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Memorandum

To: Alexandra King, Consents Officer, **Otago Regional Council**

From: Dean Olsen, **Ryder Environmental Limited**

Date: 23 September 2019

Subject: **Resource Consent Application: RM16.093.01– Criffel Irrigation Limited - Technical Review**

Dear Alex,

As requested, please find below a technical review of the application by Criffel Water Limited (hereafter the applicant or Criffel Water Ltd.) to Otago Regional Council (ORC) to renew a number of existing water takes (97629_V1, 94201, 95541, 95560, 96588, 2001.011.V1, licence for water race 7284) to take up to 358 l/s as primary allocation, 170 l/s of the first supplementary block (with a supplementary minimum flow of 788 l/s) and 86 l/s of the second supplementary block (with a supplementary minimum flow of 1,038 l/s) for the purpose of irrigation, stock water and domestic supply.

Background

Criffel Water Ltd. applied for resource consent to take water from Luggate Creek (also referred to as the North Branch of Luggate Creek) in February 2016. The application has been revised since the original application was lodged, and this assessment is based on the most recent of these, as outlined in a letter to ORC on 19 September 2019. The most relevant aspects of the application (as it currently stands) for this assessment are a primary allocation take of 358 l/s, first supplementary take of 170 l/s and a residual flow at the weir of 90 l/s. This assessment is also based on the draft consent conditions provided with the revised application.

Schedule 2A of the Regional Plan: Water (RPW, ORC 2018[1]) lists the minimum flow and primary allocation limit for Luggate Creek (Table 1). The assessments presented here are made within this context.

[1] Otago Regional Council (2018). Regional Plan: Water for Otago. Updated to 1 July 2018. Otago Regional Council, Dunedin.

Table 1 Minimum flow and primary allocation limit for Luggate Creek (from Schedule 2A of the RPW; ORC 2018).

Catchment See the B-series maps	Monitoring Site (with MS number) See the B-series maps	Minimum flow (litres per second – instantaneous flow)	Primary Allocation Limits in accord with Policy 6.4.2(a) (litres per second – instantaneous flow)
Luggate catchment	SH6 Bridge (MS 11)	180 (1 November to 30 April) 500 (1 May to 30 October)	500 *Luggate catchment from confluence with Clutha/Mata-Au to headwaters*

Hydrology

The Management Flow Report for the Luggate Creek catchment (ORC 2006[2]) presents an estimate of flow statistics for the Luggate Creek catchment, with a naturalised 7-d MALF[3] of 550 l/s at the SH^ bridge and other low-flow statistics. However, these flow statistics are somewhat out of date and were calculated based on a series of one-off flow gaugings in Luggate Creek, as the permanent flow monitoring site wasn't installed until early 2016. NIWA's NZ River Maps hydrological model[4] provides an estimated 7-d MALF for Luggate Creek at the SH6 bridge of 367 l/s (Table 2), although this estimate is based on a national model, which may be subject to substantial error.

Using NIWA's Shiny hydrological model, Luggate Creek at the Criffel intake weir is estimated to have a natural 7-d mean annual low flow (7-d MALF) of 197 l/s and a mean flow of 591 l/s (see Table 1).

Table 2 Flow statistics for the Luggate Creek catchment based on NZ River Maps.

Location	1 in 5 y LF l/s	MALF l/s	Median l/s	Mean l/s
Criffel intake weir	110	197	591	904
Luggate Creek at confluence with Alice Burn	122	209	601	912
Alice Burn at confluence with Luggate Creek	73	124	331	498
Luggate Creek downstream of confluence with Alice Burn	195	328	932	1,410
Luggate Creek at SH6 bridge	210	367	976	1,520
Luggate Creek at Clutha confluence	237	413	1,070	1,690

The estimated flow statistics for the Luggate Creek (North Branch) and Alice Burn suggest that at the 7-d MALF, approximately 63% of the flow at the confluence comes from the North Branch, while the Alice Burn contributes approximately 37%. This is in line with the relative catchment areas of these two sub-catchments.

Leakage and residual flow discharged past the Criffel Water Ltd. intake weir appears to maintain flow continuity throughout the mainstem of Luggate Creek.

[2] Otago Regional Council (2006). Management Flows for Aquatic Ecosystems in Luggate Creek. Otago Regional Council, Dunedin. August 2006. 21 p.

[3] 7-d Mean annual low flow – the average of the lowest 7-day low flow period for every year of record.

[4] Booker, D.J., Whitehead, A.L. (2017). NZ River Maps: An interactive online tool for mapping predicted freshwater variables across New Zealand. NIWA, Christchurch. https://shiny.niwa.co.nz/nzrivermaps/

Values

Schedule 1A of the RPW (ORC 2018) identifies the following ecosystem values for Luggate Creek: weedfree, rare fish (kōaro), rare invertebrates upstream of F40: 040924[5], with significant habitat for kōaro.

Fish distribution

Brown trout (*Salmo trutta*) have been recorded from the mainstem of Luggate Creek to the Alice Burn confluence, including the lower Alice Burn (Figures 1 & 2). Electric fishing records from the NZ Freshwater Fish Database (NZFFD[6]) indicate that juvenile brown trout are abundant in the lower reaches of Luggate Creek (from the vicinity of SH6, downstream) (Figures 1 & 2). Kōaro (*Galaxias brevipinnis*) and rainbow trout (*Oncorhynchus mykiss*) have been recorded from the mainstem of Luggate Creek from 2 km upstream of the Alice Burn confluence to the Criffel Station intake (Figures 1 & 2). Rainbow trout have also been recorded from the lower Alice Burn (Figures 1 & 2). Rainbow trout collected from the North Branch of Luggate Creek were of mixed size (length range: 62-209 mm), indicating the presence of fry (length range: 60-80 mm) and yearlings (length range: 100-160 mm), with some larger individuals present (lengths: 174 mm, 178 mm, 209 mm) indicating that other year-classes may also be present. If these larger individuals are 2+ or even 3+ individuals (in their second or third year of life), this suggests that this resident population may be stunted, and therefore likely to be of little interest to anglers.

The record from a survey of the Alice Burn in the vicinity of lower intake found brown trout of lengths from 56-505 mm (NZFFDB record #114093, 24 April 2018). The large trout collected during this survey is likely to have migrated into the Luggate Creek to spawn (this is especially likely given the survey was undertaken within the brown trout spawning season).

Spawning surveys undertaken by Fish and Game on 5 May 2017 observed spawning brown trout and redds[7] in the Alice Burn, Luggate Creek and irrigation races in the vicinity of where the Lake Mackay Station/Luggate Irrigation Company water takes occur (van Klink 2017[8]). No rainbow trout were observed during this survey, although this may reflect the timing of the survey; brown trout spawn in late April-July, while rainbow trout spawn later (June-August). The abundance of juvenile brown trout in the lower reaches of Luggate Creek and comparative rarity of rainbow trout recorded in the lower reach of the Luggate Creek suggest that Luggate Creek is likely to be contributing to the recruitment of brown trout to the upper Clutha/Mata-Au fishery. However, there is no available evidence to indicate that Luggate Creek makes a substantial contribution to the recruitment of rainbow trout to in the broader upper Clutha/Mata-Au fishery.

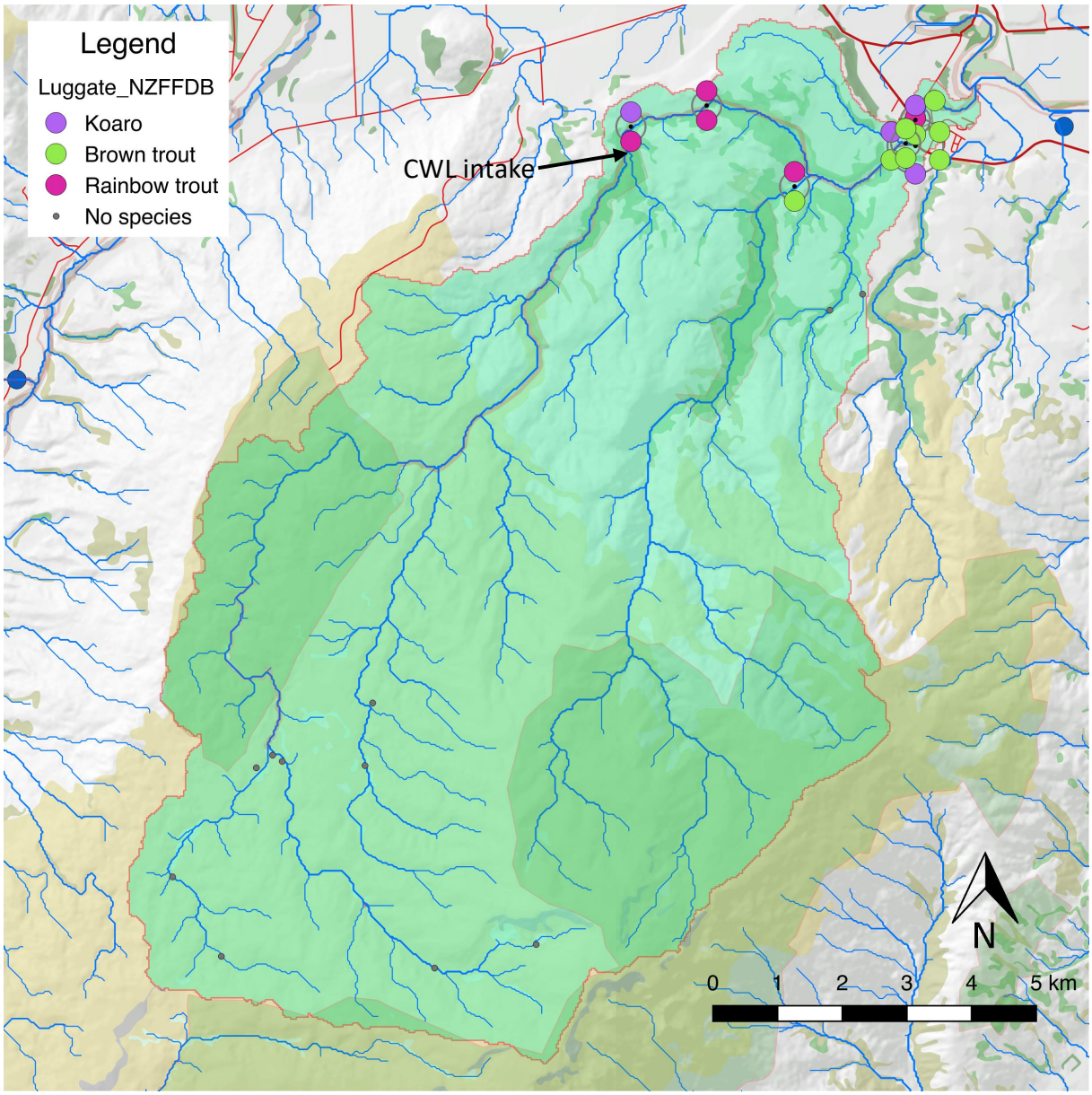
No angler effort has been recorded from Luggate Creek in the National Angler Survey (Unwin 2016).

There are anecdotal reports of longfin eels (*Anguilla dieffenbachii*) being present in Luggate Creek. Historically, longfin eels would have been widely distributed in the upper Clutha/Mata-Au, although the abundance and distribution of longfin eels in the upper Clutha/Mata-Au are currently limited by passage for juvenile eels past Roxburgh and Clyde Dams. Any eels currently present are likely to either be large individuals that entered the upper Clutha/Mata-Au catchment prior to the dams, or individuals that have been translocated to areas above the dams.

[5] This location is well upstream of the reach affected by this application.
[6] https://nzffdms.niwa.co.nz/
[7] Nests.
[8] Van Klink, P. (2017). Luggate Creek Spawning Survey. Council Report, Otago Fish & Game Council Meeting, 15 June 2017. Otago Fish & Game Council, Dunedin.

Kōaro are native to the upper Clutha/Mata-Au catchment, forming land-locked populations in tributaries to Lakes Hāwea and Wanaka. As discussed by Water Ways Consulting[9], NZFFD records from prior to the formation of Lake Dunstan suggest that low numbers of kōaro juvenile entered Luggate Creek. Since the formation of Lake Dunstan, kōaro have been entering many of the tributaries of the lake and upper Clutha/Mata-Au, including Luggate Creek. The main driver of the kōaro population in Luggate Creek is expected to be predation by trout, as juvenile kōaro entering the Luggate Creek catchment would have to migrate through the lower reaches of Luggate Creek, which has high densities of juvenile trout present.

Kōaro and longfin eels are classified by the Department of Conservation as 'at risk' (Dunn *et al.* 2018[10]).



[9] Letter from Richard Allibone (Water Ways Consulting) to Mandy Bell (Criffel Water Limited), dated 13 June 2016.

[10] Dunn, N.R.; Allibone, R.M.; Closs, G.P.; Crow, S.K.; David, B.O.; Goodman, J.M.; Griffiths, M.; Jack, D.C.; Ling, N.; Waters, J.M.; Rolfe, J.R. (2018). Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation, Wellington. 11 p.

Figure 1 ***Distribution of fish species within the Luggate Creek catchment. Based on records in the NZ Freshwater Fish Database downloaded 5 September 2019.***

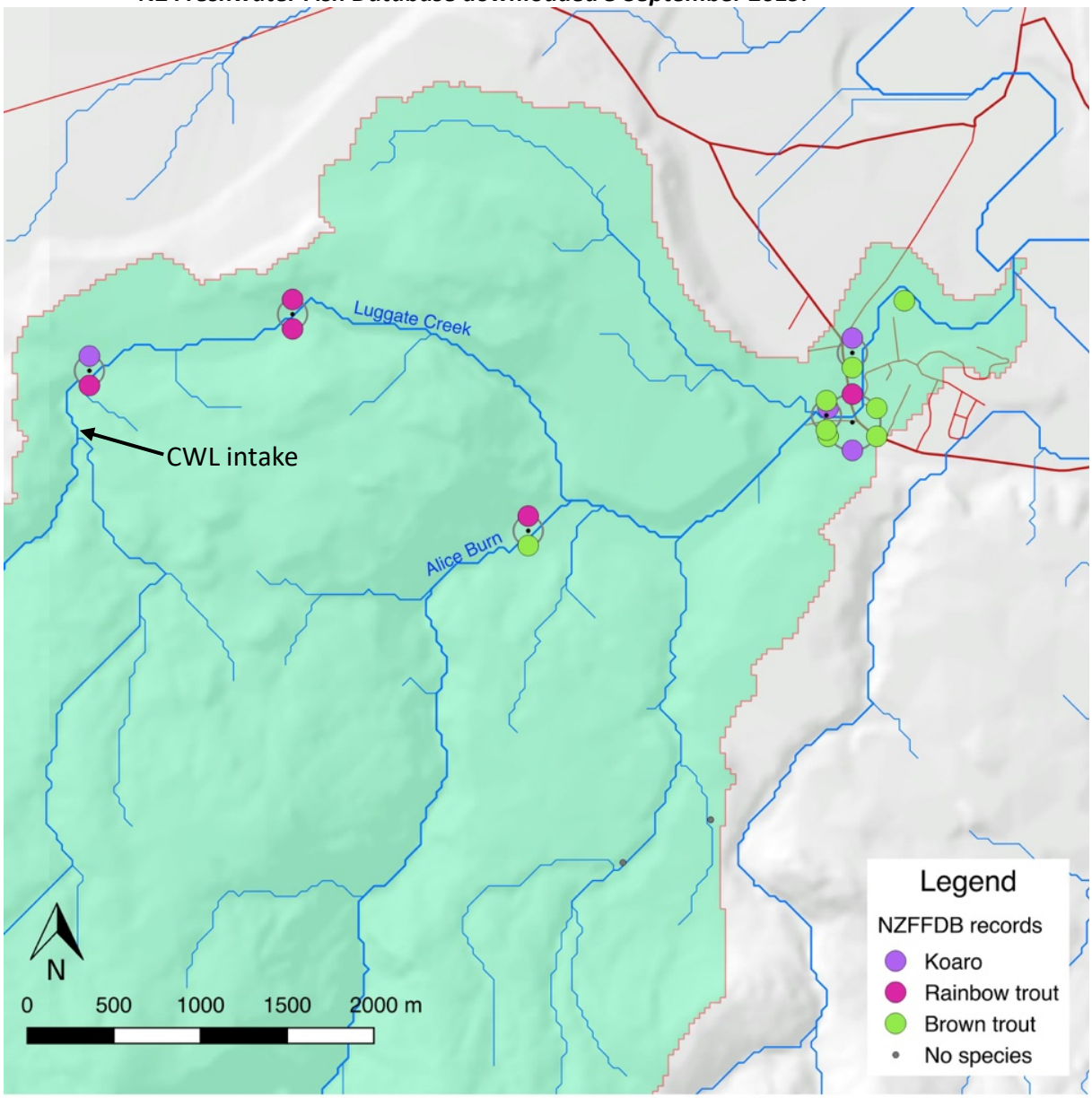


Figure 2 ***Distribution of fish species within the lower Luggate Creek catchment. Based on records in the NZ Freshwater Fish Database downloaded 5 September 2019.***

Assessment of environmental effects

Residual flow

The applicant proposes a residual flow of 90 l/s to be maintained in Luggate Creek immediately below the intake weir at all times[11]. The exception to this is to allow for stock drinking water to be taken at all times[11]. In practice, it is likely that flows in excess of 90 l/s will actually be required to maintain the summer minimum flow of 180 l/s downstream at the SH6 bridge, although there are circumstances when a residual flow of 90 l/s immediately below the weir could be reached (this would require little abstraction by other takes within the catchment).

The North Branch of Luggate Creek supports rainbow trout[12] and kōaro (Figures 1 & 2). Water Ways Consulting suggests that the lack of brown trout in this section of river during a survey in June 2016 indicates the presence of a fish barrier in the gorge downstream[12]. This seems to be a reasonable conclusion on the basis of the available information, especially given that the survey was conducted in June, when adult brown trout would be expected to be present following spawning. It would appear from aerial imagery that the topography of the river channel is steepest in the lower section of the North Branch, within 1-1.5 km of the confluence of the Alice Burn confluence.

Therefore, given the morphology of the North Branch downstream of the weir (steep, bouldery channel), along with the values present (small- to medium-sized rainbow trout, kōaro, macroinvertebrates) and absence of large trout, I conclude that a residual flow of 90 l/s is appropriate, especially given that greater flows are in fact likely to be necessary here at times in order to maintain the minimum flow for the catchment downstream.

Effects of allocation regime

The applicant proposes a primary take of 358 l/s, a first supplementary take of 170 l/s (with a supplementary minimum flow of 788 l/s) and a second supplementary take of 80 l/s (with a supplementary minimum flow of 1,038 l/s). To consider the effects of this on the hydrology of Luggate Creek beyond the North Branch, it is necessary to consider the combined primary allocation for the whole Luggate catchment. Luggate Irrigation Company/Lake Mackay Station have also applied for resource consent to take 180 l/s of primary allocation, 80 l/s of first supplementary water and a second supplementary take of 86 l/s from the North Branch of Luggate Creek and the Alice Burn. Therefore, the total primary allocation considered for the purposes of this assessment is 538 l/s, the full first supplementary block of 250 l/s (with a supplementary minimum flow of 788 l/s) and 166 l/s of the second supplementary block (with a second supplementary minimum flow of 1,038 l/s).

Hydrological modelling for the SH6 bridge flow site for the period February 2016 to February 2018 has been provided by the applicant, assuming total catchment primary allocation of 538 l/s, and first and supplementary blocks of 250 l/s. The hydrographs prepared by the applicant compare naturalised flows (i.e. flows in the absence of abstraction), observed flows (current abstraction) and the allocation regime proposed (538 l/s primary allocation, 250 l/s first supplementary allocation with 788 l/s first supplementary minimum flow, 166 l/s second supplementary allocation with 1,038 l/s second supplementary minimum flow) (attached as Appendix A). Based on these hydrographs, the proposal is not expected to result in prolonged periods of flat-lining, with flow variability largely mimicking that expected in the absence of abstraction (Appendix A). The main effect of the proposal is to reduce the amount of water taken at low flows (thereby resulting in higher flows than currently observed), but increasing the amount of water that is taken as flows recede from high flows (Appendix A). This represents an improvement in in-stream habitat availability and will significantly reduce the length of

[11] Condition 4 of the proposed consent conditions.

[12] Letter from Richard Allibone (Water Ways Consulting) to Mandy Bell (Criffel Water Limited), dated 13 June 2016.

time that the river is held at low flows compared with the existing abstraction regime. The minimum flow (180 l/s) will be the primary determinant of habitat availability in Luggate Creek for juvenile trout. Factors other than flow are likely to be the key drivers of kōaro and longfin eel populations in Luggate Creek, as discussed in the 'Fish Distribution' section above.

Fish Screening

During the survey by Water Ways Consulting, rainbow trout were observed upstream of the Criffel Water intake[12]. Therefore, fish screening is required at the intake, unless a dispensation is obtained from the Director General of Conservation.

Proposed consent condition(s)

The applicant proposes fish screening (Condition 7 of the draft consent conditions) to ensure that *"The intake shall be screened so as to prevent the ingress of small fish and elvers."*. This condition does not include any details on the technical aspects of the fish screens proposed and it is difficult to judge the likely performance of any screen installed to fulfil such a consent condition. For instance, a screen that may prevent the ingress of small fish and elvers may still cause significant damage, impingement or mortality of fish, all undesirable outcomes that can be avoided/minimised through appropriate screen design. Any screens should be designed and installed in a way that is consistent with good practice guidelines[13] developed in Canterbury, including:

(a) Water shall only be taken when a fish screen with a mesh size or maximum slot width of 3 mm is operated and maintained across the full width of the intake to ensure that fish and fish fry are prevented from passing through the intake screen; and

(b) As far as possible, the screen area shall be designed to ensure the calculated average through-screen velocity does not exceed 0.12 m/s if a self-cleaning mechanism is in place, or 0.06 m/s if no self-cleaning mechanism is in place.

(c) The sweep velocity parallel to the face of the screen shall exceed the design approach velocity.

Prior to installation of any fish screen, a report containing final design plans and illustrating how the screen will meet the required design criteria and an operation and maintenance plan should be provided to Council for consideration.

It is important that the fish screen is maintained in good working order, to ensure that the screen is performing as designed. Records should be kept of all inspections and maintenance and these should be made available to Council, on request.

Please do not hesitate to contact me should you require any further information or clarification of the above.

Yours sincerely,

Dean Olsen
Environmental Scientist & Associate Director
Ryder Environmental Limited

[13] Jamieson et al. (2007). Fish Screening: good practice guidelines for Canterbury. NIWA Client Report CHC2007.092. NIWA, Christchurch. October 2007.

APPENDIX A

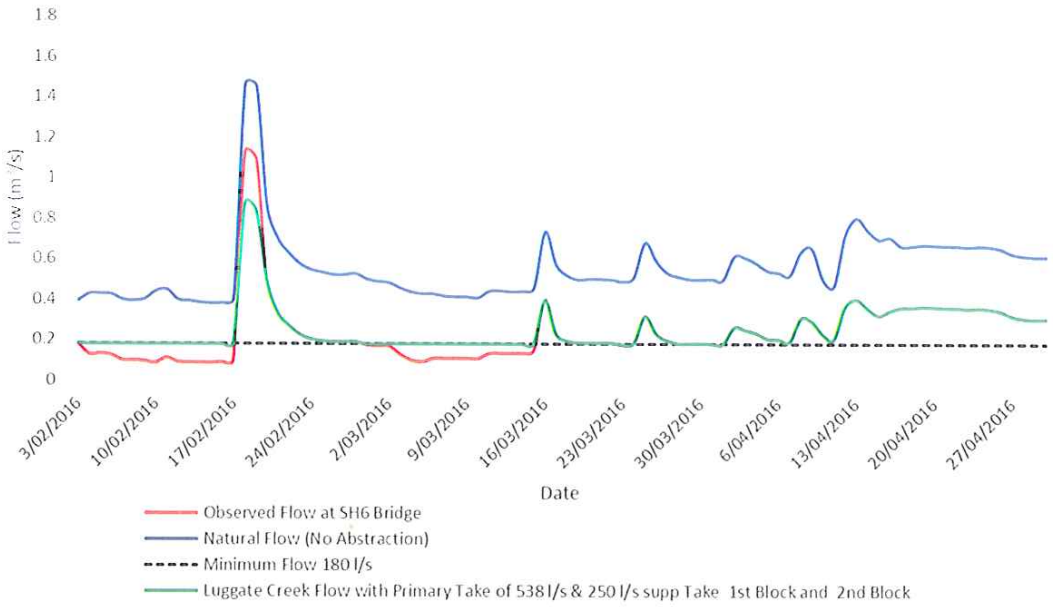


Figure 1. Observed, natural and expected flows based on the Criffel and LIC allocation proposal at ORC's SH 6 flow site from 03/2/2016 to 30/4/2016.

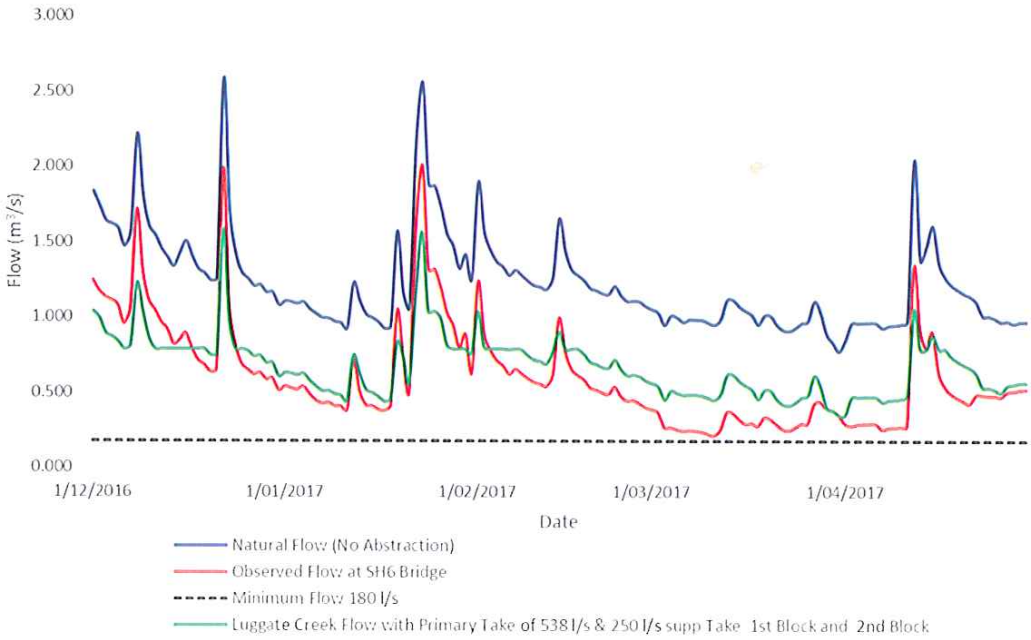


Figure 2. Observed, natural and expected flows based on the Criffel and LIC allocation proposal at ORC's SH 6 flow site from 01/12/2016 to 30/4/2017.

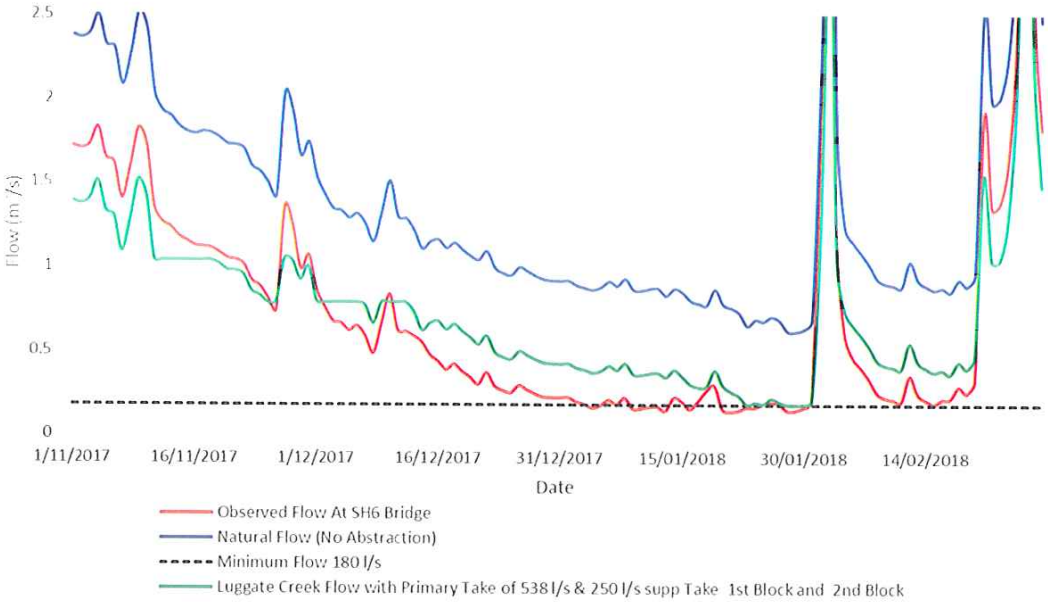


Figure 3. Observed, natural and expected flows based on the Criffel and LIC allocation proposal at ORC's SH 6 flow site from 01/11/2017 to 28/2/18