Memo

Date	19/03/18
To	Waimakariri Water Zone Committee
cc	-
From	Mark Megaughin | Hydrologist

Environmental flow regime for the Ashely River/Rakahuri catchment

1 Summary

This memorandum summarises the current status of allocation and environmental flows in the Ashley River/Rakahuri catchment, describes the issues and presents the analysis of options and their implications to address NPS for Freshwater Management objectives. There are 5 surface water allocation zones (SWAZs) within the catchment:

- Ashley River / Rakahuri
- Saltwater Creek
- Waikuku Stream
- Little Ashley Creek
- Taranaki Creek

Issues identified include:

- Surface water in the Ashley River catchment is over-allocated, with the exception of Little Ashley Creek and the 'B' and 'C' blocks of Ashley River/Rakahuri.
- Allocation limits are generally higher than typical ecological metrics suggest
- Minimum flows are generally lower than typical ecological metrics suggest
- Minimum flows are generally lower than the cultural aspirations for the catchments
- Some rivers may experience a decline in the available water due to increased use of groundwater and/or climatic trends which are reducing flows in the Ashley River/Rakahuri
- Ecological and cultural values are compromised in areas of each catchment

The outcomes of this work is a list of options which can be pursued with the Zone Committee and ultimately the community such that a final management regime can be determined. Broadly, these options include:

- Increasing minimum flows to offer greater protection of ecological and cultural values
- Do not change minimum flow levels to maintain current conditions and ensure they do not get worse
- Decrease allocation limits to offer greater protection of ecological and cultural values
- Do not change allocation limits to maintain current conditions and ensure they do not get worse
- Focus on resolving the over-allocation in a number of catchments
- Implement other mitigations which, along with options above can produce an overall net benefit to catchment values.

2 Introduction

This memorandum presents the rationale behind, and options for, revised environmental flow and allocation regimes in the Ashley River/Rakahuri catchment. The catchment is currently managed across 5 surface water allocation zones (SWAZ) each of which require their own environmental flow regime to manage abstractions. They are:

- Ashley River / Rakahuri
- Saltwater Creek
- Waikuku Stream
- Little Ashley Creek
- Taranaki Creek

We do not propose to change the number of SWAZs; minor changes to boundaries have however been made to better reflect the catchment boundaries of these watercourses. These changes do not alter the current pattern of water allocation.

The Ashley River/Rakahuri is a hill fed, gravel-bed braided river which rises in the Puketeraki Range. Low flows dominate, particularly during summer, but they are interspersed with large fresh and flood flows which modify the channel, move gravel down the river and remove macrophytes and algal growth. The remaining waterways are spring-fed lowland streams which have low base-flows that typically drop steadily over the summer months in response to the seasonal reduction in groundwater levels. Freshes and floods are of a much smaller magnitude and rarer than on the Ashley River because of the small, flat catchment surrounding the streams.

Given the very different character of these rivers, the issues which they face and the management options which can be adopted are very different.

To assess the rivers, their current management and future options we have undertaken the following work:

1. Current resource and trends in that resource (*Land and water solutions programme current state hydrology report - Draft*)
2. Current consent water and how that water is used (*Land and water solutions programme current state hydrology report - Draft*)
3. Current issues / values (COMAR, Evaluation of environmental flow regime options for the Ashley River and its tributaries, Groundwater allocation modelling results for Ashley sub-zone)
4. Options available to contribute towards outcomes (*this memo*randum)

3 Purpose

The framework for the development of management options for all watercourses across the country is the NPS for Freshwater Management (NPSFM-14) which requires that all councils meet five objectives:

Objective B1 To safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the taking, using, damming, or diverting of fresh water.

Objective B2 To avoid any further over-allocation of fresh water and phase out existing over-allocation.

Objective B3 To improve and maximise the efficient allocation and efficient use of water.

Objective B4 To protect significant values of wetlands and of outstanding freshwater bodies.

Objective B5 To enable communities to provide for their economic well-being, including productive economic opportunities, in sustainably managing fresh water quantity, within limits.

This memorandum summarises the current status of allocation and environmental flows in the Ashley River/Rakahuri catchment, describes the issues and presents the analysis of options and their implications to address the five objectives. This information will support the Zone Committee to begin the decision making process for the Ashley River/Rakahuri catchment.

The options for revised allocations and environmental flows result in various environmental, cultural and economic outcomes. The balance between the above objectives varies from option to option.

Maps for each catchment (SWAZ) are provided in Appendix A.

4 Current state of surface water

The current status of water management in the catchment is described below and is broken down into the three main elements of the management regime (allocation, minimum flow & partial restrictions). The regimes are also presented graphically in Appendix B.

4.1 Allocation

Surface water in the Ashley River catchment is over-allocated, with the exception of Little Ashley Creek and the 'B' and 'C' blocks of Ashley River/Rakahuri. Most consents are for irrigation and stockwater with a small amount for municipal water supply and industrial use.

The over-allocation is a key issue which must be dealt with and this impacts the options for each stream, as discussed in this document.

An important factor in the over-allocation of these catchments is an oversight in the original NRRP/LWRP process which set the allocation limits for some streams. We have addressed this oversight in preparation for considering the options discussed here.

When allocation limits were set for the Land and Water Regional Plan the method used in the majority of catchments was to sum the maximum rate of take for all consents and this became the allocation limit for the catchment. In the spring-fed streams of the Ashley River/Rakahuri catchment an alternative method was used which summed the average rate of take for all consents. This had the effect of making the allocation limit for each of these streams appear small, when assessed against the sum of all consented water. We have taken this opportunity to align these catchments with the method prescribed in the LWRP for the calculation of allocation, such that the over allocation of these catchments can be properly assessed. The risk of leaving the allocation limits low is that our future management decisions are not appropriate for the actual conditions present. These adjustments do not apply to the Ashley River/Rakahuri main stem as this was calculated using the correct methodology.

Table 1 – Current allocation limits

SWAZ	Allocation limit		Allocated water		Adjusted over-allocation
	Current (L/s)	Adjusted (L/s)	(L/s)	% of adjusted limit	(L/s)
Ashley River / Rakahuri 'A'	700	700	1082	155 %	382
Ashley River / Rakahuri 'B'	500	500	139	29 %	-
Ashley River / Rakahuri 'C'	3000	3000	293	10 %	-
Saltwater Creek	408	417	550	132 %	133
Waikuku Stream	460	831	1033	124 %	202
Little Ashley Creek	172	344	63	18 %	-
Taranaki Creek	69	149	274	184 %	125

Adjusting the allocation limits as per Table 1 is a paper exercise only, to create a reasonable starting point for the assessment of options. In subsequent sections of this memorandum options for future allocation limits are presented.

4.2 Minimum flows

A set of minimum flows have been set in the LWRP (Table 2). For each SWAZ this is the river level below which all takes must cease.

For the Ashley River/Rakahuri 'A 'and 'B' blocks the minimum flow regime varies by month. This is to manage issues at times of greatest stress on the river, whilst not restricting water use unnecessarily at other times. The remaining watercourses have a fixed annual minimum flow. There are however two exceptions:

1. Waikuku Stream – Weekend flow of 150 L/s to promote flushing of sediment
2. Little Ashley Creek – Lower minimum flow (30 L/s) on four days per month to allow operation of border dyke irrigation scheme (now ceased)

Many consents in the area were granted before the LWRP came into effect and as such a wide range of minimum flows exist which currently control water use in the catchment (Table 2), not the LWRP minimum flows (unless the consent was granted since the LWRP came into force.

It is important to note that the move from current consented minimum flows to the LWRP minimum flows has already been provided for when the LWRP became operative. It is presented here for completeness as it forms a key part of the story of how consent holders get from where they are now to the options presented in the document. However, this memorandum focuses on revisions required to the LWRP, not the change between current conditions and the LWRP.

Table 2 – Minimum flows

SWAZ	Minimum flow	
	LWRP (L/s)	Current consented (L/s)
Ashley River / Rakahuri 'A'	2500-4000-3000	Various from 1700 - 4200
Ashley River / Rakahuri 'B'	3200-4700-3700	Various - 3200, 3700,4700
Ashley River / Rakahuri 'C'	6000	Various - 3080, 4580, 3580, 6000
Saltwater Creek	100	150 or 100
Waikuku Stream	100 (150 at weekends)	100 or 150 or 151
Little Ashley Creek	50 (30 for 4 days/month)	None on active consents
Taranaki Creek	120	120

4.3 Partial restrictions

Partial restrictions apply above the minimum flow and begin to reduce takes once a trigger flow has been reached in the river. The LWRP does not provide specific restrictions or triggers. The restrictions imposed on a consent will depending upon whether a consent was granted under the LWRP or one of its predecessors. This results in a range of restrictions occurring across the Ashley River/Rakahuri catchment.

New consents tend to contain pro-rata reductions in take once the river flow falls below a trigger equal to the minimum flow + the allocation limit, others have a 50 % step down in take at the same trigger, whilst others have no partial restrictions and can take the full amount until the minimum flow is reached. In some cases this enables water to be taken below the minimum flow level. The restrictions currently in force are too many and varied to list here.

4.4 Water availability

Trend analysis undertaken on the Ashley River/Rakahuri shows that low flows are currently declining. Our analysis suggests climate trends as the most likely cause of the flow decline. Comparison with natural climate cycles such at the Interdecadal Pacific Oscillation (IPO) showed no correlation. We have not investigated whether this is a sign of climate change induced rainfall reduction, however this cannot be discounted. The trend in reducing low flows is reflected in the Okuku River flows and the declining groundwater levels in the Ashley and Kowai Groundwater Allocation Zones (GAZ). Given that the Ashley spring-fed streams source the majority of their water from the Ashley River/Rakahuri via groundwater it likely that this declining trend is evident in the flow of these streams. The available flow data for the spring-fed streams is not sufficient to confirm the presence of trends.

5 Model scenarios

5.1 Introduction

Modelling scenarios are summarised below. For the Ashley River/Rakahuri modelling of the effects of restrictions was undertaken using flow data from the gorge flow recorder. Modelling for the spring-fed streams was undertaken using data synthesised from the limited number of gauging and long records from other sites. We have a low confidence in this data. We tested a number of scenarios (Table 3) to provide information on the viable options for future management of the surface water resource.

These scenarios are split between two categories. The first category examines the effects of specific management decisions such as adopting various minimum flows, allocation limits and partial restrictions. The second category examines the effects of future changes to the available water resource on the management decisions. Climate change is not expected to materially change water resource availability in these catchments in the near term, however a number of factors relating to groundwater may impact on water availability.

Table 3 Model scenario definition

Scenario name	Description	Purpose
Category 1 – Analysis of management decisions		
Current	**Current consented** minimum flows, total allocated water and partial restriction regimes.	Defines the current conditions in terms of available water and take restrictions
LWRP (full allo)	LWRP minimum flows, **current allocated water used as allocation limit**, pro-rata flow restriction trigger = minimum flow + allocation limit	Assesses the maximum likely effects of surface water abstraction using current allocated water as an allocation limit. This is a 'cap at current' approach to allocation.
LWRP(adj)	LWRP minimum flows, **LWRP adjusted allocation limits**, pro-rata flow restriction trigger = minimum flow + allocation limit	Assesses the maximum effects of surface water abstraction that could potentially occur under current LWRP minimum flow and adjusted allocation limit. This would require recovery of over-allocation.
Ecological	**Ecological recommendations for minimum flows** and LWRP full_allo OR LWRPadj allocation limits allocation limits, pro-rata flow restriction trigger = minimum flow + allocation limit	Assesses the difference between LWRP and the recommendations of ecological assessments. Focused on general effects on flow and take restrictions
Cultural	**Cultural recommendations for minimum flows** and LWRP full_allo OR LWRPadj allocation limits, pro-rata flow restriction trigger = minimum flow + allocation limit	Assesses the difference between LWRP and the recommendations of cultural assessments. Focused on general effects on flow and take restrictions
Category 2 – Analysis of changes to available resource		
Full_Abs_Allo	Full abstraction, full allocation. Assumes all consented wells use 100% of consented	Explores the maximum likely effects of groundwater abstraction that could potentially occur under current LWRP rules

The changes to water resource availability in Category 2 scenarios were taken from *'Groundwater allocation modelling results from Ashley River/Rakahuri catchment'.* The groundwater modelling work indicates a range of flow reductions in the spring-fed streams (Table 4) A threshold of 10 % has been used to determine whether the result is significant enough to undertake further assessment. In all cases we have applied the modelled change in median flow to all flows; this assumed that changes are uniform across the lower half of the flow duration curve. We have no further details to upon which to base a transient analysis.

Table 4 Changes to water resource availability

Scenario name	Stream	Median flow decline
full_abs_allo	Ashley River/Rakahuri	3%
	Saltwater Creek	9%
	Taranaki Creek	23%
	Waiuku Stream	21%

5.2 Common elements

5.2.1 Partial restrictions

For all scenario's other than 'Current' we have used a pro-rata restriction regime, this being our preferred approach to managing partial restrictions which are required by LWRP Policy 4.62. This approach ensures that the minimum flow is not breached and ensures that water remains available for use. Under this regime pro-rata restrictions commence at a river flow equal to the minimum flow plus the allocation limit. Below the trigger flow restrictions increase linearly until the minimum flow is reached and all takes must cease (Figure 1).

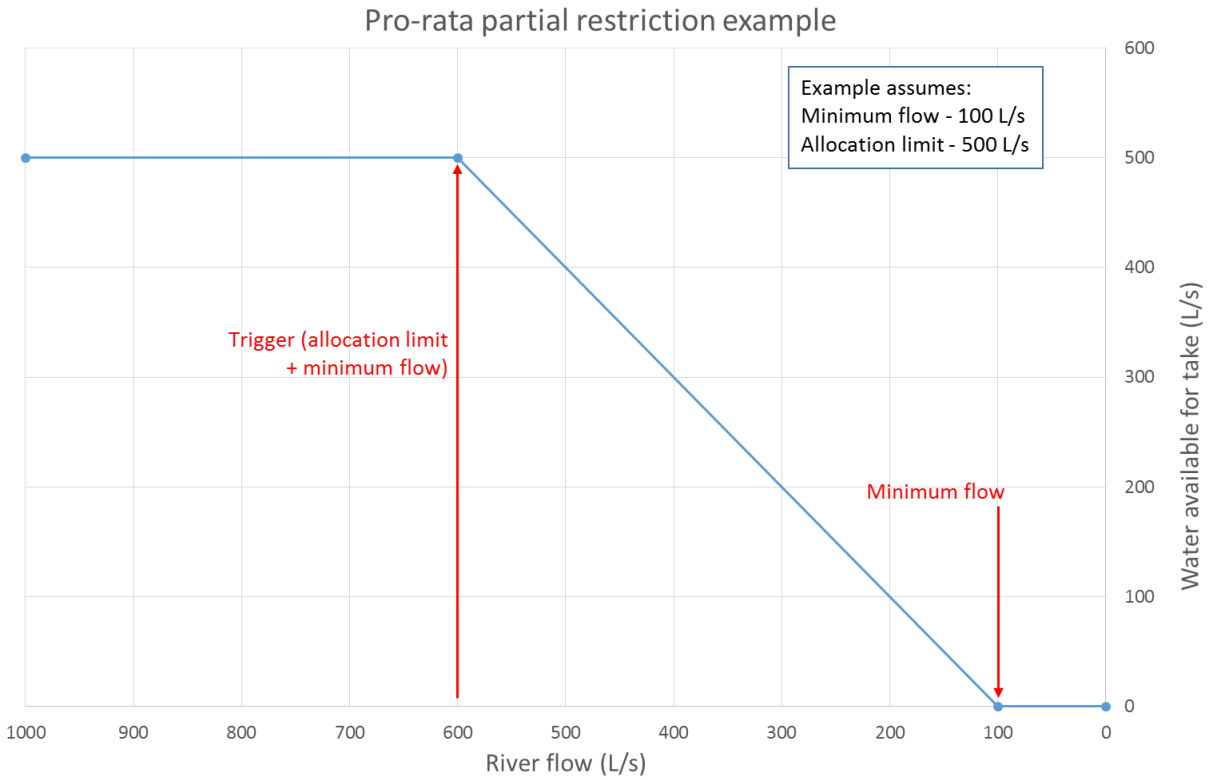
This approach provides a challenge to water users as partial restrictions increase, particularly those pumping stream depleting groundwater. Eventually such restrictions fall below the capacity of the installed pumping or intake infrastructure, meaning that the consent holder cannot physically take at the rate permitted by the partial restriction regime. One solution to the challenge is the forming of Water User Groups (WUG) and the sharing of available the resource to better match installed capacities. There are several examples of successful water users groups in the Waimakariri Water Zone and these have demonstrable benefits to both the river and the water users.

5.2.2 SWAZ boundaries

SWAZ boundaries delineate surface water allocation zones. They are based on the topography of surface water catchments and any surface water take which falls within the boundary fall under the allocation limit for that particular SWAZ. SWAZ boundaries do not apply to stream-depleting groundwater takes. These fall under the allocation limit of the watercourse (SWAZ) which they are deemed to be depleting.

We have taken the opportunity the sub-regional process offers to assess the SWAZ boundaries. In the case of the Ashely River/Rakahuri catchment only minor adjustments were necessary. The adjustments did not change the allocation totals for these catchments. SWAZ boundaries are provided in Appendix 1.

Figure 1 – Pro-rata restriction example



5.3 Scenario table

Table 5 details the main parameters used in modelling the surface water scenarios.

Table 5 – Model scenario details

(all values L/s)	Current		LWRP (full allo)		LWRP (Adj)		Ecological		Cultural		Full Abs allo	
Waterway	**Min. Flow**	**Alloc limit**	**Min. Flow**	**Alloc limit**	**Min. Flow**	**Alloc limit**	**Min. Flow**	**Alloc limit**	**Min. Flow**	**Alloc limit**	**Min. Flow**	**Alloc limit**
Ashley River / Rakahuri 'A'	Var.	700	2500 4000 3000	1082(2)	2500 4000 3000	700	2000	Adj. / full allo	Conn-ected flow	Adj. / full allo	2000	400-500
Ashley River / Rakahuri 'B'	Var.	500	3200 4700 3700	139(2)	3200 4700 3700	500	5000	Adj. / full allo	-	Adj. / full allo	5000	-
Ashley River / Rakahuri 'C'	Var.	3000	6000	293(2)	6000	3000	-	Adj. / full allo	-	Adj. / full allo	-	-
Saltwater Creek	150 /100	417(1)	100	550(2)	100	417(1)	148	Adj. / full allo	148	Adj. / full allo	148	50
Waikuku Stream	100 /150 /151	831(1)	100 150 at w-ends	1033(2)	100 150 at w-ends	831(1)	250	Adj. / full allo	600	Adj. / full allo	250	80
Little Ashley Stream	None	344(1)	50-30 for 4 days/ month	63(2)	50-30 for 4 days/ month	344(1)	70	Adj. / full allo	70	Adj. / full allo	70	25
Taranaki Creek	120	149(1)	120	274(2)	120	149(1)	158	Adj. / full allo	120	Adj. / full allo	158	60

(1) *Note that this is the adjusted LWRP allocation limit, accounting for the maximum instantaneous rate calculation, (2) Allocated water (cap at current)*

6 Model results

6.1 Introduction

The modelling results are presented below. There are two outputs to be interpreted (1) the number of days full and partial restriction occur as a result of the flow management rules being tested, and (2) the impact these rules have on the flow within the river.

For both these outputs the key inputs are minimum flow, allocation block size and the resulting partial restriction trigger level.

1. **Minimum flow** – This is the river flow below which takes must cease (i.e full restrictions). A low minimum flow will result in a smaller number of days on full restriction, but will have poorer outcomes for the stream ecological and cultural values. A higher minimum flow will result in a greater number of days on full restriction but will have better outcomes for other values.
2. **Allocation block limit** – This is the total amount of water allowed to be taken from the surface water. A large allocation block means that flow variability will be lost from a wide range of flows, a small block means that variability will be lost from only a small range of flows, better protecting the natural function of the water way.
3. **Partial restriction trigger** – This is the river flow below which takes start to be restricted. It is the sum of the minimum flow + allocation block limit. If either, or both, are large this results in a high partial restriction trigger. The effect of this is most of the flow occurring being under the trigger level and hence an increase to the number of days users are on partial restrictions. A lower trigger level results in less days on partial restriction. These restrictions are detrimental for users as they cannot take their full consented amount. Whilst partial restrictions are beneficial to ecological values, a high trigger risks flows flat-lining at the minimum flow. If this occurs over extended periods then the values of the river will suffer; this is more a function of the allocation block size rather than the partial restrictions.

It is important to note that the implications of moving from the 'Current consented regime' to the regime specified within the LWRP were debated during the NRRP/LWRP hearing process and deemed acceptable when the LWRP became operative in 2015. They are not open for re-litigation under this current process, other than to the extent a recommendation can be made to amend specific minimum flow and/or allocation limits, as would be the case with any other option. If this approach was taken it would need to be justified with evidence that shows how values will be maintained or improved as a result of returning to a previous regime.

6.2 Ashley River / Rakahuri ' A' Block

6.2.1 Reliability of supply & river flow

Changes are not proposed to the environmental flow regime and allocation for the A block. Extensive science work was undertaken during the development of the NRRP/LWRP. The minimum flow was set to avoid increasing the duration and extent of the rivers natural drying reaches. At the minimum flow of 2,500 L/s all abstractions must cease. This river flow was determined to be the flow at the gorge, below which reaches downstream go dry. Investigations were undertaken to assess higher minimum flows but these were found to contribute a few days to the preservation of connected flow and were not deemed worth the economic impacts for abstractors. Given the occurrence of drying reaches is a natural occurrence no minimum flow level will result in connected flow being achieved.

Consent holders indicate poor reliability in the A block and this aligns with the rapid recessions evident on the river. As such the river is unlikely to be able to support an allocation limit greater than the current 700 L/s. There is also an issue with the B block which supports not increasing the A block limit, as detailed below.

6.2.2 Effects of changing water resource

The assessment of effects on river flow as a result of full use of the full groundwater allocation, showed a 3 % decrease in median flow in Ashley River/Rakahuri. This is below the tolerance threshold of 10% for the modelling and as such the change is not considered significant.

6.3 Ashley River / Rakahuri ' B' Block

6.3.1 Reliability of supply

The B block was originally set such that space in the allocation system would be available for those wishing to apply for water but it was limited in size to ensure that the number of consent holders exposed to the poor reliability offered by the B block was limited. Analysis of the move from Current consents to LWRP shows a no change in restrictions, because the same minimum flows and restriction regimes are used.

Table 6 – Restriction summary

Scenario name	No. days partial restriction		No. days full restriction	
	Average	1:10 yr	Average	1:10 yr
Current (Band 10 only)	5	8	65	104
LWRP B	5	8	65	104
Ecological	3	5	88	128

Moving to a higher ecological minimum flow increases the number of days on full restriction because the minimum flow has increased. The number of days on partial restriction remains limited because of the speed of flow recession on the river.

6.3.2 River flow

The impact on river flow of implementing the ecological minimum flow is limited because of the speed of flow recession. In contrast the change to days of full restriction is 23 days.

An alternative strategy to maintain values in the river is to cap the allocation limit at the current consented amount. This leaves the B block sitting directly on-top of the A block (which leaves no space for recover of natural variability) but does limit the B block impact on fresh flows further up the flow

duration curve. This approach keeps the restrictions at the same level as LWRP and preserves the reliability of supply for current users in the future.

6.4 Ashley River / Rakahuri ' C' Block

We have not modelled changes to the C block. It is worth considering capping the block at current allocation, or current allocation with headroom. This would have two benefits (1) preserving the reliability of existing users, and (2) limit the blocks impact on fresh flows should the full allocation be taken up.

6.5 Saltwater Creek

6.5.1 Reliability of supply

Moving from 'Current consents' to the LWRP means the minimum flows moves from 150 L/s to 100 L/s. The number of days on full restriction does not change from 0 days. Under LWRP a trigger level for commencement of partial flow restrictions is introduced and therefore the days of partial restriction increases significantly.

Table 7 – Reliability summary

Scenario name	No. days partial restriction		No. days full restriction	
	Average	1:10 yr	Average	1:10 yr
Current (full allo)	0	0	0	0
LWRP(full allo)	207	213	0	0
Ecological (full allo)	201	212	7	24
Cultural (full allo)	201	212	7	24
LWRP(adj)	<207*	<213*	0*	0*
Ecological (LWRP adj)	<201*	<212*	7*	24*
Cultural (LWRP adj)	<201*	<212*	7*	24*

**Estimate*

Moving to the ecological minimum flow recommendation (148 L/s) introduces a number of days on full restriction; days on partial restriction increase slightly.

The recommended cultural minimum flow is the same as the ecological flow.

For these scenarios the river is on some form of restrictions for most of the year. The main driver behind this is allocation block limit, which is high in relation to the available water in the river.

Modelling of the ecological allocation limit recommendation (50 L/s) has not been undertaken, because of the significant impact on the viability of water users.

The LWRP(adj) allocation limit (417 L/s) modelling is expected to show no change to full days on restriction and a small decrease in the days of partial restriction. Any changes to these numbers will be notified through a re-issue of the memorandum.

6.5.2 River flow

Flow in Saltwater Creek is poorly understood. Base flows will be generally stable but declining over summer, generally in response to water levels in the Ashley River/Rakahuri and surrounding groundwater levels. Outside of rainfall events causing running from the slopes of Mt Grey there is likely to be very limited variation in flow. Given that the partial allocation trigger sits particularly high on the flow duration curve partial restrictions will be near constant, as the data suggests. This makes restrictions near constant in all scenarios. This has the potential to hold the river at the minimum flow level or below for whole the irrigation season although water use statistics make this unlikely. The higher the minimum flow the lower the risk of this situation.

Peak water use (January) was estimated as 67 % tailing off in the months either side of the peak. This means that some flow variability in the non-peak months may exist when users are not taking their full allocation, however this cannot be reliable upon as robust management option.

6.5.3 Effects of changing water resource

The assessment of effects on river flow as a result of full use of the full groundwater allocation, showed a 9% decrease in median flow in Saltwater Creek. This is below the tolerance threshold of 10% for the modelling and as such the change is not considered significant. It will be important to monitor for trends in Saltwater Creek to confirm this assertion, and to monitor for any other trends.

6.6 Waikuku Stream

6.6.1 Reliability of supply

Moving from 'Current consents' to the LWRP means the minimum flows stay constant (100-150 L/s) therefore the number of days of full restriction stays at 1 day. The trigger level for commencement of partial flow restrictions increases between these scenarios and the partial flow method changes from a variety of restrictions to pro-rata restrictions. This increases the days on partial restrictions by 30% for an average year.

Table 8 – Reliability summary

Scenario name	No. days partial restriction		No. days full restriction	
	Average	1:10 yr	Average	1:10 yr
Current (full allo)	135	179	1	1
LWRP(full allo)	174	207	1	1
Ecological (full allo)	152	195	36	94
Cultural (full allo)	35	62	154	199
LWRP(adj)	<174*	<207*	1*	1*
Ecological (LWRP adj)	<152*	<195*	36*	94*
Cultural (LWRP adj)	<35*	<62*	154*	199*

**Estimate*

Moving to the ecological minimum flow recommendation (250 L/s) significantly changes the days on full restriction; days on partial restriction reduce but the reduction is replaced by the full day restrictions.

The outcome of using the cultural minimum flow recommendation (600 L/s) that the majority days experience full restrictions.

In all the minimum flow scenarios the four days per month variability has been removed as a fixed minimum flow is considered acceptable.

For both these scenarios the river is on some form of restrictions for most of the year. The main driver behind this is allocation block limit, which is exacerbated by minimum flow increases.

Modelling of the ecological allocation limit recommendation (80 L/s) has not been undertaken, because of the significant impact on the viability of water users.

The LWRP(max) allocation limit (831 L/s) modelling is expected to show no change to full days on restriction and a small decrease in the days of partial restriction. Any changes to these numbers will be notified through a re-issue of the memorandum.

6.6.2 River flow

Flow in Waikuku Stream is poorly understood. The effects of the proposed options is that the river will be held at or below the minimum flow for most of the irrigation season. The ecological and in particular the cultural minimum flows provide for the retention of greater habitat during partial restrictions making these lower risk options.

Peak water use (January) was estimated as 62 % tailing off in the months either side of the peak. This means that some flow variability in the none-peak months may exist when users are not taking their full allocation, however this cannot be reliable upon as robust management option.

6.6.3 Effects of changing water resource

The assessment of effects on river flow as a result of full use of the full groundwater allocation, showed a 21 % decrease in median flow in Waikuku Stream. The ecological scenario, under current river flow conditions was used to compare like-for-like effects under the impacted water resources.

Under such a decline days of full restriction could approach the whole irrigation season under the cultural scenario, whilst they would dominate the irrigation season under the ecological scenario. Under the LWRP scenario full restrictions would increase to a level such that they would likely impact production. Partial restrictions would likely become near constant.

6.7 Little Ashley Creek

6.7.1 Reliability of supply

Moving from the 'Current consents' to the LWRP (50 L/s-30 L/s) introduces a minimum flow which currently does not appear on any consents. This does not appear to materially change the days of full restriction. The LWRP also introduced partial flow restrictions, resulting in 140 days in partial restrictions on average.

Table 9 – Reliability summary

Scenario name	No. days partial restriction		No. days full restriction	
	Average	1:10 yr	Average	1:10 yr
Current (full allo)	0	0	0	0
LWRP(full allo)	140	173	0	1
Ecological (full allo)	143	172	28	73
Cultural (full allo)	140	173	0	1
LWRP(adj)	>140*	>173*	0*	1*
Ecological (LWRP adj)	>143*	>172*	28*	73*
Cultural (LWRP adj)	>140*	>173*	0*	1*

**Estimate*

Moving to the ecological minimum flow recommendation (70 L/s) significantly changes the days on full restriction, days on partial restriction do not change. It is apparent that the management regime on Little Ashely River is particularly sensitive to change around the 50-70 L/s level.

The outcome of using the cultural minimum flow recommendation (50 L/s) is the same as for the LWRP scenario.

In all the minimum flow scenarios the weekend variability has been removed as a fixed minimum flow is considered appropriate now no border-dyke irrigation remains.

Modelling of the ecological allocation limit recommendation (25 L/s) has not been undertaken, because of the significant impact on the viability of water users.

The LWRP(max) allocation limit (344 L/s) modelling is expected to show no change to full days on restrictions. It is unclear how the days of partial restriction will change. It is possible that they will increase. Any changes to these numbers will be notified through a re-issue of the memorandum.

6.7.2 River flow

Flow in the Little Ashley Creek is poorly understood but given its small surface catchment and reliance on spring-flows it can be summarised as having a stable flow pattern, linked to the flow rates within the Ashley River/Rakahuri. From the data available it appears flow varies within a band of approximately 250 L/s when there is not rain over the catchment.

Given the limited flow variation likely to be present the selection of any of the options outlined will create prolonged flat-lining at the minimum flow for much of irrigation season. Although an unfavourable option this is an improvement on the current regime under which no restrictions apply and the river flow could be reduced further.

Peak water use (January) was estimated as 80 % tailing off in the months either side of the peak. This means that some flow variability in the non-peak months may exist when users are not taking their full allocation, however this cannot be reliable upon as robust management option.

6.7.3 Effects of changing water resource

Due to limited data availability no modelling of Little Ashley Creek was attempted. We consider it appropriate to use the results from Waikuku Stream as a proxy for likely changes.

With a 20 % decline in flows it can be expected that a full restrictions will become more common and that partial restrictions would be likely for entire irrigation seasons.

6.8 Taranaki Creek

6.8.1 Reliability of supply

Moving from the 'Current consents' to the LWRP the minimum flow stays constant (120 L/s) therefore the number of days of full restriction does not change. The trigger level for commencement of partial flow restrictions increases between these scenarios and the partial flow method changes from 50 % reduction at trigger to pro-rata restrictions. This increases the days on partial restrictions from just over half the irrigation season under 'Current' to approaching the full season under LWRP for an average year.

Table 10 – Reliability summary

Scenario name	No. days partial restriction		No. days full restriction	
	Average	1:10 yr	Average	1:10 yr
Current (full allo)	111	167	0	0
LWRP(full allo)	184	210	0	0
Ecological (full allo)	160	207	28	93
Cultural (full allo)	184	210	0	0
LWRP(adj)	<184*	<210*	0*	0*
Ecological (LWRP adj)	<160*	<207*	28*	93*
Cultural (LWRP adj)	<184*	<210*	0*	0*

**Estimate*

Moving to either the ecological (158 L/s) or cultural (120 L/s) minimum flow recommendation will not change the number of days on partial restriction. For the ecological minimum flow the days on partial restriction reduce a small amount, but only by around the number of days full restriction.

Modelling of the ecological allocation limit recommendation (53 L/s) has not been undertaken, because of the significant impact on the viability of water users.

The LWRP(max) allocation limit (149 L/s) modelling is expected to show no change to full days on restriction and a small decrease in the days of partial restriction. Any changes to these numbers will be notified through a re-issue of the memorandum.

6.8.2 River flow

The partial restriction triggers for the 'current consents' allows for river flow to be at or below the minimum flow level for around 20-35 % of the year.

The trigger under the LWRP, Ecological and Cultural (full allo) scenarios allows for the river to be at or below the minimum flow level for 70% of the year. Adopting the ecological minimum flow allows for greater habitat retention because of the higher minimum flow and lowers the risk of such an approach.

Estimates of the effects under LWRP, Ecological and Cultural (adj. scenarios) are that little will change for river flow when compared to the 'full allo' scenarios.

Peak water use (January) was estimated as 67 % tailing off in the months either side of the peak. This means that some flow variability in the none-peak months may exist when users are not taking their full allocation, however this cannot be reliable upon as robust management option.

6.8.3 Effects of changing water resource

The assessment of effects on river flow as a result of full use of the full groundwater allocation, showed a 23 % decrease in median flow in Taranaki Stream. The ecological scenario, under current river flow conditions was used to compare like-for-like effects under the impacted water resources.

With a 23 % decline in flows it can be expected that a full restrictions will become more common and important factor in the river regime, and that partial restrictions would be likely for almost all of the irrigation season.

7 Management options

The outcome of this memorandum is the presentation below of options for the management of the Ashley River/Rakahuri catchment.

SWAZ	Issue	Option
Ashley River/Rakahuri (A)	Connected flow, poor reliability	• Minimum flow is left as LWRP flow of 2500-4000-3000 L/s • Minimum flow is adjusted to allow connected flow from mountain to sea (would require additional water source as drying is natural) • Allocation is left as LWRP (700 L/s) • Allocation limit is capped at current allocation (1082 L/s)
Ashley River/Rakahuri (B)	There is no cap between A and B block, limiting flow variability and B block has very poor reliability	• Minimum flow is changed to ecological recommendation to provide a gap of 800 L/s • Minimum flow is left as LWRP (3200-4700-3700 L/s) • Allocation is capped at current allocation (293 L/s) • Allocation is left as LWRP (3000 L/s)
Ashley River/Rakahuri (C)	Retaining a large 'C' block risks water being taken up and loss of fresh flows for flushing	• Minimum flow is left as LWRP (6000 L/s) • Allocation limit is capped at current allocation (293 L/s) • Allocation limit is capped at current allocation + headroom (>293 L/s and < 3000L/s)
Saltwater Creek	Water abstraction, along with other pressures, is impacting upon the values of the waterway	• Minimum flow is left at LWRP flow of 100 L/s • Minimum flow is changed to ecological recommendation of 150 L/s (same as current consents and cultural) • Allocation limit is capped at current allocation (550 L/s) • Allocation limit is capped at the LWRP(*adjusted*) limit (417 L/s) • Allocation limit is capped at an agreed amount <417 L/s • For options where ecological recommendations are not accepted it may be worth exploring additional management strategies (as s6.1)

SWAZ	Issue	Option
Waikuku Stream	Water abstraction, along with other pressures, is impacting upon the values of the waterway	• Minimum flow is left at LWRP weekday flow of 100 L/s • Minimum flow is left at LWRP weekend flow of 150 L/s • Minimum flow is changed to ecological recommendation of 250 L/s • Minimum flow is changed to cultural recommendation of 600 L/s • Allocation limit is capped at current allocation (1033 L/s) • Allocation limit is capped at the LWRP(*adjusted*) limit (831 L/s) • Allocation limit is capped at an agreed amount <831 L/s • For options where ecological recommendations are not accepted it worth exploring additional management strategies (as s6.1)
Little Ashley Creek	Water abstraction, along with other pressures, is impacting upon the values of the waterway. Leaving a large allocation available on such a small waterbody risks a water take regime with significant effects on the ecology of the waterway and which cannot support reliable irrigation.	• Minimum flow is left at LWRP flow of 50 L/s (same as cultural) • Minimum flow is changed to ecological recommendation of 70 L/s • Allocation limit is capped at current allocation (63 L/s) • Allocation limit is capped at the LWRP(*adjusted*) limit (344 L/s) • For options where ecological recommendations are not accepted it worth exploring additional management strategies (as s6.1)
Taranaki Creek	Water abstraction, along with other pressures, is impacting upon the values of the waterway	• Minimum flow is left at LWRP flow of 120 L/s (same as Cultural) • Minimum flow is changed to ecological recommendation of 158 L/s • Allocation limit is capped at current allocation (274 L/s) • Allocation limit is capped at the LWRP(*adjusted*) limit (149 L/s) • Change approach to municipal supply accounting, in particular for back-up wells • For options where ecological recommendations are not accepted it worth exploring additional management strategies (as s6.1)

7.1 Additional management strategies

The over-allocation issues evident in these catchments mean that a large degree of effort will be required to manage abstractions back to the current allocation limits. Reduction of allocation limits further, towards the ecological recommendations for instance, will require extensive mitigation work to be undertaken, most likely resulting in the need for consents to be surrendered.

Provided below is a list of alternative strategies for recovering the over-allocation and taking smaller reductions in the allocated water should this de deemed appropriate.

An alternative management strategy is to accept an environmental flow and allocation regime which does not itself meet all of the values being sought and back this up with physical mitigation techniques which increase the efficacy of the environmental flow and allocation regime. Example of these techniques are also provided.

Mitigation	Justification
Revised stream depletion assessment	Stream depletion estimates used in the development of allocation limits is conservative. Site specific assessments, or use of another accepted methodology, could reduce the paper over-allocation
Consider municipal supplies differently	Some allocation blocks (Taranaki, Saltwater, Ashely River) include municipal supply water. This water is not subject to minimum flow restrictions in the same way as irrigation consents. Additionally some municipal takes as back-ups only and so are not used on a regular basis.
Voluntary surrender	If low use/no use consents which contribute to over-allocation we surrendered this would take catchments closer to the agreed allocation limits
% reductions of water use at consent renewal/review	When consents are renewed/reviewed the actual water use can be examined and the consented amount can be reduced should it be found water is not being used. Under a falling lid situation this water would stay in the river and not be reallocated.
Switch to deep groundwater	Deep groundwater could provide an alternative source of supply for some users thereby reducing the water allocated/used in catchment, leaving more in the waterways
Restrict transfers	Restricting transfer of water between properties can result in less water being used, and ultimately consents being surrendered. If transfers are deemed appropriate then it is also possible to require that a % of any transferred water be returned to the river and not reallocated.
Offset mitigation	Planting for shading and habitat purposes, and installation of riffles can improve the outcomes of environmental flow and allocation regimes. This can reduce water temperature and increase dissolved oxygen levels which can reduce the overall ecological stress of low water levels.

8 References

National Policy Statement for Freshwater Management 2014, Updated August 2017 to incorporate amendments from the National Policy Statement for Freshwater Amendment Order 2017

Appendix A | SWAZ maps

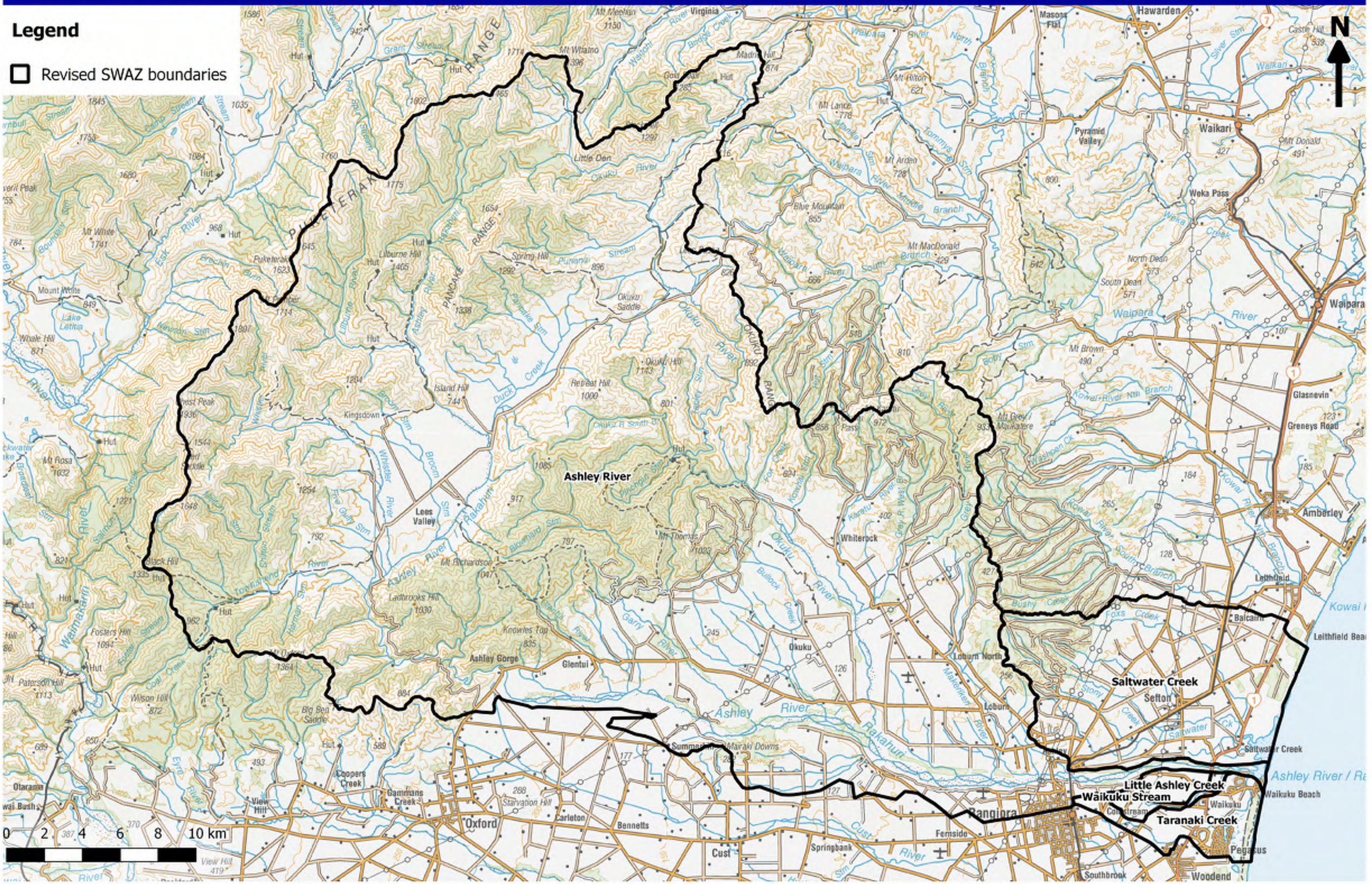
Appendix 1 maps:

- **Overview**
- **Ashley River/Rakahuri**
- **Saltwater Creek**
- **Waikuku Stream**
- **Taranaki Creek**

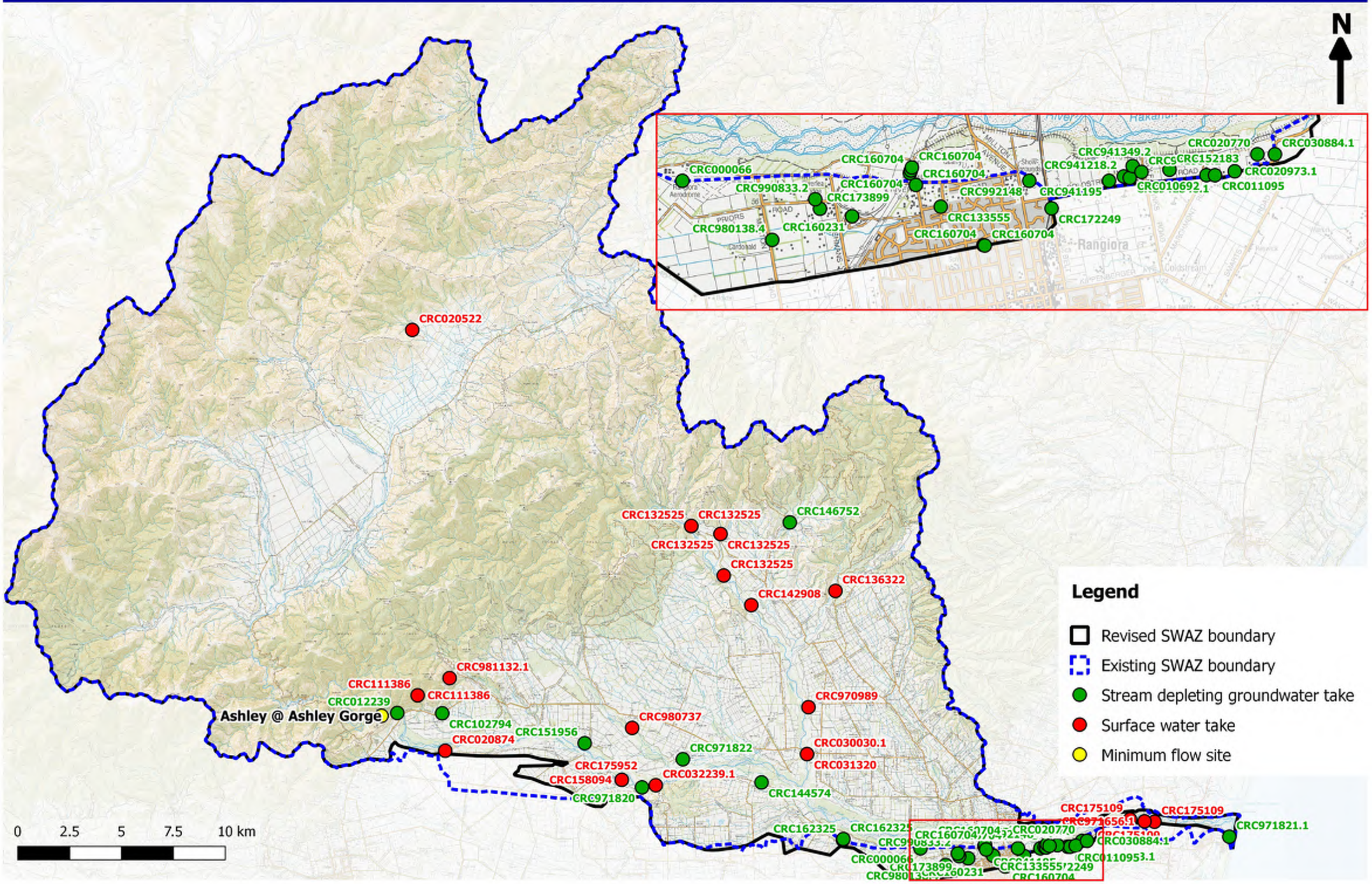
Surface Water Allocation Zones - Overview

Legend

☐ Revised SWAZ boundaries



Ashley River Surface Water Allocation Zone



Saltwater Creek Surface Water Allocation Zone

Legend

- Revised SWAZ boundary
- Existing SWAZ boundary
- Stream depleting groundwater take
- Surface water take
- Minimum flow site

N

CRC050028
CRC174931
CRC142846
CRC142846
CRC971085
CRC952024
CRC141282
CRC971634
CRC101679.1
CRC101679.1
CRC136900
CRC175958
CRC971717.1
CRC174744
CRC174744
CRC971717.1
CRC175958
CRC971717.1
CRC971717.1
Saltwater Creek @ Toppings Road
CRC981419
CRC971179
CRC136899
CRC136899
CRC136899
CRC991510
CRC971178
CRC111129
CRC950524
CRC147641
CRC970853.1
CRC000762
CRC980228
CRC971323
CRC971181
CRC001235
CRC040745
CRC971181
CRC971061.2
CRC971061.2
CRC971061.2
CRC940646.1
CRC000762
CRC981992
CRC161302
CRC971061.4
CRC161302
CRC161302
CRC161302

0 0.5 1 1.5 2 km

Waikuku Stream Surface Water Allocation Zone

Legend

- Revised SWAZ boundary
- Existing SWAZ boundary
- Stream depleting groundwater take
- Surface water take
- Minimum flow site

N

Waikuku Stream @ Waikuku Beach Road

CRC121766
CRC141308
CRC141305
CRC156224
CRC156224
CRC163560
CRC151965
CRC151961
CRC141292
CRC151963
CRC151962
CRC144927
CRC175696
CRC971090.1
CRC168161
CRC971041.3
CRC168144
CRC971041.3
CRC168133

0 0.5 1 1.5 2 km

Little Ashley Creek Surface Water Allocation Zone

Legend

- Revised SWAZ boundary
- Existing SWAZ boundary
- Stream depleting groundwater take
- Surface water take
- Minimum flow site

N

CRC147044
CRC971120
CRC971660.1
CRC162509
CRC971660.1
CRC990093.1
CRC012065
CRC971121
CRC162509
CRC971660.1
CRC175696
CRC145956
CRC971119
Little Ashley Creek @ State Highway 1
CRC012541.1

0 0.5 1 1.5 2 km

Taranaki Creek Surface Water Allocation Zone

Legend

- Revised SWAZ boundary
- Existing SWAZ boundary
- Stream depleting groundwater take
- Surface water take
- Minimum flow site

N

CRC152182
CRC971008.1
CRC971008.1
CRC990179.1
CRC174545
CRC990118.1
CRC152566
CRC011692
CRC141302
CRC103129
CRC153119
CRC961074
CRC173952
CRC157972
CRC162310
CRC157969
CRC074057
CRC074057
CRC040315
CRC971821.1
CRC133507
CRC143173
CRC163365
CRC173669
CRC147703
CRC971199.1
CRC143175
CRC143176
Taranaki Creek @ Preeces Road Bridge
CRC155458
CRC173952
CRC971340.1
CRC971659.1
CRC167359
CRC971798.2
CRC181927
CRC133685
CRC167262
CRC135323
CRC167260
CRC133685
CRC167262
CRC133685
CRC167262
CRC133685
CRC167260

Rangiora
Coldstream
Karaalea
Cattle Flat
Cressland
Waikuku
Waikuku Beach
Pegasus
Woodend

0 0.5 1 1.5 2 km

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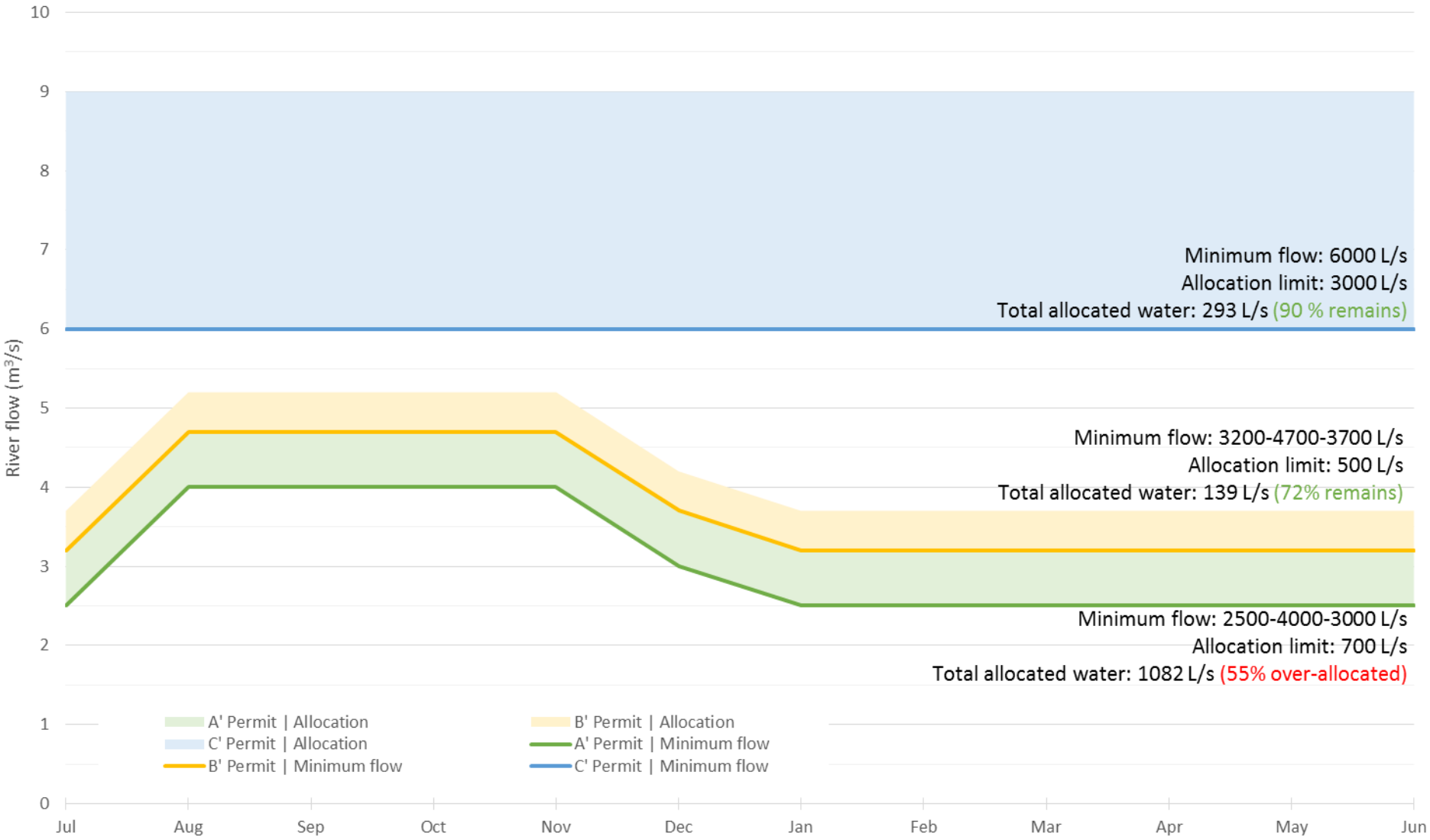
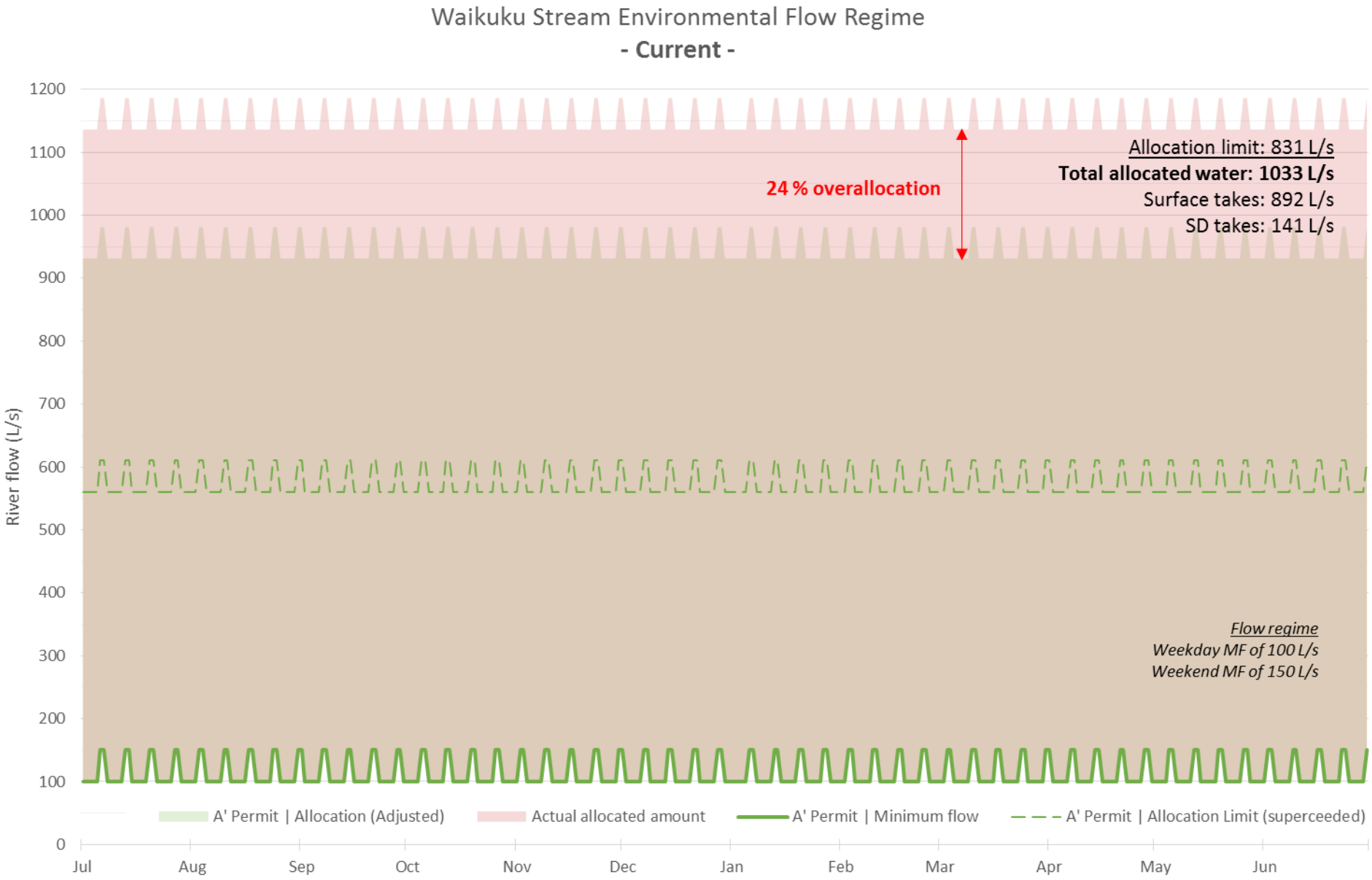
Appendix B | LWRP flow regimes

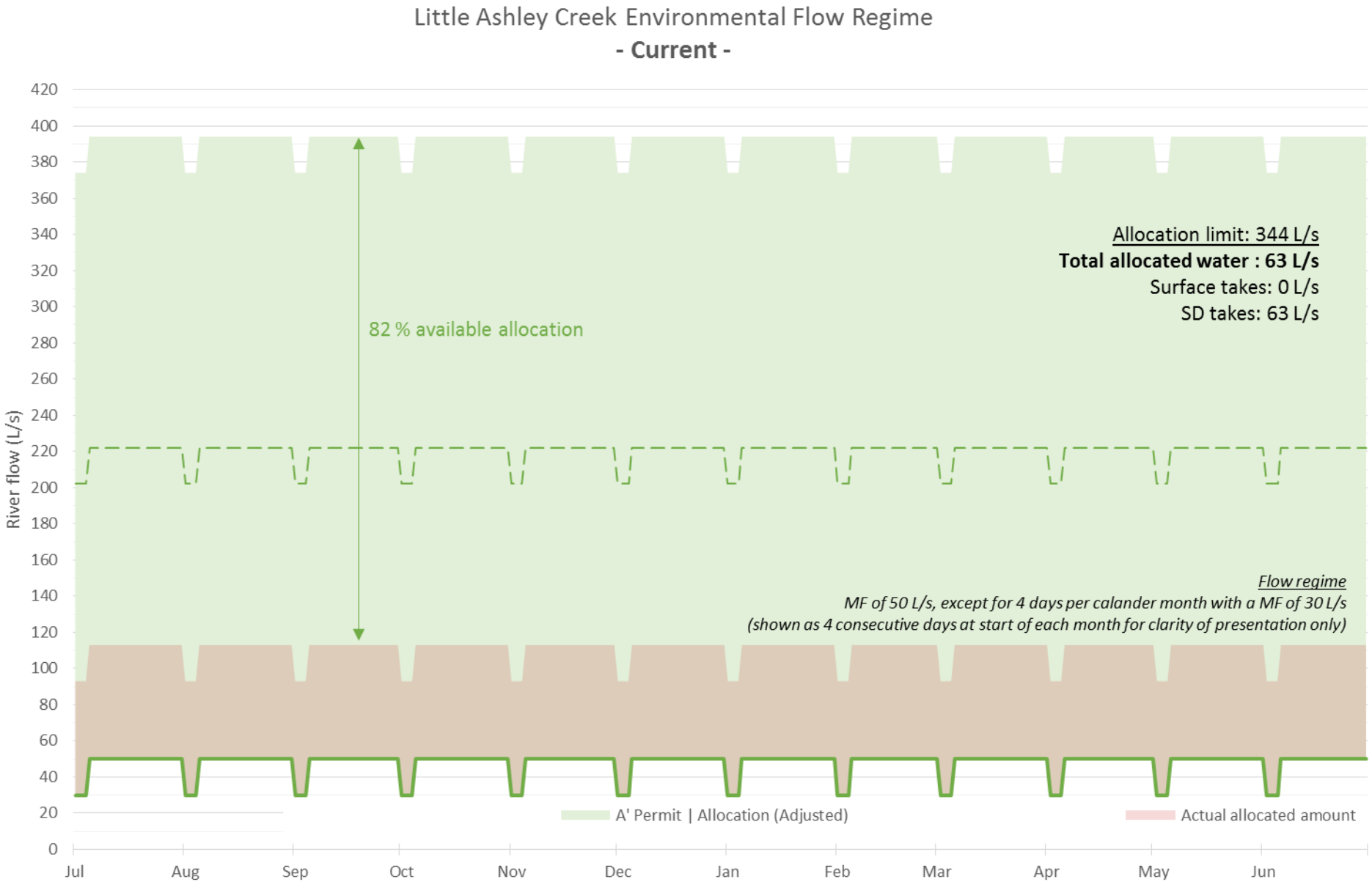
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

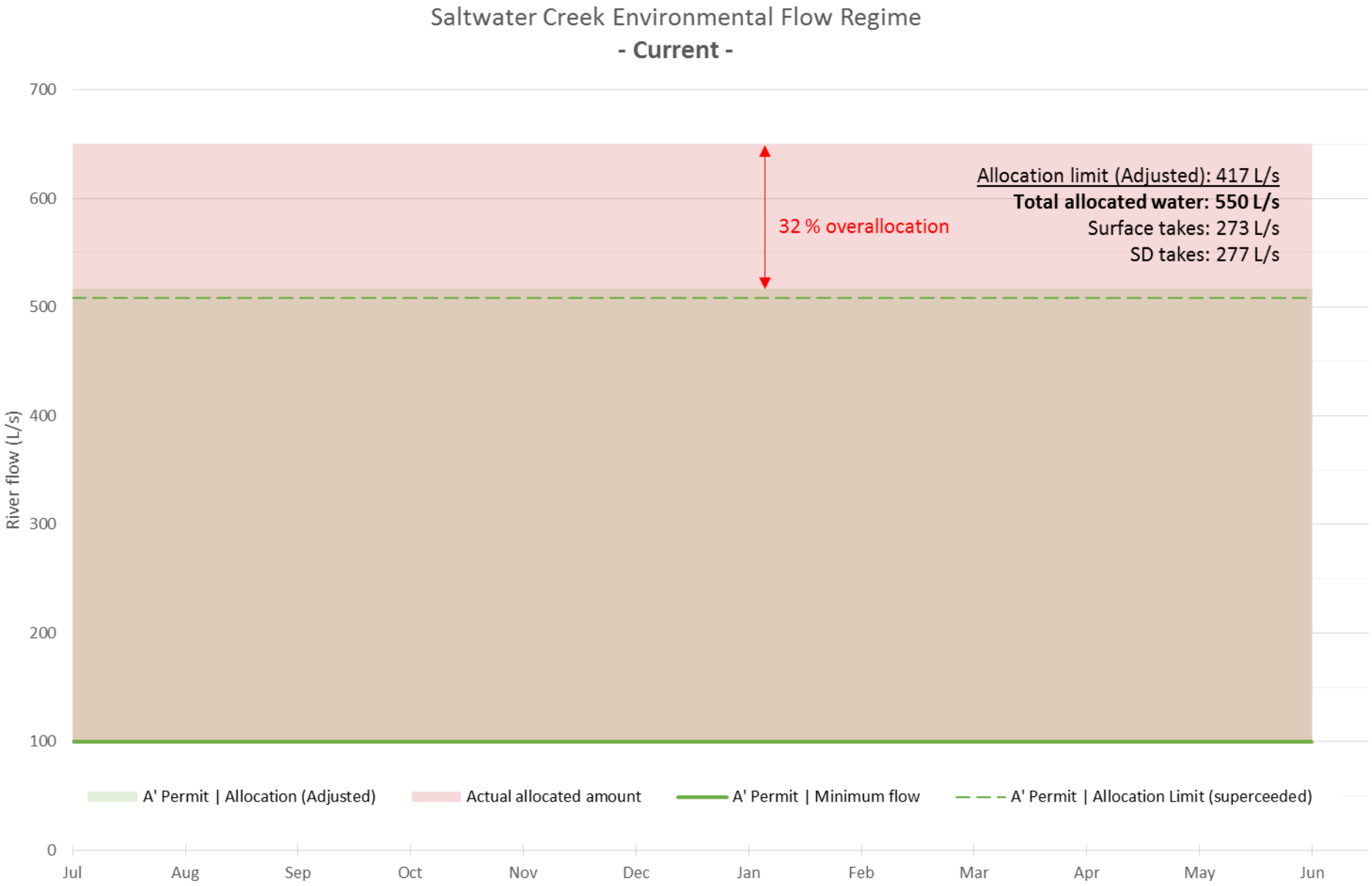
Ashley River / Rakahuri Environmental Flow Regime

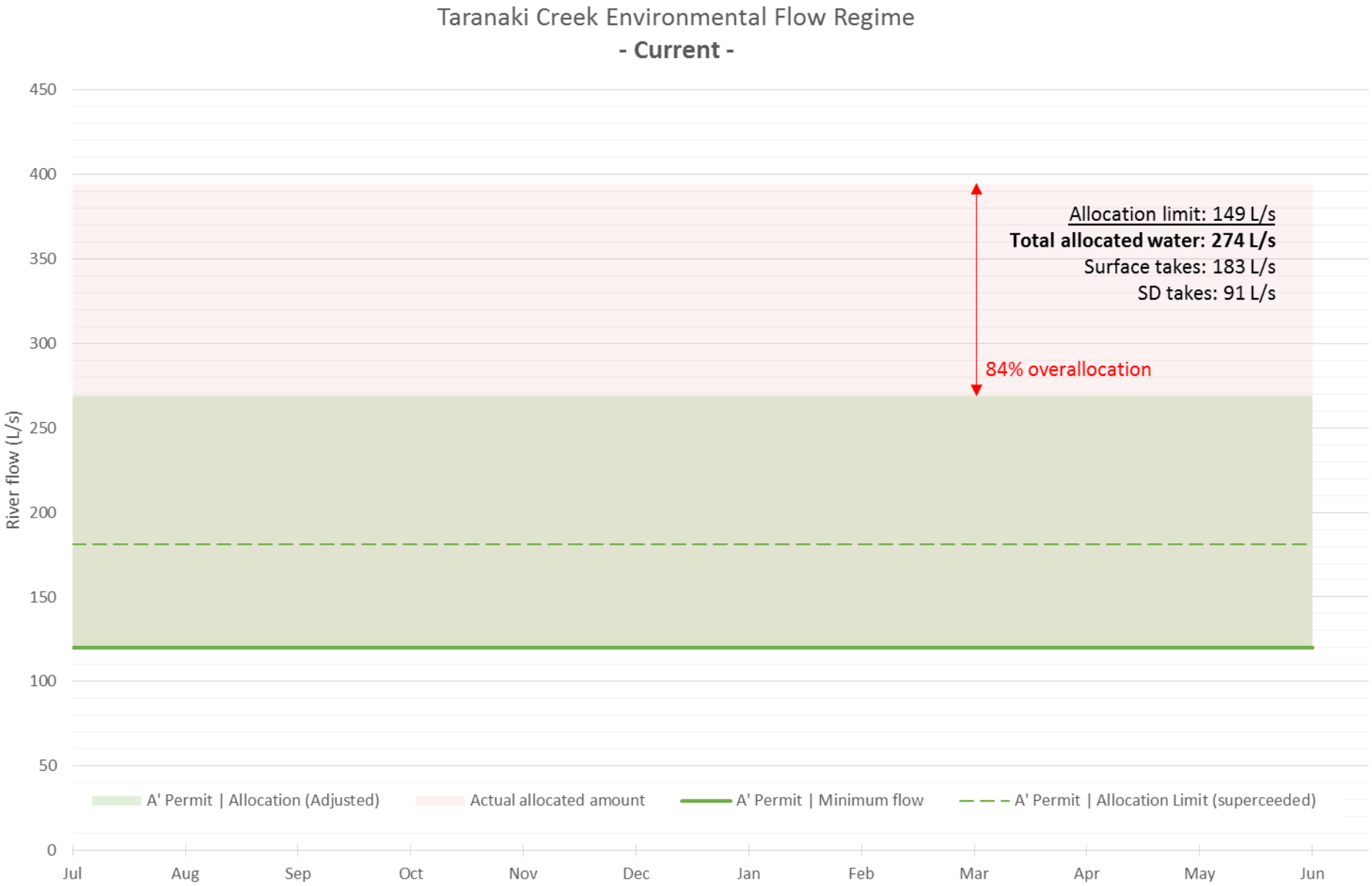
- Current -




Waikuku Stream Environmental Flow Regime
- Current -
River flow (L/s)
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
24 % overallocation
Allocation limit: 831 L/s
Total allocated water: 1033 L/s
Surface takes: 892 L/s
SD takes: 141 L/s
Flow regime
Weekday MF of 100 L/s
Weekend MF of 150 L/s
A' Permit | Allocation (Adjusted)
Actual allocated amount
A' Permit | Minimum flow
A' Permit | Allocation Limit (superceeded)


Little Ashley Creek Environmental Flow Regime
- Current -
River flow (L/s)
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
82 % available allocation
Allocation limit: 344 L/s
Total allocated water : 63 L/s
Surface takes: 0 L/s
SD takes: 63 L/s
Flow regime
MF of 50 L/s, except for 4 days per calander month with a MF of 30 L/s
(shown as 4 consecutive days at start of each month for clarity of presentation only)
A' Permit | Allocation (Adjusted)
Actual allocated amount


Saltwater Creek Environmental Flow Regime
- Current -
700
600
500
400
300
200
100
0
River flow (L/s)
32 % overallocation
Allocation limit (Adjusted): 417 L/s
Total allocated water: 550 L/s
Surface takes: 273 L/s
SD takes: 277 L/s
A' Permit | Allocation (Adjusted)
Actual allocated amount
A' Permit | Minimum flow
A' Permit | Allocation Limit (superceeded)
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun


Taranaki Creek Environmental Flow Regime
- Current -
River flow (L/s)
450
400
350
300
250
200
150
100
50
0
Allocation limit: 149 L/s
Total allocated water: 274 L/s
Surface takes: 183 L/s
SD takes: 91 L/s
84% overallocation
A' Permit | Allocation (Adjusted)
Actual allocated amount
A' Permit | Minimum flow
A' Permit | Allocation Limit (superceeded)
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun