Chapter 36: Flaxbourne And Waima/Ure Catchments

Introduction

Marlborough's East coast is one of the driest areas of New Zealand with the rain shadow effect of the Southern Alps and Kaikoura Ranges resulting in low rainfall, and providing naturally high evaporation rates.

This area has historically received little attention in terms of hydrological investigations or surveys and therefore limited hydrological records exist with a permanent hydrological network having only been established as recently as 2003 to measure rainfall, Flaxbourne River flow and Needles Creek level. Demand for water has historically been low as large scale dryland farming was the predominant land use. In recent years the expansion of the viticulture industry has consequently increased demand and encouraged investigations to discover potential water sources capable of providing enough water for irrigation. The demand has been centred around the area of flat land on the coastal lowlands or terraces. Stockwater remains important for this pastoral farming area, and together with the Ward community supply, is predominately sourced from shallow groundwater.

No deep aquifers have been discovered in the area to date and the regional geology means their existence is unlikely. So far only riparian type aquifers are known to occur.

Flaxbourne River Catchment

The Flaxbourne River catchment's surface drainage pattern is largely controlled by faulting and geology. The main channel of the Flaxbourne River is constrained to the northern side of the catchment before being joined by the Needles Creek and Tachalls Creek tributaries, near Ward township, then flowing to the sea at Ward beach (Fig. 36.1).

The Flaxbourne River catchment is mostly formed of bedrock with limited alluvium to store water and form aquifers. For this reason most freshwater is sourced from rivers or shallow wells linked to surface flows.

The local geology is complex and includes a range of rock types which have been modified by folding and faulting. The local rocks form what is known as the Ward Syncline which is the term for a group of strata which have been folded to form a concave or basin shape. This sequence of rocks is thousands of metres thick and mantled by a thin veneer of aquifer forming gravels (Fig. 36.2).

The predominant basement rocks include mudstones, commonly referred to as Papa, along with greywacke sandstone and rarer carbonaceous rocks. The distinctive grey banded appearance of the Papa makes it stand out where it outcrops along the banks of the Awatere River and in the Ward area.

Papa, greywacke, sandstone and carbonaceous rocks have limited potential for storing water because they have very low porosity.

Groundwater systems

All known groundwater in the Flaxbourne catchment is restricted to the shallow gravels associated with the Flaxbourne River or its tributaries the Tachalls or Needles Creeks.

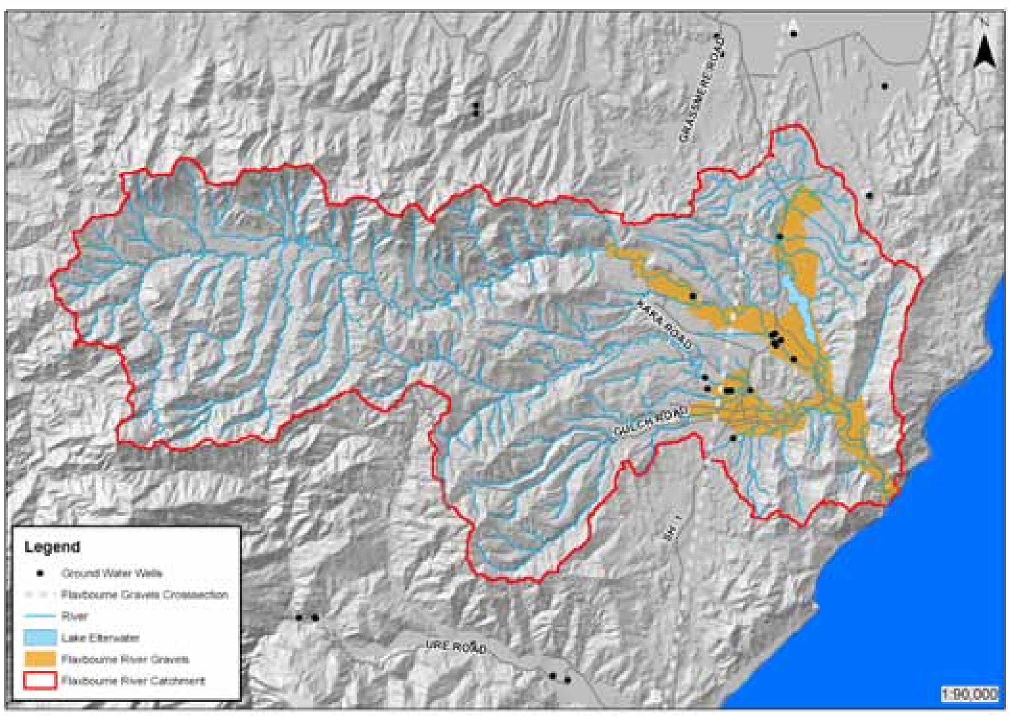

Figure 36.1: Flaxbourne River Catchment

Thin gravels occupy localised areas, creating small natural reservoirs in terms of the water volume they can store. These gravels depend on continual recharge from the nearby river or creek, and can't store sufficient rainfall through drought seasons to supply irrigation demands (Fig. 36.3).

All known production wells in the Flaxbourne catchment, source water from within ten metres of the surface. Infiltration galleries are a common adaptation to access the

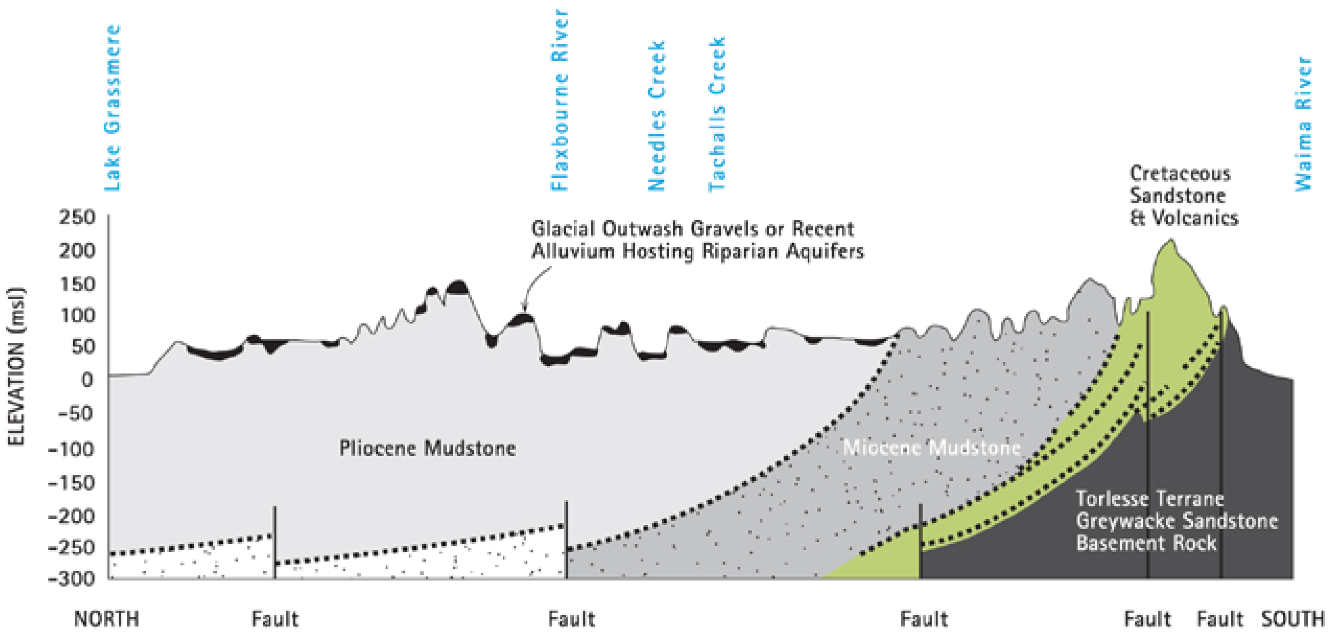

Figure 36.2: Ward Syncline cross-section. The axis of this section is marked by the dashed white line in Figure 36.1.

thin water bearing layers and low summer water tables. In many cases the maximum thickness of water holding gravels overlying the Papa mudstone is less than five metres.

Recharge and flow patterns

Most freshwater in the Flaxbourne and Waima River catchments originates as rainfall in the western hills and flows to the sea as river flow.

The Flaxbourne catchment riparian aquifers are formed of permeable gravels that lie on the naturally steep grade of the Flaxbourne River. While there is perennial flow in the headwaters of the Flaxbourne River, over summer surface flows become ephemeral in the middle reaches as water drains more quickly than it is being naturally replenished. In dry channel reaches there is likely to be some sub-surface flow in the gravels (Fig. 36.4).

Even if water demand is low, there is insufficient water stored in the gravels to offset the natural rate of drainage. Groundwater and surfacewater are essentially the same resource within the alluvial gravels and flows move between the ground and surface depending on local conditions.

Wells in the Flaxbourne catchment are either directly or indirectly connected to one of the three main surface flows. The effects of pumping on river flows may be delayed in time. The factors controlling natural water availability were summarised in the 2003 PDP report commissioned by MDC to provide a baseline assessment of catchment hydrology. It read: *"The major source of water in the watershed is rain in the upland areas, which moves through the catchment at varying speeds, rapidly as surface flows and at slower more variable speeds as groundwater seepage". "When there is continuous flow to the sea, then there is unlikely to be water shortages. However regardless of demand, water shortage is a natural phenomenon unrelated to allocation when successively dry seasons have failed to recharge groundwater storage in Spring."*

Figure 36.3: Flaxbourne riparian aquifer concept model

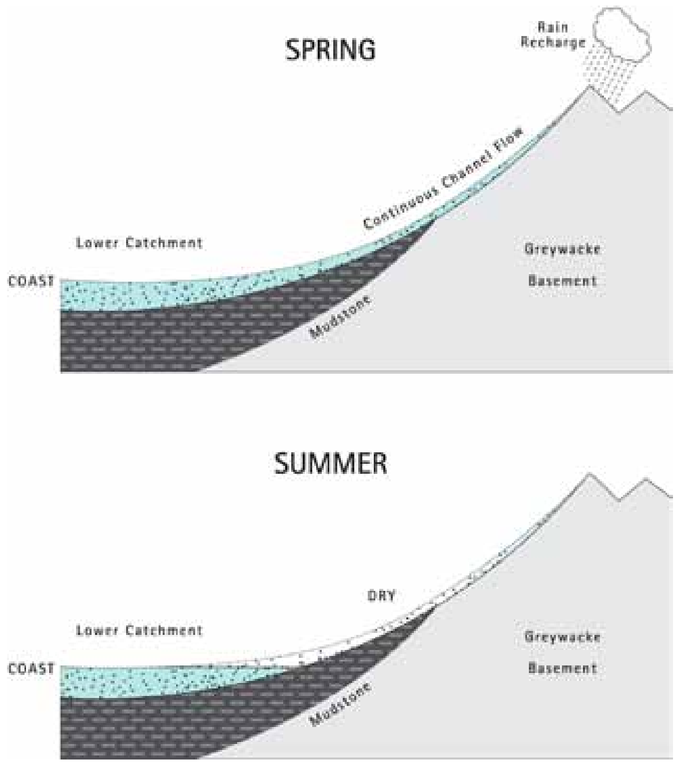

Figure 36.4: Flaxbourne Catchment flow model

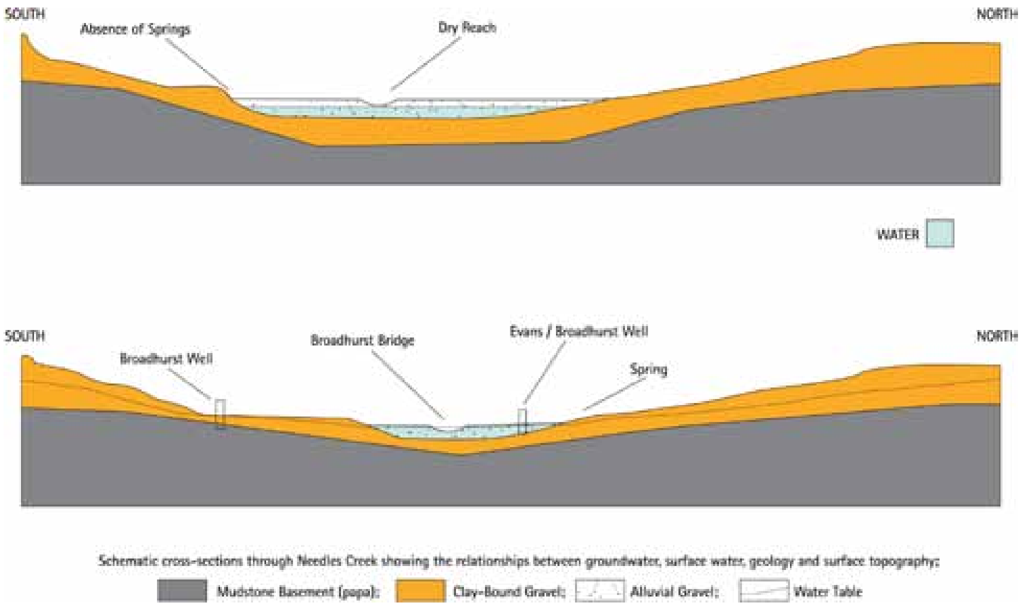

Figure 36.5: Effect of geology on hydrology (recreated from PDP 2003)

There is no evidence of significant groundwater flow originating midway down the catchment from faults, although it remains a possibility given the tectonic history of the area.

When there is continuous channel flow from the hill catchments to the sea and aquifers are full, there is likely to be sufficient water for all needs. The natural flow of water down the catchment is analogous to water flow in a pipe with inputs at the top, drainage at the bottom, and no inputs or outputs in between.

It is no coincidence that wells around the Ward area are close to rivers or creeks. Without perpetual recharge the small size of the local aquifers mean they become depleted relatively quickly, either through natural drainage or pumping.

An apparent anomaly exists in relation to well P29w/0146 on a slightly elevated terrace opposite the lower reaches of Needles Creek. In this case aquifer levels are higher in the well than the water level in the neighbouring Needles Creek channel. This is explained by the presence of low permeability strata in the vicinity of the well forcing water to the surface (Fig. 36.5). Groundwater rises naturally closer to the surface as it encounters less permeable material, or a narrowing of the alluvium forming the valley floor. Artesian pressures are often taken to be symptomatic of a high yielding aquifer, but in reality they reflect a particular structure or a combination of conditions.

Limited information exists on the aquifer hydraulic properties for the Flaxbourne catchment. The earliest results come from a test carried out by the MCRWB in May 1984. This test was carried out to investigate the potential for the Flaxbourne River gravels as a source of groundwater for a stock supply scheme. The test site was a shallow well excavated in the bed of the Flaxbourne River halfway between the SH1 road bridge and the Ford.

While a high transmissivity value of 3,290 m^2/day was measured, it was a function of both the highly permeable nature of the gravels and the proximity to flow from the Flaxbourne River. The test is unlikely to reflect the typically dry summer conditions it was attempting to simulate, as there was considerable flow in the Flaxbourne River at the time. This emphasises the principle that for riparian aquifers the nature of the sediments is less important than whether there is associated river flow to maintain groundwater.

A second test was carried out in July 2001 on well P29w/0146. The estimated aquifer transmissivity was 50 m^2/day. The test found that: "*this showed the clay-bound gravels which form much of the aquifer system are up to 50 times less permeable than the alluvial gravels" (PDP - 2003)*.

Groundwater chemistry

Much of our understanding about water chemistry in the Flaxbourne catchment has originated from the 2006 baseline survey by the MDC and GNS Science (GNS Science - 2007). To understand long-term patterns, the MDC monitor groundwater quality at well P29w/0188 each season.

The 2007 GNS Science report found that all of the waters sampled in the Flaxbourne area were young with mean residence times of less than five years. This indicates limited groundwater storage and small aquifers. Older groundwaters exist, but they represent localised seepage through low permeability sediments such as the Papa mudstone.

Because flow traverses the catchment so rapidly, the major influence on its chemical composition is the rock type it passes over, and to a lesser extent nutrients from landuse. The chemistry of water from the Needles or Tachalls Creek sub-catchments reflects the presence of fossil shells and residual sea-salts in the Papa mudstone which is of marine origin. The minerals in the Papa are relatively soluble and readily dissolved by river or groundwater as it drains the catchment. These rocks impart characteristically high levels of chloride,

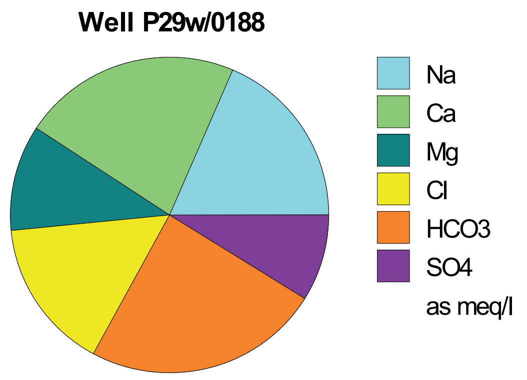

Figure 36.6: Well P29w/0188 groundwater composition

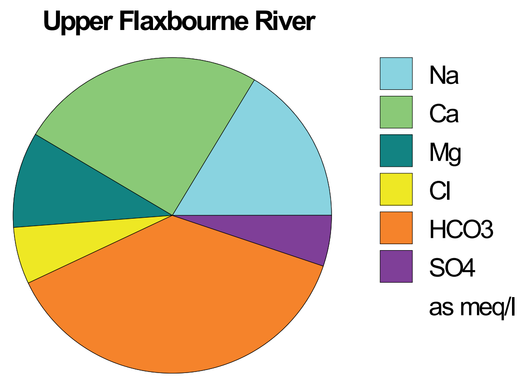

Figure 36.7: Upper Flaxbourne River composition

sodium and calcium to these waters making them hard. Conversely waters from the Flaxbourne River catchment are relatively dilute, reflecting the insoluble nature of the greywacke sandstone rocks.

As a rule the conductivity of water, which reflects the concentration of dissolved minerals, increases slightly in a downstream direction due to increased water-rock interaction. This reflects the short residence time of all catchment waters, and limits the extent to which it can naturally evolve.

The quality of groundwater or nearby channel flow is similar and effectively one and the same due to continual mixing. For example, groundwater from the Taimate stock supply scheme well P29w/0087 near SH1 is virtually identical to nearby Flaxbourne River water (GNS Science – 2007).

There is limited impact from landuses on water quality in terms of nutrients. This may be explained by natural degradation processes like denitrification. All of the waters sampled during the 2006 MDC/GNS field survey including those from rivers, were anaerobic. This is unusual for surface waters and points to a biochemical sink such as buried organic matter within the gravels. This would also explain the presence of elevated iron and manganese in some well waters.

The chemical composition of Flaxbourne River water from the upper catchment has been compared with groundwater from well P29w/0188 in the lowland area (Fig. 36.6). The Flaxbourne River water analysis (Fig. 36.7) is based on a sample from February 2006, while the well was sampled in August 2009.

The major difference between the waters is an increase in the percentage of chloride, sulphate and sodium in the well water. This reflects the influence of the Papa mudstone and agricultural activities in the lower catchment. The analysis shows the composition of the water, but doesn't communicate the dilute nature of the Flaxbourne River sample compared to its downstream groundwater counterpart in terms of the lower concentrations of salts.

Waima River catchment

Very little is known about the hydrogeology of the Waima River catchment. A flow recorder was established on the Waima River in 2008, at a point in the hill basement rock known as the Narrows. The Narrows are upstream of the main ephemeral reaches of the Waima River. The catchment is dominated by limestone rock types which is reflected in waters with naturally higher pH.

Loss gaugings carried out by the MDC from late 2008 through to mid 2009 show channel flow is lost to the gravels in the middle reaches after leaving the hill catchment (Fig. 36.8). There is a resurgence in flow downstream of the SH1 road bridge which is most likely due to a narrowing and/or thinning of the riparian gravel deposits that border the surface channel.

A small number of wells have been drilled to depths of up to 30 metres in the gravels of the Waima/Ure River bed. These wells supply water for both domestic and summer crop irrigation. Well yields vary according to drillers records, but well P29w/0141 is of a similar

Figure 36.8: Waima/Ure River gravels looking upstream

yield to a moderately high producing Wairau Plain well. However the sensitivity of this figure to seasonal variations in Waima/Ure River flow or the distance of the meandering channel, is uncertain.

No detailed or long-term water chemistry information is available yet for the Waima River groundwaters.

References

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