Resolution Copper Project and Land Exchange
Environmental Impact Statement

USDA Forest Service
Tonto National Forest
Arizona

June 22, 2020

Process Memorandum to File

Clarification of Perceived Discrepancies in Water Balance Data

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Purpose of Process Memorandum

The purpose of this process memorandum is to provide clarification of several perceived discrepancies in water balance that appear in the Draft EIS and supporting documents, and to provide confirmation that these discrepancies are not substantive to the disclosure of impacts in the EIS.

Summary of Perceived Discrepancies

A number of analyses were conducted that support the disclosures in the Draft EIS (published August 2019). The NEPA team has noted potential discrepancies among these background reports concerning the water balance of the various alternatives. While no public comments were received on these specific details, numerous public comments were received regarding related issues of water supply and seepage. For this reason, it is important to ensure that the inputs to the EIS analysis are accurate and that any discrepancies do not substantially affect the EIS conclusions.

The note discrepancy is related to the difference between Alternatives 2 and 3. Alternative 2 uses thickened tailings slurry, with the NPAG tailings deposited at 65 percent solids. Alternative 3 uses an ultrathickened tailings slurry, with the NPAG tailings deposited at 70 percent solids.

Alternative 3 is described in the DEIS (p. 78) like this (emphasis added):

> *Tailings Facility – Disposal Method*
>
> *The PAG tailings would be sent directly to a floating deposition barge for subaqueous deposition located within the PAG cell. The difference to apply high-density thickening of the NPAG tailings would occur prior to placement within the tailings storage facility* <u>*to further reduce entrained water through evaporation*</u> *and thereby reduce seepage. There is a potential for even more water to be removed from the tailings through "thin-lift" deposition techniques (depositing tailings in very thin layers), which would be used if found to be feasible with ultrathickened tailings.*

This description was based on the alternative design documents produced by Klohn Crippen Berger (KCB)[1]:

> *This approach for scavenger tailings deposition would reduce the amount of water that are entrained within the tailings compared to an alternative with less thickened tailings, prevent formation of a pond on the scavenger tailings beach, and maximize evaporation; thus, minimizing seepage from the scavenger beach. (KCB 2018, p. 2)*

The NEPA Team noted a potential discrepancy between the narrative descriptions given above and the quantitative global water balance for the various alternatives that was prepared by Westland

[1] KCB, June 2018. "DEIS Design for Alternative 3B – Near West Modified Proposed Action" [Project Record #0002640]

Resources[2], which was then used to develop Appendix H in the DEIS (Further Details of Mine Water Balance and Use) as well as information in Chapter 2 (figure 2.2.2-16, p. 60), and section 3.7.1 (table 3.7.1-7, p. 336). Appendix H shows the following for Alternatives 2 and 3:

Alternative 2 – Tailings Storage Facility Water Balance (selected terms, acre-feet/year)			
	Operations Rampup (Mine Years 6-12)	**Peak Operations (Mine Years 13-36)**	**Operations Rampdown to Closure (Mine Years 37-46)**
Evaporation	3,779	9,705	4,853
Entrainment	4,723	9,692	617
Lost seepage	77	153	153

Alternative 3 – Tailings Storage Facility Water Balance (selected terms, acre-feet/year)			
	Operations Rampup (Mine Years 6-12)	**Peak Operations (Mine Years 13-36)**	**Operations Rampdown to Closure (Mine Years 37-46)**
Evaporation	2,296	5,270	3,219
Entrainment	4,421	10,259	2,828
Lost seepage	39	77	77

In contrast to the narrative description, the quantitative water balance indicates that entrainment increases and evaporation decreases under Alternative 3, when compared to Alternative 2.

Explanation for Discrepancy

Project Manager Chris Garrett (author of this process memo) corresponded with KCB on two occasions to clarify the issue (May 23, 2019; June 22, 2020). Some slides provided by KCB during the June 2020 call are included with this process memo as Attachment 1.

It has been determined that there are two reasons the quantitative water balance shows this difference: 1) a difference in materials between the two facilities, and 2) a difference in the approach used to calculate water content for two separate analyses.

Differences in Materials and Water Content

As noted in the DEIS (p. 73, 80) Alternative 2 uses a 4:1 slope for the cyclone sand embankment, and Alternative 3 uses a 3:1 slope for the cyclone sand embankment. This results in Alternative 2 having a larger overall percentage of cyclone sand compared to Alternative 3. Cycloned sand has a lower water content than beach tailings, and therefore having more cyclone sand reduces the amount of water entrained in the facility overall.

[2] WestLand Resources, September 4, 2018. "Resolution Copper Water Balance Tailings Alternatives 2, 3, 4, 5, and 6" [Project Record #0110517]

KCB notes (see Attachment 1) that this only explains part of the discrepancy. The discrepancy is also explained by a difference in analytical approach between two separate project analyses.

Approach for Calculating Entrainment and Evaporation in WestLand Water Balance

The other difference between Alternative 2 and 3 results from the overall approach used in the water balance for calculating entrainment and evaporation, which has ramifications on the amount of makeup water needed from the Desert Wellfield.

When calculating the water balance, WestLand assumes that any water that is part of the NPAG slurry that gets spigoted onto the tailings beach does not get recovered. This water is assumed to either evaporate or get entrained with the tailings. The recovered water (identified as the term "Reclaim to West Plant Site" as shown in DEIS Appendix H) consists instead of slurry water from the PAG cell (which is lined, resulting in minimal water loss from seepage and more reclaimed water), stormwater falling within the facility, or any collected seepage pumped back from the collection system to the reclaim pond. In reality, it is anticipated that some of the water released to the tailings beach would be reclaimed, though the amount is difficult to quantify.

There is a key reason why this approach (of assuming no recovery of water from spigoted NPAG tailings) was taken by WestLand. By taking this approach, less water is available for recycling back to the West Plant Site, and therefore more makeup water is needed from the Desert Wellfield. This approach ensures that the Desert Wellfield pumping is not underestimated. This conservative approach (i.e., overestimating rather than underestimating the amount of makeup water needed) is consistent with refuting the tone of a large number of public comments received, suggesting that the Resolution Copper Desert Wellfield water demands were underestimated[3].

When calculating the division between entrainment and evaporation, only entrainment is calculated. Evaporation is then assumed to be the remainder of water released with the NPAG tailings. For the WestLand water balance, entrainment was calculated using an assumption of 100% saturation. Because the water is removed from the process—whether to entrainment or evaporation—this assumption makes no difference to the overall water balance for the mine.

Approach for Calculating Entrainment in KCB Alternative Design

The WestLand water balance was intended to identify the global water needs for the mine and provide the Forest Service with an understanding of the complicated feedback loops and recycling circuits. The actual design and modeling of the individual tailings facilities—conducted largely by KCB--requires a different and more detailed analysis approach.

In order to estimate seepage from the tailings storage facilities, KCB constructed 1-dimensional column model for each alternative. Using the model, the percent saturation over time can be estimated and plotted (see Attachment 1). For Alternative 2, the model shows saturation remaining

[3] This issue is not addressed in this process memo. A full response can be found in the response to comments in the FEIS.

close to 100 percent over most of the tailings thickness, whereas for Alternative 3 the saturation remains closer to 80 percent.

Discrepancy between WestLand and KCB Approaches and Ramifications for EIS

The different saturation values resulting from the KCB modeling estimates, as well as knowledge of tailings deposition techniques, are the basis for the statements in the KCB design reports that use of ultrathickened tailings increase evaporation and decrease entrainment. By contrast, the entrainment shown in the WestLand water balance report uses a consistent assumption—100% saturation for both Alternatives 2 and 3—and therefore does not reflect the reduced saturation of Alternative 3 modeled by KCB. Both approaches are valid for their overall purposes, but the KCB approach is more nuanced and representative of real-world conditions.

While this represents a difference of assumptions between two different analyses, it has no significance for the disclosure of impacts in the EIS itself:

- With respect to water usage by the mine, the overall water balance assumes all water from the NPAG spigoted tailings is lost. It makes no difference to the amount of Desert Wellfield pumping amount whether that water is considered lost to entrainment or to evaporation. This assumption ensures that the water demands for the mine are not underestimated.

- With respect to seepage and water quality modeling, the more detailed KCB 1D models are the basis for the analysis, not the WestLand report. The KCB modeling yields a more realistic assessment of the seepage anticipated than the global water balance.

- With respect to tailings safety and specifically the Failure Modes and Effects Analysis (FMEA) undertaken in February 2020, KCB provided guidance to the participants on the anticipated saturation of the tailings for Alternative 6, and that guidance was based on the detailed 1D modeling, not on the WestLand global water balance.

Conclusions and Resolution

The disclosure of the key impacts in the EIS is based on the appropriate techniques:

- Overall makeup water use is based on the global water balance that assumes all water associated with the NPAG spigoted tailings is lost, therefore ensuring makeup water use from the Desert Wellfield is not underestimated.

- Seepage estimates that feed the water quality modeling at each alternative tailings storage facility are based on more nuanced and site-specific 1D models, ensuring the inputs to the water quality mixing models are accurate and realistic.

No change in analytical technique is warranted.

However, the discrepancy will be noted in the FEIS and clarified by adding a footnote to pertinent sections, including Appendix H and table 3.7.1-7 in section 3.7.1, similar to the following:

> Note that entrainment for Alternative 3 is based on an assumption of 100% saturation used in the global water balance and is known to be overestimated compared to more detailed seepage modeling conducted for each alternative. See [Garrett 2020] for further details.

ATTACHMENT 1

NOTES PROVIDED BY KCB DURING JUNE 22, 2020 CALL

RESOLUTION COPPER

June 2020

Resolution Copper Project
Alt 2 and Alt 3 DEIS Water Balance - Entrainment

Alt 2 and Alt 3 DEIS Water Balance - Entrainment

Overview

- Ratio of cycloned sand to scavenger beach
- Water balance assumptions for scavenger beach slurry losses
- Estimate of saturation of scavenger beach

Ratio of cycloned sand to scavenger beach

- Alt 2 – 4H:1V embankment slope, more cyclone sand, less tailings in beach
  - cyclone sand has lower m/c[1] than tailings beach, therefore less entrained water per ton of tailings
- Alt 3 – 3H:1V embankment slope, less cyclone sand, less tailings in beach
  - beach tailings have higher m/c than cycloned sand, therefore more entrained water per ton of tailings
- However, the difference in cyclone sand volumes does not account for the discrepancy alone

1. m/c is moisture content

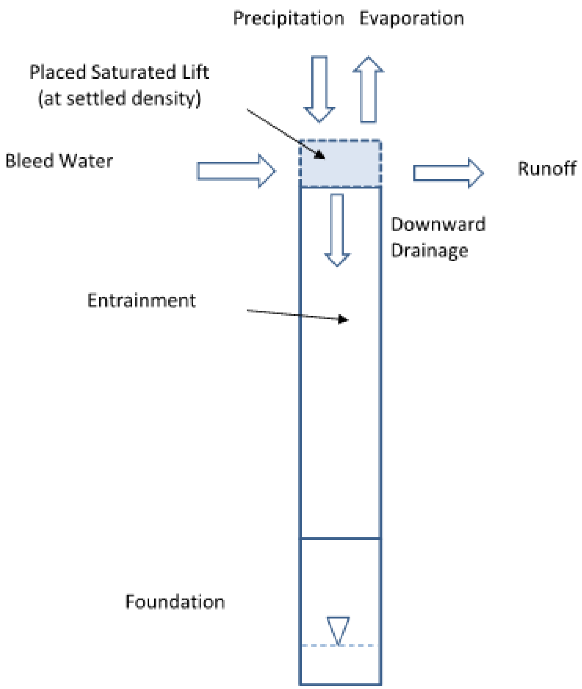
Water balance assumptions for scavenger beach slurry losses

- Slurry water deposited in scavenger beach is lost to the system (i.e., not recovered)
  - conservative assumption for estimating make-up water
  - "lost" slurry water is assumed to contribute to entrainment or evaporation
    - In the DEIS water balance, both Alt 2 and Alt 3 assumed entrainment was calculated based on a m/c estimated from 100% saturation. However, Alt 3 was estimated to have a lower saturation (~80%, see following slides), therefore, more losses should have been attributed to evaporation rather than entrainment.
- Seepage estimates are based on seepage modeling, not the assumptions around slurry water losses – therefore, there is no implications of these assumptions on seepage estimates

Alt 2 Seepage Estimate / Saturation

Conceptual Model

one-dimensional column

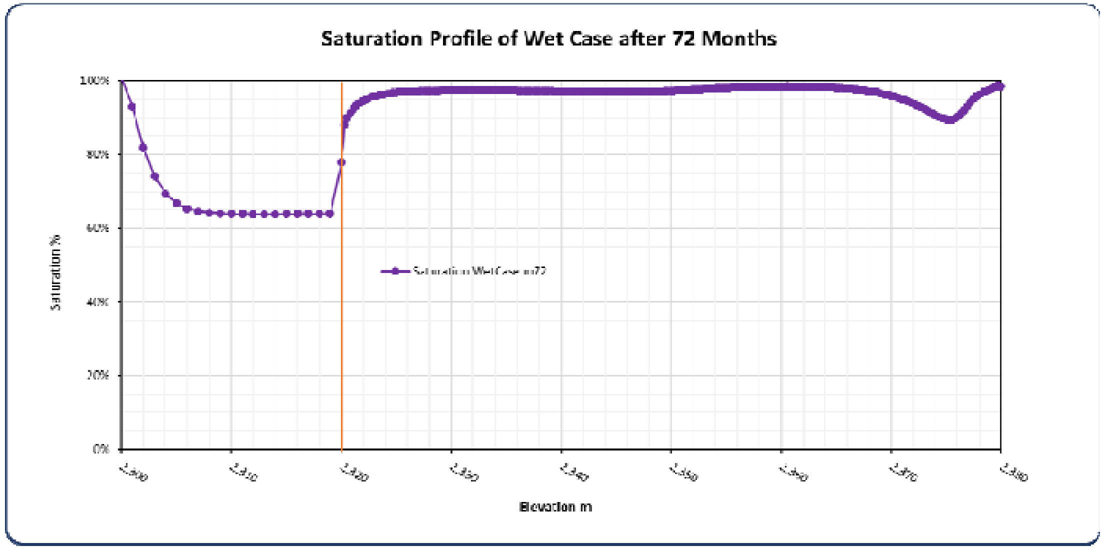


Model Results

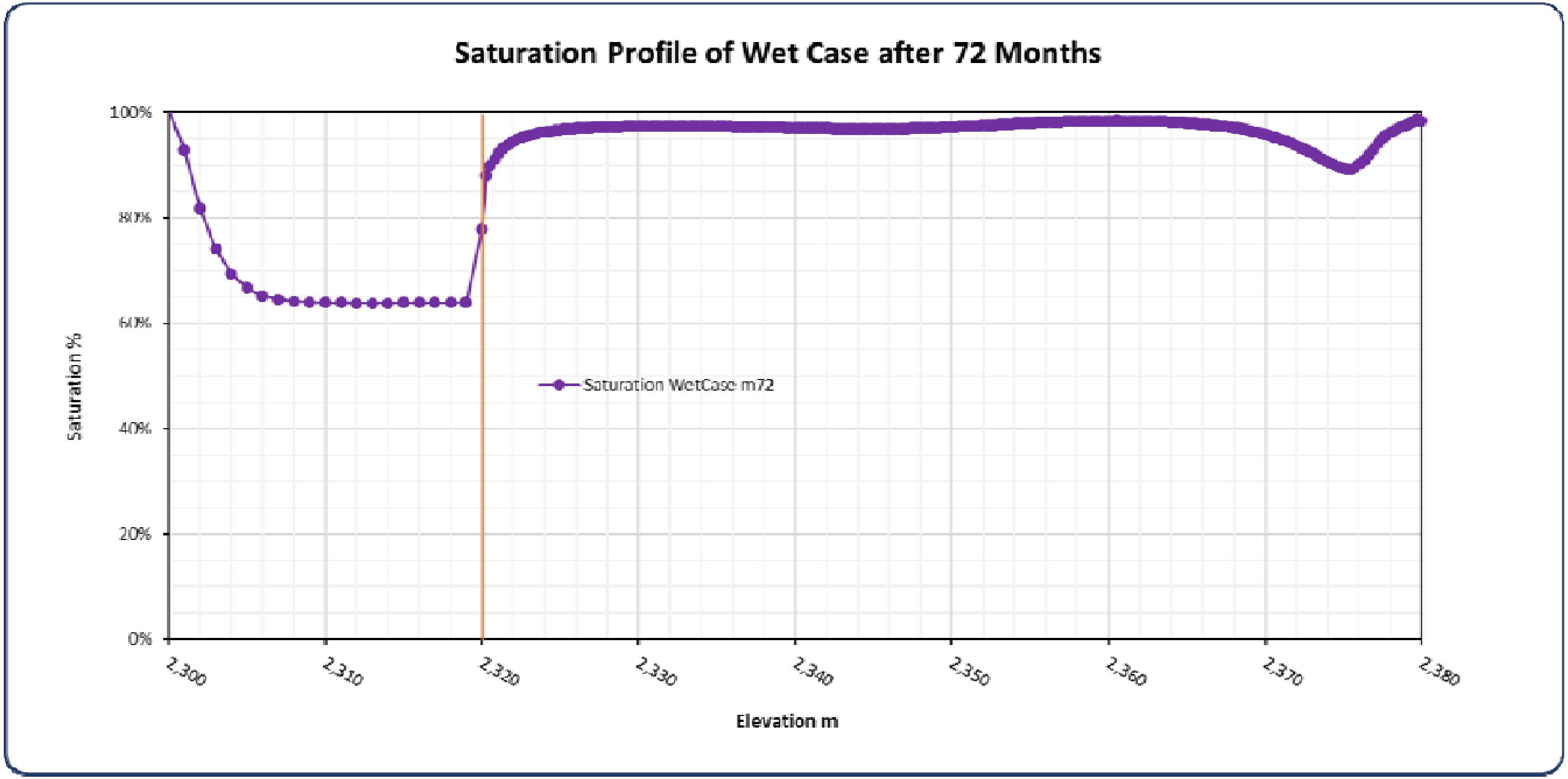
Tailings downward drainage (infiltration) (gpm/acre)	0.52

Model Inputs

Parameter		Value	Assumption
Climate			
Precipitation (in/year)		20	1987 daily climate data from Superior climate station used in assessment. Assumed to be a "typical" year.
Potential Evaporation (in/year)		75	Calculated in Vadose/W using the 1987 daily climate data from Superior climate station
Tailings Properties (Scavenger Tailings			
Specific Gravity		2.78	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see DBM, Appendix I)
Vertical Hydraulic Conductivity (kv) (in cm/s)		1E-06	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
Rate of Rise (ft/year)		10	Average over the mine-life (see tailings staging plan, Appendix II)
Slurry	Deposited solids content by weight (%)	55%	Weighted average of scavenger tailings deposited on beach (see DBM, Appendix I)
	Initial Void ratio (e)	2.25	*Calculated*
Placed (settled density)	Porosity (n)	0.45	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
	Final Void ratio (e)	0.82	*Calculated*
Bleed water	Water released per unit lift	0.79	*Calculated*
	Rate of water released per unit lift (per day)	0.026	*Calculated based on a monthly timestep for modeling*



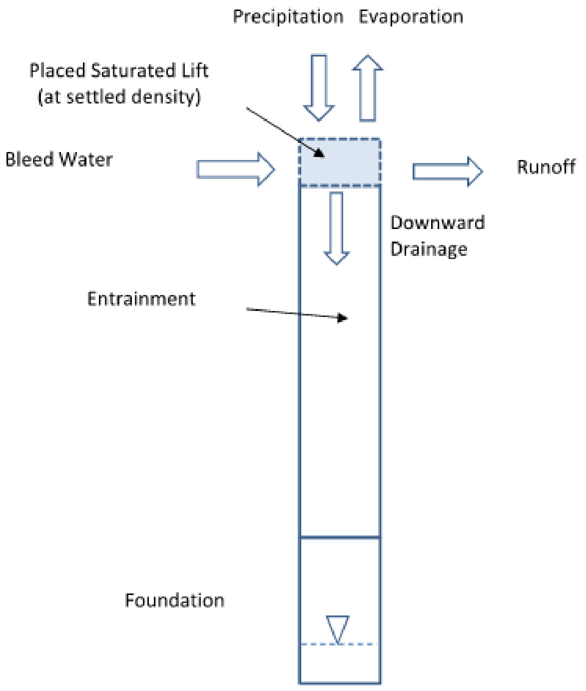
Alt 2 Seepage Estimate / Saturation



Alt 3 Seepage Estimate / Saturation

Conceptual Model

one-dimensional column

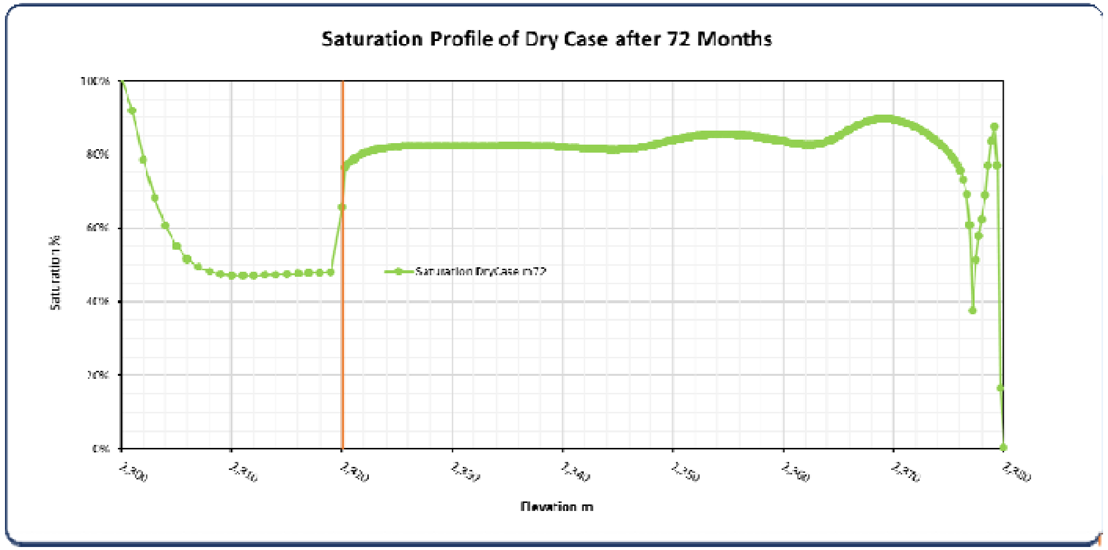


Model Results

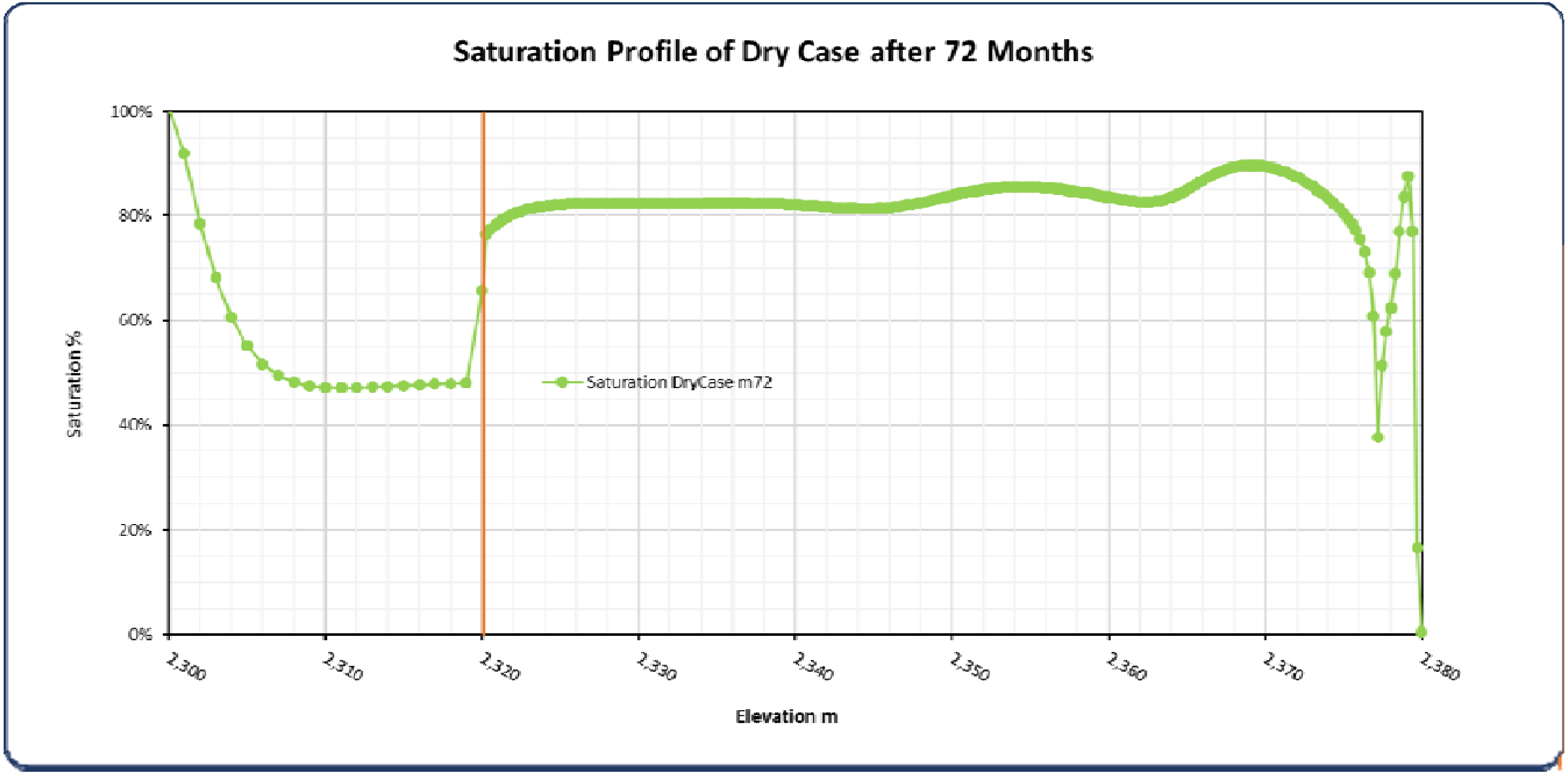
Tailings downward drainage (infiltration) (gpm/acre)	0.14

Model Inputs

Parameter		Value	Assumption
Climate			
Precipitation (in/year)		20	1987 daily climate data from Superior climate station used in assessment. Assumed to be a "typical" year.
Potential Evaporation (in/year)		75	Calculated in Vadose/W using the 1987 daily climate data from Superior climate station
Tailings Properties (Scavenger Tailings)			
Specific Gravity		2.78	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see DBM, Appendix I)
Vertical Hydraulic Conductivity (kv) (in cm/s)		1E-06	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
Rate of Rise (ft/year)		10	Average over the mine-life (see tailings staging plan, Appendix II)
Slurry	Deposited solids content by weight (%)	65%	Weighted average of scavenger tailings deposited on beach (see DBM, Appendix I)
	Initial Void ratio (e)	1.48	*Calculated*
Placed (settled density)	Porosity (n)	0.45	Assumed to be mid-range for expected scavenger tailings based on laboratory testing (see Tailings Characterization, KCB 2018)
	Final Void ratio (e)	0.82	*Calculated*
Bleed water	Water released per unit lift	0.36	*Calculated*
	Rate of water released per unit lift (per day)	0.012	*Calculated based on a monthly timestep for modeling*



Alt 3 Seepage Estimate / Saturation



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Alt 2 Water Balance Results in DEIS

Alternative 2 – Tailings Storage Facility Water Balance (selected terms, acre-feet/year)				
	Operations Rampup (Mine Years 6-12)	Peak Operations (Mine Years 13-36)	Operations Rampdown to Closure (Mine Years 37-46)	Comments
Evaporation	3,779	9,705	4,853	Valid, see below
Entrainment	4,723	9,692	617	assumed at 100% - valid as per KCB 1D seepage estimate
Lost seepage	77	153	153	based on M&A seepage assessment

Alt 3 Water Balance Results in DEIS

Alternative 3 – Tailings Storage Facility Water Balance (selected terms, acre-feet/year)				
	Operations Rampup (Mine Years 6-12)	**Peak Operations (Mine Years 13-36)**	**Operations Rampdown to Closure (Mine Years 37-46)**	**Comments**
Evaporation	2,296	5,270	3,219	should increase by the magnitude that entrainment decreases
Entrainment	4,421	10,259	2,828	estimated based on 100% saturation, but should be 80% - as per KCB 1D seepage estimate
Lost seepage	39	77	77	based on M&A seepage assessment