironmental, Inc. (R&W/GZA), has prepared this Revised Draft Tannery Interceptor System Remedial Action Plan (RAP) for the former Wolverine Tannery in Rockford, Michigan. This RAP was prepared in response to your comment letter dated August 17, 2021, and in accordance with Sections 7.7 (b)(i) of the Consent Decree.

If you need additional information, please contact Mark Westra at 616.258.7201.

Very truly yours,

Rose & Westra, a Division of GZA GeoEnvironmental, Inc.

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TANNERY INTERCEPTOR SYSTEM RESPONSE ACTIVITY PLAN

DRAFT – FOR REVIEW ONLY

Disclaimer: This document is a DRAFT document that has not received approval from the Michigan Department of Environment, Great Lakes, and Energy (EGLE). This document was prepared pursuant to a court Consent Decree. The opinions, findings and conclusions expressed are those of the authors and not those of EGLE.

November 1, 2021
File No. 16.0062961.01

PREPARED FOR:
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Rockford, Michigan

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1.0 INTRODUCTION

On behalf of Wolverine World Wide, Inc. (Wolverine), Rose & Westra, a Division of GZA GeoEnvironmental, Inc. (R&W/GZA), prepared this Revised Response Activity Plan (RAP) for the Interceptor System at the former Wolverine Tannery, 181 North Main Street, Rockford, Michigan (Site). Per Section 7.7(b)(i) of the Consent Decree (CD), the objective of this RAP is to develop initial design parameters for a groundwater interceptor system that will be "… appropriately sized to address and control perfluoroalkyl substances (PFAS) Compounds contamination in the groundwater at the Tannery before it enters the Rogue River."

To develop initial design parameters for the interceptor system, R&W/GZA utilized its comprehensive database of Site-specific geologic and hydrogeologic conditions to model the groundwater flow regime and simulate the effects of an active interceptor system at the Site. Previous Site investigation findings indicate that Site groundwater under natural flow conditions will discharge to the Rogue River and Rum Creek. Therefore, the purpose of the interceptor system is to effectively prevent the natural discharge of PFAS-impacted groundwater to these surface water features. The interceptor system will consist of a network of pumping wells that when pumping generates coalescing drawdown and inward hydraulic gradients to intercept groundwater flow effectively preventing discharge. The groundwater pumped from the extraction wells will be treated on-Site though proven granular activated carbon treatment. Based on our experience with other similar groundwater pumping systems, it is important to note that the performance of the interceptor system will not be measured by an appreciable reduction in PFAS concentrations on-Site. Instead, we will measure the groundwater elevations to document groundwater flow in multiple locations along the system to confirm groundwater flow away from the Rogue River and Rum Creek. Refer to Exhibit 1 for a visual representation of the intended changes to groundwater flow.

This RAP describes the development of a rigorous three-dimensional groundwater flow model that has been refined following Michigan Department of Environment, Great Lakes, and Energy's (EGLE's) initial review and comment. We believe the modeling effort has successfully resulted in the development of initial design parameters for the Site interceptor and groundwater treatment systems. This revised RAP responds to EGLE's August 17, 2021 comment letter on the February 2021 Draft RAP submission provided by R&W/GZA. The majority of EGLE's comments (Comments 1 through 10) were focused on refinement of the groundwater model. In subsequent conversations between R&W/GZA and EGLE, the technical comments were discussed and a path forward regarding each comment was agreed upon. **Appendix A** provides a Response Letter to EGLE's August 2021 Comments. Where applicable, specific modeling comments are addressed in **Section 5.0**.

Based on the revised modeling effort and discussions with EGLE, the interceptor system design will include 14 shallow extraction wells and three deep extraction wells south of Rum Creek, and five shallow extraction wells north of Rum Creek. Prior to the development of the groundwater model, R&W/GZA installed three extraction wells and nine monitoring wells in 2019 and conducted pumping tests to obtain in situ hydraulic characteristics for the model. These wells will be utilized along with the additional wells that will be installed following approval of this RAP. **Section 9.0** provides additional details on the system. As discussed in **Section 12.0**, the final interceptor system and its pumping rate may be adjusted or modified based on feedback obtained from Site performance monitoring in order to fulfill the stated requirements of the CD discussed above.

2.0 SUMMARY OF CONCEPTUAL SITE MODEL

The Site consists of 14.5 acres encompassing the former Wolverine Tannery property between Main Street and the Rogue River, north of Courtland Street, in Rockford, Michigan (**Figure 1**). Rum Creek flows from east to west through the central portion of the Site and discharges into the Rogue River, which flows southerly along the western Site boundary.

Figure 2-1: Site Plan

Based on Kent County LiDAR data, the Site slopes from Main Street toward the Rogue River with elevations ranging from approximately 707 feet mean sea level near the southeastern corner to 690 feet along the Rogue River. The properties surrounding the Site are a mixture of commercial (predominately south of the Site) and residential land use (east and north of the Site).

2.1 SITE HISTORY

This Site historically had a street address of 123 North Main Street, Rockford, Michigan and was developed in the late 1800s with an ice house, lumber yard and associated coal storage located north of Courtland Street and west of Main Street. A shoe factory was constructed north of Rum Creek circa 1903, and the tannery was constructed south of Rum Creek circa 1908. The tannery eventually extended to the south and west onto formerly residential land and a lumber/coal yard, respectively. The tannery operated until 2009. In 2010 and 2011, once applicable environmental permits were obtained, it was demolished. A retail outlet store and certain paved parking areas remain on-Site.

During the demolition in 2010 and 2011, Wolverine collected groundwater samples from monitoring wells and piezometers under consultation with the U.S. Environmental Protection Agency (EPA) and the former Michigan Department of Environmental Quality (MDEQ) - now EGLE. Wolverine and MDEQ collected additional samples from the Site and the Rogue River during a Preliminary Assessment under CERCLA in late 2011 and early 2012.

Starting in August 2017, groundwater samples were collected from the Site monitoring wells for analysis of PFAS due to the historical usage of Scotchgard™ in the Tannery process. Scotchgard™ was manufactured by 3M Company and contained PFAS as active ingredients.

EGLE has only promulgated Part 201 GGCC for PFAS for the GSI and drinking water pathways. For the GSI pathway, the main constituent is perfluoroalkyl sulfonic acid (PFOS), which has the most restrictive criterion at 12 nanograms/ liter or parts per trillion (ng/l). The groundwater data indicated PFOS and perfluorooctanoic acid exceeded Part 201 Generic Groundwater Cleanup Criteria (GGCC) for the only applicable exposure pathway for PFAS, i.e., the groundwater/surface water interface (GSI) pathway. Because Rockford residents are on municipal drinking water and do not utilize the groundwater beneath the Tannery or the river water as a drinking water source, the drinking water pathway has been evaluated and is not a relevant pathway. EGLE has not promulgated other Part 201 GGCC for PFAS beyond the GSI and drinking water pathways.

Additional investigations were performed across the Site in 2018, 2019, and 2020. Although the EPA's UAO and AOC[1] did not specifically identify PFAS as target constituents, R&W/GZA analyzed 225 soil samples, 112 groundwater samples, 14 surface water samples, and 100 sediment samples for PFAS in 2018. Refer to the "Final Implementation of 2018 Work Plan Summary Report, Tannery 2018 Work, Rockford, Michigan," dated January 11, 2019, prepared by R&W/GZA (R&W/GZA, 2019) for details.

In late 2019 and 2020, as part of the AOC-related activities, 14,576 cubic yards of soil and sediment were removed from nine excavation areas at the Site for disposal off-Site. These excavations were primarily backfilled with clean sand. While PFAS was not the driver for these excavations, the removal of these PFAS-containing soils from the Site reduced the source of PFAS to groundwater. Specifically, 10,748 cubic yards of material, including leather scraps that may have been treated with Scotchgard™, were removed north of Rum Creek. Refer to the "Implementation of 2019 Work Plan - Summary Report - Final, Wolverine World Wide Tannery 2019-2020 Work, Rockford, Michigan," dated July 21, 2021, prepared by R&W/GZA (R&W/GZA 2021) for additional information.

2.2 PRECIPITATION AND GROUNDWATER RECHARGE

The 2016 climate data report for Grand Rapids, Michigan, downloaded from National Oceanic and Atmospheric Administration, indicates that the mean annual precipitation for the 80-year record period is approximately 36 inches. Precipitation that is not lost to surface run-off, evaporation, vegetation uptake and transpiration can percolate to the groundwater table as groundwater recharge. Groundwater recharge at the Site was evaluated based on published GIS data and streamflow records from the U.S. Geological Survey (USGS) Gauging Station No. 04118500 located in the Rogue River.

2.2.1 Estimation of Groundwater Recharge from Published GIS Data

Stream baseflow estimates provide a means of estimating groundwater recharge because water entering a stream basin discharges to the stream as baseflow. Baseflow estimates divided by the drainage areas are used as

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[1] Unilateral Administrative Order for Removal Actions[1] (UAO) effective February 1, 2018, and U.S. EPA Administrative Settlement Agreement and Order on Consent for Removal Actions (ASAOC) associated with the Former Wolverine Tannery and House Street Disposal site agreed upon by Wolverine and EPA on October 28, 2019.

generalized groundwater recharge rate estimates. The Groundwater Inventory and Mapping Project, a cooperative effort between the former MDEQ, USGS Michigan Water Science Center, and Michigan State University, published estimated baseflow estimates and baseflow yields for Michigan stream segments using the technical method documented in the USGS report entitled "Base Flow in the Ground Lakes Basin" (Neff, Day, Piggott, & Fuller, 2005). Baseflow separations were performed on streamflow records for USGS stations in Michigan with more than ten years of daily streamflow records as of the year 2000. A series of multivariate linear regression models were developed to relate watershed characteristics to base flow estimates, such as land uses, annual growing days, precipitation, winter precipitation, percentage of lacustrine deposits, percentage of till, forest coverage, etc. Volumetric baseflow estimates were developed for stream segments. Based on the State-wide Base Flow of Michigan Streams GIS data (Groundwater Inventory and Map Project, 2005), the total baseflow for the entire Rogue River subbasin exiting to the Grand River is approximately 220 cubic feet per second (cfs), and the baseflow yield is approximately 0.86 feet per year (ft/yr). Baseflow yields were defined as baseflow estimates divided by the drainage areas, which are approximately equal to groundwater recharge. As such, the estimated groundwater recharge for the Rogue River drainage area is approximately 10.3 inches per year (in/yr). The total base flow for Rum Creek drainage area, exiting to the Rogue River, is approximately 9.4 cfs, and the baseflow yield is approximately 0.76 ft/yr. The estimated groundwater recharge for Rum Creek drainage area is approximately 9 in/yr.

Base Flow of Michigan Streams GIS data indicates the annual groundwater recharge estimates for the Site and its vicinity are 9 to 11 in/yr. These published baseflow and groundwater recharge estimates have their limitations because the estimates were generalized over spatial variability and temporal variability, and the estimated values are subject to uncertainties related to the baseflow separation technique used. However, the estimates provide reference values for comparison and further evaluation.

2.2.2 Estimation of Groundwater Recharge from Streamflow Data

Daily stream flow records from the USGS Gauging Station No. 04118500, located in the Rogue River near Packer Drive NE at Rockford, Michigan were evaluated. This gauging station is near the Rogue River confluence to the Grand River. Using USGS's Groundwater Toolbox software, baseflow separation using six different methods[2] was performed on the daily streamflow records from 1988 to 2020. The average baseflow estimates in cfs from the six methods were plotted below from 1988 to 2020. From 1988 to 2020, the average annual streamflow rate measured at Gauging Station No. 04118500, located near Packer Drive NE at Rockford, Michigan, was approximately 270 cfs (~170 million gallons per day [MGD]), and the average baseflow rate was approximately 210 cfs (~140 MGD).

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[2] Base-Flow Index (BFI) Standard, BFI Modified, Hydrograph separation program (HYSEP) Fixed Interval, HYSEP Sliding Interval, HYSEP Local Minimum, and PART methods

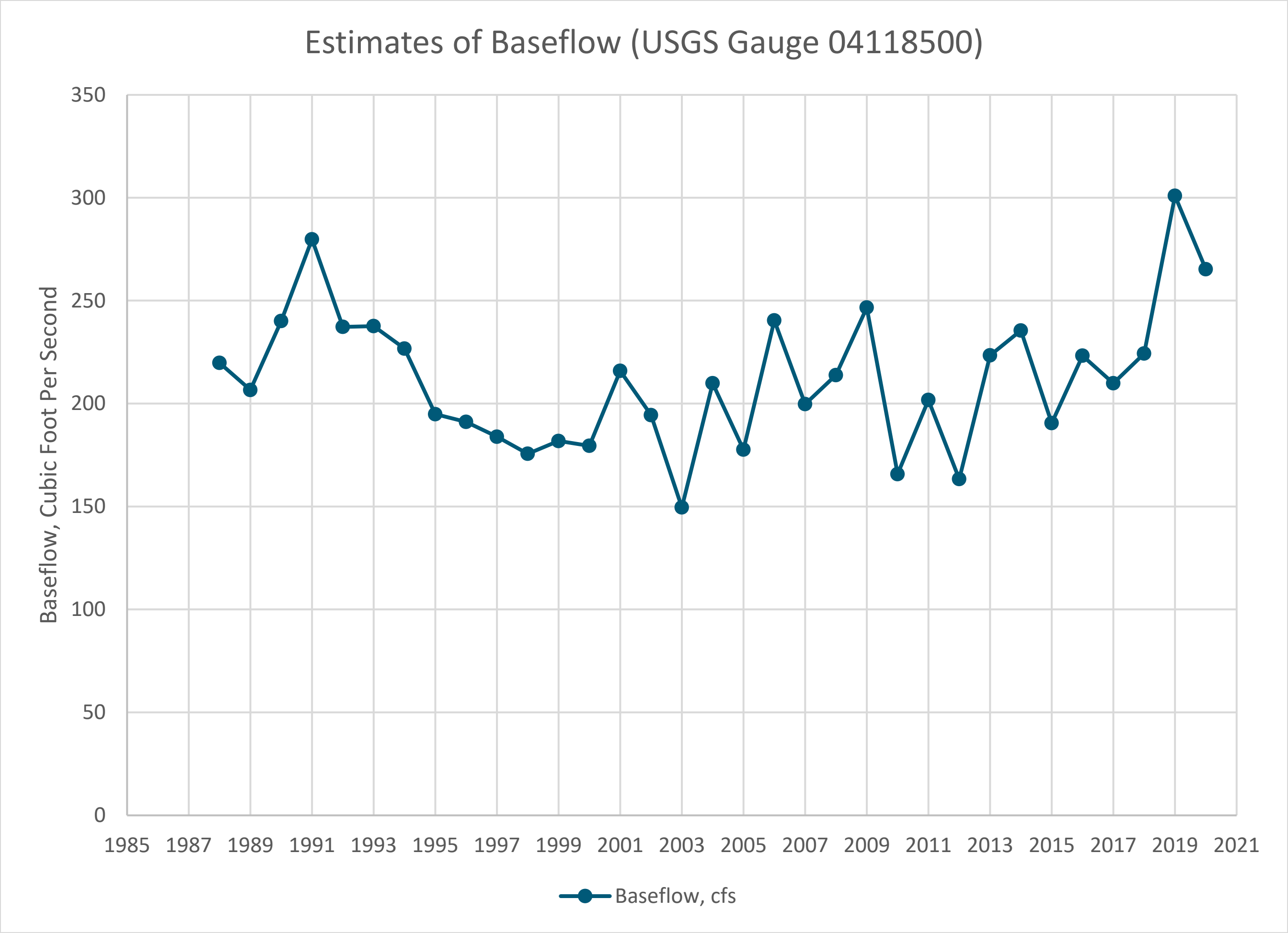


Figure 2-2: Annual Baseflow Estimates (USGS Gauge 04118500)

Based on the baseflow estimates and the drainage area, groundwater recharge for the drainage area represented by the gauging station was estimated to range from 9 to 17 in/yr, with an average of 12 in/yr from 1988 to 2020.

The annual groundwater recharge estimates for the last five years, from 2016 to 2020, are summarized below.

Year	Average Annual Groundwater Recharge Estimate, in/yr
2016	13
2017	12
2018	13
2019	17
2020	15

Table 2-1: 2016 to 2020 Annual Groundwater Recharge Estimates Based on Streamflow Records at USGS Gauge 04118500

As shown in the above table, the annual groundwater recharge estimate for 2019 is approximately 5 in/yr greater than the historical average, and in 2020, the estimate is approximately 3 in/yr greater than the historical average.

2.3 REGIONAL GEOLOGY

The unconsolidated geologic conditions in Kent County consist of a thick sequence of Pleistocene glacial deposits. The glacial deposits in the county include till, outwash, and lacustrine deposits. Till occurs in end moraines and ground moraines (till plains) interspersed on the surface throughout the County (Stramel, Wisler, & Laird, 1954). For the area near the City of Rockford and Plainfield Township, the Michigan Glacial Land systems (Groundwater Inventory and Mapping Project, 2015) indicate a proglacial outwash plain is present along the Rogue River, and end moraines are present on either side of the Rogue River extending to the “wide” near the Grand River. The ground moraine (till plain) and end moraine belong to the unstratified class of deposits, composed of fine-to- coarse-grained material, including silt, sand, gravel, and boulders.

Bedrock consisting of the Mississippian-aged sandstone (Marshall formation), shale (Michigan formation), and the Bayport limestone as well as the Pennsylvanian-aged Saginaw Formation underlay Kent County. Based on the Hydrogeologic Atlas of Michigan (Western Michigan University, Department of Geology, 1981), the top of bedrock elevation ranges from 500 to 550 feet near the City of Rockford; therefore, the overburden thickness ranges from approximately 145 feet to approximately 205 feet.

2.4 SITE GEOLOGY

R&W/GZA’s investigation activities indicated unconsolidated deposits include shallow fill and alluvial disturbed soils overlying a relatively thick, unstratified sequence of sand and silt/clay which has been generally encountered at depths of 10 to 20 feet below ground surface (bgs). The fill materials typically include sand and gravel containing varying percentages of ash, brick, cinders, and other debris. Occasional peat was also encountered in borings drilled at the Site. Bedrock has not been encountered in borings drilled to date with a maximum boring depth of approximately 150 feet bgs.

Several geologic cross-sections were created based on the soil borings and well installation completed to date. **Sheet No. 1** includes the locations of the cross-sections and **Sheet Nos. 2** through **5** for geologic cross sections I-I’ through VII-VII’. Groundwater monitoring well names are labeled on the cross-sections. PFOS concentrations in micrograms per liter (µg/L), or parts per billion, are posted by the monitoring well screens for discussions in the later sections. The posted PFOS concentrations were based on the groundwater quality data collected in 2018 or earlier.

Underlying the surficial layer of fill material at the Site, the predominant geologic conditions across the Site are characterized by sand and sand-and-gravel deposits with fine-grained soils, consisting of clay or silt. The thickness and texture of the fine-grained deposits vary laterally and with depth. In some boreholes, fine-grained soils were not observed, or the thickness of the fine-grained soil strata were less than those of coarse-grained soils, such as sand or gravel. Thicker and more frequent encounters of fine-grained soils tend to occur on the northern portion of the Site. In the area north of Rum Creek, fine-grained soils were encountered at approximately 5 to 8 feet bgs in the majority of the soil borings. Generally, fine-grained soil appears to be unstratified, and the distributions result in significant geologic heterogeneity throughout the unconsolidated deposits underlying the Site.

As noted in **Section 2.1**, excavations were conducted in nine areas at the Site in 2019 and 2020. Excavations were backfilled with sand or sand and gravel. Excavation depths ranged from one foot in most areas east of the White Pine Trail to 10 feet in one excavation located south of Rum Creek near Main Street (R&W/GZA 2021). Refer to the “Implementation of 2019 Work Plan - Summary Report - Final, Wolverine World Wide Tannery 2019-2020 Work, Rockford, Michigan,” dated July 21, 2021, prepared by R&W/GZA (R&W/GZA 2021) for plan view and cross-sectional view of the excavation areas and depths. Since the majority of the excavations were less than or equal to 5 feet deep and located within the unsaturated zone; the relatively permeable and coarse-grained backfill materials are not expected to alter the groundwater flow pattern, and because of their limited areal coverage are not expected to materially increase areal groundwater recharge.

2.5 REGIONAL HYDROGEOLOGY

The direction of regional groundwater flow is influenced by the primary surface water features of the Rogue River and the Grand River drainage. Streamflow data from the USGS Gaging Station indicates that the Rogue River is a gaining stream, a groundwater discharge zone. Therefore, the regional groundwater flow pattern within the unconsolidated deposits in the vicinity of the Site is generally westerly, with discharge occurring to the river immediately west of the Site.

2.6 SITE HYDROGEOLOGY

Groundwater monitoring wells were installed during previous investigation activities starting in 2011. **Table No. 1** summarizes the groundwater monitoring well construction information. Currently, there are 81 groundwater monitoring wells at the Site. See **Sheet No. 6** for the monitoring well location plan.

Table 2 presents the water level data collected from Site monitoring wells in April 2019. Based on the April 2019 groundwater elevations and surface water stations, groundwater contours for the shallow aquifer were interpreted. **Sheet No. 7** depicts the interpreted groundwater contours. In addition, groundwater contours interpreted from the recent September 2021 water level data are plotted in **Sheet No. 8**. As shown in **Sheet Nos. 7** and **8**, the groundwater flow direction within the upper portion of the saturated zone is generally from east-to-west, toward the Rogue River which is the primary groundwater discharge zone. Groundwater proximate to Rum Creek appears to discharge to Rum Creek. The hydraulic gradient north of Rum Creek is flatter than south of the Rum Creek. A groundwater mound is present in the central area of the Site south of Rum Creek. The groundwater mound in April 2019 is more apparent than that of September 2021, likely due to greater groundwater recharge in April 2019. The presence of the groundwater mound results in groundwater movement toward Rum Creek to the north, the Rogue River to the west, and the southwest at the southern portion of the Site. Groundwater flow patterns in the southwest corner of the Site in April 2019 appear to be less uniform than those in September 2021, due to the relatively high groundwater elevation measured at TA-MW-313A. This relatively high groundwater elevation is attributed to the fine-grained sediment observed within the well screen interval combined with the effects of the relatively high precipitation recharge in April 2019. The September 2021 groundwater contours have been refined by the additional monitoring wells south of the Site. Except for the localized variation near TA-MW-313A, the groundwater flow pattern is generally consistent from April 2019 to September 2021, confirming that the 2019/2020 excavations and backfill did not materially affect the groundwater flow at the Site.

Hydraulic conductivities measured via slug testing within monitoring wells screened above the low-permeability unit range from less than 0.1 feet per day to greater than 10 feet per day. As shown in **Sheet Nos. 7** and **8**, the average hydraulic gradient is approximately 0.006. Based on the average hydraulic gradient and the range of hydraulic conductivities, the estimated groundwater seepage velocity ranges from 0.7 to 70 feet per year.

Groundwater elevations measured in the deeper monitoring wells are generally lower than those in the shallow aquifer indicating that downward hydraulic gradients dominate across the Site. Downward vertical gradients are common for unconfined aquifers. Localized exceptions to this condition were observed at the TA-MW-317B/C/D and TA-MW-311C well clusters, where artesian conditions were observed. Both well clusters are located northeast of the Site where confining fine-grained soil stratum occurs above the well screen intervals.

Several deep monitoring wells are located close to the Rogue River. Preliminary evaluation indicates groundwater flow in the deeper portions of the aquifer is to the west towards the Rogue River. The following table provides a summary of the groundwater elevations in the deep zone wells in April 2019, as compared to the surface water elevation measured in the Rogue River, 691.81 feet. Only the groundwater elevations measured at TA-MW-309C/D are close to (but still lower than) the river water elevation. The groundwater elevations in the other deep wells are more than 2 feet lower than that of the Rogue River.

Monitoring Well	Groundwater Elevations, Feet
TA-MW-301D	689.41
TA-MW-303D	689.12
TA-MW-303E	689.14
TA-MW-309C	691.68
TA-MW-309D	691.67
TA-MW-310C	689.78
TA-MW-313B	687.03
TA-MW-313C	686.90

Table 2-2: Summary of Groundwater Elevations in Deep Zone Monitoring Wells, April 2019

2.7 CHEMICAL DATA

The only applicable pathway for PFAS compounds in groundwater at the Site is the GSI pathway. Therefore, groundwater quality data are evaluated and compared to the Part 201 generic GSI criteria. See attached **Table 3** for a summary of the 2019 and 2021 groundwater quality data. Refer to R&W/GZA, 2019 for the groundwater quality data collected in 2018. Note that the 2019/2020 excavation activities, while not driven by PFAS concentrations, removed 10,748 cubic yards of PFAS-contaminated material from the Site and thereby reduced the source material available for leaching to groundwater.

Based on spatial distribution and concentrations relative to the generic GSI criterion, PFOS is the controlling analyte designing the extent of the groundwater interceptor system.

R&W/GZA prepared summary tables and two-dimensional isoconcentration figures for compounds in groundwater that exceed GSI criteria (R&W/GZA, 2019). The extent of PFOS concentrations exceeding the GSI criteria, based on the on-Site groundwater quality data, is included as **Figure 2-3** below. **Sheet Nos. 2** through **5** present maximum PFOS concentrations (µg/L) in the groundwater monitoring wells used to construct cross-sections I-I' through VII-VII'. As shown in **Figure 2-3**, higher PFOS concentrations were in the area near Rum Creek, south of Rum Creek, and along the Rogue River. As shown in **Sheet Nos. 2** through **5**, PFOS was primarily present in the upper 10 feet of the saturated section, corresponding to approximate elevations of 680 to 690 feet.

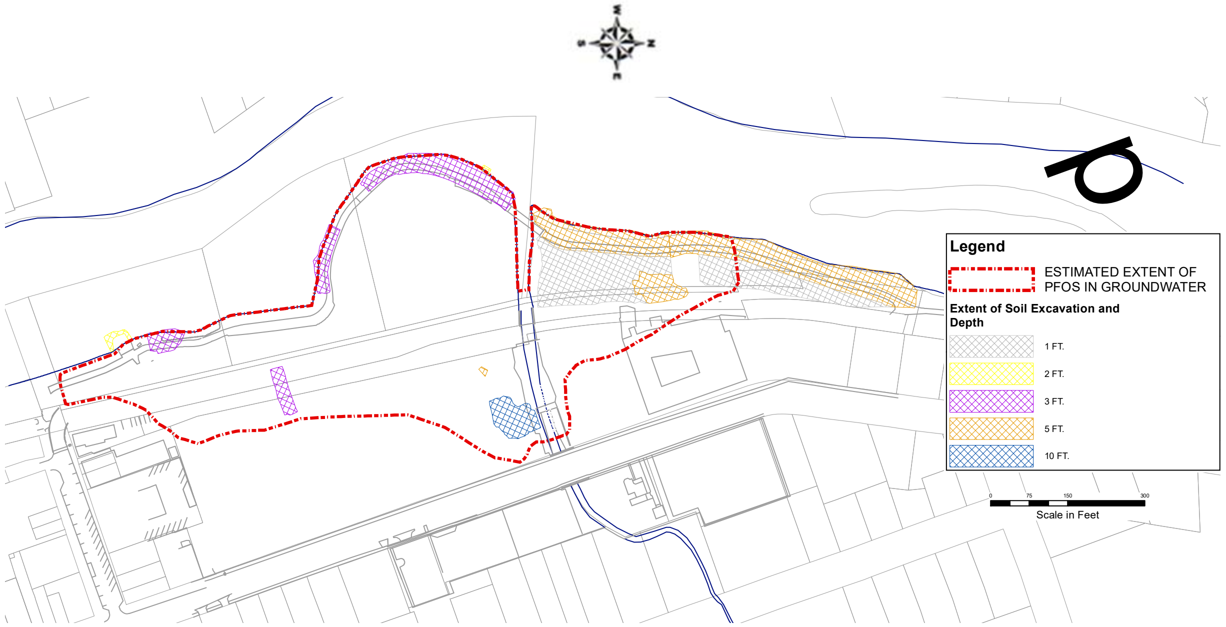


Figure 2 3: Extent of PFOS in Groundwater

Downward migration of PFOS from the upper groundwater zone is mostly affected by the presence or absence of fine-grained deposits that impede downward migration. For example, the presence of clay and silt observed at well cluster TA-MW-303A/E limits the relatively higher PFOS concentrations to above an elevation of approximately 672 feet; the presence of clay and silt in TA-MW-313 and TA-MW-316 well clusters limit the relatively higher PFOS concentrations to above an elevation of approximately 687 feet. On the other hand, the lack of fine-grained soils or relatively thin stratum of fine-grained soil allow the vertical migration of PFOS within the groundwater. Due to the relatively thin strata of fine-grained soils in well cluster TA-MW-309, relatively higher PFOS concentrations were detected in well cluster TA-MW-309 from the shallow saturated zone to an elevation of approximately 650 feet. The vertical distribution of PFOS will be taken into consideration during the design of the groundwater interceptor system.

3.0 IN SITU EVALUATION OF SITE HYDRAULIC PROPERTIES

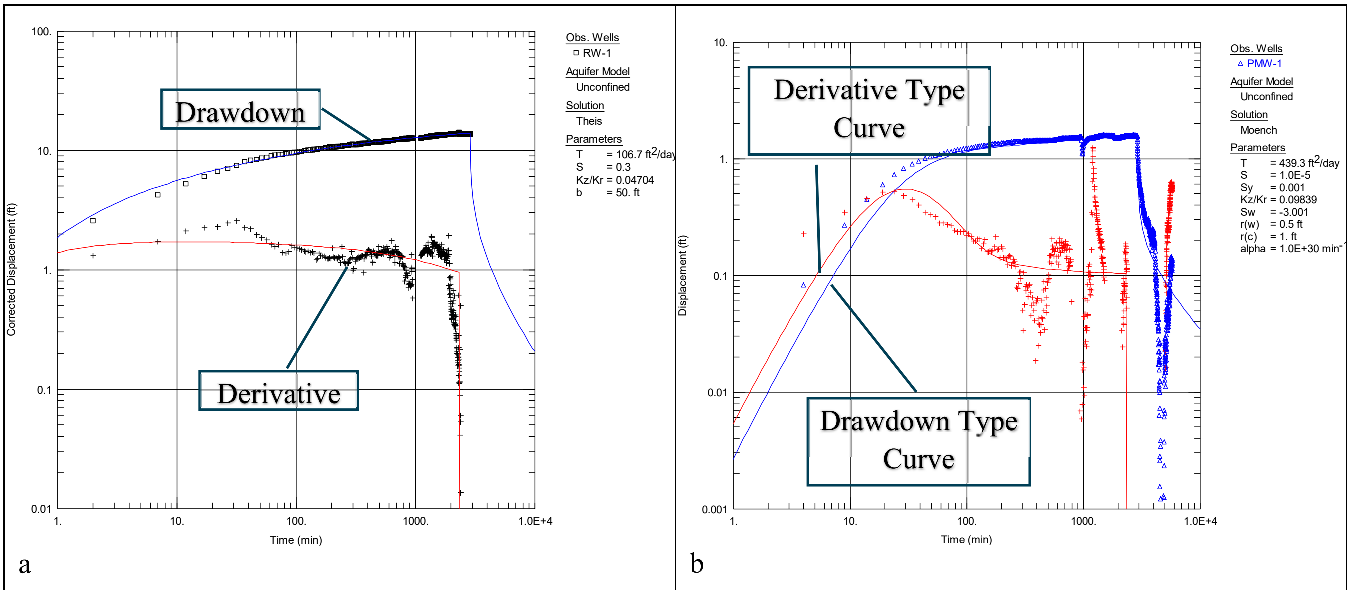
To evaluate hydraulic properties of the upper groundwater section, three pumping tests were performed at extraction wells TA-RW-1, TA-RW-2, and TA-RW-3 in May 2019. Pressure transducers were installed in the extraction wells and the nearby groundwater monitoring wells to measure water level changes before, during and after the pumping. Barometric pressures were measured and compensated. **Sheet No. 1** indicates the locations of the existing extraction wells and the existing and former monitoring wells.

Table 3-1 provides a summary of the pump start-up, shutdown, pumping rates in gallons per minute (GPM) and the list of the monitoring wells observed to have drawdowns greater than 0.3 foot for pumping test interpretation.

Extraction Well	Pumping Rate, GPM	Pumping Start	Pump Shut-off	List of Monitoring Wells Responding to Pumping
TA-RW-1	2.9	5/6/2019 12:00 PM	5/8/2019 12:12 PM	TA-PMW-1 and TA-MW-2
TA-RW-2	0.25	5/13/2019 12:30 PM	5/15/2019 3:50 PM	TA-PMW-2 and TA-MW-1
TA-RW-3	3.5	5/20/2019 1:32 PM	5/22/2019 2:08 PM	TA-PMW-3 and TA-PMW-6

Table 3-1: Summary of Pumping Test Periods

Soil boring logs and well installation logs for TA-RW-1 through TA-RW-3, and TA-PMW-1 through TA-PMW-9 and combined summary plots of the water level response data for each of the pumping tests are in **Appendix B**.



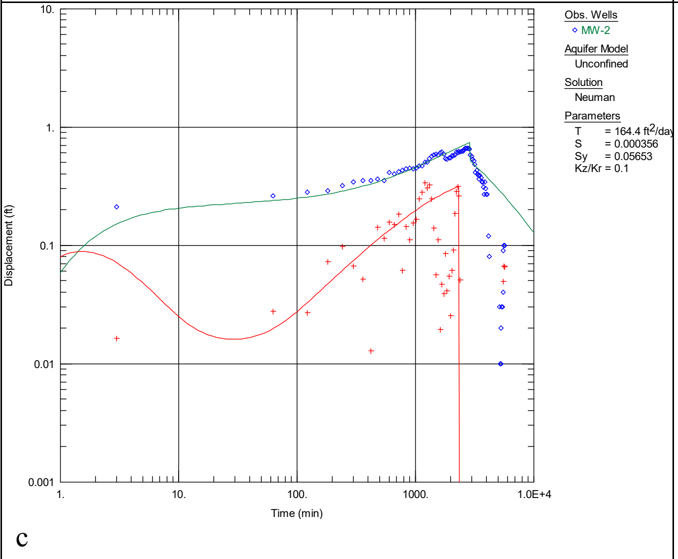


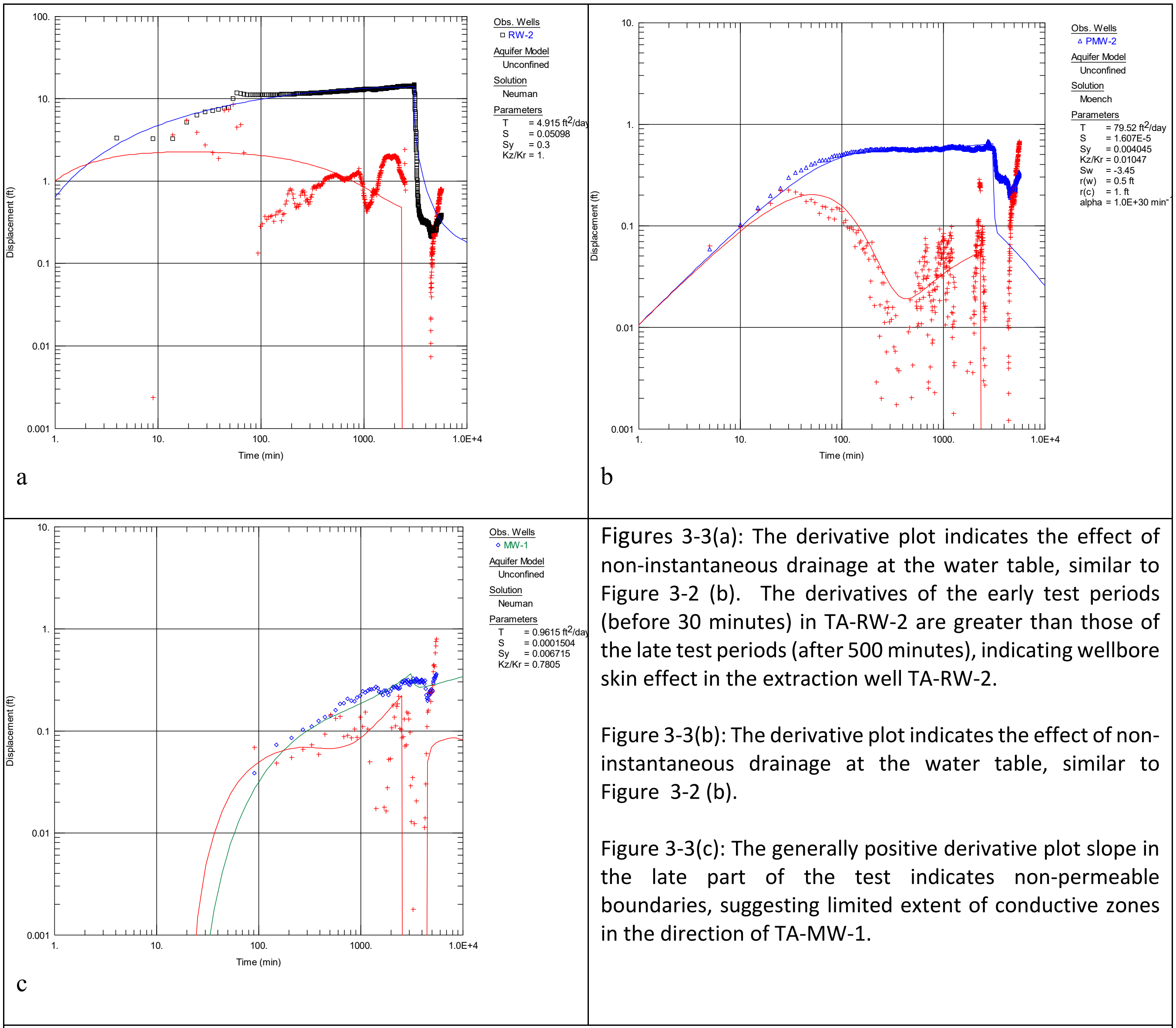
Figure 3-2(a): From 1 to 30 minutes, the derivative plot of TA-RW-1 drawdown shows a positive slope of approximately 0.25, indicating bilinear flow, which is two-dimensional flow toward a channel-like aquifer. The negative slope immediately after 30 minutes may correspond to more conductive aquifer zones, with greater hydraulic conductivity. Later on, the derivative slope continues to change but the magnitude of fluctuation become less. In average, the later derivative plot generally displays radial flow conditions.

Figure 3-2(b): The derivative plot from 20 minutes to 500 minutes indicates the effect of non-instantaneous drainage at water table.

Figure 3-2(c): The derivative plot of TA-MW-2 also indicates the effect of non-instantaneous drainage at the water table. The later positive slope, however, may indicate a non-permeable boundary, suggesting limited extent of conductive zone in that direction.

Figure 3-1: TA-RW-1 Test Drawdown and Derivative Plots: (a) TA-RW-1 (b) TA-PMW-2 (c) TA-MW-2.

Software AQTESOLVE by HydroSOLVE, Inc. of Reston, Virginia was used to perform pumping test analysis. The drawdowns and the derivatives of the drawdowns are plotted in **Figure Nos. 3-2** through **3-4**. **Figure 3-2(a)** through **Figure 3-2(c)** present the log-log plots of drawdowns and derivatives, along with pumping test solution matching type curves. The derivative plots indicate the effect of non-instantaneous drainage at the water table, the presence of low permeability zones limiting the cross-sectional groundwater flux areas, and potentially non-permeable boundary in the direction of TA-MW-2 as the stress of pumping propagates further.



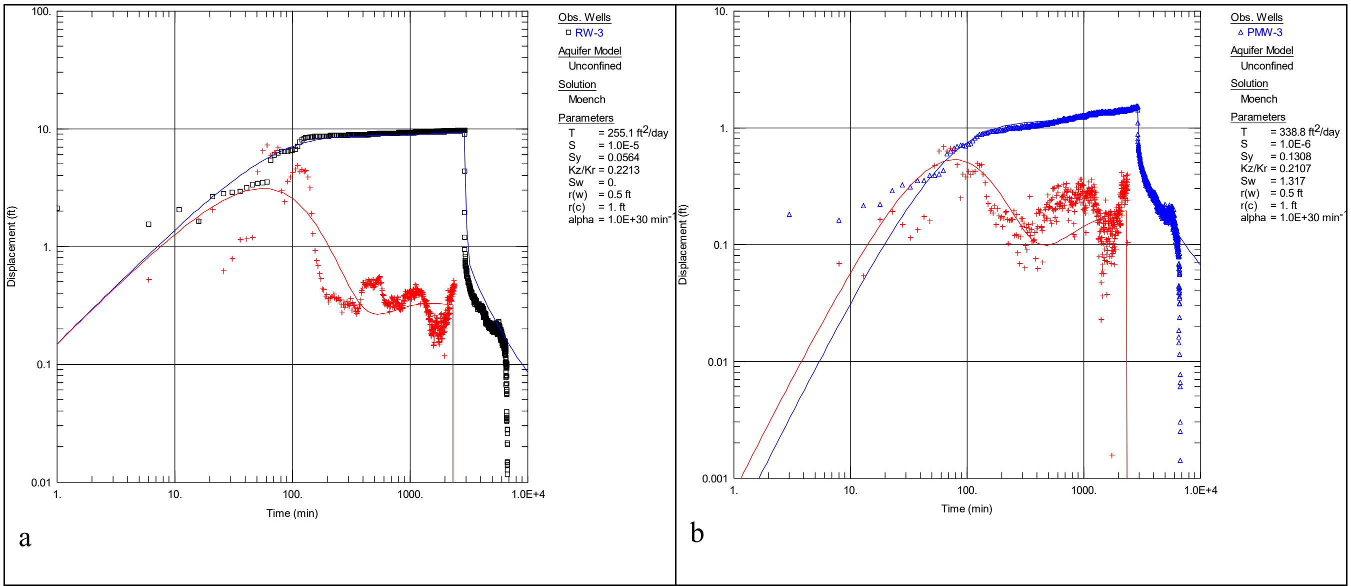
Figures 3-3(a): The derivative plot indicates the effect of non-instantaneous drainage at the water table, similar to Figure 3-2 (b). The derivatives of the early test periods (before 30 minutes) in TA-RW-2 are greater than those of the late test periods (after 500 minutes), indicating wellbore skin effect in the extraction well TA-RW-2.

Figure 3-3(b): The derivative plot indicates the effect of non-instantaneous drainage at the water table, similar to Figure 3-2 (b).

Figure 3-3(c): The generally positive derivative plot slope in the late part of the test indicates non-permeable boundaries, suggesting limited extent of conductive zones in the direction of TA-MW-1.

Figure 3-2: TA-RW-2 Test Drawdown and Derivative Plots: (a) TA-RW-2 (b) TA-PMW-2 (c) TA-MW-1

Figures 3-3(a) through **Figure 3-3(c)** presents the log-log plots of drawdowns and derivatives, along with pumping test solution matching type curves for the TA-RW-2 test. **Figures 3-3 (a)** through **3-3 (c)** show the wellbore skin effect at the extraction well, non-instantaneous drainage at the water table, and non-homogeneous nature as the effect of pumping propagating further.



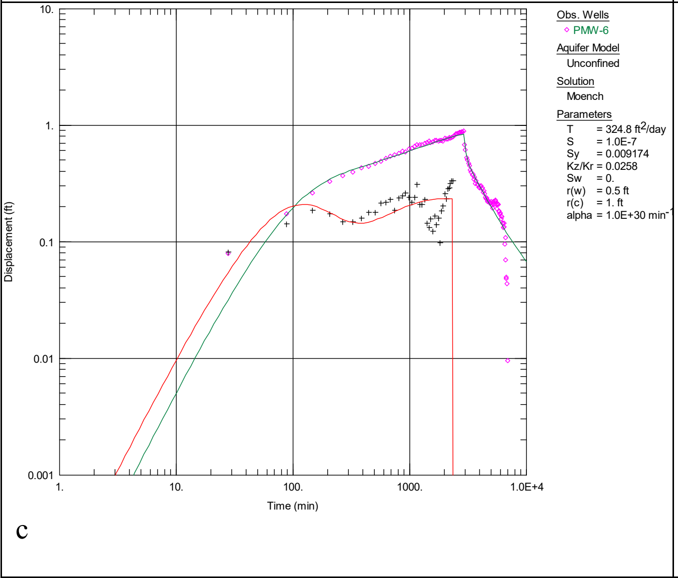


Figure 3-4(a): From 20 to 500 minutes, the derivative plot indicates the effect of non-instantaneous drainage at water table. The derivatives of the late test period (after 400 minutes) are less than those of the early test period (before 100 minutes), indicating wellbore skin effect. Later on, the derivative plot undergoes two cycles of changing from a negative slope to a positive slope, possibly indicating the lateral effects of a more conductive and then less conductive zone.

Figure 3-4 (b): The derivative plot from 100 to 400 minutes indicates the effect of non-instantaneous drainage at water table. Similar to Figure 3-2 (a), the changing slope in the late test period indicating inhomogeneity of aquifer materials or hydraulic conductivities.

Figure 3-4 (c): The derivative plot is similar to Figure 3-2 (c), exhibiting drainage at the water table and inhomogeneity.

Figure 3-3: TA-RW-3 Test Drawdown and Derivative Plots: (a)TA-RW-3 (b) TA-PMW-3 (c) TA-PMW-6

Figures 3-4 (a) through **3-4 (c)** indicate wellbore skin effect at the extraction well, non-instantaneous drainage at the water table, and non-homogeneous nature as the effect of pumping propagating further.

The drawdown and the derivative data were matched with the type curves of unconfined Neuman solutions (Neuman, 1975) or unconfined Moench solutions (Moench, 1997). The unconfined Neuman solution is appropriate for anisotropic, homogeneous, unconfined aquifer, fully or partial penetration with instantaneous drainage at the water table. The unconfined Moench solution is similar to the Neuman solution, except for the introduction of the non-instantaneous drainage parameter. The Neuman solutions were attempted for all the extraction wells and the observation wells, but for some wells where non-instantaneous drainage occurred, the Moench solutions provide a better fit to the data as shown in **Figures 3-2** through **3-6**.

Overall, the pumping test results reflect the variable hydraulic properties and general heterogeneity of the shallow groundwater flow system at the Site as observed in numerous borings drilled across the Site. **Table 3-2** provides a summary of the interpreted hydraulic conductivity, storage coefficient, specific yield, and the ratio of vertical hydraulic conductivity to horizontal hydraulic conductivity as derived from the pumping tests.

Test/Observation Well	Hydraulic Conductivity, ft/d	Storage Coefficient (dimensionless)	Specific Yield	Ratio of Vertical to Horizontal Hydraulic Conductivity (Kz/Kh)
TA-RW-1 Test				
TA-RW-1	2.1	Not Used	3.0E-01	0.05
TA-PMW-1	8.8	1.0E-05	1.0E-03	0.10
TA-MW-2	3.3	3.6E-04	5.7E-02	0.10
TA-RW-2 TEST				
TA-RW-2	0.1	Not Used	3.0E-01	1.0
TA-PMW-2	1.6	1.6E-05	4.1E-03	0.01
TA-PMW-8	0.06	3.6E-04	1.7E-02	1.0
TA-MW-1	0.02	1.5E-04	6.7E-03	0.78
TA-RW-3 TEST				
TA-RW-3	5.1	Not Used	5.6E-02	0.22
TA-PMW-3	6.8	1.0E-06	1.3E-01	0.21
TA-PMW-6	6.5	1.0E-07	9.2E-03	0.03

Table 3-2 - Summary of Interpreted Results

The interpreted hydraulic conductivity values of the TA-RW-1 and TA-RW-3 tests appear to be consistent and provide a reliable value for the coarser-grained deposits. These values are approximately one order of magnitude less than the typical values for a clean sand and gravel aquifer. The lower hydraulic conductivity values are attributed to increased percentages of finer-grained material in the well screen intervals and near the extraction wells. The interpreted hydraulic conductivity values of the TA-RW-2 test are lower than those of TA-RW-1 and TA-RW-3 because the proportion of fine-grained soil in TA-RW-2 borehole is greater than those observed near TA-RW-1 and TA-RW-3. The pumping test solutions assume a homogeneous aquifer. For the non-homogeneous aquifer at the Site, the pumping test results represent scaled-up, average values for the zone of investigation affected by the pumping stress. The interpreted hydraulic conductivity values provide a range for subsequent groundwater modeling input and calibration.

The storage coefficient values from the pumping wells were not used because observation well data generally provides a better estimate for the storage coefficient. In addition, for unconfined aquifers, the drawdown response is largely controlled by hydraulic conductivity and specific yield. The effect of elastic storage and dewatering represented by the storage coefficient is limited to the early part of the test, and generally negligible as compared to the effect of delayed water table response as represented by specific yield. For subsequent modeling input, a typical literature value of 2E-4 will be used for the storage coefficient.

The interpreted specific yields vary from 0.001 to 0.3. Fine-grained deposits typically have lower specific yield values than coarse-grained. In addition, unreasonable lower specific yield values are often obtained from unconfined pumping test solutions, such as the Neuman solution that excludes the effect of flow in the capillary fringe, while a Theis solution fitted to the late segment of the drawdown curve generally provides reliable estimates of specific yield (Kruseman & Ridder, 1994). The specific yield obtained from the TA-RW-1 test, using Theis solution, is 0.3. For subsequent modeling input, typical literature values ranging from 0.01 to 0.3 will be used.

4.0 GROUNDWATER MODELING OBJECTIVES

The objective of this modeling study was to develop a three-dimensional groundwater flow model from which initial design parameters of a groundwater interceptor system that effectively prevents Site groundwater from discharging to the Site surface water features can be developed. R&W/GZA has revised and refined the model inputs based on EGLE's comments in its letter dated August 17, 2021, the majority of which focused on technical aspects of the model as described in Sections 5.0 through 7.0.

5.0 SELECTED MODEL

The USGS MODFLOW, a three-dimensional finite difference numerical modeling software, was used to perform groundwater flow simulations, and USGS MODPATH to perform particle tracking. These software packages are publicly available, peer-reviewed models that are widely accepted by regulatory agencies world-wide. Aquaveo's Groundwater Modeling System software is used as the pre- and post-processor.

6.0 REGIONAL GROUNDWATER MODEL SETUP

A regional groundwater model, from Shaw Creek to the north and to Barkley Creek to the south, from the Rogue River to the west, and Wolverine Boulevard to the east, was first set up to evaluate regional groundwater flow (**Figure 6-1**). The eastern boundary near Wolverine Boulevard was prescribed as an artificial constant-elevation groundwater boundary. The location was selected based on the county-wide estimated groundwater elevation contours. Its distance to the Site is significantly greater than the Site size; therefore, boundary effects are expected to be negligible to the Site area groundwater elevation and flow. Surface water elevations were based on Kent County LiDAR data (Sanborn, 2014) and adjusted per R&W/GZA's April 2019 water level measurements collected at surface water gaging station SW-04[3] during the pumping tests. The elevations from the LiDAR data provide a set of synoptic data for the surface water elevations. The SW-04 data was used as a reference point, and the synoptic data set was adjusted based on the difference in water elevations at SW-04 between the LiDAR data and the measured data on May 5, 2019, prior to the pumping test. **Figure 6-1** provides the model domain and the input surface water boundary types and elevations.

A model grid size of 30 by 30 feet was used horizontally. The vertical model grid extends from the ground surface to an elevation of 560 feet. Six model layers were used with a layer thickness of approximately 20 feet for the top four layers, and approximately 25 feet for the fifth and sixth model layers. As an initial regional model, the model domain was assumed to be homogeneous, represented by one single value of horizontal hydraulic conductivity (Kh), vertical hydraulic conductivity (Kv), and groundwater recharge was assumed to be uniform.

The April 24, 2019 elevation data was used as calibration targets. The hydraulic conductivity and groundwater recharge were set as calibration parameters. The ranges of hydraulic conductivity were based on the pumping test results. The range of groundwater recharge was based on "Estimated of Annual Groundwater Recharge" (Groundwater Inventory and Mapping Project, 2005). The software "PEST" (Doherty, 2021), an inverse parameter estimation tool, was used with MODFLOW. PEST directs MODFLOW to run with numerous combinations of Kh, Kv, and groundwater recharge until it establishes the optimal calibration values of Kh, Kv, and groundwater recharge. The calibrated values are achieved when the sum of squared residuals between the field measured

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[3] SW-04 is the same location as TA-RP-04.

groundwater elevations and model calculated groundwater elevations are minimized. **Table 6-1** provides the input ranges and the PEST calibrated values:

Parameters	Minimum Value	Maximum Value	PEST Calibrated Value
Horizontal Hydraulic Conductivity (Kh), ft/day	0.10	100	4.8
Vertical Anisotropy (Kh/Kv)	1.0	50	2.3
Groundwater Recharge, inches/year	9.0	12	12

Table 6-1: Regional Model Calibration Parameters

Figure 6-2 presents the model calculated groundwater elevation contours using the PEST calibrated value.

The regional model elevation results were transferred to a local model, which is focused on the Site area and its vicinity. The vertical model grid layers remain the same. The artificial model boundaries to the north, south and east were set as constant elevation boundaries for the local model and the groundwater elevations from the regional model at these boundaries were overlaid to the local model as constant elevation values. **Figure 6-3** presents the local model domain.

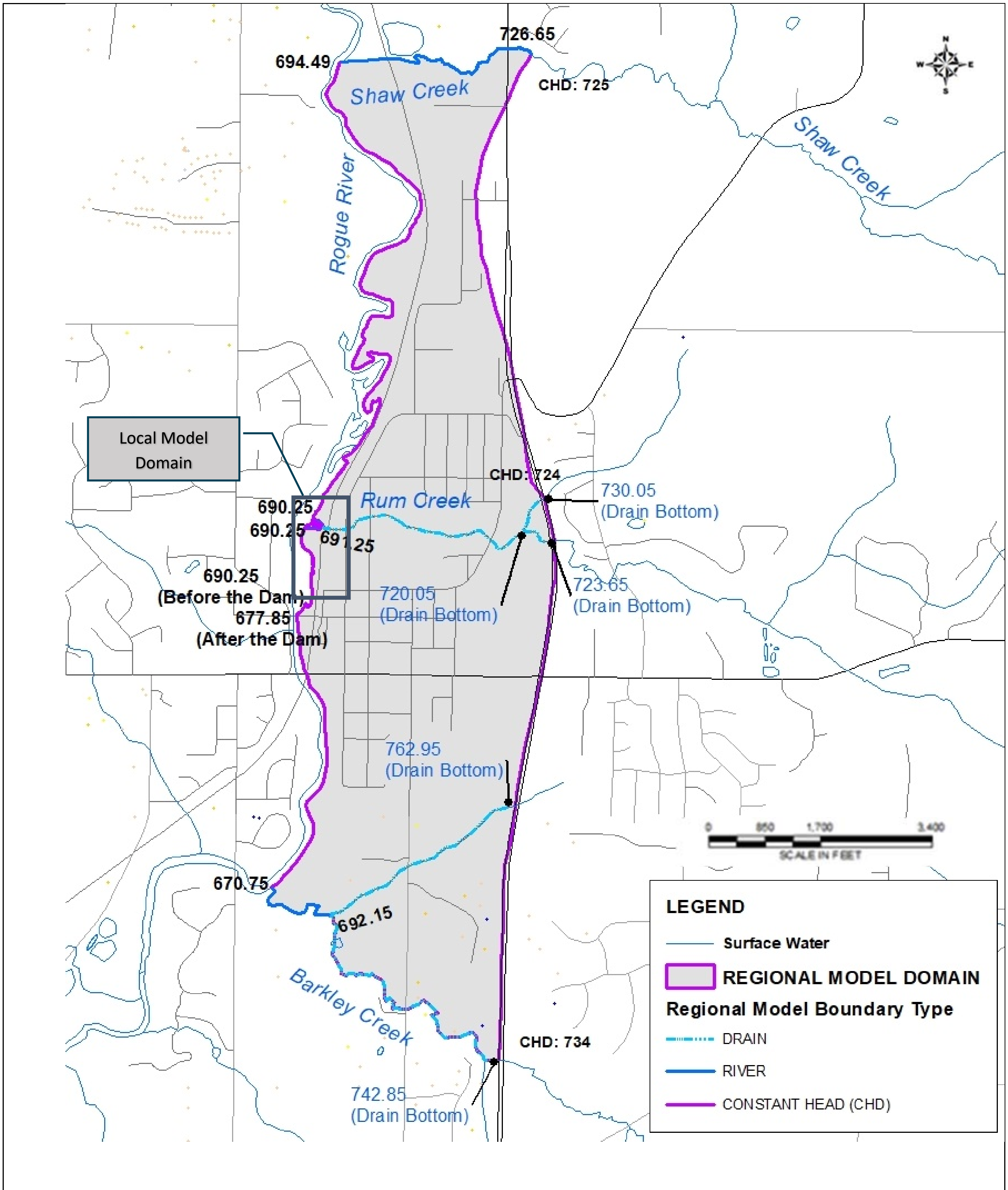
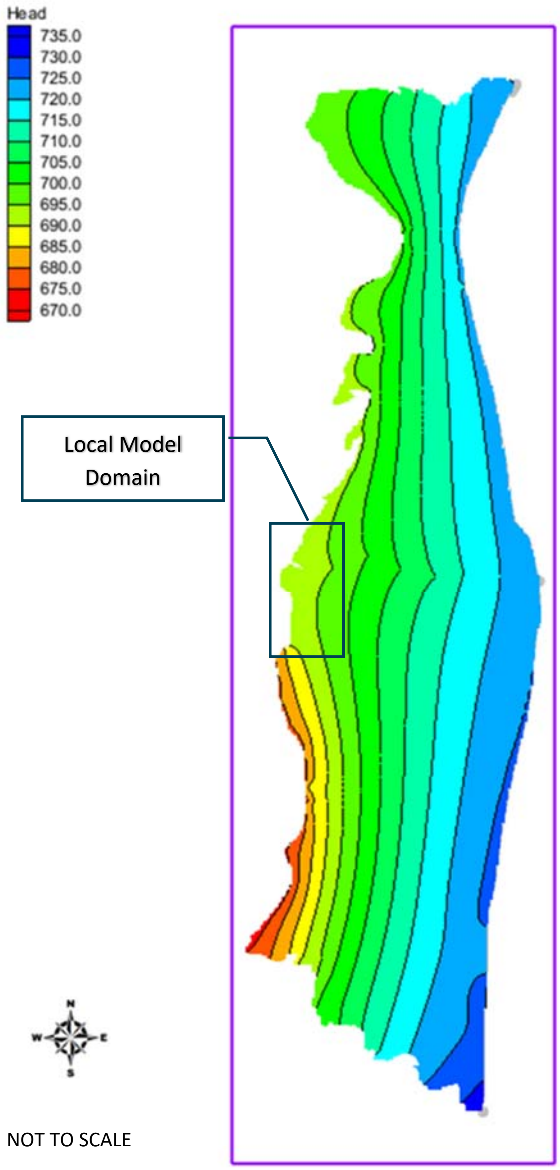
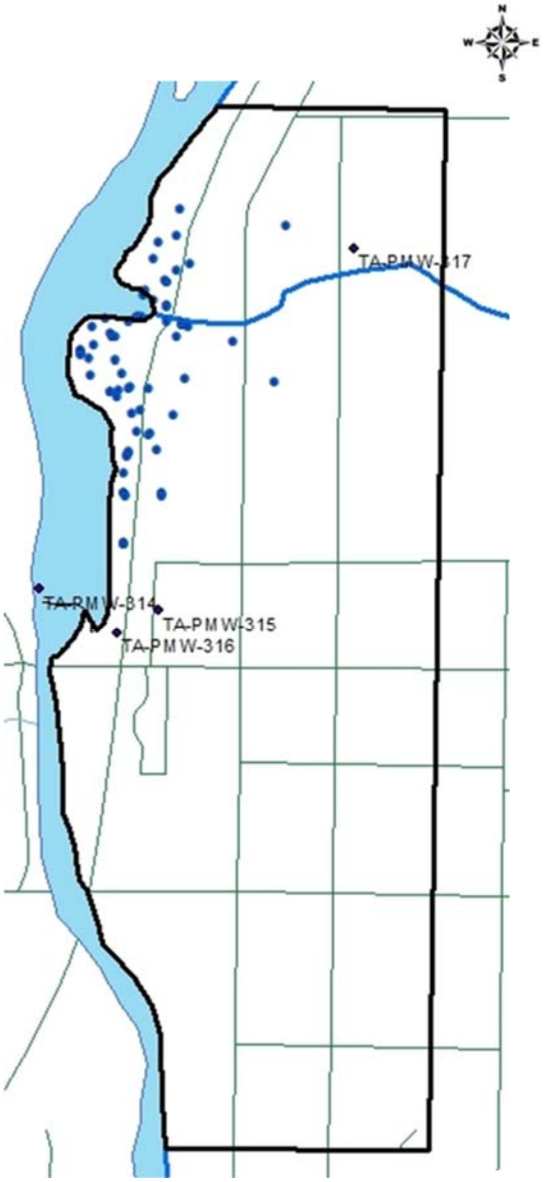


Figure 6-1:Regional Model Domain, Boundary Types



NOT TO SCALE

Figure 6-2: Modeled Groundwater Contours, Regional Model



NOT TO SCALE

Figure 6-3: Local Model Domain

7.0 LOCAL GROUNDWATER FLOW MODEL

The local model setup, input parameters, and calibration are discussed in this Section. See **Figure 6-3** for the local model domain.

7.1 LOCAL MODEL SETUP

USGS' MODFLOW-Unstructured Grid Version (MODFLOW-USG) was used for the local model. Quadtree grids as fine as 3 feet were used in the areas close to the Rogue River and Rum Creek. The grid sizes increase outside of the focused area to reduce total cell numbers and computation time. The vertical model grid layers remain the same as the regional model, and the model layer top and bottom elevations were mapped to the local model. Groundwater elevations data were collected in April 2019 and September 2021. Considering the availability of groundwater recharge estimates for 2019, and April 2019 being a relatively wet and high groundwater recharge month, the April 2019 groundwater elevation data set was used as a conservative input for model calibration.

7.2 GROUNDWATER RECHARGE ESTIMATES

Historical annual groundwater recharge is discussed in **Section 2.2.** From the daily streamflow records at USGS Gauge 04118500, groundwater recharge in April 2019 was estimated to be approximately 19 in/yr. As discussed in **Section 2.2**, groundwater recharge for the Rum Creek drainage area was expected to be less than that of Rogue River. Therefore, groundwater recharge at the Site area is expected be slightly less than 19 in/yr in April 2019 and represents a conservative recharge figure for the Site. Note that higher recharge values in the model will translate to proportionately higher design rates for groundwater pumping to meet the hydraulic capture objective of the interceptor system.

7.3 SURFACE WATER ELEVATION

Surface water elevations for the model inputs were estimated using water level measurements at several shallow river piezometers (TA-RP-1 through TA-RP-5) in the Rogue River sediment and were measured using a staff gauge (TA-SG-RC) in Rum Creek. See **Figure 7-1** below for the locations of the measurement points.

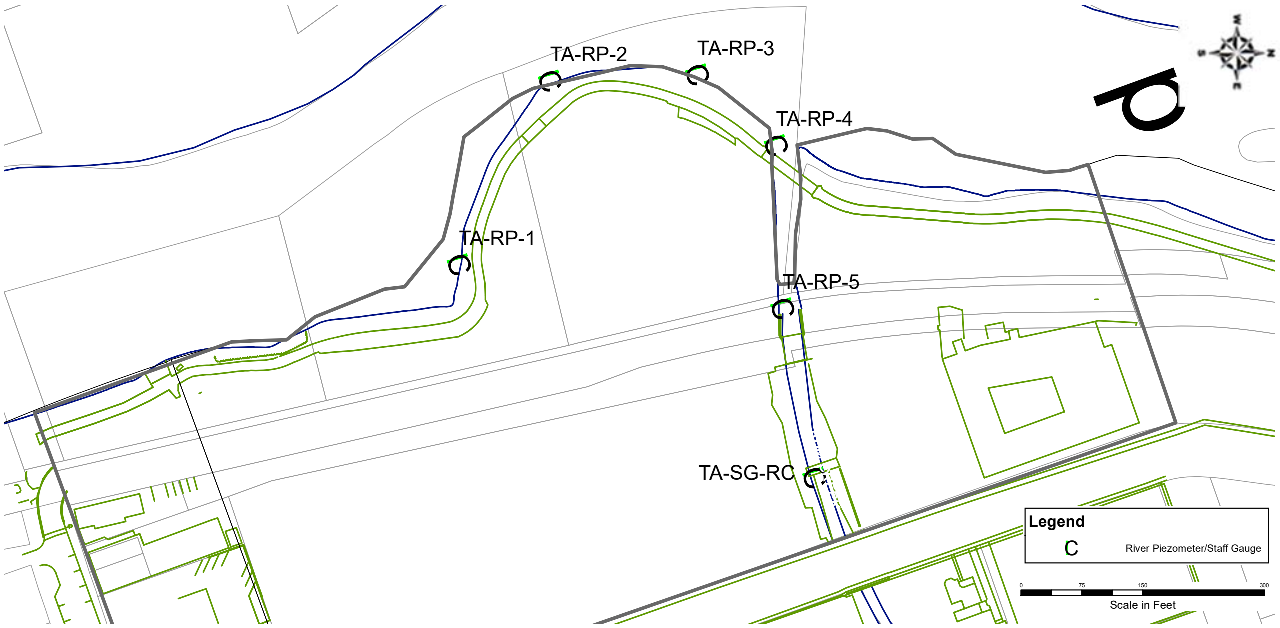


Figure 7-1: Locations of Surface Water Elevation Measurements Stations

Historical surface water elevations measured from 2013 to 2017 are plotted below:

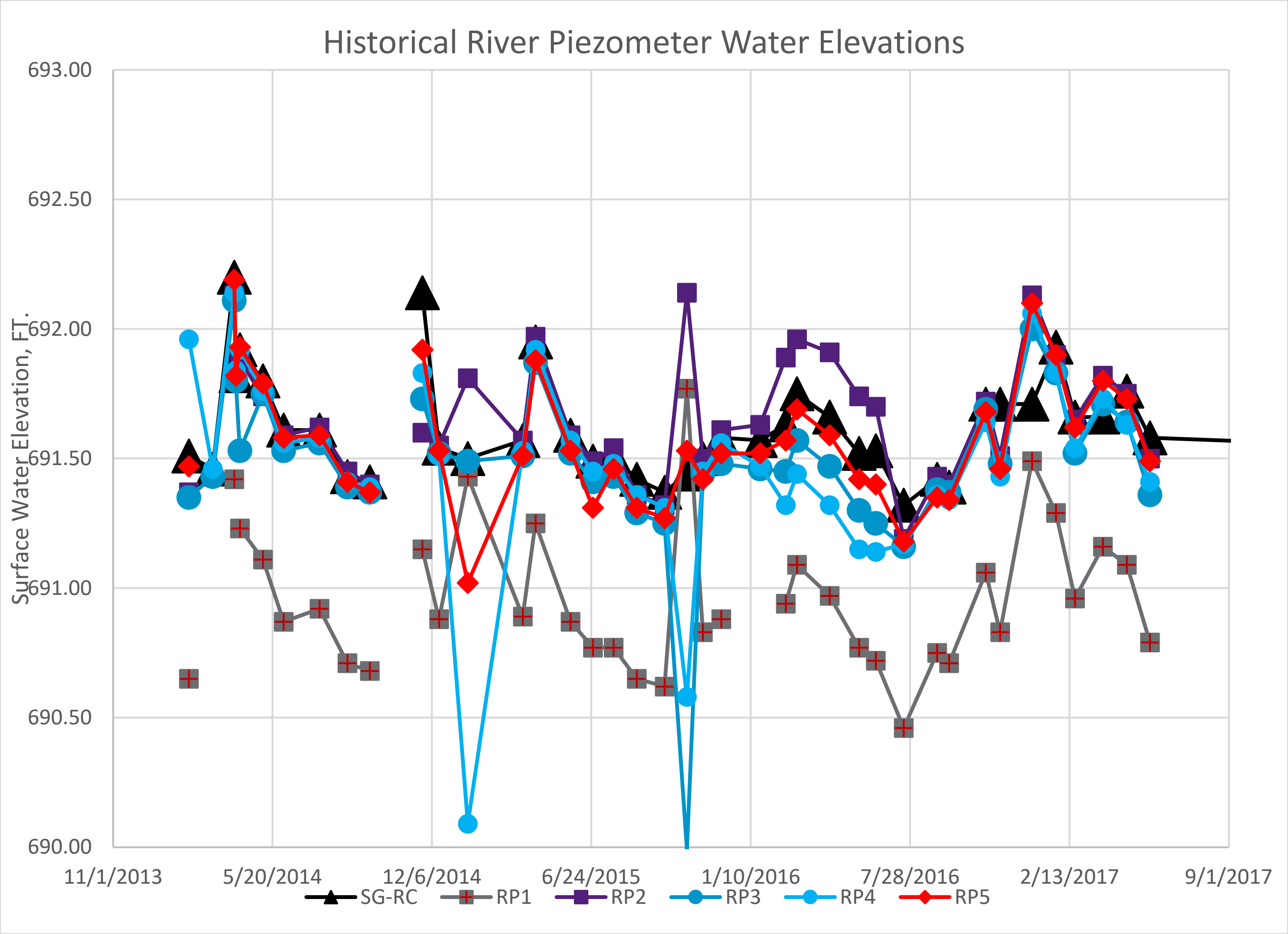


Figure 7-2: Historical Surface Water Elevations

As shown in **Figure 7-2**, the elevation readings at TA-RP-2 through TA-RP-5 show strong correlation to those of TA-SG-RC. The average surface water elevation at TA-SG-RC is approximately 0.1 foot higher than those of TA-RP-2 through TA-RP-5. The surface water elevations at TA-RP-1, the southernmost location, as expected, were lower than TA-SG-RC, and TA-RP-2 through TA-RP-5. The average surface water elevation at TA-RP-1 is approximately 0.6 foot lower than TA-SG-RC. The average differences between TA-SG-RC and other river piezometers were used to extrapolate the measurement at TA-SG-RC to the other river piezometers for the Rogue River water elevation input in the local model.

Other surface water elevations were based on Kent County LiDAR data (Sanborn, 2014) and adjusted per R&W/GZA's April 2019 water level measurements collected at the on-Site surface water gaging station in Rum Creek. The elevations from the LiDAR data provide a set of synoptic data for the surface water elevations. The SG-RC data was used as a reference point, and the synoptic data set was adjusted based on the difference in water elevations at SG-RC between the LiDAR data and the measured data in April 2019.

7.4 LOCAL MODEL CALIBRATION TARGETS

The groundwater elevations in April 2019 were used as calibration targets (See **Table No. 2**). In the absence of daily streamflow records in Rum Creek, baseflow discharged to Rum Creek was estimated and used as an approximate flow target.

A hydrologic analysis based on the Lidar bare earth elevation GIS data was performed to estimate the drainage area for the segment of Rum Creek within the local model. The actual drainage area for the segment is expected to extend beyond the model area; therefore, the base flow may be greater. But the majority of the drainage area for the segment is within the model area; therefore, the percent of error is expected to be small. The baseflow yield for Rum Creek from the State-wide Base Flow of Michigan Streams GIS data (Groundwater Inventory and Map Project, 2005), 0.76 ft/yr was multiplied by a ratio of 1.6 to reflect the relatively higher groundwater recharge in April 2019. The ratio of 1.6 was estimated from the groundwater recharge estimate of 19 in/yr for April 2019 divided by the historical average groundwater recharge of 12 in/yr estimated from the USGS Gauge from 1988 to 2020. With the estimated drainage area and the adjusted baseflow yield, the baseflow venting to Rum Creek for the segment within the model was estimated to be 5,210 cubic feet per day. This value will be used as a calibration target, along with the April 2019 groundwater elevations. The input parameters used in the estimation are summarized below.

Parameters	Symbol	Unit	Value
Estimated Drainage Area for the Rum Creek Segment in Local Model	A	Square Foot	1,563,890
Estimated Base Flow Yield for Rum Creek (Groundwater Inventory and Map Project, 2005)	Y	Ft/yr	0.76
Historical Average Groundwater Recharge (USGS Gauge)	R_{ave}	In/yr	12
April 2019 Groundwater Recharge (USGS Gauge)	R	In/yr	19
Ratio of April 2019 Groundwater Recharge to Historical Average Groundwater Recharge	R/R_{ave}	Unitless	1.6
Estimated Baseflow to the Rum Creek Segment in Local Model	Q_{base}	Cubic foot per day	5,200

Table 7-1: Estimation of Base Flow to the Rum Creek Segment in Local Model

A similar estimation for the segment of the Rogue River in the local model was not attempted because the drainage area west of the Rogue River is beyond the local model area. It is difficult to estimate the baseflow contribution from the local model area to the Rogue River segment. However, the estimated baseflow for Rum Creek is expected to provide a useful constraint to flow, and therefore improve the model calibration. In addition, the total in-flow from recharge for the Site area will be reviewed against the groundwater recharge estimates from the USGS gauge in April 2019 as another calibration check.

7.5 CALIBRATION PARAMETERS

Based on initial groundwater modeling runs and stochastic evaluation of geology, the non-homogeneous nature of the saturated zone was the controlling factor for model calibration. To improve calibration quality, pilot points of hydraulic conductivity, vertical anisotropy, and groundwater recharge were used as calibration parameters to allow for spatially varied arrays of horizontal hydraulic conductivity, vertical anisotropy, and groundwater recharge. Pilot points in the Site area were spaced at approximately 180 feet, and in the area south of the Site at approximately 360 feet to reduce computation time. See **Figure 7-3** for the pilot point locations for horizontal hydraulic conductivity in model Layer 1.

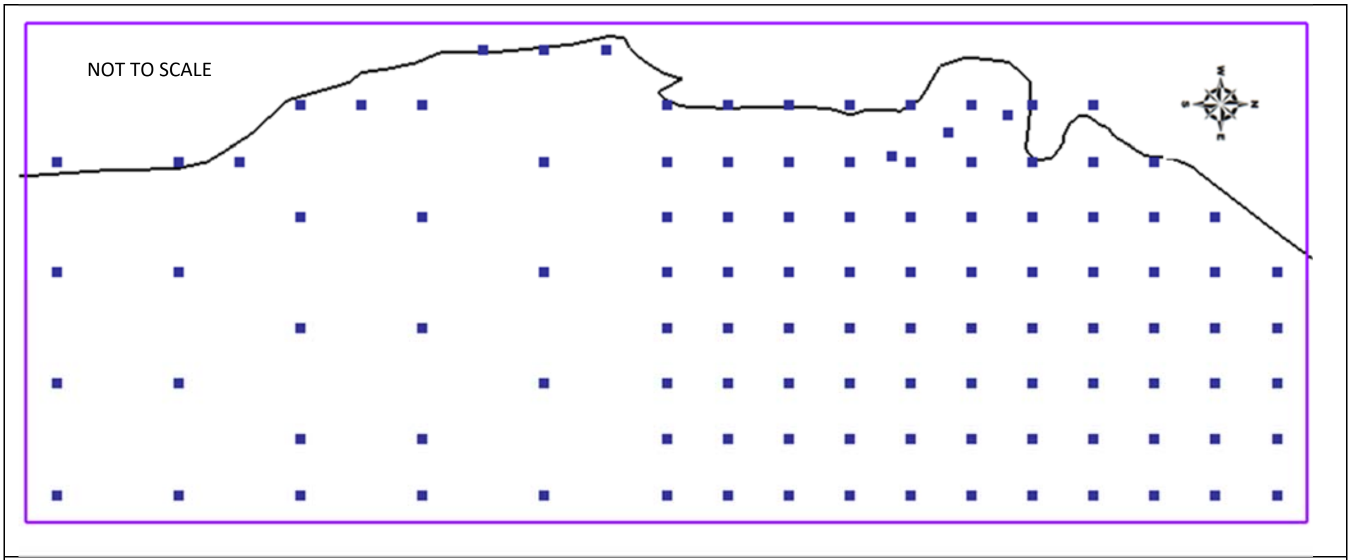


Figure 7-3: Pilot Points for Horizontal Hydraulic Conductivity, Model Layer 1

Three pilot points were added where the pumping tests were performed, TA-RW-1, TA-RW-2, and TA-RW-3, and the interpreted hydraulic conductivity at TA-PMW-1, TA-PMW-2 and TA-PMW-3 were input and the values fixed. The ranges of the pilot point values were as follow:

Parameters	Initial Value	Minimum	Maximum
Horizontal hydraulic conductivity (ft/day)	8	0.1	100
Vertical anisotropy	1	1	30
Recharge (in/yr)	12	9	20

The automated calibration software "PEST" (Doherty, 2021) was used for model calibration runs using key parameter constraints. PEST directs MODFLOW to run with numerous combinations of Kh, Kv, and groundwater recharge until the sum of squared residuals between the observed elevation or flow targets and model calculated elevations and flow rates are minimized. Manual trial and error methods were also used to adjust parameter values. Preferred homogeneous regularization was used to provide additional restrains for the PEST runs. A Singular value decomposition-assisted parameter estimation option was selected to reduce computation time.

7.6 CALIBRATION RESULTS

The computed groundwater elevations, or hydraulic heads, were compared to the observed elevations and plotted in **Figure 7-4**. See **Table No. 4** for a summary of the computed groundwater elevations versus the observed groundwater elevations. Out of the 63 observation targets, the computed elevations of 50 wells are within 1 foot of the observed elevations. For five wells, the differences between the computed and the observed elevations were more than two (2) feet, but less than three (3) feet. The list of the wells with more than 2-foot elevation differences include TA-MW-303D, TA-MW-303E, TA-MW-313A, TA-MW-313B, and TA-MW-313C. See **Figure 7-5** for the calibration elevation residual map.

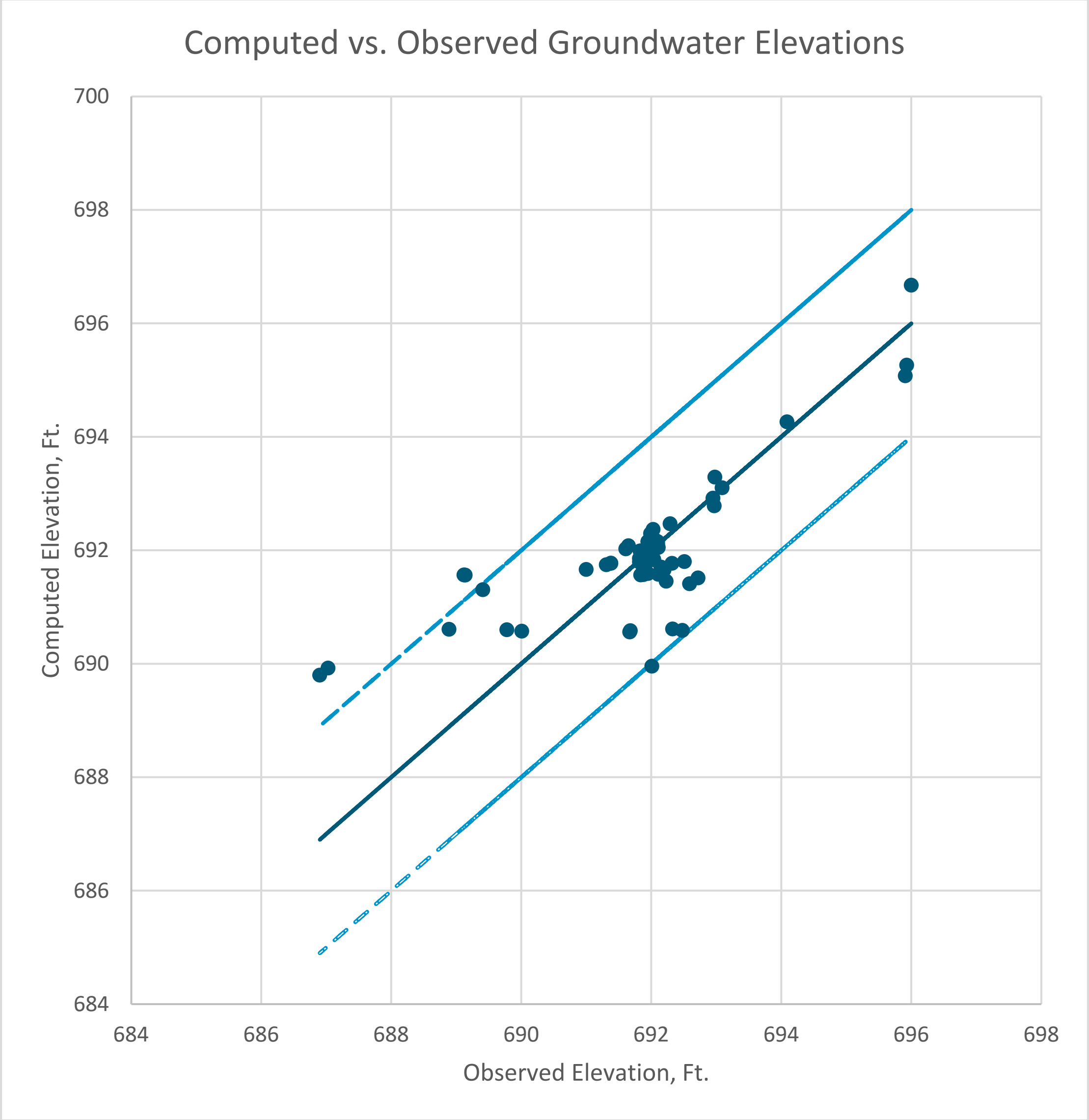


Figure 7-4: Computed Vs. Observed Hydraulic Elevations

The resulting root mean squared errors of the modeled versus observed groundwater elevations is less than 1 foot, indicating a reasonable match with the observed elevations, although some minor deviations were noted. In reviewing the comparison of modeled versus observed groundwater elevations, the greatest variations appear to correlate to geologic and hydrogeologic variations across the Site. These include the following:

- For the TA-MW-303 well cluster, the computed elevations of the shallower wells TA-MW-303A/B/C match reasonably well with the observed data. However, the higher computed elevations in TA-MW-303D/E are likely due to the well screens of TA-MW-303D/E being separated from the upper saturated zone by a stratum of fine-grained soil approximately 20 feet in thickness. The observed elevations in TA-MW-303D/E are more than 3 feet below that of wells TA-MW-303A/B. Again, the hydraulic effects of the fine-grained soil stratum near TA-MW-303 cluster were not modeled by the hydraulic conductivity arrays due to the coarse distribution of pilot points. Therefore, in the model, monitoring wells TA-MW--303D/E exhibit influence from Rogue River resulting in higher computed elevations than the observed elevations.

- For monitoring well TA-MW-313A, the majority of the well screen is within fine-grained soil resulting in poor hydraulic connection to the adjacent saturated zone and the Rogue River (See Section 2.6). The observed elevation at TA-MW-313A appears to be slightly higher than that of Rogue River in that area. Monitoring wells TA-MW-313B/C are separated from the shallow zone by a stratum of fine-grained soil approximately 30 feet in thickness. The elevations are not influenced by the Rogue River, and the measured groundwater elevations are more than 5 feet less than that of TA-MW-313A. Due to relatively coarse distribution of the pilot points, the averaged hydraulic conductivity in the model is greater than that of fine-grained soil at TA-MW-313 cluster; therefore, the model computed elevations at TA-MW-313 cluster exhibit more influence by the Rogue River than in the observed field condition, resulting in the more than 2 feet of difference in these wells.

The higher hydraulic conductivity values modeled in these two areas result in the model utilizing a greater influence of the Rogue River than observed in the field. As such, the system is conservatively designed with a higher pumping rate than may be necessary to achieve the capture objectives of the interceptor system.

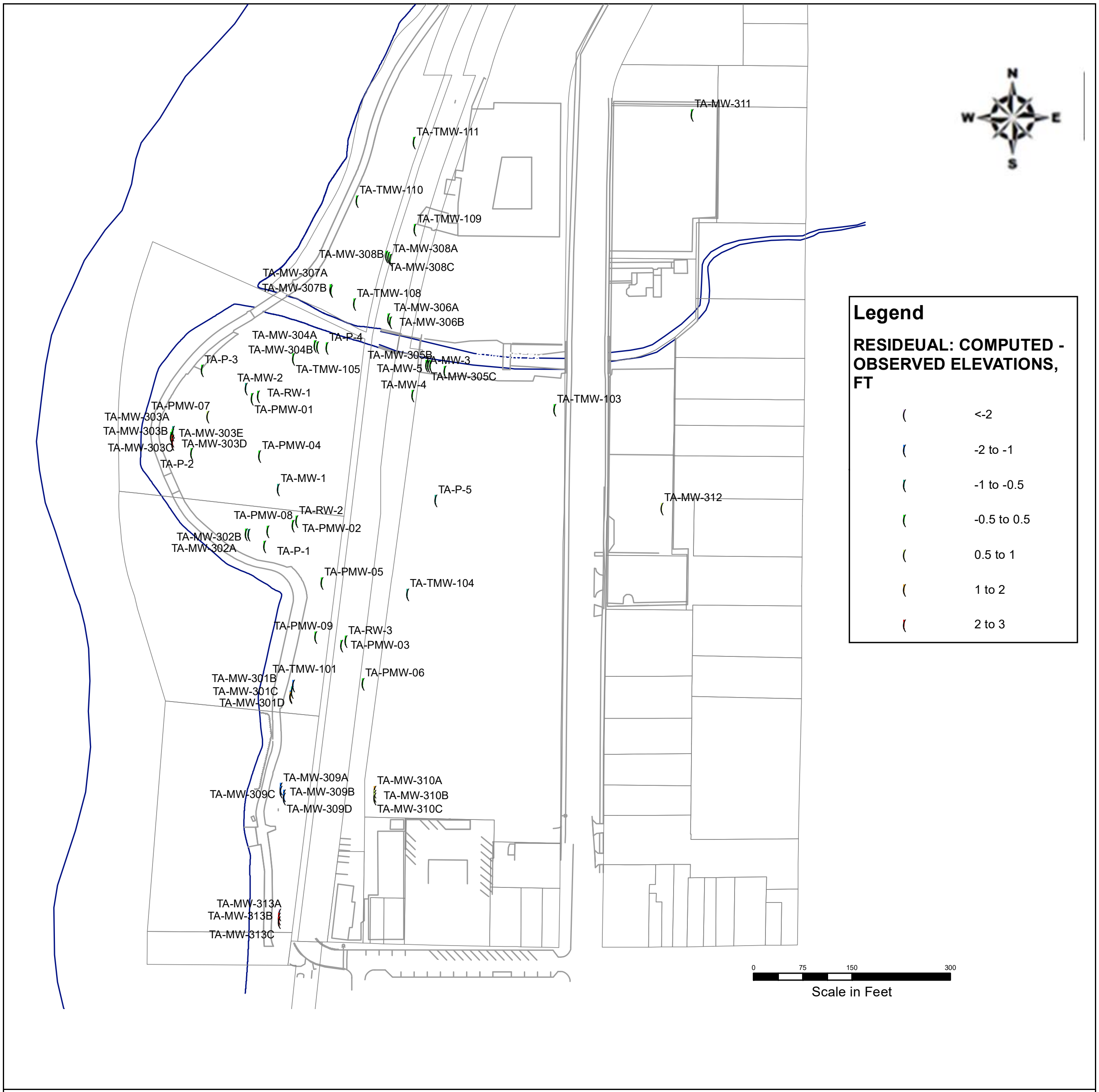


Figure 7-5: Calibration Elevation Residuals

The model computed elevations at the observation wells were used to plot groundwater contours and compare the modeled groundwater elevations to actual observed flow conditions, using SURFER® contouring software.

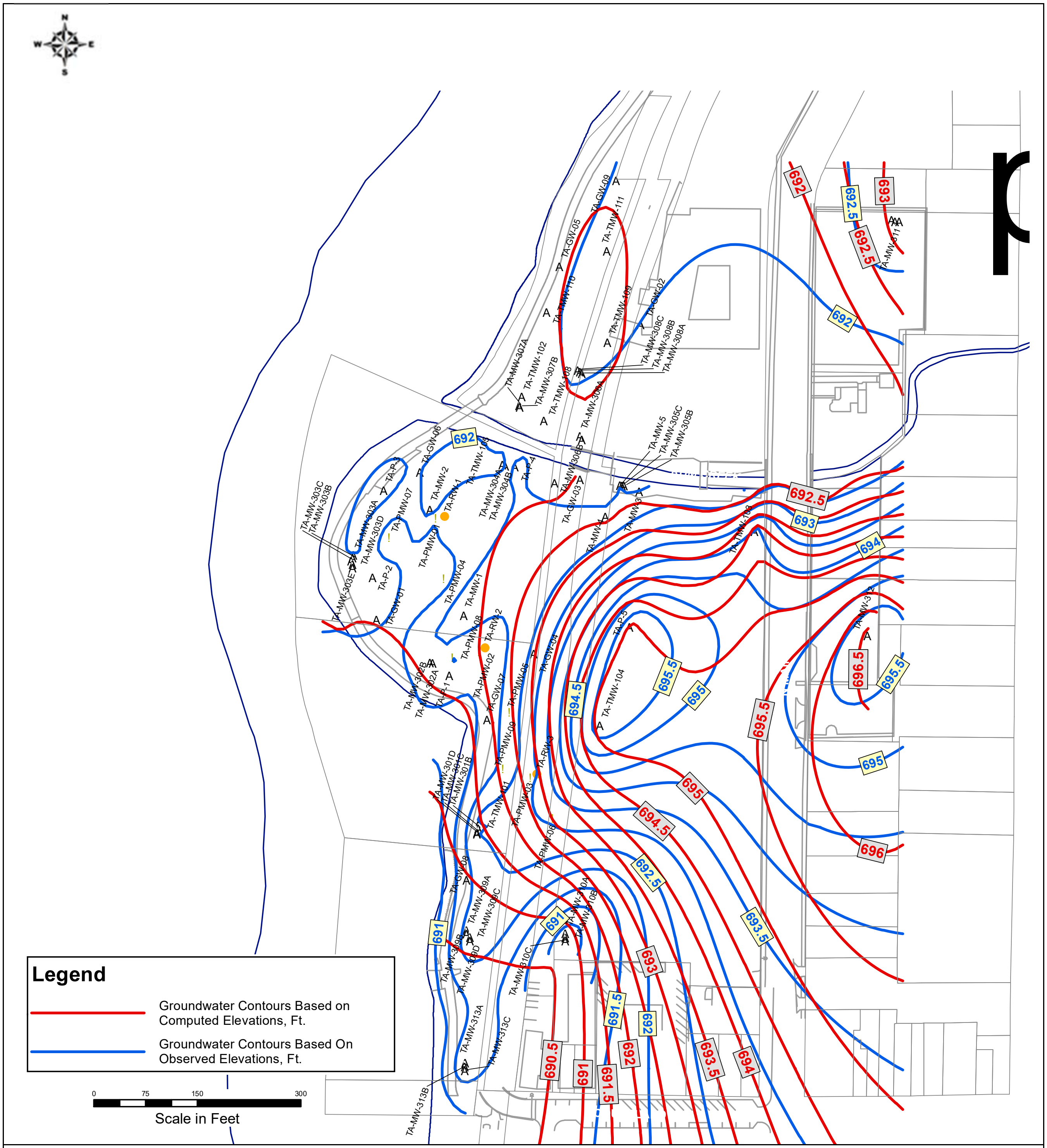


Figure 7-6: Groundwater Contours of the Computed Elevations vs. the Observed Elevations of April 2019

As shown in **Figure 7-6**, both contour maps show groundwater discharges to Rum Creek from either side of the creek, with steeper hydraulic gradient from the south. A groundwater mound in the central part of the Site south of Rum Creek, results in groundwater movement to the west and southwest toward the Rogue River. The groundwater flow patterns in the southwest corner of the property differ slightly between the observed and the computed elevations because the observed groundwater elevation in TA-MW-313A is affected by the presence of finer-grained soil, lower hydraulic conductivity, and poor hydraulic connection to the surrounding saturated zone. Note that this localized flow pattern in the southwest corner of the Site was not observed in the September 2021 groundwater contours and may reflect a temporal condition that occurs following a period of increased recharge and groundwater elevation. Overall, the modeled groundwater contours and flow directions are generally consistent with the observed groundwater contours.

Another output of the calibrated model is the computed groundwater flow discharged to Rum Creek. Within the local model area, the model groundwater discharge to Rum Creek is approximately 4,920 cubic feet (~37,000 gallons) per day as compared to the observed estimate of 5,210 cubic feet (~39,000 gallons) per day. The modeled value is within approximately 6 percent of the targeted value.

To calculate a water mass balance or flow budget for the Site using the model, a zone matching the Site area was designated as Zone 2, and the remaining local model domain outside of Zone 2 labeled as Zone 1, as shown in **Figure 7-7**. The extent of Zone 2 was selected to include the estimated extent of PFOS exceeding GSI criteria in groundwater, which is the target for capture zone, and the extent of the extraction well coverage during design phase modeling.

Figure 7-7: Flow Budget Zone

The model calculated flow budget, or mass balance, for the Site Area (Zone 2) from all the model layers (Layer 1 through Layer 6) is summarized below.

Parameter	**Flow, ft^3/d**
Inflows:	
Constant Elevation (Upgradient, East Boundary	4898
River Leakage	0
Recharge	2097
Zone 1 to Zone 2	6761
Total Inflows	13756
Outflows:	
Constant Elevation (To Rogue River)	3348
River Leakage (To Rum Creek)	1032
Recharge	0
Zone 2 to Zone 1	9370
Total Outflows	13751
SUMMARY:	
Inflow - Outflow	5.5
Percent Discrepancy	0.04%

During the PEST calibration run, groundwater recharge, like hydraulic conductivity, is spatially varied with the use of pilot points. For the groundwater recharge averaged over Zone 2, the recharge volumetric flow rate (2097 ft^3/d) was divided by the Zone 2 area, and calculated to be approximately 15.2 in/yr. It is approximately 6.2 in/yr greater than the estimate from the published baseflow yield of 0.76 feet per year (9 in/yr) in Rum Creek, as estimated from the historical average of the area representing the Site. The groundwater recharge estimate of 19 in/yr from the USGS Gauge for April 2019 is approximately 7 inches more than the average groundwater recharge of 12 in/yr. Using the 7 in/yr difference as a calibration target, the calibrated groundwater recharge matches reasonably well. The groundwater recharge in the calibrated model also represents the higher end of the likely range, which provides a conservative flow estimate for the treatment system design.

8.0 GROUNDWATER INTERCEPTOR SYSTEM EVALUATION

The local model was used to evaluate several interceptor system design scenarios using a network of groundwater extraction wells with the following evaluation criteria:

- Technical Feasibility: The performance objective of the groundwater interceptor system is to generate coalescing drawdown and inward hydraulic gradients that intercept groundwater flow and effectively prevent groundwater discharge to Rum Creek and the Rogue River. The hydraulic capture zone of the system is designed to provide spatial coverage over the extent of the groundwater plume extending near the GSI and capture the extent of the vertical plume that currently enters the Rogue River. In addition, the system will be designed to minimize the amount of induced recharge from Rum Creek and the Rogue River back into the Site groundwater system.

- Implementability: The system design is implementable in terms of the system construction and treatment system flow capacity. In addition, the flexibility of system modification in the future should be considered due to the variable productivity of individual extraction wells that compose the interceptor system and results from the heterogeneous nature of subsurface conditions underlying the Site.

As discussed in **Section 2.7**, PFOS was primarily present in the top 10 feet of groundwater, approximately from elevations 680 to 690 feet (approximately 5 to 15 feet bgs). PFOS concentrations differ by elevation, depending on lithology and location on-Site. Particularly relevant to the evaluation in this section, PFOS concentrations at an elevation of approximately 672 feet in the area south of Rum Creek, and an elevation of approximately 685 feet in the area north of Rum Creek, are meaningfully different than the PFOS concentrations at other elevations in those areas. Similarly, the lack of fine-grained soils or relatively thin stratum of fine-grained soil in some portions of the Site allows vertical PFOS migration in the groundwater, in vertical intervals from elevations 680 to 650 feet in the southern part of the Site.

Vertically, the interceptor system would be designed to capture the shallow and deep groundwater zones as follows:

1. Above elevations 685 feet north of Rum Creek:
2. Above elevations 670 feet south of Rum Creek and along the Rogue River; and
3. In the deep saturated zone from 670 to 650 feet in the southern part of the Site, along the Rogue River.

8.1 INTERCEPTOR SYSTEM DESIGN

R&W/GZA conducted numerous modeling runs to balance extraction rates with effective hydraulic control while minimizing induced recharge from both surface water bodies. Based on combining the model output with the performance objectives, optimal performance of the interceptor system is achieved using both a shallow and deep extraction well network consisting of the following elements:

1. For the Site area north of Rum Creek, five shallow groundwater extraction wells screened from elevations of approximately 690 to 680 feet; three of which will be placed along the Rogue River and two along Rum Creek.

2. For the Site area south of Rum Creek, the extraction wells will consist of 14 shallow extraction wells screened from elevations of approximately 690 to 670 feet; and

3. Also south of Rum Creek, three deep extraction wells will be screened from elevations of approximately 670 to 650 feet.

Sheet No. 9 presents the proposed well layout. During drilling and installation, the well screen positions will be adjusted, and additional wells may be added based on field observations of lithology at individual locations.

The design flow rates of the 22 extraction wells as referenced on **Sheet No. 9** are provided in the following table and basis of flow rates described below.

WELL	Screen Zone	Flow Rate, GPM
EW-1	S	3
EW-2	S	3
EW-3	S	4
EW-4	S	2
EW-5	S	2
EW-6	S	3.5
EW-7	S	2.5

WELL	Screen Zone	Flow Rate, GPM
EW-8	S	1
EW-9	S	2
EW-10	S	2
EW-11	S	2.5
EW-12	S	2.5
EW-13	S	2.5
EW-14	S	2.5
DEW-15	D	2.5
EW-16	S	2
EW-17	S	3
EW-18	S	2
DEW-19	D	1
EW-20	S	1
DEW-21	D	1
EW-22	S	1
Total Flow Rate		48.5

Table 8-1: Extraction Well Design Flow Rates

The design flow rates were obtained through numerous modeling trials with the goal of preventing groundwater from venting to the Rogue River while minimizing pumping water from the Rogue River. The calibrated groundwater model was used to simulate various well layouts and pumping rates. During the modeling trials, the model calculated groundwater contours and drawdowns were reviewed. Particle tracking software MOD-PATH3DU was used to perform forward particle tracking upgradient of the Site in model Layers 1 through 4. The capture zones of the individual wells were reviewed. Reverse particle tracking from the extraction wells was used to evaluate the coalescing drawdowns and extent of the hydraulic capture zone. See **Section 8.2** for a summary of the capture zone evaluation. The model calculated total pumping rates from the 22 extraction wells was approximately 49 GPM.

8.2 CAPTURE ZONE EVALUATION

This section provides a summary of the capture zone evaluation for the proposed extraction well system. The forward particle tracking pathlines, along with model computed groundwater contours, for model Layers 1 through 4 are depicted in **Figures 8-1** through **8-4**. The following table provides a summary of the approximate model layer top and bottom elevations at the Site area.

Model Layer	Top Elevation	Bottom Elevation
1	695	672
2	672	653
3	653	632
4	632	608
5	608	584
6	584	560

The particles were released in the model in their starting positions. The model calculated pathlines (dark blue on **Figures 8-1** through **8-5**) indicate the particle travel paths, and the end of a particle pathline usually indicates groundwater flow sinks, such as extraction wells, drains, or rivers. A particle pathline stops at an extraction well when it is hydraulically captured by the well.

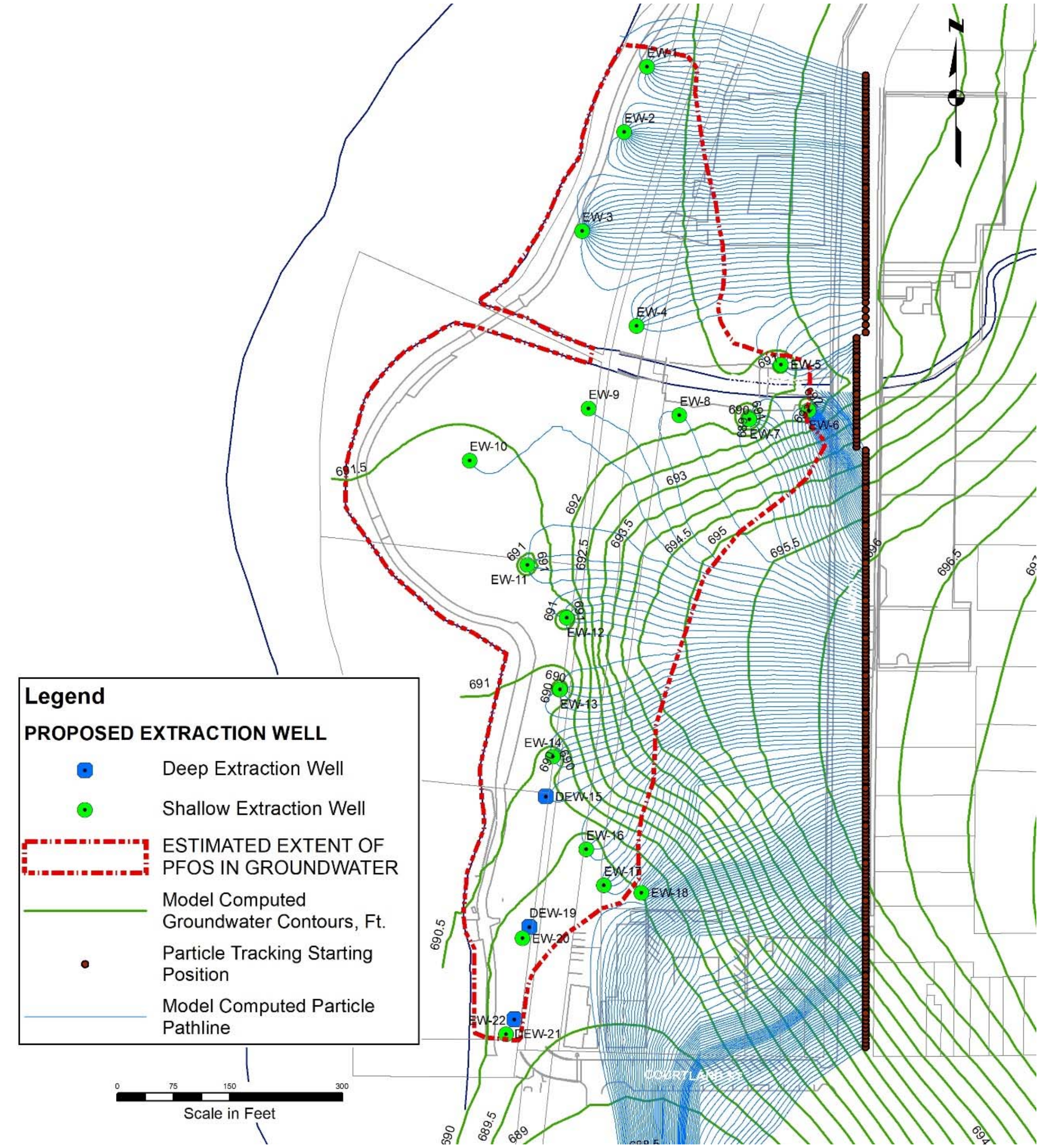


Figure 8-1: Model : Model Computed Forward Particle Pathlines, Layer 1, Elevations from Approximately 672 to 695 feet.

As shown in **Figure 8-1**, the modeled effects of the interceptor system show coalescing drawdowns from individual extraction wells and an inward hydraulic gradient that intercepts groundwater flow to Rum Creek and Rogue River in model Layer 1.

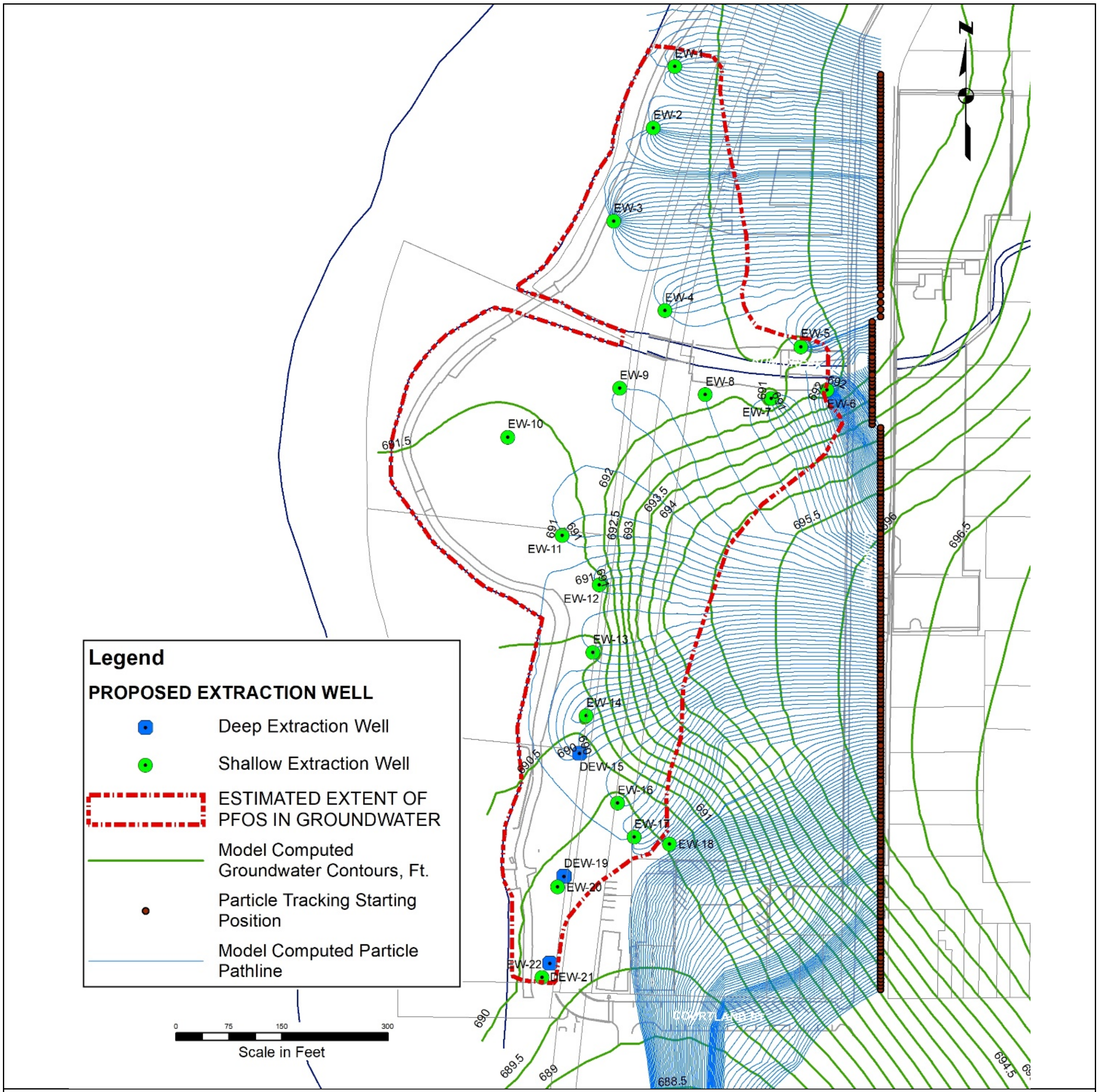


Figure 8-2: Model Computed Forward Particle Pathlines, Layer 2, Elevations from Approximately 653 to 672 feet.

As shown in **Figure 8-2**, similarly as in Layer 1, the interceptor system shows modeled effectiveness in creating inward hydraulic gradients that intercept groundwater flow to Rum Creek and Rogue River in model Layer 2.

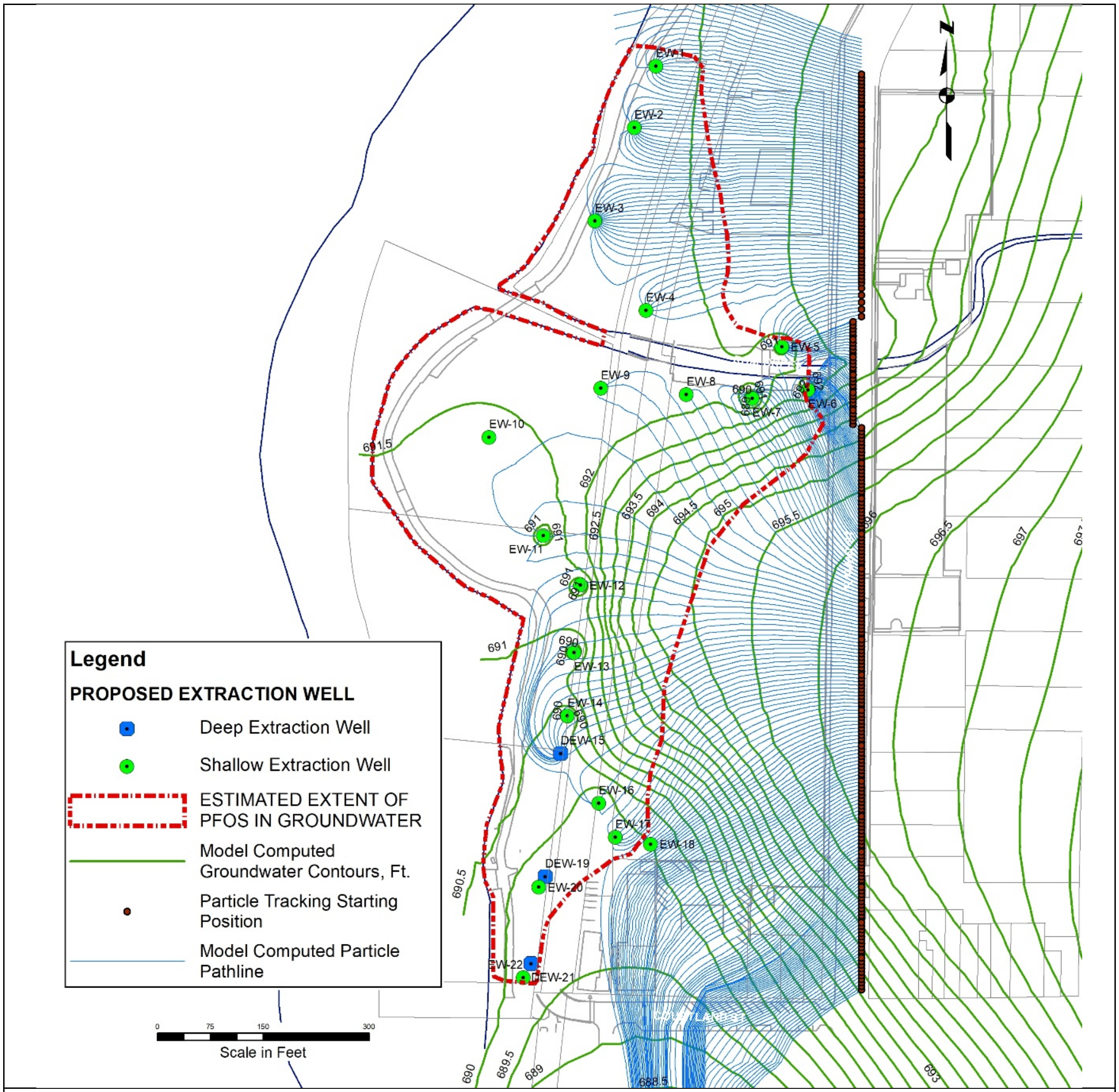


Figure 8-3: Model Computed Forward Particle Pathlines, Layer 3, Elevations from Approximately 632 to 652 feet.

As shown in **Figure 8-3**, the interceptor system is also able to create an inward hydraulic gradient and intercepts groundwater flow to Rum Creek and Rogue River in model Layer 3.

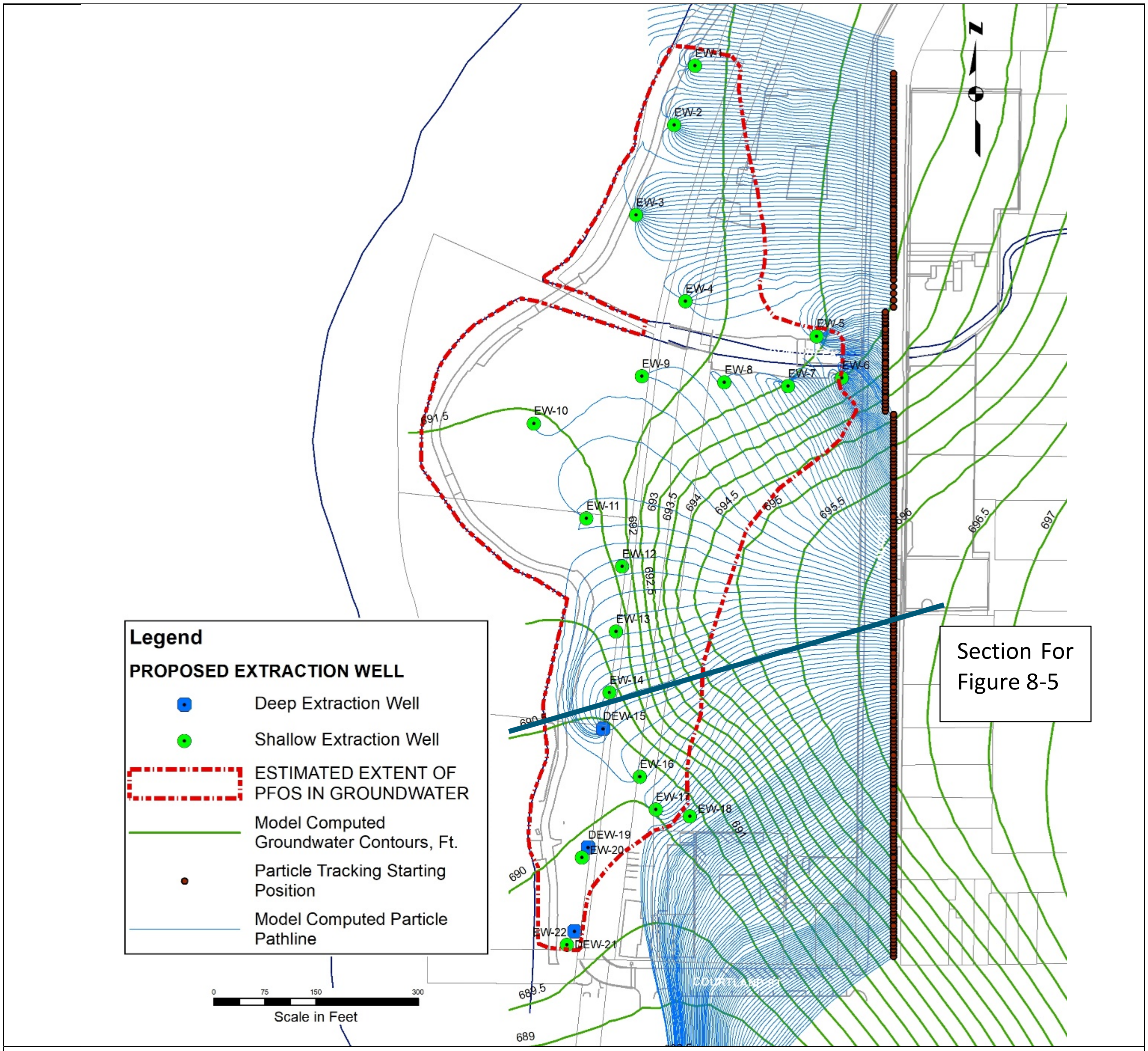


Figure 8-4: Model Computed Forward Particle Pathlines, Layer 4, Elevations from Approximately 608 to 632 feet.

As shown in **Figure 8-4**, the interceptor system is also able to create inward hydraulic gradients and intercept groundwater flow to Rum Creek and Rogue River in model Layer 4.

To review the modeled pathline in vertical profile, the vertical capture zone reaches to Layer 4 (Bottom Elevation 608 feet.) as shown in **Figure 8-5**.

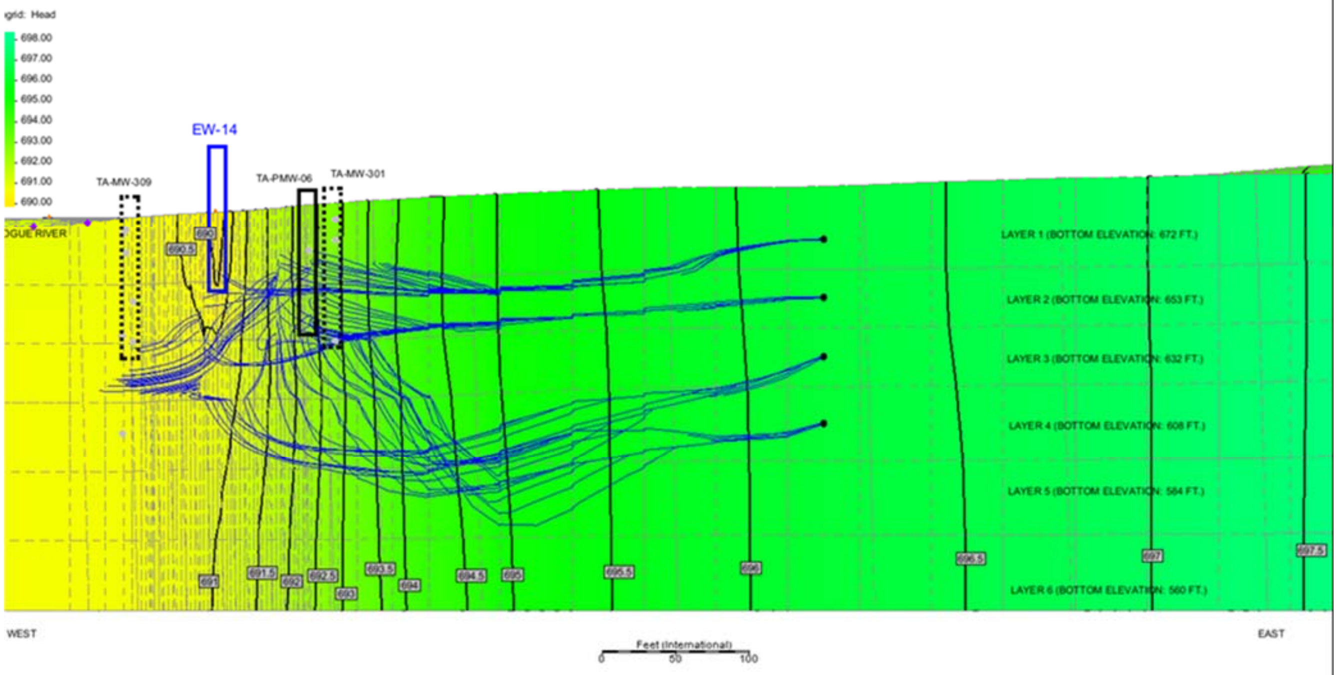


Figure 8-5: Model Computed Pathlines, West-East Cross-Section Profile, Through EW-14 Clusters

The particle pathlines indicate the designed well layout and pumping rates are expected to provide hydraulic capture of the extent of PFOS in groundwater on-Site and prevent groundwater from venting to the surface water.

The above extraction well layout and design was modeled using the calibrated model, which has approximately 15.2 in/yr groundwater recharge, representing a reasonable high end of the groundwater recharge range. Under high recharge rates, greater groundwater pumping rates are needed to intercept groundwater flux and prevent groundwater from venting to the Rogue River. The use of April 2019 groundwater recharge is conservative (i.e., results in higher groundwater extraction rates) relative to average recharge conditions. Under low recharge conditions, extraction wells located in areas of relatively low hydraulic conductivity may be pumped dry. If this happens, additional extraction wells with relatively low pumping rates will be required to provide hydraulic capture. To examine modeled groundwater capture sensitivity to recharge value, the same well layout was also evaluated with a lower groundwater recharge rate of 9.1 in/yr average, which was based on the baseflow yield of Rum Creek (Groundwater Inventory and Map Project, 2005). A multiplier of 0.6 was used in the recharge module of the calibrated model to simulate the lower recharge scenario. The modeling result indicates total pumping rate of 45 GPM, and the capture zone and flow pathlines are similar to those presented in **Figures 8-1** through **8-5.**

9.0 GROUNDWATER INTERCEPTOR AND TREATMENT SYSTEM DESCRIPTION

This section provides a description of the interceptor system, the placement and instrumentation of piezometers to measure and document that the performance objectives are being met and the treatment system components. As construction details and drawings are developed, some components are subject to change.

9.1 INTERCEPTOR SYSTEM

9.1.1 Extraction Wells

The shallow extraction wells north of Rum Creek will be screened from elevation 680 to 690 feet; the shallow extraction wells south of Rum Creek will be screened from elevation 670 to 690 feet. The deep extraction wells will be screened from elevation 650 to 670 feet. The locations and the screen intervals will be adjusted during installation, based on the soil conditions observed during drilling. See **Sheet No. 9** for the proposed extraction well location plan.

Each extraction well (EW) will be constructed of a 4-inch diameter, stainless steel, No. 20 slotted wire-wrapped screen. Filter pack sand will be filled to approximately two to three feet above the top of the well screen, followed by a bentonite plug. The remaining annulus will be filled with bentonite/cement grout. During detailed design phase, the filter pack sand specifications and well screen slot sizes may be changed based on field observations of lithology and grain size analysis.

9.1.2 Pumps

A pump will be installed in each EW, and the pump outlet will be connected to a flexible hose seated in a pitless adapter that connects to the manifold piping, A flow meter, flow control valve, and pressure switch will be installed at each manifold. The manifold piping will be connected to the main piping run. Heat cables are wrapped around the manifold piping to keep pipes from freezing in cold temperatures. A thermostat will be installed to control the heat cables, which are powered by a ground fault interrupter (GFI) breaker. In the event of a breaker trip, a signal is sent to the process logic control (PLC) and an alarm event is created.

9.1.3 Piping

The main piping run will be buried approximately 4 feet bgs. The locations of the piping runs will be surveyed so that piping can be protected from damage during future Site work. The piping run will enter the treatment building, passing through a flow meter, flow control valve, and pressure switch. Heat cables will be wrapped around the piping run starting from the EW and ending at the tank inlet. A thermostat will be installed to control the heat cables, which will be powered by a GFI breaker. In the event of a breaker trip, a signal will be sent to the PLC and an alarm event created. The portion of the force main passing under Rum Creek will be installed using a horizontal boring. This crossing has already been permitted through EGLE (Permit No. WRP021885, expires May 26, 2025).

9.1.4 Piezometers

To observe performance of the inceptor system, 17 piezometers (PZs) will be installed, each located between the extraction wells. Of the 17 PZs, five PZs, designated with “D”, will be installed and screened in the same depth interval as the nearby deep extraction wells. Five river piezometers (RPZs) will be installed between the extraction well line and the Rogue River. Two RPZs will be installed in Rum Creek and screened below the riverbed to monitor groundwater elevations beneath the creek. See **Sheet No. 10** for a location plan for the PZs and RPZs.

The PZRs and RPZs will be constructed of 3-foot long, No. 20 slot, 2-inch diameter PVC screens. The PZs will be set at approximately the same depth interval as the shallow extraction wells. The RPZs near the Rogue River will be set at an elevation of approximately 689 feet. The RPZs in Rum Creek will be installed below the river bed.

9.1.5 Pressure Transducers

A pressure transducer hard-wired to the control panel will be installed in each extraction well to measure the water elevation in each extraction well. Pressure transducers will also be installed in each of the RPZs. Considering the Rogue River surface water elevations are relatively constant from the northern end of the Site to the southern end of the Site, the groundwater elevations in the RPZs will be considered groundwater elevations at the GSI, and each RPZ will be paired with several extraction wells so that hydraulic control can be directly monitored and controlled. Water elevation data collected by the transducers will be output to the PLC to control pump operation.

9.1.6 Pump Controller

The pump controller will be installed inside the control panel. The pump controller protects the pump from over voltage, under voltage, overload, and under load.

9.1.7 Equalization Tank

Groundwater from the main piping will be discharged to an aeration tank, a settling tank, then to an equalization tank. High high-level and low-level sensors will be installed in the equalization tank. When the water level in the equalization tank reaches the high high-level, an alarm will be sent and the PLC will shut down the extraction well system until the water level in the equalization tank returns to its pre-set low- level.

9.1.8 Data Logger

A data logger, a data acquisition and logging instrument that measures and records values necessary to continuously monitor system operation, helps create reports, and analyzes system performance, will be installed in the treatment building. The data logger can be accessed using a direct USB connection, or remotely using the internet.

9.1.9 Alarm Auto Dialer

An alarm automatic dialer will be installed in the control panel to send alarm alerts to designated personnel via telephone line.

9.1.10 Electrical Control Panel and Treatment Building

An electrical control panel will be installed in the treatment building to control the groundwater extraction system. The electrical control panel will include various system control components including power control, PLC, data logger, heat trace controller, and auto-dialer. The treatment building will also house the electrical power distribution system, a heater, a heat-trace controller, a building leak detection sensor, and a temperature sensor. A portion of piping run, including the flow meter, and the main power disconnect switch to cut electrical power to the system will also be located inside the control building.

9.1.11 System Process

The system will be generally run in automatic control mode with the option of hand control mode. Hand control mode operation is used only for system troubleshooting and debugging.

In automatic mode, the system will operate, shutdown, or send alarm alerts according to the PLC and the configuration setting. The system’s primary objective is to maintain the extraction well water elevations and the

PZ water elevations at or below its corresponding RPZs water elevation. The elevation differences between the extraction well and its corresponding RPZ will be set at a user specified value termed as the DELTA value. During the first two years of demonstration period, the system performance data will be evaluated and various DELTA values will be tried and evaluated for each extraction well. The following table provides a tentative summary of the RPZs and its corresponding extraction wells and PZRs.

River Piezometers (GSI)	Paired Extraction Wells	Paired Piezometers
RPZ-1	EW-1 through EW-3	PZ-2
RPZ-2	EW-9 and EW-10	PZ-5
RPZ-3	EW-11, EW-12, EW-13	TA-MW-1
RPZ-4	EW-15, EW-15, DEW-16	PZ-9S
RPZ-5	EW-18, EW-18, DEW-19, EW-20, DEW-21, EW-22	PZ-11S
RPZ-6	EW-5, EW-6, EW-7	RPZ-6 elevation will be compared to TA-RP-5
RPZ-7	EW-4, EW-8	RPZ-7 elevation will be compared to TA-SG-RC.

Table 9-1: Performance Monitoring River Piezometers, Paired Extraction Wells, Paired Piezometers

For the extraction wells along the Rogue River, the objective is to maintain groundwater elevation in the paired piezometers at or below the river piezometers.

For the extraction wells along Rum Creek, the objective is to keep groundwater elevation beneath the riverbed (RPZ-6 or RPZ-7) at or below the surface water elevation in Rum Creek (TA-RP-5 or TA-SG-RC).

The system components as described above are preliminary and subject to change during detailed design phase.

9.2 GROUNDWATER TREATMENT SYSTEM

While multiple emerging technologies are being researched and tested for PFAS treatment, R&W/GZA selected granular activated carbon (GAC) sorption for the primary treatment technology because its effectiveness has been thoroughly demonstrated and systems using GAC can be designed, constructed, and implemented promptly. In addition to numerous literature studies, the Point-of-Entry Treatment filters installed at selected homes in the House Street and Wolven-Jewell study areas demonstrate the effectiveness of the proposed GAC treatment for the Scotchgard-related™ PFAS.

Initially, treated groundwater may be discharged to the City of Rockford sanitary sewer leading to the North Kent Sewer Authority (NKSA) treatment plant. NKSA has conditionally approved the proposed discharge and treatment scheme. Based on the substantial groundwater test results, only PFAS treatment is required to comply with the NKSA discharge limits. If the treated groundwater is not discharged to NKSA, it will be directly discharged to the Rogue River under an NPDES permit.

Based on estimated iron concentrations from groundwater sampling performed to date, iron removal prior to the GAC treatment appears to be appropriate, but the ultimate decision will be made during the final design process. We currently anticipate the groundwater treatment system will include:

- Iron removal - aeration, chemical feed, and settling
- Equalization
- Sediment filtration
- Ultra-Violet sanitizer (to reduce potential bacteriological fouling on the GAC)

- Two-stage GAC
- Sediment filtration
- Aeration
- Effluent metering and sampling

Sheet No. 11 presents the treatment schematic. Because the flow to the treatment system will be increased over time, the design accommodates two different size GAC vessels. The system is designed to accommodate flow from 3 to 70 GPM and includes an effluent clear well to provide water for re-bedding and backwashing the GAC columns. The Treatment System Basis of Design is included in **Appendix C**.

The system will also have connections for full-scale, two-stage, resin (ion exchange) sorption as an alternative or supplement to the GAC. The design accommodates resin sorption before, after, or in place of the GAC.

10.0 IMPLEMENTATION

The design will be finalized following approval of this RAP. The system installation/construction is subject to local, state, and federal permit requirements. These include, but are not limited to:

- Local zoning, site plan approval and building codes
- Surface water/utility crossing
- Capture well, pipe and conduit installation within the former railroad right-of-way owned by Michigan Department of Transportation.
- Effluent discharge

Wolverine already has conditional discharge approval to NKSA. All other approvals will be obtained prior to construction.

The conditional discharge approval from NKSA requires the system to be started incrementally, i.e., the flow will be increased stepwise. Wolverine will apply for required permits following approval of this RAP by EGLE.

Construction will commence once the final design is complete and permits and approvals have been received.

11.0 SCHEDULE

R&W/GZA developed a schedule for implementation of this RAP, which is included in **Appendix D**. Full scale operation of the system is dependent on obtaining a National Pollutant Discharge Elimination System (NPDES) permit for surface water discharge of the treated water due to current limitations on potential discharge to the NKSA. The system may be operated at a reduced capacity pending NPDES permit approval.

12.0 PRE-DESIGN INVESTIGATION DATA

R&W/GZA have identified additional data that will be helpful to further inform the System design. An ASTM Accelerated Column Test has been conducted to evaluate the carbon performance and useful life in the treatment process and we are awaiting the final results. Additional data includes vertical aquifer profiling and installation of additional nested well sets south of Rum Creek to obtain additional data on the deeper portions of the aquifer near Rum Creek. One vertical aquifer profiling boring will be performed at a location between TA-GW-06 and TA-MW-304A/B. Soil samples will be collected every 5 feet to visually observe and classify the soil. Temporary wells will be installed in the coarse-grained saturated soil at an interval of 10 feet. Groundwater samples will be collected from the temporary wells and submitted for PFAS analysis. The soil boring will be advanced to a depth of approximately 80 feet bgs, until a competent fine-grained soil stratum is encountered, or upon refusal.

Additionally, we plan to conduct slug testing on deeper wells to better estimate the K values in the deeper portions of the aquifer across the Site. This work will be done concurrently with system design and permitting and data will be utilized to evaluate whether additional deep extraction wells are warranted.

13.0 PERFORMANCE MONITORING PLAN

As previously described, the purpose of the interceptor system is to effectively interrupt the natural discharge of PFAS-impacted groundwater to Rum Creek and the Rogue River. The optimal performance of the interceptor system will result in coalescing drawdowns from each extraction well that generate inward hydraulic gradients to intercept groundwater flow and effectively prevent PFOS-containing groundwater from discharging to Rum Creek or the Rogue River. Therefore, system performance will be measured by groundwater elevation measurements from the Site monitoring well network that demonstrate the inward hydraulic gradient are being maintained. It is important to clarify that the performance of the interceptor system will not be measured by the reduction in PFAS concentrations in groundwater on-Site, but rather, the induced physical changes to the Site groundwater flow system that prevent PFOS discharge to the Rogue River and Rum Creek.

Based on these monitoring goals and following installation of the system, R&W/GZA will implement a performance monitoring program to evaluate the effectiveness of the system for the initial 2 years of operation. Following the initial 2 years of operation, the CD requires a submittal documenting the effectiveness of the system. A long-term system monitoring plan will be included in that submittal. Unless modified during the detailed design process, the performance monitoring will consist of the following:

- Collecting groundwater elevation data from the extraction wells, river piezometers RPZ-1 through RPZ-7 using pressure transducers;
- Collecting monthly manual groundwater elevation data from piezometers PZ-1 through PZ-12D, and two staff gauges in Rum Creek, TA-RP-5 and TA-SG-RC;
- Comparing and evaluating groundwater flow direction in five monitoring sections (See **Sheet No. 11** for the locations of the monitoring sections) to evaluate the effectiveness of preventing groundwater discharge to the Rogue River.
- Comparing groundwater elevation at RPZ-6 to the surface water elevation TA-RP-5 to evaluate the effectiveness of preventing groundwater discharge to Rum Creek;

- Compare groundwater elevation at RPZ-7 to the surface water elevation at TA-SG-RC to evaluate the effectiveness of preventing groundwater discharge to Rum Creek.

- The monitoring sections and evaluation criteria are summarized in the following table.

Monitoring Sections	River Piezometers (GSI)	Paired Piezometers	Performance Criteria
MS-1	RPZ-1	PZ-2	Groundwater elevation at PZ-2 less than or equal to RPZ-1, or impacted groundwater not venting to the Rogue River
MS-2	RPZ-2	PZ-5	Groundwater elevation at PZ-5 less than or equal to RPZ-1, or impacted groundwater not venting to the Rogue River
MS-3	RPZ-3	TA-MW-1	Groundwater elevation at TA-MW-1 less than or equal to RPZ-1, or impacted groundwater not venting to the Rogue River
MS-4	RPZ-4	PZ-9S	Groundwater elevation at PZ-9S less than or equal to RPZ-1, or impacted groundwater not venting to the Rogue River
MS-5	RPZ-5	PZ-11S	Groundwater elevation at PZ-11S less than or equal to RPZ-1, or impacted groundwater not venting to the Rogue River

Table 13-1: Rogue River Monitoring Sections and Performance Monitoring Criteria

- The performance monitoring evaluation criteria for the extraction wells along Rum Creek are summarized below.

River Piezometers (GSI)	Performance Criteria
RPZ-6	Groundwater elevation at RPZ-6 less than or equal to TA-RP-5, or groundwater not venting to Rum Creek
RPZ-7	Groundwater elevation at RPZ-7 less than or equal to TA-SG-RC, or groundwater not venting to Rum Creek

Table 13-2: Rum Creek Performance Monitoring Criteria

- Monthly progress reports will be prepared and submitted to EGLE to document the system operation, and performance monitoring evaluation.

If performance monitoring indicates that the system or any individual well is either drawing too much water from the river or conversely not capturing groundwater as it reaches the well network, diagnosis will be performed and system maintenance or operational modification(s) will be carried out as appropriate.

A long-term system monitoring plan will be included in the 2-year effectiveness demonstration submittal.

14.0 TREATMENT SYSTEM SAMPLING AND ANALYSIS

Groundwater flowing into the treatment system (influent) will be sampled and analyzed for PFAS. The frequency may be adjusted with time based on the variability and projected GAC life. The treatment system effluent will be sampled and analyzed for PFAS as required for discharge to NKSA or to the Rogue River under an NPDES permit. R&W/GZA will utilize the data from the influent and effluent sampling to calculate PFAS mass that is removed from the groundwater and therefore not discharged to Rogue River. Mid-point samples, collected from sample ports located between the carbon vessels, will also be collected and analyzed for PFAS monthly. This data will be utilized to determine when the carbon beds within the treatment train need to be changed out.

15.0 GROUNDWATER SAMPLING

The objective of the groundwater sampling program is to monitor the potential spatial and temporal change of the PFAS impacted groundwater plume, independent of the system performance monitoring. The proposed groundwater sampling program is described below.

A set of wells, designated as "Boundary Wells", will be monitored quarterly for the first two years of system operation. These wells will monitor the edges of the system capture zone, north, south, and vertically. If the groundwater quality data indicates PFAS-containing groundwater exceeding the Part 201 groundwater GSI criteria exists outside of the area being hydraulically contained, groundwater flow data will be evaluated to determine whether the PFAS-containing groundwater is discharging to the Rogue River or Rum Creek. If discharge is confirmed, potential modification of the groundwater extraction system will be evaluated and appropriate measures may be implemented to prevent the impacted groundwater from venting to the Rogue River or Rum Creek. **Table 15-1** provides the list of proposed Boundary Wells.

Additional groundwater monitoring wells and/or piezometers will be selected for annual sampling. The groundwater extraction system is designed to hydraulically contain groundwater flux and minimize groundwater venting to the surface waters by creating an inward gradient without drawing significant amount of water from the Rogue River and Rum Creek. As such, the hydraulic gradient between the Rogue River/Rum Creek and the extraction wells is generally small, and groundwater velocity low with little or nearly zero pore volume changes in years. It is unlikely that the constituent concentrations in the monitoring wells/piezometers will exhibit noticeable decreases in the short term, therefore the annual sampling frequency is proposed in the long term.

If the groundwater quality data indicates PFAS concentrations decrease to concentrations less than the Part 201 groundwater GSI criteria at a location being hydraulically contained by the system, potential system modification will be evaluated to stop or reduce groundwater extraction near this location.

The following groundwater monitoring wells/piezometers will be sampled and analyzed for PFAS. The sampling procedures and laboratory analytical method will follow the approved Quality Assurance Project Plan.

Area	Monitoring Wells	Sample Frequency	Laboratory Analysis
North of Rum Creek – Boundary Wells	TA-MW-308B, two additional wells to be installed north of the footwear depot	Quarterly for the first two years; Annually after two years.	PFAS
North of Rum Creek	PZ-1, PZ-2, PZ-3, TA-MW-306A, TA-MW-306B ,TA-TMW-109, TA-GW-02	Annually	PFAS
South of Rum Creek - Boundary Wells	TA-MW-303E, 1-2 additional deep wells in the middle of the Site, one additional nested well set south of the southernmost extraction wells, adjacent to the river	Quarterly for the first two years; Annually after two years.	PFAS
South of Rum Creek	TA-MW-3, TA-MW-304A, TA-MW-304B, TA-GW-06, TA-MW-303A, TA-MW-303B, TA-MW-303C, TA-MW-303D, TA-MW-302A, TA-MW-302B, TA-MW-301B, TA-MW-301C, TA-MW-301D, TA-GW-08, TA-MW-309A, TA-MW-309B, TA-MW-309C, TA-MW-309D, TA-TMW-103, TA-MW-1, TA-GW-04, TA-P-5, TA-MW-313A, TA-MW-313B, TA-MW-313C, TA-TMW-104, TA-MW-301B, TA-MW-301C, TA-MW-301D	Annually	PFAS

Table 15-1: Groundwater Quality Assessment - Sampling and Analysis Plan

In addition, quarterly groundwater elevation data will be collected from the Site monitoring wells for the evaluation of groundwater flow.

Annual groundwater monitoring reports will be prepared and submitted to EGLE.

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Exhibit 1


PUMPING WELL
ROGUE RIVER
Current flow direction
CURRENT WATER TABLE
FUTURE WATER TABLE
Future flow direction
DRAWDOWN
Future flow direction
CONFINING UNIT

Tables

TABLE 1

SUMMARY OF MONITORING WELL DETAILS
Former Tannery
Rockford, Kent County, Michigan

Well Number	Note	Depth of Well (ft bgs)	Ground Surface Elevation (ft, MSL)	Length of Screen (ft)	Top of Casing Elevation (ft, MSL)	Screen Elevation (ft, MSL)	Aquifer Zone	Construction Date
TA-GW-01		7	693.1	5	696.15	692 - 687	S	Jun-18
TA-GW-02		9.5	695.0	5	695.21	691 - 686	S	Jun-18
TA-GW-03		9	695.4	5	699.50	692 - 687	S	Jul-18
TA-GW-04		9.5	695.4	5	698.50	691 - 686	S	Jun-18
TA-GW-05	Abandoned	7	695.4	5	695.22	694 - 689	S	Jun-18
TA-GW-06		7	693.4	5	696.30	692 - 687	S	Jun-18
TA-GW-07		7	694.1	5	697.25	693 - 688	S	Jun-18
TA-GW-08		7	694.3	5	697.78	693 - 688	S	Jun-18
TA-GW-09	Abandoned	9	696.6	5	699.95	693 - 688	S	Aug-18
TA-MW-1		8.3	694.5	4.7	694.34	691 - 687	S	May-11
TA-MW-2		7.8	694.8	4.9	694.36	692 - 688	S	May-11
TA-MW-3		7	697.3	4.7	697.08	695 - 691	S	May-11
TA-MW-4		9	697.8	5	697.30	694 - 689	S	Dec-11
TA-MW-5		10	697.0	5	696.52	692 - 687	S	Dec-11
TA-MW-301B		11.3	695.1	2	694.66	686 - 684	S	Aug-13
TA-MW-301C		24.6	695.3	5	698.01	676 - 671	S	Jan-18
TA-MW-301D		71.7	695.4	5	697.99	629 - 624	D	Jan-18
TA-MW-302A		6	694.2	2.4	693.85	691 - 689	S	Aug-13
TA-MW-302B		14.4	694.2	4.8	693.87	685 - 680	S	Aug-13
TA-MW-303A		7.5	694.0	4.7	693.63	692 - 687	S	Aug-13
TA-MW-303B		14.9	694.0	4.8	693.67	684 - 680	S	Aug-13
TA-MW-303C	Abandoned	22	693.9	4.8	693.54	677 - 672	S	Aug-13
TA-MW-303D		45.5	693.9	3	696.09	652 - 649	D	Nov-17
TA-MW-303E		50.5	693.9	3	695.97	647 - 644	D	Jan-18
TA-MW-304A		5.5	694.1	2.8	693.66	692 - 689	S	Aug-13
TA-MW-304B		15	694.1	4.7	693.65	684 - 680	S	Aug-13
TA-MW-305B		16.8	697.0	4.7	696.60	685 - 681	S	Aug-13
TA-MW-305C		24.8	697.0	4.7	696.59	677 - 673	S	Aug-13
TA-MW-306A		10.2	696.5	4.6	696.24	691 - 687	S	May-14
TA-MW-306B		15.1	696.4	4.7	696.21	687 - 682	S	May-14
TA-MW-307A	Abandoned	10.2	696.5	4.6	696.08	691 - 687	S	May-14
TA-MW-307B	Abandoned	15.7	696.5	4.7	695.96	686 - 681	S	May-14
TA-MW-308A	Abandoned	7.9	696.3	4.7	696.15	694 - 689	S	May-14
TA-MW-308B		20.6	696.3	4.7	695.93	681 - 676	S	May-14
TA-MW-308C	Abandoned	26	696.2	4.7	695.85	675 - 671	S	May-14

TABLE 1

SUMMARY OF MONITORING WELL DETAILS
Former Tannery
Rockford, Kent County, Michigan

Well Number	Note	Depth of Well (ft bgs)	Ground Surface Elevation (ft, MSL)	Length of Screen (ft)	Top of Casing Elevation (ft, MSL)	Screen Elevation (ft, MSL)	Aquifer Zone	Construction Date
TA-MW-309A		9.3	696.6	5	699.30	693 - 688	S	Dec-17
TA-MW-309B		17.1	696.4	5	699.13	685 - 680	S	Dec-17
TA-MW-309C		33.6	696.2	5	698.78	668 - 663	D	Dec-17
TA-MW-309D		47.2	696.4	4.8	698.87	654 - 650	D	Dec-17
TA-MW-310A		9.5	700.0	5	699.61	696 - 691	S	Nov-17
TA-MW-310B		16.8	700.1	5	699.73	689 - 684	S	Nov-17
TA-MW-310C		50.2	700.1	3	699.73	653 - 650	D	Nov-17
TA-MW-311A		11.3	700.3	4.5	699.86	694 - 689	S	Nov-18
TA-MW-311B		25	700.3	5	699.84	681 - 676	S	May-19
TA-MW-311C		138	700.4	5	700.07	568 - 563	D	May-19
TA-MW-312		14	703.7	5	703.36	695 - 690	S	Nov-18
TA-MW-313A		10	695.8	5	695.37	691 - 686	S	Dec-18
TA-MW-313B		45	695.9	5	695.45	656 - 651	D	Dec-18
TA-MW-313C		78	695.9	5	695.05	623 - 618	D	Dec-18
TA-MW-314A		12.6	692.5	4.8	692.09	685 - 680	S	Oct-19
TA-MW-314B		29.1	692.4	4.8	691.87	669 - 664	D	Oct-19
TA-MW-314C		44.5	692.4	4.8	691.90	653 - 648	D	Oct-19
TA-MW-314D		92.4	692.3	4.8	691.87	605 - 600	D	Oct-19
TA-MW-315D		93	699.8	7	699.38	614 - 607	D	Jun-19
TA-MW-315S		11	700.0	5	699.69	694 - 689	S	Jun-19
TA-MW-316D		94	695.4	5	695.16	607 - 602	D	May-19
TA-MW-316M		40	695.5	5	695.02	661 - 656	D	May-19
TA-MW-316S		8	695.3	5.5	694.92	693 - 688	S	May-19
TA-MW-317A		9.6	NA	4.8	NA	NA	S	Aug-19
TA-MW-317B		33.9	NA	4.8	NA	NA	D	Aug-19
TA-MW-317C		82.6	NA	4.8	NA	NA	D	Aug-19
TA-MW-317D		98.5	NA	4.8	NA	NA	D	Aug-19
TA-P-1	Abandoned	8.5	694.0	4.7	693.78	691 - 686	S	May-11
TA-P-2		9.4	693.7	4.7	693.43	689 - 685	S	May-11
TA-P-3		9.3	694.2	4.6	693.93	690 - 685	S	May-11
TA-P-4		7.1	694.5	4.7	693.85	693 - 688	S	May-11
TA-P-5		8.8	700.0	4.7	699.82	696 - 692	S	May-11
TA-PMW-01		20	693.6	10	693.15	684 - 674	S	Oct-18
TA-PMW-02		17	693.6	10	693.04	687 - 677	S	Oct-18
TA-PMW-03		17	696.5	5	696.10	685 - 680	S	Oct-18

TABLE 1

SUMMARY OF MONITORING WELL DETAILS
Former Tannery
Rockford, Kent County, Michigan

Well Number	Note	Depth of Well (ft bgs)	Ground Surface Elevation (ft, MSL)	Length of Screen (ft)	Top of Casing Elevation (ft, MSL)	Screen Elevation (ft, MSL)	Aquifer Zone	Construction Date
TA-PMW-04		13	693.4	5	693.03	686 - 681	S	Oct-18
TA-PMW-05		13	694.8	5	694.40	687 - 682	S	Oct-18
TA-PMW-06		18	698.3	5	698.05	686 - 681	S	Nov-18
TA-PMW-07		18	693.4	5	692.99	681 - 676	S	Oct-18
TA-PMW-08		12	693.0	5	692.69	686 - 681	S	Oct-18
TA-PMW-09		12	694.9	5	694.60	688 - 683	S	Oct-18
TA-RW-1	Bentonite Seal Between Screens	9.6	693.6	4.5	696.10	689 - 684	S	Jan-19
TA-RW-1		24	693.6	11.5	696.10	682 - 670	S	Jan-19
TA-RW-2		19	693.5	15	697.07	690 - 675	S	Jan-19
TA-RW-3		18	696.6	7.5	699.36	687 - 679	S	Jan-19
TA-TMW-101		10.5	695.1	4.8	694.72	690 - 685	S	Jan-13
TA-TMW-102	Abandoned	10.3	696.6	4.8	696.14	692 - 687	S	Jan-13
TA-TMW-103		14.1	699.8	4.8	698.75	691 - 686	S	Jan-13
TA-TMW-104		10.4	700.5	4.9	699.99	695 - 691	S	Jan-13
TA-TMW-105		10.3	695.8	4.8	695.39	691 - 686	S	Jan-13
TA-TMW-108	Abandoned	10.1	696.7	4.7	696.44	692 - 687	S	May-14
TA-TMW-109		10.1	697.4	4.7	696.81	692 - 688	S	May-14
TA-TMW-110		10.1	696.6	4.7	696.63	692 - 687	S	May-14
TA-TMW-111	Abandoned	7.6	696.6	4.8	696.23	694 - 689	S	May-14

Notes:

1. Abbreviations include:
   - "ft" denotes feet;
   - "bgs" denotes below ground surface;
   - "MSL" denotes mean sea level;
   - "S" denotes monitoring well screened in the shallow aquifer zone;
   - "D" denotes monitoring well screened in the deep aquifer zone; and
   - "NA" denotes information not available.
2. Well screen elevations are rounded up to the nearest whole number.

TABLE 2

GROUNDWATER ELEVATION DATA - APRIL 2019
Former Tannery
Rockford, Kent County, MI

Well	Ground Surface Elevation (ft, MSL)	Top of Casing Elevation (ft, MSL)	Screen Elevation (ft, MSL)	April 2019 Groundwater Elevation (ft, MSL)
TA-P-1	694.0	693.78	691 - 686	691.91
TA-P-2	693.7	693.43	689 - 685	691.95
TA-P-3	694.2	693.93	690 - 685	692.15
TA-P-4	694.5	693.85	693 - 688	692.04
TA-P-5	700.0	699.82	696 - 692	695.91
TA-MW-1	694.5	694.34	691 - 687	692.51
TA-MW-2	694.8	694.36	692 - 688	692.32
TA-MW-3	697.3	697.08	695 - 691	691.99
TA-MW-4	697.8	697.3	694 - 689	692.03
TA-MW-5	697.0	696.52	692 - 687	692.01
TA-MW-301B	695.1	694.66	686 - 684	692.23
TA-MW-301C	695.3	698.01	676 - 671	692.59
TA-MW-301D	695.4	697.99	629 - 624	689.41
TA-MW-302A	694.2	693.85	691 - 689	692.2
TA-MW-302B	694.2	693.87	685 - 680	691.88
TA-MW-303A	694.0	693.63	692 - 687	692.11
TA-MW-303B	694.0	693.67	684 - 680	691.88
TA-MW-303C	693.9	693.54	677 - 672	691.84
TA-MW-303D	693.9	696.09	652 - 649	689.12
TA-MW-303E	693.9	695.97	647 - 644	689.14
TA-MW-304A	694.1	693.66	692 - 689	692.04
TA-MW-304B	694.1	693.65	684 - 680	691.92
TA-MW-305B	697.0	696.6	685 - 681	691.95
TA-MW-305C	697.0	696.59	677 - 673	691.95
TA-MW-306A	696.5	696.24	691 - 687	691.84
TA-MW-306B	696.4	696.21	687 - 682	691.83
TA-MW-307A	696.5	696.08	691 - 687	691.86
TA-MW-307B	696.5	695.96	686 - 681	691.82
TA-MW-308A	696.3	696.15	694 - 689	692.03
TA-MW-308B	696.3	695.93	681 - 676	692.08
TA-MW-308C	696.2	695.85	675 - 671	692.11
TA-MW-309A	696.6	699.3	693 - 688	692.33
TA-MW-309B	696.4	699.13	685 - 680	692.48
TA-MW-309C	696.2	698.78	668 - 663	691.68
TA-MW-309D	696.4	698.87	654 - 650	691.67

TABLE 2

GROUNDWATER ELEVATION DATA - APRIL 2019
Former Tannery
Rockford, Kent County, MI

Well	Ground Surface Elevation (ft, MSL)	Top of Casing Elevation (ft, MSL)	Screen Elevation (ft, MSL)	April 2019 Groundwater Elevation (ft, MSL)
TA-MW-310A	700.0	699.61	696 - 691	688.89
TA-MW-310B	700.1	699.73	689 - 684	690.01
TA-MW-310C	700.1	699.73	653 - 650	689.78
TA-MW-311A	700.3	699.86	694 - 689	692.98
TA-MW-312	703.7	703.36	695 - 690	696
TA-MW-313A	695.8	695.37	691 - 686	692.01
TA-MW-313B	695.9	695.45	656 - 651	687.03
TA-MW-313C	695.9	695.05	623 - 618	686.9
TA-TMW-101	695.1	694.72	690 - 685	692.72
TA-TMW-103	699.8	698.75	691 - 686	694.09
TA-TMW-104	700.5	699.99	695 - 691	695.93
TA-TMW-105	695.8	695.39	691 - 686	691.95
TA-TMW-108	696.7	696.44	692 - 687	691.89
TA-TMW-109	697.4	696.81	692 - 688	692.1
TA-TMW-110	696.6	696.63	692 - 687	691.96
TA-TMW-111	696.6	696.23	694 - 689	692.1
TA-RW-1	693.6	696.1	689 - 670	691.82
TA-RW-2	693.5	697.07	690 - 675	691.65
TA-RW-3	696.6	699.36	687 - 679	692.95
TA-PMW-01	693.6	693.15	684 - 674	691.38
TA-PMW-02	693.6	693.04	687 - 677	691.61
TA-PMW-03	696.5	696.1	685 - 680	692.97
TA-PMW-04	693.4	693.03	686 - 681	691.31
TA-PMW-05	694.8	694.4	687 - 682	692.29
TA-PMW-06	698.3	698.05	686 - 681	693.09
TA-PMW-07	693.4	692.99	681 - 676	691
TA-PMW-08	693.0	692.69	686 - 681	691.38
TA-PMW-09	694.9	694.6	688 - 683	692.07

Notes:

1. Abbreviations include:
    "ft" denotes feet; and
    "MSL" denotes mean sea level.
2. Well screen elevations are rounded up to the nearest whole number.

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-RW-1	TA-RW-1	TA-RW-2	TA-RW-2	TA-RW-3	TA-RW-3	TA-RW-3	TA-PMW-01	TA-PMW-01	TA-PMW-01	TA-PMW-02	TA-PMW-02	TA-PMW-02	TA-PMW-03	TA-PMW-03	TA-PMW-03
Sample Name		TA-RW-1	TA-RW-01	TA-RW-2	TA-RW-02	TA-RW-3	TA-RW-3 DUP	TA-RW-3	TA-PMW-01	TA-PMW-01	TA-PMW-01	TA-PMW-02	TA-PMW-02	TA-PMW-02	TA-PMW-03	TA-PMW-03	TA-PMW-03
Laboratory Sample ID		UE09030-001	WF25013-005	UE16023-001	WF25013-006	UE24051-001	UE24051-002	WG17016-002	UD11027-001	UF08017-002	wg16013-009	UD11027-002	UF13013-011	WF25013-009	UD11027-003	UF13013-020	WG17016-005
Sample Date		05/08/2019	06/23/2021	05/15/2019	06/23/2021	05/22/2019	05/22/2019	07/15/2021	04/10/2019	06/07/2019	07/14/2021	04/10/2019	06/10/2019	06/23/2021	04/10/2019	06/12/2019	07/15/2021
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	0.0038	<0.0076	<0.0035	<0.0075	0.033	0.038	<0.75	0.012	0.023	<0.0079	<0.0037	<0.0035	<0.0075	0.06	0.035	<0.73
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0037	<0.0076	<0.0035	<0.0075	<0.0038	<0.0039	<0.75	<0.0036	<0.0036	<0.0079	0.0094	0.012	<0.0075	<0.0036	<0.0035	<0.73
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	0.0049		<0.0035		<0.0038	<0.0039		<0.0036	<0.0036		<0.0037	<0.0035		<0.0036	<0.0035	
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.0074		<0.0071		<0.0076	<0.0078		<0.0072	<0.0072		<0.0074	<0.007		<0.0073	<0.0069	
Perfluorobutane sulfonic acid (PFBS)	NA	0.28	<0.0038	0.23	0.02	2.6	2.7	1.2	1.2	2	0.056	0.52	0.69	0.53	3.8	2.9	3.8
Perfluorobutanoic acid (PFBA)	NCL	0.054	<0.0038	0.05	0.0074	0.77	0.76	0.39	0.22	0.44	0.0071	0.068	0.12	0.093	1.5	1	1.3
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0037	<0.0038	<0.0035	<0.0037	<0.0038	<0.0039	<0.37	<0.0036	<0.0036	<0.004	<0.0037	0.0043	<0.0038	<0.0036	<0.0035	<0.36
Perfluorodecanoic acid (PFDA)	NCL	0.016	<0.0038	0.038	0.0073	0.031	0.034	<0.37	0.0044	0.0063	<0.004	0.1	0.095	0.029	0.024	0.038	<0.36
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0037	<0.0038	<0.0035	<0.0037	<0.0038	<0.0039	<0.37	<0.0036	<0.0036	<0.004	<0.0037	<0.0035	<0.0038	<0.0036	<0.0035	<0.36
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.023	<0.0038	0.048	<0.0037	0.27	0.25	<0.37	0.088	0.19	0.03	0.084	0.13	0.085	0.25	0.25	<0.36
Perfluoroheptanoic acid (PFHpA)	NCL	0.059	<0.0038	0.061	0.0062	1.5	1.6	1.2	0.19	0.37	0.013	0.15	0.24	0.19	2.3	1.5	2.1
Perfluorohexane sulfonic acid (PFHxS)	NA	0.1	<0.0038	0.14	0.011	1.3	1.4	1	0.47	0.92	0.069	0.44	0.71	0.47	1.5	1.3	1.4
Perfluorohexanoic acid (PFHxA)	NA	0.1	<0.0038	0.063	0.0096	2.3	2.3	0.99	0.44	0.86	0.019	0.15	0.24	0.2	3.2	2.2	2.6
Perfluorononanoic acid (PFNA)	NA	0.0088	<0.0038	0.017	<0.0037	0.091	0.092	<0.37	0.008	0.016	<0.004	0.033	0.037	0.025	0.13	0.1	<0.36
Perfluorooctane sulfonamide (FOSA)	NCL	0.17	<0.0038	0.2	0.048	0.16	0.17	<0.37	0.023	0.026	<0.004	2.4	1.8	0.63	0.12	0.098	<0.36
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***1.7***	<0.0038	***2.1***	***0.3***	***14***	***17***	***40***	***5.6***	***9.3***	***1.2***	***9.4***	***8.8***	***3.4***	***13***	***13***	***18***
Perfluorooctanoic acid (PFOA)	0.42 (X)	0.4	<0.0038	***0.46***	0.046	***8.2***	***9.7***	***10***	***1.1***	***1.9***	0.12	***1.7***	***2.6***	***1.5***	***12***	***8.4***	***11***
PFOA + PFOS (Calculated)	NCL	2.1	ND	2.6	0.35	22	27	50	6.7	11	1.3	11	11	4.9	25	21	29
Perfluoropentanoic acid (PFPeA)	NCL	0.036	<0.0038	0.035	0.0044	0.68	0.74	0.42	0.12	0.22	0.0053	0.068	0.11	0.084	1.2	0.69	1
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0037	<0.0038	<0.0035	<0.0037	<0.0038	<0.0039	<0.37	<0.0036	<0.0036	<0.004	<0.0037	<0.0035	<0.0038	<0.0036	<0.0035	<0.36
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0037	<0.0038	<0.0035	<0.0037	<0.0038	<0.0039	<0.37	<0.0036	<0.0036	<0.004	<0.0037	<0.0035	<0.0038	<0.0036	<0.0035	<0.36
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0037	<0.0038	0.018	0.036	<0.0038	<0.0039	<0.37	<0.0036	<0.0036	<0.004	<0.0037	<0.0035	<0.0038	<0.0036	<0.0035	<0.36
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.025	<0.0038	0.035	0.0039	0.38	0.38	<0.37	0.092	0.18	0.0055	0.14	0.2	0.13	0.52	0.41	0.49
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA		<0.0076		<0.0075			<0.75			<0.0079			<0.0075			<0.73
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL		<0.0076		0.041			<0.75			<0.0079			0.11			<0.73
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL		<0.0076		0.14			<0.75			0.044			1.7			<0.73
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL		<0.0076		<0.0075			<0.75			<0.0079			<0.0075			<0.73
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0074	<0.0038	<0.0071	<0.0037	0.0092	0.0094	<0.37	<0.0072	<0.0072	<0.004	0.011	0.014	<0.0038	0.0073	<0.0069	<0.36
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL		<0.0076		<0.0075			<0.75			<0.0079			<0.0075			<0.73
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL		<0.0076		<0.0075			<0.75			<0.0079			<0.0075			<0.73
4,8-dioxa-3H-perfluorononanoic acid	NCL		<0.0076		<0.0075			<0.75			<0.0079			<0.0075			<0.73
Total PFAS (Calculated)	NCL	3	ND	3.5	0.68	32	37	55	9.6	16	1.6	15	16	9.2	40	32	42

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^2	TA-P-1	TA-P-1	TA-P-1	TA-P-2	TA-P-2	TA-P-2	TA-P-2	TA-P-3	TA-P-3	TA-P-4	TA-P-4	TA-P-4	TA-P-4	TA-P-5	TA-P-5	TA-P-5
Sample Name		TA-P-1	TA-GW-P1	TA-GW-P-1	TA-P-2	TA-GW-P2	TA-GW-P-2	TA-P-2	TA-P-3	TA-GW-P3	TA-P-4	TA-GW-P4	TA-GW-P-4	TA-P-4	TA-P-5	TA-GW-P5	TA-GW-P-5
Laboratory Sample ID		UF13013-002	UH17008-002	VA09002-017	UF15001-003	UH17008-001	VA15036-024	WG17016-012	UF15001-002	UH17008-011	UF13013-008	UH17008-014	VA15036-020	WG17016-008	UF13013-001	UH21044-015	VA09002-010
Sample Date		06/11/2019	08/15/2019	01/08/2020	06/13/2019	08/15/2019	01/16/2020	07/16/2021	06/13/2019	08/16/2019	06/11/2019	08/16/2019	01/16/2020	07/16/2021	06/11/2019	08/21/2019	01/07/2020
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	0.012	0.02	0.011	0.015	0.028	0.022	<0.73	0.045	0.071	0.011	0.098	0.011 [J]	<0.75	0.046	<0.072	0.032
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0035	<0.0037	<0.0039	<0.0038	<0.019	<0.019	<0.73	<0.0038	<0.019	0.01	<0.074	<0.017	<0.75	0.039	<0.072	0.043
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.0035	<0.0037	<0.0039	<0.0038	<0.019	<0.019		<0.0038	<0.019	<0.0036	<0.074	<0.017		<0.037	<0.072	0.019 [J]
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.0071	<0.0074	<0.0078	<0.0076	<0.037	<0.038		<0.0075	<0.037	<0.0072	<0.15	<0.035		<0.074	<0.14	<0.039
Perfluorobutane sulfonic acid (PFBS)	NA	2.2	2.6	2	3	3.6	3.2	8	6.1	7.6	0.92	2.8	0.82	0.75	2	2.4	1.3
Perfluorobutanoic acid (PFBA)	NCL	0.49	0.72	0.41	0.39	0.63	0.35	0.77	1.1	1.4	0.18	0.76	0.13	<0.38	0.3	0.5	0.23
Perfluorodecane sulfonic acid (PFDS)	NCL	0.0067	0.0076	0.0032 [J]	<0.0038	<0.019	<0.019	<0.37	<0.0038	<0.019	0.0099	<0.074	<0.017	<0.38	<0.037	<0.072	0.0083 [J]
Perfluorodecanoic acid (PFDA)	NCL	0.012	0.0065	0.0093	0.014	<0.019	0.0072 [J]	<0.37	0.011	0.021	0.15	0.15	0.1	<0.38	0.11	0.16	0.15
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0035	<0.0037	<0.0039	<0.0038	<0.019	<0.019	<0.37	<0.0038	<0.019	<0.0036	<0.074	<0.017	<0.38	<0.037	<0.072	<0.02
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.23	0.4	0.17	0.54	1.3	0.65	0.41	0.32	0.46	0.22	0.76	0.16	<0.38	1.1	1.4	0.56
Perfluoroheptanoic acid (PFHpA)	NCL	0.85	1.4	0.74	0.52	1.1	0.59	1.9	1.4	2	0.29	1.3	0.24	<0.38	0.58	0.73	0.43
Perfluorohexane sulfonic acid (PFHxS)	NA	1.3	1.7	1.1	2	4.1	2.1	1.6	3.3	3.3	0.71	1.9	0.63	0.42	1.8	1.9	0.87
Perfluorohexanoic acid (PFHxA)	NA	1.1	1.6	1.1	0.62	1.4	0.65	2.4	2.1	2.9	0.34	2	0.26	<0.38	0.96	1.2	0.64
Perfluorononanoic acid (PFNA)	NA	0.042	0.064	0.031	0.058	0.12	0.093	<0.37	0.087	0.14	0.064	0.28	0.045	<0.38	0.11	0.13	0.073
Perfluorooctane sulfonamide (FOSA)	NCL	0.33	0.18	0.23	0.055	0.039	0.061	3.5	0.035	0.055	1.2	0.96	0.82	0.95	0.74	1.1	0.69
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***6.7***	***11***	***6.5***	***9.5***	***25***	***20***	***32***	***13***	***26***	***26***	***78***	***17***	***25***	***56***	76 [B]	***36***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***6.2***	***11***	***5.7***	***6***	***13***	***6.9***	***12***	***8***	***12***	***2.5***	***8.3***	***2***	***1.8***	***6.3***	7.3 [B]	***4.1***
PFOA + PFOS (Calculated)	NCL	13	22	12	16	38	27	44	21	38	29	86	19	27	62	83	40
Perfluoropentanoic acid (PFPeA)	NCL	0.45	0.7	0.37	0.24	0.39	0.26	0.94	0.84	1.2	0.15	0.69	0.13	<0.38	0.51	0.64	0.34
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0035	<0.0037	<0.0039	<0.0038	<0.019	<0.019	<0.37	<0.0038	<0.019	<0.0036	<0.074	<0.017	<0.38	<0.037	<0.072	<0.02
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0035	<0.0037	<0.0039	0.0086	<0.019	<0.019	<0.37	<0.0038	<0.019	<0.0036	<0.074	<0.017	<0.38	<0.037	<0.072	<0.02
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0035	<0.0037	<0.0039	<0.0038	<0.019	<0.019	<0.37	0.14	<0.019	<0.0036	<0.074	<0.017	<0.38	<0.037	<0.072	<0.02
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.58	0.8	0.46	0.41	0.63	0.36	0.67	0.7	0.7	0.14	0.37	0.11	<0.38	0.29	0.31	0.17
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA							<0.73						<0.75			
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL							<0.73						<0.75			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL							2.9						2.7			
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL							<0.73						<0.75			
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0071	<0.0074	0.0028 [J]	<0.0076	<0.037	<0.038	<0.37	<0.0075	<0.037	0.12	<0.15	0.03 [J]	<0.38	0.081	<0.14	0.043
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL							<0.73						<0.75			
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL							<0.73						<0.75			
4,8-dioxa-3H-perfluorononanoic acid	NCL							<0.73						<0.75			
Total PFAS (Calculated)	NCL	21	32	19	23	51	35	67	37	58	33	98	22	32	71	94	46

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^2	TA-P-5	TA-MW-1	TA-MW-1	TA-MW-1	TA-MW-1	TA-MW-2	TA-MW-2	TA-MW-2	TA-MW-2	TA-MW-3	TA-MW-3	TA-MW-3	TA-MW-3	TA-MW-4	TA-MW-4	TA-MW-4
Sample Name		TA-P-5	TA-MW-1	TA-GW-MW1	TA-MW-01	TA-MW-01-DUP	TA-MW-2	TA-GW-MW2	TA-GW-MW-2	TA-MW-2	TA-MW-3	TA-GW-MW3	TA-GW-MW-3	TA-MW-3	TA-MW-4	TA-GW-MW4	TA-GW-MW-4
Laboratory Sample ID		WG17016-009	UF08017-013	UH10014-019	WF25013-007	WF25013-008	UF19007-002	UH21044-009	VA15036-021	WG16013-012	UF08017-001	UH10014-007	VA15036-010	WG16013-002	UF19007-007	UH21044-011	VA15036-022
Sample Date		07/16/2021	06/06/2019	08/09/2019	06/23/2021	06/23/2021	06/17/2019	08/20/2019	01/16/2020	07/14/2021	06/07/2019	08/08/2019	01/14/2020	07/12/2021	06/18/2019	08/20/2019	01/16/2020
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.77	<0.0036	<0.0037	<0.0084	<0.0078	<0.69	<0.072	<0.019	<0.0074	<0.0035	<0.0037	0.011	0.035	0.21	0.33	0.24
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.77	<0.0036	<0.0037	<0.0084	<0.0078	<0.69	<0.072	0.0096 [J]	<0.15	<0.0035	<0.0037	<0.0039	<0.0075	<0.036	<0.073	<0.037
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL		0.015	0.007			<0.69	<0.072	<0.019		<0.0035	<0.0037	<0.0039		0.25	0.23	0.19
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL		<0.0073	<0.0074			<1.4	<0.14	<0.038		<0.0071	<0.0074	<0.0078		<0.071	<0.15	<0.075
Perfluorobutane sulfonic acid (PFBS)	NA	1.7	1	1.9	0.75	0.76	0.82	0.47	0.26	0.57	0.21	0.44	0.27	2	6	14	7.7
Perfluorobutanoic acid (PFBA)	NCL	<0.38	0.067	0.1	0.054	0.051	<0.69	0.091	0.052	0.092	0.028	0.1	0.06	0.71	2.8	6.7	3
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.38	0.0072	<0.0037	<0.0042	<0.0039	<0.69	<0.072	<0.019	0.0084	<0.0035	0.004	0.002 [J]	0.0049	<0.036	<0.073	0.026 [J]
Perfluorodecanoic acid (PFDA)	NCL	<0.38	0.047	0.037	0.041	0.04	<0.69	0.17	0.077	0.09	0.0077	0.0084	0.011	0.0096	<0.036	<0.073	<0.037
Perfluorododecanoic acid (PFDoDA)	NCL	<0.38	<0.0036	<0.0037	<0.0042	<0.0039	<0.69	<0.072	<0.019	<0.0037	<0.0035	<0.0037	<0.0039	<0.0037	<0.036	<0.073	<0.037
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.88	0.055	0.082	0.062	0.06	<0.69	0.25	0.1	0.12	0.029	0.12	0.07	0.12	0.68	0.86	0.54
Perfluoroheptanoic acid (PFHpA)	NCL	0.43	0.06	0.093	0.054	0.055	<0.69	0.19	0.1	0.15	0.12	0.25	0.16	0.72	4	7.3	3.6
Perfluorohexane sulfonic acid (PFHxS)	NA	0.99	0.17	0.33	0.16	0.15	<0.69	0.52	0.27	0.34	0.2	0.42	0.3	0.72	3.5	4.2	3.1
Perfluorohexanoic acid (PFHxA)	NA	0.59	0.055	0.083	0.052	0.048	<0.69	0.19	0.11	0.17	0.076	0.29	0.13	1.4	7.3	13	6.3
Perfluorononanoic acid (PFNA)	NA	<0.38	0.028	0.036	0.042	0.037	<0.69	0.098	0.042	0.046	0.0091	0.031	0.029	0.044	0.24	0.41	0.23
Perfluorooctane sulfonamide (FOSA)	NCL	0.78	0.22	0.22	0.24	0.24	0.95	1	0.47	0.6	0.17	0.31	0.14	0.26	3	1.1	1.9
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***35***	***3***	***2.3***	***2.5***	***2.7***	***52***	53 [B]	***22***	***24***	***1.1***	***3.5***	***3.4***	***5.3***	***52***	52 [B]	***37***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***3.9***	0.41	***0.75***	***0.46***	***0.46***	***2.3***	1.5 [B]	***0.83***	***1.1***	***0.76***	***3.2***	***1.9***	***4.4***	***24***	40 [B]	***19***
PFOA + PFOS (Calculated)	NCL	39	3.4	3.1	3	3.2	54	55	23	25	1.9	6.7	5.3	9.7	76	92	56
Perfluoropentanoic acid (PFPeA)	NCL	0.38	0.056	0.091	0.044	0.047	<0.69	0.087	0.055	0.076	0.026	0.11	0.064	0.69	2.3	4.4	2.3
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.38	<0.0036	<0.0037	<0.0042	<0.0039	<0.69	<0.072	<0.019	<0.0037	<0.0035	<0.0037	<0.0039	<0.0037	<0.036	<0.073	<0.037
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.38	<0.0036	<0.0037	<0.0042	<0.0039	<0.69	<0.072	<0.019	<0.0037	<0.0035	<0.0037	0.0085	0.017	<0.036	<0.073	<0.037
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.38	<0.0036	<0.0037	<0.0042	<0.0039	<0.69	<0.072	<0.019	<0.0037	<0.0035	<0.0037	<0.0039	<0.0037	2.9	<0.073	<0.037
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	<0.38	0.031	0.066	0.031	0.027	<0.69	0.093	0.055	0.078	0.028	0.086	0.039	0.32	0.97	1.5	0.92
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA	<0.77			<0.0084	<0.0078				<0.0074				<0.0075			
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL	1.4			0.42	0.41				0.66				0.06			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL	4.5			0.92	0.84				1.8				1.1			
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL	<0.77			<0.0084	<0.0078				<0.0074				<0.0075			
Perfluorononane sulfonic acid (PFNS)	NCL	<0.38	<0.0073	<0.0074	<0.0042	<0.0039	<1.4	<0.14	<0.038	0.16	<0.0071	<0.0074	0.002 [J]	0.0037	<0.071	<0.15	<0.075
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL	<0.77			<0.0084	<0.0078				<0.0074				<0.0075			
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL	<0.77			<0.0084	<0.0078				<0.0074				<0.0075			
4,8-dioxa-3H-perfluorononanoic acid	NCL	<0.77			<0.0084	<0.0078				<0.0074				<0.0075			
Total PFAS (Calculated)	NCL	51	5.2	6.1	5.8	5.9	56	58	24	30	2.8	8.9	6.6	18	110	150	86

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-MW-4	TA-MW-5	TA-MW-5	TA-MW-5	TA-GW-01	TA-GW-01	TA-GW-01	TA-GW-01	TA-GW-01	TA-GW-02	TA-GW-02	TA-GW-02	TA-GW-02	TA-GW-03	TA-GW-03	TA-GW-03
Sample Name		TA-MW-4	TA-MW-5	TA-GW-MW5	TA-MW-5	TA-GW-01	TA-GW-01	TA-GW-GW01	TA-GW-GW-01	TA-GW-01	TA-GW-02	TA-GW-02	TA-GW-GW02	TA-GW-02	TA-GW-03	TA-GW-03	TA-GW-GW03
Laboratory Sample ID		WG17016-011	UF13013-015	UH15001-010	WG16013-013	UB07090-023	UF19007-005	UH17008-015	VA09002-016	WG21079-006	UA26009-004	UF08017-012	UH10014-022	WF26013-004	UB07090-017	UF13013-007	UH17008-006
Sample Date		07/16/2021	06/10/2019	08/14/2019	07/14/2021	02/07/2019	06/17/2019	08/16/2019	01/08/2020	07/19/2021	01/24/2019	06/06/2019	08/09/2019	06/24/2021	02/07/2019	06/11/2019	08/15/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.71	<0.0035	0.0044	<0.15	<0.078	0.024	<0.71	<0.19	<15	<0.0037	<0.0035	<0.0037	<0.0073	<0.036	<0.018	<0.036
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.71	<0.0035	<0.0037	<0.15	<0.078	<0.017	<0.71	<0.19	<15	<0.0037	<0.0035	<0.0037	<0.0073	<0.036	<0.018	<0.036
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL		<0.0035	<0.0037		<0.078	<0.017	<0.71	<0.19		<0.0037	<0.0035	<0.0037		<0.036	<0.018	<0.036
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL		<0.007	<0.0074		<0.16	<0.034	<1.4	<0.39		<0.0075	<0.007	<0.0074		<0.072	<0.035	<0.072
Perfluorobutane sulfonic acid (PFBS)	NA	8.5	0.061	0.11	0.17	3	4.3	14	10	18	0.82	0.66	0.73	0.66	2.4	1.6	2.1
Perfluorobutanoic acid (PFBA)	NCL	3.9	0.022	0.033	<0.074	0.19	0.55	1.5	0.71	<7.4	0.17	0.15	0.15	0.16	0.42	0.29	0.4
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.36	0.014	0.011	<0.074	<0.078	<0.017	<0.71	<0.19	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	<0.036	<0.018	<0.036
Perfluorodecanoic acid (PFDA)	NCL	<0.36	0.032	0.037	<0.074	<0.078	<0.017	<0.71	<0.19	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	0.3	0.3	0.47
Perfluorododecanoic acid (PFDoDA)	NCL	<0.36	<0.0035	<0.0037	<0.074	<0.078	<0.017	<0.71	<0.19	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	<0.036	<0.018	<0.036
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.74	0.097	0.14	<0.074	0.5	0.96	6.2	4.3	7.5	0.025	0.026	0.029	0.033	0.24	0.23	0.35
Perfluoroheptanoic acid (PFHpA)	NCL	6.3	0.1	0.16	0.15	0.39	0.93	2.8	<0.19	<7.4	0.95	0.68	0.66	0.76	0.81	0.73	1
Perfluorohexane sulfonic acid (PFHxS)	NA	3.5	0.36	0.54	0.39	1.1	3.8	9.2	4.6	9.8	1.1	0.7	0.75	0.75	1	0.94	1.4
Perfluorohexanoic acid (PFHxA)	NA	8.3	0.095	0.16	0.15	0.28	0.95	2.5	1.1	<7.4	0.96	0.68	0.7	0.65	1	0.8	1.1
Perfluorononanoic acid (PFNA)	NA	<0.36	0.025	0.032	<0.074	0.13	0.08	<0.71	0.22	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	0.11	0.11	0.17
Perfluorooctane sulfonamide (FOSA)	NCL	0.84	1.6	1.5	1.5	1	0.027	1	0.94	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	0.26	0.19	0.24
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***50***	***12***	***13***	***8.6***	***57***	***16***	***550***	***540***	830 [B]	***0.55***	***0.42***	***0.43***	***0.55***	***15***	***19***	***23***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***28***	***1.2***	***1.7***	***1.3***	***4.5***	***11***	***28***	***15***	***30***	***4.5***	***4.5***	***3.6***	***3.6***	***6.9***	***5.8***	***8.1***
PFOA + PFOS (Calculated)	NCL	78	13	15	9.9	62	27	580	560	860	5.1	4.9	4	4.2	22	25	31
Perfluoropentanoic acid (PFPeA)	NCL	3.3	0.023	0.041	<0.074	0.18	0.37	1.2	0.7	<7.4	0.2	0.18	0.19	0.22	0.4	0.33	0.44
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.36	<0.0035	<0.0037	<0.074	<0.078	<0.017	<0.71	<0.19	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	<0.036	<0.018	<0.036
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.36	<0.0035	<0.0037	<0.074	<0.078	<0.017	<0.71	<0.19	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	<0.036	<0.018	<0.036
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.36	<0.0035	<0.0037	<0.074	<0.078	<0.017	<0.71	<0.19	<7.4	<0.0037	<0.0035	<0.0037	<0.0036	<0.036	<0.018	<0.036
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	1.1	0.029	0.043	<0.074	0.33	0.53	1.7	0.96	<7.4	0.31	0.31	0.33	0.35	0.27	0.28	0.36
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA	<0.71			<0.15					<15				<0.0073			
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL	<0.71			0.15					<15				<0.0073			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL	3.3			2.8					21				<0.0073			
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL	<0.71			<0.15					<15				<0.0073			
Perfluorononane sulfonic acid (PFNS)	NCL	<0.36	0.018	0.022	<0.074	<0.16	<0.034	<1.4	0.11 [J]	<7.4	<0.0075	<0.007	<0.0074	<0.0036	<0.072	<0.035	<0.072
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL	<0.71			<0.15					<15				<0.0073			
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL	<0.71			<0.15					<15				<0.0073			
4,8-dioxa-3H-perfluorononanoic acid	NCL	<0.71			<0.15					<15				<0.0073			
Total PFAS (Calculated)	NCL	120	16	18	15	69	40	620	580	920	9.6	8.3	7.6	7.7	29	31	39

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-GW-03	TA-GW-03	TA-GW-04	TA-GW-04	TA-GW-04	TA-GW-04	TA-GW-04	TA-GW-05	TA-GW-05	TA-GW-05	TA-GW-06	TA-GW-06	TA-GW-06	TA-GW-06	TA-GW-06	TA-GW-07
Sample Name		TA-GW-GW-03	TA-GW-03	TA-GW-04	TA-GW-04	TA-GW-GW04	TA-GW-GW-04	TA-GW-04	TA-GW-05	TA-GW-05	TA-GW-GW5	TA-GW-06	TA-GW-06	TA-GW-GW06	TA-GW-GW-06	TA-GW-06	TA-GW-07
Laboratory Sample ID		VA15036-017	WG17016-004	UB07090-022	UF19007-009	UH21044-016	VA15036-016	WG21079-003	UA26009-014	UF06020-010	UH10014-020	UB07090-020	UF13013-025	UH21044-002	VA15036-023	WG17016-010	UB07090-009
Sample Date		01/15/2020	07/15/2021	02/07/2019	06/18/2019	08/21/2019	01/15/2020	07/19/2021	01/25/2019	06/05/2019	08/09/2019	02/07/2019	06/12/2019	08/19/2019	01/16/2020	07/16/2021	02/06/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.02	<0.79	0.49	0.43	0.5	0.35	<1.4	<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	<0.019	<0.75	<0.0037
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.02	<0.79	<0.07	<0.036	<0.074	<0.075	<1.4	<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	0.011 [J]	<0.75	<0.0037
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.02		<0.07	<0.036	<0.074	<0.075		<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	<0.019		<0.0037
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.04		<0.14	<0.072	<0.15	<0.15		<0.0079	<0.0069	<0.0075	<0.075	<0.069	<0.072	<0.038		<0.0074
Perfluorobutane sulfonic acid (PFBS)	NA	2	2.3	11	7.9	8.3	5.9	5.5	0.3	0.15	0.28	2.2	2.3	2.6	0.73	0.94	0.13
Perfluorobutanoic acid (PFBA)	NCL	0.25	<0.39	3.1	2.8	2.6	1.6	1.4	0.038	0.018	0.031	0.45	0.49	0.58	0.15	<0.37	0.029
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.02	<0.39	<0.07	<0.036	<0.074	<0.075	<0.71	<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	<0.019	<0.37	<0.0037
Perfluorodecanoic acid (PFDA)	NCL	0.3	0.43	<0.07	<0.036	<0.074	<0.075	<0.71	0.019	0.02	0.016	0.21	0.17	0.18	0.18	<0.37	<0.0037
Perfluorododecanoic acid (PFDoDA)	NCL	<0.02	<0.39	<0.07	<0.036	<0.074	<0.075	<0.71	<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	<0.019	<0.37	<0.0037
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.22	<0.39	1	0.95	1.2	0.95	1	0.11	0.087	0.12	0.28	0.51	0.6	0.17	<0.37	0.041
Perfluoroheptanoic acid (PFHpA)	NCL	0.56	1.1	8.2	6.7	8.2	4.9	4	0.1	0.051	0.087	0.99	1.2	1.6	0.33	0.37	0.07
Perfluorohexane sulfonic acid (PFHxS)	NA	0.88	1.1	10	9	10	6.6	6.5	0.39	0.23	0.38	1.7	3.3	4.1	0.65	1.1	0.13
Perfluorohexanoic acid (PFHxA)	NA	0.66	0.91	14	10	9.3	6.1	4.8	0.067	0.034	0.057	1.4	1.6	1.6	0.38	0.43	0.063
Perfluorononanoic acid (PFNA)	NA	0.089	<0.39	0.23	0.28	0.27	0.27	<0.71	0.026	0.023	0.029	0.31	0.27	0.34	0.15	<0.37	0.015
Perfluorooctane sulfonamide (FOSA)	NCL	0.18	<0.39	<0.07	<0.036	<0.074	<0.075	<0.71	0.007	0.0098	0.0083	0.34	0.31	0.35	0.39	0.45	<0.0037
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***17***	***18***	***56***	***61***	78 [B]	***63***	63 [B]	***4.5***	***4.8***	***3.9***	***27***	***23***	***29***	***21***	***25***	***3.7***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***4.7***	***6.4***	***59***	***60***	67 [B]	***40***	***38***	***1***	***0.61***	***0.95***	***7.2***	***8***	***9.9***	***2.2***	***2.8***	***0.74***
PFOA + PFOS (Calculated)	NCL	22	24	120	120	150	100	100	5.5	5.4	4.9	34	31	39	23	28	4.4
Perfluoropentanoic acid (PFPeA)	NCL	0.25	0.41	4	3.6	3.3	2.1	1.9	0.027	0.014	0.026	0.59	0.62	0.7	0.18	<0.37	0.026
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.02	<0.39	<0.07	<0.036	<0.074	<0.075	<0.71	<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	<0.019	<0.37	<0.0037
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.02	<0.39	<0.07	<0.036	<0.074	<0.075	<0.71	<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	<0.019	<0.37	<0.0037
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.02	<0.39	<0.07	<0.036	<0.074	<0.075	<0.71	<0.004	<0.0034	<0.0037	<0.037	<0.034	<0.036	<0.019	<0.37	<0.0037
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.25	0.43	3.6	3	3.1	2.2	2.1	0.072	0.035	0.074	0.51	0.55	0.65	0.14	<0.37	0.026
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA		<0.79					<1.4								<0.75	
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL		<0.79					<1.4								0.77	
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL		<0.79					<1.4								2.7	
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL		<0.79					<1.4								<0.75	
Perfluorononane sulfonic acid (PFNS)	NCL	0.09	<0.39	<0.14	<0.072	<0.15	0.044 [J]	<0.71	<0.0079	<0.0069	<0.0075	<0.075	<0.069	<0.072	<0.038	<0.37	<0.0074
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL		<0.79					<1.4								<0.75	
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL		<0.79					<1.4								<0.75	
4,8-dioxa-3H-perfluorononanoic acid	NCL		<0.79					<1.4								<0.75	
Total PFAS (Calculated)	NCL	27	31	170	170	190	130	130	6.7	6.1	6	43	42	52	27	35	5

TABLE 3

SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-GW-07	TA-GW-07	TA-GW-07	TA-GW-07	TA-GW-07	TA-GW-08	TA-GW-08	TA-GW-08	TA-GW-08	TA-GW-08	TA-GW-09	TA-GW-09	TA-GW-09	TA-TMW-101	TA-TMW-101	TA-TMW-101
Sample Name		TA-GW-07 DUP	TA-GW-07	TA-GW-GW7	TA-GW-GW-07	TA-GW-07	TA-GW-08	TA-GW-08	TA-GW-GW08	TA-GW-GW-08	TA-GW-08	TA-GW-09	TA-GW-09	TA-GW-GW09	TA-TMW-101	TA-GW-TMW101	TA-GW-TMW-101
Laboratory Sample ID		UB07090-014	UF06020-012	UH10014-021	VA15036-005	WF26013-002	UB07090-013	UF06020-011	UH15001-019	VA15036-008	WF26013-003	UB07090-008	UF15001-001	UH15001-009	UF19007-006	UH21044-017	VA15036-001
Sample Date		02/06/2019	06/05/2019	08/09/2019	01/13/2020	06/24/2021	02/06/2019	06/05/2019	08/12/2019	01/14/2020	06/24/2021	02/06/2019	06/13/2019	08/14/2019	06/18/2019	08/21/2019	01/13/2020
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0075	<0.019	<0.0036	<0.0036	<0.0038	<0.0078	<0.018	<0.0037	<0.0037	<0.036	<0.075	<0.074
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0075	<0.019	<0.0036	<0.0036	<0.0038	<0.0078	<0.018	<0.0037	<0.0037	<0.036	<0.075	<0.074
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.0036	<0.0035	<0.0039	<0.0036		<0.019	<0.0036	<0.0036	<0.0038		<0.018	<0.0037	<0.0037	<0.036	<0.075	<0.074
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.0073	<0.007	<0.0078	<0.0072		<0.038	<0.0071	<0.0072	<0.0077		<0.036	<0.0073	<0.0073	<0.072	<0.15	<0.15
Perfluorobutane sulfonic acid (PFBS)	NA	0.14	0.19	0.51	0.19	0.58	0.049	0.09	0.16	0.08	0.13	4.6	3.5	3.8	0.54	0.68	0.16
Perfluorobutanoic acid (PFBA)	NCL	0.028	0.046	0.13	0.034	0.24	<0.019	0.017	0.038	0.018	0.022	0.16	0.22	0.23	0.38	0.25	0.11
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0038	<0.019	<0.0036	<0.0036	<0.0038	<0.0039	<0.018	<0.0037	<0.0037	<0.036	<0.075	<0.074
Perfluorodecanoic acid (PFDA)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0038	<0.019	<0.0036	<0.0036	<0.0038	<0.0039	<0.018	<0.0037	<0.0037	0.043	<0.075	0.025 [J]
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0038	<0.019	<0.0036	<0.0036	<0.0038	<0.0039	<0.018	<0.0037	<0.0037	<0.036	<0.075	<0.074
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.048	0.076	0.15	0.047	0.11	0.044	0.086	0.11	0.045	0.062	0.59	0.48	0.35	0.52	0.63	0.29
Perfluoroheptanoic acid (PFHpA)	NCL	0.067	0.1	0.23	0.072	0.43	<0.019	0.053	0.092	0.039	0.053	0.45	0.74	0.73	3.4	2.1	1.5
Perfluorohexane sulfonic acid (PFHxS)	NA	0.13	0.17	0.34	0.13	0.51	0.039	0.14	0.26	0.1	0.16	1.2	1.6	1.4	1.9	1.7	0.87
Perfluorohexanoic acid (PFHxA)	NA	0.062	0.099	0.25	0.073	0.58	<0.019	0.042	0.082	0.033	0.05	0.33	0.58	0.6	3	1.7	1.3
Perfluorononanoic acid (PFNA)	NA	0.014	0.023	0.033	0.018	0.024	<0.019	0.023	0.034	0.019	0.024	0.12	0.058	0.043	0.065	0.096	0.034 [J]
Perfluorooctane sulfonamide (FOSA)	NCL	0.0036	0.0058	<0.0039	<0.0036	<0.0038	<0.019	0.018	0.024	0.018	0.024	<0.018	0.0079	<0.0037	0.048	0.089	<0.074
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***4.5***	***6.5***	***7.5***	***4.3***	***4.2***	***8.9***	***9.1***	***10***	***5.7***	***3***	***14***	***3.7***	3.3 [E]	***130***	140 [B]	***80***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***0.85***	***1.1***	***1.7***	***0.7***	***2.5***	0.21	***0.81***	***1.3***	***0.5***	***0.66***	***5.9***	***7.2***	***6.1***	***61***	42 [B]	***21***
PFOA + PFOS (Calculated)	NCL	5.4	7.6	9.2	5	6.7	9.1	9.9	11	6.2	3.7	20	11	9.4	190	180	100
Perfluoropentanoic acid (PFPeA)	NCL	0.024	0.04	0.1	0.028	0.21	<0.019	0.018	0.051	0.021	0.026	0.18	0.27	0.31	0.76	0.46	0.24
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0038	<0.019	<0.0036	<0.0036	<0.0038	<0.0039	<0.018	<0.0037	<0.0037	<0.036	<0.075	<0.074
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0038	<0.019	<0.0036	<0.0036	<0.0038	<0.0039	<0.018	<0.0037	<0.0037	<0.036	<0.075	<0.074
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0036	<0.0035	<0.0039	<0.0036	<0.0038	<0.019	<0.0036	<0.0036	<0.0038	<0.0039	<0.018	0.0037	<0.0037	0.11	<0.075	<0.074
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.026	0.04	0.093	0.036	0.16	<0.019	0.027	0.056	0.022	0.041	0.2	0.44	0.48	0.33	0.31	0.11
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA					<0.0075					<0.0078						
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL					<0.0075					<0.0078						
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL					0.0081					0.016						
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL					<0.0075					<0.0078						
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0073	<0.007	<0.0078	0.0051 [J]	<0.0038	<0.038	<0.0071	<0.0072	0.0054 [J]	<0.0039	<0.036	<0.0073	<0.0073	0.24	0.23	0.12 [J]
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL					<0.0075					<0.0078						
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL					<0.0075					<0.0078						
4,8-dioxa-3H-perfluorononanoic acid	NCL					<0.0075					<0.0078						
Total PFAS (Calculated)	NCL	5.9	8.4	11	5.6	9.6	9.2	10	12	6.6	4.3	28	19	17	200	190	110

TABLE 3

SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-TMW-101	TA-TMW-102	TA-TMW-102	TA-TMW-102	TA-TMW-103	TA-TMW-103	TA-TMW-103	TA-TMW-103	TA-TMW-104	TA-TMW-104	TA-TMW-104	TA-TMW-104	TA-TMW-104	TA-TMW-105	TA-TMW-105	TA-TMW-105
Sample Name		TA-TMW-101	TA-TMW-102	TA-GW-TMW102	TA-GW-TMW-102	TA-MW-103	TA-TMW-103	TA-GW-TMW103	TA-TMW-103	TA-TMW-104	TA-GW-TMW104	TA-GW-TMW104 DUP	TA-GW-TMW-104	TA-TMW-104	TA-TMW-105	TA-GW-TMW105	TA-GW-TMW-105
Laboratory Sample ID		WG21079-007	UF08017-006	UH15001-007	VA11008-001	UB07090-007	UF08017-015	UH15001-018	WG16013-003	UF08017-016	UH15001-011	UH15001-012	VA15036-013	WG17016-001	UF15001-005	UH17008-013	VA15036-014
Sample Date		07/20/2021	06/07/2019	08/13/2019	01/09/2020	02/05/2019	06/06/2019	08/12/2019	07/12/2021	06/06/2019	08/14/2019	08/14/2019	01/15/2020	07/15/2021	06/13/2019	08/16/2019	01/15/2020
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.14	<0.0038	<0.0037	0.0051	<0.0038	<0.0035	0.0052	<0.0077	<0.017	<0.019	<0.018	0.025	<0.39	<0.038	<0.035	<0.019
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.14	<0.0038	<0.0037	<0.0039	<0.0038	<0.0035	<0.0038	<0.0077	<0.017	<0.019	<0.018	<0.019	<0.39	<0.038	<0.035	<0.019
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL		<0.0038	<0.0037	<0.0039	<0.0038	<0.0035	<0.0038		<0.017	<0.019	<0.018	<0.019		<0.038	<0.035	<0.019
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL		<0.0075	<0.0074	<0.0078	<0.0076	<0.0069	<0.0077		<0.034	<0.037	<0.036	<0.038		<0.076	<0.071	<0.038
Perfluorobutane sulfonic acid (PFBS)	NA	0.4	0.6	0.56	0.53	0.3	0.22	0.44	0.82	0.56	0.71	0.71	0.65	0.6	1.3	2	1.3
Perfluorobutanoic acid (PFBA)	NCL	0.072	0.11	0.1	0.12	0.04	0.032	0.063	0.11	0.065	0.081	0.085	0.069	<0.19	0.25	0.4	0.21
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.071	<0.0038	<0.0037	<0.0039	<0.0038	<0.0035	<0.0038	<0.0038	<0.017	<0.019	<0.018	<0.019	<0.19	<0.038	<0.035	<0.019
Perfluorodecanoic acid (PFDA)	NCL	<0.071	0.0096	0.0087	0.011	0.015	0.017	0.011	0.017	0.029	0.019	0.022	0.018 [J]	<0.19	0.18	0.34	0.12
Perfluorododecanoic acid (PFDoDA)	NCL	<0.071	<0.0038	<0.0037	<0.0039	<0.0038	<0.0035	<0.0038	<0.0038	<0.017	<0.019	<0.018	<0.019	<0.19	<0.038	<0.035	<0.019
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.12	0.3	0.3	0.23	0.11	0.12	0.12	0.16	0.22	0.25	0.27	0.23	0.22	0.32	0.34	0.31
Perfluoroheptanoic acid (PFHpA)	NCL	0.22	0.43	0.46	0.41	0.19	0.15	0.23	0.39	0.24	0.32	0.31	0.24	0.29	0.5	0.87	0.44
Perfluorohexane sulfonic acid (PFHxS)	NA	0.42	1.1	1.1	0.83	0.6	0.42	0.5	0.69	0.73	0.78	0.87	0.79	0.86	1.1	1.3	0.93
Perfluorohexanoic acid (PFHxA)	NA	0.23	0.37	0.36	0.38	0.17	0.13	0.22	0.4	0.21	0.23	0.26	0.19	0.19	0.52	1	0.5
Perfluorononanoic acid (PFNA)	NA	<0.071	0.046	0.042	0.055	0.029	0.027	0.029	0.052	0.057	0.056	0.062	0.062	<0.19	0.083	0.14	0.079
Perfluorooctane sulfonamide (FOSA)	NCL	0.12	<0.0038	<0.0037	<0.0039	0.22	0.21	0.19	0.17	<0.017	<0.019	<0.018	<0.019	<0.19	0.59	0.86	0.41
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	12 [B]	***5.6***	***5.7***	***5.1***	***6***	***4.7***	***4.2***	***6.6***	***14***	***17***	***19***	***16***	***19***	***28***	***27***	***18***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***2.3***	***4***	***4***	***3.4***	***2***	***1.5***	***2.2***	***3.2***	***3.4***	***3.6***	***3.7***	***3.5***	***2.7***	***4***	***6.2***	***4***
PFOA + PFOS (Calculated)	NCL	14	9.6	9.7	8.5	8	6.2	6.4	9.8	17	21	23	20	22	32	33	22
Perfluoropentanoic acid (PFPeA)	NCL	0.11	0.13	0.12	0.14	0.057	0.048	0.1	0.2	0.086	0.089	0.097	0.091	<0.19	0.26	0.41	0.22
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.071	<0.0038	<0.0037	<0.0039	<0.0038	<0.0035	<0.0038	<0.0038	<0.017	<0.019	<0.018	<0.019	<0.19	<0.038	<0.035	<0.019
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.071	<0.0038	<0.0037	<0.0039	<0.0038	<0.0035	<0.0038	<0.0038	<0.017	<0.019	<0.018	<0.019	<0.19	<0.038	<0.035	<0.019
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.071	<0.0038	<0.0037	<0.0039	<0.0038	<0.0035	<0.0038	0.3	<0.017	<0.019	<0.018	<0.019	<0.19	<0.038	<0.035	<0.019
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.12	0.28	0.29	0.2	0.14	0.11	0.14	0.27	0.2	0.26	0.28	0.25	0.23	0.22	0.35	0.22
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA	<0.14							<0.0077					<0.39			
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL	<0.14							0.22					<0.39			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL	0.24							0.39					<0.39			
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL	<0.14							<0.0077					<0.39			
Perfluorononane sulfonic acid (PFNS)	NCL	<0.071	<0.0075	<0.0074	<0.0078	<0.0076	<0.0069	<0.0077	<0.0038	<0.034	<0.037	<0.036	<0.038	<0.19	<0.076	<0.071	0.029 [J]
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL	<0.14							<0.0077					<0.39			
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL	<0.14							<0.0077					<0.39			
4,8-dioxa-3H-perfluorononanoic acid	NCL	<0.14							<0.0077					<0.39			
Total PFAS (Calculated)	NCL	16	13	13	11	9.9	7.7	8.4	14	20	23	26	22	24	37	41	27

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-TMW-105	TA-TMW-105	TA-TMW-108	TA-TMW-108	TA-TMW-108	TA-TMW-109	TA-TMW-109	TA-TMW-109	TA-TMW-110	TA-TMW-110	TA-TMW-111	TA-TMW-111	TA-MW-301B	TA-MW-301B	TA-MW-301B	TA-MW-301B
Sample Name		TA-GW-TMW-105 DUP	TA-TMW-105	TA-TMW-108	TA-TMW-108 DUP	TA-GW-TMW108	TA-TMW-109	TA-GW-TMW109	TA-TMW-109	TA-TMW-110	TA-GW-TMW110	TA-TMW-111	TA-GW-TMW111	TA-MW-301B	TA-GW-MW301B	TA-GW-MW-301B	TA-MW-301B
Laboratory Sample ID		VA15036-015	WG17016-006	UF08017-005	UF08017-007	UH15001-006	UF08017-004	UH15001-017	WG16013-001	UF15001-006	UH21044-010	UF08017-003	UH15001-020	UF13013-026	UH21044-001	VA15036-004	WG21079-008
Sample Date		01/15/2020	07/15/2021	06/07/2019	06/07/2019	08/13/2019	06/07/2019	08/12/2019	07/12/2021	06/14/2019	08/20/2019	06/07/2019	08/12/2019	06/12/2019	08/19/2019	01/13/2020	07/20/2021
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.019	<0.73	<0.0034	<0.0034	<0.0037	<0.0038	<0.0037	<0.01	<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	<1.5
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.019	<0.73	<0.0034	<0.0034	<0.0037	<0.0038	<0.0037	<0.01	<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	<1.5
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.019		<0.0034	<0.0034	<0.0037	<0.0038	<0.0037		<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.037		<0.0068	<0.0068	<0.0074	<0.0076	<0.0075		<0.074	<0.15	<0.0069	<0.0074	<0.035	<0.037	<0.038	
Perfluorobutane sulfonic acid (PFBS)	NA	1.3	1.7	0.52	0.51	0.61	0.34	0.37	0.49	0.22	0.29	0.65	0.61	0.59	0.75	0.57	<0.74
Perfluorobutanoic acid (PFBA)	NCL	0.21	<0.37	0.081	0.079	0.13	0.055	0.075	0.13	<0.037	<0.073	0.11	0.11	0.16	0.21	0.25	<0.74
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.019	<0.37	<0.0034	<0.0034	<0.0037	<0.0038	<0.0037	<0.0052	<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	<0.74
Perfluorodecanoic acid (PFDA)	NCL	0.13	<0.37	0.011	0.011	0.0095	<0.0038	<0.0037	<0.0052	<0.037	<0.073	<0.0034	<0.0037	0.056	0.06	0.055	<0.74
Perfluorododecanoic acid (PFDoDA)	NCL	<0.019	<0.37	<0.0034	<0.0034	<0.0037	<0.0038	<0.0037	<0.0052	<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	<0.74
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.3	0.44	0.27	0.23	0.25	0.066	0.066	0.073	0.56	0.71	0.19	0.22	0.2	0.26	0.27	<0.74
Perfluoroheptanoic acid (PFHpA)	NCL	0.49	0.84	0.39	0.38	0.5	0.13	0.17	0.26	0.5	0.7	0.45	0.5	0.52	0.77	1.6	<0.74
Perfluorohexane sulfonic acid (PFHxS)	NA	0.88	1.3	0.93	0.94	0.93	0.26	0.22	0.28	1.5	2.1	1	1	0.68	0.91	1.1	<0.74
Perfluorohexanoic acid (PFHxA)	NA	0.54	0.76	0.29	0.33	0.4	0.13	0.19	0.32	0.3	0.47	0.33	0.3	0.69	0.79	1.6	<0.74
Perfluorononanoic acid (PFNA)	NA	0.078	<0.37	0.04	0.042	0.037	0.019	0.019	0.033	0.062	<0.073	0.026	0.031	0.047	0.055	0.058	<0.74
Perfluorooctane sulfonamide (FOSA)	NCL	0.4	0.68	<0.0034	<0.0034	<0.0037	0.05	0.07	0.056	<0.037	<0.073	<0.0034	<0.0037	0.078	0.11	0.11	<0.74
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***18***	***28***	***5.4***	***5.3***	***3.9***	***4***	***2.9***	***3.2***	***47***	55 [B]	***3.4***	***3.5***	***28***	***33***	***37***	55 [B]
Perfluorooctanoic acid (PFOA)	0.42 (X)	***3.8***	***6.1***	***3.5***	***3.4***	***3.6***	***0.94***	***1***	***0.85***	***6.4***	7.1 [B]	***4.1***	***4.5***	***8.5***	***10***	***21***	***4.3***
PFOA + PFOS (Calculated)	NCL	22	34	8.9	8.7	7.5	4.9	3.9	4.1	53	62	7.5	8	37	43	58	59
Perfluoropentanoic acid (PFPeA)	NCL	0.21	<0.37	0.11	0.11	0.16	0.073	0.12	0.25	0.07	0.096	0.13	0.13	0.23	0.29	0.45	<0.74
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.019	<0.37	<0.0034	<0.0034	<0.0037	<0.0038	<0.0037	<0.0052	<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	<0.74
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.019	<0.37	<0.0034	<0.0034	<0.0037	<0.0038	<0.0037	<0.0052	<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	<0.74
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.019	<0.37	<0.0034	<0.0034	<0.0037	<0.0038	<0.0037	<0.0052	<0.037	<0.073	<0.0034	<0.0037	<0.017	<0.018	<0.019	<0.74
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.21	<0.37	0.24	0.24	0.25	0.048	0.055	0.075	0.22	0.33	0.28	0.3	0.15	0.2	0.22	<0.74
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA		<0.73						<0.01								<1.5
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL		<0.73						<0.01								<1.5
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL		1.5						0.15								<1.5
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL		<0.73						<0.01								<1.5
Perfluorononane sulfonic acid (PFNS)	NCL	0.023 [J]	<0.37	<0.0068	<0.0068	<0.0074	<0.0076	<0.0075	<0.0052	<0.074	<0.15	<0.0069	<0.0074	<0.035	<0.037	0.16	<0.74
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL		<0.73						<0.01								<1.5
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL		<0.73						<0.01								<1.5
4,8-dioxa-3H-perfluorononanoic acid	NCL		<0.73						<0.01								<1.5
Total PFAS (Calculated)	NCL	27	41	12	12	11	6.1	5.3	6.2	57	67	11	11	40	47	64	59

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-MW-301C	TA-MW-301C	TA-MW-301C	TA-MW-301C	TA-MW-301D	TA-MW-301D	TA-MW-301D	TA-MW-301D	TA-MW-302A	TA-MW-302A	TA-MW-302A	TA-MW-302A	TA-MW-302B	TA-MW-302B	TA-MW-302B	TA-MW-302B
Sample Name		TA-MW-301C	TA-GW-MW301C	TA-GW-MW-301C	TA-MW-301C	TA-MW-301D	TA-GW-MW301D	TA-GW-MW-301D	TA-MW-301D	TA-MW-302A	TA-GW-MW302A	TA-GW-MW-302A	TA-MW-302A	TA-MW-302B	TA-GW-MW302B	TA-GW-MW-302B	TA-GW-MW-302B DUP
Laboratory Sample ID		UF19007-010	UH21044-018	VA15036-003	WG21079-009	UF05051-014	UH10014-018	VA15036-002	WG16013-004	UF13013-013	UH17008-003	VA09002-013	WG16013-010	UF13013-009	UH17008-004	VA09002-014	VA09002-015
Sample Date		06/18/2019	08/21/2019	01/13/2020	07/20/2021	06/03/2019	08/07/2019	01/13/2020	07/12/2021	06/10/2019	08/15/2019	01/08/2020	07/14/2021	06/11/2019	08/15/2019	01/08/2020	01/08/2020
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.072	<0.36	<0.19	<3.6	<0.0036	<0.0036	<0.0038	<0.0075	<0.0035	0.0064	<0.0038	<0.0089	0.013	<0.018	0.011	0.011
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.072	<0.36	<0.19	<3.6	<0.0036	<0.0036	<0.0038	<0.0075	<0.0035	<0.0037	<0.0038	<0.0089	<0.0035	<0.018	<0.0038	<0.0036
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.072	<0.36	<0.19		<0.0036	<0.0036	<0.0038		<0.0035	<0.0037	<0.0038		<0.0035	<0.018	<0.0038	<0.0036
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.14	<0.71	<0.37		<0.0072	<0.0072	<0.0077		<0.0071	<0.0074	<0.0076		<0.007	<0.036	<0.0076	<0.0073
Perfluorobutane sulfonic acid (PFBS)	NA	1	1.1	0.85	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	1.1	2.9	0.91	2.7	2.1	1.8	2	1.9
Perfluorobutanoic acid (PFBA)	NCL	0.99	0.92	0.74	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.095	0.34	0.084	0.13	0.54	0.37	0.47	0.47
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.072	<0.36	<0.19	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.011	0.0053	0.013	0.023	<0.0035	<0.018	<0.0038	<0.0036
Perfluorodecanoic acid (PFDA)	NCL	0.1	<0.36	0.064 [J]	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.052	0.033	0.057	0.079	0.016	<0.018	0.011	0.012
Perfluorododecanoic acid (PFDoDA)	NCL	<0.072	<0.36	<0.19	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	<0.0035	<0.0037	0.0016 [J]	0.011	<0.0035	<0.018	<0.0038	<0.0036
Perfluoroheptane sulfonic acid (PFHpS)	NCL	1.8	2.4	1.7	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.084	0.14	0.062	0.16	0.2	0.2	0.14	0.14
Perfluoroheptanoic acid (PFHpA)	NCL	14	16	15	3.1	<0.0036	<0.0036	0.0013 [J]	0.0056	0.12	0.31	0.11	0.28	0.87	0.66	0.63	0.63
Perfluorohexane sulfonic acid (PFHxS)	NA	8.6	10	9.9	<1.8	<0.0036	<0.0036	0.0011 [J]	<0.0037	0.31	0.58	0.25	0.7	1.2	1.1	1.1	1.1
Perfluorohexanoic acid (PFHxA)	NA	14	17	15	<1.8	<0.0036	<0.0036	0.0018 [J]	0.0053	0.11	0.34	0.1	0.22	0.84	0.73	0.66	0.68
Perfluorononanoic acid (PFNA)	NA	0.17	<0.36	0.15 [J]	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.041	0.036	0.031	0.054	0.048	0.048	0.034	0.032
Perfluorooctane sulfonamide (FOSA)	NCL	0.072	<0.36	0.097 [J]	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.34	0.2	0.47	0.66	0.83	1.1	0.61	0.63
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***480***	490 [B]	***310***	150 [B]	***0.014***	0.011	***0.046***	***0.14***	***7.1***	***5.6***	***4.7***	***10***	***11***	***15***	***8.1***	***8.4***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***220***	210 [B]	***150***	***47***	0.0048	<0.0018	0.018	0.072	***1***	***2.4***	***0.82***	***2.2***	***5.8***	***6.4***	***5.4***	***5.3***
PFOA + PFOS (Calculated)	NCL	700	700	460	200	0.019	0.011	0.064	0.21	8.1	8	5.5	12	17	21	14	14
Perfluoropentanoic acid (PFPeA)	NCL	2.5	2.4	1.9	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.086	0.18	0.07	0.1	0.36	0.3	0.26	0.26
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.072	<0.36	<0.19	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	<0.0035	<0.0037	<0.0038	<0.0045	<0.0035	<0.018	<0.0038	<0.0036
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.072	<0.36	<0.19	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	<0.0035	<0.0037	<0.0038	0.066	<0.0035	<0.018	<0.0038	<0.0036
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.072	<0.36	<0.19	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	<0.0035	<0.0037	<0.0038	<0.0045	<0.0035	<0.018	<0.0038	<0.0036
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.92	0.99	0.79	<1.8	<0.0036	<0.0036	<0.0038	<0.0037	0.085	0.23	0.064	0.19	0.53	0.33	0.39	0.41
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA				<3.6				<0.0075				<0.0089				
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL				<3.6				<0.0075				0.042				
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL				<3.6				<0.0075				0.89				
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL				<3.6				<0.0075				<0.0089				
Perfluorononane sulfonic acid (PFNS)	NCL	0.8	0.79	1.9	<1.8	<0.0072	<0.0072	<0.0077	<0.0037	<0.0071	<0.0074	0.0066 [J]	0.013	0.0082	<0.036	0.0034 [J]	0.0037 [J]
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL				<3.6				<0.0075				<0.0089				
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL				<3.6				<0.0075				<0.0089				
4,8-dioxa-3H-perfluorononanoic acid	NCL				<3.6				<0.0075				<0.0089				
Total PFAS (Calculated)	NCL	740	750	510	200	0.019	0.011	0.068	0.22	11	13	7.7	19	24	28	20	20

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^2	TA-MW-302B	TA-MW-303A	TA-MW-303A	TA-MW-303A	TA-MW-303A	TA-MW-303A	TA-MW-303A	TA-MW-303B	TA-MW-303B	TA-MW-303B	TA-MW-303B	TA-MW-303B	TA-MW-303C	TA-MW-303C	TA-MW-303C	TA-MW-303C
Sample Name		TA-MW-302B	TA-MW-303A	TA-MW-303A	TA-GW-MW303A	TA-GW-MW303A DUP	TA-GW-MW-303A	TA-MW-303A	TA-MW-303B	TA-MW-303B	TA-GW-MW303B	TA-GW-MW-303B	TA-MW-303B	TA-MW-303C	TA-MW-303C	TA-MW-303C DUP	TA-GW-MW303C
Laboratory Sample ID		WG16013-011	UB07090-021	UF08017-014	UH21044-006	UH21044-007	VA11008-007	WG21079-004	UB07090-019	UF19007-001	UH21044-004	VA11008-004	WG21079-005	UB07090-016	UF19007-003	UF19007-004	UH21044-003
Sample Date		07/14/2021	02/07/2019	06/06/2019	08/19/2019	08/19/2019	01/10/2020	07/19/2021	02/07/2019	06/17/2019	08/19/2019	01/09/2020	07/19/2021	02/07/2019	06/17/2019	06/17/2019	08/19/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.0079	<0.0038	<0.035	<0.039	<0.037	<0.019	<1.4	<0.036	<0.34	<0.022	<0.019	<0.36	0.095	<0.17	0.08	0.069
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0079	<0.0038	<0.035	<0.039	<0.037	<0.019	<1.4	<0.036	<0.34	<0.022	<0.019	<0.36	<0.037	<0.17	<0.017	<0.018
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL		0.0065	<0.035	<0.039	<0.037	<0.019		<0.036	<0.34	<0.022	<0.019		<0.037	<0.17	<0.017	<0.018
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL		<0.0075	<0.07	<0.079	<0.075	<0.038		<0.072	<0.69	<0.044	<0.038		<0.073	<0.34	<0.035	<0.036
Perfluorobutane sulfonic acid (PFBS)	NA	2.2	2.6	11	11	12	6.7	8.3	18	9	8	6.6	11	12	8	7.9	9.3
Perfluorobutanoic acid (PFBA)	NCL	0.44	0.095	0.4	0.76	0.77	0.27	<0.71	0.79	0.49	0.92	0.61	1.5	1.7	1.5	1.5	1.6
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0039	0.0045	<0.035	<0.039	<0.037	<0.019	<0.71	<0.036	<0.34	<0.022	<0.019	<0.18	<0.037	<0.17	<0.017	<0.018
Perfluorodecanoic acid (PFDA)	NCL	0.014	0.063	0.056	<0.039	0.04	0.049	<0.71	<0.036	<0.34	<0.022	0.016 [J]	<0.18	<0.037	<0.17	<0.017	<0.018
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0039	<0.0038	<0.035	<0.039	<0.037	<0.019	<0.71	<0.036	<0.34	<0.022	<0.019	<0.18	<0.037	<0.17	<0.017	<0.018
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.15	0.091	0.4	0.48	0.48	0.32	0.71	0.53	0.41	0.37	0.3	0.8	0.51	0.3	0.28	0.29
Perfluoroheptanoic acid (PFHpA)	NCL	0.68	0.094	0.52	1.1	1.2	0.44	0.85	1	0.67	1.2	0.8	1.7	1.8	1.3	1.2	1.5
Perfluorohexane sulfonic acid (PFHxS)	NA	1.3	0.27	1.1	2.7	2.5	0.98	2.2	2.6	1.6	2.8	2.5	5.8	2.5	1.8	1.8	1.8
Perfluorohexanoic acid (PFHxA)	NA	0.69	0.1	0.48	1.2	1.4	0.36	0.95	1.2	0.77	1.5	0.97	2.6	3.2	2.8	2.6	2.8
Perfluorononanoic acid (PFNA)	NA	0.039	0.046	0.087	0.071	0.073	0.068	<0.71	0.083	<0.34	0.082	0.05	<0.18	0.18	<0.17	0.11	0.12
Perfluorooctane sulfonamide (FOSA)	NCL	0.65	0.13	0.79	0.34	0.37	0.5	<0.71	0.16	<0.34	0.16	0.13	<0.18	0.36	<0.17	0.11	0.19
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***10***	***7.5***	***37***	***32***	***32***	***27***	49 [B]	***33***	***27***	***27***	***18***	29 [B]	***33***	***18***	***19***	***23***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***6***	***0.99***	***3.9***	***5.9***	***5.9***	***3.3***	***5.5***	***6.9***	***4.3***	***7.6***	***4.8***	***14***	***13***	***8.1***	***8.3***	***9.1***
PFOA + PFOS (Calculated)	NCL	16	8.5	41	38	38	30	55	40	31	35	23	43	46	26	27	32
Perfluoropentanoic acid (PFPeA)	NCL	0.29	0.074	0.32	0.53	0.53	0.21	<0.71	0.54	0.35	0.58	0.39	0.99	1.1	0.93	0.86	0.96
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0039	<0.0038	<0.035	<0.039	<0.037	<0.019	<0.71	<0.036	<0.34	<0.022	<0.019	<0.18	<0.037	<0.17	<0.017	<0.018
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0039	<0.0038	<0.035	<0.039	<0.037	<0.019	<0.71	<0.036	<0.34	<0.022	<0.019	<0.18	<0.037	<0.17	<0.017	<0.018
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0039	<0.0038	<0.035	<0.039	<0.037	<0.019	<0.71	<0.036	<0.34	<0.022	<0.019	<0.18	<0.037	<0.17	<0.017	<0.018
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.45	0.091	0.37	0.82	0.85	0.28	<0.71	0.77	0.41	0.68	0.6	1.3	0.77	0.47	0.49	0.51
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA	<0.0079						<1.4					<0.36				
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL	0.055						<1.4					<0.36				
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL	0.98						7.2					1.5				
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL	<0.0079						<1.4					<0.36				
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0039	<0.0075	<0.07	<0.079	<0.075	0.017 [J]	<0.71	<0.072	<0.69	<0.044	<0.038	<0.18	<0.073	<0.34	<0.035	<0.036
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL	<0.0079						<1.4					<0.36				
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL	<0.0079						<1.4					<0.36				
4,8-dioxa-3H-perfluorononanoic acid	NCL	<0.0079						<1.4					<0.36				
Total PFAS (Calculated)	NCL	24	12	56	57	58	40	75	66	45	51	36	70	70	43	44	51

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^2	TA-MW-303C	TA-MW-303D	TA-MW-303D	TA-MW-303D	TA-MW-303D	TA-MW-303D	TA-MW-303E	TA-MW-303E	TA-MW-303E	TA-MW-303E	TA-MW-303E	TA-MW-303E	TA-MW-304A	TA-MW-304A	TA-MW-304A	TA-MW-304A
Sample Name		TA-GW-MW-303C	TA-MW-303D	TA-MW-303D	TA-GW-MW303D	TA-GW-MW-303D	TA-MW-303D	TA-MW-303E	TA-MW-303E	TA-GW-MW303E	TA-GW-MW-303E	TA-MW-303E	TA-MW-303E DUP	TA-MW-304A	TA-GW-MW304A	TA-GW-MW-304A	TA-MW-304A
Laboratory Sample ID		VA11008-009	UB07090-002	UF05051-015	UH10014-017	VA11008-006	WF25013-004	UB07090-001	UF05051-016	UH07038-001	VA11008-008	WF25013-002	WF25013-003	UF15001-004	UH21044-008	VA15036-011	WG17016-007
Sample Date		01/10/2020	02/04/2019	06/03/2019	08/07/2019	01/10/2020	06/22/2021	02/04/2019	06/03/2019	08/06/2019	01/10/2020	06/22/2021	06/22/2021	06/13/2019	08/19/2019	01/14/2020	07/16/2021
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	0.053	<0.0035	<0.0036	<0.0036	<0.0037	<0.0074	<0.0035	<0.0036	<0.0035	<0.0037	<0.0073	<0.0077	<0.036	<0.072	<0.019	<0.15
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.036	<0.0035	<0.0036	<0.0036	<0.0037	<0.0074	<0.0035	<0.0036	<0.0035	<0.0037	<0.0073	<0.0077	<0.036	<0.072	<0.019	<0.15
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.036	<0.0035	<0.0036	<0.0036	<0.0037		<0.0035	<0.0036	<0.0035	<0.0037			<0.036	<0.072	<0.019	
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.073	<0.0071	<0.0072	<0.0072	<0.0074		<0.007	<0.0071	<0.007	<0.0075			<0.073	<0.14	<0.038	
Perfluorobutane sulfonic acid (PFBS)	NA	5.7	0.022	0.048	0.085	0.067	0.098	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	1.1	2.1	0.61	0.92
Perfluorobutanoic acid (PFBA)	NCL	0.84	0.0042	0.0066	0.0081	0.0086	0.014	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.17	0.41	0.067	0.18
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.036	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	<0.036	<0.072	<0.019	<0.075
Perfluorodecanoic acid (PFDA)	NCL	0.0095 [J]	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.064	<0.072	0.027	<0.075
Perfluorododecanoic acid (PFDoDA)	NCL	<0.036	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	<0.036	<0.072	<0.019	<0.075
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.26	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.4	0.54	0.16	0.14
Perfluoroheptanoic acid (PFHpA)	NCL	0.84	<0.0035	0.0038	0.0048	0.005	0.0088	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.46	0.68	0.24	0.36
Perfluorohexane sulfonic acid (PFHxS)	NA	1.4	0.0035	0.0046	0.0057	0.0052	0.012	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	1.3	1.3	1.1	0.87
Perfluorohexanoic acid (PFHxA)	NA	1.6	0.0058	0.008	0.0084	0.012	0.019	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.43	0.93	0.19	0.27
Perfluorononanoic acid (PFNA)	NA	0.11	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.077	0.13	0.032	<0.075
Perfluorooctane sulfonamide (FOSA)	NCL	0.16	0.004	<0.0036	<0.0036	0.002 [J]	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.24	0.29	0.076	<0.075
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***19***	***0.023***	***0.019***	***0.021***	***0.013***	***0.017***	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	***46***	***61***	***18***	***8.1***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***5.3***	0.011	0.018	0.024	0.022	0.046	<0.0018	<0.0018	<0.0018	<0.0019	<0.0036	<0.0039	***3.6***	***4.7***	***2.2***	***2.5***
PFOA + PFOS (Calculated)	NCL	24	0.034	0.037	0.045	0.035	0.063	ND	ND	ND	ND	ND	ND	50	66	20	11
Perfluoropentanoic acid (PFPeA)	NCL	0.5	<0.0035	0.0044	0.0053	0.005	0.0075	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.16	0.34	0.069	0.15
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.036	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	<0.036	<0.072	<0.019	<0.075
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.036	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	<0.036	<0.072	<0.019	<0.075
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.036	<0.0035	<0.0036	<0.0036	<0.0037	<0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	<0.036	<0.072	<0.019	<0.075
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.36	<0.0035	<0.0036	<0.0036	0.0024 [J]	0.0037	<0.0035	<0.0036	<0.0035	<0.0037	<0.0036	<0.0039	0.23	0.3	0.16	0.17
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA						<0.0074					<0.0073	<0.0077				<0.15
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL						<0.0074					<0.0073	<0.0077				<0.15
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL						<0.0074					<0.0073	<0.0077				0.17
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL						<0.0074					<0.0073	<0.0077				<0.15
Perfluorononane sulfonic acid (PFNS)	NCL	0.032 [J]	<0.0071	<0.0072	<0.0072	<0.0074	<0.0037	<0.007	<0.0071	<0.007	<0.0075	<0.0036	<0.0039	<0.073	<0.14	0.05	<0.075
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL						<0.0074					<0.0073	<0.0077				<0.15
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL						<0.0074					<0.0073	<0.0077				<0.15
4,8-dioxa-3H-perfluorononanoic acid	NCL						<0.0074					<0.0073	<0.0077				<0.15
Total PFAS (Calculated)	NCL	36	0.074	0.11	0.16	0.14	0.23	ND	ND	ND	ND	ND	ND	54	73	23	14

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-MW-304B	TA-MW-304B	TA-MW-304B	TA-MW-304B	TA-MW-305B	TA-MW-305B	TA-MW-305B	TA-MW-305C	TA-MW-305C	TA-MW-305C	TA-MW-306A	TA-MW-306A	TA-MW-306A	TA-MW-306A	TA-MW-306B	TA-MW-306B
Sample Name		TA-MW-304B	TA-GW-MW304B	TA-GW-MW-304B	TA-MW-304B	TA-MW-305B	TA-GW-MW305B	TA-MW-305B	TA-MW-305C	TA-GW-MW305C	TA-MW-305C	TA-MW-306A	TA-MW-306A DUP	TA-GW-MW306A	TA-MW-306A	TA-MW-306B	TA-GW-MW306B
Laboratory Sample ID		UF06020-009	UH10014-011	VA15036-009	wg16013-005	UF19007-008	UH21044-012	WG21079-001	UF19007-011	UH21044-013	WG21079-002	UF13013-004	UF13013-005	UH15001-005	WG16013-008	UF13013-014	UH15001-013
Sample Date		06/05/2019	08/08/2019	01/14/2020	07/13/2021	06/18/2019	08/20/2019	07/19/2021	06/18/2019	08/20/2019	07/19/2021	06/11/2019	06/11/2019	08/13/2019	07/13/2021	06/10/2019	08/14/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	0.0076	0.0065	0.01	<0.0075	0.2	0.21	<0.73	0.38	0.29	<0.75	0.006	0.0049	0.012	0.01	0.041	0.041
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0035	<0.0037	<0.0038	<0.0075	<0.019	<0.035	<0.73	<0.036	<0.036	<0.75	<0.0034	<0.0034	<0.0035	<0.0072	<0.0036	<0.0037
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.0035	<0.0037	<0.0038		<0.019	<0.035		<0.036	<0.036		<0.0034	<0.0034	<0.0035		<0.0036	<0.0037
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.007	<0.0074	<0.0076		<0.037	<0.07		<0.072	<0.072		<0.0069	<0.0069	<0.007		<0.0073	<0.0074
Perfluorobutane sulfonic acid (PFBS)	NA	0.45	0.46	0.58	0.34	14	15	10	13	15	11	0.28	0.26	0.69	0.82	1.9	1.9
Perfluorobutanoic acid (PFBA)	NCL	0.26	0.28	0.3	0.18	4.8	4.5	3.1	5.5	5.6	4.1	0.069	0.067	0.18	0.18	0.6	0.59
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0035	<0.0037	<0.0038	<0.0038	<0.019	<0.035	<0.37	<0.036	<0.036	<0.38	<0.0034	<0.0034	<0.0035	<0.0036	<0.0036	<0.0037
Perfluorodecanoic acid (PFDA)	NCL	0.0038	0.0053	0.0053	0.0099	<0.019	<0.035	<0.37	0.088	0.088	<0.38	0.08	0.08	0.093	0.079	0.023	0.03
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0035	<0.0037	<0.0038	<0.0038	<0.019	<0.035	<0.37	<0.036	<0.036	<0.38	<0.0034	<0.0034	<0.0035	<0.0036	<0.0036	<0.0037
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.037	0.029	0.036	0.022	0.51	0.65	0.5	0.8	0.9	0.6	0.097	0.11	0.13	0.13	0.16	0.18
Perfluoroheptanoic acid (PFHpA)	NCL	0.22	0.2	0.22	0.14	8.3	8.2	4.6	8.1	10	5.4	0.12	0.12	0.25	0.34	0.9	0.8
Perfluorohexane sulfonic acid (PFHxS)	NA	0.4	0.34	0.42	0.25	5	4.6	3.8	5.7	6.1	4.5	0.27	0.29	0.52	0.64	1	1.2
Perfluorohexanoic acid (PFHxA)	NA	0.59	0.52	0.58	0.4	23	22	13	21	22	15	0.14	0.14	0.33	0.34	1.1	0.94
Perfluorononanoic acid (PFNA)	NA	0.013	0.015	0.016	0.014	0.094	0.11	<0.37	0.24	0.23	<0.38	0.062	0.062	0.091	0.086	0.064	0.068
Perfluorooctane sulfonamide (FOSA)	NCL	0.0071	0.013	0.01	0.016	<0.019	<0.035	<0.37	<0.036	<0.036	<0.38	0.23	0.22	0.15	0.17	0.038	0.091
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***1.1***	***1***	***1.4***	***1.2***	***23***	25 [B]	20 [B]	***32***	39 [B]	29 [B]	***8.6***	***9.1***	***8.9***	***8.5***	***7.1***	***6.9***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***0.8***	***0.92***	***0.98***	***0.69***	***32***	29 [B]	***20***	***42***	44 [B]	***30***	***1***	***1.1***	***2.2***	***2.6***	***6.6***	***6.4***
PFOA + PFOS (Calculated)	NCL	1.9	1.9	2.4	1.9	55	54	40	74	83	59	9.6	10	11	11	14	13
Perfluoropentanoic acid (PFPeA)	NCL	0.13	0.12	0.17	0.092	5.1	4.5	3.3	4.8	5.3	3.5	0.066	0.069	0.17	0.17	0.47	0.45
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0035	<0.0037	<0.0038	<0.0038	<0.019	<0.035	<0.37	<0.036	<0.036	<0.38	<0.0034	<0.0034	<0.0035	<0.0036	<0.0036	<0.0037
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0035	<0.0037	<0.0038	<0.0038	<0.019	<0.035	<0.37	<0.036	<0.036	<0.38	<0.0034	<0.0034	<0.0035	<0.0036	<0.0036	<0.0037
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0035	<0.0037	<0.0038	<0.0038	<0.019	<0.035	<0.37	<0.036	<0.036	<0.38	<0.0034	<0.0034	<0.0035	<0.0036	<0.0036	<0.0037
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.12	0.094	0.14	0.07	1.9	2.1	1.3	2.3	2.6	1.7	0.052	0.048	0.11	0.15	0.31	0.3
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA				<0.0075			<0.73			<0.75				<0.0072		
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL				0.013			<0.73			<0.75				0.036		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL				0.02			<0.73			<0.75				0.063		
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL				<0.0075			<0.73			<0.75				<0.0072		
Perfluorononane sulfonic acid (PFNS)	NCL	<0.007	<0.0074	<0.0076	<0.0038	<0.037	<0.07	<0.37	<0.072	<0.072	<0.38	<0.0069	<0.0069	<0.007	0.0052	<0.0073	0.0081
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL				<0.0075			<0.73			<0.75				<0.0072		
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL				<0.0075			<0.73			<0.75				<0.0072		
4,8-dioxa-3H-perfluorononanoic acid	NCL				<0.0075			<0.73			<0.75				<0.0072		
Total PFAS (Calculated)	NCL	4.1	4	4.9	3.5	120	120	80	140	150	100	11	12	14	14	20	20

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^{2}	TA-MW-306B	TA-MW-307A	TA-MW-307A	TA-MW-307A	TA-MW-307B	TA-MW-307B	TA-MW-307B	TA-MW-308A	TA-MW-308A	TA-MW-308A	TA-MW-308B	TA-MW-308B	TA-MW-308B	TA-MW-308C	TA-MW-308C	TA-MW-309A
Sample Name		TA-MW-306B	TA-MW-307A	TA-GW-MW307A	TA-GW-MW-307A	TA-MW-307B	TA-GW-MW307B	TA-GW-ME-307B	TA-MW-308A	TA-MW-308A	TA-GW-MW308A	TA-MW-308B	TA-GW-MW308B	TA-MW-308B	TA-MW-308C	TA-GW-MW308C	TA-MW-309A
Laboratory Sample ID		WG16013-006	UF13013-010	UH15001-002	VA11008-003	UF13013-012	UH10014-006	VA11008-002	UA26009-001	UF19007-012	UH17008-005	UA26009-002	UH07038-002	WF25013-001	UA26009-003	UH10014-016	UB07090-012
Sample Date		07/13/2021	06/10/2019	08/13/2019	01/09/2020	06/10/2019	08/08/2019	01/09/2020	01/24/2019	06/18/2019	08/15/2019	01/24/2019	08/06/2019	06/22/2021	01/24/2019	08/07/2019	02/06/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	0.013	<0.0035	<0.0036	0.014	<0.0035	<0.0036	<0.0038	<0.02	0.012	<0.018	<0.0038	<0.0038	<0.012	<0.0038	<0.0038	<0.0039
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0075	<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	<0.0036	<0.018	<0.0038	<0.0038	<0.012	<0.0038	<0.0038	<0.0039
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL		<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	<0.0036	<0.018	<0.0038	<0.0038		<0.0038	<0.0038	<0.0039
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL		<0.007	<0.0073	<0.0073	<0.007	<0.0073	<0.0077	<0.039	<0.0072	<0.036	<0.0077	<0.0076		<0.0076	<0.0075	<0.0079
Perfluorobutane sulfonic acid (PFBS)	NA	1.2	0.52	0.62	0.79	0.21	0.22	0.19	0.54	1	0.99	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.3
Perfluorobutanoic acid (PFBA)	NCL	0.25	0.08	0.11	0.26	0.083	0.083	0.077	0.28	0.4	0.37	<0.0038	<0.0038	<0.0062	<0.0038	0.0057	0.047
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0038	<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	<0.0036	<0.018	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	<0.0039
Perfluorodecanoic acid (PFDA)	NCL	0.02	<0.0035	<0.0036	0.0099	<0.0035	<0.0036	<0.0038	<0.02	0.012	<0.018	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	<0.0039
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0038	<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	<0.0036	<0.018	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	<0.0039
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.12	0.26	0.25	0.21	<0.0035	<0.0036	0.0028 [J]	0.25	0.23	0.33	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.18
Perfluoroheptanoic acid (PFHpA)	NCL	0.45	0.41	0.46	0.55	0.081	0.083	0.073	0.86	1	1.2	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.13
Perfluorohexane sulfonic acid (PFHxS)	NA	0.69	0.9	0.92	0.84	0.045	0.038	0.039	0.75	1	1.1	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.34
Perfluorohexanoic acid (PFHxA)	NA	0.53	0.32	0.36	0.68	0.18	0.16	0.16	0.87	1.2	1.3	<0.0038	<0.0038	<0.0062	<0.0038	0.0039	0.12
Perfluorononanoic acid (PFNA)	NA	0.051	0.039	0.04	0.052	<0.0035	<0.0036	0.0011 [J]	0.09	0.091	0.11	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.04
Perfluorooctane sulfonamide (FOSA)	NCL	0.1	<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	0.016	0.037	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.15
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***6.1***	***4.3***	***4.1***	***3.8***	0.011	***0.014***	***0.014***	***11***	***10***	***16***	<0.0038	<0.0038	<0.0062	0.0064	0.0075	***9***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***4***	***3.4***	***4***	***4.1***	0.29	0.3	0.27	***7.8***	***9.6***	***12***	<0.0019	<0.0019	<0.0062	0.0041	0.0034	***2.3***
PFOA + PFOS (Calculated)	NCL	10	7.7	8.1	7.9	0.3	0.31	0.28	19	20	28	ND	ND	ND	0.011	0.011	11
Perfluoropentanoic acid (PFPeA)	NCL	0.23	0.12	0.14	0.25	0.072	0.068	0.062	0.8	0.9	0.98	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.062
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0038	<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	<0.0036	<0.018	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	<0.0039
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0038	<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	<0.0036	<0.018	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.017
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0038	<0.0035	<0.0036	<0.0036	<0.0035	<0.0036	<0.0038	<0.02	<0.0036	<0.018	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	<0.0039
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.16	0.23	0.26	0.24	0.022	0.021	0.021	0.12	0.21	0.2	<0.0038	<0.0038	<0.0062	<0.0038	<0.0038	0.074
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA	<0.0075												<0.012			
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL	0.058												<0.012			
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL	1												<0.012			
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL	<0.0075												<0.012			
Perfluorononane sulfonic acid (PFNS)	NCL	0.0058	<0.007	<0.0073	<0.0073	<0.007	<0.0073	<0.0077	<0.039	<0.0072	<0.036	<0.0077	<0.0076	<0.0062	<0.0076	<0.0075	<0.0079
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL	<0.0075												<0.012			
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL	<0.0075												<0.012			
4,8-dioxa-3H-perfluorononanoic acid	NCL	<0.0075												<0.012			
Total PFAS (Calculated)	NCL	15	11	11	12	0.99	0.99	0.91	23	26	35	ND	ND	ND	0.011	0.021	13

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-MW-309A	TA-MW-309A	TA-MW-309A	TA-MW-309A	TA-MW-309B	TA-MW-309B	TA-MW-309B	TA-MW-309B	TA-MW-309B	TA-MW-309C	TA-MW-309C	TA-MW-309C	TA-MW-309C	TA-MW-309C	TA-MW-309D	TA-MW-309D
Sample Name		TA-MW-309A	TA-GW-MW309A	TA-GW-MW-309A	TA-MW-309A	TA-MW-309B	TA-MW-309B	TA-GW-MW309B	TA-GW-MW-309B	TA-MW-309B	TA-MW-309C	TA-MW-309C	TA-GW-MW309C	TA-GW-MW-309C	TA-MW-309C	TA-MW-309D	TA-MW-309D
Laboratory Sample ID		UF08017-017	UH15001-001	UL19062-021	WG16013-014	UB07090-010	UF13013-006	UH15001-004	UL19062-027	WG16013-015	UB07090-011	UF13013-003	UH17008-012	UL19062-019	WG16013-016	UB07090-024	UF13013-024
Sample Date		06/06/2019	08/13/2019	12/19/2019	07/14/2021	02/06/2019	06/11/2019	08/13/2019	12/20/2019	07/14/2021	02/06/2019	06/11/2019	08/16/2019	12/19/2019	07/14/2021	02/07/2019	06/12/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.0034	<0.0036	<0.004	<0.35	<0.036	<0.0035	<0.0035	<0.0037	<0.35	<0.019	<0.017	<0.018	<0.0036	<0.36	<0.037	<0.035
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0034	<0.0036	<0.004	<0.35	<0.036	<0.0035	<0.0035	<0.0037	<0.35	<0.019	<0.017	<0.018	<0.0036	<0.36	<0.037	<0.035
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.0034	<0.0036	<0.004		<0.036	<0.0035	<0.0035	<0.0037		<0.019	<0.017	<0.018	<0.0036		<0.037	<0.035
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.0069	<0.0073	<0.0079		<0.073	<0.007	<0.007	<0.0074		<0.038	<0.035	<0.037	<0.0072		<0.074	<0.069
Perfluorobutane sulfonic acid (PFBS)	NA	0.37	0.3	0.2	0.18	0.35	0.23	0.27	0.22	0.18	0.4	0.34	0.42	0.29	0.39	0.65	0.55
Perfluorobutanoic acid (PFBA)	NCL	0.057	0.052	0.042	<0.18	0.072	0.055	0.071	0.051	<0.18	0.084	0.076	0.11	0.068	<0.18	0.16	0.13
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0034	0.0043	<0.004	<0.18	<0.036	<0.0035	<0.0035	<0.0037	<0.18	<0.019	<0.017	<0.018	<0.0036	<0.18	<0.037	<0.035
Perfluorodecanoic acid (PFDA)	NCL	<0.0034	<0.0036	<0.004	<0.18	<0.036	0.004	0.0053	0.0039	<0.18	<0.019	<0.017	<0.018	<0.0036	<0.18	<0.037	0.038
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0034	<0.0036	<0.004	<0.18	<0.036	<0.0035	<0.0035	<0.0037	<0.18	<0.019	<0.017	<0.018	<0.0036	<0.18	<0.037	<0.035
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.2	0.21	0.16	<0.18	0.25	0.17	0.2	0.14	<0.18	0.36	0.22	0.29	0.2	0.22	0.28	0.33
Perfluoroheptanoic acid (PFHpA)	NCL	0.16	0.15	0.091	<0.18	0.24	0.13	0.16	0.1	<0.18	0.29	0.22	0.3	0.19	0.26	0.82	0.42
Perfluorohexane sulfonic acid (PFHxS)	NA	0.39	0.4	0.25	<0.18	0.66	0.37	0.37	0.28	0.29	0.81	0.55	0.69	0.49	0.64	1.1	0.8
Perfluorohexanoic acid (PFHxA)	NA	0.14	0.13	0.071	<0.18	0.19	0.13	0.18	0.099	<0.18	0.28	0.24	0.33	0.18	0.24	0.85	0.48
Perfluorononanoic acid (PFNA)	NA	0.046	0.05	0.035	<0.18	0.073	0.043	0.065	0.045	<0.18	0.065	0.055	0.072	0.057	<0.18	0.062	0.079
Perfluorooctane sulfonamide (FOSA)	NCL	0.12	0.27	0.15	0.18	<0.036	0.028	0.033	0.026	<0.18	<0.019	<0.017	<0.018	<0.0036	<0.18	<0.037	<0.035
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***7.2***	***8.7***	***5.1***	***5.2***	***26***	***9.2***	***8.6***	***9.4***	***10***	***21***	***17***	***19***	***14***	***15***	***34***	***35***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***2***	***2.1***	***1.2***	***0.74***	***3.6***	***2.1***	***2.4***	***1.5***	***1.5***	***5.6***	***3.5***	***3.9***	***2.5***	***3***	***13***	***6***
PFOA + PFOS (Calculated)	NCL	9.2	11	6.3	5.9	30	11	11	11	12	27	21	23	17	18	47	41
Perfluoropentanoic acid (PFPeA)	NCL	0.077	0.076	0.057	<0.18	0.084	0.068	0.097	0.063	<0.18	0.11	0.1	0.15	0.088	<0.18	0.21	0.16
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0034	<0.0036	<0.004	<0.18	<0.036	<0.0035	<0.0035	<0.0037	<0.18	<0.019	<0.017	<0.018	<0.0036	<0.18	<0.037	<0.035
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0034	0.0063	<0.004	<0.18	<0.036	<0.0035	<0.0035	<0.0037	<0.18	<0.019	<0.017	<0.018	<0.0036	<0.18	<0.037	<0.035
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0034	<0.0036	0.33	<0.18	<0.036	<0.0035	<0.0035	<0.0037	<0.18	<0.019	<0.017	<0.018	0.019	<0.18	<0.037	<0.035
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.084	0.083	0.042	<0.18	0.13	0.081	0.092	0.066	<0.18	0.14	0.12	0.16	0.1	<0.18	0.21	0.16
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA				<0.35					<0.35					<0.36		
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL				<0.35					<0.35					<0.36		
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL				0.84					<0.35					<0.36		
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL				<0.35					<0.35					<0.36		
Perfluorononane sulfonic acid (PFNS)	NCL	0.0075	0.0097	<0.0079	<0.18	<0.073	<0.007	<0.007	<0.0074	<0.18	<0.038	<0.035	<0.037	<0.0072	<0.18	<0.074	<0.069
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL				<0.35					<0.35					<0.36		
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL				<0.35					<0.35					<0.36		
4,8-dioxa-3H-perfluorononanoic acid	NCL				<0.35					<0.35					<0.36		
Total PFAS (Calculated)	NCL	11	13	7.7	7.1	32	13	13	12	12	29	22	25	18	20	51	44

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^2	TA-MW-309D	TA-MW-309D	TA-MW-309D	TA-MW-310A	TA-MW-310A	TA-MW-310A	TA-MW-310B	TA-MW-310B	TA-MW-310B	TA-MW-310B	TA-MW-310B	TA-MW-310B	TA-MW-310C	TA-MW-310C	TA-MW-310C	TA-MW-310C
Sample Name		TA-GW-MW309D	TA-GW-MW-309D	TA-TMW-309D	TA-MW-310A	TA-MW-310A	TA-GW-MW-310A	TA-MW-310B	TA-MW-310B	TA-GW-MW310B	TA-GW-MW-310B	TA-MW-310B	TA-MW-310B DUP	TA-MW-310C	TA-MW-310C	TA-GW-MW310C	TA-GW-MW-310C
Laboratory Sample ID		UH21044-005	UL19062-017	WG17016-003	UB07090-004	UF06020-004	UL19062-016	UB07090-005	UF06020-006	UH10014-005	UL19062-018	WF26013-005	WF26013-006	UB07090-006	UF06020-005	UH10014-002	UL19062-020
Sample Date		08/19/2019	12/19/2019	07/15/2021	02/05/2019	06/04/2019	12/19/2019	02/05/2019	06/04/2019	08/08/2019	12/19/2019	06/24/2021	06/24/2021	02/05/2019	06/04/2019	08/08/2019	12/19/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.037	<0.0034	<0.36	<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039	<0.0078	<0.0075	<0.0039	<0.0036	<0.0037	<0.004
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.037	<0.0034	<0.36	<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039	<0.0078	<0.0075	<0.0039	<0.0036	<0.0037	<0.004
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.037	<0.0034		<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039			<0.0039	<0.0036	<0.0037	<0.004
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.075	<0.0069		<0.0078	<0.0072	<0.0075	<0.0078	<0.0071	<0.0073	<0.0079			<0.0078	<0.0072	<0.0073	<0.0079
Perfluorobutane sulfonic acid (PFBS)	NA	0.56	0.047	0.28	0.18	0.1	0.42	0.22	0.097	0.12	0.17	0.36	0.34	0.15	0.17	0.19	0.17
Perfluorobutanoic acid (PFBA)	NCL	0.15	0.0078	<0.18	0.037	0.024	0.072	0.045	0.024	0.029	<0.0039	0.072	0.071	0.14	0.15	0.15	0.14
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.037	<0.0034	<0.18	<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039	<0.0039	<0.0038	<0.0039	<0.0036	<0.0037	<0.004
Perfluorodecanoic acid (PFDA)	NCL	0.056	<0.0034	<0.18	0.021	0.023	0.049	0.043	0.045	0.052	<0.0039	0.067	0.063	<0.0039	<0.0036	<0.0037	<0.004
Perfluorododecanoic acid (PFDoDA)	NCL	<0.037	<0.0034	<0.18	<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039	<0.0039	<0.0038	<0.0039	<0.0036	<0.0037	<0.004
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.35	<0.0034	<0.18	0.029	0.021	0.039	0.048	0.031	0.032	<0.0039	0.049	0.049	<0.0039	<0.0036	<0.0037	<0.004
Perfluoroheptanoic acid (PFHpA)	NCL	0.78	0.0094	<0.18	0.084	0.05	0.15	0.1	0.059	0.064	0.063	0.13	0.13	0.13	0.15	0.14	0.14
Perfluorohexane sulfonic acid (PFHxS)	NA	0.98	<0.0034	0.33	0.18	0.096	0.33	0.26	0.14	0.14	0.02	0.32	0.31	0.026	0.027	0.034	0.039
Perfluorohexanoic acid (PFHxA)	NA	0.92	0.047	<0.18	0.084	0.048	0.17	0.095	0.055	0.061	0.21	0.15	0.15	0.28	0.27	0.3	0.26
Perfluorononanoic acid (PFNA)	NA	0.091	<0.0034	<0.18	0.0065	0.0063	0.0087	0.012	0.011	0.012	0.0046	0.011	0.011	<0.0039	<0.0036	<0.0037	<0.004
Perfluorooctane sulfonamide (FOSA)	NCL	<0.037	<0.0034	<0.18	0.51	0.56	0.54	0.84	0.7	0.85	<0.0039	1	0.96	<0.0039	<0.0036	<0.0037	<0.004
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***43***	<0.0034	***13***	***1.1***	***1.1***	***1.2***	***2.5***	***2.1***	***2***	<0.0039	***1.7***	***1.8***	0.0058	0.0044	0.0037	0.0064
Perfluorooctanoic acid (PFOA)	0.42 (X)	***9.5***	0.013	***1.8***	***0.68***	***0.44***	***0.77***	***0.96***	***0.63***	***0.61***	0.12	***0.74***	***0.78***	0.12	0.18	0.24	0.22
PFOA + PFOS (Calculated)	NCL	53	0.013	15	1.8	1.5	2	3.5	2.7	2.6	0.12	2.4	2.6	0.13	0.18	0.24	0.23
Perfluoropentanoic acid (PFPeA)	NCL	0.25	0.028	<0.18	0.075	0.039	0.17	0.09	0.041	0.047	0.037	0.14	0.14	0.16	0.18	0.18	0.16
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.037	<0.0034	<0.18	<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039	<0.0039	<0.0038	<0.0039	<0.0036	<0.0037	<0.004
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.037	<0.0034	<0.18	<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039	<0.0039	<0.0038	<0.0039	<0.0036	<0.0037	<0.004
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.037	<0.0034	<0.18	<0.0039	<0.0036	<0.0038	<0.0039	<0.0036	<0.0036	<0.0039	<0.0039	<0.0038	<0.0039	<0.0036	<0.0037	<0.004
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.21	<0.0034	<0.18	0.055	0.032	0.11	0.067	0.035	0.041	0.0097	0.093	0.094	0.055	0.063	0.075	0.068
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA			<0.36								<0.0078	<0.0075				
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL			<0.36								0.48	0.36				
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL			<0.36								1.9	1.9				
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL			<0.36								<0.0078	<0.0075				
Perfluorononane sulfonic acid (PFNS)	NCL	<0.075	<0.0069	<0.18	<0.0078	<0.0072	<0.0075	<0.0078	<0.0071	<0.0073	<0.0079	<0.0039	<0.0038	<0.0078	<0.0072	<0.0073	<0.0079
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL			<0.36								<0.0078	<0.0075				
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL			<0.36								<0.0078	<0.0075				
4,8-dioxa-3H-perfluorononanoic acid	NCL			<0.36								<0.0078	<0.0075				
Total PFAS (Calculated)	NCL	57	0.15	15	3	2.5	4	5.3	4	4.1	0.63	7.2	7.2	1.1	1.2	1.3	1.2

TABLE 3

SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-MW-310C	TA-MW-311A	TA-MW-311A	TA-MW-311A	TA-MW-311A	TA-MW-311B	TA-MW-311B	TA-MW-311B	TA-MW-311C	TA-MW-311C	TA-MW-311C	TA-MW-312	TA-MW-312	TA-MW-312	TA-MW-312	TA-MW-312
Sample Name		TA-MW-310C	TA-MW-311	TA-MW-311A	TA-GW-MW311A	TA-GW-MW-311A	TA-MW-311B	TA-GW-MW311B	TA-GW-MW-311B	TA-MW-311C	TA-GW-MW311C	TA-GW-MW-311C	TA-MW-312	TA-MW-312	TA-MW-312	TA-GW-MW312	TA-GW-MW-312
Laboratory Sample ID		wg16013-007	UA26009-007	UF06020-003	UH07038-006	UL19062-008	UF06020-002	UH10014-015	UL19062-009	UF06020-001	UH07038-007	UL19062-010	UA26009-008	UD03042-001	UF05051-017	UH15001-003	UL19062-005
Sample Date		07/13/2021	01/22/2019	06/04/2019	08/06/2019	12/17/2019	06/04/2019	08/07/2019	12/17/2019	06/04/2019	08/06/2019	12/17/2019	01/22/2019	03/15/2019	06/03/2019	08/13/2019	12/18/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.0073	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0073	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL		<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL		<0.0077	<0.0071	<0.0072	<0.0078	<0.0073	<0.0074	<0.0077	<0.0071	<0.0072	<0.0076	<0.0079	<0.0071	<0.035	<0.0072	<0.0072
Perfluorobutane sulfonic acid (PFBS)	NA	0.19	0.035	0.034	0.027	0.016	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.14	0.0075	0.018
Perfluorobutanoic acid (PFBA)	NCL	0.15	0.01	0.011	0.0097	0.0053	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.028	<0.0036	0.004
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0036	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
Perfluorodecanoic acid (PFDA)	NCL	<0.0036	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0036	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
Perfluoroheptane sulfonic acid (PFHpS)	NCL	<0.0036	0.02	0.026	0.019	0.014	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.13	0.0052	0.021
Perfluoroheptanoic acid (PFHpA)	NCL	0.16	0.014	0.016	0.013	0.0074	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.058	0.0048	0.0098
Perfluorohexane sulfonic acid (PFHxS)	NA	0.047	0.035	0.044	0.032	0.018	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.14	0.0096	0.025
Perfluorohexanoic acid (PFHxA)	NA	0.29	0.02	0.022	0.018	0.012	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.066	0.0042	0.0089
Perfluorononanoic acid (PFNA)	NA	<0.0036	<0.0038	0.0042	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.023	<0.0036	<0.0036
Perfluorooctane sulfonamide (FOSA)	NCL	<0.0036	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.031	<0.0036	<0.0036
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***0.012***	***0.64***	***1.2***	***0.69***	***0.84***	0.0038	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	0.0093	0.0098	***7.7***	***0.079***	***0.4***
Perfluorooctanoic acid (PFOA)	0.42 (X)	0.29	0.12	0.17	0.14	0.079	<0.0018	<0.0018	<0.0019	<0.0018	<0.0018	<0.0019	0.0023	0.0037	***0.71***	0.043	0.11
PFOA + PFOS (Calculated)	NCL	0.3	0.76	1.4	0.83	0.92	0.0038	ND	ND	ND	ND	ND	0.012	0.014	8.4	0.12	0.51
Perfluoropentanoic acid (PFPeA)	NCL	0.18	0.012	0.012	0.0091	0.007	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.038	<0.0036	0.0049
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0036	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0036	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0036	<0.0038	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	<0.018	<0.0036	<0.0036
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.074	0.0059	0.0061	0.0053	<0.0039	<0.0036	<0.0037	<0.0039	<0.0036	<0.0036	<0.0038	<0.004	<0.0036	0.02	<0.0036	0.0043
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA	<0.0073															
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL	<0.0073															
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL	<0.0073															
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL	<0.0073															
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0036	<0.0077	<0.0071	<0.0072	<0.0078	<0.0073	<0.0074	<0.0077	<0.0071	<0.0072	<0.0076	<0.0079	<0.0071	<0.035	<0.0072	<0.0072
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL	<0.0073															
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL	<0.0073															
4,8-dioxa-3H-perfluorononanoic acid	NCL	<0.0073															
Total PFAS (Calculated)	NCL	1.4	0.91	1.5	0.96	1	0.0038	ND	ND	ND	ND	ND	0.012	0.014	9.1	0.15	0.61

TABLE 3
SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^2	TA-MW-313A	TA-MW-313A	TA-MW-313A	TA-MW-313A	TA-MW-313B	TA-MW-313B	TA-MW-313B	TA-MW-313B	TA-MW-313C	TA-MW-313C	TA-MW-313C	TA-MW-313C	TA-MW-313C	TA-MW-314A	TA-MW-314B	TA-MW-314C
Sample Name		TA-MW-313A	TA-MW-313A	TA-GW-MW313A	TA-GW-MW-313A	TA-MW-313B	TA-MW-313B	TA-GW-MW313B	TA-GW-MW-313B	TA-MW-313C	TA-MW-313C	TA-MW-313C DUP	TA-GW-MW313C	TA-GW-MW-313C	TA-GW-MW-314A	TA-GW-MW-314B	TA-GW-MW-314C
Laboratory Sample ID		UB07090-003	UF06020-008	UH10014-014	UL19062-024	UA26009-009	UF05051-018	UH10014-012	UL19062-026	UA26009-010	UF05051-019	UF05051-020	UH10014-013	UL19062-025	VA09002-004	VA09002-001	VA09002-003
Sample Date		02/05/2019	06/05/2019	08/07/2019	12/20/2019	01/22/2019	06/03/2019	08/07/2019	12/20/2019	01/22/2019	06/03/2019	06/03/2019	08/07/2019	12/20/2019	01/06/2020	01/06/2020	01/06/2020
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.0072	<0.007	<0.0072	<0.0073	<0.0078	<0.0071	<0.0073	<0.0078	<0.0081	<0.0072	<0.0072	<0.0074	<0.0071	<0.0074	<0.0075	<0.0072
Perfluorobutane sulfonic acid (PFBS)	NA	0.14	0.14	0.17	0.14	0.069	0.077	0.077	0.074	0.024	0.028	0.026	0.027	0.034	0.011	0.021	0.18
Perfluorobutanoic acid (PFBA)	NCL	0.043	0.066	0.057	0.045	0.02	0.024	0.023	0.022	0.0087	0.013	0.013	0.012	0.012	0.0068	0.0081	0.017
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
Perfluorodecanoic acid (PFDA)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.038	0.081	0.061	0.043	0.0048	0.0081	0.0088	0.011	0.007	0.0036	<0.0036	<0.0037	0.0046	0.0026 [J]	0.0077	0.059
Perfluoroheptanoic acid (PFHpA)	NCL	0.14	0.25	0.18	0.16	0.034	0.037	0.033	0.03	0.019	0.018	0.018	0.022	0.027	0.0033 [J]	0.0041	0.063
Perfluorohexane sulfonic acid (PFHxS)	NA	0.34	0.6	0.41	0.36	0.12	0.12	0.1	0.092	0.03	0.021	0.021	0.025	0.034	0.0057	0.01	0.18
Perfluorohexanoic acid (PFHxA)	NA	0.13	0.21	0.16	0.14	0.037	0.047	0.041	0.041	0.022	0.03	0.03	0.032	0.037	0.005	0.007	0.068
Perfluorononanoic acid (PFNA)	NA	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	0.0024 [J]	0.0016 [J]	0.0035 [J]
Perfluorooctane sulfonamide (FOSA)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***0.23***	***0.5***	***0.37***	***0.28***	***0.019***	***0.048***	***0.048***	***0.074***	***0.082***	***0.036***	***0.034***	***0.023***	***0.042***	***0.26***	***0.5***	***0.83***
Perfluorooctanoic acid (PFOA)	0.42 (X)	***1.4***	***2.3***	***1.2***	***1.6***	0.31	0.34	0.31	0.28	0.092	0.07	0.067	0.097	0.13	0.027	0.036	***0.63***
PFOA + PFOS (Calculated)	NCL	1.6	2.8	1.6	1.9	0.33	0.39	0.36	0.35	0.17	0.11	0.1	0.12	0.17	0.29	0.54	1.5
Perfluoropentanoic acid (PFPeA)	NCL	0.07	0.14	0.093	0.076	0.027	0.029	0.031	0.032	0.011	0.022	0.022	0.022	0.024	0.005	0.0049	0.015
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0036	<0.0035	<0.0036	<0.0036	<0.0039	<0.0036	<0.0037	<0.0039	<0.004	<0.0036	<0.0036	<0.0037	<0.0036	<0.0037	<0.0037	<0.0036
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	0.091	0.15	0.12	0.097	0.029	0.03	0.025	0.022	0.011	0.0095	0.0097	0.012	0.013	0.0013 [J]	0.0026 [J]	0.031
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA																
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL																
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL																
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL																
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0072	<0.007	<0.0072	<0.0073	<0.0078	<0.0071	<0.0073	<0.0078	<0.0081	<0.0072	<0.0072	<0.0074	<0.0071	<0.0074	<0.0075	<0.0072
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL																
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL																
4,8-dioxa-3H-perfluorononanoic acid	NCL																
Total PFAS (Calculated)	NCL	2.6	4.4	2.8	2.9	0.67	0.76	0.7	0.68	0.31	0.25	0.24	0.27	0.36	0.33	0.6	2.1

TABLE 3

SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface^2	TA-MW-314D	TA-MW-315D	TA-MW-315D	TA-MW-315D	TA-MW-315S	TA-MW-315S	TA-MW-315S	TA-MW-315S	TA-MW-316D	TA-MW-316D	TA-MW-316D	TA-MW-316M	TA-MW-316M	TA-MW-316M	TA-MW-316S	TA-MW-316S
Sample Name		TA-GW-MW-314D	TA-MW-315D	TA-GW-MW315D	TA-GW-MW-315D	TA-MW-315S	TA-GW-MW315S DUP	TA-GW-MW315S	TA-GW-MW-315S	TA-MW-316D	TA-GW-MW316D	TA-GW-MW-316D	TA-MW-316M	TA-GW-MW316M	TA-GW-MW-316M	TA-MW-316S	TA-GW-MW316S
Laboratory Sample ID		VA09002-002	UF22013-001	UH10014-001	UL19062-001	UF22013-002	UH10014-004	UH10014-003	UL19062-002	UF13013-022	UH07038-004	VA09002-008	UF13013-023	UH07038-003	VA09002-009	UF13013-021	UH07038-005
Sample Date		01/06/2020	06/21/2019	08/08/2019	12/18/2019	06/21/2019	08/08/2019	08/08/2019	12/18/2019	06/12/2019	08/06/2019	01/07/2020	06/12/2019	08/06/2019	01/07/2020	06/12/2019	08/06/2019
Parameter (µg/L)																	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.0076	<0.0071	<0.0073	<0.0081	<0.0069	<0.0072	<0.0071	<0.0077	<0.007	<0.0074	<0.0078	<0.007	<0.007	<0.007	<0.0071	<0.0074
Perfluorobutane sulfonic acid (PFBS)	NA	<0.0038	<0.0035	<0.0036	<0.004	0.079	0.079	0.08	0.054	<0.0035	<0.0037	<0.0039	0.048	0.054	0.043	0.0074	<0.0037
Perfluorobutanoic acid (PFBA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	0.021	0.019	0.018	0.013	<0.0035	<0.0037	<0.0039	0.014	0.014	0.012	0.011	<0.0037
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
Perfluorodecanoic acid (PFDA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
Perfluoroheptane sulfonic acid (PFHpS)	NCL	<0.0038	<0.0035	<0.0036	<0.004	0.084	0.085	0.091	0.075	<0.0035	<0.0037	<0.0039	0.0085	0.013	0.011	0.0088	<0.0037
Perfluoroheptanoic acid (PFHpA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	0.039	0.031	0.034	0.026	<0.0035	<0.0037	<0.0039	0.021	0.023	0.018	0.013	<0.0037
Perfluorohexane sulfonic acid (PFHxS)	NA	<0.0038	<0.0035	<0.0036	<0.004	0.092	0.077	0.087	0.078	<0.0035	<0.0037	<0.0039	0.036	0.042	0.036	0.0082	<0.0037
Perfluorohexanoic acid (PFHxA)	NA	<0.0038	<0.0035	<0.0036	<0.004	0.047	0.035	0.037	0.027	<0.0035	<0.0037	<0.0039	0.036	0.038	0.028	0.021	0.0038
Perfluorononanoic acid (PFNA)	NA	<0.0038	<0.0035	<0.0036	<0.004	0.0092	0.011	0.0093	0.0076	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	0.00087 [J]	<0.0035	<0.0037
Perfluorooctane sulfonamide (FOSA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	<0.0038	0.0069	<0.0036	***0.024***	***2.4***	***2.4***	***2.5***	***2.1***	<0.0035	<0.0037	<0.0039	***0.041***	***0.067***	***0.071***	***0.32***	***0.39***
Perfluorooctanoic acid (PFOA)	0.42 (X)	<0.0019	0.0077	0.002	0.0047	***0.43***	0.4	0.39	0.35	<0.0018	<0.0018	<0.0019	0.16	0.16	0.14	0.059	0.013
PFOA + PFOS (Calculated)	NCL	ND	0.015	0.002	0.029	2.8	2.8	2.9	2.5	ND	ND	ND	0.2	0.23	0.21	0.38	0.4
Perfluoropentanoic acid (PFPeA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	0.028	0.024	0.023	0.016	<0.0035	<0.0037	<0.0039	0.029	0.032	0.024	0.022	0.0039
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0038	<0.0035	<0.0036	<0.004	<0.0034	<0.0036	<0.0036	<0.0038	<0.0035	<0.0037	<0.0039	<0.0035	<0.0035	<0.0035	<0.0035	<0.0037
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	<0.0038	<0.0035	<0.0036	<0.004	0.014	0.013	0.013	0.0096	<0.0035	<0.0037	<0.0039	0.0072	0.0087	0.0075	<0.0035	<0.0037
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA																
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL																
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL																
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL																
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0076	<0.0071	<0.0073	<0.0081	<0.0069	<0.0072	<0.0071	<0.0077	<0.007	<0.0074	<0.0078	<0.007	<0.007	<0.007	<0.0071	<0.0074
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL																
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL																
4,8-dioxa-3H-perfluorononanoic acid	NCL																
Total PFAS (Calculated)	NCL	ND	0.015	0.002	0.029	3.2	3.2	3.3	2.8	ND	ND	ND	0.4	0.45	0.39	0.47	0.41

TABLE 3

SUMMARY OF GROUNDWATER SAMPLE ANALYSIS - PFAS
Former Tannery
Rockford, Kent County, Michigan

Location	Part 201 Generic Groundwater Cleanup Criteria – Groundwater Surface Water Interface[2]	TA-MW-316S	TA-MW-317A	TA-MW-317B	TA-MW-317C	TA-MW-317C	TA-MW-317D
Sample Name		TA-GW-MW-316S	TA-GW-MW-317A	TA-GW-MW-317B	TA-GW-MW-317C	TA-GW-MW-317C DUP	TA-GW-MW-317D
Laboratory Sample ID		VA09002-007	UL19062-003	UL19062-004	UL19062-012	UL19062-013	UL19062-011
Sample Date		01/07/2020	12/18/2019	12/18/2019	12/17/2019	12/17/2019	12/17/2019
Parameter (μg/L)							
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
N-Methyl perfluorooctane sulfonamide (MeFOSA)	NCL	<0.0075	<0.0078	<0.0076	<0.0075	<0.0076	<0.0077
Perfluorobutane sulfonic acid (PFBS)	NA	0.013	0.024	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorobutanoic acid (PFBA)	NCL	<0.0037	0.014	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorodecane sulfonic acid (PFDS)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorodecanoic acid (PFDA)	NCL	0.0016 [J]	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorododecanoic acid (PFDoDA)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Perfluoroheptane sulfonic acid (PFHpS)	NCL	0.00094 [J]	0.015	<0.0038	<0.0037	<0.0038	<0.0038
Perfluoroheptanoic acid (PFHpA)	NCL	<0.0037	0.016	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorohexane sulfonic acid (PFHxS)	NA	0.0022 [J]	0.024	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorohexanoic acid (PFHxA)	NA	0.00096 [J]	0.03	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorononanoic acid (PFNA)	NA	<0.0037	0.0078	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorooctane sulfonamide (FOSA)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorooctane sulfonic acid (PFOS)	0.011 (X)	***0.13***	***1.9***	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorooctanoic acid (PFOA)	0.42 (X)	0.0043	0.085	<0.0019	<0.0019	<0.0019	<0.0019
PFOA + PFOS (Calculated)	NCL	0.13	2	ND	ND	ND	ND
Perfluoropentanoic acid (PFPeA)	NCL	<0.0037	0.013	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorotetradecanoic acid (PFTeDA)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Perfluorotridecanoic acid (PFTrDA)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Perfluoroundecanoic acid (PFUnDA)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Perfluoro-1-pentanesulfonate (PFPeS)	NCL	<0.0037	<0.0039	<0.0038	<0.0037	<0.0038	<0.0038
Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (GenX)	NA						
N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	NCL						
N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	NCL						
1H,1H,2H,2H-perfluorohexane sulfonate (4:2FTS)	NCL						
Perfluorononane sulfonic acid (PFNS)	NCL	<0.0075	<0.0078	<0.0076	<0.0075	<0.0076	<0.0077
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	NCL						
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	NCL						
4,8-dioxa-3H-perfluorononanoic acid	NCL						
Total PFAS (Calculated)	NCL	0.15	2.1	ND	ND	ND	ND

TABLE 3 NOTES

Former Tannery
Rockford, Kent County, Michigan

NOTES:

1. Concentration and criteria units are micrograms per Liter (μg/L) or parts per billion (ppb).
2. Michigan Part 201 Groundwater Cleanup Criteria are based on "Table 1, Groundwater: Residential and Nonresidential Part 201 Generic Cleanup Criteria and Screening Levels/Part 213 Tier I Risk Based Screening Levels," Michigan Administrative Code, Cleanup Criteria Requirements for Response Activity, Rules 299.44 and 299.49, effective December 30, 2013; updated December 21, 2020.

   Abbreviations Include:

   "NA" indicates a criterion or value is not available or, in the case of background, not applicable.

   "NCL" indicates no criterion listed in EGLE Table 1.

   Footnotes Include:

   (X) - For groundwater discharge to the Great Lakes and their connecting waters or discharge in close proximity to a water supply intake in inland surface waters, the generic GSI criterion shall be the surface water human drinking water value (HDV) listed in the table of this footnote except for those HDV indicated with an asterisk. For HDV with an asterisk, the generic GSI criterion shall be the lowest of the HDV, the wildlife value (WV), and the calculated final chronic value (FCV). Criterion listed have been updated to the HDV, WV, or FCV.
3. Bold, italic number with thick line border or italic parameter name indicates that parameter was detected above the Michigan Part 201 Groundwater Cleanup Criteria.
4. Abbreviations include:

   "< LOQ" indicates the parameter was analyzed for but not detected above the limit of quantitation (LOQ).

   Blank indicates the parameter was not analyzed for the indicated sample.

   "DUP" indicates a duplicate sample.

   "ND" indicates the parameters used in the calculation were not detected.

   "B" indicates the parameter was also detected in the method blank.

   "J" indicates the parameter was detected at a concentration less than the LOQ but greater than or equal to the detection limit (DL) and the result is estimated.

   "E" indicates the quantitation of the parameter exceeded the calibration range.

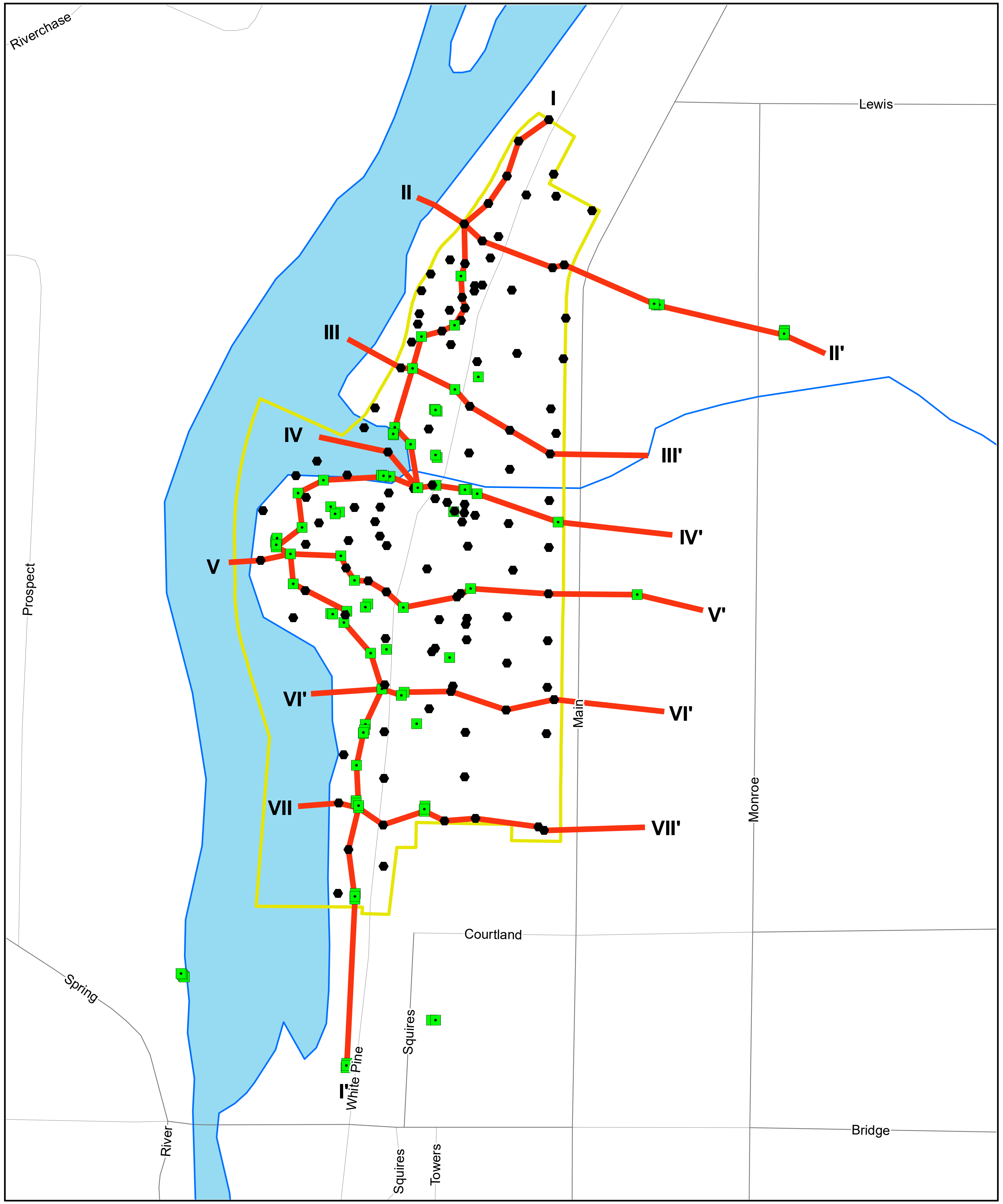
TABLE 4
MODEL COMPUTED GROUNDWATER ELEVATIONS VS. OBSERVED ELEVATIONS
FORMER TANNERY,
ROCKFORD, KENTY COUNTY, MICHIGAN

Name	**Computed, Ft**	**Observed, Ft.**	**Residual (Computed minus Observed)**
TA-P-1	691.75	691.91	-0.16
TA-P-2	691.59	691.95	-0.36
TA-P-3	691.7	692.15	-0.45
TA-P-4	691.84	692.04	-0.2
TA-P-5	695.07	695.91	-0.84
TA-MW-1	691.8	692.51	-0.71
TA-MW-2	691.77	692.32	-0.55
TA-MW-3	692.3	691.99	0.31
TA-MW-4	692.37	692.03	0.34
TA-MW-5	692.14	692.01	0.13
TA-MW-301B	691.45	692.23	-0.78
TA-MW-301C	691.41	692.59	-1.18
TA-MW-301D	691.3	689.41	1.89
TA-MW-302A	691.66	692.2	-0.54
TA-MW-302B	691.65	691.88	-0.23
TA-MW-303A	691.58	692.11	-0.53
TA-MW-303B	691.57	691.88	-0.31
TA-MW-303C	691.57	691.84	-0.27
TA-MW-303D	691.57	689.12	2.45
TA-MW-303E	691.56	689.14	2.42
TA-MW-304A	691.83	692.04	-0.21
TA-MW-304B	691.83	691.92	-0.09
TA-MW-305B	692.16	691.95	0.21
TA-MW-305C	692.15	691.95	0.2
TA-MW-306A	691.98	691.84	0.14
TA-MW-306B	691.99	691.83	0.16
TA-MW-307A	691.86	691.86	0
TA-MW-307B	691.86	691.82	0.04
TA-MW-308A	692.06	692.03	0.03
TA-MW-308B	692.06	692.08	-0.02
TA-MW-308C	692.05	692.11	-0.06
TA-MW-309A	690.61	692.33	-1.72
TA-MW-309B	690.59	692.48	-1.89
TA-MW-309C	690.58	691.68	-1.1
TA-MW-309D	690.56	691.67	-1.11
TA-MW-310A	690.61	688.89	1.72
TA-MW-310B	690.57	690.01	0.56
TA-MW-310C	690.6	689.78	0.82
TA-MW-311	693.29	692.98	0.31
TA-MW-312	696.67	696	0.67
TA-MW-313A	689.96	692.01	-2.05

TABLE 4
MODEL COMPUTED GROUNDWATER ELEVATIONS VS. OBSERVED ELEVATIONS
FORMER TANNERY,
ROCKFORD, KENTY COUNTY, MICHIGAN

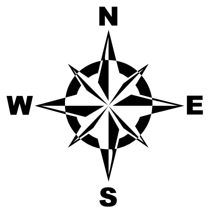
Name	Computed, Ft	Observed, Ft.	Residual (Computed minus Observed)
TA-MW-313B	689.92	687.03	2.89
TA-MW-313C	689.8	686.9	2.9
TA-TMW-101	691.51	692.72	-1.21
TA-TMW-103	694.26	694.09	0.17
TA-TMW-104	695.26	695.93	-0.67
TA-TMW-105	691.84	691.95	-0.11
TA-TMW-108	691.89	691.89	0
TA-TMW-109	692.15	692.1	0.05
TA-TMW-110	691.96	691.96	0
TA-TMW-111	692.11	692.1	0.01
TA-RW-1	691.79	691.82	-0.03
TA-RW-2	692.08	691.65	0.43
TA-RW-3	692.92	692.95	-0.03
TA-PMW-01	691.77	691.38	0.39
TA-PMW-02	692.03	691.61	0.42
TA-PMW-03	692.78	692.97	-0.19
TA-PMW-04	691.75	691.31	0.44
TA-PMW-05	692.47	692.29	0.18
TA-PMW-06	693.1	693.09	0.01
TA-PMW-07	691.66	691	0.66
TA-PMW-08	691.77	691.38	0.39
TA-PMW-09	692.17	692.07	0.1

Figures



LEGEND

- ● SOIL BORING
- 🟩 MONITORING WELL
- ◉ WATER WELL
- ▬ SECTIONLINE
- ∿ RUM CREEK
- ▭ FORMER TANNERY SITE
- ▨ ROGUE RIVER
- ─ MINOR ROADS AND TWO TRACKS
- ─ MAJOR CITY ROADS
- ─ MINOR CITY ROADS



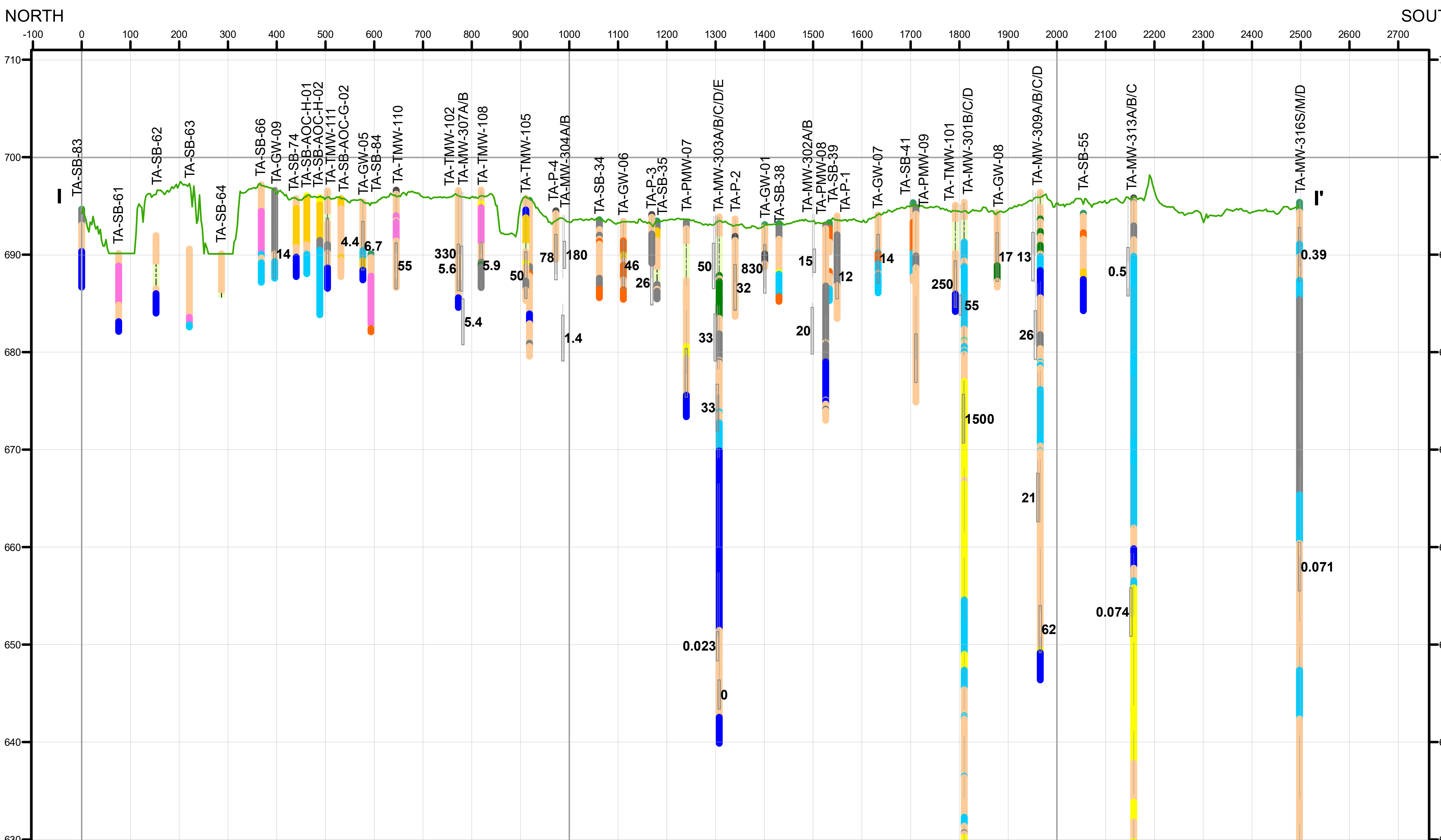
0 125 250 500

SCALE IN FEET

FORMER TANNERY
ROCKFORD, MICHIGAN

LOCATIONS OF CROSS SECTIONS

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: WNJ/WWW	
PROJ MGR:	REVIEWED BY:	CHECKED BY:	SHEET NO. 1
DESIGNED BY:	DRAWN BY:	SCALE: 1 in = 250 ft	
DATE: 10/25/2021	PROJECT NO:	REVISION NO:	



CROSS SECTION LEGEND

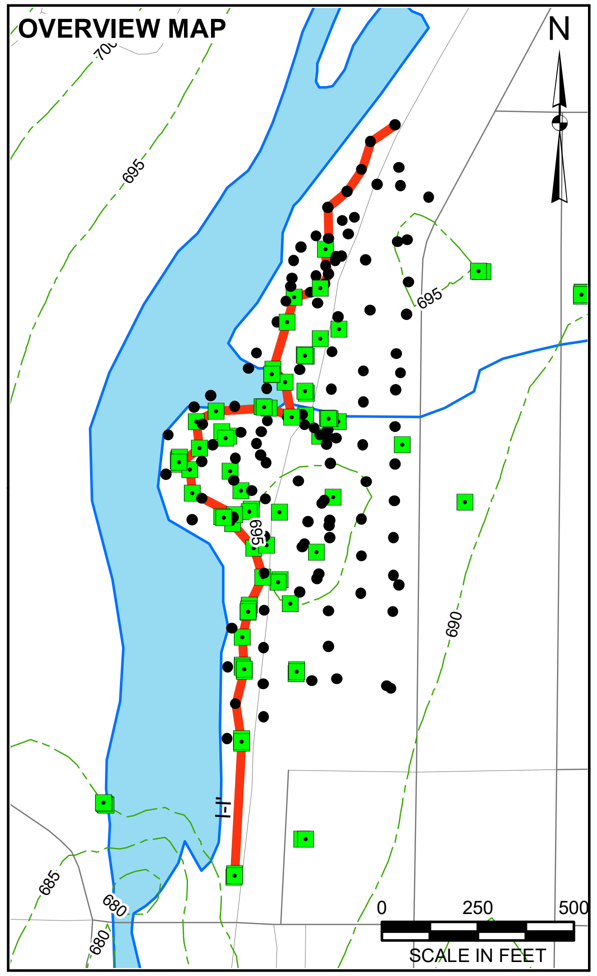
	WELL CASING	**BOREHOLE LITHOLOGY**			SILT
	GROUND SURFACE				CLAY AND SILT
☐	WELL SCREEN (PFOS - ug/L)		GRAVEL		CLAY
			SAND AND GRAVEL		TOP SOIL
			SAND		ORGANIC SOIL
			SAND/GRAVEL WITH CLAY/SILT		WASTE
					FILL
			CLAY/SILT WITH SAND/GRAVEL		PAVEMENT

NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. GROUND SURFACE ELEVATIONS ARE BASED ON DIGITAL RASTER FILES OF BARE EARTH DIGITAL ELEVATION MODELS (DEMS), GENERATED FROM LIDAR DATA WITH 1-METER HORIZONTAL ACCURACY AND 18.5-CENTIMETER VERTICAL ACCURACY. DIGITAL FILES OF DEMS AND LIDAR DATA WERE PROVIDED BY KENT COUNTY.

3. WELL SCREEN ELEVATIONS PROVIDED IN FEET ABOVE MEAN SEA LEVEL, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88). ELEVATIONS ARE ROUNDED TO THE NEAREST FOOT.

Data Frame Name: Layers



OVERVIEW MAP LEGEND

●	SOIL BORING		RUM CREEK
🟩	MONITORING WELL		ROGUE RIVER
	SECTIONLINE		MINOR ROADS AND TWO TRACKS
	GROUNDWATER CONTOUR, NOVEMBER 2019		MAJOR CITY ROADS
			MINOR CITY ROADS

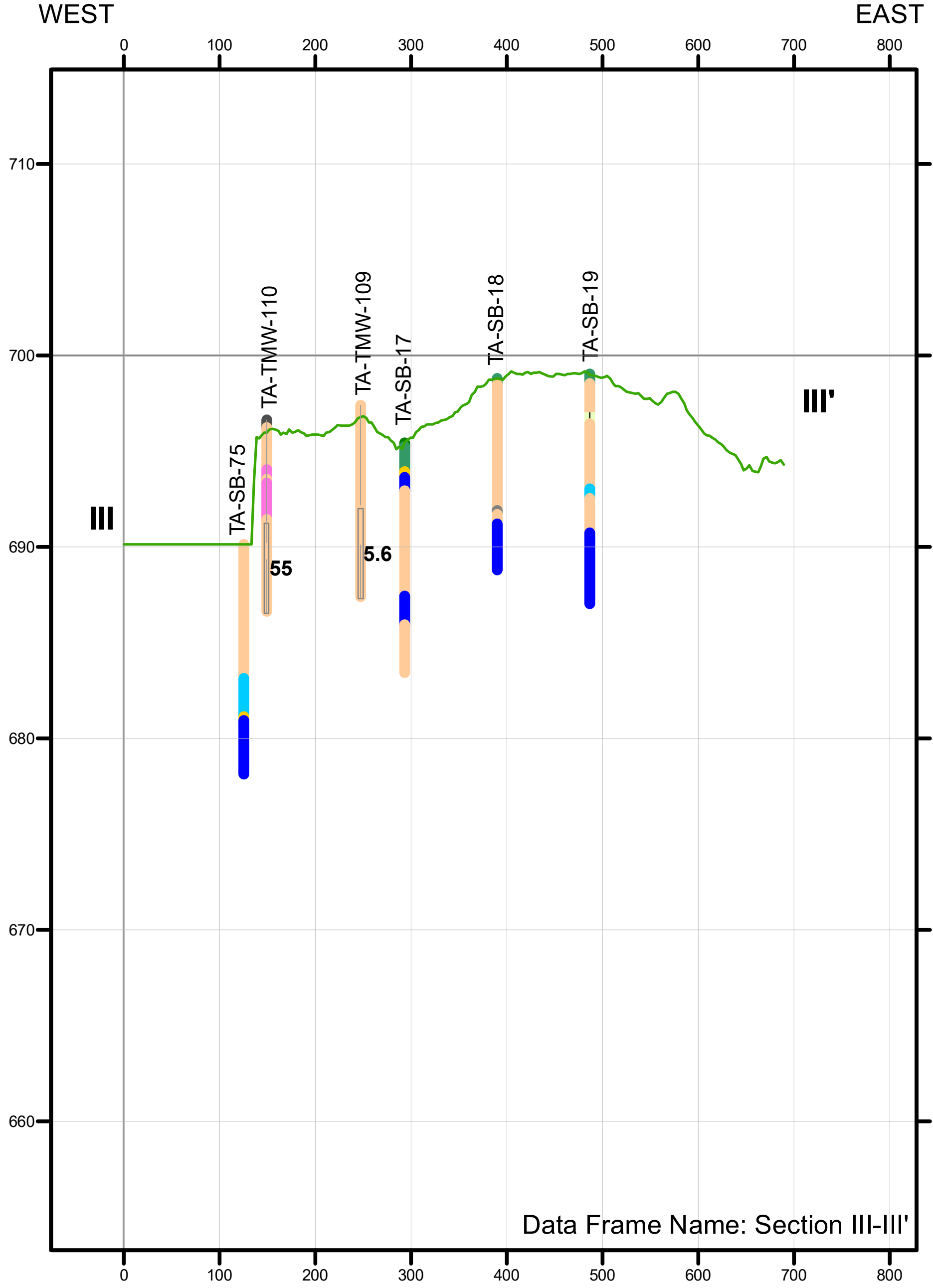
FORMER TANNERY
ROCKFORD, MICHIGAN

CROSS SECTION I-I'

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
WNJ/WWW

PROJ MGR: LMN	REVIEWED BY: MAW	CHECKED BY: JC	SHEET NO. 2
DESIGNED BY: JC	DRAWN BY: JC/JMG	SCALE: 1 in = 500 ft	
DATE: 10/25/2021	PROJECT NO: 16.0062961.01	REVISION NO:	



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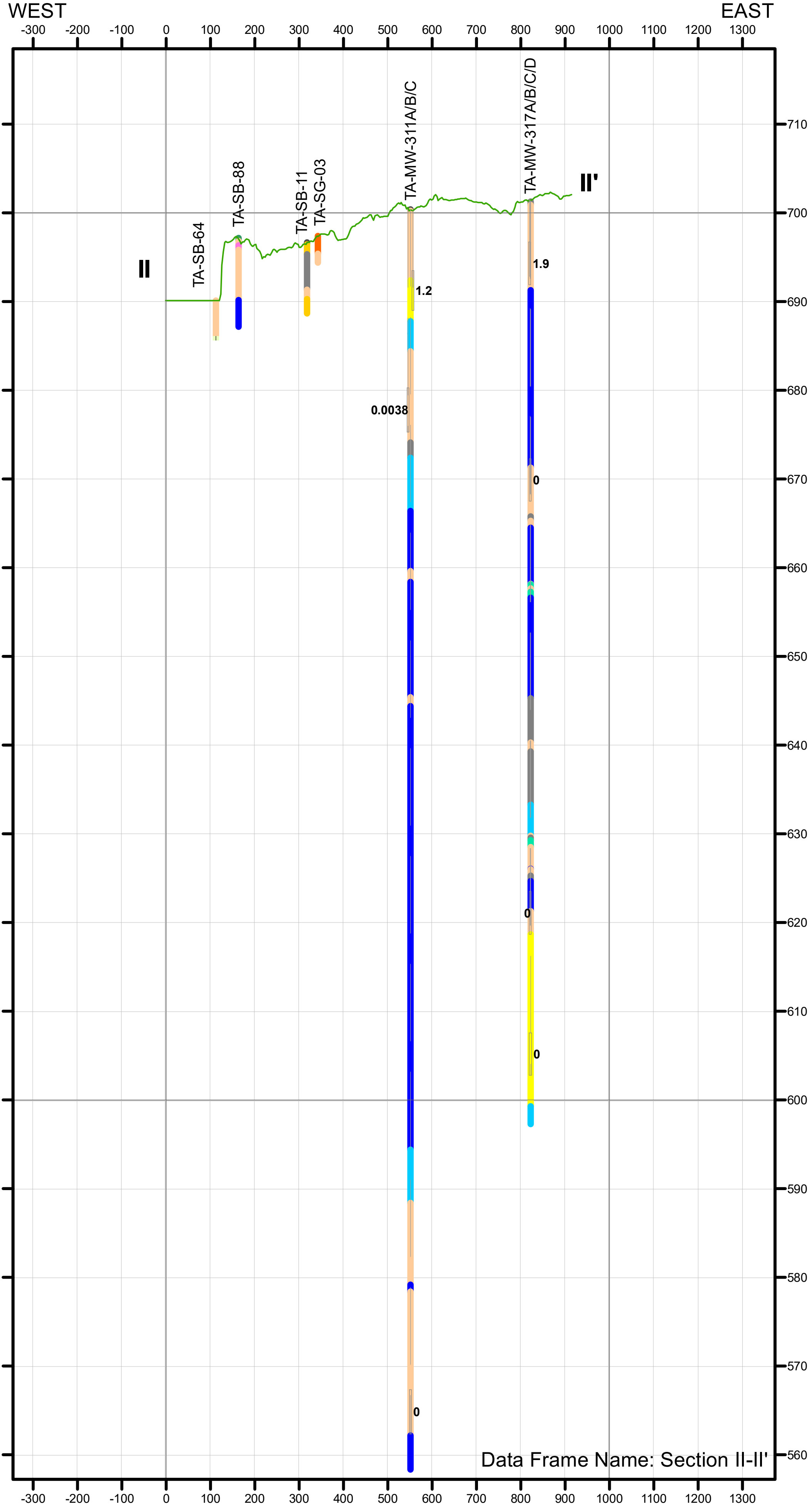

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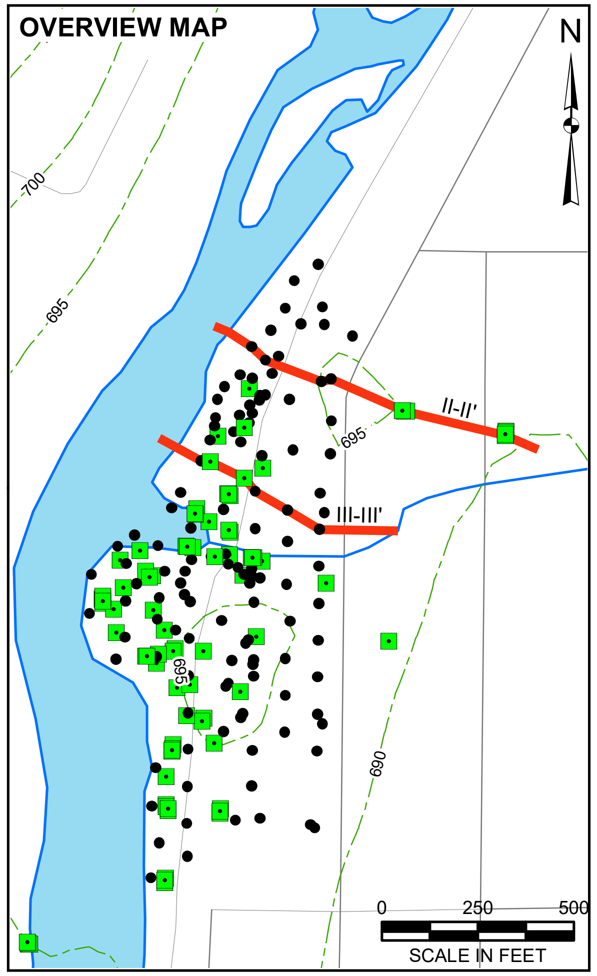

OVERVIEW MAP LEGEND

● SOIL BORING

🟩 MONITORING WELL

🟥 SECTIONLINE

GROUNDWATER COUNTOUR, NOVEMBER 2019

RUM CREEK

ROGUE RIVER

MINOR ROADS AND TWO TRACKS

MAJOR CITY ROADS

MINOR CITY ROADS

NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. GROUND SURFACE ELEVATIONS ARE BASED ON DIGITAL RASTER FILES OF BARE EARTH DIGITAL ELEVATION MODELS (DEMS), GENERATED FROM LIDAR DATA WITH 1-METER HORIZONTAL ACCURACY AND 18.5-CENTIMETER VERTICAL ACCURACY. DIGITAL FILES OF DEMS AND LIDAR DATA WERE PROVIDED BY KENT COUNTY.

3. WELL SCREEN ELEVATIONS PROVIDED IN FEET ABOVE MEAN SEA LEVEL, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88). ELEVATIONS ARE ROUNDED TO THE NEAREST FOOT.

CROSS SECTION LEGEND

WELL CASING

☐ WELL SCREEN (PFOS - UG/L)

GROUND SURFACE

BOREHOLE LITHOLOGY

🟨 GRAVEL

SAND AND GRAVEL

SAND

🟧 SAND/GRAVEL WITH CLAY/SILT

CLAY/SILT WITH SAND/GRAVEL

SILT

CLAY AND SILT

🟦 CLAY

TOP SOIL

WASTE

FILL

PAVEMENT

FORMER TANNERY
ROCKFORD, MICHIGAN

CROSS SECTIONS II-II' AND III-III'

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PROJ MGR: LMN
REVIEWED BY: MAW
CHECKED BY: JC
DESIGNED BY: JC
DRAWN BY: JC/JMG
SCALE: 1 in = 500 ft
DATE: 10/25/2021
PROJECT NO: 16.0062961.01
REVISION NO:
SHEET NO. 3

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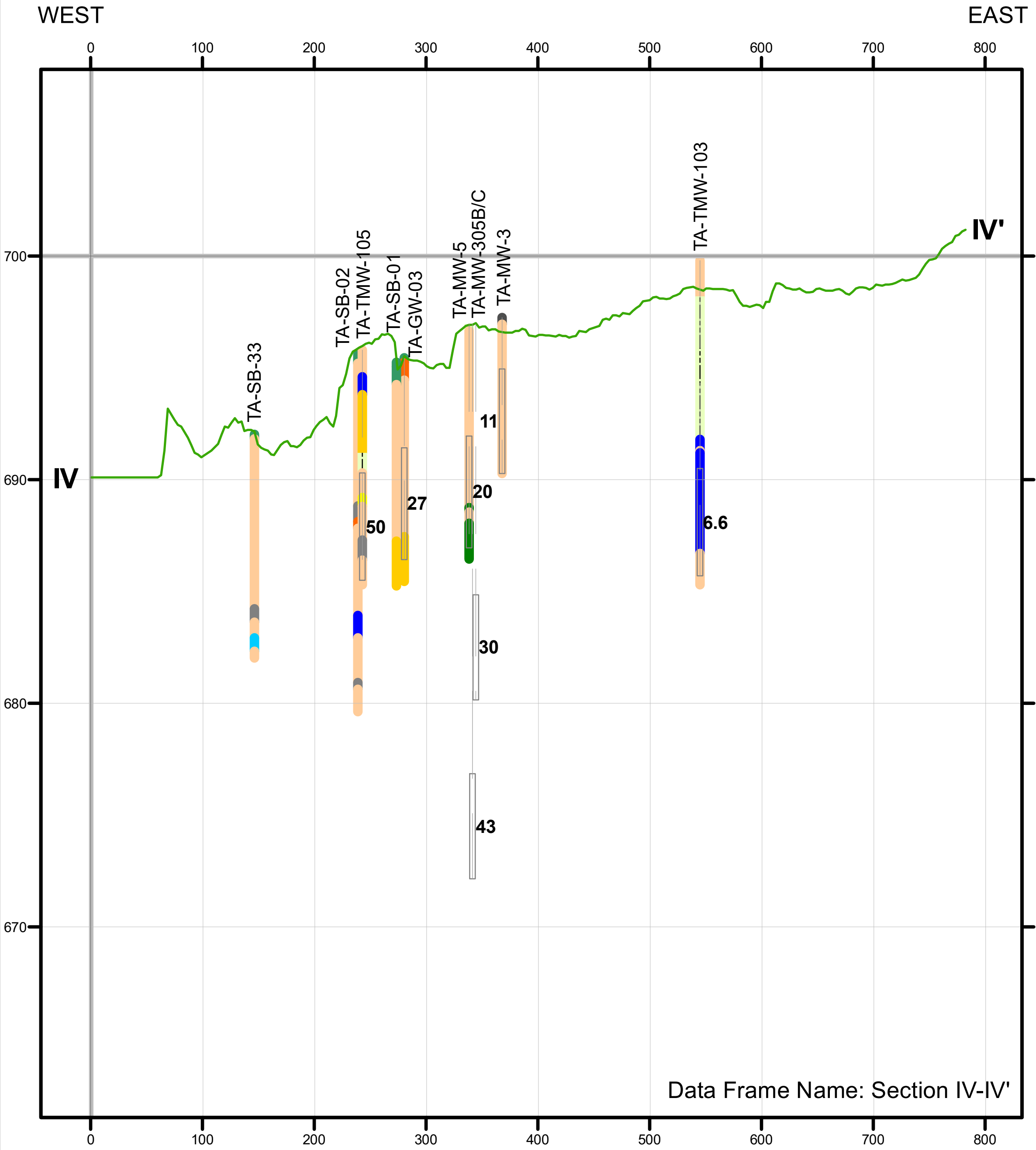

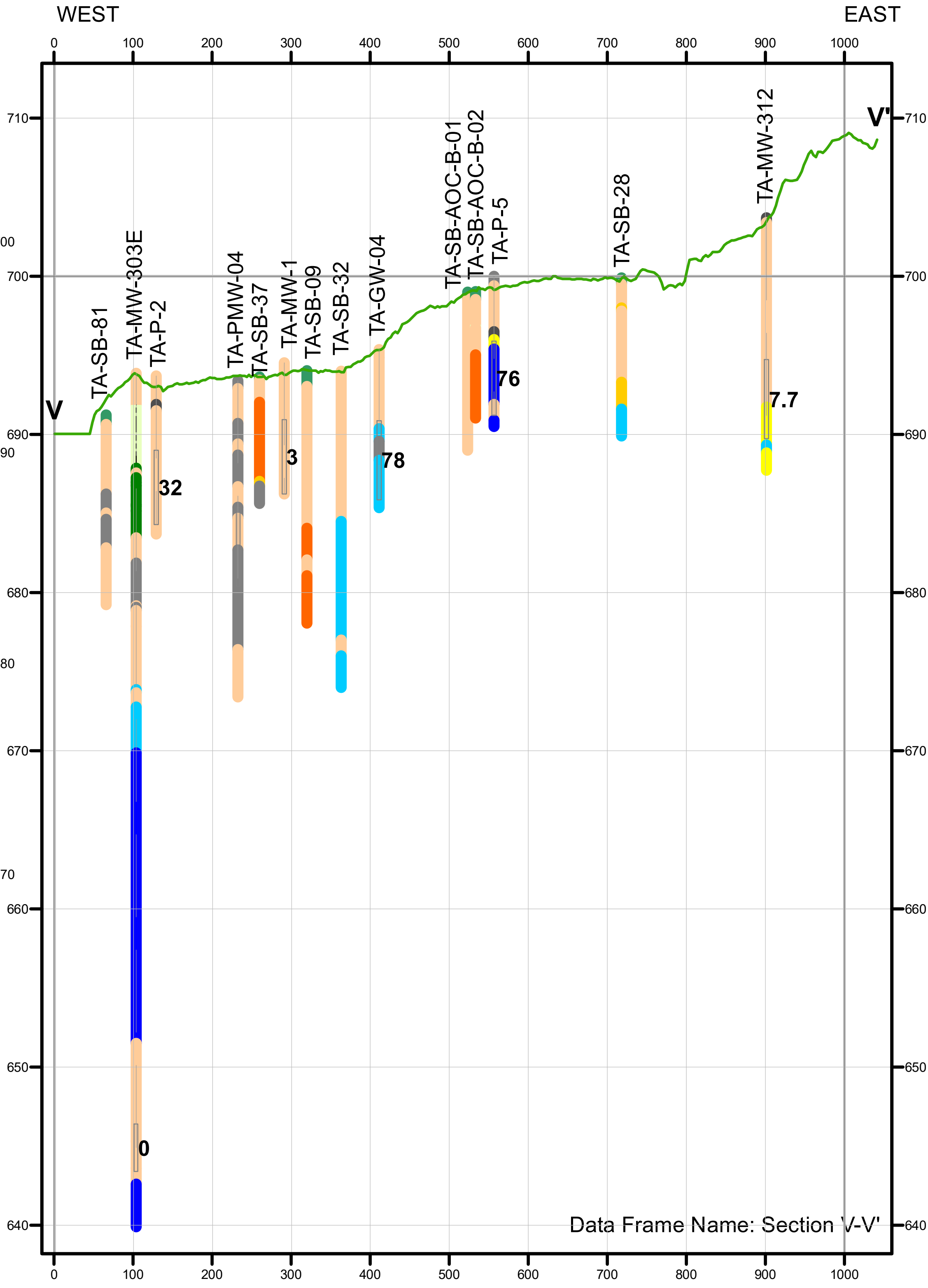

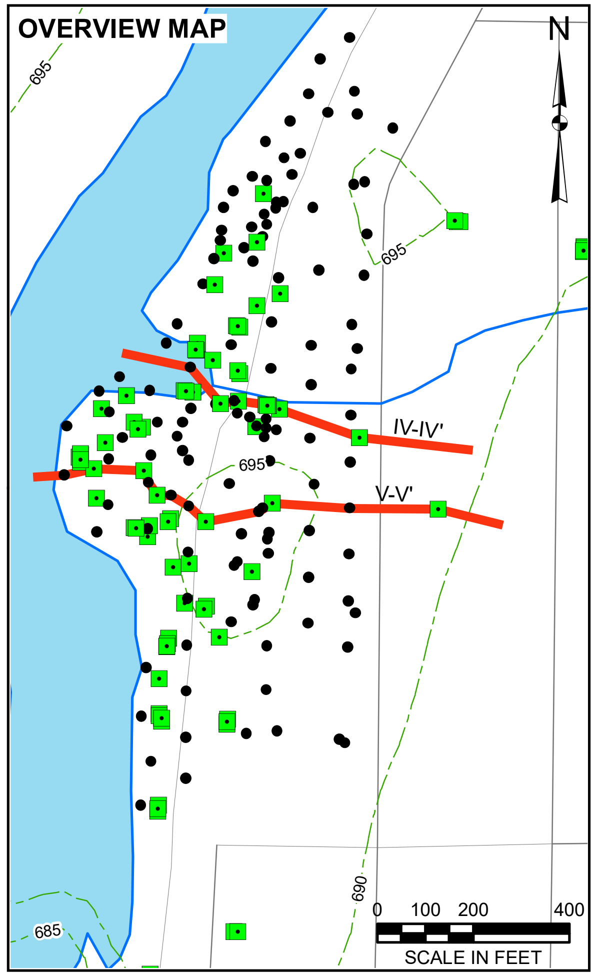

OVERVIEW MAP LEGEND

- ● SOIL BORING
- 🟩 MONITORING WELL
- SECTIONLINE
- GROUNDWATER CONTOURS, NOVEMBER 2019
- RUM CREEK
- ROGUE RIVER
- MINOR ROADS AND TWO TRACKS
- MAJOR CITY ROADS
- MINOR CITY ROADS

CROSS SECTION LEGEND

- WELL CASING
- ☐ WELL SCREEN (PFOS - UG/L)
- GROUND SURFACE

BOREHOLE LITHOLOGY

- GRAVEL
- SAND AND GRAVEL
- SAND
- SAND/GRAVEL WITH CLAY/SILT
- SILT
- CLAY AND SILT
- CLAY
- TOP SOIL
- ORGANIC SOIL
- FILL
- PAVEMENT

NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. GROUND SURFACE ELEVATIONS ARE BASED ON DIGITAL RASTER FILES OF BARE EARTH DIGITAL ELEVATION MODELS (DEMS), GENERATED FROM LIDAR DATA WITH 1-METER HORIZONTAL ACCURACY AND 18.5-CENTIMETER VERTICAL ACCURACY. DIGITAL FILES OF DEMS AND LIDAR DATA WERE PROVIDED BY KENT COUNTY.

3. WELL SCREEN ELEVATIONS PROVIDED IN FEET ABOVE MEAN SEA LEVEL, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88). ELEVATIONS ARE ROUNDED TO THE NEAREST FOOT.

FORMER TANNERY
ROCKFORD, MICHIGAN

CROSS SECTIONS IV-IV' AND V-V'

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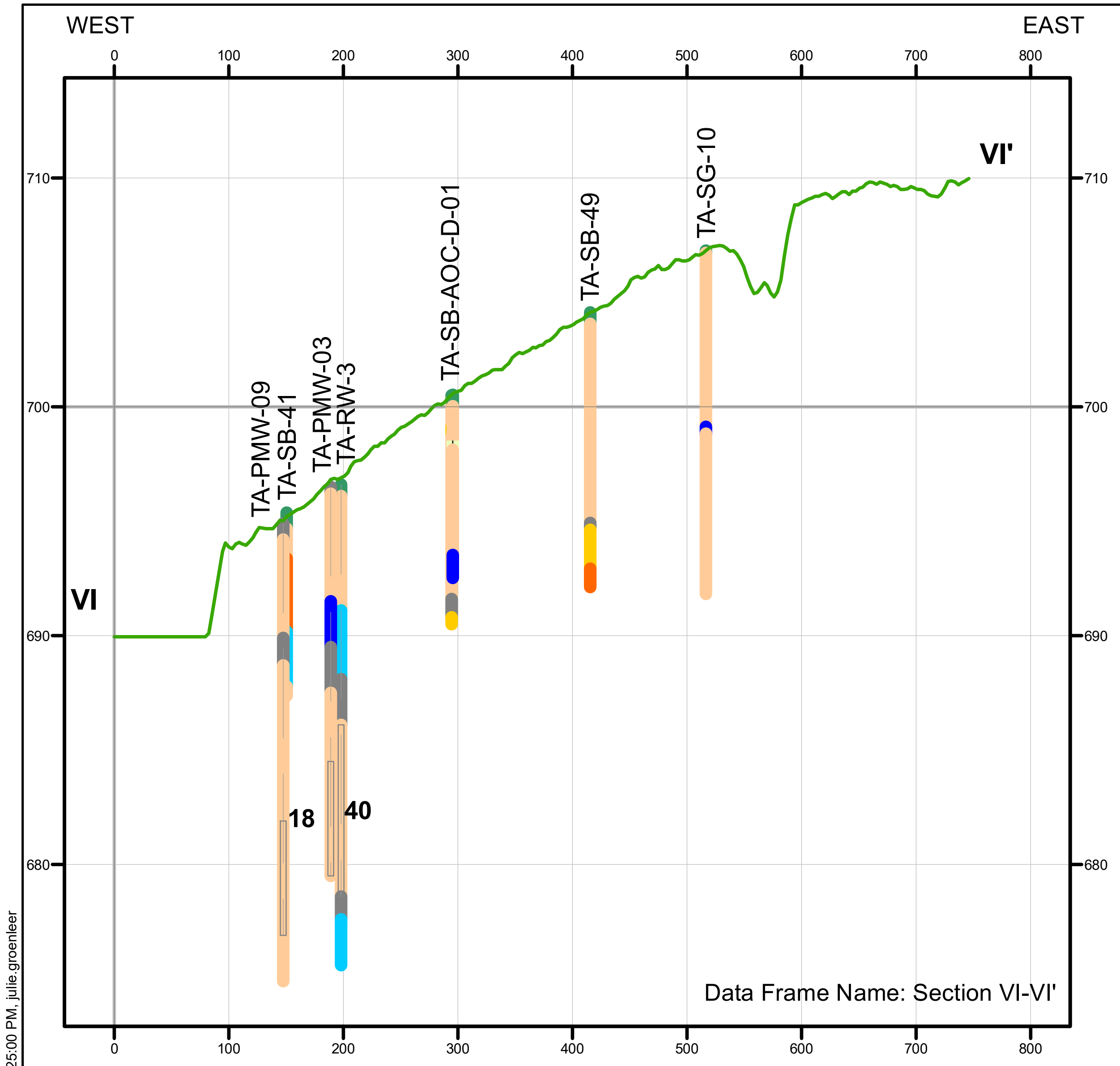
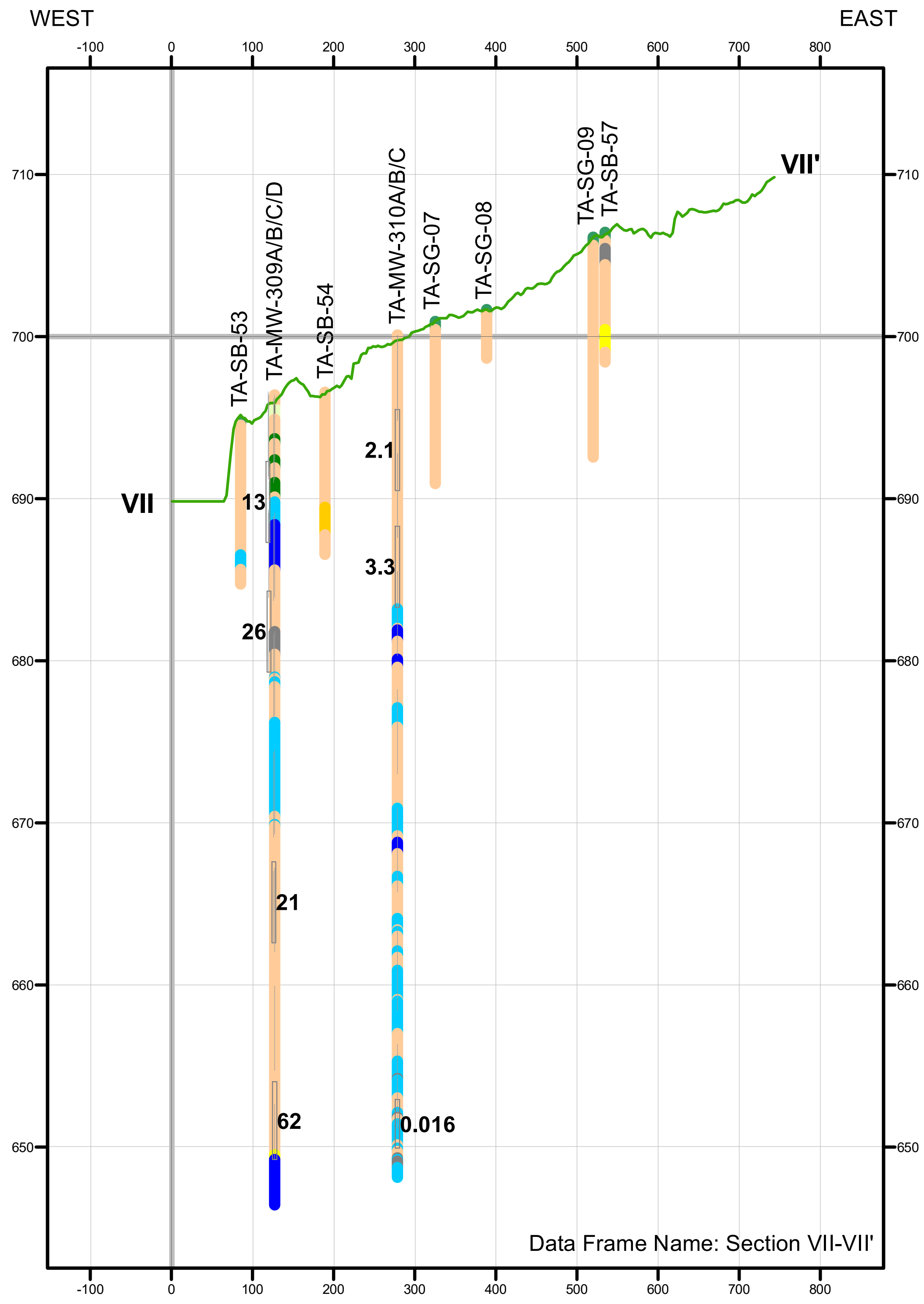
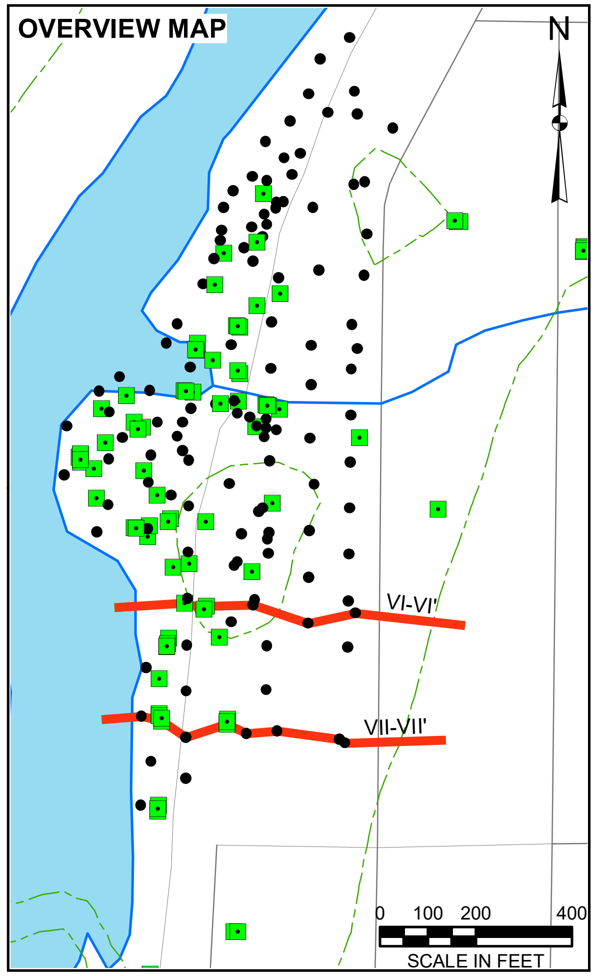
PROJ MGR: LMN
REVIEWED BY: MAW
CHECKED BY: JC
DESIGNED BY: JC
JC/JMG
SCALE: 1 in = 400 ft
DATE: 10/25/2021
PROJECT NO: 16.0062961.01
REVISION NO:
SHEET NO. 4







OVERVIEW MAP LEGEND

- ● SOIL BORING
- 🟩 MONITORING WELL
- SECTIONLINE
- GROUNDWATER CONTOURS, NOVEMBER 2019
- RUM CREEK
- ROGUE RIVER
- MINOR ROADS AND TWO TRACKS
- MAJOR CITY ROADS
- MINOR CITY ROADS

CROSS SECTION LEGEND

- WELL CASING
- ☐ WELL SCREEN (PFOS - UG/L)
- GROUND SURFACE

BOREHOLE LITHOLOGY

- GRAVEL
- SAND AND GRAVEL
- SAND
- SAND/GRAVEL WITH CLAY/SILT
- CLAY/SILT WITH SAND/GRAVEL
- SILT
- CLAY AND SILT
- CLAY
- TOP SOIL
- ORGANIC SOIL
- FILL

NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. GROUND SURFACE ELEVATIONS ARE BASED ON DIGITAL RASTER FILES OF BARE EARTH DIGITAL ELEVATION MODELS (DEMS), GENERATED FROM LIDAR DATA WITH 1-METER HORIZONTAL ACCURACY AND 18.5-CENTIMETER VERTICAL ACCURACY. DIGITAL FILES OF DEMS AND LIDAR DATA WERE PROVIDED BY KENT COUNTY.

3. WELL SCREEN ELEVATIONS PROVIDED IN FEET ABOVE MEAN SEA LEVEL, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88). ELEVATIONS ARE ROUNDED TO THE NEAREST FOOT.

FORMER TANNERY
ROCKFORD, MICHIGAN

CROSS SECTIONS VI-VI' AND VII-VII'

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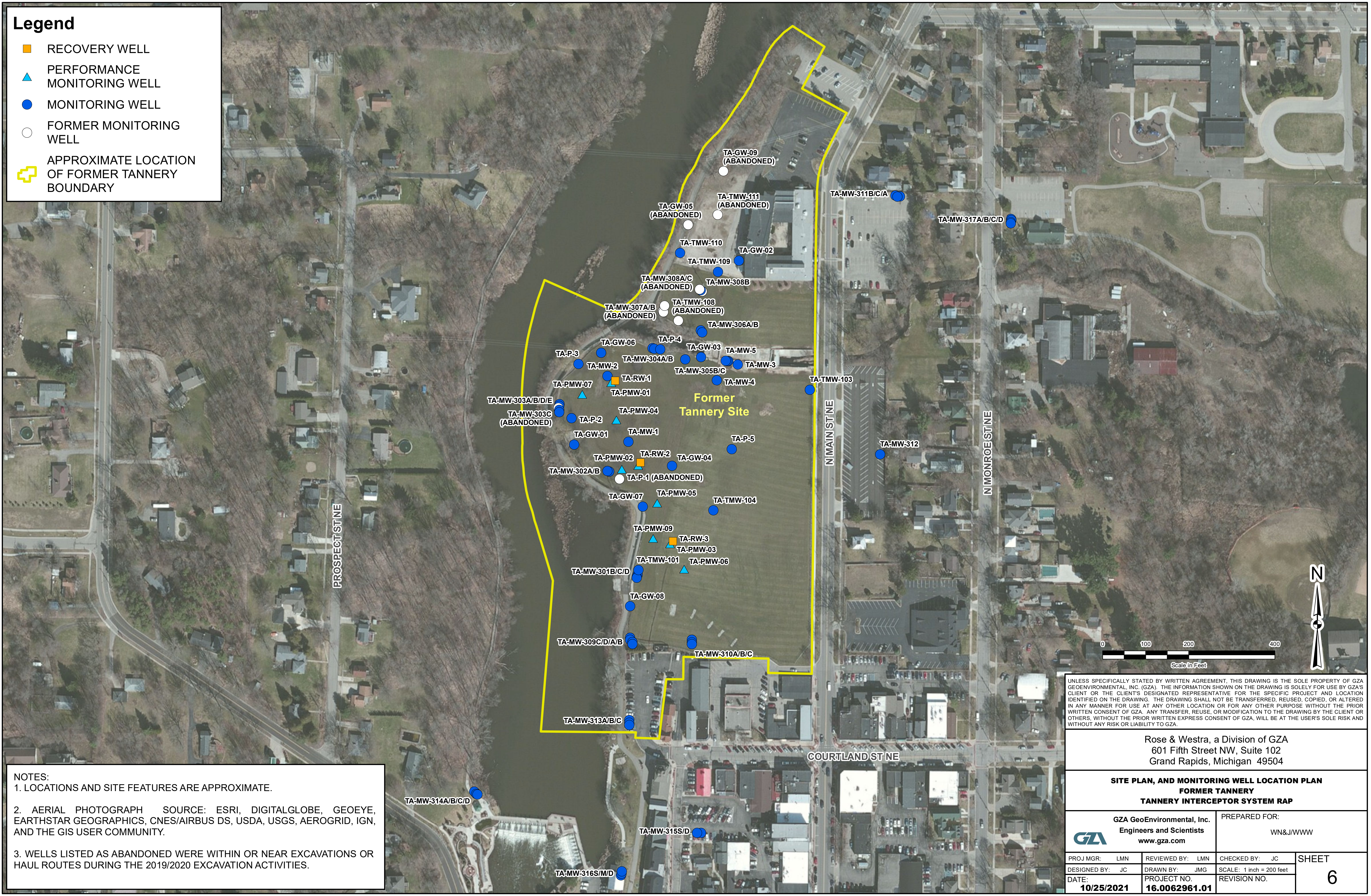
PROJ MGR: LMN	REVIEWED BY: MAW	CHECKED BY: GR	SHEET NO. 5
DESIGNED BY: JC	DRAWN BY: JC/RMG	SCALE: 1 in = 400 ft	
DATE: 10/25/2021	PROJECT NO:	REVISION NO:	



Legend

🟧	RECOVERY WELL
▲	PERFORMANCE MONITORING WELL
●	MONITORING WELL
○	FORMER MONITORING WELL
▭	APPROXIMATE LOCATION OF FORMER TANNERY BOUNDARY

NOTES:

1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. AERIAL PHOTOGRAPH SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

3. WELLS LISTED AS ABANDONED WERE WITHIN OR NEAR EXCAVATIONS OR HAUL ROUTES DURING THE 2019/2020 EXCAVATION ACTIVITIES.

Rose & Westra, a Division of GZA
601 Fifth Street NW, Suite 102
Grand Rapids, Michigan 49504

SITE PLAN, AND MONITORING WELL LOCATION PLAN
FORMER TANNERY
TANNERY INTERCEPTOR SYSTEM RAP

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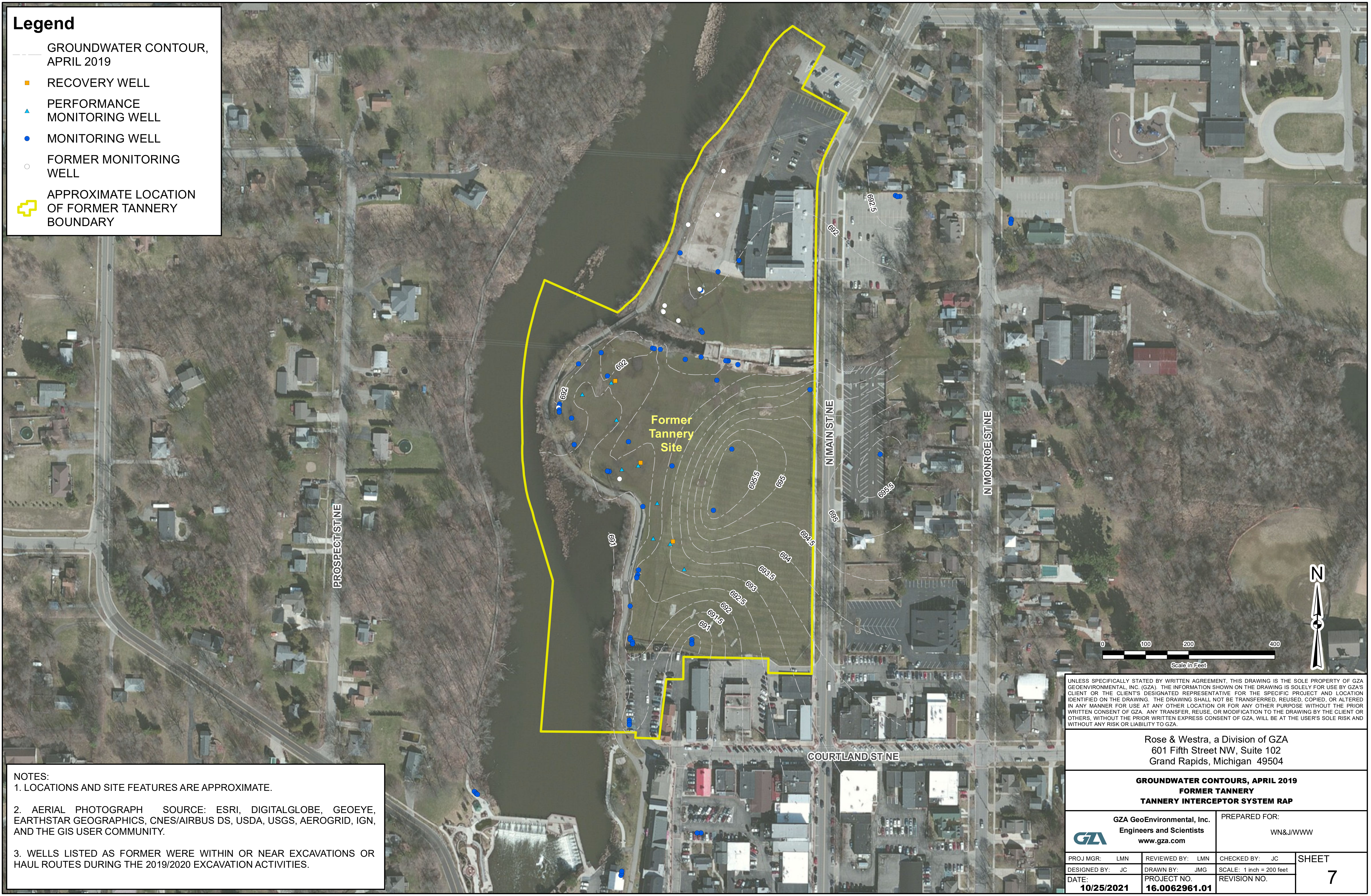
PREPARED FOR:
WN&J/WWW

PROJ MGR: LMN	REVIEWED BY: LMN	CHECKED BY: JC	SHEET
DESIGNED BY: JC	DRAWN BY: JMG	SCALE: 1 inch = 200 feet	6
DATE: **10/25/2021**	PROJECT NO. **16.0062961.01**	REVISION NO.	



NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. AERIAL PHOTOGRAPH SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

3. WELLS LISTED AS FORMER WERE WITHIN OR NEAR EXCAVATIONS OR HAUL ROUTES DURING THE 2019/2020 EXCAVATION ACTIVITIES.

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GROUNDWATER CONTOURS, APRIL 2019
FORMER TANNERY
TANNERY INTERCEPTOR SYSTEM RAP

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PROJ MGR: LMN	REVIEWED BY: LMN	CHECKED BY: JC	SHEET 7
DESIGNED BY: JC	DRAWN BY: JMG	SCALE: 1 inch = 200 feet	
DATE: **10/25/2021**	PROJECT NO. **16.0062961.01**	REVISION NO.	

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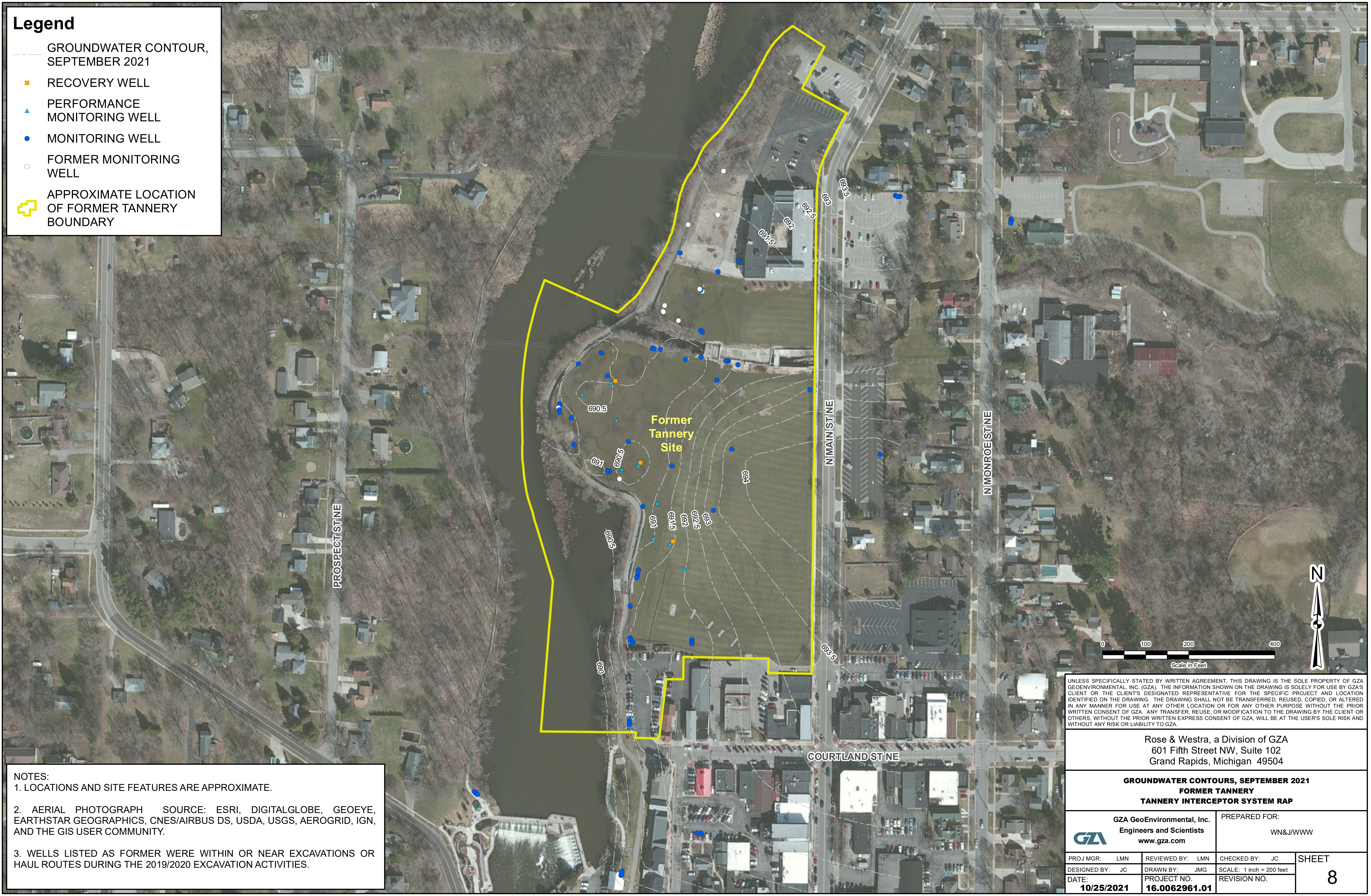

Legend

- — — GROUNDWATER CONTOUR, SEPTEMBER 2021
- ■ RECOVERY WELL
- ▲ PERFORMANCE MONITORING WELL
- ● MONITORING WELL
- ○ FORMER MONITORING WELL
- ▭ APPROXIMATE LOCATION OF FORMER TANNERY BOUNDARY

NOTES:
1. LOCATIONS AND SITE FEATURES ARE APPROXIMATE.

2. AERIAL PHOTOGRAPH SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY.

3. WELLS LISTED AS FORMER WERE WITHIN OR NEAR EXCAVATIONS OR HAUL ROUTES DURING THE 2019/2020 EXCAVATION ACTIVITIES.

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GROUNDWATER CONTOURS, SEPTEMBER 2021
FORMER TANNERY
TANNERY INTERCEPTOR SYSTEM RAP

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PROJ MGR: LMN	REVIEWED BY: LMN	CHECKED BY: JC	SHEET
DESIGNED BY: JC	DRAWN BY: JMG	SCALE: 1 inch = 200 feet	8
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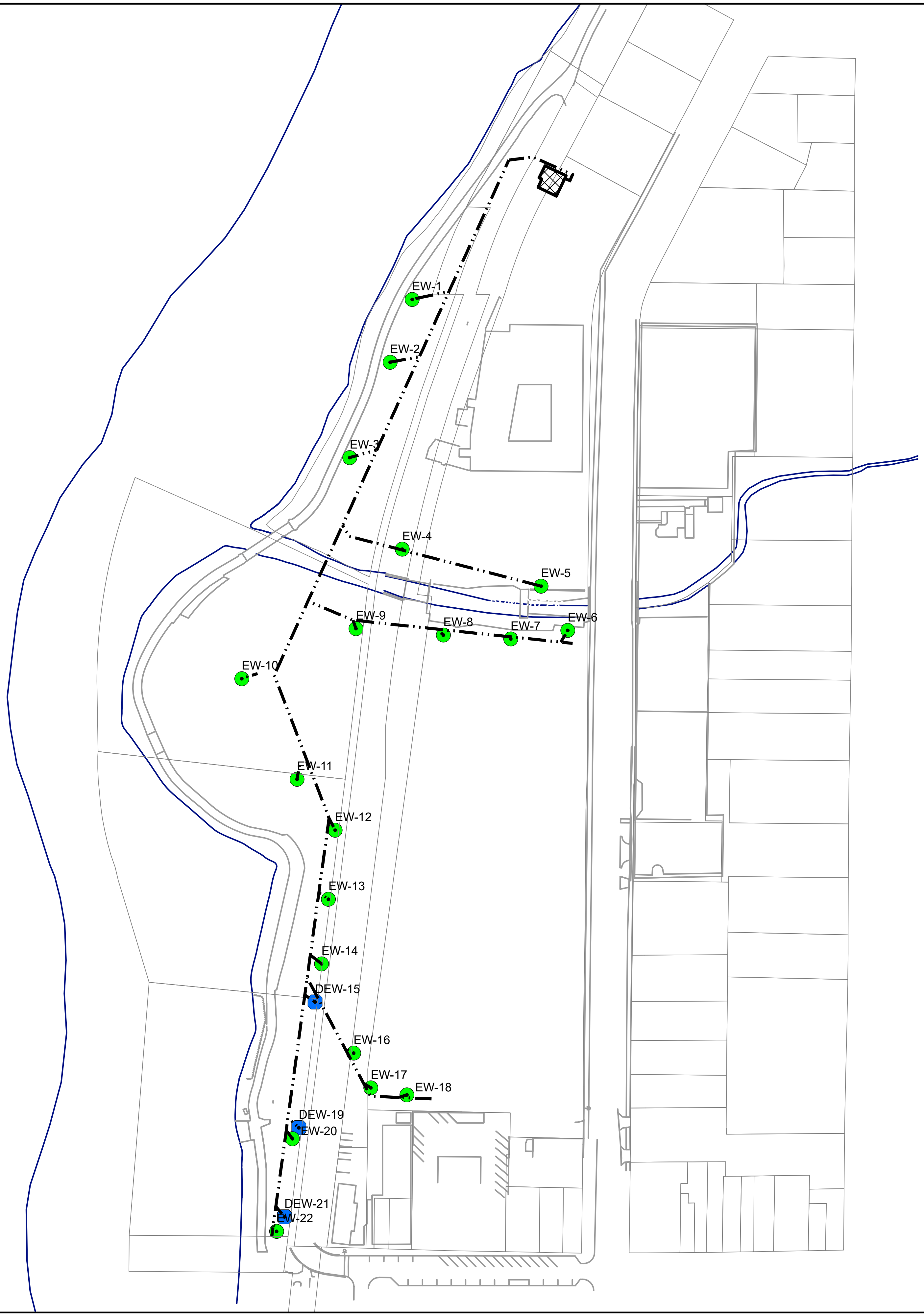

Legend

PROPOSED EXTRACTION WELL

🟦	Deep Extraction Well
🟩	Shallow Extraction Well
-·—·—·—	PROPOSED PIPING RUN
▨	PROPOSED TREATMENT BUILDING LOCATION

0 75 150 300

Scale in Feet

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PROPOSED EXTRACTION WELL LAYOUT, PIPING RUN AND TREATMENT BUILDING LOCATION

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WOLVERINE WORLD WIDE, INC.

PROJ MGR: LMN	REVIEWED BY: LMN	CHECKED BY: LJP	SHEET NO. 9
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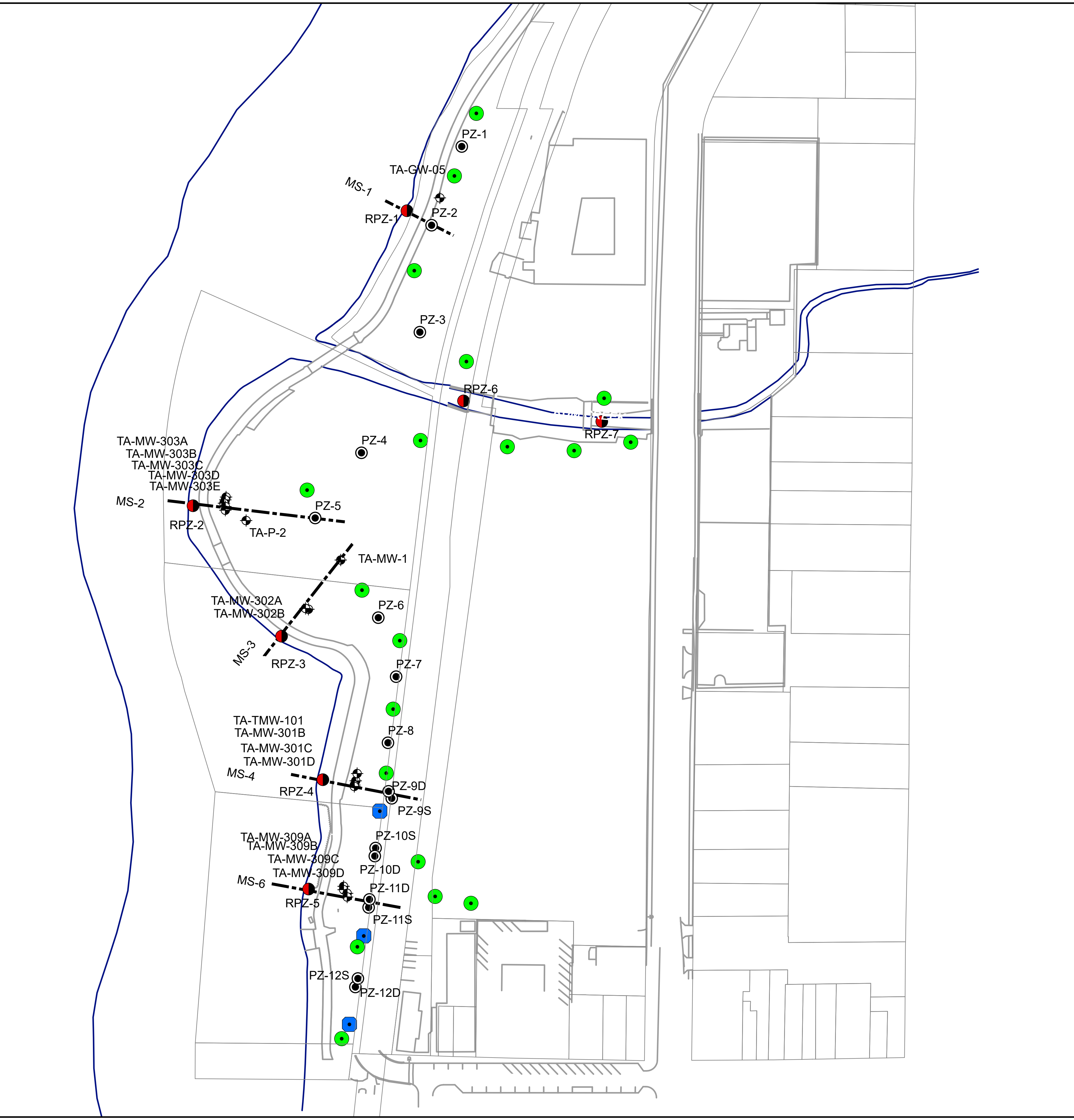

N

Legend

PROPOSED EXTRACTION WELL

🟦	Deep Extraction Well
●	Shallow Extraction Well

PIEZOMETER

◉	PIEZOMETER
◐	RIVER PIEZOMETER
-·-·-	MONITORING TRANSECT

Existing Monitoring Well

⌖	**Monitoring Well**
●	**Performance Monitoring Well**
●	**Recovery Well**

0 75 150 300

Scale in Feet

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Grand Rapids, Michigan 49504

PROPOSED PERFORMANCE MONITORING PIEZOMETERS AND TRANSECTS

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WOLVERINE WORLD WIDE, INC.

PROJ MGR: LMN	REVIEWED BY: LMN	CHECKED BY: LJP	SHEET NO. 10
DESIGNED BY: LMN	DRAWN BY: JMG	SCALE: 1 inch = 150 feet	
DATE: 10/15/2021	PROJECT NO. 16.0062355.05	REVISION NO.	

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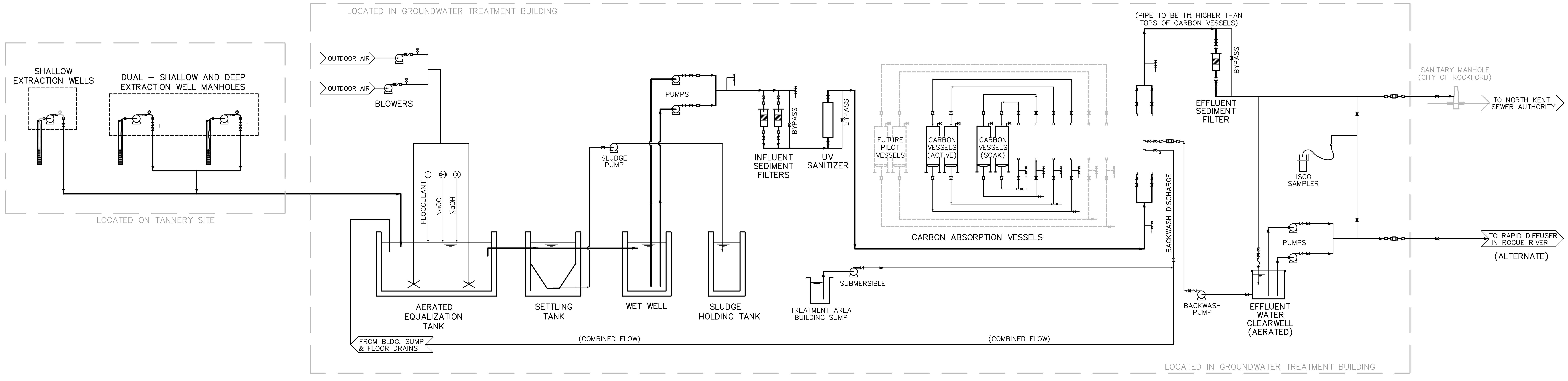

GROUNDWATER INTERIM REMEDY – CONCEPTUAL PROCESS FLOW DIAGRAM

DRAFT COPY

DRAWN BY	DESIGN BY	DATE
KJB	BLR	10/26/21

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NO.	R E V I S I O N S	BY	DATE

REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS

WOLVERINE WORLD WIDE/WNJ
FORMER TANNERY SITE, 123 MAIN ST. ROCKFORD, MI.
GROUNDWATER INTERIM REMEDY

ROSE & WESTRA
A DIVISION OF GZA
Grand Rapids, Michigan
GEOTECHNICAL–ENVIRONMENTAL–ECOLOGICAL–WATER–CONSTRUCTION MANAGEMENT

PROJECT NO.
16.0062335.05

SHEET NO.
11

Appendix A – Response Letter to EGLE’s August 2021 Comments

R&W/GZA RESPONSE TO EGLE AUGUST 17, 2021 COMMENTS
General Comments on the Groundwater Modeling:

1.0 Water Budget:

A water budget was not provided as part of this submission. A water budget should be included within this document as it helps clarify the site conceptual model and important features the numerical model must reproduce (see https://www.michigan.gov/documents/deq/wrd-water-budget_565040_7.pdf). The lack of a water budget for the site, combined with recharge rates and permeabilities that appear to be unconstrained by the calibration data, results in high uncertainty regarding how much flow beneath the site must be intercepted by the extraction system, and, therefore, low confidence that the project objective of hydraulic capture of per- and poly-fluoroalkyl substances (PFAS) compounds is likely to be successful.

Response: Much of the referenced guidance document is related to how to estimate surface run-off, evapotranspiration, and groundwater recharge using the soil water balance method. A water budget for a groundwater model, or mass balance, is used to itemize the various components of groundwater flowing in and out of the model domain. As clarified during our technical meetings with the EGLE team, the water budget question pertained to the mass balance of the groundwater model, not the soil water balance method for groundwater recharge estimate described in the EGLE-Water Resource Division document. R&W/GZA has included the water budget (mass balance) in Section 7.0 of the revised report. Regarding the comment "..unconstrained by the calibration data…", we understood and stated in our draft report the mismatch between field observed data at some observations and model computed data existed and attributed this to the simplified homogeneous model vs. the non-homogeneity of the field conditions. The simplified homogeneous model assumes the hydraulic conductivity of the aquifer and groundwater recharge are constant throughout the model domain while the actual properties are spatially varied in the field and the aquifer hydraulic conductivity and groundwater recharge are non-homogeneous. The inverse parameterization model runs in the draft report were restrained by appropriate ranges of hydraulic conductivity, groundwater recharge, and hydraulic heads, which were not the cause for the mismatch.

2.0 Aquifer Interaction with Rum Creek:

Contours from measured and simulated Layer 1 water levels should be presented for the calibration data set so that the impact of Rum Creek on water levels can be compared. A fair comparison can generally be made if measured and simulated water levels are contoured using the same process, e.g., machine contouring of corresponding measured and simulated water levels using only data from well locations, and not from the rest of the model grid.

A comparison of Figure 2-2 with Figure 8-1a suggests that the interaction between Rum Creek and the groundwater system is underestimated in the simulation. Note that the minor contour deflection due to Rum Creek in the simulation does not resemble the complete control Rum Creek appears to have over nearby groundwater flow directions in the contours of field data.

Response: The local model has been revised and recalibrated using PEST pilot points to represent the non-homogeneity. As discussed in Section 7.0 of the revised report, the modeled groundwater flow pattern near the Rum Creek matches well with the groundwater contours and flow direction interpreted from the field measured groundwater elevations.

3.0 Aquifer Test Data Processing

The text in Section 3 and Appendix A does not discuss whether any data-cleaning was performed on the aquifer test data, and the appearance of the hydrographs in figures suggests the data have not been cleaned to remove barometric and background effects. For example, the TA-RW-1 combined plot (Appendix A) shows 0.4 foot of steady decline over 6 days at RW-3, or 0.13 foot during the 2-day pumping duration. The background trend of declining water levels contributes a significant fraction of the drawdown that is being analyzed at some observation wells. A data-cleaning tool such as the US Geological Survey's Series SEE (https://water.usgs.gov/software/SeriesSEE/) should be used to remove unwanted influences from the data set, such as background water-level trends and the impact of stage changes in the Rogue River. This data processing should be done before using the data for aquifer test analysis and groundwater model calibration.

A possible result of this data-cleaning is that clear drawdown responses will be identifiable in more observation wells, resulting in better geographic coverage in the calibration data set. The 0.3-foot drawdown threshold for inclusion should be reconsidered after data-cleaning – small responses to pumping are also meaningful in aquifer test interpretation, especially when aquifer testing is simulated in a groundwater model. In effect, deviations from ideal drawdown curves (such as a diminished response to pumping) can reveal subsurface heterogeneity or aquifer boundary conditions (such as the presence of a nearby river). Excluding small deviations from analysis and calibration eliminates the opportunity to reveal that detail.

Response: Our data was adjusted for barometric pressure. As discussed with EGLE and their consultant during our technical calls, the ambient change (RW-03) of 0.13 foot over 2 days is not significant compared to the wells used for pump test analysis (mostly having drawdown >1 foot). Generally, low response wells with low drawdown values are susceptible to measurement errors. For example, a field measurement error of 0.1 foot for an observation well with 0.3-foot drawdown would create significant error in interpreted aquifer properties. As such, low response wells are typically not reliable, especially, in a non-homogeneous aquifer. For the low response wells, if we deduct the assumed ambient fluctuation of 0.13 foot observed at RW-03 from the drawdown values, the residual drawdown values become small and the observation wells unreliable for data interpretation. That is why we selected a 0.3-foot drawdown as a threshold to exclude low response wells.

USGS SeriesSEE simulates environmental fluctuations as synthetic water level components. It uses moving average of barometric and background water level components, computed earth tide due to lunar and solar cycles, Theis transformation for pumping effect, gamma transformation for precipitation, etc. to calibrate against the measure water levels. The software inversely computes the parameters for the different synthetic water level components. After calibration, then the drawdown would be the measured drawdown minus the synthetic background water level components (barometric, background, precipitation, earth tides, etc.) It typically requires data before the pumping test in a period three times greater than the period affected by pumping to fit the synthetic water level components. Each of the three pumping tests lasted approximately two days, and the data were recorded for approximately two days before the pumping test. As such, the software is not considered to be an appropriate tool for the available data.

The discussion in Section 3 of aquifer test results does not suggest that the Rogue River could have influenced the results as a recharge boundary (see http://www.aqtesolv.com/pumping-tests/pumping-tests-in-bounded-aquifers.htm). Negative slopes on drawdown derivatives are entirely attributed to "non- instantaneous drainage at the water table", but negative slopes on drawdown derivatives can also indicate the presence of a nearby recharge boundary (or both conditions can be present). The aquifer tests were all conducted about 100 feet from the Rogue River, which is unambiguously a recharge boundary for the purpose of aquifer test analysis at the site. The analysis should acknowledge and address the expected impact of a nearby recharge boundary on measured drawdown and whether that impact was observed (and if not, discuss what about the site conceptual model has changed). The curve-matching aquifer test analyses do not mention the use of image well theory. Image well theory, or some other method of addressing the nearby Rogue River as a recharge boundary should have been used in every analysis.

A contour plot for each aquifer test of the maximum drawdown (after data cleaning) should be presented and discussed. The influence of the Rogue River is likely to show in contours of maximum drawdown, and other deviations from an ideal (circular) cone of depression may assist with site understanding.

Response: The negative slopes in the early part of the test are classic "non-instantaneous drainage at the water table". See typical derivative curve indicating non-instantaneous drainage at water table in Figure No. 1

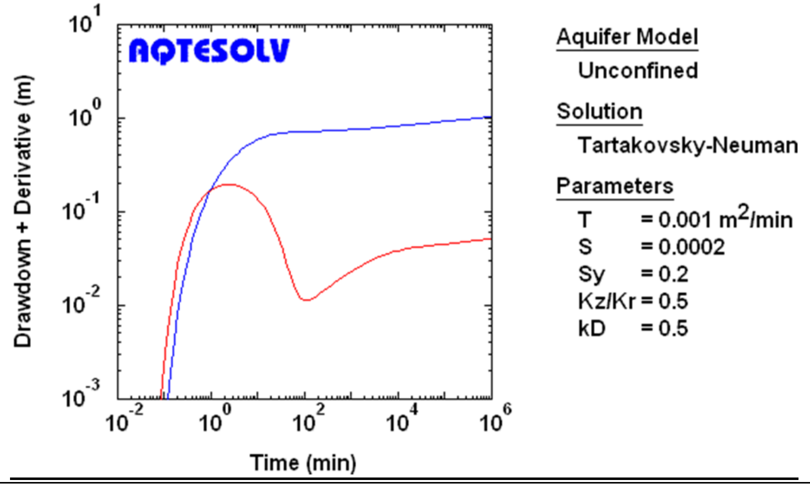


Figure No. 1:

Typical Derivative Plot Indicating Non-Instantaneous Drainage at Water Table

From: http://www.aqtesolv.com/pumping-tests/derivative-analysis.htm

Negative slope (negative 1) at the end of the test usually means constant head boundary, which was not observed. See typical derivative curve in Figure No. 2.

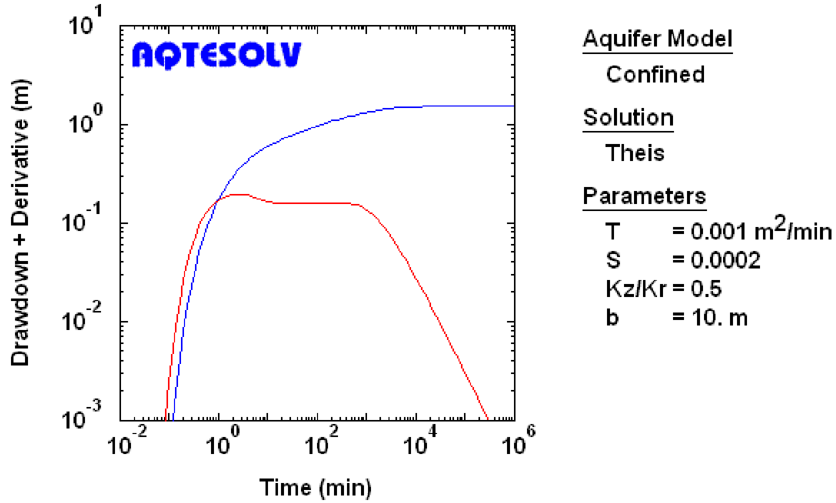


Figure No. 2:

Typical Derivative Plot Indicating Recharge Boundary (Constant Head)

From: http://www.aqtesolv.com/pumping-tests/derivative-analysis.htm

In addition, radius of investigation calculations indicate that two days of pumping barely reaches about 80 feet from RW-1. The Rogue River is about 145 feet away from RW-1 (See Table Below). With the derivative plot and the radius of investigation estimation, we are confident the pumping influence had not reached the river. As such, it was not useful to use image wells for the pumping test analysis.

Parameter	Unit	TA-RW-01 Test	TA-RW-02 Test	TA-RW-03 Test
Calculated Radius of Investigation	Ft	76	36	67
Measured Distance to Rogue River	Ft	145	100	115

In Section 7 (page 23, second paragraph), the authors attribute a mismatch between heads observed in pumping wells during aquifer testing and the model results for the same locations to well inefficiencies. The apparent efficiency seems low for an extraction well, possibly less than 20 percent. Additional development of groundwater extraction wells may improve extraction well efficiency, allowing each well to capture more groundwater contaminated with PFAS compounds.

Response: Upon completion of the new extraction well installation, the new and existing wells will be developed to improve well efficiency.

4.0 Calibration Quality: Static Water Levels (Homogeneous and Stochastic Models)

The aquifer properties and water budget at the site are poorly constrained by the calibration data set and calibration quality. The introduction of stochastic techniques is a reasonable approach to handle the uncertainty, but the number of realizations is too small (eight) and the calibrations are too flawed to provide confidence that the proposed extraction system design is likely to be successful. In addition, it seems likely that stochastic realizations were introduced too early in the model development process: the homogeneous model appears to suffer from significant conceptual weaknesses that stochastic approaches cannot resolve.

Response: As documented in the draft report, the modeling objective was to design an extraction well system to intercept the incoming groundwater flux and prevent groundwater from discharging to the Rogue River as well as provide information for the detailed system design phase; therefore, the modeling approach was to focus on the Site scale without detailing the spatial variability of hydraulic conductivity, recharge, etc. The calibration against three pumping tests did not match well with the observed data because of the non-homogeneity. But the model represents an average condition over the Site scale. The stochastic modeling was to evaluate the uncertainties related to the simplified homogeneous model and potential effect of geological variability on the pumping well design, not for model calibration.

Calibration quality for static conditions does not appear to have been evaluated during this effort, or was not reported on. Section 6.0 refers to a set of 64 measured water levels as calibration targets, but there is no discussion or presentation of calibration results, quality, or insights developed during the regional or local model calibration. Basic information is absent, such as the quality of the match to static conditions, whether major features identifiable in field interpretations are adequately simulated by the model, and whether the calibration has a bias that could impact forecasts. For example, it seems likely that north-northeastern flow into Rum Creek from the aquifer immediately south of Rum Creek is underestimated and potentially not represented in the model at all, but the presentation of the regional and local calibrations do not allow this to be evaluated directly. Indirect evidence can be found in the number of calibration hydrographs in Appendix C that underestimate water levels. Flow to Rum Creek and the Rogue River are controlled by elevation-based features (river stage, drain bottom), and the proximity to and ubiquity of elevation-based boundary conditions at and near the site suggests that a fairly tight calibration should be possible, even with a relatively simple model construction. The use of MODFLOW's evapotranspiration boundary condition is likely to greatly improve the calibration to static water levels, because the depth to water at the site is so shallow that it is directly influenced by the consumption of groundwater by vegetation.

Response: GZA revised the steady state local model, incorporating PEST pilot points for hydraulic conductivity and groundwater recharge to model the non-homogeneity. In the revised RAP, calibration results, such as the observed hydraulic head vs. the computed hydraulic head plot, observed groundwater contours vs. computed groundwater contours, root mean squared errors, etc. are provided. The groundwater flow to Rum Creek is modeled to better represent the field observed conditions in the revised RAP. While MODFLOW's evapotranspiration package may provide an alternative to model the variable groundwater recharge, we modeled the net groundwater recharge directly. Evapotranspiration directly from groundwater table stops at the plant extinction depth. The majority of the Site is covered by grass, with a small portion being asphalt and the Footwear Depot building. Depth to water at the Site ranges from 2 to 9 feet bgs with an average of approximately 5 feet. As such we don't expect the variability of evapotranspiration from groundwater table extinction depth would have a significant effect on the model calibration.

As an example of a serious calibration mismatch that likely has a critical impact on model forecasts, the simulated and observed hydrographs for well TA-TMW- 101 are presented in Appendix C. Well TA-TMW-101 is located adjacent to the Rogue River, and, therefore, has a direct impact on the gradient that controls the quantity of flow from the aquifer into the river. Note that the measured water levels vary over approximately 0.25 foot (and that range appears attributable to aquifer testing), but the starting water levels that (presumably) reflect static conditions vary by approximately 2.3 feet, depending on the realization. This degree of mismatch is extreme – according to Figure 2-2, there are only four feet of head relief across the entire site. The mismatch is also heavily biased – seven realizations underestimate head at well TA-TMW-101, implying that flow to the Rogue River is generally underestimated (insufficient driving force compared to field observations). This underestimation of flow to the Rogue River implies that the designed extraction system will be inadequate to completely capture groundwater flowing under the site.

Response: The cited example was from one of the stochastic runs that had the worst match against the observed data. The stochastic modeling was performed to evaluate the potential effect of geological variability on the extraction well design and installation, not for model calibration. We believe the statement that underestimated heads/gradients will underestimate groundwater flux to the Rogue River is misguided. The reason the computed heads at TA-TMW-101 in these stochastic modeling runs were lower than the observed values was that the stochastic modeling assigns greater extent and thickness of coarse-grained material than what was observed in the field in that area. While the model calculated gradients from TA-MW-101 to the Rogue River were lower, the hydraulic conductivity values were higher. The groundwater flux is equal to hydraulic gradient multiplied by hydraulic conductivity, as indicated by Darcy's Law. Therefore, as discussed with EGLE, we believe the variations do not underestimate groundwater flux in that area.

The homogeneous-model calibration to static conditions should be presented using maps, a scattergram, and statistics. If the static calibration does not adequately represent major features of the site such as substantial flow to Rum Creek, the general pattern of radial flow south of Rum Creek, gradient changes across the site, and head differences between the aquifer and discharge locations (Rogue River and Rum Creek), the introduction of transient aquifer testing as a calibration target is likely premature.

Response: As stated above, the local steady state model was revised and the requested information is included in Section 7.0 of the revised RAP.

5.0 Calibration Quality: Aquifer Tests

The calibration match to aquifer test responses is generally weak. Curve shapes generally have obvious mismatches. For example, on Figure 7-1, the mismatch between measured and simulated drawdown in well TA-PMW-01 is a factor of two, with a trend of increasing mismatch if the test had gone longer. The field- measured water levels become relatively stable after a matter of hours, but the simulated water levels continue to decline after a day of pumping. The measured drawdown has the appearance of encountering a recharge boundary condition, but the simulated drawdown does not. On Figure 7-2, simulated response at TA-PMW-02 appears to be approximately one-third of the field response, and does not show the leveling-off of drawdown that is obvious in the measured data.

On Figure 7-4, two wells show no apparent simulated response where the field measurements seem to indicate approximately 0.8 foot of drawdown.

Field-measured drawdown responses to aquifer testing show a strong recharge boundary effect in response to the adjacent Rogue River. The simulated calibration hydrographs do not; drawdown continues to increase at a high rate throughout the pumping phase. While heterogeneity and grid spacing can explain away some degree of calibration misfit, the calibrated model must reproduce interactions between the aquifer and surface water system, because the goal of the extraction system is to interrupt that interaction by intercepting the water from the aquifer.

In cases where simulated drawdown in an observation well does not match field observations because of a model grid too coarse to resolve it, local grid refinement should be considered, or another solution provided.

Response. As stated in our draft report and discussed during our technical meetings with EGLE, we understood and acknowledged this mismatch, but believe it was because of the non-homogeneity in the field vs. the homogeneous model. The mismatch existed at individual locations, but at the larger Site scale, the homogenous model was appropriate for its purpose. To address some of the comments, the local steady state model was revised to incorporate non-homogeneous variability. As documented in the RAP, we will ultimately use performance data from the full-scale system to determine if additional extraction wells or other adjustments are necessary to optimize groundwater capture.

6.0 Vertical Grid Discretization

In Section 9.1 (page 31), shortcomings of grid resolution are discussed, particularly the 20-foot-thick model cells. Most of the contamination to be contained occurs in shallow groundwater, and heterogeneity is described as occurring at vertical scales much less than 20 feet. The boring logs presented in Appendix A show interbedded sands and silts in the pumped interval.

The cross-sections raise questions in terms of both litho-stratigraphic correlation and classic depositional interpretations. Cross-Section I-I' does not depict contacts, correlative information, presence of water-bearing units, vertical gradients, and other inputs you would expect to be quantified for a capture model.

In the T-PROGS implementation described in Section 9, each model cell is assigned a single lithology. The clay and silt (CLSM) is about 40 percent of the aquifer volume. What should be expected from this is that groups of model cells ("lenses") will be assigned a (low) clay-silt permeability for the entire 20-foot thickness, and if an extraction well is located in the clay-silt, it is simulated as if it has been screened in clay and silt. In other words, it is simulated as if it is a poor location to place an extraction well. The groundwater model grid appears to be too coarse to forecast the impact of pumping where T-PROGS assigns the clay- silt lithology, because it does not adequately capture the expected aquifer heterogeneity. Boring logs at the site (Appendix A) do not indicate the presence of laterally-continuous 20-foot thicknesses of clay-silt just below land surface, but the T-PROGS simulations assume that such features are 40 percent of the aquifer system, because the vertical grid cannot result in the vertical lithologic variability observed in boring logs.

The vertical grid spacing and T-PROGS implementation should be re-evaluated in the context of whether a 20-foot thickness of clay-silt is an adequate representation of a 20-foot sequence of sand and gravel adjacent to clay. Boring logs in Appendix A suggest that sand and gravel are present in the top 20 feet of almost all boring logs. Using T-PROGS on a finer grid than the flow model to compute effective permeability (horizontal and vertical) for each model cell is one possible method to incorporate heterogeneity without having a very fine flow model grid.

Response: As stated in the draft report, some variability of hydrostratigraphic unit is present at a smaller scale than the model grid size of 10 feet wide, 10 feet long, approximately 20 feet thick. The model was incapable of representing the heterogeneity at a finer scale than its grid size. As discussed and agreed during technical calls with EGLE, the revised local steady state model reflecting groundwater discharge to Rum Creek and incorporating non-homogeneity should suffice for the detailed system design phase. Additional modeling at a finer scale is unnecessary to achieve the goal of the modeling.

7.0 Vertical Delineation of Aquifer Properties

In Section 8.1 (page 26), the proposed extraction well system is described with 6 shallow extraction wells (screened 685 to 690 feet) north of Rum Creek combined with 10 shallow extraction wells (screened 670-690 feet) and 3 deep extraction wells (screened 650 to 670 feet) south of Rum Creek. Per the site map (Figure 3-1), all three wells used for aquifer testing are located south of Rum Creek. TA-RW-1 is screened from 5.1-24 ft bgs (approximately 669.6 to 688.5 ft msl); TA-RW-2 is screened from 4-19 ft bgs (approximately 674.5 to 689.5 ft msl); TA-RW-3 is screened from 10.5-18 ft bgs (approximately 678.6 to 686.1 ft msl). It appears there is no aquifer test data available for the deeper zone. The report should discuss how well the aquifer test results represent the deeper aquifer materials and the impact on uncertainty regarding hydraulic capture.

Response. Section 12.0 of the revised RAP includes a summary of additional data to be collected during the final design of the system.

8.0 Use of PEST

Autocalibration tools like PEST (a parameter estimation tool software) are very useful for both model calibration and site understanding. PEST does not communicate clearly about site understanding, but when PEST is unable to calibrate a model well, it generally indicates that the model design is unable to produce a calibrated model, not that PEST was unable to find a solution.

According to the Response Activity Plan, PEST repeatedly gave signals that the model construction was inadequate in one or more ways, but instead of adjusting the model design in response, it seems that the signals from PEST were documented but not addressed.

Based on the number of parameters in the homogeneous and stochastic versions of the model that PEST adjusted to an upper or lower bound, all models presented are likely experiencing parameter compensation. Parameter compensation is when PEST adjusts a parameter to an extreme value to compensate for parameters missing from the model. As an example, if there is a low-permeability riverbed at the surface water-groundwater interface in the Rogue River, but the model represents it as a specified head, the only control PEST currently has to limit the interaction is to reduce the permeability of the entire aquifer. Even when parameter limits represent reasonable maximum and minimum values, the likelihood that any actual physical system can be well- represented by a series of minimum and maximum values seems low (e.g., Stochastic Realization 2 has six of nine calibration parameters at upper and lower bounds). A single parameter at a bound is unlikely to be problematic, but a model with most of its parameters at a maximum or minimum is a signal that parameter values are not the limiting factor on achieving a good calibration; some other factor is responsible.

If the calibration data set does not adequately constrain the aquifer properties or site water budget, the proposed hydraulic capture system should be designed to be successful despite the uncertainty. The particle-tracking figures in Appendix D suggest that the design is not robust and is likely to fail in part if site conditions resemble certain stochastic realizations. Unfortunately, the minimum-maximum parameter combinations make it questionable whether any stochastic realizations resemble site conditions by the end of the calibration process.

An approach that might be able to account for uncertainty at the site without the computational overhead of stochastic calibrations would be to calibrate the homogeneous model to high/medium/low recharge scenarios. A wellfield design would be considered robust if it is forecasted to capture the PFAS-contaminated groundwater in all three recharge scenarios.

Response: As documented in the draft report, the mismatch between the observed pumping test water elevations and the computed elevations was primarily due to using the homogeneous model for a non-homogeneous aquifer. The stochastic modeling runs were performed to evaluate the effect of the heterogeneity.

In the revised RAP, GZA calibrated the steady state model to the April 2019 groundwater elevation data. The extraction well design was evaluated with both relatively high and low groundwater recharge rates. April 2019 is one of the highest groundwater recharge months. Under high recharge rates, greater groundwater pumping rates are needed to intercept groundwater flux and prevent groundwater from venting to the Rogue River. The use of April 2019 groundwater recharge is conservative (i.e., results in higher groundwater extractions rates) relative to other recharge conditions. A low recharge scenario was modeled by using the same hydraulic conductivity array but a lower groundwater recharge to evaluate its potential effect on the design of extraction wells. Under low recharge conditions, extraction wells located in areas of relatively low hydraulic conductivity may be pumped dry. If this happens, additional extraction wells with relatively low pumping rates will be required to provide hydraulic capture.

9.0 Recharge + Evapotranspiration versus Net Recharge

Because the water table is shallow and encountered at between 3 and 8 feet below ground surface (from the *Final Implementation of 2018 Work Plan Summary Report),* groundwater (or precipitation that would otherwise become groundwater) is likely to be consumed by vegetation, and also to evaporate directly to the atmosphere. While the simulated groundwater recharge rate range of 9 to 12 inches per year is appropriate (although a symmetrical range around the average of 11 inches per year may be more appropriate to explore uncertainty), the ability of the model to reproduce static water levels may be improved by adding this elevation-based boundary condition. Note that the applied recharge rate in the model should be increased so that recharge minus actual evapotranspiration (not the assigned rate) matches the estimated groundwater recharge rate range.

Response: See Response to Comment 4 regarding the use of evapotranspiration package. GZA used the net recharge module for groundwater recharge. Groundwater recharge estimates were *based on baseflow estimates from streamflow records in USGS Gauging Station No. 04118500 in the Rogue River downstream of the Site as well as published baseflow estimates and baseflow yields for the segments of the Rogue River and Rum Creek near the Site.*

10.0 Use of Forward-Tracked Particles to Measure Simulated Capture

The achievement of hydraulic capture should be measured with forward-tracked particles started from throughout the target capture volume (laterally and vertically). Reverse-tracked particles can give a false impression of capture if they pass beneath the source area at a different elevation than the target capture volume. In addition, reverse-tracked particles generally cannot answer the question "Is the entire thickness of the target capture volume captured?"
Forward-tracked particles directly indicate whether the model forecasts capture, as well as the forecast destination for any uncaptured particles.

Response: The model and RAP have been updated to include forward-tracked particles.

Specific Comments by Report Section:

11.0 Section 2.1

The last paragraph of this section references that 14,576 cubic yards of soil and sediment were removed from nine excavation areas at the Tannery property in late 2019 and 2020. The cross-sections associated with this report should be updated to depict these removal activities and what material(s) were used as backfill, as they will have different porosity and hydraulic conductivity values than the material removed. These removal activities should also be incorporated into the modeling for the site to verify the excavation backfill materials would not have an effect on the performance of the system.

Response: Section 2.1 has been expanded to include additional information about the 2019 and 2020 excavations. The majority of the excavations east of the White Pine Trail were above the groundwater and will not influence groundwater flow to the extraction system. Deeper excavations were in small, targeted, areas which should not materially affect the overall groundwater flow at the site.

12.0 Section 2.4:

As shown on Cross Section I-I', no soil borings deeper than approximately 673 feet above mean sea level (AMSL) were advanced between Rum Creek and boring TA-MW-303E. No documentation or supporting information for how it is known that deeper groundwater contamination does not exist in that area of the site is provided. If no documentation can be provided, additional investigation activities should be completed and incorporated into the design of the interceptor system to ensure the system is able to meet the Consent Decree performance objectives.

Response: Section 12.0 of the revised RAP includes additional data to be obtained during the final design phase. The additional data will address this comment.

13.0 Section 2.6:

Discussion of the hydrogeology within the deeper portion of the saturated zone should be included in this section, as well as discussion of any upward vertical gradients. Information regarding vertical gradients should also be depicted on cross-sections.

Response: Section 2.6 has been updated to include further information about the deeper portion of the aquifer.

14.0 Section 3:

Please include *Figure 3-1: Well Location Plan* as a larger figure in the attached figures as the current figure embedded in the text of the report is difficult to read.

Response: Figure 3-1 has been included as Sheet No. 6, attached to the RAP.

15.0 Section 8.1

As shown on Sheet No. 6, the proposed interceptor system does not extend as far south as it was previously designed to do in Appendix F, Figure 3. There was no explanation provided for this change and based on historic monitoring well sampling, groundwater exceeding the PFAS water quality standards is present in the monitoring wells located on the southern property boundary. Based on the groundwater model, it did not appear that the PFAS contaminated groundwater found at the MW-313 nested well set would be influenced by the three deeper proposed extraction wells south of Rum Creek. The interceptor system needs to be updated to include coverage for this area based on the known PFAS concentrations.

Response: The revised RAP shows the system extended further south to help assure that the groundwater in the area of TA-MW-313 would be captured by the extraction wells.

16.0 Section 11

The proposed monitoring plan does not provide sufficient data to demonstrate that the interceptor system is effective at addressing PFAS Compounds contamination and preventing PFAS Compounds from entering the surface water above water quality standards. As currently designed and based on the information provided in this Response Activity Plan, EGLE has concerns that the proposed interceptor system will not be able to achieve the Consent Decree performance objectives; especially with the potential on/off cycling of the system. The performance monitoring plan needs to be robust enough to verify and defend the system design and be able to demonstrate that no PFAS Compounds are leaving the site and entering the Rogue River at concentrations that exceed water quality standards. The performance monitoring plan would also need to verify that PFAS groundwater contamination is not entering Rum Creek at concentrations exceeding water quality standards since Rum Creek discharges directly into the Rogue River.

Response: Please refer to the revised Performance Monitoring Plan in Section 13 of the revised RAP, which provides additional detail on how the plan will monitor the effectiveness of the extraction/capture system . The Performance Monitoring Plan was discussed with EGLE at length during the revision process and the revised document reflects these discussions and agreed approach

17.0 Appendix F

17.1 The body of the Response Activity Plan refers to Appendix F for details on the groundwater treatment portion of the system. However, the system configuration, design, total estimated extraction volumes, and treatment system building location have all changed since generation of that March 2020 document. Either an updated Appendix F needs to be provided, or a section added to the Response Activity Plan Report that depicts and outlines this information based on the currently proposed system.

Response: Appendix F was a preliminary design/layout of the capture system which was modified based on the more detailed monitoring conducted after March 2020. Appendix F has been removed. The revised RAP includes updated figures showing the updated site plan and extraction system configuration.

17.2 Verify that the final construction product (e.g., what is seen at the surface) will be coordinated with the City of Rockford Planning Commission so the visual aesthetics and exterior appearance/architecture of the remediation system building and associated system components will be acceptable to the city.

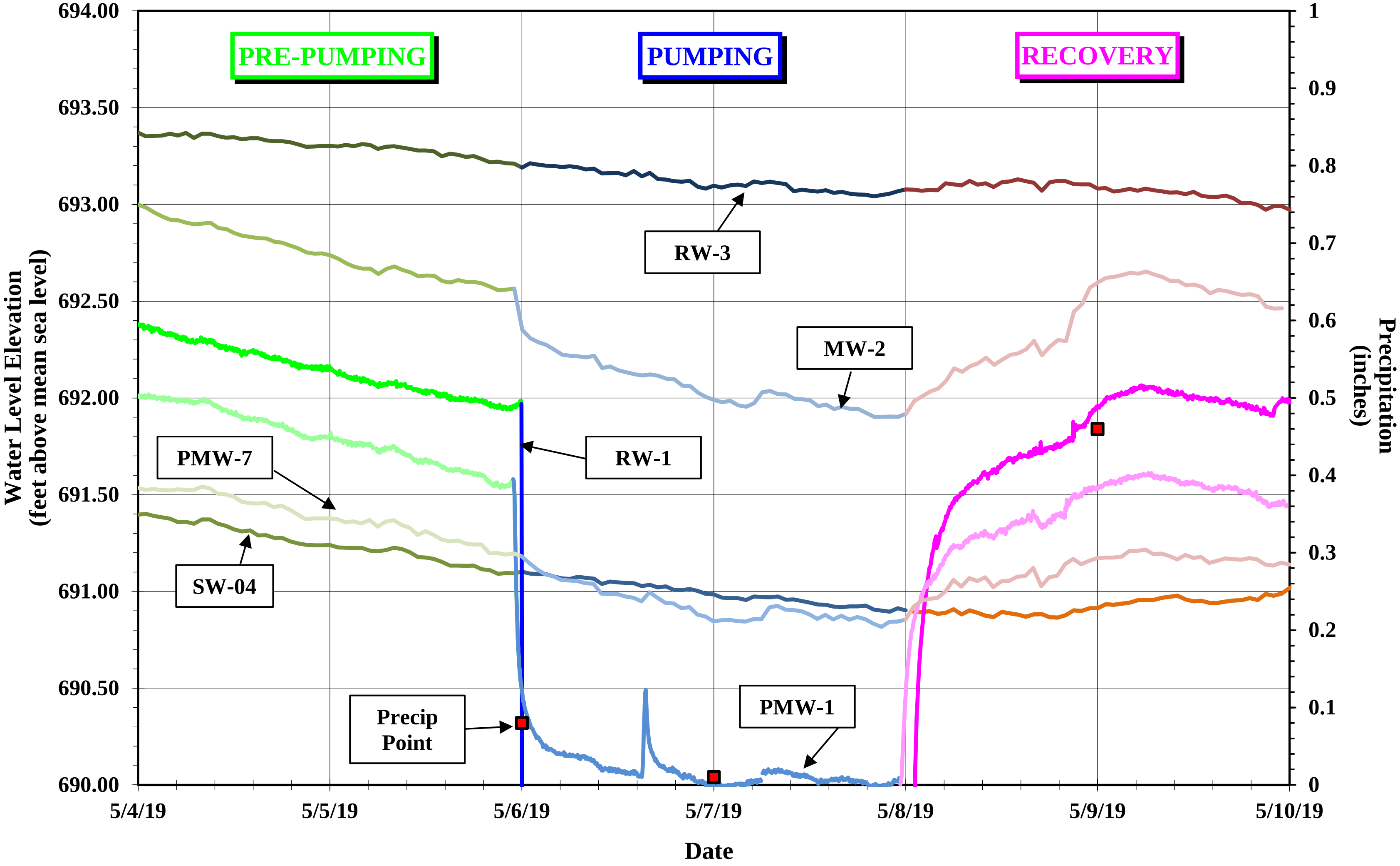
Response: WWW has a long and positive relationship with the City of Rockford and has always coordinated work at the Tannery property with the City and will comply with applicable ordinances.

17.3 In this document it was noted that GZA/Wolverine had some difficulty in finding pumps meeting the design specifications and variable frequency drives. Because of that, GZA is planning to use pressure transducers in the well and the equalization tank as the "on/off" for the pumps in the extraction wells. One main concern EGLE has with this approach is that it is not clear what that cycling will look like (e.g., how long they will be off) and how that will affect capture. An alternate approach would be the use of more robust sampling pumps and controls designed for continuous sampling, such as the Grundfos Redi-flow (model 2) or the stainless-steel Monsoon/Typhoon pumps. These types of pumps may require inverters, but with the controls, these pumps may better achieve the design flow at the design head and eliminate the cycling if that reduces capture/system performance.

Response: Additional details about system operation have been included in the revised RAP. GZA will evaluate and specify appropriate pumps during the detailed design process.

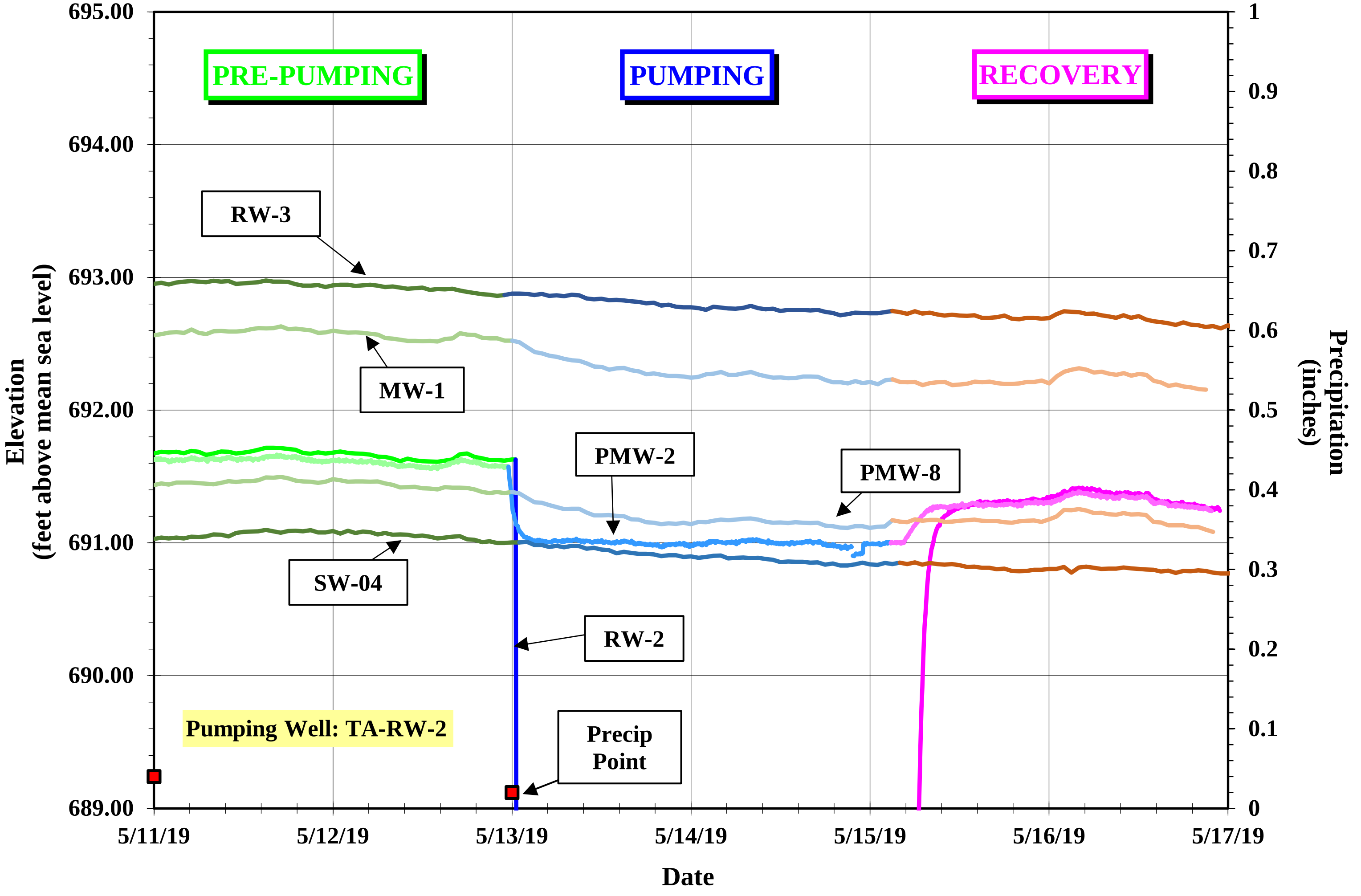
Appendix B – Pumping Test Groundwater Elevation Plots and Well Logs

TA-RW-1 Test - Combined Plot



Plot of Water Level Elevation versus Time for May 4 to May 10, 2019
Tannery Interim GW Remedy
Rockford, Michigan

TA-RW-2 Test - Combined Plot

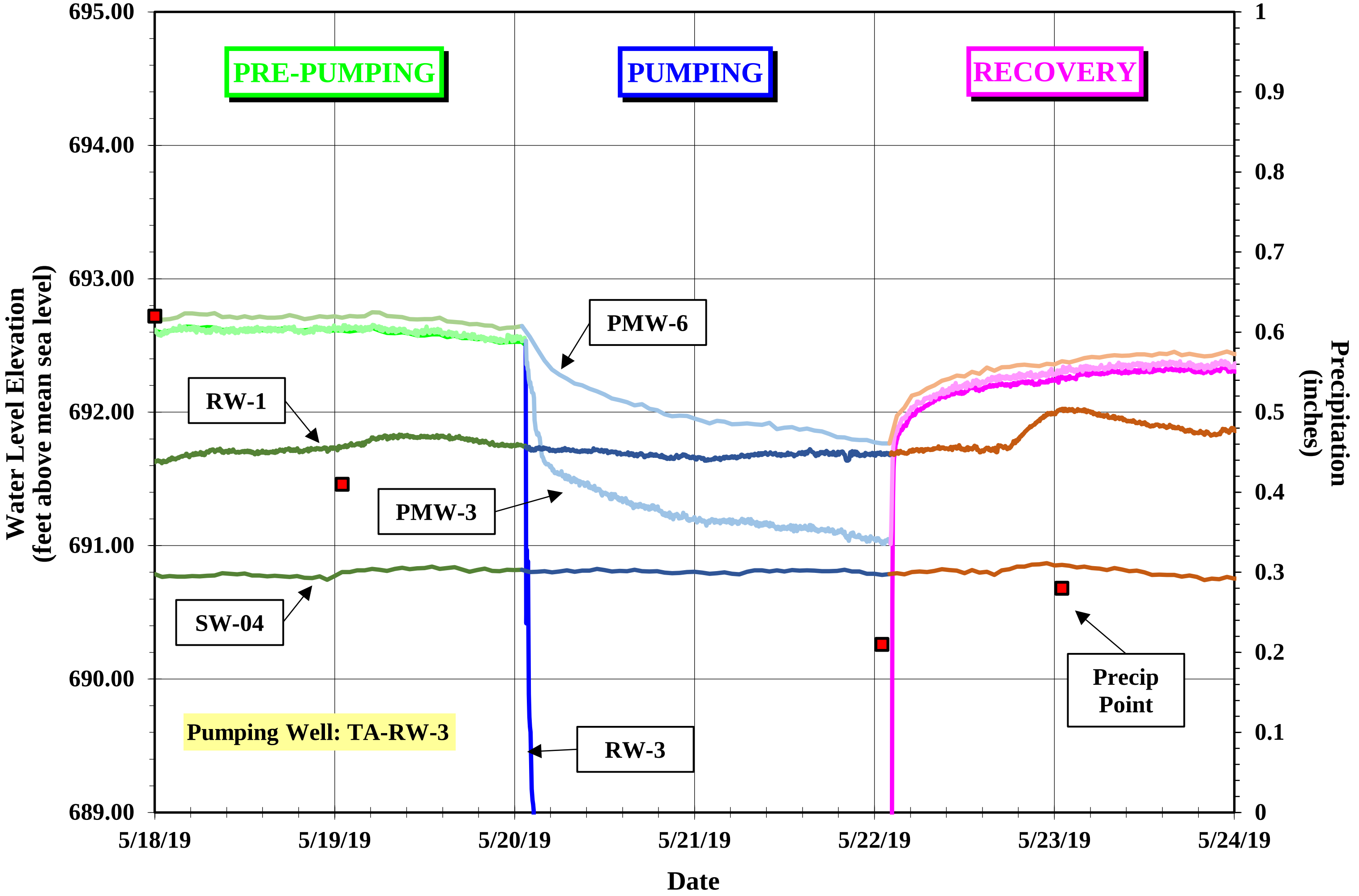


Plot of Water Level Elevation versus Time for May 11 to May 17, 2019

Tannery Interim GW Remedy

Grand Rapids, Michigan

TA-RW-3 Test - Combined Plot



Plot of Water Level Elevation versus Time for May 18 to May 24, 2019

Tannery Interim GW Remedy

Rockford, Michigan

GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: B-RW-1
Page: 1 **of** 2
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Matt Bergen
Date Start/Finish: 10-24-18 / 10-24-18
Boring Location: See Survey
GS Elev.: 693.60' **Datum:**

	Auger/ Casing	**Sampler**
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	8.0" / 4.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

GROUNDWATER READINGS

Date	**Time**	**Depth**	**Casing**	**Stab**
NM				

Surveyed By: NA **Survey Date:**

Depth	**Sample Information**					**Sample Description & Classification**	**Stratum Desc.**	**Remarks**	**Equipment Installed**
	No.	**Pen./ Rec. (in.)**	**Depth (Ft.)**	**Blows (/6")**	**Test Data**				
1	1	24/17	0-2	2-9-50/5		Medium dense, brown, SILT and SAND, trace Organics (TOPSOIL). Changing at 0.6 feet to: Medium dense, brown, fine to medium SAND, little Gravel, little Silt.	TOPSOIL 0.6' SAND	1	None
2 3	2	24/18	2-4	16-6 3-0		Loose, brown, fine to medium SAND, some Silt, little Gravel. Changing at 2.5 feet to: Loose, brown, trace Silt. Changing at 3.0 feet to: Loose, black, fine SAND and SILT, little Gravel, trace Organic Matter (wood), wet with Sulfur like odor (FILL).	3' SAND and SILT		
4 5	3	24/6	4-6	1-1 1-1		Very loose, black, fine to medium SAND and SILT, some Gravel with bottom 1" Silt and Organic, wet.			
6 7	4	24/9	6-8	1-2 2-1		Very loose, black, fine to coarse SAND and SILT, trace Gravel, wet. Changing at 6.2 feet to: ORGANIC MATTER (wood), wet. Changing at 6.5 feet to: Soft, black, Clayey SILT with fine Sand seams, wet.	6.2' 6.5' ORGANIC MATTER Clayey SILT		
8 9	5	24/15	8-10	1-1 1-1		Very loose, black, fine SAND, some Silt, trace Gravel, wet. Changing at 8.8 feet to: Very loose, brown, fine SAND, some Silt, wet.	8' Silty CLAY	2	
10 11	6	24/15	10-12	1-3 5-6		Medium stiff, olive brown, Silty CLAY with fine Sand and Silt lenses, moist. Changing at 11.5 feet to: mottled orange and gray, fine SAND withSilt lenses, trace Gravel, wet.			
12 13	7	24/16	12-14	3-3 11-11		Medium dense, tan and gray, SILT and fine SAND, trace Gravel, moist.	12' SILT and SAND		
14	8	24/19	14-16	6-7 9-10		Medium dense, tan and gray, SILT and SAND, little Gravel, moist.			

REMARKS

1. Concrete in tip of spoon.
2. Black staining at 8.6 feet.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: B-RW-1

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: B-RW-1
Page: 2 **of** 2
File No.: 16.0062335.02
Check: John Morehouse

Depth	Sample Information No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks	Equipment Installed
							SILT and SAND		
16	9	24/18	16-18	8-10 10-15		Medium dense, tan and gray, SILT and fine SAND, little Gravel, moist.			
17									
18	10	24/0	18-20	4-12 14-20		Medium dense, tan and gray, SILT and fine SAND, some Gravel with 1 inch of Clay seam, moist.			
19									
20	11	24/24	20-22	10-12 16-16		Medium dense, tan and gray, SILT and fine SAND, some Gravel, moist.			
21									
22	12	24/24	22-24	4-12 26-37		Medium dense, tan and gray, fine SAND and SILT, little Gravel, moist.			
23									
24	13	24/24	24-26	14-20 24-26		Dark Tan, fine SAND with Clayey Silt seams, trace Gravel, wet.	24' SAND		
25									
26						Bottom of Borehole at 26.0 Feet	26'	3	
27									
28									
29									
30									
31									
32									

REMARKS

3. Backfilled with bentonite chips upon completion.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: B-RW-2
Page: 1 **of** 2
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Matt Bergen
Date Start/Finish: 10-24-18 / 10-24-18
Boring Location: See Survey
GS Elev.: 693.50' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	8.0" / 4.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Depth	Sample Information: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks	Equipment Installed
1	1	24/22	0-2	4-11 12-12		Brown, SILT and fine SAND, trace Organics (TOPSOIL), moist. Changing at 0.3 feet to: Medium light brown, fine to coarse SAND, little Silt, moist. Changing at 1.2 feet to: Medium brown, fine to medium SAND, little Silt, trace Gravel, moist.	TOPSOIL 0.5' SAND		None
2 3	2	24/22	2-4	7-8 8-7		Medium tan, fine SAND, little Silt, trace Gravel, wet with gray stained from 2.6 to 3.0 feet, wet.		1	
4 5	3	24/18	4-6	1-2 3-3		Very light gray and black, fine SAND and SILT, wet.	4' SAND and SILT		
6 7	4	24/14	6-8	2-3 3-2		Very light gray, fine SAND and SILT, wet.			
8 9	5	24/20	8-10	1-1 6-11		Very light gray, fine SAND and SILT, wet. Changing at 8.4 feet to: Light gray and black, fine to medium SAND, some Silt, some Gravel, wet. Changing at 8.8 feet to: Medium stiff, black and gray, Clayey SILT, wet. Changing at 8.9 feet to: Gray and orange mottled, SILT, little fine Sand, little Gravel, moist with Clay seams, wet.	9' SILT		
10 11	6	24/10	10-12	4-7 14-18		Red and orange mottled, SILT, little fine Sand, little Gravel, moist.			
12 13	7	24/22	12-14	11-12 20-18		Hard, gray, SILT, little fine Sand, trace Gravel, wet.			
14	8	24/20	14-16	11-15 23-26		Hard, gray, SILT, little fine Sand, little Gravel, moist.			

REMARKS

1. Groundwater was encountered at approximately 2.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: B-RW-2

Depth	Sample Information					Sample Description & Classification	Stratum Desc.	Remarks	Equipment Installed
	No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data				
							SILT		
16	9	24/20	16-18	14-24 29-31		Hard, gray, SILT, some Gravel, little fine Sand, dry.			
17									
18	10	24/6	18-20	12-16 23-27		Hard, gray, SILT, little fine Sand, little Gravel, dry.			
19									
20						Bottom of Borehole at 20.0 Feet	20'	2	
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									

REMARKS

2. Backfilled with bentonite chips upon completion.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

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Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: B-RW-3
Page: 1 **of** 2
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Matt Bergen
Date Start/Finish: 10-25-18 / 10-25-18
Boring Location: See Survey
GS Elev.: 696.60' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	8.0" / 4.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Depth	Sample Information					Sample Description & Classification	Stratum Desc.	Remarks	Equipment Installed
	No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data				
1	1	24/17	0-2	4-6 11-11		Medium brown, SILT and SAND, trace Organic Matter, moist (FILL). Changing at 0.5 feet to: Medium tan, fine to coarse SAND, some Silt, trace Gravel, moist. Changing at 1.0 foot to: Medium brown, fine to medium SAND, some Silt, trace Gravel, moist.	TOPSOIL 0.5' SAND		None
2 3	2	24/11	2-4	9-12 33-23		Medium, red and brown, fine to medium SAND, little Silt, trace Gravel, moist.			
4 5	3	24/16	4-6	1-6 4-5		Loose, brown, fine to medium SAND, some Silt, trace Gravel, moist. Changing at 5.0 feet to: Stiff, brown, SILT & CLAY, some fine to coarse Sand, moist.	5' SILT & CLAY		
6 7	4	24/20	6-8	7-5 7-8		Stiff, brown, SILT & CLAY, little fine to medium Sand, moist.			
8 9	5	24/17	8-10	13-6 10-15		Very soft, brown, SILT & CLAY, little fine to medium Sand, moist. Changing at 8.5 feet to: Very soft, brown, SILT, some fine to medium Sand, trace Gravel, moist.	8.5' SILT		
10 11 12	6	24/17	10-12	4-14 17-21		Hard, light brown, SILT, some fine to medium Sand, trace Gravel, wet. Changing at 10.2 feet to: Dense, light brown, fine to medium SAND, little Silt, wet.	10.5' SAND	1	
13 14	7	24/16	13-15	6-9 18-21		Medium tan, fine to coarse SAND, little Silt, trace Gravel, wet.			

REMARKS

1. Groundwater was encountered at approximately 10.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: B-RW-3

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Rockford, Michigan

Boring No.: B-RW-3
Page: 2 **of** 2
File No.: 16.0062335.02
Check: John Morehouse

Depth	No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks	Equipment Installed
	8	24/24	15-17	8-18 24-34		Dark tan, fine to coarse SAND, little Silt, trace Gravel, wet.	SAND		
16									
17	9	24/18	17-19	6-11 25-60		Dense, tan, fine to coarse SAND, little Silt, wet. Changing at 17.8 feet to: Hard, gray, SILT, little fine to coarse Sand, trace Gravel, moist.	17.8' SILT		
18									
19	10	24/17	19-21	7-15 35-51		Hard, gray, Clayey SILT with fine Sand lenses, moist.	19' CLAY & SILT		
20									
21						Bottom of Borehole at 21.0 feet	21'	2	
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									

REMARKS

2. Backfilled with bentonite chips upon completion.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: B-RW-3

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Rockford, Michigan

Boring No.: TA-PMW-1
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Matt Bergen
Date Start/Finish: 10-26-18 / 10-26-18
Boring Location: See Survey
GS Elev.: 693.60' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

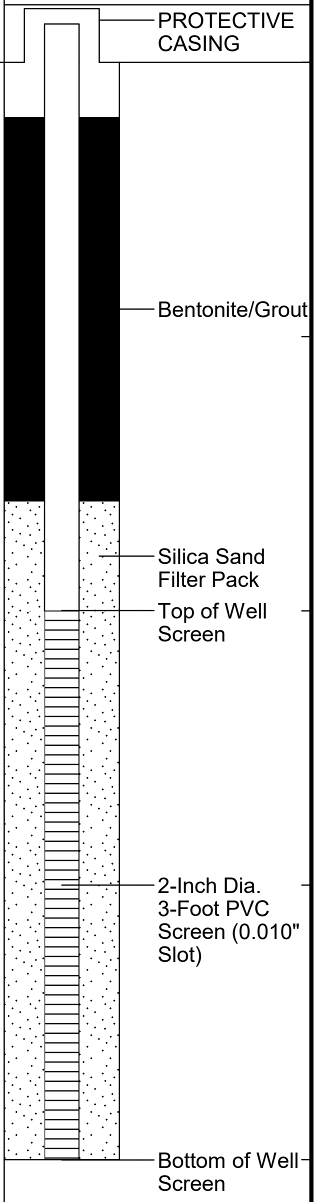
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Depth	Sample Information No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
	1	24/17	0-2	2-3 14-11		Very stiff, brown, SILT, some fine Sand, trace Organic Matter (TOPSOIL). Changing at 0.9 feet to: Medium dense, light brown, fine to coarse SAND, some Gravel, trace Silt, moist.	SILT (TOPSOIL) 0.9' SAND	
5	2	24/0	5-7	WOH-WOH WOH-WOH		NO RECOVERY	5' NO RECOVERY	
7	3	24/8	7-9	1-1 1-1		Medium dense, black, SILT with fine to medium Sand lenses, trace Gravel, wet.	7' SILT	1
9	4	24/0	9-11	3-2 1-1		NO RECOVERY.	9' NO RECOVERY	
11	5	24/8	11-13	2-2 4-8		Medium stiff, olive and brown, SILT, some fine to medium Sand, some Gravel, trace Organic Matter (wood), wet.	11' SILT	
13	6	24/15	13-15	3-3 6-8		Stiff, gray, SILT, little fine to medium Sand, trace Gravel with fine Sand, seams, moist.		
15	7	24/16	15-17	5-5 7-7		Stiff, gray, SILT, some fine to medium Sand with fine Sand lenses, trace Gravel, wet.		
17	8	24/14	17-19	13-11 15-12		Very stiff, gray, SILT, little fine to medium Sand, trace Gravel, moist to wet. Changing at 17.7 feet to: Medium dense, gray, fine to coarse SAND, some Silt, trace Gravel, wet.	17.7' SAND	
19	9	12/12	19-20	5-10		Stiff, gray, Clayey SILT, little fine to medium Sand lenses, moist.	19' Clayey SILT	
20						Bottom of Borehole at 20.0 Feet	20'	2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 7.0 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 10.0 to 20.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-PMW-1

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Engineers and Scientists

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Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-2
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Matt Bergen
Date Start/Finish: 10-25-18 / 10-26-18
Boring Location: See Survey
GS Elev.: 693.60' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

GROUNDWATER READINGS

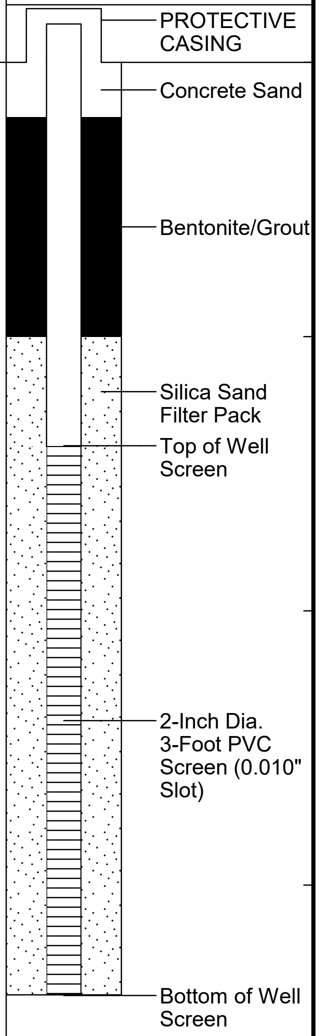
Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Sample Information

No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	24/21	0-2	3-10 11-13		Very stiff, brown, SILT, some fine Sand, trace Organic Matter, moist (TOPSOIL). Changing at 0.5 feet to: Medium dense, light brown, fine to coarse SAND, some Gravel, little Silt, moist. Changing at 1.1 feet to: Gray, fine SAND, some Silt, moist.	0.5' SAND (TOPSOIL) SAND	
2	24/19	2-4	10-11 13-12		Medium dense, gray, fine SAND and SILT, trace Gravel, wet.		1
3	24/14	4-6	2-1 1-2		Very light gray, fine SAND with Silt, some black Peat from 4.7 to 4.8 feet, wet.		
4	24/17	6-8	WR-1 1-1		Very light gray with black layers, fine SAND and SILT, trace Gravel, wet.		
5	24/11	8-10	1-2 4-2		Gray with black staining, fine SAND, trace Silt, wet. Changing at 8.3 feet to: Medium stiff, olive, SILT, some fine to medium Sand, little Gravel, wet.	8.3' SILT	
6	24/14	10-12	5-11 16-19		Very stiff, light brown to gray, SILT, little fine to medium Sand, trace Gravel, moist.		
7	24/13	12-14	7-11 18-22		Very stiff, gray, Clayey SILT, little fine to medium Sand, trace Gravel, moist.		
8	24/23	14-16	10-14 21-23		Hard, gray, Clayey SILT, little fine to medium Sand, trace Gravel, fine Sand lenses, moist.		
9	12/12	16-17	13-24		Hard, gray, SILT, some fine to medium Sand, trace Gravel, moist.	17'	
					Bottom of Borehole at 17.0 Feet		2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 2.0 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 7.0 to 17.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-PMW-2

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Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-3
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Matt Bergen
Date Start/Finish: 10-25-18 / 10-25-18
Boring Location: See Survey
GS Elev.: 696.50' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

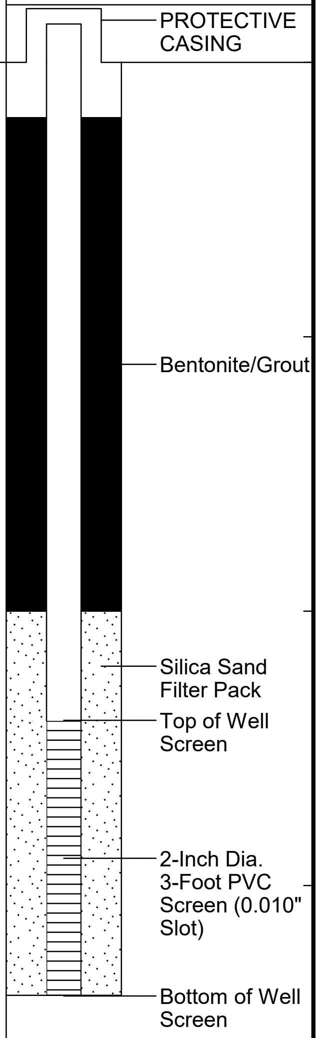
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Sample Information No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	24/15	0-2	4-10 18-13		Very stiff, brown, SILT, some fine Sand, trace Oganic Matter, moist (TOPSOIL). Changing at 0.3 feet to: Medium dense, brown, fine to coarse SAND and Gravel, some Silt, trace Brick, moist (FILL).	0.3' SILT (TOPSOIL) SAND (FILL)	
2	24/20	5-7	4-7 6-10		Stiff, light brown, Silty CLAY with Sand and Gravel, dense fine to medium Sand and Gravel seam from 5.7 to 5.9 feet, moist.	5' Silty CLAY	
3	24/20	7-9	5-8 10-14		Very stiff, light brown, SILT with fine to coarse Sand lenses, moist. Changing at 8.8 feet to: Medium dense, light brown, fine to coarse SAND and GRAVEL, some Silt, wet.	7' SILT	
4	24/18	9-11	9-16 22-30		Dense, light brown, fine to coarse SAND and Gravel, little Silt, wet.	9' SAND	1
5	24/19	11-13	13-32 38-47		Very dense, light brown, fine to coarse SAND and Gravel, trace Silt, red stained from 11.8 to 12.1 feet, wet. Changing at 12.1 feet to: Very dense, gray, fine to coarse SAND and Gravel, trace Silt, wet.		
6	24/19	13-15	3-18 23-29		Dense, gray, fine to coarse SAND and Gravel, trace Silt, wet.		
7	24/18	15-17	4-12 27-33		Dense, gray, fine to coarse SAND, some Silt, little Gravel, wet.	17'	
					Bottom of Borehole at 17.0 Feet		2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 8.8 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 12.0 to 17.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-PMW-3

BORING_WELL 6233502 WWW FORMER TANNERY ROCKFORD 10_16_18.GPJ GZA_CORP.GDT 7/1/19

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Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-4
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Kevin Hedinger
Date Start/Finish: 10-30-18 / 10-30-18
Boring Location: See Survey
GS Elev.: 693.40' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

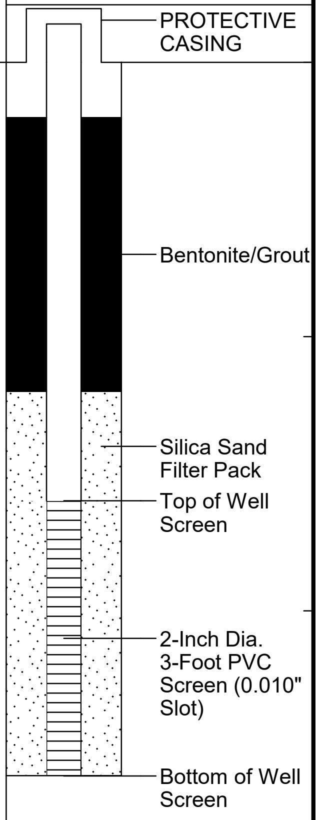
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Depth	Sample Information					Sample Description & Classification	Stratum Desc.	Remarks
	No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data			
1	1	24/24	0-2	4-9 13-9		Loose, dark brown, SILT, moist (TOPSOIL). Changing at 1.0 foot to: Loose, gray, fine to medium SAND, some coarse Sand and Gravel, moist. Changing at 1.5 feet to: Loose, black, fine to medium SAND, some coarse Sand, with 1 inch layer of clay at 1.5 feet, moist.	0.5' SILT (TOPSOIL) SAND	
2 3	2	24/12	2-4	5-5 3-4		Loose, black, fine to medium SAND, some coarse Sand, moist. Changing at 2.3 feet to: Gray, fine to medium SAND, some Gravel, some Organic Matter (wood chips), wet. Changing at 2.7 feet to: Dark brown, SILT, trace Gravel, trace fine Sand, wet.	2.7' SILT	1
4 5	3	24/12	4-6	1-1 3-1		Loose, fine to medium SAND, some Organic Matter (roots), some Silt, wet. Changing at 4.3 feet to: Loose, coarse SAND and GRAVEL, trace medium Sand, wet. Changing at 4.7 feet to: Soft, black, SILT, some Clay, wet.	4' SAND 4.7' SILT	
6 7	4	24/14	6-8	1-1 1-1		Soft, black, SILT, some Clay, wet. Changing at 6.7 feet to: Loose, gray, fine SAND, wet.	6.7' SAND	
8 9	5	24/12	8-10	3-3 4-2		Very loose, brown, SILT, trace Gravel, wet. Changing at 8.7 feet to: Very loose, brown, fine to medium SAND, trace Gravel, trace Silt, wet.	8' SILT 8.7' SAND	
10 11	6	24/14	10-12	1-1 1-1		Loose, gray and brown, fine to medium SAND, trace coarse Sand with Silt inclusions, moist. Changing at 10.7 feet to: Soft, gray, SILT, trace to some Clay, trace Gravel, wet.	10.7' SILT	
12 13	7	24/16	12-14	6-8 9-10		Stiff, gray, SILT, trace fine Sand, moist. Changing at 13.2 feet to: Stiff, gray, SILT, some Clay, moist.		
14 15	8	24/24	14-16	7-9 11-14		Stiff, gray, SILT, some Clay, some Sand, trace Gravel, moist.		
16 17	9	24/20	16-18	6-13 14-17		Stiff, gray, SILT, some Clay, some Sand, trace Gravel, moist. Changing at 17.0 feet to: Dense, gray, fine SAND, some Silt, trace Gravel, moist.	17' SAND	
18 19	10	24/12	18-20	10-12 26-29		Dense, gray, SILT, some fine Sand, trace Gravel, moist.		
20						Bottom of Borehole at 20.0 Feet	20'	2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 2.3 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 8.0 to 13.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-PMW-4

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Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-5
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Kevin Hedinger
Date Start/Finish: 10-31-18 / 10-31-18
Boring Location: See Survey
GS Elev.: 694.80' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

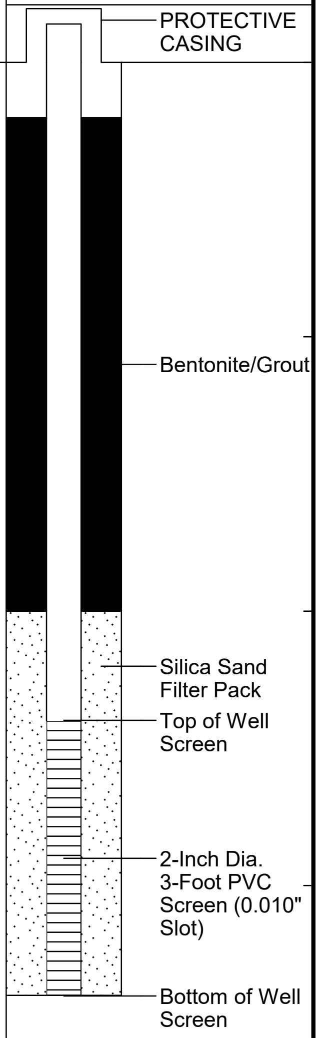
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Depth	Sample Information No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1	1	24/20	0-2	4-4 8-7		Brown, SILT, moist (TOPSOIL). Changing at 0.5 feet to: Loose, brown and orange, fine SAND, moist with 1 inch layer of Gravel at 1.5 feet and 1.8 feet.	SILT 0.5' SAND	
2 3	2	24/24	2-4	6-4 4-3		Loose, brown and orange, fine SAND, trace Gravel, moist. Changing at 3.2 feet to: Loose, dark brown, fine SAND, wet with Clay inclusion at 4 feet.		1
4 5	3	24/16	4-6	1-3 1-1		Soft, dark brown to gray, SILT, some Clay, trace Gravel, wet with Organic Matter (wood pieces) at 4.0 feet.	4' SILT	
6 7	4	24/14	6-8	1-1 1-3		Soft, gray, Silty CLAY, moist to wet. Changing at 7.2 feet to: Soft, gray, Silty CLAY, trace Gravel, trace fine Sand, moist to wet.	6' Silty CLAY	
8 9	5	24/12	8-10	3-4 4-5		Soft, brown, Silty CLAY, trace Gravel, trace Sand, moist. Changing at 8.1 feet to: Stiff, brown, Silty CLAY, trace Gravel, trace Sand, moist.		
10 11	6	24/20	10-12	3-6 13-16		Loose, brown and orange, fine to medium SAND, wet. Changing at 10.7 feet to: Stiff, brown and gray, Silty CLAY,trace fine Sand, trace Gravel, wet. Changing at 11.5 feet to: Loose, brown and orange, fine to medium SAND, wet.	10' SAND 10.7' Silty CLAY	
12 13	7	24/20	12-14	3-9 25-31		Loose, brown, fine to medium SAND, wet.	12' SAND	
14 15	8	24/24	14-16	7-21 27-38		Loose, brown, fine medium SAND, wet. Changing at 15.0 feet to: Loose, brown, fine to medium SAND, trace Silt & Clay, wet.		
16 17	9	24/24	16-18	3-6 20-27		Loose, brown and gray, fine SAND, wet. Changing at 17.0 feet to: Loose, brown and gray, fine to medium SAND, trace Silt, wet.		
18 19	10	24/24	18-20	10-20 33-38		Loose, brown and gray, fine SAND, wet. Changing at 18.7 feet to: Stiff, gray, Silty CLAY, trace Gravel, wet.	18.7' Silty CLAY	
20						Bottom of Borehole at 20.0 feet	20'	2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 3.0 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 8.0 to 13.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

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GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-6
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Matt Bergen
Date Start/Finish: 11-1-18 / 11-1-18
Boring Location: See Survey
GS Elev.: 698.30' **Datum:**

	Auger/ Casing	**Sampler**
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

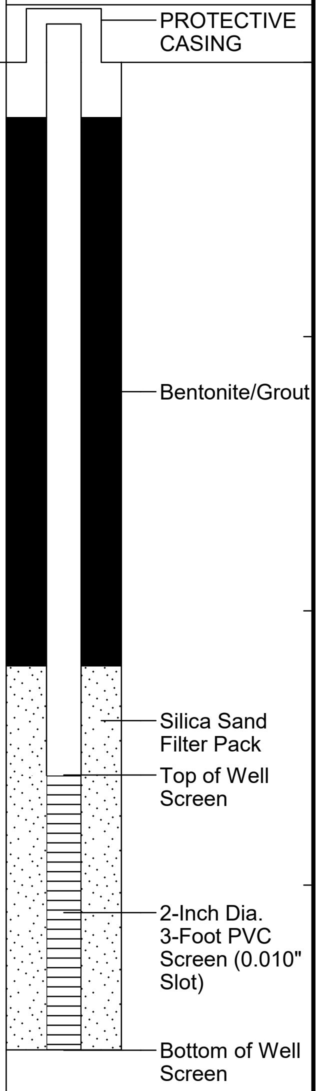
GROUNDWATER READINGS

Date	**Time**	**Depth**	**Casing**	**Stab**
NM				

Surveyed By: NA **Survey Date:**

Depth	**Sample Information**					**Sample Description & Classification**	**Stratum Desc.**	**Remarks**
	No.	**Pen./ Rec. (in.)**	**Depth (Ft.)**	**Blows (/6")**	**Test Data**			
1	1	24/20	0-2	1-3 14-31		Brown, SILT, Organic Matter (roots), trace Clay, moist (TOPSOIL). Changing at 0.8 feet to: Loose, orange, fine to medium SAND, moist. Changing at 1.3 feet to: Loose, brown, fine to medium SAND, some Gravel, moist.	SILT (TOPSOIL) 0.8' SAND	
2 3	2	24/16	2-4	9-10 8-7		Loose, orange, fine to medium SAND, moist. Changing at 2.2 feet to: Loose, brown, fine to medium SAND, some Gravel, moist. Changing at 3.2 feet to: Soft, brown, SILT, some Clay, moist.	3.2' SILT	
4 5	3	24/17	4-6	4-3 2-4		Soft, brown, SILT, some Clay, moist. Changing at 4.2 feet to: Brown, SAND and GRAVEL, moist. Changing at 4.9 feet to: Soft, brown and orange, fine SAND, some Silt & Clay, moist to wet.	4.2' SAND and Gravel 4.9' SAND	1
6 7	4	24/20	6-8	5-9 12-17		Soft, brown and orange, fine SAND, some Silt & Clay, moist to wet. Changing at 6.2 feet to: loose, orange, fine SAND, some coarse Sand, wet. Changing at 6.8 feet to: Loose, gray, medium to coarse SAND, some fine Sand, some Gravel, wet.		
8 9	5	24/24	8-10	7-17 13-15		Loose, gray, medium to coarse SAND, some fine Sand, some Gravel, trace Silt, wet. Changing at 9.2 feet to: Loose, orange, fine to medium SAND, trace Gravel, trace Silt.		
10 11	6	24/20	10-12	4-13 20-27		Loose, brown, fine to medium SAND, some coarse Sand, some Gravel, trace Silt, wet.		
12 13	7	24/20	12-14	14-20 29-34		Loose, brown, fine to medium SAND, some coarse Sand, some Gravel, trace Silt, wet.		
14 15	8	24/22	14-16	19-33 30-33		Loose, brown, medium SAND, some fine to coarse Sand, trace silt, trace Gravel, wet.		
16 17	9	24/24	16-18	10-25 36-38		Loose, brown, medium to coarse SAND, some fine Sand, trace Gravel, wet.		
18 19	10	24/24	18-20	9-25 26-38		Loose, brown, medium to coarse SAND, wet.		
20						Bottom of Borehole at 20.0 Feet	20'	2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 4.9 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 13.0 to 18.0 feet below ground surface.

BORING_WELL 6233502 WWW FORMER TANNERY ROCKFORD 10_16_18.GPJ GZA_CORP.GDT 7/1/19

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

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Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-7
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

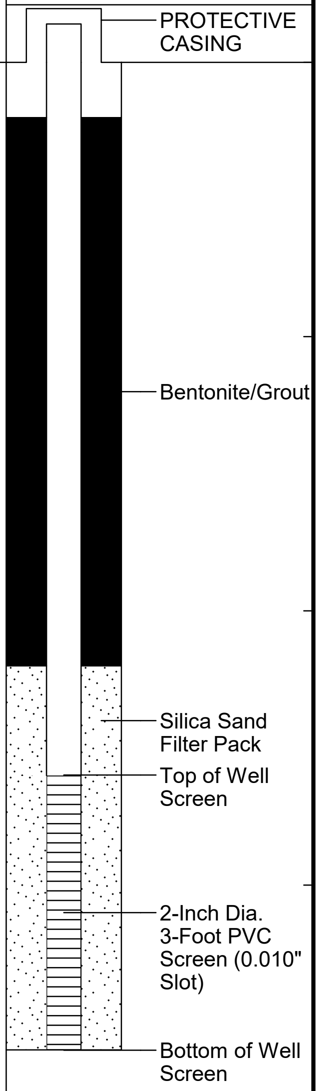
Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Kevin Hedinger
Date Start/Finish: 10-30-18 / 10-30-18
Boring Location: See Survey
GS Elev.: 693.40' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Depth	Sample Information: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks	Equipment Installed
1	1	24/20	0-2	2-6 19-17		Loose, dark brown, SILT, moist (TOPSOIL). Changing at 0.6 feet to: Dense, gray to brown, fine to medium SAND, some Gravel, damp.	SILT (TOPSOIL) 0.7' SAND		
2 3	2	24/10	2-4	5-6 7-5		Loose, gray to brown, fine to medium SAND, some Gravel, some Organic Matter (roots), wet (TOPSOIL). Changing at 2.3 feet to: CONCRETE pieces, wet.	2.3' CONCRETE Pieces	1	
4 5	3	24/8	4-6	13-50/2"		CONCRETE pieces, wet.			
6 7	4	24/18	6-8	1-2 3-4		Loose, gray and brown, fine SAND, wet.	6' SAND		
8 9	5	24/14	8-10	1-2 2-5		Loose, gray, fine SAND, some Gravel, wet. Changing at 8.3 feet to: Loose, gray, fine SAND, wet.			
10 11	6	24/9	10-12	5-4 3-3		Loose, gray, fine SAND, some Gravel, wet.			
12 13	7	24/20	12-14	7-6 44-9		Loose, gray, SAND, wet. Changing at 12.8 feet to: Gray, GRAVEL, with loose, coarse wet Sand at 13.9 feet.	12.8' GRAVEL		
14 15	8	24/20	14-16	4-5 6-8		Loose, dark gray, fine SAND, trace Gravel, wet. Changing at 14.8 feet to: Loose, brown, fine SAND, some Gravel, wet.	14' SAND		
16 17	9	24/24	16-18	3-7 7-8		Loose, brown to orange, fine SAND, some Gravel, wet. Changing at 17.6 feet to: Stiff, gray, Silty CLAY, moist.	17.8' Silty CLAY		
18 19	10	24/12	18-20	4-9 10-12		Stiff, gray, Silty CLAY, moist.			
20						Bottom of Borehole at 20.0 feet	20'	2	

REMARKS

1. Groundwater was encountered at approximately 2.3 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 13.0 to 18.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

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Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-8
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Kevin Hedinger
Date Start/Finish: 10-30-18 / 10-30-18
Boring Location: See Survey
GS Elev.: 693.00' **Datum:**

	Auger/ Casing	**Sampler**
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

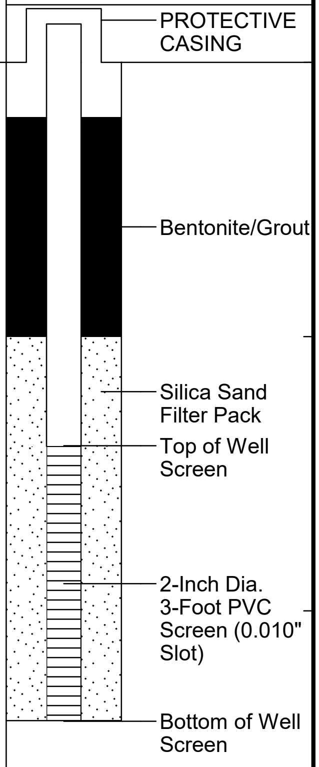
GROUNDWATER READINGS

Date	**Time**	**Depth**	**Casing**	**Stab**
NM				

Surveyed By: NA **Survey Date:**

Depth	**Sample Information**					**Sample Description & Classification**	**Stratum Desc.**	**Remarks**
	No.	**Pen./ Rec. (in.)**	**Depth (Ft.)**	**Blows (/6")**	**Test Data**			
1	1	24/18	0-2	3-8 10-10		Brown, SILT (TOPSOIL). Changing at 0.3 feet to: Loose, brown, fine to medium SAND, some Gravel, some coarse Sand, moist.	0.3' SILT (TOPSOIL) SAND	
2 3	2	24/22	2-4	7-9 24-25		Loose, brown, fine SAND, trace Gravel, wet. Changing at 2.8 feet to: Loose, dark gray to black, fine SAND, some Gravel, wet.		
4 5	3	24/12	4-6	3-2 2-1		Loose, black, fine to medium SAND, some Silt, some Gravel, wet.		
6 7	4	24/4	6-8	0-0 0-2		Loose, gray, fine to medium SAND, wet. Changing at 7.0 feet to: Soft, black, Silt, wet.	6.2' SILT	1
8 9	5	24/10	8-10	0-2 2-2		Soft, black, SILT, some fine to coarse Sand, some Gravel, wet.		
10 11	6	24/18	10-12	5-5 6-8		Soft, gray, SILT, trace Clay, trace Peat, wet. Changing at 10.2 feet to: Stiff, gray and brown, SILT, some Clay, trace Gravel, wet.		
12 13	7	24/18	12-14	3-4 7-11		Loose, gray, fine to medium SAND, wet. Changing at 12.2 feet to: Stiff, gray, SILT, some Clay, some Gravel, moist.	12' 12.2' SAND SILT	
14 15	8	24/22	14-16	9-13 20-24		Stiff, gray, Silty CLAY, trace Gravel, moist.	14' Silty CLAY	
16 17	9	24/24	16-18	12-18 18-24		Stiff, gray, Silty CLAY, trace Gravel, moist. Changing at 17.9 feet to: Gray, fine to medium SAND, some Silt, moist.		
18 19	10	24/20	18-20	4-8 18-24		Stiff, gray, Silty CLAY, moist. Changing at 18.3 feet to: Soft, gray, fine SAND, moist. Changing at 18.8 feet to: Stiff, gray, SILT, moist. Changing at 19.0 feet to: Soft, gray, fine SAND, moist.	17.9' 18' SAND 18.3' Silty CLAY 18.8' SAND 19' SILT SAND	
20						Bottom of Borehole at 20.0 Feet	20'	2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 6.2 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 7.0 to 12.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-PMW-8

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Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-PMW-9
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Mike Hofferon
Logged by: Kevin Hedinger
Date Start/Finish: 10-31-18 / 10-31-18
Boring Location: See Survey
GS Elev.: 694.90' **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	GeoProbe
O.D. / I.D.:	8.0" / 4.25"	NA
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:	NM	NA

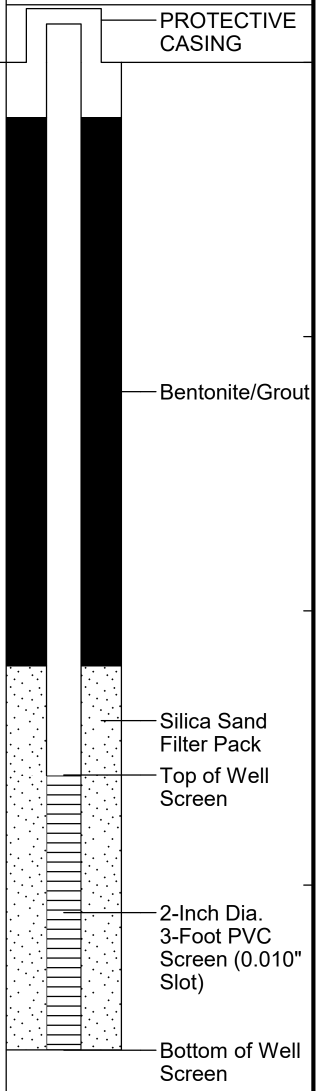
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab
NM				

Surveyed By: NA **Survey Date:**

Depth	No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
1 2	1	24/21	0-2	4-8 6-9		Loose, brown, SILT, some Organic Matter (roots), moist. Changing at 0.7 feet to: Loose, tan, fine to medium SAND, some Gravel, moist. Changing at 1.6 feet to: Loose, black, fine to medium SAND, some Gravel, moist.	SILT 0.7' SAND	
3 4	2	24/12	2-4	4-3 3-3		Loose, tan, fine to medium SAND, moist. Changing at 2.3 feet to: Loose, black, fine to medium SAND, some Gravel, wet.		1
5 6	3	24/22	4-6	1-1 1-1		Soft, brown, fine to medium SAND, some Silt, trace Clay, trace Gravel, wet. Changing at 5.0 feet to: Soft, gray, SILT, trace fine Sand, trace Gravel, moist.	5' SILT	
7 8	4	24/20	6-8	5-5 7-10		Soft, gray, SILT, trace fine Sand, trace Gravel, trace Clay, wet. Changing at 6.2 feet to: Loose, fine SAND, wet. Changing at 7.3 feet to: Loose, orange, fine to medium SAND, wet.	6.2' SAND	
9 10	5	24/21	8-10	2-4 6-10		Loose, brown, fine SAND, some Silt, wet.		
11 12	6	24/20	10-12	7-12 15-26		Loose, brown to orange, fine to medium SAND, trace Silt, trace Gravel, wet.		
13 14	7	24/18	12-14	12-19 23-27		Loose, orange, fine to medium SAND, some Gravel, wet.		
15 16	8	24/14	14-16	17-25 29-35		Loose, orange to brown, fine to medium SAND, wet.		
17 18	9	24/24	16-18	6-25 39-43		Loose, orange, fine to medium SAND, wet. Changing at 16.8 feet to: Loose, gray, fine SAND, wet.		
19 20	10	24/18	18-20	16-28 35-47		Loose, gray, fine SAND, wet.	20'	
						Bottom of Borehole at 20.0 Feet		2

Equipment Installed



REMARKS

1. Groundwater was encountered at approximately 2.3 feet below ground surface.
2. Monitoring well was installed in borehole upon completion. Well screen set from 7.0 to 12.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-PMW-9

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Former Tannery
Rockford, Michigan

Boring No.: TA-RW-1
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Jerry H.
Logged by: Chris Melby
Date Start/Finish: 1-7-19 / 1-8-19
Boring Location:
GS Elev.: **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	8.0" / 4.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:		NA

GROUNDWATER READINGS

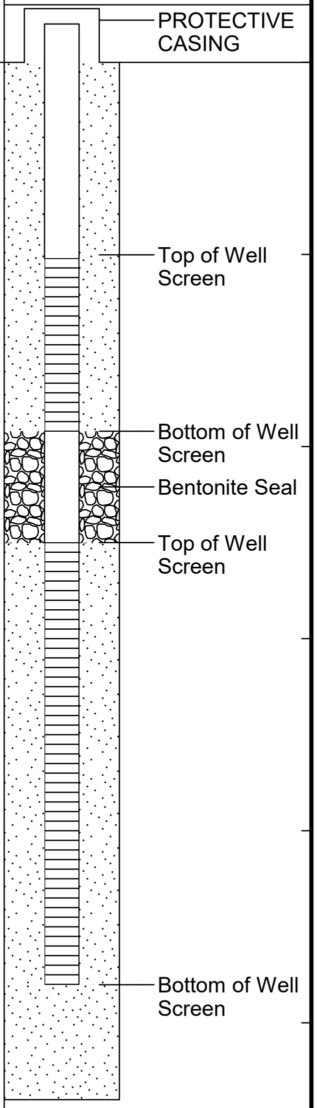
Date	Time	Depth	Casing	Stab

Surveyed By: **Survey Date:**

Depth	Sample Information No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
	1		0			See boring log B-RW-1 for soil descriptions.		
27						Bottom of Borehole at 27.0 Feet		1

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29

Equipment Installed



REMARKS

1. Monitoring well was installed in borehole upon completion. Well screen set from approximately 12.5 to 24.0 feet below ground surface. Well screen set from approximately 5.1 to 9.6 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-RW-1

BORING_WELL 6233502 WWW FORMER TANNERY ROCKFORD 10_16_18.GPJ GZA_CORP.GDT 7/1/19

GZA
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Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-RW-2
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Jerry H.
Logged by: Chris Melby
Date Start/Finish: 1-6-19 / 1-7-19
Boring Location:
GS Elev.: **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	8.0" / 4.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:		NA

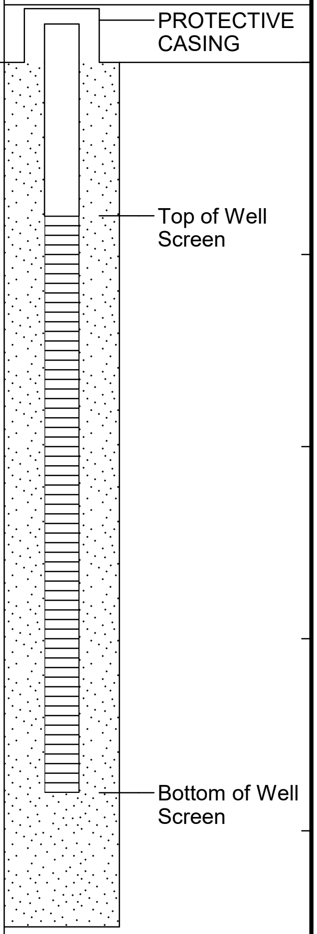
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab

Surveyed By: **Survey Date:**

Depth	Sample Information: No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
	1		0			See boring log B-RW-2 for soil descriptions.		
23						Bottom of Borehole at 22.5 Feet		1

Equipment Installed



REMARKS

1. Monitoring well was installed in borehole upon completion. Well screen set from approximately 4.0 to 19.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-RW-2

GZA
GeoEnvironmental, Inc.
Engineers and Scientists

Wolverine World Wide, Inc.
Former Tannery
Rockford, Michigan

Boring No.: TA-RW-3
Page: 1 **of** 1
File No.: 16.0062335.02
Check: John Morehouse

Contractor: Stearns Drilling Company
Foreman: Jerry H.
Logged by: Chris Melby
Date Start/Finish: 1-4-19 / 1-6-19
Boring Location:
GS Elev.: **Datum:**

	Auger/ Casing	Sampler
Type:	Hollow Stem Auger	Split Spoon
O.D. / I.D.:	8.0" / 4.25"	2.0" / 1 3/8"
Hammer Wt.:	140lbs	NA
Hammer Fall:	30.0"	NA
TOC Elev.:		NA

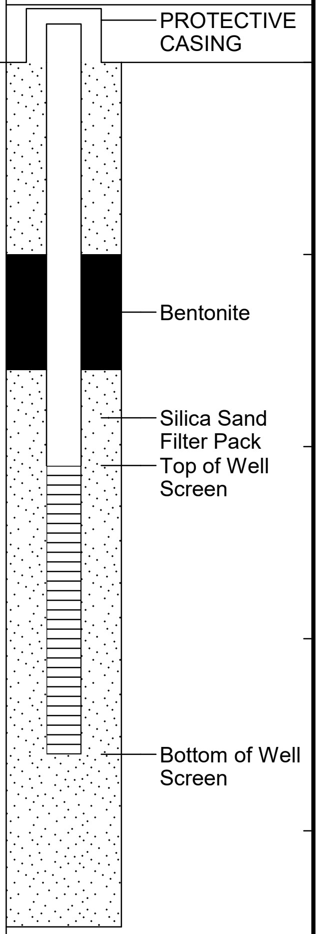
GROUNDWATER READINGS

Date	Time	Depth	Casing	Stab

Surveyed By: **Survey Date:**

Depth	Sample Information No.	Pen./ Rec. (in.)	Depth (Ft.)	Blows (/6")	Test Data	Sample Description & Classification	Stratum Desc.	Remarks
	1		0			See boring log B-RW-3 for soil descriptions.		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23						Bottom of Borehole at 22.5 Feet		1
24								
25								
26								
27								
28								
29								

Equipment Installed



REMARKS

1. Monitoring well was installed in borehole upon completion. Well screen set from approximately 10.5 to 18.0 feet below ground surface.

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring No.: TA-RW-3

Appendix C –Treatment System Basis of Design

Wolverine Tannery IR
Wastewater Treatment
Last Revised: 10/27/21 - LMN

Influent Flow-	gpm	gpd
Phase I - NKSA discharge	7	10080
Phase II - NPDES discharge (includes Phase I)	45	64800
Phase III (Phase I & II + Unknown future)	70	100800

Extraction Wells	gpm	gpd
Phase I (4-5)	7	10080
Phase II (17-18 additional extaction wells)	38	54720
Subtotal	45	64800

Influent Concentrations

PFAS - GW	27464	ppt
Fe - GW	2.1	mg/l
Ammonia - GW	0.9	mg/l
Chloride	979	mg/l

Effluent Required for NKSA discharge
PFAS ND

Aeration Tank

Design Objective - oxidize iron for precipitation and settling.

Since the rate of the reaction is pH dependent, pH adjustment equipment will be installed to raise the pH, if required.

At pH 6 - requires > 100 hours.
At pH of 7.0 - 90% Fe+2 oxidation requires 1 hour at 21C - requires 10 hours at 5C
At pH of 8 - 90% Fe+2 oxidation in 30 seconds.

However, the aeration tank will be designed to provide 30 minutes of detention at a pH of 7.5 based on no addition of hydroxide.

Average pH of Groundwater 7.5

Detention Time (minimum) 30 minutes

Tank volume based on Phase III - 50 gpm	1500	gallon
Type	Concrete	
Size (cu ft) required	201	
width	3	ft
length	14	ft
depth	6	ft (swd)
Cubic foot designed	252	

Oxygen Required:

TOC	3.6	mg/l	assume 3lb Oxygen/lb TOC
Fe	2.1	mg/l	assume 1lb/lb
Increase DO	6	mg/l	
Oxygen Required	15.9	lb/day	
	0.6625	lb oxygen/hour	
say 4% transfer	0.04		
say .21 percent oxygen in air	0.21		
Air required	78.9	lb air/hour	
Air density	0.0765	lb/cu ft	
	1031	cu ft/hr	
	17	CFM	

Notes: Use NaOCl to inhibit nitrification if needed

Air Supply

Type	Rotary Vane	
Number	2	installed Standby
Equal to	PB Gast	
Diffusers	removable for cleaning hand drilled orifices - Fabricate with 1" SS pipe	

Settling Tank

Overflow Rate (OR)	0.5	gpm/sf
Surface Area Required at 50 gpm influent flow	140	SF
Area provided		
length	18	

width	6	
Area provided	108	SF

Wet Well/Equalization

Purpose - on-off control of PD pumps discharging to treatment

Size - on-off cycle, dwell in tankage when all off, re-bed backwash	8078	gallon
Available for re-bed backwash	6000	gallon
Pumps		
P-1 - 1 standby (on shelf) for NKSA	7	gpm
P-2 - NPDES Phase II	28	gpm

Control

Set flow rate and control pump speed to maintain flow rate.

Solids Generation

Iron hydroxide solids	2.1	mg/l
Fe-OH Solids	1.7654112	lb/day
Fe-OH Solids	1.7654112	lb/day
Chemical/conditioning	2.5	Multiplier
Total Solids 50 gpm	4.413528	lb/day
Monthly	132.40584	lbs/month
underflow (2-5%) use 3	0.03	
volume	529.2	gallons/month

Tank size - 3' wide, 6' deep, 18' long =	2424	gallons
Months of storage	4.5795918	
Ultimate disposal	Pump and Haul	

Pre-Carbon Sediment Filters

Number	2	
One operating, one standby		
Polyester Felt Bag	20-25	micron
Mesh basket	40	micron

UV Sanitizer

UV Viqua Pro 50

Design flow	50	gpm

GAC Vessels

	Phase I NKSA	Phase II NPDES
Concentration ppt	28740	28740
Lead size CF	24	38
Peak flow (gpm)	10	70
Avg Flow (gpm)	7	45
# columns in lead	1	1
Column height (in)	72	72
Column dia (in)	30	48
Column Area (SF)	4.9	12.6
HLR Average	1.4	3.6
HLR Peak	2.0	5.6
EBCT min	18	4
tb (time to breakthrough, days)	88	35

Post-Carbon Sediment Filters

Number	1	
Polyester Felt Bag	20-25	micron
Mesh basket	40	micron

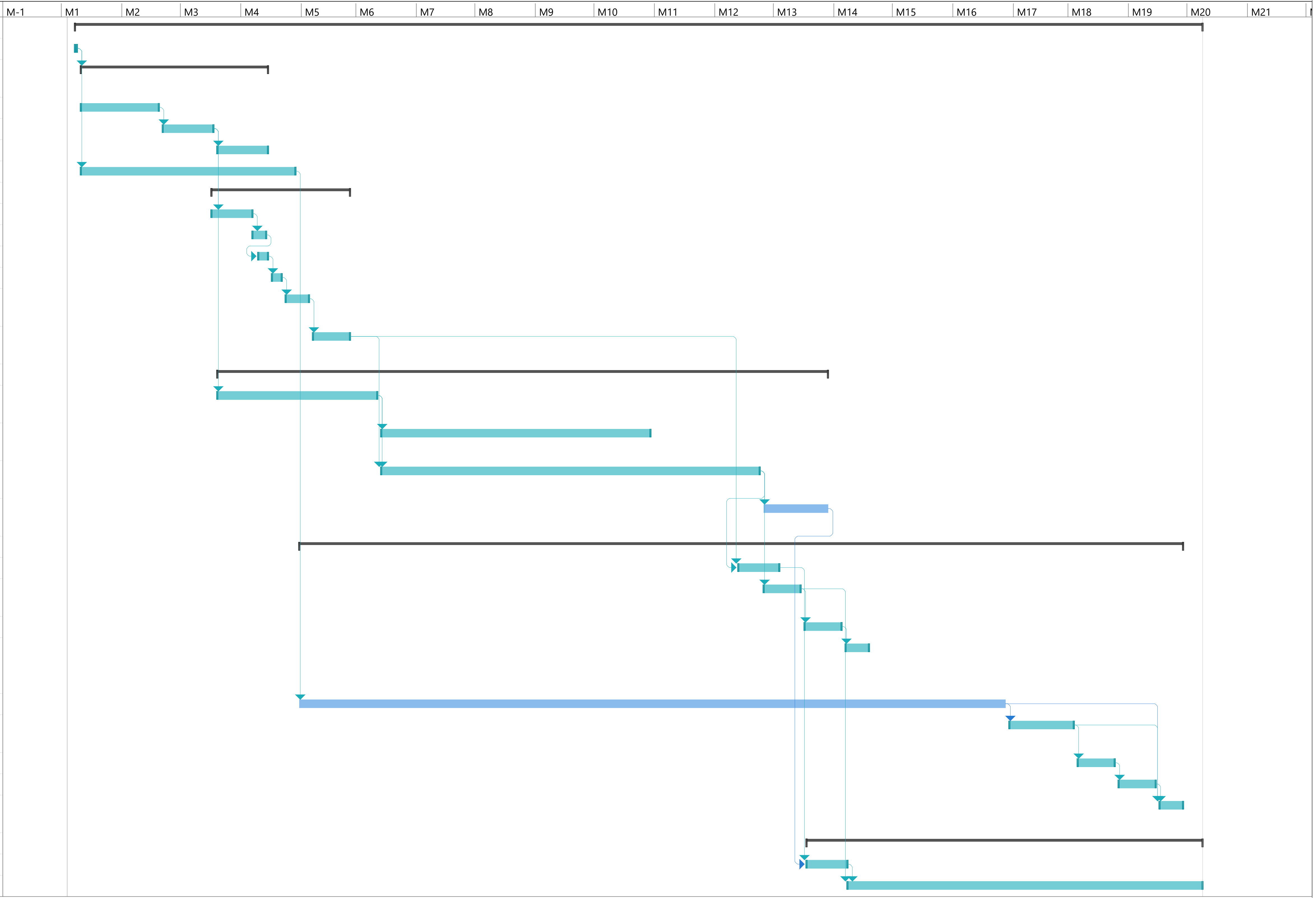
Sampling/Metering

ISCO Refrigerated Model 5800 - Flow Proportional Sampling

Appendix D – Proposed Project Schedule

Tannery Groundwater System

ID	ⓘ	Task	Task Name	Duration
1			**Tannery Groundwater System**	**412 days**
2			EGLE RAP Approval	1 day
3			**Finalize Design and Specifications**	**70 days**
4			Finalize Design	30 days
5			Finalize Specifications	20 days
6			Permitting (SESC, Rockford)	20 days
7			NPDES Permit Application	80 days
8			**Bidding Process**	**51 days**
9			Select Contractors to bid	15 days
10			Issue bid documents	5 days
11			Pre-bid meeting	5 days
12			Bids Due	5 days
13			Review Bids and Select Contractor	10 days
14			Contracting with selected contractor	15 days
15			**System Installation (1)**	**225 days**
16			Order Equipment (long lead)	60 days
17			Treatment system building construction	100 days
18			Well, pump and piping installation	140 days
19			Performance monitoring well installation	25 days
20			**System Start Up**	**325 days**
21			Staff gauge installation	15 days
22			Initial start up (partial operation)	15 days
23			Troubleshooting	15 days
24			Start up operation/discharge (partial operation)	10 days
25			EGLE NPDES Approval (2)	260 days
26			Extraction well redevelopment	25 days
27			Full system start up	15 days
28			Full system troubleshooting	15 days
29			Full System Operation/Discharge	10 days
30			**Performance Monitoring**	**145 days**
31			Transducer installation	15 days
32			Weekly monitoring (3)	130 days



Project: Tannery Groundwater S
Date: Fri 2/19/21

Task	▬	Project Summary	⌐¬	Manual Task	▬	Start-only	[	Deadline	⇩
Split	┈	Inactive Task	▭	Duration-only	▬	Finish-only	]	Progress	─
Milestone	◆	Inactive Milestone	◇	Manual Summary Rollup	▬	External Tasks	▬	Manual Progress	─
Summary	⌐¬	Inactive Summary	⌐¬	Manual Summary	⌐¬	External Milestone	◆		

(1) Construction schedule is estimated based on previous project experience.
(2) NPDES Permit approval schedule is estimated.
(3) Performance monitoring will be conducted for the duration of system operation.

GZA GeoEnvironmental, Inc.