7 Kaipara River-North Shore Water Resource Area

7.1 Introduction

The Kaipara River-North Shore water resource area extends from the northern and western Waitemata Harbour to the Kaipara Harbour and across to Silverdale (fig. 7.1). It is the second most urbanised of the water resource regions, with major urban centres in North Shore and Waitakere. All types of urban land use are present: residential, industrial and commercial. Beyond the metropolitan urban limits, towns such as Kumeu, Helensville and Silverdale are the key rural service centres. Rural lifestyle blocks are common around both the urban fringe and these towns.

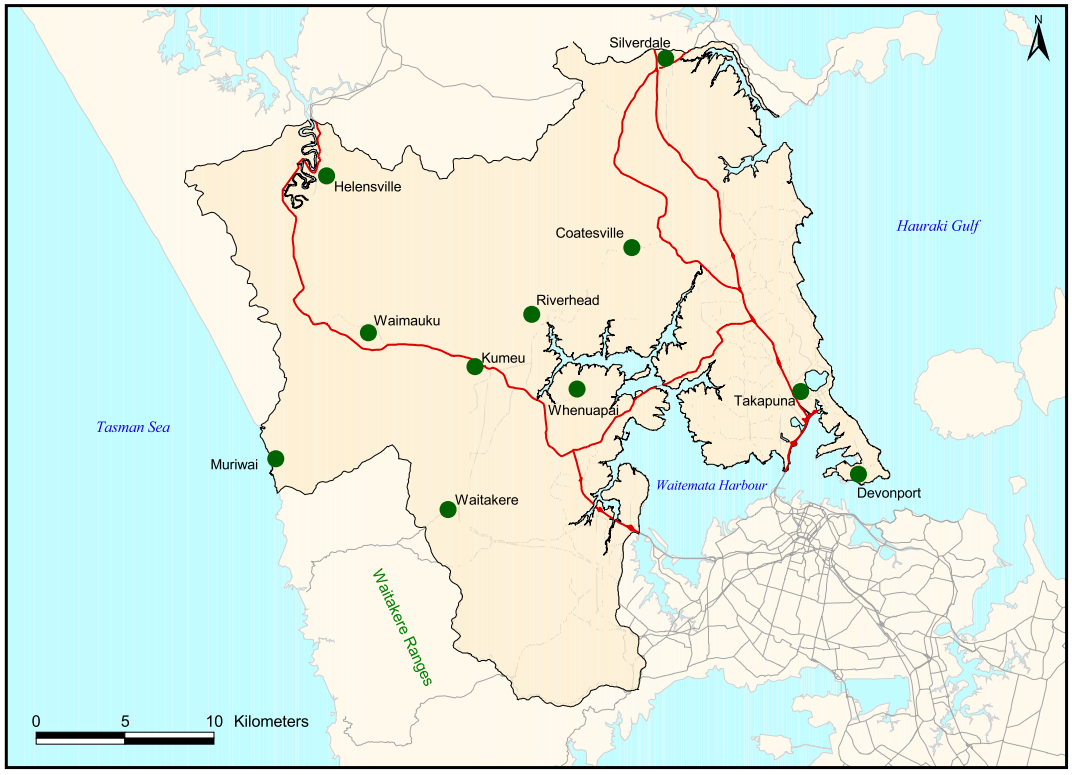

Figure 7.1: Location map for the Kaipara River-North Shore water resource reporting area.

The area is generally low-lying - gentle rolling hills. The steepest parts of the area are along the foothills of the Waitakere Ranges, Riverhead State Forest and Paehoka south-east of Helensville. Waitemata Group underlies much of the area. In low-lying areas thin alluvial materials overlie these rocks. Limestone, serpentinite and basalt rocks are also found in the area. Streams draining the areas are typically small first and second order streams, other than the Kaipara River, which drains the third largest catchment in the Auckland Region. Most groundwater abstraction is from Waitemata Aquifers.

Horticulture is a key productive land use in the area from Waimauku, through Kumeu and Taupaki to Coatesville. Beef, deer and sheep farming and dairying occur on the more productive land of the lower Kaipara River Catchment. Forestry is also a significant land use, with the largest area of forest at Riverhead Forest, in the central part of the area.

There are no significant areas of native bush, although there are small areas of remnant bush in the sub-catchments of the Okura Stream, Ararimu Stream, Kumeu River, Wharauroa Stream, and Mangakura Stream.

7.2 Rainfall

Information that helps to describe the distribution of rainfall across North Shore/Kaipara is obtained from five automated rainfall recorder sites (fig. 7.2). These sites cover the Kaipara Catchment and extend as far south as Swanson Stream Catchment. The longest serving site is maintained at Whenuapai Airbase (647601), the record for which extends back to 1945. On average there are 184 wet days per year at the Airbase. In addition to these six automated sites, there are three manual sites. The Upper Opanuku Stream Catchment site (649515) provides data on the rainfall that falls leeward of the Waitakere Ranges. Although the record only spans a 3-year period, a maximum of 103mm of rainfall over a 24-hour period has already been recorded.

The general pattern of rainfall across the region (fig. 7.2) reflects a strong orographic effect. Areas of higher annual rainfall occur close to the Waitakere Ranges in the upper Kumeu River Catchment and in the Riverhead Forest area.

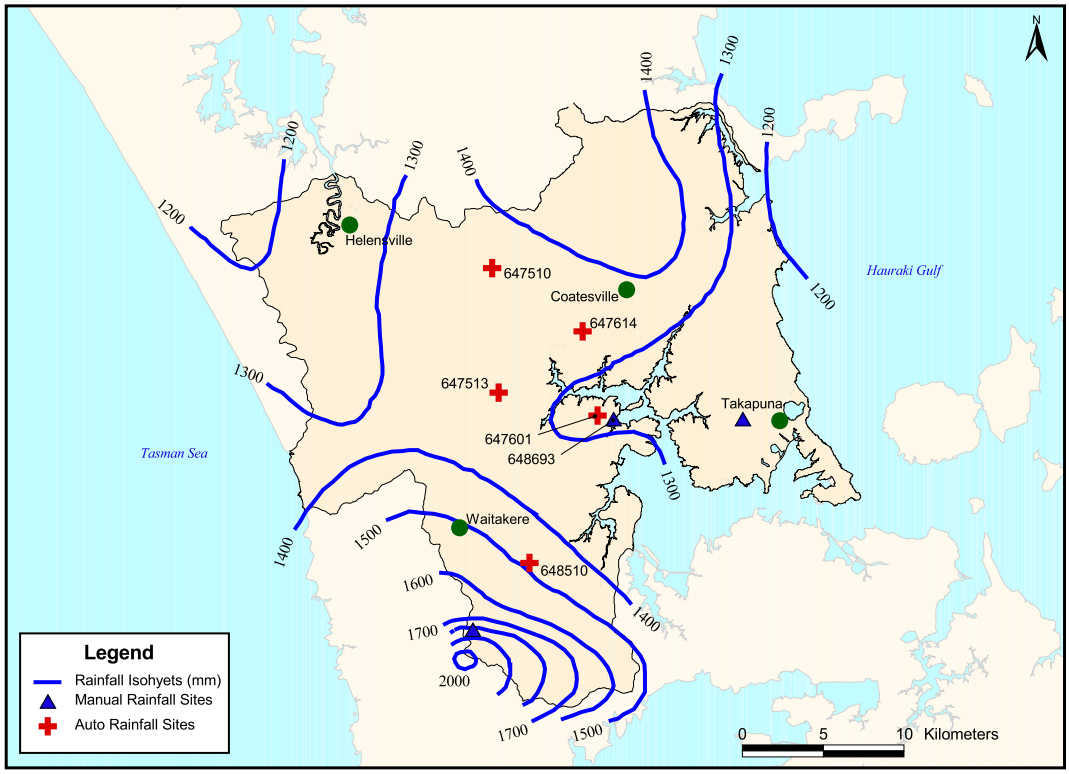

Figure 7.2: Kaipara River-North Shore area rainfall monitoring sites and mean annual rainfall isohyets.

7.3 Hydrology

The Kaipara River-North Shore hydrological area comprises catchments, which drain into the Kaipara Harbour, the Tasman Sea (via the Okiritoto Stream), the Waitemata Harbour and the Hauraki Gulf. Eight stream water level recorder sites are operated and maintained by the ARC in this area (fig. 7.3). Three recorder sites are located in the Kaipara River Catchment: at Waimauku (45311), Maddrens (45315) and Old North Road Bridge (45326). Two sites are located on the northern side of the Upper Waitemata in the Rangitopuni (Walkers 7805) and Lucas Creek catchments (7811); and three sites are on streams that drain from the eastern Waitakere Ranges, namely Swanson (7907), Oratia (7911) and Opanuku (7912). These sites collect data to support water allocation, water quality and flood monitoring programs.

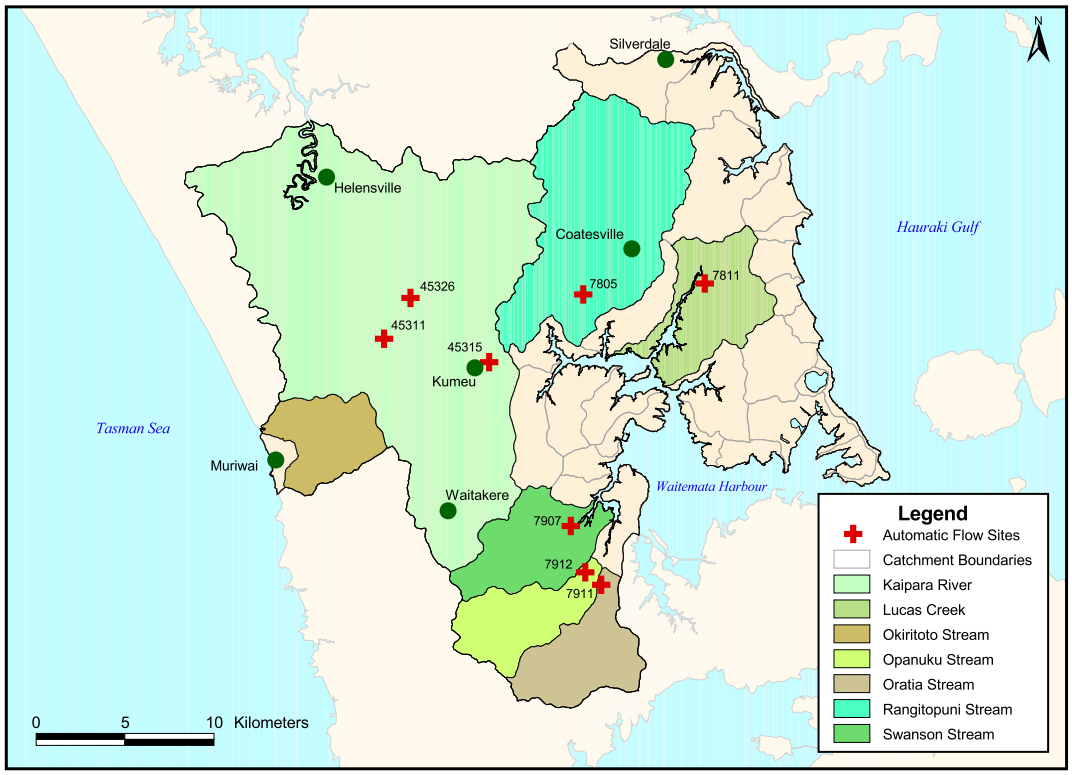

Figure 7.3: Kaipara River-North Shore surface water catchments & automatic flow monitoring sites.

Stream flows within the Kaipara River-North Shore area are strongly influenced by the underlying geology. Flow duration curves for some monitoring sites are shown in figure 7.4. The flow of streams with low gradient curves have a relatively higher proportion of total flow contributed from sustained baseflow. In contrast, the curve for Rangitopuni Stream is steep, suggesting that this catchment is `flashy', with very low summer baseflows. Streams in the eastern Waitakere Ranges and in the Riverhead Forest areas are less likely to be subject to extreme low flows. Streams that are likely to experience extreme low flows lie in Kumeu, Rangitopuni and Dairy Flat areas. The Q_5 specific discharge at the Walkers recorder site on the Rangitopuni Stream is 0.04 l/s/km^2. This is significantly lower than 0.72 l/s/km^2 at Old North Road Bridge in the Ararimu Catchment reflecting the different underlying catchment geology. Appendix 3 lists low flow statistics for sites in this area in more detail. There are numerous manual gauging sites within the North Shore/Kaipara area, particularly in the Kaipara and Rangitopuni catchments. Data collected from these sites support water allocation in small tributaries. Further hydrological information on the Kaipara River is available from the ARC Technical Publication No. 146 (ARC, 2001).

Extreme low stream flow periods occur during summer months and higher flows are generally in July. An example is shown in figure 7.5. The average stream flow at Waimauku in June is 7,827 l/s or 7.8 m^3/second and in February stream discharge decreases to an average of 632 l/s or 0.63 m^3/s.

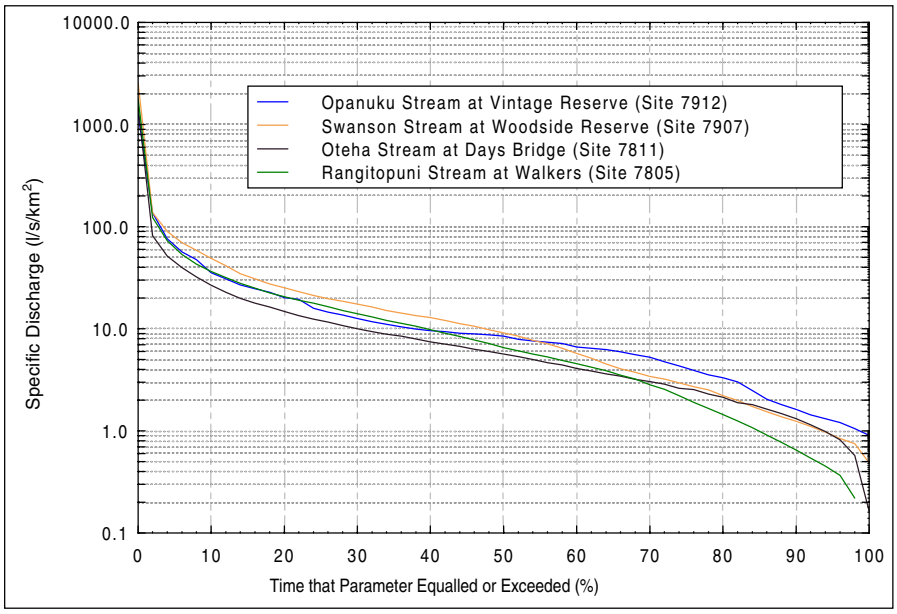

Figure 7.4: Flow duration curves for four Kaipara River-North Shore area surface water catchments..

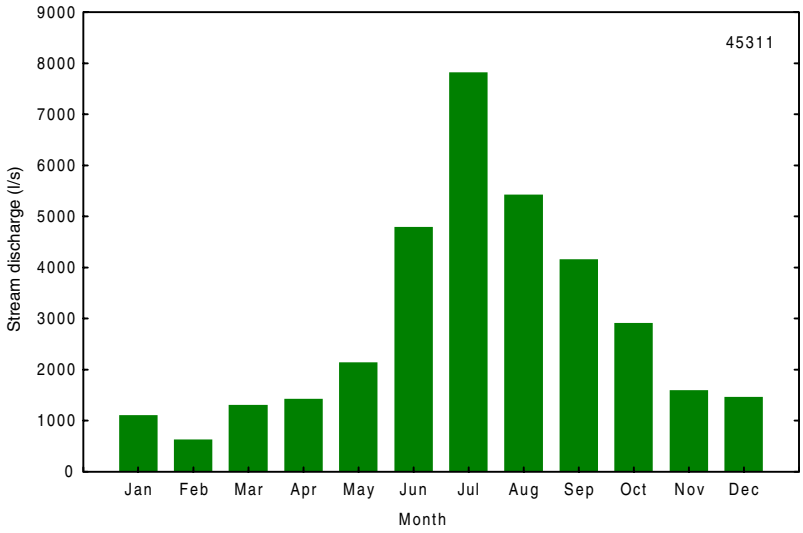

Figure 7.5: Mean monthly stream flows at Waimauku (45311) flow monitoring site.

South of the Kaipara River Catchment are several small catchments that drain from the eastern Waitakere Ranges. These streams are important sources of freshwater to the Upper Waitemata Harbour. The largest source of freshwater to enter the Harbour comes from the Rangitopuni Stream. A flow recorder site at Walkers has recorded flows from this catchment since 1975. This record provides information to assist water allocation and water quality programs. Oteha Stream site in the Lucas Creek Catchment was established to monitor the impact of urban development on stream hydrology.

Flow sites on the Swanson; Oratia and Opanuku streams have been established to provide information for flood management. The lower reaches of these streams are surrounded by urban and industrial properties. These flow sites have only recently been installed and insufficient data has been collected to allow robust estimates of flow statistics to be made.

7.4 Hydrogeology

7.4.1 Waitemata Aquifer

The Waitemata Aquifer is variable across the area; in some areas the aquifer yields sufficient quantities for horticultural development e.g. Kumeu, Taupaki, Riverhead and Hobsonville; other areas have significantly lower yields and bore water abstraction must be managed carefully to gain required volumes without damaging the bore.

Most information about the Waitemata Aquifer is from areas of groundwater development. The aquifer has been highly developed in the Kumeu-Hobsonville area and moderately developed in Coatesville and Waimauku. Over 600 bores have been drilled in the Kumeu-Hobsonville area and 9 of these have had a pumping test carried out on them. The aquifer has comparatively poor properties in the south of the area e.g. Henderson and in the east e.g. North Shore. However, bores have been drilled in these areas to provide small, but sufficient supplies for small commercial/limited irrigation purposes. Waitemata Aquifer transmissivities in North Shore/Kaipara area range from 0.1-10 m^2/day and storativities range from $1x10^{-3}$ to 2×10^{-5}. Most bores are 100mm diameter and are drilled to depths of between 50m and 370m.

The ARC monitors water levels in 6 groundwater monitoring bores in the Kumeu-Hobsonville area monthly (fig. 7.6). Many of these manual sites were monitored automatically prior to 1998, to enable a better understanding of the seasonal and annual fluctuations in water levels and to determine the impact of pumping on the aquifer.

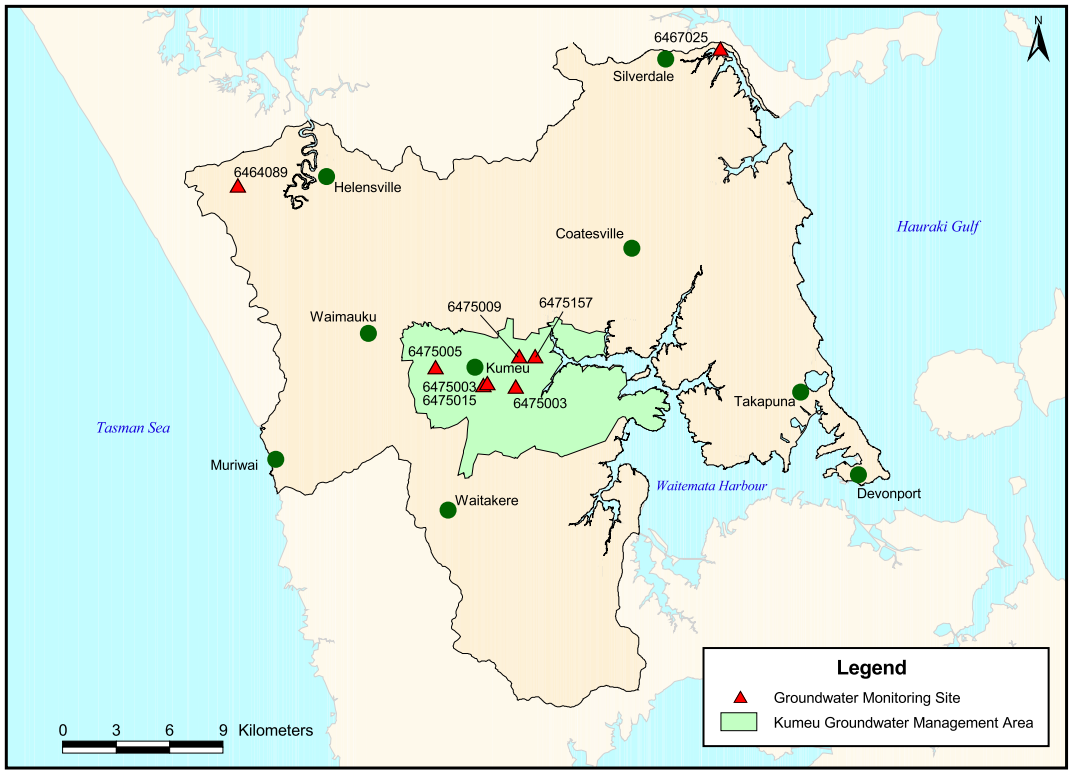

Figure 7.6: Location of groundwater level monitoring sites in the Kaipara River-North Shore area.

Without pumping groundwater levels would show a natural seasonal rise and fall. However, abstraction deepens the `troughs' in late summer/early autumn. An example of this is shown in figure 7.7; the water level record for Lathrope Road monitoring bore (6475009). A production bore is located 230m from the ARC monitoring bore and peak daily extraction rates are around 400 m^3/day. During 1999 water use from the nearby bore proved to be significantly higher than allocated, deepening the pumping trough further and causing a drop in average groundwater level at the site. The groundwater monitoring bore at Waitakere Road (6475015) shows a more typical groundwater level record for the Waitemata Aquifer.

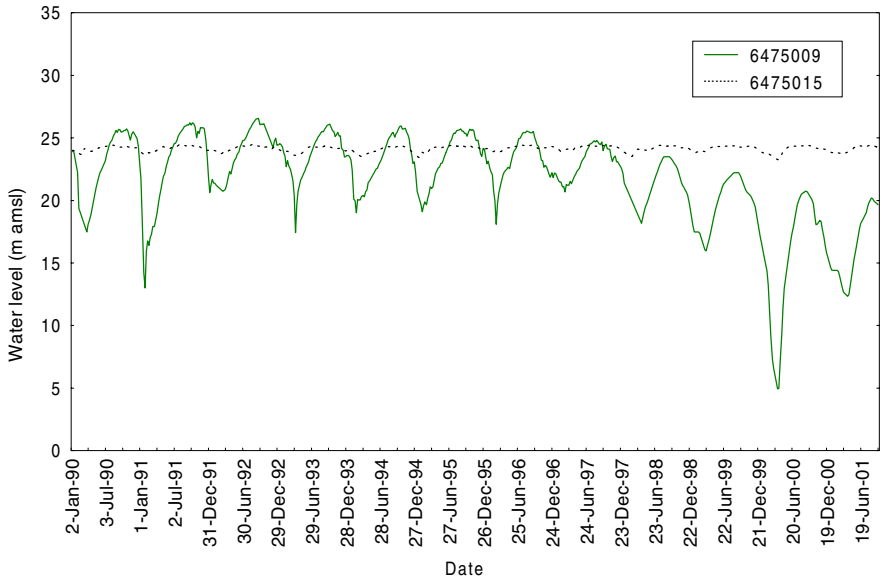

Figure 7.7: Groundwater level record at Lathrope Road Production (6475009) and Waitakere Road (6475015) monitoring bores.

7.4.2 Kaipara Sand Aquifer

The Kaipara Sand Aquifer sands are up to 120m thick and comprise a useful source of shallow groundwater. Most bores drilled in the aquifer are up to 100m and are cased and screened. In 1997 the ARC commissioned a new groundwater monitoring bore as part of ARC long-term baseline groundwater quality monitoring programme. The Rimmer Road bore (6464089) (fig. 7.6) is 63.5m deep with screens set at 46.5-61.5m below ground level. The bore penetrates sandy clays and sands in the upper 20m and uniforms sands in the remainder of the hole (Crowcroft & Scoble, 1999). Test results after bore development indicated bore yield of 65 m^3/day.

7.5 Water Management

7.5.1 Surface Water

The Kaipara River-North Shore area has a relatively high level of surface water use, reflecting this area's mix of urban and horticultural land uses. There are six surface water management areas within the area, defined by the [illegible] of small catchments (fig. 7.8). [illegible] consents and [illegible] management area [illegible] in table [illegible]

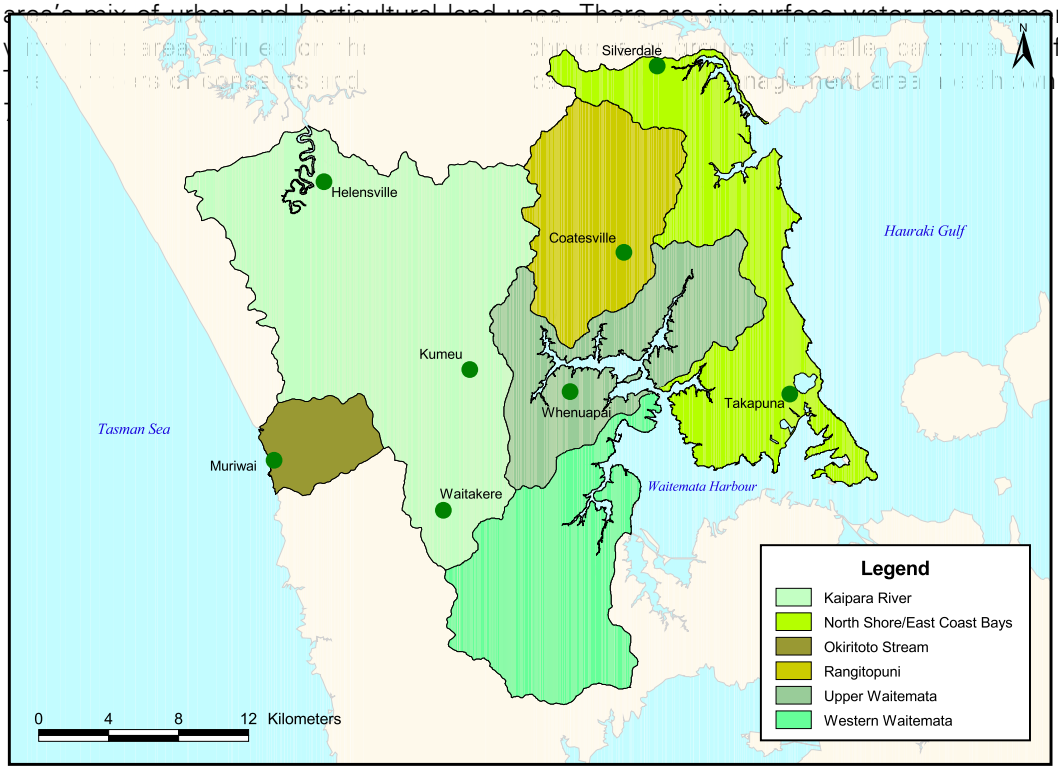

Figure 7.8: Surface water management areas in the Kaipara River-North Shore area.

Table 7.1: Surface water consent numbers and consent allocations in the Kaipara River-North Shore area.

Catchment	Number of take consents		Daily allocation m^3/day		Total daily allocation from surface water
	Stream	Dam	Stream	Dam	m^3/d
Kaipara River	25	30	4,319	7,871	12,189
Upper Waitemata	1	13	100	1,770	1,870
Okiritoto	7	1	1,630	50	1,680
Rangitopuni	6	11	398	1,247	1,645
North Shore/East Coast Bays	1	1	1,200	35	1,235
Western Waitemata	3	0	238	0	238
TOTAL	43	56	7,885	10,973	18,857

The Kaipara River Catchment is the most important surface water resource in this area, accounting for around 75% of the total water allocated in the Kaipara River-North Shore area. Although much of this water is taken for horticultural irrigation around Waimauku and Kumeu, the largest single stream allocation is to Rodney District Council for municipal water supply at Helensville (1,200 m^3/day). There are also a small number of consented industrial users in Kumeu. Surface water management in the Kaipara River Catchment was recently reviewed through the preparation of a water allocation strategy. Water allocation plans had previously been prepared for the Kaipara River and Rangitopuni catchments in the 1980s.

There are some notable contrasts in the pattern of water demand elsewhere in this area. Consented water use in the Upper Waitemata and Rangitopuni catchments is predominantly for horticultural use, with most of this water taken from dams reflecting the unreliability of summer low flows. The reverse is true in the Okiritoto Stream Catchment, within which most water is taken from run-of-stream flow. Around two thirds of the total water allocated from the Okiritoto Stream is allocated to Muriwai Golf Club near the catchment outlet. The other notable consented water user in this area is the Chelsea Sugar Refinery, which is allocated up to 1,200 m^3/day from ponds at its plant on the North Shore.

The most highly valued streams for their non-consumptive in-stream values are the Okura Stream, Ararimu Stream, Wharauroa Stream, and headwater streams in the foothills of the Waitakere Ranges. These are streams, which run through relatively significant areas of riparian vegetation. Streams throughout much of the low lying parts of the area, for instance the Kumeu River, Kaipara River and Dairy Flat streams are of very low ecological value due to significant modification and damage. Large numbers of small farm dams have been built through these areas to compensate for very low summer baseflows. In addition, the trend towards small 'lifestyle' properties in these areas has resulted in an increasing popularity of dams constructed as ornamental ponds. These dams are typically built without prior authorisation and can not only cause problems for neighbouring property owners but also result in increasingly significant cumulative effects on stream flow. The rivers and streams of this area are not noted for their landscape or recreational values. However, Lake Pupuke on the North Shore, is valued for recreational uses.

Kaipara River water allocation strategy

The Kaipara River Catchment water allocation strategy (ARC, 2001) identifies surface water resource management objectives for each sub-catchment and provides guidance for the processing of resource consent applications.

The strategy identifies the relatively high level of demand in the catchment. It recommends that the processing of applications to take surface water from run of stream flow during periods of low flow (1 November to 30 April) should have regard to the significant cumulative effects on instream values.

Similarly, the large number of dams in certain parts of the catchment is identified as a key issue. The strategy recommends that applications to dam water should demonstrate that the effects on the environment (including additional cumulative effects) would be avoided, remedied or mitigated, or that any adverse effects are offset by any benefits, which may accrue from the damming of water. Consent applications to dam water are likely to be required to maintain residual or bypass flows and to install fish pass measures, particularly in the Ararimu Stream sub-catchment.

Additionally, the strategy gives guidance on providing for dam safety by directing consent holders to ensure that dams are designed, constructed, maintained and operated to minimise the risk of failure, having regard to the Auckland Region Dam Safety Guidelines (ARC, 2000).

Regard was had to these guidelines in the assessment of around 70 applications for replacement consents in the Kaipara River Catchment. This is documented in the decision report on these applications, dated November 2000.

The water allocation strategy also sets out a programme of further investigations, which will aim to validate initial analyses of relationships between flow, water quality and habitat. This will allow for a review of the long-term recommendations of the strategy, and could result in the imposition of minimum flows and abstraction restrictions. Any minimum flows, whether here or in any catchment in the Region, would be implemented through the Proposed Auckland Regional Plan: Air, Land and Water.

Rangitopuni Surface Water Management and Allocation Plan

The Rangitopuni Surface Water Management and Allocation Plan (ARWB, 1988) provides guidance for the damming and taking of surface water in the Rangitopuni Catchment. The plan was written in response to the high demand to dam and take surface water and includes guidance for minimum flows, damming and riparian planting/fencing. The plan expired in 1996 and the ARC undertook a review of catchment hydrology. The 1988 Plan has not yet been superceded.

In 1988 resource consent applications were assessed against the 1 in 5 year low flow estimate. This approach is no longer used as it does not take into account ecological flow requirements at different locations within a catchment and is likely to underestimate in-stream water requirements. Conditions on resource consents to take surface water include a maximum rate of abstraction which is determined on site and use specific information.

The Plan encourages abstraction from off-main stream storage during times of low flow. Reservoirs can be filled during non-low flow conditions. Since 1988 no new applications to dam water, either on stream or off stream, in the main Rangitopuni stream have been lodged with the ARC.

The Plan requires that all dams have a low flow bypass to ensure that the natural flow of the stream immediately above any impoundment, up to an equivalent of three times the one in five year low flow, is bypassed at all times.

The Plan provides for the construction of permitted activity dams, in accordance with the relevant rule of the Auckland Transitional Regional Plan. This rule allows the construction of small low risk dams provided that, prior to construction, the ARC is first notified. However, many small dams built within the catchment have been done so without the required notification, an issue the ARC faces throughout the Auckland Region.

The Plan acknowledges the value of retaining and enhancing native bush around the tributaries of the Rangitopuni stream and encourages fencing of stream banks to prevent trampling by stock. The ARC made submissions on the Rodney District Plan which resulted in planting/ fencing requirements in relation to subdivisions.

7.5.2 Groundwater

Most resource consents to take groundwater in the Kaipara- North Shore area abstract water from bores drilled into the Waitemata Aquifer. The area is split into 5 main groundwater areas; a small part of two areas in the north extend into the Kaipara River-North Shore area (fig. 7.9). The total number of consents to take groundwater in these areas, and the total groundwater allocation is presented in table 7.2. The most intensive groundwater use is from the Kumeu Groundwater Management area. Groundwater management in this area is discussed in more detail below.

Most groundwater use in the North-west is for irrigation. In North Shore irrigation for golf courses accounts for the most use while horticulture and flower cultivation accounts for most groundwater use elsewhere in the Kaipara River-North Shore area.

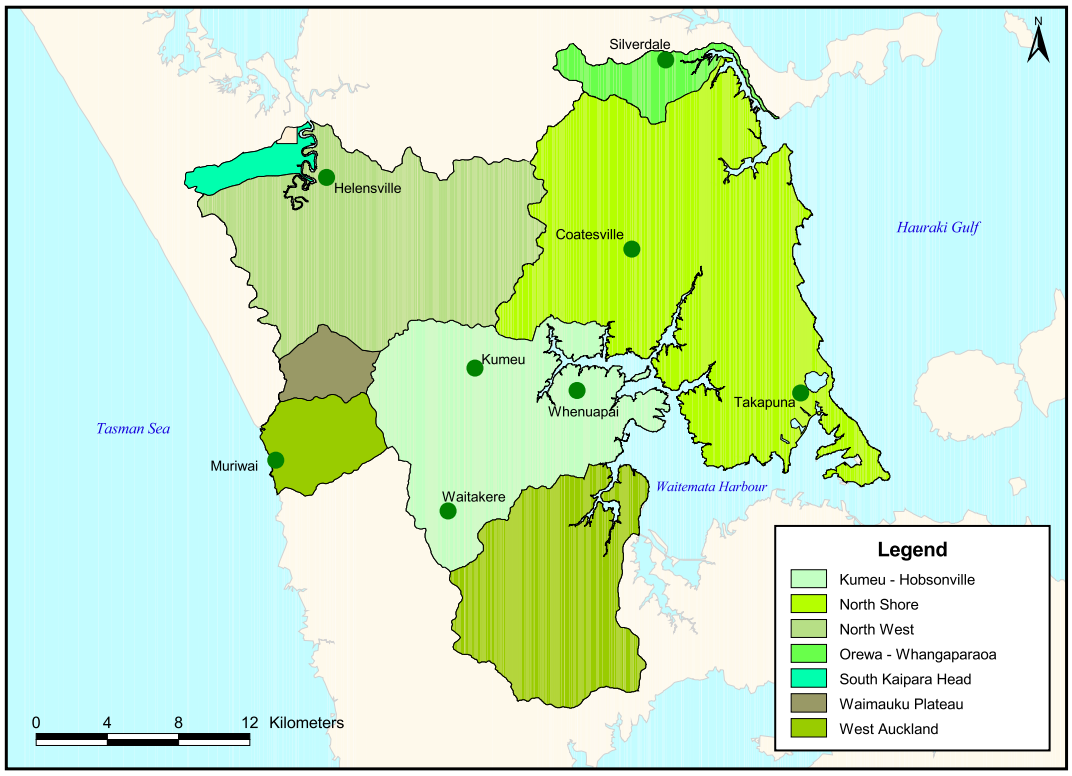

Figure 7.9: Groundwater Management areas in the Kaipara River-North Shore area.

Table 7.2: Groundwater consent allocations and consent numbers in the Kaipara River-North Shore area.

Groundwater Management Area	Water Allocation m^3/year	Number of consents
North Shore Groundwater	99,900	23
North West groundwater	93,404	12
Kumeu/Hobsonville	953,496	220
Waimauku Plateau	34,400	8
West Auckland Groundwater	416,100	12
TOTAL	1,597,300	275

Kumeu Groundwater Management

The Kumeu – Hobsonville groundwater management area contains a large groundwater system to the North-west of Auckland City. The management area represents a concentration of groundwater users; it does not represent the geological boundary of the aquifer system.

For groundwater management purposes the area was divided in to 3 zones based on groundwater demand. Zones 1, 2 and 3 represent areas where groundwater demand considerably exceeded, approximately equalled and was considerably less than groundwater availability respectively. Zone 1 covered six separate geographical locations within the area. These were nominated as zone 1A to 1F (fig. 7.10). The management zones were first adopted in 1989 (ARWB, 1989). They represented demand at that time. The same management zone approach has generally been retained since then.

Resource consents to take groundwater in the area generally expired in 1989. Replacement and new permits applications that were granted generally expired in May 1994. Consents that were subsequently granted were given an expiry date of December 2015, with provision for review of their allocation in December 2000 and five yearly intervals there after. Processing of the 1994 applications for replacement and new consents resulted in some re-allocation of water within the zones. The objective was to avoid the potential adverse environmental effects, measured by declining water levels and saline intrusion at the coast, from over exploitation of the groundwater resource. The management approach adopted is to limit the use of groundwater within the separate zones to no more than the quantity that had been determined to be available for allocation from the respective zones. In processing the 1994 applications this was achieved in all the zones except 1A (Riverhead) and 1F.

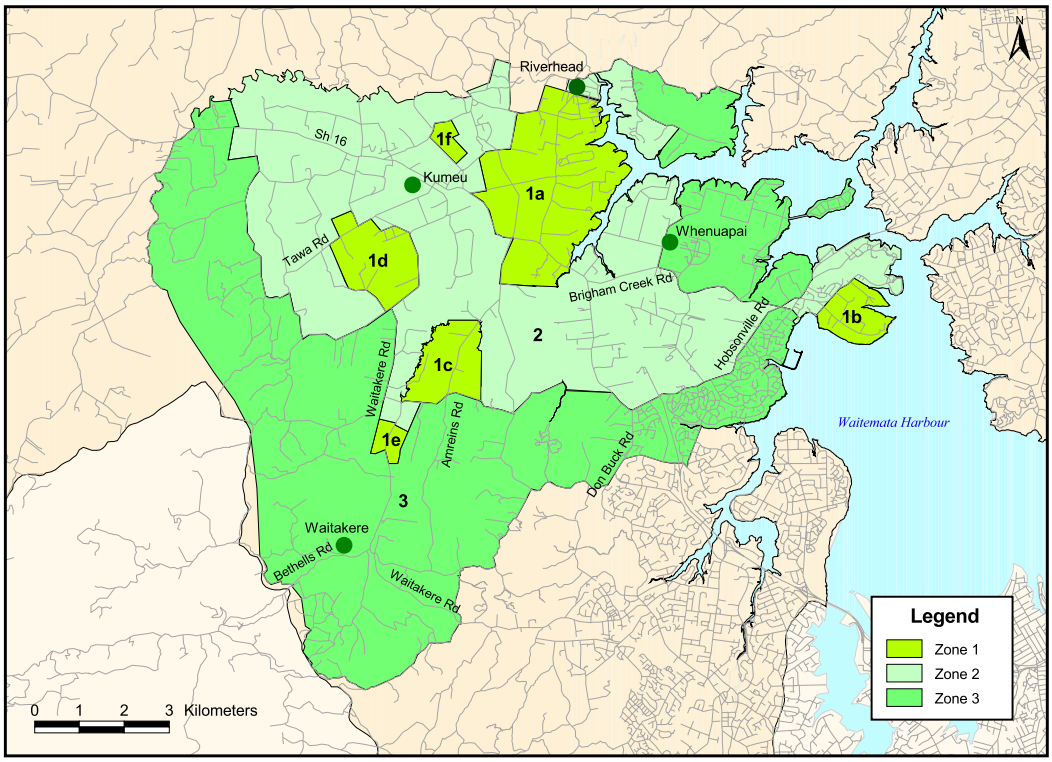

Figure 7.10: Kumeu-Hobsonville Groundwater management zones.

Prior to the 1994 applications being processed, the total allocation of all consents within zone 1A (Riverhead) was 256,220 m^3/year (approximately 220% of availability). In processing the 1994 applications this was reduced to 142,350 m^3/year (approximately 123% of availability). The over allocation was balanced by water available from the surrounding zone 2 area. After processing the 1994 applications there was still a significant number of consent holders who had insufficient allocation for their existing developments. However, other consent holders in the same zone have not used all of their allocation. A revised allocation of water available within zones to address changing demands for groundwater may be achieved through consent reviews.

Zone 1F is a much smaller area than zone 1A Riverhead. It only contains five consent holders compared to 58 in zone 1A Riverhead. The over allocation in zone 1F was also balanced by water available from the surrounding zone 2 area. While the percentage of availability allocated is higher than in zone 1A Riverhead the actual amount of water is much smaller.

The total quantity of water available for allocation from the individual management zones and the respective allocations are shown in the table 7.3.

Table 7.3: Groundwater availability and allocation within Kumeu-Hobsonville groundwater management zones.

Zone	Availability m^3/year	Allocation m^3/year	Allocation as % of availability
1A	115,920	142,350	123
1B	20,959	20,960	100
1C	29,756	29,000	98
1D	32,731	32,405	99
1E	6,468	6,200	96
1F	4,916	8,780	179
2	585,994	588,721	100
3	762,494	125,080	16
TOTAL	1,559,238	953,496	61

7.6 References

Auckland Regional Water Board, 1989: Kumeu-Hobsonville groundwater study management plan 1989. ARWB.

Auckland Regional Water Board, 1988: Rangitopuni Catchment: surface water management and allocation plan : ARWB 1988

ARC, 2000: Dam safety guidelines for construction, maintenance and monitoring. TP 109. Auckland Regional Council.

ARC 2001: Kaipara River Catchment Water Allocation Strategy. TP 146. Auckland Regional Council.

8 Waitakere Water Resource Area

8.1 Introduction

The Waitakere Ranges are a dominant landform in the Auckland Region. The ranges are formed predominantly of volcanic breccia and conglomerate, and andesitic and basaltic lava flows (Hayward, 1983). Volcanic conglomerate often forms rounded peaks and deeply incised gorges. Most lava flows, capping the central parts of the ranges, are intensely and deeply weathered, resulting in less rugged relief (Hayward, 1983). To the north and east of the ranges Waitemata Group sandstones and siltstones form the gentle low, relief topography.

Most of the Waitakere Ranges is Regional Parkland, administered by the ARC. Of the 232 km^2 Waitakere area regional parkland covers approximately 70%. The parkland is used for recreation, conservation and contains the 5 municipal water supply dams. The Waitakere area (fig. 8.1) is an important water supply area for the Auckland urban area. The construction of the first of 5 water supply dams started in 1907. Three concrete dams had been completed by 1929; the last two dams (earth) were completed in 1948 and 1971. These dams play an important part of the municipal water supply network. Land use in the north, around the Waitakere River Catchment is approximately equally divided between native bush and scrub and cleared grazing land, with a small area of exotic forestry. The area is not highly populated, although beach settlements of Bethells Beach, Piha and Karekare are all busy summer locations.

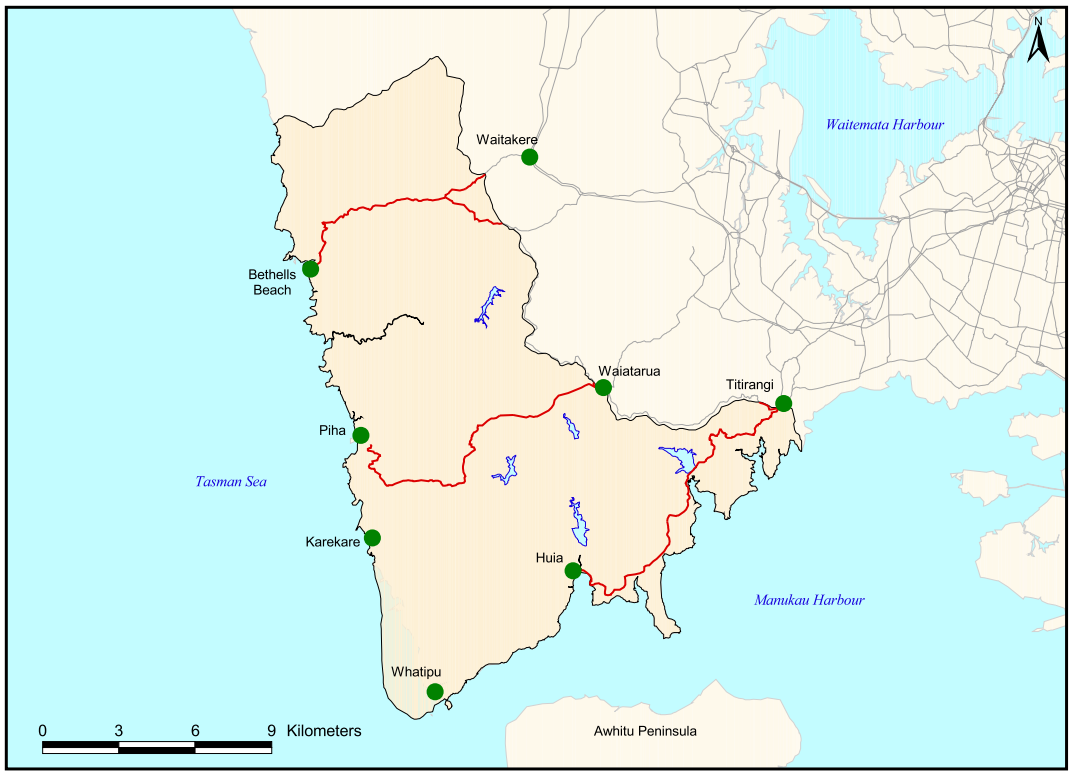

Figure 8.1: Location map for the Waitakere water resource reporting area.

8.2 Rainfall

The ARC does not operate rainfall sites in the Waitakere area; rainfall is monitored by Watercare Services Limited, who also monitor inflows into 5 water supply reservoirs in the Waitakere Ranges. The Waitakere area experiences the highest recorded annual rainfall in the Auckland Region due to orographic processes. The westerly flow of moisture-laden air from the Tasman Sea is forced to rise by the Waitakere Ranges, which causes precipitation. Rainfall isohyets, illustrated in figure 8.2, show that parts of the Waitakere area experiences average annual rainfall over 2000mm. The isohyets describe rainfall gradients from the western coastline to the inner Waitakere area, and from this area to the Manukau Harbour.

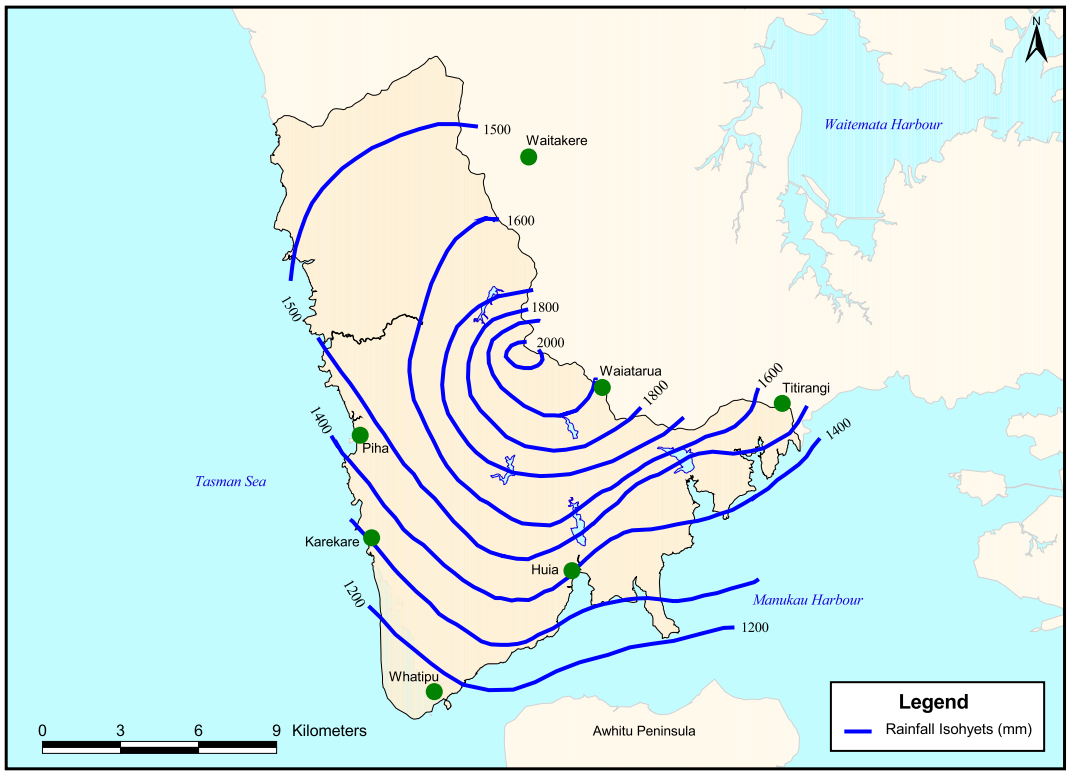

Figure 8.2: Waitakere area rainfall monitoring sites and mean annual rainfall isohyets.

8.3 Hydrology

The five large municipal water supply dams have greatly modified the natural hydrology of the some catchments in the Waitakere area. The reservoirs lie within three catchments: Waitakere River (Waitakere Dam), Nihotupu Stream (Upper and Lower Nihotupu Dams) and Huia Stream (Upper and Lower Huia Dams). The natural flow regime in each of these catchments has been significantly modified immediately downstream of each of the dams. The two latter catchments drain to the Manukau Harbour, whilst the Waitakere River Catchment drains to the Tasman Sea (fig.8.3). Catchment sizes vary across the Waitakere region with small catchments distributed along the west coast and inner Manukau Harbour. Over 27% of all catchments are less than or equal to 1 km^2 and 57% are between 1 and 10 km^2 .

The ARC does not operate any automatic water level recorder sites in the Waitakere area. Manual flow measurements are carried out in the Anawhata and Waitakere catchments over summer months.

Due to the lack of monitoring data low flows in the Waitakere area are difficult to accurately estimate, except for the Waitakere River where the greatest number of flow gaugings have been made. The Q_5 low flow at Bethels Beach is estimated at 134 l/s, or 2.12 l/s/km^2.

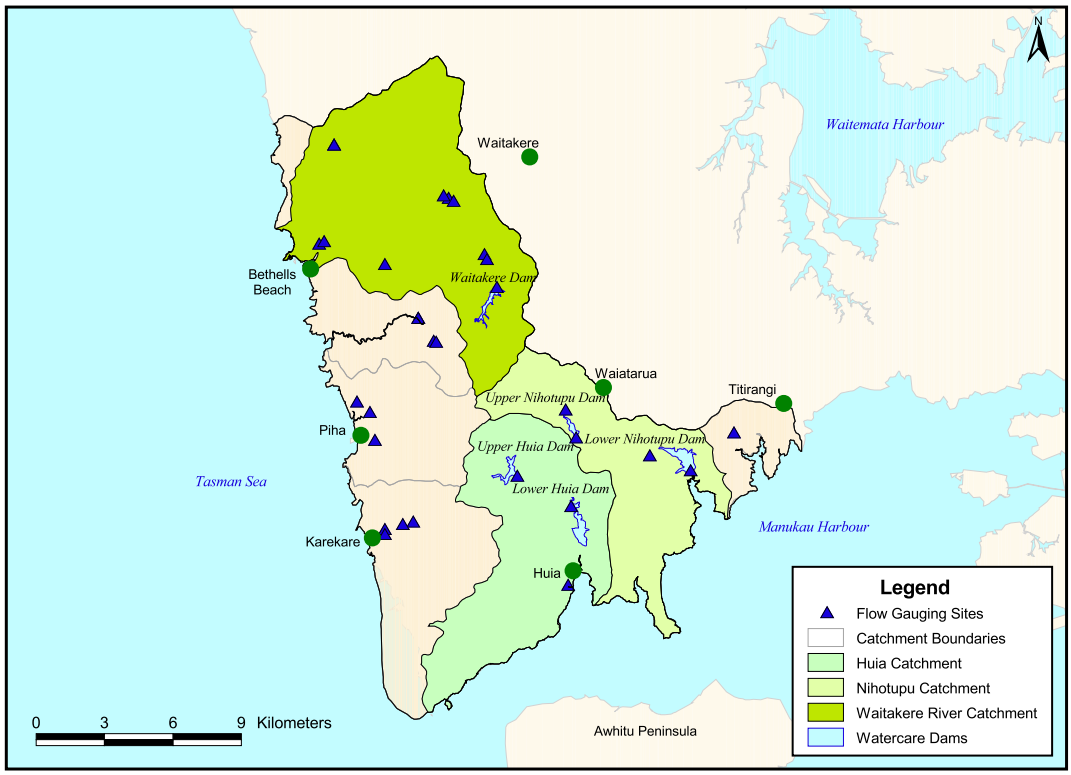

Figure 8.3: Surface water catchments and flow monitoring sites in the Waitakere area.

8.4 Hydrogeology

Groundwater development in the Waitakere area is limited. This is due to the generally low water bearing rocks of the Waitakere Group, which dominate the area. Few successful bores have been constructed in the Waitakere Group rocks in this area. Underlying the Waitakere Group, at least in the north and east is the Waitemata Group. The extent of the Waitemata Group in the south and west Waitakere area is unknown. Bores drilled in the Waitemata aquifer can yield sufficient volumes for domestic supply and small scale development. However, it is worth noting that some bores drilled into the aquifer yielded such low volumes that the bores have been abandoned. Low- to no-yielding bores in the area has tended to curtail further drilling, especially since the value of the supply may not outweigh the cost of drilling a deep Waitemata bore.

During the 1994 Auckland Water Crisis a deep (330m) bore was drilled in the Waitakere area. At the time it was hoped that a well-fractured zone, or underlying aquifer might have been found to supplement municipal water supplies. Unfortunately adequate bore yields were not found during the investigations and the bores were not developed for water supply.

8.5 Water Management

Most water demand in the Waitakere area is from surface water, specifically the five water supply dams. Groundwater resources are limited and hence not well developed although there are adequate supplies in the north and east of the area for small developments.

8.5.1 Surface Water

Water abstraction is dominated by Watercare Services LTD's abstraction from the five water supply reservoirs to meet part of Auckland's urban water demand. There are also a small number of consented users in the Waitakere River Catchment, including a quarry, along with stock water demand. In the southern part of the area there is little water demand other than for beach facilities and community water supplies. In total there are 8 of these other consents to take water from run-of-stream flow, with a total allocation of 721 m^3/day.

The streams and rivers of the Waitakere Ranges are amongst the least modified and with the highest ecological values in the Auckland Region (ARWB, 1990). They provide high quality habitat with good water quality. The Te Henga wetland in the lower reaches of the Waitakere River is the largest wetland within the Auckland Region and is highly valued, despite the invasion of willows and other exotic species.

The rivers and streams of the area are also highly valued for their landscape and recreational values. These streams typically have large lagoon areas in their lower reaches where they meet the Tasman Sea. In the mid to upper reaches there are many waterfalls, for instance on the Mokoroa Stream and Cascades Stream. Dune lakes (such as Lake Wainamu and Lake Okaihau) are also a significant feature of the area.

8.5.2 Groundwater

The Waitakere area is not divided into separate groundwater management areas. At 1 June 2001 there were only 3 issued consents to take groundwater in the Waitakere area; One for golf course irrigation (8,500 m^3/year), another for nursery irrigation (7500 m^3/year) and the third for amenities at Piha Beach (7,780 m^3/year). No groundwater management plans have been produced for the area.

8.6 References

ARWB, 1990; Waitakere River Catchment water and soil management plan. TP 61 ARWB.

Hayward, B.H., 1983: Geological map Sheet Q11 Waitakere, NZ Geological Survey, Lower Hutt.

9 Gulf Islands Water Resource Area

9.1 Introduction

There are over 50 Hauraki Gulf Islands within the Auckland Regional Boundary (fig. 9.1). The inner islands are typically recreational areas while the outer islands are primarily conservation reserves. Individual islands vary in geology and land use. Many Hauraki Gulf islands are formed of greywacke rocks (e.g. Rakino, the Noises) while some are formed of both Waitemata Group and greywacke rocks (e.g. Motutapu, Motuihe and Kawau). The remaining islands are formed of basalt (Rangitoto), andesite or rhyolite (Mokohinau Islands), or a combination of volcanic and sedimentary rocks (Great Barrier Island) (Hauraki Gulf Maritime Board, 1983). The variable geology (and age) of the Gulf Islands has resulted in variable island morphology. Those islands with andesitic and/or rhyolitic rocks are typically steep with sheer cliffs and deep valleys. Islands of predominantly greywacke rocks are less rugged, although are still steep, particularly around the coastline.

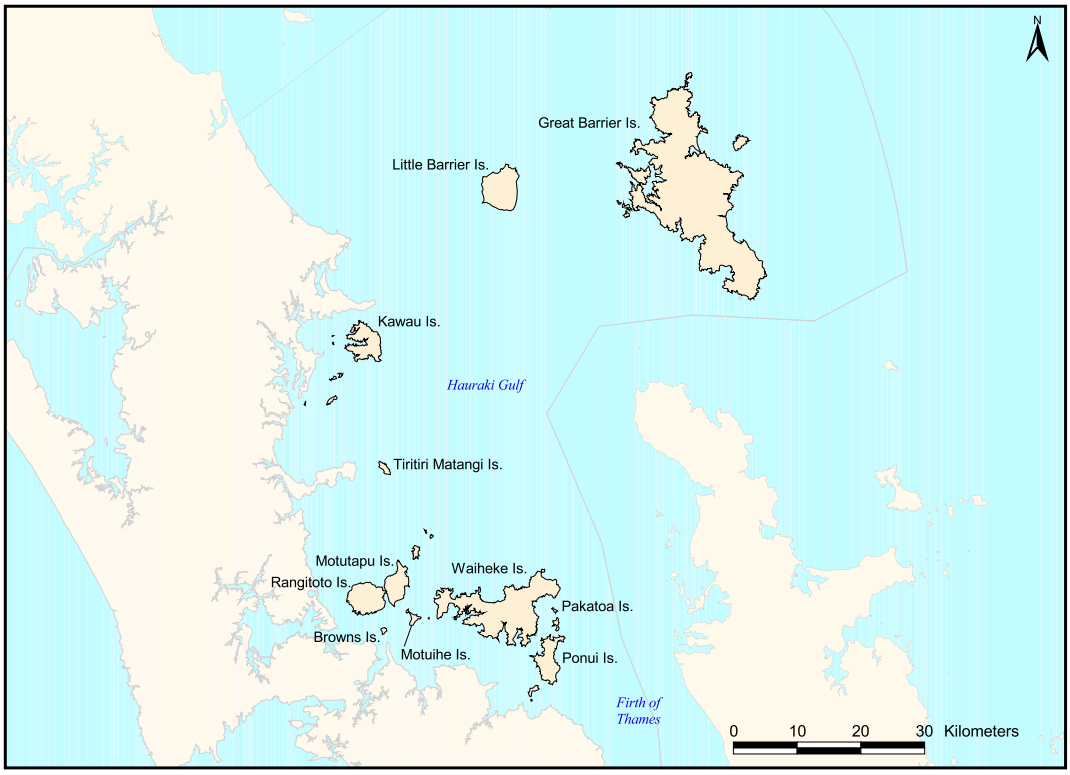

Figure 9.1: Location map for the Gulf Islands water resource reporting area.

The Department of Conservation administers Motutapu, Browns Island, Motuihe, Rangitoto, Little Barrier Island, and Tiritiri Matangi as reserves, although the former three are farmed. Waiheke Island is the most settled of the Gulf islands, with a population of around 6,500 (Statistics NZ, 2001). Other populated islands include Great Barrier Island, Kawau, Ponui, Rotoroa and Pakatoa.

The key water management issues for the Gulf region are in areas of both urban and rural development. Since the early 1970's Waiheke Island residential development has flourished, bringing with it problems for island dwellers, including summer water shortages and wastewater disposal issues. Most Gulf Islander's obtain water supplies from rainwater stored in tanks.

A survey of Waiheke Island residents determined 95% used collected rainwater as their primary water source, but 30% needed to supplement this water source on average twice a year. Recognition of water supply issues is important when considering the scale and location of urban development on Gulf Islands, particularly on Waiheke where the population has been predicted to increase to 10,000 by 2006 (Auckland City Council, 2000). The absence of a reticulated supply means groundwater taken from several bores by water carriers is important in meeting water shortages over the summer.

9.2 Rainfall

The Hauraki Gulf generally experiences dryer conditions than on the mainland. NIWA and the NZ Meteorological Service have long-term rainfall monitoring sites on Great Barrier Island, at Port Fitzroy, and at Awaroa on Waiheke Island. There are no ARC climate stations on the Gulf Islands. Hessell (1988) found that mean annual rainfall across the Hauraki Gulf was as low as 1,000mm. This estimate is only an average as localized rainfall patterns are likely to occur over large landmasses. Mean annual rainfall in the Awaroa Valley, Waiheke Island, is approximately 1,280mm while at Port Fitzroy on Great Barrier Island, annual rainfall is close to 1,836mm. On Little Barrier Island, mean rainfall is approximately 1,450mm per year. This is based on NIWA records from 1933-1993.

9.3 Hydrology

Hauraki Gulf islands typically have numerous small surface water catchments. Thirty-seven percent of these catchments are less than or equal to 1 km^2, a considerably higher proportion than on the Auckland mainland (17%). Small catchments of steep gradient often have short duration peak discharges. Stream flows on Great Barrier and Little Barrier Islands are likely have stronger base flows, and reduced peak discharges of longer duration, due to the large areas of forest and native bush cover.

There are no ARC automatic flow recorder sites in the Hauraki Gulf Islands. Manual flow gaugings have been made, generally to assist in the processing of resource consents, on Great Barrier Motutapu and Waiheke Islands.

9.4 Hydrogeology

Groundwater resources on islands are susceptible to saline intrusion as soon as the balance between inflows and outflows is changed and groundwater abstraction starts. Water infiltrating the ground is stored in aquifers as a lens of freshwater floating on the more dense saline water. The shape and thickness of the lens is a factor of climate, island size and aquifer parameters. On Waiheke Island aquifer fracturing (orientation, continuity etc) all impact the susceptibility of the island aquifer(s) to saline intrusion.

There are currently no ARC groundwater monitoring bores on the Hauraki Gulf Islands. The fractured nature of the greywacke aquifer on Waiheke Island makes it difficult to reliably monitor the state of the aquifer.

On Waiheke Island the greywacke aquifer is low yielding, although supplies of up to 200 m³/day are able to be abstracted from a 100mm diameter bore [Auckland City Council Onetangi water permit number 23226]. However, some greywacke bores have yielded very little water (2-10 m^3/day), highlighting the variability of aquifer fracturing on the island. The combination of low permeability rocks and relatively steep topography leads to high rates of rainfall runoff, resulting in only a small proportion of rain recharging the aquifer. Most bores have been drilled on the western half of the island, in urban and commercial areas.

Great Barrier Island has comparatively few groundwater bores and comparatively little is known about the Island's groundwater resources. Unlike Waiheke, Great Barrier has variable geology (Armitage et al., 2001) and there are likely to be several aquifers. The northern section of the island is underlain by greywacke rock while the remainder of the island has similar geology to the Coromandel (rhyolites and andesites). Bore yields tend to be low although adequate supplies for domestic or small developments exist.

9.5 Water Management

Most water demand in the Hauraki Gulf Islands is on Waiheke Island. This trend will continue to grow in the future as a function of its growing population, driven by the relative size of the island, its lifestyle opportunities, and its proximity to the urban heart of Auckland City.

A unique, semi-urban environment has been created and maintained through the lack of a comprehensive reticulated water supply and wastewater disposal system. Consequent water shortages and wastewater disposal difficulties have restricted development. The ARC supports an integrated approach to supplementing water supply in water short areas like the Gulf Islands by way of stormwater/wastewater management, as well as encouraging conservation and public education about efficient use and management of water.

Water shortages and inevitable increases in demand, means water storage by property owners is encouraged. There is the potential to re-use stormwater runoff, retained at the source of its generation. This should be especially considered when planning stormwater control measures in new urban development. While the re-use of wastewater is encouraged, its use should be in accordance with Ministry of Health guidelines. Residential usage on Waiheke Island averaged 100 litres/head/day, as compared to around 180 in Auckland City, with annual use estimated to be around 200,000 cubic metres. Gulf Islanders are water conscious and tend to use less water per capita than mainland Aucklander's.

9.5.1 Surface water

There were 13 consents to take surface water from the Gulf Island area in May 2001. On Waiheke Island there are 6 consents to take surface water from streams totaling 105 m^3/day and a consent to take water from a dam totaling 185 m^3/day. There are four consents to take surface water from streams on Great Barrier Island (140 m^3/day), one consent to take surface water from a stream on Motutapu Island (25 m^3/day) and a consent to take surface water from a dam on Kawau Island (24 m^3/day).

The majority of surface water allocation on the Gulf Islands is for pastoral, horticultural and recreation field irrigation, totaling 275 m^3/day. Community supply is the second main use of water with a total allocation of 149 m^3/day. Minimum and maximum individual daily allocations ranged from 7.5 to 185 m^3 for horticultural and recreational irrigation respectively.

9.5.2 Groundwater

There are currently no documents providing guidance on water resource allocation and groundwater management for Hauraki Gulf Islands. One of the greatest threats to groundwater on Waiheke Island, and indeed any of the Gulf Islands, is that of saline intrusion. The freshwater body on islands is limited and the balance between annual recharge and annual abstraction is important to ensure that saltwater is not drawn into the aquifer, thereby reducing the total volume of freshwater available. All coastal bores in current use have the potential to induce saline intrusion, as can large abstractions within proximity of the coast.

ARC databases indicate that there are in excess of 90 bores on Waiheke Island. Most of these bores are used for domestic supply only. Groundwater demand is high around Onetangi and some Putiki Bay catchments, where further groundwater allocations will be difficult to obtain, and require significant supporting information. Consent holders that abstract large volumes of bore water near the coast are required to monitor water levels and water chemistry (for changes in chloride and sodium), as a condition of their resource consent. This monitoring data, together with water use information, assists in determining the impact of abstraction on the groundwater resource, providing an early warning of any imbalance between recharge, natural discharge and abstraction.

Thirty-one resource consents are currently issued on Waiheke Island, authorising annual groundwater abstraction of around 110,000 m^3. Most groundwater demand is for water carrier supply (45,000 m^3/year) and the hospitality industry (33,000 m^3/year) which includes hotels, motels, restaurants and cafes. Industry and recreational purposes (e.g. golf course and bowling green irrigation) are the next largest consumers of groundwater on Waiheke Island. Daily allocations vary between 5 and 180 m^3. Great Barrier, Karamurama, Pakatoa, Rangitoto, and Rotoroa Islands each had one resource consent to take groundwater. All these abstractions are for small community supplies (camping grounds, toilets etc).

9.6 References

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