Chapter 30: Omaka-Hawkesbury Valley Aquifers

Introduction

The Omaka-Hawkesbury Valley is located approximately 12 kilometres south-west of Blenheim and forms part of the Southern Valleys catchments. It occupies an area of 4,400 hectares of which approximately 1,000 hectares is potentially irrigable flats and the remainder is steep to rolling hill country. North to south orientated ridge lines separate this valley from the Omaka River Aquifer to the west, and the Fairhall-Brancott Valley to the east (Fig. 30.1).

Up until the early 1980s, agricultural land overlying the Omaka Aquifer was used for semi-intensive farming. Only minor volumes of groundwater were being used for stock or domestic use. Today the predominant landuse on the flats is vineyard which requires relatively large volumes of water by comparison. The SVIS supplements water usage in the area, however, during dry conditions when the Southern Valleys Irrigation Scheme (SVIS) is not operating, all irrigation water is sourced from groundwater.

Groundwater systems

There are two distinct groundwater systems in the Omaka-Hawkesbury Valley. The first is a localised riparian aquifer associated with the permeable gravels of Wards/Mill Stream, which is the main drainage channel for the catchment. The thin gravels associated with Wards/Mill Stream are permeable and provide water to those living close to Wards/Mill Stream itself. Wells are generally shallow at 10 metres or less in depth, and are more often than not located in the stream bed itself or very close to it. The water abstracted from these wells is of limited importance except for stock or domestic supply. Wells tapping this riparian aquifer are directly dependent on the flow regime of Wards/Mill Stream. When surface flows cease, groundwater is present as underflow but in limited volumes.

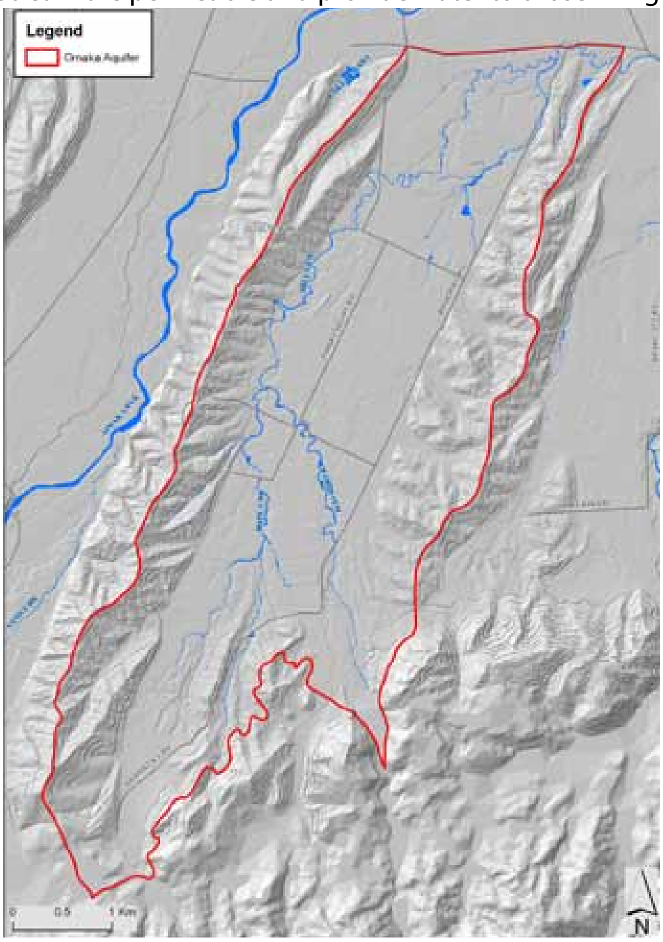

Figure 30.1: Omaka Aquifer boundary

The second and more important groundwater system, in terms of water supply and size of the resource, is the Omaka Aquifer. The Omaka Aquifer is the collective name given to a series of low yielding, semi-confined to confined, independent water bearing gravel layers. The gravels occur at depths of greater than 30 metres and extend to several hundreds of metres.

An hydraulic connection exists between the two aquifers and flow in Wards/Mill Stream. The ephemeral nature of Wards/Mill Stream means all stream flow is lost to groundwater for much of a typical summer. While the riparian gravels are relatively permeable compared to the underlying material, they are still claybound.

Omaka Aquifer

The claybound gravels which form the Omaka Aquifer belong to a series of glacial outwash formations. The gravels contain high proportions of fine silts or clays and as a result the permeability of this material is low. The Omaka Aquifer has been explored by both private landowners and local bodies since the early 1980s. Dozens of wells have been drilled into the Omaka Aquifer, but a high proportion no longer exist because they produced insufficient groundwater.

The occurrence of water bearing layers is unpredictable, but the highest yields are generally associated with the upper 60 metres of gravels closest to the surface. Most wells are 30 to 100 metres in depth. The deepest production well 3418 is located just south of Falveys Road and is screened between 78 and 198 metres below the surface.

Most of the deeper wells have very long screens compared to those fitted in Wairau Aquifer wells. The long screens collect every contributing groundwater lense throughout the vertical profile. Long screens were common practice across all Southern Valleys Aquifers in the late 1980s and 1990s.

History of use and investigations

There has been intensive prospecting for groundwater over the years because of the ephemeral nature of surface flows when water is needed most. Drilling has had varying success, from the occasional high flow, to many dry and abandoned wells.

Figure 30.2: Exploratory well 2917 under construction

In the 1980s an exploratory drilling programme was drawn up by the MCRWB and circulated to land-owners for their approval. However, the programme was not implemented because of a lack of community interest at the time.

Montana Wines, the major landowner in the valley in the 1980s, was not deterred by the lack of community support and continued with water exploration in the area. They sought advice from the water divining fraternity and proceeded to drill a well more or less in the centre of the valley. They hoped to find a limestone cavern in which there was reputed to be ample water and from which pumping rates in excess of 100 m^3/hour could be expected. This particular well 0956, was drilled to a depth of 52 metres without so much as a trace of water.

In 1980 N.B. McCallum drilled the first of a number of successful irrigation bores in the valley floor system which is now known as the Omaka Aquifer. The results from the various bores drilled in the valley indicate a large variation in both the type of material encountered and the groundwater yields obtained. There appears to be no general pattern to well productivity in this area, although the depth of successful wells is generally at least 35 metres.

The best known bore is the 39 metre deep well 1110, half way along Hawkesbury Road. It is well known for its high yields and artesian flow with yields of up to 20 cubic metres per hour. This well was a targeted site based on the results of the 1984 electric resistivity survey (GCNZ - 1984).

Exploratory drilling programme

In 1995 the MDC commissioned the drilling of exploratory well 2917 (Fig. 30.2). It was drilled to an overall depth of 405 metres and screened between 60 and 400 metres depth. The upper 60 metres of the well was cased to isolate it from other production wells during testing. This well is the deepest drilled in Marlborough and provides the clearest picture yet of the Southern Valleys Aquifers geology. The base of the exploratory bore extends to over 300 metres below sea-level.

The resulting well log showed that the Omaka Valley was underlain by a 400 metre deep sequence of sedimentary material overlying basement rocks. While groundwater existed throughout the sequence, the most productive layers existed in the currently utilised upper 100 metres of gravels nearest the surface (Fig. 30.3). Water bearing zones were encountered at depths of: 48, 190, 285 and 330 metres. While no new major sources of irrigation water were encountered, this in itself was a significant advance in knowledge.

The static or non-pumping level at well 2917 was 24 metres below the surface at the time of construction. This is one of the deepest observed at any well in Marlborough to date, and significantly lower than

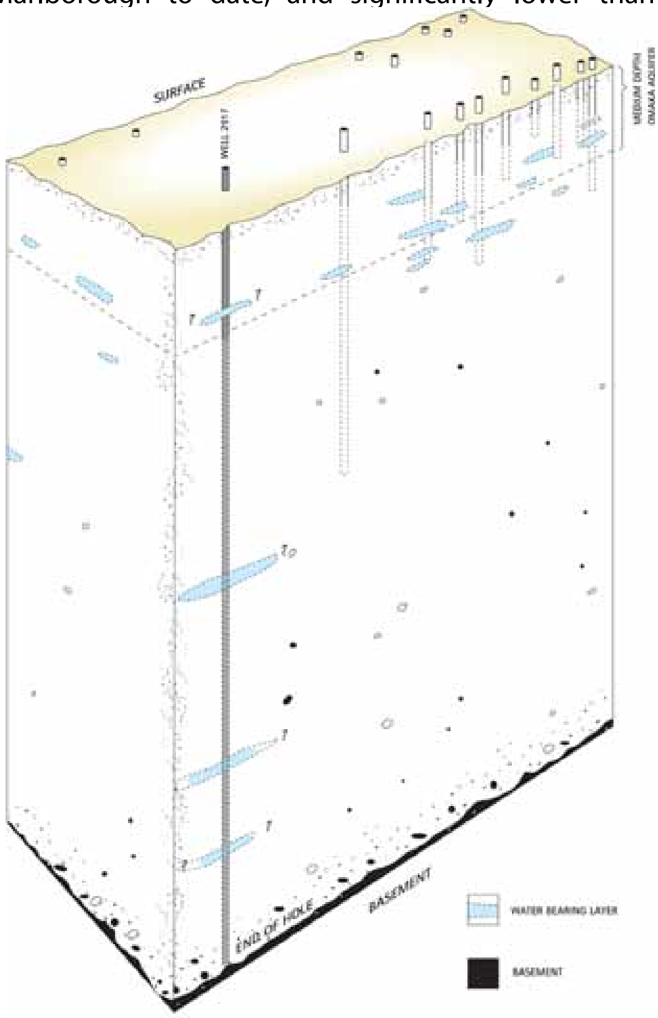

Figure 30.3: Omaka Aquifer structure

static levels in shallower neighbouring wells. The low static level indicates a discontinuous aquifer structure and led to the notion of three semi-connected layers. Furthermore the static level in well 2917 decreased with depth during drilling, which is a characteristic of an aquifer recharge zone. In other words groundwater is draining downwards in the southern-most area of the valley, but the pattern is reversed further north.

Following construction, the exploratory bore was tested. No drawdown measurements were made at neighbouring wells because the upper 60 metres of the test bore had deliberately been cased off to isolate only the deeper section of interest.

Testing involved pumping the bore for 23 hours at a constant rate of 1.3 l/s. An aquifer transmissivity value of 4.7 m^2/day was calculated, which is low even by Southern Valleys Aquifer standards. This confirms that the currently utilised upper aquifer layers remain the primary source of groundwater.

Unfortunately the precise chemical composition of groundwater from the test bore 2917 remains uncertain as the single sample taken at the end of the aquifer test was spoilt due to a laboratory error.

The exploratory bore confirmed that the upper 100 metres of the Omaka Aquifer remains the most productive in terms of groundwater availability, and supplies the bulk of water for all purposes. The lack of locally available water for the increased demands of viticulture paved the way for the introduction of the SVIS a decade later.

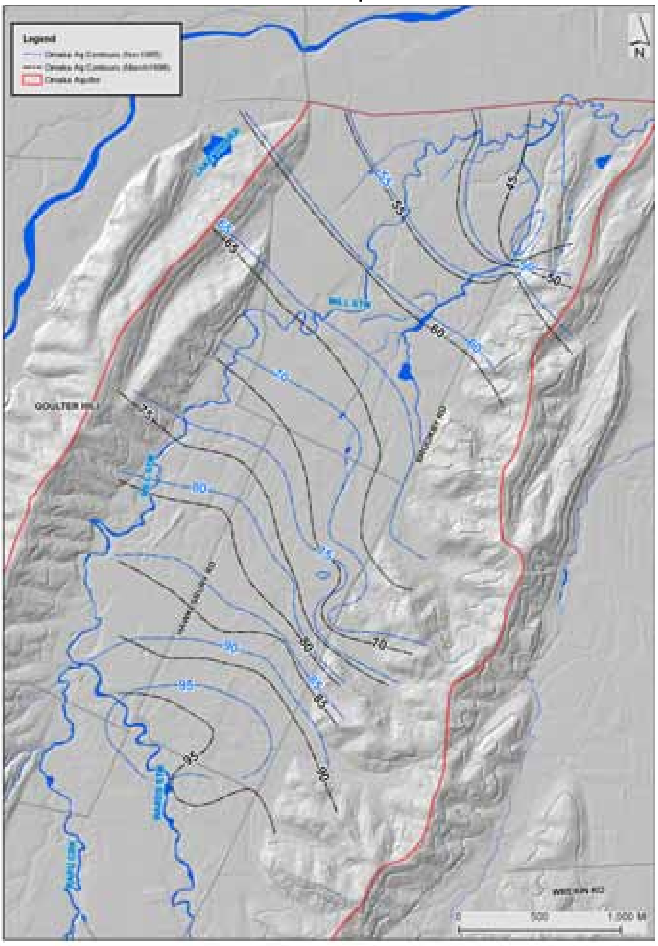

Figure 30.4: Omaka Aquifer water table contours

Recharge and flow patterns

A small number of environmental isotope samples have been taken from local wells and streams to assess the origin and flow pattern of groundwater beneath the Omaka/Hawkesbury Valley. The results showed that groundwater is much older than for the shallower layers of the Wairau Aquifer, with residence times of greater than 60 years.

Recharge originates predominantly from Wards/Mill Stream and to a lesser extent rainfall. Dr C. Taylor described flow through the Omaka Aquifer as slow moving and postulated the existence of intervalley flow between the various Southern Valleys Catchments.

Two aquifer level surveys across 43 wells were carried out in November 1995 and March 1996 by the MDC to assess the regional direction of groundwater flow, the effects of summer pumping and the homogeneity of the aquifer. The November 1995 survey represented relatively wet conditions compared to those experienced in March 1996 (Fig. 30.4). Levels for exploratory bore 2917 were excluded. The general direction of groundwater flow is down valley from south to north. Levels are lower in summer when some contours are distorted due to the influence of pumping wells nearby.

One of the limitations of measuring aquifer pressure in the Southern Valleys Aquifer wells are long screens which average pressures from across a range of strata, rather than at a single, discrete point. Notwithstanding this, there are many examples of gross differences in aquifer pressure during the construction of individual wells. During the drilling of well 3418 the static level varied from 10 metres close to the surface, to 32 metres at the base of the well, at a final depth of 201 metres.

Wells located in the southern part of the Omaka-Hawkesbury Valley exhibit lower static levels with increasing depth below the surface. The opposite occurs in the northern part of the valley around Dog Point Road. This pattern points to a natural aquifer circulation whereby surface waters are lost to groundwater in the recharge zone to the south through gravity drainage. In the northern area groundwater is confined and these pressures force it to the surface thereby creating springs, wetlands and artesian flow in wells (Fig. 30.5).

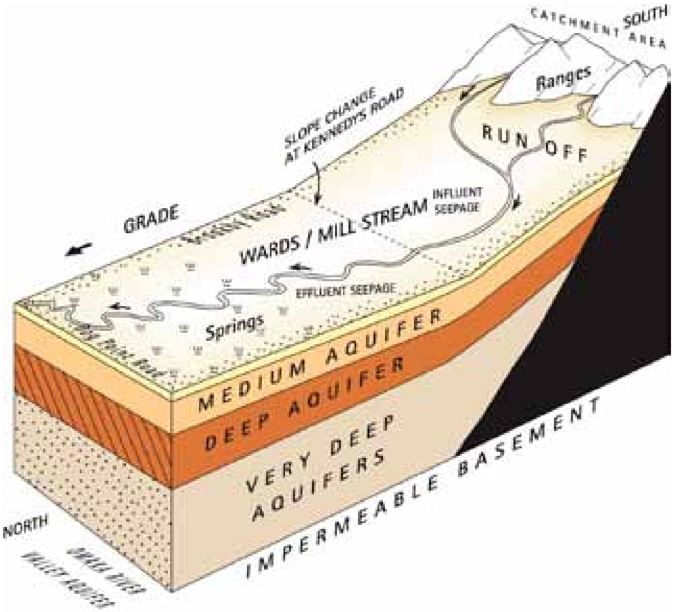

Figure 30.5: Omaka Aquifer conceptual model

The artesian pressures encountered when drilling well 1136 in 1981 were an anomaly as it located further to the south where surface flow is usually lost to groundwater. The artesian pressure is most probably generated by local confining beds, and not symptomatic of the regional flow pattern.

The long screen lengths present in many deeper wells makes it difficult to discriminate between the water bearing layers and their hydraulic properties. However, based on drillers observations and in particular the results of the MDC exploratory well, yield appears to decrease with depth. This shows relatively permeable sediments close to the surface corresponding with the highest groundwater flows. These are underlain by successively less permeable sediments with slower and volumetrically lesser groundwater through-flow (Fig. 30.6).

Hydraulic properties

A number of aquifer tests have been carried out on wells tapping the Omaka Aquifer. Transmissivity values vary by three orders of magnitude from a minimum of 0.5 up to 60 m^2/day. Such large differences reflect the variable nature of the geology and explain the range in well productivity.

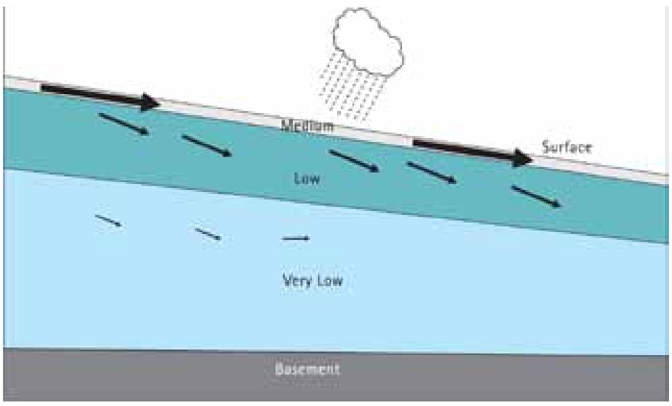

Figure 30.6: Omaka Aquifer throughflow model

A consequence of low transmissivity values is that while well yields may be low and drawdowns large, the radius of influence is relatively small, meaning neighbouring wells beyond a certain distance are relatively unaffected by one another's pumping.

Several tests show the presence of relatively impermeable aquifer boundaries. In other words the aquifers are not large or extensive. This is reflected in characteristically steeper drawdowns when the cone of depression caused by pumping intercepts the edge of the small reservoir of water. The steepening of the drawdown curve with time during the test pumping of well 1130 in Hawkesbury Road in August 1989 by Montana Wines Ltd, is symptomatic of this (Fig. 30.7).

Omaka sediments are referred to as bounded channel type aquifers because they are hosted by narrow ribbons of gravels sandwiched between finer grained, non-water bearing sediments. The water bearing gravels represent fossil gravel deposits laid down by a local stream. Their presence supports there being a non-homogeneous geology and aquifer structure.

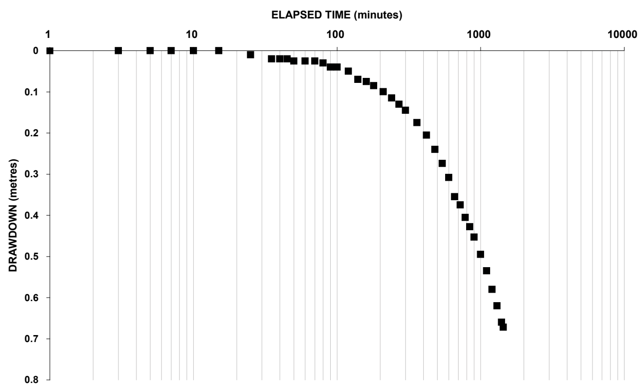

Figure 30.7: Well 1130 aquifer test drawdown plot

Few measured values of storativity exist because of the lack of observation wells sufficiently close to provide a response during testing. Those that do exist are of the order of 10^{-4}, indicating a confined aquifer structure which is consistent with our knowledge of the geology from drilling records.

The degree of confinement varies from partial to full confinement depending on location and well depth. Overall the structure and hydraulic properties of the Omaka or Brancott Aquifers are less uniform and in particular, far less confined than for the Benmorven Aquifer. This reflects their terrestrial origin and the lack of the thick clay layers associated with marine transgressions which only affected the eastern or lowland Wairau Plain.

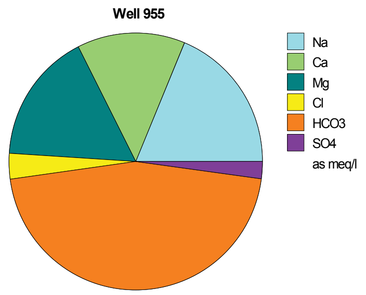

Figure 30.8: Well 0955 groundwater chemical composition

Groundwater chemistry

The quality of groundwater is variable and largely a function of well depth. Younger groundwater near the surface is similar to rainwater, while deeper groundwater is more evolved because of its older age and longer residence time in contact with gravels and clays.

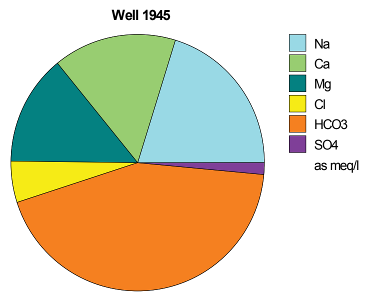

Figure 30.9: Well 1945 groundwater chemical composition

The presence of hydrogen sulphide gas (H_2S) during the construction of one of the deeper wells 2902, drilled to a depth of 195 metres below the surface, indicates relatively old water with advanced reducing conditions, and a lack of free oxygen.

In common with other Southern Valleys Aquifers, there are often issues with high concentrations of iron and manganese which can cause aesthetic problems for householders. In general the water is quite suitable for the full range of agricultural and horticultural uses. Groundwater from greater depths should be tested for arsenic if it is to be used for drinking purposes.

Because it is less confined than either of the neighbouring Brancott or Benmorven Aquifers, groundwater residence times are generally younger for wells of a similar depth, and quality is likely to be

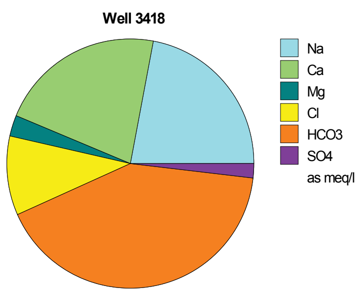

Figure 30.10: Well 3418 groundwater chemical composition

superior. This also reflects the lack of marine sediments this far west, which contribute nuisance levels of sodium and chloride salts to groundwater at Benmorven.

The chemical composition of the shallow wells 955 and 1945 is similar, and are only slightly evolved from recent runoff or stream waters (Fig. 30.8 and Fig. 30.9).

Water from the deepest production well 3418 in the Omaka-Hawkesbury Valley is significantly different with higher proportions of sodium and chloride (Fig. 30.10). The proportion of calcium is also higher in groundwater from the deeper well 3418 which might reflect the long screen allowing younger water to flow downwards.

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