



29 August 2016

Gavin Kemble
Ryder Consulting Ltd
PO Box 13009
Tauranga 3141

Dear Gavin

REQUESTED HYDROLOGICAL INFORMATION

As requested in the e-mail from Saskia Ball (at the Canterbury Regional Council) to yourself (dated 4 August 2016) this letter provides additional information related to the Klondyke Storage Proposal - Hydrology Assessment. We understand that the information requested is not part of the formal request for further information but would aid in making the application clearer to understand. This letter answers the hydrology questions in the same order as they are expressed in Ms Ball's e-mail.

- *Question 1: The report mentions that the proposal enables potential future uses for water such as MAR or TSA – however the locations and flows available for release are not mentioned.*

Answer: As detailed in the hydrology assessment (Executive Summary, section 1.0 and section 3.1.3) the proposal has the potential to provide water for other uses than irrigation, such as Managed Aquifer Recharge (MAR) and Targeted Stream Augmentation (TSA). At this stage the locations and flows for these potential uses are unknown. The application simply points out that the proposal has the potential to provide for these 'other' uses. As detailed in section 3.1.3 of the hydrology AEE the use of water for these purposes are not part of this pond proposal and would require a separate use consent.

- *Question 2: The hydrographs in Appendix H of the hydrology assessment are in the log scale – it would be good to retain these but also to provide a graph of the effects of the proposal at a natural scale as well (maybe truncated at a maximum flow of 500 m³/s).*

Answer: Hydrographs with a natural scale (truncated at a maximum flow of 500 m³/s) are attached to this letter (Attachment 1).

- *Question 3: The flow distribution curves in Appendix I of the hydrology assessment are also in the log scale – same as above, it would be good to retain these but also to provide a graph of the effects at a natural scale as well.*

Answer: Flow duration curves with a natural scale (truncated at a maximum flow of 300 m³/s) are attached to this letter (attachment 2).

- ✧ *Question 4: Please provide annual flow plots from 1 November to 30 April to show when the FRE3 would be absent (requires over plots of natural, current and proposal). This would allow an assessment of effects of the proposal upon the duration of periods between FRE3 events.*

Answer: Annual flow plots from 1 November to 30 April are provided in attachment 3 for the three example years (average, wet and dry). These plots include a line indicating a flow of three times the natural median ($222 \text{ m}^3/\text{s}$). We note that the relevant comparison for this application is between the existing and proposed state. In these example years there is no difference in the number of FRE3 events over the period 1 November to 30 April between the existing and proposed state. One additional hydrograph (November 1981 – April 1982) is added to show one year where there is a change in the number of events exceeding three times the median flow. In that year the modelled flood peak in November for the existing state is $222.4 \text{ m}^3/\text{s}$ which is reduced to $212.4 \text{ m}^3/\text{s}$ under the proposal. The duration of time between events exceeding three times the median flow is quantified in Appendix J of the hydrology AEE (mean and maximum accrual time) and further comments on the significance of these changes as a result of the proposal on the risk of nuisance periphyton growth are provided in the Water Quality and Aquatic Ecology Assessment (Ryder Consulting Ltd, July 2016).

- ✧ *Question 5: Please include the Rangitata River in its natural state as part of Table 17.*

Answer: Updated Table 17 below (which now includes the Rangitata River in its natural state).

Table 17: Rangitata River Mouth Opening Flood Events ($150 \text{ m}^3/\text{s}$ Threshold)			
Scenario	Natural	Existing	Existing plus RDR proposed take
Average Number of Flood Events Per Annum	13	9	8
Average Length of Baseflow Periods (Days Between Flood Events)	24	39	43

- ✧ *Question 6: The assessment associated with Table 17 could be aided by graphs of annual flow plots to display when the $150 \text{ m}^3/\text{s}$ would be absent – this would enable an assessment of effects of the proposal upon the duration of periods between $150 \text{ m}^3/\text{s}$.*

Answer: Annual flow plots are provided in attachment 2 (same hydrographs as those prepared for question 2) for the three example years (average, wet and dry). These plots include a line indicating a flow of $150 \text{ m}^3/\text{s}$. In these example years there is no appreciable difference in the duration of periods between freshes/floods of $150 \text{ m}^3/\text{s}$ or greater between the existing and proposed state. As detailed in the AEE (section 7.7) overall the numbers in Table 17 in terms of average number of flood events and average length of baseflow periods between freshes/floods of $150 \text{ m}^3/\text{s}$ is small between the existing and proposed state and therefore it is considered that there is a less than minor impact on the ability of the Rangitata River to breach a new outlet as a result of the proposal in the unlikely event that its mouth is closed.

- ❖ *Question 7: Please provide a discussion as to how 6Mm^3 would become available for other uses under Scenario 3 in the MATLAB scenario modelling.*

Answer: Table 9 of the AEE can also be used to determine how much water is potentially available for other purposes such as irrigation outside the RDRML consented irrigable area and/or for other uses (such as irrigation outside the RDRML, MAR and TSA). An example is provided in section 5.5.3 of the AEE indicating that based on a proposed storage pond of 53Mm^3 at Klondyke (59Mm^3 in total when including Carew Storage) and the upgrade of the RDR to convey an additional $10\text{m}^3/\text{s}$ scenario 2 would result in 23Mm^3 being available for other purposes. Similarly, the data provided in Table 9 of the AEE indicates that under scenario three 53Mm^3 would be required to irrigate the current consented RDRML irrigable area of 94,486 ha. Based on a proposed storage pond of 53Mm^3 at Klondyke this would result in a total storage volume of 59Mm^3 being available when including Carew Storage. This indicates that 6Mm^3 ($59\text{Mm}^3 - 53\text{Mm}^3 = 6\text{Mm}^3$) would be available for other uses.

Limitations

This letter has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Ryder Consulting Ltd, Borman Consultants, MWH and Rangitata Diversion Race Ltd. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the letter. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This letter has been prepared by PDP on the specific instructions of Rangitata Diversion Race Management Limited for the limited purposes described in this letter. PDP accepts no liability if the letter is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by



Bas Veendrick

Water Services Leader

Reviewed and approved by

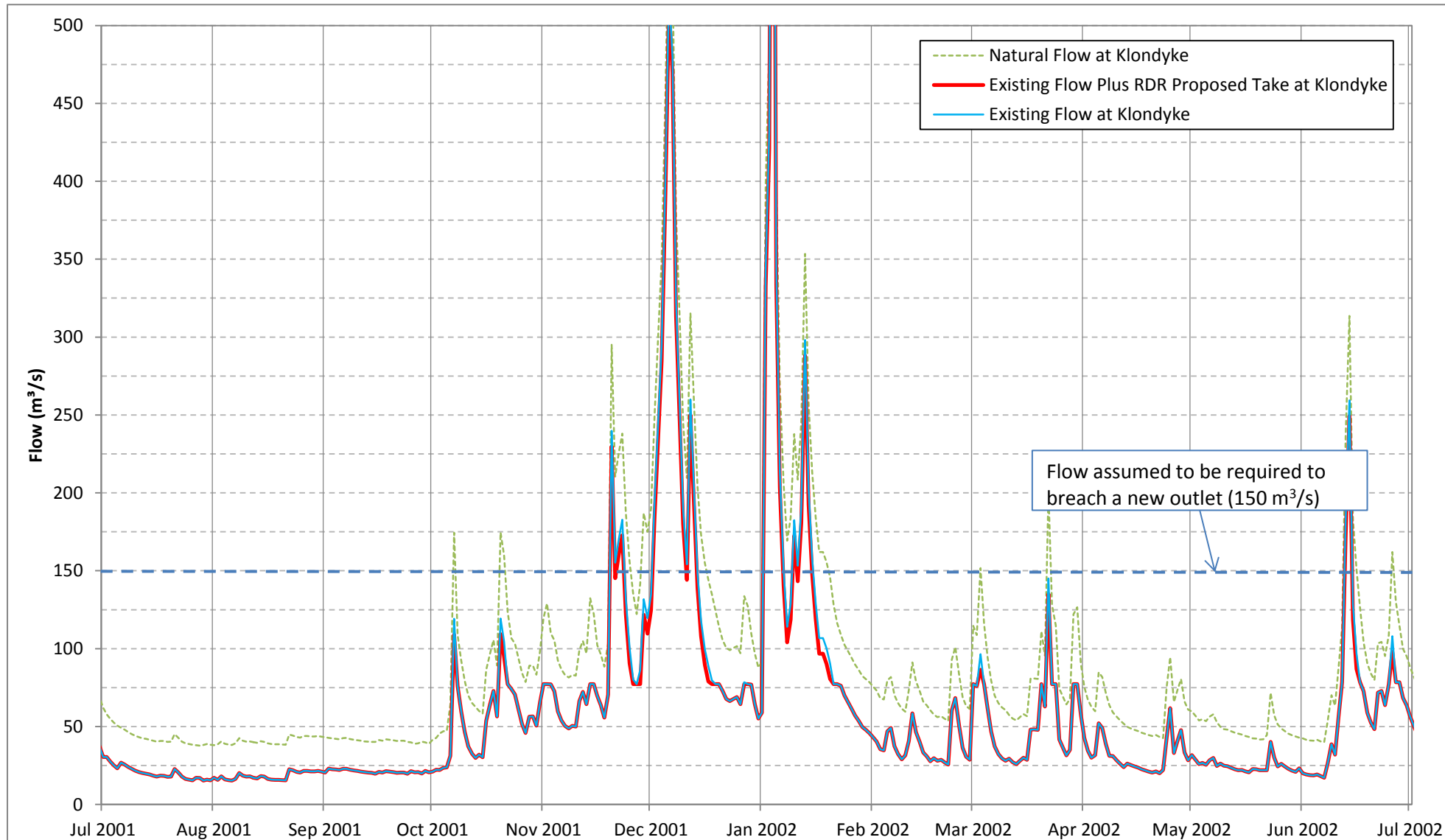


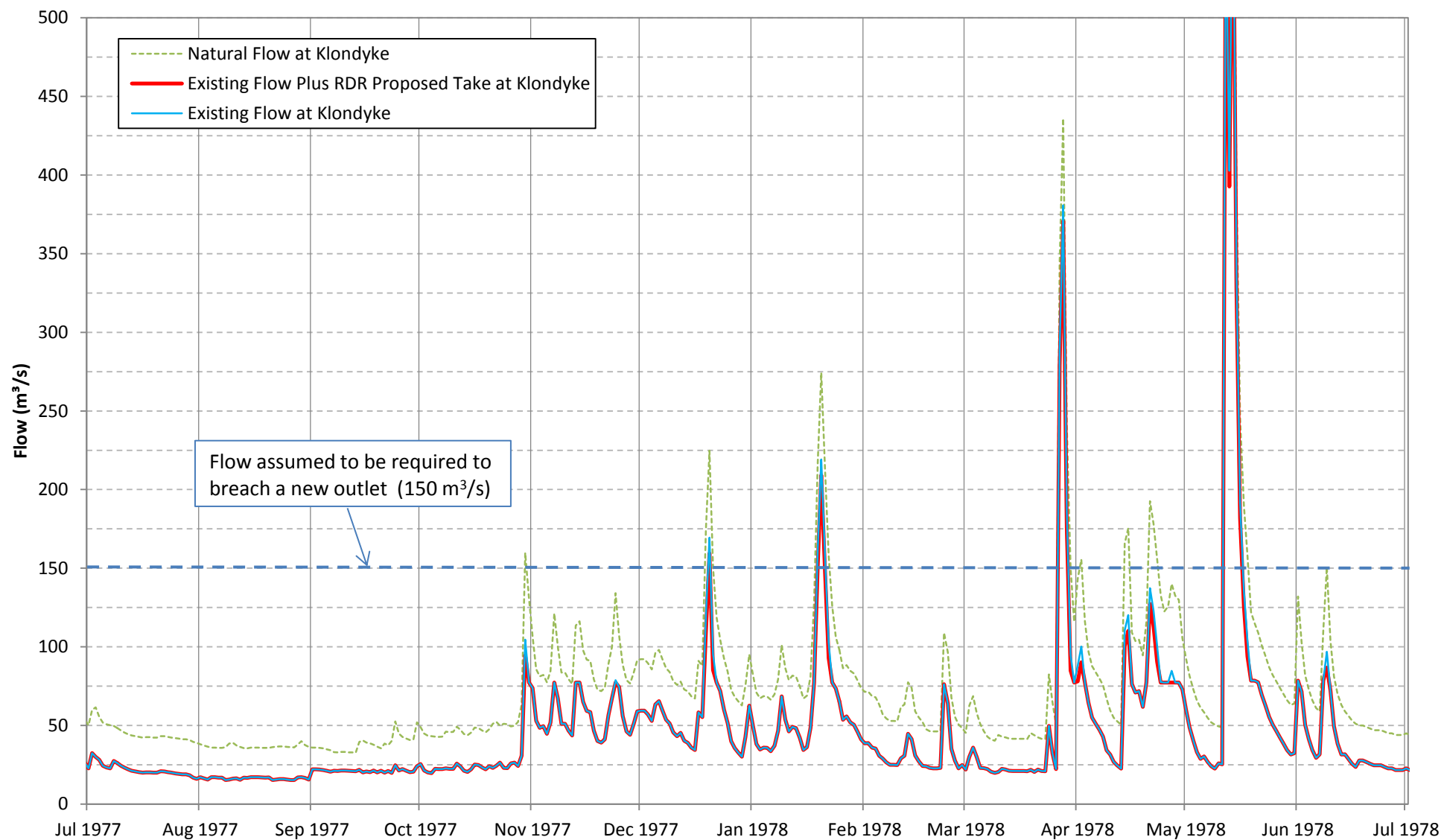
Peter Callander

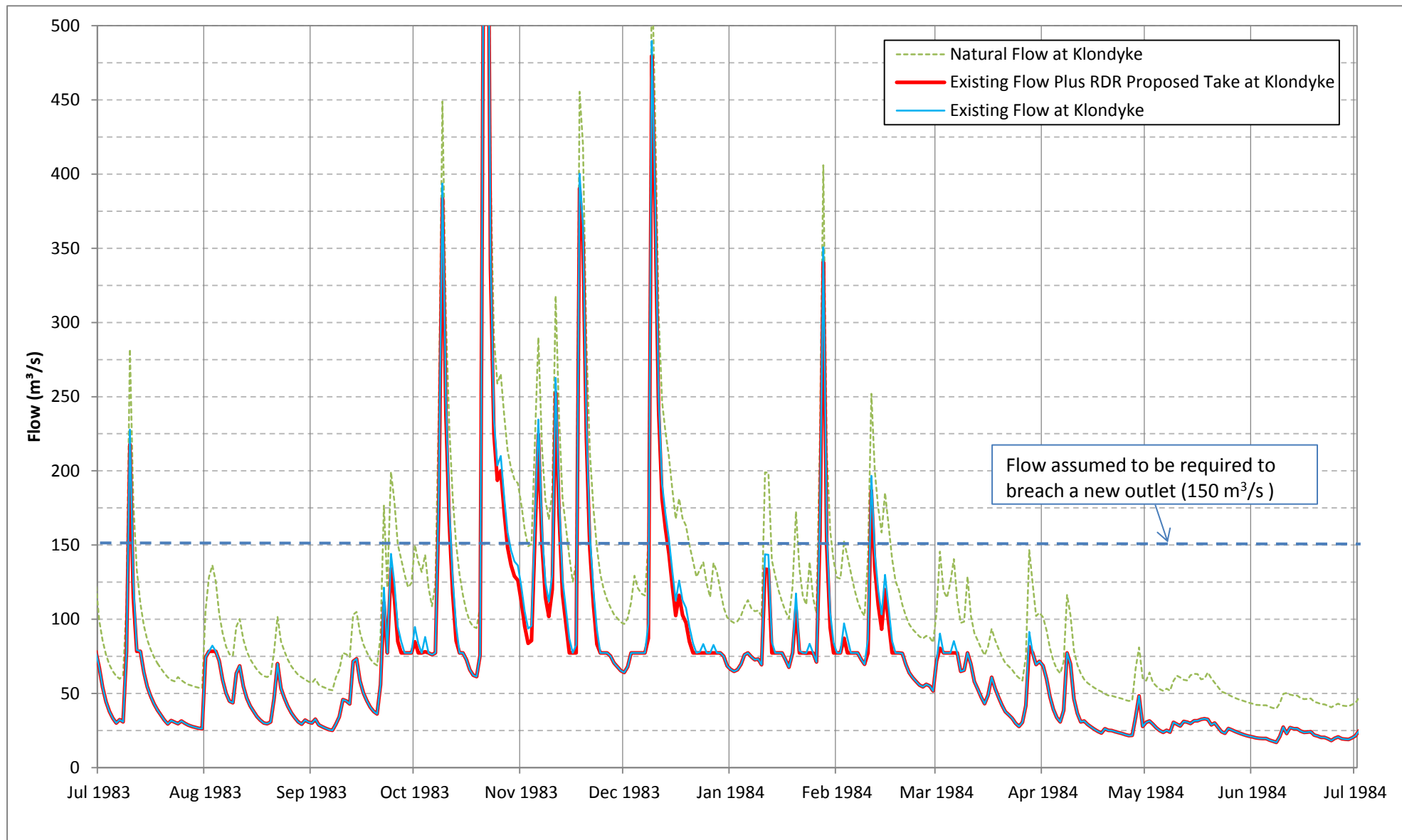
Director

Attachment 1

Example Hydrographs Natural Scale

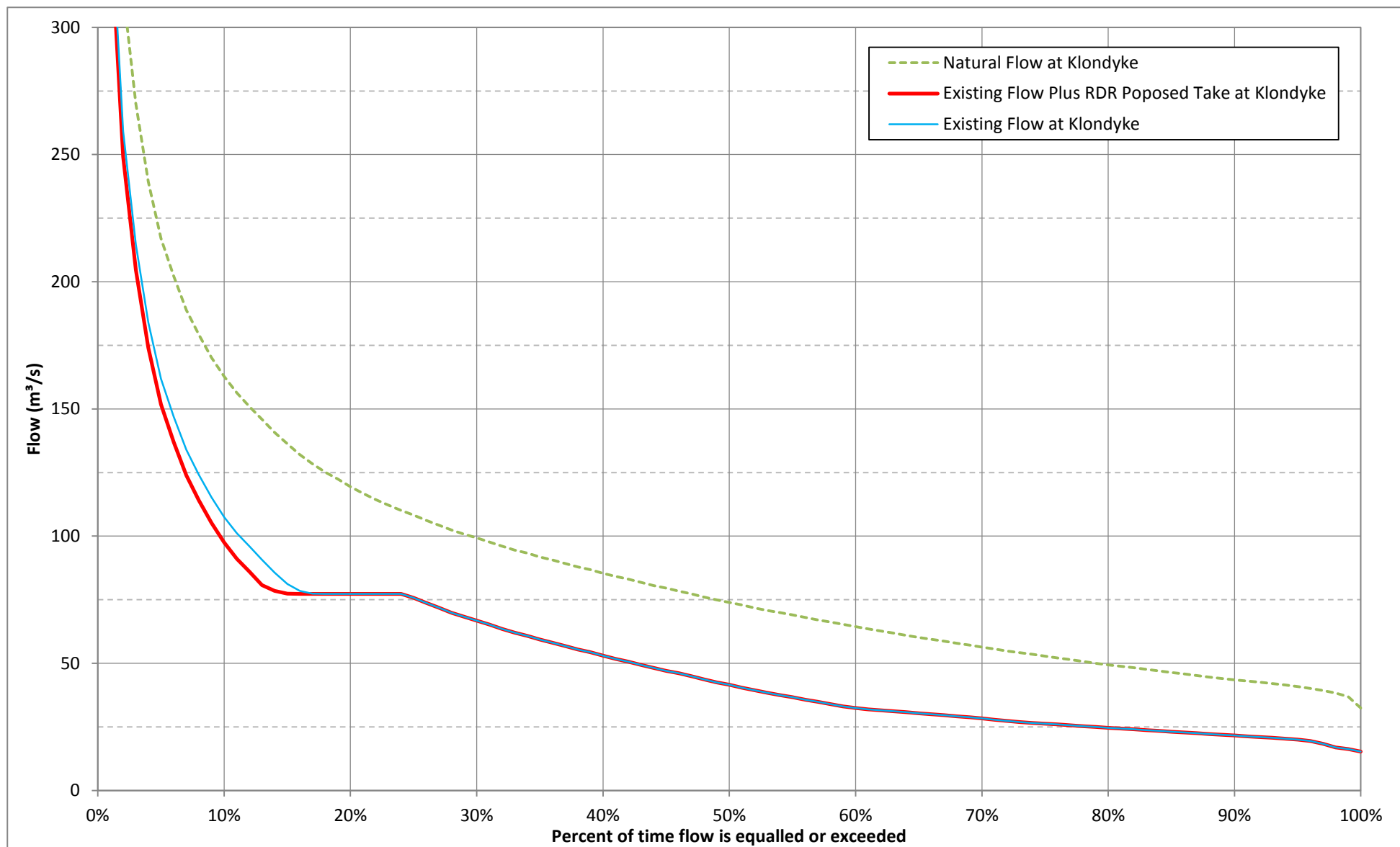
**Example Hydrograph for Rangitata River: Average Year (2001-2002)**

**Example Hydrograph for Rangitata River: Dry Year (1977-1978)**

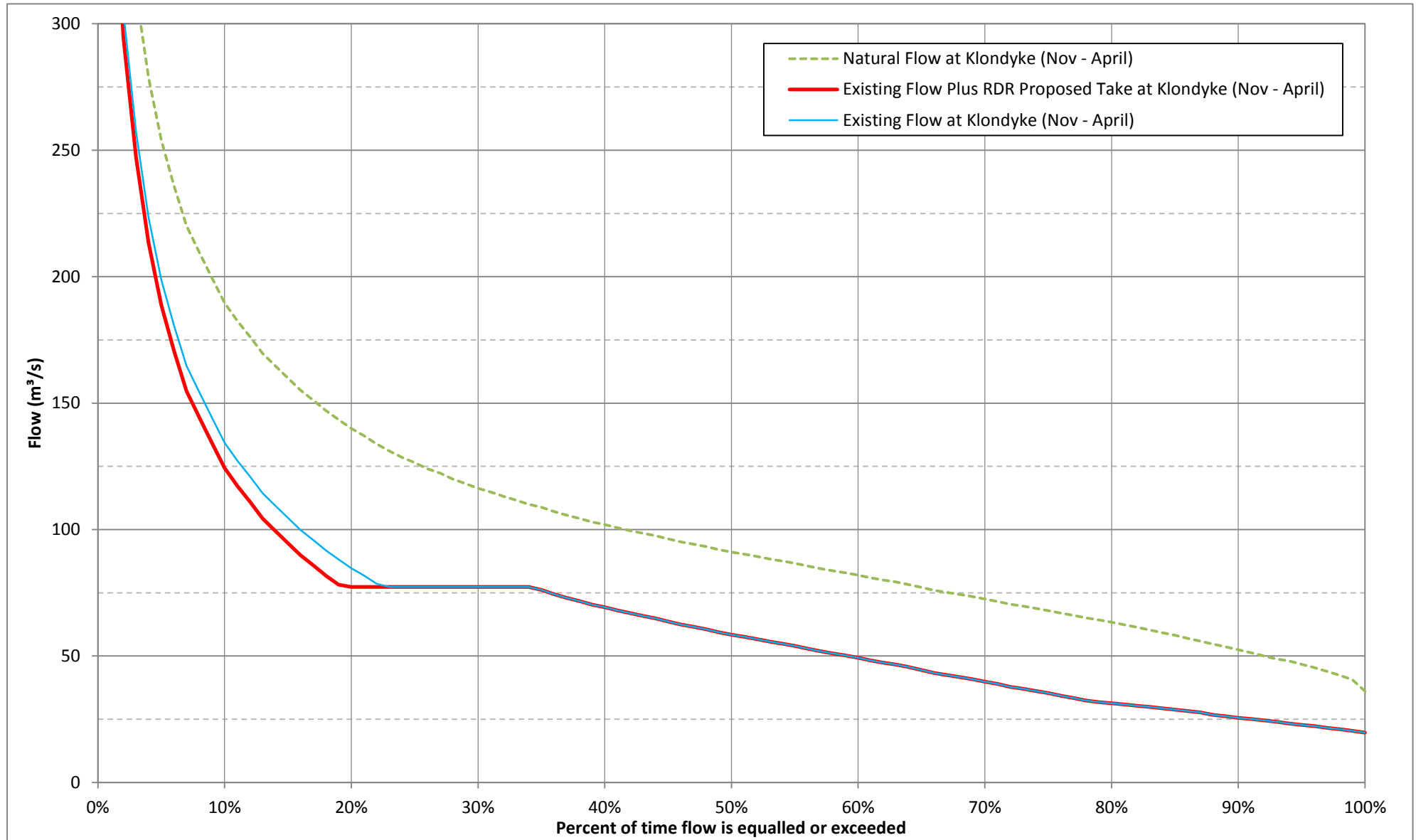
**Example Hydrograph for Rangitata River: Wet Year (1983-1984)**

Attachment 2

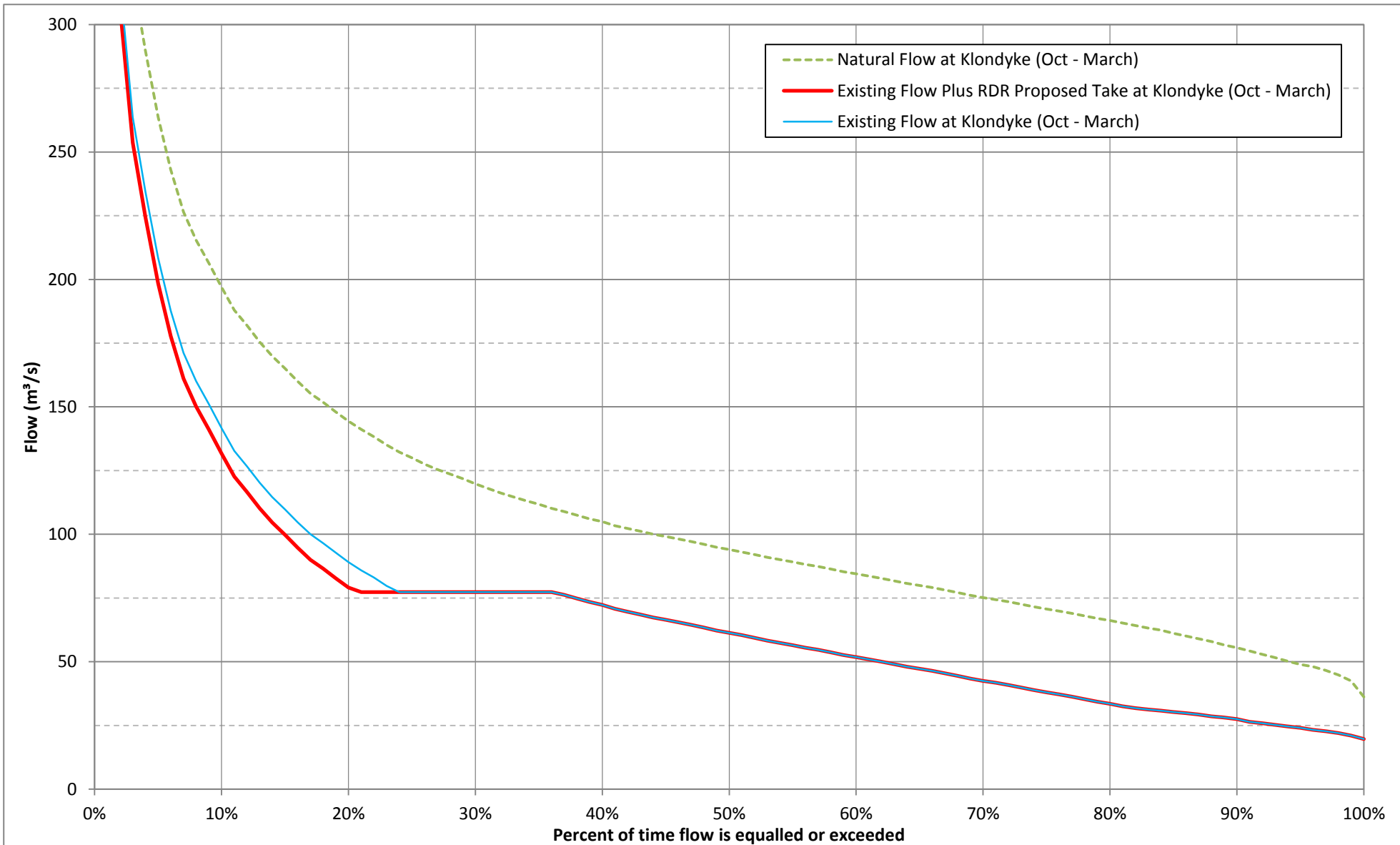
Flow Duration Curves Natural Scale



Flow Duration Curves for Rangitata River: Full Year



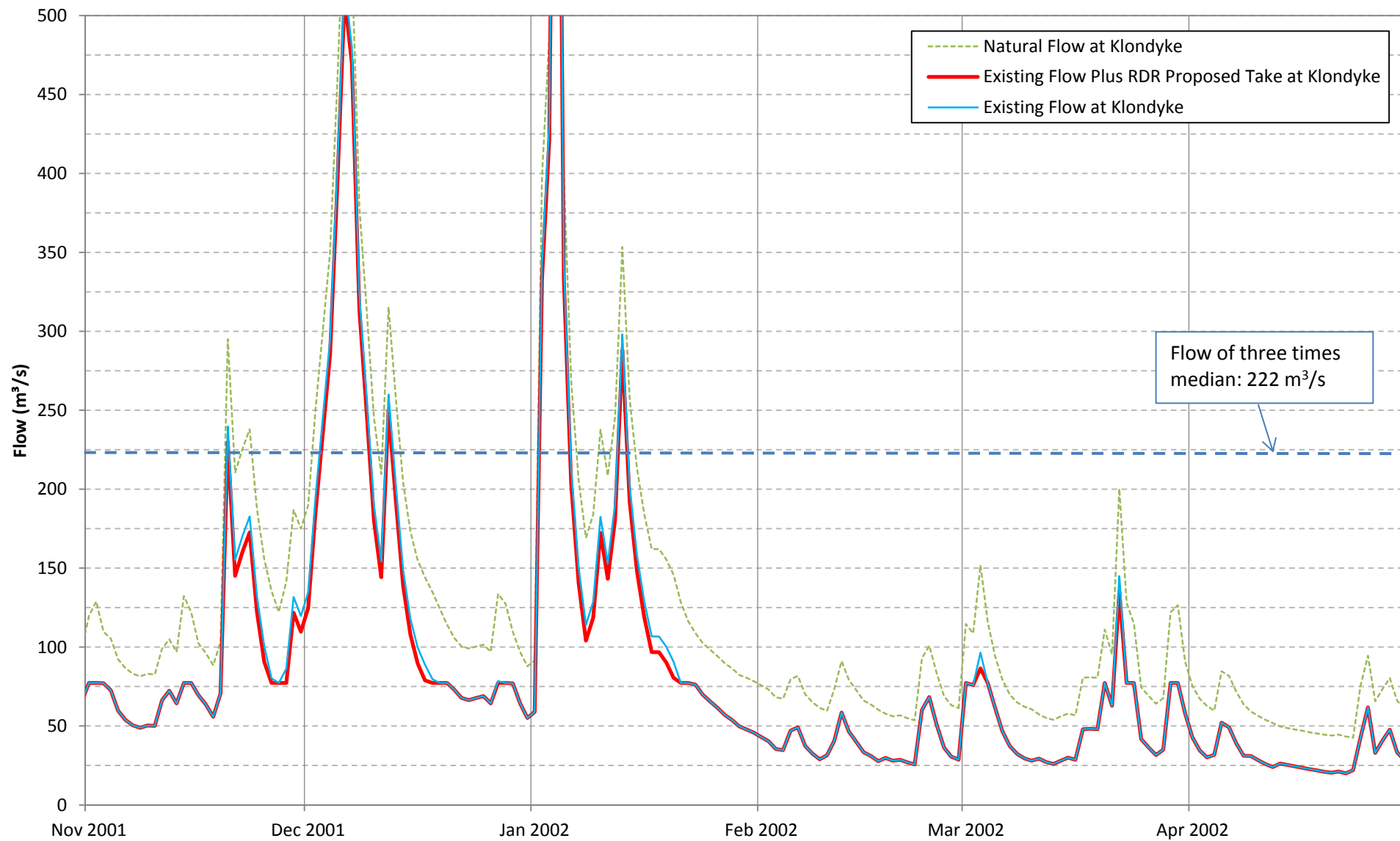
Flow Duration Curves for Rangitata River: 1 November – 30 April Flows Only



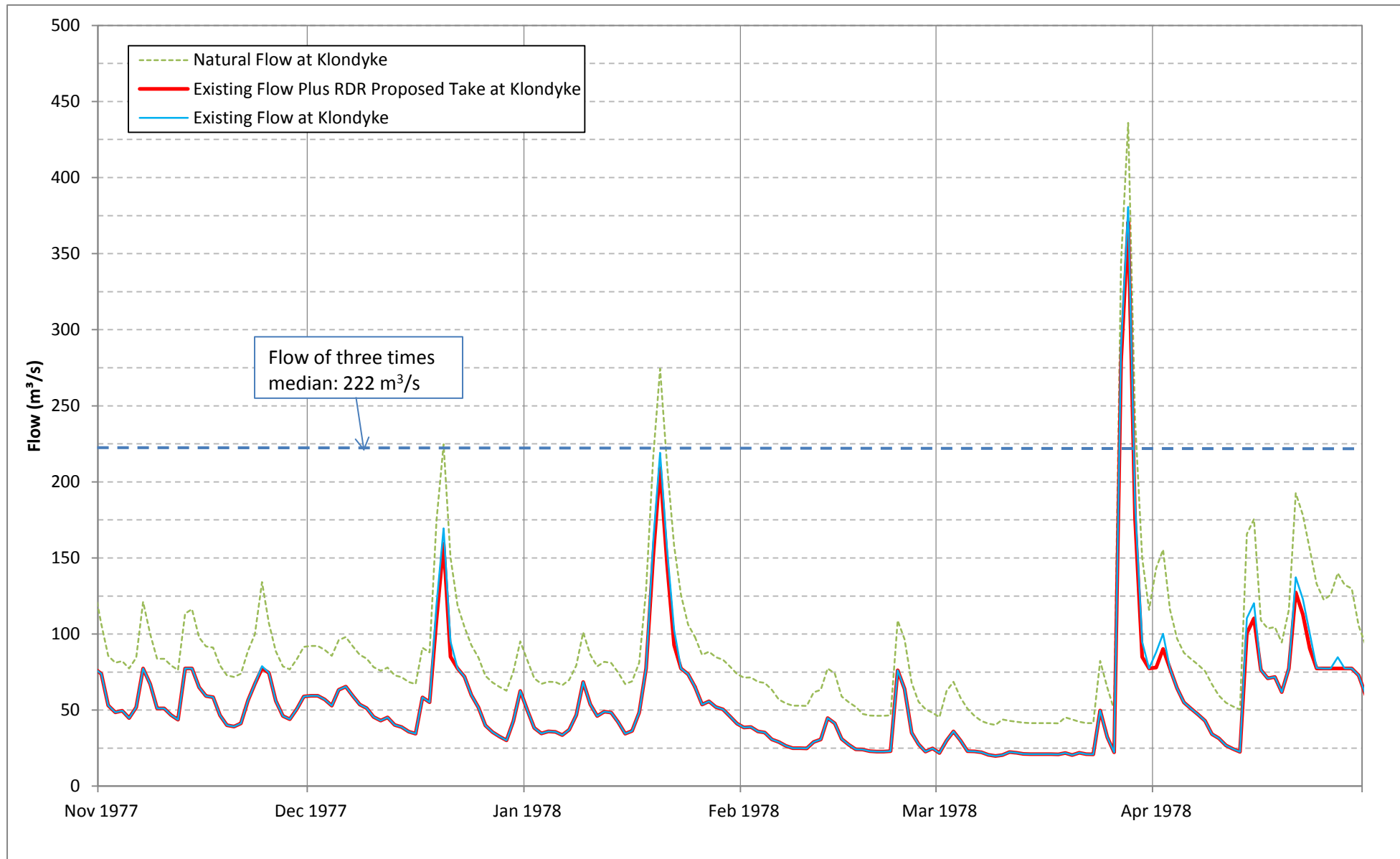
Flow Duration Curves for Rangitata River: 1 October – 31 March Flows Only

Attachment 3

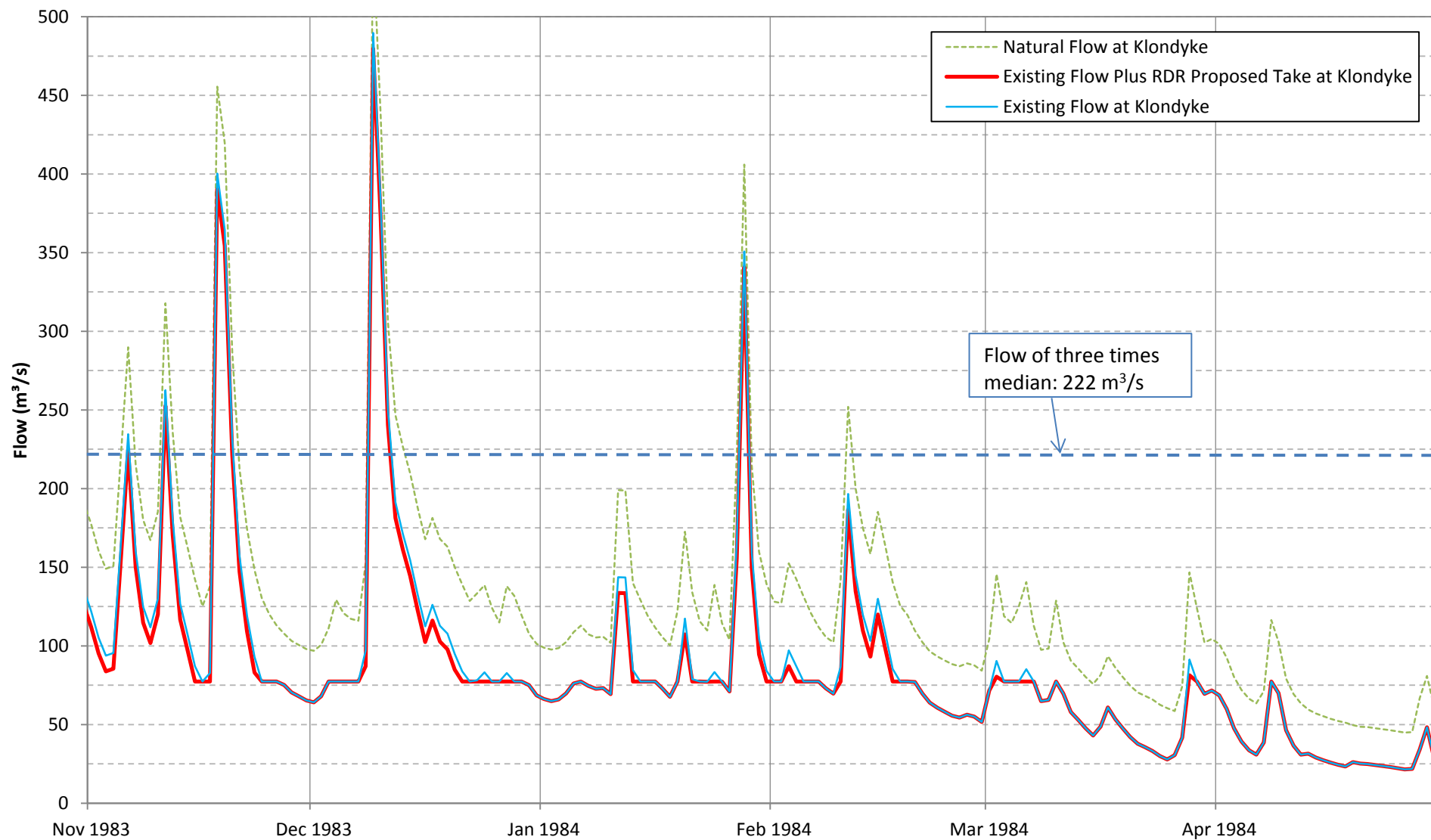
Annual flow plots between 1 November and 30 April

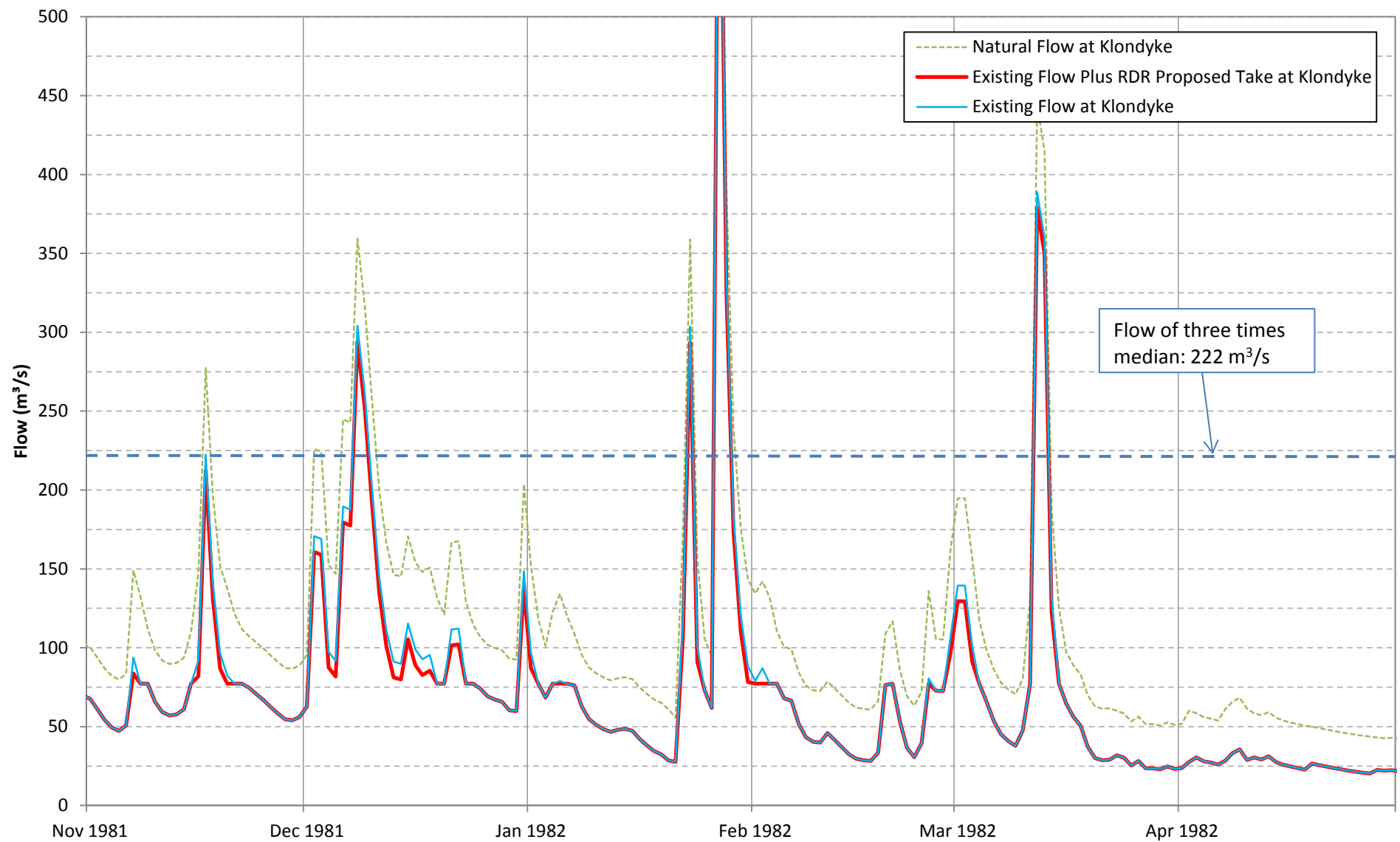


Example Hydrograph for Rangitata River: Average Year (November 2001 – April 2002)



Example Hydrograph for Rangitata River: Dry Year (November 1977 – April 1978)

**Example Hydrograph for Rangitata River: Wet Year (November 1983 – April 1984)**

**Example Hydrograph for Rangitata River: November 1981 – April 1982**