

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications by Waka Kotahi NZ Transport Agency (Waka Kotahi) to Manawatū-Whanganui Regional Council and Greater Wellington Regional Council for resource consents to enable the construction, operation and maintenance of new state highway, shared use path and associated infrastructure, between Taylors Road (to the north of Ōtaki) and Stage Highway 1 north of Levin.

**SECTION 87F REPORT OF MICHAELA JAYNE STOUT – SURFACE
WATER TAKE AND ALLOCATION**

**MANAWATŪ-WHANGANUI REGIONAL COUNCIL AND GREATER
WELLINGTON REGIONAL COUNCIL**

28 APRIL 2023

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A. OUTLINE OF REPORT

1. This report, required by section 87F of the Resource Management Act 1991 (“**RMA**”), addresses surface water takes (allocation) proposed as part of the activities the subject of resource consent applications lodged with the Manawatū-Whanganui Regional Council (“**Horizons**”) and Greater Wellington Regional Council (“**GWRC**”) for the Ōtaki to North of Levin Highway Project (the “**Ō2NL Project**”).
2. The resource consents applied for, by Waka Kotahi NZ Transport Agency (“**Waka Kotahi**”), are required to authorise the construction, operation and maintenance of a new state highway, shared use path and associated infrastructure, between Taylors Road (to the north of Ōtaki) and State Highway 1 north of Levin.
3. In addition, Waka Kotahi separately lodged Notices of Requirement (“**NoRs**”) relating to the Ō2NL Project with Horowhenua District Council and Kāpiti Coast District Council (the “**District Councils**”), respectively. Matters relating to the NoRs are outside the scope of this report and being addressed by technical advisors for the District Councils.
4. In preparing this report, I have relied on the advice from the following experts advising Horizons and GWRC:
 - (a) Logan Brown, Freshwater Ecology/Water Quality;
 - (b) Jonathan Williamson, Hydrogeology and Groundwater; and
 - (c) Michael Thompson, Surface Water Abstractions.
5. While this report is pursuant to section 87F of the RMA, I have in accordance with section 42A(1A) and (1B) attempted to minimise the repetition of information included in the application and where I have considered it appropriate, adopt that information.

B. QUALIFICATIONS / EXPERIENCE

6. My name is Michaela Jayne Stout.

7. I hold the position of Scientist – Water Allocation at Horizons. I have been in this position since September 2021.
8. I work within the science team at Horizons. A core aspect of my role is providing scientific and technical advice to support the resource consent process. This includes undertaking hydrological and water allocation assessments and investigations for resource consent applications. More broadly, as noted below, I am also involved with work to inform surface water allocation policy development and implementation in the region. I also provide technical support to other areas of Horizons where required.
9. I am currently involved in a number of projects being undertaken to support the Horizons National Policy Statement for Freshwater Management (NPS-FM) (2020) plan change process, including supporting a review of the Manawatū-Whanganui One Plan (the “**One Plan**”) surface water allocation framework.
10. I hold a Bachelor of Science majoring in Environmental Science and a Master of Environmental Management (Distinction). Both degrees were awarded by Massey University. I am a member of the New Zealand Hydrological Society.
11. I am familiar with the site and surrounding area. I have spent time in and around the Ōhau, Waikawa, and Manakau catchments as part of my current and previous role at Horizons. I also had a tour of the general Ō2NL Project corridor on 18 January 2023.

C. CODE OF CONDUCT

12. I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023. I confirm that I have stated the reasons for my opinions I express in this report and considered all the material facts that I am aware of that might alter or detract from those opinions.
13. I have addressed the proposed abstraction of surface water for construction water purposes. While I have considered proposed water abstractions from the Horizons region (i.e. from the Koputaroa,

Waikawa, Manakau, Waiauti and Ōhau Streams/Rivers), Mr Thompson has provided a technical report with regard to the proposed water take from the Waitohu Stream in the GWRC region.

14. Statements expressed in this report are made within the scope of my expertise, except where I rely on the technical advice which I have referred to in paragraph 4 of this report.
15. I have noted where further information is required through the relevant sections of my report. I also note that the river systems that Waka Kotahi are seeking to abstract from are hydrologically complex, and that not all of these complexities are well understood. Where there is some residual uncertainty in my assessment of the proposed activities due to these complexities, I have noted this in my report.
16. Further, I note that the key measurements used to assess the effects of abstractions also carry a degree of uncertainty. Specifically:
 - (a) River flow measurements are generally regarded as being accurate to $\pm 8\%$. Therefore, all individual river flow measurements and analysis should be treated as having a $\pm 8\%$ margin of error.
 - (b) Abstraction measurements are generally required to be accurate to $\pm 5\%$. Therefore, I assume that the measurement of the proposed abstraction will carry a $\pm 5\%$ margin of error.

D. EXECUTIVE SUMMARY

17. Waka Kotahi has applied to take surface water for 'construction water' purposes to support the construction of the Ō2NL Project. Waka Kotahi have applied to take water from the Koputaroa, Waikawa, Manakau, Waiauti and Ōhau Streams/Rivers in the Horizons region.
18. In the Waikawa, Manakau, Waiauti, and Koputaroa Streams, the proposal includes water being taken at all flows above the One Plan 'minimum' flow, set out in Schedule C, with additional water available at flows above the median flow. Therefore, the proposed abstraction of

surface water from these streams are assessed against the 'core' and 'supplementary' allocation frameworks set out in the One Plan.

19. In the Ōhau River, the application initially sought water under the core and supplementary allocation frameworks, but was amended earlier this year to only take water under the supplementary allocation. Therefore, I have assessed the proposed abstraction from the Ōhau River under the supplementary allocation regime only.
20. The proposed core allocations fit within the relevant core allocation limits set out in Schedule C of the One Plan, and the abstractions will cease below the minimum flows set out in Schedule C of the One Plan.¹
21. For both the core and supplementary allocation, Waka Kotahi have proposed to base the rate of take on 'actual' river flow, up to a maximum rate of take in the case of the core allocation. Waka Kotahi is not proposing to measure river flow at the proposed abstraction sites, and are instead proposing to extrapolate flow data measured at existing flow recorders either upstream or downstream of the proposed abstraction, to the proposed abstraction sites. I have assessed the methods proposed to extrapolate this data and make the following conclusions:
 - (a) In the Ōhau, Manakau, and Waiauti Streams the flow recorders can provide a reasonable estimation of actual river flow at the proposed abstraction sites.
 - (b) In the Waikawa Stream, I recommend an adjustment factor when extrapolating flow data to the abstraction sites below the median flow, due to apparent streamflow losses between the flow recorder and the abstraction site.

¹ The most recent revised conditions imply that the abstraction from the Koputaroa Stream will not cease below the One Plan Schedule C minimum flow, based at the Manawatū at Teachers College flow recorder, and will instead only cease below an alternative minimum flow calculated for the Koputaroa at Tavistock Road flow recorder, which is an alternative to Schedule C. This condition is contradictory to further information received from Dr McConchie. Mr St. Clair has since been in communication with Waka Kotahi (3 April 2023) who advised that the take will comply with both the Schedule C minimum flow at the Manawatū at Teachers College flow recorder, and an alternative minimum flow calculated for the Koputaroa at Tavistock Road flow recorder.

- (c) In the Koputaroa Stream, I recommend that same-day gauging data be collected to support the proposed adjustment factor to extrapolate flow data to the proposed abstraction site. This is due to the uncertainty around where streamflow may be gaining from/losing to groundwater between the proposed abstraction site and the flow recorder.
 - (d) I recommend that Waka Kotahi consider the 'time lag' between flows measured at the flow recorders and the flows at the abstraction sites. This time lag is most relevant in the application of the trigger flows to commence and cease the supplementary allocation. In my view, appropriate consent conditions should be introduced, to ensure that the takes only occur when flows are above median flow at the proposed abstraction sites.
22. Originally the proposed conditions implied that the rate of take would be adjusted based on real time river flow. However, the conditions have been amended by Waka Kotahi so that the rate is limited based on the mean daily flow on the preceding day. While I acknowledge that this will simplify the operation and monitoring of the takes, I am concerned that this may have unintended adverse effects. River flows, particularly as they rise above the median flow, can vary considerably within a short period of time, meaning that the mean daily flow on the preceding day will not always provide a reasonable estimate of river flow on the following day.
23. In the case of the supplementary allocation, the revised method for estimating 'actual river flow' could mean that the proposal does not comply with the restrictions set out in Policy 5-17, which requires abstractions to be limited to 10% of actual river flow. Further information is therefore required to illustrate how the proposed conditions will ensure that the proposed supplementary allocation is consistent with the restrictions set out in Policy 5-17. In those circumstances, I am also concerned that Waka Kotahi have not provided information to satisfy the requirements of Policy 5-17(b).
24. The proposed method for estimating 'actual river flow' also means the rate of take under the core allocation could be higher than 10% of the

actual river flow at the time of take if flows recede quickly after a peak in river flow (which is plausible in the streams/rivers). Mr Brown has addressed this matter further in his report.

25. In my view, further information should also be supplied to illustrate that the proposed allocation is efficient (i.e. to illustrate that no more water has been applied for than is needed to meet the projected demands of the Ō2NL Project with reasonable security).

E. SCOPE OF REPORT

26. My report focuses only on issues related to the proposed surface water abstractions from Waikawa, Waiauti, Manakau, and Ōhau Streams/Rivers in the Horizons region. Specifically, it covers the following topics:

- (a) The size of the proposed takes relative to the available core allocation;
- (b) The size of the proposed takes relative to the available supplementary allocation; and
- (c) Whether the proposed method for estimating actual river flow to determine the maximum rate of take is reasonable.

27. I have reviewed the following information from the resource consent applications for the Ō2NL Project, as well as from technical advisors acting on behalf of Waka Kotahi:

- (a) Waka Kotahi (November 2022). *Ōtaki to north of Levin Highway Project: Volume II Notices of Requirement for a designation and application for resource consents: Supporting information and assessment of effects on the environment*. Specifically;
 - (i) *Section 19.4.1 – Take, use and diversion of water – Horizons One Plan*
 - (ii) *Appendix 4 – Design and Construction Report*
 - (1) *Section 4.7.6.8 Construction water*

- (2) *Appendix 4.7 Potential surface sources of construction water*
- (iii) *Appendix 5 – Draft Conditions*
 - (1) *Condition RWT1*
- (iv) *Volume III – Drawing Set*
 - (1) *07 – Accommodation Works*
- (b) Kelly, C. (2022). *Ōtaki to north of Levin Highway Project – Response to request for additional information pursuant to section 92 of the Resource Management Act 1991*,²
- (c) McConchie, J. (2023a). *Clarification of proposed abstraction of construction water*,³
- (d) McConchie, J. (2023b). *Clarification of matters relating to application for 'construction water'*,⁴
- (e) Kelly, C. (2023a). *Ōtaki to North of Levin Highway project: Resource consent application to take water from Ohau River (APP-2021203231.00)*,⁵ and
- (f) Kelly, C. (2023b). *Otaki to north of Levin Highway Project - APP-2021203231.00 [Updated proposed conditions and McConchie (2023a) and (2023b) appended]*.⁶

F. BACKGROUND

28. Waka Kotahi have applied to take surface water from the Koputaroa, Waikawa, Manakau, Waiauti and Ōhau Streams/Rivers in the Horizons region, and from the Waitohu Stream in the GWRC region.⁷

² Provided to Horizons via letter on 23 December 2022.

³ Provided to Horizons via memorandum on 31 January 2023.

⁴ Provided to Horizons in email form on 27 February 2023.

⁵ Provided to Horizons via letter on 7 March 2023.

⁶ Provided to Horizons via letter on 21 March 2023.

⁷ As I have noted, Mr Thompson has assessed the proposed abstraction from the Waitohu Stream.

29. In the Waikawa, Manakau, Waiauti, and Koputaroa Streams, the proposed conditions for the Ō2NL Project allow for water to be taken at all flows above the One Plan 'minimum' flow (Schedule C) with additional water available at flows above the median flow. On this basis, the proposed abstraction of surface water can be addressed under the 'core' and 'supplementary' allocation frameworks in the One Plan.
30. In the Ōhau River, the application initially sought water under the core and supplementary allocation regimes, but it was recently amended so the proposal only took water under the supplementary allocation. I have assessed the proposed abstraction from the Ōhau River under the supplementary allocation regime only.

One Plan Framework – Surface Water Allocation

31. Surface water allocation in the Horizons region is managed under the water management framework in the One Plan.⁸ This framework divides the region into 43 water management zones ('zones'), and 124 surface water management subzones ('subzones'). Values are then assigned to water management zones and subzones, as well as to specific sites and reaches. These values are identified in Schedule B.
32. Schedule B identifies the following zone wide values to all of the water management zones Waka Kotahi are seeking to abstract water from: life supporting capacity, aesthetics, contact recreation, Mauri, industrial abstraction, irrigation, stock water, existing infrastructure, and capacity to assimilate pollution.
33. Schedule B also identifies a range of site/reach specific values relevant to the sites Waka Kotahi are seeking to abstract from. I detail these later as part of my review.
34. The core allocation framework sets a core allocation limit and minimum flow for each subzone. Core allocation limits outline how much water can be allocated per day from each subzone. Core allocation limits can also apply to whole zones, and combinations of subzones. The core allocation limits that apply to zones and combinations of subzones are

⁸ One Plan Policy 5-1.

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cumulative. When assessing new proposals to abstract water, proposed abstractions are assessed against all relevant core allocation limits. Minimum flows then determine when non-essential takes must generally cease abstraction.

35. The core allocation limits and minimum flows for each subzone are set out in Table C.1 of Schedule C of the One Plan. Table C.1 is attached as **Appendix A**.⁹
36. The main rule governing the taking of surface water under the core allocation is Rule 16-5. Rule 16-5 determines that takes that comply with the core allocation limits and minimum flows set out in Schedule C are a controlled activity. The rule reserves control over several matters, outlined below:
 - (a) the volume and rate of water[^] taken, and the timing of the take,
 - (b) the location of take,
 - (c) intake velocity and screening requirements,
 - (d) measures to avoid, remedy or mitigate any adverse effects[^] on the Values of the water body[^] at and below the point of take,
 - (e) effects[^] on the natural flow regime, the magnitude of the median flow and the frequency of flushing flows,
 - (f) the efficiency of water[^] use,
 - (g) effects[^] on other water[^] takes,
 - (h) effects[^] on rare habitats*, threatened habitats*, at-risk habitats* and Sites of Significance – Aquatic,
 - (i) compliance with minimum flow requirements,

⁹ Policy 5-16 describes the approach taken to set the core allocation limits and minimum flows in Schedule C. Further detail regarding the methods used to set the minimum flows and core allocation limits for the streams and rivers in question can be found in Hurdell (2009).

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- (j) duration of consent, and
- (k) review of consent conditions^ (l) compliance monitoring.

37. The proposed abstractions fit within the core allocations set out in Schedule C, and will comply with the minimum flows set out in Schedule C.¹ Therefore, each of the proposed core allocations will be assessed against Rule 16-5 as a controlled activity.
38. The supplementary allocation regime makes additional water available for abstraction when flow in the respective waterway is above median flow. The supplementary allocation is most useful when users have storage available, so that water can be harvested at high flows and stored for use during periods of lower flow.
39. Policy 5-17 describes the approach used to manage supplementary allocations. Policy 5-17(a) caps the supplementary allocation at 10% of actual river flow. Policy 5-17(b) sets out a number of additional requirements, including the requirement that the supplementary allocation will not increase the frequency or duration of minimum flows; lead to a significant departure from the natural flow regime; or cause any adverse effects that are more than minor on the Schedule B values of the water body or its bed. Policy 5-17 is set out in full in **Appendix B**.
40. The rule governing the taking of surface water under the supplementary allocation is Rule 16-9 of the One Plan. Rule 16-9 has discretionary activity status. No specific matters of discretion are included. Therefore, Policy 5-17 is relied on to inform the management and assessment of supplementary abstractions.

G. REVIEW OF APPLICATION

41. My review of the application splits the proposed abstractions into the water management subzones that Waka Kotahi are seeking to abstract surface water from. I have considered the proposed abstractions from the Waiauti and Manakau Streams together, as the two streams are in the same water management subzone. I have then considered the proposed core (i.e. below median flow) allocation, and supplementary

(i.e. above median flow) proposed allocations, and the method proposed to estimate 'actual river flow' to determine the maximum rates of take.

42. I have set out the issues/conditions identified in my review, common to all abstractions in the section titled "G.E General" so as to avoid repetition.

G.A Koputaroa Stream

G.A.A Location and Schedule B values

43. The Koputaroa Stream is in the Koputaroa (Mana 13e) water management subzone, and the Coastal Manawatū (Mana 13) water management zone.
44. The proposed abstraction point, inferred from Volume III - Drawing Set – 07 Accommodation Works, is at approx. 1796997E, 5501473N. This is where McDonald Road crosses the Koputaroa Stream.
45. The location of the abstraction point is shown in Figure 1.
46. In addition to the zone wide values,¹⁰ the One Plan identifies the following site/reach specific values for the proposed abstraction site: flood control and drainage.

G.A.B Assessment of proposed core allocation

47. Waka Kotahi have sought a core allocation of 231 m³/day from the Koputaroa Stream and Koputaroa (Mana 13e) subzone, at a maximum rate of 10% of the mean daily flow on the preceding day or 6 l/s, whichever is less. The maximum rate of take sought is sufficient to abstract the daily volume over a period of approximately 11 hours.
48. The proposed abstraction will cease below minimum flow.
49. Schedule C of the One Plan sets out a core allocation limit of 432 m³/day for the Koputaroa (Mana 13e) water management subzone, and 598,752 m³/day for the Coastal Manawatū (Mana 13) zone. The Coastal

¹⁰ The zone wide values are identified at paragraph 32.

Manawatū (Mana 13) zone is a cumulative limit and includes everything allocated from the Manawatū catchment.

50. There is currently 81 m³/day allocated within the Koputaroa (Mana 13e) subzone, and 350,041.7 m³/day allocated within the wider Coastal Manawatū (Mana 13) zone. There are a number of other proposed abstractions which are counted under the Coastal Manawatū (Mana 13) zone allocation limit. These total to 21,131.4 m³/day. The granting of this resource consent would increase the level of allocation in the Koputaroa (Mana 13e) subzone to 312 m³/day and the level of allocation in the Coastal Manawatū (Mana 13) zone to 371,404.1 m³/day. Note that the calculated level of allocation in the Coastal Manawatū (Mana 13) zone takes into account the other proposed abstractions referenced in the earlier sections of this paragraph. Therefore, having reviewed the relevant data, the proposed core allocation from the Koputaroa Stream fits within the relevant core allocation limits set out in Schedule C.
51. The proposed allocation volumes against the One Plan (Schedule C) core allocation limits are summarised in Table 1.

Table 1 Current and proposed core allocations against One Plan limits (Schedule C) in the Koputaroa Stream

	¹ Currently allocated	² Other proposed allocations (i.e. excl. this application)	³ Waka Kotahi proposed allocation	Proposed total allocation (i.e. 1 + 2+ 3)	Core allocation limit
	m³/day				
Koputaroa (Mana 13e)	81	-	231	312	432
Coastal Manawatū (Mana 13)	350,041.7	21,131.4	231	371,404.1	598,752

52. The proposal to limit the rate of abstraction to 10% of actual river flow on the preceding day is assessed under the section G.E General below.
53. Schedule C of the One Plan sets out a minimum flow of 12.240 m³/s at the Manawatū Teachers College flow recorder for the Koputaroa (Mana 13e) water management subzone. Waka Kotahi have advised that they will comply with the Schedule C minimum flow.¹ However, this is not yet reflected in the proposed conditions.⁶ In my view, compliance with the minimum flow set out in Schedule C must be required by the conditions to ensure that the proposal meets the requirements of Rule 16-5.
54. In addition to the Schedule C minimum flow, Waka Kotahi will calculate a second minimum flow at the Koputaroa at the Tavistock Road flow recorder, and comply with this as well.⁶ The proposed condition explains that the minimum flow will be calculated using the same method as the regional plan.⁶ Dr McConchie, on behalf of Waka Kotahi, has suggested that the local minimum flow should be set at 0.032 m³/s, which is equivalent to 80% of the 1-day MALF [assumed to be 0.04 m³/s].³ It is my understanding that in a stream with a MALF of 0.04 m³/s, that the regional plan would have set the local minimum flow at 95% of the 1-day mean annual low flow (MALF).¹¹ Therefore, if the local minimum flow were to be set using the same method as the regional plan, as per revised condition RWT1(e)(ii), the minimum flow would be set at 0.038 m³/s (i.e. 95% of the 1-day MALF calculated by Dr McConchie).^{3,6}
55. I understand that the interaction between the Koputaroa Stream and groundwater, particularly as the interactions relate to where the lowest stream flows are typically observed, are not well understood. Mr Williamson addresses this matter further in his section 87F report. Therefore, while I am satisfied that the proposal fits within the provisions set out in Schedule C, it may be that additional measures are required to avoid, remedy or mitigate adverse effects on instream values.¹² Mr Brown addresses this matter in his report.

¹¹ Hurndell, 2008.

¹² Paragraph 36.

G.A.C Assessment of proposed supplementary allocation

56. Waka Kotahi have applied to take the supplementary allocation at a rate of 10% of the mean daily flow on the preceding day when flow in the Koputaroa Stream [measured at the Koputaroa at Tavistock Road flow recorder] is above median.
57. The proposal to limit the rate of abstraction to 10% of actual river flow on the preceding day, and the implications of this for complying with Policy 5-17 is assessed in section G.E General, as this is common to all of the proposed supplementary abstractions.
58. Proposed condition RWT1(b) proposes that the supplementary abstraction can commence when the flow in the Koputaroa Stream [measured at the Koputaroa at Tavistock Road flow recorder] is greater than 0.059 m³/s. Waka Kotahi have advised that the condition is incorrect and that the median flow is 0.15 m³/s, as shown in Appendix 4 DCR – Appendix 4.7.^{4,13} The revised proposed conditions have not been updated to reflect this position, however, I understand they are intended to be.⁶
59. Using historic data from the Koputaroa at Tavistock Road flow recorder (1974-1989) and the data from November 2021-February 2023 provided by Dr McConchie, I calculate the median flow as 0.164 m³/s. This is greater than an 8% deviation from the proposed median flow of 0.15 m³/s. Therefore, to ensure that the supplementary allocation can only be taken above the median flow, as per Policy 5-17, I recommend that the median flow cut-off under proposed condition RWT1(b) be increased to 0.164 m³/s.

G.A.D Assessment of the flow relationship between the abstraction sites and proposed flow monitoring site

60. As explained earlier, the maximum rate of take for the proposed core and supplementary allocations, set out in proposed condition RWT1(d), is dependent on actual river flow.
61. To measure actual river flow, Waka Kotahi are proposing to use the Koputaroa at Tavistock Road flow recorder. The Koputaroa at Tavistock

¹³ Appendix 4 DCR – Appendix 4.7.

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Road flow recorder is the only continuous flow recorder in the Koputaroa catchment. The location of the flow recorder relative to the proposed abstraction site is shown in Figure 1.

62. I understand Waka Kotahi have contracted NIWA to maintain the flow recorder for the duration of the construction period.¹⁴ As the flow recorder will be required to comply with the proposed conditions, in my view, Waka Kotahi must ensure that the flow recorder is maintained to the standard specified within the National Environmental Monitoring Standard 'Open Channel Flow Measurement' for the duration of the consent.¹⁵
63. I do not support the use of the Koputaroa at Tavistock Road flow recorder as a measure of actual river flow at the proposed abstraction site without adjustment. This is because the flow measured at the Koputaroa at Tavistock Road flow recorder will be different to the actual river flow at the proposed abstraction site due to the position in the catchment (Figure 1). The original application addressed this through a method to adjust the flow recorded at the Koputaroa at Tavistock Road flow recorder to determine the maximum rate of take for both the core and supplementary allocation.^{3,14} However, the revised conditions proposed by Waka Kotahi appear to withdraw the proposal to adjust flows above median flow.⁶ On this basis, I understand that Waka Kotahi are now only proposing to adjust flows below median flow.
64. I assess the method that has been proposed to adjust the flow below median flow [to inform the maximum rate of take for the core allocation] in paragraphs 65-66 below, and I explain the implications of not adjusting flows above median flow [to inform the maximum rate of take for the supplementary allocation] in paragraphs 67-68 below.
65. To adjust for the differences in catchment area between the Koputaroa at Tavistock Road flow recorder and the McDonald Road abstraction site, Waka Kotahi have explained that the flow measurements at the Koputaroa at Tavistock Road flow recorder would be adjusted by a factor of 0.4 when flows are below median. This adjustment factor was derived by comparing

¹⁴ Verbal conversation with Dr McConchie.

¹⁵ <https://www.nems.org.nz/documents/open-channel-flow-measurement/>.

the catchment area at the Koputaroa at Tavistock Road flow recorder and at the proposed abstraction site at McDonald Road. Specifically, Dr McConchie calculates that the catchment area upstream of the proposed abstraction site is 40% of the catchment area at the Koputaroa at Tavistock Road flow recorder, thereby arriving at the adjustment factor of 0.4. The flow adjustment method proposed by Dr McConchie is based on the assumption that the average flow yield per catchment area at the proposed abstraction site is the same as the average flow yield per catchment area at Koputaroa at Tavistock Road.

66. I acknowledge that the suggested flow adjustment method is often used to extrapolate flow data from gauged to un-gauged sites. However, I am concerned that if there are significant groundwater gains or losses between the proposed abstraction site at McDonald Road and the flow recorder at Koputaroa at Tavistock Road, that the flow adjustment method suggested by Dr McConchie may not provide a reasonable estimate of actual river flow at the point of abstraction. These concerns are compounded by general uncertainty around the interaction between surface water and groundwater in the area. If actual river flow at the point of abstraction is overestimated due to interactions between surface water and groundwater that have not been accounted for, this could lead to more water being abstracted than what is permitted by Policy 5-17(a).
67. The revised proposed conditions appear to withdraw the proposal to adjust flows recorded at the Koputaroa at Tavistock Road flow recorder for catchment area above median flows.⁶ What this means, is that Waka Kotahi will assume that the flow at McDonald Road is the same as the flow at Tavistock Road, despite the differences in the position in the catchment. In my view, there has been insufficient information to show that this assumption is reasonable, and that the assumption will not result in the supplementary allocation exceeding what is permitted by Policy 5-17(a).
68. To determine whether the proposed flow adjustment method is appropriate both above and below median flows, for the reasons outlined above, I recommend that Waka Kotahi is required to collect a minimum of four concurrent gaugings at the Koputaroa at Tavistock Road flow recorder, and at the proposed abstraction site at McDonald Road. Two of these should

be taken when flow at the Koputaroa at Tavistock Road flow recorder is below median flow, and two should be collected when flow at the Koputaroa at Tavistock Road flow recorder is above median flow. At least one of the below median flow gaugings should be collected during low flow conditions (and preferably after the stream has been in low flow conditions for at least 3 days). The results of these concurrent gauging sets should then be used to determine what flow adjustment factor is applied to the proposed abstraction site, and whether different flow adjustment factors are appropriate at below and above median flows. This should then be used to introduce an agreed adjustment factor(s) into proposed condition RWT1(d).

G.B Waikawa Stream

G.B.A Location and Schedule B values

69. The Waikawa Stream is in the Waikawa (West 9a) water management subzone, and the Waikawa (West 9) water management zone.
70. Waka Kotahi are proposing to abstract the water from two sites on the Waikawa Stream. The sites, taken from Volume III - Drawing Set – 07 Accommodation Works, are at approx. 1788423E, 5491924N (NZTM) and 1788517E, 5491934N (NZTM). The two sites are within 100 metres of each other. The locations of the proposed abstraction sites are shown in **Figure 2**.
71. In addition to the zone wide values,¹⁶ the One Plan identifies the following site/reach specific values for the proposed abstraction sites: aquatic site of significance (short jaw kōkopu and redfin bully), riparian site of significance (dotterel and wader), domestic food supply, and flood control and drainage.

G.B.B Assessment of proposed core allocation

72. Waka Kotahi seek a core allocation of 2,998 m³/day from the Waikawa Stream and West 9a subzone. Waka Kotahi have applied to take the water at a maximum rate of 10% of the mean daily flow on the preceding day, or

¹⁶ The zone wide values are identified at paragraph 32.

70 l/s, whichever is less. The maximum rate of take sought is sufficient to abstract the total daily volume over a period of approximately 12 hours.

73. Schedule C of the One Plan sets out a core allocation limit of 6,048 m³/day for both the Waikawa (West 9a) water management subzone (“subzone”), and the Waikawa (West 9) water management zone (“zone”).
74. The current level of allocation within the Waikawa (West 9a) subzone is 770 m³/day, and the current level of allocation within the wider Waikawa (West 9) zone is 1,046 m³/day. The granting of this water take would increase the level of allocation in the Waikawa (West 9a) subzone to 3,768 m³/day, and the level of allocation in the wider Waikawa (West 9) zone to 4,146 m³/day. The calculations against the Waikawa (West 9) zone limits take into account the proposed abstractions from the Waikawa (West 9a), Manakau (West 9b), and Waiauti (West 9b) streams. Having reviewed the relevant data, the proposed allocation therefore fits within the relevant core allocation limits set out in Schedule C.
75. The proposed allocation volumes against the One Plan (Schedule C) core allocation limits are summarised in Table 2.

Table 2 Current and proposed core allocation against One Plan limits (Schedule C) in the Waikawa Stream

	¹Currently allocated	²Waka Kotahi proposed allocation	Proposed total allocation (i.e. 1 + 2)	Core allocation limit
	m³/day			
Waikawa (West 9a)*	1046	3,100	4,146	6,048

*Includes allocation/proposed allocation within the Manakau Subzone, as the Waikawa (West 9a) limit is a cumulative limit for the wider Waikawa (West 9) zone

76. The proposal to limit the rate of abstraction to 10% of actual river flow on the preceding day is assessed in the section G.E General below.
77. Schedule C sets out a minimum flow of 0.220 m³/s at the Waikawa at North Manakau Road flow recorder. The proposed abstraction will cease below the Schedule C minimum flow.
78. The Waikawa Stream is known to lose a considerable proportion of its stream flow to groundwater in the reaches below SH1, particularly during periods of low flow. The entire length of the Waikawa Stream, including the reaches which experience these streamflow losses, is listed as having the aquatic site of significance value for short jaw kōkopu and/or redfin bully (this varies along the length of the stream). Therefore, while I am satisfied that the proposal fits within the provisions set out in Schedule C, it may be that additional measures are required to avoid, remedy or mitigate adverse effects on instream values.¹⁷ Mr Brown addresses this matter in his report.

G.B.C Assessment of proposed supplementary allocation

79. Waka Kotahi have applied to take the supplementary allocation at a rate of 10% of the mean daily flow on the preceding day when flow in the Waikawa Stream [measured at the Waikawa at North Manakau Road flow recorder] is above median.
80. I consider the proposal to limit the rate of abstraction to 10% of actual river flow on the preceding day, and the implications of this under Policy 5-17 under the section G.E General below.
81. Proposed condition RWT1(b) proposes that the supplementary allocation can commence when flow in the Waikawa Stream [as measured at the Waikawa at North Manakau Road flow recorder] is above 0.95 m³/s. Lennard (2022, in draft) recently re-calculated the flow statistics for the Horizons region using the processed flow record to the end of June 2021. This work calculated the median flow as 0.87 m³/s. The difference between the proposed median flow cut off and the

¹⁷ See paragraph 36.

median flow calculated in Lennard (2022, in draft), is just outside the 8% margin of error. However, as the proposed median flow cut off is higher than the median flow calculated in Lennard (2022, in draft) it is likely to be conservative.

82. As I have noted, the Waikawa Stream is known to lose a considerable proportion of its streamflow to groundwater in the reaches downstream of SH1 during low flow conditions. In his report, Jon Williamson explains that he does not anticipate any additional losses of streamflow to groundwater above median (over and above what currently occurs). Therefore, limiting the abstraction to 10% of actual river flow at the point of take would not be expected to exceed 10% of actual river flow downstream of the take.

G.B.D Assessment of the flow relationship between the abstraction sites and proposed flow monitoring site

83. The maximum rate of take for the proposed core and supplementary allocations, based on proposed condition RWT1(d), is dependent on actual river flow. To measure actual river flow, Waka Kotahi are proposing to use the Waikawa at North Manakau Road flow recorder.
84. The location of the flow recorder relative to the proposed abstraction point is shown in **Figure 2**. The flow recorder is operated by Horizons.
85. To assess whether the Waikawa at North Manakau Road flow recorder provides a reasonable estimate of actual river flow at the proposed abstraction site, I have undertaken an analysis of same-day gaugings taken at the North Manakau flow recorder (~1.3 km upstream of the proposed abstraction points) and the SH1 gauging site (~0.7 km downstream of the proposed abstraction points).
86. I have undertaken two analyses; one considering gaugings taken below median flow [relevant to the proposed core allocation], and one considering gaugings taken above median flow [relevant to the proposed supplementary allocation]. The same-day gaugings used in this analysis, and the associated analysis are set out in **Appendix C** for

reference. The locations of the flow recorder and gauging site relative to the proposed abstraction sites are shown in **Figure 3**.

87. I have located five same-day gaugings taken at the Waikawa at North Manakau flow recorder and the Waikawa at SH1 gauging site, when the Waikawa at North Manakau Road flow recorder was below median flow [0.87 m³/s (Lennard, 2022, in draft)]. Across the five gaugings, four showed that flow at the SH1 gauging site was more than 8% less than the flow measured at the North Manakau Road flow recorder (albeit one very slightly). Given this, and noting the location of the proposed abstraction sites between the Waikawa at North Manakau flow recorder and SH1 gauging site, in my view, the flow record from the North Manakau Road flow recorder should be adjusted to account for potential streamflow losses between the flow recorder and the abstraction sites.

88. Plotting the gaugings yields the following linear regression:

$$y \text{ [flow at SH1 flow gauging site in m}^3\text{/s]} = 0.8857 \times \text{[flow at North Manakau Road flow recorder in m}^3\text{/s]} - 0.0042$$

89. In the absence of further information at the actual abstraction sites, I recommend that this relationship be used to adjust the flow measured at the Waikawa at North Manakau Road flow recorder, when calculating actual river flow to determine the maximum rate of take under the core allocation.

90. There is one same-day gauging available between the Waikawa at North Manakau flow recorder and the proposed abstraction site when the Waikawa at North Manakau Road flow recorder was above median flow [0.87 m³/s (Lennard, 2022, in draft)]. This is attached as **Appendix C** for reference. This data showed that flow at the SH1 gauging site was 107% of the flow at the North Manakau Road flow recorder. This increase is within the 8% margin of error for open channel flow measurements. Given that only one same-day gauging is available, there is some uncertainty about whether this would normally be the case. However, streamflow losses to groundwater on the Waikawa are generally lower

at high flow than at low flow,¹⁸ so it is unlikely that the relative flow losses observed at below median flows would be the same at above median flows. Therefore, in my view, the Waikawa at North Manakau Road flow recorder provides a reasonable, and potentially conservative estimate of actual river flow at the proposed abstraction sites above median flow.

G.C Manakau and Waiauti Streams

G.C.A Location and Schedule B values

91. The Manakau and Waiauti Streams are in the Manakau (West 9b) water management subzone, and the Waikawa (West 9) water management zone.
92. Waka Kotahi are proposing to abstract the water from two sites; one is on the Waiauti Stream and one is on the Manakau Stream.
93. On the Waiauti Stream, Waka Kotahi are proposing to abstract water from one site. The site, taken from Volume III - Drawing Set – 07 Accommodation Works, is at approx. 1786592E, 5488680N (NZTM). There are no major inflows between the proposed abstraction point and the confluence with the Manakau Stream.
94. In addition to the zone wide values,¹⁹ the One Plan identifies the following site/reach specific values for the proposed abstraction site on the Waiauti Stream: domestic food supply and flood control and drainage.
95. On the Manakau Stream, Waka Kotahi are proposing to abstract water from one site. The site, taken from Volume III - Drawing Set – 07 Accommodation Works, is at approx. 1786722E, 5488791N (NZTM). There are no major inflows between the proposed abstraction point and the confluence.

¹⁸ See s87F Report, Jon Williamson, 28 April 2023, at paragraph 73.

¹⁹ The zone wide values are identified at paragraph 32.

96. In addition to the zone wide values,²⁰ the One Plan identifies the following site/reach specific values for the proposed abstraction site on the Manakau Stream: domestic food supply.
97. The locations of the abstraction points are shown in **Figure 4**.
98. The resource consent application did not initially explain how the abstraction of water in this subzone would be split between the two abstraction points and related back to the actual river flow measured at the Manakau at SH1 flow recorder. Further information was sought from Waka Kotahi as part of the s92 request for information. Waka Kotahi provided clarification through Dr McConchie, on 27 February 2023.

We are proposing a total maximum daily abstraction 102m³/day from both streams, with the abstraction managed using the flow gauge on Manakau Stream at SH1 Bridge. The total abstraction is two-thirds of that available currently from the Core Allocation. We are proposing to take water from either Manakau OR Waiauti Stream as the designation for the Project passes through both catchments, however, the maximum combined daily abstraction will be capped at 102m³/day.

The catchment areas of Waiauti and Manakau Streams are 8.013km² and 7.517km² respectively just upstream of the flow recorder at the SH1 Bridge. Consequently, each catchment contributes approximately 50% of the total flow at the recorder (52% and 48% respectively but certainly within the ±8% uncertainty of open channel flow measurements.

While at low flows i.e., flows close to the minimum of 40L/s, the 102m³/day will likely have to come from both streams with half the abstraction coming from each stream. This will reduce any potential environmental effect on the streams. Since any potential increase in environmental stress is most likely during periods of low flow, and low flow is determined largely by those physical characteristics of the catchment that affect drainage, we believe that this is a reasonable approach. The approach

²⁰ The zone wide values are identified at paragraph 32.

has been confirmed by the Project Ecologist who has indicated that any effects will be 'less than minor'. However, at higher flows, likely in the order of 120L/s at the SH1 bridge, the Project wishes to abstract up to 6L/s from just one of the streams; still capped at 102m³/day. The rationale for this is that at 120L/s at the SH1 Bridge, there is likely to be at ~60L/s in each of the two streams and the abstraction of 10% of this would be 6L/s.

A maximum rate of abstraction from Manakau and Waiauti Streams of 6L/s has been proposed. This recognizes the abstraction from the two streams while at the same time considering potential pump configuration. Discussion with the Project Ecologist (Alex James) has indicated that this rate would have effects that are 'less than minor'."

99. I comment on this proposed abstraction approach in the relevant sections below.

G.C.B Assessment of proposed core allocation

100. Waka Kotahi have sought a core allocation of 102 m³/day from the Manakau and Waiauti Streams and West 9b subzone. Given the information recently provided by Waka Kotahi (on 27 February 2023) and the revised conditions, I understand:

- (a) the **combined** maximum rate of take will not be more than 10% of the mean daily river flow on the preceding day [measured at the Manakau at SH1 flow recorder], up to a maximum of 6 l/s; and
- (b) that the rate of take from each take point will be further limited to 5% of the actual river flow measured at the Manakau at SH1 flow recorder.

101. The additional restrictions set out in the additional information are not currently reflected in proposed condition RWT1. In my opinion, RWT1 must be updated to reflect the management regime now proposed by Waka Kotahi.

102. Schedule C of the One Plan sets out a core allocation limit of 432 m³/day for the Manakau (West 9b) water management subzone, and a core allocation limit of 6,048 for the Waikawa (West 9) water management zone.
103. The current level of allocation within the Manakau (West 9b) subzone is 276 m³/day, and the current level of allocation within the wider Waikawa (West 9) zone is 1,046 m³/day. The granting of this water take would increase the level of allocation in the Manakau (West 9b) subzone to 378 m³/day, and the level of allocation in the wider Waikawa (West 9) zone to 4,146 m³/day. The calculations against the Waikawa (West 9) zone limits take into account the proposed abstractions from the Waikawa (West 9a), Manakau (West 9b), and Waiauti (West 9b) streams. Therefore, having reviewed the relevant data, the proposed allocation fits within the relevant core allocation limits.
104. The proposed allocation volumes against the One Plan (Schedule C) core allocation limits are summarised in Table 3.

Table 3 Current and proposed core allocation against One Plan limits (Schedule C) in the Manakau and Waikawa Streams

	¹Currently allocated	²Waka Kotahi proposed allocation	Proposed total allocation (i.e. 1 + 2)	Core allocation limit
	m³/day			
Waikawa (West 9)⁺	1046	3,100	4,146	6,048
Manakau (West 9)[*]	276	102	378	432

⁺Includes allocation/proposed allocation within the Manakau and Waikawa subzones, as the (West 9a limit is a cumulative limit for both subzones

^{*}Includes proposed abstractions from the Manakau and Waikawa Streams

105. Schedule C of the One Plan also sets out a minimum flow of 0.04 m³/s at the Manakau at SH1 flow recorder. The proposed abstraction will cease below the Schedule C minimum flow.
106. In my view, the proposed method for splitting the proposed abstraction between the two abstraction sites/streams²¹ is generally reasonable. However, I do not have the same confidence now that the proposal has been amended to limit the rate of abstraction to 10% of mean daily flow on the preceding day, rather than real time river flow. I require further information to show that the proposed method remains reasonable under these conditions. I assess this proposed method/condition more generally in section G.E [assessment of general rate of take conditions].
107. The maximum rate of take sought would allow the entire daily volume to be abstracted in approximately 5 hours. The other abstractions seek to take the maximum daily rate of take over periods of 10-12 hours, which is consistent with the management approach explained in Section 92 Response.²² Dr McConchie explains that this rate of take was proposed because of the 'potential pump configuration', and that the project ecologist (Dr James) indicated that the rate of take would have a 'less than minor' effect.⁴ Mr Brown addresses this in his section 87F report.
108. I understand that the interaction between the Manakau Stream and groundwater, particularly as the interactions relate to where the lowest stream flows are typically observed, are not well understood.²³ Therefore, while I am satisfied that the proposal fits within the provisions set out in Schedule C, and therefore qualifies as a controlled activity under Rule 16-5, it may be that additional measures are required to avoid, remedy or mitigate adverse effects on instream values.²⁴ Mr Brown addresses this matter in his section 87F report.

²¹ As understood through the additional information provided by Waka Kotahi on 23 February 2023.

²² Response to Question 5.

²³ Although Mr Williamson advises that they appear to respond the same as other Alpine Rivers, which lose water to the aquifer during low to median low conditions.

²⁴ Paragraph 36.

G.C.C Assessment of proposed supplementary allocation

109. Waka Kotahi have applied to take the supplementary allocation at a rate of 10% of the mean daily flow on the preceding day when flow in the Manakau Stream [measured at the Manakau at SH1 bridge flow recorder] is above median. Following the further information provided by Waka Kotahi (February 2023) and the revised conditions, I understand that:
- (a) the **combined** maximum rate will not be more than 10% of the mean daily flow on the preceding day [measured at the Manakau at SH1 flow recorder];
 - (b) the rate at each point of take will be further limited to 5% of the mean daily flow on the preceding day [measured at the Manakau at SH1 flow recorder]; and
 - (c) the median flow cut-off will be based on the flow measured at the Manakau at SH1 flow recorder.
110. The additional restrictions set out in the additional information are not currently reflected in proposed condition RWT1. In my opinion, RWT1 must be updated to reflect the management regime now proposed by Waka Kotahi.
111. The proposal to limit the rate of abstraction to 10% of actual river flow on the preceding day, and compliance with Policy 5-17 is assessed in section G.E General.
112. Proposed condition RWT1(b) proposes that the supplementary allocation can commence when flow in the Manakau Stream [as measured at the Manakau at SH1 flow recorder] is above 0.14 m³/s. Lennard (2022, in draft) recently re-calculated the flow statistics for the Horizons region using the processed flow record to the end of June 2021. This work calculated the median flow as 0.18 m³/s. The calculation of this median included the record from Manakau at Gleesons Road, which is the historic flow recorder in this subzone. Given that the difference between the median calculated in Lennard (2022, in draft) and the median suggested in proposed condition RWT1 is greater than 8%,

I recommend that the median flow cut off for the Manakau and Waiauti Streams in condition RWT1 be increased to 0.18 m³/s.

113. As noted in paragraph 106 above, I require further information to show that the proposal to limit the rate of abstraction to 10% of mean daily flow on the preceding day is reasonable. As mentioned previously, I discuss this proposed method/condition more generally in section G.E General.
114. As I have explained limiting the abstraction to 10% of actual river flow at the point of take is not expected to exceed 10% of actual river flow downstream of the take.

G.C.D Assessment of the flow relationship between the abstraction sites and proposed flow monitoring site

115. The maximum rate of take for the proposed core and supplementary allocations, based on proposed condition RWT1, is dependent on actual river flow. To measure actual river flow, Waka Kotahi are proposing to use the Manakau at SH1 flow recorder.
116. The Manakau at SH1 flow recorder is ~0.65 km below the confluence of the Manakau and Waiauti Streams. There are no major inflows between the abstraction points and the confluence of the two streams. There are also no major inflows between the confluence of the two streams and the flow recorder. Therefore, flow measured at the recorder is considered to be a direct measurement of the combined flows from the Manakau and Waiauti streams, less any seepage or interaction with groundwater.
117. The location of the flow recorder relative to the proposed abstraction point is shown in **Figure 4**.
118. The additional information provided by Waka Kotahi in February 2023 assumes that the flow at each of the proposed abstraction sites will be 50% of the flow measured at Manakau at SH1 flow recorder. To test this assumption, I have undertaken an analysis of the same-day gauging records held by Horizons at the following locations:

- (a) The Manakau SH1 flow recorder and the historic recorder site just downstream at Gleesons Road; and
 - (b) On the Manakau and Waiauti Streams between the proposed abstraction points and the confluence of the two streams at South Manakau Road.
119. In total, there are five gaugings series available where flow was measured at two or more of the above sites of interest. Four of these gaugings were taken below the Q80 (i.e. the flow that is exceeded 80% of the time) and one was taken between the Q25 and Q30 (i.e. the flows that are exceeded between 25 and 30% of the time, respectively) (Lennard, 2022, in draft). Therefore, both below median and above median flows are present in the analysis.
120. The same-day gaugings are attached as **Appendix E** for reference. The locations of these sites relative to the proposed abstraction sites are shown in **Figure 5**.
121. In the first four same-day gauging series, flow was only measured at either the Manakau at SH1 flow recorder or its predecessor at Manakau at Gleesons Road, and Manakau at South Manakau Road. These four gaugings show that the flow measured at Manakau at South Manakau Road ranged from 48-67% of the flow measured at the Manakau at SH1/Gleesons Road flow recorder. On three of the four occasions, flow at Manakau at South Manakau Road was significantly (i.e. greater than 8%) more than half of the flow measured at the Manakau at SH1 flow recorder. This suggests that Dr McConchie's assumption that flow at the proposed abstraction site on the Manakau Stream is 50% of the flow recorded at Manakau at SH1 is reasonable, and potentially conservative.
122. In the fifth and most recent same-day gauging series available, flow was measured at all three sites of interest (i.e. the Manakau at SH1 flow recorder, Manakau at South Manakau Road, and Waiauti at South Manakau road). This gauging series showed that the combined flow measured at the Manakau and Waiauti at South Manakau Road gauging sites was 118% of the flow measured at the Manakau at SH1 flow

recorder. Further, the flow measured at Waiauti at South Manakau Road gauging site was higher than the flow recorded at the Manakau at South Manakau Road gauging site. This alleviates concerns that the Waiauti may be lower yielding, and contributing <50% of the flow at the Manakau at SH1 flow recorder. This again suggests that Dr McConchie's assumption that flow at the proposed abstraction sites will be 50% of the flow recorded at Manakau at SH1 is reasonable, and potentially conservative.

G.D Ōhau River

G.D.A Location and Schedule B values

123. The Ohau River is in the Ōhau (Ōhau 1) water management zone.
124. Waka Kotahi are proposing to abstract the water from two sites. The sites, taken from Volume III - Drawing Set – 07 Accommodation Works, are at approx. 1788423E, 5491924N (NZTM) and 1788517E, 5491934N (NZTM). The two sites are within 100 metres of each other. The locations are shown in **Figure 6**, and are in the Lower Ōhau (Ōhau 1b) subzone.
125. In addition to the zone wide values,²⁵ the One Plan identifies the following site/reach specific values for the proposed abstraction sites: aquatic site of significance (short jaw kōkopu and redfin bully), domestic food supply, trout fishery (other), and flood control and drainage. There are also riparian sites of significance (dotterel and wader), alternative aquatic sites of significance (lamprey), and trout spawning values nearby.

G.D.B Assessment of proposed core allocation

126. Waka Kotahi initially applied to take 409 m³/day at a maximum rate of 70 l/s or 10% of actual river flow, whichever is less. Waka Kotahi were subsequently advised by Horizons that there is currently no water remaining under the core allocation.²⁶ The application to abstract water under the core allocation was withdrawn on 7 March 2023.⁵

²⁵ The zone wide values are identified in paragraph 36.

²⁶ Letter sent by Horizons on 24 February 2023.

127. The daily maximum abstraction volume in proposed condition RWT1(a) has been reduced to zero to reflect the withdrawal of this application. The maximum abstraction rate of 70 l/s must also be reduced to zero.

G.D.C Assessment of proposed supplementary allocation

128. Waka Kotahi have applied to take the supplementary allocation at a rate of 10% of the mean daily flow on the preceding day when flow in the Ōhau River [measured at the Ōhau at Rongomatane flow recorder] is above median.
129. The proposal to limit the rate of abstraction to 10% of actual river flow on the preceding day is assessed under the section G.E General below.
130. Proposed condition RWT1(b) proposes that the supplementary allocation can commence when flow in the Ōhau River [as measured at the Ōhau at Rongomatane flow recorder] is above 4.15 m³/s. Lennard (2022, in draft) recently re-calculated the flow statistics for the Horizons region using the processed flow record to the end of June 2021. This work calculated the median flow as 4.21 m³/s, which is within 8% of the proposed median flow cut off. Therefore, in my view, the proposed median cut off for the Ōhau River in proposed condition RWT1(b) is reasonable.
131. The Ōhau River is known to lose streamflow to groundwater in the reaches downstream of SH1 during times of low flow. In his report, Mr Williamson explains that he does not anticipate any additional losses of streamflow to groundwater above median (over and above what currently occurs). Therefore, limiting the abstraction to 10% of actual river flow at the point of take would not be expected to exceed 10% of actual river flow downstream of the take. However, in my view, additional information is required to show that the proposed method for managing the takes will limit the abstractions to 10% of actual river flow. I discuss this in section G.E General below.

*G.D.D Assessment of the proposed method to estimate actual river flow
[to determine the rate of take]*

132. The maximum rate of take for the supplementary allocation, based on proposed condition RWT1(d) is dependent on actual river flow. To measure actual river flow, Waka Kotahi are proposing to use the Ōhau at Rongomatane flow recorder.
133. The Ōhau at Rongomatane flow recorder is ~8.4 km upstream of the proposed abstraction points. The site is operated and maintained by Horizons. The location of the flow recorder relative to the proposed abstraction point is shown in **Figure 7**.
134. The flow recorder is operated and maintained by Horizons.
135. To assess whether the Ōhau at Rongomatane flow recorder provides a reasonable estimate of actual river flow at the proposed abstraction site above median flow, I have undertaken an analysis of same-day gaugings taken at the Ōhau at Rongomatane flow recorder and the State Highway 1 (“**SH1**”) gauging site when the flow at Ōhau at Rongomatane was above median flow [4.21 m³/s (Lennard, 2022, in draft)].
136. The same-day gaugings used in this analysis are attached as **Appendix E** for reference, and a map showing the location of these sites relative to the proposed abstraction sites is in **Figure 7**.
137. Overall, the same-day gaugings in **Appendix E** show that flow at the Ōhau at SH1 gauging site was a minimum of 100% of the flow measured at the Ōhau at Rongomatane flow recorder, and up to 123% of the flow measured at the Ōhau at Rongomatane flow recorder. Furthermore, as explained above, in his report, Mr Williamson explains that he does not anticipate any additional losses of streamflow to groundwater above median (over and above what currently occurs). Therefore, the Ōhau at Rongomatane flow recorder is likely to provide a reasonable, and potentially conservative measure of actual stream flow at the proposed abstraction sites above median flow.

G.E General

Allocation efficiency

138. I have not assessed the efficiency of the actual water use, as the efficiency of water use for road construction purposes is outside my area of expertise. My assessment otherwise assumes that the projected peak and average daily water demands are accurate and represent a reasonable and efficient use of water.
139. I have, however, considered the efficiency of the proposed allocation. Assessing the efficiency of the proposed allocation is important to ensure that an appropriate volume of water is allocated so that the allocation will not unnecessarily 'lock up' the water resource because more water is granted than what is needed.
140. Waka Kotahi have explained that peak daily water demand will be 3,900 m³/day, and the average daily demand across all sites will be 2,350 m³/day.¹³ The total core allocation sought across all Horizons and GWRC abstraction points is equivalent to 5,491 m³/day. Additional water is sought via the supplementary allocation. No cap or limit on the supplementary allocation over and above '10% of the mean daily flow on the preceding day' has been proposed. Therefore, the amount of water sought under the core allocation across all sites exceeds both the peak and average daily demand, and the supplementary allocation is additional to this.
141. There are a number of reasons why Waka Kotahi have sought an allocation over and above the average and peak daily demand. These include:
- (a) Security of supply during times of minimum flow restriction: Waka Kotahi have explained that peak water demand is most likely to occur during summer and autumn. This is the same time of year that abstraction is most likely to be limited by minimum flow restrictions which require abstractions to cease, or by low flows which prevent the full volume of water being abstracted. Waka Kotahi have indicated that they will build water storage structures

to store water harvested at higher flows, and to supply water during times when demand exceeds the ability to take water under the core allocation.

- (b) Recognising that not all abstractions will be used at once: Waka Kotahi have explained that they wish to avoid transporting water between catchments. Presumably, the road will be built in stages, which would suggest that it is unlikely that all abstraction points will be used at the same time.

142. Therefore, Waka Kotahi have outlined some reasons why the allocation sought exceeds what will be required on any one day. However, given how infrequently some of the streams and rivers in question experience minimum flow restrictions, I queried through the s92 request whether further information could be provided to illustrate that proposed allocation is efficient. The Section 92 Response referenced existing documentation which I do not consider to provide sufficient evidence to illustrate that the proposed allocation is efficient. Therefore, in my view, Waka Kotahi should provide additional analysis or information to show that the allocation sought across both the core and supplementary allocation regimes is required to meet the water demand during the construction period to illustrate that the proposed allocation is efficient.

143. Further to the above, Waka Kotahi have indicated that if they acquire land with productive bores, that water from those bores will be used to support the construction of the road.¹³ Given this, I queried how much water was expected to be acquired through such sources, and whether there was a strategy to reduce the amount of water allocated to surface water to ensure that the allocation of water was efficient. The Section 92 Response stated:

At this stage the location and volume of any bores that have the potential to be used to support construction activities is unknown. That said, resource consent is sought for a maximum amount of water to support construction sourced from a hierarchy of sources. Abstraction from rivers and streams will only be used to 'top up' the available water to meet

the actual demand. This will assure optimal efficiency of water use and minimise abstraction from rivers and streams.

144. In my view, to ensure that the proposed allocation of water is efficient, Waka Kotahi should either (a) estimate how much water is likely to be acquired from bores, and reduce the volume they are seeking to take from surface water accordingly, or (b) include a new condition that if more than 500 m³/day is acquired via bores, that the volume of surface water allocation will be reduced by the same amount acquired.

Assessment of general rate of take conditions

145. Waka Kotahi initially applied to take the water allocation at a rate of not more than 10% of the stream discharge on any particular day.²⁷ The revised proposed conditions amend this condition to take at a rate of not more than 10% of the mean daily flow on the preceding day.⁶ I understand that this condition applies across the core and supplementary allocations.
146. I acknowledge that the amendment to the condition will simplify the operation and monitoring of the abstractions. However, there is the potential for this change to result in the abstraction exceeding 10% of actual river flow by a significant margin. This is because if the mean daily flow is higher than the actual river flow when Waka Kotahi are wanting to take water the following day, then taking 10% of the mean daily flow from the preceding day will equate to more than 10% of actual river flow.
147. As outlined earlier, it is my understanding that Policy 5-17(a) makes a maximum of 10% of actual river flow available for 'supplementary' allocation when river flow is above median flow. Therefore, it is my view that more information is required to illustrate how the proposal will ensure that the proposed supplementary abstraction will be consistent with Policy 5-17 generally.

Assessment of supplementary take conditions

²⁷ Original proposed conditions.

148. Given the distance between some of the flow recorders and the proposed abstraction sites, there may be a significant time lag between the flow recorder and the abstraction sites. Given that the proposal is now to limit the rate of take based on the mean daily flow on the preceding day,²⁸ this time lag will now be most relevant in the application of the trigger flows to commence and cease the supplementary allocation. I am not aware of any analysis in the application to address this matter. In my opinion, this must be considered, and appropriate consent conditions introduced, to ensure that the take only occurs when rivers flows are above median flow at the proposed abstraction sites.
149. In the circumstances described in my report, Policy 5-17 requires an assessment of the criteria listed against Policy 5-17(b). The Section 92 Response explained that '*Appendix 4.7 to the Design and Construction Report illustrated that the abstractions will not give rise to any of the circumstances in Policy 5-17(b)*'. I have been unable to locate a full assessment against Policy 5-17(b) in the Design and Construction Report. Therefore, I understand that the requirements of Policy 5-17(b) have not yet been satisfied, and an itemised 5-17(b) assessment should be provided.

Monitoring provisions

150. In addition to the issues raised and recommendations made throughout this report, I recommend the inclusion of standard water metering conditions. I also recommend that telemetry be required, and standard telemetry conditions included, so that the councils have access to abstraction data in near-real time.

H. SUBMISSIONS

151. I have read the submissions. Only one requires comment within my area of expertise. I note that Mr Williamson has responded to submissions regarding impacts on bores.

²⁸ Noting my comments that further evidence is required to show this approach will ensure the water takes are consistent with Policy 5-17.

59. Wellington Fish and Game Council

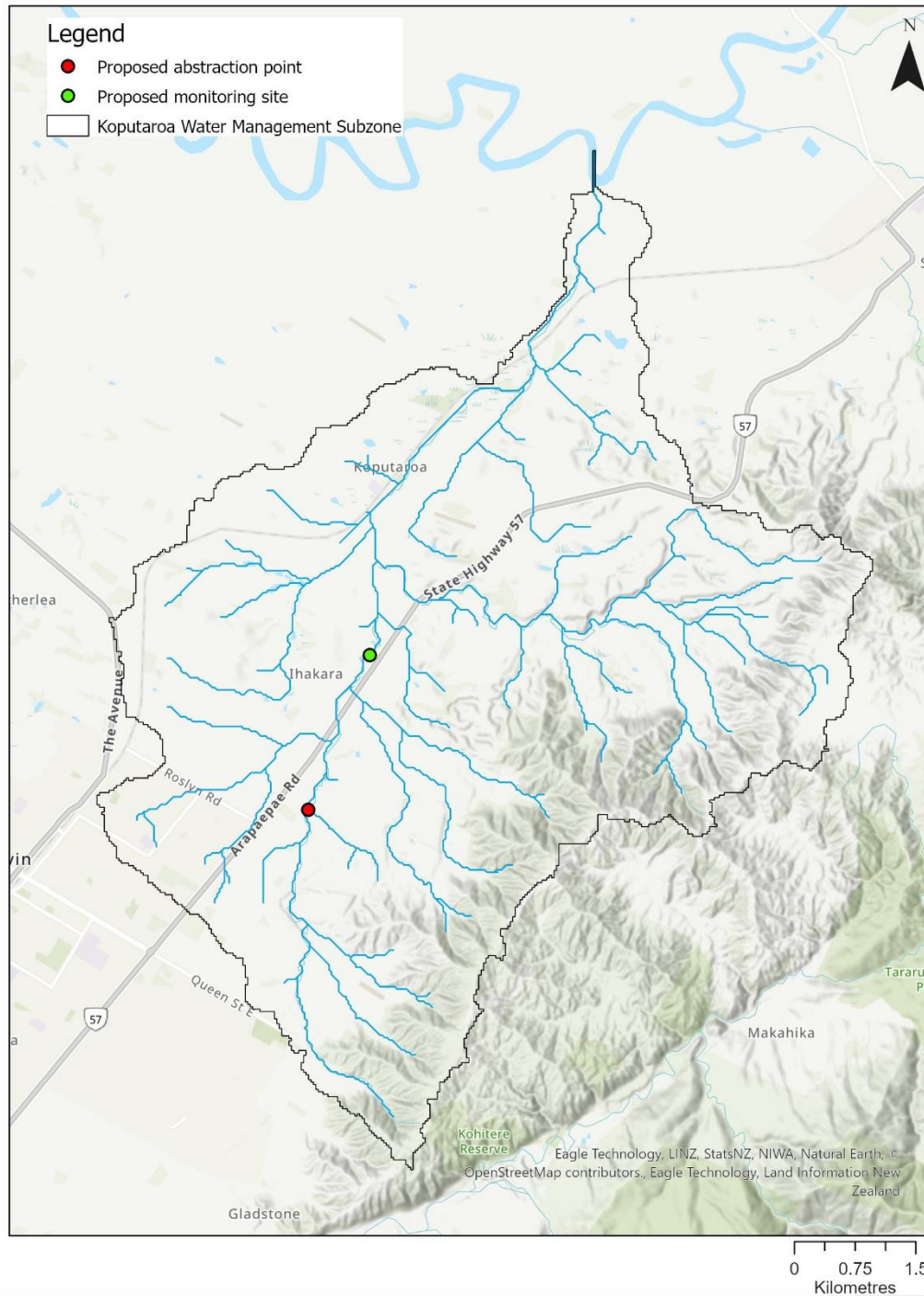
152. Submission 59 on behalf of the Wellington Fish and Game Council raises a number of points that are relevant to the proposed surface water abstractions. I only address those aspects of the submission, with additional matters to be addressed by other experts.
153. The submission opposes any additional drain on the municipal supply from this or any other development project. As the application currently stands, Waka Kotahi have applied for their own consent to take water for construction, rather than to connect to any existing municipal water take consent. I can only assess the information before me in the consent applications, and any future plans, if any, of Waka Kotahi in this regard are best addressed by Dr McConchie, and Waka Kotahi.
154. The submission seeks that the water takes are only to be used during the construction phase, not in any future maintenance or development. It is my understanding that the water takes will only be able to be used to support the construction of the road, rather than future maintenance or development, as the water take consents have been sought in the bundle of 'construction phase' consents. However, I agree that it is appropriate to include a condition limiting the use of surface water to activities to support the construction of the road during the primary construction period. This would mean that the consents to take water would expire at the earlier of (a) the 10-year consent term sought, or (b) the actual active construction period, which is expected to take 4-5 years.²⁹

Michaela Jayne Stout

28 April 2023

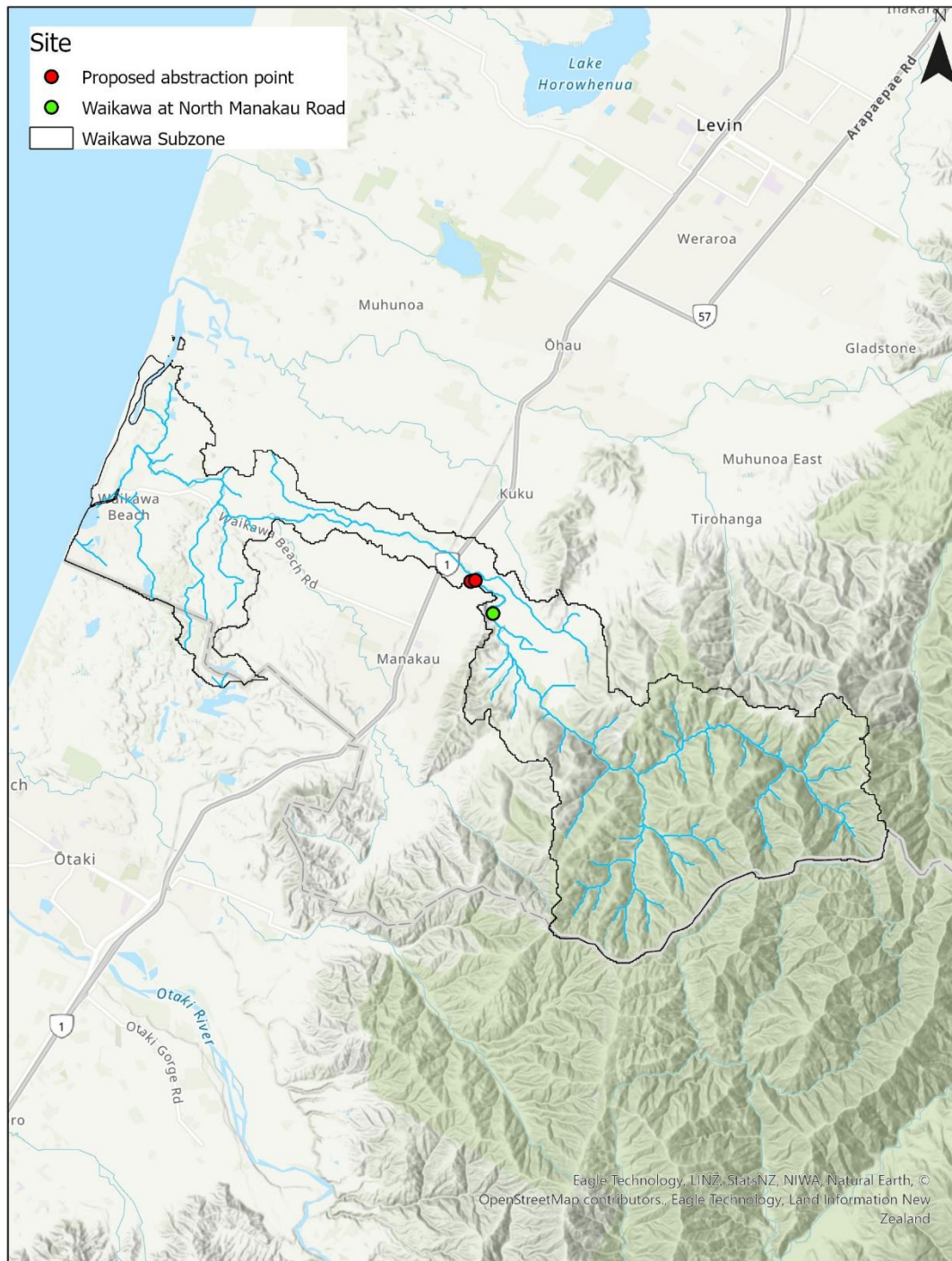
²⁹ Volume II - Notices of Requirement for a Designation and Application for Resource Consents: Supporting Information and Assessment of Effects on the Environment – Section 65.3.1.

I. FIGURES



<p>Ō2NL PROPOSED ABSTRACTION AND FLOW MONITORING SITES: KOPUTAROA</p> <p><small>EXCLUSION OF LIABILITY ARISING FROM SUPPLY OF INFORMATION: Horizons Regional Council endeavours to provide useful and accurate information. Horizons Regional Council shall not, however be liable whether in contract, tort, equity or otherwise, for any loss or damage of any type (including consequential losses) arising directly or indirectly from the inadequacy, inaccuracy or any other deficiency in information supplied irrespective of the cause. Use of information supplied is entirely at the risk of the recipient and shall be deemed to be acceptance of this liability exclusion.</small></p>	<p>Prepared by: M Stout Date: 7/03/2023 Contains Crown Copyright Data</p>	
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Figure 1 Map showing the location of the proposed abstraction point (inferred from Volume III - Drawing Set – 07 Accommodation Works) and the proposed flow monitoring site at Tavistock Road.



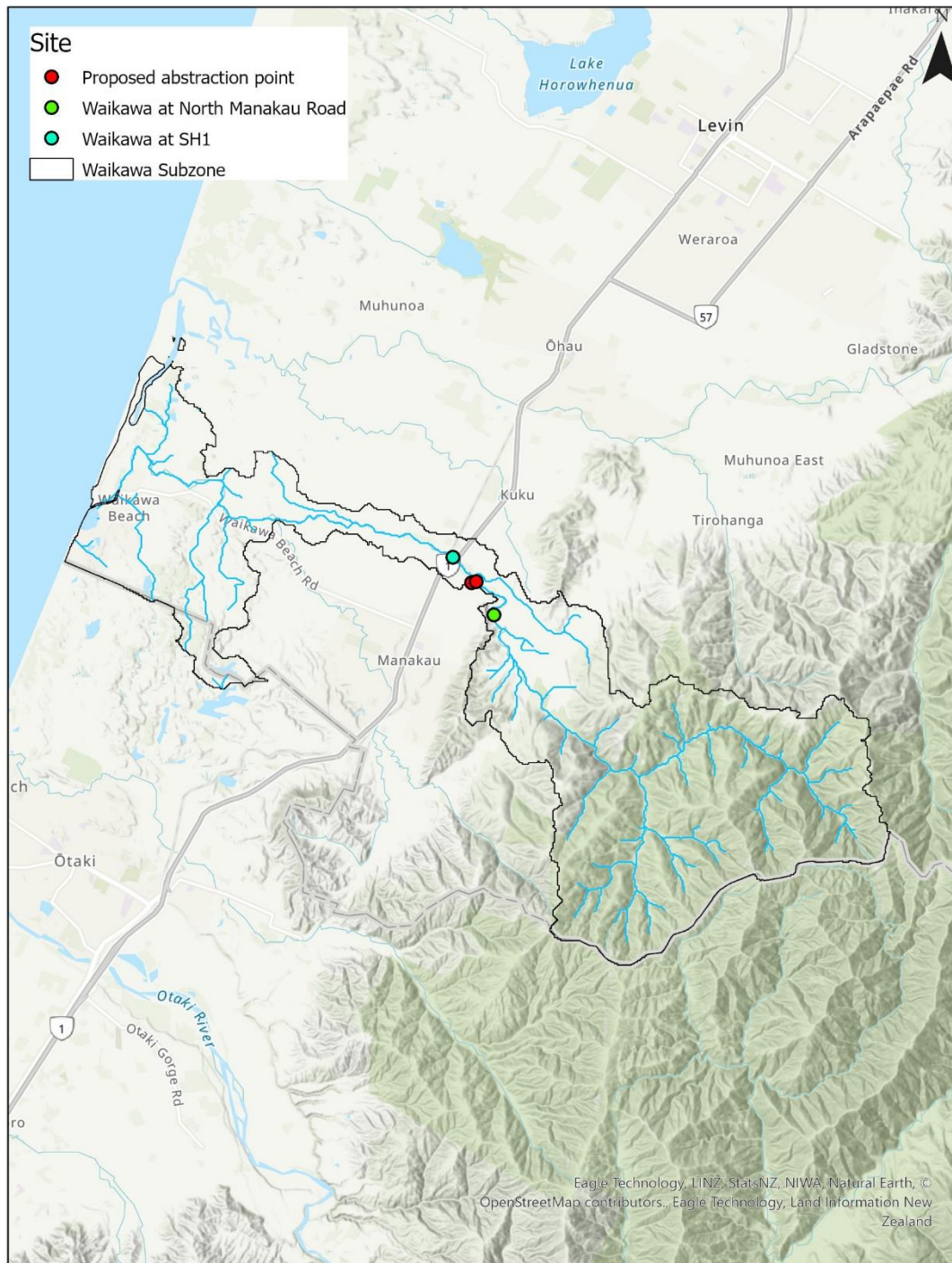
**LOCATION OF CONCURRENT FLOW OBSERVATION SITES:
WAIKAWA**

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Figure 2 Map showing the location of the proposed abstraction sites (inferred from Volume III - Drawing Set – 07 Accommodation Works) on the Waikawa Stream, and the proposed flow monitoring site at North Manakau Road.



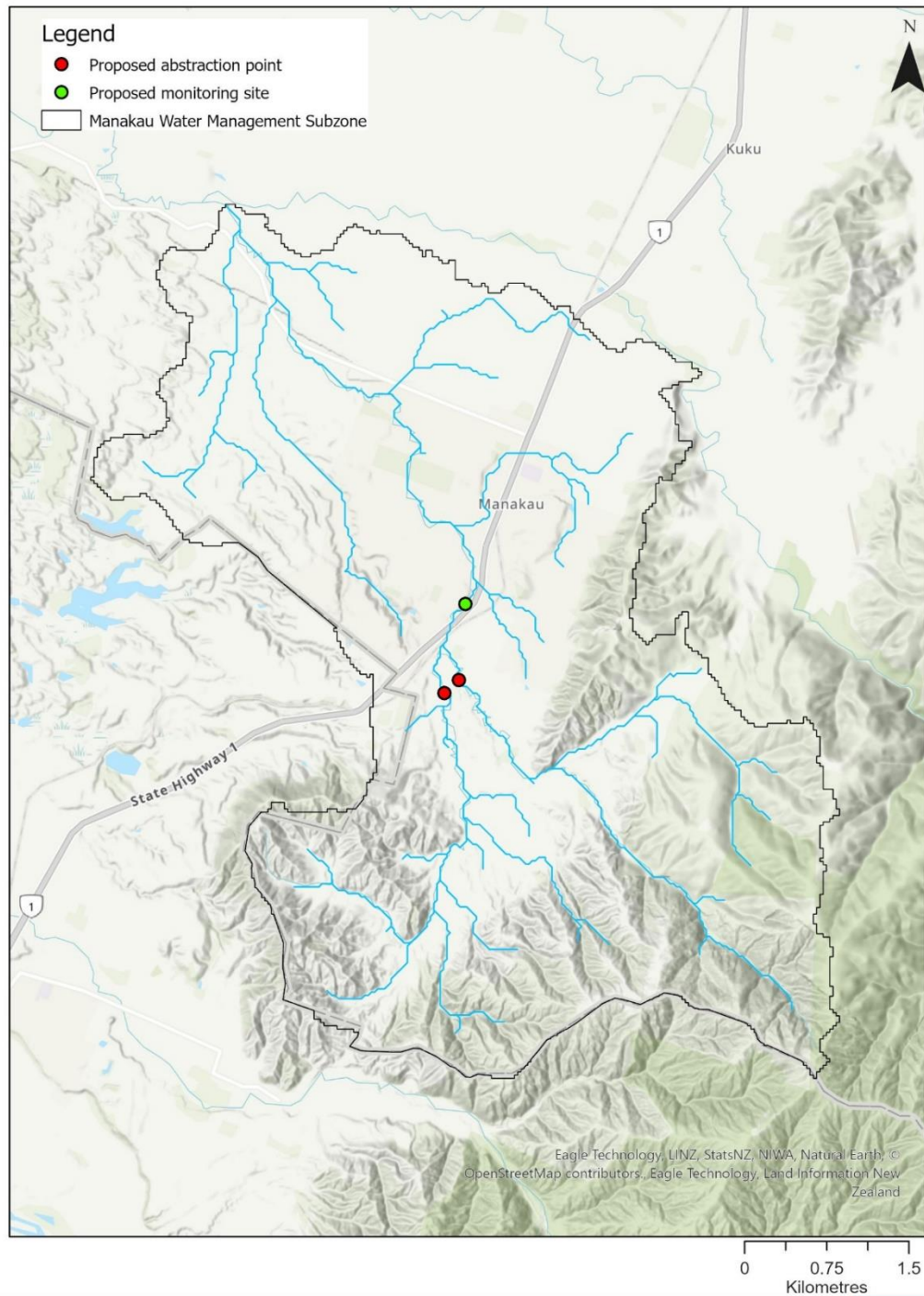
**LOCATION OF CONCURRENT FLOW OBSERVATION SITES:
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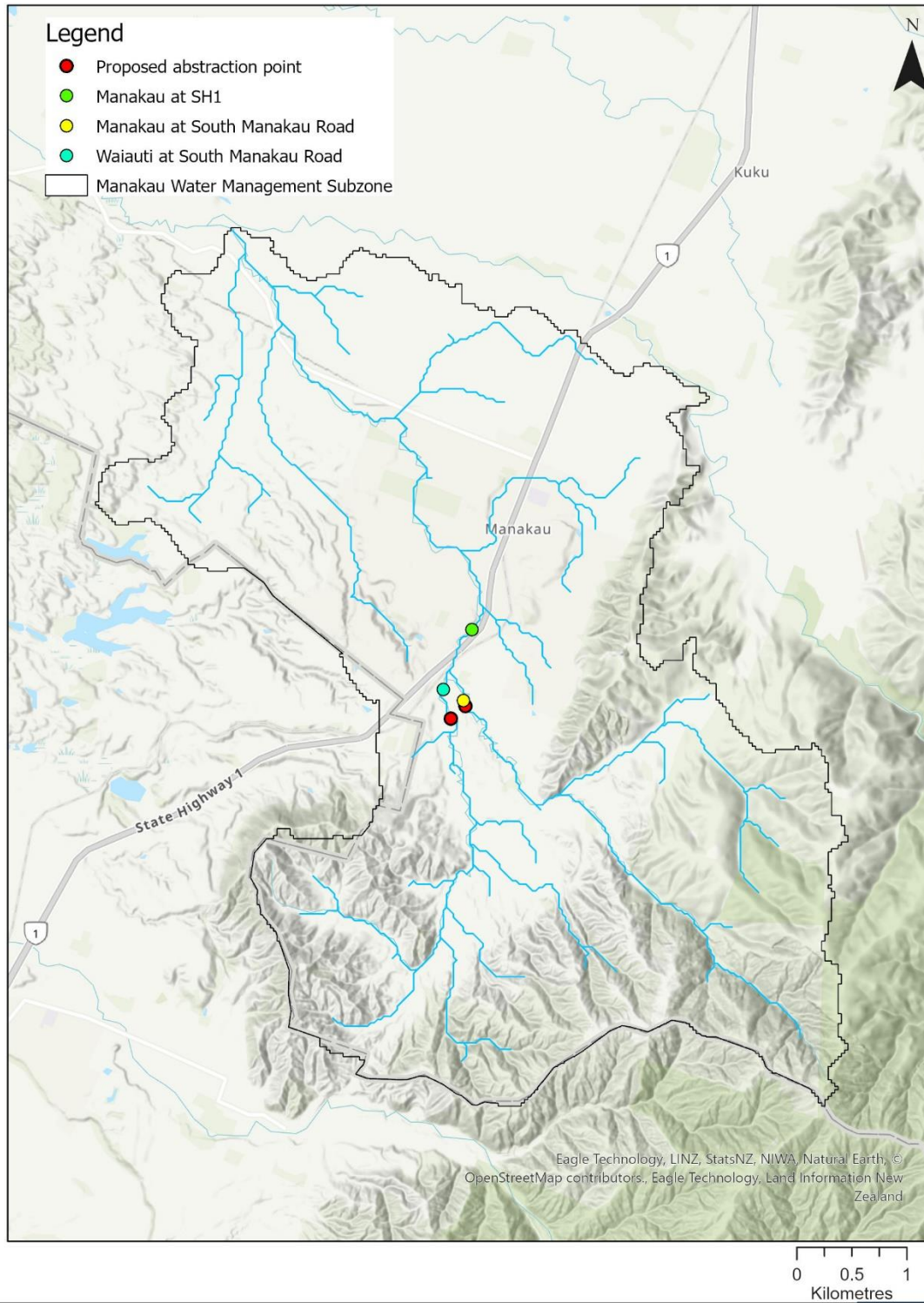
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Figure 3 Map showing the location of the proposed abstraction sites (inferred from Volume III - Drawing Set – 07 Accommodation Works) on the Waikawa Stream, and the locations of the sites used in the same-day flow gauging analyses



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Figure 4 Map showing the location of the proposed abstraction points (inferred from Volume III - Drawing Set – 07 Accommodation Works) on the Waiauti and Manakau Streams, and the proposed monitoring site on the Manakau Stream at SH1 [Manakau at SH1 Bridge]



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MANAKAU AND WAIAUTI**

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Figure 5 Map showing the location of the proposed abstraction sites (inferred from Volume III - Drawing Set – 07 Accommodation Works) on the Manakau and Waiauti Streams, and the locations of the sites used in the same-day flow gauging analyses



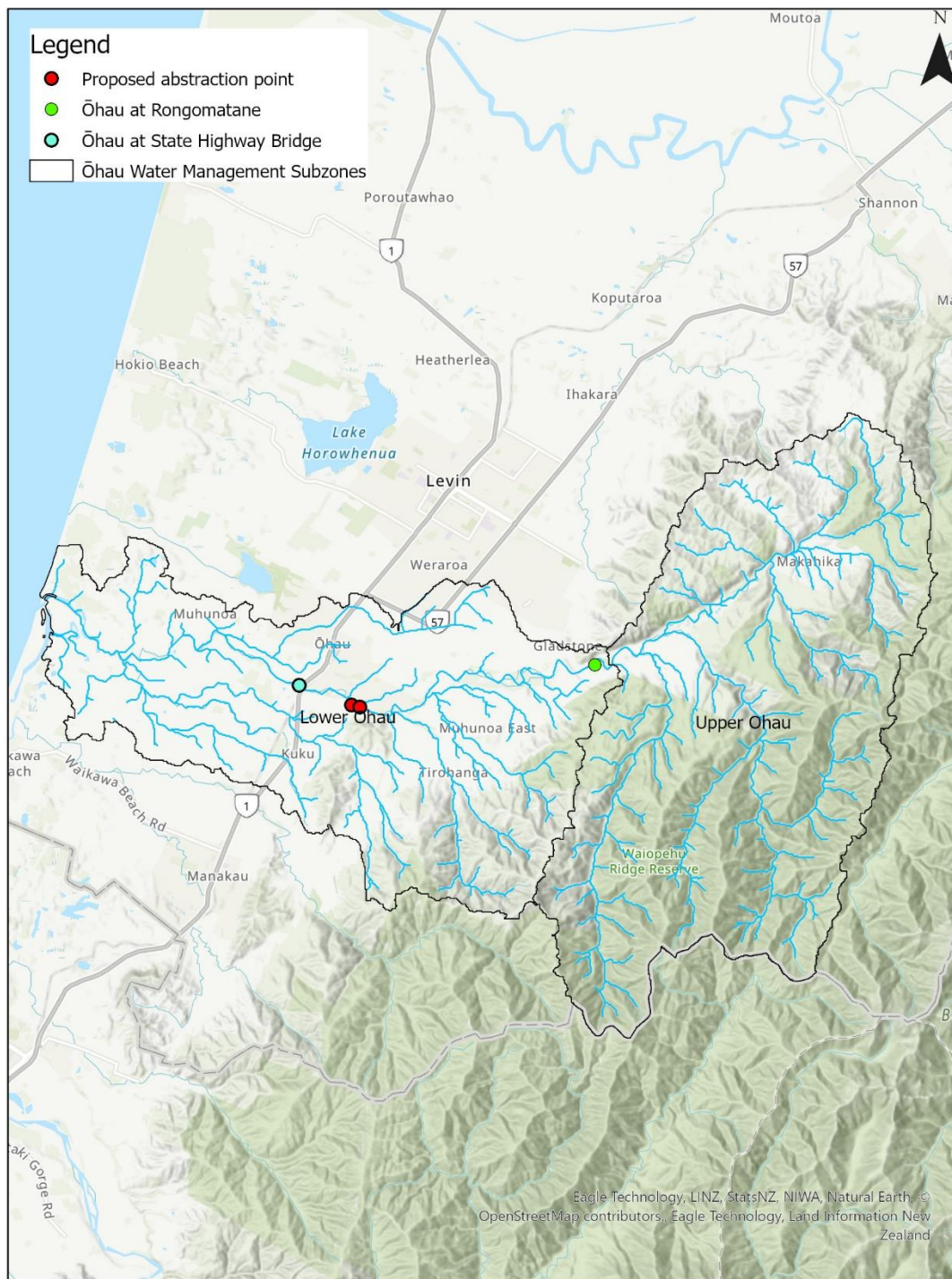
Ō2NL PROPOSED ABSTRACTION AND FLOW MONITORING SITES: ŌHAU

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Figure 6 Map showing the location of the proposed abstraction points (inferred from Volume III - Drawing Set – 07 Accommodation Works) and the proposed flow monitoring at Rongomatane [Ōhau at Rongomatane]



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ŌHAU**

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Figure 7 Map showing the location of the proposed abstraction sites (inferred from Volume III - Drawing Set – 07 Accommodation Works) on the Ōhau River, and the locations of the sites used in the same-day flow gauging analyses

J. REFERENCES

Hurdell, R. (2009). *Section 42A report of Ms Raelene Ellen Hurdell on behalf of Horizons Regional Council.*

<https://www.horizons.govt.nz/HRC/media/Media/One%20Plan%20Documents/Ms-Raelene-Ellen-Hurdell.pdf?ext=.pdf>

Lennard, A. (2022, in draft). *Hydrological statistics for the Horizons region.*

K. APPENDICES

Appendix A

Table C.1 (Schedule C of the One Plan)

Schedule C: Surface *Water*[^] Quantity

Schedule C is a component of Part II - the Regional Plan.

Schedule C only applies to *rivers*[^].

How to use the contents of this schedule:

Step 1: Identify which *Water Management Sub-zone*^{*} your proposed abstraction lies in (go to Schedule A).

Step 2: Refer to Table C.1 to identify which cumulative core allocation limits and minimum flows apply to your *Water Management Sub-zone*^{*}.

Advice Note:

In accordance with Policy 5-15(b), the taking of *water*[^] for hydroelectricity generation that was lawfully established as at 31 May 2007 falls outside the cumulative core allocation limits and minimum flows in this Schedule.

The cumulative core allocation in any *Water Management Sub-zone*^{*} is only available where:

- (a) the point of take is downstream of the locations described in Table C.2 which identifies the location of infrastructure related to existing hydroelectricity generation schemes, or
- (b) the point of take is upstream of the locations described in the Table C.2 and the quantity of *water*[^] to be taken is no more than was lawfully allocated to be taken upstream of those locations as at 31 May 2007.

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone*^{*}

<i>Water Management Zone</i> [*]	<i>Sub-zone</i> [*]	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
Upper Manawatu (Mana_1)	Upper Manawatu (Mana_1a)	1.600	Manawatu at Weber Rd	U23:751-027	17,712
	Mangatewainui (Mana_1b)	1.600	Manawatu at Weber Rd	U23:751-027	5,616
	Mangatoro (Mana_1c)	0.700	Mangatoro at Mangahei Rd	U23:813-019	10,368

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone</i> *	<i>Sub-zone</i> *	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
Whole Zone (Mana_1)					17,172
Weber-Tamaki (Mana_2)	Weber-Tamaki (Mana_2a)	1.600	Manawatu at Weber Rd	U23:751-027	21,600
	Mangatera (Mana_2b)	1.600	Manawatu at Weber Rd	U23:751-027	3,888
Catchment cumulative allocable volume (Mana_1 + Mana_2)					21,600
Upper Tamaki (Mana_3) Upper Kumeti (Mana_4) Tamaki-Hopelands (Mana_5)	Upper Tamaki (Mana_3)	0.240	Tamaki at Water Supply Weir	U23:709-111	6,912
	Upper Kumeti (Mana_4)	0.055	Kumeti at Te Rehunga	T24:616-899	864
	Tamaki-Hopelands (Mana_5a)	2.980	Manawatu at Hopelands	T24:616-899	83,808
	Lower Tamaki (Mana_5b)	0.360	Tamaki at Stephenson's	U23:707-022	12,096
	Cumulative allocable volume (Mana_3 + Mana_5b)				12,096
	Lower Kumeti (Mana_5c)	2.980	Manawatu at Hopelands	T24:616-899	5,184
	Cumulative allocable volume (Mana_4 + Mana_5c)				5,184
	Oruakeretaki (Mana_5d)	0.208	Oruakeretaki at SH2 Napier	T23:679-014	13,651
	Raparapawai (Mana_5e)	0.035	Raparapawai at Jacksons Rd	T24:645-938	1,296
Catchment cumulative allocable volume (Mana_1 + Mana_2 + Mana_3 + Mana_4 + Mana_5)					83,808
Hopelands-Tiraumea (Mana_6)	Hopelands-Tiraumea (Mana_6)	2.980	Manawatu at Hopelands	T24:616-899	90,720
Catchment cumulative allocable volume (Mana_1 + Mana_2 + Mana_3 + Mana_4 + Mana_5 + Mana_6)					90,720
Tiraumea (Mana_7)	Upper Tiraumea (Mana_7a)	2.040	Tiraumea at Ngaturi	T24:578-780	3,456

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone</i> *	<i>Sub-zone</i> *	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
	Lower Tiraumea (Mana_7b)	2.040	Tiraumea at Ngaturi	T24:578-780	23,328
	Mangaone River (Mana_7c)	2.040	Tiraumea at Ngaturi	T24:578-780	1,728
	Makuri (Mana_7d)	1.700	Makuri at Tuscan Hills	T24:583-717	8,640
	Cumulative allocable volume (Mana_7a + Mana_7c + Mana_7d)				8,640
	Mangaramarama (Mana_7e)	2.040	Tiraumea at Ngaturi	T24:578-780	2,160
Whole Zone (Mana_7)					23,328
Mangatainoka (Mana_8)	Upper Mangatainoka (Mana_8a)	0.370	Mangatainoka at Larsons Road	T25:308-596	1,728
	Middle Mangatainoka (Mana_8b)	1.305	Mangatainoka at Pahiatua Town Bridge	T24:501-802	5,184
	Lower Mangatainoka (Mana_8c)	1.305	Mangatainoka at Pahiatua Town Bridge	T24:501-802	27,913
	Makakahi (Mana_8d)	0.320	Makakahi at Hamua	T25:424-676	2,694
	Cumulative allocable volume (Mana_8a + Mana_8b + Mana_8d)				5,184
Whole Zone (Mana_8)					27,913
Catchment cumulative allocable volume Mangatainoka and Tiraumea (Mana_7 + Mana_8)					51,241
Upper Gorge (Mana_9)	Upper Gorge (Mana_9a)	9.175	Manawatu at Upper Gorge	T24:494-933	198,288
	Mangapapa (Mana_9b)	0.035	Mangapapa at Troup Road	T24:520-922	1,296
	Mangaatua (Mana_9c)	0.070	Mangaatua at Hutchinsons	T24:581-932	432
	Upper Mangahao (Mana_9d)	1.415	Mangahao at Ballance	T24:468-818	7,344
	Lower Mangahao (Mana_9e)	1.415	Mangahao at Ballance	T24:468-818	7,344

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone*</i>	<i>Sub-zone*</i>	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
	Cumulative allocable volume (Mana_9d + Mana_9e)				7,344
Whole Zone (Mana_9)					198,288
Catchment cumulative allocable volume (Mana_1 + Mana_2 + Mana_3 + Mana_4 + Mana_5 + Mana_6 + Mana_7 + Mana_8 + Mana_9)					198,288
Middle Manawatu (Mana_10)	Middle Manawatu (Mana_10a)	12.240	Manawatu at Teachers College	T24:331-892	264,384
	Upper Pohangina (Mana_10b)	1.960	Pohangina at Mais Reach	T23:467-053	9,936
	Middle Pohangina (Mana_10c)	1.960	Pohangina at Mais Reach	T23:467-053	39,312
	Cumulative allocable volume (Mana_10b + Mana_10c)				39,312
	Lower Pohangina (Mana_10d)	1.960	Pohangina at Mais Reach	T23:467-053	39,312
	Cumulative allocable volume (Mana_10b + Mana_10c + Mana_10d)				39,312
	Aokautere (Mana_10e)	12.240	Manawatu at Teachers College	T24:331-892	432
Whole Zone (Mana_10)					264,384
Catchment cumulative allocable volume (Mana_1 + Mana_2 + Mana_3 + Mana_4 + Mana_5 + Mana_6 + Mana_7 + Mana_8 + Mana_9 + Mana_10)					264,384
Lower Manawatu (Mana_11)	Lower Manawatu (Mana_11a)	12.240	Manawatu at Teachers College	T24:331-892	336,096
	Turitea (Mana_11b)	0.041	Turitea at Ngahere Park	T24:354-852	37,100
	Kahuterawa (Mana_11c)	0.180	Kahuterawa at Johnsons Rata	T24:323-808	864
	Upper Mangaone Stream (Mana_11d)	0.035	Mangaone at Milson Line	T24:311-953	432
	Lower Mangaone Stream (Mana_11e)	0.035	Mangaone at Milson Line	T24:311-953	864

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by Water Management Sub-zone*

<i>Water Management Zone*</i>	<i>Sub-zone*</i>	<i>Minimum flow (m³/s)</i>	<i>Flow recorder</i>	<i>Flow recorder location</i>	<i>Cumulative core allocation limit (m³/day)</i>
	Cumulative allocable volume (Mana_11d + Mana_11e)				1,296
	Main Drain (Mana_11f)	12.240	Manawatu at Teachers College		10% of MALF*
Whole Zone (Mana_11)					336,096
Catchment cumulative allocable volume (Mana_1 + Mana_2 + Mana_3 + Mana_4 + Mana_5 + Mana_6 + Mana_7 + Mana_8 + Mana_9 + Mana_10 + Mana_11)					336,096
Oroua (Mana_12)	Upper Oroua (Mana_12a)	1.005	Oroua at Almadale	T23:365-113	34,128
	Middle Oroua (Mana_12b)	1.030	Oroua at Kawa Wool	S23:287-038	34,992
	Lower Oroua (Mana_12c)	1.085	Oroua at Awahuri Bridge	S23:243-002	37,152
	Cumulative allocable volume (Mana_12a + Mana_12b + Mana_12c)				37,152
	Kiwitea (Mana_12d)	0.150	Kiwitea at Haynes Line	T23:366-207	1,296
	Makino (Mana_12e)	0.075	Makino at Boness Road	S23:254-023	1,296
Whole Zone (Mana_12)					37,152
Catchment cumulative allocable volume (Mana_1 + Mana_2 + Mana_3 + Mana_4 + Mana_5 + Mana_6 + Mana_7 + Mana_8 + Mana_9 + Mana_10 + Mana_11 + Mana_12)					373,248
Coastal Manawatu (Mana_13)	Coastal Manawatu (Mana_13a)	12.240	Manawatu at Teachers College	T24:331-892	598,752
	Upper Tokomaru (Mana_13b)	0.240	Tokomaru at Riverland Farm	S24:218-772	1,296
	Lower Tokomaru (Mana_13c)	0.240	Tokomaru at Riverland Farm	S24:218-772	14,688
	Cumulative allocable volume (Mana_13b + Mana_13c)				14,688
	Mangaore (Mana_13d)	MALF*	Mangaore at d/s Mangahao Power Station	S25:173-670	10% of MALF*
	Koputaroa (Mana_13e)	12.240	Manawatu at Teachers College	T24:331-892	432

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by Water Management Sub-zone*

<i>Water Management Zone*</i>	<i>Sub-zone*</i>	<i>Minimum flow (m³/s)</i>	<i>Flow recorder</i>	<i>Flow recorder location</i>	<i>Cumulative core allocation limit (m³/day)</i>
	Foxton Loop (Mana_13f)	MALF*			10% of MALF*
Whole Zone (Mana_13)					598,752
Catchment cumulative allocable volume (Mana_1 + Mana_2 + Mana_3 + Mana_4 + Mana_5 + Mana_6 + Mana_7 + Mana_8 + Mana_9 + Mana_10 + Mana_11 + Mana_12 + Mana_13)					598,752
Upper Rangitikei (Rang_1)	Upper Rangitikei (Rang_1)	n/a			0
Middle Rangitikei (Rang_2)	Middle Rangitikei (Rang_2a)	5.000	Rangitikei at Pukeokahu	U21:713-708	21,600
	Pukeokahu-Mangaweka (Rang_2b)	12.250	Rangitikei at Mangaweka	T22:504-513	52,704
	Cumulative allocable volume (Rang_2a + Rang_2b)				52,704
	Upper Moawhango (Rang_2c)	n/a		T21:557-745	0
	Middle Moawhango (Rang_2d)	n/a		T21:557-745	0
	Lower Moawhango (Rang_2e)	n/a		T21:557-745	0
	Upper Hautapu (Rang_2f)	0.640	Hautapu at Alabasters	T21:486-683	9,936
	Lower Hautapu (Rang_2g)	0.640	Hautapu at Alabasters	T21:486-683	12,960
	Cumulative allocable volume (Rang_2f + Rang_2g)				12,960
	Whole Zone (Rang_2)				
Catchment cumulative allocable volume (Rang_1 + Rang_2)					52,704
Lower Rangitikei (Rang_3)	Lower Rangitikei (Rang_3a)	12.100	Rangitikei at Onepuhi	S23:201-222	141,696
	Makohine (Rang_3b)	0.040	Makohine at Viaduct	T22:395-450	864

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone</i> *	<i>Sub-zone</i> *	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
Whole Zone (Rang_3)					141,696
<i>Catchment cumulative allocable volume (Rang_1 + Rang_2 + Rang_3)</i>					141,696
Coastal Rangitikei (Rang_4)	Coastal Rangitikei (Rang_4a)	10.230	Rangitikei at McKelvies	S24:033-985	213,840
	Tidal Rangitikei (Rang_4b)	10.230	Rangitikei at McKelvies	S24:033-985	285,120
	Porewa (Rang_4c)	12.100	Rangitikei at Onepuhi	S23:201-222	0
	Tutaenui (Rang_4d)	10.230	Rangitikei at McKelvies	S24:033-985	6,653
Whole Zone (Rang_4)					285,120
<i>Catchment cumulative allocable volume (Rang_1 + Rang_2 + Rang_3 + Rang_4)</i>					285,120
Upper Whanganui (Whai_1)	Upper Whanganui (Whai_1)	26.6	Whanganui at Te Maire		518
Whole Zone (Whai_1)					518
Cherry Grove (Whai_2)	Cherry Grove (Whai_2a)	26.6	Whanganui at Te Maire		15,121
	Upper Whakapapa (Whai_2b)	26.6	Whanganui at Te Maire		3,937
	Lower Whakapapa (Whai_2c)	26.6	Whanganui at Te Maire		5,517
	Piopiotea (Whai_2d)	26.6	Whanganui at Te Maire		80
	Pungapunga (Whai_2e)	26.6	Whanganui at Te Maire		0
	Upper Ongarue (Whai_2f)	26.6	Whanganui at Te Maire		1,270
	Lower Ongarue (Whai_2g)	26.6	Whanganui at Te Maire		1,422

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone</i> *	<i>Sub-zone</i> *	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
Whole Zone (Whai_2)					15,121
Catchment cumulative allocable volume (Whai_1 + Whai_2)					15,121
Te Maire (Whai_3)	Te Maire (Whai_3)	MALF*			10% of MALF*
Catchment cumulative allocable volume (Whai_1 + Whai_2 + Whai_3)					10% of MALF*
Middle Whanganui (Whai_4)	Middle Whanganui (Whai_4a)	MALF*			10% of MALF*
	Upper Ohura (Whai_4b)	MALF*			10% of MALF*
	Lower Ohura (Whai_4c)	MALF*			10% of MALF*
	Retaruke (Whai_4d)	MALF*			10% of MALF*
Whole Zone (Whai_4)					10% of MALF*
Catchment cumulative allocable volume (Whai_1 + Whai_2 + Whai_3 + Whai_4)					10% of MALF*
Pipiriki (Whai_5)	Pipiriki (Whai_5a)	MALF*			10% of MALF*
	Tangarakau (Whai_5b)	MALF*			10% of MALF*
	Whangamomona (Whai_5c)	MALF*			10% of MALF*
	Upper Manganui o te Ao (Whai_5d)	n/a			0
	Makatote (Whai_5e)	n/a			0
	Waimarino (Whai_5f)	7 day MALF*			5% of 7 day MALF*

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone*</i>	<i>Sub-zone*</i>	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
	Middle Manganui o te Ao (Whai_5g)	7 day MALF*			5% of 7 day MALF*
	Mangaturuturu (Whai_5h)	n/a			0
	Lower Manganui o te Ao (Whai_5i)	7 day MALF*			5% of 7 day MALF*
	Orautoha (Whai_5j)	7 day MALF*			5% of 7 day MALF*
Whole Zone (Whai_5)					10% of MALF*
Catchment cumulative allocable volume (Whai_1 + Whai_2 + Whai_3 + Whai_4 + Whai_5)					10% of MALF*
Paetawa (Whai_6)	Paetawa (Whai_6)	MALF*			10% of MALF*
Catchment cumulative allocable volume (Whai_1 + Whai_2 + Whai_3 + Whai_4 + Whai_5 + Whai_6)					10% of MALF*
Lower Whanganui (Whai_7)	Lower Whanganui (Whai_7a)	MALF*			10% of MALF*
	Coastal Whanganui (Whai_7b)	MALF*			10% of MALF*
	Upokongaro (Whai_7c)	MALF*			10% of MALF*
	Matarawa (Whai_7d)	MALF*			10% of MALF*
Whole Zone (Whai_7)					10% of MALF*
Catchment cumulative allocable volume (Whai_1 + Whai_2 + Whai_3 + Whai_4 + Whai_5 + Whai_6 + Whai_7)					10% of MALF*
Upper Whangaehu (Whau_1)	Upper Whangaehu (Whau_1a)	8.700	Whangaehu at Karioi	S21:218-864	47,520
	Waitangi (Whau_1b)	0.470	Waitangi at Tangiwai	T21:316-886	9,504

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone</i> *	<i>Sub-zone</i> *	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
	Tokiahuru (Whau_1c)	3.840	Tokiahuru at Junction	S21:217-870	41,472
Whole Zone (Whau_1)					47,520
Middle Whangaehu (Whau_2)	Middle Whangaehu	9.650	Whangaehu at Aranui	S21:175-627	52,272
Catchment cumulative allocable volume (Whau_1 + Whau_2)					52,272
Lower Whangaehu (Whau_3)	Lower Whangaehu (Whau_3a)	11.770	Whangaehu at Kauangaroa	S22:045-397	127,008
	Upper Makotuku (Whau_3b)	0.095	Makotuku at Below Race Intake	S20:091-002	2,506
	Lower Makotuku (Whau_3c)	0.165	Makotuku at Raetihi	S20:065-955	3,802
	Upper Mangawhero (Whau_3d)	1.020	Mangawhero at Pakihi Road	S20:100-945	20,736
	Lower Mangawhero (Whau_3e)	2.405	Mangawhero at Ore Ore	S21:045-794	24,624
	Makara (Whau_3f)	0.045	Makara at d/s Airstrip		0
	Cumulative allocable volume (Whau_3b + Whau_3f)				
Cumulative allocable volume (Whau_3b + Whau_3c + Whau_3f)					3,802
Whole Zone (Whau_3)					127,008
Catchment cumulative allocable volume (Whau_1 + Whau_2 + Whau_3)					127,008
Coastal Whangaehu (Whau_4)	Coastal Whangaehu (Whau_4)	11.770	Whangaehu at Kauangaroa	S22:045-397	127,008
Catchment cumulative allocable volume (Whau_1 + Whau_2 + Whau_3 + Whau_4)					127,008
Turakina (Tura_1)	Upper Turakina (Tura_1a)	0.340	Turakina at Otairi	S22:236-471	3,024
	Lower Turakina (Tura_1b)	0.805	Turakina at O'Neills Bridge	S23:006-287	12,528

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone*</i>	<i>Sub-zone*</i>	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
	Ratana (Tura_1c)	0.805	Turakina at O'Neills Bridge	S23:006-287	10% of MALF
Whole Zone (Tura_1)					12,528
<i>Catchment cumulative allocable volume (Tura_1)</i>					12,528
Ohau (Ohau_1)	Upper Ohau (Ohau_1a)	0.820	Ohau at Rongomatane	S25:072-577	24,192
	Lower Ohau (Ohau_1b)	0.820	Ohau at Rongomatane	S25:072-577	24,192
Whole Zone (Ohau_1)					24,192
<i>Catchment cumulative allocable volume (Ohau_1)</i>					24,192
Owahanga (Owha_1)	Owahanga (Owha_1)	0.030	Owahanga at Branscombe Bridge	U25:893-587	432
East Coast (East_1)	East Coast (East_1)	<i>MALF*</i>			10% of <i>MALF*</i>
Akitio (Akit_1)	Upper Akitio (Akit_1a)	0.045	Akitio at Weber	U24:919-832	864
	Lower Akitio (Akit_1b)	0.145	Akitio at Mouth	U25:988-655	2,592
	Waihi (Akit_1c)	0.050	Waihi at SH52	U24:892-804	1,296
<i>Catchment cumulative allocable volume (Akit_1)</i>					2,592
Northern Coastal (West_1)	Northern Coastal (West_1)	<i>MALF*</i>			10% of <i>MALF*</i>
Kai Iwi (West_2)	Kai Iwi (West_2)	0.445	Kai Iwi at Handley Road	R22:726-455	3,888
Mowhanau (West_3)	Mowhanau (West_3)	<i>MALF*</i>			10% of <i>MALF*</i>
Kaitoke Lakes (West_4)	Kaitoke Lakes (West_4)	<i>MALF*</i>			10% of <i>MALF*</i>

Table C.1: Cumulative Core Allocation Limits and Minimum Flows by *Water Management Sub-zone**

<i>Water Management Zone*</i>	<i>Sub-zone*</i>	Minimum flow (m ³ /s)	Flow recorder	Flow recorder location	Cumulative core allocation limit (m ³ /day)
Southern Whanganui Lakes (West_5)	Southern Whanganui Lakes (West_5)	<i>MALF*</i>			10% of <i>MALF*</i>
Northern Manawatu Lakes (West_6)	Northern Manawatu Lakes (West_6)	<i>MALF*</i>			10% of <i>MALF*</i>
Waitarere (West_7)	Waitarere (West_7)	<i>MALF*</i>			10% of <i>MALF*</i>
Lake Papaitonga (West_8)	Lake Papaitonga (West_8)	<i>MALF*</i>			10% of <i>MALF*</i>
Waikawa (West_9)	Waikawa (West_9a)	0.220	Waikawa at North Manakau Road	S25:987-530	6,048
	Manakau (West_9b)	0.040	Manakau at SH1 Bridge	S25:968-512	432
Whole zone (West_9)					6,048
Lake Horowhenua (Hoki_1)	Lake Horowhenua (Hoki_1a)	<i>MALF*</i>			10% of <i>MALF*</i>
	Hokio (Hoki_1b)	<i>MALF*</i>			10% of <i>MALF*</i>

Appendix B

Policy 5-17 (Supplementary Water Allocation - One Plan)

In addition to the core allocations set out in Policy 5-15, a supplementary allocation from rivers[^] may be provided:

- (a) in circumstances where water[^] is only taken when the river[^] flow is greater than the median flow, and the total amount of water[^] taken by way of a supplementary allocation does not exceed 10% of the actual flow in the river[^] at the time of abstraction, and
- (b) in circumstances where it can be shown that the supplementary allocation will not:
 - (i) increase the frequency or duration of minimum flows
 - (ii) lead to a significant departure from the natural flow regime, including the magnitude of the median flow and the frequency of flushing flows
 - (iii) cause any adverse effects[^] that are more than minor on the Schedule B Values of the water body[^] or its bed[^]
 - (iv) limit the ability of anyone to take water[^] under a core allocation
 - (v) derogate from water[^] allocated to hydroelectricity generation.

Appendix C

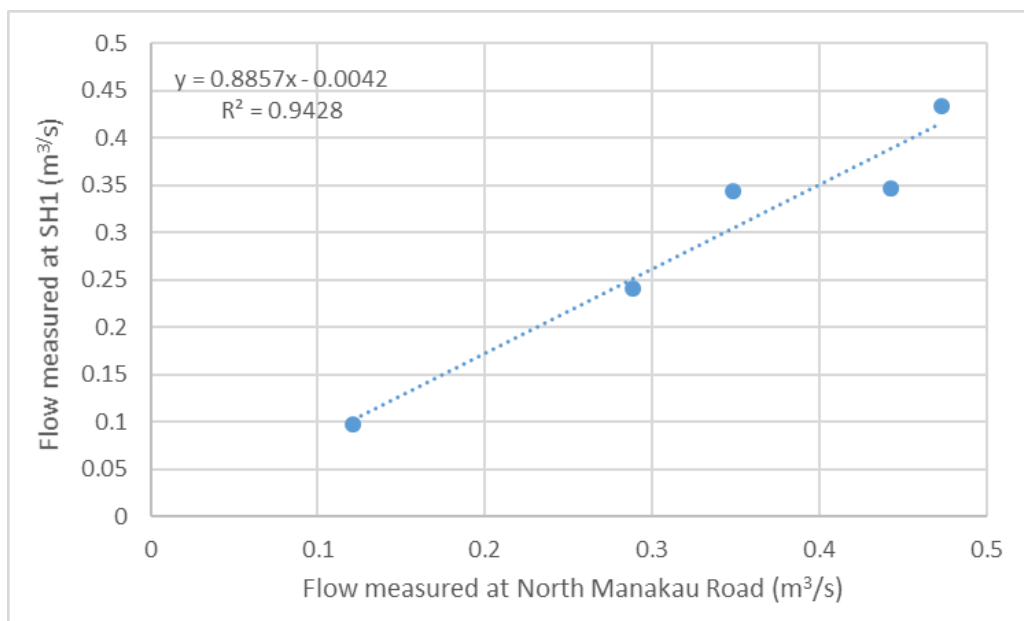
Same-day flow gaugings taken at the Waikawa at North Manakau Road flow recorder and the Waikawa at SH1 Bridge Gauging site, and linear regression of the observations taken below median flow at the Waikawa at North Manakau Road flow recorder

Date	Waikawa at SH1		Waikawa at North Manakau Road
	Flow (l/s)	Flow (% measured at North Manakau Road)	Flow (l/s)
26/03/2003 ⁺	98	81.0	121
29/01/2008 ⁺	433	91.5	473
16/12/2014 [*]	1959	107.0	1830
22/01/2015 ⁺	346	78.1	443
23/02/2015 ⁺	241	83.7	288
01/03/2016 ⁺	343	98.6	348

⁺ Gauging taken when the Waikawa at North Manakau Road was below median flow

^{*} Gauging taken when the Waikawa at North Manakau Road was above median flow

Linear regression of concurrent flow observations taken when flow at the Waikawa at North Manakau Road flow recorder was below median flow [0.87 m³/s (Lennard, 2022, in draft)].



Appendix D

Same-day flow gaugings taken at the Manakau at SH1 Bridge/Gleesons Road flow recorder and the Manakau at South Manakau Road and Waiuti at South Manakau Road gauging sites

Date	Waiuti at South Manakau Road		Manakau at South Manakau Road		Manakau at SH1/Gleesons
	Flow (l/s)	Flow (% measured at SH1/Gleesons)	Flow (l/s)	Flow (% measured at SH1/Gleesons)	Flow (l/s)
26/032003	-	-	6	67	9
16/12/2014	-	-	209	62	339
22/012015	-	-	30	48	63
23/02/2015	-	-	20	67	30
1/03/2016	25	66	20	53	38

Appendix E

Same-day flow gaugings taken at the Ōhau at Rongomatane flow recorder and the Ōhau at SH1 Bridge gauging site when the flow measured at the Ōhau at Rongomatane flow recorder was above median

Date	Ōhau at SH1 Bridge		Ōhau at Rongomatane
	Flow (l/s)	Flow (% measured at Rongomatane)	Flow (l/s)
3/11/2015	6935	100	6933
6/12/2016	5356	118	4553
3/10/2017	10070	115	8743
3/07/2018	5413	123	4394
6/11/2018	6488	114	5700
8/01/2019	6417	104	6187
8/10/2019	6113	111	5491
3/11/2020	5796	109	5306
5/10/2021	6430	111	5805
2/11/2021	6660	108	6171
8/02/2022	5549	109	5079
7/06/2022	5695	110	5154
05/07/2022	3543	108	3284
08/11/2022	2142	99	2163