

History and Findings of Alberta's Athabasca Oil Sands Area Groundwater Quality Monitoring Program



Trevor Butterfield, Ken Sommerstad

Advisian, WorleyParsons Group, Edmonton, Alberta, Canada

Cynthia McClain

Environmental Monitoring and Science Division, Alberta Environment and Parks, Calgary, Alberta, Canada

ABSTRACT

Groundwater quality in the North and South Athabasca Oil Sands (N/SAOS) region, and the Cold Lake-Beaver River Basin of Alberta, Canada, has been monitored at varying spatial and temporal resolutions since the 1970s. The number of wells being monitored for groundwater quality and frequency of monitoring declined in the 1980s, but has increased since the mid-2000s due to expanding industrial and oil sand development in the region. The current active groundwater quality network consists of approximately 100 monitoring wells, plus supplemental monitoring data from industry in each region.

This presentation traces the historical development of the groundwater quality monitoring network and identifies preliminary historical spatial and temporal trends in the NAOS and SAOS groundwater quality data using Mann-Kendall and Theil-Sen trend tests. The statistical results suggest that the majority of the identified statistically significant hydrochemical trends in multiple primary indicator parameters at 14 locations in the NAOS may be artifacts of groundwater well installation, development, monitoring and sampling activities that occurred at these monitoring wells in the 1970s and 1980s. Within the SAOS, statistically significant trends in groundwater quality were observed for chloride at three monitoring wells and for sodium at one monitoring well. Kruskal-Wallis analysis of each formation, which was completed in both regions to test for significant differences in primary indicators between wells completed in the same formations, indicated that nearly all primary indicators at monitoring locations within individual aquifers/completion units were statistically different in both regions. This result supports previous interpretations that the groundwater chemistry in the regional network is spatially diverse, both within and between formations. Based on this spatial variability, a discussion of ideas for further development and refinement of the existing groundwater monitoring program will also be presented to improve and support ongoing evaluation of Alberta's groundwater resources.