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Date: November 18, 2021
Our Ref: 30015296
Subject: Revised Appendix B: Ditch A Flow Monitoring and Reporting Methods
Tyco Fire Technology Center
BRRTS #: 02-38-580694

Dear Ms. Sellwood,

Arcadis U.S., Inc. (Arcadis) has prepared the attached revision to Appendix B of the Operation, Maintenance, and Long-Term Monitoring Plan (OM&M Plan) for the Ditch A treatment system on behalf of Tyco Fire Products LP (Tyco). The original OM&M Plan was submitted to the Wisconsin Department of Natural Resources (WDNR) on July 19, 2021. Revisions to Appendix B: Ditch A Flow Monitoring and Reporting Methods were requested by the WDNR in a letter dated October 29, 2021; and are addressed in this submittal. The revisions made to Appendix B are outlined below.

Background

- Revised to include a summary paragraph detailing the timeline of the original submittal and requested revisions.

Ditch A Treatment System Flow Rate

- Equation 1 was simplified to describe the daily flow volume of the Ditch A treatment system as the sum of the daily flow volumes for the two treatment trains.

Ditch A Estimated Stream Flow Rate

- The previous Equations 2 and 3 were combined and simplified to a revised Equation 2 which describes the daily Ditch A estimated stream flow volume as equal to the daily Ditch A treatment system flow volume during normal operating conditions (no overtopping of the check dam).

- Revised to include a method for estimating the volume of water overtopping the check dam should an overtopping event occur.

  - Added a new Equation 3 describing the daily Ditch A estimated stream flow volume as the sum of the daily Ditch A treatment system flow volume and the estimated daily volume overtopping the check dam.

Estimate of Untreated Water Volume Moving Past the Ditch A Treatment System

- Clarified that any check dam overtopping that occurs during system downtime for maintenance will be included as overtopping events.

Alyssa Sellwood
WDNR
November 18, 2021

- Clarified that surface water elevation trends upstream of the check dam will be provided in the Semi-Annual Operation, Maintenance, and Optimization Progress Reports to provide evidence that untreated water did not overtop the check dam when the overtopping volume is reported as 0 gallons.

- Added a new Equation 4 describing the daily untreated water volume moving past the Ditch A treatment system as equal to the daily estimated volume of water overtopping the check dam.

PFOS and PFOA Estimated Mass Migration Downstream of Ditch A Treatment System
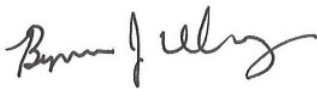
- Renumbered and revised the previous Equation 4 to Equation 5.
  - The new Equation 5 describes the estimated monthly mass of perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) migrating downstream of the Ditch A treatment system as equal to the sum of the weekly PFOA and PFOS mass discharged by the Ditch A treatment system and the PFOA and PFOS mass for each overtopping event in each month.

Closing

This submittal supersedes all previous versions of Appendix B: Ditch A Flow Monitoring and Reporting Methods in the Ditch A treatment system OM&M Plan.

Please contact me with any comments or questions.

Sincerely,
Arcadis U.S., Inc.

Ben Verburg, PE
Principal Engineer

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CC.   Jeff Danko (Tyco)
        Scott Wahl (Tyco)
        Denice Nelson (Tyco)
        Mike Bedard (Arcadis)
        Scott Potter (Arcadis)

Enclosure:
        Attachment 1. Appendix B: Ditch A Flow Monitoring and Reporting Methods – Revised November 2021

Attachment 1

Appendix B: Ditch A Flow Monitoring and Report Methods – Revised November 2021

Appendix B: Ditch A Flow Monitoring and Reporting Methods – Revised November 2021

Background

Per the Wisconsin Department of Natural Resources' (WDNR's) request in a letter dated April 20, 2021, Tyco Fire Products LP (Tyco) will collect the data outlined below as part of the Operation, Maintenance, and Long-Term Monitoring Plan (OM&M Plan). Calculation methods for each parameter are provided in this Appendix B.

- Record or estimate the stream flow in Ditch A during each weekly monitoring event.
- Record or estimate the duration of Ditch A check dam overtopping events and the depth of flow above the check dam.
- Collect a per- and polyfluoroalkyl substances (PFAS) sample from the surface water in Ditch A at location downstream of the treatment system at least once per month. Use the 36 PFAS analyte list JCI/Tyco is required to report.
- Calculate or estimate perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) mass migrating downstream of the Ditch A treatment system for each month during the reporting period.

Tyco submitted the OM&M Plan for the Ditch A treatment system on July 19, 2021. Revisions to Appendix B: Ditch A Flow Monitoring and Reporting Methods were requested by WDNR in a letter dated October 29, 2021. The requested revisions are incorporated into this revised Appendix B.

Ditch A Treatment System Flow Rate

Electromagnetic flow meters FIT-05 and FIT-07 are installed immediately upstream of the two granular activated carbon (GAC) treatment trains (herein referred to as the 100-train and 200-train, respectively) that serve as the primary method of PFAS removal in the Ditch A System. The flow rates and totalizer readings from these flow meters are recorded by the supervisory control and data acquisition (SCADA) system on an hourly basis. The Ditch A treatment system flow rate calculation is described by Equation 1, where V_{System} is the total daily volume processed by the Ditch A treatment system in gallons, V_{100} is the daily totalized volume recorded by FIT-05 in gallons, and V_{200} is the daily totalized volume recorded by FIT-07 in gallons. The daily values will be summed and reported on a weekly basis in the Semi-Annual Operation, Maintenance, and Optimization Progress Reports. The flow rate will be reported on a daily basis in the monthly electronic discharge monitoring reports (eDMRs).

$$V_{System} = V_{100} + V_{200} \qquad\qquad (1)$$

Ditch A Stream Flow Rate

A permeable check dam constructed of Wisconsin Department of Transportation heavy rip rap (D50 = 1.33 feet) is installed in Ditch A between the system intake and outfall. Pressure transducers installed in stilling wells located upstream and downstream of the check dam record surface water levels on an hourly basis by the SCADA system. The Ditch A stream flow rate will be estimated as described below. The daily values will be summed and reported on a weekly basis in the Semi-Annual Operation, Maintenance, and Optimization Progress Reports.

Condition 1: Normal Operation (No Overtopping of Check Dam)

The Ditch A treatment system operates at 100 gallons per minute under normal operating conditions. However, the system may be operated at lower flow rates during low flow or freezing conditions. While the upstream surface water level is below the height of the check dam (as measured by the upstream stilling well), the Ditch A stream flow rate will be estimated to be equal to the system operating flow rate. This relationship is described by Equation 2, where V_{Stream} is the estimated Ditch A daily stream flow volume in gallons and V_{System} is as described in Equation 1.

$$V_{Stream} = V_{System} \qquad (2)$$

Condition 2: Overtopping of Check Dam

Overtopping of the Ditch A check dam occurs infrequently throughout the year (seven occurrences in 2020) and is typically resolved within 24 hours. In the event that the upstream surface water level rises above the height of the check dam and the downstream surface water level elevation (as indicated by the levels in the stilling wells), the duration of the overtopping event and the depth of flow above the check dam will be recorded. Flow estimates will be based on visual observations of the overtopping event that will include an estimate of the width of the overflow, the average depth of the overflow, and an estimate of the average velocity of water flowing over the dam. The flow estimate will be made by multiplying the width of the overflow by the average depth of the overflow by the average velocity of the overflow. When direct observation is not possible (for example, during non-working hours at night), the overtopping flow estimates will be based on the water height above the check dam, duration of the overtopping event, and typical flow rate ranges observed in Ditch A. During overtopping events, the Ditch A stream flow rate will be described by Equation 3 below where $V_{Overtop}$ is the daily volume of water overtopping the Ditch A check dam and V_{System} is as described in Equation 1.

$$V_{Stream} = V_{System} + V_{Overtop} \qquad (3)$$

Estimate of Untreated Water Volume Moving Past the Ditch A Treatment System

Field observations have shown negligible seepage through the check dam while the Ditch A treatment system is offline, and an inward gradient towards the system intake is maintained while the system is operating. Therefore, the seepage volume though the check dam is assumed to be negligible. Consequently, the untreated water volume moving past the Ditch A treatment system is equal to the overtopping flow volume. The daily overtopping flow volume will be summed and reported on a weekly basis in the Semi-Annual Operation, Maintenance, and Optimization Progress Reports. This relationship is described by Equation 4 below, where V_U is the daily untreated water volume moving past the Ditch A treatment system and $V_{overtop}$ is the daily volume of water overtopping the Ditch A check dam. If flow past the check dam occurs during system downtime for maintenance, this volume will be estimated and included as an overtopping event. A comparison of the water level measured at the upstream stilling well and the check dam elevation during the reporting period will be included in the Semi-Annual Operation, Maintenance, and Optimization Progress Reports to provide evidence that untreated water did not overtop the check dam when the overtopping volume is reported as 0 gallons.

$$V_U = V_{Overtop} \qquad (4)$$

PFOA and PFOS Mass Migration Downstream of Ditch A Treatment System

The mass of PFOA and PFOS migrating downstream of the Ditch A treatment system will be calculated by Equation 5, where m is the monthly mass of PFOA or PFOS migrating downstream of the Ditch A treatment system, $C_{in,x}$ is the concentration of PFOA or PFOS in the system influent sample collected most recently in relation to the overtopping event x, $\overline{C_{out}}$ is the average weekly system effluent concentration of PFOA or PFOS, n is the number of weeks for a given month, x is the number of overtopping events in a given month, $V_{Overtop,x}$ is the estimated overtopping volume for event x, and $V_{System,Weekly}$ is the weekly treatment system flow volume.

$$m = \sum_1^n \overline{C_{out,n}}\left(V_{System,Weekly,n}\right) + \sum_1^x C_{in,x}\left(V_{Overtop,x}\right) \qquad (5)$$

The influent and effluent PFOA and PFOS samples will be collected from the Ditch A system influent sampling port (V-200) and effluent sampling port (V-900), respectively.

Low Flow Adjustments

The treatment system flow rate will be decreased as necessary during low flow conditions to maintain continuous operation of the treatment system. In the event that Ditch A is dewatered to the extent that continuous operation cannot be maintained, the treatment system will be disabled via the human-machine interface (HMI). Water levels will be monitored on a daily basis and the treatment system will be re-enabled once sufficient flow is present to resume normal operation.