Summary report for Ruamāhanga Whaitua Committee

The geology of the Ruamāhanga catchment

Physical setting of the Ruamāhanga catchment

The Ruamāhanga catchment is bound by the Tararua Range to the northwest. The mountainous area reaches a maximum elevation of 1571 metres and has steep, forested slopes with fast-flowing streams and rivers deeply incised into the hard greywacke bedrock. Further south, the catchment is bounded to the west by the Rimutaka Range, which has its highest peak at 940 m. To the east of the catchment lies the eastern Wairarapa hill country, which consists of steep hills, commonly cleared of forest, with streams and rivers incised into soft sandstone and mudstone. The Aorangi (or Haurangi) Range, at the southeastern boundary of the Ruamāhanga catchment, consists of steep, forest-clad hill country of hard greywacke bedrock, rising to an elevation of 981 m.

The central valley of the Ruamāhanga catchment, containing the Ruamāhanga River, its tributaries, and extensive gravel floodplains, is characterised by gentle slopes that are mostly deforested and intensively farmed. At the southern (downstream) end of the Ruamāhanga River system lies Lake Wairarapa, Lake Onoke, and the Palliser Bay coast.

Geological setting and history

The Wairarapa Coast is about 65-125 km northwest of the Hikurangi Trough, which is the boundary between the Australian Plate (to the west) and the Pacific Plate (to the east). The plates are converging at a rate of around 40 mm/year, with the thicker Australian plate over-riding the thinner, denser Pacific Plate (Figure 1). The strain associated with the plate collision has resulted in extensive faulting, tilting and uplifting, creating the three broad zones described above: the axial (Tararua and Rimutaka) range, the Wairarapa Valley, and the eastern hill country (Begg et al. 2005).

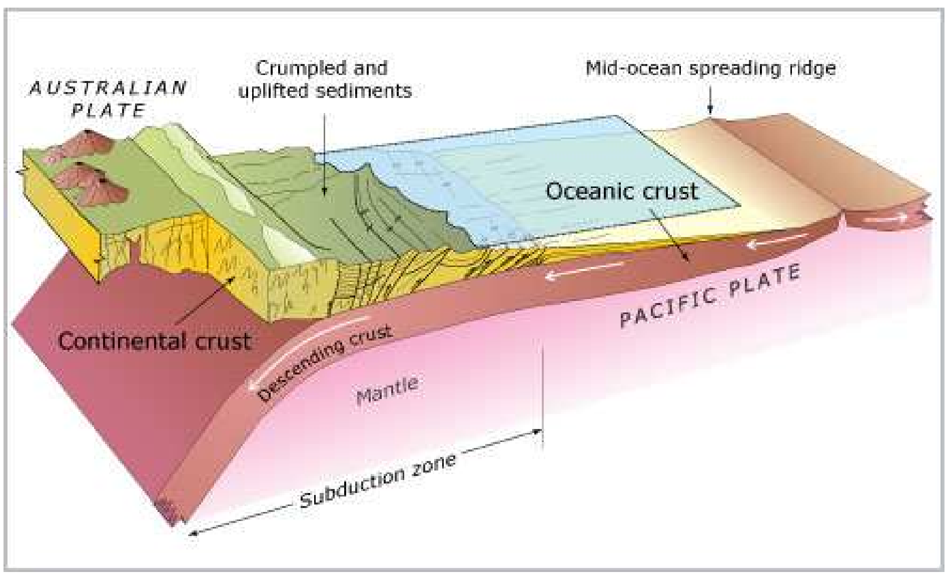

Figure 1: An east-west cross-section through the North Island, showing how the Pacific Plate subducts beneath the Australian Plate. Source: McSaveney and Nathan (2013)

The geological history of the Wairarapa dates back to around 300 million to 100 million years before present, when sand and mud deposits accumulated in deep marine basins along the eastern margin of Gondwanaland. Around 100 million years ago, a major tectonic event resulted in widespread tilting, folding and faulting. The Wairarapa region was low-lying or submarine during this time, and marine deposition occurred in the subsiding basins. The deposited sand and silt were, over long periods of time, transformed into the hard greywacke that comprises the Tararua, Rimutaka and Aorangi ranges.

About 20 million years ago, a tectonic regime is believed to have re-activated, with subduction at the Hikurangi margin, westward-tilting of the eastern coastal ranges and a slow retreat of the sea from the Wairarapa basin: the shoreline had retreated almost as far as the current coastline by the start of the Early Quaternary[1] (2.5 million years before present). Reverse faulting on the large regional faults such as the West Wairarapa fault resulted in uplift, forming hills and mountains (notably the Tararua Range). The mountains resulting from the uplift supplied the developing Ruamāhanga catchment system with large volumes of greywacke cobblestone, forming large gravel fans in the central valley.

The Ruamāhanga Valley depositional environment and its influence on hydrogeology

The Ruamāhanga valley basin is filled with a sequence of sediments that has been deposited, and locally reworked, by the rivers during successive Quaternary glacial and interglacial periods. The spatial pattern of sediment accumulation in the valley has been greatly influenced by tectonic processes (folding and faulting) associated with structural deformation along the plate boundary forming subsiding sedimentary basins. Fault movement has also displaced blocks of uplifted basement rock against the younger sedimentary sequence, resulting in a geologically complex area.

The thick alluvial gravel deposits contain groundwater, with the spatial extent and productivity of the aquifers[2] being influenced greatly by the geological setting. In broad terms, the Ruamāhanga valley basin contains an unconfined to leaky-confined aquifer system with greater degrees of confinement occurring at depth within the sub-basins. The regional aquifer system is internally compartmentalised by geological structures that have resulted in flow barriers and sub-basins. The main hydrogeological units of the valley are described in Table 1 and are shown spatially in Figure 2.

The geological features worth specific mention due to their impact on hydrogeology of the Ruamāhanga catchment are basement ridges and splay faults. Te Maire Ridge and Tiffen Hill represent blocks of greywacke basement that have been uplifted along faults on the eastern side of the valley. The ridges form a groundwater divide between the Ruamāhanga River Valley and alluvial fan / sub-basin deposits to the west, and influence the flow pattern of groundwater. These are shown as the 'uplifted blocks' in Figure 2.

Three major cross-valley active faults branch eastwards from the Wairarapa Fault in the upper Ruamāhanga valley area: the Mokonui, Masterton and Carterton faults (shown as red

[1] The Quaternary period spans from 2.59 million years ago to the present
[2] An aquifer is an underground formation of permeable rock or loose material which can produce useful quantities of water when tapped by a well (Environment Canada 2013)

lines in Figure 2). Each cuts across the rivers (and their terrace gravels) flowing into the northern end of the valley. The faults form groundwater flow barriers, commonly resulting in the emergence of springs along the fault traces.

Table 1: Main hydrogeological units of the Wairarapa valley, from Jones & Gyopari (2006) and Hughes & Gyopari (2011)

Structure	Description	Linkage to hydrology / hydrogeology
Alluvial fan deposits (shown as 'poorly sorted fan gravels' in Figure 2)	On the western side of the Ruamāhanga valley major rivers emerging from the foothills have formed large alluvial fans. Smaller alluvial fans are also associated with the rivers emerging from the eastern hills and Aorangi range. On the eastern side of the valley, the alluvial deposits are generally more fine-grained sediment than in the central and western valley, because the material is derived from marine sediments of the eastern hill country and break down rapidly upon weathering.	Alluvial fans contain extensive moderate to low permeability groundwater aquifers. In the east of the valley the aquifers may be more productive than in the west, due to the deposits containing finer grained sediments.
Recent alluvial gravels*	Recent floodplains of the major river tributaries of the Ruamāhanga River.	The gravels contain shallow, highly permeable unconfined aquifers that are connected to the rivers.
Ruamāhanga River valley*	The Ruamāhanga River has entrenched into a relatively narrow valley within the Wairarapa plains, running along the eastern side of the overall valley between the eastern hills and the uplifted basement blocks of Tiffen Hill and Te Maire Ridge (see below). Gravel deposits within the valley are typically less than 15m deep.	The gravel deposits form a moderately to highly permeable unconfined aquifer system which is connected to the Ruamāhanga River.
Alluvial sub-basins	Resulting from structural deformation and accumulation of successive deposits of sediment associated with glacial and interglacial periods. Individual alluvial sub-basins are present in the Te Ore Ore, Parkvale, Carterton and Lake Wairarapa areas.	These deep basins often have a sequence of semi-confined aquifers.
Lake Wairarapa basin	Lake Wairarapa occupies a large, actively subsiding sub-basin at the southern end of the valley. In this area reworked alluvial gravel deposits are separated with layers of fine-grained sediments associated with the lake.	This basin contains a series of discrete confined aquifers in the gravel layers. The aquifers pinch out before reaching the south coast due to a basement high in the vicinity of Lake Onoke.

*Shown as "Q1 gravels" in the diagram (Figure 2)

See Figure 2 overleaf

References

Begg, J., Brown, L., Gyopari, M. and Jones, A. 2005. Review of Wairarapa geology - with a groundwater bias. Report prepared for Greater Wellington Regional Council. GNS publication 2005/159.

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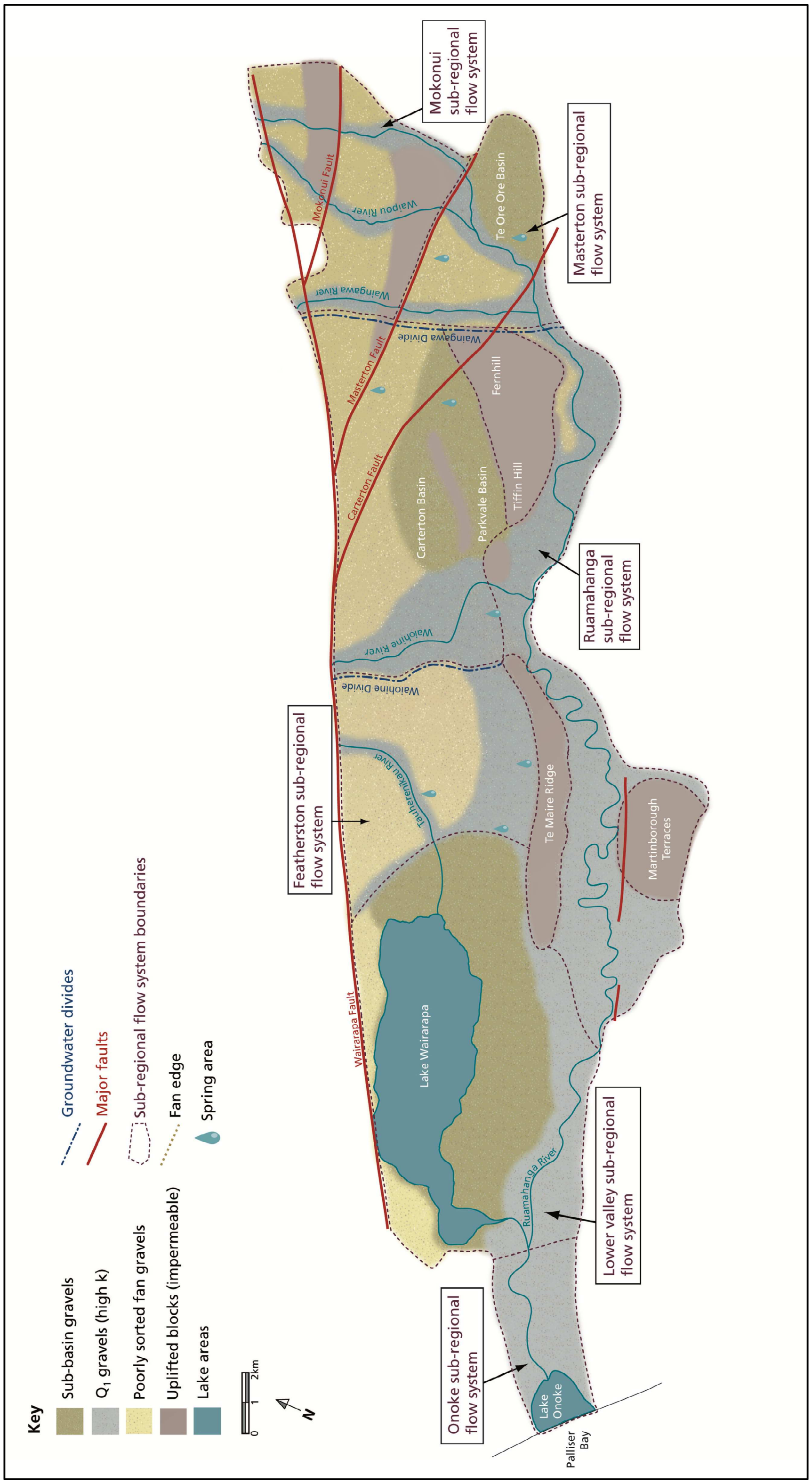

Figure 2: Bird's eye view of the Ruamāhanga valley showing the main hydrogeological units. Source: Jones and Gyopari (2006)