

Multi Disciplinary Approach to Assess and Manage Risk of Chloride Rich Groundwater Discharging to Elkwater

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The site is located in the southern Alberta and has two distinct regions, the highway maintenance yard (up-gradient) and Elkwater Lake (down-gradient).

The maintenance yard was operated with a salt storage. The salt storage has been moved, however earlier reports cited dead or stressed vegetation between the salt storage yard and the lake. Losses of salt from the yard were suspected of being the cause.

Further investigations discovered that surface water had drained from the site to the lake and that leaching from the salt storage area had affected the quality of the soil and groundwater. Construction of a surface water runoff containment pond eliminated the surface runoff pathway. Over the long term, groundwater migration from the former salt storage yard site to the lake through the groundwater was considered a potential risk to the lake water quality and to the aquatic habitat along the section of the lake's shoreline. The lake has been used as a recreational resource and water supply to the South Saskatchewan River.

Risk Assessment

A multi disciplinary approach was used to assess the risk and provide management options of chloride rich groundwater discharging to the Elkwater Lake. The investigations conducted include soil and groundwater assessment, surface water monitoring, benthic survey, geotechnical evaluation and groundwater modeling. These investigations helped to improve understanding of the maximum chloride concentration entering the lake and the extent of the lake's benthic habitat likely to be most seriously affected, and provide geotechnical data for the feasibility of construction of interceptor trench and/or installation of extraction wells.

The soil and groundwater assessment results showed that salt affected groundwater extended to the full depth of the sediments overlying the bedrock and were more than 10 times the applicable guideline in the wells adjacent to the lake.

The chloride concentrations immediately beneath the former maintenance yard were not exceptionally greater

and the greatest mass of chloride was to the north of the maintenance yard and migrating towards the lake.

The numerical model results suggested a rapid decline in concentration over a period of 5 to 10 years; however the chloride concentrations in groundwater at the lake were predicted greater than the applicable guidelines. The benthic habitat showed no adverse effect due to control with the chloride rich groundwater.

Risk Management

Since the former salt storage yard was located on a hillside slope, underlain by a layer of clay on top of sand and within an area of the park used by wildlife, therefore these circumstances create geotechnical constraints that greatly influence the feasibility of constraining measures to control the salt migration.

The principal constraints with a trench or barrier placed along the northern perimeter of the site are the soft soils encountered and the location close to the edge of the slope. At this location, an interceptor trench would be keyed into the bedrock surface. Such a trench or barrier would create a large ground disturbance of the slope and for protection of the lake, considerable silt fencing and surface erosion control.

Geotechnical constraints due to the sloped ground and soft soils at depth suggest that interceptor trenches or barrier walls will be costly and will create a ground disturbance in a sensitive area of the park that may not be looked on fondly or need to proceed in a time of the year that makes work difficult.

It was therefore suggested that electro-kinetic methods to extract salt from the groundwater and move salt from the soil pore water to collect in wells be considered. To make this option feasible a further declination of the chloride plume will be required.

It was confirmed that there were no adverse effects on the benthic fauna with chloride rich groundwater that has been discharging to the lake. This leads to the consideration that the benthic fauna has high tolerance to the chloride concentrations and would need less stringent site cleanup criteria for salts to manage the risk.

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Mr. J. Thomas Dance, M.Sc., P.Geol.

Mr. Dance is a principal hydrogeologist with EBA. He is responsible for overall technical direction and administrative supervision undertaken by EBA involving hydrogeology and contaminant hydrogeology. Mr. Dance has more than 28 years' experience as a consultant working with the municipal, provincial, and federal governments on a variety of sites that involve appreciating the relationship between alluvial, outwash, and bedrock aquifers, and surface water. Those projects have included not only protection of groundwater supply quality from surface water incursions (especially waterborne pathogens) but also, and more commonly, protection of surface water from industrially affected groundwater. .

Mr. Deryck Masterman, B.Sc., A.Ag

Mr. Masterman was the program manager and maintained the corporate responsibility for the project work and final reporting. Mr. Masterman is an Environmental Scientist with Lethbridge's environmental practice. He has over six years of field and project management experience in various site assessment and environmental monitoring programs and has been active on this site since 2004.

Mr. Aziz Shaikh, M.Sc., P.Eng.

Mr. Shaikh is a hydrogeological engineer with 12 years' experience in groundwater modelling, groundwater resources exploration, groundwater dewatering, hydrogeological impact studies, risk assessment, and other environmental/civil engineering projects involving the control and management of groundwater. He has provided lead role on projects require modelling. His other hydrogeological experience includes conducting hydrogeological investigations (water well and monitoring well drilling, and step, slug, and pump testing) for the purpose of developing various analytical and numerical models.

The models were built to characterize alluvial and bedrock aquifers, to estimate volumetric flow, horizontal and vertical flow velocities, and travel times.

Mr. Bryan Gale, B.E.S

Mr. Gale has over three years of experience in environmental consulting and has completed several environmental assessments, biophysical impact assessments, and CEEA Screenings for land development within the City of Calgary , the City of Lethbridge, and other municipalities. Mr. Gale has experience conducting various aquatic and terrestrial studies including: breeding bird surveys; benthic invertebrate sampling studies, amphibian call surveys; wildlife track studies; wetland classification and delineation; and fish habitat and sampling studies. Mr Gale also has been responsible for working with regulatory authorities to produce compensation and mitigation plans to ensure compliance with government acts and regulations. His background includes government experience with the enforcement of the Federal Fisheries Act and the Navigable Waters Protection Act.

Mr. Clint Gellrich, B.Sc., BIT

Mr. Gellrich is an environmental scientist with EBA's environment practice in Lethbridge, Alberta. Mr. Gellrich has 5 years of experience focused on site investigations related to natural resource inventory (vegetation and wildlife), Phase I and Phase II environmental site assessments (ESAs), and soil assessment.