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Hydrogeological Characterisation of the Calgary-Lethbridge Corridor to Inform Land Use Planning

Jessica Liggett and Lisa Atkinson, Alberta Geological Survey

In order to support the development of the South Saskatchewan Regional Plan (SSRP), the Alberta Energy Regulator/Alberta Geological Survey completed a regional hydrogeological assessment in the Calgary to Lethbridge area, under the Provincial Groundwater Inventory Program, in partnership with Alberta Environment and Parks. The objective was to compile existing geological and hydrogeological information in the Calgary-Lethbridge Corridor (CLC), and interpret it within a new, regionally focused, hydrostratigraphic framework to enhance our knowledge of the regional hydrogeology in this area. New geological modelling was undertaken to develop a hydrostratigraphic model of the CLC, which allowed for the analysis of hydrogeological data within each mapped hydrostratigraphic unit (HSU). In the Neogene-Quaternary sediments, three HSUs were identified: two sand and/or gravel HSUs confined to paleovalleys and upland areas, and one intervening HSU that is dominantly fine-grained. The lower sand and/or gravel HSU forms an important aquifer in the CLC while the overlying fine grained unit may provide local sources of water from thin, discontinuous, coarse-grained lenses. In the Upper Cretaceous–Paleogene bedrock strata, nine formation-based, lithostratigraphic HSUs were identified lying above the regional confining Lea Park/Pakowki Fm. The distribution of water supply wells from the Alberta Water Well Information Database (AWWID) shows that groundwater is mainly sourced from bedrock HSUs in the CLC, although in some areas (generally along paleovalleys) groundwater is sourced from a mixture of bedrock and unconsolidated HSUs. Potentiometric surface maps show a strong positive link between hydraulic head and local-scale variations of the land surface and/or bedrock topography within each HSU. The associated maps of depth to potentiometric surface identify areas that are likely under unconfined, confined, or flowing artesian conditions on a regional scale. Further geological characterisation included mapping of net-to-gross sandstone ratios in the bedrock strata, helping to identify potentially permeable sandstone-bodies. The net-to-gross sandstone ratio analysis was combined with shallow groundwater data from the AWWID to provide additional hydrogeological knowledge in the near-surface HSUs, and provide a depiction of aquifer continuity in the deeper subsurface where hydrogeological data may be lacking. The hydrogeological characterization in the CLC also included mapping of total dissolved solids in each HSU, numerical modelling of recharge, and estimation of vertical hydraulic gradients. The integration of geological and hydrogeological mapping and modelling results on a regional scale represents an important contribution for future delineation of groundwater management units in the CLC, thereby providing an opportunity to inform the development of a groundwater management framework in the SSRP.

Jessica Liggett, Ph.D.

Jessica is currently a groundwater specialist at the Alberta Geological Survey, part of the Alberta Energy Regulator. Her background is in hydrogeology with a focus on the near surface, including integrated surface-subsurface modelling, recharge modelling, and aquifer vulnerability mapping at both regional and local scales.