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Greenville, SC 29601
864.214.8771

15 March 2024
File No. 0129420

TO: Southern Indiana Gas and Electric Company

FROM: Haley & Aldrich, Inc.

SUBJECT: Semi-Annual Remedy Selection Progress Report Pursuant to 40 CFR §257.97(a)
A.B. Brown Generating Station – Ash Pond

The Southern Indiana Gas and Electric Company (SIGECO) initiated an evaluation of the nature and extent of contamination and an assessment of corrective measures for the Ash Pond at the A.B. Brown Generating Station on 15 April 2019 in response to a statistically significant level of an Appendix IV constituent exceeding Groundwater Protection Standards. Pursuant to 40 Code of Federal Regulations (CFR) §257.96(a), a demonstration of need for a 60-day extension for the assessment of corrective measures was completed on 12 July 2019. The Corrective Measures Assessment (CMA) Report was completed and placed in the facility operating record on 13 September 2019.

Following completion of the CMA, SIGECO must, as soon as feasible, select a remedy that meets the standards listed in 40 CFR §257.97(b). Pursuant to 40 CFR §257.97(a), the owner or operator of a Coal Combustion Residual management unit that has completed a CMA for groundwater shall prepare a semi-annual report describing the progress made in selecting and designing the remedy. This report documents activities completed in support of selecting and designing a remedy during the period from 14 September 2023 through 15 March 2024. A summary of the progress in selecting a remedy is provided below.

Summary of Actions Completed

The following actions have been completed during this reporting period:

- collected groundwater samples on 7 to 9 November 2023 from monitoring wells at the Ash Pond for laboratory analysis in accordance with 40 CFR § 257.95;
- evaluated semi-annual groundwater sampling analytical results to supplement and enhance the site conceptual model and groundwater characterization;
- began evaluation of geochemical data collected during site-specific studies completed in support of remedy selection; and
- continued work to elevate potential corrective measures to supplement the favorable CMA alternative, the results of which are summarized in a technical memorandum presented in Attachment A.

Planned Activities

A conceptual schedule for completion of the Selection of Remedy process is included in Attachment B. Anticipated activities for the upcoming six months include the following:

- conduct semi-annual groundwater sampling in May 2024 consistent with 40 CFR §257.95(b) and (d)(1); and
- complete evaluation of bench testing results and geochemical data collected during site-specific studies completed in support of remedy selection.

Enclosures:

Attachment A – Supplemental Groundwater Remedial Alternatives Feasibility Review
Attachment B – A.B. Brown Ash Pond Selection of Remedy Schedule

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ATTACHMENT A
Supplemental Groundwater Remedial Alternatives Feasibility Review

HALEY & ALDRICH, INC.
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864.214.8771

February 2024
File No. 0129420-035

To: Southern Indiana Gas and Electric Company

From: Haley & Aldrich, Inc.

Subject: Supplemental Groundwater Remedial Alternatives Feasibility Review
A.B. Brown Generating Station – Ash Pond
Mount Vernon, Indiana

Southern Indiana Gas and Electric Company (SIGECO) retained Haley & Aldrich, Inc. to complete a Corrective Measures Assessment (CMA) for the Ash Pond at the A.B. Brown Generating Station (Site). Molybdenum and lithium concentrations in groundwater were detected at statistically significant levels greater than the Groundwater Protection Standard (GWPS). The CMA was completed in accordance with 40 Code of Federal Regulations (CFR) §257.97. Recognizing that SIGECO is in a long-term contract to provide the material in the ash pond to a beneficial user, three remedial alternatives were the focus of comparison in the CMA as the source will be removed through the beneficial use project. Those three remedial activities include:

- Monitored Natural Attenuation (MNA) with Closure by Removal (CBR);
- Hydraulic containment with no groundwater treatment, CBR, and MNA; and
- Hydraulic containment with groundwater treatment, CBR, and MNA.

MNA with CBR compared most favorably among the three alternatives (Figure 1, below).

Alternative Number	Remedial Alternative Description	THRESHOLD CRITERIA					BALANCING CRITERIA		
		Be protective of human health and the environment	Attain the groundwater protective standard	Control the source of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment	Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems	Management of waste to comply with all applicable RCRA requirements	CATEGORY 1 Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success that the remedy will prove successful	CATEGORY 2 Effectiveness in controlling the source to reduce further releases	CATEGORY 3 The ease or difficulty of implementation
1	Monitored Natural Attenuation (MNA) with Closure by Removal (CBR)	✓	✓	✓	✓	✓			
2	Hydraulic Containment with No Treatment, CBR, and MNA	✓	✓	✓	✓	✓			
3	Hydraulic Containment with Treatment, CBR, and MNA	✓	✓	✓	✓	✓			

Figure 1. Summary of Corrective Measures

Purpose

After completion of the CMA, and upon learning of a new technology that may be applicable at the Site, SIGECO requested an evaluation of a supplemental groundwater remedy (it was agreed by SIGECO and Haley & Aldrich to evaluate an in-situ groundwater treatment method (i.e., horizontal treatment wells)) to determine if that type of technology could reduce the time to achieve the GWPS because preliminary modeling simulations indicated a relatively long time to achieve the GWPS through MNA with CBR.

Approach

Haley & Aldrich conducted additional investigation activities to refine the site conceptual model (SCM) and enhance our understanding of the nature and extent of affected groundwater downgradient of the Ash Pond dam. The results of these additional activities were used to update the Site groundwater flow and transport model and support this supplemental groundwater remedy evaluation.

The groundwater flow and transport model[1] was used to evaluate and compare passive drainage remedial alternatives like the horizontal wells and perimeter drains. Areas west of the upper ash pool (near CCR-AP-2R) and along the downgradient side of the Ash Pond dam (CCR-AP-3R and CCR-AP-5R) were the primary focus of the passive drainage remedial alternative evaluation. Significant model updates were completed in support of this effort as follows:

- flow calibration included 16 additional groundwater monitoring wells installed to support CMA and the selection of remedy;
- transport calibration included a first quarter 2023 groundwater level gauging and analytical results obtained from the 16 CMA wells;

[1] For these modeling activities, a combination of MODFLOW and MT3D groundwater modeling tools were utilized.

- transport calibration also included surface water sampling results obtained from seeps and surface water features south and east of the Ash Pond;
- improved source term assumptions by calibrating constituent concentrations and distribution from the initial stages of active material impoundment operation (circa 1974) to current conditions (2023);
- incorporated the Ash Pond closure design and schedule prepared by AECOM (August 2021); and
- added a laboratory-based evaluation of the molybdenum partition coefficient (K_d) value used in most current transport simulations.

Model simulations completed to evaluate the effects of Ash Pond excavation for beneficial use of material and subsequent closure (project planned from 2023 through 2038) and potential supplemental remedies included:

- Pond operation (1974 – 2023)
- Ash Pond post-closure (2038 – 2338)
- Primary evaluation – Ash Pond post-closure with horizontal well (2038 – 2338)
- Comparative technology – Ash Pond post-closure with perimeter drain (2038 – 2338)

Results

Model simulation results are summarized in Table 1, below:

Table 1. In Situ and Supplemental Alternatives Evaluation Findings

Simulation	Time to achieve GWPS (years, approximate)		
	CCR-AP-2R	CCR-AP-3R	CCR-AP-5R
Ash Pond CBR	>300	>250	<50; rebounding concentrations indicated
Ash Pond CBR with horizontal well	>300	>250	<50; rebounding concentrations indicated
Ash Pond CBR with perimeter drain	>300	75	150

Corrective measure alternative configurations and groundwater monitoring well CCR-AP-2R, CCR-AP-3R, and CCR-AP-5R locations are shown on Figure 2. Model simulations, at 270 years post-closure, are shown on Figure 3.

Well CCR-AP-2R is located along the western side of the upper ash pool and is an area of maximum concentrations and used to inform the source term within the groundwater flow and transport model. Wells CCR-AP-5R and CCR-AP-3R represent compliance monitoring points on the downgradient side of the Ash Pond where statistically significant levels have been identified.

While simulations with CBR alone and CBR with horizontal wells may initially achieve the GWPS in less than 50 years, simulations show concentrations rebound as constituent mass moves downgradient over time. Simulations show that a perimeter drain improves constituent mass removal, reducing concentrations to near the GWPS in less than 50 years. Because the perimeter drain improves constituent mass flux from the area near CCR-AP-2R, a longer period is simulated to achieve the GWPS,

and rebounding conditions are not observed. Concentrations through time of molybdenum for the entire 300-year simulation are plotted on Figure 4 (CCR-AP-3R) and Figure 5 (CCR-AP-5R).

Conclusions

Evaluation of in situ and passive drainage remedial alternatives concluded:

- Three horizontal wells with passive groundwater collection simulated near areas of maximum concentrations (CCR-AP-2R, CCR-AP-3R, and CCR-AP-5R) would not decrease the time to achieve the GWPS compared to Ash Pond closure with CBR alone.
- Passive Perimeter groundwater collection features were simulated as a comparison to passive horizontal well technology, and while favorable compared to passive horizontal wells, cleanup times for both technologies generally remain long (hundreds of years, except for location CCR-AP-3R where modeling simulations indicate approximately 75 years to achieve the GWPS[2]).

Low groundwater flux in the SCM is the primary factor resulting in simulations of long cleanup times. Site-specific field data indicate low hydraulic conductivity values (10^{-3} to 10^{-6} centimeter per second with an average of 10^{-5}), and flow model simulations of post-closure conditions demonstrate reduced horizontal gradients. Those combined site characteristics result in low groundwater flux, slow constituent migration, and long cleanup times. These physical site constraints affect the positive potential benefits of the passive hydraulic control options to reduce cleanup times to achieve the GWPS.

Additional work is in progress to determine potential attenuation processes that may occur or be enhanced to meet the threshold criteria described in 40 CFR §257.97(b) which include:

- Be protective of human health and the environment;
- Attain the GWPS as specified pursuant to 40 CFR § 257.95(h);
- Control the source(s) of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;
- Remove from the environment as much of the groundwater affected by the coal combustion residual (CCR) unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and,
- Comply with standards for management of wastes as specified in 40 CFR§ 257.98(d).

After evaluation of potential attenuation mechanisms, review of the CMA will confirm findings remain appropriate and will be completed to support a Selection of Remedy. A preliminary completion schedule of the selection of remedy process is summarized below:

- Attenuation focused feasibility study – Fourth Quarter 2023/First Quarter 2024
- Supplemental remedial alternatives evaluation – Second Quarter 2024
- Selection of Remedy reporting – Third Quarter 2024

[2] Modeling simulations show achieving GWPS at location CCR-AP-5R of less than 50 years, but the passive technologies considered in this exercise had no net improvement (CCR-AP-5R) or increased the time to achieve the GWPS at that same location.

- Certify Selection of Remedy – Fourth Quarter 2024

We appreciate the opportunity to provide CCR management support services on this project. Please do not hesitate to call if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.

Todd Plating
Senior Geologist

Neal Kochis
Senior Project Manager

cc: Haley & Aldrich, Inc.; Attn: Steven Putrich, PE (IN)

Attachments: Table 1 – In Situ and Supplemental Alternatives Evaluation Findings (Page 3)
Figure 1 – Summary of Corrective Measures (Page 1)
Figure 2 – Remedial Alternatives Summary at Time of Ash Pond Closure (2038)
Figure 3 – Remedial Alternatives Evaluation Model Output Summary (270 years)
Figure 4 – Simulated Cleanup Time Summary – CCR-AP-3R
Figure 5 – Simulated Cleanup Time Summary – CCR-AP-5R

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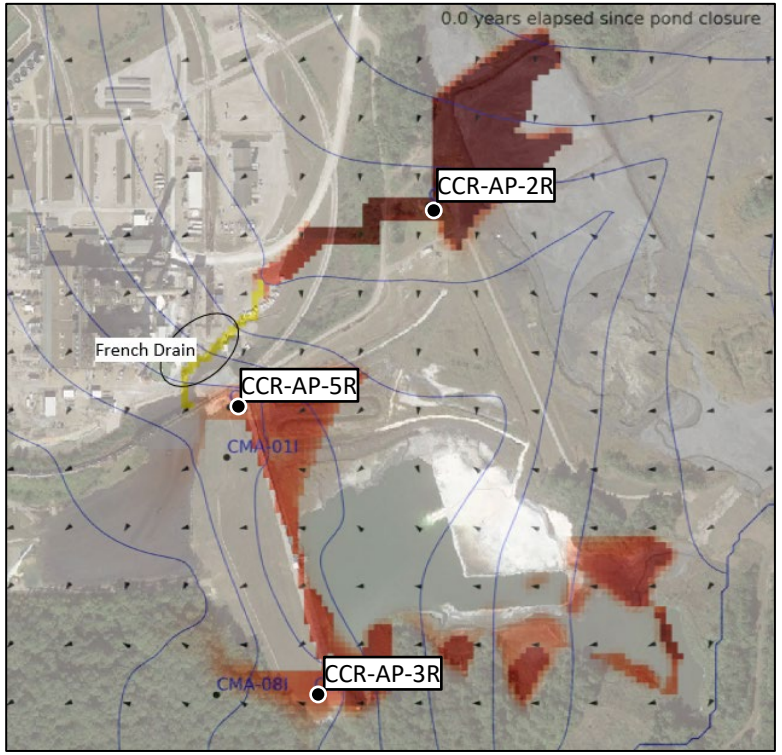
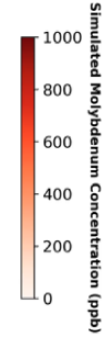
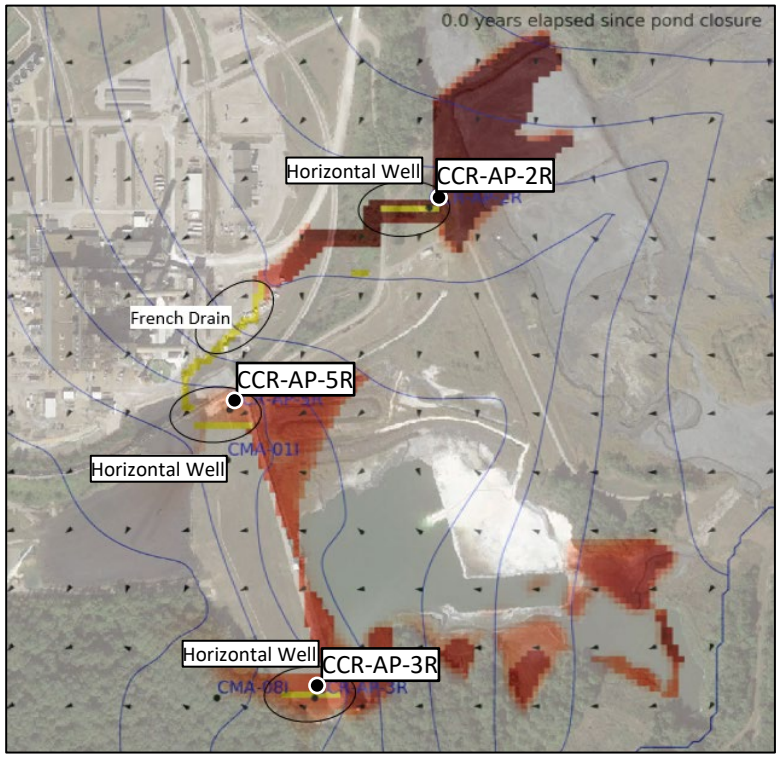
FIGURES

Pond Closure Transport





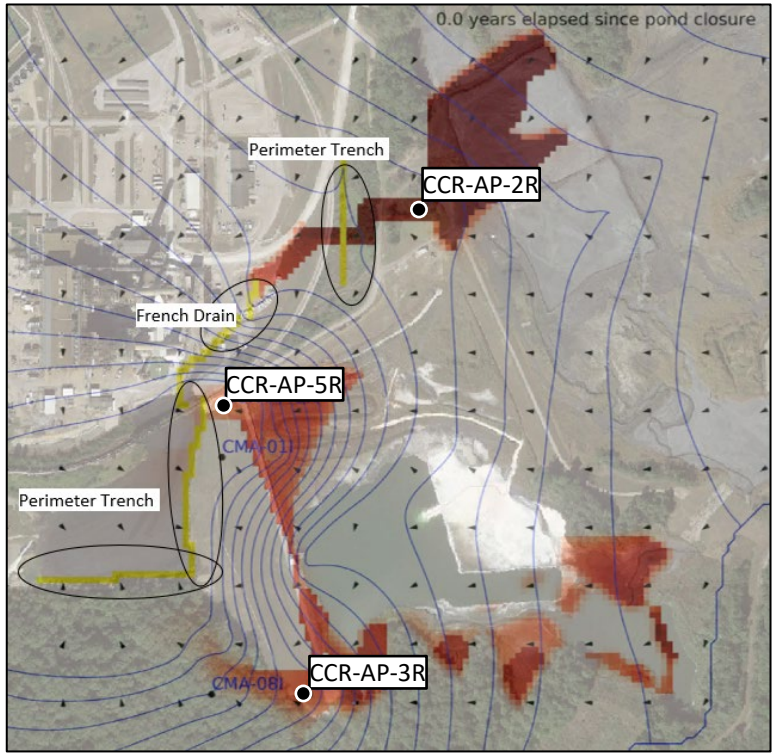
Closure by removal and horizontal well



Horizontal well specifications:

- Length: 250 ft
- Depth: 30 ft
- Radius of Influence: 50 ft
- Cumulative flow (3 wells): <1 gpm

Closure by removal and perimeter trench drain



Perimeter trench drain specifications:

- Length: 500 ft, 700 ft, 700 ft
- Depth: approximately 60 ft
- Cumulative flow (3 drains): 20 gpm

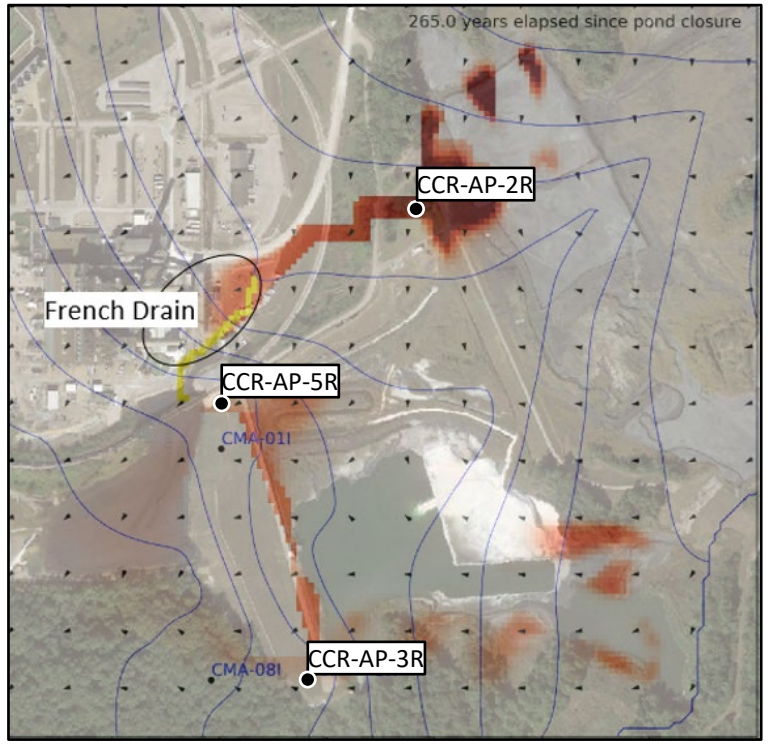
FIGURE 2

REMEDIAL ALTERNATIVES SUMMARY AT TIME OF ASH POND CLOSURE (2038)

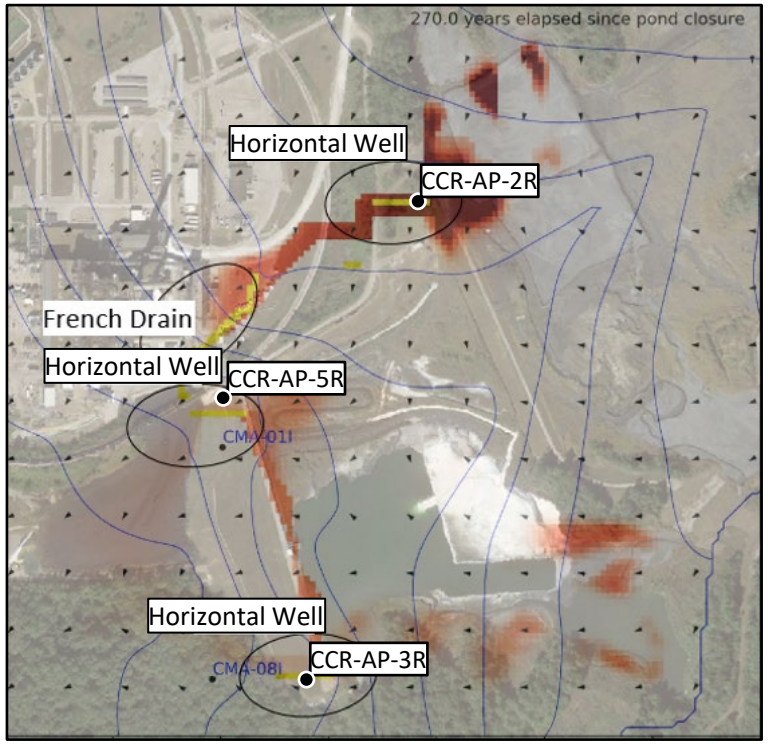
SEPTEMBER 2023

HALEY ALDRICH

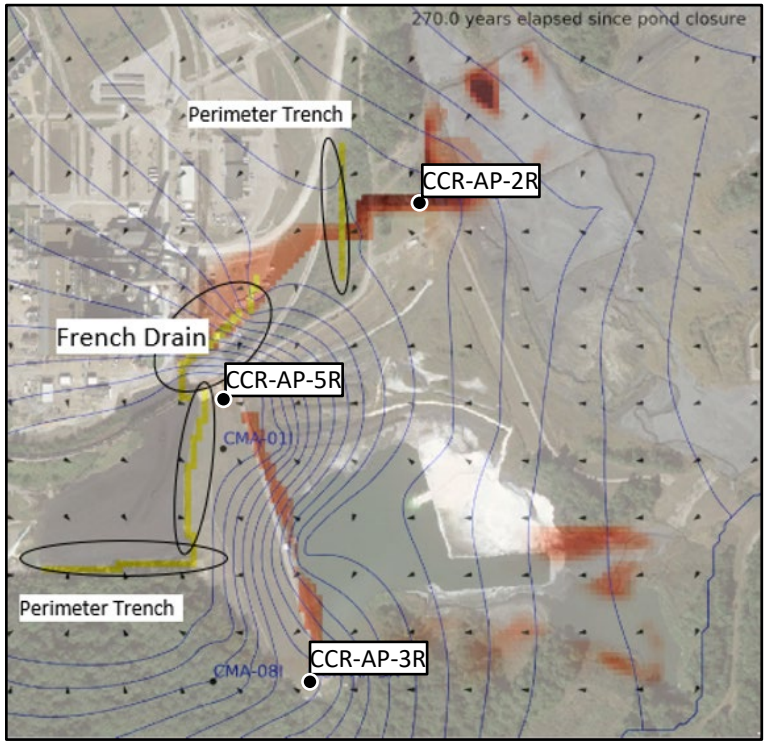
Pond Closure Transport



Closure by removal and horizontal well



Closure by removal and perimeter trench drain



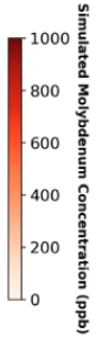


FIGURE 3
REMEDIAL ALTERNATIVES EVALUATION MODEL OUTPUT SUMMARY (270 YEARS)
SEPTEMBER 2023

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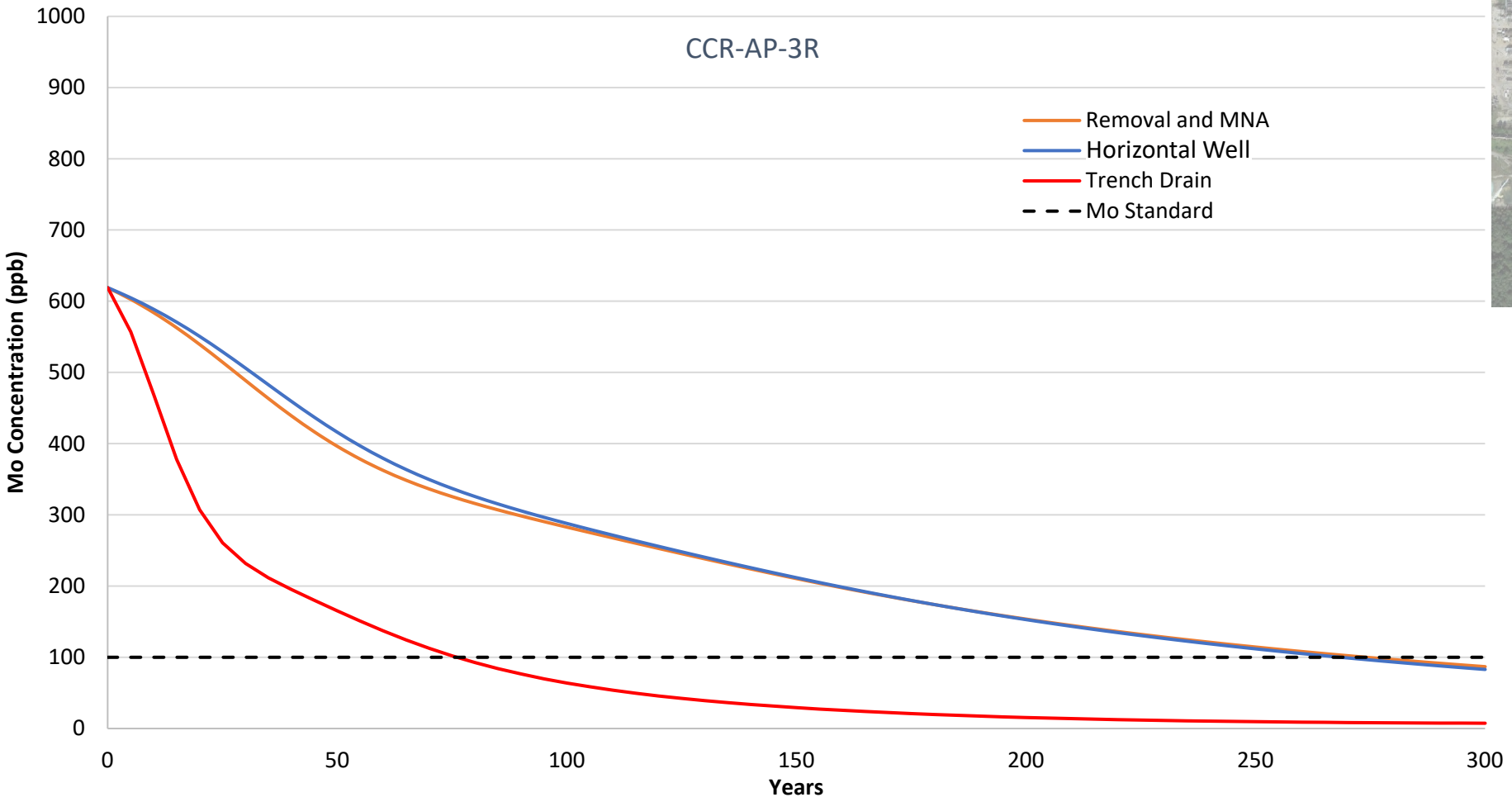

FIGURE 4
SIMULATED CLEANUP TIME SUMMARY - CCR-AP-3R
SEPTEMBER 2023

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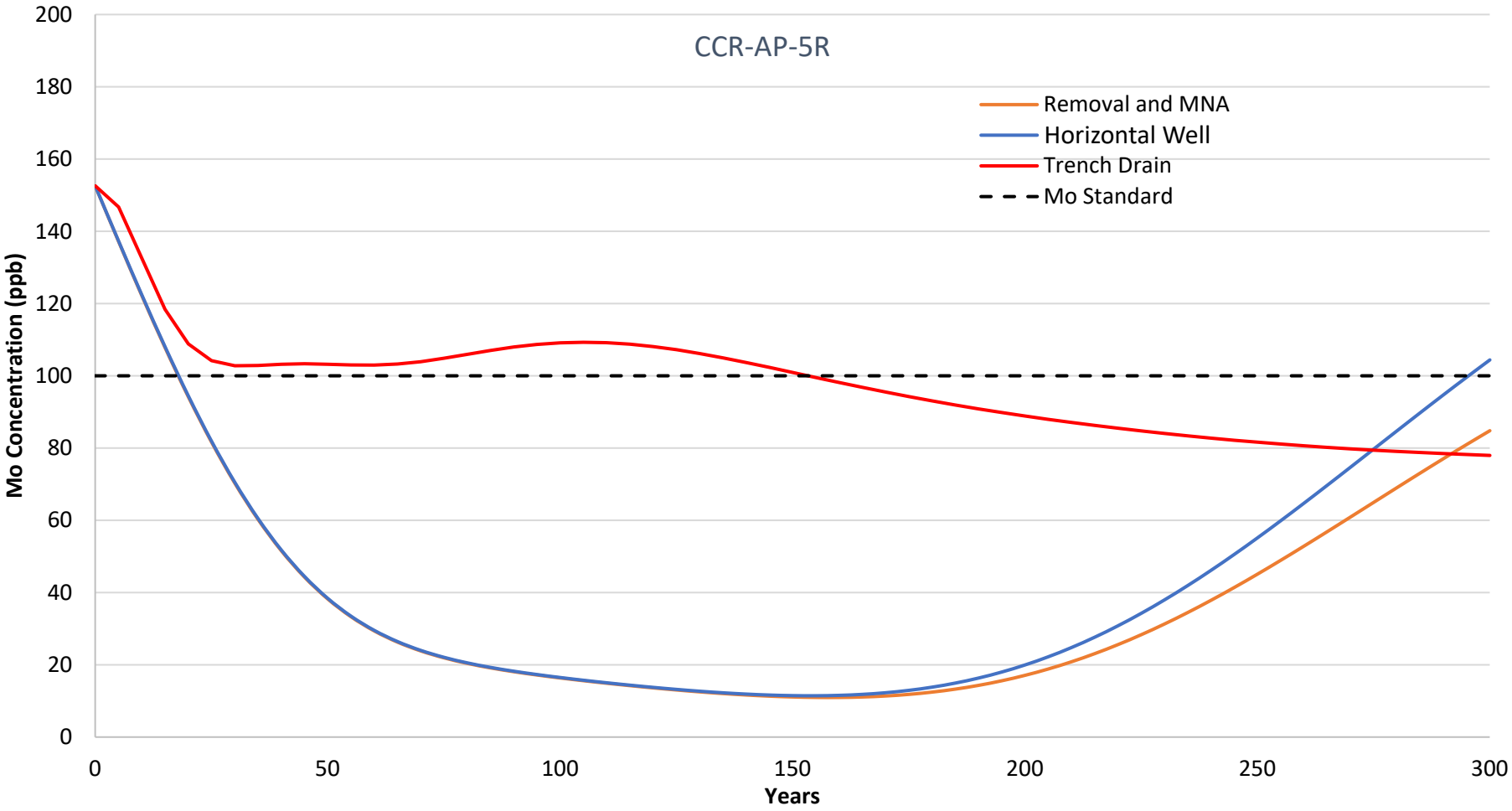

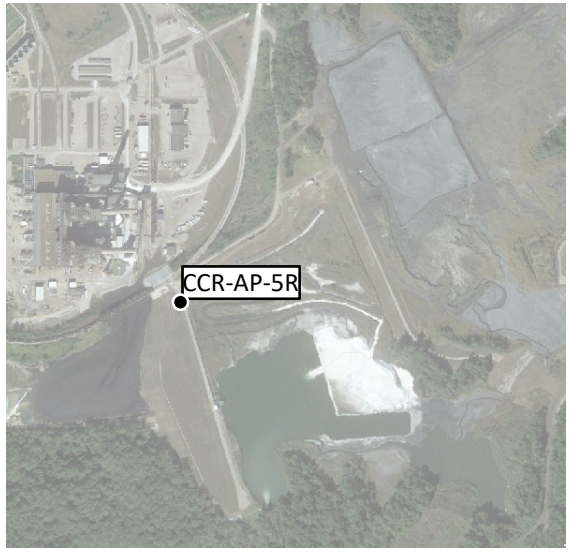

FIGURE 5
SIMULATED CLEANUP TIME SUMMARY - CCR-AP-5R
SEPTEMBER 2023

HALEY ALDRICH

ATTACHMENT B
A.B. Brown Ash Pond Selection of Remedy Schedule

MARCH 15, 2024
A.B. BROWN ASH POND SELECTION OF REMEDY SCHEDULE

#	Description of Task
1	**Selection of Remedy (257.97)**
1.1	In-situ horizontal treatment well technology Evaluation
1.2	MNA Focused Feasibility Evaluation
1.3	Supplemental Corrective Measures Evaluation
1.4	Prepare Selection of Remedy Report
1.5	Specify a schedule for implementing and completing remedial activities
1.6	CenterPoint Selection of Remedy Review
1.7	Certify the selected remedy
2	**Implementation of the Corrective Action Program (257.98)**
2.1	Establish and implement Corrective Action Groundwater Monitoring Program
2.2	Corrective Action Groundwater Monitoring Program
2.3	Evaluate results