



June 23, 2023

MS. DENICE NELSON
JOHNSON CONTROLS, INC
5757 N. GREEN BAY AVENUE
MILWAUKEE, WI 53209

Via Email Only to denice.karen.nelson@jci.com

SUBJECT: Response to *Site Investigation Status Report*
JCI/Tyco FTC PFAS, 2700 Industrial Parkway South, Marinette, WI
BRRTS #02-38-580694

Dear Ms. Nelson:

On Apr. 3, 2023, the Wisconsin Department of Natural Resources (DNR) received the *Site Investigation Status Report* (the “SI Status Report”) for the above-referenced site (the “Site”) that was submitted by Arcadis U.S., Inc. (Arcadis), on behalf of Johnson Controls, Inc. and Tyco Fire Products LP (JCI/Tyco). The SI Status Report was accompanied by the fee required under Wisconsin Administrative Code (Wis. Admin. Code) § NR 749.04(1) for DNR review and response.

The DNR reviewed the SI Status Report, which documented recent work and progress in the site investigation (the “SI”) of per- and polyfluoroalkyl substances (PFAS) contamination at the Site. The SI Status Report included new data and built upon information provided in six earlier SI status reports¹. Additional work is needed in order for JCI/Tyco to satisfy its site investigation obligations (Wis. Admin. Code ch. NR 716). Within this letter, the DNR identifies data gaps in the current site characterization and shares suggestions on how JCI/Tyco might choose to address these data gaps in its next phase of work in the SI.

Background

JCI/Tyco is investigating and responding to the discharge of PFAS to the environment at the JCI/Tyco Fire Technology Center (FTC), located at 2700 Industrial Parkway South in Marinette, Wisconsin. The discharge occurred as the result of fire suppressant training, testing, research and development of PFAS-containing aqueous film forming foams (AFFF) at the Site starting in the early 1960s.

JCI/Tyco initiated the SI for PFAS contamination at the Site in 2018 and its prior SI work is documented in the six reports noted below in footnote 1. On Oct. 27, 2021, the DNR sent a letter to JCI/Tyco advising that additional actions were required to advance and complete the SI according to Wis. Admin. Code ch. NR 716. In response, on Feb. 11, 2022, JCI/Tyco submitted a SI Work Plan to complete additional groundwater and surface water

¹ Reports documenting prior progress in the SI include:

- *Site Investigation Report* – Sept. 28, 2018 (Posted to BRRTS Oct. 4, 2018)
- *Data Summary Report* – Mar. 8, 2019 (Posted to BRRTS Mar. 13, 2019)
- *Southern Area Groundwater Evaluation Report* – Mar. 20, 2020 (Posted to BRRTS Apr. 10, 2020)
- *Interim Site Investigation Report* – May 15, 2020 (Posted to BRRTS Jun. 5, 2020)
- *Conceptual Site Model* – May 20, 2020 (Posted to BRRTS Jun. 5, 2020)
- *Air Pathway Site Investigation Report* – Submitted as App. A to the Site Investigation Work Plan – Feb. 11, 2022

monitoring at the Site, which the DNR responded to on Apr. 11, 2022. The DNR approved the work plan with the understanding that JCI/Tyco intended to use the data from its proposed field investigation to inform next steps in the SI. In the Apr. 2022 letter, the DNR recommended additional monitoring locations to help JCI/Tyco close data gaps in the SI. The figures showing DNR's previous recommendations are in **Appendix A**.

Summary of the SI Status Report

JCI/Tyco's SI Status Report documented the field investigations it completed in 2022 and its evaluations to incorporate the new data into the ongoing SI and conceptual site model (CSM). The 2022 field work included the first comprehensive sampling event for PFAS from a network of groundwater monitoring wells and an evaluation of surface-water transport and quality in and around the Site. Deviations from the SI Work Plan were documented in Table 9 of the SI Status Report. Some of the planned surface-water work could not be completed in 2022 and is scheduled to take place in 2023; a report documenting completion of the surface water field investigation is anticipated later this year.

The SI work that JCI/Tyco completed in 2022 included:

- Sampled 38 existing monitoring wells during a preliminary groundwater monitoring event (spring 2022).
- Completed 26 vertical-aquifer profile (VAP) borings in the overburden.
- Completed 14 test borings to evaluate conditions at the weathered bedrock.
- Installed 30 monitoring wells in the overburden and nine monitoring wells into bedrock. Some of the wells were nested at various depths in the same location (i.e., the 39 new wells were installed at 18 locations).
- Measured water levels in 153 monitoring wells and sampled 143 of these same wells for PFAS during a comprehensive monitoring event in fall 2022. This first comprehensive groundwater monitoring event included the 39 newly installed wells.
- Evaluated records to assess historical surface water drainage patterns in and around the Site.
- Gauged flow and sampled and measured surface-water-to-groundwater vertical gradients in Ditches A, B, C, D, and E twice in the fall of 2022 (18 locations in Sept. and 8 locations in Nov.).
- Sampled surface water in the Menominee River once in 2022.
- Completed a principal component analysis (PCA) to evaluate the chemical signatures of PFAS in the area.

The SI Workplan indicates that in 2023 JCI/Tyco plans to:

- Install and sample new monitoring wells screened in the overburden near piezometers PZ-63, PZ-78, VAP-PZ-72 and VAP-PZ-74.
- Install and sample a new monitoring well screened in the weathered bedrock near PZ-32.
- Complete flow and gradient measurements in Ditches A, C, D, and E three times prior to the fall of 2023.
- Sample surface water in the Menominee River once in 2023.
- Sample surface water in Ditches A, C, D, and E and Green Bay in spring and summer of 2023.

In the SI Status Report, JCI/Tyco provided tables, figures and supporting information to document its 2022 field investigation, provided plans to complete and report on the remaining field work in 2023 and concluded that its work to define the extent of PFAS contamination at the Site is complete.

DNR Review

The DNR acknowledges that JCI/Tyco has made progress with the SI through its sampling of surface water and installation of a NR 141-compliant monitoring well network in an area spanning over 7 square miles. JCI/Tyco's first comprehensive sampling of these monitoring wells provides a foundation from which it can monitor and document stability or changes in the groundwater plume over time. The DNR also acknowledges that the SI Status Report was well organized, included the required supporting documentation and provided clear summaries of the data. The DNR appreciates the time and effort taken to deliver an organized and complete report of this magnitude.

The DNR does not agree with JCI/Tyco's conclusion that it has sufficiently characterized the nature, degree and extent of PFAS contamination in certain locations at the Site. The DNR's technical review of the SI Status Report identified additional data and evaluations that are needed to make progress toward a complete SI and satisfy the requirements of Wis. Admin. Code. ch. NR 716. While the DNR's review was focused on the SI Status Report, it also considered information previously provided in JCI/Tyco's CSM and other reports documenting completed SI activities.

Additional Data

Locations that will require additional data to make progress toward a complete SI are shown on **Figures 1 and 2** and are described below with reference to the figures with the DNR's prior recommendation in **Attachment A**.

- Groundwater East and Below Ditch B: The highest concentrations of PFAS in groundwater are currently found on the FTC property near the outdoor testing area (OTA) and in groundwater flowing toward the east-northeast from the OTA. While a portion of the groundwater is anticipated to be captured by the extraction wells that are part of JCI/Tyco's interim remedial action – the Groundwater Extraction and Treatment System (GETS) – additional monitoring wells are needed to characterize and monitor the groundwater conditions downgradient (east) of Ditch B and vertically below the capture zone of the extraction wells. Groundwater disperses and follows preferential flow paths east of Ditch B, and currently there is not sufficient coverage in the monitoring well network to evaluate the contaminant distribution in the groundwater in this area. This data is needed not only to define the nature, degree and extent of impacts for the SI, but also to evaluate the outcomes and performance of the GETS. The DNR previously suggested location “A.” If JCI/Tyco determined that this location was not suitable for new monitoring wells, new monitoring wells at other locations between piezometers PZ-31 and PZ-61 are necessary for purposes of the SI and to evaluate the efficacy of the GETS. Completing these evaluations will likely require new wells installed at multiple locations and multiple depths where groundwater flow paths are identified in this portion of the Site.
- Groundwater Southeast of FTC: PFAS impacts to groundwater were detected in private wells and samples from VAPs in the area southeast of the FTC. Currently there is not sufficient coverage in the monitoring well network to evaluate the contaminant distribution in the groundwater and contaminant flux to the Bay of Green Bay from this area of the Site. JCI/Tyco has indicated plans for 2023 to install four new monitoring wells at two vertical aquifer profile locations that were completed in 2022; two new wells at VAP-PZ-72 and two new wells at VAP-PZ-74, each to be screened at depths based on the VAP sampling results. The DNR agrees with these four proposed monitoring wells and recommends that JCI/Tyco install additional monitoring wells to evaluate the groundwater plume downgradient (southeast) of VAP-PZ-72. These additional monitoring wells should be screened at depth(s) based on VAP results and the vertical hydraulic gradients measured in the area. The DNR recommends monitoring wells be completed near location “D” and/or near VAP-35 south of Ditch E.

- Groundwater flow paths originating from the entire losing segment of Ditch A south of the FTC: JCI/Tyco's CSM and data collected to date show that Ditch A is a significant historical and current surface water drainage feature in the area that cuts through the FTC property. PFAS contamination reached the ditch through surface runoff and wetland drainage from the FTC. The PFAS impacts in Ditch A can infiltrate into groundwater along the segment of ditch that is a losing stream – a segment that spans over ½-mile as Ditch A flows south from the FTC past Madsen Road. The groundwater flow paths for PFAS that enter the groundwater anywhere along this ½-mile segment differ from the flow paths for PFAS that infiltrate and begin flowing in groundwater from the OTA. The placement of monitoring wells and conclusions on the nature, degree and extent of contamination must consider flow paths originating from the losing segment of Ditch A. A few examples from the DNR's review of the SI Status Report include the following:
 - PFOA detected at 194 ppt in the shallow groundwater at VAP-09 is likely to be within the extent of the plume because this location is near the end of the losing segment of Ditch A connected to the FTC. To accurately characterize this area, DNR recommends installing monitoring wells screened at depths where PFAS were detected in VAP-09, which corresponds to location "F."
 - PFAS detected in PZ-41, VAP-63 and VAP-PZ-73 are likely to be within the extent of the PFAS impacts from the FTC, because these locations align with groundwater flow paths originating at Ditch A south of Madsen Road. To accurately characterize the aquifer along this groundwater flow path originating from Ditch A, DNR recommends installing monitoring wells screened at depths where PFAS were detected in samples collected from VAP-PZ-73 and VAP-63.
- Weathered bedrock layer following the slope and strike of bedrock south of the FTC: The data in the SI Status Report confirmed that PFAS reached the weathered bedrock in areas where it has hydraulic connection to the overlying unconsolidated aquifer (e.g., natural features or because of poor well construction) and further confirmed that the weathered bedrock is a transport pathway for PFAS migrating east from the FTC. Because groundwater in the unconsolidated aquifer flows radially from northeast and to the south from the FTC, it is reasonable to conclude that a similar flow pattern occurs in the weathered bedrock layer and that there is a southern component of groundwater flow in the weathered bedrock. PFAS in groundwater migrating in weathered bedrock south of the FTC may follow the slope and/or strike of the bedrock surface. Currently, there are not sufficient monitoring wells to evaluate the weathered bedrock layer south of the FTC. Because flow in the weathered bedrock is highly "heterogenous and anisotropic," more than one monitoring well is recommended to evaluate this potential pathway. The DNR previously recommended locations "B," "F" and "G."
- Surface water in Ditch B at SW-15: The concentrations of PFAS in the surface water in Ditch B near the outlet to the Bay of Green Bay (previous sample location SW-15) remains a data gap in the Site characterization. In the SI Status Report, JCI/Tyco indicated that in spring and summer 2023 it will sample surface water in Ditches A, C, D, and E at the respective outlets to the Bay of Green Bay and the surface water in the Bay of Green Bay (presumably at the six locations shown in Attachment A). The DNR recommends that JCI/Tyco also collect surface water samples at SW-15 during these surface water monitoring events.² The PFAS results from upstream sample location SW-39 are not expected to be representative of the PFAS concentrations in the surface water conditions near the ditch's outlet to the Bay of Green Bay.

² The DNR also requested that JCI/Tyco update and add surface water sampling at SW-15 to the monitoring program for evaluating the Ditch B Treatment System interim remedial action (see DNR letter dated Jun. 12, 2023).

Additional Evaluations

Additional evaluations and possibly additional sampling are needed to define the nature, degree and extent of the contamination for some areas of the Site.

- **West and Northwest of FTC:** Lower concentrations of PFAS were detected in groundwater on the western and northwestern boundaries of the FTC property. JCI/Tyco interpreted these PFAS to be from unknown upgradient sources. While this is a possible explanation, another explanation supported by the current data is that these PFAS are from the FTC (e.g., the PFAS resulted from diffusion of PFAS from the very high concentrations of PFAS in groundwater near FTC source areas and/or drainage of PFAS-impacted water through wetlands on the western half of the FTC property). This alternative explanation is further strengthened by new data presented in the SI Status Report that support discharges of PFAS occurred on the western half of the FTC property (i.e., west of Ditch A). Additional testing of groundwater farther west and northwest from the FTC would provide information necessary to further the assessment of the likely source of PFAS in this area. Currently, the PFAS concentration gradients in the groundwater from documented FTC sources and the presence of wetlands connected to source areas on the FTC property suggest these impacts are linked to the Site and should be included in the mapping of the extent of groundwater contamination.
- **Impacts at PZ-27-12:** JCI/Tyco suggested that PFAS detected in PZ-27-12, which is northeast of the FTC, are from another source (e.g., the former Arnovitz Junk Yard). Figure 20 in the SI Status Report shows that the location of PZ-27-12 aligns with the path of the sanitary sewer line that connects the FTC property to the city of Marinette's Wastewater Treatment Plant. JCI/Tyco should further evaluate the depth of the sanitary line in this area and whether historical leaks in the sanitary sewer could have introduced PFAS to the groundwater near this location. If so, the results from PZ-27-12 should be included in the mapping of the extent of groundwater contamination from the Site.
- **Plume Stability:** The 2022 groundwater monitoring was the first comprehensive sampling event of NR 141-compliant monitoring wells. JCI/Tyco's conclusion in the SI Status Report that the plume is stable or receding is premature. Determination of plume stability requires that the degree and extent of the plume first be defined and the stability then monitored over time through an established monitoring well network.
- **Flow into Green Bay:** In Section 4.2.1 of the SI Status Report, JCI/Tyco suggests that the conditions in the unconsolidated aquifer inhibit groundwater flow into Bay of Green Bay. This contrasts with its CSM, where JCI/Tyco reported that "*groundwater from the Site flows generally east, with flow paths radiating along an arc from southeast to northeast, discharging to Green Bay and the Menominee River.*" The DNR's review of the data presented in the SI Status Report (e.g., boring logs and upward vertical hydraulic gradients along the Bay of Green Bay shoreline) supports the prior CSM's conclusion that the groundwater plume discharges into the Bay of Green Bay. JCI/Tyco should represent these discharges into the Bay of Green Bay on the groundwater plume maps.

Principal Component Analysis (PCA)

Geosyntec completed a principal component analysis (PCA) on behalf of JCI/Tyco, which was included as Appendix M in the SI Status Report. The PCA is a statistical method to evaluate chemical signatures and correlations in a dataset. JCI/Tyco presented the PCA as a line of evidence to support its conclusion that it has defined the boundaries of contamination from the Site.

The DNR does not agree that the PCA supports JCI/Tyco's interpretation on the extent of contamination for the Site for the following reasons:

- Look for Locational Groupings: The PCA assigned boundaries to pre-defined areas, including the expanded site investigation area (ESIA), and then examined whether the zones contain a chemical signature associated with the Site. This process is the reverse of what is expected for this type of analysis. Typically, the PCA would first look if there are clusters in the data that are locationally unique and would generate zones based on a statistically unbiased method for data clustering. Assignment of the ESIA as one large zone does not allow specific locations within the ESIA to be considered for inclusion as part of clusters associated with the Site.
- Data Variability in ESIA: In the PCA, all the data from the ESIA was first lumped together and compared to the data from the FTC source areas. This "ESIA" group has variability, where some samples look more like the data from the FTC than other samples pre-assigned to the ESIA.
- PFAS Variability: To establish and form a strong correlation in a PCA, the DNR would have expected the number of components affecting the variability in 80 to 90 percent of the data to be limited to one or two; however, that is not the case for this PCA. In this PCA, the data is generally lumped together, and does not show enough differences or groupings to conclude that the FTC is not a contributing source.

Next Steps

The DNR expects that JCI/Tyco will conduct the SI activities and reporting it proposed for 2023 and will conduct additional work to satisfy its SI obligations per Wis. Admin. Code ch. 716. JCI/Tyco should submit an SI work plan to the DNR within **60 days** of the date of this letter that includes additional field investigations and evaluations to address, at a minimum, the data gaps and questions described in this letter (Wis. Admin. Code § NR 716.09). JCI/Tyco may opt to proceed with any of the sampling recommended herein prior to the DNR's approval of the SI work plan.

As a reminder, this Site is subject to an enforcement action and therefore all submittals to the DNR under Wis. Admin. Code chs. NR 700-799 and submittals directed by the DNR must be accompanied by an Wis. Admin. Code ch. NR 749 fee per Wis. Stat. § 292.94. These fees are not pro-ratable or refundable per Wis. Admin. Code § NR 749.04(1). If you have any questions about whether to include a fee with a submittal, please contact DNR staff prior to submitting a document without a fee.

If you have any questions, please contact me at Alyssa.Sellwood@wisconsin.gov or (608) 622-8606.

Sincerely,

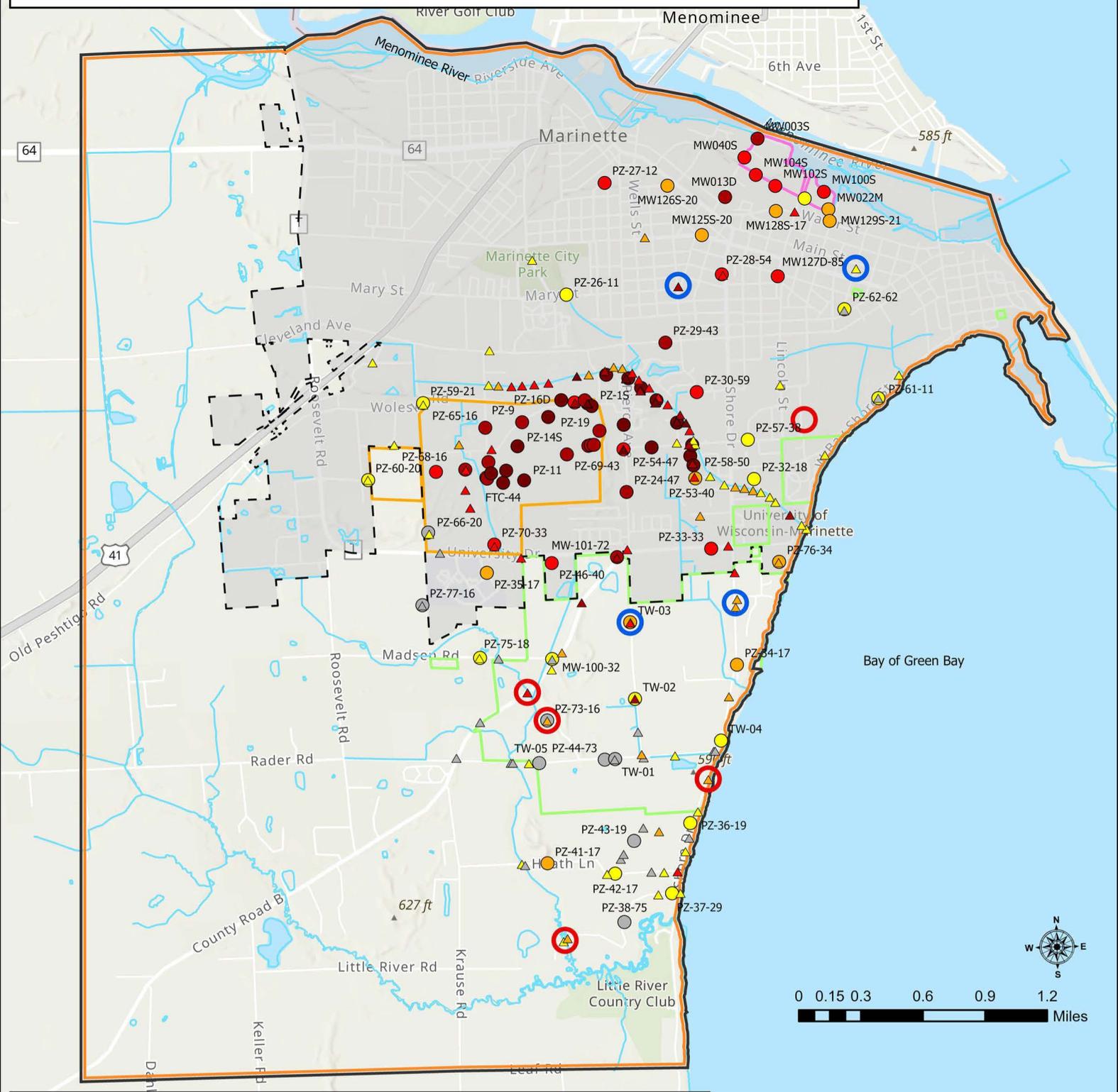


Alyssa Sellwood, PE
Complex Sites Project Manager
Remediation & Redevelopment Program

Attachments: Figure 1: PFOA Results in Groundwater: Overburden
Figure 2: PFOA Results in Groundwater: Shallow Weathered Bedrock
Attachment A: Figures from DNR's Apr. 11, 2022 Letter with Suggested Monitoring Locations

cc: Jodie Thistle, DNR (via email: Jodie.Thistle@wisconsin.gov)

Figure 1: PFOA Results in Groundwater: Overburden Soils



- Surface Water
 - Expanded Site Investigation Area (ESIA)
 - JCI/Tyco Stanton Property
 - JCI/Tyco FTC Property
 - Municipality Boundary
 - JCI/Tyco Private Well Sampling Area (PWSA)
- NR141 Well Locations Proposed by:
- JCI/Tyco for installation in 2023
 - DNR for JCI/Tyco to install in next phase of SI work

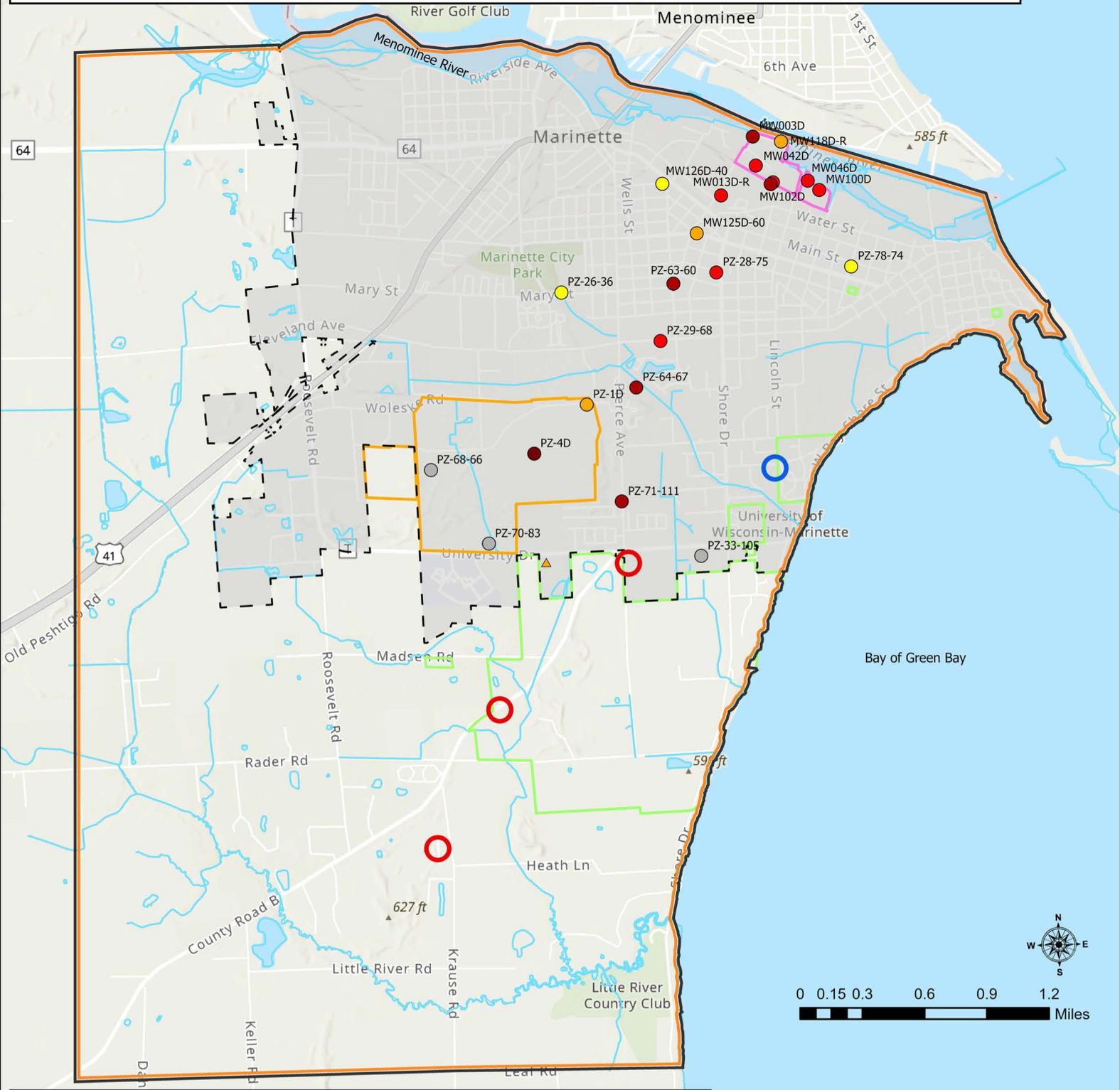
NR141 Wells - PFOA Results (ppt)	Other Groundwater Sampling Points - PFOA Results (ppt)
● <2	▲ <2
● 2.1-20	▲ 2.1 - 20
● 20.1-100	▲ 20.1 - 100
● 100.0-1,000	▲ 100.1 - 1,000
● 1,000.1-10,000	▲ 1,000.1 - 10,000
● >10,000	▲ >10,000

Notes:

- * Sample locations and PFOA concentrations are from data submitted to the DNR by JCI/Tyco in various reports and database updates. Locations digitized from figures are approximate.
- * PFOA concentrations are based on the most recent sampling event available at each monitoring location. When multiple depth intervals are available at a location, the highest concentration is represented on this figure.
- * Map prepared by WSP on behalf of the DNR on 6/21/23

Service Layer Credits: World Topographic Map: Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA
World Hillshade: Esri, CGIAR, USGS

Figure 2: PFOA Results in Groundwater: Shallow Weathered Bedrock



<ul style="list-style-type: none"> — Surface Water Expanded Site Investigation Area (ESIA) JCI/Tyco Stanton Property JCI/Tyco FTC Property Municipality Boundary JCI/Tyco Private Well Sampling Area (PWSA) <p>NR141 Well Locations Proposed by:</p> <ul style="list-style-type: none"> JCI/Tyco for installation in 2023 DNR for JCI/Tyco to install in next phase of SI work 	<p>NR141 Bedrock Wells - PFOA Results (ppt)</p> <ul style="list-style-type: none"> ● <2 ● 2.1-20 ● 20.1-100 ● 100.0-1,000 ● 1,000.1-10,000 ● >10,000 	<p>Other Groundwater Sampling Points - PFOA Results (ppt)</p> <ul style="list-style-type: none"> ▲ <2 ▲ 2.1 - 20 ▲ 20.1 - 100 ▲ 100.1 - 1,000 ▲ 1,000.1 - 10,000 ▲ >10,000
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Service Layer Credits: World Hillshade: Esri, NASA, NGA, USGS
World Topographic Map: Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA

Notes:

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- * Map prepared by WSP on behalf of the DNR on 6/21/23

Attachment A
Figures from DNR's Apr. 11, 2022 Letter with Suggested Monitoring Locations

