



Field programme to assess unconsented and permitted water use in the Bay of Plenty region 2014/2015

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Part 1: Introduction

The Proposed National Environmental Statement (NES) on Ecological Flow and Water Levels requires allocation limits to be set for water resources. Water use is currently only tracked and monitored when allocated under resource consent, however, water is also allocated without the requirement of resource consent under the Resource Management Act 1991 (RMA) and/or a permitted activity under the Bay of Plenty Regional Water & Land Plan (RW&LP). The total volume of water used under the RMA and RW&LP is unknown due to the fact there being no requirements for landowners to record or submit any water use information and therefore the effects of such takes on water bodies have not been determined.

A numerical model was constructed in 2012 by Science staff. This work is reported on in Environmental Publication 2014/02 (Objective ID: A1866891). A programme of work was undertaken 2014/2015 to apply this model to data collected from the field. This report documents that field programme and applied model.

A numerical model (Objective ID: A2050062, 2015 permitted takes model spreadsheet) has been constructed that calculates potential water use under the permitted provisions within a surface water catchment for domestic supply, stock watering and dairy shed wash-down. The model is based on the assumption that all properties have access to surface water, groundwater or both and because of a lack of robust permitted water use information, a worst case scenario – assuming all permitted provisions are implemented to their fullest extent – has been applied to the model.

The worst case scenario and full-range water source access assumptions however, are unrealistic; most properties do not have access to both water sources and many rely solely on rainfall. In addition, the majority of properties find what is permitted under the RMA provision sufficient for their needs and what is permitted under the RW&LP is superfluous.

It was for these reasons a field survey was conducted to provide ground-truthing to the model; providing more accurate estimates of water source, aggregate water taken and the provisions water is being taken under. The field survey was conducted over 50 surface water catchments, across six Water Management Areas (WMAs). This report describes the model used in more detail, the method of the survey, observations made during survey implementation and the collation of results and interpretation.

Part 2: The model

The model is separated into two parts. One part designed to estimate water required for 'reasonable' domestic and stock requirements as permitted under the RMA. The other adds the estimated permitted use as permitted under the RW&LP.

The three permitted provisions as stands:

- RMA Section 14(3)(b) – permits water use for reasonable domestic and stock watering needs provided the use does not or is not likely to have an adverse effect on the environment.
- RW&LP Rule 38 – permits the take and use of groundwater up to 35 m³/day per property.
- RW&LP Rule 41 – permits the take and use of surface water up to 15 m³/day per property.

Because the RMA provision is not quantifiable, average daily demand (ADD) and peak daily demand (PDD) figures have been estimated for both domestic and stock purposes. This has then been run against 2013 Census information in regards to population and dwellings within each surface water catchment as well as the most up to date livestock numbers obtained from AgriBase™. For areas not covered by AgriBase™ ADD and PDD figures are based on average stocking rate figures per hectare determined by type of grassland. The tables¹ below show the figures for domestic water use and stock water use applied in the model.

Domestic water use	ADD	PDD	Units litres/person/day
Per person (all ages)	180	300	l/p/d
Stock	ADD	PDD	Units litres/head/day
Dairy cattle: Milking cow.	45	70	l/h/d
Beef cattle: Mature beef cattle, herd replacement stock and bulls.	30	55	l/h/d
Sheep: Ewes, hoggets and rams.	3	4.5	l/h/d
Deer: Hinds and stags (all ages).	6	12	l/h/d
All other large stock	30	55	l/h/d
All other small stock	3	4.5	l/h/d

In addition to the water uses permitted under the RMA, the intent of the RW&LP provisions is to provide for purposes such as dairy-shed wash-down, horticultural spray makeup and irrigations of garden/small glasshouse operations, stock drinking water and domestic uses. No water use is excluded from the RW&LP.

¹ Barber, J. (2014). A model for assessing permitted water use in the Bay of Plenty region. BOPRC Environmental Publication 2014/02.

A dairy shed use figure of 70 litres/cow/day has been applied in the model. This is for the purpose of wash-down and cooling water. Dairy shed use is not covered by the RMA and instead falls under RW&LP provisions.

The model estimates water use situations where:

- Only water permitted under the RMA provision is used.
- RMA provision is used with the addition of dairy shed wash-down estimations – based on an estimated water volume use per cow.
- RMA provision is used with the addition of both RW&LP provisions. This is a worst case scenario – assuming each property takes the maximum (50 m³/day) permitted water volume per day from both ground and surface water sources.
- RMA provision is used with the addition of Rule 38 of the RW&LP – permitting the take and use of groundwater up to 35 m³/day per property.
- RMA provision is used with the addition of Rule 41 of the RW&LP – permitting the take and use of surface water up to 15 m³/day per property.

Part 3: Method

In the summer of 2012/2013 a field survey was undertaken in the Lower Kaituna surface water catchment area. The purpose of this survey was to gain information from properties with regard to the water resource used in relation to the permitted provisions. The Lower Kaituna Catchment was chosen for this particular survey as a result of a groundwater evaluation undertaken by GNS Science (REF) which indicated an allocation concern. The results of this survey were collated and a report on its findings was produced².

One conclusion taken from this report was that the 'results [of the survey] support the assumption of the RMA and the RW&LP that permitted use is marginal and of no more than minor effect on the environment in the overall scheme of water allocation'. However, the report stressed that this is the result of the survey in one catchment only and recommended that further surveys be undertaken.

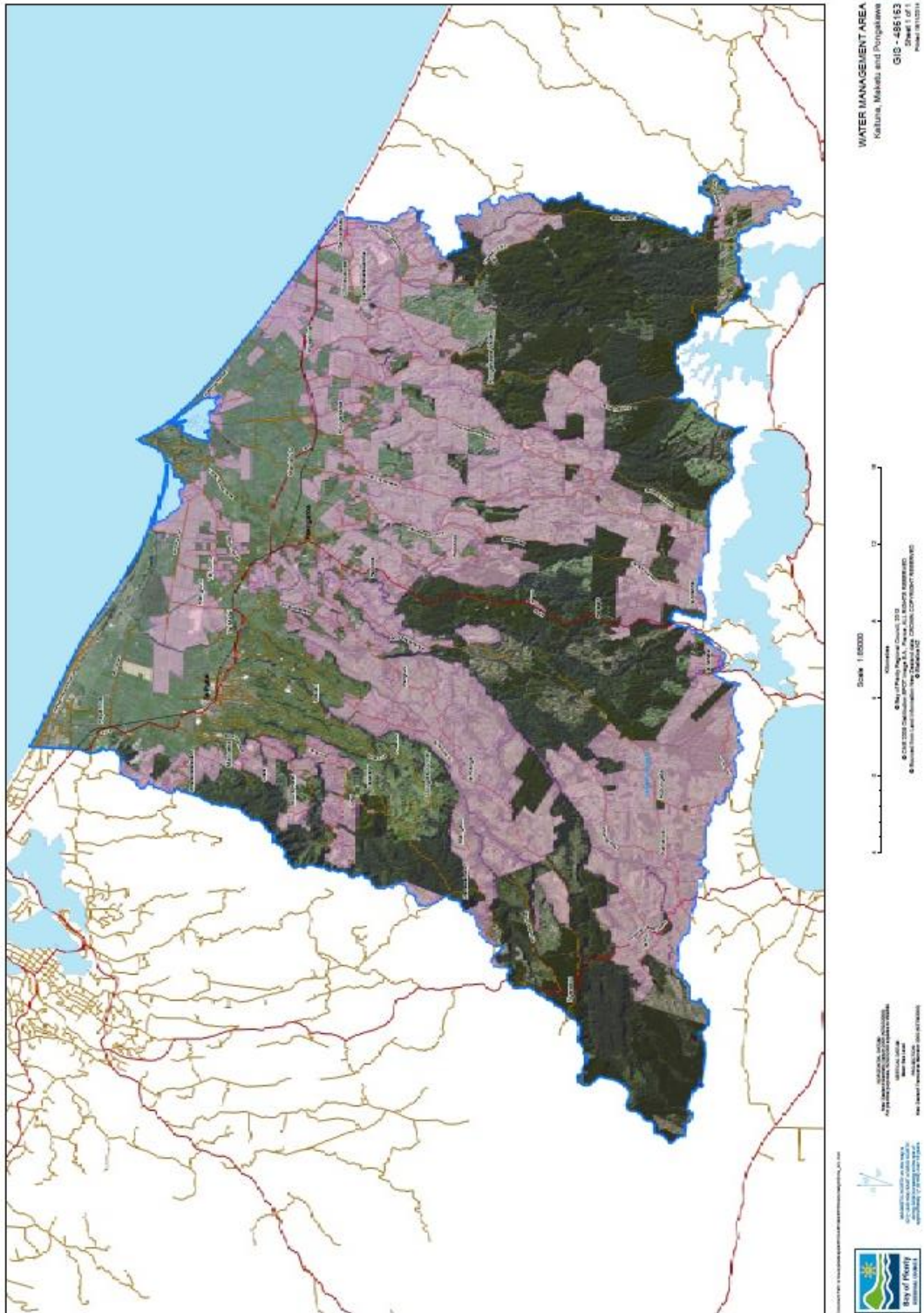
For this reason, over the summer 2014/2015 a field survey was undertaken across six WMAs and included 50 surface water catchments.

The maps below show the six WMAs that were involved in the survey. Properties that had resource consents for their water-takes were not included in the survey as it was assumed that where there is a consented water-take the permitted allocation is included within. The remaining properties are those highlighted in purple and cover many land uses.

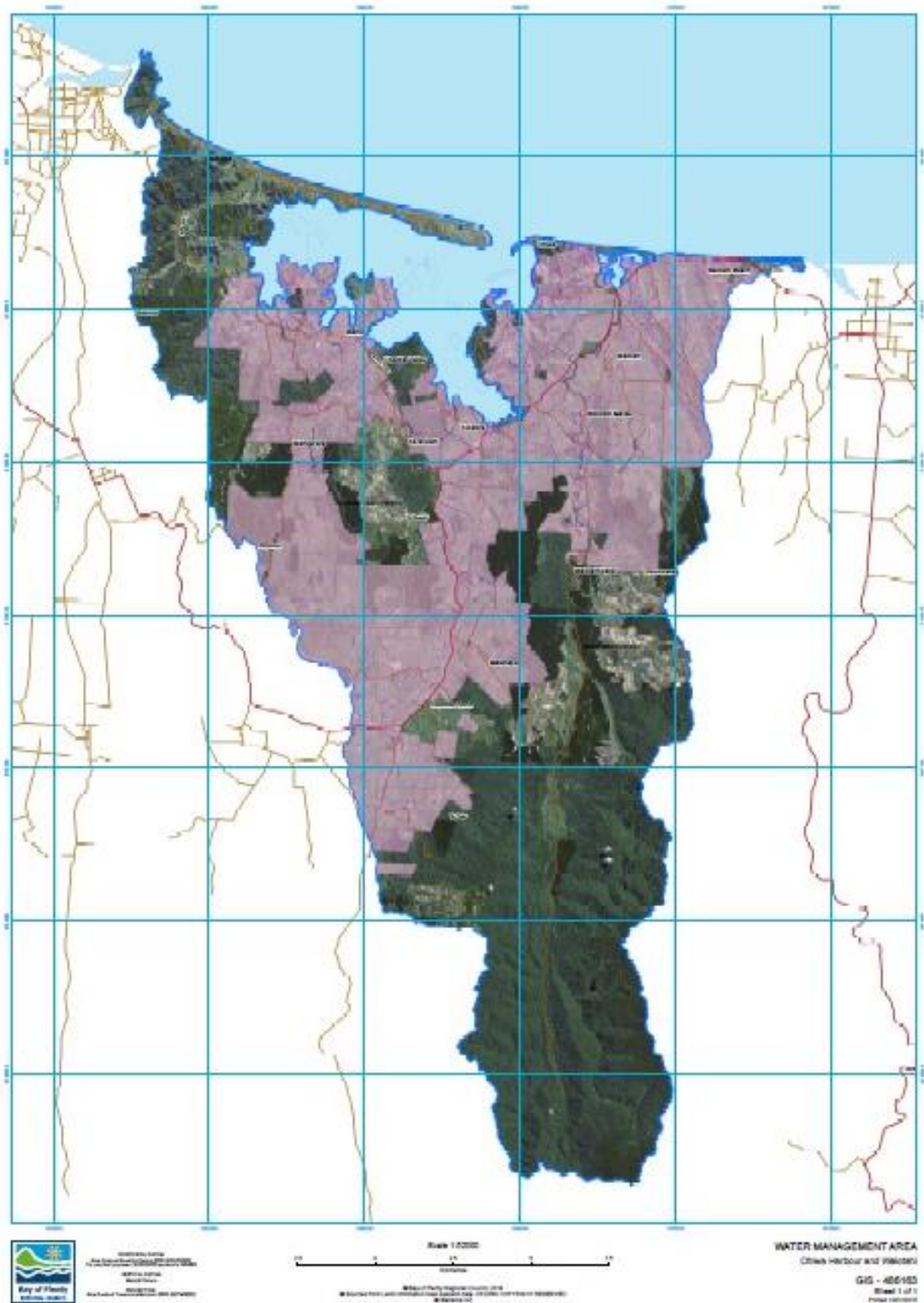
² Barber, J. (2015). Lower Kaituna permitted takes survey (Internal report Objective ID: A1849306).
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Map 1

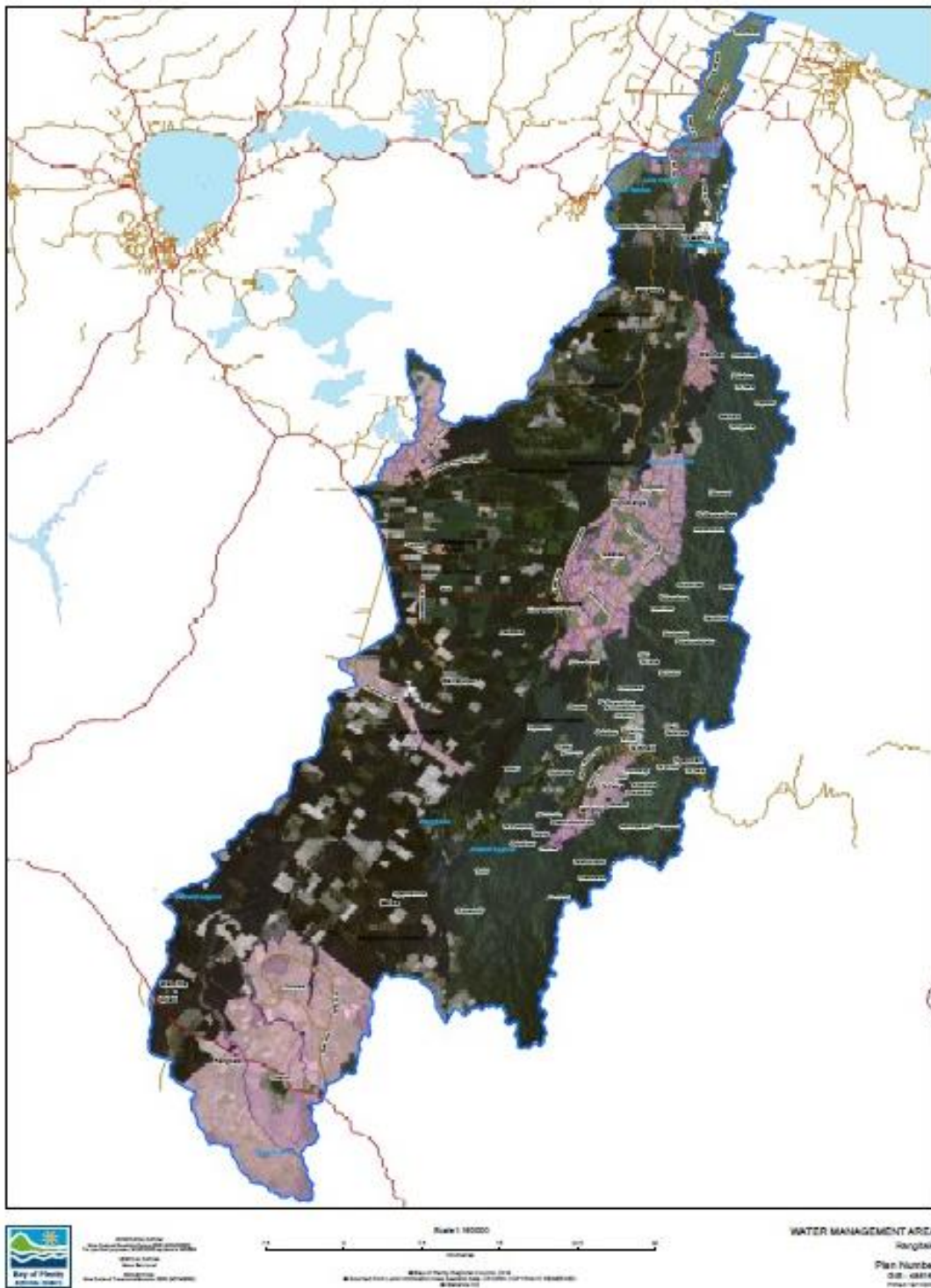
Permitted takes survey area for Kaituna, Maketū and Pongakawa Water Management Area.



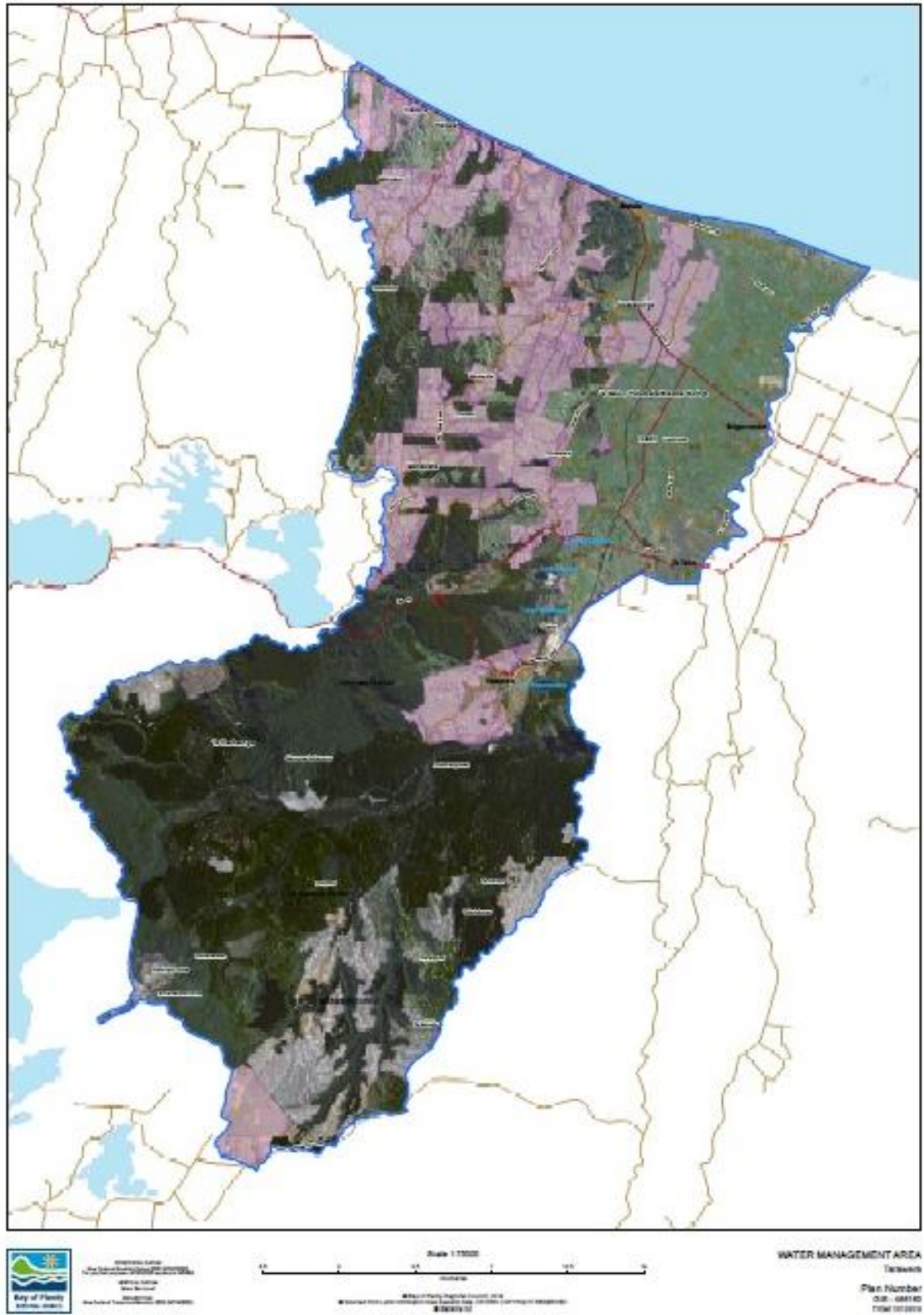
Map 2 Permitted takes survey area for Ōhiwa Harbour and Waiotahi Water Management Area.



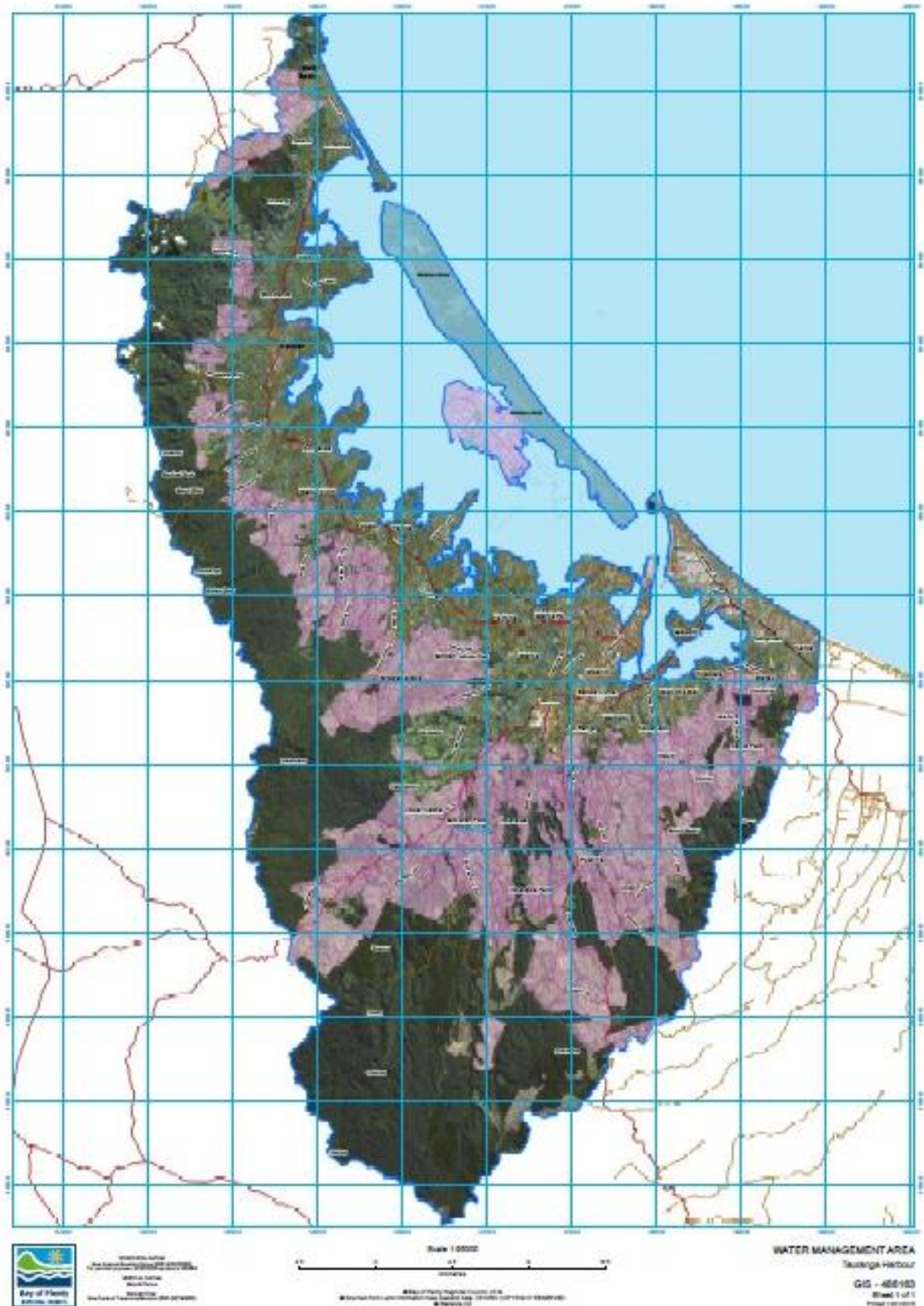
Map 3 Permitted takes survey area for Rangitāiki Water Management Area.



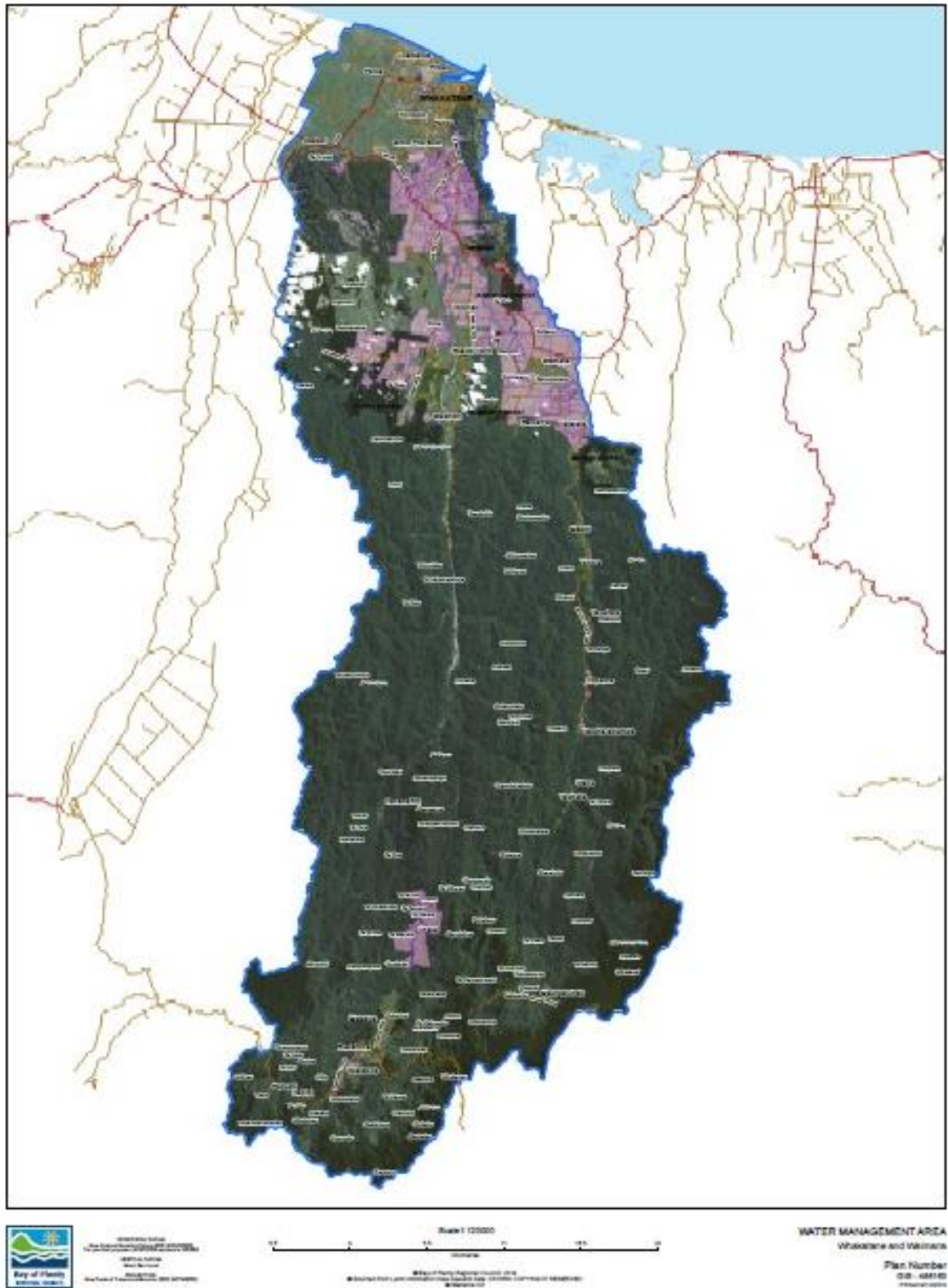
Map 4 Permitted takes survey area for Tarawera Water Management Area.



Map 5 Permitted takes survey area for Tauranga Harbour Water Management Area.



Map 6 Permitted takes survey area for Whakatāne and Waimana Water Management Area.



The source of a property's water use and what the water is used for could be determined by speaking with the property's owner/occupier when visiting the site. If the owner/occupier was not home at the time of visit, a survey form was left in the property's letterbox along with a Bay of Plenty Regional Council prepaid self-addressed envelope and an information sheet detailing the purpose of the survey.

Below is the form used in the survey:

Water Use survey Form – 2014/15



Property address: _____
 Map reference: _____
 Date visited: _____
 Surveyor: _____

Property water supply: tick as many as apply.

- Groundwater (bore/well)
- Surface water (stream)
- Other _____ (specify e.g. rain tank)

Water use: tick as many as apply.

- Domestic house supply
- Stock drinking water
- Dairy Farm
- Kiwifruit
- Avocado
- Other _____ (say what this is)

Other: tick as many as apply.

- Consented activity _____ (specify e.g. water take)
- metered water take?

Comments:

The data collected from this survey was then organised into a spreadsheet, separated by WMAs. These can be found in the six 'survey data' tabs of the 2014 summer survey ground-truthing results spreadsheet (Objective ID A2058862). This information can also be found aggregated per surface water catchment in the 'Catchment totals' tab.

The survey information was separated across categories:

- Groundwater supply and specified water use(s).
- Surface water supply and specified water use(s).
- Total water sources – separated into rain water, groundwater and surface water columns.
- Provision exercised – separated into groundwater RMA, groundwater RW&LP, surface water RMA and surface water RW&LP columns.

The results of the last two categories enable the data to be proportionally applied to ground-truth the model for better estimates of water use.

Part 4: Physical observations

Assumption of model:

If a property has a postal address, the land was occupied/contained a dwelling. Survey revealed this is not always the case. There was the possibility an addressed property contained no dwelling and instead was used for agricultural or horticultural purpose only, and the possibility for a dwelling to exist but not be occupied. For the model purposes this could over-estimate the number of dwellings in an area and/or the population.

Address and ownership information did not match the physical addresses shown on property letterboxes. And property letterboxes existed which did not feature on the property owners lists (properties unlikely to have been removed for resource consent purposes). This resulted in many properties that could have provided useful information being excluded from the survey. This occurred most often in Rangitāiki and Whakatāne/Waimana WMAs.

In the model, the assumption has been made that each address point represents a household with a standard population size. However, from physical observations, it would not be uncommon in some areas for an address point to contain many occupied dwellings. For the model purposes, this could under-estimate the number of dwellings in an area and/or the population. This was most common in Whakatāne/Waimana and Ōhiwa/Waiotahi WMAs.

Properties were using rain tanks as storage to supply water, and that one bore on a property could provide water to several neighbouring dwellings/properties.

Also present were private water schemes which pumped surface water or groundwater from a single location and distributed to neighbouring properties. And likewise in the case of the Minginui community bore which supplied those households within the Minginui township.

Clarification or a separate entry box required over the water category (ground/surface) water sourced from a spring falls into, particularly for the purpose of the posted survey forms.

Part 5: Steps to apply survey data and discussion

The applied survey data results can be found in the results tab of the 2014 summer survey ground-truthing results spreadsheet (Objective ID: A2058862).

The first step here was to find the proportion of addresses surveyed against the total amount of households given by the mesh-block 2013 Census data in the numerical model. The difference between these figures is for several reasons:

- 1 The most common reason being a household occupier was not home at the time and did not return the posted survey form.
- 2 The occupier refused to answer the survey questions for various held beliefs or grievances.
- 3 The assumption used is each address point considered in the survey represents a standard household with an average population (calculated by the model). The address point in the GIS data may not contain a dwelling at all or the dwelling may have been unoccupied.
- 4 The GIS address point data, by error, excluded addresses that should have otherwise been included.
- 5 The survey was designed to exclude addresses which held consents – however, it was later determined that the survey results would also apply to consented properties.

The proportions of addresses surveyed varied from catchment to catchment and there exist some substantial outliers e.g. the lowest surveyed proportion of households occurred in the Pukehina Coastal Catchment where the figure is just 2% of the total. The highest surveyed proportion was 100% of addresses, this occurred in three catchments. The average surveyed proportion of all 50 catchments is 53%. All surface water catchment data regardless of the proportion surveyed was considered to be representative of the whole catchment and hence contributed to the overall findings. The proportion surveyed data per catchment is locatable in the results tab of the spreadsheet.

The next step applied the groundwater and surface water proportions to the model data. The figure used here was based on total water uses; the water source(s) used on a single property were applied to all selected water practices e.g. if an address used groundwater for whichever ticked boxes in the survey form this figure was applied to both domestic and stock use. Below are the basic proportion statistics:

Groundwater

- Minimum: 6%.
- Maximum: 100% in seven catchments.
- Average: 73%.

Surface water

- Minimum: 0% in 14 catchments.
- Maximum: 75%.
- Average: 11%.

Groundwater and surface water

- Minimum: 0% in 26 catchments.
- Maximum: 25%.
- Average: 3%.

Addresses using both groundwater and surface water were initially excluded to a separate category to avoid the double counting of estimated water taken by these addresses and also to show how many addresses realistically have access to both water sources.

The next step was to apply these proportions to the 2013 Census population data to determine the ADD and PDD figures for domestic water consumption by water source.

Following this, the proportions were applied to the ADD and PDD figures calculated in the model for stock water use and stock water use + dairy shed wash-down use.

The same method was then used to determine water volume taken under the RW&LP provisions. The RW&LP provisions are based on per property, as opposed to per household that the RMA provision is based on. Property numbers per catchment were determined by GIS mapping. As the survey was based on address point data, there was no precise information on how many properties using RW&LP provisions were visited. To estimate surveyed property numbers the proportion of property numbers to household numbers per catchment was found, this figure was then multiplied by the number of addresses surveyed to provide an *estimate of number of properties surveyed*. The overall proportion statistics for RW&LP use is below.

RW&LP Rule 38 – Groundwater: 35 m³/day/property

- Minimum: 0% in eight catchments.
- Maximum: 100% in one catchment.
- Average: 20%.

RW&LP Rule 41 – Surface water: 15 m³/day/property

- Minimum: 0% in 25 catchments.
- Maximum: 50%.
- Average: 5%.

RW&LP Rule 38 and Rule 41 – Groundwater and surface water: 50 m³/day/property

- Minimum: 0% in 39 catchments.
- Maximum: 25%.
- Average: 1%.

In total the RW&LP provisions are enacted in 23% of properties surveyed.

Part 6: Results and discussion

The summary table shown in Appendix 1 is designed to provide a better estimate of aggregate water use over the 50 surface water catchments included in the survey. Those findings are compared against those estimated in the model and the difference in calculated.

Two important considerations; the first being the difference between the model estimates and survey estimates for water use permitted under the RMA is the use of rain water. Since there is no allocation concern in regards to rain fall, the model overestimates total water usage for domestic and stock purposes. The second consideration is the vastly overestimated use of the RW&LP provisions.

The chart shown in Appendix 4 provides the water use proportions by WMA and allows for comparisons to be made between them. Across all surveyed WMAs, groundwater use far exceeded the use of surface water with the range being between 63% and 85%. Consequently, surface water use is low in all WMAs, the range being between 4% and 21%, with Whakatāne and Ōhiwa Harbour the lowest users at 4% and the higher users; Rangitāiki and Kaituna using 21% and 16% respectively. The use of rain water is very significant in most WMAs, with Tauranga Harbour and Whakatāne/Waimana WMAs being the largest consumers at 28% and 25% respectively. Rangitāiki and Tarawera are the lowest users of rain water at 3% and 9% respectively. The data and calculations for these tables can be found in the water use ratios tab of the spreadsheet.

It is worth noting that the use of rain water could be even more significant in terms of volume used than depicted here as many rain water users are also attached to ground or surface water sources claimed to be used only at times of consistently low rain fall. Because part of this projects purpose is to provide a better picture of ground and surface water allocation, on any address claiming to be using surface or groundwater even at a level considered above is assumed to be taking the whole ADD and PDD amounts. The rain water proportion is effectively the proportion remaining after ground and surface water proportions have been accounted for.

Appendixes 5–10 provide the total estimated water usage per WMA with regard to the more likely water use scenarios and the water source used. These tables compare the estimated findings with those estimated by the model and calculate the proportion of the model estimates used. The data and calculations for these tables can be found in the WMA estimates tab of the spreadsheet.

The most accurate information to use for assessment against water allocation in a particular area is to look at the data collected for the relevant individual surface water catchment. However, by averaging data by WMA, a more employable set of results appear. This is reasonable to do as the majority, if not all surface water catchments within a WMA, were surveyed. One exception to this is the Tauranga Harbour WMA where surface water catchments north of the Wairoa surface water catchment (or State Highway 2 north between Tauranga city and Waihī) were not surveyed due to the time constraints of the water programme. It is possible the results used for Tauranga Harbour are not fully representative of the whole WMA.

Applying the survey results for RW&LP use and total RMA and RW&LP use per catchment to the model, the estimations are:

Kaituna, Maketū and Pongakawa WMA

- Of the address total, 86% of water estimated under the RMA is used.
- Of the property total, 23% of water estimated under the RW&LP is used.
- Overall, 24% of total water estimated under RMA and RW&LP is used.

Ōhiwa Harbour and Waiotahi WMA

- Of the address total, 84% of water estimated under the RMA is used.
- Of the property total, 9% of water estimated under the RW&LP is used.
- Overall, 11% of total water estimated under RMA and RW&LP is used.

Rangitāiki WMA

- Of the address total, 97% of water estimated under the RMA is used.
- Of the property total, 29% of water estimated under the RW&LP is used.
- Overall, 33% of total water estimated under RMA and RW&LP is used.

Tarawera WMA

- Of the address total, 91% of water estimated under the RMA is used.
- Of the property total, 7% of water estimated under the RW&LP is used.
- Overall 10% of total, water estimated under RMA and RW&LP is used.

Tauranga Harbour WMA

- Of the address total, 72% of water estimated under the RMA is used.
- Of the property total, 5% of water estimated under the RW&LP is used.
- Overall, 6% of total water estimated under RMA and RW&LP is used.

Whakatāne and Waimana WMA

- Of the address total, 75% of water estimated under the RMA is used.
- Of the property total, 13% of water estimated under the RW&LP is used.
- Overall, 15% of total water estimated under RMA and RW&LP is used.

There are some important outcomes of these results to consider.

The results show that estimated water use is far less than what was estimated under the model. There are two main reasons for that:

- 1 The number of properties estimated to be using water under RW&LP provisions is low.
- 2 The amount of water permitted under RW&LP provisions drastically exceeds the amount estimated for 'reasonable use' under RMA provisions. RW&LP provisions account for a much larger portion of total water estimated hence it has a greater influence on the comparable results.

In appendixes 5–10, the proportion of water use estimated under RMA is calculated against that estimated under the RW&LP. The results show across the six WMAs RMA average daily demand water use accounts for between 10% and 43% of estimated RW&LP water use, with an average of 23% across WMAs.

This shows that changes in RW&LP provision use will have the most impact on changes to total water use within a catchment. Changes in RMA water use (population changes and stocking number changes) will have a relatively small effect on total water use.

Part 7: Conclusion

The numeric model constructed provides a good starting point for assessing potential water allocation in the region under the permitted provisions. To assess the reliability and practical application of the model results a field survey was undertaken. The survey covered 50 surface water catchments across six WMAs where water allocation is of most concern. The survey provided informative data as to the proportional sources of water use in the region which can be used specifically in the case of an over-allocated surface water catchment or as a greater catchment or WMA average. It also highlighted the extent to which the RW&LP provisions are used. The usefulness of these provisions based on these results can be interpreted.

The field survey found that across all WMAs, groundwater use was far greater than that of surface water, and in many catchments the use of surface water is negligible. These figures can assist in determining allocation impacts in areas of concern.

RW&LP provision use is low across properties but still accounts for the majority of estimated water use in all WMAs. Water use estimated under RMA for 'reasonable use' is comparatively small and hence appears to play a minor role in water allocation.

Because there is no information on how much is being used under RW&LP provisions the assumption is they are taking the maximum permitted allowance per day. This may or may not be true but could result in RW&LP estimations grossly overestimating permitted use. There is no way of knowing without metering or requiring consents for these properties.

It is reasonable to assume a property's water source will remain as it is, or at least the connection to such water source will remain a considerable time. In the future perhaps easier and/or more cost effective to monitor land use change to estimate changes in RW&LP use or metering properties whose water requirements extend beyond what is permitted under the RMA. More likely to change than the survey estimates might be the populations and stocking information the model relies on. These can be updated through Census information and AgriBase™. Changes in landowner information can be updated through GIS.

Appendices

Appendix 1

Summary table comparing RMA and RW&LP potential permitted water use survey estimates with model estimates.

	Survey estimates		Model estimates		Difference		Use of model estimates
	m ³ /day		m ³ /day		m ³ /day		%
	ADD	PDD	ADD	PDD	ADD	PDD	
Total RMA domestic use	4,191	6,984	4,879	8,131	688	1,147	
Total RMA stock use	14,270	22,743	16,160	25,775	1,890	3,032	
Total RMA stock + dairy shed use	31,464	39,936	35,517	45,132	4,053	5,196	
Total RMA use	18,461	29,727	21,039	33,906	2,578	4,179	86%
Total RMA + dairy shed use	35,654	46,921	40,396	53,263	4,742	6,342	86%
RW&LP groundwater use	117,475		488,390		378,388		24%
RW&LP surface water use	11,889		209,310		200,624		6%
RW&LP total use	129,369		697,700		568,331		19%
Total RMA + total RW&LP	147,830	159,096	718,739	731,606	570,909	572,510	21%

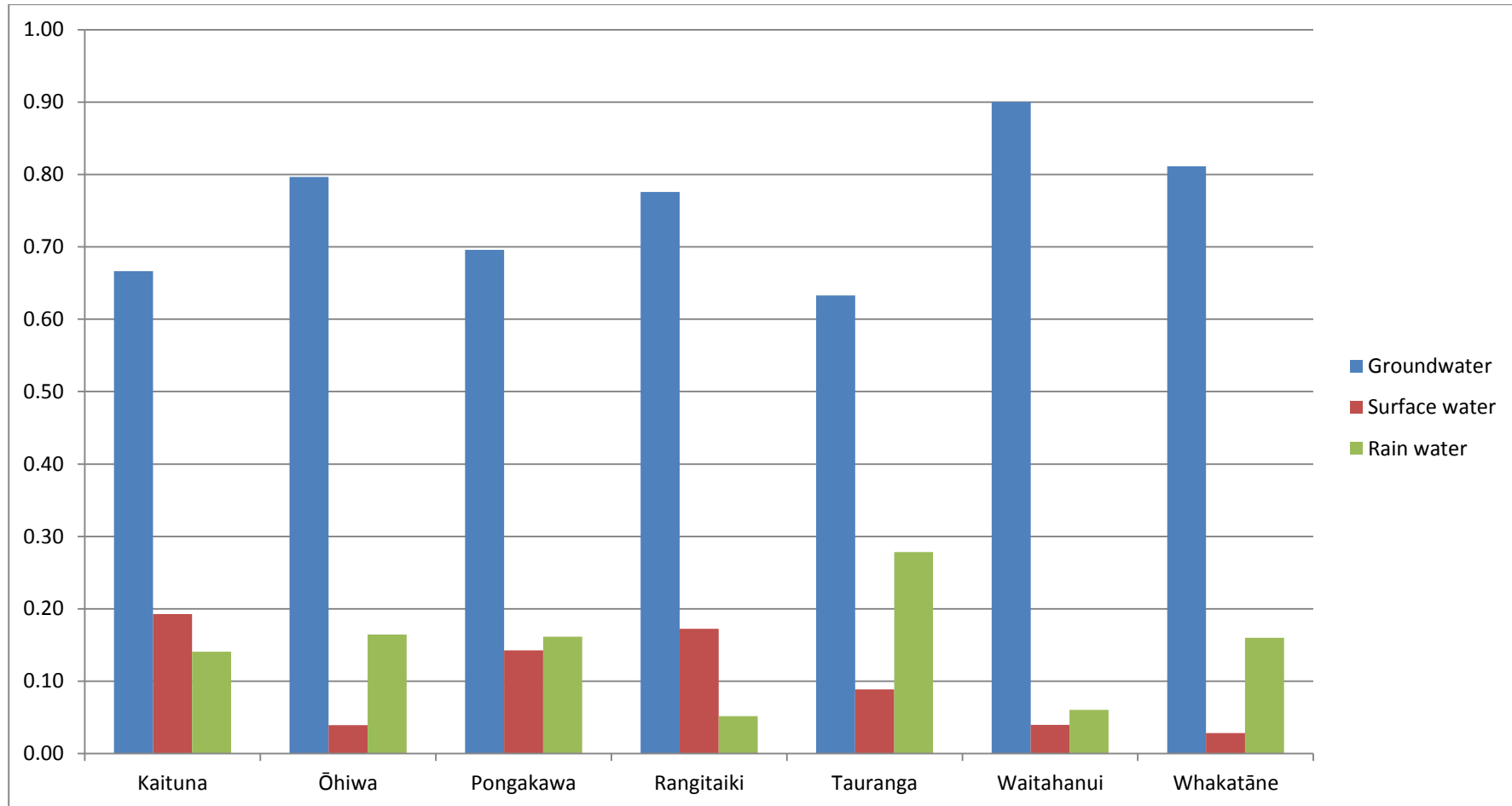
Appendix 2

Water source use: RMA and RW&LP potential permitted water use survey estimates.

	Groundwater		Surface water	
	m ³ /day		m ³ /day	
	ADD	PDD	ADD	PDD
RMA domestic use	3,590	5,983	601	1,002
RMA stock use	12,218	19,478	2,053	3,267
RMA stock + dairy shed	26,929	34,188	4,536	5,750
Total RMA use	15,808	25,460	2,654	4,269
Total RMA + dairy shed use	30,519	40,170	5,137	6,751
RW&LP use	117,475		11,889	
Total RMA + RW&LP	133,283	142,935	14,543	16,158

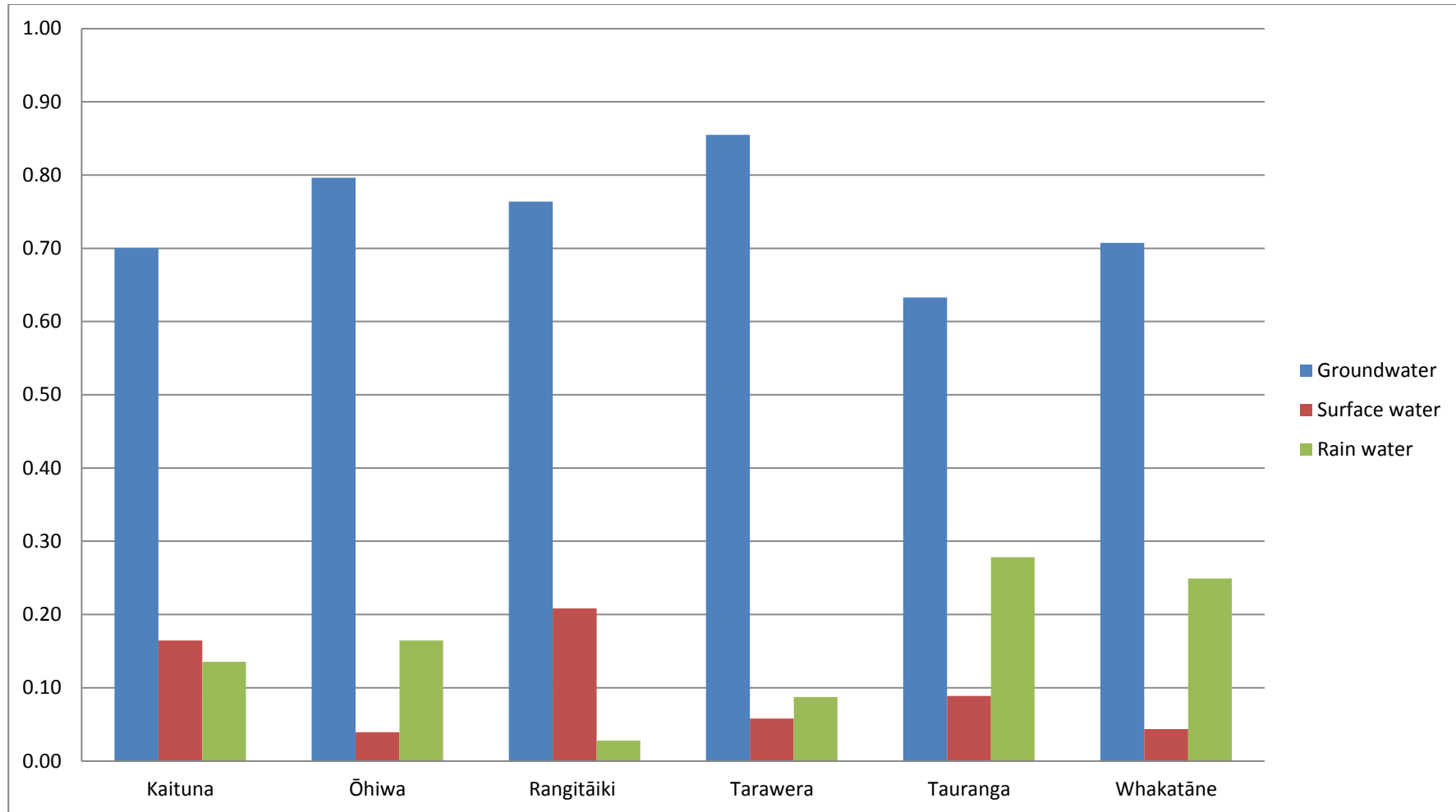
Appendix 3

Water source ratios applied to greater catchment.



Appendix 4

Water source ratios applied to Water Management Area.



Appendix 5

Kaituna, Maketū, Pongakawa Water Management Area.

	Groundwater		Surface water		Total water		Model estimate		Use of model estimations
	ADD	PDD	ADD	PDD	ADD	PDD	ADD	PDD	%
Total RMA water use	4,641	7,487	1,091	1,759	5,732	9,246	6,629	10,693	86%
Total RMA water use + dairy shed	9,116	11,962	2,142	2,811	11,258	14,773	13,021	17,085	86%
RW&LP use	48,958		7,547		56,505		249,950		23%
Total RMA + RW&LP	53,599	56,445	8,638	9,306	62,237	65,751	256,579	260,643	24%
RMA:RW&LP use proportion	9%	15%	14%	23%	10%	16%	3%	4%	

Appendix 6

Ōhiwa and Waiotahi Water Management Area.

	Groundwater		Surface water		Total water		Model estimate		Use of model estimations
	ADD	PDD	ADD	PDD	ADD	PDD	ADD	PDD	%
Total RMA water use	1,265	2,057	62	101	1,327	2,158	1,589	2,583	84%
Total RMA water use + dairy shed	2,467	3,259	121	160	2,588	3,419	3,097	4,091	84%
RW&LP use	5,695		145		5,839		65,100		9%
Total RMA + RW&LP	6,960	7,752	207	246	7,167	7,998	66,689	67,683	11%
RMA:RW&LP use proportion	18%	36%	43%	69%	23%	37%	2%	4%	

Appendix 7

Rangitāiki Water Management Area.

	Groundwater		Surface water		Total water		Model estimate		Use of model estimations
	ADD	PDD	ADD	PDD	ADD	PDD	ADD	PDD	%
Total RMA water use	3,407	5,492	930	1,499	4,337	6,990	4,462	7,191	97%
Total RMA water use + dairy shed	6,930	9,015	1,891	2,460	8,822	11,475	9075	11,804	97%
RW&LP use	19,547		3,015		22,562		77,450		29%
Total RMA + RW&LP	22,954	25,039	3,945	4,514	26,899	29,552	81,912	84,641	33%
RMA:RW&LP use proportion	17%	28%	31%	50%	19%	31%	5%	9%	

Appendix 8

Tarawera Water Management Area.

	Groundwater		Surface water		Total water		Model estimate		Use of model estimations
	ADD	PDD	ADD	PDD	ADD	PDD	ADD	PDD	%
Total RMA water use	3,422	5,460	232	370	3,654	5,831	4,003	6,388	91%
Total RMA water use + dairy shed	6,369	8,400	432	570	6,801	8,970	7,451	9,836	91%
RW&LP use	8,022		491		8,513		114,250		7%
Total RMA + RW&LP	11,443	13,482	723	862	12,167	14,344	118,253	120,638	10%
RMA:RW&LP use proportion	42%	68%	47%	75%	43%	68%	4%	6%	

Appendix 9

Tauranga Harbour Area.

	Groundwater		Surface water		Total water		Model estimate		Use of model estimations
	ADD	PDD	ADD	PDD	ADD	PDD	ADD	PDD	%
Total RMA water use	4,107	6,775	576	951	4,683	7,725	6,490	10,706	72%
Total RMA water use + dairy shed	5,943	8,611	834	1,208	6,777	9,819	9,391	13,607	72%
RW&LP use	20,214		1,147		21,361		457,400		5%
Total RMA + RW&LP	24,321	26,988	1,724	2,098	26,044	53,032	463,890	468,106	6%
RMA:RW&LP use proportion	20%	36%	20%	83%	22%	36%	1%	3%	

Appendix 10

Whakatāne and Waimana Management Area.

	Groundwater		Surface water		Total water		Model estimate		Use of model estimations
	ADD	PDD	ADD	PDD	ADD	PDD	ADD	PDD	%
Total RMA water use	2,230	3,610	138	223	2,368	3,833	3,153	5,104	75%
Total RMA water use + dairy shed	4,347	5,727	269	354	4,616	6,081	6,147	8,098	75%
RW&LP use	12,081		528		12,610		95,750		13%
Total RMA + RW&LP	14,311	15,691	666	751	14,977	16,443	98,903	100,854	15%
RMA:RW&LP use proportion	18%	30%	26%	42%	19%	30%	3%	5%	