# Chapter 42: Tuamarina River Valley And Picton

## Introduction

The Tuamarina River is a tributary of the Wairau River which flows south from its origins on the slopes of Mt. Freeth, near Picton (Fig. 42.1). The valley that contains the Tuamarina River is also known as the Waitohi Valley.

Geological subsidence of the Marlborough Sounds has reduced the slope of the Tuamarina River channel and resulted in the creation of the Para Wetland (Fig. 42.2).

The surrounding hills are formed of a mix of schist or greywacke basement rock, except around the Elevation where marine siltstones and coal measures occur. Alluvial gravels and sands that fill the base of the valleys have been deposited by the Tuamarina River over geological time. Aquifers are associated with the gravels and sands forming the valley floors. The depth and width of the aquifer forming alluvium varies depending on the proximity of the basement rock to the surface and the width of the valley.

Groundwater resources in the northern and middle reaches of the valley were first studied during the 1970s as part of investigations for the expansion of the Picton municipal water supply. Various investigations involving isotope tracers, geochemistry and pumping tests were used to understand the groundwater resource.

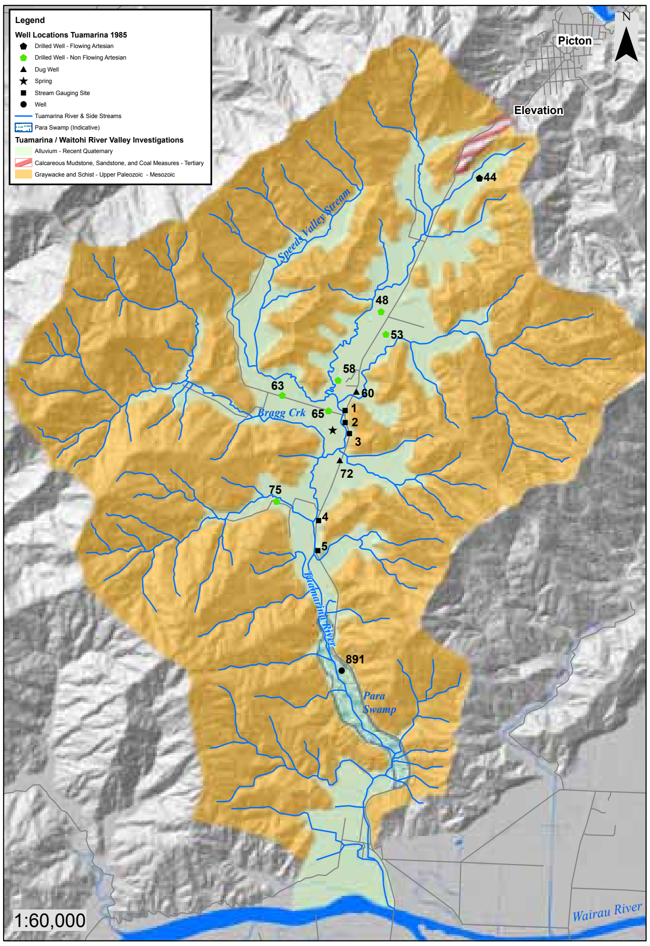


**Figure 42.1: Tuamarina catchment boundary and geology**

**Figure 42.2: Tuamarina River and Para wetland looking south towards the Wairau Plain**

Apart from the irrigation of the local golf course, traditionally there has been limited irrigation in the Tuamarina River Valley. Pasture irrigation wasn't required because of the relatively high rainfall in the area. Since the 2000/2001 drought however, a series of water permits have been granted to landowners, primarily for dairy pasture irrigation.

The Picton municipal water supply well-field at Speeds Road is the largest user of Tuamarina River Valley groundwater. The municipal supply was established in the early 1970s by the Picton Borough Council. The well-field is a supplementary source of water prior to Christmas. When the Picton water supply dams empty as summer progresses, the Speeds Road well-field becomes the primary source of public water supply for Picton residents.

## Groundwater systems

### Picton

While groundwater exists in the Picton area, to our knowledge it has never been found in sufficient quantities to warrant a commercial supply. There doesn't appear to be any reports documenting groundwater resources at Picton, or historic investigations.

In the early 1970s, Picton's water storage reservoirs were established in Essons Valley. The lack of potential aquifers in the local area led to exploration in the Waitohi/Tuamarina River Valley to the south, and ultimately the development of the present day well field at Speeds Road.

A review of the well logs from the Picton area suggests the area is underlain by alluvium, varying in thickness from 10 to 30 metres, overlying weathered bedrock. The alluvium is comprised of terrestrially derived yellow clay-bound gravels, and marine clays, timber or shells.

Much of what we know about groundwater beneath Picton is based on geotechnical investigation bores, rather than wells drilled specifically to pump groundwater. The earliest recorded bores were drilled as part of the port development in the early 1960s or 1970s by the Marlborough Harbour Board.

Investigation or monitoring bores were drilled in the mid 1990s as part of the Picton sewage treatment plant construction works, and for monitoring the closed landfill. These bores commonly show an alluvium layer 13 metres thick in places, overlying fractured basement rock. At around the same time, test drilling associated with the construction of the Edwin Fox graving dock encountered water bearing layers, although measured flows were low. For example a flow of 0.05 l/s was recorded at a depth of around 12 metres during the construction of geotechnical well P27w/0249.

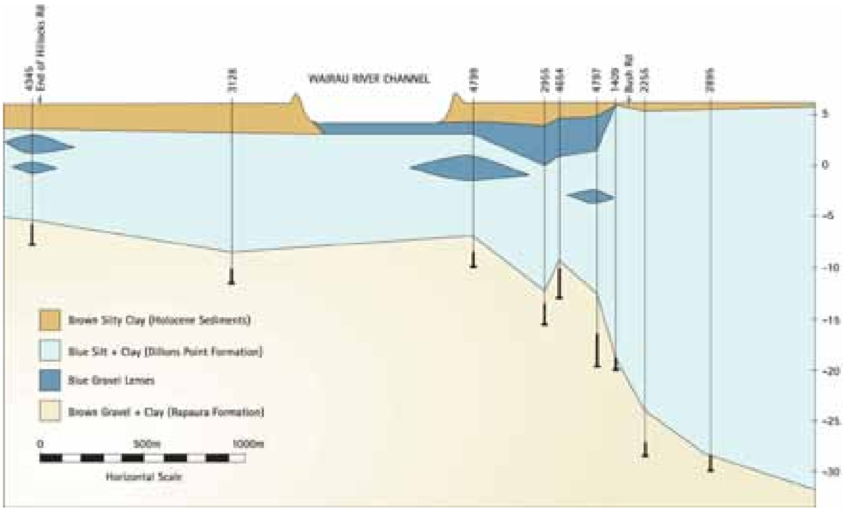

**Figure 42.4: Lower Tuamarina Valley/Wairau River cross-section**

Similar geology was encountered by test wells drilled over the years associated with construction projects. Large flows of groundwater were encountered during the excavation of the centre pier of the rail overbridge on the Picton side of the Elevation. It is likely that this water partly represents leakage from the nearby Waitohi Stream rather than an independent aquifer.

The Marlborough Harbour Board also prospected for groundwater in Shakespeare Bay in the late 1970s, but according to the bore log comments, the results indicate only domestic volumes of groundwater are likely.

## Tuamarina River Valley

The early investigations of the 1970s confirmed that several groundwater systems existed beneath the Tuamarina River Valley, which are collectively known as the Tuamarina River Aquifer (Fig. 42.3). The most significant system is generally found throughout the valley at a depth of around 5 to 25 metres below the surface. Wells tapping this upper layer, such as the Picton municipal water supply wells, are relatively high yielding. This reflects a combination of more permeable gravels closer to the surface, and a shorter flow path for recharge waters. This aquifer has small available drawdowns due to its thin nature, and limited storage during drought conditions. As a result, during the 2000/01 drought, several domestic wells in the Koromiko area dried up. Para Wetland levels, which rely on groundwater for summer baseflow, were also depleted at the time.

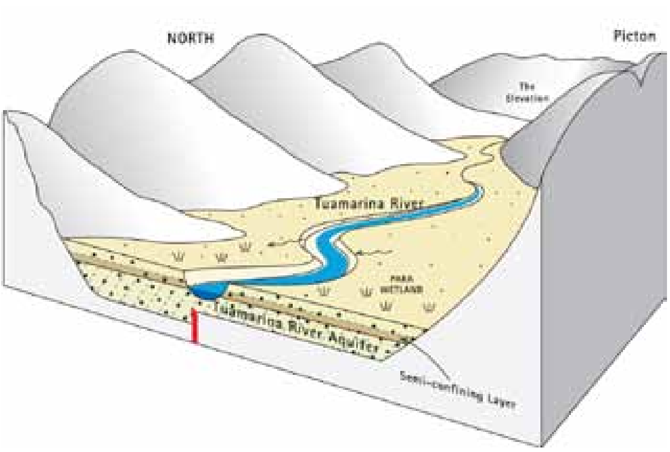

**Figure 42.3: Tuamarina River Aquifer conceptual model**

The MDC Picton municipal well-field consists of three wells. These wells were originally screened at shallow depths of less than 10 metres below the surface. However in April 2001, at the height of the 2000/01 drought, they almost ran dry. Contingency plans were drawn up to transport water by rail from Blenheim into the Speeds Road siding to supply Picton. Rains however arrived and this drastic measure was not needed. Following the drought, the wells were deepened to improve their reliability.

The less significant aquifer layer is restricted to the upper or northern reaches of the catchment. Wells here may be in excess of 50 metres deep, show artesian characteristics and contain waters significantly older than that sourced from the MDC Picton wellfield. Water from this confined aquifer is primarily used for stock and domestic water supply purposes.

Relatively little is known about the physical characteristics of the deeper aquifer. Well P27w/0044 is one of the few wells known to tap this aquifer at 18 metres in depth.

Another confined aquifer occurs north of the Wairau River at the Tuamarina settlement. This is a source of water for stock, drinking and irrigation purposes. In this area fine grained muds of terrestrial and marine origin have created a series of highly confined water bearing layers. The marine muds were deposited as the

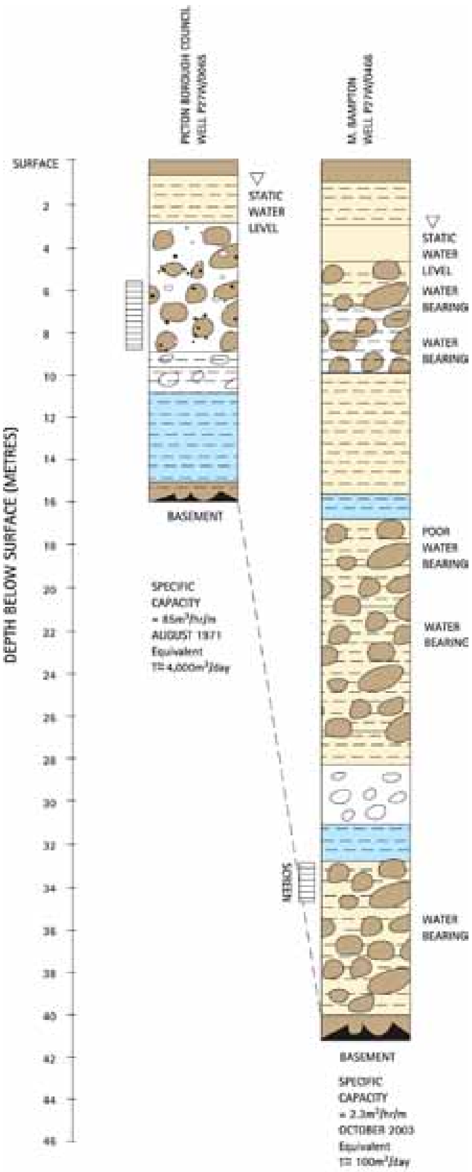


**Figure 42.5: Speeds Road lithologic section**

sea invaded the land during the early Holocene. Wells in this area need to be deeper to penetrate beneath the confining layer and reach the aquifer (Fig. 42.4). There is a range of depth between shallow wells near the Wairau River, such as the Tuamarina West Community water supply well 2955, and deeper wells further north.

**Figure 42.6: Blue Hole Spring during the 1997/98 drought**

Wells to the north are typically screened at 25 metres or more below the surface. The thinning of the confining layer beneath the Wairau Plain was probably caused by erosion from the Wairau River and replacement by gravels.

## Recharge and flow patterns

The Tuamarina River gains some of its flow from groundwater throughout the year. In summer it is reliant on groundwater for its base flow. The degree of hydraulic connection is likely to vary, with water moving backwards and forwards between the river and the aquifer depending on the relative grade between the channel and the water table.

The area is heavily faulted which is likely to influence groundwater flow. Where basement rocks occur closer to the surface, the overlying sediments are thinner, forcing water to the surface and creating springs such as the Blue Hole Spring at Speeds Road.

The depth to basement schist also varies across the valley floor. Well P27w/0065, located at Speeds Road municipal well-field, encountered schist basement at 16 metres depth while 400 metres to the north-west, well P27w/0466 intercepted the same material at 41 metres depth (Fig. 42.5). Five water bearing layers were identified during the drilling of well P27w/0466, with the lowest lying strata at a depth of 35 metres below the surface also having the lowest yield.

The irregular basement topography is likely to be caused by buried ridges rather than faulting as local faults are inactive with no movement for 120,000 years.

The mean residence time of groundwater sampled from the MDC Picton municipal well-field is 13 years based on oxygen isotope results. This age is relatively old given the shallow depth of these wells and their known interaction with the Tuamarina River.

The dating results suggests the wells may be tapping an older component of water, either from deeper water bearing layers rising to the surface, or water being held up in the hill catchments.

The original isotope surveys showed that all water is derived from local rainfall with a mean $\delta^{18}O$ value of -6.5 compared to the average for the Wairau River of about -8.5 (NZGS – 1985).

The most studied and notable hydrological feature of the Tuamarina Valley is the Blue Hole Spring, located next to the MDC wellfield in Speeds Road (Fig. 42.6). The spring is formed by up-welling groundwater and flows continuously, except under drought conditions.

It appears to be a central collection and discharge point for groundwater draining from points upstream in the Tuamarina River Catchment. Groundwater is forced to the surface as the layer of alluvium forming the aquifer thins in the Speeds Road area. The reduction in thickness of the sediments is caused by a combination of the underlying basement rock approaching the surface, and the narrowing of the valley width. Blue Hole Spring has been intensively studied because pumping from the Picton municipal well field about 150 metres to the north affects its flow.

Testing has demonstrated that a direct relationship exists between pumping and outflow from the Blue Hole Spring itself. It is calculated that 70-95% of the municipal well-field water is from the spring or would have otherwise contributed to its flow, depending on seasonal conditions (PDP – 2002).

Studies during the 1973 drought showed that Blue Hole Spring contributes a very high proportion of Tuamarina River flow during later summer months. River channel flow, and ultimately the Para Wetland, rely on groundwater storage for baseflow in drier months and especially droughts.

Recent work by the MDC and testing by private land-owners, has revealed a clear hydraulic link between Tuamarina River channel flow and groundwater. Surveys of wells and the adjacent Tuamarina River channel near Speeds Road show that under normal conditions there is little difference in water levels. However PDP (2005) found that under dry conditions, unpumped groundwater levels were 0.3 metres higher than the level of water in the Tuamarina River channel. Gaugings also showed that pumping from wells near the upper reaches of the Tuamarina River directly reduced channel flow (PDP - 2001).

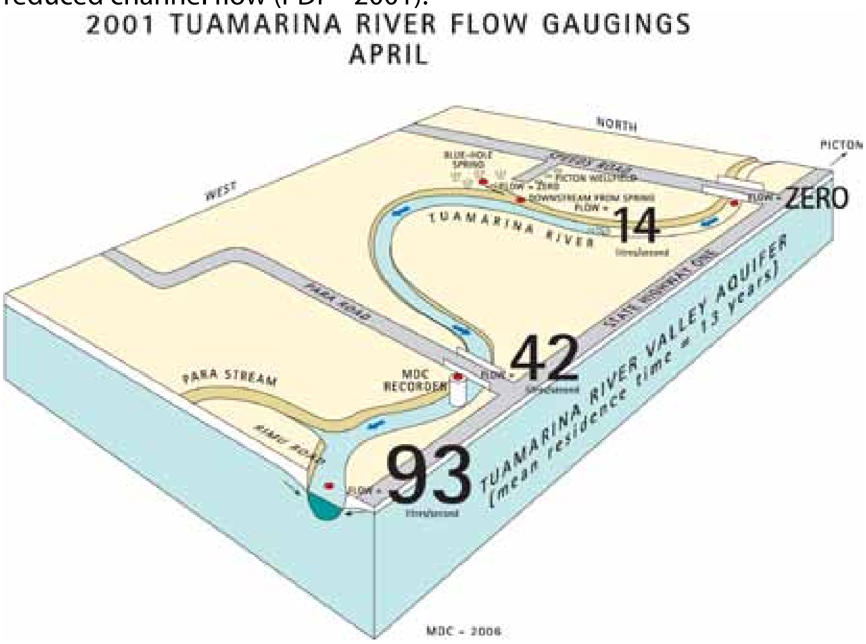

Figure 42.7: Tuamarina River flow gaugings during the 2001 drought

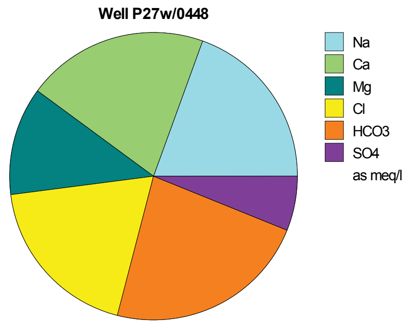


Figure 42.8: Well P27w/0448 groundwater composition

The 2000/01 drought had widespread effects on both well levels and Tuamarina River flows. At its height in early 2001, flow had ceased in the headwaters of the Tuamarina River where it crossed Speeds Road. Gauging surveys showed that groundwater contributed 42 l/s to Tuamarina River flow, upstream of Para Stream (Fig. 42.7).

## Hydraulic properties

Analysis of the well records show there is a large range in well yields, with productivity generally decreasing with depth. Well specific capacity values range from less than one, to greater than 100 $m^3$/hour/metre. This is equivalent to estimated transmissivity values of 50 to 5,000 $m^2$/day. This large range in transmissivity reflects the variation in both gravel permeability and the level of saturation of shallow layers.

A small number of aquifer tests have been carried out in the Tuamarina valley. The most comprehensive test was carried out to the north of the MDC Speeds Road well field in late May 2001 (PDP - 2001). The test measured Aquifer transmissivity and storativity values of 2,750 $m^2$/day and 0.01. This is a relatively high transmissivity value which is expected to vary seasonally. The storativity value indicates an intermediate aquifer structure, somewhere between confined and unconfined.

These values are likely to be representative of shallow aquifer layers only and not of the deeper aquifers near the foot of the Elevation and the Tuamarina settlement.

## Groundwater chemistry

Within the Tuamarina River Valley the water quality and chemistry of groundwater can vary significantly depending on location. Shallow groundwater from the MDC Picton wellfield in the central valley is relatively dilute and unchanged from rainwater (Fig. 42.8). Deeper groundwaters from wells near the foot of the Elevation and the Bush Road/ Tuamarina West area, are more evolved because of their longer residence time underground.

Despite shallower groundwaters having high water tables and being associated with intensive agricultural activities, there have been few signs of microbial contamination. However, the proportion of sulphate found in the shallow groundwater is quite high and indicates a landuse impact on groundwater.

In general deeper groundwaters are more mineralised, with a higher pH and less nutrients. These characteristics support the existence of a varied geology with shallower permeable gravels transmitting most of the groundwater, overlying less permeable, deeper gravels.

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