



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
REGION 4  
ATLANTA FEDERAL CENTER  
61 FORSYTH STREET  
ATLANTA, GEORGIA 30303-8960

February 5, 2021

Mr. Brian T. Hennessey, SRS Remedial Project Manager  
Infrastructure and Area Completion Division  
U.S. Department of Energy  
Savannah River Operations Office  
P.O. Box A  
Aiken, South Carolina 29802

**ENVIRONMENTAL COMPLIANCE &**

**FEB - 5 2021**

**AREA COMPLETION PROJECTS**

**RE: EPA Comments on the Effectiveness Monitoring Report (EMR) for the C-Area Groundwater (CAGW) Operable Unit Removal Action (U) – April 2019 through June 2020, SEMS Number: 82, SRNS-RP-2020-00566, Revision 0, September 2020, dated October 6, 2020, Savannah River Site, South Carolina**

Dear Mr. Hennessey,

The U.S. Environmental Protection Agency, Region 4 (EPA), has reviewed the Effectiveness Monitoring Report (EMR) for the C-Area Groundwater (CAGW) Operable Unit Removal Action (U) – April 2019 through June 2020, SEMS Number: 82, SRNS-RP-2020-00566, Revision 0, September 2020). EPA comments are attached.

If you have any questions or require additional information, please contact me at (404) 562-8513.

Sincerely,

**JENNIFER  
TUFTS**

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JENNIFER TUFTS  
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Jennifer Tufts  
Remedial Project Manager  
Superfund Division

cc: C.L. Bergren, SRNS-ACP  
Susan Fulmer, SCDHEC

**EPA Comments on the Effectiveness Monitoring Report (EMR) for the C-Area  
Groundwater (CAGW) Operable Unit Removal Action (U) – April 2019 through June  
2020, SEMS Number: 82, SRNS-RP-2020-00566, Revision 0, September 2020, Savannah  
River Site, South Carolina**

**GENERAL COMMENTS**

1. Based on the information presented in the Environmental Monitoring Report (EMR) for the C-Area Groundwater (CAGW) Operable Unit Removal (U) (the EMR), it appears the C-Area Groundwater (CAGW) Operable Unit (OU) Non-Time Critical Removal Action (NTC RA) has had minimal impact on the groundwater trichloroethylene (TCE) concentrations from reductive dechlorination (RD). In general, the results of the field measurement data indicate the optimum levels necessary for complete RD to occur were not achieved in the middle aquifer zone (MAZ). For example, the field measurement trends for oxidation-reduction potential (ORP), dissolved oxygen (DO), and pH levels as reported in Appendix A, CAGW OU NTC RA Analytical Data 2019-2020, and as depicted in Figure 21 and Figure 22 for primary monitoring wells CRW023C and CRW026C, respectively, were not within the optimal ranges necessary for complete RD to occur. Ideally, pH should be in the 7 to 8 range for RD, and no lower than 6.5. To reduce vinyl chloride (VC), ORP should be less than -200 millivolts (mV), and preferably below -250 mV. DO should be less than 0.5 milligrams per liter (mg/L). However, as seen in Figures 21 and 22, ORP readings remained in the positive range, DO remained greater than 0.5 mg/L, and pH was never measured above 6. As such, conditions suitable for RD were not achieved during the subsequent monitoring events. This is evidenced primarily by increasing TCE concentration in CRW026C and the detection of TCE contamination at the seepage wells and from surface water samples collected from the tributary to Castor Creek.

The text in Section 5.0 (Summary) on Pages 20-21 of 100 indicates field measurements for DO, ORP, and pH indicate reduced oxygen, which is favorable for anaerobic biodegradation of TCE. However, as noted, favorable conditions suitable for RD were not achieved and it is not clear that conditions will improve in the future without additional actions. Revise the Effectiveness Monitoring Report (EMR) for the C-Area Groundwater (CAGW) Operable Unit Removal Action (U), April 2019 Through June 2020; SEMS Number: 82, SRNS-RP-2020-00566, Revision 0, September 2020 (the EMR) to address this issue.

2. The EMR indicates microbial counts, especially of anaerobic bacteria, are also expected to increase in the groundwater samples over the next 5 years. Additionally, the text in Section 5.0 (Summary) on Page 21 of 100 states “The QuantArray®-Chlor analyses of the BioTraps indicated an increase in anaerobic microbial activity at some wells.” While it is noted an increase in anaerobic microbial activity occurred at some wells, it appears there are insufficient microbes to conduct RD, based on the BioTrap results presented in Table 4 for microbial results. Typically, microbial results should be in the range of  $10^6$  or  $10^7$  cells per milliliter (ml) at a minimum. However, the ranges of microbial results presented in Table 4 are several orders of magnitude lower than  $10^6$  or  $10^7$  cells/ml. It is possible the injected microbes may have been stressed or killed by exposure to oxygen (or to oxygenated water) during injection or the methanogens outcompeted microbes for all of the resources (carbon substrate, vitamins, etc.). One other possibility is that the pH was too low, or the ORP was not low enough or was strongly reducing. As such, it is unclear whether the anaerobic microbes will continue to increase in the future based on the current unfavorable geochemical aquifer conditions (i.e., high DO, positive ORP and low pH levels). Revise the EMR to address this issue.
3. The significance of the aerobic biodegradation pathway and its impact on cis-1,2-dichloroethylene (DCE) and VC were not discussed in the EMR. It is noted that the biodegradation of cis-1,2-DCE

and VC can occur via the aerobic pathway and the BioTrap sampling indicted the presence of aerobic microbes and related enzymes. Currently, the CAGW OU NTC RA monitoring results indicate concentrations of cis-1,2-DCE and VC are virtually non-detect at all sampling locations. Revise the EMR to discuss the significance of aerobic biodegradation on reducing concentrations of cis-1,2-DCE and VC.

4. The EMR states methanogenesis indicates conditions favorable to the biodegradation of TCE by anaerobic bacteria. The EMR further indicates the presence of methane above background concentrations in areas with chlorinated solvents is an indication that the groundwater geochemical conditions are favorable for anaerobic reductive dechlorination. However, the presence of methane and methanogenesis does not provide evidence that complete reductive dechlorination is occurring, and ethane and ethene are better indicators. Methanogenic bacteria compete with reductive dechlorinating bacteria like *Dehalococcoides* sp. for free hydrogen and compete for fermentation substrates. The injected substrate is being used to produce methane. Methanogens double every hour, while it takes about 48 hours for reductive dechlorinators like *Dehalococcoides* sp. to reproduce. Revise the text to acknowledge that the presence of methane does not indicate that complete reductive dechlorination is occurring, that methanogens compete with anaerobic bacteria capable of complete reductive dechlorination, and that ethane and ethene are better indicators that reductive dechlorination is occurring.

### SPECIFIC COMMENTS

1. **Figure 2. CAGW OU TCE Plume 2019, and Figure 3. CAGW OU NTC RA Area (Baseline Conditions), Pages 27 and 29 of 100:** The most current TCE sampling results for the monitoring stations (i.e., monitoring wells, seep line wells, surface water stations) are not presented in the figures. As such, it is difficult to assess results relative to the TCE maximum contaminant level (MCL) of 5 micrograms per liter ( $\mu\text{g/L}$ ) since up to 2 orders of magnitude is represented in a single range of concentrations. For example, in Figures 2 and 3, the orange colored symbols indicate a TCE concentration range of 5.00 - 99.9  $\mu\text{g/L}$  and 5.00 - 49.9  $\mu\text{g/L}$ , respectively, representing two orders of magnitude. For clarity and completeness, revise the figures to include the most recent TCE data, and to split the concentration range of 5.00 - 99.9  $\mu\text{g/L}$  and 5.00 - 49.9  $\mu\text{g/L}$  into smaller increments, such as from 5.00 - 9.99  $\mu\text{g/L}$  and 10.00 to 99.9  $\mu\text{g/L}$  and 10 - 49.99  $\mu\text{g/L}$ , respectively.
2. **Figure 6. CAGW OU Monitoring Stations, Page 35 of 100:** Castor Creek monitoring station CC-07 is not depicted in the figure. Revise the figure to illustrate the location of CC-07.