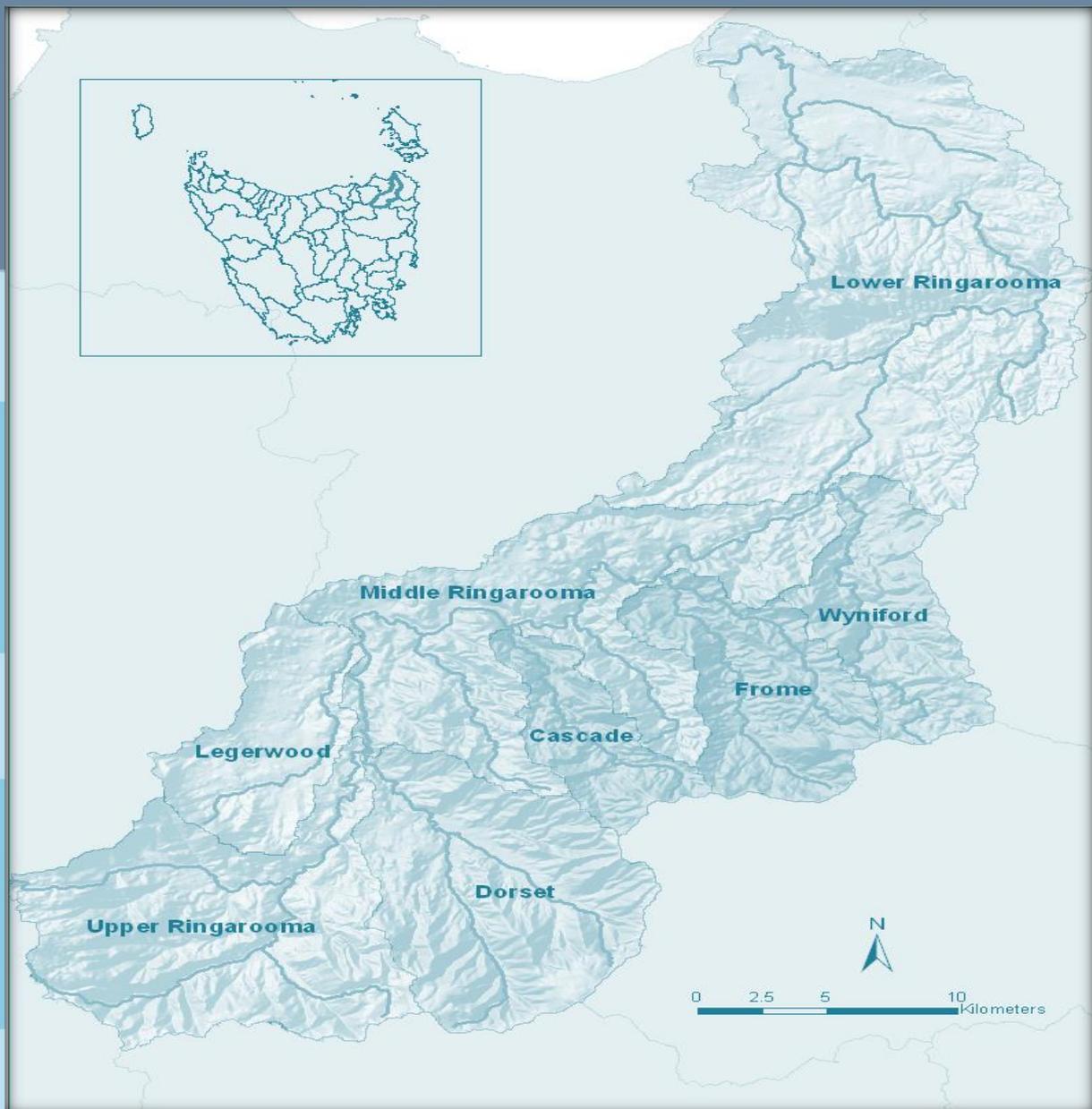


# Water Assessment Hydrology Report Series

## Ringarooma River Catchment Stage II Hydrology Report



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Water Assessment Branch  
Water and Marine Resources Division  
Department of Primary Industries, Parks, Water and Environment.

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Cover Page Image: The Ringarooma River catchment

**The Department of Primary Industries and Water**

The Department of Primary Industries, Parks, Water and Environment provides leadership in the sustainable management and development of Tasmania's resources. The Mission of the Department is to advance Tasmania's prosperity through the sustainable development of our natural resources and the conservation of our natural and cultural heritage for the future.

The Water and Marine Resources Division provides a focus for water management and water development in Tasmania through a diverse range of functions including the design of policy and regulatory frameworks to ensure sustainable use of the surface water and groundwater resources; monitoring, assessment and reporting on the condition of the State's freshwater resources; facilitation of infrastructure development projects to ensure the efficient and sustainable supply of water; and implementation of the *Water Management Act 1999*, related legislation and the State Water Development Plan.

## ***Executive Summary***

This report provides relevant hydrological information supporting the development of a water management plan for the Ringarooma River catchment. Water management plans provide a framework for managing catchment water resources in accordance with objectives of the Water Management Act 1999, and the State Policy on Water Quality Management 1997.

This report complements the Ringarooma Stage I Hydrology Report (DPIPWE, 2010) which characterised the surface water hydrology for the Ringarooma River Catchment, by providing information on catchment surface water budget in relation to current water usage and impact on yields under future climatic conditions. The surface water budget is used to manage water allocations in the proposed water management zones in Ringarooma River catchment.

The average annual natural flow yield in the Ringarooma catchment estimated from the surface water model is approximately 414,000 ML and comprises 41% of the total annual rain water input into the catchment. This indicates that around 59% of the gross water input is absorbed into the system through surface and subsurface interactions. The summer and winter catchment average yields are approximately 57,000 ML and 357,000 ML, respectively. The upper Ringarooma and the Dorset River water management regions are the highest yielding catchments and together contribute 47% of total annual yield.

The current total annual volume of water allocated, including pending applications, in the Ringarooma River catchment is around 86866 ML and makes up approximately 21 % of the average annual yield or 22% of the median annual yield (392,000 ML). The bulk of the allocation is non-consumptive (55,015 ML) and the remainder (31,851 ML) is allocated, or pending, for consumptive purposes. Water allocation for irrigation purposes comprises approximately 13% of the total annual allocation.

Based on the current consumptive water allocations the net available catchment yield (after environmental flow requirements and surety 5 and 6 allocation limits are met) is approximately 58,695 ML. Approximately 3,003 ML is potentially available in the catchment during summer direct take period while in winter 56,693 ML is available for storage allocations. The upper Ringarooma, Cascade and Middle WMRs have a net over allocation during the summer direct take period while water is potentially available for winter storage allocation in all WMRs except for Cascade WMR.

Future climate scenario modelling projections to 2030 indicated that under future dry conditions there is likely to be approximately a 14% reduction in total available catchment yield.

The yield analysis provided in this report is based on the natural flow estimated from a catchment hydrological model and is dependent on the performance of the model to mimic the natural conditions and accuracy of the allocation data provided. Future improvements on the model performance and accurate accounting of water allocations are likely to provide a better estimate of the sustainable natural flow yields in the Ringarooma catchment.

**Ringarooma River Catchment  
Stage II Hydrology Report**

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## **1 Introduction**

This report provides details and relevant information of water allocations and a hydrological model developed to inform and support the progress of a water management plan for the Ringarooma River catchment. Water management plans provide a framework for managing catchment water resources in accordance with objectives of the Water Management Act 1999, and the State Policy on Water Quality Management 1997.

In a stage I hydrology report (DPIPWE, 2010), detailed hydrological analysis and water balance modelling for the Ringarooma River catchment were carried out to provide information on the catchment's surface water resources. This report utilises hydrological information from the stage I report and presents surface water yield analysis for the eight water management regions in the Ringarooma River catchment. The analyses provide information on the amount and distribution of yields in the water management regions for the calculation of sustainable allocation limits under current and future climatic conditions, indicating the gross and net amounts of available water in the catchment according to DPIPWE's draft Water Allocation Policy.

The eight proposed water management regions (WMR) include:

1. Upper Ringarooma;
2. Dorset;
3. Legerwood;
4. Cascade;
5. Frome;
6. Middle Ringarooma;
7. Wyniford;
8. Lower Ringarooma.

## **2 Water Management Regions (WMR)**

The Water Management and Water Policy and Planning Branches of DPIPW have divided the Ringarooma River catchment into eight Water Management Regions (WMR).

They were determined using a combination of the following:

- Existing water management areas (e.g. irrigation districts and old water districts)
- Practical and logical management areas based on experiences of managing water resources in the catchment
- Confluence of streams (nodes), as these form the basis of water trading zones
- Areas with similar riverine geomorphology

The eight WMR are listed below and shown in Figure 1.

1. Upper Ringarooma River, comprising the Ringarooma River and all its tributaries above the Dorset River junction;
2. Dorset River and its tributaries, including the New River catchment;
3. Legerwood Rivulet and its tributaries;
4. Cascade River and its tributaries;
5. Frome River and its tributaries, including the Weld River Catchment;
6. Mid Ringarooma River, comprising the Ringarooma River and all its tributaries below the junction of the Dorset River and above the junction with the Wyniford River;
7. Wyniford River and its tributaries;
8. Lower Ringarooma River, comprising the Ringarooma River and all its tributaries below the junction of the Wyniford River and above the junction with the Boobyalla River.

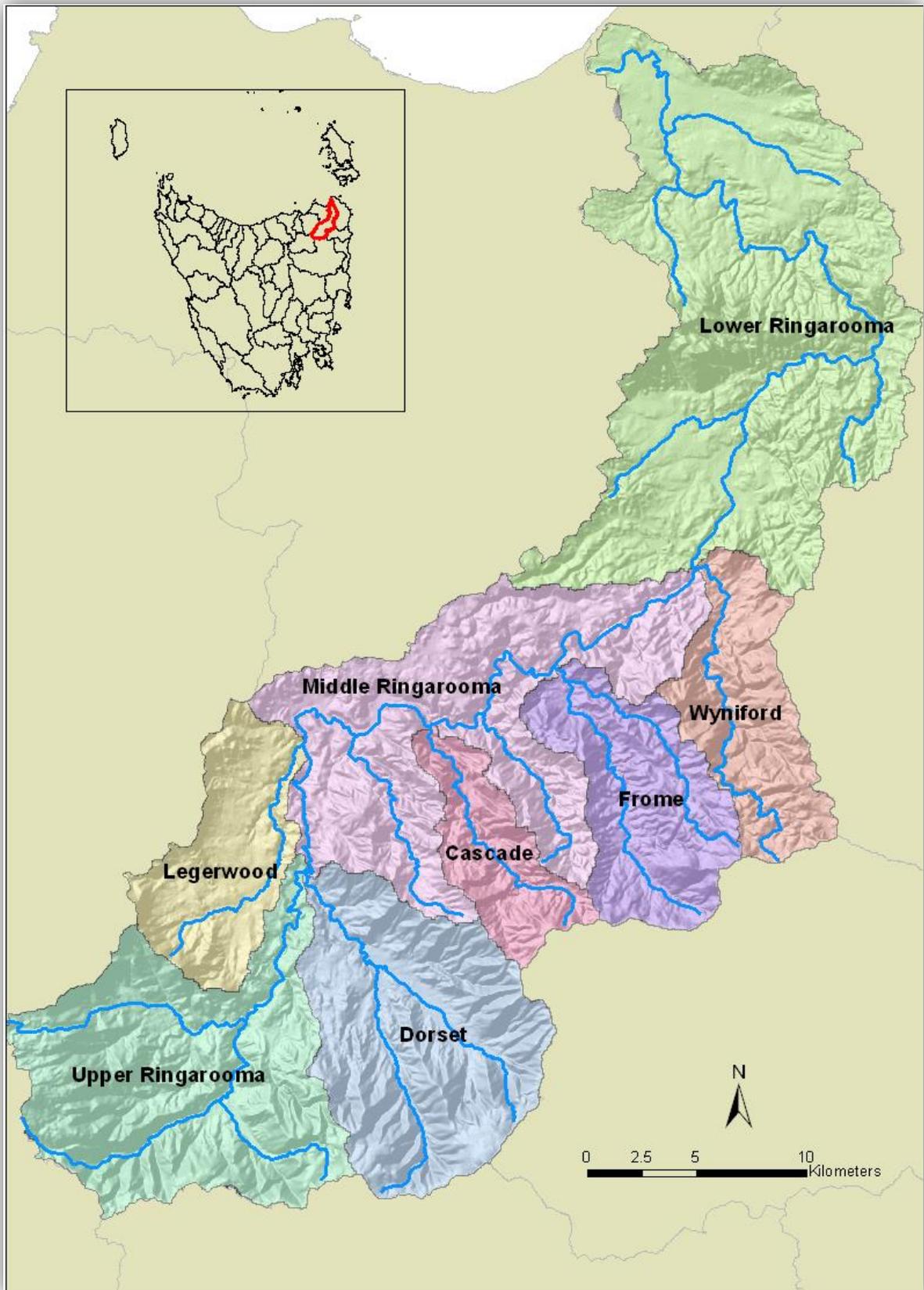


Figure 1 Water Management Regions for the Ringarooma Catchment

### 3 Current Water Allocations

Current surface water usage and allocations in the Ringarooma River Catchment is described in the Water Management Report DPIPW (2011). The current total surface water allocated, including pending applications, in the Ringarooma River catchment is approximately 86,866 ML, of which 31,851 ML is for consumptive usage and the remaining 55,015 ML for non-consumptive purposes, and makes up approximately 21% of the average annual yield or 22% of the median annual yield. Water allocation for irrigation purposes comprises approximately 13% of the total annual allocation.

A summary of the current surface <sup>2</sup> water allocations in the water management regions is presented in Table 1.

Table 1 Summary of current water allocation in the WMRs.

WMRs	Direct	Storage	Total
Upper Ringarooma	2398	10952 <sup>2</sup>	13350
Dorset	638	1069 <sup>2</sup>	1707
Legerwood	570	1741	2311
Cascade <sup>1</sup>	24700	5400	30100
Frome <sup>1</sup>	17360	2027 <sup>2</sup>	19387
Mid Ringarooma	2798	498	3296
Wyniford <sup>#</sup>	11000	1700 <sup>2</sup>	12700
Lower Ringarooma	943	3072	4015
<b>Total</b>	<b>60407</b>	<b>26459</b>	<b>86866</b>

# Historic operation 35 ML/day (12700 ML/year) diverted to Frome via the Wyniford offtake race.

<sup>1</sup> Includes non-consumptive hydropower generation.

<sup>2</sup> WMR with pending allocations.

The surface water resource in the catchment is allocated at various surety levels and is subject to restriction rules. The bulk of the consumptive water allocations (28,080 ML) in the Ringarooma catchment are at surety 1 & 5 levels whereas surety 6 allocations amounts to 8,667 ML. A summary of the consumptive water allocations in the Ringarooma River catchment is presented in Table 2.

The allocation information in Table 2 forms part of determination of water availability within each water management region and provides basis for sustainable management of water use in the catchment.

Table 2 Current consumptive water allocations (ML) in the Ringarooma River catchment.

Period	Surety	Upper Ringarooma	Dorset	Legerwood	Cascade	Frome	Middle Ringarooma	Wyniford	Lower Ringarooma	Total
<b>Direct</b>										
	<b>1 &amp; 5</b>	2398	638	570	1407	60	625		155	5853
	<b>6</b>				827				130	957
	<b>Total</b>	2398	638	570	2234	60	625		285	6810
<b>Storage</b>										
	<b>1 &amp; 5</b>	10631	619	1714	1993	2027	503	1700	3040	22227
	<b>6</b>	321	450	27	1173		153		690	2814
	<b>Total</b>	10952	1069	1741	3166	2027	656	1700	3730	25041
	<b>Total</b>	<b>13350</b>	<b>1707</b>	<b>2311</b>	<b>5400</b>	<b>2087</b>	<b>1281</b>	<b>1700</b>	<b>4015</b>	<b>31851</b>

Direct = summer allocation (December to April inclusive); Storage = winter allocation (May to November inclusive).

Note: the information in this Table depicts water allocations by type, and does not necessarily reflect the period when water may be taken under a particular allocation. Allocations for the full year licence (eg. Cascade WMR) is divided into equivalent number of days summer and winter periods.

## 4 Catchment Water Balance Models

### 4.1 Overview

The Ringarooma River catchment currently has three stream gauge stations located within the catchment that monitor river flows at strategic locations. While this coverage of stream gauges is quite large for Tasmanian catchments, the coverage does not allow for yield estimates for the catchment as a whole, the major tributaries to the Ringarooma River, predominantly the Dorset, Legerwood, Cascade, Frome, Weld and Wyniford rivers that drain the upper half of the catchment.

To overcome this shortfall of flow measurement coverage, and to enable the estimation of water availability across the catchment, a hydrological model was developed for the Ringarooma River catchment. The catchment model and calibration procedures are described in stage I hydrology report (DPIPWE, 2010).

Under a project funded by the National Action Plan for Salinity and Water Quality (NAPSWQ), a rainfall and runoff water balance model was developed for the Ringarooma River catchment (HEC, 2005). In 2010 the model was updated to encompass the “Tascatch” format of models developed under the Australian Government Water Fund (AGWF) program.

Daily time-step climate data was obtained from the Queensland Department of Natural Resources & Mining (QNRM). Further information describing this data is presented in (HEC 2005).

The model has the capability to generate a daily time-series of natural flow<sup>1</sup> and current flow<sup>2</sup>.

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<sup>1</sup> Natural flow: Flow that is expected to occur in a river where there is no water extracted for consumptive use. This is generally produced from a catchment hydrologic model using rainfall and evaporation as the primary input data. It does not take into account any changes in land-use that may have occurred over the period of interest.

<sup>2</sup> Current flow: Flow in a river where water has been extracted for consumptive use. For the purpose of this report this involved subtracting the licensed water use for 2008 from the entire ‘natural’ flow record produced by the hydrologic catchment model.

## 4.2 Natural flow estimations

The model has been calibrated by matching modelled flow to observed flow records for the stream gauge site Ringarooma River at Moorina (30). The model calibration processes is discussed in stage I hydrology report (DPIPWE, 2010) and a summary of the model performance regression fit values is presented in Table 3. Overall the calibration of modelled current flow against observed flow at Moorina (1978-2009) gave a good fit.

Table 3 Regression coefficient ( $R^2$ ) fit descriptions.

<b>Qualitative Fit</b>	<b>Daily <math>R^2</math></b>	<b>Monthly <math>R^2</math></b>	<b>Daily Flow @Moorina</b>	<b>Monthly Flow @ Moorina</b>
<b>Poor</b>	$R^2 < 0.65$	$R^2 < 0.80$		
<b>Fair</b>	$0.65 \geq R^2 < 0.70$	$0.80 \geq R^2 < 0.85$		
<b>Good</b>	$R^2 \geq 0.70$	$R^2 \geq 0.85$	0.83	0.91

Duration analysis of the modelled and observed flows at Moorina gauge indicated that the model generally provided a good estimation of natural flow but was consistently lower than the observed flow (Figure 2). Modelled current flow was under-estimated at exceedance greater 40% indicating possible inconsistencies in direct take allocation data during summer period. Other factors such as use of current allocation across all calibration periods, time of extractions, landuse practices and baseflow behaviour may also affect estimation of natural & current flow during low flow period.

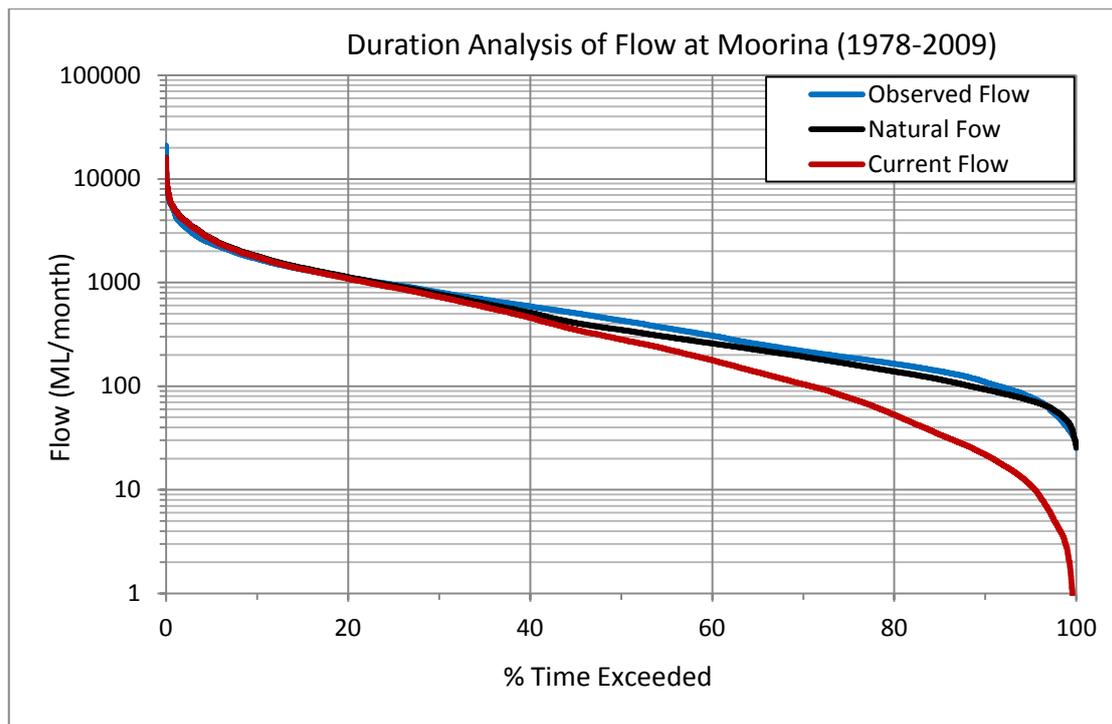


Figure 2 Flow duration analysis of observed, current and natural flow for Ringarooma River at Moorina (site 30).

The Ringarooma Tascatch model provided an annual yield of 414,378 ML for the period 1970 to 2009. While the model may not fully reproduce the observed record following calibration, the recent CSIRO Sustainable Yields project also obtained a similar average annual yield for the historical period 1924 to 2007 of 453,000 ML. The recently released Climate Futures for Tasmania project provides a much smaller modelled average annual yield of 390,000 ML for the period 1961 to 1990.

For allocation purposes a natural yield estimate for all regions across the catchment is required. This is not possible with the stream gauge coverage on the ground now or into the future and use of a model is necessary to provide yield estimates catchment wide. With uncertainty around model outputs from varying projects, the Tascatch model results, which fall between the TasSY and CFT results, were selected to determine water availability, so as not to disadvantage any current water user. When models are reviewed or updated, the calibration may improve and provide more precise yield estimates which will be utilised in any future resource assessment.

## **5 Catchment and Subregion Water Budget**

### **5.1 Natural flow water yields**

The distribution of average monthly, seasonal and annual natural flow yields in the eight WMRs is given in Table 4. Natural flow yields are consistently highest during the winter months June to September while February and March are the lowest yielding months. Winter yields generally comprise greater than 84% of the annual average yields for all the WMRs.

The modelled annual average natural flow yield of the Ringarooma River catchment at the outlet is 414,378 ML, with an average daily discharge of 1,135 ML/day. The modelled median annual natural flow yield for the same period is 392,126 ML. Approximately 86% of the natural flow yield at the outlet is contributed by winter flows and the bulk of the yield (47%) is from upper Ringarooma and Dorset WMRs.

The annual average yield for the upper Ringarooma with an area of 147 km<sup>2</sup> is approximately 108,693 ML and increases to 336,731 ML at the middle Ringarooma outlet that has a cumulative catchment area of 592 km<sup>2</sup>. The yield further increases to 414,378 ML at the outlet of the lower Ringarooma (catchment outlet) with a total catchment area of 926 km<sup>2</sup>. The corresponding annual specific yields (yield per km<sup>2</sup>) are 741 ML/km<sup>2</sup> in the upper Ringarooma, 569 ML/km<sup>2</sup> in the middle Ringarooma and 447 ML/km<sup>2</sup> in the lower Ringarooma, indicating that most of the water is generated in the upper reaches of the Ringarooma catchment. It is worth noting here that a large part of the lower Ringarooma WMR consists of marshes and wetlands and it is possible that a significant portion of the natural yield could be held as resident water.

Table 4 Distribution of average monthly, seasonal and annual natural water yields (ML) in the water management regions of the Ringarooma River catchment.

Month	Upper Ringarooma	Dorset	Legerwood	Cascade	Frome	Middle Ringarooma	Wyniford	Lower Ringarooma
Jan	2882	2627	810	525	1248	9673	947	12577
Feb	1878	1772	550	367	909	6744	688	9174
Mar	1671	1500	468	301	734	5544	554	7280
Apr	2840	2581	663	439	1222	8531	892	10180
May	8034	6153	2019	1077	2274	21447	1643	24394
Jun	13916	10444	3937	1963	4043	38950	2939	45395
Jul	20724	15971	6486	3381	6737	62364	5008	74825
Aug	22218	16503	7226	3935	7369	68956	5530	84701
Sep	14669	11081	4976	2795	5185	48114	3921	60667
Oct	9991	7727	3318	1814	3751	32863	2828	41918
Nov	5653	4887	1779	1067	2394	19153	1789	24833
Dec	4218	3891	1241	790	1861	14394	1388	18435
<b>Summer</b>	<b>13489</b>	<b>12371</b>	<b>3732</b>	<b>2422</b>	<b>5974</b>	<b>44886</b>	<b>4469</b>	<b>57646</b>
<b>Winter</b>	<b>95205</b>	<b>72765</b>	<b>29742</b>	<b>16032</b>	<b>31754</b>	<b>291846</b>	<b>23657</b>	<b>356733</b>
<b>Annual</b>	<b>108693</b>	<b>85137</b>	<b>33474</b>	<b>18454</b>	<b>37728</b>	<b>336731</b>	<b>28126</b>	<b>414378</b>

Summer (December to April inclusive); Winter (May to November inclusive).

## 5.2 Climate change and natural water yields

In Tasmania two major climate change projects have been recently completed, the CSIRO Tasmanian Sustainable Yields (TasSY) project and the ACE CRC Climate Futures for Tasmania (CFT). The projects have varying methods, inputs and results timelines.

Future climate is difficult to predict and these projects provide a range of potential outcomes for Tasmania. The relatively recent climate has been very dry and Tasmanian catchments have only recently come out of drought conditions. If sustainable allocation limits were established using wet climate outcomes this would cause issues with over allocation if the future climate was dry. Using a dry future climate scenario provides a precautionary approach against over allocation into the future and aims to protect the reliability of current allocations.

The Ringarooma catchment projections from both climate change projects are presented in Table 5. The table shows that the CFT project central estimate projection to 2039 is only 1% less dry than the Scen C Wet TasSY projections to 2030.

Table 5 Future percentage runoff change projections for Ringarooma catchment from TasSY and CFT projects.

Project	Tasmanian Sustainable Yields (TasSY)			Climate Futures for Tasmania (CFT)
	Scen C Wet	Scen C Mid	Scen C Dry	Central estimate#
Projected % change in future run-off. Change relative to historical record	-3%	-8%	-14%	-2%

Note TasSY projections are out to 2030 while the CFT percentage change is for the period 2010 to 2039.

#. The Central Estimate is the average of the outputs from the six Global Climate models used in CFT.

In the longer term, the Department intends to incorporate future climate data (rainfall and evaporation derived from projects such as CFT) into its hydrological modelling processes, so that model outputs can be generated for various future climate scenarios. In the interim, the TasSY results (Scen C Dry) will be used to determine the extent to which allocations can be made in relation to the sustainable allocation limits derived through hydrological modelling. This is considered a more robust approach than simply “adjusting” the sustainable allocation limits down by the relevant forecast reduction in yield.

### **5.3 Natural water yields and water sustainable allocation limits**

Table 4 presents summary information regarding modelled natural water yields. The statistics are averages and do not represent probabilities of occurrence or percentiles which are used to inform reliability of yields. Sustainable allocation limits or water availability estimates are calculated using percentile statistics. These are presented in Table 6. The values presented relate to a reliability of occurrence.

While several reliability yields are presented to demonstrate the range of reliability of yields, the 80 percent and 50 percent reliability yields incorporated with the corresponding environmental water requirements are used to establish sustainable allocation limits for Surety Level 5 and Surety Level 6 allocations.

The following formulae were used to determine the sustainable allocation limits.

**Surety Level 5 Allocation Limit = 80% Reliability volume - Environmental Water Requirement (EWR).**

Note that the Surety Level 5 allocation limit includes the volume available for Surety Levels 1 through to 5.

**Surety Level 6 Allocation Limit = 20% x (50% Reliability volume - 80% Reliability volume).**

This approach to setting sustainable allocation limits is based on retaining 80% of the median annual discharge, which is considered to be a reasonable “rule of thumb” guide to meeting the water needs of river ecosystems. This approach is also being incorporated within a new draft water allocation policy that is being developed by the Department.

The Direct take period EWR is calculated by summing the 30th percentile yield for each month of December to April inclusive (over the period of record assessed).

The 30th percentile is the value (or score) below which 30 percent of the observations may be found.

The Storage take period EWR is calculated by summing the 20th percentile yield for each month of May to October inclusive (over the period of record assessed).

The 20th percentile is the value (or score) below which 20 percent of the observations may be found.

While the policy stipulates 30th percentile yield as the direct take period EWR, sustainable allocation limits for the eight WMRs were calculated using the average percentile equivalent of the measured low risk EWR (75<sup>th</sup> percentile of available

habitat) from sites listed below. Environment flows measurements at these sites are described in DPIW (2008).

Site 1. Ringarooma River at Cottons Bridge;

Site 2. Dorset River at Dead Horse Hill;

Site 3. Ringarooma River at Yeates property.

The average percentile equivalent of the daily EWR (ML/d) for the summer direct period (December to April) for sites 1 & 2 was the 17<sup>th</sup> percentile, while for site 3 it was equivalent to the 13<sup>th</sup> percentile. The Direct take period EWR for all the WMRs is thus calculated by summing the measured equivalent percentile yield for each month of December to April inclusive.

The EWR for the Upper Ringarooma, Dorset, Legerwood, Cascade, Frome and Wyniford WMRs were calculated using the 17<sup>th</sup> percentile yield equivalent of the measured EWR from sites 1 & 2 while a 13<sup>th</sup> percentile yield equivalent of the measured EWR from site 3 was found appropriate for the Middle and the Lower Ringarooma WMRs.

The sustainable allocation limits based on these formulae are presented in Table 7. Under the Department's draft water allocation policy, water would only be allocated up to the volumes set out in Table 8 (as discussed in Section 5.2), notwithstanding the limits set out in Table 7. In effect, allocation up to 86% of the allocation limit will occur (allowing for a reduction in yield of 14% generated by the Tas SY Scen C Dry).

Table 6 Water Management Region “Natural Water Yield” Reliabilities.

Period Reliability	Upper Ringarooma	Dorset	Legerwood	Cascade	Frome	Middle Ringarooma	Wyniford	Lower Ringarooma
<b>Direct 80% (ML)</b>	6415	5564	2329	1443	3063	24497	2331	33842
<b>Direct 70% (ML)</b>	8684	7420	2645	1608	3823	31680	3046	39323
<b>Direct 60% (ML)</b>	9113	8192	3162	1890	4118	34905	3179	44851
<b>Direct 50% (ML)</b>	10535	9485	3532	2124	4591	36651	3469	49558
<b>Direct 40% (ML)</b>	12960	10364	3785	2268	5453	42012	3937	54223
<b>Direct 30% (ML)</b>	16975	13952	4335	2397	6079	49289	4527	61122
<b>Direct 20% (ML)</b>	19106	17709	4932	3285	7683	62535	5852	76702
<b>Direct EWR (ML)</b>	<b>6023</b>	<b>4995</b>	<b>1986</b>	<b>1253</b>	<b>2643</b>	<b>21616</b>	<b>2045</b>	<b>28628</b>
<b>Storage 80% (ML)</b>	70512	50410	20163	9975	20604	197509	14357	239415
<b>Storage 70% (ML)</b>	77334	53607	24381	11612	23542	228513	17002	269446
<b>Storage 60% (ML)</b>	82965	59870	25561	12920	25824	248071	19395	296601
<b>Storage 50% (ML)</b>	86081	67392	26814	14080	30173	261850	22685	331249
<b>Storage 40% (ML)</b>	100632	73403	30703	16662	32734	310180	24271	366103
<b>Storage 30% (ML)</b>	112459	84691	35144	18113	36231	335660	26846	408290
<b>Storage 20% (ML)</b>	119193	91725	37809	21771	44496	382518	33172	466108
<b>Storage EWR (ML)</b>	<b>50237</b>	<b>37171</b>	<b>14560</b>	<b>7738</b>	<b>14925</b>	<b>150044</b>	<b>10697</b>	<b>177048</b>

Direct (December to April inclusive) and Storage (May to November inclusive)

The Direct take period EWR for Upper Ringarooma, Dorset, Legerwood, Cascade, Frome and Wyniford WMRs is calculated by summing the 17<sup>th</sup> percentile equivalent volume for each month of December to April inclusive from the measured EWR. The Direct take period EWR for Middle Ringarooma and Lower Ringarooma WMRs is calculated by summing the 13<sup>th</sup> percentile equivalent volume for each month of December to April inclusive from the measured EWR.

The Storage take period EWR is calculated by summing the 20<sup>th</sup> percentile volume for each month of May to November inclusive.

Table 7 Ringarooma catchment sustainable allocation limits from "Natural Water Yield" modelled output.

Period	Upper Ringarooma	Dorset	Legerwood	Cascade	Frome	Middle Ringarooma	Wyniford	Lower Ringarooma
<b>Direct (Dec-Apr)</b>								
<b>Surety 5 Allocation Limit (ML)</b>	392	569	343	190	420	4037	286	6669
<b>Surety 6 Allocation Limit (ML)</b>	824	784	241	136	306	2431	227	3143
<b>Storage (May-Nov)</b>								
<b>Surety 5 Allocation Limit (ML)</b>	20275	13239	5602	2237	5679	47465	3660	62367
<b>Surety 6 Allocation Limit (ML)</b>	3114	3396	1330	821	1914	12868	1666	18367
<b>Overall Total</b>	<b>24605</b>	<b>17989</b>	<b>7516</b>	<b>3384</b>	<b>8319</b>	<b>66800</b>	<b>5840</b>	<b>90546</b>

Table 8 Volumes of water that would be allocated in the Ringarooma catchment, based on future climate projections.

Period	Upper Ringarooma	Dorset	Legerwood	Cascade	Frome	Middle Ringarooma	Wyniford	Lower Ringarooma
<b>Direct (Dec-Apr)</b>								
<b>Surety 5 Allocation Limit (ML)</b>	337	490	295	163	361	3471	246	5736
<b>Surety 6 Allocation Limit (ML)</b>	709	674	207	117	263	2091	196	2703
<b>Storage (May-Nov)</b>								
<b>Surety 5 Allocation Limit (ML)</b>	17436	11386	4818	1924	4884	40820	3148	53636
<b>Surety 6 Allocation Limit (ML)</b>	2678	2921	1144	706	1646	11067	1433	15795
<b>Overall Total</b>	<b>21160</b>	<b>15471</b>	<b>6464</b>	<b>2911</b>	<b>7154</b>	<b>57448</b>	<b>5022</b>	<b>77870</b>

#### **5.4 Sustainable allocation limits and water availability**

Combining sustainable allocation limits with volumes of water currently allocated allows for determination of whether additional water is available for allocation within a catchment.

The annual sustainable allocation limit of natural flow in the Ringarooma catchment is 90,546 ML. Sustainable allocation limits for summer direct take and winter storage periods are 9,812 ML and 80,734 ML respectively.

The consumptive current allocation information provided in Table 2 forms the basis for deriving water availability in the eight WMRs in the Ringarooma catchment. Water availability is considered under principles 7 and 8 of the Water Allocation Policy. Allocation license is provided on an annual volume basis at various surety levels and with restriction rules applied during summer direct take & winter storage periods. The bulk of the allocation is during winter when water is stored for summer usage. Currently only surety 1, 5 and 6 level allocations exist in the Ringarooma catchment. The total annual volume of consumptive allocation in the Ringarooma catchment is 31,851 ML.

A summary of the available surface water yield in the eight WMRs is given in Table 9. Based on the current consumptive water allocations in the catchment, except for Frome and Wyniford the remaining WMRs have no surety 5 water available during summer. Surety 6 level water is available across the eight WMRs except for the Cascade WMR. However, when Surety Level 5 and 6 are considered together, there is little resource available above the Middle Ringarooma WMR during the summer period.

Further considerations is also given to future climate scenarios and as discussed in section 5.2 indicates that to protect current allocations under a future dry climate no further water would be allocated during the summer period.

During winter, sustainable water allocation limits indicate that surety 5 and 6 water is available across all the WMRs except for the Cascade WMR. An over allocation of 3300 ML surety 5 water has resulted in the net negative yield for the Cascade WMR.

Overall the WMRs in the Ringarooma River catchment have sustainable allocation limits that indicate water is available for future allocations during the winter period. The total storage water available for allocation in the Ringarooma catchment over the winter period is approximately 55,693 ML.

Table 9 Available natural flow yield under current allocation limits in the Ringarooma River catchment WMRs.

Period	Upper Ringarooma	Dorset	Legerwood	Cascade	Frome	Middle Ringarooma	Wyniford	Lower Ringarooma
<b>Direct (Dec-Apr)</b>								
<b>Surety 5 Allocation Limits</b>	392	569	343	190	420	4037	286	6669
<b>Surety 5 Allocated</b>	2398	638	570	1407	60	5697		5853
<b>Surety 5 Available</b>	-2006	-68	-227	-1217	361	-1661	286	816
<b>Surety 6 Allocation Limits</b>	824	784	241	136	306	2431	227	3143
<b>Surety 6 Allocated</b>				827		827		957
<b>Surety 6 Available</b>	824	784	241	-691	306	1604	227	2186
<b>Total Direct Available</b>	-1182	716	14	-1908	666	-57	514	3003
<b>Storage (May-Nov)</b>								
<b>Surety 5 Allocation Limits</b>	20275	13239	5602	2237	5679	47465	3660	62367
<b>Surety 5 Allocated</b>	10631	619	1714	1993	2027	17487	1700	22227
<b>Surety 5 Available</b>	9644	12620	3888	244	3652	29977	1960	40140
<b>Surety 6 Allocation Limits</b>	3114	3396	1330	821	1914	12868	1666	18367
<b>Surety 6 Allocated</b>	321	450	27	1173		2124		2814
<b>Surety 6 Available</b>	2793	2946	1303	-352	1914	10744	1666	15553
<b>Total Storage Available</b>	12437	15567	5191	-108	5566	40722	3626	55693
<b>Total available Yield</b>	<b>11255</b>	<b>16283</b>	<b>5205</b>	<b>-2016</b>	<b>6232</b>	<b>40665</b>	<b>4140</b>	<b>58695</b>

Surety 5 & 6 allocations for Middle and Lower Ringarooma WMRs are cumulative from upstream catchments.

## 6 Summary

To assess water resource availability of eight defined WMR in the Ringarooma River catchment a hydrological surface water model was developed for the catchment.

Applying outcomes from CSIRO climate change scenario to modelled natural flow estimates and combining these estimates with the current water allocations facilitated an assessment of water availability in the catchment and determination of sustainable water allocation limits.

The analysis indicates that:

- the average annual natural flow yield in the Ringarooma catchment is approximately 414,000 ML;
- current annual water allocation in the catchment is 86,866 ML of which 31,851 ML is for consumptive purposes;
- 58,695 ML of water is potentially available for allocation in the Ringarooma catchment within a given year;
- 3,003 ML of water is potentially available for allocation during the summer direct take period (December to April inclusive). Upper Ringarooma, Cascade and Middle Ringarooma WMRs show net over allocation during the summer;
- while the sustainable allocation limit for the summer period indicates 3,003 ML of water is potentially available, under a future dry climate there is limited further water available to allocate during the summer period;
- 55,893 ML of water is potentially available for allocation during winter storage period (May to November inclusive);
- considering a future dry climate scenario, up to 86% of the sustainable allocation limits would be allocated to ensure current entitlements and the environment are not impacted by climate change impacts on the water resource.

## 7 References

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