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COSIA Regional Groundwater Solutions Project for the Southern Athabasca Oil Sands – Predictive Simulations on Long Term Usability of Major Aquifers

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Introduction

The Canada's Oil Sands Innovation Alliance (COSIA) Regional Groundwater Solutions (RGS) project was established to evaluate the potential range of change in aquifer pressures resulting from groundwater withdrawals and disposal associated with future in situ bitumen production within the Southern Athabasca Oil Sands (SAOS) region. In 2016, Matrix Solutions Inc. was retained to undertake model update and computationally intensive coupled steady-state and transient calibration using PEST software (Matrix 2016). Using the updated numerical model, three potential water forecasts were developed and simulated to explore uncertainty in future growth of in-situ oil sands production within the SAOS region. These scenarios were identified as Status Quo, Medium Growth, and High Growth scenarios.

Summary

Predictive scenarios covered a period of 62 years from 2013 to 2075. Timing of peak change in hydraulic heads varied spatially but in general occurred between 2030 and 2040 when industry water demand was projected to be highest. Effects were evaluated relative to a benchmark of 50% reduction to aquifer available head, which is aligned with the criterion laid out for non-saline water use within the Alberta Conservation and Allocation Policy for Oilfield Injection (2006). Although this criterion does not apply to non-saline aquifers, it nonetheless serves as a useful reference for evaluating impacts on pressures in all aquifers.

For the Empress Channel, Lower Grand Rapids, Clearwater A, Clearwater B, and Basal McMurray Sand aquifers, all three predictive scenarios have resulted in a maximum simulated change in available head of less than 50% for more than 99% of respective aquifer area over the predictive simulation period. Areas where more than a predicted 50% reduction in available head were found to occur close to operations, where best practices and compliance with existing provincial regulations should preclude such an occurrence or would otherwise require corrective action to remedy.

In addition to the operational uncertainty assessed through Status Quo, Medium Growth, and High Growth scenarios, the uncertainty in calibrated parameters was quantified using the Null Space Monte Carlo (NSMC) methodology on the Medium Growth predictive scenario. A total of 300 realizations with independent parameter sets were used in this effort. Results from this exercise demonstrated, that the operational uncertainty as to the rate of future project development and the associated water requirements is likely the greatest uncertainty on potential future cumulative effects.

Predictive analysis demonstrates the aquifers within the SAOS regional would not experience unacceptable pressure reductions due to oil sands water production under any of the three potential/hypothetical future development scenarios. In other words, there is sufficient groundwater available to support future growth of the SAGD oil sands without adverse impacts on the sustainability of water resources.

Acknowledgements

COSIA Regional Groundwater Solutions Project Participants

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