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A Study of the Vulnerability of a South African Coastal Plain Aquifer to Seawater Intrusion Using the GALDIT Index Method

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The Zululand coastal plain in northeastern South Africa contains one of the largest primary aquifers in the country. The primary aquifer is made up of the Maputaland Group rocks which constitute the main aquifers of the area that are underlain by the impermeable sediments of the Zululand Group which is locally known as the hydrogeologic basement. The GALDIT Index method has been applied to study the vulnerability of the Zululand coastal aquifers to seawater intrusion along the Indian Ocean coastline. The GALDIT index, which has been tested at various coastal aquifer settings around the world, computes the vulnerability of coastal aquifer based on six parameters that are known to control the migration of seawater into coastal fresh groundwater resources. These parameters are: groundwater occurrence (G), aquifer hydraulic conductivity (A), groundwater level above the sea level (L), distance from the shore (D), impact of existing extent of sea water intrusion in the area (I), and aquifer thickness (T). Each of the GALDIT Index parameter were analyzed, mapped and evaluated for the Zululand Coastal Plain aquifer to determine the relative importance of each factor in controlling seawater intrusion and to determine the overall vulnerability of the Zululand Coastal Plain aquifer to sea water intrusion.

Results of the vulnerability analysis show that the Zululand Coastal Plain Aquifer has a low to moderately vulnerability to seawater intrusion. Areas around Richards Bay, St. Lucia and the southern part of the coastal plain are the main “hotspots” of vulnerability to seawater intrusion. The high vulnerability of these “hotspot” areas compared to the entire coastal aquifer is explained mainly due to increased exploitation of groundwater, the permeability of the aquifer and the areas’ connection to the sea. It is recommended that the groundwater resources within these relatively high vulnerable areas be managed appropriately and dedicated seawater intrusion monitoring networks established.

Key words/Phrases: Coastal Aquifer, GALDIT Index, Seawater intrusion, South Africa, Zululand plain coastal aquifer.

