



The Effects of Alternative Hurunui River Allocation Regimes on Abstractive Users

Prepared for Environment Canterbury

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EXECUTIVE SUMMARY

Environment Canterbury aims to identify the most effective management regime for protecting the instream values of the Hurunui River while providing for the present and future needs of people for water in the Hurunui catchment. Dr MP Mosley's report (Mosley, 2002) on the Hurunui River instream values and flow regime recommends the adoption of a flow management regime for the Hurunui River that is different to the present regime.

The key objectives of this study were as follows:

- Explore the effects of the proposed regime on existing abstractive users of Hurunui water;
- Calculate the appropriate size of the "A" permit allocation having regard to different methods to assess reliability of supply;
- Assess the ability of the Hurunui River to meet potential future demands within the Hurunui catchment, assuming the "A" permit allocation on a run-of-river basis, and a "B" permit allocation for storage; and
- Assess the effect of the total "A" plus "B" permit take on floods and freshes in the Hurunui River.

The maximum authorised abstraction rate for all surface water bodies in the Hurunui catchment is 10.454 cumecs, of which 0.794 cumecs is due to pumping from hydraulically connected groundwater. The total consented take for the main stem of the Hurunui River is 7.545 cumecs. As the current "A" permit block size for the main stem of the Hurunui is 7.5 cumecs, the "A" permits are currently fully allocated. Nearly all the consented water is taken for the purpose of irrigation. The largest take (5 cumecs) is by the Amuri Irrigation Company Limited for the Balmoral Irrigation Scheme.

Modelling irrigation demand for irrigable land that is currently unirrigated indicates the total potential peak demand from the catchment would be approximately 21.3 cumecs. This is based on the status quo for the existing irrigated areas and assumes irrigation development on 80% of irrigable land, including land currently occupied by the Balmoral and Medbury Forests.

There is enough water available from the Hurunui River under the proposed allocation regime to meet the future demand, although water restrictions, particularly in late summer and autumn, mean water storage would be required to ensure good supply reliability.

The Hurunui River is fundamentally unreliable for abstractive users in late summer/autumn, but the block size is not the most critical factor contributing to this. The reliability is predominantly driven by the hydrological characteristics of the catchment and the minimum flows. It therefore seems reasonable to recommend increasing the "A" permit block size to 10 cumecs. The existing users are able to manage the current level of restrictions imposed on them, and increasing the "A" permit block size from 7.5 to 10 cumecs will only further decrease their reliability slightly. However, it will make further water available to new users.

The consent conditions the Balmoral Irrigation Scheme abstraction operates under are inherently more reliable than both the existing regime and the proposed regime. A change to the Mosley minimum flow regime will therefore more significantly affect the reliability of this take than the other existing users.

To meet a 10 cumec "A" permit irrigation demand 100% of the time, some storage would be required, particularly in a few key years and predominantly in the late summer/autumn. Storage volumes of 50 MCM are needed to meet full demand in all years, or 30 MCM to meet full demand 9 years in 10, or 15 MCM needed to meet full demand 4 years in 5.

To meet an 11.3 cumec "B" permit irrigation demand 100% of the time, more significant storage would be required in most years. Storage volumes of 90 MCM are needed to meet full demand in all years, or 65 MCM to meet full demand 9 years in 10, or 48 MCM needed to meet full demand 4 years in 5.

Under this "B" block size (11.3 cumecs), there is potentially water available to "export" from the catchment (e.g. to provide for increased water demand or augment river flows in the Waipara catchment).

It may not be critical to set a "B" allocation block at present, but it is still recommended that a "B" permit block size of 10 cumecs is set. Although it is unlikely this block would be used substantially in the short term, it sends a clear signal that there is further water available at a lower reliability (and without compromising instream values), and indicates allocation has been put aside to meet the potential future demands of the area.

The recently completed assessment of instream values and flow regimes for the Waiau River (Mosley, 2004) indicates that there is opportunity for further abstractive water use from the Waiau. To minimise storage requirements and reduce effects on the Hurunui, it may therefore be more appropriate to investigate options for utilising additional Waiau water in the Hurunui catchment in order to free up water to be "exported" to demand areas south of the Hurunui catchment. An assessment of water demand and availability in the Waiau catchment would be a prerequisite of any further work in this regard.

On a per hectare basis, the Balmoral Scheme's peak and seasonal water demand is respectively 1.9 and 2.5 times the modelled demand for the remaining area, indicating that the Balmoral Irrigation Scheme has a considerably larger water demand per hectare than a typical spray system. This is largely a function of applying water under a border-dyke system and the inefficiencies and operating limitations of an open race distribution network.

Further improvements in irrigation management practices for all irrigation systems are likely to occur if costly storage schemes are developed. This could include variable depth application systems to apply no more than is required, and deficit irrigation practices in order to make the best use out of rain that falls during the irrigation season. This could potentially reduce the storage volume required, or for the same storage, either increase the area able to be irrigated or improve the supply reliability.

1 INTRODUCTION

The key feature of run-of-river supply systems is that the flows that can be diverted from a river on a particular day determine the potential use of water for that day. Any restrictions in supply, caused through the application of allocation rules from the river or from natural events, results in a shortfall of water for economic use, if water is required on that day. Allocation rules, therefore, have a direct effect on the reliability of water supply on run-of-river schemes.

Allocation rules also have a direct effect on water storage systems. This particularly relates to the size of storage required to meet water demand, whether storage dams can be filled, and the timing of when water can be used. All factors are critical in providing a reliable supply of water.

The components of allocation rules that influence water supply reliability for abstractive use are:

- Minimum flow – the amount of water that must remain in the river after abstraction has taken place;
- Block size – the maximum amount of water that can be diverted at any one time;
- Sharing rule – the proportion of the available flow that can be abstracted at flows above the minimum flow; and
- Priority of use – whether a particular user or group of users have priority over other users of the resource.

Environment Canterbury aims to identify the most effective management regime for protecting the instream values of the Hurunui River while providing for the present and future needs of people for water in the Hurunui catchment. Dr MP Mosley's report (Mosley, 2002) on the Hurunui River instream values and flow regime recommends the adoption of a flow management regime for the Hurunui River that is different to the present regime.

Therefore, the key objectives of this study are to:

- a) Explore the effects of the "Proposed regime to better protect Hurunui River instream values" on existing users of Hurunui water;
- b) Calculate the size of the "A" permit allocation¹ to accord with the National Resource Regional Plan (NRRP) Policy WQN14 (5);
- c) Determine the appropriate size of the "A" permit allocation having regard to different methods to assess reliability of supply;

¹ An "A" permit allocation is an allocation of a block of water from a river to a group of abstractors. Abstractors in the "A" group enjoy a much more reliable water supply than do abstractors in a "B" group who must cease taking water at a minimum flow equivalent to the "A" permit minimum flow plus the "A" permit allocation. The object is to find the level of "A" permit allocation at which the greatest benefit from the use of a public resource (Hurunui River water available for abstraction) accrues to the community as a whole. This involves making an assessment of the size of "A" permit allocation, beyond which the reliability of supply becomes unacceptably low.

- d) Assess the ability of the Hurunui River under the proposed regime to meet the potential irrigation demands within the Hurunui catchment, assuming the “A” permit allocation on a run-of-river basis, and a “B” permit allocation for storage together with unused winter “A” permit allocation; and
- e) Assess the effect of the total “A” plus “B” permit take to irrigate all land within the Hurunui catchment on floods and freshes.

This report quantifies the level of restriction imposed by the different allocation rules at the water supply-demand level to provide a relative level of effect of different allocation rules on supply reliability compared to the current allocation rules. It does not address the effects on production and profitability.

2 CURRENT AND PROPOSED ALLOCATION REGIMES

Dr Mosley’s report on the Hurunui River instream values and flow regime recommends the adoption of a flow management regime for the Hurunui River that is different to the present regime and the regime specified in the Amuri Irrigation Co Ltd’s consent. These regimes are set out in Table 1 below:

Table 1: Existing minimum flow regime on the Hurunui River and recommended minimum flow regime to maintain instream values (cumecs)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Sharing regime for flows above the minimum flow
Existing regime	10	11	13	17	16	11.5	10	10	10	10	10	10	Yes 1:1
Amuri consent	12	13	15	19	18	13.5	12	12	12	12	12	12	No
Mosley regime	15	15	20	20	20	20	15	12	15	15	15	15	No
Note: Minimum flows are based on measured flows at the Hurunui at Mandamus recorder site, which is located just upstream of the Mandamus confluence (see Figure 1).													

For the main stem of the Hurunui River, Environment Canterbury has historically considered all those consents that were granted up to the combined maximum allocation of 7.5 cumecs are to be treated as “A” permits. Assuming this allocation limit, the last “A” permit was granted in January 2003.

3 WATER DEMAND IN THE HURUNUI CATCHMENT

3.1 Current Demand

Environment Canterbury report U03/48 (ECan, 2003) collates all resource consents and applications to divert, dam, take, use and discharge water in the Hurunui catchment as at May 2003. It found that:

- There are 87 water permits that authorise the abstraction of surface water and hydraulically connected groundwater from the Hurunui River and its tributaries and six applications for water permits in process as at May 2003.
- The maximum authorised abstraction rate for all surface water bodies in the Hurunui catchment is 10.454 cumecs, of which 0.794 cumecs is due to pumping from hydraulically connected groundwater.
- Nearly all the consented water is taken for the purpose of irrigation. Only a small amount (0.132 cumecs) is taken for stock water, domestic supply, and fire fighting purposes.
- The largest take is by the Amuri Irrigation Company Limited. This irrigation scheme takes 5 cumecs from the Hurunui River into its intake below the Mandamus River confluence.
- The total consented take for individual catchments is: Main stem of Hurunui River 7.545 cumecs, Pahau River 2.062 cumecs, Dry Stream (also known as Stony Creek) 401 ℓ/s, and Waitohi River 292 ℓ/s. The total take from the other tributaries of the Hurunui River are all less than 100 ℓ/s (Waikari River, School Creek, Cold Stream, Awatui Stream, and Washpen Stream).

Daily time series of water demand were developed for 31 years of historical climate conditions (1 June 1972 – 31 May 2003), assuming the current levels of water allocation from the Hurunui River. Lincoln Environmental's irrigation demand and scheduling model (AEI, 1991) was run to generate the time series.

Daily records from two representative long-term rainfall sites (Riverside H22781 and Lowry Hills Station H23811) and one representative long-term climate site (Hanmer G22581-2) were used to model the water demand. Potential evapotranspiration (PET) data for Culverden would be more representative, but a short record limits its use. Using linear regression Lloyd (2002) found Culverden PET to be 11% higher than Hanmer PET, and therefore the original Hanmer record was scaled up by this factor to improve the representativeness of the site to the irrigated area in the Hurunui catchment. Soil water holding characteristics from the Land Resource Information System were grouped into four classes in a method outlined in the Canterbury Strategic Water Study (LE, 2002). A location map with this information is presented in Figure 1.

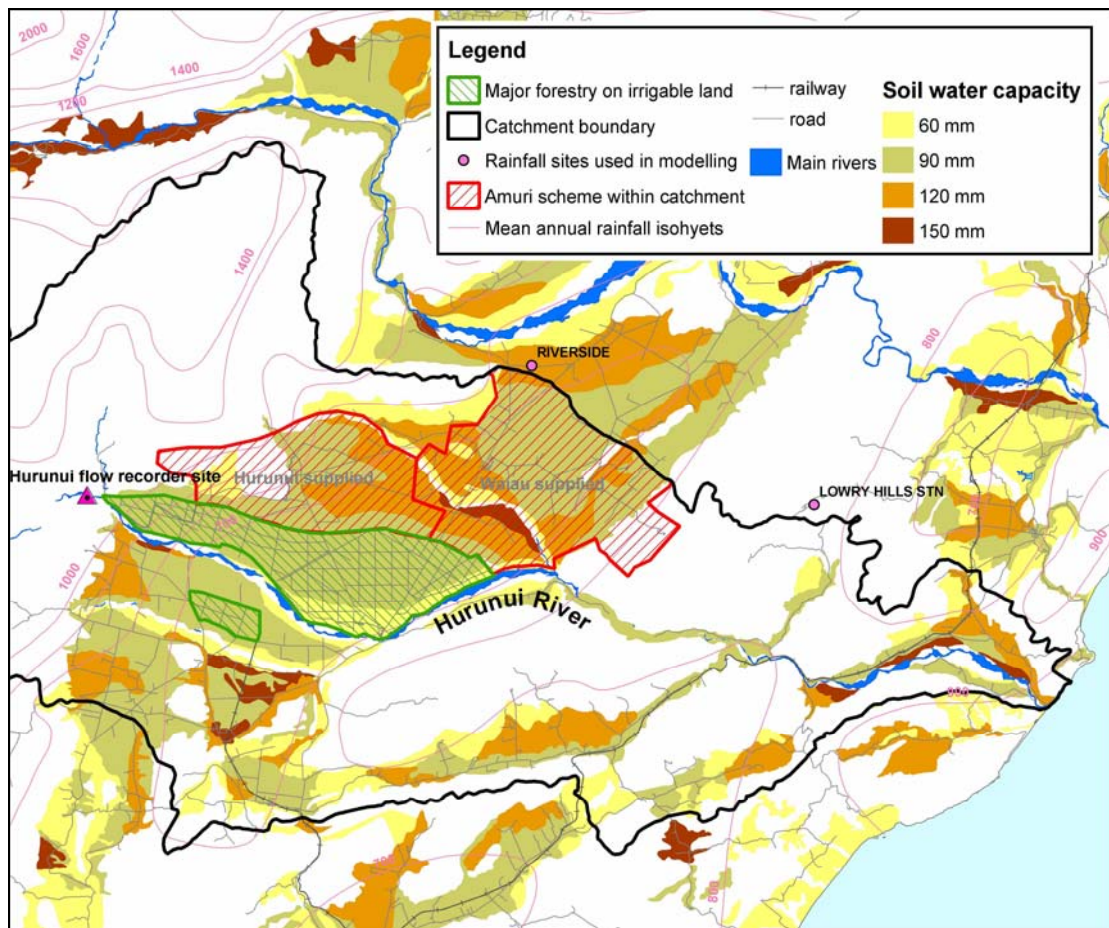


Figure 1: Irrigable land in the Hurunui catchment

3.1.1 Balmoral Irrigation

A large part of the command area of the Amuri Irrigation Co Ltd's irrigation schemes (Balmoral and Waiau) is within the Hurunui catchment and uses water supplied from both the Hurunui and Waiau rivers.

The Balmoral Irrigation Scheme takes water from the Hurunui River just downstream of the Mandamus River confluence for the irrigation of a gross area of 5,500 ha. The maximum flow taken for irrigation is 5 cumecs for a net irrigable area of 5,243 ha. The Waiau Irrigation Scheme takes water from the Waiau River at the Leslie Hills bridge for the irrigation of a gross area of 17,000 ha. The maximum flow taken for irrigation is 11 cumecs for a net irrigable area of 14,380 ha.

The Balmoral scheme has been modelled as all border-dyke irrigation. A model calibration check was carried out on the modelled water demand for the scheme using actual recorded monthly data at the scheme intake (Figure 2). It indicates the model is a good representation of the actual demand.

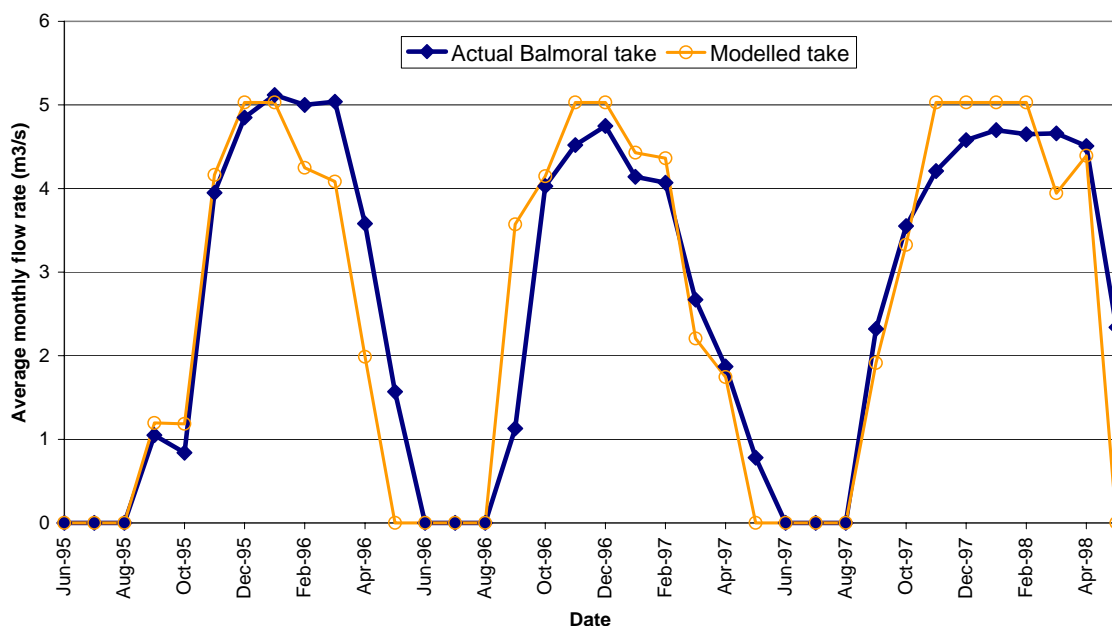


Figure 2: Comparison of actual Balmoral scheme take with modelled take for three irrigation seasons

3.1.2 Remaining Irrigation Takes

The remaining irrigation takes in the Hurunui catchment have approximately 5 cumecs allocated to them (4.1 from surface water and 0.9 from groundwater). It is estimated, using consent data, that this is currently used to irrigate a net area of 7,900 ha (or gross area of 9,900 ha).

A time series of the remaining irrigation takes was developed assuming the key parameters outlined in Table 2.

Table 2: Summary of key irrigation parameters used in modelling water demand for areas outside the Balmoral scheme

Land use	Maximum system capacity (ℓ/s/ha)	Soil water holding capacity (mm)	Proportion of total area in each soil category (%)	Application depth (mm)	Return period (days)
Intensive pasture (predominantly spray irrigated)	0.5-0.8	60	28	30-48	7
		90	45	43-69	10
		120	23	60-97	14
		150	4	73-118	17

In reality, there is a wide variety of irrigation practice occurring, and this regime is by no means a worst-case or best-case. It is considered representative of typical or average irrigation practice occurring today.

3.2 Potential Future Demand

A GIS analysis of irrigable land (Figure 1) yielded a total potential irrigable area within the Hurunui catchment of 62,700 ha. By subtracting the area within the Balmoral and Waiau irrigation scheme boundaries and the remaining area of existing irrigation, we are left with a potentially future irrigable area of 34,500 ha. This includes the Balmoral and Medbury Forests with a combined area of 9,600 ha. It is uncertain, in the long-term, if these forests would continue as is. Economic circumstances may change and it may not be unrealistic to see these converted to an alternative land-use. Therefore, two future demand time series were constructed, one assuming the forests remain (and therefore unirrigated) and one assuming a change to an irrigated land-use.

Two daily time series of potential future water demand were then constructed with Lincoln Environmental's irrigation demand and scheduling model using the soil data in Table 3, climate and rainfall data in Section 3.1, and the irrigation parameters outlined in Table 2. One of the demand series was for the Balmoral and Medbury Forests while the other was for the remaining potentially irrigable areas. For both series it assumed all spray irrigation and 80% of the gross area is irrigated. A maximum system capacity of 0.5 ℓ /s/ha was used which, in times of peak evapotranspiration, may not quite keep up with demand. However, it is usually uneconomic to design irrigation systems to provide a maximum system capacity that meets irrigation demand 100% of the time. This capacity will satisfy demand approximately 90% of the time.

Table 3: Gross potentially irrigable land within the Hurunui catchment (ha)

	Soil water holding capacity (mm)				Total
	60	90	120	150	
Balmoral and Medbury Forests	1,400	8,200	0	0	9,600
Remaining potentially irrigable areas	6,900	11,200	5,800	1,000	24,900
Total	8,300	19,400	5,800	1,000	34,500

3.3 Summary of Demand Time Series

Results from the water demand modelling are summarised in Table 4. The peak demand is the maximum design flow rate required. Seasonal water demand is described in three ways:

- a) An average flow in cubic metres per second (m^3/s). This is the equivalent of a continuous flow throughout the whole year to meet the required demand.
- b) An annual irrigation application depth in millimetres (mm).
- c) An annual volume of water in millions of cubic metres (MCM).

Three annual scenarios are also described, where a year is a water demand year from 1 June to 31 May:

- Average annual demand, which is the mean of the annual totals of irrigation demand for the 31 years of record.
- Greatest demand year, which is the maximum of the annual totals of irrigation demand for the 31 years of record. For all areas, it was the 1997/98 year that was the greatest demand year.
- 90 percentile demand year, which is statistically equivalent to a 1-in-10-year “drought”.

Table 4: Summary of water demand requirements

	Balmoral scheme	Other existing consents from catchment (from Hurunui) ⁽¹⁾	Balmoral and Medbury forests	Remaining potentially irrigable areas	Total from Hurunui River
Gross area (ha)	5,500	9,900 (4,950)	9,600	24,900	44,950
Irrigated area (ha)	5,243	7,900 (3,950)	7,680	19,920	36,793
Peak water demand (m³/s)	5.0	5 (2.5)	3.8	10.0	21.3
Seasonal water demand					
Average annual demand (m ³ /s)	2.2	1.9 (0.9)	1.2	3.3	7.7
Average annual demand (mm)	1,330	750	510	530	660
Average annual demand (MCM)	70	30 (15)	39	105	243
Greatest demand year (m ³ /s)	2.8	2.5 (1.2)	1.8	4.6	10.4
Greatest demand year (mm)	1,670	990	720	730	890
Greatest demand year (MCM)	87	39 (20)	55	145	327
90 percentile demand year (m ³ /s)	2.5	2.2 (1.1)	1.5	4.0	9.1
90 percentile demand year (mm)	1,510	880	630	630	780
90 percentile demand year (MCM)	79	35 (17)	48	126	288
Note: (1) The first figure is from the entire Hurunui catchment, and the second figure (in brackets) is from the main stem of the Hurunui River.					

4 CALCULATION OF THE “A” PERMIT BLOCK SIZE USING NRRP POLICY WQN14 (5)

The NRRP proposes the following simple generic reliability of supply approach as a means to determine the size of the “A” allocation block. This method can be used unless a specific catchment specific approach is deemed more appropriate.

NRRP policy WQN14 (5):

- (5) *For a surface water body, when establishing an allocation block for Schedule WQN1, unless an alternative catchment specific approach is more appropriate, or for Schedule WQN2, the size of the A allocation block shall be set so that all takes from that block have a level of reliability that will provide, on average:*
- (a) *the full allocation rate 95% or more of the time during the period mid October to mid March in 6 years out of 10; and*
 - (b) *the full allocation rate 75% or more of the time during the period mid October to mid March in 9 years out of 10.*

Assuming the Mosley regime, this method yielded an “A” permit allocation block of 5.3 cumecs for the main stem of the Hurunui River, and compares with 4.3 cumecs if calculated using the existing regime and 6.5 cumecs if calculated using the regime specified in the Amuri Irrigation Co Ltd’s consent (for the Balmoral Scheme). A more detailed table summarising this analysis is presented in Appendix A.

5 RELIABILITY OF SUPPLY FOR “A” PERMITS

5.1 Defining Reliability of Supply

There are two broad approaches to calculating reliability of supply:

- Comparing available supply with water allocated – **Allocable flow methods**
- Comparing available supply with required demand – **Matching supply with demand methods**

5.1.1 Allocable Flow Methods

This reasonably straightforward method assesses the availability of water under the allocation rules. For each day of recorded river flow, the flow allocated for abstraction is calculated and compared with the full allocation block. This calculated time series can then be summarised in various ways – in this case, the number of days of full water availability, partial availability and no availability. This has been undertaken for an “A” permit allocation of 7.5 cumecs under the existing regime, the Mosley regime and the regime specified in the Amuri Irrigation Co Ltd’s consent for the Balmoral Scheme (the Amuri regime)(see Appendix B), and for an “A” permit allocation of 10 cumecs (see Appendix C).

The same has also been applied to the 5 cumecs of water allocated from the Hurunui River to the Balmoral Irrigation Scheme under its current consent (Appendix D). The scheme utilises a modified allocation regime where flow sharing is not applied; but to offset this, the minimum flow for each month has been raised by 2 cumecs.

A more simplified summary of results using this method is presented in Section 5.2

5.1.2 Matching Supply with Demand Methods

Assessing reliability of supply of run-of-river water by allocable flow methods can give an unrealistic evaluation of the reliability for irrigation. Irrigation demand changes according to climate, soils, crop stage, irrigation method, irrigation management, and the risk that farmers are prepared to take in not always meeting full irrigation demand.

It is important to compare available supply with required demand on a daily basis to quantify the shortfalls and assess reliability. Using monthly or seasonal averages can obscure important short-term shortfalls.

Therefore, four key factors should be considered to quantify reliability of supply. They are:

- Severity – size or amount of restriction
- Frequency – how often the restrictions occur
- Duration – how long the restrictions last
- Timing – when restrictions occur

A restriction in water supply results in the inability of an irrigation system to fully replenish soil moisture deficits. When that occurs, production and farm profitability is reduced. The four factors determine the magnitude of decreases in production and profit.

There are several methods available to quantify reliability of supply of water for irrigation from a hydrological perspective. Each method encompasses some of the four key factors of severity, frequency, duration and timing, but no one method fully addresses all factors. For this reason, the approach is to use three different methods (according to the methods undertaken for the Rangitata Water Conservation Order hearing²), and to rank and combine each method to give an overall assessment of reliability of supply.

Because of the different methods of describing reliability, it is useful to categorise reliability into five bands, as follows:

- Very good reliability
- Good reliability
- Marginal reliability
- Poor reliability
- Very poor reliability

² Evidence of I McIndoe (Lincoln Environmental), presented at the hearing of August 2003.

Very good reliability usually demands unrestricted surface water or groundwater takes, and is required for irrigation of high value horticultural or arable crops, or very intensive irrigated agricultural systems. Intensive dairy farms usually require this level of reliability – for example, to avoid a potential reduction in production.

Good reliability demands water supplies that are limited to short infrequent periods of restriction. It is usually required for average or semi-intensive irrigated enterprises, and carries some risk of lost production or profitability.

Marginal reliability applies to water supplies subjected to more frequent and severe restrictions. It is not recommended to operate intensive irrigated farms under this reliability, as the risk of production losses is high.

Poor reliability applies to situations where restrictions are frequent and irrigation can only be considered as complementary to dryland farming. Storage of water to overcome the shortfalls is highly recommended.

Very poor reliability is not recommended unless storage of water is used to overcome shortfalls.

The following three methods have been used to determine the reliability of supply for the five allocation options considered:

- Robb reliability bands
- Farming experts reliability thresholds
- Supply/demand ratios

Results using these methods are presented in Section 5.2.2.

Robb reliability bands

This method was established through informal discussions between Lincoln Environmental staff and farm advisors in Canterbury, and described in LE (2001a, b). The bands are defined as follows:

- Good reliability – Over 28 years of historical river flow and climate data, there are no more than three months (November to February) when restrictions greater than 50% are in place for more than 15 days, and never more than 10 days off from 1 November to 31 January.
- Marginal reliability – Over 28 years of record, there are no more than three months (November to January) when there is no water available for more than 15 days.
- Poor reliability – Over 28 years of record, there are no more than 20 months (November to January) (approximately 25% of months) when there is no water available for more than 15 days.
- Very poor reliability – Over the 28 years of record, there are more than 20 months (November to January) (approximately 25% of months) when there is no water available for more than 15 days.

The required adjustments have been made to the Hurunui analysis to take account of the three years' longer length of available data.

Farming experts criteria

In the project carried out by Lincoln Environmental for Environment Canterbury (LE, 2001a) that investigated reliability of supply, acceptable levels of reliability were discussed formally with key farmers and farm consultants from the Canterbury region. As part of this consultation, water availability thresholds (high and low) for intensive pastoral farming were quantified, as follows:

High threshold	Can accept three days off from 1 December to 31 January, which translates to a 5% restriction or the full allocation available 95% of the time throughout the critical period – mid October to mid March. Can accept 50% restrictions (full water available 50% of the time) outside peak period.
Low threshold	15 days off from 1 December to 31 January, which translates to full allocation available 75% of time throughout the critical period – mid October to mid March. Water available 50% of time prior to mid October with no water from mid March.

Based on the above the following water availability thresholds for intensive pastoral farming were used in the modelling.

	Sep	1 st 1/2 Oct	2 nd 1/2 Oct	Nov	Dec	Jan	1 st 1/2 Feb	2 nd 1/2 Feb	1 st 1/2 Mar	2 nd 1/2 Mar	Apr
	(%)										
High threshold	60	60	80	80	95	95	80	80	80	60	60
Low threshold	60	60	65	70	75	75	70	65	55	0	0

Supply/Demand ratios (annual, irrigation year, seasons)

On any day during the irrigation season, the supply of water available under an allocation rule can be compared with the demand for irrigation on that day. If available supply equals or exceeds demand, reliability is 100%. If demand exceeds supply, reliability is calculated by dividing supply by demand to give a supply/demand ratio.

The daily ratios can be combined into weekly, monthly, seasonal (spring, summer, autumn), irrigation season (September-April) or annual figures. Irrigation season values are often used to indicate the overall reliability of a particular supply.

As a general guide, the following average irrigation season reliability assessments apply:

100%	Very good reliability
94-99%	Good reliability
87-94%	Marginal reliability
<87%	Poor or very poor reliability

5.2 Results

5.2.1 Allocable Flow Method

The current “A” Permit allocation is set at 7.5 cumecs. Appendix B tabulates the number of days of full water availability, partial availability and no availability for an “A” permit allocation of 7.5 cumecs under the existing regime, the Mosley regime and the Amuri regime. Appendix C is the same analysis assuming an “A” allocation block of 10 cumecs.

The current consent (5 cumecs) held by the Balmoral Irrigation Scheme to take water from the Hurunui River utilises a modified allocation regime. Flow sharing is not applied, but to offset this, the minimum flow for each month has been raised by 2 cumecs. Appendix D tabulates the number of days of full water availability, partial availability and no availability for the Balmoral consent of 5 cumecs.

Table 5 shows that as the allocation limit is raised, the reliability of the water available decreases. Although the Mosley regime has significantly higher minimum flows in most months, the removal of the one to one sharing ensures there is little difference between the three allocation regimes until the “A” permit allocation is over 10 cumecs. Above a 10 cumecs allocation block, the removal of the flow sharing means more water is available under the Mosley and Amuri regimes. The existing regime is slightly more reliable than the Mosley regime if the “A” allocation water is less than 7.5 cumecs, and the Mosley regime is more reliable if the “A” allocation water is greater than 7.5 cumecs. The Amuri regime is the most reliable overall and is significantly more reliable than the existing regime when the size of the “A” allocation is greater than 7.5 cumecs.

Table 5: Average water availability (cumecs) for various “A” permit allocation levels

“A” permit allocation	Existing regime (irrigation season ⁽¹⁾)	Mosley regime (irrigation season ⁽¹⁾)	Amuri regime (irrigation season ⁽¹⁾)
2.5	2.47 (99%)	2.42 (97%)	2.46 (98%)
5	4.83 (97%)	4.74 (95%)	4.88 (98%) ⁽²⁾
7.5	6.94 (93%)	6.95 (93%)	7.22 (96%)
10	8.76 (88%)	9.00 (90%)	9.43 (94%)
12.5	10.32 (83%)	10.90 (87%)	11.49 (92%)
15	11.64 (78%)	12.66 (84%)	13.41 (89%)
17.5	12.76 (73%)	14.28 (82%)	15.19 (87%)
20	13.72 (69%)	15.77 (79%)	16.84 (84%)

Notes: 1) The irrigation season is defined as the months September to April inclusive.
2) Represents the existing situation for Amuri Irrigation Co Ltd’s Balmoral scheme.

The impact on the river’s flow duration curve of an allocation block under the existing, Mosley and Amuri regimes is shown in Figure 3 to Figure 5. Each figure assumes a different “A” permit allocation block (5, 7.5 and 10 cumecs). These figures indicate that there is an insignificant difference between the existing and Mosley regime when the “A” permit allocation block is 7.5 cumecs. Similarly there are minor

differences, between the existing and Amuri regimes, particularly in that residual river flows between 12 and 16 cumecs (occurring about 9% of the time) are slightly better protected under the existing regime. When the “A” permit allocation block is 5 cumecs, there are minor differences, particularly in that residual river flows between 12 and 15 cumecs (occurring about 6% of the time) are slightly better protected under the Mosley regime and are less protected under the Amuri regime. When the “A” permit allocation block is 10 cumecs, there are minor differences between the existing and Mosley regimes, particularly in that residual river flows between 15 and 19 cumecs (occurring about 14% of the time) are slightly better protected under the existing regime. The differences are greater between the existing and Amuri regimes, in that the residual river flows between 12 and 20 cumecs (occurring about 18% of the time) are better protected under the existing regime than the Amuri regime.

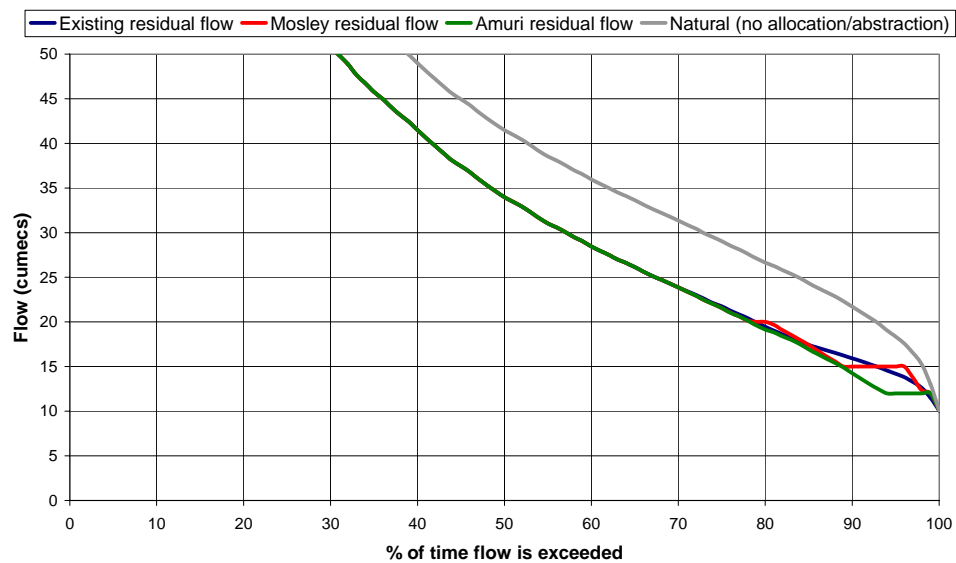


Figure 3: Flow duration curves for natural and residual flow assuming full 7.5 cumec “A” allocation block is abstracted

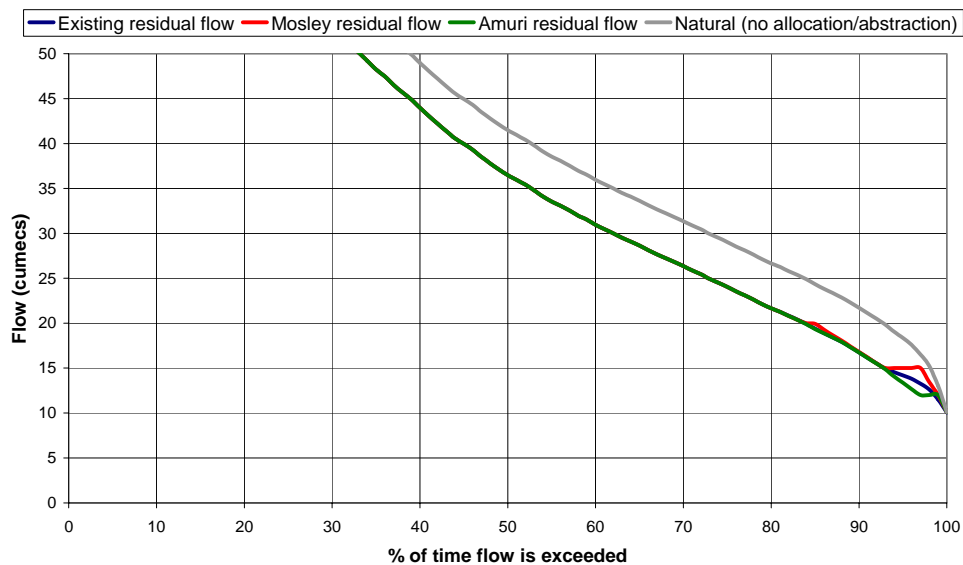


Figure 4: Flow duration curves for natural and residual flow assuming full 5 cumec “A” allocation block is abstracted

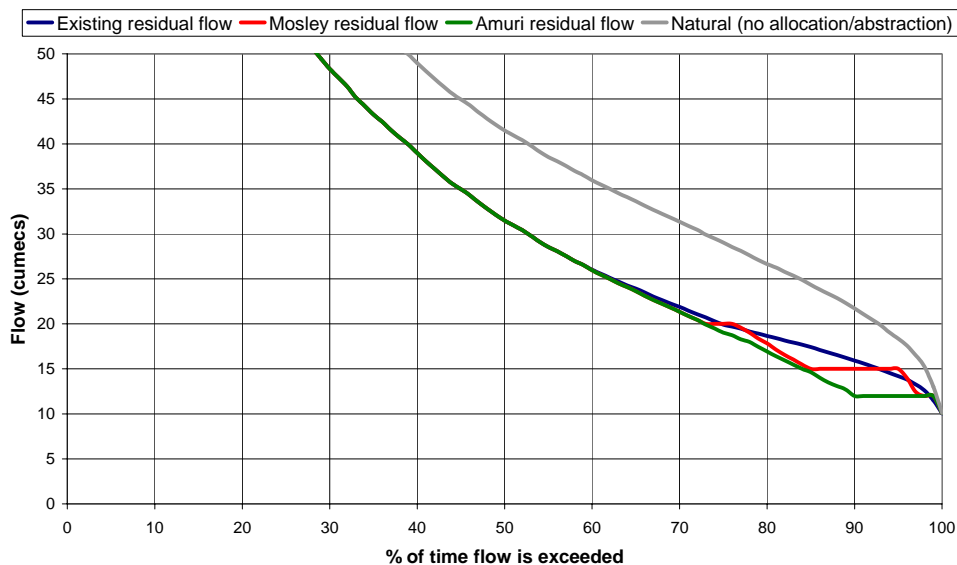


Figure 5: Flow duration curves for natural and residual flow assuming full 10 cumec “A” allocation block is abstracted

5.2.2 Matching Supply with Demand Methods

Table 6 presents results from the nine scenarios that have been modelled: assuming the existing minimum flows and flow sharing with an “A” block of 7.5, 10 and 5.3 cumecs; the Mosley minimum flow regime with an “A” block of 7.5, 10 and 5.3 cumecs; and the flow regime stipulated in Amuri Irrigation Co Ltd’s consent for the Balmoral Scheme with an “A” block of 5, 7.5 and 10 cumecs.

In developing the demand series used in the calculations, it has been assumed that the Amuri Irrigation Co Ltd’s abstraction for the Balmoral Scheme made up the first 5 cumecs of the allocation with the remainder (“A” block allocation - 5 cumecs) being a proportion of the demand series developed for the remaining potentially irrigable areas (Section 3.2 and Table 4).

Table 6: Summary of supply reliability results

Reliability method	Robb reliability bands	Farming experts criteria			Supply/demand ratio (%)				
		Years reliability is above high threshold (out of 31)	Years between high and low thresholds (out of 31)	Years reliability is below low threshold (out of 31)	Mean (average)	Median (middle ranked year)	Minimum (worst year)	Maximum (best year)	1-in-10-year "drought"
Allocation regime									
<i>Balmoral Consent 5</i>									
Spring shoulder (Sep-Oct)	Good	30	0	1	100	100	97	100	100
Peak (Nov-Feb)	Marginal	25	1	5	99	100	87	100	97
Autumn shoulder (Mar-Apr)	Poor	24	3	4	94	100	33	100	66
Full season (Sep-Apr)		23	3	5	98	100	77	100	91
<i>Existing 7.5</i>									
Spring shoulder (Sep-Oct)	Good	29	1	1	99	100	93	100	98
Peak (Nov-Feb)	Marginal	9	10	12	95	98	75	100	88
Autumn shoulder (Mar-Apr)	Poor	19	6	6	93	99	52	100	76
Full season (Sep-Apr)		7	12	12	96	98	77	100	88
<i>Mosley 7.5</i>									
Spring shoulder (Sep-Oct)	Good	30	0	1	99	100	91	100	99
Peak (Nov-Feb)	Marginal	15	5	11	96	99	75	100	89
Autumn shoulder (Mar-Apr)	Poor	17	7	7	88	99	25	100	62
Full season (Sep-Apr)		12	7	12	95	97	71	100	86
<i>Amuri 7.5</i>									
Spring shoulder (Sep-Oct)	Good	30	0	1	100	100	96	100	100
Peak (Nov-Feb)	Marginal	22	3	6	98	100	83	100	95
Autumn shoulder (Mar-Apr)	Poor	24	3	4	93	100	31	100	64
Full season (Sep-Apr)		22	3	6	97	99	74	100	90
<i>Existing 10</i>									
Spring shoulder (Sep-Oct)	Good	29	0	2	99	100	90	100	97
Peak (Nov-Feb)	Marginal	3	6	22	91	93	66	100	82
Autumn shoulder (Mar-Apr)	Poor	17	5	9	91	96	49	100	73
Full season (Sep-Apr)		2	7	22	93	96	73	100	83
<i>Mosley 10</i>									
Spring shoulder (Sep-Oct)	Good	29	0	2	99	100	88	100	97
Peak (Nov-Feb)	Marginal	8	6	17	94	97	68	100	85
Autumn shoulder (Mar-Apr)	Poor	17	5	9	87	97	25	100	62
Full season (Sep-Apr)		5	9	17	94	96	68	100	84
<i>Amuri 10</i>									
Spring shoulder (Sep-Oct)	Good	29	1	1	100	100	94	100	99
Peak (Nov-Feb)	Marginal	15	7	9	97	99	79	100	92
Autumn shoulder (Mar-Apr)	Poor	21	4	6	92	100	30	100	64
Full season (Sep-Apr)		15	7	9	96	99	72	100	88
<i>Existing 5.3</i>									
Spring shoulder (Sep-Oct)	Good	30	0	1	100	100	96	100	100
Peak (Nov-Feb)	Marginal	22	3	6	98	100	84	100	95
Autumn shoulder (Mar-Apr)	Poor	24	3	4	95	100	63	100	90
Full season (Sep-Apr)		22	3	6	98	100	83	100	92
<i>Mosley 5.3</i>									
Spring shoulder (Sep-Oct)	Good	30	0	1	100	100	95	100	100
Peak (Nov-Feb)	Marginal	18	3	10	98	100	81	100	93
Autumn shoulder (Mar-Apr)	Poor	18	7	6	90	100	25	100	63
Full season (Sep-Apr)		15	6	10	96	98	73	100	88

5.3 Discussion on “A” Permit Reliability

Results from the reliability modelling indicate that the reliability from the Hurunui is good in spring, marginal in the peak summer season, and poor in autumn. Increasing or decreasing the “A” permit block size (from the current 7.5 cumec block) does have some effects on the reliability of abstractions but not enough to change the overall Robb reliability band. If the scenarios modelled are ranked from “highest” to “lowest” reliability, the “Balmoral consent” and the “Existing 5.3” are the most reliable and the “Existing 10” scenario the least reliable:

“highest”	Balmoral consent and Existing 5.3
	Amuri 7.5
Increasing reliability ▲	Amuri 10
	Mosley 5.3
	Existing 7.5
Decreasing reliability ▼	Mosley 7.5
	Mosley 10
“lowest”	Existing 10

Note though, there is not a great difference between the “best” and “worst” scenarios. The Hurunui River is fundamentally unreliable in late summer/autumn, and the block size is not the most critical factor contributing to this. The reliability is predominantly driven by the hydrological characteristics of the catchment and the minimum flows.

Storage required to meet 100% of “A” permit demand

In order to meet “A” permit irrigation demand 100% of the time, some storage would be required, particularly in a few key years and predominantly in the late summer/autumn. Figure 6 and Figure 7 show the storage required to meet demand 100% of the time for an “A” block of 7.5 cumecs and an “A” block of 10 cumecs under the Mosley regime. They show that the peak storage required over the period analysed is 36.5 MCM for the 7.5 cumec block (4.9 MCM per cumec) and 50 MCM for the 10 cumec block. (5 MCM per cumec). The storage per unit rate of take is not significantly greater for the larger allocation block, indicating that an increase in block size to 10 cumecs would not adversely affect the ability of an existing “A” permit user to improve their reliability through storage.

Figure 6 and Figure 7 show that there are approximately six to eight seasons of the 31 modelled years where significant storage is required. This averages about one every four or five years. It is unlikely for most pastoral farming enterprises that investing in storage capacity for events less frequent than this would be economic. Table 7 summarises the storage requirements to meet “A” permit demand for a block size of 10 cumecs. The use of mitigating methods such as storing or buying in additional feed to manage the water restrictions would, in most circumstances, be more economic.

To give an indication of the size of these storage volumes, 30 MCM is equivalent to an area of 300 ha covered by 10 metres of water.

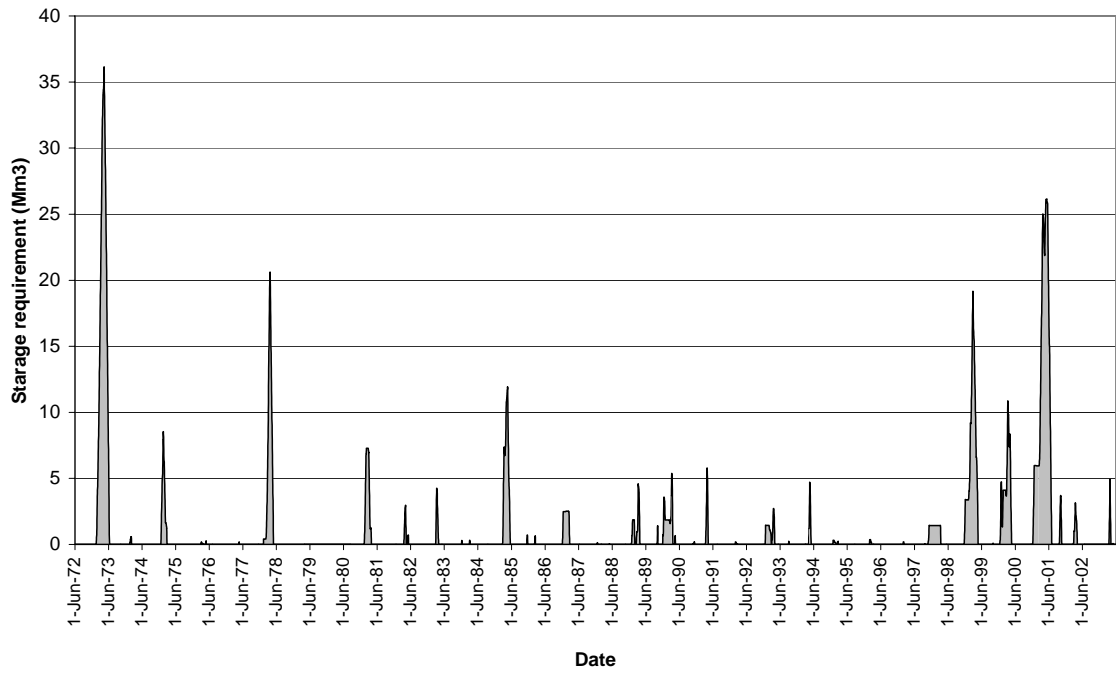


Figure 6: Storage required to meet demand 100% of the time for an “A” block size of 7.5 cumecs under the Mosley regime.

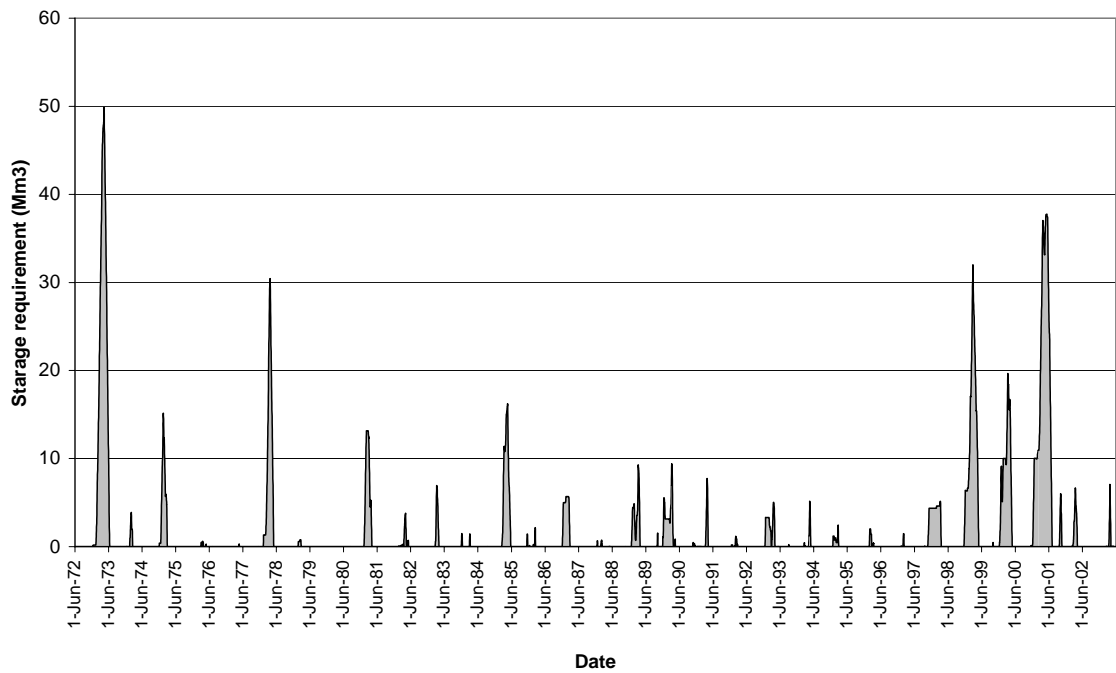


Figure 7: Storage required to meet demand 100% of the time for an “A” block size of 10 cumecs under the Mosley regime.

Table 7: Storage requirements to meet “A” permit demand (10 cumec block size) under the Mosley regime

	Storage needed (MCM)	Storage per hectare ⁽¹⁾ (m ³)	Duration assuming peak demand (days)
To meet all demand in 31 years of record	50	2,500	58
To meet all demand 9 years in 10	30	1,500	35
To meet all demand 4 years in 5	15	750	17

Note: (1) Assumes the peak demand is 0.5 ℓ/s/ha.

Balancing individual benefit with wider economic benefits

Both the Regional Policy Statement (RPS) and Draft NRRP refer to the need to balance the needs of an individual to maintain a viable economic enterprise and the wider needs of the community to maximise the benefits of the water allocated (Appendix E).

While seeking adequate reliability, the aim is to distribute the resource to the best advantage of the wider community. This may mean that in order to spread the resource more widely and make it available to more users, an existing individual’s reliability of supply may be less than what they consider they need to maximise their long-term production potential. However, whilst aiming to maximise community benefit, the aim is also to ensure that their long-term economic viability is not compromised by setting an “A” permit block too high.

A detailed economic analysis on-farm and district-wide would be required to find the optimal block size. Economic circumstances continuously fluctuate, which means the optimal level would probably also fluctuate to a certain degree.

In the absence of this detailed economic information, it is considered that there is justification in raising the “A” permit block size from 7.5 to 10 cumecs. Although this slightly reduces the reliability to existing users, it allows for expansion and greater community benefit. The existing reliability is already marginal or poor later in the irrigation season, and a slight further reduction in reliability is considered acceptable, given the increased benefit by allowing a further 2.5 cumec allocation or approximately 5,000 ha of further irrigation (at 0.5 ℓ/s/ha).

It is likely that farmers already use a variety of methods, such as storing or buying in additional feed, to manage the water restrictions that may be imposed later in the season.

Is the modelled data from 1972 to 2003 representative?

Although river flow data for the Hurunui River goes back to 1957, limitations in climate data mean that the demand time series starts in 1972. The underlying assumption in this type of modelling is that as long as the period of record used is sufficiently long, then the period modelled will be representative of a similar period of time in the future. However, Mosley discusses a trend of increasing mean flow and minimum annual flow. He suggests it could be associated with global warming or the

effects of the Pacific Decadal Oscillation. This can be seen in the flow duration curves presented in Appendix F.

Global warming scenarios suggest the potential for increased westerly airflows over New Zealand leading to warmer and drier conditions in the drought-prone east coast areas. An increase in the incidence or duration of north-westerly winds could also increase flows in the rivers whose headwaters capture north-west rain. Climate change will therefore affect both the demand for irrigation water and the capacity of the water resources to meet that demand. A Lincoln Environmental study for MAF analysed the potential effects of climate change on water usage and availability in three areas of New Zealand – Rangitata, Motueka, and Ruataniwha Plains (LE, 2001c). The Hurunui would be expected to behave more similar to the Rangitata example.

Results of this study show that:

- Potential evapotranspiration is consistently higher across all months. However, more frequent rain in the spring and autumn leads to a significant reduction in irrigation demand at the beginning and end of the irrigation season. Peak irrigation demand increases by about 10%, which implies the consented maximum rate of water take for irrigation will need to be increased by 10%. Demand on water resources will probably become more intense but over a shorter period of time.
- River flow generally increases in rivers from the main South Island catchments that respond to north-westerly rain. In general, it appears that water supply shortfalls for irrigation will reduce in frequency and magnitude for a river, such as the Hurunui, that capture a lot of rain from the north-west.

The Pacific Decadal Oscillation appears to shift between regimes approximately every 20-25 years. A shift occurred around 1978 to wetter years, and a return shift to drier years may have occurred in the last few years. If linked with the Pacific Decadal Oscillation, it is suggested that we may be entering a prolonged period of predominantly lower flows. If this is the case, the years modelled may not be as representative of expected conditions in the next two decades.

6 ABILITY TO MEET POTENTIAL WATER DEMAND WITH “B” PERMIT WATER

If it is assumed that the “A” allocation block size is raised to 10 cumecs, then there is a further 11.3 cumec peak potential demand to irrigate the remaining irrigable land in the Hurunui catchment.

At this stage, it is not critical to cap the “B” permit allocation block. However, it is useful to identify the ability of “B” permit water to meet the potential future demand and identify the approximate storage volumes that would be required.

Figure 8 shows the storage requirements to meet demand 100% of the time for a “B” block size of 11.3 cumecs. The analysis assumes the ability to utilise the unused “A” permit allocation in the off-season (May to August). It illustrates that there is enough available water to satisfy the future water demand from the catchment without requiring storage capacities which rely on carrying water over from year to year.

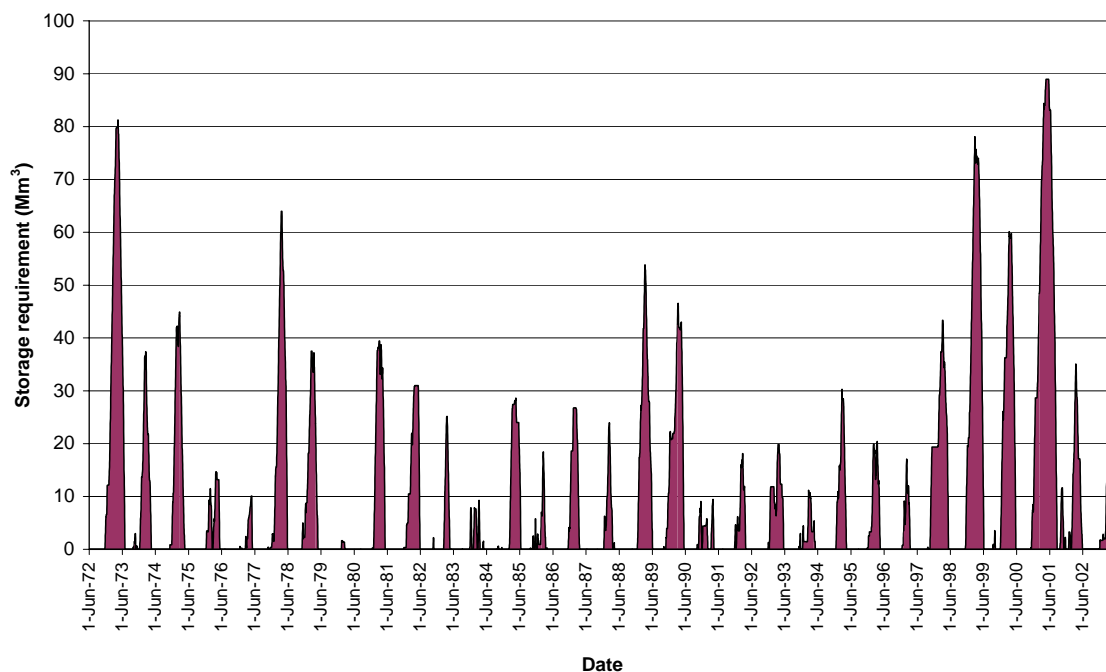


Figure 8: Storage required to meet future water demand (11.3 cumecs) 100% of the time with a “B” block size of 11.3 cumecs under the Mosley regime

Table 8 summarises the storage requirements to meet all “B” permit demand (11.3 cumecs) in the 31 years of record, 9 years out of 10, and 4 years out of 5. It indicates that the storage requirements are significantly higher than for the “A” permit water.

Table 8: Storage requirements to meet “B” permit demand (11.3 cumec block size) under the Mosley regime

	Storage needed (MCM)	Storage per hectare ⁽¹⁾ (m ³)	Duration assuming peak demand (days)
To meet all demand in 31 years of record	90	4,000	93
To meet all demand 9 years in 10	65	2,900	67
To meet all demand 4 years in 5	48	2,100	49

Note: (1) Assumes the peak demand is 0.5 l/s/ha.

Under this “B” block size (11.3 cumecs), there is potentially water available to “export” from the catchment, for example, to provide for increased water demand or augment river flows in the Waipara catchment. Figure 9 illustrates the storage required to meet 100% of “B” permit demand if the peak water demand is 2 cumecs larger (i.e. 13.3 cumecs) and assumes the “B” block size remains at 11.3 cumecs.

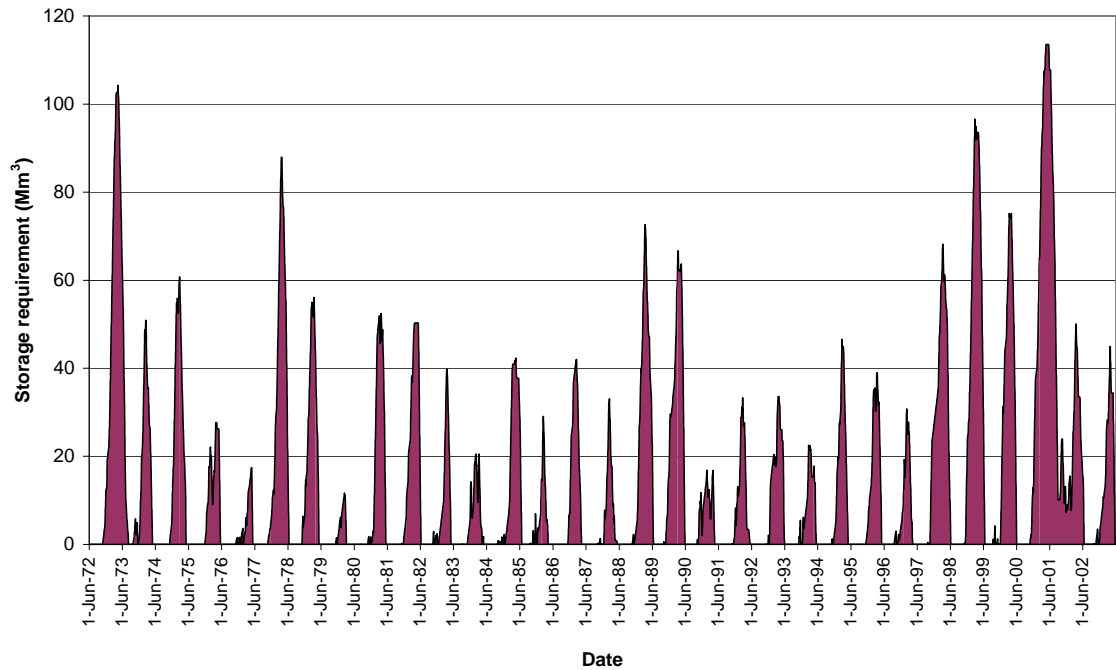


Figure 9: Storage required to meet extended future water demand (13.3 cumecs) 100% of the time with a “B” block size of 11.3 cumecs under the Mosley regime

7 EFFECT OF WATER DEMAND ON FLOODS AND FRESHES

Flow variability is an important environmental characteristic of most river systems. By removing the flow sharing regime above the minimum flow, there is a greater potential to reduce flow variability and thereby “flat line” the river’s flow for long periods of time. However, Mosley indicates that a run of river take of 15 cumecs is likely to have little effect on the important floods and freshes under the proposed minimum flows.

Appendix G illustrates the impact a 10 cumec “A” allocation block combined with a “B” block of 11.3 cumecs would have on the Hurunui River flows for each of the last 10 years (1 June 1993 to 31 May 2003) under the Mosley regime. The analysis assumes that all the demand is met, firstly from run-of-river water if available, and secondly from storage if unavailable from the river on that day. Water from the river is used to replenish storage at the first availability. The analysis assumes the ability to utilise the unused “A” permit allocation in the off-season (May to August) to replenish storage.

The figures in Appendix G indicate that there is generally little or no effect on floods and freshes in the winter and spring. This is due to the limited demand from the river in winter and the fact that floods and freshes tend to be larger at this time of the year. The 2001 winter season appears to be an exception to this. In this year, replenishment of storage was needed well into the winter due to extended low flows and high

demand in the previous irrigation season, and with low winter river flows, the small freshes are noticeably affected during the 2001 winter.

During most summer and autumn seasons, many of the small freshes less than approximately 60 cumecs are reduced appreciably. However, in nearly all circumstances, there is still some variation in flow. As freshes increase over 60 cumecs, the actual reduction in flow may still be around 20 cumecs; but as a proportion of actual flow, the effects become significantly less pronounced. For floods or freshes over 100 cumecs, it is unlikely that the different flow regimes would be noticed by an observer in or on the river.

This analysis could be considered somewhat conservative, as it has been undertaken on mean daily flow data. Actual instantaneous flow hydrographs would show greater variations than the hydrographs presented.

8 CONCLUSIONS AND RECOMMENDATIONS

The maximum authorised abstraction rate for all surface water bodies in the Hurunui catchment is 10.454 cumecs, of which 0.794 cumecs is due to pumping from hydraulically connected groundwater. The total consented take for the main stem of the Hurunui River is 7.545 cumecs. As the current "A" permit block size for the main stem of the Hurunui is 7.5 cumecs, the "A" permits are currently fully allocated. Nearly all the consented water is taken for the purpose of irrigation. The largest take (5 cumecs) is by the Amuri Irrigation Co Ltd for the Balmoral Irrigation Scheme.

Modelling irrigation demand for irrigable land that is currently unirrigated indicates that the total potential peak demand from the catchment would be approximately 21.3 cumecs. This is based on the status quo for the existing irrigated areas and assumes irrigation development on 80% of irrigable land, including land currently occupied by the Balmoral and Medbury Forests.

There is enough water available from the Hurunui River under the proposed allocation regime to meet the future demand, although water restrictions, particularly in late summer and autumn, mean water storage would be required to ensure good supply reliability.

The Hurunui River is fundamentally unreliable for abstractive users in late summer/autumn, but the block size is not the most critical factor contributing to this. The reliability is predominantly driven by the hydrological characteristics of the catchment and the minimum flows. It therefore seems reasonable to recommend increasing the "A" permit block size to 10 cumecs. The existing users are able to manage the current level of restrictions imposed on them, and increasing the "A" permit block size from 7.5 to 10 cumecs will only further decrease their reliability slightly. However, it will make further water available to new users.

The consent conditions that Amuri Irrigation Co Ltd's Balmoral Irrigation Scheme take operates under are inherently more reliable than both the existing regime and the proposed regime. A change to the Mosley minimum flow regime will therefore more significantly affect the reliability of this take than the other existing users.

To meet a 10 cumec “A” permit irrigation demand 100% of the time, some storage would be required, particularly in a few key years and predominantly in the late summer/autumn. Under the Mosley regime storage volumes of 50 MCM are needed to meet full demand in all years, or 30 MCM to meet full demand 9 years in 10, or 15 MCM needed to meet full demand 4 years in 5.

To meet an 11.3 cumec “B” permit irrigation demand 100% of the time, more significant storage would be required in most years. Under the Mosley regime storage volumes of 90 MCM are needed to meet full demand in all years, or 65 MCM to meet full demand 9 years in 10, or 48 MCM needed to meet full demand 4 years in 5.

Under this “B” block size (11.3 cumecs), there is potentially water available to “export” from the catchment, for example, to provide for increased water demand or augment river flows in the Waipara catchment.

It may not be critical to set a “B” allocation block at present, but it is still recommended that a “B” permit block size of 10 cumecs is set. Although it is unlikely that this block would be used substantially in the short term, it sends a clear signal that there is further water available at a lower reliability (and without compromising instream values), and indicates allocation has been put aside to meet the potential future demands of the area.

The recently completed assessment of instream values and flow regimes for the Waiau River (Mosley, 2004) indicates that there is opportunity for further abstractive water use from the Waiau. To minimise storage requirements and reduce effects on the Hurunui, it may therefore be more appropriate to investigate options for utilising additional Waiau water in the Hurunui catchment in order to free up water to be “exported” to demand areas south of the Hurunui catchment. An assessment of water demand and availability in the Waiau catchment would be a prerequisite of any further work in this regard.

On a per hectare basis, the Balmoral Scheme’s peak and seasonal water demand is 1.9 and 2.5 times (respectively) the modelled demand for the remaining area, indicating that the Balmoral Irrigation Scheme has a considerably larger water demand per hectare than a typical spray system. This is largely a function of applying water under a border-dyke system and the inefficiencies and operating limitations of an open race distribution network.

Further improvements in irrigation management practices for all irrigation systems are likely to occur if costly storage schemes are developed. This could include variable depth application systems to apply no more than is required and deficit irrigation practices in order to make best use out of rain that falls during the irrigation season. This could potentially reduce the storage volume required, or for the same storage, either increase the area able to be irrigated or improve the supply reliability.

The analysis in this report assumes that all water once abstracted from the Hurunui is completely consumed. In reality, irrigation cannot be completely efficient, and there will always be an increase in drainage under irrigated farmland compared with dryland farming. This drainage will increase the flows in the lowland streams, which will eventually return to the Hurunui River or could be available for abstraction, thus reducing the pressure on the main stem of the river.

It should be noted that although the analysis undertaken in this study has used 31 years of historic water demand and availability conditions, due to either global warming or the Pacific Decadal Oscillation, the years modelled here may not necessarily be wholly representative of future conditions.

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Appendix A: Calculation of the “A” permit block size using NRRP policy WQN14 (5)

Season	Existing regime 4.3 cumec block		Mosley regime 5.3 cumec block		Amuri consent (Balmoral scheme) regime 6.5 cumec block	
	Days of full allocation in season	% of days of full allocation	Days of full allocation in season	% of days of full allocation	Days of full allocation in season	% of days of full allocation
1972-73	103	68.2	99	65.6	104	68.9
1973-74	151	100.0	151	100.0	151	100.0
1974-75	142	94.0	129	85.4	142	94.0
1975-76	151	100.0	149	98.7	151	100.0
1976-77	151	100.0	151	100.0	151	100.0
1977-78	117	77.5	118	78.1	117	77.5
1978-79	151	100.0	151	100.0	151	100.0
1979-80	151	100.0	151	100.0	151	100.0
1980-81	136	90.1	133	88.1	137	90.7
1981-82	151	100.0	151	100.0	151	100.0
1982-83	139	92.1	141	93.4	140	92.7
1983-84	151	100.0	151	100.0	151	100.0
1984-85	134	88.7	133	88.1	134	88.7
1985-86	145	96.0	147	97.4	145	96.0
1986-87	151	100.0	144	95.4	151	100.0
1987-88	151	100.0	151	100.0	151	100.0
1988-89	139	92.1	135	89.4	139	92.1
1989-90	140	92.7	131	86.8	141	93.4
1990-91	149	98.7	144	95.4	149	98.7
1991-92	148	98.0	146	96.7	148	98.0
1992-93	151	100.0	141	93.4	151	100.0
1993-94	151	100.0	147	97.4	151	100.0
1994-95	148	98.0	144	95.4	148	98.0
1995-96	151	100.0	151	100.0	151	100.0
1996-97	151	100.0	151	100.0	151	100.0
1997-98	147	97.4	146	96.7	147	97.4
1998-99	118	78.1	111	73.5	119	78.8
1999-00	131	86.8	121	80.1	131	86.8
2000-01	125	82.8	113	74.8	125	82.8
2001-02	140	92.7	144	95.4	140	92.7
2002-03	151	100.0	151	100.0	151	100.0
No of years full allocation 95% of the time (out of 31)		19		19		19
No of years full allocation 75% of the time (out of 31)		30		28		30

Appendix B: The number of days of water availability for an “A” permit allocation of 7.5 cumecs under the existing, Mosley and Amuri regimes

Note: This method does not consider the seasonal variations in water demand. It assumes the need for water equals the full allocation throughout the whole season.

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1972-73	Days of full availability - existing	22	31	14	30	31	30	28	12	0	0	14	31	243
	Days of partial availability - existing	8	0	17	0	0	0	3	19	28	31	16	0	122
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	27	31	28	30	31	30	26	17	0	0	15	31	266
	Days of partial availability - Mosley	3	0	3	0	0	0	5	14	28	0	0	0	53
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	31	15	0	46
	Days of full availability Amuri	30	31	31	30	31	30	31	24	0	0	15	31	284
	Days of partial availability - Amuri	0	0	0	0	0	0	0	7	28	31	6	0	72
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	9	0	9
1973-74	Days of full availability - existing	30	8	26	30	30	30	31	17	22	27	30	31	312
	Days of partial availability - existing	0	23	5	0	1	0	0	14	6	4	0	0	53
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	10	26	30	31	30	31	24	27	30	30	31	330
	Days of partial availability - Mosley	0	21	5	0	0	0	0	7	1	1	0	0	35
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	17	27	30	31	30	31	31	27	31	30	31	346
	Days of partial availability - Amuri	0	14	4	0	0	0	0	0	1	0	0	0	19
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1974-75	Days of full availability - existing	27	31	31	30	31	30	23	10	19	31	30	31	324
	Days of partial availability - existing	3	0	0	0	0	0	8	21	9	0	0	0	41
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	22	12	28	31	30	31	337
	Days of partial availability - Mosley	0	0	0	0	0	0	9	19	0	0	0	0	28
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	30	17	28	31	30	31	350
	Days of partial availability - Amuri	0	0	0	0	0	0	1	14	0	0	0	0	15
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1975-76	Days of full availability - existing	30	31	31	30	31	30	31	31	29	13	5	30	322
	Days of partial availability - existing	0	0	0	0	0	0	0	0	0	18	25	1	44
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	31	29	22	8	31	335
	Days of partial availability - Mosley	0	0	0	0	0	0	0	0	0	9	20	0	29
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	2	0	2
	Days of full availability Amuri	30	31	31	30	31	30	31	31	29	31	15	31	351
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	15	0	15
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1976-77	Days of full availability - existing	30	31	31	30	24	30	31	31	27	19	1	29	314
	Days of partial availability - existing	0	0	0	0	7	0	0	0	1	12	29	2	51
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	30	30	31	31	28	25	2	31	330
	Days of partial availability - Mosley	0	0	0	0	1	0	0	0	0	6	28	0	35
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	28	31	26	31	361
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	4	0	4
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1977-78	Days of full availability - existing	30	31	15	17	31	30	31	26	0	5	28	25	269
	Days of partial availability - existing	0	0	16	13	0	0	0	5	28	26	2	6	96
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	25	17	31	30	31	28	7	5	30	28	293
	Days of partial availability - Mosley	0	0	6	13	0	0	0	3	21	3	0	3	49
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	23	0	0	23
	Days of full availability Amuri	30	31	31	27	31	30	31	31	7	6	30	31	316
	Days of partial availability - Amuri	0	0	0	3	0	0	0	0	21	11	0	0	35
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	14	0	0	14
1978-79	Days of full availability - existing	30	31	31	30	31	27	31	27	19	27	30	31	345
	Days of partial availability - existing	0	0	0	0	0	3	0	4	9	4	0	0	20
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	30	28	31	30	31	364
	Days of partial availability - Mosley	0	0	0	0	0	0	0	1	0	0	0	0	1
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1979-80	Days of full availability - existing	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-81	Days of full availability - existing	30	31	27	30	31	30	31	8	17	20	25	31	311
	Days of partial availability - existing	0	0	4	0	0	0	0	23	11	11	5	0	54
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	10	24	23	27	31	329
	Days of partial availability - Mosley	0	0	0	0	0	0	0	21	4	8	3	0	36
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	17	24	30	30	31	346
	Days of partial availability - Amuri	0	0	0	0	0	0	0	14	4	1	0	0	19
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1981-82	Days of full availability - existing	30	28	24	26	31	30	31	30	19	11	0	21	281
	Days of partial availability - existing	0	3	7	4	0	0	0	1	9	20	30	10	84
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	28	26	31	30	31	31	28	17	1	22	306
	Days of partial availability - Mosley	0	0	3	4	0	0	0	0	0	14	21	2	44
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	8	7	15
	Days of full availability Amuri	30	31	31	30	31	30	31	31	28	20	7	23	323
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	11	23	8	42
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1982-83	Days of full availability - existing	22	19	31	30	25	30	31	31	16	10	30	31	306
	Days of partial availability - existing	8	12	0	0	6	0	0	0	12	21	0	0	59
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	24	21	31	30	31	30	31	31	25	14	30	31	329
	Days of partial availability - Mosley	6	10	0	0	0	0	0	0	3	17	0	0	36
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	25	31	30	31	30	31	31	25	18	30	31	343
	Days of partial availability - Amuri	0	6	0	0	0	0	0	0	3	13	0	0	22
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1983-84	Days of full availability - existing	30	31	31	30	31	30	29	31	25	22	17	31	338
	Days of partial availability - existing	0	0	0	0	0	0	2	0	4	9	13	0	28
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	28	31	29	28	23	31	353
	Days of partial availability - Mosley	0	0	0	0	0	0	3	0	0	3	7	0	13
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1984-85	Days of full availability - existing	30	31	31	30	22	30	31	31	10	0	7	5	258
	Days of partial availability - existing	0	0	0	0	9	0	0	0	18	31	23	26	107
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	31	21	0	9	7	282
	Days of partial availability - Mosley	0	0	0	0	0	0	0	0	7	23	2	24	56
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	8	19	0	27
	Days of full availability Amuri	30	31	31	30	31	30	31	31	21	0	10	17	293
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	7	31	9	14	61
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	11	0	11
1985-86	Days of full availability - existing	26	31	29	28	21	18	31	29	14	23	28	30	308
	Days of partial availability - existing	4	0	2	2	10	12	0	2	14	8	2	1	57
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	26	31	31	28	26	22	31	31	22	27	30	31	336
	Days of partial availability - Mosley	4	0	0	2	5	8	0	0	6	4	0	0	29
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	28	31	31	30	29	26	31	31	22	31	30	31	351
	Days of partial availability - Amuri	2	0	0	0	2	4	0	0	6	0	0	0	14
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1986-87	Days of full availability - existing	30	29	31	30	31	30	22	26	28	31	30	31	349
	Days of partial availability - existing	0	2	0	0	0	0	9	5	0	0	0	0	16
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	21	29	28	31	30	31	353
	Days of partial availability - Mosley	0	0	0	0	0	0	10	2	0	0	0	0	12
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1987-88	Days of full availability - existing	30	31	31	30	31	27	30	28	14	31	18	22	323
	Days of partial availability - existing	0	0	0	0	0	3	1	3	15	0	12	9	43
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	29	30	28	31	20	22	343
	Days of partial availability - Mosley	0	0	0	0	0	0	2	1	1	0	10	7	21
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	2	2
	Days of full availability Amuri	30	31	31	30	31	30	31	31	28	31	23	23	350
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	1	0	7	8	16
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1988-89	Days of full availability - existing	30	31	31	30	31	30	27	19	8	19	25	13	294
	Days of partial availability - existing	0	0	0	0	0	0	4	12	20	12	5	18	71
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	27	25	19	21	27	19	321
	Days of partial availability - Mosley	0	0	0	0	0	0	4	6	9	10	3	12	44
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	28	19	24	30	25	340
	Days of partial availability - Amuri	0	0	0	0	0	0	0	3	9	7	0	6	25
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1989-90	Days of full availability - existing	29	27	15	20	23	22	22	31	11	12	15	31	258
	Days of partial availability - existing	1	4	16	10	8	8	9	0	17	19	15	0	107
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	24	22	24	26	21	31	23	14	18	31	295
	Days of partial availability - Mosley	0	0	7	8	6	4	10	0	5	17	12	0	69
	Days of no availability - Mosley	0	0	0	0	1	0	0	0	0	0	0	0	1
	Days of full availability Amuri	30	31	30	30	24	29	28	31	23	18	24	31	329
	Days of partial availability - Amuri	0	0	1	0	7	1	3	0	5	13	6	0	36
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1990-91	Days of full availability - existing	28	21	31	18	15	17	31	31	28	5	28	25	278
	Days of partial availability - existing	2	10	0	12	16	13	0	0	0	26	2	6	87
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	29	31	19	24	25	31	31	28	8	28	30	314
	Days of partial availability - Mosley	0	2	0	11	7	5	0	0	0	23	2	1	51
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	29	26	27	31	31	28	13	29	31	337
	Days of partial availability - Amuri	0	0	0	1	5	3	0	0	0	18	1	0	28
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1991-92	Days of full availability - existing	29	19	31	30	29	30	31	27	21	21	13	7	288
	Days of partial availability - existing	1	12	0	0	2	0	0	4	8	10	17	24	78
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	28	31	30	31	30	31	29	28	22	15	9	314
	Days of partial availability - Mosley	0	3	0	0	0	0	0	2	1	9	15	22	52
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	28	26	21	15	335
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	1	5	9	16	31
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1992-93	Days of full availability - existing	15	29	31	30	31	30	25	31	24	1	17	16	280
	Days of partial availability - existing	15	2	0	0	0	0	6	0	4	30	13	15	85
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	19	29	31	30	31	30	24	31	28	5	19	19	296
	Days of partial availability - Mosley	11	2	0	0	0	0	7	0	0	26	11	8	65
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	4	4
	Days of full availability Amuri	24	31	31	30	31	30	31	31	28	15	24	22	328
	Days of partial availability - Amuri	6	0	0	0	0	0	0	0	0	16	6	9	37
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1993-94	Days of full availability - existing	29	29	8	22	27	24	31	31	15	16	7	19	258
	Days of partial availability - existing	1	2	23	8	4	6	0	0	13	15	23	12	107
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	29	31	14	23	31	27	31	31	28	20	8	23	296
	Days of partial availability - Mosley	1	0	17	4	0	3	0	0	0	11	17	8	61
	Days of no availability - Mosley	0	0	0	3	0	0	0	0	0	0	5	0	8
	Days of full availability Amuri	30	31	19	27	31	30	31	31	28	27	10	27	322
	Days of partial availability - Amuri	0	0	12	3	0	0	0	0	0	4	20	4	43
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1994-95	Days of full availability - existing	30	31	31	30	31	30	29	28	11	21	30	30	332
	Days of partial availability - existing	0	0	0	0	0	0	2	3	17	10	0	1	33
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	28	31	23	21	30	31	347
	Days of partial availability - Mosley	0	0	0	0	0	0	3	0	5	10	0	0	18
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	23	25	30	31	354
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	5	6	0	0	11
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1995-96	Days of full availability - existing	30	29	27	30	31	30	31	24	25	19	29	31	336
	Days of partial availability - existing	0	2	4	0	0	0	0	7	4	12	1	0	30
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	29	30	31	30	31	27	29	26	30	31	355
	Days of partial availability - Mosley	0	0	2	0	0	0	0	4	0	5	0	0	11
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1996-97	Days of full availability - existing	30	31	31	30	31	30	31	25	25	31	28	24	347
	Days of partial availability - existing	0	0	0	0	0	0	0	6	3	0	2	7	18
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	28	28	31	30	31	362
	Days of partial availability - Mosley	0	0	0	0	0	0	0	3	0	0	0	0	3
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1997-98	Days of full availability - existing	28	31	29	15	21	23	31	27	22	28	30	23	308
	Days of partial availability - existing	2	0	2	15	10	7	0	4	6	3	0	8	57
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	16	26	23	31	31	28	30	30	29	336
	Days of partial availability - Mosley	0	0	0	14	5	7	0	0	0	1	0	2	29
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	30	27	31	31	28	31	30	31	361
	Days of partial availability - Amuri	0	0	0	0	1	3	0	0	0	0	0	0	4
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1998-99	Days of full availability - existing	27	31	31	30	31	19	25	8	3	18	24	27	274
	Days of partial availability - existing	3	0	0	0	0	11	6	23	25	13	6	4	91
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	23	25	13	5	22	28	31	300
	Days of partial availability - Mosley	0	0	0	0	0	7	6	18	23	9	2	0	65
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	26	31	21	5	28	30	31	325
	Days of partial availability - Amuri	0	0	0	0	0	4	0	10	23	3	0	0	40
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1999-00	Days of full availability - existing	30	31	26	27	27	30	18	14	12	3	26	29	273
	Days of partial availability - existing	0	0	5	3	4	0	13	17	17	28	4	2	93
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	28	27	30	16	18	24	5	27	31	298
	Days of partial availability - Mosley	0	0	0	2	4	0	15	13	5	23	3	0	65
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	3	0	0	3
	Days of full availability Amuri	30	31	31	30	28	30	29	24	24	9	28	31	325
	Days of partial availability - Amuri	0	0	0	0	3	0	2	7	5	22	2	0	41
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
2000-01	Days of full availability - existing	30	21	31	30	31	22	15	22	5	3	7	11	228
	Days of partial availability - existing	0	10	0	0	0	8	16	9	23	28	23	20	137
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	27	14	31	15	3	11	11	265
	Days of partial availability - Mosley	0	0	0	0	0	3	17	0	13	1	18	5	57
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	27	1	15	43
	Days of full availability Amuri	30	31	31	30	31	30	31	31	15	3	16	12	291
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	13	7	14	19	53
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	21	0	0	21

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
2001-02	Days of full availability - existing	20	18	31	5	12	30	31	31	1	18	16	7	220
	Days of partial availability - existing	10	13	0	25	19	0	0	0	27	13	14	24	145
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	21	25	31	7	20	30	31	31	17	21	18	10	262
	Days of partial availability - Mosley	9	6	0	23	11	0	0	0	11	10	12	21	103
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	24	31	31	29	22	30	31	31	17	24	30	21	321
	Days of partial availability - Amuri	6	0	0	1	9	0	0	0	11	7	0	10	44
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
2002-03	Days of full availability - existing	22	31	31	28	31	30	31	31	18	13	13	30	309
	Days of partial availability - existing	8	0	0	2	0	0	0	0	10	18	17	1	56
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	22	31	31	28	31	30	31	31	28	16	15	30	324
	Days of partial availability - Mosley	8	0	0	2	0	0	0	0	0	15	15	1	41
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	25	31	31	30	31	30	31	31	28	21	20	30	339
	Days of partial availability - Amuri	5	0	0	0	0	0	0	0	0	10	10	1	26
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Days of full availability - existing		864	866	860	836	865	859	882	779	517	529	631	764	9252
Total Days of partial availability - existing		66	95	101	94	96	71	79	182	358	432	299	197	2070
Total Days of no availability - existing		0	0	0	0	0	0	0	0	0	0	0	0	0
Total Days of full availability - Mosley		888	917	918	844	921	893	870	847	732	611	679	817	9937
Total Days of partial availability - Mosley		42	44	43	83	39	37	91	114	143	258	201	116	1211
Total Days of no availability - Mosley		0	0	0	3	1	0	0	0	0	92	50	28	174
Total Days of full availability Amuri		911	941	944	922	934	915	955	906	732	710	778	866	10514
Total Days of partial availability - Amuri		19	20	17	8	27	15	6	55	143	216	132	95	753
Total Days of no availability - Amuri		0	0	0	0	0	0	0	0	0	35	20	0	55
Average Days of full availability – existing		27.9	27.9	27.7	27.0	27.9	27.7	28.5	25.1	16.7	17.1	20.4	24.6	298.5
Average Days of partial availability - existing		2.1	3.1	3.3	3.0	3.1	2.3	2.5	5.9	11.5	13.9	9.6	6.4	66.8
Average Days of no availability - existing		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Days of full availability - Mosley		28.6	29.6	29.6	27.2	29.7	28.8	28.1	27.3	23.6	19.7	21.9	26.4	320.5
Average Days of partial availability - Mosley		1.4	1.4	1.4	2.7	1.3	1.2	2.9	3.7	4.6	8.3	6.5	3.7	39.1
Average Days of no availability - Mosley		0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	3.0	1.6	0.9	5.6
Average Days of full availability Amuri		29.4	30.4	30.5	29.7	30.1	29.5	30.8	29.2	23.6	22.9	25.1	27.9	339.2
Average Days of partial availability - Amuri		0.6	0.6	0.5	0.3	0.9	0.5	0.2	1.8	4.6	7.0	4.3	3.1	24.3
Average Days of no availability - Amuri		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.6	0.0	1.8

Appendix C: The number of days of water availability for an “A” permit allocation of 10 cumecs under the existing, Mosley and Amuri regimes

Note: This method does not consider the seasonal variations in water demand. It assumes the need for water equals the full allocation throughout the whole season.

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1972-73	Days of full availability - existing	20	31	5	25	31	23	16	8	0	0	12	31	202
	Days of partial availability - existing	10	0	26	5	0	7	15	23	28	31	18	0	163
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	22	31	20	30	31	30	19	12	0	0	14	31	240
	Days of partial availability - Mosley	8	0	11	0	0	0	12	19	28	0	1	0	79
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	31	15	0	46
	Days of full availability Amuri	27	31	26	30	31	30	31	18	0	0	15	31	270
	Days of partial availability - Amuri	3	0	5	0	0	0	0	13	28	31	6	0	86
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	9	0	9
1973-74	Days of full availability - existing	28	4	25	30	17	30	26	12	18	13	27	20	250
	Days of partial availability - existing	2	27	6	0	14	0	5	19	10	18	3	11	115
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	8	26	30	31	30	29	17	25	27	30	31	314
	Days of partial availability - Mosley	0	23	5	0	0	0	2	14	3	4	0	0	51
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	10	26	30	31	30	31	25	25	31	30	31	330
	Days of partial availability - Amuri	0	21	5	0	0	0	0	6	3	0	0	0	35
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1974-75	Days of full availability - existing	16	29	30	29	27	29	14	7	7	31	30	24	273
	Days of partial availability - existing	14	2	1	1	4	1	17	24	21	0	0	7	92
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	27	31	31	30	31	30	16	10	24	31	30	31	322
	Days of partial availability - Mosley	3	0	0	0	0	0	15	21	4	0	0	0	43
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	28	14	24	31	30	31	341
	Days of partial availability - Amuri	0	0	0	0	0	0	3	17	4	0	0	0	24
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1975-76	Days of full availability - existing	30	31	31	30	31	30	31	22	25	4	2	23	290
	Days of partial availability - existing	0	0	0	0	0	0	0	9	4	27	28	8	76
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	31	29	13	5	30	322
	Days of partial availability - Mosley	0	0	0	0	0	0	0	0	0	18	23	1	42
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	2	0	2
	Days of full availability Amuri	30	31	31	30	31	30	31	31	29	27	8	31	340
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	4	22	0	26
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1976-77	Days of full availability - existing	30	31	31	27	24	30	31	31	17	7	1	18	278
	Days of partial availability - existing	0	0	0	3	7	0	0	0	11	24	29	13	87
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	28	26	30	31	31	28	19	1	29	315
	Days of partial availability - Mosley	0	0	0	2	5	0	0	0	0	12	29	2	50
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	28	30	31	31	28	26	3	31	330
	Days of partial availability - Amuri	0	0	0	0	3	0	0	0	0	5	27	0	35
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1977-78	Days of full availability - existing	23	24	5	13	23	30	31	15	0	5	22	22	213
	Days of partial availability - existing	7	7	26	17	8	0	0	16	28	26	8	9	152
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	18	16	31	30	31	26	3	5	28	25	274
	Days of partial availability - Mosley	0	0	13	14	0	0	0	5	25	3	2	6	68
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	23	0	0	23
	Days of full availability Amuri	30	31	24	18	31	30	31	28	3	5	30	28	289
	Days of partial availability - Amuri	0	0	7	12	0	0	0	3	25	12	0	3	62
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	14	0	0	14
1978-79	Days of full availability - existing	25	28	31	30	31	21	29	16	13	14	26	31	295
	Days of partial availability - existing	5	3	0	0	0	9	2	15	15	17	4	0	70
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	30	27	25	27	30	31	353
	Days of partial availability - Mosley	0	0	0	0	0	0	1	4	3	4	0	0	12
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	25	31	30	31	362
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	3	0	0	0	3
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1979-80	Days of full availability - existing	27	28	31	30	31	30	31	30	29	30	30	18	345
	Days of partial availability - existing	3	3	0	0	0	0	0	1	0	1	0	13	21
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-81	Days of full availability - existing	30	24	19	30	31	30	31	2	12	13	22	31	275
	Days of partial availability - existing	0	7	12	0	0	0	0	29	16	18	8	0	90
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	29	30	31	30	31	8	22	20	25	31	318
	Days of partial availability - Mosley	0	0	2	0	0	0	0	23	6	11	5	0	47
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	11	22	23	27	31	328
	Days of partial availability - Amuri	0	0	0	0	0	0	0	20	6	8	3	0	37
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1981-82	Days of full availability - existing	29	23	18	23	31	30	29	25	13	5	0	20	246
	Days of partial availability - existing	1	8	13	7	0	0	2	6	15	26	30	11	119
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	28	25	24	31	30	31	30	26	11	0	21	287
	Days of partial availability - Mosley	0	3	6	6	0	0	0	1	2	20	22	3	63
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	8	7	15
	Days of full availability Amuri	30	31	27	29	31	30	31	31	26	17	3	22	308
	Days of partial availability - Amuri	0	0	4	1	0	0	0	0	2	14	27	9	57
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1982-83	Days of full availability - existing	19	16	31	30	15	30	31	31	12	7	30	31	283
	Days of partial availability - existing	11	15	0	0	16	0	0	0	16	24	0	0	82
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	22	19	31	30	28	30	31	31	21	10	30	31	314
	Days of partial availability - Mosley	8	12	0	0	3	0	0	0	7	21	0	0	51
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	24	21	31	30	30	30	31	31	21	15	30	31	325
	Days of partial availability - Amuri	6	10	0	0	1	0	0	0	7	16	0	0	40
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1983-84	Days of full availability - existing	30	31	31	23	31	28	23	21	22	18	9	28	295
	Days of partial availability - existing	0	0	0	7	0	2	8	10	7	13	21	3	71
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	27	31	30	24	31	29	22	17	31	334
	Days of partial availability - Mosley	0	0	0	3	0	0	7	0	0	9	13	0	32
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	29	28	23	31	356
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	3	7	0	10
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1984-85	Days of full availability - existing	18	31	31	16	21	30	31	31	6	0	5	2	222
	Days of partial availability - existing	12	0	0	14	10	0	0	0	22	31	25	29	143
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	28	25	30	31	31	13	0	7	5	262
	Days of partial availability - Mosley	0	0	0	2	6	0	0	0	15	23	4	26	76
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	8	19	0	27
	Days of full availability Amuri	30	31	31	30	27	30	31	31	13	0	9	9	272
	Days of partial availability - Amuri	0	0	0	0	4	0	0	0	15	31	10	22	82
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	11	0	11
1985-86	Days of full availability - existing	18	25	20	24	15	15	29	24	10	17	21	23	241
	Days of partial availability - existing	12	6	11	6	16	15	2	7	18	14	9	8	124
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	26	31	30	26	22	19	30	29	17	23	28	30	311
	Days of partial availability - Mosley	4	0	1	4	9	11	1	2	11	8	2	1	54
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	26	31	31	30	23	22	31	31	17	30	30	31	333
	Days of partial availability - Amuri	4	0	0	0	8	8	0	0	11	1	0	0	32
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1986-87	Days of full availability - existing	30	23	31	30	31	24	15	23	22	28	29	26	312
	Days of partial availability - existing	0	8	0	0	0	6	16	8	6	3	1	5	53
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	29	31	30	31	30	16	26	28	31	30	31	343
	Days of partial availability - Mosley	0	2	0	0	0	0	15	5	0	0	0	0	22
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	29	31	28	31	30	31	363
	Days of partial availability - Amuri	0	0	0	0	0	0	2	0	0	0	0	0	2
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1987-88	Days of full availability - existing	30	28	30	26	31	20	26	18	11	25	12	22	279
	Days of partial availability - existing	0	3	1	4	0	10	5	13	18	6	18	9	87
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	29	27	28	18	31	18	22	326
	Days of partial availability - Mosley	0	0	0	0	0	1	4	3	11	0	12	7	38
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	2	2
	Days of full availability Amuri	30	31	31	30	31	30	31	31	18	31	20	22	336
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	11	0	10	9	30
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1988-89	Days of full availability - existing	30	31	31	30	31	30	25	12	4	14	16	2	256
	Days of partial availability - existing	0	0	0	0	0	0	6	19	24	17	14	29	109
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	26	19	12	19	25	13	297
	Days of partial availability - Mosley	0	0	0	0	0	0	5	12	16	12	5	18	68
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	26	12	22	27	20	321
	Days of partial availability - Amuri	0	0	0	0	0	0	0	5	16	9	3	11	44
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1989-90	Days of full availability - existing	29	21	5	15	18	13	20	31	4	7	13	31	207
	Days of partial availability - existing	1	10	26	15	13	17	11	0	24	24	17	0	158
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	29	27	18	18	24	23	20	31	16	12	15	31	264
	Days of partial availability - Mosley	1	4	13	12	6	7	11	0	12	19	15	0	100
	Days of no availability - Mosley	0	0	0	0	1	0	0	0	0	0	0	0	1
	Days of full availability Amuri	30	31	22	28	24	24	23	31	16	14	18	31	292
	Days of partial availability - Amuri	0	0	9	2	7	6	8	0	12	17	12	0	73
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1990-91	Days of full availability - existing	16	13	31	11	11	15	28	31	28	0	25	17	226
	Days of partial availability - existing	14	18	0	19	20	15	3	0	0	31	5	14	139
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	28	21	31	14	19	20	30	31	28	5	28	25	280
	Days of partial availability - Mosley	2	10	0	16	12	10	1	0	0	26	2	6	85
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	29	31	24	22	24	31	31	28	8	28	31	317
	Days of partial availability - Amuri	0	2	0	6	9	6	0	0	0	23	2	0	48
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1991-92	Days of full availability - existing	23	13	31	28	28	26	29	22	17	19	9	3	248
	Days of partial availability - existing	7	18	0	2	3	4	2	9	12	12	21	28	118
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	29	19	31	30	31	30	29	27	23	21	13	7	290
	Days of partial availability - Mosley	1	12	0	0	0	0	2	4	6	10	17	24	76
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	28	31	30	31	30	31	30	23	23	16	10	313
	Days of partial availability - Amuri	0	3	0	0	0	0	0	1	6	8	14	21	53
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1992-93	Days of full availability - existing	12	28	31	30	28	28	20	31	20	0	8	8	244
	Days of partial availability - existing	18	3	0	0	3	2	11	0	8	31	22	23	121
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	15	29	31	30	31	30	21	31	27	1	17	16	279
	Days of partial availability - Mosley	15	2	0	0	0	0	10	0	1	30	13	11	82
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	4	4
	Days of full availability Amuri	21	29	31	30	31	30	31	31	27	5	19	19	304
	Days of partial availability - Amuri	9	2	0	0	0	0	0	0	1	26	11	12	61
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1993-94	Days of full availability - existing	29	17	1	12	27	17	30	31	8	9	4	17	202
	Days of partial availability - existing	1	14	30	18	4	13	1	0	20	22	26	14	163
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	29	29	10	19	29	25	31	31	22	16	7	19	267
	Days of partial availability - Mosley	1	2	21	8	2	5	0	0	6	15	18	12	90
	Days of no availability - Mosley	0	0	0	3	0	0	0	0	0	0	5	0	8
	Days of full availability Amuri	30	31	13	26	31	27	31	31	22	21	8	23	294
	Days of partial availability - Amuri	0	0	18	4	0	3	0	0	6	10	22	8	71
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1994-95	Days of full availability - existing	30	31	31	30	31	30	25	22	7	19	30	23	309
	Days of partial availability - existing	0	0	0	0	0	0	6	9	21	12	0	8	56
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	30	31	30	26	28	18	21	30	30	336
	Days of partial availability - Mosley	0	0	0	0	0	0	5	3	10	10	0	1	29
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	31	18	22	30	31	346
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	10	9	0	0	19
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1995-96	Days of full availability - existing	29	26	25	30	31	30	31	18	21	13	28	31	313
	Days of partial availability - existing	1	5	6	0	0	0	0	13	8	18	2	0	53
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	29	27	30	31	30	31	24	26	19	29	31	337
	Days of partial availability - Mosley	0	2	4	0	0	0	0	7	3	12	1	0	29
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	27	30	31	30	31	28	26	28	30	31	353
	Days of partial availability - Amuri	0	0	4	0	0	0	0	3	3	3	0	0	13
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1996-97	Days of full availability - existing	30	28	27	26	31	30	31	14	21	30	25	18	311
	Days of partial availability - existing	0	3	4	4	0	0	0	17	7	1	5	13	54
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	31	29	31	30	31	25	25	31	28	24	346
	Days of partial availability - Mosley	0	0	0	1	0	0	0	6	3	0	2	7	19
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	30	31	29	25	31	30	31	360
	Days of partial availability - Amuri	0	0	0	0	0	0	0	2	3	0	0	0	5
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1997-98	Days of full availability - existing	24	21	22	7	16	20	31	21	15	23	30	16	246
	Days of partial availability - existing	6	10	9	23	15	10	0	10	13	8	0	15	119
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	28	31	31	10	23	23	31	27	28	28	30	23	313
	Days of partial availability - Mosley	2	0	0	20	8	7	0	4	0	3	0	8	52
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	23	24	23	31	31	28	31	30	30	343
	Days of partial availability - Amuri	0	0	0	7	7	7	0	0	0	0	0	1	22
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1998-99	Days of full availability - existing	14	31	31	30	31	16	22	2	2	8	19	22	228
	Days of partial availability - existing	16	0	0	0	0	14	9	29	26	23	11	9	137
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	27	31	31	30	31	19	22	8	4	18	24	27	272
	Days of partial availability - Mosley	3	0	0	0	0	11	9	23	24	13	6	4	93
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	30	31	31	30	31	22	28	13	4	23	29	31	303
	Days of partial availability - Amuri	0	0	0	0	0	8	3	18	24	8	1	0	62
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1999-00	Days of full availability - existing	30	29	15	13	27	30	8	12	9	2	25	23	223
	Days of partial availability - existing	0	2	16	17	4	0	23	19	20	29	5	8	143
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	31	29	24	27	30	10	14	18	3	26	29	271
	Days of partial availability - Mosley	0	0	2	6	4	0	21	17	11	25	4	2	92
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	3	0	0	3
	Days of full availability Amuri	30	31	31	30	27	30	24	19	18	5	27	31	303
	Days of partial availability - Amuri	0	0	0	0	4	0	7	12	11	26	3	0	63
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
2000-01	Days of full availability - existing	30	16	31	30	31	17	10	16	2	3	1	5	192
	Days of partial availability - existing	0	15	0	0	0	13	21	15	26	28	29	26	173
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	30	21	31	30	31	24	11	22	7	3	7	11	228
	Days of partial availability - Mosley	0	10	0	0	0	6	20	9	21	1	22	5	94
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	27	1	15	43
	Days of full availability Amuri	30	31	31	30	31	26	21	31	7	3	13	11	265
	Days of partial availability - Amuri	0	0	0	0	0	4	10	0	21	7	17	20	79
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	21	0	0	21

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
2001-02	Days of full availability - existing	20	11	24	0	9	28	31	28	0	14	12	0	177
	Days of partial availability - existing	10	20	7	30	22	2	0	3	28	17	18	31	188
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	20	18	31	0	16	30	31	31	12	18	16	7	230
	Days of partial availability - Mosley	10	13	0	30	15	0	0	0	16	13	14	24	135
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	21	27	31	15	18	30	31	31	12	21	20	12	269
	Days of partial availability - Amuri	9	4	0	15	13	0	0	0	16	10	10	19	96
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
2002-03	Days of full availability - existing	22	31	27	28	30	30	31	31	15	9	11	23	288
	Days of partial availability - existing	8	0	4	2	1	0	0	0	13	22	19	8	77
	Days of no availability - existing	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability - Mosley	22	31	31	28	31	30	31	31	26	13	13	30	317
	Days of partial availability - Mosley	8	0	0	2	0	0	0	0	2	18	17	1	48
	Days of no availability - Mosley	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of full availability Amuri	23	31	31	30	31	30	31	31	26	17	15	30	326
	Days of partial availability - Amuri	7	0	0	0	0	0	0	0	2	14	15	1	39
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Days of full availability - existing		771	754	763	736	801	790	796	638	390	387	534	609	7969
Total Days of partial availability - existing		159	207	198	194	160	140	165	323	485	574	396	352	3353
Total Days of no availability - existing		0	0	0	0	0	0	0	0	0	0	0	0	0
Total Days of full availability - Mosley		864	866	883	801	890	872	820	779	629	529	631	764	9328
Total Days of partial availability - Mosley		66	95	78	126	70	58	141	182	246	340	249	169	1820
Total Days of no availability - Mosley		0	0	0	3	1	0	0	0	0	92	50	28	174
Total Days of full availability Amuri		892	919	909	883	905	888	928	861	629	631	688	825	9958
Total Days of partial availability - Amuri		38	42	52	47	56	42	33	100	246	295	222	136	1309
Total Days of no availability - Amuri		0	0	0	0	0	0	0	0	0	35	20	0	55
Average Days of full availability – existing		24.9	24.3	24.6	23.7	25.8	25.5	25.7	20.6	12.6	12.5	17.2	19.6	257.1
Average Days of partial availability - existing		5.1	6.7	6.4	6.3	5.2	4.5	5.3	10.4	15.6	18.5	12.8	11.4	108.2
Average Days of no availability - existing		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Days of full availability - Mosley		27.9	27.9	28.5	25.8	28.7	28.1	26.5	25.1	20.3	17.1	20.4	24.6	300.9
Average Days of partial availability - Mosley		2.1	3.1	2.5	4.1	2.3	1.9	4.5	5.9	7.9	11.0	8.0	5.5	58.7
Average Days of no availability - Mosley		0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	3.0	1.6	0.9	5.6
Average Days of full availability Amuri		28.8	29.6	29.3	28.5	29.2	28.6	29.9	27.8	20.3	20.4	22.2	26.6	321.2
Average Days of partial availability - Amuri		1.2	1.4	1.7	1.5	1.8	1.4	1.1	3.2	7.9	9.5	7.2	4.4	42.2
Average Days of no availability - Amuri		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.6	0.0	1.8

Appendix D: The number of days water is available under the current Balmoral Irrigation Scheme consent conditions

Note: This method does not consider the seasonal variations in water demand; it assumes the need for water equals the full allocation throughout the whole season.

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1972-73	Days of full availability - Amuri	30	31	31	30	31	30	31	31	0	0	15	31	291
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	28	31	6	0	65
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	9	0	9
1973-74	Days of full availability - Amuri	30	29	28	30	31	30	31	31	28	31	30	31	360
	Days of partial availability - Amuri	0	2	3	0	0	0	0	0	0	0	0	0	5
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1974-75	Days of full availability - Amuri	30	31	31	30	31	30	31	29	28	31	30	31	363
	Days of partial availability - Amuri	0	0	0	0	0	0	0	2	0	0	0	0	2
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1975-76	Days of full availability - Amuri	30	31	31	30	31	30	31	31	29	31	21	31	357
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	9	0	9
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1976-77	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1977-78	Days of full availability - Amuri	30	31	31	30	31	30	31	31	13	7	30	31	326
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	15	10	0	0	25
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	14	0	0	14
1978-79	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1979-80	Days of full availability - Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1980-81	Days of full availability - Amuri	30	31	31	30	31	30	31	26	28	31	30	31	360
	Days of partial availability - Amuri	0	0	0	0	0	0	0	5	0	0	0	0	5
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1981-82	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	26	12	24	335
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	5	18	7	30
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1982-83	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	28	30	31	362
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	3	0	0	3
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1983-84	Days of full availability - Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1984-85	Days of full availability - Amuri	30	31	31	30	31	30	31	31	25	6	11	27	314
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	3	25	8	4	40
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	11	0	11
1985-86	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1986-87	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1987-88	Days of full availability - Amuri	30	31	31	30	31	30	31	31	29	31	28	23	356
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	2	8	10
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1988-89	Days of full availability - Amuri	30	31	31	30	31	30	31	31	27	27	30	31	360
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	1	4	0	0	5
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0

Season	Data	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Annual
1989-90	Days of full availability - Amuri	30	31	31	30	24	30	31	31	28	30	30	31	357
	Days of partial availability - Amuri	0	0	0	0	7	0	0	0	0	1	0	0	8
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1990-91	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	21	30	31	355
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	10	0	0	10
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1991-92	Days of full availability - Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1992-93	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	29	29	24	355
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	2	1	7	10
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1993-94	Days of full availability - Amuri	30	31	27	27	31	30	31	31	28	31	19	31	347
	Days of partial availability - Amuri	0	0	4	3	0	0	0	0	0	0	11	0	18
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1994-95	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1995-96	Days of full availability - Amuri	30	31	31	30	31	30	31	31	29	31	30	31	366
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1996-97	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1997-98	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	31	30	31	365
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1998-99	Days of full availability - Amuri	30	31	31	30	31	30	31	26	8	31	30	31	340
	Days of partial availability - Amuri	0	0	0	0	0	0	0	5	20	0	0	0	25
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
1999-00	Days of full availability - Amuri	30	31	31	30	31	30	31	31	29	15	29	31	349
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	16	1	0	17
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
2000-01	Days of full availability - Amuri	30	31	31	30	31	30	31	31	20	4	23	13	305
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	8	6	7	18	39
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	21	0	0	21
2001-02	Days of full availability - Amuri	30	31	31	30	26	30	31	31	28	31	30	31	360
	Days of partial availability - Amuri	0	0	0	0	5	0	0	0	0	0	0	0	5
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
2002-03	Days of full availability - Amuri	30	31	31	30	31	30	31	31	28	25	25	30	353
	Days of partial availability - Amuri	0	0	0	0	0	0	0	0	0	6	5	1	12
	Days of no availability - Amuri	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Days of full availability - Amuri		930	959	954	927	949	930	961	949	800	807	842	916	10924
Total Days of partial availability - Amuri		0	2	7	3	12	0	0	12	75	119	68	45	343
Total Days of no availability - Amuri		0	0	0	0	0	0	0	0	0	35	20	0	55
Average Days of full availability - Amuri		30.0	30.9	30.8	29.9	30.6	30.0	31.0	30.6	25.8	26.0	27.2	29.5	352.4
Average Days of partial availability - Amuri		0.0	0.1	0.2	0.1	0.4	0.0	0.0	0.4	2.4	3.8	2.2	1.5	11.1
Average Days of no availability - Amuri		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.6	0.0	1.8

Appendix E: Policy guidance from RPS and NRRP

Regional Policy Statement (RPS)

Issue Resolution – Water (Chapter 9)

Issue 1

There are competing demands for the quantity of water in water bodies from: abstractors; those who discharge into water either directly or indirectly through activities on land; instream users including those who store water and generate electricity; those who drain or divert water; fishers and other recreational users; those who value the water for its natural character and its ecological life-supporting capacity; and Tangata Whenua who value the water for its wahi tapu, wahi taonga and mahinga kai.

Objective 1

Achieve sufficient quantities of water in the region's water bodies to enable present and future generations to gain cultural, social, recreational, economic and other benefits from those water bodies while:

- (a) safeguarding their existing value for efficiently providing sources of drinking water for people;
- (b) safeguarding the life-supporting capacity of the water, including its associated: aquatic ecosystems, significant habitats of indigenous fauna and areas of significant indigenous vegetation;
- (c) safeguarding their existing value for providing mahinga kai for Tangata Whenua;
- (d) protecting wahi tapu and other wahi taonga of value to Tangata Whenua;
- (e) preserving the natural character of lakes and rivers and protecting them from inappropriate use and development;
- (f) protecting outstanding natural features and landscapes from inappropriate use and development;
- (g) protecting significant habitat of trout and salmon; and
- (h) maintaining, and where appropriate, enhancing amenity values.

Policy 1

Water flow, level, or allocation regimes for water bodies should be set and managed to achieve (a) to (g) of Objective 1, except that the Regional Council, in accordance with Policy 2, may set and manage water flow, level or allocation regimes that do not achieve (e) to (h) where adverse effects on the matters addressed in (e) to (h) will be remedied or mitigated.

In setting these regimes for surface water bodies particular regard should be had to:

- natural patterns of flow or water level change;
- river or lake bed morphology and substrate material;
- bed gradient;
- water quality;
- habitat requirements; and
- appropriate alternative minimum flow regimes including mean annual low flow.

Policy 2

Subject to Policy 1, water flow, level and allocation regimes should be set and managed with the aim of:

- (a) enabling people and communities to maximise the wellbeing obtained from Canterbury's water resources through taking account of its value both instream and out of stream; and
- (b) where appropriate enhancing the availability of water for present and future generations through increased efficiency of use, augmentation or storage.

Policy 3

Promote efficiency in the use of water.

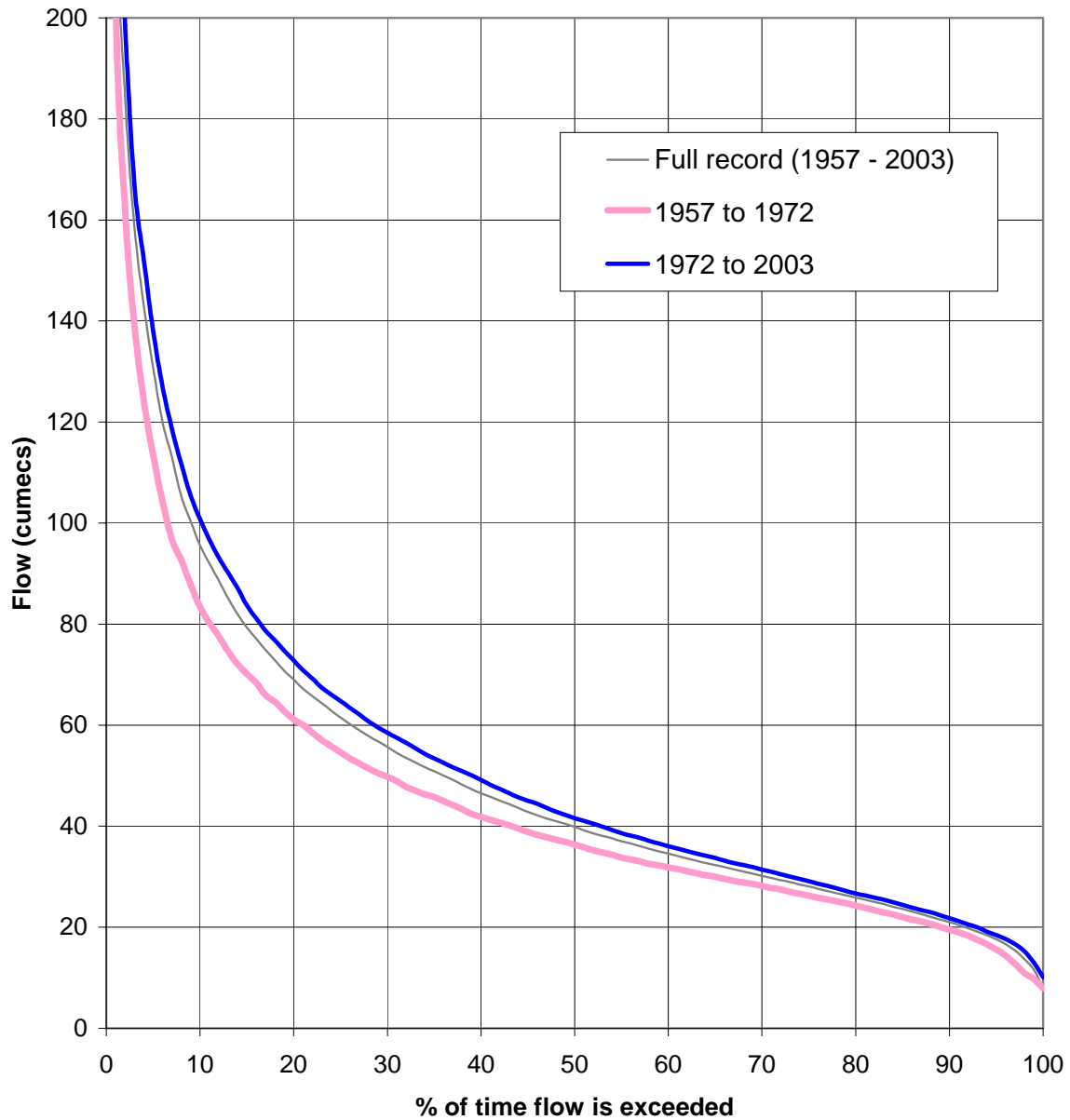
Natural Resources Regional Plan (NRRP) – December 2003 Draft

Chapter 5: Water Quantity

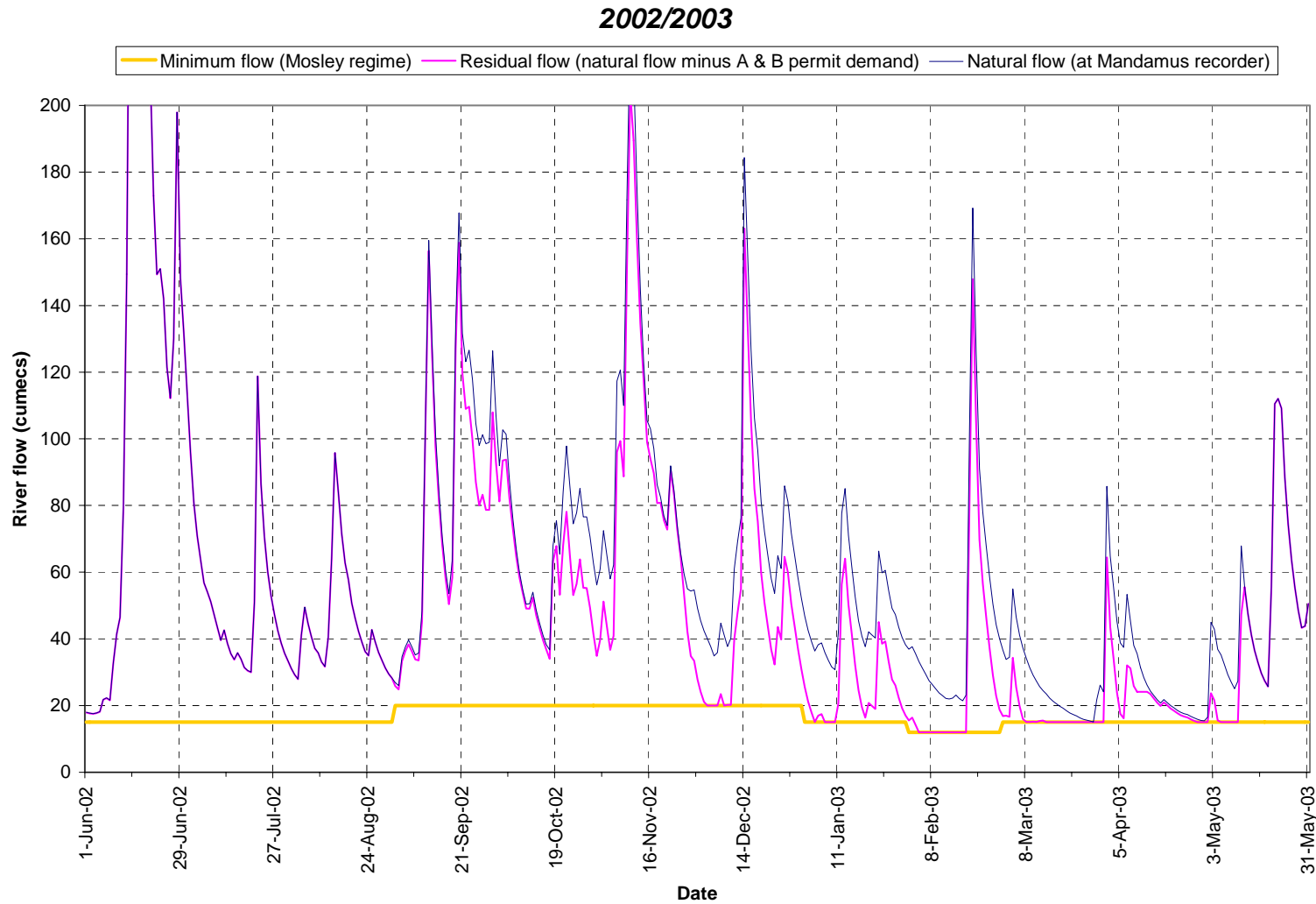
Objective WQN4 Allocation of the available water resource

- (1) The available water is allocated in ways that enables communities to maximise their social, economic and cultural wellbeing and their health and safety.
- (2) Allocation regimes are established that identify, at least, one allocation block within which the reliability of supply of water does not become a factor that limits the long-term economic viability of uses that are dependent on that block of water.

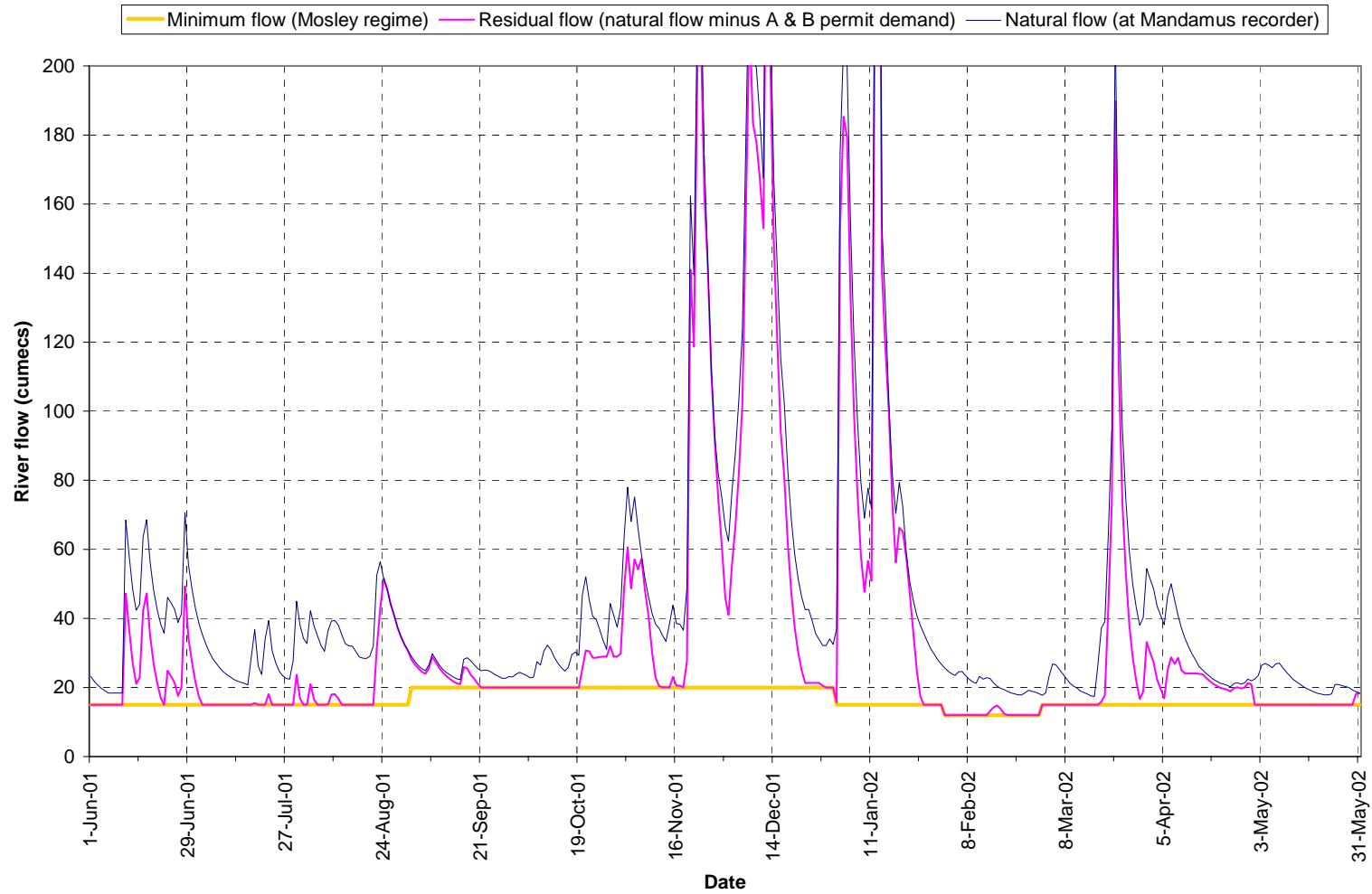
Appendix F: Flow duration curves for different time periods



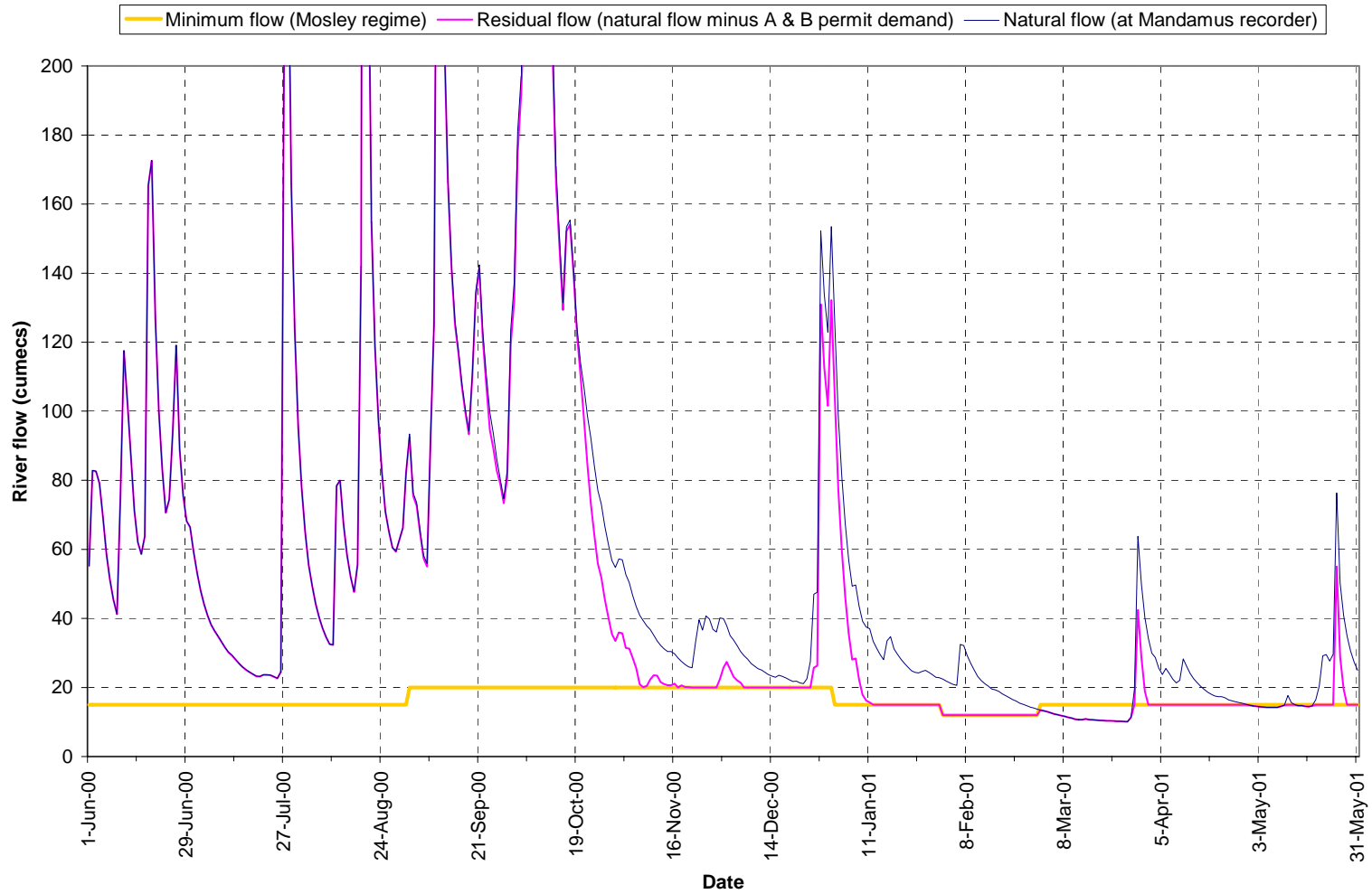
Appendix G: Effect of water demand on floods and freshes – annual hydrographs 1993-2003



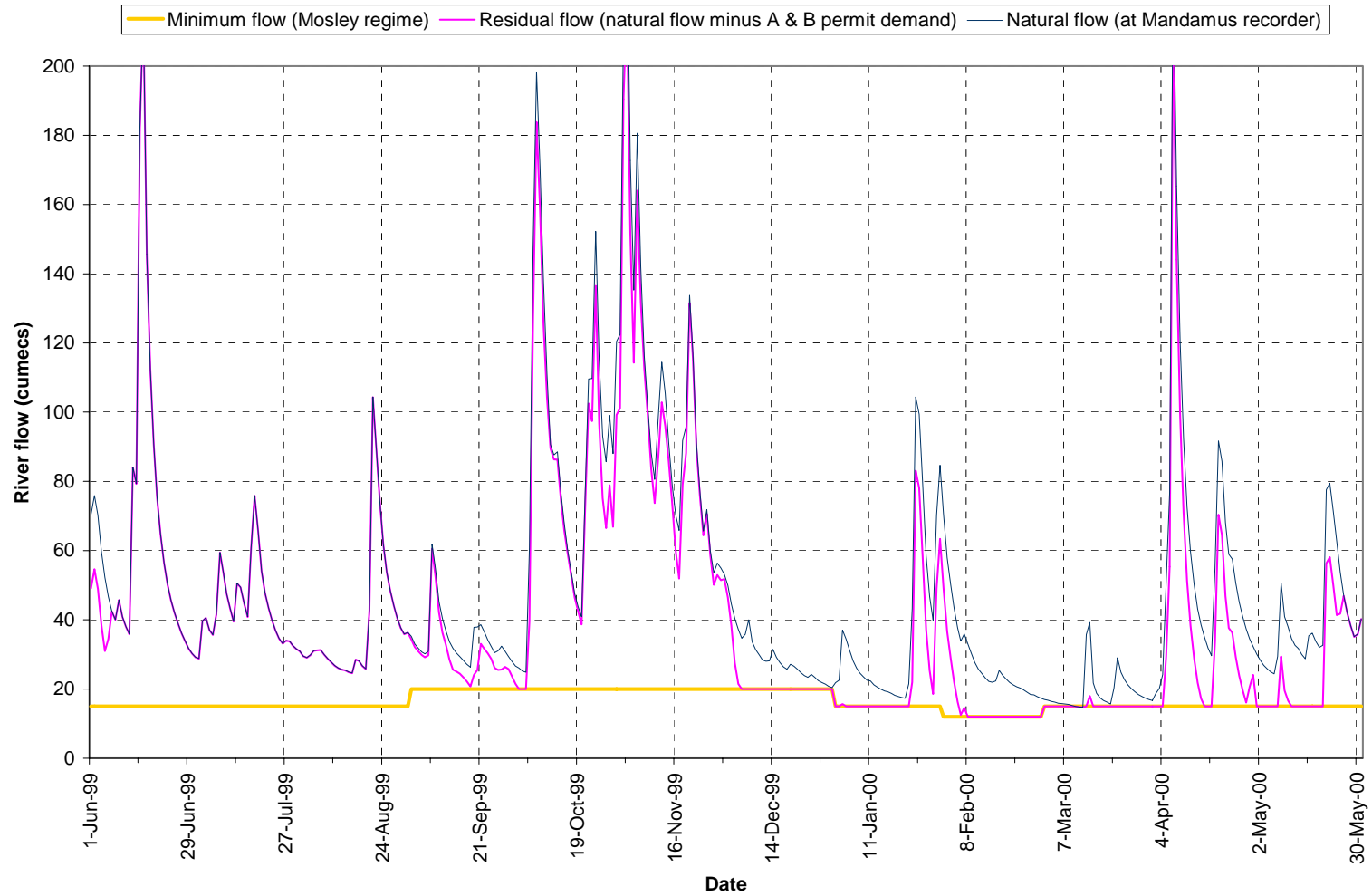
2001/2002



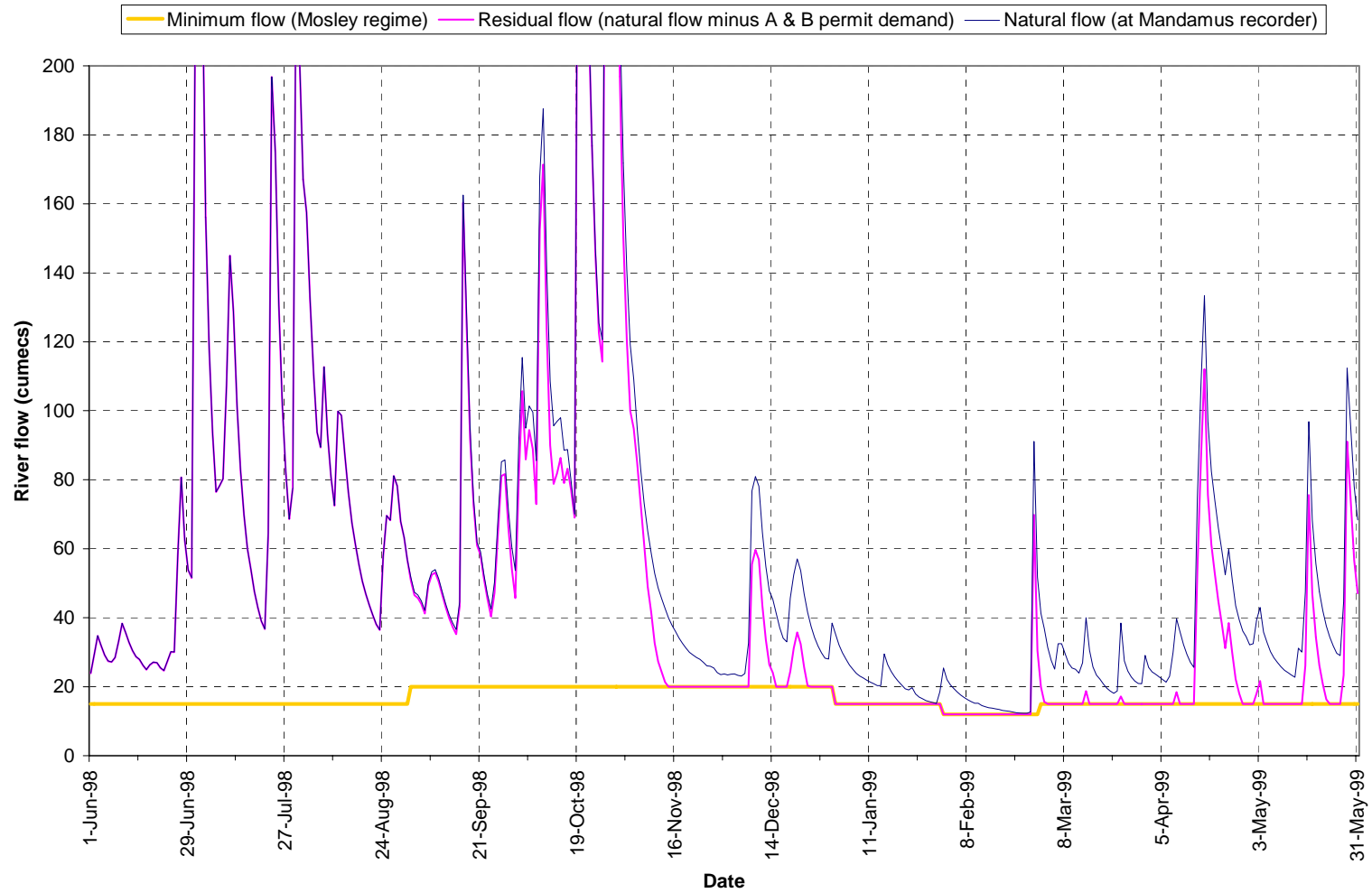
2000/2001



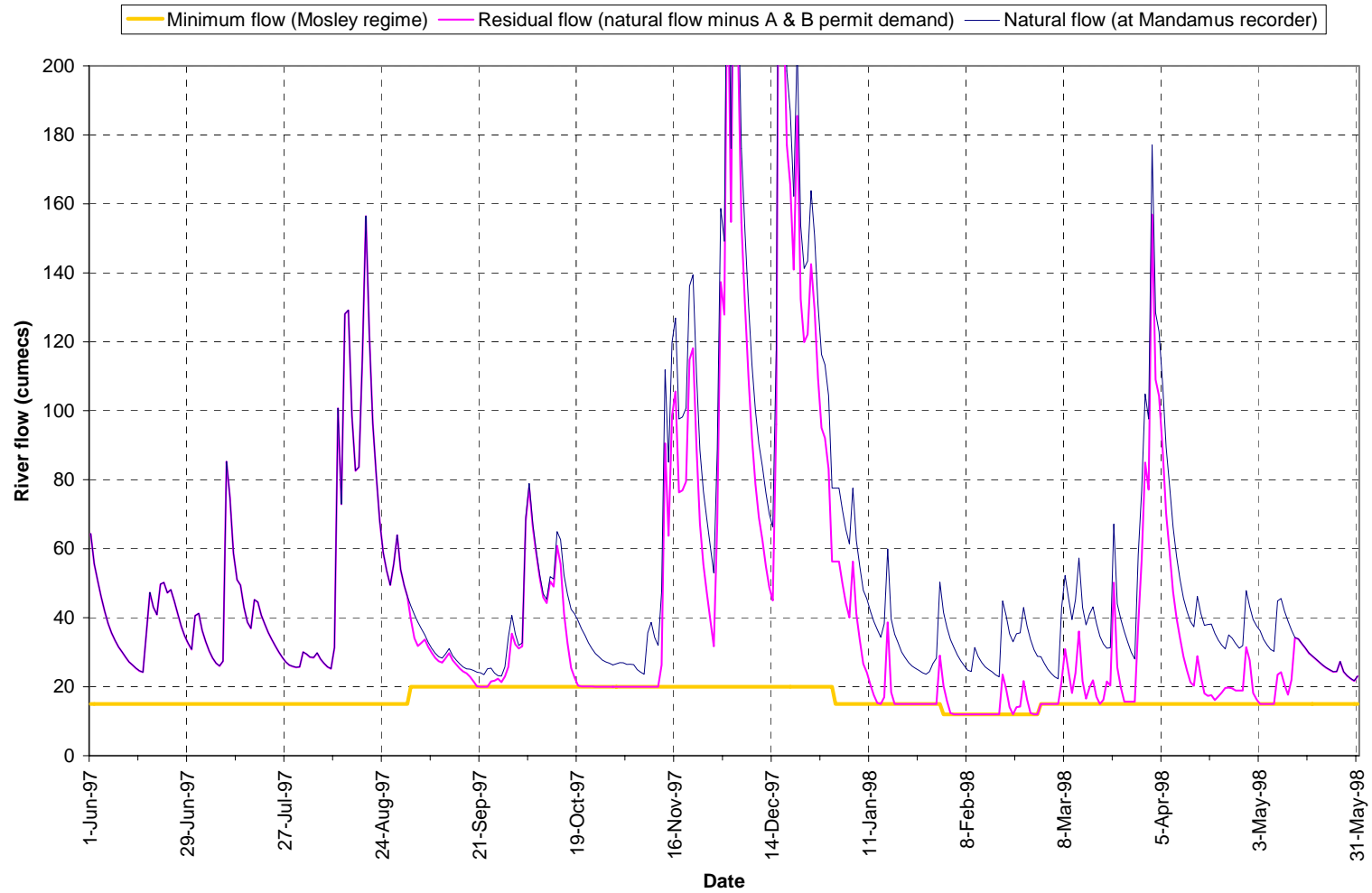
1999/2000



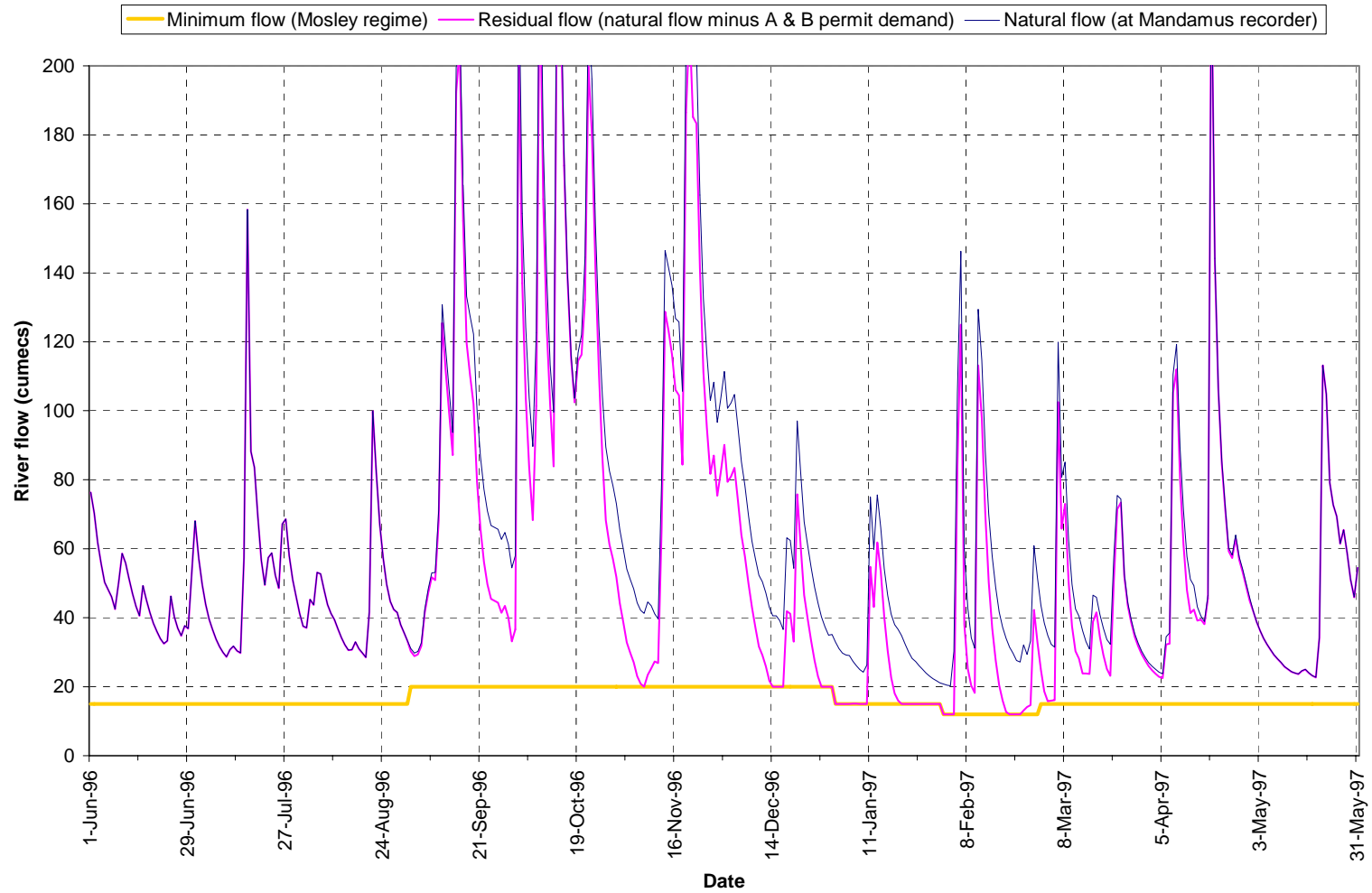
1998/1999



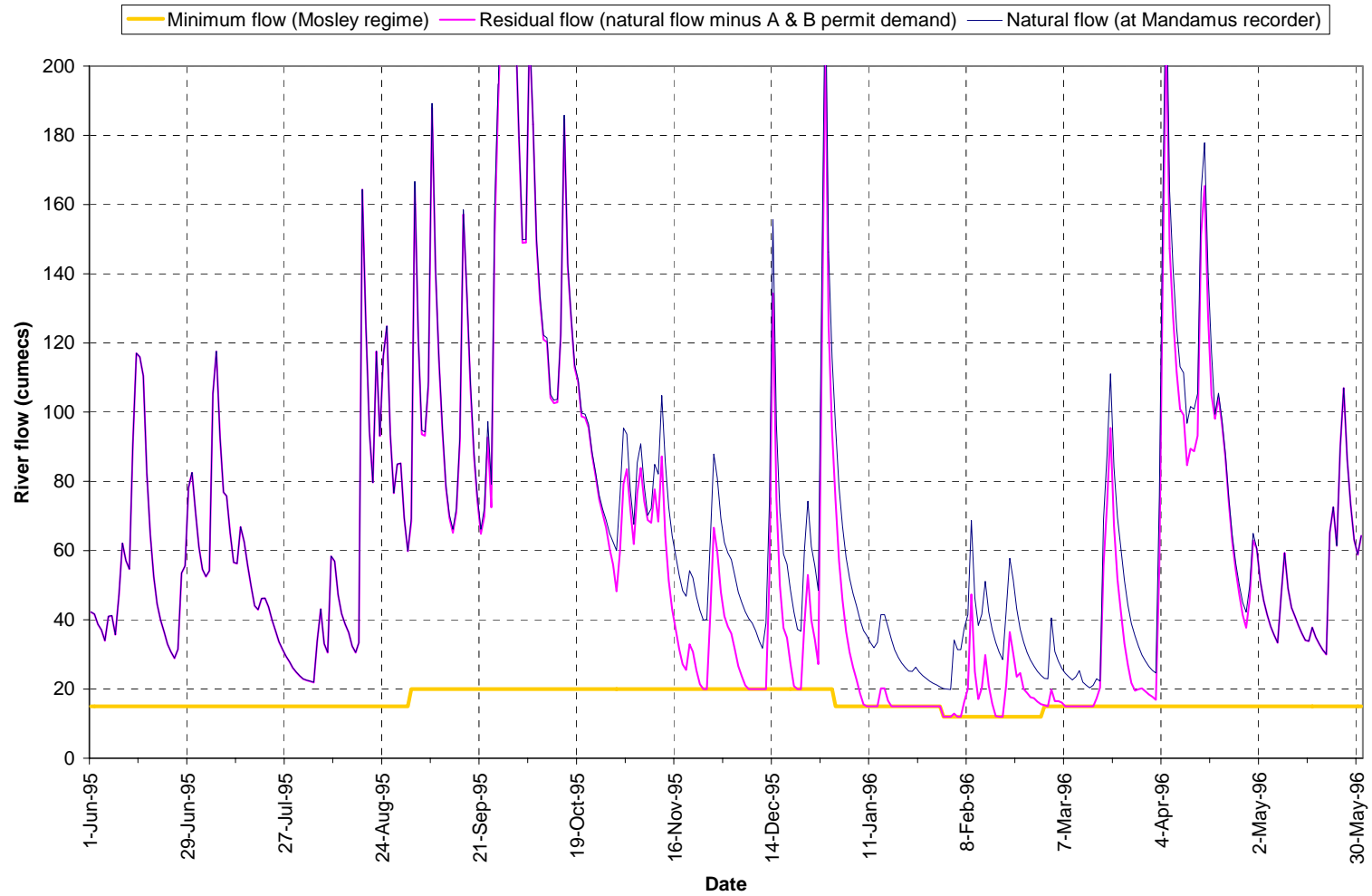
1997/1998



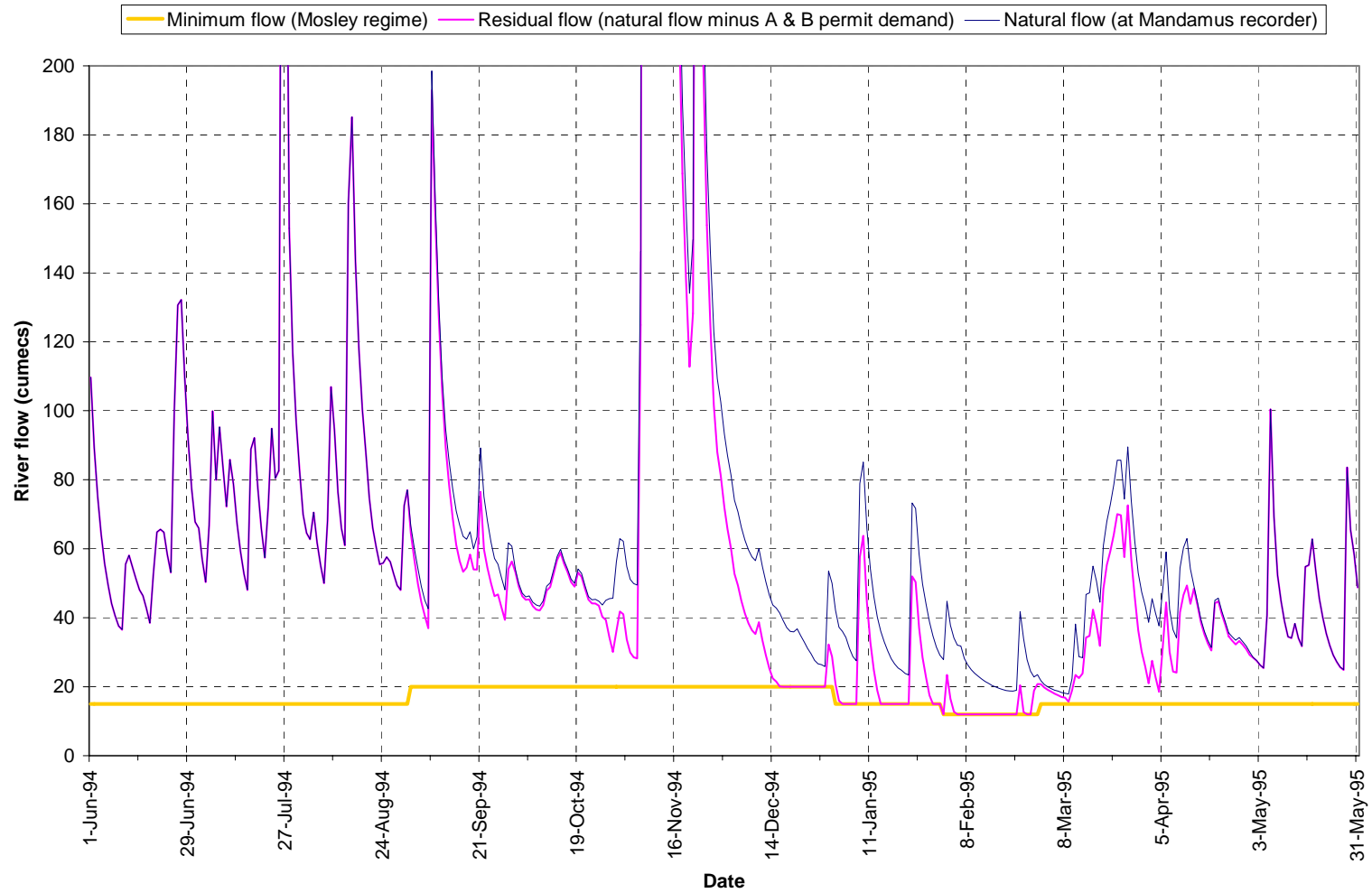
1996/1997



1995/1996



1994/1995



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