**From:** Ziegelbauer, Heather <Heather.Ziegelbauer@jacobs.com>
**Sent:** Monday, April 1, 2024 8:52 PM
**To:** Kleinberg, Andrew
**Cc:** Krueger, Sarah E - DNR; Carey, Angela J - DNR; Cooper, Shanelle; Denice Nelson; Ryan Suennen; Finney, David; Mitchell, David; Graham, Jack
**Subject:** RE: WID006125215 Tyco Safety Products - 2022 Barrier Wall Annual GW Monitoring Report Review - Response to Comments
**Attachments:** 20240401-Tyco-RTC_2022AnualReport.pdf

**Follow Up Flag:** Follow up
**Flag Status:** Flagged



Andrew,
On behalf of Tyco, the attached memorandum responds to the Agencies comments submitted via email on February 14, 2024 regarding the 2022 Annual Groundwater Monitoring Report for the Tyco property located at One Stanton Street, Marinette, Wisconsin.

Please let us know if you have any question.

Thanks,

**Heather Ziegelbauer, PE*** | Jacobs | Project Manager
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**From:** Kleinberg, Andrew <Kleinberg.Andrew@epa.gov>
**Sent:** Wednesday, February 14, 2024 2:13 PM
**To:** Denice Nelson <denice.karen.nelson@jci.com>
**Cc:** Ziegelbauer, Heather <Heather.Ziegelbauer@jacobs.com>; Krueger, Sarah E - DNR <sarah.krueger@wisconsin.gov>; angela.carey@wisconsin.gov; Cooper, Shanelle <Cooper.Shanelle@epa.gov>; Patel, Shilpa <patel.shilpa@epa.gov>; Clarizio, Richard <Clarizio.Richard@epa.gov>
**Subject:** [EXTERNAL] WID006125215 Tyco Safety Products - 2022 Barrier Wall Annual GW Monitoring Report Review

Hello,

Please see attached EPA and WDNR'S review of the 2022 Barrier Wall Annual GW Monitoring Report. Let me know if you have any questions or concerns.

Thank you,

**Andrew Kleinberg**
Project Manager - Geologist
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Land, Chemicals & Redevelopment Division, Region 5, U.S. EPA
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# Response to Comments on 2022 Barrier Wall Annual Groundwater Monitoring Report Review

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|---|---|
| **Date:** | April 1, 2024 |
| **Project name:** | Tyco Fire Products LP, One Stanton Street, Marinette, Wisconsin |
| **Project No:** | D3766600 |
| **Attention:** | Andrew Kleinberg |
| **Company:** | U.S. Environmental Protection Agency |
| **Prepared By:** | Jacobs |
| **Document No:** | D3838400.316 |
| **Copies To:** | Sarah Krueger, WDNR<br>Angela Carey, WDNR<br>Ryan Suennen, Tyco Fire Products<br>Denice Nelson, Johnson Controls<br>Heather Ziegelbauer, Jacobs<br>Dave Finney, Jacobs |

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On behalf of Tyco Fire Products LP (Tyco), Jacobs Engineering Group Inc. (Jacobs) prepared this memorandum as a response to U.S. Environmental Protection Agency (EPA) and Wisconsin Department of Natural Resources (WDNR's) (collectively referred to as the Agencies) comments on the *2022 Barrier Wall Annual Groundwater Monitoring Report* (2022 Annual Report) dated April 15, 2023 (Jacobs 2023). This memorandum responds to the Agencies comments submitted via email on February 14, 2024. At the Agencies request, the 2023 *Five-Year Technical Review Report* submitted April 1, 2024 (2023 Five-Year Report) also includes the 2023 Barrier Wall Groundwater Monitoring Annual Report as Appendix A (2023 Annual Report). The 2023 Five-Year Report and the 2023 Annual Report have incorporated the clarifications and modifications requested in the 2022 Annual Report comments. This response memorandum along with the updates included in the *Five-Year Technical Review Report* and 2023 Annual Report submitted on April 1, 2024, will close out the 2022 Annual Report.

Each of the Agencies' comments on the 2022 Annual Report is shown below in *italic* font, followed by Tyco's responses in plain text.

1. **Agencies General Comments:**

   *The purpose of the Barrier Wall Groundwater Monitoring Annual Reports is to summarize the prior year's work, document site conditions, and provide data that adequately demonstrates the performance of the barrier wall. The quarterly reports should be the basis for much of the annual report, and relevant comments herein should be considered for incorporation in future quarterly reports. These comments are to be considered, addressed, and/or incorporated into future annual reports unless specifically directed to revise the 2022 annual report. The vertical barrier wall (VBW) containment system was designed to prevent highly contaminated groundwater from leaving the site and re-contaminating surface water and sediment in the Menominee River. Given the nature, degree, and extent of arsenic contamination at the site, the VBW system will require monitoring and maintenance in perpetuity or until an action is taken to remove or stabilize the arsenic. The VBW monitoring should evaluate the present effectiveness as well as the long-term effectiveness.*

*Designing an effective monitoring program is critical in understanding the short-term and long-term efficacy of the system. Traditional features of sites with containment systems including a continuous cap and maintenance of an inward gradient across the entire perimeter do not exist at the Stanton Street site and make evaluation of hydraulic conditions challenging. Multiple lines of evidence have been used at the site in the evaluation of the VBW's efficacy.*

*These include:*

- *VBW inspections (limited and where possible)*
- *Hydraulic conditions (potentiometric surface)*
- *Hydraulic head differences*
- *Hydraulic independence*
- *Total arsenic concentration in groundwater*

*The interpretation of the data and observations that inform these lines of evidence still leaves some uncertainty in the conclusion that the wall is serving as an effective barrier. Additional information is required to further support this statement. EPA and WDNR are providing the following comments and recommendations to improve the ability of the monitoring and maintenance program to assess the effectiveness of the VBW system, prevent contaminated groundwater from leaving the site, and ensure long term protectiveness. Future reports should build on the current evaluation and lines of evidence by including the following recommendations and any other appropriate methods:*

- *Develop a water balance for each of the four sections of the containment system and the site as a whole.*
  - *Include hydraulic conductivity calculations for each of the barrier wall systems that make up the distinct hydraulic units.*
  - *Include features that may affect containment such as variations in the height of different barrier walls or utility corridors that cross vertical barrier walls.*
- *Update the Conceptual Site Model (CSM) to reflect current conditions including information from each of the existing lines of evidence studied and the water balance.*
- *Evaluate if and how the 4 sections of the site are hydraulically connected.*
- *Demonstrate how groundwater is recovering outside the VBW system following its construction.*
  - *The focus of the monitoring program has been on conditions within the VBW system with data collected outside the system to inform its effectiveness. Data to illustrate conditions outside the wall should be collected and isoconcentration lines generated.*
- *Assess the risks associated with surface water and groundwater mixing and potential releases to the river.*

**Tyco Response**.

Comment noted. The site is in a post remedy monitoring phase that has been developed with the Agencies as part of an iterative and collaborative process documented in the various monitoring plans and agreements (2011 Monitoring Plan, 2014 Agreement, 2015 Monitoring Plan [update], and 2019

Addendum[1]). The following responds to the last five bullets of the comment and how each was incorporated into the 2023 Five-Year Report or 2023 Annual Report:

- A water balance for each of the four sections of the containment system and the site as a whole will be included in the 2024 Annual Report. The Agencies' comments were received on February 14, 2024 and Tyco will need to obtain additional data to allow for this calculation; therefore, an accurate water balance for 2023 could not be developed at this time. Only the volumes of water removed from the extraction well network and from phyto-plot evapotranspiration were included in the 2023 Five-Year Report and 2023 Annual Report. In the 2024 Annual Report, a comprehensive water balance will be provided using site data obtained over the course of 2024.
- Updates to the CSM were added to the 2023 Annual Report as Section 3.5 and Figure 3-10 to reflect current conditions, including information from each of the existing lines of evidence studied. The estimated volume removed from the well network and phyto-plot evapotranspiration was included on the 2023 CSM updates; the water balance will be included on the 2024 CSM update.
- Similar to the water balance, evaluation of how the site contained areas that are hydraulically connected will be included in the 2024 Annual Report.
- Review of groundwater outside the VBW system is discussed in the 2023 Annual Report as part of the arsenic distribution and trends in Sections 3.3.1 and 3.3.2, respectively. The arsenic trends (Section 3.3.2) mainly focuses on the review of wells outside the wall. The concentrations outside the wall are included on Figures 3-6 to 3-8, and the Mann-Kendall trends at each of the monitoring wells outside the wall are summarized on Figure 3-9. The development of isoconcentration contours outside the wall is not possible based on the number of wells beyond the wall, their proximity to the wall, and the limited variability in concentrations between each; given the objectives of the post-remedy barrier wall monitoring, the network that was agreed to with the Agencies as part of the 2015 Monitoring Plan and 2019 Addendum was not developed for this purpose. The recovery of groundwater outside the wall and upgradient/side gradient of the contained source is evaluated through regular sampling and statistical assessments of the concentration trends.
- Potential for surface water and groundwater mixing and potential discharge to the river is discussed in Section 3.2.2; groundwater–surface water mixing above the ground surface was not a concern in 2022 or 2023 (hydraulic heads were below the ground surface within the contained area during times of any overtopping). As part of understanding resiliency to rising lake levels and climate change, additional assessment of the risks associated with future surface water and groundwater mixing and potential releases to the river in the Wetlands Area will be considered and included in an upcoming quarterly report.

[1] CH2M HILL, Inc. (CH2M). 2011. *Barrier Wall Groundwater Monitoring Plan, Tyco Fire Products LP, Stanton Street Facility.* January 25.

U.S. Environmental Protection Agency (EPA). 2014. *Agreement on Resolution of 2013 Five Year Technical Issues, Ansul Incorporated Site, Marinette, WI.* RCRA Consent Order No. RCRA-05-2009-007. April 23.

CH2M HILL, Inc. (CH2M). 2015. *Final Revision 2, Revised Barrier Wall Groundwater Monitoring Plan Update.* September 3.

Jacobs Engineering Group Inc. (Jacobs). 2019. *Addendum to 2015 Barrier Wall Groundwater Monitoring Plan Update.* June 24.

2. **Agencies Specific Comment – 1.1 Site Overview – Paragraph 3:**

   - *"Additionally, soft sediment in the former 8th Street Slip was removed, the former slip area was filled with clean material and covered with asphalt, and groundwater monitoring was performed to demonstrate the effectiveness of the interim corrective measures."*
     - *It should be clarified in the text that although clean fill was used, it was placed in an area with elevated arsenic concentrations in shallow groundwater and that assumptions cannot be made that the material has not come in contact with contaminated groundwater.*

   **Tyco Response**.

   The wording has been revised in Section 1.2 of the 2023 Five-Year Report to provide clarification. The intent of the text referenced was not to indicate the area was clean but to highlight the past work completed at the property, which involved the addition of clean fill.

3. **Agencies Specific Comment – 3.3 Pump Down Program Performance:**

   - *Consider evaluating the water level in each individual well compared to the target elevation. Any individual well with a higher-than-average head may be an indicator that additional assessment is needed.*
     - *Consider providing individual Pump Down Program system hydrographs for the salt vault and 8th street slip with elevations from each individual well in addition to average well and river elevations.*
     - *Future quarterly report PDP system hydrographs should also be updated to reflect this comment.*

   **Tyco Response**.

   As noted in the *Response to Comments on 2023 Q3 Progress Report Review with Comments*, submitted January 18, 2024 (Jacobs), the individual well locations are evaluated and reviewed as the data are collected to assess whether additional pumping is needed. However, in accordance with the 2015 Monitoring Plan, the arithmetic average of the groundwater elevations in each cell is calculated for comparison to the target elevation and assessing overall compliance against the target elevation of 577.9 feet North American Vertical Datum 1988 (NAVD88). A condition of noncompliance occurs only if the if the average groundwater elevation exceeds 578.4 feet NAVD88.

   Pump down program (PDP) system hydrographs for the former Salt Vault and former 8th Street Slip with individual monitoring well elevations were included in the 2022 Annual Report as Figures 3A and 3B, respectively, with the averages for both areas provided on Figure 3C. The 2023 Annual Report figures have been updated to include the average on the same figure as the individual wells and a figure with just the averages for both areas (Figure 2-2 with the former Salt Vault individual wells and average, Figure 2-3 with the former 8 Street Slip individual wells and average, and Figure 2-4 with the average for both areas). The fourth quarter 2023 quarterly report figures submitted January 16, 2024, also have been updated to include both the individual well and the average for each area. These hydrographs will be included in quarterly and annual reports moving forward.

4. **Agencies Specific Comment – 4.2 Phyto-pumping System:**

   - *Include the Phyto-pumping system in the water balance for each section of the site and the site as a whole.*
     - *Evaluate how the system may contribute to a net reduction in the volume of water requiring management at the site.*
     - *Include the Phyto-pumping system as part of the lines of evidence for site control and its effectiveness.*

   **Tyco Response**.

   The phyto-plots are a voluntary component of the remedy Tyco installed to augment the groundwater collection and treatment system and reduce the volume of active water withdrawal necessary to prevent flooding at the site. The phyto-pumping system contribution is discussed in the 2023 Annual Report Section 2.1.4, the 2023 Five-Year Report Section 2.5, and was included on the 2023 CSM updates on Figure 3-10 in the 2023 Annual Report. As discussed in the response to the Agencies' General Comment, the water balance will be included in the 2024 Annual Report.

5. **Agencies Specific Comment – 5. Barrier Wall Effectiveness Evaluation:**

   - *"Barrier wall inspections are conducted annually on the land and water sides of the barrier wall to note any damage of the visible portions of the barrier wall and identify any visible leaks or integrity issues that would affect the onsite groundwater management required by the AOC. Additionally, the sheet pile barrier wall along the river is surveyed to document any changes to the barrier wall alignment that may affect its effectiveness."*
     - *Describe the scope of the VBW inspection to clarify how much of the wall is observable and able to be inspected.*

   **Tyco Response.**

   The detailed scope for the annual VBW inspection is outlined in the 2015 Monitoring Plan, and additional details for the underwater inspection are included in the 2019 Addendum. During the typical annual inspections (conducted above-waterline on the river side), the river elevation dictates the portions of the wall on the water side that can be seen from a boat. The underwater inspection (conducted every 5 years) is able to inspect the exposed portion of the wall to the river bottom on the water side or to the top of the riprap in place over a portion of the wall starting in the Turning Basin and to the Wetlands Area (as shown on Figure 4-1 in the *2023 Sediment Sampling Report* [Jacobs 2023]). On the land side, there is minimal wall exposed because it is either covered or mostly covered with soil, gravel, asphalt, or concrete.

   Additional details for the 2023 inspection and scope completed have been included in the 2023 Annual Report in Section 3.1 and Attachments 4 (detailed memorandum on the sheet pile VBW inspection and inspection form) and 5 (inspection form for the slurry wall inspection).

6. **Agencies Specific Comment – 5.1 2022 Barrier Wall Visual Inspections and Survey:**

   - *Inspection of the visible portions of the land and river side of the VBW along the north side of the site is important to identify conditions that may indicate that this portion of the containment system is not functioning as intended.*
     - *Contracted staff (Endpoint Solutions) conducting the visual inspections should be listed in the report along with their credentials/qualifications (professional engineer, surveyor, etc.).*

  - *In future annual reports, provide a barrier wall inspection form that documents site conditions with photos and notes as well as the name and credentials of who completed the inspection.*

- *Define and provide justification for what observations indicate additional action beyond continued monitoring may be necessary. What observations indicate satisfactory condition/performance? List relevant sources for criteria.*
- *Include discussion of any new/alternative technologies which may produce a more accurate inspection of the underwater portion of the VBW system and may be an alternative to the underwater inspection performed by a diver every five years.*
- *Include discussion of any new/alternative technologies which may support inspection of the VBW at depth around the salt vault, 8th street slip, and main plant areas.*

**Tyco Response**.

- Staff conducting the inspections or surveys and their credentials/qualifications/role will be included in the 2023 and future reports, and an inspection report or form with photos will be provided to document site conditions. These have been included in Section 3.1 or in Attachments 4 and 5 in the 2023 Annual Report.
- The 2019 Addendum Section 4 (Multiple Lines of Evidence for Assessing Wall Effectiveness and Potential Corrective Actions [updates to 2015 Monitoring Plan Sections 2.1.6, 2.2.6 and 2.3.6]) provides details for what observations indicate additional action beyond continued monitoring may be necessary. Some additional details have also been included in the last/fourth bullet of this response.
- New/alternative technologies to the underwater inspection performed by a diver every 5 years were reviewed/considered as part of this response to comments memorandum in consultation with Jacobs subject matter experts. No new/alternative technologies were identified that would produce a more accurate inspection of the underwater portion of the VBW system than that by a diver. The following summarizes the alternative technologies and their suitability to the site relative to the diver inspections:
  - Remote Operated Vehicles (ROVs): At this stage, the technology has not advanced enough to substitute for a diver who can move more easily in the water, see better without looking through a camera screen, and use their hands and tools for a tactile inspection. Marine growth, which would not be removed by an ROV inspection, would also limit what can be observed to assess the structure. ROVs have been most useful when inspecting areas a diver cannot reach, such as the inside of an intake tube or culvert or areas otherwise hazardous, such as the inside of a channel in a sewage plant.
  - Sector Scanning Sonar: This creates an overall image of a structure underwater where multiple sonar images are spliced together, sometimes with topside photos, to create a cohesive picture of the structure. This results in large-scale imaging of the structure, but it cannot capture small defects such as small-scale penetrations or gaps or identify loose bolts, etc. Marine growth would also limit what can be observed of the structure using this technology. This method works best on walls, as opposed to pile supported piers. This could augment the diver's inspection but is unlikely to provide any substantive benefit beyond the diver inspection.
  - Note technologies that may support inspection of the VBW were also reviewed and discussed in detail with the Agencies between 2017 and 2019. Technologies reviewed and discussed during that time included various geophysical surveying methods, temperature differential surveys using fiber optics, dye testing, and seam sampling using Diffusive Gradient in Thin Film (DGT) samplers. The culmination of this collaborative effort led to the current approach as

documented in the 2019 Addendum. The agreed upon and approved approach documented in the 2019 Addendum was considered the most reliable and repeatable option. In addition to the use of periodic underwater diver inspections, it included the enhancement/expansion of the monitoring well network, installation of additional transducers, and performance of the SeriesSEE evaluations.

- In consultation with Jacobs subject matter experts, a review of new/alternative technologies that could support inspection of the VBW around the wider site at depth was performed as part of this response to comments memorandum. The alternate technologies identified are listed for reference. Many of the following technologies were discussed in detail with the Agencies between2017 and 2019, as noted previously:
  - Nondestructive testing methods:
    - Geophysical Testing: Cross-hole seismic imaging, surface-based seismic refraction survey, ground-penetrating radar, electrical resistivity tomography, electrical resistivity imaging
    - Electrochemical Sensing Systems: Such as with fiberoptic sensors, not likely applicable to the Tyco site at depth
    - Dye tracing
    - Stress/pumping tests using wells installed adjacent to the barrier
  - Destructive sampling or testing methods:
    - Laboratory testing of core samples from the constructed barrier
    - In situ falling or rising head tests (that is, slug tests) performed in a borehole within the barrier
    - In situ piezocone soundings with pore pressure dissipation measurements in the barrier wall
    - Digging test pits to inspect the VBW; however, this would not be recommended unless there were significant signs of deterioration, such as global displacement

  With the exception of stress/pumping tests (which is already part of regular monitoring at the site; see response to comment 9), the nondestructive methods identified, above are not commonly applied in the practice of evaluating hydraulic barriers. This is due mostly to the qualitative nature of how the data are interpreted and the uncertainty and imprecision around their ability to detect and locate defects. The destructive methods listed can be effective tools for evaluating specific areas of soil mixed walls, but their use risks compromising the effectiveness of these structures and thus they cannot be used at larger scales or as part of regular periodic monitoring.

  In combination with the supplemental measures added in the 2019 Addendum, the water level gauging, transducer data collection, groundwater sampling, evaluations, and inspections currently conducted to evaluate the barrier wall's effectiveness is considered a robust multiple lines of evidence approach consistent with EPA's recommended approach for evaluating subsurface barrier performance at waste sites (EPA 1998).[2] Per the 2019 Addendum, when multiple lines of evidence indicate a concern, the results would be highlighted to the Agencies in the quarterly or annual report, along with a plan for assessment or mitigation, as necessary. Potential additional assessment activities may include additional SeriesSEE analysis, additional above- and below-waterline inspections, additional groundwater sampling, surface water sampling, or other

[2] EPA Office of Solid Waste and Emergency Response. 1998. *Evaluation of Subsurface Engineered Barriers at Waste Sites*. EPA 542-R-98-005. August.

evaluation methods to be described in the plan that would be submitted to EPA. Depending on the location and nature of issue, the evaluation methods may include some of the technologies listed earlier. This stepwise approach is also consistent with EPA's recommendations (EPA 1998), which is for the use of a system of monitoring techniques (for the Tyco site the multiple lines of evidence evaluated as noted in the 2015 Monitoring Plan and 2019 Addendum), rather than reliance on a single method, and additional assessment activities, as needed; collectively, this provides the highest level of confidence achievable.

**7. Agencies Specific Comment – 5.2 Hydraulic Conditions:**

- *Consider interpreting the potentiometric surface in the 8SS and SV to 0.1 feet to capture the influence of the PDP extraction wells.*
- *List all assumptions used in developing the potentiometric surfaces.*
- *To adequately characterize the groundwater flow patterns outside the VBW, additional wells are needed upgradient and away from the wall.*

**Tyco Response**.

- June 2022 shallow well hydraulic heads from the former Salt Vault were all within approximately 0.1 foot. Contouring at intervals of 0.1 feet or less is not recommended because this resolution can be affected by imperfections in the data quality (survey and manual measurement data) and may not be indicative of the actual conditions. The former 8th Street Slip had a difference of approximately 1.4 feet, and contours at the 0.5-foot interval generally capture the influence of extraction wells EW-8 and EW-9. December 2022 former Salt Vault and former 8th Street Slip shallow well hydraulic heads exhibited the same general conditions as June 2022. The conditions in July and October 2023 were similar to those observed in 2022 (Figures 3-2 and 3-4 in the 2023 Annual Report).
- Assumptions used to develop the potentiometric surfaces were added to Section 3.2.1 Groundwater Flow included in in the 2023 Annual Report.
- Outside the wall, the monitoring wells evaluated are those approved by the Agencies as part of the 2015 Monitoring Plan and 2019 Addendum are included. There is sufficient data collected to show the hydraulic heads are relatively consistent outside the wall over time and how those hydraulic heads are in relation to the wall. While additional wells might help to further characterize groundwater flow patterns outside the wall, this information is not critical to the objective of monitoring the effectiveness of the barrier wall.

**8. Agencies Specific Comment – 5.3 Hydraulic Head Difference:**

- *Provide the technical basis and sources for the interpretation of the magnitude of head differences across the barrier wall. Specifically, the statement that a one-foot head difference is a significant change that would indicate hydraulic independence.*
- *Provide the technical basis and sources that support the conclusion that the impacts of mounding outside the VBW and PDP extraction in the unconsolidated aquifer are enough to influence HH in the deep/bedrock aquifer.*

**Tyco Response**.

- The hydraulic head evaluation and interpretations are performed in accordance with the agreed upon approach with the Agencies documented in the 2015 Monitoring Plan and 2019 Addendum. Hydraulic head differences and the groundwater concentrations are the main components for long

term monitoring of VBWs. As indicated in the EPA report *Evaluation of Subsurface Engineered Barriers at Waste Sites* (EPA 1998) the requirements and approach are typically determined based on performance criteria[3] established on a site-by-site basis; if required at a site, the measured values used to assess cross-barrier head differential performance varied but were typically greater than 1 foot. At the Tyco site, the hydraulic head differential of 1 foot across the wall is based on the relatively short distances between the wells that are being compared and thus is a clear indication of an unnatural gradient that is steeper than what has historically been observed at the site in the absence of an interstitial hydraulic barrier.

- In response to the comment regarding influence to hydraulic heads in the deep/bedrock aquifer:
  - The 2022 annual report text does not indicate that mounding outside the VBW is influencing the bedrock aquifer. The text indicates that the mounding observed in the shallow wells is not observed in the bedrock. Added clarification to the 2023 Annual Report in Section 3.2.3.2, "because the VBW does not go through the bedrock".
  - As for the PDP, all that is indicated is the vertical gradient is an upward gradient. This is based on water levels collected and transducer water level data over time and consistent pumping in the former 8th Street Slip area. In the vertical gradient Table 3-4 included in the 2023 Annual Report, it shows in 2016 and prior (PDP pumping started in June 2016) there was a downward gradient, after that it has been upward. Also see the 2022 transducer data that shows an upward gradient in Appendix E Figure 2. Finally, note the upward gradient does not necessarily indicate the pumping is affecting the bedrock hydraulic heads or the bedrock ground flow, just that the bedrock hydraulic heads are higher than the shallow hydraulic heads where pumping is occurring; clarifying text similar to this was added to the 2023 Annual Report in Section 3.2.3.2.

**9. Agencies Specific Comment – 5.4 Hydraulic Independence:**

- *Provide the technical basis and sources used to evaluate hydraulic independence. To establish hydraulic independence, all inputs and outputs must be considered.*
- *Based on visual analysis, the transducer graphs indicate the potential for an outward gradient towards the river. The agencies are not convinced that the SerieSEE evaluation has sufficient data quality or selection criteria, to conclude that the groundwater and river are not connected along the Main Plant wall.*

[3] 2009 AOC objectives for the site are 1) Contain on-site groundwater to the maximum extent practicable (not absolute); and 2) Maintain sediment arsenic concentrations at or below 20 mg/kg. The 2014 Agreement added meeting the target elevation in the former Salt Vault and former 8th Street Slip.

**Tyco Response**.

- The hydraulic evaluations and interpretations being conducted are completed in accordance with the agreed upon approach documented in the 2015 Monitoring Plan (Section 2.2) and 2019 Addendum (Sections 3 and 4). The hydraulic independence section (Section 3.2.4 in the 2023 Annual Report) includes an evaluation of the transducer data to confirm the groundwater inside the VBW is acting independently of the groundwater outside the VBW and independently of the Menominee River stage, as applicable. Evidence of independent behavior of groundwater serves as one of several lines of evidence the VBW is effectively containing site groundwater. These evaluations rely primarily on measuring the hydraulic responses in groundwater within, below, and outside the barrier wall to changes in the river level. These river level fluctuations are a proven stressor on the adjacent groundwater units where hydraulic barriers do not exist. Like pumping or injection at a well as part of in situ aquifer testing, falling or rising river levels will stress the adjacent groundwater units, resulting in corresponding changes to measured water levels. Where groundwater is hydraulically independent from the river or adjacent units affected by it, changes in water levels resulting from these river fluctuations are not observed or are di minimis.

  The program developed for the site uses both qualitative and quantitative means to evaluate this hydraulic independence as one line of evidence for assessing the barrier wall's performance. Specifically, continuous hydraulic head data from select monitoring wells are qualitatively evaluated using hydrographs, rainfall records, and pumping information to assess whether responses to river level changes are evident in the continuous water level record. At other wells (as agreed to in the 2019 Addendum), the U.S. Geological Society program SeriesSEE is used. SeriesSEE accounts for fluctuations resulting from barometric pressure changes and allows for the identification of hydraulic responses from river fluctuations alone. The magnitude of these responses can be quantified and compared year over year to determine whether and where the barrier wall may not be functioning as designed. As stated previously, these hydraulic independence evaluations are only one line of evidence; the hydraulic head differences, groundwater flow, arsenic groundwater concentrations, and VBW inspections are also used as other lines of evidence (2019 Addendum; Figures 2-3 and 2-4), and the 2023 Annual Report continues to indicate it is an effective barrier for limiting contaminant migration in overburden groundwater. The water balance (requested in the Agencies' General Comment) will be included in the 2024 and future annual reports that consider the inputs and outputs and will provide another line of evidence (the sixth main line of evidence) for consideration as part of the overall evaluation.

- Comment noted. Visual analysis of the transducer graphs for the Main Plant and Wetlands Area do indicate the potential for an outward gradient toward the river. Pursuant to the 2009 Administrative Order on Consent, Tyco is not required to maintain a target elevation or an inward gradient in the Main Plant and Wetlands Area; the Wetlands Area is lower than other areas of the site and is designed to allow natural overland drainage, thus allowing the area to retain wetlands characteristics. A target elevation cannot be maintained in the Main Plant because increased pumping and lowering of the water table may cause settlement and damage to buildings and underground piping.

Additional figures for some of the transducer hydrographs have been included in Attachment 6 of the 2023 Annual Report that zoom-in on a smaller timeframe of data. The zoom-ins provide another way to look at a smaller time period and allow for a better visual comparison of the monitoring well and river transducer data (versus the entire year on one graph) and how they may differ (in particular during dry periods with no rain), which can then also be compared to the SeriesSEE results. The 2023 zoom-ins provide another line of evidence and indicate, like the SeriesSEE evaluation, that the VBW is an effective barrier for limiting contaminant migration in overburden groundwater because the graphs show no hydraulic correlation between the river and the shallow onsite monitoring wells during the May 19 to June 11 and September 11 to October 10, 2023 periods evaluated (with no extraction well pumping in the May to June 2023 period and the September to October 2023 period including pumping in the Main Plant and Wetlands Area extraction wells).

10. Agencies Specific Comment – Figure 5 – VBW Details and 2022 Inspection:

- *Figure 5 identifies the approximate locations of notable conditions on the wall that warrant action or continued observation.*
  - *Please highlight which surveyed dimple points had deflections > 1 inch on this figure.*

**Tyco Response**.

Survey points were highlighted in the 2023 Annual Report Figure 3-1.