# Mechanisms of Contaminant Migration through Buried Channels from an Oil Sands Tailings Pond

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## Abstract

Oil sands extraction is expected to double in the next few years and the risks of contaminating groundwater from tailings impoundments could increase in a similar fashion. A comprehensive understanding of the flow and transport processes associated with buried channels in oil sands mining areas will assist in mitigating the risks associated with groundwater contamination. This study focuses on the migration and evolution of a dissolved contaminant plume emitted by oil sands tailing ponds via a buried sand and gravel channel. A conceptual model of groundwater flow and contaminant migration was developed based on existing and new characterization data. This conceptual model was the basis of a 2D-vertical finite element groundwater flow and mass transport numerical model, which was used to simulate flow and transport patterns between the tailings pond and the Athabasca River. Forward particle tracking simulations for the buried high conductivity channel show that groundwater originating from the tailings pond is discharging to the surface after 19 years. This travel time increases significantly, between 156 and 230 years, outside of the high conductivity channel. Chloride breakthrough curves are reproduced reasonably well with the evolution of tailings pond concentrations observed in the buried channel at various stages depending on the distance from the pond. Chloride concentrations also assist in determining the lateral boundaries of the buried high conductivity channel. Thus, for a similar geological setting in the proximity of oil sands tailings ponds, contaminant migration through these channels poses a threat to the environment and should be taken into account in the environmental management of tailings ponds.