Assessment of surface water availability and estimates of current allocation levels October 2016

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Version 1.2 December 2018

Contents

Disclaimer

Information presented in this report is for the purpose of general guidance only. A number of limitations are explained in the report. Consent applicants and others with an interest in taking water should make enquiries to the Bay of Plenty Regional Council Duty Consents officer before relying on any information contained in this report.

Changes made to this report in June 2017 and December 2018 are shown in ~~strike through~~ and underline format.

Limitations on use of data

Water allocation data shown in the following tables was the best known available information at the time of publication (18 October 2016). As new water is allocated or existing consents expire and are not renewed, that data will become out of date. Over time there may also be revised estimates of flow as more science becomes available. Please contact BOPRC for up to date information.

2018 Revision

In December 2018 the groundwater section of this report was superseded by a web-based system. As a result, the groundwater section of this report is redundant and has been struck out.

Part 3 – Assessment of water available for allocation has also been deleted as the method for estimating surface water and groundwater allocation status is now proposed for inclusion in the Regional Natural Resources Plan via Schedule 15 of Proposed Plan Change 9.

The surface water section of this report will also be superseded by a similar web-based system in the near future. In the interim, the actual allocation data for surface water has not been updated and as previously recommended, potential water users should enquire to Bay of Plenty Regional Council for up to date information.

Executive Summary

Allocation limits and minimum flows or water levels determine how much water is available for allocation and the reliability of that allocation. They are important tools for ensuring that the values of water bodies are not unacceptably compromised by abstraction.

The limits identified in Proposed Plan Change 9 to the Bay of Plenty Regional ~~and Water~~ Natural Resources Plan are interim limits based on relationships between flow and ecological values (surface water) ~~and sustaining the characteristics of aquifers~~. Over time, in conjunction with local iwi and communities, these limits will be replaced in each of the region's nine Water Management Areas as we undertake sub regional plan changes through to 2025.

This report provides information regarding surface water availability, including:

- ~~how estimates of water availability are made~~
- how much water is available for allocation in a particular water resource
- how much of that water is already allocated, or remains available for allocation.

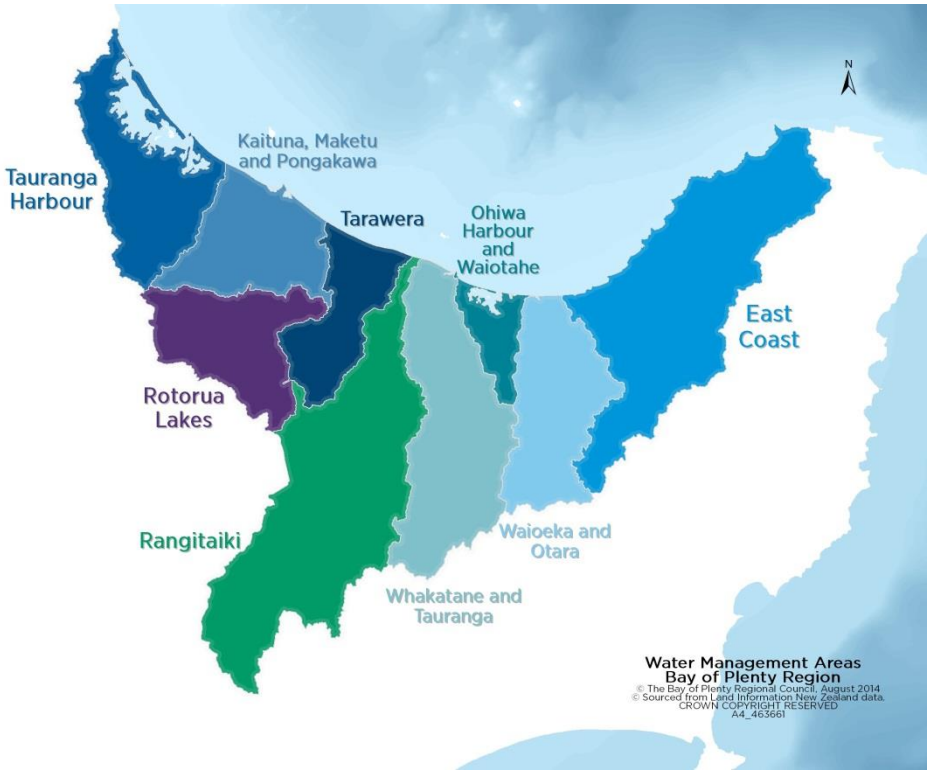


Figure 1 Map of the region, highlighting the nine Water Management Areas.

Part 1: Purpose

1.1 The purpose

The purpose of this report is to assist water users in the Bay of Plenty to access information about water availability. ~~and to understand the principles of how availability is assessed.~~ It is not part of the Regional ~~Water and Land~~ Natural Resources Plan.

~~The report provides a brief explanation of the method used to calculate aquifer recharge for groundwater and flow rates for surface water. Applications for new allocation that would cause limits to be breached will generally be declined (WQ P10), unless specific constraints are placed on the abstraction or the take is consistent with the objectives of the plan.~~

This report lists the allocation status of many of the region's ~~water resources~~ streams and rivers and can assist potential water users to understand water availability.

Allocation status will change as new applications are lodged or granted and water users should contact the Bay of Plenty Regional Council (BOPRC) for up to date information.

There are two key gaps in existing information:

1 For some water bodies with few resource consents to take and use water, no data is currently available. In these cases, applicants will have to undertake their own data gathering to support an application.

2 Currently there is insufficient information to include estimates of water takes not requiring resource consents.

Part 2: Water Allocation Policy

2.1 Water allocation

Water allocation means water that is allocated via a resource consent or in accordance with section 14(3) of the Resource Management Act 1991 (for example for permitted activities in a regional plan, or reasonable needs for an individual's domestic needs, or a person's animals for stock drinking water, or geothermal water taken for tikanga Māori purposes or firefighting).

Limit is defined under the National Policy Statement Freshwater Management 2014 as the maximum amount of resource use available, which allows a freshwater objective to be met. Instream minimum flow for surface water is defined in the Regional Policy Statement as being the flow of water in a river or stream necessary to sustain aquatic life, water quality, recreational use, outstanding natural features or Māori cultural values. It is the flow rate at which non-essential abstractions should stop.

Under the Resource Management Act 1991 the Bay of Plenty Regional Council (BOPRC) is responsible for allocating water in the region. The National Policy Statement Freshwater Management 2014 requires that regional councils define allocation limits and minimum flows or water levels.

The Motu River and specified tributaries are locations in the region where it is a prohibited activity to apply for a resource consent to take water. A consent must not be granted to take and use water in these locations. The prohibited activity is EC R1 (Rule 49) of the Bay of Plenty Regional Council Regional ~~Water and Land~~ Natural Resources Plan (Operative December 2008). It includes the following rivers and streams:

(a) Motu River, from the Motu Falls (NZMS 260 X16 123 179) to the State Highway 35 Bridge inclusive.

(b) Waitangirua Stream.

(c) Mangaotane Stream.

(d) Te Kahika Stream.

(e) Mangatutara Stream.

(f) Takaputahi River below the confluence with the Whitikau Stream.

Unless the activity is:

(g) The maintenance of State Highway 35, including any bridge over the Mōtū River that forms part of the State Highway.

(h) Soil conservation works and related matters undertaken in accordance with the Soil Conservation and Rivers Control Act 1941.

BOPRC is taking a two-step approach to setting limits to allocation and minimum flows for water in the region. The first step is applying region-wide interim limits to 'hold the line'. These region-wide default limits are based on simple hydrological statistics and set boundaries. The second step involves determining limits based on the freshwater objectives for each Freshwater Management Unit.

Table 1 shows allocation limits and minimum flows under the Regional ~~Water and Land~~ Natural Resources Plan Change 9.

Table 1 *Water allocation in the Bay of Plenty.*

	Allocation limit	Minimum flow/level
Surface water	10% Q_5 7day	90% Q_5 7day
~~**Groundwater**~~	~~35% of average aquifer recharge~~	-

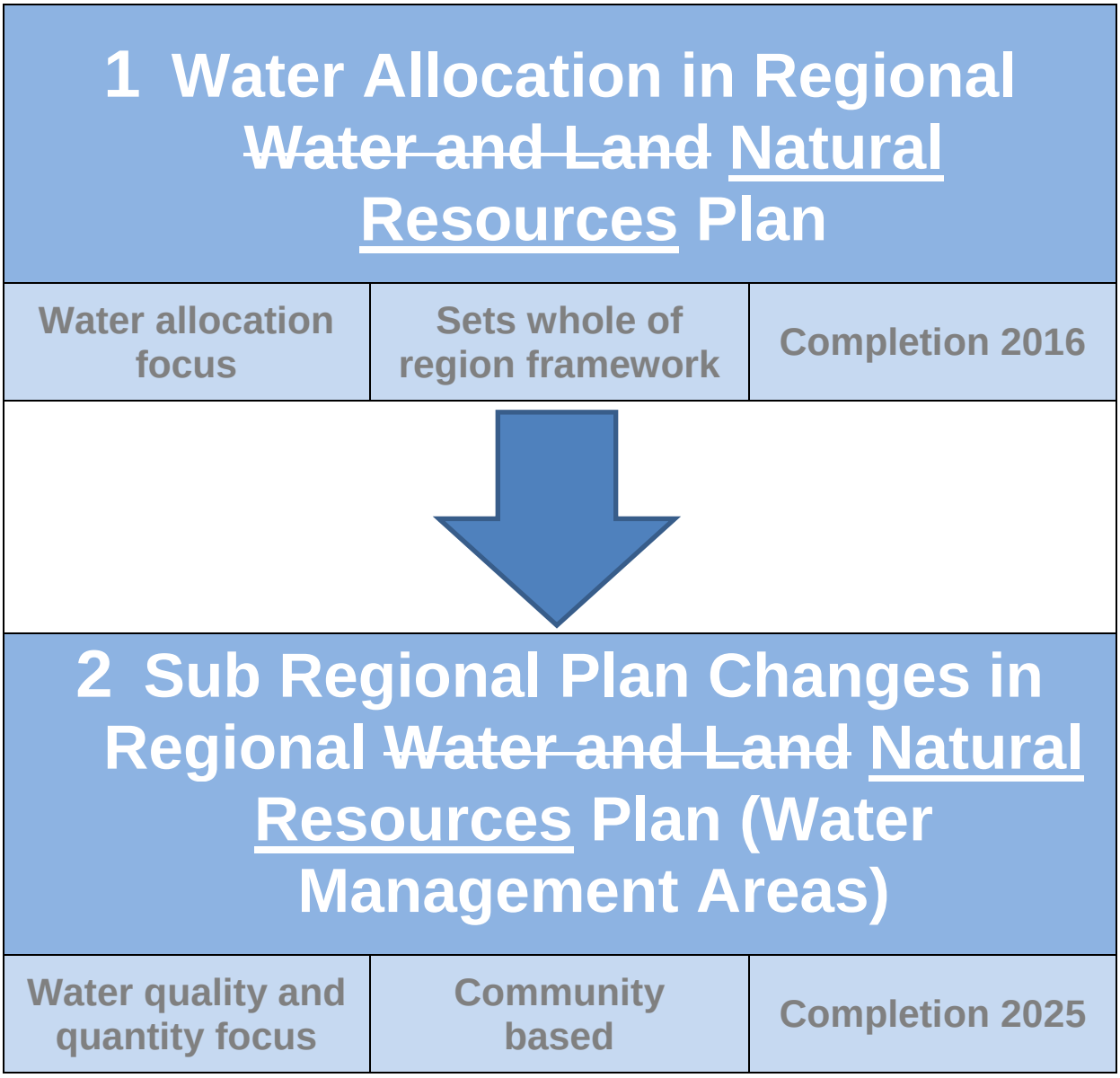


Figure 2 *Two-step approach to setting limits for water quantity in the Bay of Plenty. Note that Water Management Areas are not Freshwater Management Units for the purposes of the National Policy Statement Freshwater Management. There are likely to be several Freshwater Management Units within each Water Management ~~Unit~~ Area.*

Part 3: Assessment of water available for allocation

3.1 Groundwater allocation

The current allocation limits for groundwater in the Bay of Plenty are based on a series of mass water balance calculations carried out by GNS Science. These studies provide preliminary groundwater budgets and have been used to inform allocation levels. The reports are listed in Appendix 1 with relevant sections identified for ease of reference.

For the purposes of allocation, groundwater resources have been split into two categories as follows:

- Groundwater catchments – these aquifers correspond to surface water catchments and are likely to have a connection to surface water.
- Groundwater zones – these are the deeper aquifers and are unlikely to have a connection to surface water.

The groundwater catchments are shown in Figure 3.

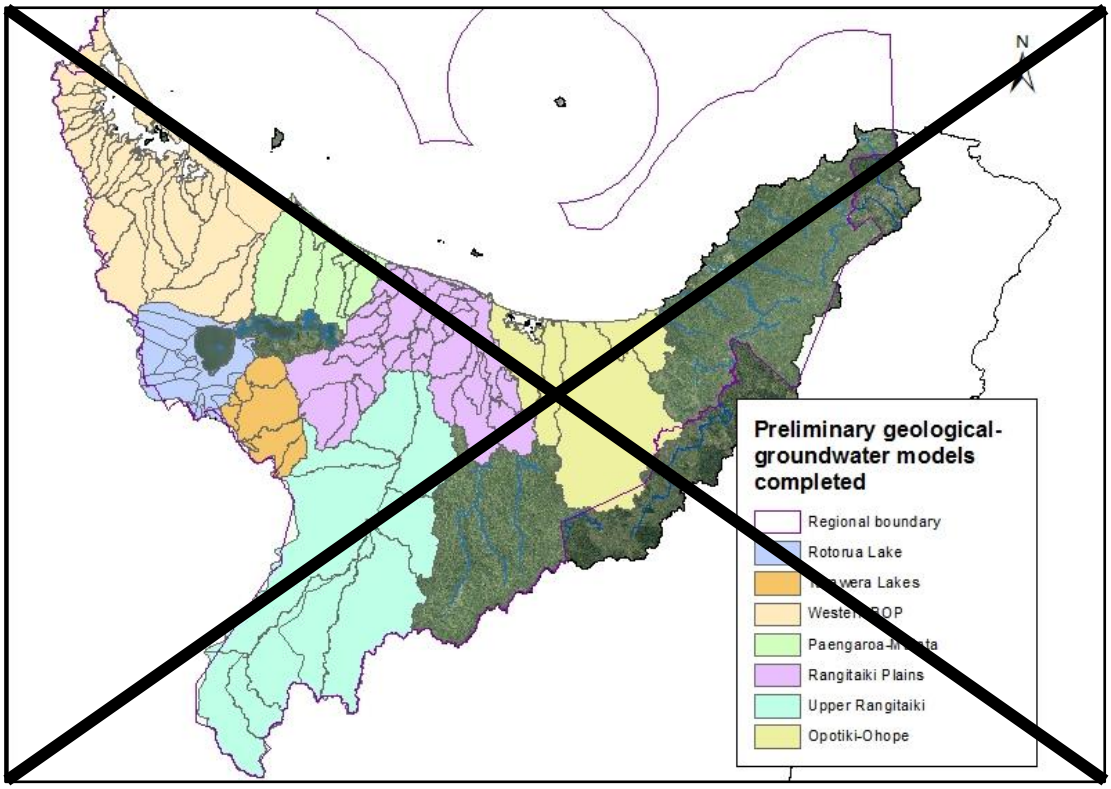


Figure 3 Groundwater catchments currently defined for the Bay of Plenty.

The groundwater flow budgets are based on mass water balances and form the basis for determining allocation levels for each groundwater catchment or zone. The creation of these budgets relies on a variety of different data sets and the nature of the data used can vary in different parts of the region. For example, in some areas monitoring data on groundwater recharge is available from lysimeter sites, while in others recharge may be calculated using data on rainfall, river level and flow, and evapotransporation.

The process used to create groundwater flow budgets generally occurs as follows to:

- identify geological units important to groundwater flow and model these units
- estimate rainfall on catchments
- esimate rainfall recharge on catchments
- estimate baseflow disharge from catchments via streams
- estimate 'shallow' groundwater recharge
- estimate 'deep' groundwater recharge
- estimate groundwater storage volumes.

Figure 6 shows how groundwater is allocated using the information on groundwater flow.

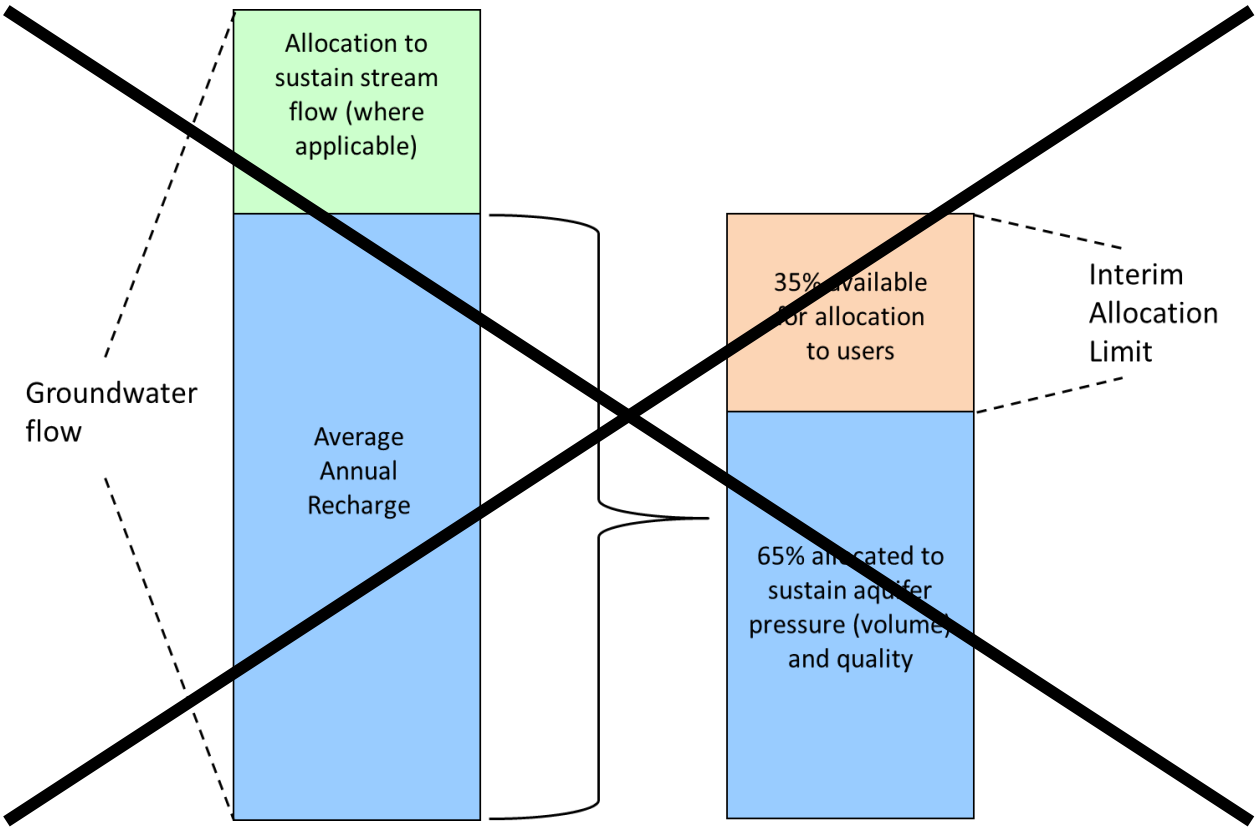


Figure 4 Conceptual illustration showing how groundwater is allocated in many of the aquifer systems in the Bay of Plenty.

Note that this diagram shows how water availabity within the aquifer was estimated. It does not address all effects that maybe associated with a particular groundwater take, individual consideration of the localised effects of a particular take on nearby bores or streams, or the risk of saline intrusion.

To summarise:

- The groundwater flow is estimated for the aquifer.

- An allocation is subtracted to sustain stream flow where it has been determined that there is connection between groundwater and surface water (note that this is not necessary for the deeper groundwater zones, where there is unlikely to be connection to surface water).
- The groundwater remaining is referred to as the 'Annual Average Recharge' - 35% of this may be allocated to users (the 'Interim Allocation Limit') while 65% is retained to sustain the aquifer.

Note that the actual method used to estimate groundwater recharge varies depending on the availability of data and the local geology. The relevant GNS reports and BOPRC science staff should be consulted where there is specific interest in the calculation of the allocation limit for individual aquifers.

3.2 Surface water allocation

Data to inform allocation of surface water is sourced from continuous flow stations, manual flow gauging, and by estimation based on catchment size and basin characteristics.

The key statistic used for water allocation is the five-year seven-day mean annual low flow probability (Q5 7-day). This is the seven day low flow value which has a 20% probability of occurring in any one year and is determined as follows:

- Calculate the daily moving averages of the last seven days.
- Select the minimum value for the year.
- Calculate the exceedance probability for each of the minima for the years.
- Plot on a probability graph and fit a curve.
- Obtain the value for the desired exceedance value.

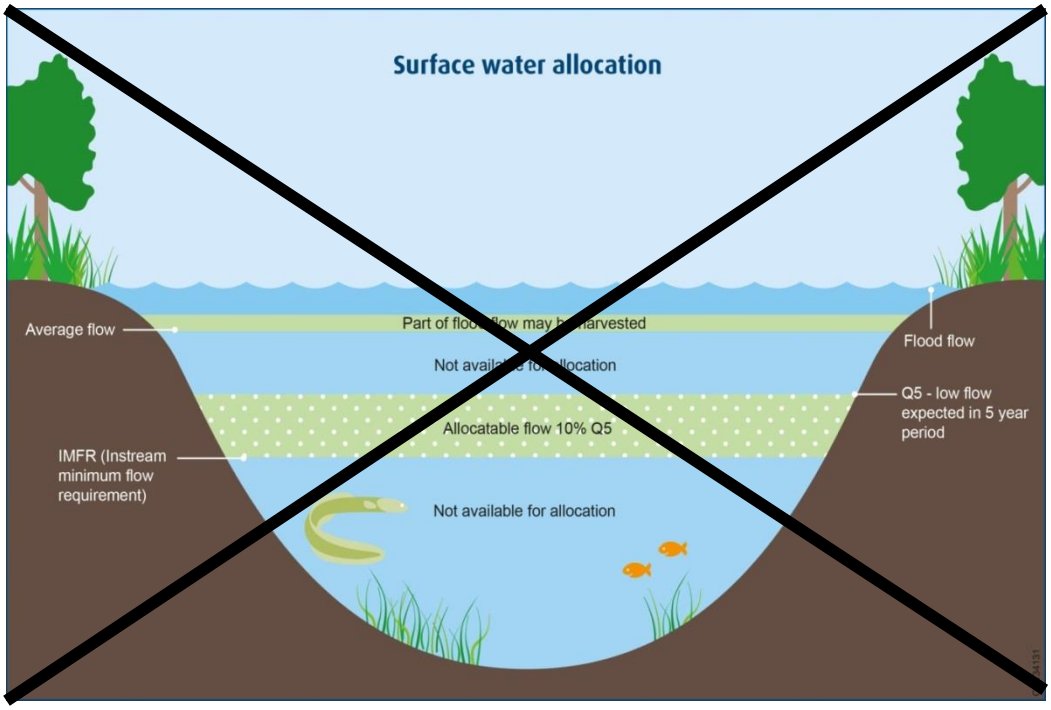


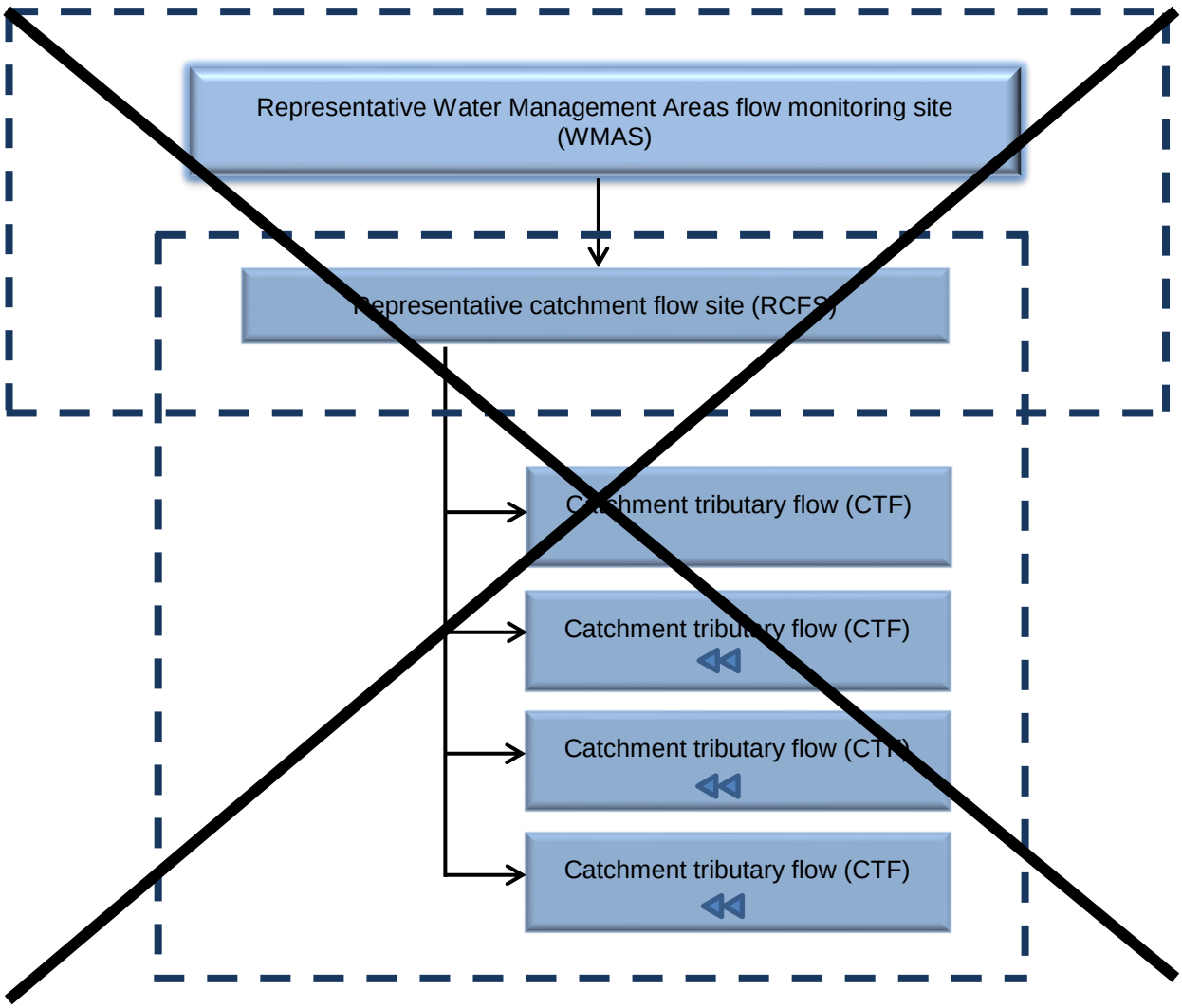
Figure 5 Illustration of the Operative Regional Water and Land Plan Method used to allocate surface water.

~~Data for all of the permanent flow monitoring stations is provided in the Environmental Data Summaries which are published periodically for the Bay of Plenty. These summaries include low flow as well as flood flow information. The low flow statistics, including the Q5 7-day low flow, are most relevant to water allocation.~~

~~The current method used to develop low flow statistics for manually gauged sites is described in the Low Flow Monitoring Strategic Review (Ellery & Putt, 2012). The process (see Figure 6) is similar to that of Smakhtin (2001) and is the most widely used technique in low flow estimation at manually gauged sites. This process involves:~~

- ~~The establishment of key representative flow monitoring sites (WMAS) to provide a continuous data series for several locations in the catchment.~~
- ~~Identification of key Representative Catchment Flow Sites (RCFS).~~
- ~~Completion of a series of discrete low flow surveys to build a statistical relationship between the flow at the WMAS and the flow at the RCFS.~~

~~The relationship between the Water Management Area flow monitoring Site (WMAS) and the Representative Catchment Flow Sites thus defines the statistics of the ungauged catchment.~~



~~*Figure 6 Illustration of the current method used to develop low flow statistics for manually gauged sites in the Bay of Plenty.*~~

Estimates of water availability shown in Table 1 (surface water allocation) are assessments made at a point generally in the lower part of a catchment. As a consequence the Q5 7 day low flow and allocable flow at the very bottom of a catchment maybe different to the assessments presented in this report. Please contact the Council for details of the location of individual gauging sites. Water availability for an individual consent application will be assessed at the point of the proposed take. In some cases this will result in insufficent water being available at the point of take, even although the stream or river is not over allocated.

3.3 Ground and surface water interaction

Resource consent applicants seeking to take groundwater need to show how they have assessed any impacts on surface water.

Part 4: Assessment of existing allocation and estimates of water available for allocation

4.1 Limitations on use of data

Water allocation data shown on these tables was up to date at the time of publication 18 October 2016. As new water is allocated or existing consents expire and are not renewed it will become out of date. Over time there may be revised estimates of flow as more science becomes available. Please contact the Council for up to date information.

Following the hearing on Proposed Plan Change 9 in 2018, the term 'Net allocation' was added to the 'Definition of Terms' in the plan. It was defined as follows; *"For the purpose of determining fully allocated/full allocation net allocation means the amount of water that is no longer available to others as a result of the allocation. Net allocation = Water authorised to be taken minus water required to be returned*."

As a result of this definition, the allocation status of some rivers has changed. In future, these accounts will be revised accordingly. In the interim, an individual assessment will be made where relevant to a particular resource consent application.

4.2 Water use that is not currently consented

Unconsented takes, including those allowed by RMA Section 14(3)(b), provided for as a permitted activity under Rules ~~WQ R1, WQR 2 and~~ WQ R 3~~,~~ of the ~~Regional Water and Land~~ Natural Resources Plan Change 9 and unauthorised use on dairy farms for milk cooling and wash down are current uses that are not consented or included in the assessment of existing allocation. BOPRC will add these takes to the existing allocation once adequate information is available.

In addition to the above takes, a 2016 programme at BOPRC has registered approximately 130 currently unauthorised horticultural irrigation water users who will be applying for resource consent to take water during 2016/2017. Any water allocated to these users will be shown in water accounts once resource consent applications are processed.

4.3 Water that is allocated but not currently used

This report assesses how much water is allocated to consent holders. Actual use will be different to allocation because:

- Irrigation allocations are based on meeting water requirements for nine out of 10 years. In most years less water will be required, but it is during the dry years that the grower/farmer most benefits from water availability.
- Other water uses (not irrigation) also have peaks in demand and, generally, the quantity of water granted is to meet the peak demand.
- Almost half the region's resource consents to take water were granted under the Water and Soil Conservation Act and became 35 year consents under the Resource Management Act 1991. Anecdotal evidence suggests that many of these consent holders are no longer using the amount of water for which they were granted consents.

- Some uses such as municipal have long planning requirements and obtain consent for water significantly in advance of actual taking.

A 2010 report on water usage versus allocation in New Zealand[1] indicated that, nationally, only 25 – 75% of consented allocation is used. Bay of Plenty Regional data fell in the middle of this range (50%). The limited amount of metering data available at present prevents meaningful analysis of allocation versus actual use.

4.4 Location of surface water takes within a stream or river

The allocation limit shown for each stream/river represents 10% of Q_5 7 day at the point of assessment (normally at a downstream point in the stream/river). Water availability for an individual resource consent application will be assessed at the point of the proposed take. In some cases, this will result in there being insufficient water available at the point of take, despite there being water available in the wider catchment.

4.5 Aggregation of surface water takes within a catchment

Surface water allocation is calculated by adding together the rates of takes for all consented takes at a stream or river level. This conservative calculation represents a worst case scenario because it is unlikely that all takes are exercised on the same day at the same time.

4.6 Surface water takes for frost protection

Frost protection takes tend to have a higher rate of take than irrigation because the whole orchard must be covered at the same time and for the duration of the frost. This use is not included in the surface water allocation report. It should be noted that stream flows don't tend to be near low flows during the frost period.

Future reporting will be modified to include surface water allocated for frost protection from surface water to better reflect the timing and scale of these low season water takes.

~~4.7 Calculating groundwater availability and allocation~~

~~Groundwater allocation and availability is expressed as litres per second. Annual volumes can be determined by multiplying the rate by the number of seconds in a year. For example Table 2 shows the Aongatete groundwater catchment as having 237.4 l/s water currently available for allocation. The annual volume available can be calculated as follows:~~

~~Quantity shown as remaining available for allocation = 237.4 l/s~~

~~237.4 l/s = 0.2374 m^3/second~~

~~0.2374 m^3/s x 86,400 seconds/day x 365 days/year = 7,486,646.4 m^3/year~~

~~An application to take 1,000 m^3/day for irrigation will be calculated as follows:~~

~~1,000 m^3 x 155 days = 155,000 m^3 annual allocation~~

[1] Aqualinc 2010: Update of water allocation data and estimate of actual use of consented takes 2009/2010 Prepared for Ministry for the Environment (Report no. H10002/3, October 2010).

4.8 ~~Modifications to estimates of groundwater allocation~~

~~Historically, resource consents were issued for a maximum daily quantity and did not specify the period of use. For the purposes of the water accounts, the amount of groundwater allocated for irrigation is based on:~~

- ~~155 days irrigation (over 24-hours) – includes crops and pasture.~~
- ~~30 days frost protection (over 24-hours) – kiwifruit.~~
- ~~365 days continuous use (over 24-hours) – includes municipal and commercial.~~

~~This was considered a fair representation of the period a consent holder will use water and helps make the estimate of allocation more realistic because irrigation does not occur outside of the summer season. Groundwater allocated to irrigation outside of the 155 day irrigation season is not included in water accounts.~~

4.9 Using the maps and allocation tables

The maps and tables collate information about water availability in the regions streams ~~and aquifers,~~ based on resource consents. New applications or consents that expire and are not renewed will change the allocation status. The information is provided for guidance and isn't to be relied on to confirm that water is or is not available. Some reasons for differences in available allocation compared to that listed in this report are:

- seasonal use patterns of water demand
- actual flow at the point of take compared to point at which flow is gauged
- ~~effects of groundwater takes on nearby bores~~
- review of flow data ~~or revised science assessments of groundwater recharge~~
- consents recently granted or applications received or consents that expire.

Note that estuarine sections of streams are not shown on the surface water allocation maps.

Part 5: Allocation tables and maps

5.1 Table 1 Surface water allocation

This table shows streams with resource consents to take water and only takes authorised by resource consent. Information on some other streams is available by calling the office. The Motu River and specified tributaries are locations in the region where it is a prohibited activity to apply for a resource consent to take water. No water is taken from them so they are not shown. Pink shading indicates that the water body is allocated above the allocable flow, green that the water body is allocated at less than the allocable flow, orange that there is insufficient information for flow records.

Surface Water Body	Q5 7 day low flow (L/s)	Allocable flow (L/s)	Allocated flow (L/s)	Remaining allocation (L/s)
Tauranga Harbour WMA				
Aongatete River	238.0	23.8	41.4	0.0
Apata Stream	*		2.7	*
Hikurangi Stream	*		34.4	*
Kaiate Stream	*		5.7	*
Kaitemako Stream	25.0	2.5	1.5	1.0
Kauri Point Tributary	2.0	0.2	2.5	0.0
Kopurererua Stream	1334.0	133.4	169.6	0.0
Mangawhai Stream	7.0	0.7	2.5	0.0
Ohourere Stream	230.0	23.0	63.9	0.0
Okawe Stream	27.0	2.7	1.3	1.4
Omanawa River	1300.0	130.0	5.2	124.8
Otawhiti Stream	*		0.7	*
Otumanga Stream	*		1.0	*
Otumoetai Stream	*		4.6	*
Oturu Creek	10.0	1.0	1.1	0.0
Pukekonui Stream	*		6.5	*
Tautau Stream	326.0	32.6	442.3	0.0
Te Mania Stream	51.0	5.1	4.2	0.9
Te Puna Stream	130.0	13.0	11.2	1.8
Te Rereatukahia	100.0	10.0	27.6	0.0
Tuapiro Creek	350.0	35.0	84.0	0.0
Tuapo Stream	42.0	4.2	6.0	0.0
Uretara Stream	~~25.0~~ 200.0	~~2.5~~ 20.0	163.4	0.0
Waiau River	173.0	17.3	27.8	0.0
Waimapu Stream	705.0	70.5	2.1	68.4
Wainui Stream	*		1.7	*
Waione Stream	*		70.4	*

Surface Water Body	Q5 7 day low flow (L/s)	Allocable flow (L/s)	Allocated flow (L/s)	Remaining allocation (L/s)
Waiorahi Stream	740.0	74.0	638.9	0.0
Wairere Stream	*		26.5	*
Waipapa Stream	200.0	20.0	92.1	0.0
Wairoa River[2]	413.0	41.3	27.3	14.0
Waitao Stream	198.0	19.8	7.6	12.2
Waitekohe Stream	73.0	7.3	29.7	0.0
Whatakao Stream	180.0	18.0	23.6	0.0
Kaituna, Maketū and Pongakawa WMA				
Kaikokopu Canal	*		195.6	*
Kaituna River	26043.0	2604.3	1125.4	1478.9
Kirikiri Stream	*		4.2	* 0.0[3]
Kopuroa Stream	71.0	7.1	17.6	0.0
Mangorewa River	5450.0	545.0	171.0	374.0
Oeuteheuheu Stream	427.0	42.7	62.0	0.0
Ohineangaanga Stream	154.0	15.4	46.1	0.0
Ohinepanea Stream	*		27.2	*
~~Opato Stream~~	*		~~5.0~~	*
Pakipaki Stream	750.0	75.0	37.5	37.5
Parawhenuamea Stream	*		29.4	*
Pokopoko Stream	1596.0	159.6	~~123.0~~ 185.0[4]	~~36.6~~ 0.0
Pongakawa Stream	4115.0	411.5	782.6	0.0
Puanene Stream	*		6.6	*
Raparapahoe Stream	610.0	61.0	~~54.9~~ 205.0[5]	~~6.1~~ 0.0
Waiari Stream	2984.0	298.4	790.8	0.0
Wairapukao Stream	*		6.3	* 0.0[3]
Waitahanui Stream[6]	~~5500.0~~ 4360.0	~~1700~~ 560.0 / ~~550~~ 436.0	1295.4	~~404.6~~ 0.0 / 0.0
Waiteti Stream	840.0	84.0	4.9	79.1
Wharere Stream	287.0	28.7	62.7	0.0
Whataroa Stream	~~180.0~~ 282.0	~~18.0~~ 28.2	139.6	0.0
Rotorua Lakes WMA				
Awahou Stream	1390.0	139.0	115.0	24.0

[2] Subject to existing Hydro Electric Power Scheme.
[3] Tributary of the Raparapahoe Stream which has no remaining allocation.
[4] Pokopoko Stream allocated flow includes that from the Oeuteheuheu Stream tributary.
[5] Raparapahoe Stream allocated flow includes that from its tributaries (Whataroa Stream, Wairapukao Stream and Kirikiri Stream).
[6] The Waitahanui Stream has an IMFR set in the RWLP (~~1,700~~ 3,800 L/s) under PC9 the allocation limit becomes 10% of Q5 7 day low flow and the stream becomes over allocated.

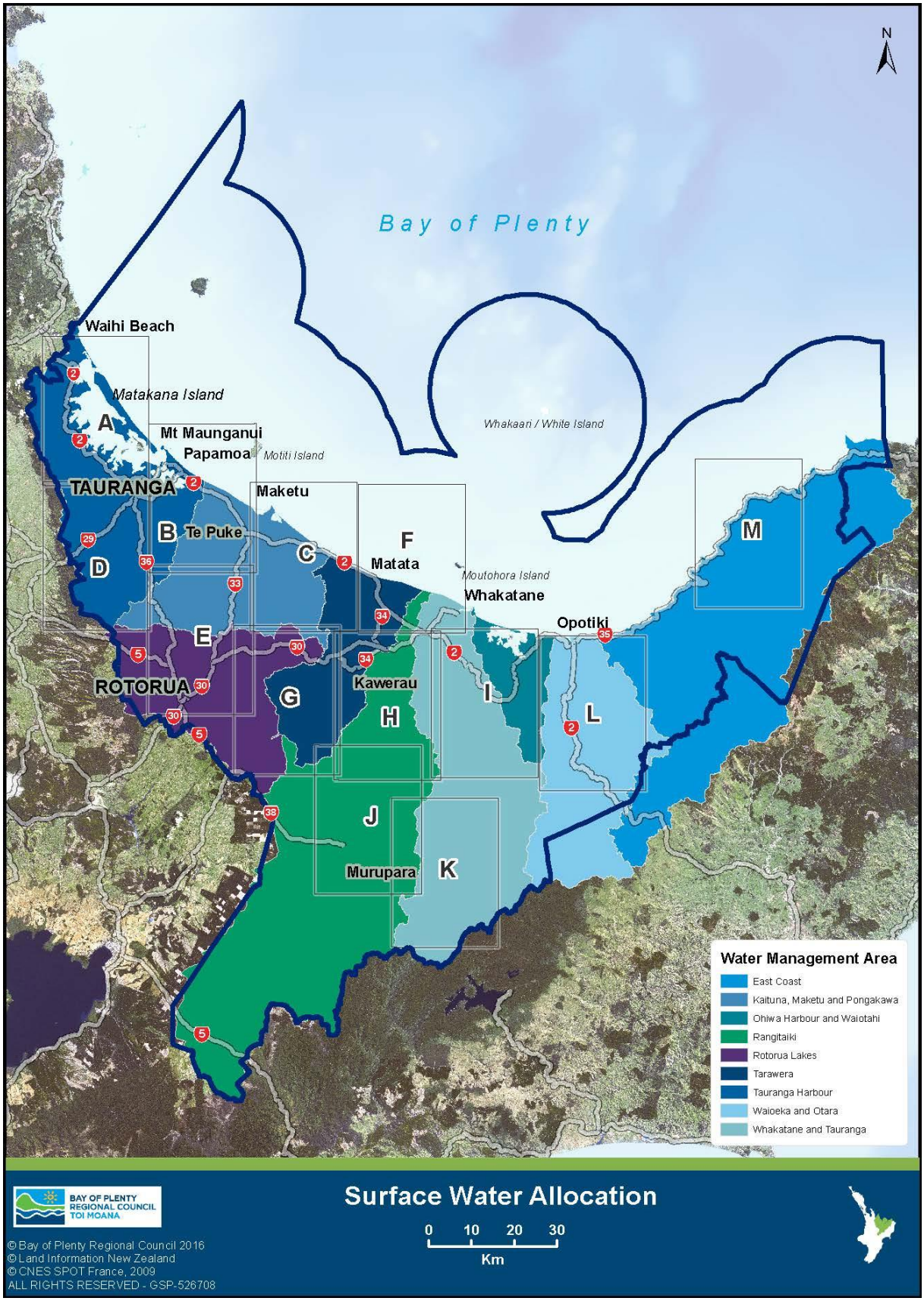
Surface Water Body	Q5 7 day low flow (L/s)	Allocable flow (L/s)	Allocated flow (L/s)	Remaining allocation (L/s)
Hamurana Stream	2270.0	227.0	45.0	182.0
Lake Rotoiti	*		19.2	*
Ngongotaha Stream	937.0	93.7	140.0	0.0
Ohuanui Stream	*		0.6	*
Ōkataina Lake	*		0.8	*
Rewarewa Stream	*		45.0	*
Rotomā Lake	*		58.7	*
Utuhina Stream	1165.0	116.5	420.9	0.0
Waiiti Stream	*		6.5	*
Waiohewa Stream	220.0	22.0	3.0	19.0
Waiowhiro Stream	~~220.0~~ 245.0	~~22.0~~ 24.5	3.6	~~18.4~~ 20.9
Waipa Stream	430.0	43.0	178.0	0.0
Waitangi Stream	*		239.0	*
Tarawera WMA				
Awaiti Canal	*		135.0	*
Awakaponga Stream	30.0	3.0	31.2	0.0
Herepuru Stream	*		0.5	*
Mangaone Stream	1290.0	129.0	21.0	~~108.0~~ 0.0[7]
Mangawiki Stream	*		23.0	* 0.0[7]
~~Ngakaroa Stream~~	~~*~~		~~8.1~~	~~*~~
Omeheu canal	165.0	16.5	199.8	0.0
Ruruanga Stream	676.0	67.6	49.0	~~18.6~~ 0.0[7]
Tarawera River	20174.0	2017.4	~~5117.1~~ 5210.1[8]	0.0
Rangitāiki WMA				
Haumea Stream	780.0	78.0	100.3	0.0
Horomanga River	460.0	46.0	128.0	0.0
Mangakotukutuku Stream	95.0	9.5	58.8	0.0
Mangamate Stream	*		12.1	*
Mangamutu Stream	50.0	5.0	55.4	0.0
Ngakaroa Stream	*		8.1	*
Omahuru Stream	*		33.3	*
~~Orini Canal~~	~~*~~		~~40.0~~	~~*~~
Pokairoa Stream	*		125.0	*

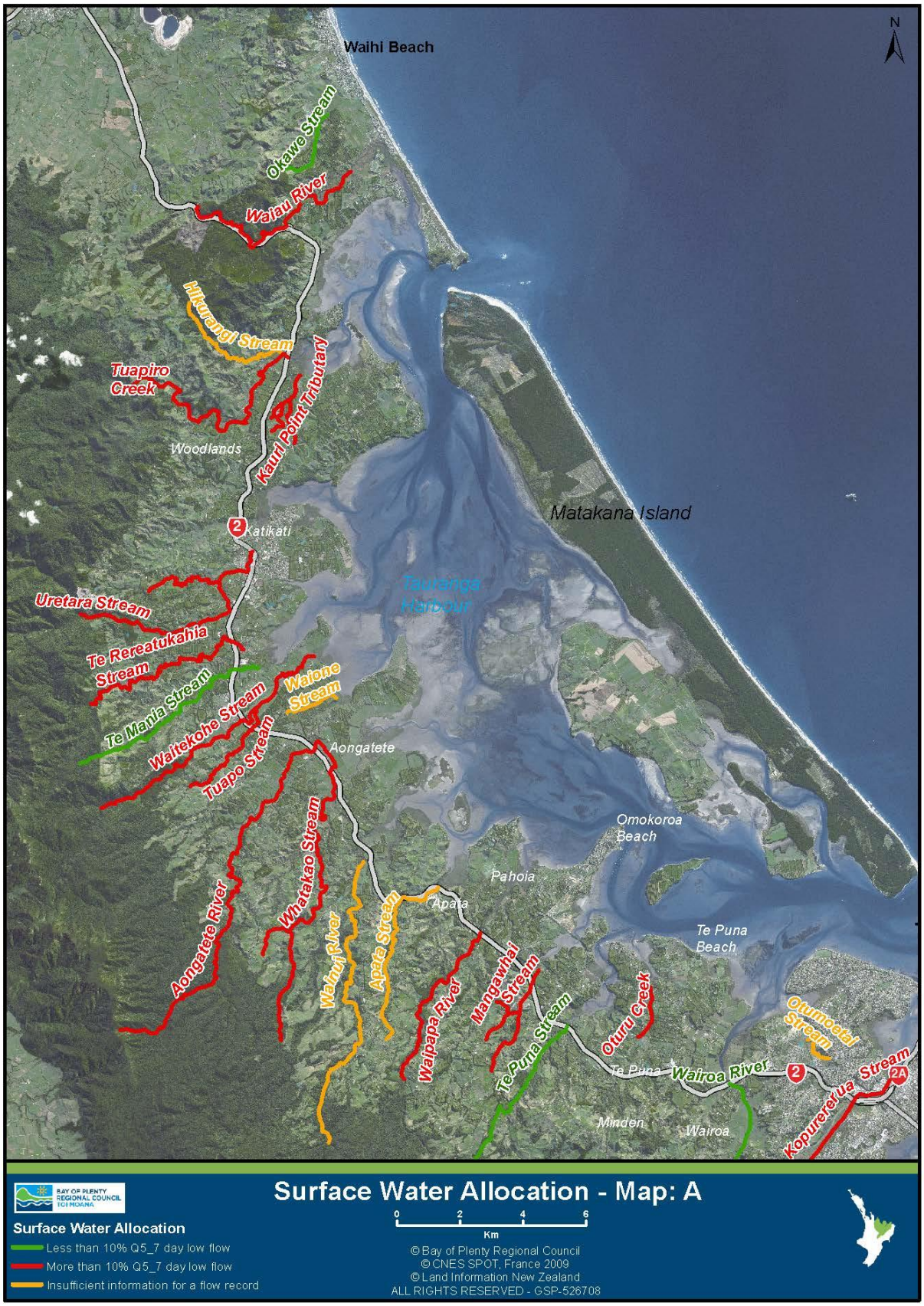
[7] Tributary of the Tarawera River which has no remaining allocation.
[8] Tarawera River allocated flow includes that from its mapped tributaries (Mangaone Stream, Mangawiki Stream and Ruruanga Stream).

Surface Water Body	Q5 7 day low flow (L/s)	Allocable flow (L/s)	Allocated flow (L/s)	Remaining allocation (L/s)
Rangitāiki River at Murupara[9]	12933.0	1293.3	2464.8	0.0
Rangitāiki River at Te Teko[9]	37647.0	3764.7	2464.8	1299.9
Te Kopua Stream	50.0	5.0	10.5	0.0
Te Rahu Stream	*		7.8	*
~~Wairere Stream~~	*		~~26.5~~	*
Whirinaki River	3917.0	391.7	542.5	0.0
Whakatane and Tauranga WMA				
Kopaenui Stream	*		1.0	*
Mangaroa Stream	*		4.0	*
Orini Canal	*		40.0	*
Waioho Stream	339.0	33.9	37.0	0.0
Whakatane River	8554.0	855.4	826.6	28.8
Ohiwa Harbour and Waiotahi WMA				
Nukuhou River	152.0	15.2	44.0	0.0
Waioeka and Otara WMA				
Opato Stream	*		5.0	*
Otara River	1922.0	192.2	175.0	17.2
Te Karaka Stream	*		42.0	*
Tirohanga Stream	~~50.0~~ *	~~5.0~~	7.0	~~0.0~~ *
Waiaua Stream	337.0	33.7	60.0	0.0
Waioeka River	~~4800.0~~ 4121.0	~~480.0~~ 412.1	~~83.8~~ 88.8[10]	~~396.2~~ 323.3
East Coast WMA				
Maraetea Stream	*		30.8	*
Puremutahuri Stream	34.0	3.4	15.0	0.0
Waiorore Stream	9.0	0.9	14.0	0.0
Whanarua Stream	31.0	3.1	3.1	0.0

[9] Subject to existing Hydro Electric Power Scheme.
[10] Waioeka River allocated flow includes that from the Opato Stream tributary.

5.2 Surface water maps




Waihi Beach
N
Okawe Stream
Waiau River
Hikurangi Stream
Tuapiro Creek
Kauri Point Tributary
Woodlands
Katikati
Matakana Island
Tauranga Harbour
Uretara Stream
Te Rereatukahia Stream
Te Mania Stream
Waitekohe Stream
Waione Stream
Tuapo Stream
Aongatete
Omokoroa Beach
Pahoia
Apata
Te Puna Beach
Aongatete River
Whatakao Stream
Wairuri River
Apata Stream
Waipapa River
Mangawhai Stream
Te Puna Stream
Oturu Creek
Otumoetai Stream
Te Puna
Wairoa River
Kopurererua Stream
Minden
Wairoa
Surface Water Allocation - Map: A
BAY OF PLENTY REGIONAL COUNCIL TE MOANA
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
0 2 4 6
Km
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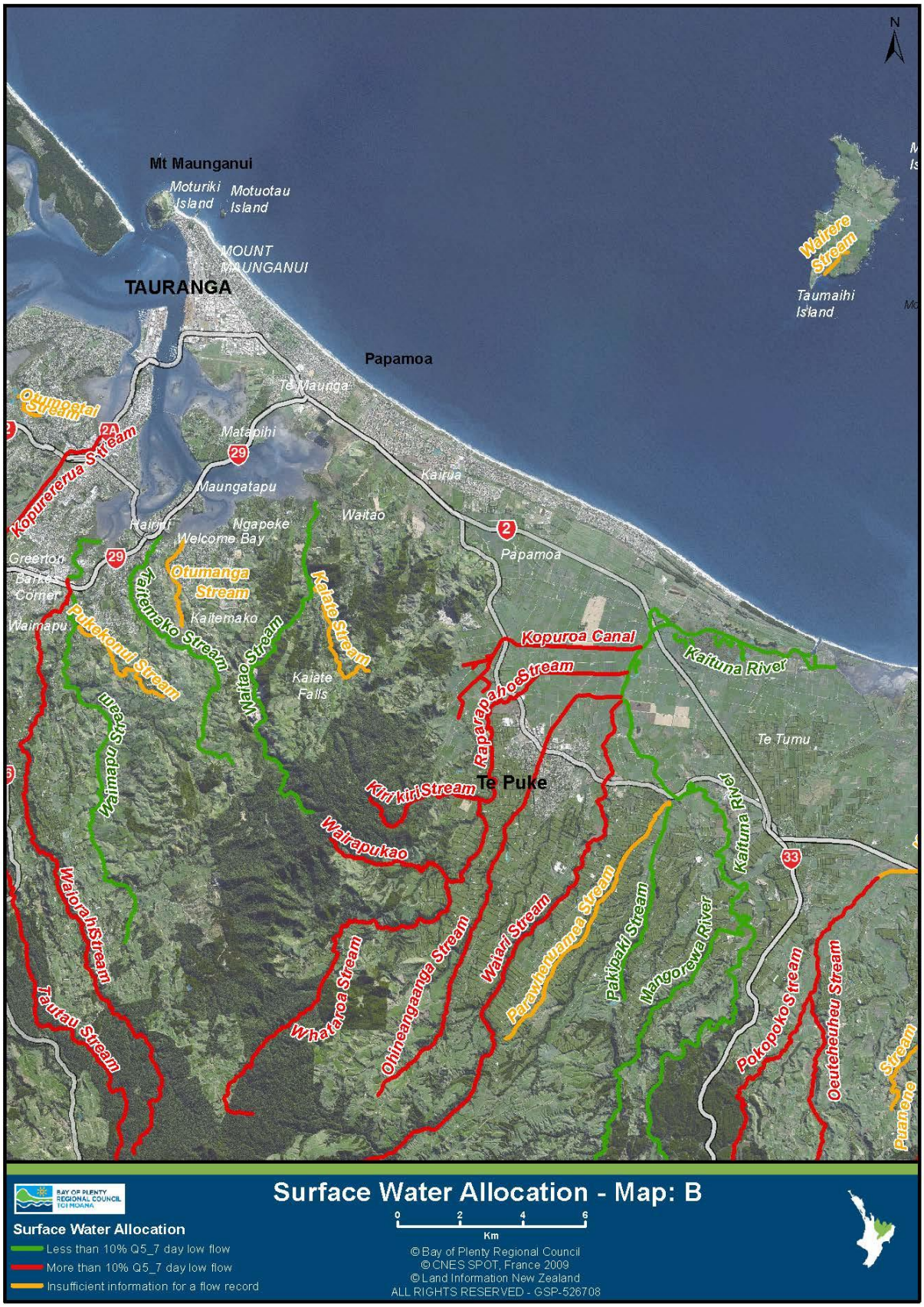
Mt Maunganui
Moturiki Island
Motuotau Island
MOUNT MAUNGANUI
TAURANGA
Papamoa
Te Maunga
Matapihi
Maungatapu
Kairua
Waitao
Ngapeke
Welcome Bay
Papamoa
Greerton
Bethlehem Corner
Waimapu
Kaitemako
Kaiate Falls
Te Puke
Te Tumu
Waitaha Stream
Kaiate Stream
Kopuroa Canal
Kaituna River
Kaituna River
Waimapu Stream
Kiri kiri Stream
Waiorah Stream
Tautau Stream
Whataroa Stream
Ohineangaanga Stream
Waiari Stream
Pakihaki Stream
Mangorewa River
Pokopoko Stream
Oeuteheuheu Stream
Puanene Stream
Wairere Stream
Taumaihi Island
Surface Water Allocation - Map: B
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
0 2 4 6
Km
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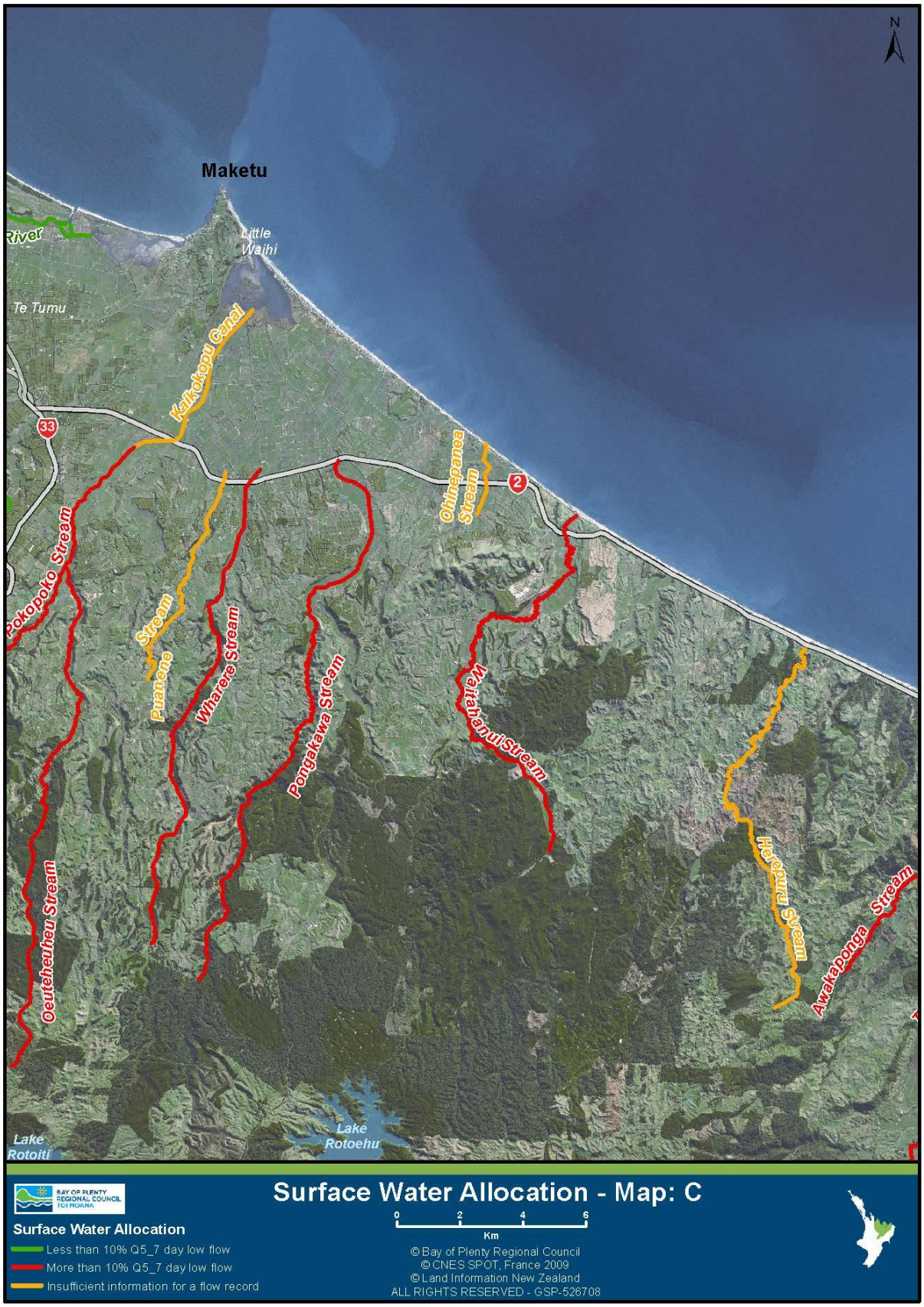
N
Maketu
Little Waihi
Te Tumu
Kaikokopu Canal
33
2
Ohinepanea Stream
Pokopoko Stream
Stream
Pruniene
Wharere Stream
Pongakawa Stream
Waitahanui Stream
Hereawa Stream
Awakaponga Stream
Lake Rotoiti
Lake Rotoehu
Surface Water Allocation - Map: C
0 2 4 6
Km
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
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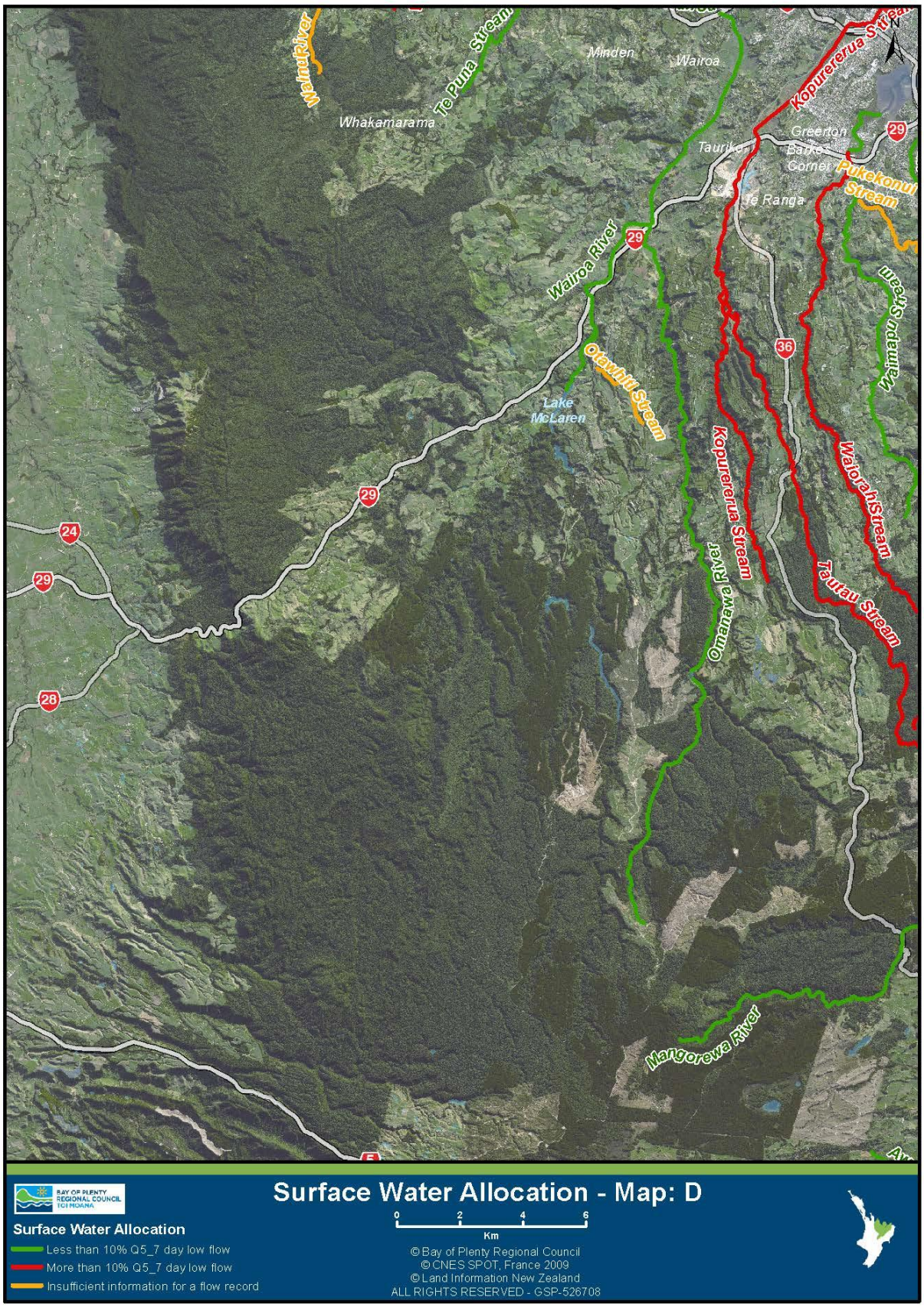
Waimea River
Te Puna Stream
Minden
Wairoa
Whakamarama
Kopurererua Stream
Greerton
Tauriko
Barkes Corner
Pukekonui Stream
Te Ranga
29
Wairoa River
Waimapu Stream
36
Otawhiti Stream
Lake McLaren
Kopurererua Stream
Omanawa River
Waiorahi Stream
Tauriau Stream
24
28
Mangorewa River
Surface Water Allocation - Map: D
0 2 4 6
Km
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
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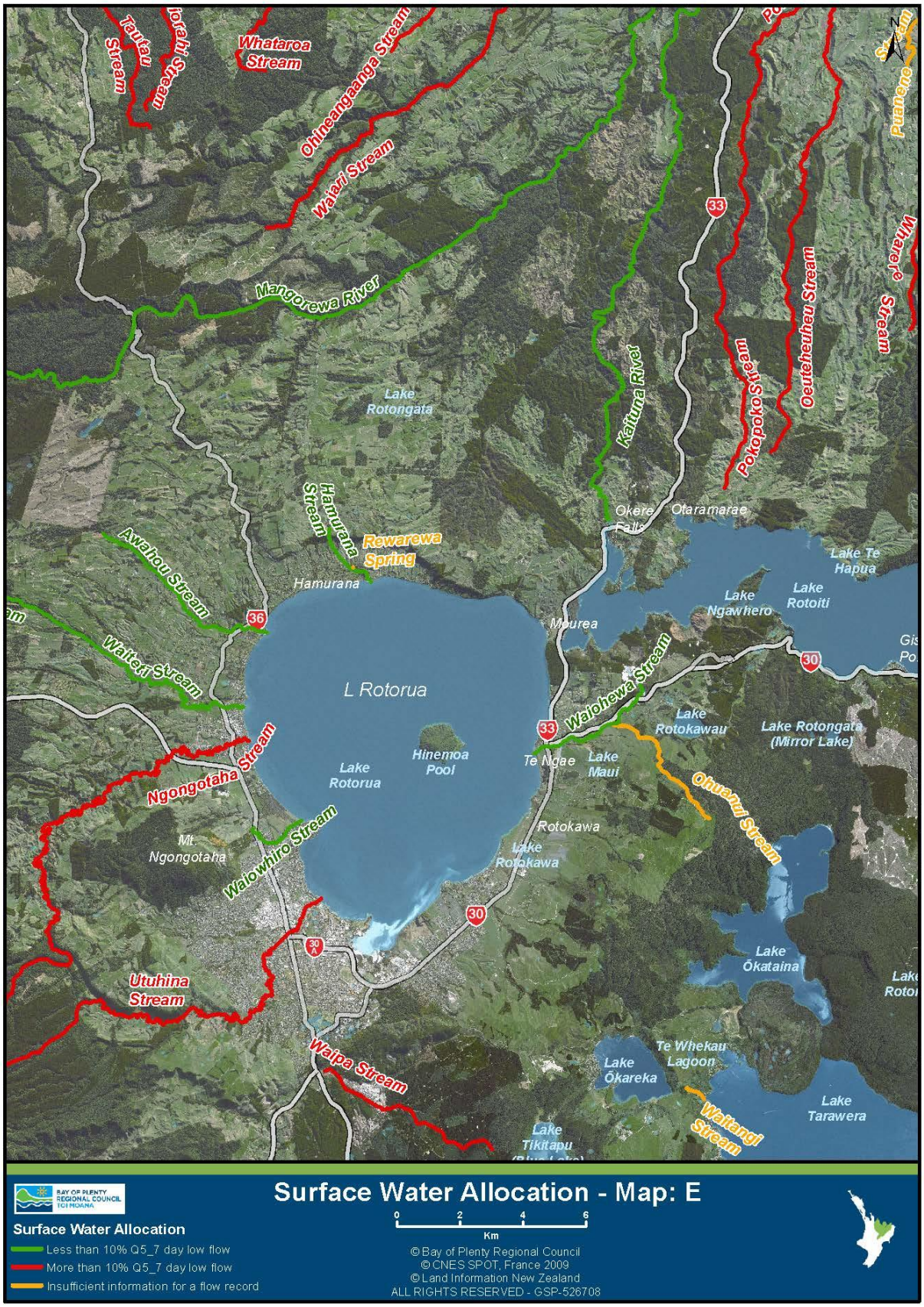
Surface Water Allocation - Map: E
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
0 2 4 6
Km
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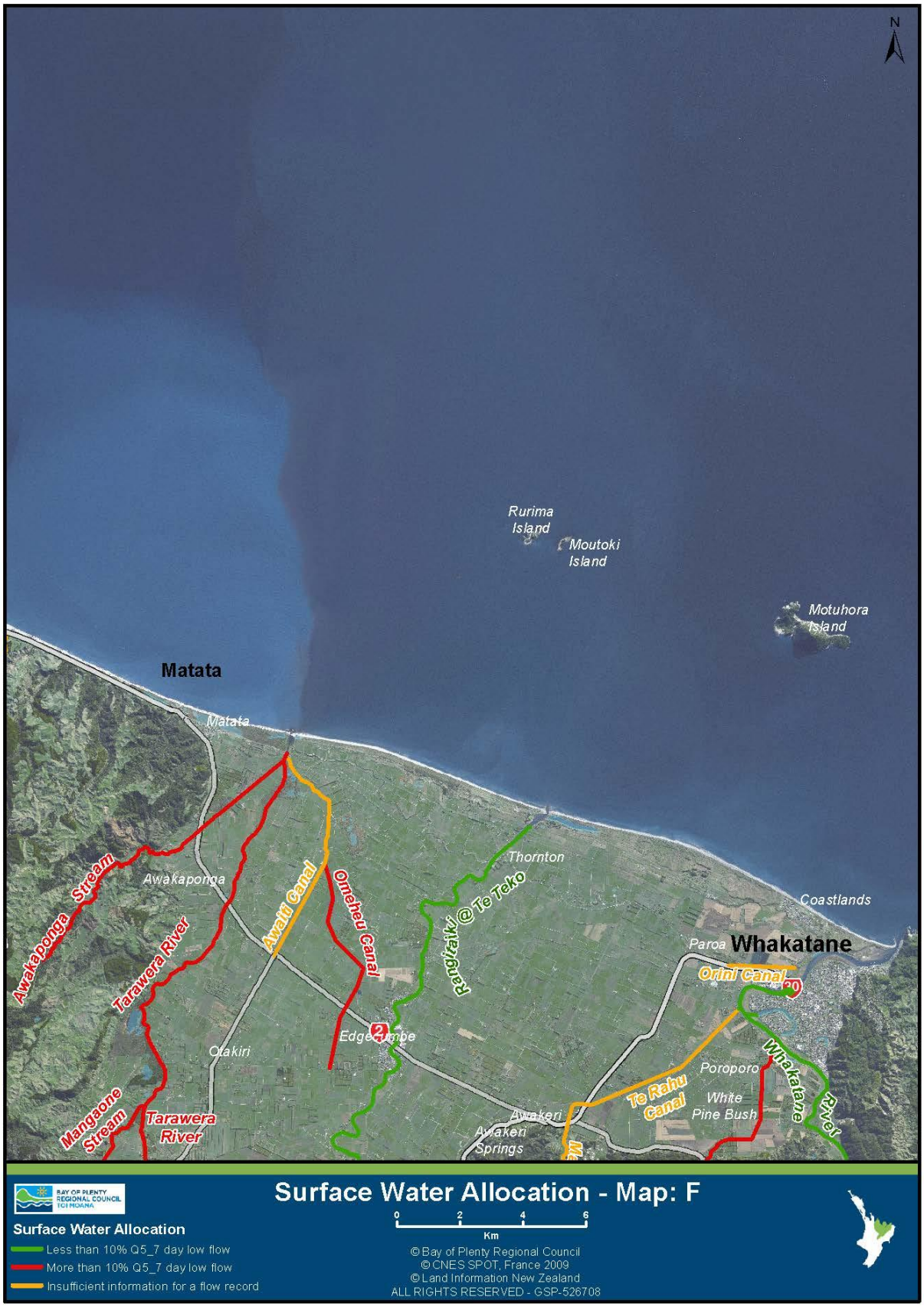
Whataroa Stream
Ohineangaanga Stream
Waiari Stream
Mangorewa River
Kaituna River
Pokopoko Stream
Oeuteheuheu Stream
Lake Rotongata
Hamurana Stream
Rewarewa Spring
Hamurana
Awahou Stream
Waiteti Stream
L Rotorua
Lake Rotorua
Hinemoa Pool
Ngongotaha Stream
Mt. Ngongotaha
Waiowhiro Stream
Utuhina Stream
Waipa Stream
Lake Tikitapu
Okere Falls
Otaramarae
Lake Te Hapua
Lake Rotoiti
Lake Ngawhero
Mourea
Waiohewa Stream
Lake Rotokawau
Lake Rotongata (Mirror Lake)
Te Ngae
Lake Maui
Ohuanuri Stream
Rotokawa
Lake Rotokawa
Lake Ōkataina
Te Whekau Lagoon
Lake Ōkareka
Lake Tarawera
Waitangi Stream
33
36
30
30A


N
Rurima Island
Moutoki Island
Motuhora Island
Matata
Matata
Awakaponga
Awakaponga Stream
Tarawera River
Awaiti Canal
Ormeheu Canal
Rangitaiki @ Te Teko
Thornton
Coastlands
Paroa
Whakatane
Orini Canal
Edgecumbe
Otakiri
Poroporo
Te Rahu Canal
White Pine Bush
Whakatane River
Awakeri
Awakeri Springs
Mangaone Stream
Tarawera River
Surface Water Allocation - Map: F
0 2 4 6
Km
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
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Pokopoko Stream
Otaramarae
Lake Te Hapua
Lake Ngawhero
Lake Rotoiti
Hinehopu
Lake Rotoehu
Rotoehu
Whakarewarewa Lagoon
Onewhero Lagoon
Mangawiki Stream
Mangaone Stream
Gisborne Point
Rotoiti
Waiiti Stream
Lake Rotomā
Matahī Lagoon
Lake Rotokawau
Lake Rotongata (Mirror Lake)
Ruruanga Stream
Ohuanui Stream
Makatiti Dome
Lake Ōkataina
Lake Te Rotoroniu
Tarawera River
Te Whekau Lagoon
Waitangi Stream
Lake Tarawera
Green Lake
Lake Rotomahana
Southern Crater Lake
Lake Ōkaro
Lake Rerewhakaaitu
Pokairoa Stream
30
38
N
Surface Water Allocation - Map: G
0 2 4 6
Km
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
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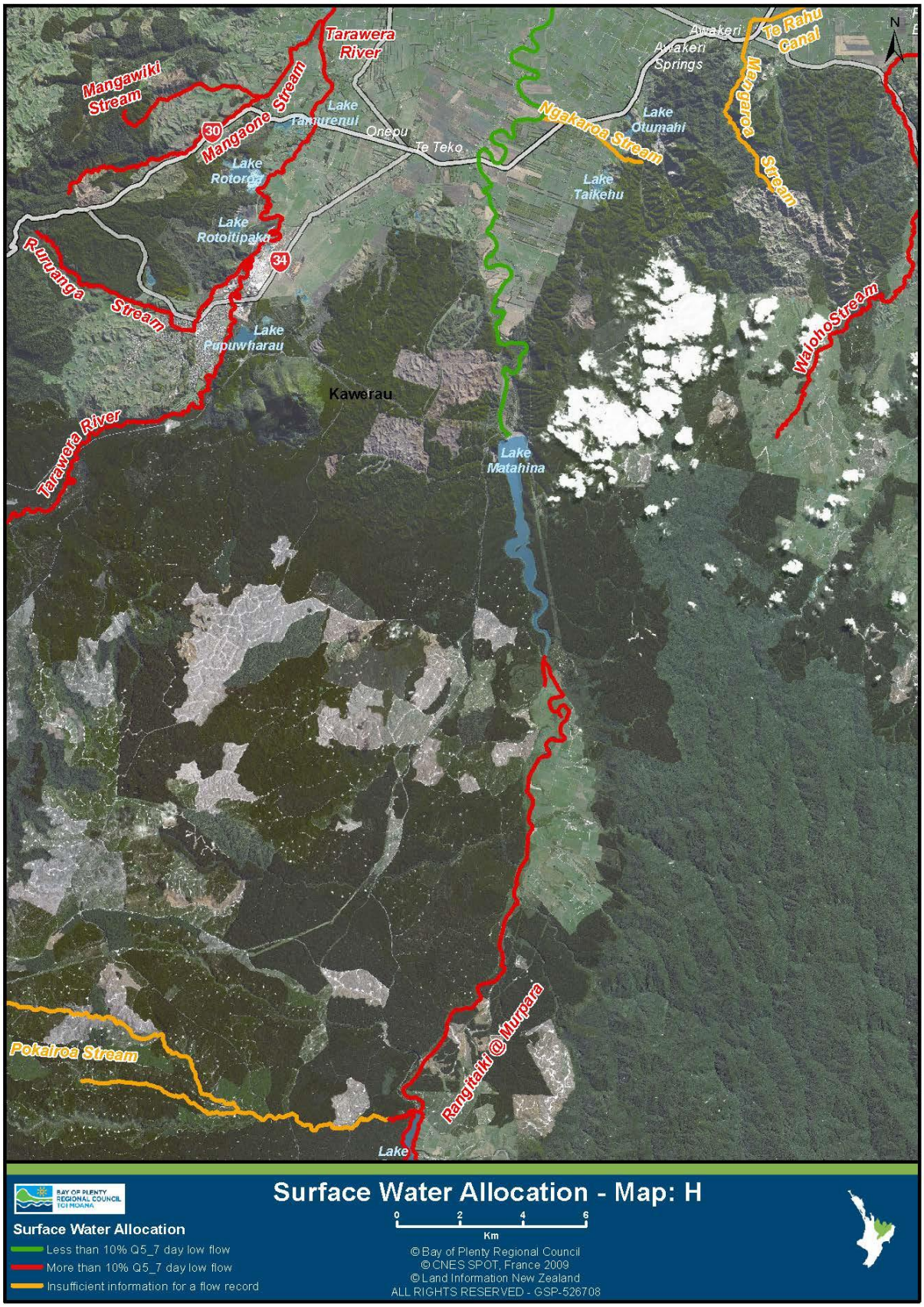
Tarawera River
Mangawiki Stream
Mangaone Stream
30
Lake Tarawera
Onepu
Te Teko
Lake Rotorua
Lake Rotoitipaka
34
Ruruanga Stream
Lake Pupuwharau
Kawerau
Tarawera River
Awakeri
Awakeri Springs
Te Rahu Canal
Ngakaroa Stream
Lake Otumahi
Waiarora Stream
Lake Taikehu
Waiohoo Stream
Lake Matahina
Pokairoa Stream
Rangitaiki @ Murpara
Lake
N
Surface Water Allocation - Map: H
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
0 2 4 6
Km
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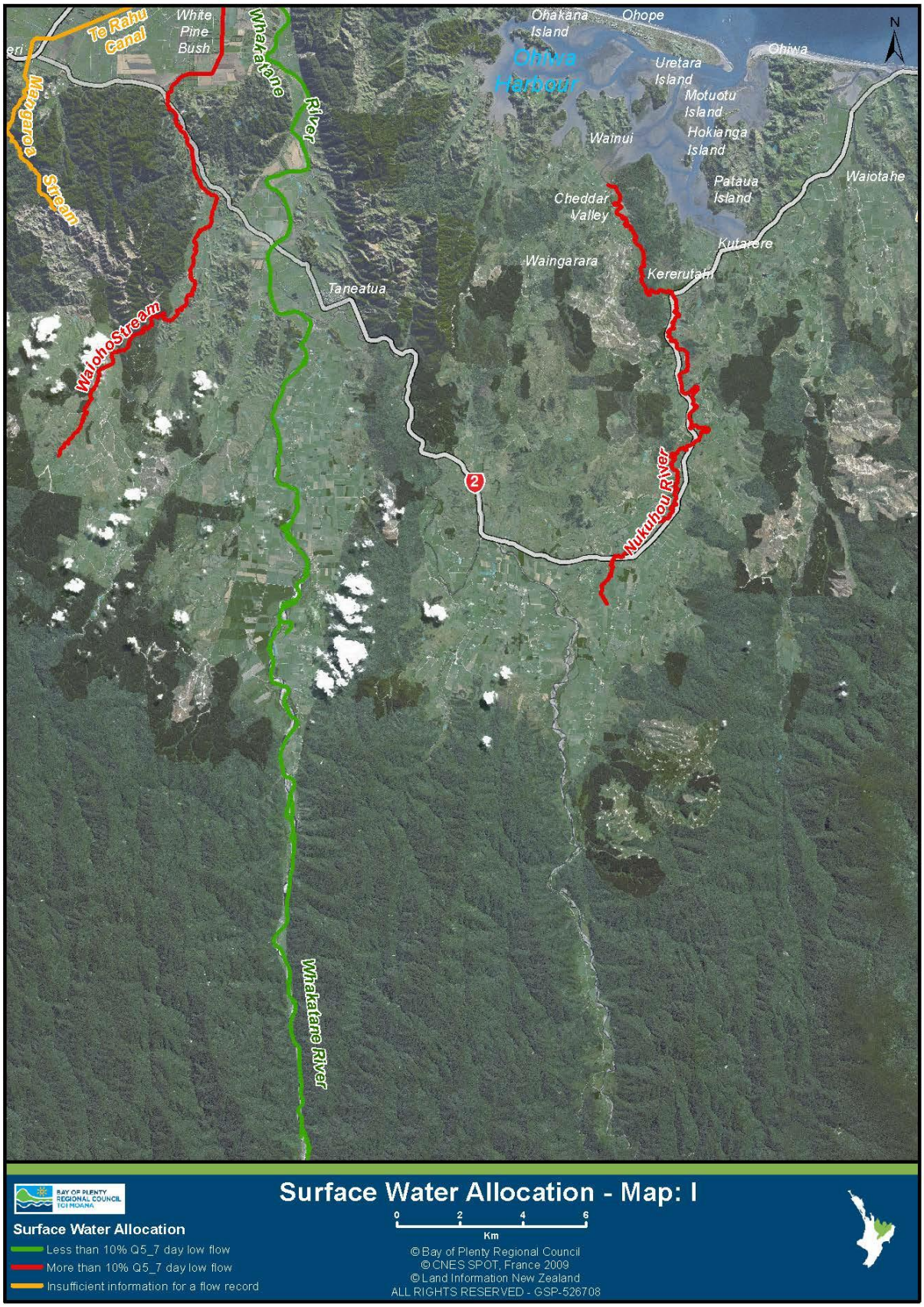
Te Rahu Canal
White Pine Bush
Whakatane River
Waiohou Stream
Ohakana Island
Ohope
Ohiwa Harbour
Ohiwa
Uretara Island
Motuotu Island
Hokianga Island
Wainui
Pataua Island
Waiotahe
Cheddar Valley
Kutarere
Waingarara
Kererutahi
Taneatua
Nukuhou River
Whakatane River
N
Surface Water Allocation - Map: I
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
0 2 4 6
Km
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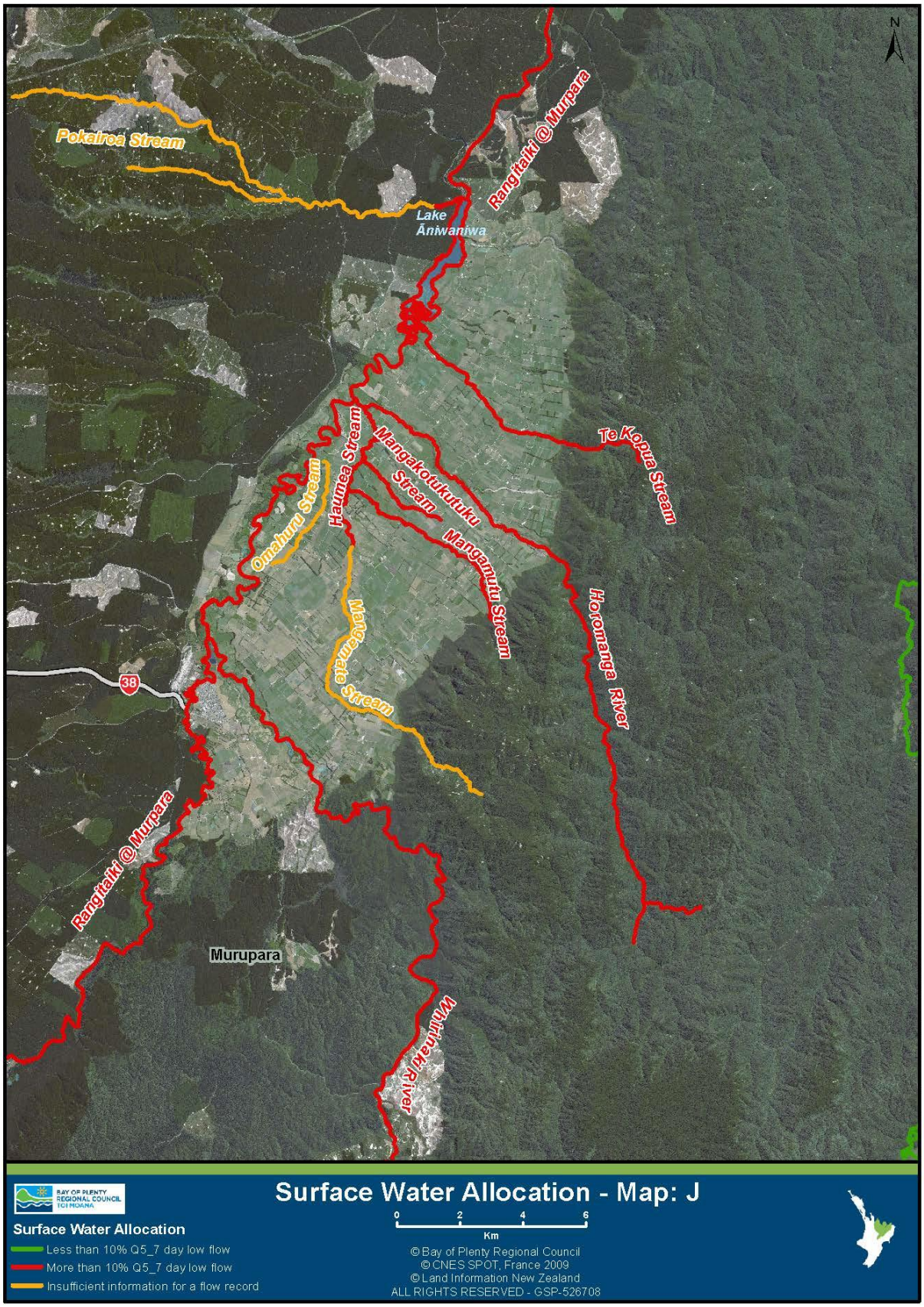
N
Pokairoa Stream
Rangitaiki @ Murupara
Lake Aniwaniwa
Te Kopua Stream
Mangakotukutuku Stream
Haumea Stream
Omahuru Stream
Manganuiti Stream
Horomanga River
Mangamate Stream
38
Rangitaiki @ Murupara
Murupara
Whirinaki River
Surface Water Allocation - Map: J
BAY OF PLENTY REGIONAL COUNCIL TOI MOANA
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
0 2 4 6
Km
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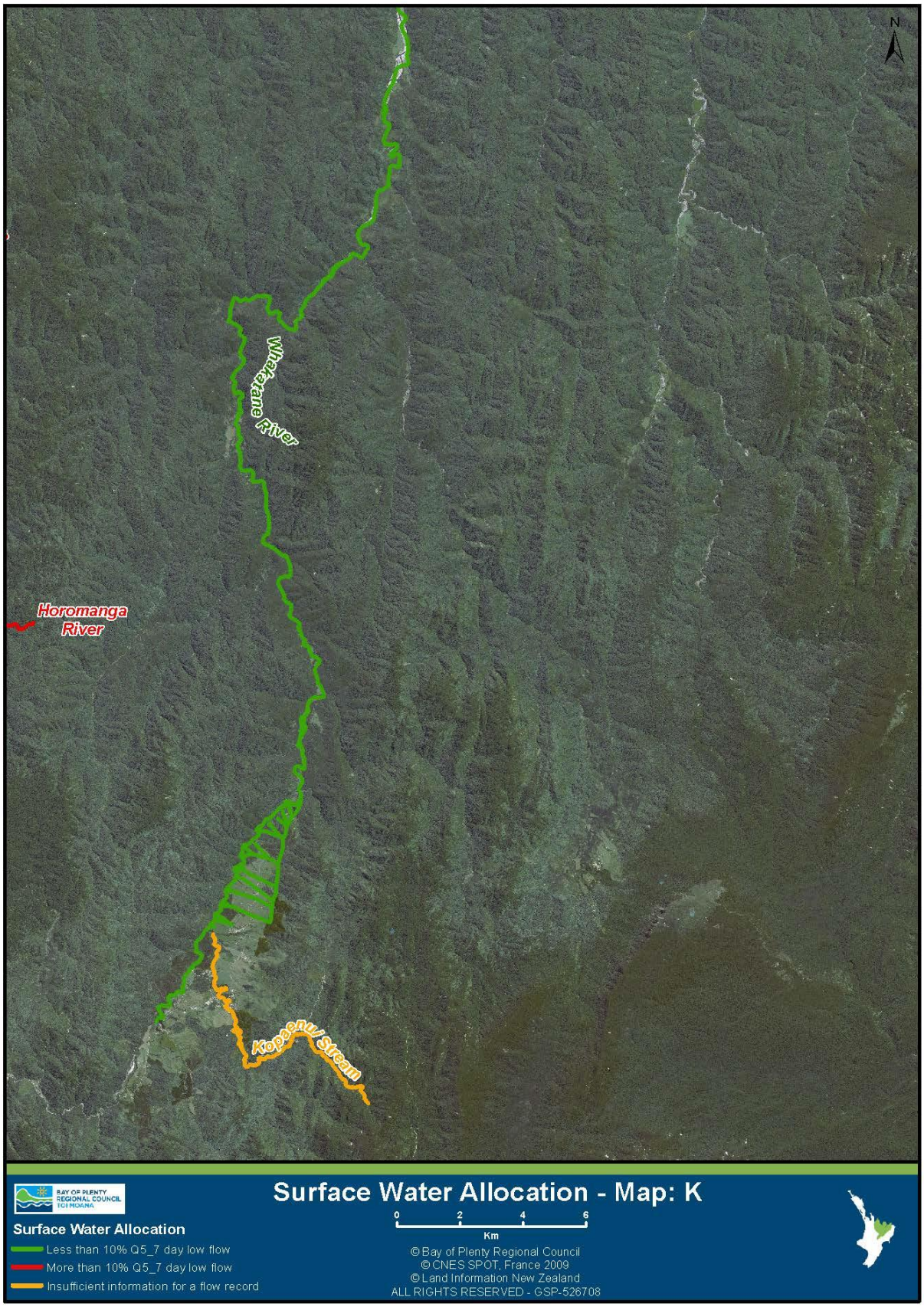
N
Whakatane River
Horomanga River
KoppeRW Stream
Surface Water Allocation - Map: K
0 2 4 6
Km
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
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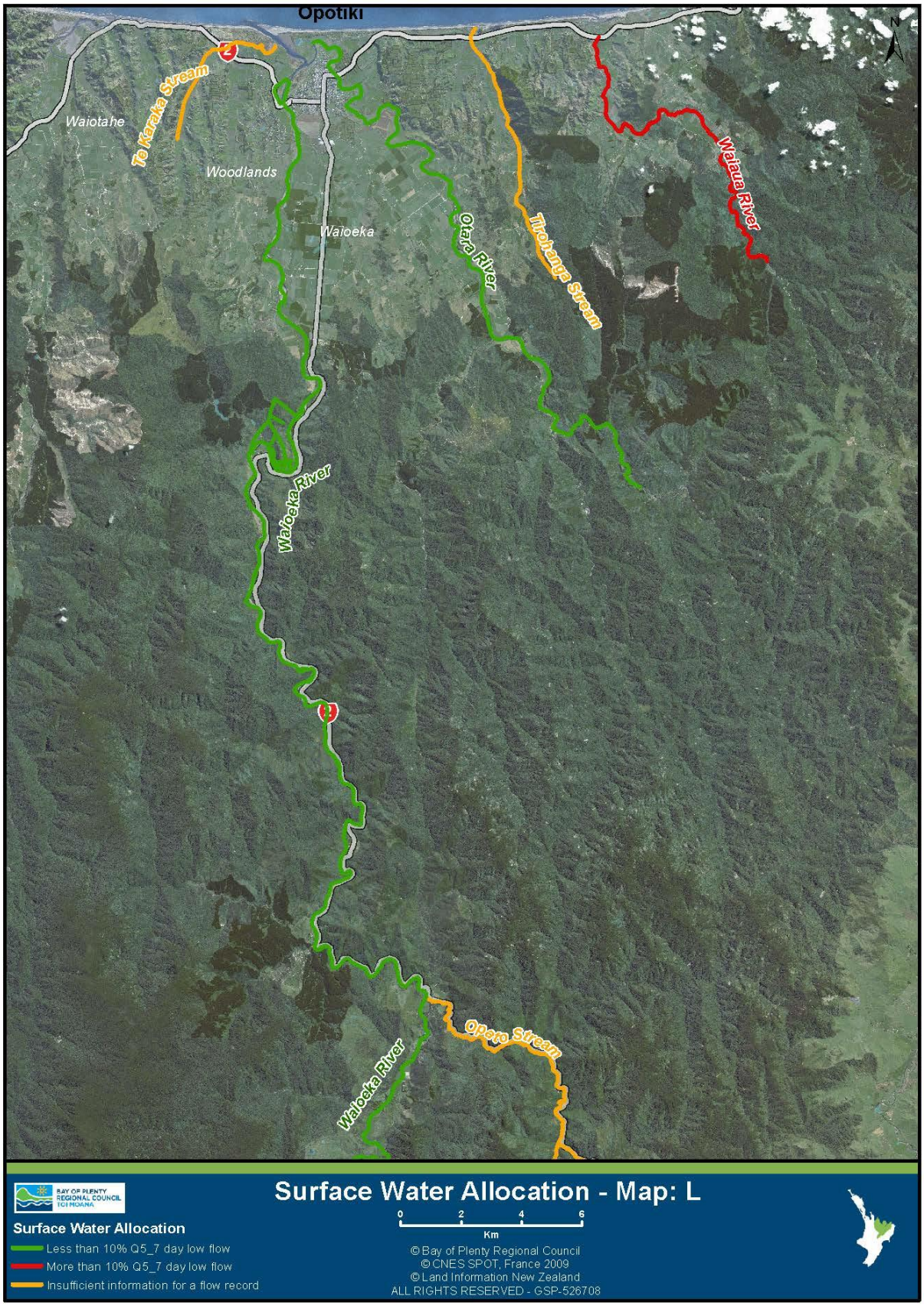
Opotiki
Waiotahe
Te Karaka Stream
Woodlands
Waioeka
Otara River
Tiohanga Stream
Waiaua River
Waioeka River
Opero Stream
Waioeka River
Surface Water Allocation - Map: L
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
0 2 4 6
Km
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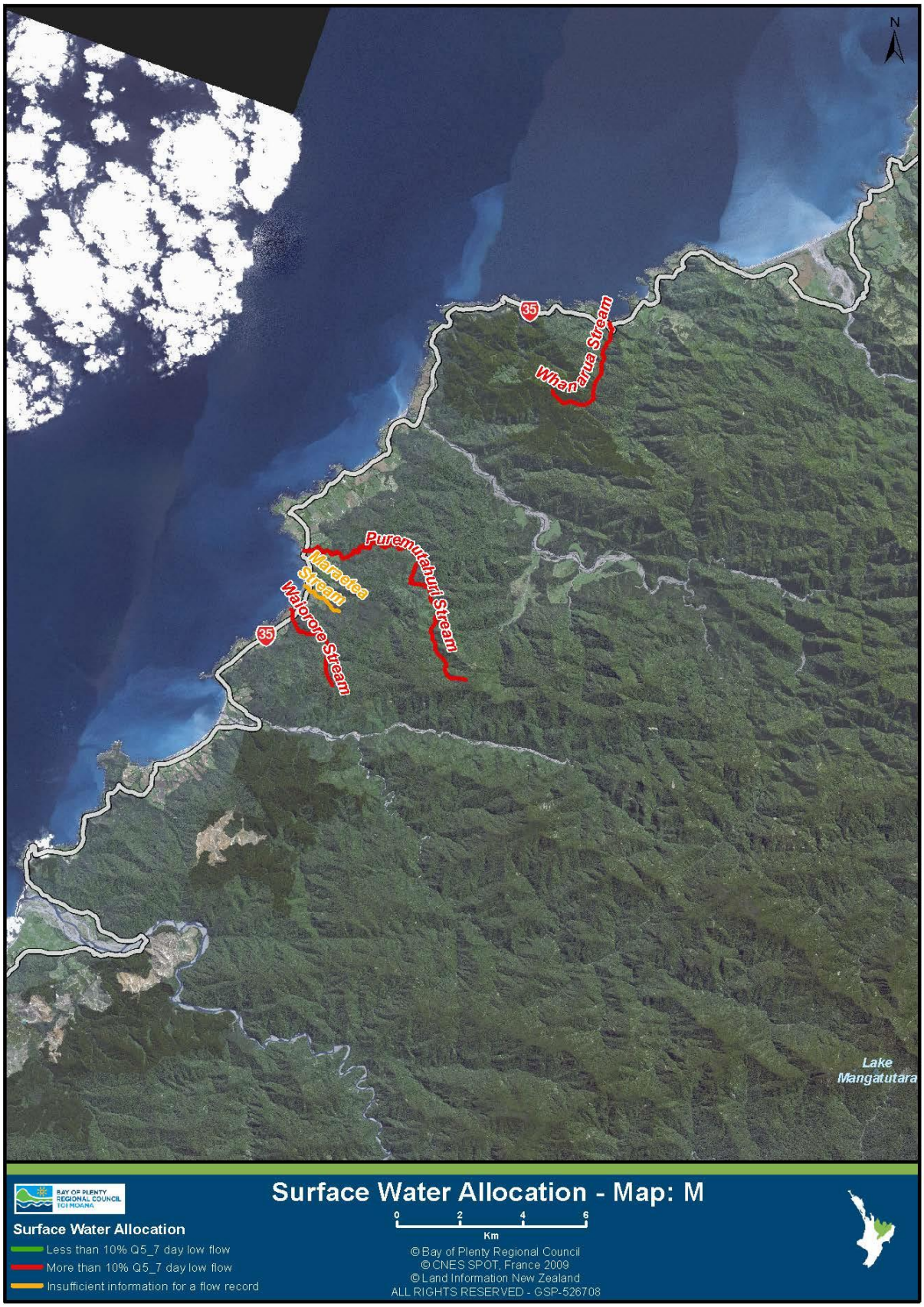
N
35
Whararua Stream
Puremurahuri Stream
Maraetea Stream
Waiorore Stream
35
Lake Mangatutara
BAY OF PLENTY REGIONAL COUNCIL TOI MOANA
Surface Water Allocation
Less than 10% Q5_7 day low flow
More than 10% Q5_7 day low flow
Insufficient information for a flow record
Surface Water Allocation - Map: M
0 2 4 6
Km
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5.3 Table 2 – Groundwater allocation

Groundwater allocation compared to allocable flow. Red shading indicates that the water body exceeds 35% of recharge, green shading indicates that the water body does not exceed 35% of recharge and orange shading indicates that the water body is a recharge area.

No data is provided for the Upper Rangitāiki area, although preliminary studies have been completed. Potential applicants seeking groundwater in this area should contact the duty Consents Planner. Establishing new groundwater takes is constrained by existing surface water allocation, unless the applicant can show that the take will not affect surface water.

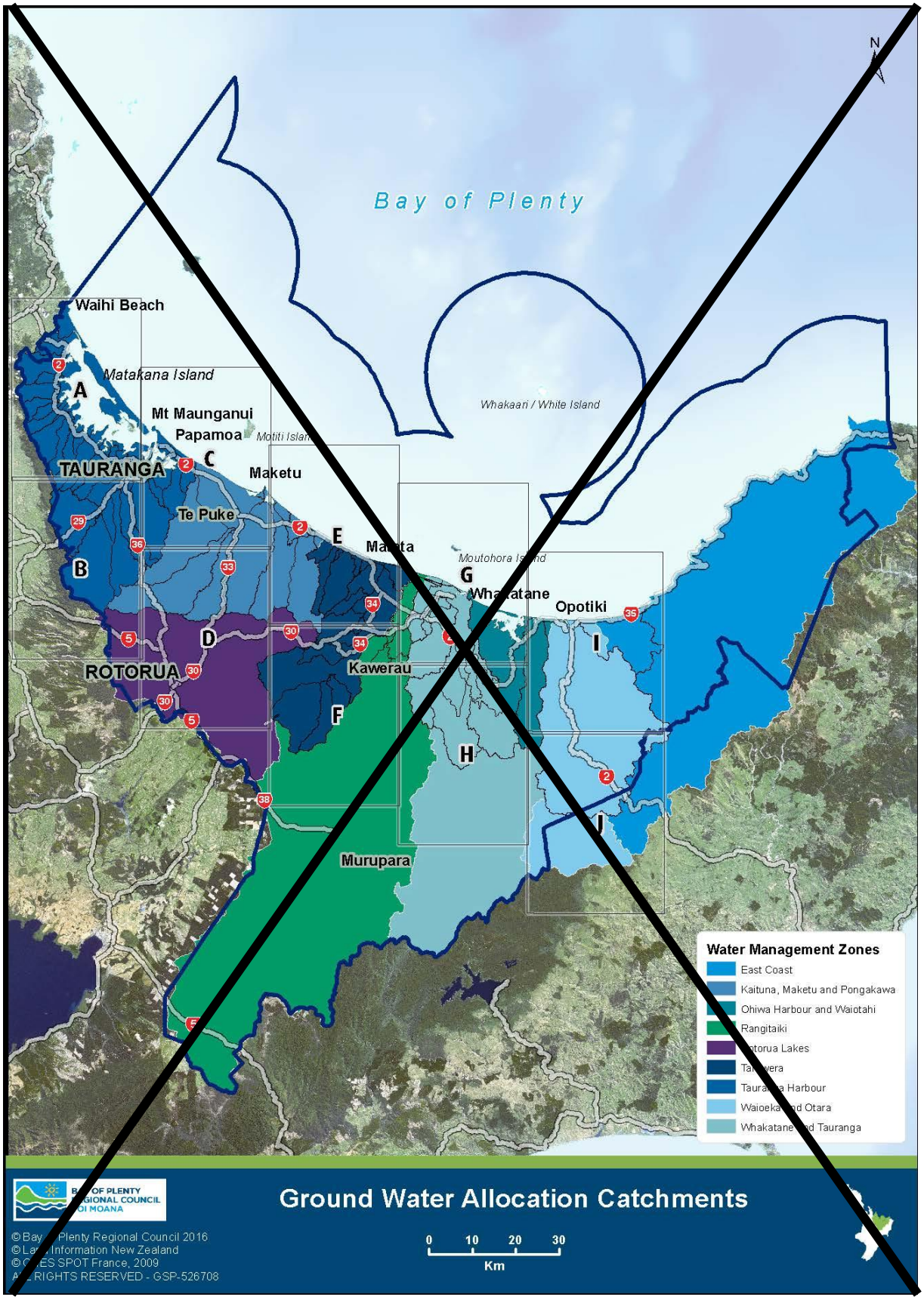
Groundwater Catchment	Annual average recharge (L/s)	Allocable flow (L/s)	Allocated Flow (L/s) 2016	Remaining allocation (L/s)
Tauranga Harbour WMA				
Aongatete	686.0	240.1	2.7	237.4
Apata	260.0	91.0	5.9	85.1
Kaitemako	227.0	79.5	0.4	79.0
Katikati Streams	132.0	46.2	7.2	39.0
Kopurererua	462.0	161.7	38.9	122.8
Mangapapa/Opuiaki	0.0	0.0	2.3	NAA
Matakana Island	707.0	247.5	4.7	242.8
Maungatawa area	502.0	175.7	68.0	107.7
Omanawa	0.0	0.0	1.9	NAA
Ongare/Tanners Point	175.0	61.3	32.7	28.6
Otumoetai area	4.0	1.4	1.7	0.0
Oturu	116.0	40.6	5.6	35.0
Tahawai	199.0	69.7	6.3	63.3
Tauranga city area	84.0	29.4	0.6	28.8
Te Mania	101.0	35.4	2.5	32.8
Te Puna	0.0	0.0	4.8	NAA
Te Puna area	771.0	269.9	2.0	267.9
Te Rereatukahia	303.0	106.1	0.7	105.3
Tuapiro	502.0	175.7	0.8	174.9
Uretara	490.0	171.5	146.1	25.4
Waiau	479.0	167.7	45.8	121.8
Waihi Beach	498.0	174.3	3.9	170.4
Waimapu	1949.0	682.2	9.6	672.5
Wainui	0.0	0.0	1.5	NAA
Waione	129.0	45.2	12.4	32.8
Waipapa	776.0	271.6	172.6	99.0
Wairoa - Ngamawahine	0.0	0.0	0.0	NAA
Wairoa-Ohourere	799.0	279.7	150.0	129.7

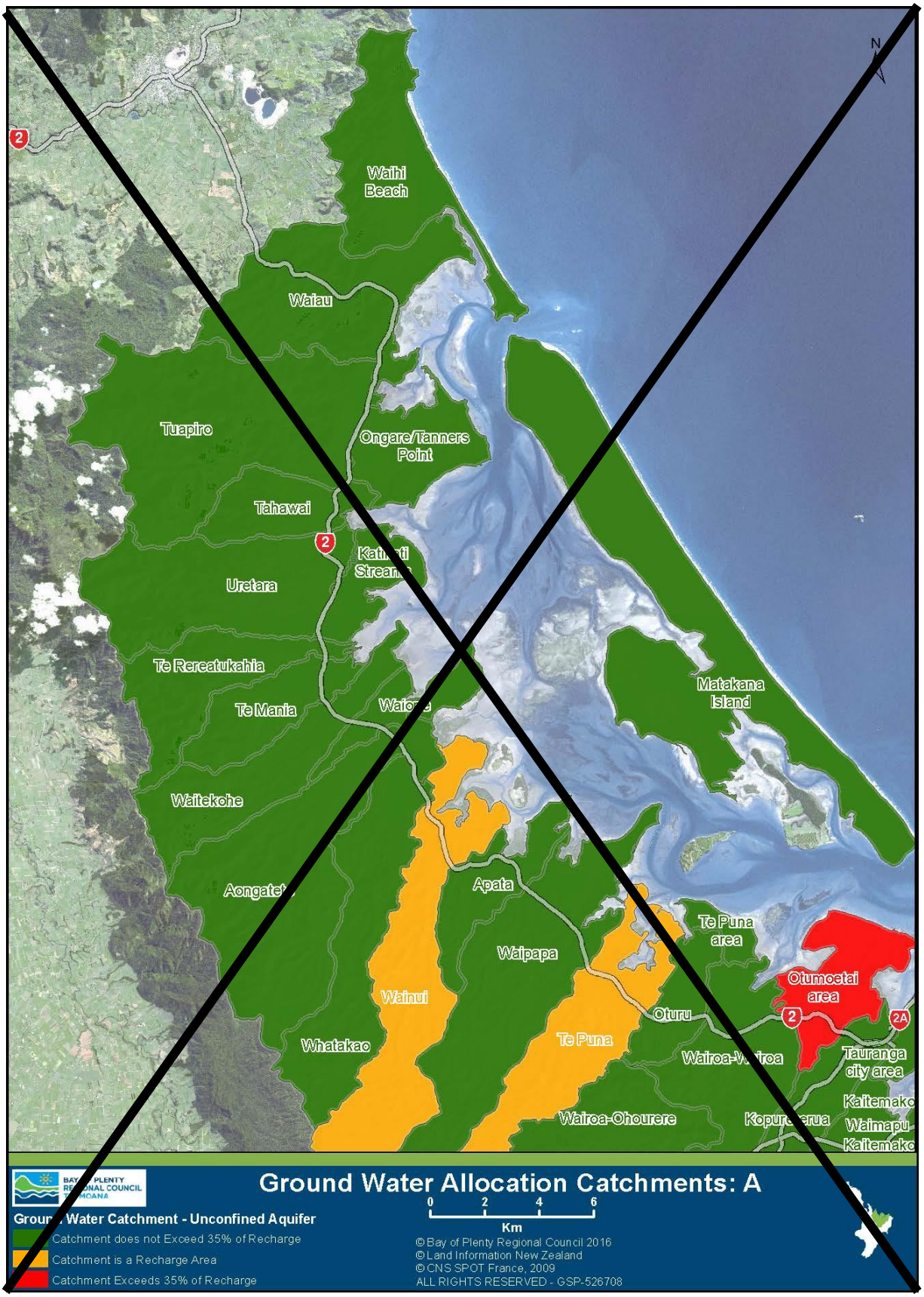
Groundwater Catchment	Annual average recharge (L/s)	Allocable flow (L/s)	Allocated Flow (L/s) 2016	Remaining allocation (l/s)
Waiōpa-Wairoa	408.0	142.8	8.5	134.3
Waitahanui area	824.0	288.4	2.3	286.1
Waitekohe	404.0	141.4	0.5	140.9
Welcome Bay area	260.0	91.0	0.0	91.0
Whatakao	532.0	186.2	0.0	186.2
Kaituna, Maketū and Pongakawa WMA				
Hauone	268.0	93.8	11.5	82.3
Kaikokopu - Pokopoko-Wharere	1444.0	505.4	372.0	133.4
Lower Kaituna	854.0	298.9	358.2	0.0
Maketū	24.0	8.4	0.0	8.4
Mangaone Stream	0.0	0.0	0.0	NAA
Mangorewa	0.0	0.0	13.9	NAA
Newdicks	22.0	7.7	1.7	6.0
Ohinepanea	307.0	107.5	65.5	42.0
Otamarakau	19.0	6.7	0.0	6.7
Pongakawa	296.0	103.6	81.5	22.1
Pukehina	76.0	26.6	0.0	26.6
Pukehina Beach	10.0	3.5	0.0	3.5
Waitahanui	283.0	99.1	39.7	59.4
Rotorua Lakes WMA				
Mangaone Stream	0.0	0.0	0.0	NAA
Upper Tarawera	2946.0	1031.1	139.5	891.6
Waiaute	0.0	0.0	0.0	NAA
Waikanapiti	327.0	114.5	7.9	106.6
Tarawera WMA				
Awaiti Canal	764.0	267.4	167.1	100.3
Awakaponga	388.0	135.8	5.5	130.3
Edgecumbe Catchwater	304.0	106.4	22.8	83.6
Hauone	268.0	93.8	11.5	82.3
Mangaone Stream	0.0	0.0	0.0	NAA
Mangate	783.0	274.1	0.0	274.1
Mangawhio	0.0	0.0	0.0	NAA
Matata	23.0	8.1	0.0	8.1
~~Matata~~	~~23.0~~	~~8.1~~	~~0.0~~	~~8.1~~
Mimiha	462.0	161.7	0.0	161.7
Ohinekoao	138.0	48.3	0.0	48.3
Old Rangitāiki Canal	0.0	0.0	11.8	NAA

Groundwater Catchment	Annual average recharge (L/s)	Allocable flow (L/s)	Allocated Flow (L/s) 2016	Remaining allocation (L/s)
Tarawera WMA				
Pikowai	73.0	25.6	1.4	24.2
Rangitāiki Dunes	0.0	0.0	3.6	NAA
Rotoroa	373.0	130.6	36.6	94.0
Ruataniwha	68.0	23.8	0.0	23.8
Tarawera Dunes	0.0	0.0	0.0	NAA
Tumarau	143.0	50.1	0.0	50.1
Tumurenui	113.0	39.6	1.8	37.7
Upper Tarawera	2946.0	1031.1	139.5	891.6
Waiaute	0.0	0.0	0.0	NAA
Waikamihi Stream	483.0	169.1	9.7	159.3
Waikanapiti	327.0	114.5	7.9	106.6
Waikowhewhe area	0.0	0.0	48.7	NAA
Rangitāiki WMA				
Awaiti Canal	764.0	267.4	167.1	100.3
Edgecumbe Catchwater	304.0	106.4	22.8	83.6
Kope Orini 1	0.0	0.0	43.5	NAA
Kope Orini 2	0.0	0.0	0.0	NAA
Mangamako area	0.0	0.0	107.9	NAA
Mangate	783.0	274.1	0.0	274.1
Mangawhio	0.0	0.0	0.0	NAA
Ngakauroa Stream	439.0	153.7	142.3	11.3
Nursery Drain	13.0	4.6	23.5	0.0
Old Rangitāiki Canal	0.0	0.0	11.8	NAA
Rangitāiki Dunes	0.0	0.0	3.6	NAA
Reids Central Canal	521.0	182.4	24.9	157.5
Te Rahu 1	306.0	107.1	5.1	102.0
Upper Tarawera	2946.0	1031.1	139.5	891.6
Waiaute	0.0	0.0	0.0	NAA
Waikowhewhe area	0.0	0.0	48.7	NAA
Waioho Canal	707.0	247.5	2.4	245.1
Whakatane West Hills	0.0	0.0	0.0	NAA

Groundwater Catchment	Annual average recharge (L/s)	Allocable flow (L/s)	Allocated Flow (L/s) 2016	Remaining allocation (L/s)
Whakatāne WMA				
Kope Orini 1	0.0	0.0	43.5	NAA
Kope Orini 2	0.0	0.0	0.0	NAA
Kope Orini 3	0.0	0.0	1.6	NAA
Mangamako area	0.0	0.0	107.9	NAA
Ngakauroa Stream	439.0	153.7	142.3	11.3
Oromoeroa Flats	0.0	0.0	25.4	NAA
Oromoeroa Hills	0.0	0.0	0.0	NAA
Rangitāiki Dunes	0.0	0.0	3.6	NAA
Reids Central Canal	521.0	182.4	24.9	157.5
Te Rahu 1	306.0	107.1	5.1	102.0
Te Rahu 2	254.0	88.9	5.4	83.5
Waimana East Flats	0.0	0.0	2.3	NAA
Waimana Hills	0.0	0.0	9.3	NAA
Waimana West Flats	0.0	0.0	0.0	NAA
Waioho Canal	707.0	247.5	2.4	245.1
Whakatane Dunes	0.0	0.0	0.0	NAA
Whakatane East	257.0	90.0	14.0	76.0
Whakatane West Hills	0.0	0.0	0.0	NAA
Ōhiwa Harbour and Waiōtahe WMA				
Ohope-Ohiwa	2955.0	1034.3	4.7	1029.5
Opotiki	6508.0	2277.8	236.7	2041.1
Waimana East Flats	0.0	0.0	2.3	NAA
Waimana Hills	0.0	0.0	9.3	NAA
Waiotahi	877.0	307.0	1.4	305.6
Whakatane East	257.0	90.0	14.0	76.0
Waioeka and Otara WMA				
Opotiki	6508.0	2277.8	236.7	2041.1
Tirohanga	1396.0	488.6	6.7	481.9
East Coast WMA				
Tirohanga	1396.0	488.6	6.7	481.9

5.4 Groundwater maps

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Waihi Beach
Waiau
Tuapiro
Ongare/Tanners Point
Tahawai
Uretara
Te Rereatukahia
Te Mania
Waitekohe
Matakana Island
Apata
Waipapa
Wainui
Whatakao
Te Puna
Te Puna area
Otumoetai area
Oturu
Wairoa-Ohourere
Tauranga city area
Waimapu
Ground Water Allocation Catchments: A
0 2 4 6
Km
Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
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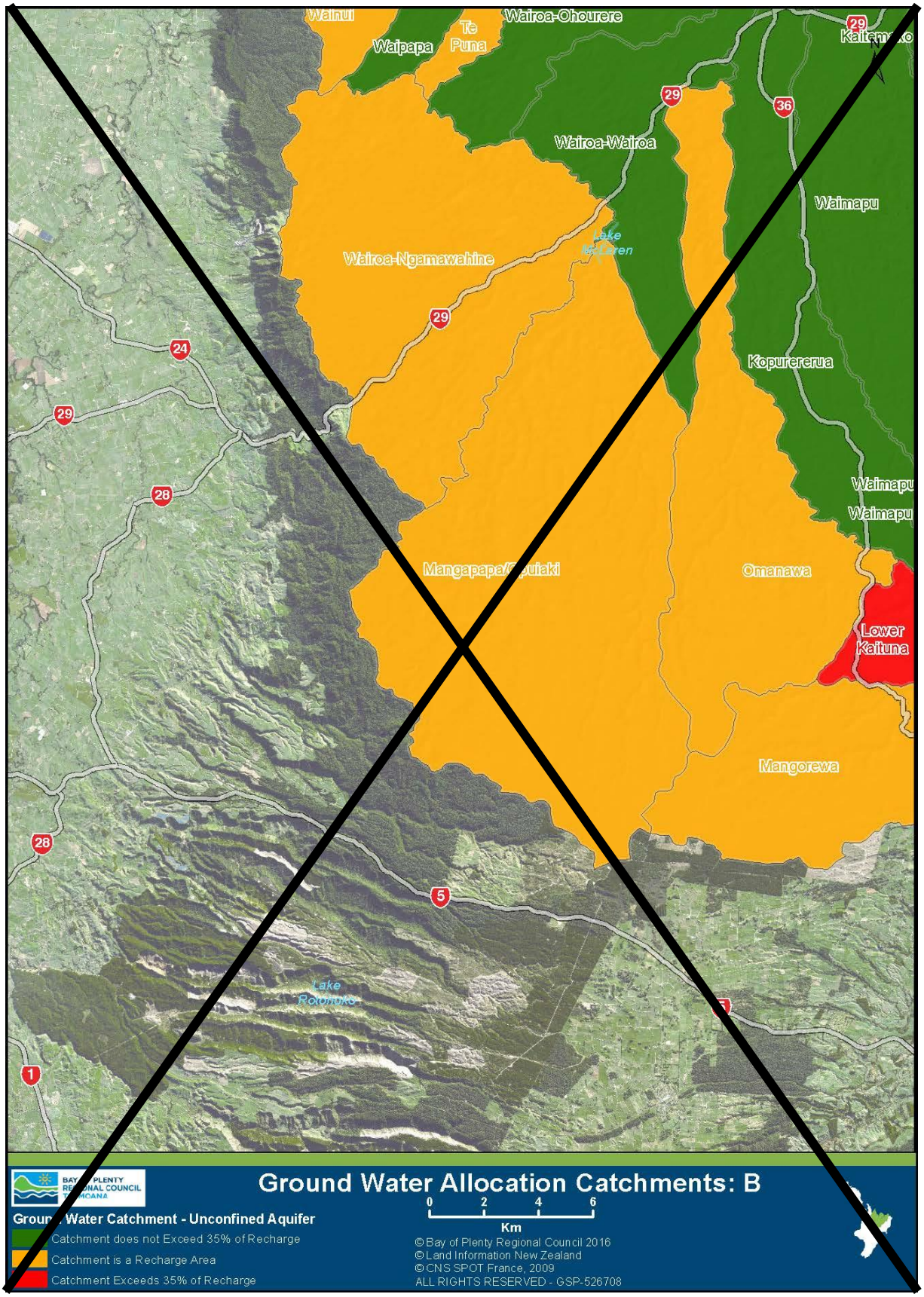
Wainui
Waipapa
Te Puna
Wairoa-Ohourere
Wairoa-Wairoa
Wairoa-Ngamawahine
Lake Rotoiti
Waimapu
Waimapu
Waimapu
Kopurererua
Omanawa
Lower Kaituna
Mangorewa
Lake Rotomoko
29
36
24
28
5
1
Ground Water Allocation Catchments: B
Ground Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
0 2 4 6
Km
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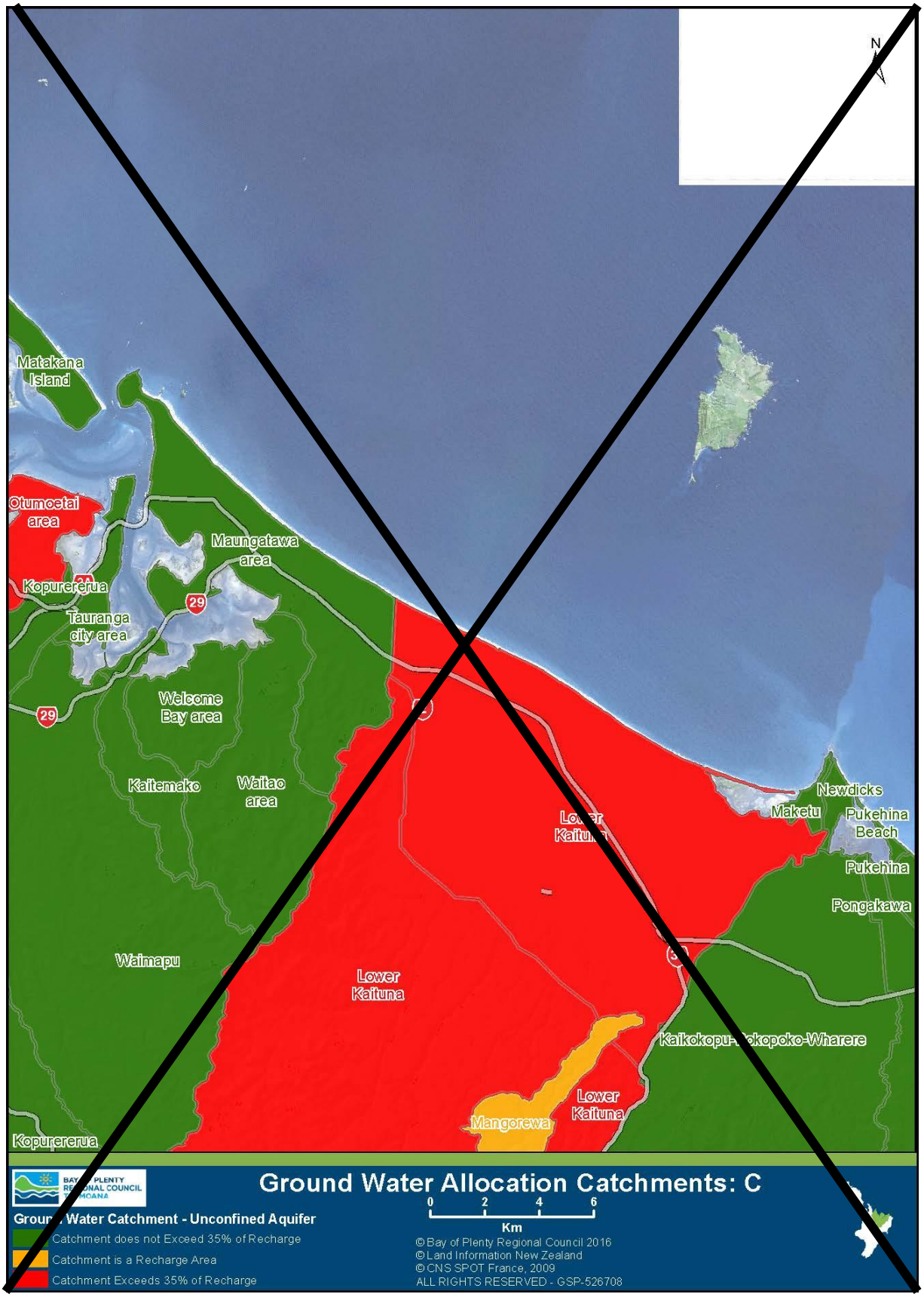
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Matakana Island
Otumoetai area
Maungatawa area
Kopurererua
29
Tauranga city area
Welcome Bay area
Kaitemako
Waitao area
Newdicks
Maketu
Pukehina Beach
Pukehina
Pongakawa
Waimapu
Lower Kaituna
Kaikokopu-Tokopoko-Wharere
Mangorewa
Ground Water Allocation Catchments: C
0 2 4 6
Km
Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
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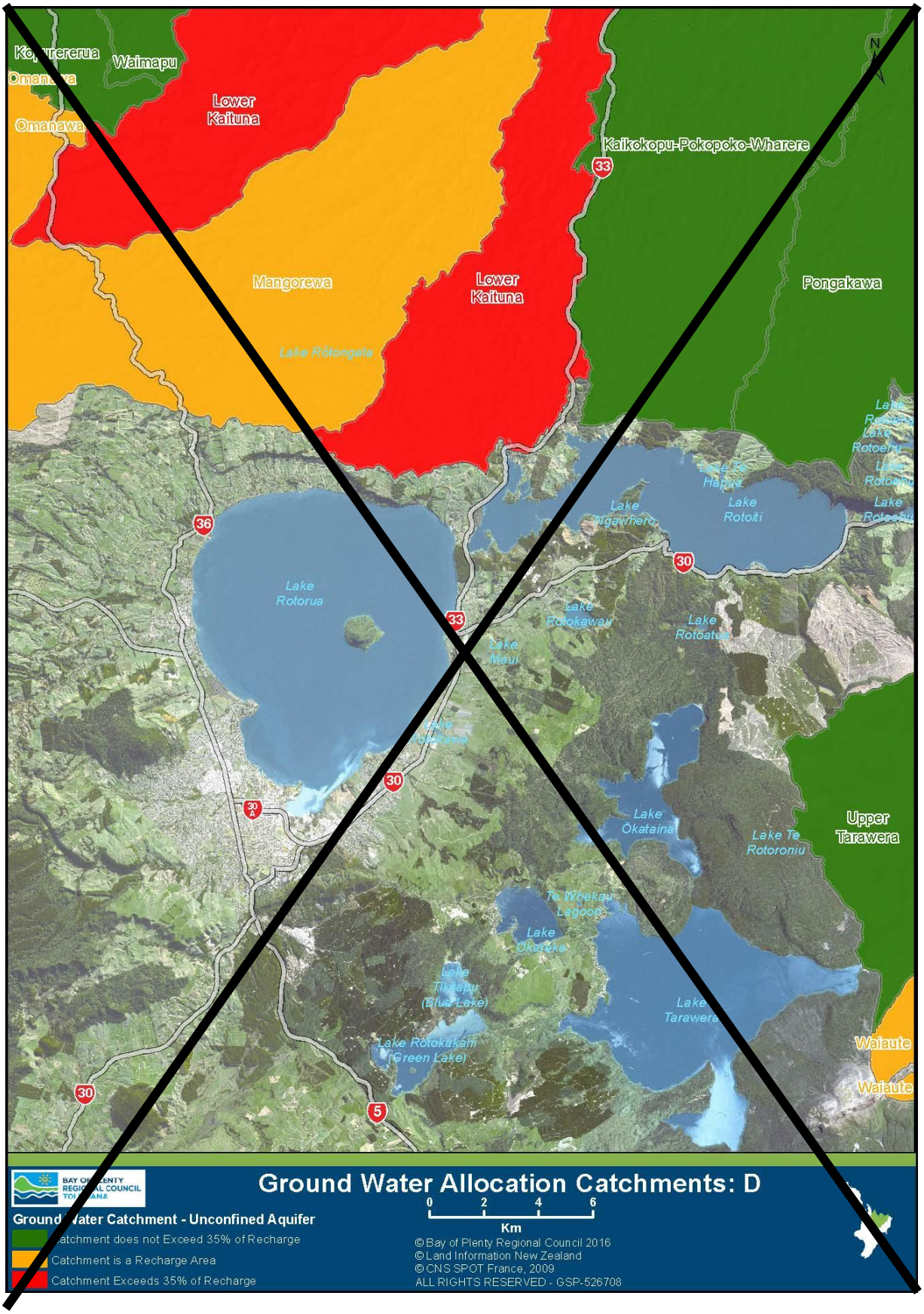
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Lower Kaituna
Omanawa
Kaikokopu-Pokopoko-Wharere
Mangorewa
Lower Kaituna
Pongakawa
Lake Rōtongata
Lake Rotorua
Lake Rotokawau
Lake Rotoiti
Lake Rotoatua
Lake Maui
Lake Okataina
Lake Te Rotoroniu
Upper Tarawera
Te Whekau Lagoon
Lake Okareka
Lake Tikitapu (Blue Lake)
Lake Tarawera
Lake Rotokakahi (Green Lake)
Waiaute
Ground Water Allocation Catchments: D
Ground Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
0 2 4 6
Km
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Maketu
Newdicks
Pukehina Beach
Lower Kaituna
Pukehina
Ohinepanea
2
Otamarakau
Kaikokopu-Pokopoko-Wharere
Hauone
Ohinekoao
Tarawera Dunes
Matata
Old Rangitaiki Canal
Pongakawa
Waitahanui
Mimiha
Awaiti Canal
2
Waikamihi Stream
Tumarau
Reids Central Canal
Mangaone Stream
Lake Rotoiti
Lake Rotoma
Tumurenui
Ground Water Allocation Catchments: E
0 2 4 6
Km
Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
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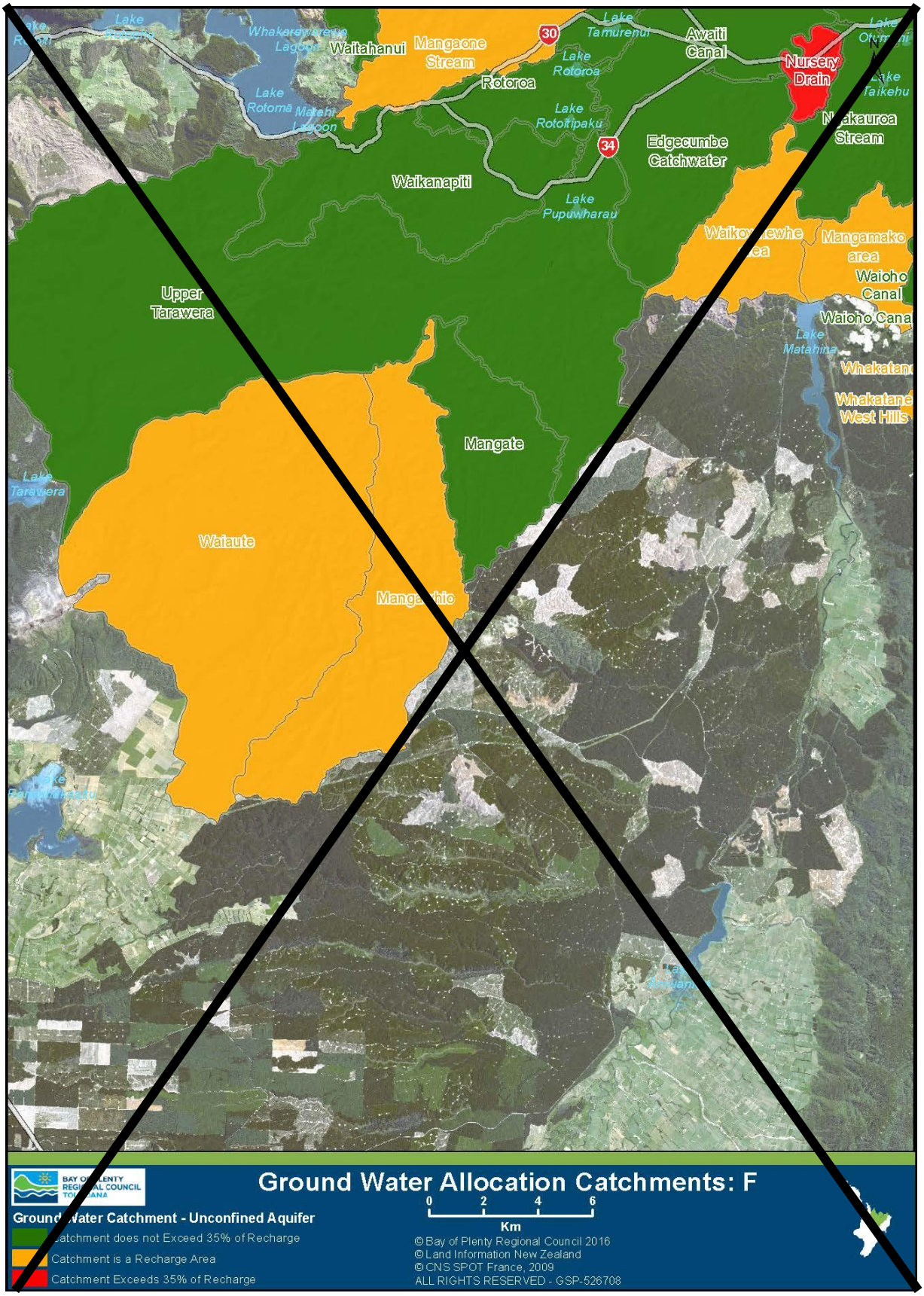
Lake Rotoiti
Whakarewarewa Lagoon
Waitahanui
Mangaone Stream
30
Lake Tarawera
Awaiti Canal
Lake Rotoroa
Rotoroa
Nursery Drain
Lake Taikehu
Lake Rotoma
Matahi Lagoon
Lake Rotorua
Lake Rotoiti
Nukuhou Stream
34
Edgecumbe Catchwater
Waikanapiti
Lake Pupuwharau
Mangamako area
Upper Tarawera
Waioho Canal
Waioho Cana
Lake Matahina
Whakatane
Whakatane West Hills
Mangate
Lake Tarawera
Waiaute
Mangaohio
Ground Water Allocation Catchments: F
Ground Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
0 2 4 6
Km
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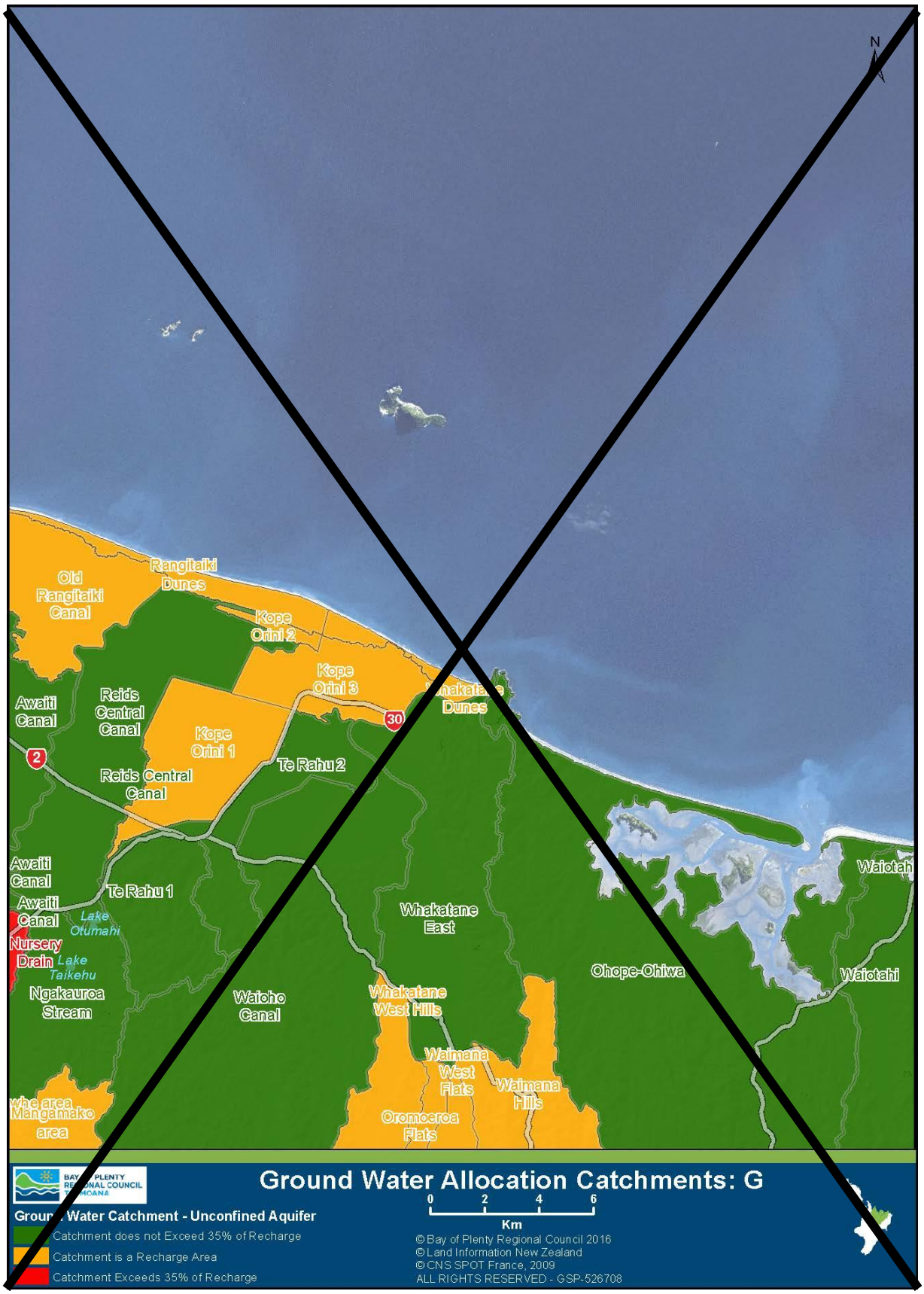
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Old Rangitaiki Canal
Rangitaiki Dunes
Kope Orini 2
Kope Orini 3
Awaiti Canal
Reids Central Canal
Kope Orini 1
Te Rahu 2
Reids Central Canal
Awaiti Canal
Te Rahu 1
Awaiti Canal
Lake Otumahi
Nursery Drain
Lake Taikehu
Ngakauroa Stream
Waioho Canal
Whakatane East
Whakatane West Hills
Waimana West Flats
Waimana Hills
Oromoeroa Flats
Ohope-Ohiwa
Waiotah
Waiotahi
Ground Water Allocation Catchments: G
0 2 4 6
Km
Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
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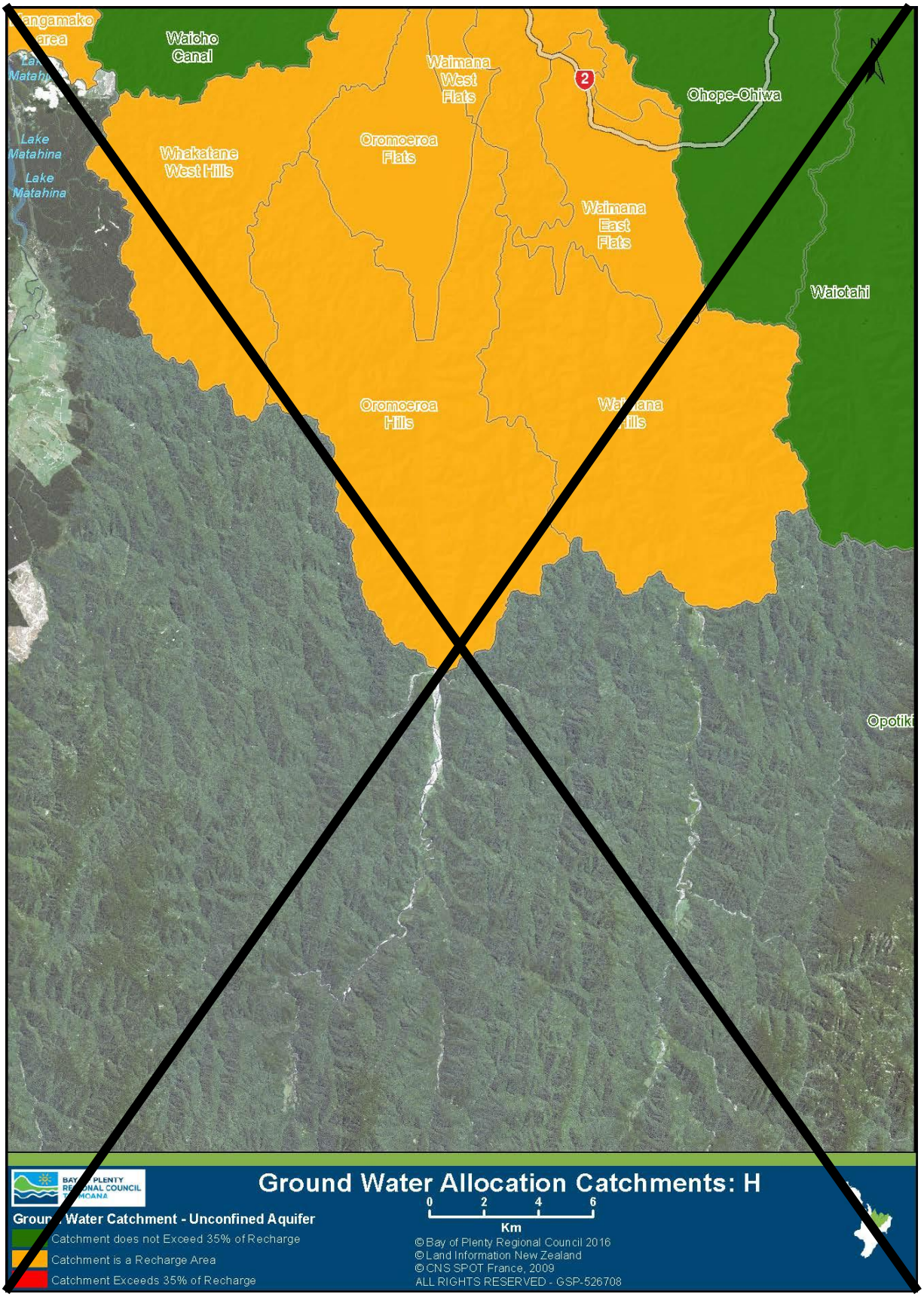
Waioho Canal
Waimana West Flats
Ohope-Ohiwa
Lake Matahina
Lake Matahina
Whakatane West Hills
Oromoeroa Flats
Waimana East Flats
Waiotahi
Oromoeroa Hills
Opotiki
Ground Water Allocation Catchments: H
0 2 4 6
Km
Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
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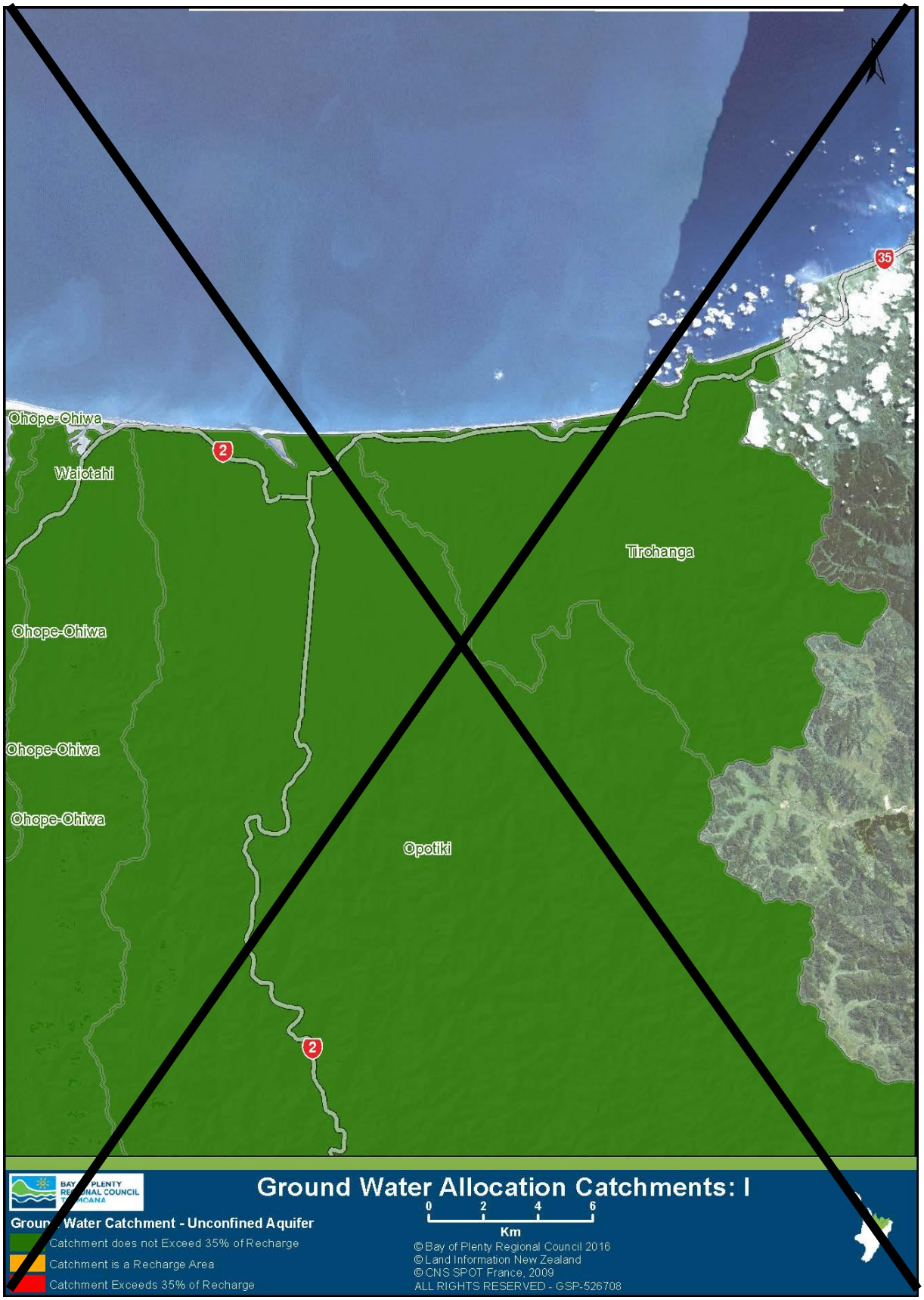
Ohope-Ohiwa
Waiotahi
Tirohanga
Ohope-Ohiwa
Ohope-Ohiwa
Ohope-Ohiwa
Opotiki
35
2
2
Ground Water Allocation Catchments: I
0 2 4 6
Km
Ground Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
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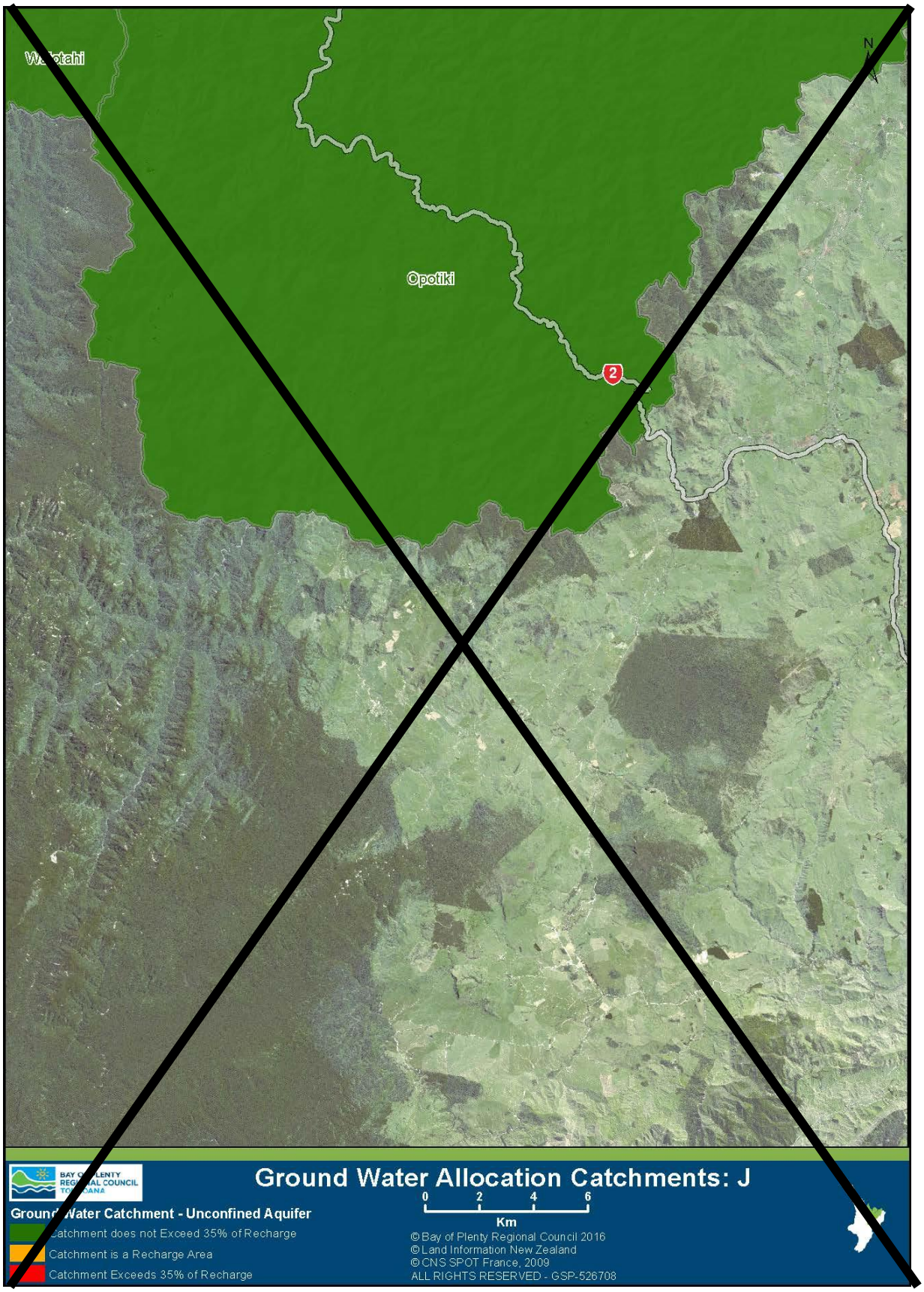
Opotiki
2
N
Ground Water Allocation Catchments: J
0 2 4 6
Km
Ground Water Catchment - Unconfined Aquifer
Catchment does not Exceed 35% of Recharge
Catchment is a Recharge Area
Catchment Exceeds 35% of Recharge
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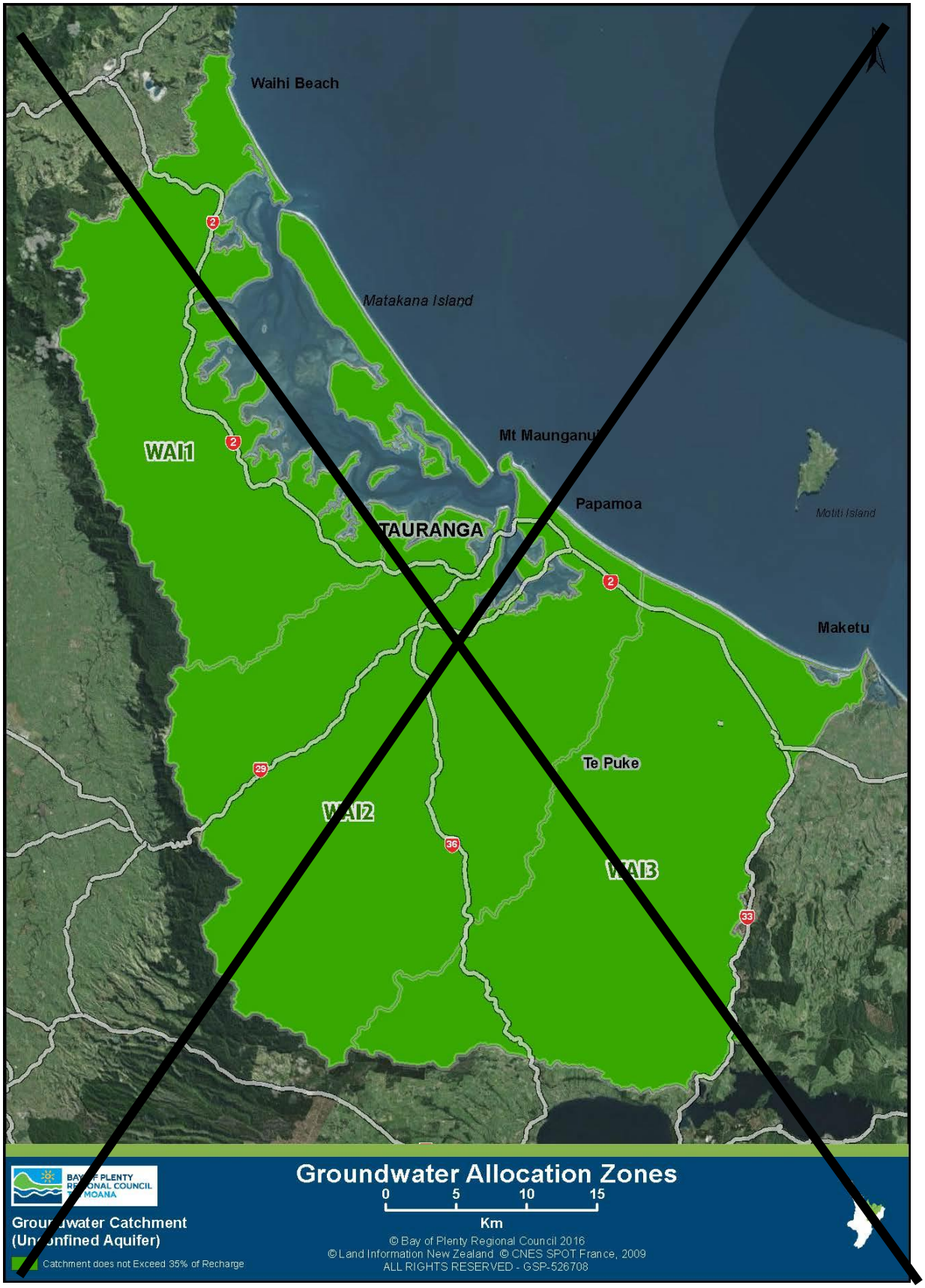
5.5 Table 3 – Deep groundwater allocation

Groundwater Zone	Annual average recharge (L/s)	Allocable flow (L/s)	Allocated Flow (L/s) 2016	Remaining allocation (l/s)
WAI1 Ignimbrite	4251.0	1487.9	210.6	1277.3
WAI2 Ignimbrite	2753.0	963.6	163.8	799.8
WAI3 Ignimbrite	726.0	254.1	40.8	213.3

5.6 ~~Deep groundwater maps~~



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  Smakhtin, V. U. (2001). Low flow hydrology : A review. Journal of Hydrology, 147-186.

- ~~Groundwater resource investigations of the Paengaroa-Matata area stage 1 – conceptual geological and hydrogeological models and preliminary allocation assessment.~~

  ~~GNS Science Consultancy Report 2008/134~~
  ~~January 2009~~
  ~~Objective ID A268418~~
  ~~Chapter 5 Hydrology~~
  ~~Chapter 6 Groundwater allocation~~

- ~~Groundwater resource investigations of the Western Bay of Plenty area stage 1 – conceptual geological and hydrological models and preliminary allocation assessment.~~

  ~~GNS Science Consultancy Report 2008/240~~
  ~~April 2009~~
  ~~Objective ID A270962~~
  ~~Chapter 5 Hydrology~~
  ~~Chapter 6 Groundwater allocation~~

- ~~Groundwater resource investigations of the Rangitāiki Plains stage 1 – conceptual geological model, groundwater budget and preliminary groundwater allocation assessment.~~

  ~~GNS Science Consultancy Report 2010/113~~
  ~~November 2010~~
  ~~Objective ID A571695~~
  ~~Chapter 6 Groundwater Budget~~
  ~~Chapter 7 Groundwater Allocation~~

- ~~Groundwater resource investigations in the Upper Rangitāiki River Catchment, Bay of Plenty Region. Stage 1 – preliminary groundwater allocation assessment.~~

  ~~GNS Science Consultancy Report 2014/283~~
  ~~April 2015~~
  ~~Objective ID A2085150 Chapter 5 Results: Groundwater Budget~~

- ~~Groundwater and surface water resource investigations of the Ōpōtiki-Ōhope area stage 1 – preliminary groundwater allocation assessment.~~

  ~~GNS Science Consultancy Report 2012/263~~
  ~~March 2013~~
  ~~Objective ID A1572510~~
  ~~Chapter 2.3 Hydrology~~
  ~~Chapter 3.2 Groundwater catchments~~
  ~~Chapter 3.3 Water budget and groundwater flows~~
  ~~Chapter 3.4 Water available for allocation~~
  ~~Chapter 4.2 Water budget with natural flows~~
  ~~Chapter 4.3 Water budget for geological units and water available for allocation~~
  ~~Chapter 4.4 Water allocation and use~~
  ~~Chapter 4.5 Water available for allocation, current allocation and estimated use~~

- ~~Groundwater resource investigations in the Upper Rangitāiki River Catchment, Bay of Plenty Region. Stage 1 – preliminary groundwater allocation assessment.~~

  ~~GNS Science Consultancy Report 2014/283~~
  ~~April 2015~~
  ~~Objective ID A2085150~~
  ~~Chapter 5 Results: Groundwater Budget~~

- ~~Barber, J. and Harvey, NERM Groundwater Monitoring Report 2013/02.~~