

The proposed approach to assess the potential effects to groundwater from any additional unsaturated flow does not appear to address the NRC staff concern regarding the potential for constituent concentrations in the groundwater to exceed applicable groundwater protection standards at the designated compliance points. The NRC staff would expect that the existing flow model would be coupled with a mass transport model capable of simulating advection, dispersion, diffusion, and concentration change due to sink/source mixing to evaluate potential concentration changes that may result from unsaturated or saturated flow during consolidation of the tailings. The following is a list of specific comments and concerns regarding the technical memo.

- 1) The last paragraph of page one of the technical memo states that “The modeling will be based on a ten-year period to allow evaluation of the impacts of settlement, as well as anticipated reduction in surface infiltration due to the repository configuration and ET cover system.” The NRC staff would expect that the length of the model run would be sufficient to capture the peak rate of drainage resulting from consolidation of the existing tailings. A shorter or longer modeling timeframe could be justified or required based on the initial model results.

In addition, a final cover design has not been submitted for a formal NRC review. This technical memo was not intended to address the effectiveness of the ET cover system. The effectiveness of the cover system design must be based on long-term performance. Therefore, the NRC staff will be focusing its review on potential impacts to the groundwater due to consolidation of the tailings at the UNC mill site.

- 2) The Technical Memo states that “The ten-year average will provide a conservative analysis which fully captures the impact of the additional loading and settlement, as well as reductions in infiltration due to the new cover system.” The NRC staff disagrees that the average climate data over a ten-year period will provide conservatism in the model. The model should be based on daily historical climate conditions.
- 3) It appears that the evaluation of the effects of increased unsaturated flow on groundwater will only be initiated if the rate of unsaturated flow at the base of the tailings increases sufficiently to influence saturated groundwater flow. However, the technical memo does not quantify a rate of unsaturated flow capable of influencing saturated groundwater flow. The NRC staff would expect an evaluation to be initiated once an increased rate of drainage resulted from consolidation. The level of complexity required to determine groundwater impacts should be dependent on the resulting level of increased flux. If the increased rate of flux appears to be minimal, a simplistic and highly conservative analysis may be appropriate to evaluate groundwater impacts.

The NRC staff would like to point out that the current groundwater protection standards may not be appropriate for determining whether or not impacts would result from the placement of the mine spoils on top of the UNC Mill site. The feasibility of returning groundwater quality back to the NRC approved groundwater protection standards may not be practical within all of the impacted groundwater zones at the UNC Mill site. Increased concentrations in the groundwater

resulting from additional seepage could provide a basis for establishing the Alternate Concentration Limits (ACLs) if corrective actions were determined to be impractical and if the as low as reasonably achievable requirements were met. UNC would also have to demonstrate that the requested ACLs would be protective of public health and safety and the environment at the determined point of exposure. If corrective actions were determined to be practical, the increased seepage must not result in exceedances of the approved groundwater protection standards at the determined compliance points. Engineering controls or an alternate design capable of mitigating potential impacts from the increased rate seepage would be required prior to approval.

- 4) The technical memo is proposing to use particle tracking to evaluate the influence of additional seepage on hydraulic gradients and groundwater flow velocities. Variances between the current hydraulic gradients and groundwater flow velocities and those resulting from the additional seepage would not indicate potential impacts at the points of compliance. Groundwater impacts resulting from the additional seepage would be determined by an exceedance of the groundwater protection standards at designated compliance points. The proposed use of particle tracking alone would not demonstrate that the groundwater will be unimpacted by the additional seepage.
- 5) The technical memorandum states that a comparative set of analyses will be performed to evaluate the flow through the tailings impoundment at the Church Rock mill site and that each analysis will be composed of a 1-dimensional model of a determined profile using UNSAT H. The staffs from various agencies had comments and concerns with the original modeling that was done in 2011, and NRC staff would like an opportunity to resolve those issues before the model is run to determine the flow through the tailings impoundment. The more significant issues are listed below. NRC staff can provide more detail and specifics about these issues upon request.
 - a. It is not clear how the Terzaghi assumptions are being fulfilled, or why it is not significant if one or more of these assumptions are not being fulfilled. However, a previous UNC response did state that: "...the assumptions have been shown to be valid in similar applications..." in reference to Terzaghi's theory of consolidation. NRC staff has long expressed interest in such documents and is interested in reviewing documentations pertaining to these similar applications which demonstrate that Terzaghi's theory (for saturated soils) has been successfully applied to partially saturated, heterogeneous/ anisotropic soils to predict consolidation. This information is necessary to demonstrate the conservatism of the simulations.
 - b. Section 3.1 in the 2011 Consolidation report stated that the first stage of consolidation is the "Immediate" stage. No further discussion was presented in the report on this stage. Technical literature suggests that immediate settlement analyses are used for all fine-grained soils including silts and clays with a degree of saturation of 90% or less, and for all coarse-grained soils, while consolidation settlement analyses are used for all

saturated, or nearly saturated, fine-grained soils. If the impact from immediate settlement is not significant in comparison to the Terzaghi's primary and secondary consolidation, a technical basis should assumption should be provided.

- c. Provide a technical justification for holding the hydraulic property values of the cover materials and mill tailings (e.g. Van Genuchten parameters, etc.) after consolidation constant with the original assigned property values before consolidation.