Additional Comments Regarding AES Puerto Rico Ash Cell Construction and Groundwater Monitoring

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In addition to prior comments, I offer the following additional comments in light of the following correspondence since my previous comments:

(i) AES responses to prior EPA comments dated November 5, 2021;

(ii) EPA's letter to AES dated January 11, 2022;

(iii) AES letter to EPA dated March 31, 2022;

(iv) AES's 2021 Annual Groundwater Monitoring Report dated January 31, 2022; and

(v) AES's Addendum to its 2021 Annual Groundwater Monitoring Report dated March 11, 2022.

Based on this review, I offer the following observations:

1. AES has not provided any information indicating that its choice of liner materials are compatible with Agremax. This was a prior comment that therefore remains unanswered. Since there will be contact of the Agremax with liner materials, establishing that this compatibility is of critical importance. This is even more important now because in its latest (March 31, 2022) letter, AES confirms that plume attenuation is driven not by the GCL layer but rather the HDPE and leachate collection layers in its liner:

> "The limited difference among the three runs indicates that varying the Geosynthetic Clay Liner (GCL) permeability of the liner system does not appreciably affect plume attenuation. The groundwater modeling results demonstrated that the <u>protection of groundwater is primarily achieved via the high-density polyethylene (HDPE) liner layer and leachate collection layer</u>. The GCL intrinsic permeability (within the range of permeability values assigned) had no noteworthy effect on the overall plume attenuation and thus, no effect on the overall liner system performance."

(Emphasis added.) Thus, ensuring that the HDPE layer is and will remain compatible and undeteriorated over time is critical.

2. AES's groundwater monitoring reports in 2021 and 2019 indicate that at downgradient monitoring well MW-5, there are exceedances of the arsenic groundwater standard of 10 ug/L or 0.010 mg/L. These are excerpted below.

Table 2. Analytical Results and Monitoring Data for Groundwater Samples Collected in April 2021
AES Puerto Rico, LP in Guayama, Puerto Rico

	Well ID	MW-1	MW-2	MW-3	MW-4	MW-4-Dup	MW-5
	Well Location	Upgradient	Upgradient	Downgradient	Downgradient	NA	Downgradient
	Sample ID	AES-MW1-040621	AES-MW2-040621	AES-MW3-040621	AES-MW4-040621	AES-MW4-DUP-040621	AES-MW5-040621
	Sampling Date	4/6/2021	4/6/2021	4/6/2021	4/6/2021	4/6/2021	4/6/2021
Static Water Elevation (ft MSL)		8.97	9.24	8.85	1.75	NA	1.33
Field Parameters	**Units**						
pH	SU	7.08	6.58	6.75	7.02	NA	6.44
Conductivity	mS/cm	1.434	1.374	16.00	42.32	NA	13.31
Redox Potential	mv	178.6	148.0	-25.5	-133.3	NA	-22.5
Dissolved Oxygen	mg/L	2.36	2.18	1.91	0.75	NA	3.24
Turbidity	NTU	5.12	11.31	3.79	22.03	NA	29.45
Temperature	°C	29.5	30.7	30.4	32.4	NA	29.1
Analytical Results	**Units**						
Antimony	mg/L	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U
Arsenic	mg/L	0.00081 J	0.00067 J	0.0032	0.0037	0.0033	0.016
Barium	mg/L	0.043	0.16	0.22	0.043	0.044	0.024

Table 3. Analytical Results and Monitoring Data for Groundwater Samples Collected in October 2021
AES Puerto Rico, LP in Guayama, Puerto Rico

	Well ID	MW-1	MW-2	MW-3	MW-4	MW-4-Dup	MW-5
	Well Location	Upgradient	Upgradient	Downgradient	Downgradient	NA	Downgradient
	Sample ID	AES-MW1-100421	AES-MW2-100421	AES-MW3-100421	AES-MW4-100421	AES-MW4-DUP-100421	AES-MW5-100421
	Sampling Date	10/4/21	10/4/21	10/4/21	10/4/21	10/4/21	10/4/21
Static Water Elevation (ft MSL)		6.94	7.63	2.22	3.42	NA	2.87
Field Parameters	**Units**						
pH	SU	6.95	6.72	6.79	7.07	NA	6.48
Conductivity	mS/cm	1.97	1.08	15.79	41.9	NA	14.01
Redox Potential	mv	44.1	29.1	66.0	158.7	NA	64.6
Dissolved Oxygen	mg/L	0.91	0.31	0.11	0.08	NA	0.78
Turbidity	NTU	9.86	3.52	1.86	4.20	NA	24.27
Temperature	°C	30.2	31.6	31.1	32.9	NA	30.1
Analytical Results	**Units**						
Antimony	mg/L	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U
Arsenic	mg/L	0.00073 J	0.00059 J	0.0028	0.0033	0.0034	0.022
Barium	mg/L	0.042	0.11	0.11	0.042	0.044	0.011

Table 3. Analytical Results and Monitoring Data for Groundwater Samples Collected in September 2019
AES Puerto Rico, LP in Guayama, Puerto Rico

	Well ID	MW-1	MW-2	MW-3	MW-4	MW-4	MW-5
	Well Location	Upgradient	Upgradient	Downgradient	Downgradient	NA	Downgradient
	Sample ID	AES-MW1-092319	AES-MW2-092319	AES-MW3-092319	AES-MW4-092319	AES-MW4-DUP-092319	AES-MW5-092319
	Sampling Date	9/23/2019	9/23/2019	9/23/2019	9/23/2019	9/23/2019	9/23/2019
Static Water Elevation (ft MSL)		9.82	10.16	2.07	4.37	NA	2.18
Field Parameters	**Units**						
pH	SU	6.59	6.71	6.54	6.58	NA	6.03
Conductivity	mS/cm	1.983	1.052	13.01	26.19	NA	12.33
Redox Potential	mv	-98.6	-99.1	-106.6	-107.8	NA	82.0
Dissolved Oxygen	mg/L	0.48	0.68	0.47	0.49	NA	1.20
Turbidity	NTU	4.70	2.16	7.08	18.95	NA	28.72
Temperature	°C	30.05	30.66	31.43	33.60	NA	30.08
Analytical Results							
Arsenic	mg/L	0.00043 J	0.00031 J	0.0019	0.0041	0.0034	0.015
Barium	mg/L	0.035	0.14	0.16	0.061	0.061	0.034

The excerpts above clearly show that there are consistent exceedances of the arsenic levels at the same MW-5 wells across multiple wells. However, there is no discussion or acknowledgement by AES of these exceedances and their implications. For example, there is no discussion of whether the remedy should still be MNA given these arsenic exceedances?

3. AES provides some statistical analyses in Appendix C of its March 11, 2022 letter to the EPA. However, for reasons that are not explained or clear, this analysis only relies on the two upgradient and three downgradient MW wells alone. It does not include any of the data from the additional (i.e., TW-series) wells which are located in the same vicinity. Omitting data that are relevant and

available is not proper and violates the CCR rule provisions that require disclosure of groundwater monitoring data from wells installed to characterize the nature and extent of contamination.

4. In its March 11, 2022 letter, AES discusses MNA and, in support that MNA may be occurring, references a Haley and Aldrich analysis, provided in Exhibit 2.

I first note that EPA has provided extensive comments about why MNA cannot automatically be presumed, and that significant evidence needs to be provided relating to groundwater conditions in order to show sufficient evidence that MNA will be successful in restoring groundwater to original conditions. EPA provided specific comments to AES in its January 11, 2022 letter, as well as in its proposed denials of several CCR Part A applications, published on January 11, 2022.

Haley and Aldrich provide some analysis of likely groundwater conditions in downgradient wells at AES pertaining to three metals: selenium, molybdenum, and lithium. I note that there is no discussion of arsenic in this analysis, which is a significant omission, given the exceedances noted in the previous comment.

<u>For selenium</u>, Haley and Aldrich provide the following pH-Eh diagrams for three well data, MW3, TW102, and TW103. The red circles are my highlights.

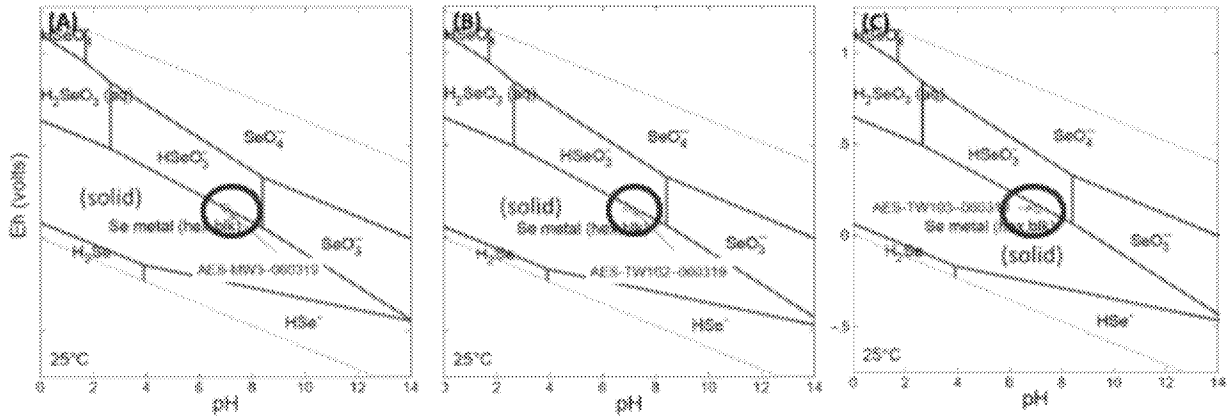

Figure 8: *Eh-pH diagrams for selenium under geochemical conditions specific to (A) MW-3, (B) TW-102, and (C) TW-103.*

It is clear that in each instance the data are at the very boundary between the solid and dissolved phases at each well. At the very least, this is not a robust finding that selenium will be present in the precipitated solid phase, indicating MNA for this metal. I note the very qualified, speculative, and hedged language used by Haley and Aldrich based in their own analysis:

> "This assessment demonstrates that Se precipitation is <u>likely</u> a major attenuation mechanism to remove soluble selenium from groundwater at the Site. As discussed in Section 3, because of the favorable Site conditions for selenium removal from groundwater though natural redox controlled precipitation reaction, the Site aquifer attenuation capacity for Se can be considered unlimited <u>as long as the favorable redox conditions last</u>. Beside the precipitation attenuation mechanism, Se <u>may also be attenuated through adsorption into aquifer solids</u>…."

(Emphasis added.)

For molybdenum, Haley and Aldrich provide similar discussion at four wells, MW-3, MW-4, TW102, and TW103.

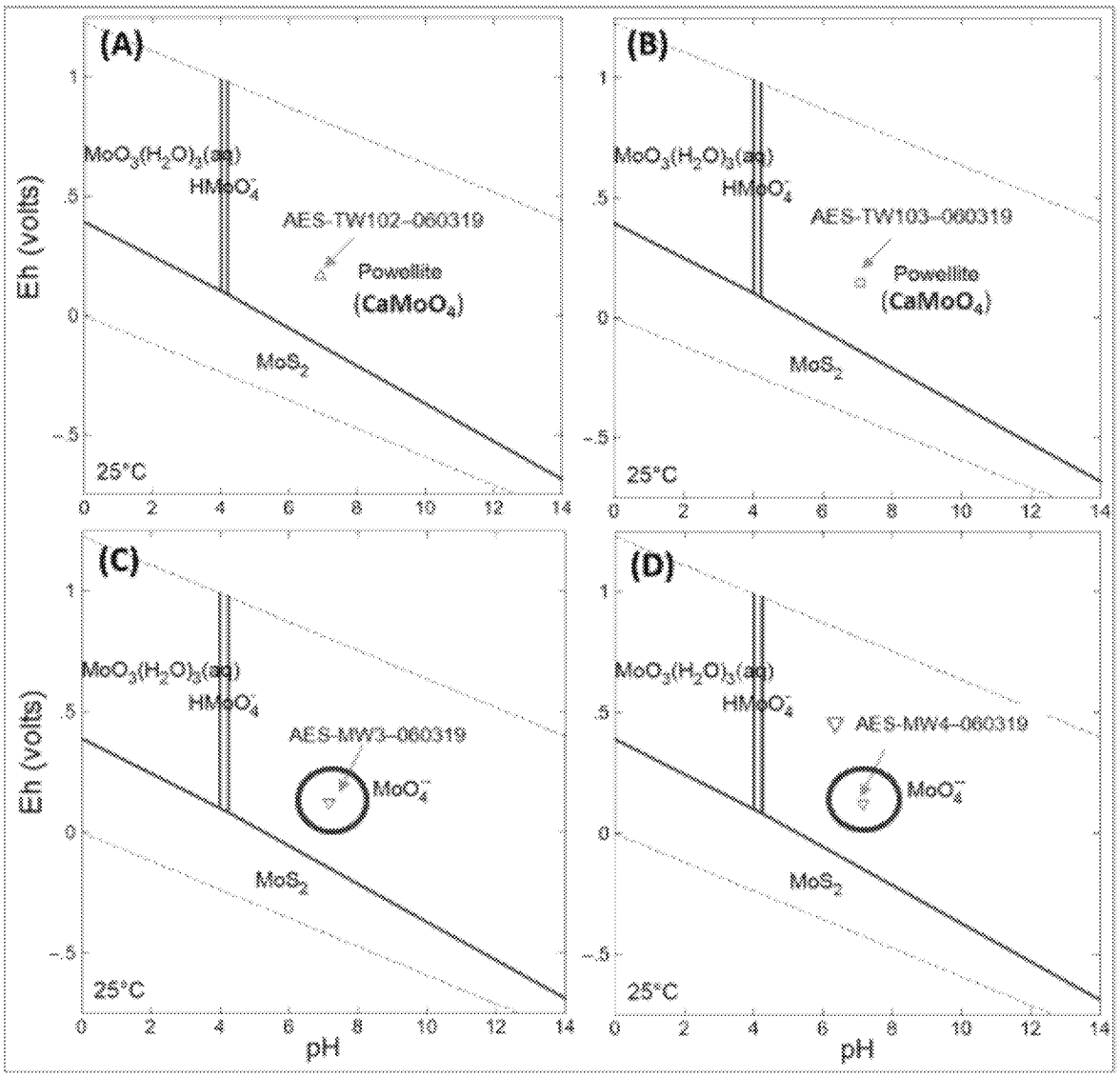

Figure 9: *Eh-pH diagrams for molybdenum under geochemical conditions specific to (A) TW-102, (B) TW-103, (C) MW-3, and (D) MW-4.*

It is obvious that there is no precipitation of molybdenum at least at MW-3 and MW-4. In fact, Haley and Aldrich confirm: "For MW-3 and MW-4, no powellite precipitation occurs and the aqueous species – molybdate (MoO4 2-) is the predicted outcome." (Emphasis added.) Thus, there is simply no basis to presume MNA for molybdenum, regardless of future speculation as noted by Haley and Aldrich's analysis: "Other attenuation mechanisms, such as adsorption and matrix diffusion, likely play a synergistic role in observed Mo attenuation at the Site."

Finally, for lithium, Haley and Aldrich simply do not provide even the pH and Eh analysis because, even they conclude that, "Lithium is soluble in the range of Site geochemical conditions. It is not likely to be permanently removed from groundwater during its transport at typical groundwater conditions, but it can be subject to sorption to clay minerals or metal oxide minerals to various degrees…" (Emphasis added.) The latter speculation notwithstanding, simply, there is no indication that there is any MNA applicable for lithium.

Based on the above, AES' own analysis provides no evidence of MNA for any of the three metals that they have analyzed: i.e., none at all for lithium; partial, at best, for two wells and none at all for two other wells for molybdenum, and not at all conclusive for selenium.

Coupled with EPA's comments in the draft Part A denials, AES has failed to provide sufficient supporting evidence for the use of MNA, and there is no reason to rely on MNA at this site.