

Estimation of permitted water take volumes across Taranaki

1. Introduction

As part of the review of the Regional Freshwater Plan the Council has undertaken various studies to investigate water takes permitted under the Council's Regional Freshwater Plan (2001) (RFP). An important consideration for water resource management is quantifying the takes and assessing their impact on surface and groundwater resources for water allocation and accounting purposes.

The purpose of this report is to estimate the permitted take demand across FMUs and determine their significance for water resource management and to inform a water accounting system for the region as required by the National Policy Statement for Freshwater Management (MfE, 2014) (NPS-FM).

2. Background

Pursuant to sections 14(3)(b) of the Resource Management Act 1991 (RMA), the minor taking and use of surface and groundwater for stock and domestic use is generally allowed, subject to the taking or use not resulting in any adverse effects on the environment.

In the Taranaki region the taking and use of surface and groundwater for minor water use, including stock, cowshed and domestic use, is a Permitted Activity under Rule 15 of the RFP. The permitted take rule includes several conditions that must be met, including restricting the rate and volume of the take to <1.5 L/s and 50 m³/day, respectively.

The NPS-FM requires Councils to establish freshwater quantity accounting systems. These requirements arise under Objective CC1, Policy CC1 and Policy CC2 (Appendix 1). Within a freshwater quantity accounting system, all water taken from a freshwater management unit must be quantified. This includes both water taken under resource consents, as well as any takes that are permitted or do not require resource consent, such as stock, domestic and cowshed water (MfE, 2015).

As permitted takes are not generally measured, it is necessary to estimate the potential volumes being taken. The following report details work undertaken by the Council to estimate the volume of water potentially taken in Taranaki under the permitted rule. The assessment provides estimates of permitted take demand across each of the Freshwater Management Unit's (FMUs) proposed in the Draft Freshwater and Land Management Plan for Taranaki (Figure 1).

The work carried out is an initial attempt by the Council to estimate potential permitted use volumes. This is a high level assessment designed to provide initial estimates of the potential magnitude of permitted take volumes across Taranaki. It is envisaged that further investigations will be undertaken to validate and refine these initial estimates.

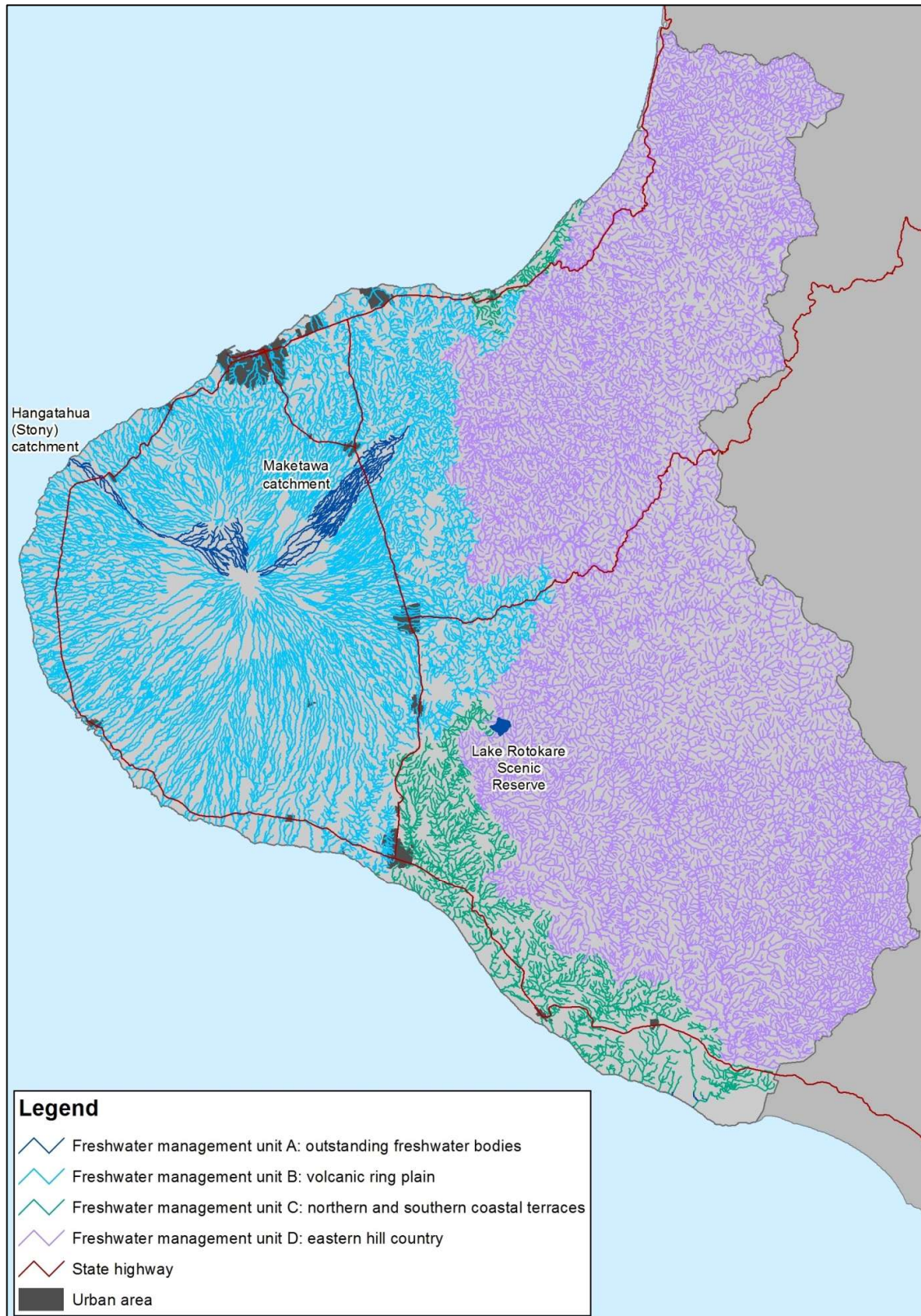


Figure 1: Proposed Freshwater management units for the Taranaki region

It should be noted that while permitted take volumes are not routinely measured, they are inherent within the hydrological record maintained by the Council across the region. That is, surface water flows measured and monitored by the Council, and the flow statistics generated using this data, include within them the 'effects' of the permitted take rights being exercised within each catchment. Therefore the effects of permitted takes are already being monitored, but estimates of their volume need to be quantified to satisfy the accounting requirements of the NPS-FM.

3. Information Sources

As noted above permitted takes are not directly monitored. However, there are various ways to estimate the water used.

In the early 1980s, the Taranaki Catchment Commission undertook the Taranaki Ring Plain water resources survey. This concluded with the release of six major reports, one of which addressed water and land use (Taranaki Catchment Commission, 1984). This survey set out to document on a catchment by catchment basis, all existing water use from surface and groundwater. Seventy-seven percent of the ring plain was able to be surveyed, with western Taranaki unable to be surveyed in the available time. The survey involved interviewing each land owner/occupier and the completion of a land and water use survey form. The survey was based on a dairy cow daily maximum use of 140 L/day. Where there were resource consents in place for takes the consent holders supplied data about actual water use. The survey found:

- 139,853,800 L/day (1,619 L/s) of water was being abstracted with 86.5% coming from streams, 12.8% from groundwater and 0.7% through the collection of rainwater.
- Stream sources were used in the upper areas of each catchment while groundwater was used more extensively used in the lower areas.
- Rainwater was used only for domestic purposes.
- Approximately 33% of all water used was used directly in agriculture purposes. Most of the water was abstracted from streams and a substantial portion (23.5%) was supplied by community supply schemes. Urban supply accounted for 45.9% of water use. Industry also accounted for a substantial portion of this quantity and was also a specific use for a further 17%.
- Domestic use accounted for 2.2% of water used, the largest proportion of which was supplied by stream water.
- Horticultural use accounted for 1.9% of water use.
- Most (93.4%) of the land surveyed was used for agricultural production.

Data obtained through the Ring Plain Survey has not been used directly in this assessment given the time that has elapsed since it was undertaken and the evolution and development that has occurred across the region's main industry sectors over that time. The information above does provide useful context however and a baseline with which revised water usage assessments can be compared.

The Council's Geographic Information System (GIS) has been used extensively in this assessment. This has included provision of basic FMU and catchment information, such as spatial areas and boundary details, while allowing interrogation of more specific information and data sets discussed below.

Dairy cow numbers used in this assessment have been obtained from the Council's consents database. Consents for dairy effluent discharge have conditions that specify the maximum number of cows that can contribute effluent to the farms treatment system. This generally limits the number of cows that can be carried on a farm at any one time. In addition, this assessment has used GIS data to ascertain the areas

within catchments serviced by rural and urban water supply schemes, and the number of cows numbers located within these specific areas. Comparisons between data sources are discussed in Section 6.

The locations and coverage areas of urban and rural water supply schemes across Taranaki were taken from GIS shapefiles provided by the District Councils'. These water schemes have been developed extensively over the years and currently service 26% percent of the ring plain and marine terrace area. The area covered by water schemes across Taranaki is shown in Figure 2.

The water demand figures for specific animal types included in this assessment have been taken from Horizons Regional Council (2007). These include estimates for both peak and average dairy cow water demand, including drinking water and dairy shed demand, as well as peak demand estimates for beef cattle and sheep (Table 1).

Table 1: Standard values for animal water demand used in assessment

Animal type	Peak demand (L/h/d)	Average demand (L/h/d)
Dairy cow (drinking water + dairy shed use)	$70 + 70 = 140$	$45 + 50 = 95$
Beef cattle	55	30
Sheep	4.5	3.0

Land cover information was sourced from The New Zealand Land Cover Database (Landcare Research, 2015) (LCDB4). The database classifies land cover across New Zealand into 33 distinct classes e.g. high and low producing grassland, exotic forestry and scrubland etc. Land use capability information was sourced The New Zealand Land Resource Inventory Database (Landcare Research, 2010) (NZLRI), from which slope classification was the primary variable of interest.

This assessment has also utilised information recorded by the Council's Land Management Staff in comprehensive farm plans. Comprehensive farm plans look at all facets of a farm's operation including land and stock management and include detailed surveys and assessments of farm properties. Of particular relevance to this project were details of stock numbers recorded on properties, the relative ratios of differing animal types carried on properties and estimates of stock carrying capacity.

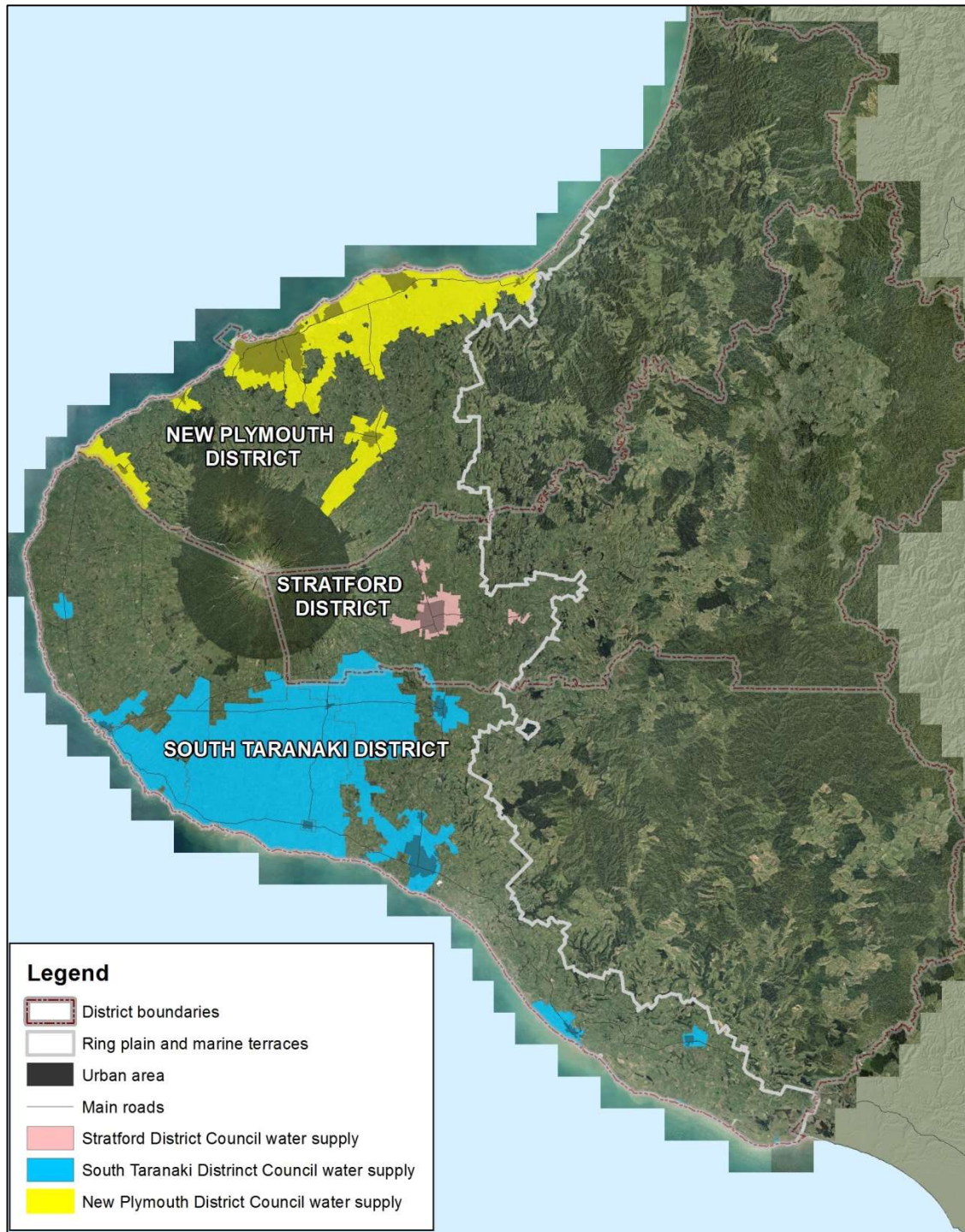


Figure 2: Coverage of rural and urban water supply schemes in Taranaki

4. Methodology

Two differing methodologies have been used to estimate permitted take water demand as part of this assessment. The differing methodologies were required to reflect differing land use types and predominant agricultural systems across the region.

The first methodology was used to account for permitted take water use in FMU-A, FMU-B and FMU-C. This method is based solely on dairy cow water demand across these FMUs. This was deemed appropriate given that dairy farming is the primary land use in each of them and the greatest driver of permitted take demand.

The assessment provides estimates of permitted use water demand at both an FMU and catchment scale. In order to achieve this, the number of catchments within each FMU, their names and respective areas contained within FMU boundaries were derived from the Council's GIS system.

GIS was then used to isolate the areas of each catchment serviced by urban and rural water supply schemes. The number of cows located on properties in these coverage areas was then quantified using consent data. It has been reasonably assumed that the water demands of dairy cows and related dairying activities are serviced by water schemes where access to these reticulated supplies is available.

The total dairy cow water demand within each FMU was then calculated by multiplying the remaining number of dairy cows, i.e. those located outside of areas serviced by urban or rural water supply schemes, by the estimated peak dairy cow water demand figure of 140 L/day.

The calculated total water demand figure was further broken down by catchment and any consented take volumes for stock/general farm use within each catchment were subtracted from the total demand estimate.

A proportion of the remaining potential water demand figure within each catchment was then allocated to groundwater. A groundwater allocation of 13% was used in calculations. This percentage was based on the proportion of groundwater usage determined during the Council's ring plain survey. The remaining 87% of potential dairy cow water demand within each catchment was assumed to be taken from surface water bodies. It is this figure that is assumed to represent the peak permitted take demand in each catchment.

An outline of this methodology is provided in Figure 3.

A separate methodology was then used to estimate water demand across FMU-D, which encompasses the eastern hill country. A revised methodology was required given that drystock farming is the predominant land use within the FMU, and therefore a methodology based on dairy cow water demand was not appropriate.

Given the variance in land cover and land use suitability, a more detailed GIS assessment was required. Initially, the areas of each catchment contained within FMU-D were identified and their respective area calculated. In addition, the area of each catchment with differing land cover and slope class were calculated using a combination of data from the LCDB4 and NZLRI databases.



Figure 3: Outline of methodology adopted for the calculation of permitted take demand in FMU-A, FMU-B and FMU-C

In order to estimate potential stock numbers within FMU-D, a potential stock carrying capacity was applied to each specific land cover and slope combination. High and low producing grassland cover areas with a low slope classification had the greatest stock carrying capacity. Carrying capacity was reduced as land slope increased and areas classified as having scrubland, indigenous and exotic forestry land cover were deemed to have no capacity to carry stock.

Data from Council farm plans were also used to estimate the proportions of differing animal types making up total stock numbers across FMU-D. As would be expected, data from these plans indicate that beef cattle and sheep predominate. Farm plans indicate a very small number of farmed deer present. The numbers are so small that their water demand is deemed insignificant, and therefore they have not been considered in the calculated estimate.

The relative ratio of beef cattle to sheep for was establishing using farm plan information for the Waitotara Catchment, which indicated the ratio to be in the vicinity of 60:40 (relative to stock units). The ratio taken from this catchment, the largest within FMU-D, was deemed as representative for the FMU. For this study, stock unit benchmarks of 5.5 have been used for beef cattle and 1.0 for sheep (Beef + Lamb New Zealand, 2013). These benchmarks indicate the number of stock units assigned per animal. Therefore a 60:40 beef cattle to sheep stock unit ratio implies approximately 11 beef cattle per 40 sheep.

The total numbers of beef cattle and sheep per catchment was then calculated. These stock numbers were then multiplied by the peak water demand figures for beef cattle and sheep of 55 and 4.5 L/h/day, respectively. This calculation gave a total estimated stock water demand by catchment across the entire FMU.

As of June 2017, there were a total of three resource consents authorising the taking of water for stock or general farm use across FMU-D. The volumes authorised for abstraction under these consents was subtracted from the total estimated water demand for the catchment in which the takes are located. There are no registered group water supply schemes within the FMU.

Groundwater is accessed in a number of locations across the FMU where it discharges through springs. Landowners will often construct stock water dams at these locations. Takes at these locations are however deemed to be merely intercepting water that would otherwise flow to the nearest surface water drainage system and are therefore classified as surface water takes for the purposes of this assessment. A proportion of the potential permitted take water demand figure has however been allocated to groundwater. As with the methodology used for all other FMUs, a figure of 13% of the total permitted take demand was used in calculations.

An outline of this methodology is provided below in Figure 4.

5. Results

The four proposed FMUs for Taranaki cover a total area of 724,138 ha. FMU-D, which encompasses the eastern hill country, is the largest FMU by area, accounting for 404,734 ha or 56% of the total land area. FMU-B, covering the volcanic ring plain, is the second largest FMU, accounting for a further 250,962 ha or 35% of the total land area. FMU-C and FMU-A account for 8% and 2% of the total land area, respectively (Table 2).

Table 2: Spatial characteristics of Taranaki FMUs as used in this assessment

FMU	Description	Catchments	Total area (ha)	% of total land area
A	Outstanding fresh water bodies	3	11,793	2
B	Volcanic ring plain	147	250,962	35
C	Northern and southern coastal terraces	50	56,919	8
D	Eastern hill country	38	404,734	56



Figure 4: Outline of methodology adopted for the calculation of permitted take demand in FMU-D

An assessment of dairy effluent discharge consent conditions indicates the potential for a total of 565,138 dairy cows to be present across Taranaki dairy farms. Of this total number, the vast majority are located on the volcanic ring plain, which is defined as FMU-B. Cow numbers in FMU-B are estimated at 476,653 or 84% of the potential dairy cow population across Taranaki. FMU-C accounts for the second largest population of dairy cows within Taranaki, with potential for 77,740 animals to be present, or 14% of the total population. A further 10,745 dairy cows are located within FMU-A (2%).

The estimated total dairy cow population of 565,138 exceeds the most recent estimate of dairy cow numbers produced by LIC (2016) of 486,953 by 78,185 (16%). This is not unexpected given the original estimate is based on consent conditions and consent applications are generally made with provision for an expansion in animal numbers on farm. The cow numbers stipulated in consent conditions can therefore often represent an overestimate of actual cow numbers on a property at any one time but, in effect, represent the number of stock that could potentially be carried on a property. The total estimate of dairy cow numbers produced using consent conditions does correlate well with the estimate for Taranaki of 541,931 produced by Stats NZ (2015), which is based on a survey of actual stock numbers.

Urban and rural water supply schemes are available across FMU-A, FMU-B and FMU-C. In total, available schemes cover approximately 29% of the total grassland area across these FMUs. The greatest coverage of schemes is found across FMU-B, where approximately 67,788 ha, or 34% of its grassland area is serviced. In

comparison, water schemes cover approximately 16% (885 ha) and 8% (3,482 ha) of grassland within FMU-A and FMU-C, respectively.

Within FMU-B, approximately 277,231 dairy cows are located outside of areas with urban or rural water supply scheme coverage. In addition, 9,105 and 69,275 cows are located outside areas of scheme coverage areas in FMU-A and FMU-C, respectively. It is these animals from which the total potential peak dairy cow water demand has been calculated for each FMU.

A potential peak dairy cow water demand of 38,812 m³/day has been estimated for FMU-B. When the estimated proportion of this demand attributed to groundwater sources is removed, and consented stock water use are subtracted from this figure, the total estimated permitted surface water take volume across the FMU is 30,230 m³/day. This is the equivalent of 605 individual permitted takes, based on the maximum permitted take volume of 50 m³/day. Using the same methodology, a total estimated permitted surface water take volume of 415 m³/day has been calculated for FMU-A and 7,029 m³/day for FMU-C. These figures represent the equivalent of 8 and 141 individual permitted takes, respectively.

At the catchment scale, the estimated permitted surface water take volumes range from zero in catchments fully serviced by urban and/or rural water supply schemes to 8,176 m³/day in the Waitara catchment. This equates to a range of between zero and 164 individual permitted surface water takes per catchment. In terms of the density of takes within each FMU, calculations indicate there is one permitted take for every 219 ha of grassland area (outside of areas serviced by urban or rural water supply schemes) in FMU-B. Similarly, there is one permitted take per 555 ha in FMU-A and every 304 ha in FMU-C.

Table 3: Summary results for FMU-A, FMU-B and FMU-C

FMU	Total dairy cows	Dairy cows on grassland not covered by urban/rural water supply scheme	Potential peak dairy cow water demand (m³/day)	Consented stock use (m³/day)	Potential peak permitted take demand (m³/day)	Estimated permitted groundwater use (m³/day)	Estimated permitted surface water use (m³/day)	Equivalent number of permitted surface water takes @ 50 m³/day
A	10,745	9,105	1,275	694	581	166	415	8
B	476,653	277,231	38,812	3,561	35,267	5,037	30,230	605
C	77,740	69,275	9,699	1,409	8,290	1,261	7,029	141

The calculations carried out for FMU-D, using the alternate methodology discussed in Section 4, defined 123,847 ha of the total FMU area of 404,734 ha as having the potential to carry stock (31%). Across this area there is an estimated carrying capacity of 1,389,331 stock units.

A logic check was carried out on these calculated estimates of stock carrying capacity using actual stock numbers within the Waitotara Catchment, which is the largest catchment within FMU-D. Council Land Management staff have undertaken detailed farm surveys across the Waitotara catchment as part of developing comprehensive farm plans to promote sustainable land use. These surveys include records of stock units on 77% (47 of 64) of farms at the time of the visit. Based on information contained in farm plans, the total stock carrying capacity on farms surveyed within the Waitotara catchment is approximately 187,625. This correlates reasonably well with the stock unit estimate of 209,338 for 100% of farms derived using the methodology detailed above.

Using stock unit benchmarks and the estimated stocking ratio, the total number of stock units across FMU-B is estimated to translate to 151,563 cattle and 555,732 sheep. These estimates correlate reasonably well with estimates of actual stock numbers produced for Taranaki by Stats NZ (2015) of 128,274 beef cattle and 499,840 sheep. It is not unexpected that estimated stock numbers might exceed the actual numbers of stock currently on farms given the methodology used represents a potential stock carrying capacity. The estimate produced by Stats NZ is also for the entire Taranaki region and will therefore include the presence of animals outside of FMU-D, although these numbers are anticipated to be small relative to the number of these animals in FMU-D.

From these animal number estimates, the total estimated stock water demand across FMU-D is 10,837 m³/day. There are very few current consents for stock water supply in the FMU, with a total consented allocation of 326 m³/day. This leaves a remaining water demand of 10,510 m³/day, to be met by water taken under the permitted rule. This equates to an estimated permitted take demand from groundwater of 1,366 m³/day and 9,144 m³/day from surface water, the equivalent of 183 individual permitted surface water takes (Table 4).

Table 4: Summary results for FMU-D

FMU	Estimated stock units	Peak cattle water demand (m ³ /day)	Peak sheep water demand (m ³ /day)	Total peak water demand (m ³ /day)	Consented use (m ³ /day)	Estimated permitted groundwater use (m ³ /day)	Estimated permitted surface water use (m ³ /day)	Equivalent number of permitted of surface water takes @ 50 m ³ /day
D	1,389,331	8,336	2,501	10,837	326	1,366	9,144	183

A full summary of all results by FMU and catchment is presented in Appendix 2.

6. Discussion

For catchments within FMU-A, FMU-B and FMU-C, the calculation of potential permitted surface water take volumes has been based solely on dairy farming water demand (peak drinking water + estimated shed use). Other potential land use activities and domestic/industrial water demands within these FMUs include drystock farming, horticultural operations, domestic household water supply, and light industrial water supply e.g. hydrocarbon exploration and roading works (which are temporary in nature). The potential permitted take water demand in FMU-D has been calculated on drystock (beef cattle and sheep) water demand, as drystock farming is the predominant land use activity being undertaken within the FMU.

In general, the water demand associated with a dairy cow is significantly higher than that of other livestock. Beef cattle and sheep have peak daily water demands of 45 and 4.5 L/h/day, respectively, in comparison to a peak demand of 70 L/h/day for a dairy cow. In addition, a further water requirement of 70 L/h/day is required per dairy cow for shed wash down and cooling water, equating to a potential peak usage of 140 L/h/day.

Water demand by domestic households is generally in the region of 1 m³/day, allowing for 200 L/person/day for a family of five. In Taranaki, dwellings typically rely on urban and/or rural water supply schemes, or the collection of rainwater for water supply purposes outside the coverage area of such schemes. A small volume of groundwater may also be accessed for private supply, but the use of surface water for consumptive purposes is now rare.

It is difficult to estimate permitted take demands in relation to horticultural and light industrial operations, but it is reasonably assumed to be minor. Any large industrial activities generally require water supplies that exceed the maximum permitted take volume and/or rate limits and are therefore authorised through a resource consent.

Notwithstanding the potential for additional water use in activities outside of dairy farming land use, given the predominance of dairy farming land use within FMU-A, FMU-B and FMU-C, and the likely demand for surface water supply in association with the activity, it is considered that the use of dairy cow water demand data to quantify the potential volumes of water taken from catchments under the permitted take rule is valid as an initial approach.

In addition, the methodology used to calculate the estimated demand are likely to overestimate the actual demand from dairy farming activities and therefore by default account for some degree of additional water use in relation to other, non-dairy related activities. For example, the use of the peak water demand for a lactating dairy cow of 70 L/h/day is likely to overestimate actual daily consumption over a longer term period. The annual average water demand for a lactating dairy cow is estimated to be 45 L/h/day. For an average sized Taranaki dairy herd of approximately 350 dairy cows, the difference between peak and average water demands represents a potential overestimation in water demand of approximately 8.75 m³/day. This would be sufficient to meet the peak water demands of 1,944 sheep, 159 cattle or 9 domestic dwellings per day. For the 355,611 dairy cows located outside of urban and/or rural water supply scheme coverage areas across FMU-A, FMU-B and FMU-C, the difference between peak and average water demand could account for an additional 8,890 m³/day, or 178 additional permitted takes.

Where urban and rural water schemes are available, it has been assumed that farmers will utilise these to meet their water demand. Farmers often prefer to access water from these schemes where available, given the quality of the water and the reliability of supply. This is evidenced by the high take up of rural supply schemes, such as the Waimate West scheme, which has over 800 farm connections. It is also known however that some farmers will often supplement this supply with water taken under the permitted take rule, particularly for use in yard washing or other activities with reduced hygiene requirements (M Joyce pers. comm). This mixed use is difficult to quantify for calculating water use estimates.

Outside of urban and rural water supply scheme coverage areas, resource consent, water use and farm survey information indicate that surface water systems provide the preferred source of water for stock drinking and dairy shed wash down across Taranaki, where access to such waterbodies is available. The assessment undertaken also included an allowance for water supply from groundwater sources, assumed to be 13% of the total potential permitted take demand across each FMU. In general, groundwater usage is relatively minor across Taranaki, in terms of volume. There are numerous reasons for this including the higher capital cost of installing groundwater supply systems, limited water yields from shallow aquifers and natural occurring water quality issues, such as elevated iron and manganese concentrations, which can reduce usage options and cause issues with reticulation infrastructure. The lower cost and high availability of surface water bodies to service permitted take needs make them the preferred water supply option. Overall, the volume of groundwater being abstracted under the permitted take rule is deemed negligible in relation to the size of the region's potentially allocable groundwater resource.

FMU-D is the largest FMU in Taranaki, accounting for 56% of the regions total land area. The majority of the land cover within the FMU is however native and exotic forestry, with only 31% of the total area of the FMU potentially suitable for farming purposes. There are large areas of Department of Conservation land in the FMU. Where potential exists for farming, this is generally restricted to low intensity drystock farming. The potential permitted take demand for the FMU has been calculated based on drystock animal numbers. A

cross check of calculated stock numbers against known animal numbers in the Waitotara catchment correlated well, giving confidence in the methodology used to estimate animal numbers across catchments.

To add perspective to the estimated volumes of water being taken from surface water systems under the permitted take rule, the estimated permitted take volumes (converted to L/s) have been compared with mean annual low flow (MALF) statistics for a selected range of catchments. The results are presented below in Table 5. The comparisons provide important context in terms of the percentage of flow permitted activities comprise at critical low flow periods. In most cases the takes are less than 3% and increase up to 25% in smaller catchments.

The estimates of peak permitted take demand will be added back into the hydrologic record for water accounting purposes and be used to naturalise flows for water allocation assessment. The water accounting system and allocation of water will be managed through the Council's Consents Section.

Table 5: Estimated permitted take rates from selected catchments as a proportion of MALF

Catchment/river	Catchment area (ha)	MALF at mouth (L/S)	Estimated permitted take volume (L/s)	Proportion of MALF (%)
Hauroto	342	88	1.02	25.4
Inaha	6,163	447	5.17	2.6
Kaihihi	3,902	316	3.66	1.0
Kapoaiaia	1,675	95	1.10	0.4
Kapuni	4,368	82	0.94	0.2
Kaupokonui	14,691	482	5.58	0.4
Oakura	4,409	96	1.11	0.2
Oaoiti	2,150	495	5.73	3.1
Oeo	3,573	291	3.37	2.8
Otahi 2 (Otahi)	1,479	434	5.02	5.7
Otakeho	4,291	129	1.49	0.3
Ouri	2,414	85	0.99	0.5
Punehu	4,000	161	1.87	0.7
Taungatara	3,767	97	1.13	0.2
Waiaua 2 (Waiaua)	4,503	238	2.75	0.2
Waihi 5 (Waihi)	2,380	121	1.40	3.0
Waimoku	596	73	0.85	1.5
Waingongoro	21,909	1,499	28.19	1.9
Waiongana	15,888	1,007	19.03	1.9
Waitara	114,017	7,299	94.63	1.4
Waiweranui	1,908	8,176	94.63	0.5
Waiwhakaiho	14,527	3,250	9.90	0.3
Werekino	909	150	1.74	8.4

Catchment/river	Catchment area (ha)	MALF at mouth (L/S)	Estimated permitted take volume (L/s)	Proportion of MALF (%)
Wairoa	3,387	2,010	2.31	0.1
Waitotara	119,553	5,139	24.62	0.5
Whenuakura	46,874	1,347	10.25	0.8
Tangahoe	29,765	960	37.44	3.9
Patea	104,730	4,820	86.55	1.8

7. Conclusions

An exercise has been undertaken to estimate permitted activity takes across all FMUs set out in the Council's Draft Regional Freshwater and Land Plan. The calculations are based on the predominant agricultural land use within each FMU. While there are assumptions inherent within the calculations, the methodology is seen as a conservative initial assessment, which will be further developed and refined over time. The data estimates developed will be used to assist in its management of the regions water resources and inform the Council's water accounting system required under the NPS-FM.

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Appendix 1:

Accounting for freshwater takes and contaminants objective and policies
from the NPS-FW

Objective CC1

To improve information on freshwater takes and sources of freshwater contaminants, in order to:

- a) ensure the necessary information is available for freshwater objective and limit setting and freshwater management under this national policy statement; and
- b) ensure information on resource availability is available for current and potential resource users.

Policy CC1

By every regional council:

- a) establishing and operating a freshwater quality accounting system and a freshwater quantity accounting system for those freshwater management units where they are setting or reviewing freshwater objectives and limits in accordance with Policy A1, Policy B1, and Policies CA1-CA4; and
- b) maintaining a freshwater quality accounting system and a freshwater quantity accounting system at levels of detail that are commensurate with the significance of the freshwater quality and freshwater quantity issues, respectively, in each freshwater management unit.

Policy CC2

By every regional council taking reasonable steps to ensure that information gathered in accordance with Policy CC1 is available to the public, regularly and in a suitable form, for the freshwater management units where they are setting or reviewing, and where they have set or reviewed, freshwater objectives and limits in accordance with Policy A1, Policy B1, and Policies CA1-CA4.

Appendix 2:

Calculated permitted take volumes by FMU

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m ³ /d)	Consented stock use in catchment (m ³ /d)	Potential peak permitted take demand (m ³ /d)	Estimated permitted GW use (m ³ /d)	Estimated permitted SW use (m ³ /d)	Equivalent number of permitted SW takes @ 50 m ³ /d
A	Hangatahua (Stony)	5,053	1,300	1,100	154	-	154	20	134	3
A	Waitara (Maketawa sub-catchment)	6,486	9,445	8,005	1,121	694	427	146	281	6
A	Tangahoe	254	0	0	-	-	-	-	-	-
	Totals:	11,793	10,745	9,105	1,275	694	581	166	415	8

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m³/d)	Consented stock use in catchment (m³/d)	Potential peak permitted take demand (m³/d)	Estimated permitted GW use (m³/d)	Estimated permitted SW use (m³/d)	Equivalent number of permitted SW takes @ 50 m³/d
B	Arawhata	673	1,805	1,805	253	-	253	33	220	4
B	Hauroto	342	720	720	101	-	101	13	88	2
B	Heimama	1,693	4,515	3,715	520	-	520	68	452	9
B	Herekawe	1,002	400	-	-	-	-	-	-	-
B	Hihiwera	419	2,390	-	-	-	-	-	-	-
B	Hongihongi	76	-	-	-	-	-	-	-	-
B	Horomanga	113	160	-	-	-	-	-	-	-
B	Huatoki	3,755	1,550	800	112	-	112	15	97	2
B	Inaha	6,163	16,695	4,080	571	50	521	74	447	9
B	Kaihihi	3,902	5,530	2,595	363	-	363	47	316	6
B	Kapoaiaia	1,675	1,380	780	109	-	109	14	95	2
B	Kapuni	4,368	9,815	670	94	-	94	12	82	2
B	Katikara	2,203	2,650	2,650	371	-	371	48	323	6
B	Kaupokonui	14,691	29,120	3,960	554	-	554	72	482	10
B	Koteoteo	471	2,890	2,890	405	-	405	53	352	7
B	Maitahi	242	490	490	69	-	69	9	60	1
B	Mangahume	3,013	4,525	3,870	542	-	542	70	471	9

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m³/d)	Consented stock use in catchment (m³/d)	Potential peak permitted take demand (m³/d)	Estimated permitted GW use (m³/d)	Estimated permitted SW use (m³/d)	Equivalent number of permitted SW takes @ 50 m³/d
B	Mangakino	78	230	230	32	-	32	4	28	1
B	Manganui 1 (Manganui)	161	1,050	1,050	147	-	147	19	128	3
B	Mangati	572	300	300	42	-	42	5	37	1
B	Mangatoromiro	530	3,080	-	-	-	-	-	-	-
B	Manu	84		-	-	-	-	-	-	-
B	Matanehunehu	1,569	6,115	6,115	856	-	856	111	745	15
B	Motukara	478	770	170	24	-	24	3	21	0
B	Motumate	1,402	5,760	-	-	389	389	-	-	8
B	Moukoro	83	180	180	25	-	25	3	22	0
B	Moutoti	826	1,450	1,450	203	-	203	26	177	4
B	Ngapirau	199	1,475	1,475	207	-	207	27	180	4
B	Oakura	4,409	1,495	790	111	-	111	14	96	2
B	Oaoiti	2,150	4,515	4,065	569	-	569	74	495	10
B	Oaonui	4,216	7,015	7,015	982	-	982	128	854	17
B	Oeo	3,573	10,165	2,390	335	-	335	43	291	6
B	Okahu	3,516	4,625	3,845	538	-	538	70	468	9
B	Okaweu	1,219	2,470	2,250	315	-	315	41	274	5

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m³/d)	Consented stock use in catchment (m³/d)	Potential peak permitted take demand (m³/d)	Estimated permitted GW use (m³/d)	Estimated permitted SW use (m³/d)	Equivalent number of permitted SW takes @ 50 m³/d
B	Okurukuru	56	-	-	-	-	-	-	-	-
B	Onaero	913	880	620	87	-	87	11	76	2
B	Oneroa	23	210	210	29	-	29	4	26	1
B	Opuhi	353	470	-	-	-	-	-	-	-
B	Otahi 1 (Otahi)	969	1,830	1,830	256	-	256	33	223	4
B	Otahi 2 (Otahi)	1,749	3,785	3,560	498	-	498	65	434	9
B	Otakeho	4,291	10,725	1,060	148	-	148	19	129	3
B	Otupoto	104	220	220	31	-	31	4	27	1
B	Otuwhenua	207	400	400	56	-	56	7	49	1
B	Ouri	2,414	5,320	700	98	-	98	13	85	2
B	Ouwe	147	745	-	-	-	-	-	-	-
B	Owhakaangi	64	670	-	-	-	-	-	-	-
B	Parahaki	1,151	1,955	-	-	-	-	-	-	-
B	Patea	20,455	39,350	35,395	4,955	220	4,735	644	4,091	82
B	Pehu 2 (Pehu)	91	-	-	-	-	-	-	-	-
B	Pitone	796	1,130	940	132	-	132	17	114	2
B	Puketapu	287	1,190	-	-	-	-	-	-	-

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m³/d)	Consented stock use in catchment (m³/d)	Potential peak permitted take demand (m³/d)	Estimated permitted GW use (m³/d)	Estimated permitted SW use (m³/d)	Equivalent number of permitted SW takes @ 50 m³/d
B	Punehu	4,000	9,270	1,325	186	-	186	24	161	3
B	Pungaereere	3,818	12,746	10,366	1,451	-	1,451	189	1,263	25
B	Rawa	896	4,045	-	-	-	-	-	-	-
B	Taikatu	1,412	3,820	-	-	-	-	-	-	-
B	Tangihapu	277	1,830	1,830	256	-	256	33	223	4
B	Tapuae	3,188	5,865	5,750	805	-	805	105	700	14
B	Taungatara	3,767	5,450	800	112	-	112	15	97	2
B	Te Henui	2,843	1,205	1,205	169	-	169	22	147	3
B	Teikaparua (Warea)	3,201	6,845	6,060	848	-	848	110	738	15
B	Teikiwanui	30	-	-	-	-	-	-	-	-
B	Temahau	20	150	150	21	-	21	3	18	0
B	Timaru	3,144	1,805	1,805	253	-	253	33	220	4
B	Titirangi	79	600	-	-	-	-	-	-	-
B	Unnamed catchment 23	149	1,340	1,340	188	-	188	24	163	3
B	Unnamed catchment 24	93	420	420	59	-	59	8	51	1
B	Unnamed catchment 25	18	-	-	-	-	-	-	-	-
B	Unnamed catchment 26	185	980	980	137	500	363	18	381	8

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m ³ /d)	Consented stock use in catchment (m ³ /d)	Potential peak permitted take demand (m ³ /d)	Estimated permitted GW use (m ³ /d)	Estimated permitted SW use (m ³ /d)	Equivalent number of permitted SW takes @ 50 m ³ /d
B	Unnamed catchment 27	431	725	-	-	-	-	-	-	-
B	Unnamed catchment 28	579	1,150	-	-	-	-	-	-	-
B	Unnamed catchment 29	150	500	-	-	-	-	-	-	-
B	Unnamed catchment 30	601	2,170	-	-	-	-	-	-	-
B	Unnamed catchment 31	191	-	-	-	-	-	-	-	-
B	Unnamed catchment 32	277	780	-	-	-	-	-	-	-
B	Unnamed catchment 33	39	-	-	-	-	-	-	-	-
B	Unnamed catchment 34	41	-	-	-	-	-	-	-	-
B	Unnamed catchment 35	29	-	-	-	-	-	-	-	-
B	Unnamed catchment 36	226	-	-	-	-	-	-	-	-
B	Unnamed catchment 37	14	-	-	-	-	-	-	-	-
B	Unnamed catchment 38	23	230	230	32	-	32	4	28	1
B	Unnamed catchment 39	43	-	-	-	-	-	-	-	-
B	Unnamed catchment 40	36	190	190	27	-	27	3	23	0
B	Unnamed catchment 41	265	200	200	28	-	28	4	24	0
B	Unnamed catchment 42	278	1,450	1,450	203	-	203	26	177	4
B	Unnamed catchment 43	14	-	-	-	-	-	-	-	-

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B	Unnamed catchment 44	146	1,005	1,005	141	-	141	18	122	2
B	Unnamed catchment 45	136	-	-	-	-	-	-	-	-
B	Unnamed catchment 46	55	-	-	-	-	-	-	-	-
B	Unnamed catchment 47	181	-	-	-	-	-	-	-	-
B	Unnamed catchment 48	159	400	400	56	-	56	7	49	1
B	Unnamed catchment 49	40	220	220	31	-	31	4	27	1
B	Unnamed catchment 50	51	-	-	-	-	-	-	-	-
B	Unnamed catchment 51	145	600	600	84	-	84	11	73	1
B	Unnamed catchment 52	49	460	460	64	-	64	8	56	1
B	Unnamed catchment 53	54	640	640	90	-	90	12	78	2
B	Unnamed catchment 54	581	2,735	2,735	383	-	383	50	333	7
B	Unnamed catchment 55	45	400	400	56	-	56	7	49	1
B	Unnamed catchment 56	66	-	-	-	-	-	-	-	-
B	Unnamed catchment 57	270	765	765	107	-	107	14	93	2
B	Unnamed catchment 58	121	500	500	70	-	70	9	61	1
B	Unnamed catchment 59	35	-	-	-	-	-	-	-	-
B	Unnamed catchment 60	38	200	200	28	-	28	4	24	0

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B	Unnamed catchment 61	45	-	-	-	-	-	-	-	-
B	Unnamed catchment 62	87	-	-	-	-	-	-	-	-
B	Unnamed catchment 63	88	300	-	-	-	-	-	-	-
B	Unnamed catchment 64	382	240	-	-	-	-	-	-	-
B	Unnamed catchment 65	38	-	-	-	-	-	-	-	-
B	Unnamed catchment 66	112	200	-	-	-	-	-	-	-
B	Unnamed catchment 67	13	-	-	-	-	-	-	-	-
B	Wahamoko	958	1,920	-	-	-	-	-	-	-
B	Waiarere	216	-	-	-	-	-	-	-	-
B	Waiau	2,249	4,640	2,850	399	-	399	52	347	7
B	Waiaua 1 (Waiaua)	212	1,690	1,690	237	-	237	31	206	4
B	Waiaua 2 (Waiaua)	4,503	3,320	1,950	273	-	273	35	238	5
B	Waihi 2 (Waihi)	324	-	-	-	-	-	-	-	-
B	Waihi 3 (Waihi)	112	530	200	28	-	28	4	24	0
B	Waihi 4 (Waihi)	157	250	-	-	-	-	-	-	-
B	Waihi 5 (Waihi)	2,380	2,910	995	139	-	139	18	121	2
B	Waihowaka	126	-	-	-	-	-	-	-	-

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B	Waikaretu	198	685	-	-	-	-	-	-	-
B	Waikirikiri 2 (Waikirikiri)	294	-	-	-	-	-	-	-	-
B	Waikoukou 2 (Waikoukou)	100	340	340	48	-	48	6	41	1
B	Waimate	191	-	-	-	-	-	-	-	-
B	Waimoku	596	600	600	84	-	84	11	73	1
B	Waingongoro	21,907	57,382	31,820	4,455	1,470	2,985	579	2,406	48
B	Waiokura	2,686	6,095	-	-	-	-	-	-	-
B	Waiongana	15,888	24,695	14,565	2,039	130	1,909	265	1,644	33
B	Waipaepaeiti	167	1,370	-	-	-	-	-	-	-
B	Waipaepaenui	474	1,130	-	-	-	-	-	-	-
B	Waipapa 3 (Waipapa)	706	3,680	350	49	-	49	6	43	1
B	Wairau	558	272	92	13	-	13	2	11	0
B	Waireka 1 (Waireka)	229	-	-	-	-	-	-	-	-
B	Wairere	58	140	140	20	-	20	3	17	0
B	Wairongomai	313	250	250	35	-	35	5	30	1
B	Waitaha 1 (Waitaha)	311	300	-	-	-	-	-	-	-
B	Waitaha 2 (Waitaha)	1,189	950	300	42	-	42	5	37	1

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B	Waitapuae	344	900	900	126	-	126	16	110	2
B	Waitara	32,411	52,350	45,425	6,360	50	6,310	827	5,483	110
B	Waitearata	63	280	280	39	-	39	5	34	1
B	Waiteika	1,112	4,030	460	64	80	-	-	-	-
B	Waitekaure	980	4,565	3,965	555	-	555	72	483	10
B	Waitotoroa	2,499	4,670	4,670	654	-	654	85	569	11
B	Waiweranui	1,908	1,783	1,783	250	67	183	32	150	3
B	Waiwhakaiho	14,527	13,980	11,990	1,679	605	1,074	218	855	17
B	Werekino	909	1,900	1,900	266	-	266	35	231	5
B	Whanganui	1,122	1,895	1,895	265	-	265	34	231	5
B	Whenuariki	756	510	510	71	-	71	9	62	1
	Totals:	250,962	476,653	277,231	38,812	3,561	35,267	5,037	30,230	605

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C	Kaikura	1,592	4,525	4,525	634	-	634	82	551	11
C	Manawapou	3,449	4,045	3,995	559	-	559	73	487	10
C	Mangaroa	1,666	3,810	3,610	505	-	505	66	440	9
C	Mimi	600	910	910	127	-	127	17	111	2
C	Motukara	1	-	-	-	-	-	-	-	-
C	Onaero	1,450	535	-	-	-	-	-	-	-
C	Papatiki	374	650	650	91	-	91	12	79	2
C	Patea	4,889	7,240	5,610	785	-	785	102	683	14
C	Tangahoe	16,562	22,675	21,445	3,002	-	3,002	390	2,612	52
C	Unnamed catchment 1	626	1,250	-	-	140	140	-	140	3
C	Unnamed catchment 10	533	-	-	-	-	-	-	-	-
C	Unnamed catchment 11	288	640	640	90	-	90	12	78	2
C	Unnamed catchment 12	658	-	-	-	-	-	-	-	-
C	Unnamed catchment 13	411	1,175	1,175	165	-	165	21	143	3
C	Unnamed catchment 14	103	275	275	39	-	39	5	33	1
C	Unnamed catchment 15	70	-	-	-	-	-	-	-	-
C	Unnamed catchment 16	64	305	305	43	-	43	6	37	1

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C	Unnamed catchment 17	55	-	-	-	-	-	-	-	-
C	Unnamed catchment 18	96	-	-	-	-	-	-	-	-
C	Unnamed catchment 19	120	700	-	-	-	-	-	-	-
C	Unnamed catchment 2	288	750	750	105	125	20	14	34	1
C	Unnamed catchment 20	141	200	200	28	-	28	4	24	0
C	Unnamed catchment 21	51	-	-	-	-	-	-	-	-
C	Unnamed catchment 22	399	810	-	-	-	-	-	-	-
C	Unnamed catchment 3	638	-	-	-	-	-	-	-	-
C	Unnamed catchment 4	239	1,200	1,200	168	-	168	22	146	3
C	Unnamed catchment 5	426	-	-	-	-	-	-	-	-
C	Unnamed catchment 67	18	-	-	-	-	-	-	-	-
C	Unnamed catchment 68	35	-	-	-	-	-	-	-	-
C	Unnamed catchment 69	24	-	-	-	-	-	-	-	-
C	Unnamed catchment 70	14	150	-	-	-	-	-	-	-
C	Unnamed catchment 71	25	-	-	-	-	-	-	-	-
C	Unnamed catchment 72	9	-	-	-	-	-	-	-	-
C	Unnamed catchment 73	55	-	-	-	-	-	-	-	-

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C	Unnamed catchment 74	21	-	-	-	-	-	-	-	-
C	Unnamed catchment 75	53	-	-	-	-	-	-	-	-
C	Unnamed catchment 76	165	400	400	56	-	56	7	49	1
C	Unnamed catchment 77	71	-	-	-	-	-	-	-	-
C	Unnamed catchment 78	40	-	-	-	-	-	-	-	-
C	Unnamed catchment 9	982	-	-	-	-	-	-	-	-
C	Urenui	785	330	-	-	-	-	-	-	-
C	Waihi 5 (Waihi)	81	-	-	-	-	-	-	-	-
C	Waiiti	322	665	665	93	-	93	12	81	2
C	Waikaikai	646	1,080	1,080	151	-	151	20	132	3
C	Waikaramarama	75	180	180	25	-	25	3	22	0
C	Waingongoro	0	250	250	35	-	35	5	30	1
C	Wairoa	3,331	2,840	1,640	230	-	230	30	200	4
C	Waitoetoe	199	820	820	115	-	115	15	100	2
C	Waitotara	7,534	8,130	8,130	1,138	284	854	148	706	14
C	Whenuakura	6,645	11,200	10,820	1,515	860	655	197	458	9
	Totals:	56,919	77,740	69,275	9,699	1,409	8,290	1,261	7,029	141

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D	Awaawaroa	39	545	59	218	4	-	1	4	0
D	Awahahae	28	295	32	118	2	-	0	2	0
D	Kaikura	43	-	-	-	-	-	-	-	-
D	Kuwhatahi	687	499	54	199	4	-	1	3	0
D	Manawapou	8,784	59,586	6,500	23,834	465	100	47	317	7
D	Mangapukeatea	39	274	30	109	2	-	0	2	0
D	Mimi	12,738	41,329	4,509	16,532	322	-	42	280	6
D	Mohakatino	11,923	18,052	1,969	7,221	141	-	18	123	3
D	Ohanga	31	355	39	142	3	-	0	2	0
D	Onaero	6,619	32,135	3,506	12,854	251	-	33	218	5
D	Papatiki	645	1,448	158	579	11	-	1	10	0
D	Patea	79,316	398,515	43,474	159,406	3,108	-	404	2,704	62
D	Pukerewa	22	241	26	97	2	-	0	2	0
D	Rapanui	1,321	3,064	334	1,226	24	-	3	21	0
D	Tangahoe	12,948	91,775	10,012	36,710	716	-	93	623	14
D	Tongaporutu	27,298	45,944	5,012	18,378	358	-	47	312	7
D	Tutupuha	32	273	30	109	2	-	0	2	0

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m ³ /d)	Consented stock use in catchment (m ³ /d)	Potential peak permitted take demand (m ³ /d)	Estimated permitted GW use (m ³ /d)	Estimated permitted SW use (m ³ /d)	Equivalent number of permitted SW takes @ 50 m ³ /d
D	Unnamed catchment 79	126	348	38	139	3	-	0	2	0
D	Unnamed catchment 80	35	60	7	24	0	-	0	0	0
D	Unnamed catchment 81	283	76	8	31	1	-	0	1	0
D	Unnamed catchment 82	56	971	106	388	8	-	1	7	0
D	Unnamed catchment 83	66	610	67	244	5	-	1	4	0
D	Unnamed catchment 84	54	585	64	234	5	-	1	4	0
D	Unnamed catchment 85	28	320	35	128	2	-	0	2	0
D	Urenui	12,501	35,485	3,871	14,194	277	-	36	241	6
D	Waiau	15	241	26	96	2	-	0	2	0
D	Waihi 1	143	1,640	179	656	13	-	2	11	0
D	Waiiti	314	3,586	391	1,434	28	-	4	24	1
D	Waikaramarama	574	1,793	196	717	14	-	2	12	0
D	Waikiekie	0	0	0	0	0	-	0	0	0
D	Waikorora	283	782	85	313	6	-	1	5	0
D	Waipingau	936	22	2	9	0	-	0	0	0
D	Waitara	74,471	355,437	38,775	142,175	2,772	-	360	2,412	55
D	Waitoetoe	225	2,381	260	952	19	86	-9	-59	1

FMU	Catchment	Area of catchment within FMU-A (ha)	Cow numbers - total catchment	Number of cows located in areas of catchment not serviced by urban/rural water supply	Potential peak dairy cow water demand (m³/d)	Consented stock use in catchment (m³/d)	Potential peak permitted take demand (m³/d)	Estimated permitted GW use (m³/d)	Estimated permitted SW use (m³/d)	Equivalent number of permitted SW takes @ 50 m³/d
D	Waitotara	111,873	209,338	22,837	83,735	1,633	-	212	1,421	33
D	Warekarianga	17	305	33	122	2	-	0	2	0
D	Wharau	0	0	0	0	0	-	0	0	0
D	Whenuakura	40,222	81,021	8,839	32,408	632	140	64	428	10
	Totals:	404,734	1,389,331	151,563	555,732	10,837	326	1,366	9,144	183