HYDROGEOLOGICAL INVESTIGATIONS OF THE PALMERSTON NORTH REGION

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ABSTRACT

The Lower Manawatu River Valley and its major tributary the Pohangina River Valley are incised within the marine strata of the South Wanganui Basin. Lining each valley are a flight of both aggradational and degradational terraces. Three aggradational terraces are identified and correlated with the Ohakea, Rata, and Porewa terraces of the Rangitikei River Valley which aggraded during stadial periods of the Last (Otiran) Glaciation. The distribution of these terraces in the Lower Manawatu River Valley is discussed and their cover beds described. Previous river channels of the Manawatu River are identified by means of bore-log information.

The nature and history of the Manawatu River has resulted in a sequence of clay, silt, sand, and gravel deposits which is exceedingly complex in detail. Cross-sections are presented which show this complexity. This has been the main factor influencing the distribution and nature of the aquifers in the region. Water is normally extracted from the coarsest deposits with 75% of the bores in the region obtaining water from gravel layers, 15% from sand layers, and 10% from sand/gravel mixtures. The aquifer system is considered to be "*leaky*" due to the complex arrangement of lithologies allowing water to flow both vertically and horizontally without much impedance. Depth ranges of 0-60 m, 60-120 m, and >120 m below the ground surface are considered to be the closest resemblance to separate aquifers. Piezometric contour maps are presented which show an overall groundwater flow direction for all the depth ranges from east to west along the Manawatu River Valley with additional water influx from the Pohangina and Oroua River catchments. Transmisivities of the aquifer system ranges between 150-2000 m^2/day and storativity between 1.1 x 19^{-4} and 3.2 x 10^{-4}. Static water levels and discharge rates increase with depth and decrease from east to west. Nearly all the bores in the area are naturally flowing artesian, making the entire area a discharge zone. Recharge of the aquifer system is from two sources. Firstly, direct percolation of atmospheric precipitation, the main source areas being the Tararua Range, the Ruahine Range, and both the eastern and western flanks of the Pohangina Anticline, and secondly, river recharge.

There is a significant loss (6,500 l/s) of water as the Manawatu River flows through the Manawatu Gorge which is identified as occurring in the vicinity of White Horse Rapids. This water loss is attributed to groundwater river recharge of shallow aquifers. Groundwater accounts for nearly 90% of total water use within this area and the estimated water extraction from the aquifer system is 120,000 m^3/day (43 x 10^6 m^3/year.)

The hydrochemistry of the area is presented by way of isoconcentration contour maps. Total alkalinity, calcium, magnesium, chloride, electrical conductivity, potassium, manganese, sodium, and total dissolved solids increase from east to west within the research area. Free carbon dioxide, fluorine, and iron show no trend but have local "highs". Only sulphate shows an increase from west to east. The average concentrations for the various chemical parameters are: total alkalinity - 157 ppm, Ca - 104 ppm, Cl - 36 ppm, free CO_2 - 11 ppm, conductivity - 43 mS/m, F - 0.16 ppm, Fe-2.1 ppm, Mg - 55 ppm, Mn - 0.38 ppm, nitrate - 0.02 ppm, Na - 23 ppm, SO_4^{2-} - 10 ppm, and total dissolved solids - 256 ppm. Concentrations increase with depth for all the chemical parameters. Conductivity diagrams are presented which show extremely good linear relationships when plotted against all the major cations and anions. These diagrams have practical significance because conductivity is easy to measure in the field.

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