Department of Energy Comment Matrix			
Project:	**Homestake, Grants, NM Title II Disposal Cell (Large Tailings Pile)**	**Licensee:**	**Homestake Mining Company of California**
Document:	**Attachment A. Design Report: Grants Reclamation Project Large Tailings Pile Evapotranspiration Cover Project Attachment B. Environmental Report for the Large Tailings Pile Evapotranspiration Cover Project: Radioactive Materials License #SUA-1471**		
NRC Accession Number:	**ML23222AA192, ML23222AA193**	**Date of Report:**	**July 2023**
Reviewers:	**Jon Luellen (JL), David Holbrook (DH), Mike Morse (MM)**		

Item	Reference	Reviewer's Comments and Recommendations
Applied Studies & Technology Comments		
1 (JL)	Att. A – Design Report, Sec. 4.1, p. 4	The text states the erosion protection layer is to be constructed as a growth media layer with 25% rock (1-inch *median* diameter) added. This appears to be inconsistent with Technical Specification 310000, Item 2.2.5 which indicates that the rock fraction of this layer is to have *a* D_{100} of 1 inch.
2 (JL)	Att. A – Design Report, Sec. 4.1, pp. 4-7	Test data from test pits excavated in the West and North Borrow Area soils indicate that variabilities exist in soil types within these areas. Soils at and around Test Pits TP-24 and TP-25 in the North Borrow Area are proposed to be sourced for constructing the erosion protection layer. Given the likely variability in soil types and soil conditions across this borrow area, material sourced from these two locales for building this cover layer should be tested at a high frequency for dispersion potential (Emerson Crumb, pinhole, and double hydrometer) prior to transporting the soil to the LTP for use in erosion protection layer construction. The Homestake cite is situated in a region where, based on a combination of average annual precipitation level (about 10 inches, within a ~ 10 to 14 inch range) and generally prevailing soil and vegetation conditions, high sediment yields may generally be expected to occur (Langbeim and Schumm 1958). Use of dispersive soils for constructing the erosion protection layer should be avoided as such soils are likely to be highly susceptible to erosion and could facilitate future formation of rills and gullies in the cover. Should soil testing conducted on these soils prior to transport indicate soils intended for use in constructing the erosion protection layer are dispersive, alternative sources of (non-dispersive) soils should be sought and tested. If soil dispersion potential test data are ambiguous, additional testing to characterize the soil's erodibility characteristics might be warranted, e.g., Erosion Function Apparatus Test; Hole Erosion Test; etc. (National Academies of Sciences, Engineering, and Medicine 2019).
3 (JL)	Att. A – Design Report, Sec. 8.3, para. 3, pp. 37-38	Please clarify whether an additional criterion for judging success of the revegetated cover is that the completed test fill meet a prescribed infiltration (percolation) standard (in order to "isolate contaminated materials from meteoric precipitation and aqueous transport" as discussed in this section) and that the established vegetation community needs to provide sufficient ground cover and exhibit adequate diversity for maintaining erosional stability of the cover.

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4 (JL)	Att. A – Design Report, Sec. 4.5.2, pp. 29-32 (and Appendix F to Design Report, Erosion Protection, 1st and 3rd tables)	It is unclear whether a calculation such as the Horton/NRC Method calculation (Eqn. A-14 in Section 2.4.3 of NUREG-1623) was performed to support a demonstration of the erosional stability of the proposed erosion protection layer design. If completed, the value of D_{75} used for representing the aggregate rock/soil admixture material proposed to comprise the completed erosion protection layer should be stated. In determining this value, the gradation of the soil fraction of the rock/soil admixture needs to be taken into account as well as the gradation of the rock fraction. Given the long slope lengths (≤ 991 ft) and relatively steep slope inclinations (~2.0 %) of the proposed top slope ET cover, the low percentage of rock proposed for the rock/soil matrix and the small diameter of the rock material, the potential for future formation of rills/gullies in the proposed top slope cover represents a significant potential concern that needs to be thoroughly analyzed. The lack of an intermediate depth cobble (bio)barrier layer within the cover profile that could serve to prevent further incisement of future gullies that might form further contributes to this concern. Please provide calculation details for this calculation or alternative calculation(s) demonstrating the erosional stability of the proposed design with minimal to no active maintenance. For clarity, an approximate PSD (particle size distribution) curve for the proposed completed admixture would also be helpful for reference.
5 (JL)	Att. A – Appendix G to Design Report, CQA Plan, Table 1, page 5	Some of the entries in column 1 of Table 1 are confusing, e.g., as to intent. Please revise for clarity.
6 (JL)	Att. A – Appendix G to Design Report, CQA Plan, Table 3, p. 17	Recommend that an additional Hold Point Description/Requirement could be that the Construction Contractor will have demonstrated through completion of a test fill that their proposed method of constructing the erosion protection layer is effective, and prior monitoring of that test fill indicates that the erosion protection and percolation performance, and the character of the established plant community meet the project specifications, and revegetation success criteria specified in the established performance standards described in Section 8.3 of the Design Report, respectively.

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7 (JL)	Att. A – Appendix G to Design Report, CQA Plan, Appendix B	Appendix B, Inspection and Testing Plans (ITPs), to Appendix G (CQA Plan) references ITP**s**, but only includes one ITP (for the radon barrier placement element). Field testing of the borrow soils intended for use in constructing the erosion protection layer should include frequent prior testing of the soils to verify they do not exhibit dispersive soil behavior (see other related comments) prior to using them to create the rock/soil matrix erosion protection layer. Suggest that a separate ITP be added addressing the erosion protection layer placement element (with prior required testing of borrow source soils included in that ITP; additional details regarding how the erosion protection layer would be placed and tested, how the organic enriched soil would be blended into the erosion protection layer, etc…, could also be included). Adding a separate ITP for the growth media layer element may also be beneficial, especially if growth and long-term sustainability of vegetation on the cover is a key goal/objective.
8 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 2.2.1.C.	The statement, as currently stated, is unclear and may be incomplete. What parameter was intended to be included as Item "6)"?

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9 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 2.2.5.B.3.c.	The erosion protection layer as proposed, would consist of a layer comprised of a mixture of rock and soil where the rock is to "be thoroughly and uniformly incorporated into the soil by mixture off-site prior to transport and placement on the LTP […unless an alternative method is proposed by the Contractor and approved by the Engineer]". This form of erosion protection layer is not consistent with the concept of an erosion protection layer comprised of a rock/soil matrix layer where the layer has the majority of the rock on the surface and within the top portion of the layer, where the rock exhibits good rock-to-rock contact within this zone, and the gradation of the completed layer resembles normal gradation criteria consistent with typical construction practices, e.g., as recommended by the USACE (1994) for a rock layer possessing a minimum of fines and intended to serve as an erosion protection layer. For maximizing long-term erosion resistance, the surficial/near surface portion of the completed layer should resemble a desert pavement type surface/landform (Johnson 2002) consisting of closely packed, interlocking rock fragments of pebble and cobble size. Caldwell et al. (2022) discuss the inferred performance of desert pavement landforms. An efficiently designed erosion protection layer of this type would be similar to a well-designed riprap layer, with rock in the layer located on and near the top of the soil surface rather than uniformly mixed within the entire soil layer. This is important because it is expected that an erosionally resistant rock/soil matrix layer would rely on substantial rock-to-rock contact to provide the necessary overall stability. The proposed 25/75 rock- to- soil admixture ratio would have too many fines to provide the necessary rock-to-rock contact. The proposed construction method also includes mixing 1% organic material into the top 3 inches of the erosion protection layer. It is not clear from the specifications that the mixing process envisioned would not adversely affect the rock-to-rock contact criterion and interfere with achieving the tightly interlocked soil/rock matrix condition that should be achieved in the top portion of the completed layer.

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10 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Part 3: Execution	Recommend that an additional subsection be added to specify additional earthwork requirements that may be needed to ensure that flows from the proposed ET top slope cover will "seamlessly" transition into the upper portion of the existing side slope cover. An example condition that would require some additional earthwork to rectify is the presence of dune deposits that have accumulated onto the upper portion of the side slope cover in some areas (see photo below). In this case, if pore spaces in the side slope riprap layer are filled with sediment and these areas are not adequately remediated and the affected cover areas not regraded to match the top slope cover grade, this could result in obstacles to future unimpeded flow of runoff from the top slope area to the side slopes in these areas. Other earthwork measures (e.g., excavating other out-of-specification portions of the side slope cover and reconstructing the cover layers in affected areas to meet the original specifications, etc.) might also be needed to ensure the smooth transition of flows from the completed top slope ET cover to the side slope cover.  Is there a need to insert a new granular transition zone at any layer interface between the top slope cover and the existing side slope cover materials to satisfy applicable filter criteria?
11 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 3.9.1.A.	Item 3.9.1.A states that the Radon Barrier, Growth Media Layer, and Erosion Protection Layer are to be placed over the approved regraded surface area in successive horizontal lifts of loose material not more than 6 inches in depth. This appears to be inconsistent with Item 3.9.2.2 which requires the erosion protection layer to be placed in a 12-inch thick loose lift, and with Item 3.11.3 which states that an appropriate loose lift thickness for constructing the erosion protection layer will be determined through completion of the test fill. Please revise the text here or under Item 3.9.2.2 and/or under Item 3.11.3 for consistency and for the final construction methodology.

Item	**Reference**	**Reviewer's Comments and Recommendations**
12 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 3.9.2.A.	Item 3.9.2.A.1 : Change "demonstrated" to "demonstrate" Item 3.9.2.A.2: See comment on Item 3.9.1.A above Item 3.9.2.A.2: There is considerable uncertainty regarding the projected performance of the proposed top slope ET cover with respect to long-term erosional stability. Additional engineering justification should be provided to support the contention that the erosion protection layer, if designed and constructed as proposed, would provide the required erosion protection to satisfy the 200- to 1,000 -year performance period requirement with a minimum of required maintenance. The potential for future formation of rills/gullies in the completed top slope cover is a significant potential concern requiring thorough analysis. Preliminary hydraulic flume testing (Abt et al. 1988; Johnson 2002) investigated a rock-soil matrix cover layer and obtained very favorable results from the standpoint of erosion protection under simulated peak future precipitation conditions. Erosion resistance provided was found to be equal to or better than that provided by similar rock riprap layers tested; However, that testing involved a rock-soil matrix layer constructed as follows: A *layer of rock riprap was placed on a compacted soil subbase layer and soil was then placed onto and vibrated into the riprap layer in a series of relatively thin (e.g., 3-to 4-inch thick) lifts until the soil filled the void spaces in the rock layer and reached the elevation of the top of the rock fraction in the completed rock/soil admix layer*. On this basis, given the likely challenges associated with trying to produce and maintain a "uniform" rock/soil admixture and the likelihood of soil segregation occurring during subsequent transport and placement and compaction of a separately produced rock/soil admixture into the cover section (especially if the Contractor proposes to mix the materials off the cover), and based on the considerations discussed in comments on Appendix H, Technical Specifications Item 2.2.1. and Item 2.2.5.C (low rock-to-soil ratio proposed, lack of a specified rock-to-rock contact criterion, etc…), it is unclear how the level of long-term erosion protection provided by the proposed erosion protection layer would compare with that which could reasonably be expected to be provided for a rock/soil matrix layer constructed using the different construction approach used in the early Abt et al. 1988 flume testing. Smith and Benson (2016) provide additional information regarding the projected long-term erosion resistance of rock/soil matrix vs. rock riprap layers.
13 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 3.10.1.A.	Additional justification should be provided for selecting 88 – 92% **%** of Maximum Dry Density at -3 to optimum moisture content (ASTM D698) as the appropriate compaction criterion for the completed growth medium layer. How does this compaction level range relate to published guidance (e.g., Daddow et al. 1983; Gray 2002; Goldsmith et al. 2001; Haigh 1995; ITRC 2003 USDA/NRCS Undated; U.S. NRCS 1996) on recommended maximum bulk density ranges (e.g., ~ 1.5 to 1.8 g/cm^3 depending on soil type) for growth medium layers designed to not restrict plan root development?

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14 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 3.11.3	It is not clear from the stated requirement whether a test fill is to be constructed for the erosion protection layer only or if it is required for other cover layers. Please clarify whether the test fill would be completed for the full cover profile.
15 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 3.12	Field testing of the borrow soils intended for use in constructing the erosion protection layer should include frequent prior testing of the soils to verify they do not exhibit dispersive soil behavior (see other related comments) prior to using them to create the rock/soil matrix erosion protection layer. See other comment on Section 4.1 of Design Report..
16 (JL)	Att. A – Appendix H to Design Report, Technical Specification 310000, Item 3.13.2.A	Item 3.13.2.A states that the maximum size of demolition debris shall not exceed 20 feet in the longest dimension. Depending on local conditions and debris shapes and forms, placement of such long debris items may create multiple opportunities for void spaces to be created in the LTP/cover profile. For clarity, additional information on the "designated disposal area" should be described, e.g., where would this area be located and what are the required characteristics for, and local conditions in/around, this designated area? Will this area be located outside the LTP top slope footprint?
17 (JL)	Att. A – Appendix H to Design Report, Technical Specification 329200, Part 3: Execution; and Item 1.3.1	The requirement that 1% organic material amendment be added into the uppermost 3 inches of the erosion protection layer (shown in the Construction Drawings, Final Cover Surface System Detail), and a general description of how this is to be accomplished, is not discussed in this section. For example, is a less than 6-inch thick loose lift of organic-enriched soil to be placed on the 12 inch-thick loose lift erosion protection layer component placed before compacting the erosion protection layer components? Other approach? Section 329200, Item 1.3.1 states that compost should be added at 8 cubic yards per acre incorporated to 3 inches depth but does not describe the manner for doing so or how such application and potential mixing of this layer into the lower portion of the erosion protection layer would affect a targeted end-state condition for the upper portion of the completed erosion protection layer (e.g., that the cover resemble a desert pavement type landform, with significant rock-to-rock contact) as discussed in other comments.
18 (JL)	Att. B – Environmental Report, Sec. 1.1 , p. 1-1, para. 1	Need to add USNRC 2003b to the References section

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19 (JL)	Att. B – Environmental Report, Sec. 1.2.1.3, p. 1-4, para. 3 & Sec. 1.2.1.5.3, p. 1-7, para. 2	These two sections list a different thickness for the riprap layer placed on the existing side slopes.
20 (JL)	Att. B – Environmental Report, Sec. 1.4, p. 1-10, para. 2	It would be useful to cross-reference here the average annual precipitation and average annual pan evaporation for the site/vicinity (this information is included in Sec. 3.6.2).
21 (JL)	Att. B – Environmental Report, Sec. 2.1.2, p. 2-1, para. 1, 2nd sentence	See review comments on the Design Report concerning proposed specification requirements for constructing the ET cover. Requirements stated in this sentence for constructing the ET cover should match the technical specification requirements.
22 (DH)	Att. B – Environmental Report, p. 2-2 Att. A – Design Report, pp. 12, 21	"The infiltration of precipitation into the proposed evapotranspiration cover is modeled at or less than 0.01 inch per year which is approximately one percent of the annual precipitation (Stantec, 2023)" "The annual average precipitation for the site is 10.32 inches." Could be reader error. Please clarify conflicting statements Infiltration modeling results, as described (0.01"/year), is not 1% of annual precipitation (10.32"), it is 0.1%. Consider rewording as "less than 1%" or "0.1%".
23 (DH)	Att. A – Design Report, pp. 25-26	"However, it is critical to note the simulation is overly conservative in that the effects of fire or prolonged drought are not likely to preclude vegetation rebound for 100 years." "Finally, even without vegetation, bare soil evaporation is sufficient to limit net infiltration through the cover" Please clarify conflicting statements. Should the later statement say "except in wet years"? Consider adding narrative to explain why successful revegetation is a goal.
24 (DH)	Att. B – Environmental Report, p. 3-20	"Groundcover varies from 79 percent to 99 percent." These values are over double than success criteria and reference / analog site data.

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25 (DH)	Att. A – Design Report, p. 23	"…transpiration (2.66 in/year)" "run-off 0.1 in/year" "Consequently, the vegetation community does not influence predicted net infiltration" Conflicting statements if plants transpire 2.66 in/yr (~25%) of annual precipitation and 0.1 in/year runoff. Or is the ET cover expected to perform (e.g. infiltration) in the absence of vegetation and rely evaporation and soil water storage? Further clarification needed.
26 (DH)	Att. A – Design Report, p. 33	"…60% ground cover of grassy vegetation" 60% is near double the value of revegetation success criteria.
27 (DH)	Att. A – Appendix J - Revegetation Plan and Monitoring Protocols, Sec. 3.2 Determination of Ground Cover, p. 8 and p.10 (Figure 1)	Consider adding citation for "state-of-the-art instrumentation" used for ground cover determination and success criteria comparisons. This instrument is not described in the provided references (Bonham 1989 or NMMMD 1996). Consider adding citation to Figure 1. Ground Cover Sampling Procedure. Do methods listed in Bonham 1989 or NMMMD 1996 provide sufficient comparison to "state-of-the-art instrumentation"? Consider adding statement to clarify the methods are repeatable with or without the instrument. The instrument, as described, may be proprietary and not readily available outside of Cedar Creek Associates Inc.

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28 (DH)	Att. A – Appendix J - Revegetation Plan and Monitoring Protocols, Sec. 3.2 Determination of Ground Cover, p. 8 and p.10 (Figure 1)	Current methods, as described, may or may not include standing dead in the "litter" category. Consider adding "Standing Dead" as its own ground cover component or define litter cover in relation to standing dead cover. It is unclear if the success criteria separate living vs dead (standing dead) vegetation, depending on how "perennial vegetation" is defined. Consider defining "perennial vegetation". • Perennially vegetation (especially grasses and shrubs in semi-arid climates) can encompass a large percent of standing plant parts (i.e., plant elements, usually grey in color, that are still attached to a stem or root -standing- but are no long living -dead-). Standing dead vegetation can accumulate over time, hinder new plant growth, and increase fire fuels – potentially being detrimental to cover performance. • The engineered habitat on the disposal cell (physical, chemical, and moisture properties) could produce unique types and distribution (amount, space, and time) of vegetation – potentially different from the analog / reference site. This could result in die off or on-set of early seral stage plant communities (and leaving remanence standing dead vegetation). • The seed mix contains high quality species but there are typical of a rangeland ecosystem, one that receives regular grazing. This disposal cell will also not be grazed and standing dead could be an important factor. For these reasons, % standing dead should be considered a component of the ground cover (or, at a minimum, litter defined to include standing dead). % Standing dead and % litter has been tracked at Monticello site since 2015 and increases are being observed.
29 (DH)	Att. A – Appendix J - Revegetation Plan and Monitoring Protocols, p. 8 and Att. A – Appendix J – Ecological Report, p. 1-1	"…Vegetation sampling procedures included metrics for (1) ground cover (canopy cover)…" Consider defining vegetative cover as either canopy cover (interstitial space between leave and stems count) or foliar cover (interstitial space between leaves and stems do not count). It appears the laser from the instrument listed in Figure 1 would be collecting foliar cover, while the ecological report cites canopy cover.

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30 (DH)	Att. B – Environmental Report, Pg 2-2, Att. A – Design Report, p. 37, AND Att. A – Appendix J - Revegetation Plan and Monitoring Protocols, p. 8	"Final year information would be collected in such a manner as to provide defensible verification that success has been achieved." "…final effort during the last inspection year would be an evaluation for success determination. Final year information would be collected in such a manner as to provide defensible verification that success has been achieved." It is unclear if data is collected from reference areas annually or just once at the beginning. Consider adding clarifying statement. If it is collected each year, along with the revegetation areas, the success criteria values would be dynamic. Standardized data and comparisons to success criteria should be explained for each data collection event, regardless if data are within or out of success criteria and if monitoring should or should not continue (i.e. "final monitoring").
31 (DH)	Att. A – Appendix J - Ecological Report for Design of the Evapotranspiration Cover, pp. 3-3, 3-4	Data collection from the reference/analog areas, as described, was conducted using , "10 co-located ground cover, production (current annual biomass), and woody plant density belts". Consider adding details/citation of the method and explaining the use of a different methods than listed in the REVEGETATION PLAN AND MONITORING PROTOCOLS appendix, which uses line point-intercept. Consider adding column that provides the success criteria calculation for the reference/analog communities. Saltbush-grassland perennial vegetation = 40.3% x .75 = 30.23%, plant density = …, diversity = … It is unclear if data is collected from reference areas annually or just once. Consider adding clarifying statement. If it is collected each year, along with the revegetation areas, the success criteria values would be dynamic.
32 (DH)	Att. A – Design Report, p. 20 Att. A – Appendix J – Ecological Report for Design of the Evapotranspiration Cover, pp. 1-1, 3-5, 3-10	"Ground cover results were analyzed to present Leaf Area Index (LAI) for each projected community" "LAI values were obtained from ground cover values" Consider adding citation for LAI data collection methods, especially if values are used for modeling. Consider using an LAI photomonitor instrument.
33 (DH)	Appendix J - Ecological Report for Design of the Evapotranspiration Cover, p. 3-9, Table 4	Add Hilaria to jamesii

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34 (MM)	Att. A – Design Report, Sec. 4.1.11 Additional Inputs for Infiltration Modeling, p. 15, para. 2 (bullet list)	Overall concern is that the upper bound Ksat values in cover layers developed for model sensitivity analysis are not sufficiently conservative to account for natural soil forming processes. Ksat for all cover layers was increased by a factor of 5-10. This seems low considering Ksat in cover materials has been measured to increase by a factor of 100-1000 from as-built specifications at certain LM study sites (e.g. Grand Junction Disposal Site Lysimeter Test Facility, etc.) due to natural soil forming processes. Further, the increase in Ksat for model sensitivity seems to cover only potential variability in available cover material at time of placement, not changes in Ksat due to natural soil forming processes over time.
35 (MM)	Att. A – Design Report, Sec. 4.2.1.3 Climate Analysis Results, p. 18, para. 4	"Frequency analysis of the annual PET for the 1000-year synthetic climate set was completed using the same methods described for precipitation." It is not clear how the PET data were determined for the distributions. Does this paragraph mean to say that PET data was taken (or calculated?) from the same weather stations for the same historical periods?
36 (MM)	Att. A – Design Report, Table 18	Units for PET are missing (in?)
37 (MM)	Att. A – Design Report, Sec. 4.2.4.1 Sensitivity Analyses	General comment: It may be helpful to decision-makers reviewing and assessing the validity of these sensitivity analyses if a table or series of tables were provided showing the changes made to relevant model input parameters for each sensitivity study.
38 (MM)	Att. A – Design Report, Sec. 4.2.5 Model Results and Appendix C: Variably Saturated Flow Model Results	General comment: Detail on model configuration is generally lacking. What were the model time steps, daily or yearly? What were the initial energy and state variable conditions prior to model spin-up, prior to predictive simulation, and during key time steps for each scenario? These seem like typical information to communicate to inform decision makers that the model is adequately representing the natural system it is trying to simulate. Lack of these reported details suggests low confidence in a model's representativeness.
39 (MM)	Att. A – Design Report, Sec. 4.2.5 Model Results and Appendix C: Variably Saturated Flow Model Results	General comment: Iterating the above comment with respect to lack of the statistical uncertainty analysis of the model outputs for each scenario. Was the predicted net infiltration fluxes and other water balance fluxes generated from one model solution for the base case and each sensitivity analysis, or were there several solutions with a range of outputs? Were any model input parameters estimated? Understanding any error and uncertainty associated with the model inputs and output predictions would help determine uncertainty and risk associated with the net infiltration predictions and long-term protectiveness of the cover design.

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40 (MM)	Att. A – Design Report, Sec. 4.2.5 Model Results and Appendix C: Variably Saturated Flow Model Results	General comment: It is not clear throughout the Model Results section as to how the model handles, or computes, runoff. What are the model input parameters that affect runoff calculations, and how were these adjusted (if they were adjusted) for the various sensitivity analyses? Previous ET cover water balance modeling studies emphasize the importance of runoff calculation for model performance evaluation.
41 (MM)	Att. A – Design Report, Sec. 4.2.5.1 Base Case (Model Results), p. 22, para. 3	Does the predicted average annual storage of 22.01 in/year also include storage within the compacted tailings layer and the sand tailings layer? Reported storage values that include these tailings layers would seem to obfuscate the storage fluctuations in response to P and ET within the cover layers. The latter indicates how well the model represents the water balance within the cover system in response to ET. Off-hand calculations (subject to reviewer error) indicate that >50% of the total pore water storage in the model domain is represented by the tailings layers below the cover system (4 ft of compacted tailings/17 ft total = 23.5%; 5 ft sandy tailings/17 ft total = 29.4%; not-to-mention the sandy tailings had the greatest porosity (0.44) of all materials and layers [Sec. 4.1.10.2]). It was reported in 4.1.11 (p.12, paragraph 5) that the AWHC of the cover was 9.59 inches, which is less than 50% the average annual storage for the 1000-year period reported by the base case model. Nothing in this report compares storage fluctuations as a result of cover water balance to the reported AWHC value. Any discussion of, or comparison to AWHC is trivialized when only total storage is reported that also includes storage within the tailings layers.
42 (MM)	Att. A – Design Report, Sec. 4.2.5.1 Base Case (Model Results)	General comment: Regarding the above comment, is it generally appropriate to include tailings layers in a model evaluating hydrologic performance of an ET cover design? The argument as to the validity of the model configuration, with the free drainage bottom boundary within the sandy tailings layer, is outside the scope of this independent review. P. 1, Paragraph 1 of this report defines 'net infiltration' as "the portion of precipitation that infiltrates into the cover and waste material and not subsequently lost to evaporation or transpiration." By this definition that the authors proposed up front, wouldn't the increase in storage over time within the tailings material be a net infiltration flux? According to the root density profiles in Figure 23, the Sagebrush Model, if this was what was used for the model inputs for root density function, shows a max rooting depth of about 140 cm or 4.6 ft, which would be the upper portion of the radon barrier in the model domain. By this definition alone, downward moisture flux past this depth would be net infiltration flux.

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Item	Reference	Reviewer's Comments and Recommendations
43 (MM)	Att. A – Design Report, Sec. 4.2.5.1 Base Case (Model Results), p. 22, para. 4	"Predicted net infiltration for the wettest 100-year period and the period with the wettest 100 winters is higher than the 1000-year average, though not significant." To this point, it is still not clear how the model handles winter precipitation, of which there was a rigorous statistical dataset generated for the 1000-yr simulation period. Is there reported snowmelt during the winter months, and if so, how does the model handle snowmelt as a precipitation input at the top boundary? Or is winter precipitation merely periods of precipitation when T is at a minimum and the model is accounting for seasonal T trends? This is another reason why it is useful to understand the model time stepping.
44 (MM)	Att. A – Design Report, Sec. 4.2.5.1 Base Case (Model Results), p. 22, para. 4	"Predicted evaporation is all higher than the 1000-year annual prediction." The purpose of this statement is unclear. Predicted evaporation for the wettest 100-year period? Wettest 10-year period? Higher than the 1000-year average? Greater precision is requested. Suggest showing a table that communicates more clearly the comparisons the authors are seemingly trying to make between predicted E, T, and storage during the 100-wettest, and 10-wettest years compared to the 1000-year annual average.
45 (MM)	Att. A – Design Report, Sec. 4.2.5.1 Base Case (Model Results), p. 22, para. 4	"Predicted evaporation and transpiration are higher than the 1000-year annual average for each wet period." The purpose of this statement is also unclear. Same as above comment.
46 (MM)	Att. A – Design Report, Sec. 4.2.5.1 Base Case (Model Results), p. 22, para. 4	"Predicted average storage for the wet periods is very close the annual average for the 1000-year simulation period (Appendix C)." Requesting more elaboration on the significance of this model output, especially considering the statement made earlier on total storage including the tailings layers and drawing the significance of this outcome to modeled cover layer performance in regard to net infiltration. How much is 'very close', and did any increase in storage during the wet periods result in gravity drainage and subsequent net infiltration? What was the quantity of any such net infiltration and how did it compare to the average annual flux?
47 (MM)	Att. A – Design Report, Sec. 4.2.5.2 Material Properties Sensitivity (Model Results)	General Comment: As an independent reviewer, it is impossible to assess the sensitivity of the model to changes in material properties when only a summary table of the 1000-yr average is provided and no data on model outputs are given. None of the statements made in this singular paragraph describing the model sensitivity to material properties are supported by any visual representations of data – only a summary table – and may be difficult for decision-making reviewers to agree with the conclusions made on material properties sensitivity when none of the results or conclusions or supported by model input or output datasets.

Item	Reference	Reviewer's Comments and Recommendations
48 (MM)	Att. A – Design Report, Sec. 4.2.5.2 Material Properties Sensitivity (Model Results), p. 23, para. 1	This paragraph reads similarly unprecise to the statements made for the Base Case scenario. Suggest adding additional detail and cite specific data to support each statement being made.
49 (MM)	Att. A – Design Report, Sec. 4.2.5.2 Material Properties Sensitivity (Model Results), p. 23, para. 1	"Average storage decreased relative to the base case simulation mostly due to material properties which were more coarse relative to the base case (Figure 11)" Provide additional detail as to how the coarseness of the material properties is the cause in a decrease in average soil water storage relative to the base case and how this translated to the changes made to model input parameters for this sensitivity scenario. Also, because this is an examination of the model's sensitivity to variability in material properties, suggest providing additional detail about which of these model input parameters related to material properties were more influential to the predicted cover water balance and net infiltration.
50 (MM)	Att. A – Design Report, Sec. 4.2.5.2 Material Properties Sensitivity (Model Results), p. 23, para. 1	"Material properties in this simulation are modified to be generally more coarse than the base case." See above comment about providing more specifics on model input parameters for each sensitivity analysis. How much 'more coarse' and how did this translate to the material properties input parameters for each layer?
51 (MM)	Att. A – Design Report, Sec. 4.2.5.3 Saltbush-grassland Vegetation (Model Results),	General comment: Same comment applies to this sensitivity analysis section as with the Material Properties section regarding lack of data presented to support the conclusions made for this sensitivity analysis scenario. Refer to Comment #21 above.
52 (MM)	Att. A – Design Report, Sec. 4.2.5.3 Saltbush-grassland Vegetation (Model Results), p. 23, para. 2	"Predicted evaporation decreased slightly compared to the base case simulation, while predicted transpiration increased slightly. Average storage decreased by nearly 22% compared to the base case simulation (Table 23)." Please provide more detail and reasoning about the difference between the model predictions between this sensitivity case and the base case. In what layers were the average storage decreases most pronounced? How did changes in the LAI and root density function inputs affect E and T partitioning accordingly? These are all crucial details that inform the reader the model is representing the natural system reasonably.

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53 (MM)	Att. A – Design Report, Sec. 4.2.5.3 Saltbush-grassland Vegetation (Model Results), p. 23, para. 3	"Similar to the sagebrush-grassland community, predicted net infiltration is negligible. Consequently, the vegetation community does not influence predicted net infiltration." It would be more convincing to support this conclusion with modeled water balance flux data for the cover layers over the 1000-year simulation period. What was the T flux over time compared to the sagebrush-grassland community? The second statement here is very conclusive and needs to be supported by multiple lines of reasoning and not just one 1000-year average.
54 (MM)	Att. A – Design Report, Sec. 4.2.5.4 Successional Regression (Model Results), Figure 28	The 'Net infiltration' dashed line in Figure 28 seems to be routinely above a net infiltration of 0.01 in/year, even though it is reported that the average net infiltration of 0.01 in/year occurs over the 1000-year period. Please provide quantitative support for the assertion that net infiltration is an average of 0.01 in/year.
55 (MM)	Att. A – Design Report, Sec. 4.2.5.4 Successional Regression (Model Results), p. 23, para. 4	"Predicted average storage increases 56% relative to the base case simulation value (Table 23)" What portion of this increase in storage is within the tailings layers? The purpose of this modeling task is to evaluate the performance of the proposed ET cover design. If storage is considerably increasing within the tailings then would arguably pertain to cover performance with regard to net infiltration. See comment #16 regarding the appropriateness of the model configuration for the purpose of evaluating net infiltration to the tailings.
56 (MM)	Att. A – Design Report, Sec. 4.2.5.4 Successional Regression (Model Results), p. 23, para. 4	"As presented in Table 23, the predicted evaporation is higher than the sum of evaporation and transpiration for the base case simulation." Was this the same during months with winter precipitation and reduced E? It is well-documented from many related studies that as E and T are reduced during winter months, storage is increased, which is later removed by plants when T increases again in the spring. Arguably, E is not capable of removing storage from deeper layers (or at any significant depth in the cover profile both within modeled and natural environments). It is unclear how this model handles the seasonal trends in E and T. 1000-year average E can be greater than 1000-yeaer average P and 1000-year average ET (for base case) and still result in significant net infiltration due to seasonal impacts on flux. Also, see above comment pertaining to using summary tables to provide basis for model conclusions, as opposed to detailed model output data.
57 (MM)	Att. A – Design Report, Sec. 4.2.5.4 Successional Regression (Model Results), Figure 29	Provide an explanation as to how moisture content is being reduced in the growth media layer and the (deeper) radon barrier layer for this scenario. Is E at the top boundary the sole reason moisture content is decreasing in the cover layers? If so, how? Or is it solely gravity drainage? HYDRUS is capable of quantifying this.

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58 (MM)	Att. A – Design Report, Sec. 4.2.5.4 Successional Regression (Model Results), p. 23, para. 4	"The average annual volumetric water content is higher in each of the three upper layers in the successional regression simulation compared to the base case. This results in efficient bare-soil evaporation with no vegetation in the successional regression simulation." See above comment. This conclusion is not valid unless it is shown that E is responsible for moisture decreases within the radon barrier and growth media layers and not gravity drainage that results in net infiltration flux below the radon barrier and into tailings.
59 (MM)	Att. A – Design Report, Sec. 4.2.5.4 Successional Regression (Model Results), p. 24, para. 2 and Figure 28	"Predicted net infiltration for the wet periods examined for the successional regression simulation ranges from 0.10 in/year to 1.77 in/year." This range in net infiltration is not apparent in Figure 28. Please provide additional detail about the wet periods (for all sensitivity analyses) and their durations.
60 (MM)	Att. A – Design Report, Sec. 4.2.5.4 Successional Regression (Model Results), p. 24, para. 3	"These results indicate vegetation is not a critical factor in reducing net infiltration, and evaporation alone is sufficient to return surface infiltration to the atmosphere and limit net infiltration . . ." The evidence presented is not sufficient to convincingly support this conclusion. Please use the considerations in the comments above to provide sufficient detail/proof that the cover design will effectively function as an E cover to minimize net infiltration flux into the tailings over the next 1000 years. In Table 23, the reported 1000-year average storage is 34.47 in/year compared to the base case which is 22.01 in/year. If this increase in average storage is not removed by evaporation and amounts to storage increase within the tailings then this apparent increase in storage may actually be unaccounted net infiltration flux hidden within the storage term.
61 (MM)	Att. A – Design Report, Sec. 4.2.5.5 Climate-Change Precipitation (Model Results)	General comment: Same comment applies to this sensitivity analysis section as with the previous sensitivity analysis sections regarding lack of data presented to support the conclusions made for this sensitivity analysis scenario. Refer to Comment #21 above.

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62 (MM)	Att. A – Design Report, Sec. 4.2.5.5 Climate-Change Precipitation (Model Results), p. 24, para. 5	" . . Intense wet periods may compromise cover performance, although this simulation demonstrates the influence is generally small overall." The summary of 1000-year averages reported in Table 23 are not at all different between the base case and this sensitivity analysis, which leads the reader to believe that either the modeled cover system performance is not at all dependent on rainfall intensity and duration, or the sensitivity scenario is not adequately devised to evaluate wet periods. It is generally well understood from ET cover field datasets that especially wet periods account for a significant proportion of net infiltration flux through store-and-release cover systems, and that a cover design must take these possible events or wet periods into account by having the adequate amount of storage. The conclusion proposed in this cover design report suggests the opposite is true without field data or modeled water balance trend data to support.
63 (MM)	Att. A – Design Report, Sec. 4.2.6 Discussion, Figure 31	Figure 31 shows a decrease in moisture content in each of the material layers from year 0-100 except for the compacted tailings layer, which increased in moisture content from initial condition. Please explain the trends in each of these moisture contents as it relates to the processes removing/adding moisture to the model layers. Is the sand tailings layer effectively acting as a capillary barrier in this domain?
64 (MM)	Att. A – Design Report, Sec. 4.2.6 Discussion, p. 25, para. 4	"Predicted net infiltration for the wettest 100-year period for the successional regression simulation is 1.77 in/year, and 1.14 in/year for the period of wettest 100 winters." Please provide the water balance trend data from the model outputs that shows net infiltration in relation to the "wettest periods" or the "wettest winters"
65 (MM)	Att. A – Design Report, Sec. 4.2.6 Discussion, p. 26, para. 1	"Finally, even without vegetation, bare soil evaporation is sufficient to limit net infiltration through the cover. Refer to comment #34 above. Provide additional support showing that this cover design is protective when bare soil evaporation is the lone mechanism for precipitation store-and-release.

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