

Appendix C Methods Report





Appendix C

Methods Report

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Summary of methods

This Appendix summarises the methods for determining the volume of permitted take and actual take. The determination of these volumes supports Victoria's reporting against sustainable diversion limit compliance.

Annual permitted take in the Northern Victoria water resource plan area, Victorian Murray water resource plan area and the Goulburn-Murray water resource plan area is either calculated or estimated based on the best available information for that form of take and the water resources in the water resource plan area. The methods are outlined in [Table 6](#) for surface water and [Table 11](#) for groundwater.

Annual actual take is the volume of water actually taken from the system within an accounting period. At the end of each water accounting period, actual take is subtracted from the annual permitted take. The difference is recorded as either an annual debit or credit, as outlined in section 6.11 of the Basin Plan. To remain compliant with sustainable diversion limits (SDL), cumulative debit cannot be equal to or greater than 20 percent of the SDL as required by section 6.12 of the Basin Plan. The obligation to comply with permitted take is provided in response to section 10.11 of the Basin Plan.

A summary of whether permitted take and actual take are estimated or calculated is shown in [Table 1](#).

Where the form of take relates to take under an entitlement, the method relies on volumes recorded in the Victorian Water Register (VWR). The VWR provides the most up-to-date information about entitlement volumes for an area or resource as it records the volume taken under a particular entitlement. These volumes are measured rather than estimated.

Where there is no recorded entitlement data, such as for domestic and stock rights, or net take by commercial plantations, an estimate is required to determine the permitted take for the accounting period. Equally, where there is no recorded entitlement data for a form of take, an estimate will be required to determine actual take.

Table 1: Summary of permitted take and actual take methods

Form of take	Method	
	Permitted take	Actual take
Surface water		
Take from a regulated river (excluding basic rights)	Determined using a water resource plan model adjusted for water recovered for the environment and trade	Calculated using usage data on the Victorian Water Register
Take from a regulated river under basic rights and take from a watercourse under basic rights	Determined based on best available hydrological model information	Estimated based on best available hydrological model information
Take from a watercourse (excluding basic rights) – modelled component	Determined using a water resource plan model adjusted for water recovered for the environment and trade	Calculated using usage data on the Victorian Water Register
Take by runoff dams (excluding basic rights)	Determined based on entitlement data on the Victorian Water Register	Calculated based on entitlement data on the Victorian Water Register
Take from a watercourse (excluding basic rights) – out of model component*	Determined as the long-term average take for the period between 1997-98 to 2009-10*	Estimated as the long-term average take for the period between 1997-98 to 2009-10*
Take by runoff dams under basic rights	Determined based on best available hydrological model information	Estimated based on best available hydrological model information
Net take by commercial plantations	Determined using the SoilFlux model	Estimated using the SoilFlux model
Groundwater		
Take from groundwater (excluding basic rights)	Determined by the relevant SDL	Calculated using usage data and estimates on the Victorian Water Register
Take from groundwater (basic rights)	Determined based on best available water user information	Estimated based on best available water user information

* interim method is subject to a 2-year review (see [Part 2.2.1](#), [Part 3.1.3.2](#) and [Table 6](#))

1. Background information

1.1 Basin Plan requirements

Division 2—Take for consumptive use

Note: This Division sets out the principal provisions for how a water resource plan incorporates and applies the sustainable diversion limit for each SDL resource unit. Sustainable diversion limits take effect from 1 July 2019. Water resource plans may be accredited before then and ordinarily have effect for 10 years. See section 64 of the Commonwealth Water Act.

10.10 Annual determinations of water permitted to be taken

For each SDL resource unit in a water resource plan area, and for each form of take, the water resource plan must set out the method for determining the maximum volume of water that the plan permits to be taken for consumptive use during a water accounting period.

The method for subsection (1) may include modelling, and must be designed to be applied after the end of the relevant water accounting period, having regard to the water resources available during the period.

The method must:

- *account for the matters in subsection 10.12(1); and*
- *be consistent with the other provisions of the water resource plan*

The plan must also set out a demonstration that the method relates to the SDL of each resource unit in such a way that, if applied over a repeat of the historical climate conditions, it would result in meeting the SDL for the resource unit, including as amended under section 23B of the Act.

Note 1: Under the Basin Plan, the SDL is the same as the long-term annual diversion limit because the temporary diversion provision for each SDL resource unit is zero. Section 6.04 and Schedules 2 and 4 set out the SDLs for each SDL resource unit.

Note 2: Amendments under section 23B of the Act are made following proposals for adjustment under Chapter 7.

If, as a result of an amendment under section 23B of the Act, the SDL for a surface water SDL resource unit is expressed as a formula that changes with time, the SDL for subsection (4) is taken to be:

- *for a water accounting period beginning on or after 1 July 2019—the SDL as it stood on 30 June 2019; and*
- *for a water accounting period beginning on or after 1 July 2022—the SDL as it stood on 30 June 2022; and*
- *for a water accounting period beginning on or after 1 July 2024—the SDL as it stood on 30 June 2024*

10.12 Matters relating to accounting for water

3. For paragraph 10.10(3)(a), the following matters must be accounted for:

- all forms of take from the SDL resource unit and all classes of water access right;
- water allocations that are determined in one water accounting period and used in another, including water allocations that are carried over from one water accounting period to the next;
- for a surface water SDL resource unit—return flows, in a way that is consistent with arrangements under the Agreement immediately before the commencement of the Basin Plan;
- subject to subsection (3)—trade of water access rights;
- water resources which have a significant hydrological connection to the water resources of the SDL resource unit;
- circumstances in which there is a change in the way water is taken or held under a water access right;
- changes over time in the extent to which water allocations in the unit are utilised; Note: Paragraph (g) includes what is commonly known as a growth-in-use strategy;
- water sourced from the Great Artesian Basin and released into a Basin water resource, by excluding that water; and
- water resources which are used for the purpose of managed aquifer recharge
- Subject to this section, the method may account for other matters
- For paragraph (1)(d), the water resource plan must account for the disposal and acquisition of held environmental water separately and in a way that does not affect the method under section 10.10

Division 3—Actual take

10.15 Determination of actual take must be specified

1. A water resource plan must set out how the quantity of water actually taken for consumptive use by each form of take from each SDL resource unit will be determined after the end of a water accounting period using the best information available at the time.

Note: The annual actual take for the SDL resource unit is the sum of the quantity of water actually taken by each form of take for consumptive use: see subsection 6.10(2).

Paragraph 71(1)(c) of the Act requires the annual actual take to be set out in a report to the Authority within 4 months after the end of the water accounting period.

2. For a particular form of take, and subject to the requirement that a determination use the best information available at the time, a determination may be made by:

- measuring the quantity of water actually taken; or
- estimating the quantity of water actually taken; or
- a combination of the above

Where a determination for a form of take is made by estimating the quantity of water actually taken, the water resource plan must provide for the estimate to be done consistently with the method under subsection 10.10(1) that relates to that form of take.

The quantity of water actually taken must:

- *include water that was held environmental water which was disposed of and then used in the SDL resource unit for consumptive use; and*
- *exclude water sourced from the Great Artesian Basin and released into and taken from a Basin water resource*

1.2 Best available information summary

Victoria has used the best available information to develop the models and methods in this report.

The information is considered the best available because:

- it is the most current at the time at which the model or method must account for water taken from the system
- it is based on an updated model and more accurately reflects the management of Victoria's water resources
- it is obtained in a manner that is cost effective and fit for purpose
- the Victorian Water Register holds the most accurate and up-to-date information regarding water entitlements

It is not proposed to use methods of obtaining information to assess consumptive water take from the system where the cost and effort involved in obtaining the information is not commensurate with the benefit or increased certainty achieved by including the data.

For the purposes of determining take by entitlement holders, the Victorian Water Register is the most accurate means of determining the number of entitlements and the total volume authorised to be taken under those entitlements. All entitlements issued in Victoria are recorded on the register in accordance with the requirements in the Victorian Water Act.

1.3 Utilisation

The sustainable diversion limit (SDL) represents the long-term average of the environmentally sustainable limit on the volume of water that can be taken from the Murray-Darling Basin resource. In Victoria, water entitlements (water access rights) are not issued above the sustainable limit for the relevant resource. This sustainable limit will now be represented by the SDL in Victoria's water resource plan areas.

In determining whether entitlements can be issued, there is an assumption of full use of an entitlement. This means that in considering whether a new entitlement can be issued in respect of a resource or system, consideration is given to the total volume of water authorised to be taken from that resource or system under existing entitlements.

In circumstances where water users are not using the total volume of water allocated under their entitlement, it is not assumed that underutilised water from an existing entitlement is water available for new users. Victoria's commitment to secure entitlements to water is based on water management decisions that advance security and reliability of a user's entitlement to the extent possible.

As a result, there may be circumstances where the total volume of water allocated under entitlements is higher than the volume of water actually taken by the entitlement holders in a system. However, this does not result in the allocation of new entitlements to take up the unused water.

2. Baseline diversion limit and sustainable diversion limit estimates

2.1 Sustainable diversion limits (SDL)

2.1.1 Shared and local reduction amounts

Sustainable diversion limits are focused on confining consumptive water use to an environmentally sustainable limit. The difference between baseline diversion limits and SDLs is the volume of water that needs to be recovered. The sustainable diversion limits take effect from 1 July 2019 and are made up of local reduction amounts, shared reduction amounts and offsets achieved through the Sustainable Diversion Limit Adjustment Mechanism (SDLAM).

Local reduction amounts are long-term average volumes of water identified to be recovered in a specific SDL resource unit. The volumes are listed in Schedule 2 of the Basin Plan in reference to estimated BDLs.

The shared reduction amounts are long-term average volumes of water that can be allocated between SDL resource units and must be recovered to meet the southern Basin Victoria zone shared reduction target of 425.3 GL per year. This is because this volume is intended to contribute to broader environmental outcomes across the Basin. Shared reduction targets for northern Victorian catchments by SDL resource unit are shown in [Table 2](#).

In Victoria, the water has been recovered through a number of projects and partly through Commonwealth purchases. The recovery to date has been from regulated systems.

2.1.2 Sustainable diversion limit adjustment mechanism

The Basin Plan allows for changes to water recovery targets through the Sustainable Diversion Limit Adjustment Mechanism.

The adjustment mechanism allows for up to 605 gigalitres (GL) of the Basin Plan's total water recovery target to be achieved through offsets from projects that deliver equivalent environmental outcomes without the need for more water, and therefore increases the sustainable diversion limit. Projects may include environmental works and measures or operational rule changes. The projects are explained further in [Schedule 1](#).

The 605 GL Basin-wide offset has been apportioned to each SDL resource unit in Victoria's North and Murray water resource plan area as shown in [Table 2](#). The Basin Plan limits the offset to 5 percent of the Basin's SDL which at the time was equal to 543 GL. Therefore, an additional 62 GL of efficiency measures must be implemented by 2024 across the Basin for the full 605 GL adjustment to be available.

As the efficiency measures are progressively completed, the SDL will change between 2019 and 2024 to reflect this. Section 10.10(5) of the Basin Plan allows for a staged SDL if the method for determining permitted take is a formula that changes with time. Efficiency measures are outlined in [Schedule 1](#).

Table 2: Local and shared reduction amounts and SDL offsets by SDL resource unit

SDL resource unit ¹	Local reduction amount (GL/yr)	Shared reduction amount (GL/yr) ²	Apportioned supply contribution (GL/yr) ³	Target recovery at 30 June 2019 ^{2,3}
Victorian Murray	253.0	210.8	72.8	391
Kiewa	0	1.1	1.3	(0.2)
Ovens	0	2.7	3	(0.3)
Goulburn	344.0	186.4	174.5	355.9
Broken	0	1.3	1.1	0.2
Campaspe	18.0	13.2	2.6	28.6
Loddon	12.0	9.8	10.9	10.9
Total	627	425.3	266.2	786.1

1. does not include Wimmera-Mallee SDL resource unit
2. brackets indicate a negative number, where a negative target recovery is given this is a net zero change from BDL to SDL. Note: the target recovery does not include the current efficiency contribution which is required as part of the SDL adjustment amount (see Schedule 6A of the Basin Plan).
3. full apportioned supply contribution only applies if 62 GL of efficiency measures are complete

2.1.3 Sustainable diversion limits and Basin Plan section 10.10(5) requirements

Taking into account the information in [Part 2.1.1](#) and [Part 2.1.2](#), the sustainable diversion limit for the relevant water year will be determined based on the target recovery as at 30 June of the preceding year. The target recovery will be determined by the volume of target environmental water to be recovered as at 30 June of the relevant water year, accounting for any offsets achieved. That is;

Target recovery = local reduction amount + shared reduction amount - SDL adjustment amount

If less than 62 GL of efficiency measures are complete, the SDL adjustment amount is determined in accordance with the formula outlined in section Schedule 6A of the Basin Plan. Column 5 in [Table 2](#), gives the apportioned supply contribution for 30 June 2019 assuming that the full 62 GL of efficiency measures are complete. These volumes can be found in subsection S6A.02(1) of Schedule 6A of the Basin Plan.

As the sustainable diversion limit is a formula that changes with time, section 10.10(5) of the Basin Plan applies. This means:

- As at 1 July 2019: SDL = BDL – target recovery as at 30 June 2019
- As at 1 July 2022: SDL = BDL – target recovery as at 30 June 2022
- As at 1 July 2024: SDL = BDL - target recovery as at 30 June 2024

The SDLs in [Table 3](#) for Victoria’s estimate assume that zero GL of efficiency measures are complete.

2.2 Comparison to Basin Plan estimates of baseline diversion limits and sustainable diversion limits

This section provides a brief discussion and comparison of Victoria's estimates of baseline diversion limits (BDL) and sustainable diversion limits provided in [Table 3](#), compared to the estimates of these numbers provided in schedules 2–4 of the Basin Plan.

In each case the revised estimate is based on the same level of development as specified in the Basin Plan, 30 June 2009, for all SDL resource units in the Victorian Murray and Northern Victoria water resource plan areas. Refer to [Part 3](#) of this report for more detailed discussion of the method used to determine the SDL in each case.

2.2.1 Surface water

The total surface water BDL for the Victorian Murray water resource plan area was estimated to be 1731.6 GL/year in the Basin Plan compared to 1,745.7 GL/year in Victoria's estimate. For the Northern Victoria water resource plan area, the total surface water BDL was estimated to be 2161 GL/year in the Basin Plan compared to 2,066.6 GL/year in Victoria's estimate.

Victoria's SDL estimates in [Table 3](#) for take from a regulated river (excluding basic rights) and take from a watercourse (excluding basic rights) for the Kiewa, Ovens and Victorian Murray SDL resource units, account for the local reduction amounts, shared reduction amounts and offsets achieved from the Sustainable Diversion Limit Adjustment Mechanism. This estimate assumes zero efficiency measures are complete.

For the out of model component of take from a watercourse (excluding basic rights), early discussions with the MDBA identified a revised method of total entitlement volume as the method for determining BDL, SDL and permitted take. This would have increased the BDL and SDL in some SDL resource units. This remains Victoria's preferred method as under Victoria's water management framework, take and use licence holders and unregulated bulk entitlement holders are able to take the full volume of their entitlement in a given water year, subject to the licence or bulk entitlement conditions.

In late 2018 the MDBA advised that this would not be an acceptable method. Victoria has proposed a two-year review be undertaken to revise the BDL, SDL and permitted take method for this form of take. Whilst the review is completed, the BDL equals the SDL, permitted take and actual take (see [Part 3.1.3.2](#) and [Table 6](#)).

The Basin Plan estimate for the total combined BDL for Goulburn, Broken, Campaspe and Loddon SDL resource units for this form of take has been adopted as shown in [Table 3](#). The total combined volume has been reapportioned by Victoria based on recent actual take data. The Basin Plan estimate for the Victorian Murray out of model component of 5.5 GL/year has been adopted and is also subject to the two-year review.

The adoption of the interim method does not:

- limit the ability of a holder of a take and use licence to utilise their entitlement during the two-year review process;
- prejudice Victoria from identifying a method on review that would enable the accumulation of credits if actual take is below what would be permitted in a given year,
- prejudice Victoria from adopting a method in 2 years which may result in an increased BDL
- prevent a revised SDL compliance assessment to be undertaken of the period since 1 July 2019, once a revised BDL and permitted take method is agreed (consistent with the MDBA's SDL reporting and compliance framework).

For all other forms of take, the SDL equals the baseline diversion limit. An explanation of the differences between the Basin Plan BDL estimates and Victoria's BDL estimates is given in [Table 4](#), and the methods are further explained in [Table 6](#).

2.2.2 Groundwater

The Basin Plan estimates of baseline diversion limits and sustainable diversion limits for groundwater have been adopted as shown in [Table 5](#).

Table 3: Comparison of Victoria's and Basin Plan surface water baseline diversion limit and sustainable diversion limit estimates for each form of take for all SDL resource units in the Victorian Murray and Northern Victoria water resource plan areas.

Form of take:		(a)	(b)	(c)	(d)	(d)(i)	(d)(ii)	(e)
SDL resource unit		Take from a regulated river (excluding basic rights)	Take from a watercourse (excluding basic rights)	Take from a waterway (regulated river and watercourse) under basic rights	Take by run off dams	Runoff dams (excluding domestic and stock)	Runoff dams (domestic and stock)	Net take of water by commercial plantations
Victorian Murray (SS2)	Basin Plan	n/a	1,662	n/a	23	n/a	n/a	22
		BDL (GL/yr)						
	Victoria	n/a	1,279.4 ^a	n/a	23	n/a	n/a	22
		BDL (GL/yr)		8.2	12.4	4.8	7.6	24.2
Kiewa (SS3)	Basin Plan	n/a	1,274.7 ^{bc}	8.2	12.4	4.8	7.6	24.2
		BDL (GL/yr)		n/a	6.6	n/a	n/a	7
	Victoria	n/a	11	n/a	6.6	n/a	n/a	7
		BDL (GL/yr)		11.2 ^d	8.2	4.5	3.7	7.3
Ovens (SS4)	Basin Plan	n/a	11.2 ^c	1	8.2	4.5	3.7	7.3
		BDL (GL/yr)		n/a	26	n/a	n/a	32
	Victoria	n/a	25	n/a	26	n/a	n/a	32
		BDL (GL/yr)		25.4 ^d	25	12.5	12.5	32.5
Goulburn (SS6)	Basin Plan	1,552	25.4 ^c	2.9	25	12.5	12.5	32.5
		BDL (GL/yr)		n/a	86	n/a	n/a	23
	Victoria	1,190.1 ^a	29	n/a	86	n/a	n/a	23
		BDL (GL/yr)		6.3	51.5	27.1	24.4	22.4
	SDL (GL/yr)	1,178.9 ^c	18.3 ^b	6.3	51.5	27.1	24.4	22.4

Form of take: SDL resource unit		(a) Take from a regulated river (excluding basic rights)	(b) Take from a watercourse (excluding basic rights)	(c) Take from a waterway (regulated river and watercourse) under basic rights	(d) Take by run off dams	(d)(i) Runoff dams (excluding domestic and stock)	(d)(ii) Runoff dams (domestic and stock)	(e) Net take of water by commercial plantations
Broken (SS5)	Basin Plan	13	0	n/a	30	n/a	n/a	13
		BDL (GL/yr)	0	n/a	30	n/a	n/a	13
	Victoria	12.5 ^a	2.9 ^b	1.6	16.7	10.4	6.3	14.9
		BDL (GL/yr)	13.2 ^d	2.9 ^b	1.6	16.7	10.4	6.3
Campaspe (SS7)	Basin Plan	111	2	n/a	39	n/a	n/a	1
		BDL (GL/yr)	2	n/a	39	n/a	n/a	1
	Victoria	81.9 ^a	0.9 ^b	1.6	20.5	6.1	14.4	18
		BDL (GL/yr)	115.8 ^d	0.9 ^b	1.6	20.5	6.1	14.4
Loddon (SS8)	Basin Plan	89	0	n/a	85	n/a	n/a	5
		BDL (GL/yr)	0	n/a	85	n/a	n/a	5
	Victoria	771 ^a	8.9 ^b	4.8	34.6	18.1	16.6	5.5
		BDL (GL/yr)	85.8 ^d	8.9 ^b	4.8	34.6	18.1	16.6

a. includes the local and shared reduction amounts, and the full offset volume apportioned from the SDL adjustment mechanism, assuming 62GL of efficiency measures are complete

b. interim volumes subject to a two-year review (see [Table 6](#), and [Section 3.1.3.2](#))

c. expected SDL from 1 July 2019 – see [Section 2.1.3](#); assumes zero GL efficiency measures achieved to be apportioned as the SDL offset apportionment, as explained in Schedule 6A of the Basin Plan.

d. the BDLs are the best estimate at the time Victoria's North and Murray Water Resource Plan was accredited. They may be subject to change as the models are progressively updated with improved information

Table 4: Explanation for differences between Basin Plan BDLs and Victoria's BDLs

Form of take		Explanation of difference between Basin Plan and Victoria's estimates
(a)	Take from a regulated river (excluding basic rights)	Changes in estimates are based on updated information and models see - Hydrologic Models for Basin Plan Compliance in the Northern Victoria Water Resource Plan Area (DELWP, 2019).
(b)	Take from a watercourse (excluding basic rights) – modelled component	Changes in estimates are based on updated information and model see - Revised BDL Estimate for NSW, Victoria and SA Murray and Lower Darling SDL Units, Technical Report no. 2019/02 (MDBA 2019)
(b)	Take from a watercourse (excluding basic rights) – out of model component	<p>The Basin Plan estimate is based on long-term average take between 1997-98 and 2009-10.</p> <p>The same method will be used until a more appropriate method is developed (as explained in Part 2.2.1, Part 3.1.3.2 and Table 6). The estimate for the Goulburn, Broken, Campaspe and Loddon SDL resource units is different to Basin Plan as the total BDL has been reapportioned for accounting purposes and to better align with recent actual take data. The BDLs are subject to the two-year review identified in Part 3.1.3.2.</p>
(c)	Take from a waterway under basic rights	The volume is estimated based on a model of stock and domestic use. This volume also includes a best estimate of take under section 8A rights by Traditional Owners who have a natural resource agreement under the <i>Traditional Owner Settlement Act 2010</i> .
(c) (i)	Take from a regulated river under basic rights	This is being estimated together with take from a watercourse under basic rights, see above.
(c) (ii)	Take from a watercourse under basic rights	This is being estimated together with take from a regulated river under basic rights see above.
(d)	Take by runoff dams	Volume is based on more accurate data and comprises consumptive take and take for domestic and stock purposes by runoff dams
(d) (i)	Runoff dams (excluding domestic and stock)	This volume was estimated based on the sum of existing entitlements recorded on the Victorian Water Register as of July 2016
(d) (ii)	Runoff dams (domestic and stock)	Estimate is based on modelling using the number and volume of dams shown in aerial imagery as at 2005 adjusted to account for the entitlements shown in item (d)(i)
(e)	Net take of water by commercial plantations	Estimate is based on modelling recently undertaken by DELWP using the Soilflux model.

Table 5: Basin Plan groundwater baseline diversion limit and sustainable diversion limit estimates for each form of take

Form of take		BDL (ML) ^a	SDL (ML) ^b
Goulburn-Murray: Shepparton Irrigation Region SDL resource unit			
1	Take from groundwater (excluding basic rights)	244,100	244,100
2	Take from groundwater under basic rights		
Goulburn-Murray: Highlands SDL resource unit			
1	Take from groundwater (excluding basic rights)	38,300	68,700
2	Take from groundwater under basic rights		
Goulburn-Murray: Sedimentary Plain SDL resource unit			
3	Take from groundwater (excluding basic rights)	203,500	223,000
4	Take from groundwater under basic rights		
Goulburn-Murray: deep SDL resource unit			
5	Take from groundwater (excluding basic rights)	0	20,000
6	Take from groundwater under basic rights	0 [^]	0 [^]

a. estimates from column 3, Schedule 4 of the Basin Plan have been adopted

b. estimates from column 4, Schedule 4 of the Basin Plan have been adopted

[^] at the time of setting these estimates there was no take from the deep SDL resource unit under basic rights, but this may be revised in the future.

2.3 SDL resource units for compliance with sustainable diversion limits

Part 3 of Chapter 10 of the Basin Plan provides the basis for how Victoria must report and demonstrate compliance with SDLs.

The SDL compliance test is provided for in sections 6.10, 6.11 and 6.12 of the Basin Plan for surface water and sections 6.12A, 6.12B and 6.12C for groundwater. Under these sections, SDL compliance reporting is done in this way:

- a determination of annual permitted take is made in accordance with the methods provided in Victoria's North and Murray Water Resource Plan in accordance with section 10.10 of the Basin Plan
- a determination of annual actual take is made in accordance with the methods provided in Victoria's North and Murray Water Resource Plan in accordance with section 10.15 of the Basin Plan
- an assessment is made as to whether actual take exceeded permitted take for the accounting year, a debit or credit is recorded in accordance with section 6.12 and 6.12C of the Basin Plan
- an assessment is made as to whether the cumulative excess take is equal to or more than 20 percent of the relevant sustainable diversion limit

Section 6.12(2)(a) of the Basin Plan allows for the combined limits for Victorian Murray, Kiewa and Ovens SDL resource units to be treated as a single SDL resource unit. Section 6.12(2)(b) of the Basin Plan also allows the combined limits for Goulburn, Broken, Campaspe and Loddon SDL resource units to be treated as a single SDL resource unit.

The volume of annual actual take and the volume of annual permitted take for each form of take for consumptive use in each SDL resource unit will be reported. In addition, the difference between annual actual take and annual permitted take will be reported at the SDL resource unit scale as well as for the combined SDL resource units for the purposes of determining overall compliance with the SDL across those areas.

This means that when reporting compliance with SDLs, the Victorian Murray water resource plan area will include the resources of the Ovens SDL resource unit and the Northern Victoria water resource plan area will exclude the Ovens SDL resource unit. Victoria's obligation is to ensure that water taken does not exceed these limits:

- combined Victorian Murray sustainable diversion limit
- combined Northern Victoria sustainable diversion limit
- Goulburn-Murray groundwater sustainable diversion limit

The Murray-Darling Basin Authority is required to publish a register of the amount of water taken each year across the basin. Further information on this process and how MDBA and basin states will respond to non-compliance with sustainable diversion limits can be found in *Sustainable Diversion Limit Reporting and Compliance Framework – Summary* (Murray-Darling Basin Authority, 2018).

3. Surface water

3.1 Determination of permitted and actual take

Under section 10.10(1) of the Basin Plan, Victoria's North and Murray Water Resource Plan is required to set out the method for determining permitted take for each form of take in the water resource plan areas.

Section 6.10 of the Basin Plan defines permitted take to be the maximum volume of water permitted to be taken by each form of take for consumptive use from the sustainable diversion limit resource unit. Section 6.10 defines actual take as the sum of the volume of water actually taken by each form of take for consumptive use from the SDL resource unit.

Permitted take is determined for each form of take using the methods detailed here. The method for determining permitted take will be applied at the end of each water accounting period (yearly), using the best available information at the time.

The Victorian Murray water resource plan area and the Northern Victoria water resource plan area consider the following forms of take:

- take from a regulated river (excluding basic rights)
- take from a watercourse (excluding basic rights)
- take from a regulated river under basic rights
- take from a watercourse under basic rights
- take by runoff dams (excluding basic rights)
- take by runoff dams under basic rights
- net take by commercial plantations

Actual take is the water diverted or taken by water users from the resource or system to be stored or used. [Chapter 15](#) Measuring and monitoring of the Victoria's North and Murray Water Resource Plan Comprehensive Report discusses actual take and how take is metered or measured.

Section 10.15 of the Basin Plan requires that Victoria's North and Murray Water Resource Plan sets out how the volume of water actually taken for consumptive use will be determined for each form of take within each SDL resource unit.

Actual take must be assessed against permitted take and the difference is recorded as either a debit or credit. The cumulative volume of water actually taken cannot exceed or equal a debit of 20 percent of the sustainable diversion limit.

3.1.1 Methods

The following sections provide a summary of the water management framework and assessment tools used to determine actual take and permitted take for above forms of take. [Table 6](#) outlines the methods used for determining actual and permitted take for each form of take in the Northern Victoria water resource plan area and the Victorian Murray water resource plan area.

Where the form of take relates to take under a Victorian entitlement (water access right), the Victorian water management framework has measures in place to make sure that actual take during the accounting period responds to water availability during that same period. These mechanisms are outlined below.

For forms of take that rely on the estimation of use because they are not actively monitored, and take is not metered, the tools used to estimate the volume of actual use are also outlined here.

Table 6: Methods for determining permitted take—surface water

**Basin
Plan
s10.10(1)
&
s10.15(1)**

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
1	Take from a watercourse (excluding basic rights) – modelled component	<p>The method used for determining permitted take from a regulated river (excluding basic rights) in the Victorian Murray (SS2), Kiewa (SS3) and Ovens (SS4) SDL resource units includes the Source Murray Model which was developed by:</p> <ul style="list-style-type: none"> Updating the BDL model with known operating changes since 30 June 2009 (note: where no recovery is included, this is equivalent to the BDL) Scaling modelled diversions to match the BDL minus recovery included in the model <p>The Source Murray Model will be used at the end of each year as follows:</p> <ol style="list-style-type: none"> extend the inputs (inflows, rainfall, evaporation and demands) to 30 June, being the end of the last water accounting year run the model from 1 July 2019 to the end of the last water accounting year by initialising the simulation with recorded storage volumes at the end of June 2019 determine the annual permitted take using the consumptive diversions calculated by the model and adjusting it for: <ul style="list-style-type: none"> any water recovery not included in the model using a scaling method that accounts for different entitlement types; an annualised adjustment of any incomplete water recovery; an annualised adjustment for the volume of water achieved through supply contribution an annualised adjustment for the volume of water achieved through efficiency measures; and adjusting for any actual net temporary trade volume into the SDL resource unit from the Victorian Water Register. 	<p>The actual take is the sum of all diversions taken under an entitlement from a regulated river excluding take of environmental water held (or HEW) by VEWH and CEWH as recorded in the Victorian Water Register as of 30 June in each year.</p>	<p>The model is based on policy and operating rules that are applicable from 1 July 2019 and is therefore consistent with the other provisions of the water resource plan, see <i>Source Murray Model – method for determining permitted take</i> (MDBA 2019).</p>

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
2	Take from a regulated river (excluding basic rights)	<p>The method used for determining permitted take from a regulated river (excluding basic rights) in the Goulburn (SS6), Broken (SS5), Campaspe (SS7) and Loddon (SS8) SDL resource units includes a WRP model which was developed by:</p> <ul style="list-style-type: none"> Updating the BDL model with known operating changes since 30 June 2009 (reserve rules, carryover and change in storage volume) Scaling modelled diversions to match the BDL minus recovery included in the model (note: where no recovery is included, this is equivalent to the BDL) <p>The WRP model will be used at the end of each year as follows:</p> <ol style="list-style-type: none"> extend the inputs (inflows, rainfall, evaporation and demands) to 30 June, being the end of the last water accounting year run the model from 1 July 2019 to the end of the last water accounting year by initialising the simulation with recorded storage volumes at the end of June 2019 determine the annual permitted take using the consumptive diversions calculated by the model and adjusting it for: <ul style="list-style-type: none"> any water recovery not included in the model using a scaling method that accounts for different entitlement types; an annualised adjustment of any incomplete water recovery; an annualised adjustment for the volume of water achieved through supply contribution adjusting for the volume of water achieved through efficiency measures; and an annualised adjustment for any actual net temporary trade volume and any back-trade of legacy exchange rate trade that has occurred since 30 June 2009 but not included in the model, into the SDL resource unit, as recorded on the Victorian Water Register. 	<p>The actual take for the Northern Victoria (surface water) water resource plan area is the sum of all diversions taken under an entitlement from a regulated river excluding take of environmental water held (or HEW) by VEWH and CEWH as recorded in the Victorian Water Register as of 30 June in each year.</p>	<p>The model is based on policy and operating rules that are applicable from 1 July 2019 and is therefore consistent with the other provisions of the water resource plan. See <i>Hydrologic Models for Basin Plan Compliance in the Northern Victoria Water Resource Plan Area</i> (DELWP, 2019).</p> <p>The method described in column 2 will be used to determine annual permitted take until better information is available to allow WRP conditions to be modelled to a satisfactory level of certainty.</p> <p>The adjustment for environmental water recovery includes a 30 ML take and use licence that was recovered in the Campaspe SDL resource unit.</p>
<p>This method applies to the following SDL resource units: Goulburn (SS6), Broken (SS5), Campaspe (SS7) and Loddon (SS8) located in the Northern Victoria water resource plan area</p>				

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
3	Take from a watercourse (excluding take under basic rights) – out of model component	Determined as the sustainable diversion limit. Where the SDL is equal to the BDL.		<p>This method applies to the Goulburn, Broken, Loddon and Campaspe SDL resource units in the Northern Victoria water resource plan area and the out of model component for the Victorian Murray SDL resource unit in the Victorian Murray water resource plan area</p> <p>The method will be used for two years whilst Victoria undertakes a review of a more accurate method of determining permitted take from a watercourse (excluding basic rights).</p> <p>It is not cost effective or fit for purpose to develop a simulation model for the small volume of the SDL that applies to this form of take.</p> <p>Until Victoria can determine a more appropriate and cost-effective method for determining permitted take from a watercourse (excluding basic rights) that recognises adjustments under bans and restrictions it is proposed that the permitted take and actual take is equal to the sustainable diversion limit. Annual actual take from the Victorian Water Register will continue to be reported under section 71 reporting requirements. The SDL is equal to the BDL as there is only a small volume of water recovered from this form of take – a 30 ML take and use licence in the Campaspe SDL resource unit which will be accounted for in take from a regulated river (excluding basic rights), see item 2 above.</p> <p>The Basin Plan BDL was estimated using long-term average take data for the period between 1997-98 to 2009-10. This method will also be considered as part of the two-year review to assess whether a better, more robust and cost-effective method is available.</p> <p>In the interim, the total volume of the combined BDL for this form of take will not increase from the Basin Plan BDL, but will be reapportioned between the Goulburn, Broken, Loddon and Campaspe SDL resource units based on recent actual take data from the last three years. The Victorian Murray BDL for this form of take was estimated as 5.5 GL/year and will remain the same in the interim, but will also be subject to the review.</p>

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
				<p>Given that advice from MDBA regarding the appropriateness of the method was not provided until late 2018 Victoria has agreed to a two-year review period within which a new more appropriate method will be developed. The adoption of the interim method does not;</p> <ul style="list-style-type: none"> • limit the ability of a holder of a take and use licence to utilise their entitlement during the two-year review process • prejudice Victoria from identifying a method on review that would enable the accumulation of credits if actual take is below what would be permitted in a given year • prejudice Victoria from adopting a method in two years which may result in an increased BDL • prevent a revised SDL compliance assessment to be undertaken of the period since 1 July 2019, once a revised BDL and permitted take method is agreed (consistent with the MDBA's SDL reporting and compliance framework).

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
<p>Methods apply to the Goulburn, Broken, Loddon, Campaspe and Ovens SDL resource units in the Northern Victorian water resource plan area and the Victorian Murray and Kiewa SDL resource units in the Victorian Murray water resource plan area</p>				
4	<p>Take from a regulated river under basic rights</p>	<p>Estimated as the sum of:</p>	<p>a) a modelled estimate of the volume of water taken from freehold land and Crown frontage based on estimated domestic demand of 0.3 ML/house/year and stock drinking water of 0.03 ML/year/per ha of land grazed; and</p>	<p>This is the baseline diversion limit (BDL) method. Water taken under this form of take can only be used for stock and domestic or in accordance with a section 8 right and represents a relatively consistent pattern of use compared to commercial uses of water. As such, the volume of water taken is not expected to vary greatly from year to year. The method to determine annual permitted take is based on estimates of the long-term average of water taken each year having regard to the water resources available in the water accounting period. This is explained in Stock and Domestic Water Use Modelling Resource Manager's Handbook (RMCG, 2011) and is based on best available information. The modelled estimate uses the upper limit to account for the uncertainty in domestic and stock estimates. The method for determining permitted take and actual take is fit-for purpose for this form of take. The data and information used in the model will be reviewed five yearly, to determine whether it is still the best available. For example, GIS modelling used to determine the number of properties with access to a main waterway will be reviewed to account for any subdivisions.</p>
	<p>Take from a watercourse under basic rights</p>	<p>b) an estimate of the volume of expected water demand under section 8A of the Victorian Water Act where the Traditional Owners have a natural resource agreement under the <i>Traditional Owner Settlement Act 2010</i>.</p>		<p>To date there has been no water taken under section 8A of the Victorian Water Act in the Northern Victoria water resource plan area. For this reason, an estimate has been made of the expected demand for the Northern Victoria water resource plan area or the Victorian Murray water resource plan area. Further work is being undertaken in response to Part 14 of Chapter 10 of Basin Plan to build capacity of Aboriginal communities and explore how section 8A can be utilised. As the level of take increases the method will be reviewed to consider whether it needs to be amended. Where take under basic rights increases to a level that may impact on compliance with sustainable diversion limits, section 10.13 of the Basin Plan applies (for more information see Chapter 9 of Victoria's North and Murray Water Resource Plan Comprehensive Report).</p> <p>Note: no water recovery applies to this form of take.</p>

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
5	Take by runoff dams (excluding basic rights)	<p>Sum of the total volume of licences and registrations associated with runoff dams based on the volume of existing entitlements in the Victorian Water Register as at July 2016.</p> <p>Note: Total volume of licences and registrations refers to the maximum volume authorised to be taken under take and use licences and registration licences.</p>		<p>This is the baseline diversion limit method. The method for determining permitted take and actual take is fit-for-purpose for this form of take and has appropriate regard to the water resources available in the water accounting period for this form of take. This is the volume of existing entitlements as at 30 June 2009 based on data from the Victorian Water Register as at July 2016. Information on the register is considered to be the best available information regarding entitlements in Victoria, and no further licences or registrations for runoff dams have been issued since 30 June 2009. Further information on runoff dams can be found in Chapter 11 on Interception in the Victoria's North and Murray Water Resource Plan comprehensive report.</p> <p>Bulk entitlements are not included as no bulk entitlements have been issued for this form of take in the Northern Victoria water resource plan area or the Victorian Murray water resource plan area.</p> <p>Note: no water recovery applies to this form of take.</p>

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
6	Take by runoff dams (basic rights)	Estimate is based on modelling using the number and volume of dams shown in aerial imagery as at 2005, adjusted by subtracting the volume of runoff dams which are associated with entitlements which are not basic rights to ensure these are fully excluded. Entitlement information was adopted as given in the Victorian Water Register as at July 2016.		<p>The methods are the same as the baseline diversion limit method. As forecast information is not reliable at the present time and introduces additional uncertainty into the estimate, the 2005 aerial imagery is considered to be the best available information for the BDL estimate. This is the volume of existing entitlements as at 30 June 2009 based on data from the Victorian Water Register as at July 2016. Information on the register is considered to be the best available information regarding entitlements in Victoria, and no further licences or registrations for runoff dams have been issued since 30 June 2009.</p> <p>Changes in the extent of runoff dams within the Northern Victoria water resource plan area or the Victorian Murray water resource plan area will be determined using aerial imagery periodically at least every 10 years. This information is proposed to be reviewed at least every 10 years as part of the review of Victoria's sustainable water strategies and the plan will be amended as required to reflect any update in the method.</p> <p>Water taken under this form of take can only be used for stock and domestic purposes under section 8 rights, or where a section 8A right applies, and represents a relatively consistent pattern of use compared to commercial uses of water. As such, the volume of water taken is not expected to vary greatly from year to year, and the method for permitted take uses the long-term averages taken. The method for determining permitted take and actual take is fit-for-purpose for this form of take. For more information see Section 11.4.1 and Section 11.4.2 of the Comprehensive Report.</p> <p>Note: no water recovery applies to this form of take.</p>

Item	Form of take	Permitted take (accredited text for 10.10(1))	Actual take (accredited text for 10.15(1))	Best available information
7	Net take by commercial plantations	<p>Net take is estimated as the difference between the long-term average rate of evapotranspiration from commercial plantations that were present as at 30 June 2009 and from the vegetation type that was thought to be present before the commercial plantations were established. The long-term average rate of evapotranspiration is estimated using the SoilFlux model (HARC, 2016), commercial plantations present in 2009 was estimated by using the SoilFlux model with the following inputs:</p> <ul style="list-style-type: none"> • areas of plantations present as at 2009 using data from the Victorian Land Use Information System (VLUIS) dataset 2009 and improved using aerial imagery and plantation industry data. This is considered the best available data of current commercial plantation conditions and best available evidence suggests that this has not changed between June 2009 and June 2016. • climate data between 1961 and 2016 from the Bureau of Meteorology <p>The long-term average rate of evapotranspiration from plantations present before the commercial plantations were established was estimated by using the SoilFlux model with the following inputs:</p> <ul style="list-style-type: none"> • Estimated land use types present prior to establishment of plantations present in 2009 using nearby land use data from the Victorian Land Use Information System (VLUIS) dataset and expert judgement. • climate data between 1961 and 2016 from the Bureau of Meteorology. 	<p>The methods are the same as the baseline diversion limit method. Victoria's estimate is based on modelling recently undertaken by DELWP, whereas the Basin Plan volume was an estimate prepared by the MDBA. The method is based on the SoilFlux model, (HARC, 2016), (Jacobs, 2016), which is considered to be the best available information.</p> <p>Changes in the extent of plantations within Northern Victoria water resource plan area or the Victorian Murray water resource plan area will be determined using information that is provided on an annual basis by the managers and owners of large plantation estates for bushfire and emergency management purposes. This information will be reviewed every ten years subject to any significant changes in the industry which would cause a review to occur earlier.</p> <p>Take by this form is relatively consistent from year to year, and the method uses the long-term average rate of evapotranspiration to calculate take. The method has appropriate regard to the water resources available in the water accounting period.</p> <p>Note: no water recovery applies to this form of take.</p>	

3.1.2 Consistency with permitted take method

Section 10.15(3) of the Basin Plan also requires that the determination of actual take where it is estimated is done consistently with the method used to determine permitted take. [Table 6](#) identifies the methods for actual and permitted take. For all forms of take where actual take is estimated, the same method is used to determine permitted take.

3.1.3 Managing forms of take under methods for permitted take

3.1.3.1 Take from regulated rivers (excluding under basic rights)

This form of take accounts for the largest proportion of total surface water take in the Northern Victoria water resource plan area and the Victorian Murray water resource plan area. This discussion also applies to modelled component of take from a watercourse (excluding basic rights).

There are seven declared water systems covered in the water resource plan areas, the Murray, Ovens, Broken, Goulburn, Campaspe, Bullarook and Loddon. These systems have been declared in accordance with section 6A of the Victorian Water Act.

In a declared water system, individual water rights and take and use licences have been converted into unbundled entitlements, which means individuals hold water shares, water-use licences or water-use registrations, and works licences or delivery shares.

Goulburn-Murray Water (GMW) is the Authority appointed under section 64GA of the Victorian Water Act to make seasonal determinations in these systems. GMW is responsible for determining the volume of water available to entitlement holders each year in the regulated river systems of the Victorian Murray water resource plan area and the Northern Victoria water resource plan area.

Seasonal determinations are made by Goulburn-Murray Water regularly throughout the season and these inform entitlement holders of the percentage of their entitlement that is available to them in the current year.

Seasonal determinations are based on a water budget which accounts for how much water is in the dams and the expected inflows over a planning period. It also accounts for the volume of water already allocated (i.e. in the current year, carried over from previous years, or water held in inter-valley trade accounts), losses from storages, river and channels, passing flows, reserves for the following year and supplements.

The method for making seasonal determinations is set out in Goulburn-Murray Water's bulk entitlements for each system.

Detailed calculation methods are set out for the larger systems as:

- Murray System: Schedule 3 of Bulk Entitlement (River Murray – Goulburn-Murray Water) Conversion Order 1999
- Goulburn System: Schedule 8 of Bulk Entitlement (Eildon-Goulburn Weir) Conversion Order 1995
- Loddon System: Schedule 4 of Bulk Entitlement (Loddon System – Goulburn-Murray Water) Conversion Order 2005

In the Goulburn and Murray systems, an early reserve exists to improve the security of system operations. Under the early reserve rule for each system, when seasonal determinations against high-reliability water shares for the current season reach 30 percent, half of the further resource improvements are reserved for the following season until specific volumes are set aside. The volume is 270 GL in the Goulburn system and 218 GL in the Murray system. This water is set aside for the following year's water balance.



In the Campaspe and Loddon systems, if full allocation to high-reliability entitlements is possible where the seasonal determination is 100 percent high-reliability water shares, the water budget is calculated over a two-year period. This means inflows and commitments to the end of the following season are considered. This is a less secure reserve than the Goulburn and Murray systems, but it creates some reserves to secure operating water the following year if conditions turn dry.

In the Broken and Bullarook systems, once seasonal determinations reach 100 percent high-reliability water shares, additional resource is attributed to increasing allocation of low-reliability water shares, up to 100 percent.

Victoria's seasonal determination policy is where possible to secure the following year's allocation of high-reliability entitlements before making seasonal determinations to low-reliability entitlements. The security of our high-reliability entitlements has supported the development of high-value irrigated agriculture in Victoria.

These methods are replicated in the models used as part of the method for determining annual permitted take at the end of each year, and this is how the method responds to water availability as required under section 10.10(2) of the Basin Plan.

Method and models for Victoria's North and Murray water resource plan

Hydrological models are used as part of the method for determining permitted take from regulated rivers (excluding basic rights) and the modelled component of take from a watercourse (excluding basic rights). The models are further described in the methods for determining permitted take in [Table 6](#) and the key model runs are listed in [Table 7](#). The models are run at the end of the water accounting period to determine the consumptive diversions expected under the observed climate conditions. The Source Murray Model is used as part of the method for the Ovens and Kiewa SDL resource units and the modelled component for the Victorian Murray SDL resource unit. The Source Murray Model uses a regression equation based on diversions and climatic variables for the Kiewa SDL resource unit and Ovens REALM model outputs for the Ovens SDL resource unit.

The REALM Goulburn/Broken/Coliban/Campaspe/Loddon (GBCCL) model is used as part of the method for the Goulburn, Broken, Lodon and Campaspe SDL resource units.

Adjustments are made to the modelled diversions to determine the annual permitted take. This includes adjusting for trade and water recovered for the environment, including any offsets. The models and methods are explained further in the following sections and in [Table 6](#).

Method for Victorian Murray, Kiewa and Ovens SDL resource units

The Source Murray Model has been developed in consultation with the Murray-Darling Basin Authority and other Basin States for the modelled component of the Victorian Murray, Kiewa and Ovens SDL resource units. The model has been developed using the eWater Source modelling platform for the water resource plan areas that cover the Murray and Lower Darling River systems (see MDBA, 2019).

Method for Goulburn, Broken, Campaspe and Loddon SDL resource units

Victoria has developed an interim water resource plan model (interim WRP model) for the Goulburn, Broken, Campaspe and Loddon SDL resource units, using the REALM modelling platform. (see DELWP, 2019). At the time of accrediting the Victoria's North and Murray Water Resource Plan, there were uncertainties in modelling some projects that were still in progress, such as Goulburn-Murray Water Connections Project and New Goulburn Constraints Measure. Additionally, there was uncertainty in how recovered environmental water would be used.

Both the Source Murray Model and the GBCCL REALM model are 'interim WRP models' as further information is required to model water resource plan conditions. Until the better information is available to allow these conditions to be modelled to a satisfactory level of certainty, the method for determining permitted take uses a version of the WRP model developed from the BDL model. The model will reflect the best available knowledge of water resource plan conditions post 30 June 2019, but without Basin Plan water recoveries. It may include some Basin Plan water recoveries if these are deemed to have been recognised and/or formalised, and modelling details for these recoveries have been agreed upon at the time of application of this method. The model will have average annual diversions under historical climate conditions equal to the baseline diversion limit if no water recovery is included, or equal to the BDL adjusted for modelled water recoveries if some are included. This model can be used to determine annual permitted take through the appropriate scaling of modelled diversions to adjust for water recoveries not included in the model.

Any changes to infrastructure or operational rules that impact on the application of the model to adequately determine permitted take during the life of the Victoria's North and Murray Water Resource Plan will be considered in accordance with the review process outlined at [Section 1.7](#) of the Comprehensive Report.

Table 7: Model runs documented in the modelling technical reports

Run description	Key files [^]	Model run period	Analysis period
Model for the Victorian Murray, Kiewa and Ovens SDL resource units			
Interim WRP model	Software: Source 4.8.0.b8359 Beta Model: River Murray 4.8.0.rsproj Run no.: WRP Scenario 9486	July 1891–June 2018	July 1895 – June 2009
Interim BDL model	Software: Source 4.8.0.b8359 Beta Model: River Murray 4.8.0.rsproj Run no.: BDL Scenario 9484	July 1891–June 2018	July 1895– June 2009
Model for the Goulburn, Broken, Campaspe and Loddon SDL resource units			
Interim WRP model	Goul1934.sys L934.scn L934.log	July 1891–June 2018	July 1895 – June 2009
Interim BDL model	GoulV931.sys O935.scn O935.log	July 1891–June 2018	July 1895 – June 2009

[^] Note: the WRP model is subject to improvement as better information becomes available. The model run above reflects the best available information at the time Victoria's North and Murray Water Resource Plan was accredited.

3.1.3.2 Take from watercourses that are not regulated rivers (excluding basic rights)

This form of take relates to take from unregulated rivers (excluding basic rights).

It includes take by small urban water supply systems and take and use licensees. The authorisation to take water under bulk entitlement is for urban water supply is based on full utilisation of each entitlement, however these instruments do specify rules that limit take that can respond to water availability year to year, including:

- minimum passing flows to be met before diversions can occur, and in some cases the months of the year when no diversion is permitted
- capacity of on-stream storage
- maximum rates of diversion
- volumetric limits on take

Take and use licences are used to authorise the take and use of water by individual water users from the system. A total of 27,869 ML is authorised to be taken under take and use licences issued to individuals on various unregulated watercourses in the Victorian Murray water resource plan area and 49,890 ML in the Northern Victoria water resource plan area (these volumes exclude the amount determined to be associated with take from runoff dams). Similar to bulk entitlements, while full utilisation is assumed when authorising take under these instruments, take and use licence holders are required to comply with rosters, bans or restrictions. These rosters, bans and restrictions are articulated in either local management plans or water supply protection area water management plans.

The interim method for determining permitted take and actual take is outlined in [Table 6](#). The existing simulation models for systems in Victoria's North and Murray water resource plan area do not include take on these unregulated streams, for Goulburn, Broken, Campaspe, Loddon SDL resource units and for a portion of the Victorian Murray SDL resource unit.

Victoria does not support the development of a new simulation model suitable for determining annual SDL compliance for this component of take because of the high cost for a very limited return.

Incorporating rules that apply to bulk entitlements and take and use licences that affect the rate and volume of water that can be diverted in response to water availability is difficult due to the varied nature in which they are applied. In late 2018 the MDBA advised that Victoria's proposed method of using total entitlement volume to determine permitted take was not appropriate. Therefore alternative approaches must be investigated to determine the most appropriate method for determining permitted take.

Until Victoria can determine a more appropriate and cost-effective method for determining permitted take for the out of model component of take from a watercourse (excluding basic rights) that recognises adjustments under bans and restrictions it is proposed that the permitted take method is the same as the sustainable diversion limit.

By setting permitted and actual take equal to the sustainable diversion limit, Victoria will not be able to accumulate credits under SDL reporting for water not taken under the SDLs year to year until the method is updated. This is appropriate given the alternative method of using total entitlement volume is not reflective of adjustments that are made during the year to respond to water availability and therefore may result in the accumulation of credits in years of low availability when the water could not actually be taken.

This approach also reflects that the BDL and SDL methods also need to be revised to determine a more accurate means of representing levels of take as at 2009 for this form of take. The BDLs in the Basin Plan were determined using actual take data from the period between 1997-98 to 2009-10. The total volume of the Basin Plan BDLs for Goulburn, Broken, Loddon and Campaspe

SDL resource units has been reapportioned to better align with recent actual take data for accounting purposes. Adopting the interim method does not limit the ability of a holder of a take and use licence to utilise their entitlement during the two-year review process.

Accreditation of the interim method does not prejudice Victoria from identifying a method on review that would enable the accumulation of credits if actual take is below what would be permitted in a given year, or that would result in an increased BDL. The interim method will be reviewed in two years. The review will allow for the permitted take method to be an annual representation of the sustainable diversion limit. The SDL will equal the BDL, and the BDL will be revised to determine the best representation of water available under unregulated bulk entitlements and take and use licences based on the quantity of water that could be taken under State water management law as at 30 June 2009.

3.1.3.3 Take from a regulated river and watercourses under basic rights

Basic rights are defined under the Basin Plan to include rights to take water for domestic and stock purposes and Traditional Owner rights. Under Victorian legislation, basic rights are prescribed in section 8 of the Victorian Water Act and Traditional Owners' rights are described in section 8A of the Victorian Water Act.

Under section 8, waters users have a right to take water, free of charge, from a waterway for domestic and stock purposes under prescribed circumstances. In general terms, a person can exercise that right if they occupy the land over which the water is flowing, or their land is next to a waterway of which the bed and banks remain the property of the Crown. See [Chapter 7](#) of the Comprehensive Report for more detail on basic rights.

The right of Traditional Owners to take water under section 8A where the Traditional Owners have a natural resource agreement under the *Traditional Owner Settlement Act 2010* aligns with the requirements under section 8 regarding the circumstances in which the right can be exercised.

Traditional Owner rights to take water under section 8A are outlined in more detail in [Chapter 7](#) of the Comprehensive Report. At the time of producing this report there are no circumstances of Traditional Owner groups exercising this right in the Northern Victoria water resource plan area. However, this may change as a result of the implementation of the Aboriginal Water policy outlined in *Water for Victoria*.

Take under basic rights is generally not metered and the volume of take is difficult to estimate precisely. Take under this right may be metered in circumstances where bores or pumps are used to take water for other purposes under an entitlement, along with water taken under domestic and stock rights. In these cases, a meter may be attached to the works. However, where the works provide only for take for domestic and stock rights there is no requirement to install a meter to monitor volumes of take.

While take under this right is not metered, the total take is relatively small. Water taken under this right cannot be used for commercial purposes and most of the regulated parts of the Northern Victorian rivers and their tributaries are covered by a Crown Reserve. As a result the landowners who are separated from the waterway by Crown land are not eligible to exercise the right under section 8 of the Victorian Water Act.

Also because of irregular seasonal flows in this region, the majority of stock and domestic take in these circumstances is likely to be harvested and stored in runoff dams, which are already included as a separate form of take.

3.1.3.4 Take by runoff dams (excluding basic rights)

Runoff dams, often referred to in Victoria as small catchment dams, are small dams not located on a defined watercourse. Runoff dams used for commercial and irrigation purposes are required to be licensed or registered in Victoria. Refer to [Chapter 11](#) of the Comprehensive Report for further details on runoff dams.

Some hydrological modelling of this form of take was done as part of addressing take by runoff dams under basic rights. Due to significant uncertainties in the modelling, the modelled results were not used. Instead, the recorded entitlement volume was considered to be the best available estimate of the 'long-term annual average limit' of take as required by Schedule 3 of the Basin plan for this form of take.

The annual volume of water authorised to be taken by these runoff dams by individuals is estimated to be 74,200 ML in the Northern Victoria water resource plan area and 9,400 ML in the Victorian Murray water resource plan area. The estimate was obtained from the Victorian Water Register as of July 2016.

3.1.3.5 Take by runoff dams under basic rights

Under section 8 of the Victorian Water Act, occupiers of land may take water free of charge for domestic and stock use under prescribed circumstances. As with other section 8 rights, the take is not required to be metered.

Victoria has estimated the number and volume of runoff dams used for domestic and stock purposes in the Northern Victoria water resource plan area and Victorian Murray water resource plan area, and also the total annual extraction which varies with climatic conditions. These estimates were made from desktop studies and hydrologic modelling using maps and aerial photographs from 2005.

Many dams identified in aerial photographs were already licensed and so were already counted as a different form of take. These licensed dams were separated, based on the data available, to avoid double counting of take.

The annual volume of water authorised to be taken by unlicensed runoff dams used for stock and domestic (basic rights) purposes is 74,000 ML within the Northern Victoria water resource plan area and 11,300 ML within the Victorian Murray water resource plan area.

When estimating the volume of permitted take and actual take for runoff dams under basic rights, the volume determined does not represent a legislative limit for take under section 8 rights. The Victorian Water Act does not set a volumetric limit on the right to take water under section 8. The right to take water under section 8 is limited by the method of access and the purposes for which the water may be used.

3.1.3.6 Net take by commercial plantations

Commercial plantations are a significant industry in the Upper Murray, Kiewa and Ovens valleys, but less so in other valleys in the Victorian Murray and Northern Victoria water resource plan areas. Plantations depend on rainfall and typically occur in regions with more than 600 to 800 mm of annual rainfall (SMEC, 2010). Sufficient rainfall for commercial timber plantations occurs only in the eastern parts of the Victoria's North and Murray water resource plan areas.

Commercial plantations cover an area of 667 km² of the Northern Victoria water resource plan area and this plantation area has remained stable since 2009. A small reduction occurred in the Goulburn River Basin, where the area of plantations decreased by 3 km² since 2009. In all other areas, there was no change in the area of plantations between 2009 and 2016.

Where a small reduction did occur in the Goulburn River Basin, this change will increase runoff and recharge at a small local scale where plantations have been removed, and therefore reduce interception, depending on what replaces the plantations. Little or no growth in commercial plantations or the scale of existing plantations is expected to occur over the next decade, so interception by commercial plantations is expected to remain equal to 2009 levels.

The effect of commercial forestry plantations on the water balance in the Northern Victoria water resource plan area and Victorian Murray water resource plan area is not accurately monitored and good data is not readily available.

The annual permitted take of water by commercial plantations will be estimated as the difference between the long-term average rate of evapotranspiration from plantations that were present in 2009 and from the vegetation type that was thought to be present before the plantation was established. The long-term average rate of evapotranspiration will be estimated using the SoilFlux model.

The long-term annual average net take by commercial plantations is estimated to be 77,000 ML in the Northern Victoria water resource plan area, and 31,500 ML in the Victorian Murray water resource plan area.

3.2 Accounting for water availability

Section 10.10(2) of the Basin Plan requires the method to be designed to be applied after the end of the relevant water accounting period, having regard to the water resources available during that period.

In respect of take from a regulated river excluding basic rights, the impact of water availability is managed in practice on a monthly basis throughout the accounting period. Water available during the period is accounted for in the models used as part of the method to determine permitted take at the end of the period, based on seasonal conditions in the preceding year and the allocation rules detailed in [Part 3.1.3.1](#) and [Table 8](#) of this report.

For take from watercourses (excluding basic rights), the method for determining permitted take is linked to actual take (discussed above in [Part 3.1.3.2](#)). As actual take adjusts to water availability it is considered the most appropriate method until a more appropriate method is developed that recognises adjustments under bans and restrictions. Actual take in this circumstance will be adjusted by measures that response to water availability (see [Section 6.7](#) of the Comprehensive Report) or water shortages during extreme dry periods (see [Section 9.3](#) of the Comprehensive Report).

For all other forms of take, there is no mechanism to allocate or restrict water take on an annual basis and the estimates are based on long-term averages. As a result, the method for permitted take does not take into account water availability on an annual basis.

3.3 Matters accounted for in the permitted take method (10.12)

The matters identified in section 10.12 of the Basin Plan are accounted for in the methods proposed for determining the maximum volume of water that the plan permits to be taken for consumptive use during a water accounting period. [Table 8](#) outlines how the matters were taken into account (the alphabetical numbering corresponds to the paragraph numbering in section 10.12 of the Basin Plan).



Basin Plans 10.12(1)

Table 8: Matters relating to accounting for water (surface water)

	Section 10.12(1) Basin Plan	How the matters were accounted for by the requirements methods for determining permitted take
(a)	All forms of take from the SDL resource unit and all classes of water access right	<p>For the Northern Victoria water resource plan area and the Victorian Murray water resource plan area all forms of take from each SDL resource unit and all classes of water access rights are accounted for by the methods specified for the purposes of 10.10(1), as detailed in Part 3.1 of this report. The classes of water access right accounted for by the methods are:</p> <ul style="list-style-type: none"> • bulk entitlement, environmental entitlement, water share and take and use licence (take from a regulated river and a watercourse) • take and use licence (runoff dams excluding basic rights) • section 8 and section 8A rights to take water (basic rights) <p>For take from regulated rivers (excluding basic rights) and the modelled component of take from a watercourse (excluding basic rights) the relevant water access rights are documented in Source Murray Model - method for determining permitted take (MDBA, 2019) and Hydrologic Models for Basin Plan Compliance in the Northern Victoria Water Resource Plan Area (DELWP, 2019).</p>
(b)	Water allocations that are determined in one water accounting period and used in another, including water allocations that are carried over from one water accounting period to the next (also referred to as carryover)	<p>Carryover applies to take from a regulated river (excluding basic rights). It is enabled in all of the regulated surface water systems of Northern Victoria and Victorian Murray water resource plan areas, except the Ovens SDL resource unit where storages are too small to support carryover.</p> <p>Carryover is accurately accounted for in the model for the form of take being taken from the relevant regulated rivers (see model reports DELWP, 2019 and MDBA, 2019).</p> <p>Under the relevant bulk and environmental entitlements, carryover is accounted for and included when the appointed authority Goulburn-Murray Water makes seasonal determinations (see Section 7.2.2.5 of the Comprehensive Report).</p> <p>Carryover is not relevant to other forms of surface water take.</p>

	Section 10.12(1) Basin Plan	How the matters were accounted for by the requirements methods for determining permitted take
(c)	<p>For a surface water SDL resource unit, return flows must be taken into account in a way that is consistent with arrangements under the Murray–Darling Basin Agreement immediately before the beginning of the Basin Plan</p>	<p>Return flows are enabled in the regulated rivers of the Northern Victoria and Victorian Murray water resource plan areas under bulk and environmental entitlements held by the VEWH and water corporations.</p> <p>Goulburn–Murray Water, as the Resource Manager in the regulated river systems, is required to approve any return flow credits if the application meets the conditions outlined in the bulk entitlement. Return flows are accounted for and included in the equation used by Goulburn–Murray Water, as the authority appointed to make seasonal determinations.</p> <p>Return flows are accounted for in the models used to determine permitted take from a regulated river (excluding basic rights) and the modelled component of take from a watercourse (excluding basic rights) as described in the model reports (DELWP, 2019 and MDBA, 2019).</p>
(d)	<p>Trade of water access rights</p>	<p>For take from a regulated river (excluding basic rights) and the modelled component of take from a watercourse (excluding basic rights), the models used as part of the method for determining permitted take account for legacy exchange rate trade from the Goulburn (as at 30 June 2009) using the inter-valley trade account and tagged trade from the Goulburn is modelled as an end of system demand. Further information can be found in the model reports (DELWP, 2019 and MDBA, 2019).</p> <p>All other changes to entitlements or allocation as a result of trade is recorded in the VWR and is taken into account in the method used to determine permitted take for both take from a regulated river (excluding basic rights) and take from a watercourse (excluding basic rights). This includes separate accounting of held environmental water (section 10.12(3) of the Basin Plan).</p> <p>The trade of water from consumptive use to HEW or from HEW to consumptive use is not part of the methods used to determine permitted take under section 10.10 of the Basin Plan since the net balance of any disposals or acquisitions of HEW will be used to adjust the cumulative balance of take at the end of the water accounting period, as outlined in section 6.12 of the Basin Plan.</p>

	Section 10.12(1) Basin Plan	How the matters were accounted for by the requirements methods for determining permitted take
(e)	<p>Water resources which have a significant hydrological connection to the water resources of the SDL resource unit</p>	<p>The Kiewa, Ovens, Goulburn, Campaspe and Loddon (Bullarook) rivers are natural waterways that flow into the River Murray. Further, part of the flow in the Broken river may also flow into the River Murray as the Broken River splits at Casey's Weir and the main branch (west branch), the continuation of the Broken River, flows into the Goulburn River and then to the River Murray. The east branch flows north and directly into the River Murray.</p> <p>Surface water transfers via infrastructure from the Goulburn River to the Murray, Campaspe and Loddon Rivers are included in the method for determining permitted take for regulated systems (excluding basic rights).</p> <p>Details of how these matters are accounted for are provided in the model reports (DELWP, 2019 and MDBA, 2019).</p> <p>Details of all significant hydrological connections for the Northern Victoria and Victorian Murray water resource plan areas can be accessed at the Victorian Water Register where there are details in bulk entitlements about supplements and are explained in Chapter 4 of the Comprehensive Report.</p> <p>For all other forms of take (Items 3-7 of Table 6), the permitted take is equal to the SDL, which is equal to the BDL, and the matter is taken into account when determining the BDL. Consequently, it is unnecessary for this matter to be addressed in the method for these forms of take.</p>
(f)	<p>Circumstances in which there is a change in the way water is taken or held under a water access right</p>	<p>The method used to determine permitted take for regulated rivers (excluding basic rights) and the modelled component of take from a watercourse (excluding basic rights) includes simulation of environmental demand patterns that differ from previous consumptive demand patterns. The impacts of changes in consumptive demand patterns will be taken into account, like a result of any future trade or conversion of additional water savings to held environmental water. This will be done by adjusting permitted take for trade of allocation in a single year or in updates to the method and water resource plan as a result of any permanent changes.</p>

	Section 10.12(1) Basin Plan	How the matters were accounted for by the requirements methods for determining permitted take
(g)	<p>Changes over time in the extent to which water allocations in the unit are used.</p> <p>Note: Paragraph (g) includes what is commonly known as a growth-in-use strategy</p>	<p>Changes over time in the extent to which water allocations in the SDL resource unit are utilised will be addressed through the related provisions in section 10.11(1) which will ensure SDL compliance. Changes to the permitted take method will be given effect consistent with the responses implemented by Victoria. See Section 9.3.3 of the Comprehensive Report for Victoria's accredited response to section 10.11(1) of the Basin Plan.</p> <p>For take from regulated rivers (excluding basic rights) and the modelled component of take from a watercourse (excluding basic rights), Victoria allocates water in a system based on an assumption of full use and meeting required reserves for the following water year. The total licensed volume of entitlements is included in the models used in the method and the models replicate allocation rules used in the seasonal determinations.</p> <p>Analysis done until now does not indicate any growth in use. Any changes to this will be resolved through the accredited response to section 10.11 of the Basin Plan. The MDBA's reporting and compliance framework allows for further investigation to be undertaken if the cumulative balance of the difference between annual actual take and annual permitted take exceeds 20 percent of the sustainable diversion limit (MDBA, 2018). If the investigation determines an exceedance is the result of increased utilisation under the allocation framework, Victoria will consult with stakeholders on the appropriate corrective actions that are outlined in the accredited response to section 10.11 of the Basin Plan.</p> <p>For example, subsequent allocations could take into account any excess take that must be offset. This is similar to the existing clause in Bulk Entitlement (River Murray - Goulburn-Murray Water) Conversion Order 1999 that requires corrective actions to be implemented to mitigate non-compliance with consumptive diversion limits.</p> <p>For take from watercourses (excluding basic rights), growth-in-use is not expected to impact on SDL compliance using the current interim permitted take method. Consideration of how the revised permitted take method will demonstrate SDL compliance and consider potential growth-in-use responses will inform the two-year review (see Table 6).</p> <p>For take under basic rights, where there is growth in use that may affect compliance with sustainable diversion limits, section 10.13 of the Basin Plan applies (for more information see Chapter 9 of the Comprehensive Report).</p>

	Section 10.12(1) Basin Plan	How the matters were accounted for by the requirements methods for determining permitted take
(h)	Water sourced from the Great Artesian Basin and released into a Basin water resource, by excluding that water.	This matter is not relevant to the Northern Victoria and Victorian Murray water resource plan areas.
(i)	Water resources which are used to manage aquifer recharge.	This matter is not relevant to the Northern Victoria and Victorian Murray water resource plan areas.

3.4 Demonstration of method

Section 10.10(4) of the Basin Plan requires that Victoria's North and Murray Water Resource Plan sets out a demonstration that the method relates to the sustainable diversion limit of each SDL resource unit in such a way that, if applied over a repeat of the historical climate conditions, it would result in the meeting of the SDL for the SDL resource unit. This includes amendments under section 23B of the Commonwealth Water Act.

3.4.1 Take from a regulated river (excluding basic rights)

The methods for determining take from a regulated river (excluding basic rights) and the modelled component of take from a watercourse (excluding basic rights) in [Table 6](#) are scaled to ensure that under historical climate conditions (1985-2009), the long-term average diversions are equal to the sustainable diversion limit.

The sustainable diversion limit is defined on 30 June of the preceding water year based on the formula in the Schedule 6A of the Basin Plan and published by the MDBA on its website annually. For the purposes of section 10.10(4) and section 10.10(5) of the Basin Plan, the SDL assumes zero efficiency measures have been achieved in the Basin and are set out [Table 3](#).

3.4.2 Take from a watercourse (excluding basic rights)

As explained in [Part 2.1.1](#) and [Part 3.1.3.2](#), Victoria is undertaking a review of the method for the out of model component of take from a watercourse (excluding basic rights). Until the review is completed, permitted take and actual take are equal to the sustainable diversion limit, where the SDL is equal to the BDL. Any water recovered from this form of take is captured in the adjustments for take from a regulated river (excluding basic rights).

3.4.3 All other forms of take

In Victoria, the method for determining permitted take is the same method used for determining the sustainable diversion limit, which is equal to the BDL, for all other forms of take. This means that methods are based on the same climate sequences and therefore the permitted take method would always produce the same result as the SDL model. Therefore, the requirement under section 10.10(4) of the Basin Plan is considered satisfied for all forms of surface water take.

Given that Victoria is required to run the method for permitted take on an annual basis, only the long-term average of permitted take can be compared to the sustainable diversion limit to demonstrate compliance with SDLs over the life of the Victoria's North and Murray Water Resource Plan.

[Table 9](#) and [Table 10](#) identify the same volumes for sustainable diversion limit and long-term average permitted take on the basis that the methods for calculating permitted take and SDL are identified and based on identical climate sequences, and therefore always provide the same result.

Basin Plans
s10.10(4)**Table 9: SDL volume and permitted take volume (demonstration under section 10.10(4) Basin Plan) for Victorian Murray water resource plan area**

Form of take	Victorian Murray		Kiewa	
	SDL (GL/year)	Long-term average permitted take (GL/year)	SDL (GL/year)	Long-term average permitted take (GL/year)
Take from a regulated river (excluding basic rights) and modelled component of take from a watercourse (excluding basic rights)	See Part 3.4.1			
Take from a watercourse (excluding basic rights) – out of model component	5.5*	5.5*	n/a	n/a
Take from a waterway under basic rights which includes: <ul style="list-style-type: none"> take from a regulated river under basic rights take from a watercourse under basic rights 	8.2	8.2	1.0	1.0
Take by runoff dams (excluding basic rights)	4.8	4.8	4.5	4.5
Take by runoff dams under basic rights	7.6	7.6	3.7	3.7
Take by commercial plantations	24.2	24.2	7.3	7.3

* these volumes are subject to a two-year review as explained in [Part 3.1.3.2](#) and [Table 6](#).

Table 10: SDL volume and permitted take volume (demonstration under section 10.10(4) Basin Plan) for Northern Victoria water resource plan area

Form of take	Ovens		Goulburn		Broken		Campaspe		Loddon	
	SDL (GL/year)	Long-term average permitted take (GL/year)	SDL (GL/year)	Long-term average permitted take (GL/year)	SDL (GL/year)	Long-term average permitted take (GL/year)	SDL (GL/year)	Long-term average permitted take (GL/year)	SDL (GL/year)	Long-term average permitted take (GL/year)
<ul style="list-style-type: none"> Take from a regulated river (excluding basic rights) and; the modelled component of take from a watercourse (excluding basic rights) 	See Part 3.4.1									
Take from a watercourse (excluding basic rights) - out of model component	n/a	n/a	18.3*	18.3*	2.9*	2.9*	0.9*	0.9*	8.9*	8.9*
Take from a waterway under basic rights which includes: <ul style="list-style-type: none"> take from a regulated river under basic rights take from a watercourse under basic rights 	2.9	2.9	6.3	6.3	1.6	1.6	1.6	1.6	4.8	4.8
Take by runoff dams (excluding basic rights)	12.5	12.5	27.1	27.1	10.4	10.4	6.1	6.1	18.1	18.1
Take by runoff dams under basic rights	12.4	12.4	24.4	24.4	6.3	6.3	14.4	14.4	16.6	16.6
Take by commercial plantations	32.5	32.5	22.4	22.4	14.9	14.9	1.8	1.8	5.5	5.5

* these volumes are subject to a two-year review as explained in [Part 3.1.3.2](#) and [Table 6](#).

4. Groundwater

4.1 Determination of permitted take and actual take

4.1.1 Permitted take

Under section 10.10(1) of the Basin Plan, Victoria's North and Murray Water Resource Plan is required to set out the method for determining permitted take for each form of take in the water resource plan area. The method for determining permitted take must be applied at the end of each accounting period (yearly). Actual take must be assessed against permitted take to ensure that the volume of water actually taken during the year does not exceed permitted take and therefore will not exceed the sustainable diversion limit.

The Basin Plan at section 6.10 defines permitted take to be the maximum volume of water permitted to be taken by each form of take for consumptive use from the SDL resource unit. Section 6.10 defines actual take as the sum of the volume of water actually taken by each form of take for the consumptive use from the SDL resource unit.

The determination of permitted take in the Goulburn-Murray water resource plan area varies depending on the form of take. [Table 8](#) outlines the methods used for determining permitted take for each form of take in the Goulburn-Murray water resource plan area.

4.1.2 Actual take

Section 10.15 of the Basin Plan requires that a water resource plan set out how the volume of water actually taken will be determined after the end of the water accounting period, using the best information available.

Actual take of groundwater incorporates entitlement use as recorded in the Victorian Water Register and estimates of domestic and stock use (basic rights). The method incorporates information from the register, which is considered to have the most accurate information regarding the inputs into the method.

Water used as part of a Managed Aquifer Recharge (MAR) Scheme is not relevant to the Goulburn-Murray water resource plan area where there are no MAR schemes operating. At such time as MAR schemes do operate this will be incorporated into the accounting of actual take in accordance with the estimated net take of groundwater and surface water.

4.1.3 Managing and determining take in the Goulburn-Murray

In the Goulburn-Murray water resource plan area there are these forms of take:

- take from an aquifer (excluding basic rights)
- take from an aquifer under basic rights

These forms of take are prescribed as 'take from groundwater' under the Basin Plan. For this reason, the tables in this report refer to take from groundwater when providing the methods and volumes for sustainable diversion limit and permitted take to meet Basin Plan requirements.

Victoria uses its Water Register to account for all groundwater entitlements and groundwater use. This public register of all water-related entitlements in Victoria was designed and built to record water entitlements with integrity and provide crucial information for managing the state's water resources.

For the purposes of the Basin Plan requirements for groundwater management and trade, Victoria acknowledges that the state management unit, as defined by the Commonwealth

groundwater trade guidelines, is the Goulburn-Murray water resource plan area. This is made up of the Goulburn-Murray: Highlands SDL resource unit, the Goulburn-Murray: Sedimentary Plain SDL resource unit, the Goulburn-Murray: Shepparton Irrigation Region SDL resource unit and the Goulburn-Murray: deep SDL resource unit. Victoria manages the resource and licensing within Victoria's North and the Murray water resource plan area.

The groundwater management framework is applied by Victoria for accounting and reporting purposes and this does not align exactly with the four Goulburn-Murray groundwater SDL resource units specified in the Goulburn-Murray water resource plan area.

Work is progressing to enable the Victorian Water Register to generate the report on the volume of groundwater taken from each respective SDL resource unit in Victoria's North and Murray Water Resource Plan, including trade and carryover.

The Victorian Government plans to enable reporting at the scale of the water resource plan SDL resource units. This will help with the relevant MDBA trading rules where applicable and reporting on compliance with the Basin Plan SDL resource units for groundwater in the future.

4.1.3.1 Take from an aquifer (excluding basic rights)

Take from an aquifer is managed through Victoria's entitlement framework, except where it is under a basic right, and a water user must hold a take and use licence and a works licence to take water from an aquifer. The works licence regulates the construction, use, maintenance and alteration of the bore used to extract groundwater. The take and use licence is the water access right that authorises the maximum volume the user is permitted to take in a year. The take and use licence also prescribes the place at which groundwater may be taken and the time and rate.

These conditions protect other users and the aquifer by regulating how water is extracted by all users, to prevent third party impacts from extraction and to protect the resource and environment.

4.1.3.2 Take from an aquifer under basic rights

Basic rights are defined under the Basin Plan to include rights to take water for domestic and stock purposes and Traditional Owner rights. Basic rights are prescribed in section 8 and 8A of the Victorian Water Act.

Under section 8, water users have a right to take water free of charge from a bore for domestic and stock purposes under prescribed circumstances. In general terms, people or businesses can exercise that right if they own the land on which the bore is located. See [Chapter 7](#) for detail on basic rights.

Take under section 8 is generally not metered and the volume of take is unknown. Take under this right may be metered in circumstances where bores are used to take water for other purposes under an entitlement, in addition to water taken under section 8. In these cases, a meter may be attached to the works. However, the works only provide for take for domestic and stock rights, there is no requirement to install a meter to monitor volumes of take. Take under basic rights is relatively small because water taken under this right cannot be used for commercial purposes, including irrigation.

The right of Traditional Owners to take water under section 8A aligns with the requirements under section 8 regarding the circumstances in which the right to take can be exercised.

Traditional Owner rights to take water under section 8A are outlined in more detail at [Chapter 7](#). At the time of producing this report there are no circumstances of Traditional Owner groups exercising this right in the Goulburn-Murray water resource plan area. However, this may change as a result of the implementation of the Aboriginal Water Policy outlined in *Water for Victoria*.

4.1.4 Methods

The methods for determining permitted take and actual take of groundwater in the Goulburn-Murray water resource plan area apply to the following forms of take in the following SDL resource units:

- Goulburn-Murray: Shepparton Irrigation Region
- Goulburn-Murray: Highlands
- Goulburn-Murray: Sedimentary Plain
- Goulburn-Murray: deep

Table 11: Methods for determining permitted take and actual take – groundwater

Basin Plan s10.10(1) & s10.15(1)

Form of take	Method Permitted take 10.10(1) Basin Plan	Actual take 10.15(1) Basin Plan	Best available information
The methods apply to all groundwater SDL resource units in the Goulburn–Murray water resource plan area			
Take from groundwater (excluding basic rights)	For each SDL resource unit, the permitted take is equal to the SDL as prescribed in schedule 4 of the Basin Plan, minus the annual permitted take for take from groundwater under basic rights.	Determined using entitlement data for all forms of take except basic rights use, on the Victorian Water Register based on the location of licensed and registered bores in the water resource plan SDL reporting area. For unmetered bores less than 20ML, actual take is estimated to be equal to the total volume of the entitlement.	<p>Permitted take for groundwater SDL resource units is determined by the sustainable diversion limit prescribed for the SDL resource unit.</p> <p>Actual take reflects take under entitlements in Victoria as this is how a user is authorised to take water in a given accounting period. Therefore, the water actually taken is equal to the water taken under entitlement for this form of take. The best available information in relation to entitlement use is the Victorian Water Register. This includes metered take under entitlements and estimates for unmetered bores. In Victoria bores greater than 20 ML are metered. For unmetered bores less than 20 ML, actual take is estimated to be equal to the total volume of the entitlement.</p>
Take from groundwater under basic rights	Estimated based on the number of bores in the SDL resource unit less than 30 years old with a rate of 2 ML/year as at 30 June 2009.		<p>This estimate is considered to be based on the best available information. Victoria’s assessment of bores and reasonable domestic and stock use identified:</p> <ul style="list-style-type: none"> • 2 ML/year as a reasonable volume for domestic and stock users and expected to be sufficient on average to allow for any uptake of Traditional Owner rights as permitted under basic rights • 2 ML/year allowance is for a typical size farm and may be adjusted to reflect the property size • bores older than 30 years are considered to be non-functional and are excluded from the estimation.

4.2 Matters accounted for in the permitted take method (10.12)

The matters outlined in section 10.12 of the Basin Plan are accounted for in the methods proposed for determining the maximum volume of water that the plan permits to be taken for consumptive use during a water accounting period (see [Table 12](#)). The alphabetical numbering corresponds to the paragraph numbering in section 10.12 of the Basin Plan.

**Basin Plan
s10.12(1)**

Table 12: Matters relating to accounting for water (groundwater)

Section 10.12(1) Basin Plan		How the matters were accounted for by the methods requirements for determining permitted take
(a)	All forms of take from the SDL resource unit and all classes of water access right	<p>All forms of take from the SDL resource units and all classes of water access rights are accounted for by the methods specified for the purposes of section 10.10(1) of the Basin Plan.</p> <p>A different method has been developed for each form of take being taken from groundwater (excluding basic rights) and from groundwater under basic rights, as detailed in Part 4.1 of this report.</p> <p>The classes of water access right accounted for by the methods are:</p> <ul style="list-style-type: none"> • bulk entitlements • take and use licences (take from groundwater) • section 8 and section 8A rights (take from groundwater under basic rights)
(b)	Water allocations that are determined in one water accounting period and used in another, including water allocations that are carried over from one water accounting period to the next, also referred to as carryover	<p>Carryover of groundwater take is permitted in some groundwater management areas and is recorded in the Victorian Water Register.</p> <p>For groundwater, carryover is accounted for in the year carryover is accumulated. It may be used in the subsequent year (i.e. the actual take for that year). Carryover is accumulated when the actual take for an individual user is less than the licensed take in areas where carryover is allowed. It is limited to a percentage of the entitlement. This percentage is different in different areas and not all areas can have carryover. It cannot be carried over for more than one year. The carryover will always be less than the net take in a given year.</p> <p>Carryover does not affect the method for determining permitted take as permitted take is based on the SDL which is the long-term average sustainable take and carry over is based on a percentage of unused allocation for a licensed entitlement in the reporting period. Carryover is therefore part of the permitted take accounted for in the year carry over is accumulated.</p>

Section 10.12(1) Basin Plan		How the matters were accounted for by the methods requirements for determining permitted take
(c)	For a surface water SDL resource unit, return flows must be taken into account in a way that is consistent with arrangements under the Murray–Darling Basin Agreement immediately before the beginning of the Basin Plan	This matter is not relevant for the Goulburn–Murray water resource plan area.
(d)	Trade of water access rights	<p>Trade is allowed within the SDL resource units which does not affect annual permitted take. Where trade is allowed between the SDL resource units, it is only allowed where it will not exceed the annual permitted take and the requirements of Part 4 of Chapter 10 the Basin Plan. As this does not cause any net change in water availability in the SDL resource unit, accounting for trade in the annual permitted take method is not necessary.</p> <p><i>Between groundwater SDL resource units in the water resource plan area</i></p> <p>Trade of entitlements to take and use groundwater may occur in accordance with the circumstances specified in response to section 10.37 of the Basin Plan (see Section 7.4.2.8 of Victoria's North and Murray Comprehensive Report).</p> <p>Groundwater is not held under an entitlement for the environment and therefore the requirement in section 10.12(3) is not relevant for the Goulburn–Murray water resource plan area. As permitted take is determined to be equal to the long-term average sustainable limit, trade does affect the method for determining permitted take. All trade is recorded in the Victorian Water Register and will be used to adjust the actual take if any such trade occurs.</p>

Section 10.12(1) Basin Plan	How the matters were accounted for by the methods requirements for determining permitted take
	<p><i>Groundwater to groundwater connected resources outside the water resource plan area</i></p> <p>Trade of entitlements to take and use groundwater may occur in accordance with the circumstances specified in response to section 10.38 of the Basin Plan (see Section 7.4.2.9 of Victoria's North and Murray Comprehensive Report). Groundwater in the water resource plan area is connected to groundwater resources south of the water resource plan area primarily at the southern boundary of the Loddon Highlands water supply protection area which is based on the groundwater flow divide . This is not the same as the surface water flow divide, which is the same as the WRP boundary. Trade across this boundary is not being considered and there is no intention to adjust the permitted take in these circumstances.</p> <p>There are connected aquifers across the boundary with New South Wales in the Lower Murray Alluvium for which trade in future may occur however no mechanisms are in place to facilitate this at this time, and there is no intention to adjust the permitted take in these circumstances.</p> <p><i>Groundwater to surface water connected resources in the water resource plan area</i></p> <p>Trade of entitlements to take and use groundwater may occur in accordance with the circumstances specified in response to section 10.39 of the Basin Plan (see Section 7.4.2.10 of Victoria's North and Murray Comprehensive Report). Currently, trade between groundwater and surface water SDL resource units only occurs in the Upper Ovens River water supply protection area and volumes of trade between these two SDL resource units is very unlikely to affect the actual take. There is no intention to alter the permitted take method for these cases. See response to 10.12(1)(e) below for further information.</p>

Section 10.12(1) Basin Plan	How the matters were accounted for by the methods requirements for determining permitted take
<p>(e) Water resources which have a significant hydrological connection to the water resources of the SDL resource unit</p>	<p><i>Groundwater to groundwater connected resources outside the water resource plan area</i></p> <p>Goulburn-Murray groundwater SDL resource units have limited connections to water resources outside the Basin Plan area which are predominantly south of the hydrological divide of the Great Dividing Range and is not considered to have a significant hydrological connection for accounting purposes. There is no intent to trade between these resources that would affect compliance with the SDL.</p> <p>The groundwater resources in the Goulburn-Murray: Sedimentary Plain SDL resource unit has a significant hydrological connection to the Ovens surface water SDL resource unit, however, the relatively small volumes extracted from groundwater will be accounted for as groundwater for SDL compliance purposes.</p> <p>The hydraulic connection with the Wimmera Mallee Sedimentary Plain and Highlands SDL resource units are not considered significant for accounting purposes as groundwater flows generally down groundwater catchments and the two WRP areas contain distinct groundwater catchments. For the purposes of groundwater take and there is no intent to trade between these resources that would affect compliance with the SDL of these SDL resource units.</p> <p>There may be significant hydrological connection with New South Wales groundwater resources under the Murray River between Yarrowonga and Echuca adjacent to the Katunga and Lower Campaspe water supply protection areas. Work with New South Wales will assess the degree of connection and if sufficiently connected, whether trade may be allowed and accounting for this for trade purposes and consequences for compliance with the SDL.</p> <p><i>Groundwater to surface water connected resources</i></p> <p>The groundwater resources in the Goulburn-Murray water resource plan area:</p> <p>The Goulburn-Murray: Sedimentary Plain SDL resource unit has a significant hydrological connection to the surface water SDL resource unit where the Calivil formation is outcropping or relatively shallow, particularly in the Upper Ovens River water supply protection area. However, the relatively small volumes extracted from groundwater will be accounted for as groundwater for SDL compliance purposes. There is no intention to account for groundwater take in the permitted take of surface water systems or vice versa.</p>

Section 10.12(1) Basin Plan		How the matters were accounted for by the methods requirements for determining permitted take
		<p>In the Goulburn-Murray: Shepparton Irrigation Region SDL resource unit, groundwater extraction is primarily to protect against saline groundwater discharge and manage salinisation, and efforts are made to minimise groundwater discharge, so while this SDL resource unit is significantly connected to surface water there is no intention to account for groundwater use in the permitted take method for its connected surface water systems.</p> <p>See Section 4.4 of Victoria's North and Murray Comprehensive Report for further discussion on connectivity of groundwater resources.</p>
(f)	Circumstances in which there is a change in the way water is taken or held under a water access right	This matter is not relevant to the Goulburn-Murray (groundwater) water resource plan area as there are no groundwater environmental entitlements and there are no proposed changes to the way groundwater is taken or held.
(g)	<p>Changes over time in the extent to which water allocations in the unit are used.</p> <p>Note: Paragraph (g) includes what is commonly known as a growth-in-use strategy.</p>	The SDL method for permitted take allows for growth as full utilisation of existing licences is well below the SDL and therefore growth in use is permitted up to this prescribed limit. If growth were to result in the SDL being exceeded, the related provisions in section 10.11(1) will ensure SDL compliance.
(h)	Water sourced from the Great Artesian Basin and released into a Basin water resource, by excluding that water	This matter is not relevant to the Goulburn-Murray water resource plan area as there is no water sourced from the Great Artesian Basin.
(i)	Water resources which are used to manage aquifer recharge	This matter is not relevant for the Goulburn-Murray water resource plan area. Currently there are no managed aquifer recharge schemes operating or proposed in the Goulburn-Murray water resource plan area.

4.3 Demonstration of method

Section 10.10(4) of the Basin Plan requires that Victoria's North and Murray Water Resource Plan set out a demonstration that the method relates to the sustainable diversion limit of each SDL resource unit in such a way that, if applied over a repeat of the historical climate conditions, it would result in meeting the SDL for the SDL resource unit, including as amended under section 23B of the Commonwealth Water Act.

The demonstration or explanation as to how this requirement has been met is outlined in [Table 13](#) for each method outlined in this report. [Table 11](#) relates to the methods for determining permitted take for groundwater forms of take.

As Victoria is required to run the method for permitted take on an annual basis, only the long-term average of permitted take can be compared to the SDL to demonstrate compliance with sustainable diversion limits over the life of the plan.

Table 13 identifies the same volumes for SDL and long-term average permitted take on the basis that the methods for calculating permitted take and sustainable diversion limit are identified and based on identical climate sequences, and therefore always provide the same result.

Basin Plans 10.10(4)

Table 13: SDL volume and permitted take volume (demonstration under section 10.10(4) Basin Plan)

Form of take	SDL (ML)	Long-term average permitted take (ML)
Goulburn-Murray: Shepparton Irrigation Region SDL resource unit		
Take from groundwater (excluding basic rights)	241,490	241,490
Take from groundwater under basic rights	2,610*	2,610
Goulburn-Murray: Highlands SDL resource unit		
Take from groundwater (excluding basic rights)	55,590	55,590
Take from groundwater under basic rights	13,110*	13,110
Goulburn-Murray: Sedimentary Plain SDL resource unit		
Take from groundwater (excluding basic rights)	211,454	211,454
Take from groundwater under basic rights	11,546*	11,546
Goulburn-Murray: deep SDL resource unit		
Take from groundwater (excluding basic rights)	20,000	20,000
Take from groundwater under basic rights	0	0

* basic rights estimate from original SDL estimates (2010)

5. References

DELWP. (2019). *Hydrologic Models for Basin Plan Compliance in the Northern Victoria Water Resource Plan Area*.

HARC. (2016). *User Manual for SoilFlux Tools*. Melbourne: Department of Environment, Land, Water and Planning.

Jacobs. (2016). *SoilFlux User Manual*. Melbourne: Department of Environment, Land, Water and Planning.

Murray-Darling Basin Authority. (2018). *Sustainable Diversion Limit Reporting and Compliance Framework Summary*. Canberra: Murray-Darling Basin Authority.

Murray-Darling Basin Authority. (2019). *Source Murray Model - method for determining permitted take*. Canberra: Murray-Darling Basin Authority.

RMCG. (2011). *Stock and Domestic Water Use Modelling Resource Manager's Handbook*.

SMEC. (2010). *Afforestation Risks to Water Resources in the Murray-Darling Basin*. Canberra: Murray-Darling Basin Authority.

6. Schedule 1

6.1 Sustainable diversion limit adjustment mechanism projects

The Murray-Darling Basin Ministerial Council endorsed the final package of environmental works and measures to be included in the sustainable diversion limit adjustment mechanism in June 2017.

The Murray-Darling Basin Authority has been progressively modelling the offsets from all projects from Victoria, New South Wales and South Australia.

Victoria has put forward 22 projects to achieve the Basin Plan's environmental targets without the need for further Commonwealth water buybacks. These projects will contribute significantly to meeting the requirements of the Basin Plan.

Victoria's 22 projects will deliver great outcomes for regional communities with real benefits for local waterways and wetlands along the Murray and its tributaries.

The package of 22 projects includes constraints and rules-based projects and an Enhanced Environmental Delivery Project. It also contains the completed Living Murray Projects already delivering results, including Chowilla Floodplain, Gunbower Forest, Hattah Lakes Environmental Flows, Koondrook-Perricoota Forest Flood Enhancement, Lindsay Island (Stage 1) Upper Lindsay Watercourse Enhancement and Mulcra Island Environmental Flows.

6.2 Environmental works and measures

Environmental works include channels, regulators and pumps that deliver water to priority, high-value sites to meet the needs of plants and animals such as fish, frogs, waterbirds and river red gum and black box woodlands.

Works provide a better outcome for areas of high environmental value, particularly during dry years. They directly deliver the water flows an ecosystem needs that often are not possible under river regulation.

Works can deliver and hold water in specifically targeted areas on the river floodplain that are usually only inundated where there are high flows. This means natural flood-dependent ecological processes can occur, even under regulated river conditions.

These projects aim to improve environmental outcomes at large Murray floodplain areas and key river red gum ecosystems. Water delivery through works improves forest, river and wetland habitats and provides conditions for successful feeding, breeding and migration of native fish, reptiles, birds, frogs and insects.

Environmental works projects include:

Belsar-Yungera Floodplain Management Project

This proposed supply measure will maintain and improve flora and fauna habitat values and provide periodic breeding opportunities for wetland species like fish, frogs and waterbirds. Managed flows will be able to be delivered to 2,370 ha of highly valued floodplain, representing one third of the total area.

The works can be operated flexibly to meet the water requirements of different vegetation localities, mimicking a broad range of River Murray flows of up to 170,000 ML per day (ML/d). By constructing three large regulators, a series of smaller supporting regulators, track raising to form levees and a pipeline to allow use of temporary pumps, this project will connect extensive



floodplain areas through tiered watering events. These works will make use of natural flow paths to increase the extent, frequency and duration of inundation from either Basin Plan flows or pumping during low-flow events.

Burra Creek Management Proposal

The proposed works will enable inundation of 407 ha. This represents 33 percent of the total forest area and almost all of the flood-dependent ecological communities found within the forest, and provides a greater extent of watering than is possible under Basin Plan flows. The works involve the construction of three large regulators, raising tracks to form levees and removing barriers to flow on the floodplain.

Gunbower National Park Floodplain Management Project

The project has been developed to enable the delivery of environmental water to the wetlands and forest of the Gunbower National Park. It will mimic a natural flood of up to 45,000 ML/d in the River Murray across 500 ha. This includes almost half of the permanent and temporary wetlands in the project area and 20 percent of river red gum with flood-dependent understorey seedlings and saplings. The package of works includes a pump station, regulator and creek enhancement works. The mid-forest works will consist of a 100 ML/d pump station located on the Murray and a number of regulators, as well as upgrades to infrastructure on Camerons Creek. This will provide water to around 500 ha of Gunbower National Park which currently cannot be watered by any other infrastructure.

Guttrum and Benwell State Forests Floodplain Environmental Works Project

The project will reinstate a more natural flooding regime for the Guttrum and Benwell Forests and addresses the reduced frequency and length of floods. The proposed works will water 1,200 ha by pump stations off the River Murray, including semi-permanent wetlands and 82 percent of the river red gum forest with flood-dependent understorey seedlings and saplings. The works will include two separate pump stations to deliver environmental water into Guttrum Forest, one pump station in Benwell Forest and containment works of regulators and levees in both forests to contain water on the floodplain. The works have been designed to meet the water requirements of the forest by mimicking a 26,000 ML/d flood event in the River Murray for Guttrum Forest and a 24,000 ML/d flood event for Benwell Forest.

Hattah Lakes North Floodplain Management Project

This project will complement the Living Murray initiative works at the Hattah Lakes Icon Site by boosting flooding across higher floodplain terraces. The proposed works will water an additional 1,130 ha of floodplain by constructing two new regulators, a causeway across an existing track and 1.7 km of levees along track alignments. The project will increase flexible environmental water management across the lakes.

Lindsay Island (Stage 2) Floodplain Management Project

The Lindsay Island Floodplain Project will inundate 5,152 ha of the floodplain. It will connect many parts of the floodplain through tiered watering events, including areas of unique fast-flowing aquatic habitat, through to sections of black box and lignum and onto the higher alluvial terraces. The proposed works will operate alongside the recently completed Living Murray works at this Lindsay State 1 site and Lock 7 to mimic flows of 40,000 to 120,000 ML/d.

The proposed works include two components:

- Primary: Berribee Regulator and fishway, five containment regulators and 2.6 kilometres of levees along track alignments
- Secondary: 13 regulators and associated work and 4.9 kilometres of levees along track alignments

Nyah Floodplain Management Project

The proposed works will water almost 500 ha of floodplain within Nyah Forest, replicating River Murray flows of up to 25,000 ML/d. They will influence over 53 percent of the total forest area and almost all of the flood-dependent plants and animals. The works consist of four regulators, three on the downstream end of Parnee Malloo Creek and one on the upstream end. Extra works to contain water within the forest include 1.7 km of low-level track raising, forming a levee at the downstream end of the forest.

Vinifera Floodplain Management Project

This project will water up to 350 ha of floodplain within Vinifera Forest. It represents 55 percent of the total 638 ha forest area and almost all of the flood-dependent plant species. The proposed works involve constructing four regulators and raising 1.1 km of low-level track to control both flood and pumped flows into and out of Vinifera Creek. Water will be delivered to the site through a combination of natural inflows or temporary pumping when river flows are insufficient.

Wallpolla Island Floodplain Management Project

Wallpolla Island is part of the Living Murray Lindsay-Wallpolla Islands Icon Site and proposed works will complement existing Living Murray works at this site. This project will increase the frequency and length of floodplain inundation across 2,650 ha, significantly benefitting nationally important species, threatened vegetation, ecological values, carbon cycling and downstream water quality. This will benefit both Wallpolla Island and the broader Lower Murray region.

The proposed works include four major regulators, 22 smaller containment regulators and 4.5 km of levees or raised tracks. The works have been designed to complement weir pool manipulation activities at Locks 8 and 9 and connect areas of flowing aquatic habitat with sections of black box, lignum and higher alluvial terraces. This will enable watering at a landscape scale, mimicking flows of 30,000 to 120,000 ML/day.

6.3 Constraints Management Strategy

As well as the agreed 2,750 GL sustainable diversion limit, the Basin Plan allows for a potential further 450 GL of water to be recovered for the environment by 2024 by removing operational and physical constraints in the river system. The Commonwealth has agreed it will fund works required under its Constraints Management Strategy 2013 to 2024 provided that the works are socio-economically neutral and have no adverse third party impacts.

Victoria has been looking at opportunities to get better environmental outcomes by delivering environmental water more efficiently. This includes exploring opportunities to increase natural higher flows by putting measures in place that prevent and mitigate any potential impacts of higher flows on public and private land. Two constraints measures are included in Victoria's package of 22 projects that seeks to achieve the Basin Plan's environmental targets without the need for further Commonwealth water buybacks. These constraints measures are in their early development and involve ongoing community consultation.

Hume to Yarrawonga key focus area

Investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows of up to 40,000 ML/d from Hume Dam. Investigations will include the potential effects of higher flows on third parties and mitigation options to address unacceptable impacts, including easements and/or infrastructure, to allow the delivery of these flows to support improved river and wetland health outcomes. Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.

New Goulburn key focus area



Investigation of opportunities to address in-channel constraints to the delivery of higher regulated flows of up to 20,000 ML per day at Shepparton. Allowing the delivery of flows to the top of the bank would improve river health outcomes. This work will be done with communities in a staged and bottom-up way to understand the risks, impacts and costs, and develop feasible and acceptable solutions to mitigate third party impacts.

Building on this work, further improvements to environmental water delivery will also be investigated in close consultation with landholders and communities. Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects.

6.4 Operational rule changes and system enhancements

Victoria is working with other Basin states on projects that involve changing the way river systems operate. These are known as Operational Rule Changes.

Five Operational Rule Change projects are part of Victoria's package of 22 projects to achieve the Basin Plan's environmental targets without the need for further Commonwealth water buybacks. These are joint projects with New South Wales.

The projects involve changes to river operation rules to improve flexibility and control over delivering environmental water to the River Murray. They achieve the environmental outcomes of the Basin Plan using less water to meet the rigorous statutory requirements for offsets under the sustainable diversion limit adjustment mechanism.

Barmah-Millewa Forest Environmental Water Allocation

Rule change to vary the rules associated with the water set aside by Victoria and New South Wales in the Barmah-Millewa Forest Environmental Watering Account to water the Barmah-Millewa Forest. The change proposes allowing the use of other environmental entitlements to target the environmental requirements specified in the Basin Plan. This measure proposes to not initiate or continue release from the Barmah-Millewa Forest Environmental Watering Account if a four-monthly flood has already occurred.

Flexible rates of fall in river levels downstream of Hume Dam

Rule change to allow releases from Hume Dam to be reduced more quickly when flows have not been elevated for an extended period beforehand. The water saved would be released at a different point in time or in a different flow pattern to provide additional environmental benefits. The extra flexibility improves Hume Dam operational efficiency.

Hume Dam airspace management and pre-release rules

Rule change to allow future environmental water releases in airspace management.

2011 Snowy Water Licence schedule 4 amendments to River Murray increased flow call out provisions

Amendments to Snowy Hydro licence in 2011 allow the water recovered by the River Murray Increased Flows to be held and called out. Previously the release of the water was at the discretion of Snowy Hydro and was generally at times suited to Snowy Hydro's commercial outcomes. The proposal intends to provide a way of controlling the timing of River Murray Increased Flows water releases from the Snowy Scheme, allowing more flexibility to achieve environmental outcomes targeted in the River Murray below Hume Dam.

6.5 Efficiency measures

Efficiency measures recover and provide more water for the environment by increasing the efficiency of consumptive water uses, like irrigation.

Victoria has carried out a series of water efficiency programs to meet its share of the 2,750 GL water recovery target. However the Basin Plan also allows for efficiency measures - usually called 'upwater' - to deliver a further 450 GL above that target for the environment. The Basin Plan requires that these 450 GL efficiency measures achieve neutral or improved socio-economic outcomes.

At Murray-Darling Basin Ministerial Council in December 2018, all governments agreed to socio-economic criteria which were adopted as the basis of the neutrality test for assessing efficiency measures projects. Ministers agreed that these criteria be applied to all efficiency measures projects that are part of the additional 450 GL proposed, prior to approval of projects. They agreed that each state establish a process to assess each project against the criteria to ensure their compliance. Projects will then be submitted to the Commonwealth.

At the December Ministerial Council meeting, the Commonwealth government also committed to fund state projects to contribute to the initial focus of recovering 62 GL of additional water through socio-economically neutral or positive projects to enable the full 605 GL Sustainable Diversion Limit Mechanism offset to be achieved.

This includes Victoria's Northern Water Infrastructure Prospectus which was submitted to the Commonwealth government in October 2018 for funding consideration. The prospectus meets Victoria's commitment to provide up to 9 GL of socio-economically neutral or positive projects to meet the initial water recovery priority of 62 GL.

Victoria has a number of existing projects that aim to improve water delivery. These processes involve upgrading or evolving components specific to each project, while minimising impacts to the environment and economy.

Modernising irrigation systems can involve:

- automating and upgrading channels to reduce the need to operate the system manually, while measuring water flows accurately and in real time
- removing redundant channels
- replacing open channels with pipelines to minimise water losses
- upgrading the accuracy of metered outlets that deliver water to farms
- lining and remodelling channels to minimise water lost during transport.

These works, combined with changes to the way systems operate, are improving service levels to irrigators and saving billions of litres of water.

There are a number of modernisation projects currently underway that aim to bring existing irrigation systems to current standards.

Goulburn-Murray Water Connections Project

The Connections Project is the largest irrigation modernisation project in Australia, ensuring a sustainable future for productive agriculture in northern Victoria and long-term water security for the Goulburn-Murray Irrigation District.

The \$2 billion Victorian and Commonwealth Government-funded project is upgrading the irrigation delivery system to recover 429 GL of water savings to benefit irrigators, the environment and Melbourne retail water corporations. The project is a key part of Victoria's contribution to the Basin Plan in a way that minimises any socio-economic impacts.

When the project is completed, water users in the region will benefit from a modern delivery system providing increased productivity and greater water reliability.

Sunraysia Modernisation Project

The \$120 million Sunraysia Modernisation Project has created a more efficient irrigation network with better water quality across the Mildura, Merbein and Red Cliffs irrigation districts.

It has:

- upgraded key pump stations across the three districts
- replaced approximately 24 kilometres of open channels with pipelines
- installed channel automation in the remaining 20 kilometres of open channels, including 19 regulating structures

The project was funded with \$103 million from the Commonwealth Government and \$17 million from the Victorian Government through Lower Murray Water's capital works budget. It was delivered by Lower Murray Water and officially opened in September 2016.

Benefits of the project include:

- greater reliability and water availability for more than 2,000 customers, with 365-day access to irrigation water through the ordering system
- improved water quality helping to reduce on-farm filtration costs
- greater operational flexibility to improve service delivery to irrigation customers
- seven GL in water savings transferred to the environment to bridge the gap under the Basin Plan