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Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Characterizing Uncertainty in the Hydraulic Parameters of Oil Sands Mine Reclamation Covers and its Influence on Water Balance Predictions" *by* Md. Shahabul Alam et al.

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General Comments The objectives of this manuscript are not clear, are focused on minor modelling considerations and do not contribute valuable findings to the field of waste cover design. This is unfortunate as it forms part of a broader program of work that would bring interesting findings worth publishing. For mine reclamation covers, key objectives of the design should be that (1) it will lead to successful ecosystem restoration ( eg. plants are growing successfully) (2) the quality of the seepage does not lead to impacts on the receiving environment and (3) it addresses any other objec-



tive identified as part of design and mine closure planning. The manuscript does not clearly state how it contributes to the understanding of how the selected cover designs will meet these objectives. Among other things, models are used to provide a simplified mathematical representation of reality so that various scenarios can be analysed. If we change the parameters in the mathematical representation, the results from the model will be different. It does not meant the reality itself has changed, so I struggle to understand what the study is trying to prove. It seems like a circular proposition. If we modify the van Genuchten parameters then of course the predicted water balance will be different. The issue is not the value of the parameters but our ability to understand how changes to the water balance can prevent the design from meeting the objectives stated above. For instance, a design is developed specifically to minimise seepage but a modification in the surrounding environment leads to increased seepage and risk to the receiving environment. Statistical analysis can assist with quantifying the probability of that scenario and this is what we should be focusing on. If the scenario is likely then there is a requirement to develop mitigation options, such as installation of additional monitoring equipment to capture changes and mitigate them. The values of the hydraulic parameters in the mathematical representation are not that relevant to the mitigation of the issue. With advances in mathematical software, particularly Mathematica, MatLab or R, there is less and less of a need to develop specific mathematical approaches for solving soil science or environmental science problems. With the Wolfram Language now in the public domain, it is even less justifiable. I have never heard of the Latin Hypercube Sampling, but looking at the description in the manuscript, all I would need to do in Mathematica is to Map the Range function unto the parameters. It seems very straight forward and certainly does not justify a publication. Hydrus 1D could probably be re-coded in Mathematica very quickly and the predictions would be much faster and much more stable. It does not seem that there has been much evolution in the field of vadose zone hydrological modelling in the last 20 years. There would be value in re-assessing these models in light of advances in mathematical software. In terms of developing a more robust approach to test the performance of cover design,

I would suggest leaching experiments on large columns, which can reproduce leaching results much more quickly than what can be obtained in the field. It is a more reliable method to investigate the impact of variations in the water balance. The greatest long term risk to the viability of soil covers and associated ecosystems is climate change with associated variations in temperature and precipitation. Column tests can provide an indication of expected changes in soil water behaviour under extreme precipitation or temperature regimes. This would be a much more robust contribution than mathematical manipulations of soil parameters. Another key gap seems to be the assessment of snow pack height on cover behaviour. This could also be investigated with column testing. Assessment against HESS criteria The paper is well-written, well-referenced and well-structured. Figures, tables and cross-references are fine. The key issue relates to the value of the contribution to the hydrological community. The objectives and research questions are ill defined. The paper does not present novel concepts, ideas or tools. Clear conclusion are provided but they do not contribute much to the assessment of the performance of cover designs. The description of experiments and calculations are complete and precise. The authors give proper credit to related work. The work described in the paper is part of a broader project that is very interesting. The title clearly reflects the contents of the paper. The abstract provides a concise and complete summary.The language is fluent and precise. The number and quality of references appropriate There is no need to provide details about the Latin Hypercube Sampling methodology, it is a routine calculation.

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