

**INDEPENDENT REVIEW OF THE SOUTH AUSTRALIAN METHOD AND
PLANNING ASSUMPTIONS FOR LONG TERM DIVERSION LIMIT
EQUIVALENCE (LTDLE) FACTORS IN THE MURRAY-DARLING BASIN**

The Independent Review Panel

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Summary

This is an independent review of the planning assumptions and the calculation methodologies used by South Australia to determine their Long Term Diversion Limit Equivalence (**LTDLE**) factors.

The LTDLE factors are important because they relate the volume of a water entitlement class to the long-term average permitted water use for that entitlement class, and allow for comparison between different entitlement classes.

Consequently these factors are a key basis for determining whether the water recovery under the Basin Plan will 'bridge the gap' from the baseline diversion limit (**BDL**) to the sustainable diversion limit (**SDL**).

Review Findings

- (a) This review endorses the LTDLE factors presented in the LTDLE spreadsheet and South Australian Department for Environment and Water fact sheet.
- (b) The methods and assumptions upon which the factors are based have been reviewed and are considered by the reviewers to be the best available at the current time.
- (c) There are inherent difficulties and uncertainties in predicting the effect of the purchase of entitlements on consumptive water use into the future. This is because water management in any valley is dynamic and complex and utilisation of entitlements in the future is impacted by a range of considerations. These include the way environmental water will be used, the use rules that will be set by the resource manager, the manner in which consumptive users will respond to changing conditions, the potential changes in prevailing climate and other considerations.
- (d) Given these uncertainties, and to provide consistency with the approach used by the MDBA to set the basin plan, the approach proposed by South Australia has been to use the BDL model, and the planning assumptions that have been defined and included in this model, to determine LTDLE factors. These assumptions reflect 2009 conditions. The reviewers agree with the use of the BDL models to determine South Australia's LTDLE factors. The planning assumptions and representation in the model have been reviewed by South Australia and updated by the MDBA, and represent the best available information.

Because of the above uncertainties in assessing changes in water use as a result of water recovery, and that LTDLE factors are associated with permitted use, it is inevitable that changes in water use will not exactly match the change in permitted use determined by LTDLE factors. This means that the management of water use by each jurisdiction to comply with the SDL is particularly important. However, it is noted that the diversion limit control mechanisms which will be in place under the new WRPs are intended to ensure that diversions will be maintained within the SDL over time through the compliance processes set in place by the MDBA and state Water Resource Plans.

1 Introduction

1.1 What are LTDLE Factors?

Water allocated to, and used by, the various classes of entitlement across the Basin varies according to the irrigation crops and practices in each valley, local climate, and water management rules. Long Term Diversion Limit Equivalence (**LTDLE**) factors provide a conversion between the “face value” or number of shares on a water entitlement and the long-term average permitted annual use of that entitlement over the reference period used to develop the Basin Plan (1895 – 2009). LTDLE factors in most states are specific for an entitlement class within each valley for which water resource plans (**WRPs**) are being prepared under the Basin Plan.

This is an independent review of the planning assumptions and the calculation methodologies used to determine the LTDLE factors for the South Australian Murray SDL resource unit within the Basin. Other SDL resource units in South Australia do not require LTDLE factors to be determined as there is no requirement or proposal to recover water in these other SDL resource units.

South Australia has also identified that unlicensed stock and domestic usage from the River Murray under basic landholder rights had not been included in previous Cap or BDL volumes. It is proposed that the Basin Plan be updated for this form of take and then the BDL volume be increased accordingly (and hence the SDL volume increases as well). Until this occurs, this use is accounted for under the existing SDL. An LTDLE factor is not required for these basic rights, as they are not able to be recovered for environmental purposes by purchase or infrastructure works.

These LTDLE factors have been prepared by the South Australian Department for Environment and Water (**DEW**).

1.2 Why are LTDLE Factors Required?

The Basin Plan sets new Sustainable Diversion Limits (**SDLs**) for all river valleys across the Murray-Darling Basin. These SDLs are set relative to a Baseline Diversion Limit (**BDL**), which is defined by the Basin Plan for most valleys as the diversions that could be taken under existing state arrangements on 1 July 2009. For the South Australian Murray SDL resource unit, the BDL is defined as the long-term average limit on the quantity of water that can be taken in accordance with Schedule E of the Murray Darling Basin Agreement as at 30 June 2009 (but excluding water recovered under the TLM initiative)¹.

To implement these SDLs, the Commonwealth has committed to recover water from consumptive users by purchasing entitlements and funding water savings projects, with the aim of reducing permitted water use to the SDL. The aim of the LTDLEs is to ‘bridge the gap’ from the BDL to the SDL set in the Basin Plan.

LTDLE factors provide the key basis for determining whether the recovered water entitlements will ‘bridge the gap’ in long-term average permitted water use (i.e. use limit) between BDL and SDL in the future when the WRPs are implemented.

¹ Refer to Schedule 3 of the Basin Plan 2012

1.3 Existing LTDLE Factors

Prior to 2019, a set of LTDLE factors had been used to reflect the conversion between an entitlement and its long-term water use. These LTDLE factors have been used to estimate water recovery by the Commonwealth (known as version 2.05 or 'v2.05' factors). These factors were derived from a mixture of sources, including a set of 'Cap Factors'. Other LTDLE factors adopted for use in the northern Basin come from a variety of different sources.

The Murray-Darling Basin ministers requested the continued use of a set of LTDLE factors to estimate water recovery in 2011, which were still formally being used by the Commonwealth up to 2019. Recognising that these factors could be improved, in 2015 Basin ministers requested each state to bring forward appropriate updated factors.

1.4 Documents Examined and Review Tasks Undertaken

This review was initially commenced in March 2019 and was then progressively completed as additional information became available and within the availability constraints of both reviewers.

The review was undertaken based on the documents available at that time. Prior to the review commencing, the reviewers understand various discussions about South Australia's approach to the calculation of LTDLE factors took place between the MDBA and the South Australian government including exchange of some preliminary documentation.

The calculation of LTDLE factors is primarily based on the simulation of the long-term water use behaviour in various hydrologic models. The reviewers have checked the credentials of the models upon which DEW relies to ensure they are the best available, but it has not been within the scope of the review to undertake an assessment of the accuracy of any of these models.

To undertake this review, the MDBA have made available a number of documents and calculation spreadsheets prepared by the DEW of which the following were the most significant:

- *Baseline Diversion Limit for the South Australian Murray SDL Resource Unit (SS11)*. Submitted as supporting evidence for WRP accreditation – DEW, 2019. (**BDL Report**);
- *SA Revised LTDLE factors – 28 Mar 2019*. Spreadsheet provided by DEW (**LTDLE factors spreadsheet**);
- *SA Revised LTDLE factors - 9 July 2019*. Spreadsheet provided by DEW (**LTDLE factors spreadsheet**) - N.B. this spreadsheet updated and superseded the March 2019 spreadsheet
- *DEW factsheet - LTDLE factors*. Final draft of a fact sheet summarising the SA approach to LTDLE factors – DEW September 2019.

The MDBA has also facilitated teleconferences with MDBA and South Australian Government (DEW) staff to assist with the review.

The MDBA and DEW have also been given the opportunity to review a draft of the report prior to its finalisation.

2 Method Proposed by South Australia

2.1 Entitlement Classes for which LTDLE Factors are Required

LTDLE Factors are required for all entitlement classes where water purchases for ‘bridging the gap’ have occurred or are likely to occur under the Basin Plan. In addition, LTDLE factors are needed where water entitlements have been created through savings projects including those currently underway or proposed to occur. However, there are no water entitlements that have been created through water savings in South Australia.

These entitlement classes for which LTDLE Factors are required are summarised in Table 1.

Table 1: *Entitlement Classes where LTDLE Factors are Required*

Entitlement class	Description
Class 1	Licensed Stock and Domestic
Class 2	Urban water - Country Towns
Class 3	Irrigation
Class 4	Recreation
Class 5	Industrial
Class 6*	Metropolitan Adelaide
Class 7	Environmental
Class 8	Environmental Land Management

* Note: Class 6 entitlements are set aside for Metropolitan Adelaide requirements. Trade of these entitlements is currently not permitted under Schedule E of the MDB Agreement; therefore no environmental recovery will occur for this class of water access right.

2.2 Use of BDL Models

South Australia have set out their methodology for determining LTDLE factors in the LTDLE factors fact-sheet document. The methodology uses the BDL model for the Murray River system, developed by the MDBA. This model was used to simulate water allocations and permitted water that would occur given a repeat of the historical climate conditions from 1895 to 2009, under the Cap and the water sharing and water management policies that were in place in South Australia as at 30 June 2009. The model outputs were used to estimate the annual and long-term average allocations and diversions to allow calculation of the utilisation, for each entitlement class.

The BDL model used by South Australia is the Source Murray Model Run 9354², which is the most recent model representation of BDL conditions that has been prepared by the MDBA, and has been adopted for use under the basin plan. This model scenario has been developed by the MDBA to replace the pre-existing Murray Simulation Model.

Whilst it is not within the scope of this review to assess the veracity of individual models, the reviewers were informed by the MDBA that the differences between the Source Murray Model Run 9354 and the previous Murray Simulation Model representation of BDL conditions (Run 871) were small, despite this model utilising a different platform (i.e. eWater Source). The reviewers note that

² Source Murray Model – method for permitted take, MDBA Technical report 2018/16

Victoria has also used the Source Murray Model (BDL scenario Run 9484) to determine its proposed LTDLE factors.

2.3 Cross-Check of Entitlements

The quantum of the entitlements on issue in 2009 in each class used in their LTDLE factor assessment spreadsheet, was compared with the entitlements currently on issue in SA, as described in the 2019 Water Allocation Plan for the River Murray Prescribed Watercourse. The results are shown in Table 2. The entitlements currently on issue are consistent with those used in the revised BDL estimate modelling.

Table 2: Entitlement cross-check

Entitlement class	2009 BDL Entitlement Volume (GL)	2019 Water Allocation Plan Entitlement Volume (GL)
Classes 1 and 5 (Licensed Stock and Domestic, Industrial)	13.9	13.9
Classes 3, 4, 7 and 8 (Irrigation, recreation, environment, ELMA)	630*	630*
Class 2 (Country Towns)	50	50
Class 6 (Metro Adelaide)	130	130

*Includes non-consumptive volumes held for environmental purposes (e.g. 43.9 GL of TLM entitlements).

2.4 Assessment of MDBA Source Modelling

2.4.1 Background to Source Modelling

The review has considered the Source modelling and the implications for the LTDLE factors for the various entitlements in the South Australian River Murray WRP area.

As noted above, the revised BDL model was used to develop the updated LTDLE factors. This model was also used as the basis for development of the SA WRPs for accreditation under the Basin Plan. All of South Australia's WRPs have now been accredited.

As part of development of the SA WRPs, DEW staff worked in collaboration with MDBA modellers and undertook a detailed review of the BDL assumptions and BDL estimate prepared for the Basin Plan, and a revised BDL estimate was developed. The revisions to the initial BDL estimate parameters are extensively detailed in the BDL report. The revised BDL volume estimated using the updated assumptions and data is 681.056 GL, which represents a small increase compared to the original BDL estimate of 665 GL.

The changes in the BDL estimate have been assessed by SA, and the key factors contributing to the changes were identified as:

- 5.4 GL – updates to address minor coding bugs found in the original model.
- 7.5 GL – revised BDL assumptions

- 3.1 GL – model improvements in the representation of SA Entitlement in the Source BDL model.

2.4.2 How are the Source modelling results used?

Key updates to data and relevant revisions to the BDL modelling assumptions were also incorporated into the SA cap models and an updated Cap model was developed. This represented the permitted diversion limits that SA was required to comply with. The reference period for the Cap model is 1891 – 2003.

The additional “BDL” changes to state water policy subsequent to the Cap baseline were incorporated into the BDL model and the modelled demands were scaled to ensure that diversions over the Cap reference period matched the permitted diversions under the Cap. The model was then run over the Basin Plan reference period of 1895 – 2009 to determine the BDL.

The LTDLE factor for each water access entitlement class, or group of entitlement classes, is determined by dividing the annual average simulated diversions for that class of entitlement by the volume of that class of entitlement on issue at the 2009 baseline. The LTDLE factors are shown in Table 3.

Table 3: SA LTDLE factors

Consumptive Water Access Entitlements – BDL conditions¹	Water Access Entitlement Volume (ML)¹	BDL permitted Diversions (ML)²	LTDLE Factor
Classes 1 and 5 (Licensed Stock and Domestic, Industrial)	13,900	13,900	1.000
Classes 3, 4, 7 and 8 (Irrigation, recreation, environment, ELMA)	586,130	516,802	0.882
Class 2 (Country Towns)	50,000	49,759	0.995
Class 6 (Metropolitan Adelaide)	130,000	100,595	0.774
Total	780,030	681,056	-

Notes:

1. The water access entitlement classes and associated volumes are those under the Water Allocation Plan for the River Murray Prescribed Watercourse as at 30 June 2009. The volumes exclude those entitlements recovered under The Living Murray.
2. The BDL permitted diversions are from the revised BDL Source Murray Model run, submitted as supporting evidence to the SA River Murray WRP. These volumes exclude use against those entitlements recovered under The Living Murray program.

It is noted that some of the key model changes to reflect BDL conditions involved incorporating the SA allocation priorities and water sharing rules as at 30 June 2009, which were extensively revised based on the learnings from the Millennium drought. Water access entitlement classes with the same allocation priority and assumed utilisation have been grouped together for the purpose of developing LTDLE factors.

3 Using LTDLE Factors to ‘Bridge the Gap’ – Review of Key Assumptions

3.1 Assumptions and Uncertainties in Calculating LTDLE factors

The Commonwealth government will use LTDLE factors to provide confidence that the water recovery will reduce the BDL levels of permitted take to the SDL levels of permitted take in each valley (i.e. ‘bridge the gap’).

The MDBA has noted that, in some locations (such as in Queensland and South Australia) the BDL levels of permitted take were set at levels higher than the use in 2009. This reflects arrangements previously negotiated as part of the Murray-Darling Basin Cap on diversions, and is represented within the BDL models used to underpin the BDL estimates included in the Basin Plan.

In such instances, the aim of water recovery is to reduce the baseline diversion limit (as opposed to actual diversions as they were in 2009) to the sustainable diversion limit, noting that some allowable growth in actual take may occur up to those limits over the life of the WRP.

The intention is to ensure the resultant LTDLE factors provide a consistent measure of the relative contribution of different entitlements to ‘bridging the gap’ (i.e. reducing the use limits), both within and between valleys, and that the best available information has been used. Given that the Basin Plan water recovery target was developed on the basis of modelled BDL conditions, the most consistent approach to calculating LTDLEs is with respect to the BDL, being the *diversion limit* under state law at that time.

When considering the future operations within a valley under its new WRP, the change in consumptive diversions arising from the past purchase of entitlements will vary depending on:

- the original utilisation of the entitlement prior to purchase/recovery;
- the utilisation of the purchased entitlements that is achieved by environmental water managers following the purchase;
- the future behaviour of consumptive water users; and
- the characteristics of different types of entitlements within and across valleys (such as the reliability of allocations to those entitlements).

These issues create some uncertainties as to whether the recovered entitlements will consistently provide the same reduction in long-term diversions that they have in the past.

For each WRP prepared under the Basin Plan, the states are required to develop a ‘method’ for calculating the annual permitted take each year that shows diversions will be within the SDL over a repeat of the reference climate period (1895-2009). In preparing this method, the effect of the

above issues and uncertainties will not be known precisely, and assumptions have been made, which are acknowledged by the MDBA in documentation regarding ‘planning assumptions’.³

The key intention in making these assumptions is to ensure the resultant factors provide a consistent measure of the relative share of water use limits attributable to different entitlements, both within and between valleys, and that the best available information has been used.

The Commonwealth and MDBA have indicated that LTDLE factors in regulated river systems are for an entitlement class and not for an individual entitlement. Consequently, when calculating LTDLE factors, all entitlements are assumed to share the permitted diversions attributable to that class of entitlement equally. This involves averaging of the ‘value’ of individual entitlements across an entitlement class within a valley. This averaging accounts for the different spatial location and differing water use characteristics of individual entitlements within an entitlement class.

For example, consider the South Australian Class 3, 4, 7, and 8 entitlements. These entitlement classes are comprised of numerous individual entitlements. For the purpose of calculating LTDLE factors, the long-term average diversions attributed to all class 3, 4, 7, and 8 entitlements are assumed to be distributed to an individual entitlement pro-rata according to that entitlement’s share of the total class 3, 4, 7, and 8 entitlement on issue.

Using an average factor for each entitlement class is appropriate for entitlements recovered from consumptive use, where the estimate of long-term average use from models is also aggregated, and all of the entitlement holders have an equal right to utilise their entitlements. South Australia is proposing a common factor across multiple entitlement classes in some cases. In particular, a common factor for the class 3, 4, 7, and 8 entitlements as discussed above. These entitlement classes also have the same allocation priority under the 2019 Water Allocation Plan, and receive the same level of allocation in all but the driest of years.

Where individual water use entitlements are modelled (e.g. some Queensland entitlements) using an average factor would not be appropriate, but this does not occur for most South Australian entitlements.

3.2 Representativeness of BDL Models

All models are only approximations, and to the extent that these models contain approximations of reality, this creates some uncertainties in the models’ results.

The BDL models used to prepare the Basin Plan 2012 have been previously reviewed and adopted as the best estimates of BDL conditions at the time. Nevertheless, over the last seven years, the MDBA has prepared a new Murray model using the Source modelling platform. This new model includes some further minor improvements to better represent the management of water restrictions at 30 June 2009, following the worst of the millennium drought. As this upgraded model has been prepared by making small improvements to the original model, it is expected that the upgraded model is to an equal or better standard than the original model. The reviewers have assumed this to

³ Refer ‘Basin Plan Water Resource Plan Requirements Position Statement 3H – Planning assumptions’ issued by the MDBA in March 2016.

be the case, noting that there has been an independent review of the upgraded model (and it is also noted that any assessment of these models is outside the scope of this review).

3.3 Adjustment of Valley-Scale Use Limits

The Basin Plan requires that WRPs demonstrate that diversions will be reduced to SDL levels. The Commonwealth government is seeking to achieve this through its funding of the recovery of water (entitlement purchases, and savings projects) and that states' WRPs would then simply reset the valley-scale use limit from the BDL to the SDL. The intent is that the new SDL could be set in place without impact to the remaining consumptive water users.

Because of the uncertainties involved in assessing LTDLE factors, it is inevitable that small over or under recovery might occur in attempting to 'bridge the gap' by direct reductions in consumptive water use through purchase. However, the new valley-scale diversion limits set via WRPs are intended to force diversions to remain within the SDL over time, through the compliance processes set in place by the MDBA and state Water Resource Plans.

In general, each valley within the basin has been managed to a water use limit, such as the 1993/94 Cap, or NSW Water Sharing Plan Limits etc., and in the future, consumptive use in each valley will be managed to the SDL. If the utilisation of consumptive entitlements is currently at BDL levels (or was at 2009), and reasonable compliance processes are in place, it could be assumed that there is unlikely to be any long term growth in water use at a valley scale.

If growth in water use were to occur, valley-scale water use limits may require reduction in access to water to maintain compliance with the SDL, and these actions may occur differentially across entitlement classes, which may affect the volume of water recovered.

3.4 Changes in Management Rules

There is also potential for management rule changes to occur that may change the reliability of allocations to individual entitlement classes.

However, it is understood that there have been no changes of significance to management rules since 2009 in the South Australian Murray River system.

4 Conclusions

This review has found that the results of the BDL model have been used appropriately to determine the SA LTDLE factors.

In particular:

- The Source Murray Model simulates water management and use in the South Australian Murray SDL resource unit (SS11), and the MDBA worked with SA to prepare a revised Source Murray Model to represent BDL conditions. This revised model includes updates to water entitlements and management rules to better reflect the BDL conditions.
- South Australia has provided this review with a report (BDL Report) that details the updates to the entitlements and management rules within the Source Murray Model for South Australia. The reviewers are satisfied that this report demonstrates that the revised entitlement volumes and management rules can be verified against the 2019 Water Allocation Plan for the (South Australian) River Murray Prescribed Watercourse.
- South Australia have proposed factors based on results from the Source Murray Model developed by the MDBA in conjunction with South Australia. The difference in simulated diversions between the Source Murray Model and the previous Murray Simulation Model Run 871 that was used for initial estimates of the BDL is understood to be small and is not considered significant for South Australia.

The methods and assumptions upon which the factors are based have been reviewed and are considered by the reviewers to be the best available at the current time.

The Commonwealth intends for its purchase of entitlements and funding of water savings projects to reduce consumptive water use from the BDL to the SDL, and 'bridge the gap'. To ensure this has been achieved, the Commonwealth intends for LTDLE factors to represent the likely water use during the life of the first WRPs (2019 – 2029). This review endorses the LTDLE factors presented in the LTDLE spreadsheet and South Australian Department for Environment and Water fact sheet, based on BDL modelling of the water use limits in South Australia.

Because of the uncertainties involved in assessing changes in water use as a result of water recovery, and that LTDLE factors are associated with permitted use, it is inevitable that changes in water use will not exactly match the change in permitted use determined by LTDLE factors. This means that the management of water use by each jurisdiction to comply with the SDL is particularly important. The diversion limit control mechanisms which will be in place under the new WRPs are intended to ensure that diversions will be maintained within the SDL over time through the compliance processes set in place by the MDBA and state Water Resource Plans.