Murray-Darling Basin SDL adjustment mechanism

Report by the Victorian and NSW Ministers' Independent Expert Panel

Confidential report prepared for the Victorian and New South Wales Governments

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Abbreviations

ANAE	Australian National Aquatic Ecosystem
BOC	Basin Officials Committee
CLLMM	Coorong, Lower Lakes and Murray Mouth
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ESLT	Environmentally Sustainable Level of Take
GL	Gigalitres
HIS	Hydrologic Indicator Sites
M&E	Monitoring and Evaluation
MDBA	Murray-Darling Basin Authority
NSW	New South Wales
NVIS	National Vegetation Information System
SDL	Sustainable Diversion Limit
SDLAAC	SDL Adjustment Advisory Committee
SFI	Site-specific flow indicator
TWG	SDL Adjustment Technical Working Group

Glossary

19-pack	A group of 19 supply measures tested in a preliminary trial of the default method.
Benchmark conditions of development	The benchmark conditions of development are the conditions of development that are assumed in the benchmark model described in Schedule 6.
Benchmark model	The benchmark model is a modification of the BP-2800 scenario (model run 847 (MDBA, 2012b)), which informed development of the Basin Plan, with a set of mandated refinements described in Schedule 6 (Part 2) of the Basin Plan and a number of non-mandated changes jurisdictions have agreed to be included in the benchmark model.
CSIRO method	The component of the default method documented in Overton et al. (2014) and associated reports.
Default method	The method used to determine the supply contribution component of the SDL adjustment mechanism unless another method is agreed by the MDBA and Basin Officials Committee.
Efficiency measure	A measure that operates to decrease the quantity of water required for one or more consumptive uses in a set of surface water SDL resource units, compared with the quantity required under the benchmark conditions of development.
Ecological significance weighting	A weighting used in the default method to recognise the different ecological value of areas of the floodplain
ESLT	According to the *Water Act 2007* (Cth), the level at which water can be taken from a water resource which, if exceeded, would compromise: • key environmental assets of the water resource; or • key ecosystem functions of the water resource; or • productive base of the water resource; or • key environmental outcomes for the water resource.
Flow constraints	River management practices and structures that govern the volume and timing of regulated water delivery through the river system.
Hydro cues operation	The ability for river operators (at the request of environmental water holders) to make regulated releases from storages to coincide with rainfall, when dams are filling and downstream tributaries are flowing. This is a semi-translucent flows approach.
Limits of change	Limits in score or outcome that ensure that supply contributions maintain environmental outcomes within identified limits.
Mandated changes	Refinements to MDBA model run 847 listed in S6.02(1) of the Basin Plan.
Non-mandated changes	Refinements to MDBA model run 847 additional to the “mandated changes” listed in S6.02(1) of the Basin Plan.

Notified measure	Any measure that has been notified under subsection 7.12(1) or (1A) of the Basin Plan. ‘Notified efficiency measure’ and ‘notified supply measure’ have corresponding meanings.
SFI	Flow targets used in the development of the ESLT. They were used to express environmental water requirements at hydrologic indicator sites. The indicators include the volumes, frequency, duration and the periods during which flows are required at hydrologic indicator sites.
SDL	The maximum long-term annual average quantities of water that can be taken on a sustainable basis from Basin water resources as a whole, and from each SDL resource unit. The *Water Act 2007* (Cth) requires that these reflect an environmentally sustainable level of take.
Supply contribution	The total supply contribution of the notified measures is the total increase in the SDLs for all the units affected by notified supply measures that will ensure that, calculated in accordance with the applicable method on the basis of: (a) a repeat of the historical climate conditions; and (b) the benchmark conditions of development modified by: (i) the addition of the notified supply measures; and (ii) the removal of any unimplemented policy measures; the following results occur, as compared with the benchmark environmental outcomes: (c) there are equivalent environmental outcomes; and (d) there are no detrimental impacts on reliability of supply of water to the holders of water access rights that are not offset or negated.
Supply measure	A measure that operates to increase the quantity of water available to be taken in a set of surface water SDL resource units compared with the quantity available under the benchmark conditions of development.
Without-development scenario	A scenario based on the baseline scenario, but with all the dams, irrigation and environmental works/infrastructure, all consumptive users and the rules governing flow such as channel constraints removed. It is not a representation of pre-European or natural conditions as inflow estimates were not corrected for land use changes and on-farm development in the catchments. The baseline scenario is the best available estimate of current use of water resources of the basin as at 2009. It reflects the water sharing arrangements that were in place in June 2009.

Executive summary

The Independent Expert Panel (the Panel) was asked by the Victorian and New South Wales (NSW) Governments to complete a review of the Sustainable Diversion Limits adjustment mechanism (SDL adjustment mechanism) and in particular the application of the mechanism, key assumptions, interpretations and environmental outcomes.

Background

The SDL adjustment mechanism is a mechanism established under the Murray-Darling Basin Plan (the Plan), which was set down in Commonwealth legislation in 2012, with the agreement of Basin States, to chart a future pathway for sustainable management of the Basin's water resources. It is administered by the Murray-Darling Basin Authority (MDBA).

Under the Plan, a long-term average sustainable diversion limit (SDL) is established for the Basin as a whole for both surface water and groundwater resources, and individual SDLs are established for each of the surface water and groundwater SDL resources that span the Basin. In each instance, these SDLs represent an environmentally sustainable level of take (ESLT) of water for those water resources.

At the time of the Plan's development, a computer model was used to estimate the existing Baseline Diversion Limit (BDL) and found it to be 13,623 gigalitres (GL) per year. The SDL was estimated to be 10,873 GL per year, therefore requiring a reduction of 2,750 GL per year from the MDBA's estimate of the BDL for all surface water SDL resource units.

The SDL adjustment mechanism is a mechanism through which the Basin-wide SDL may be varied up or down. Any adjustments to the SDL through proposed projects (such as infrastructure or altering flow management) are to be determined by the end of 2017, and all approved projects that impact on the SDL through the SDL adjustment mechanism must be completed by 2024. Beyond the initial estimates associated with proposed projects, the MDBA is required to assess the final volumetric implication of delivered projects and adjust SDLs through a formal adjustment process under section 23A of the *Water Act 2007* (Cth).

Projects to be considered under the SDL adjustment mechanism will either be supply measures (which allow equivalent environmental outcomes to be achieved with less water) or efficiency measures (which increase the volume of water available for environmental use by improving the efficiency with which water is used for consumptive purposes). If implemented, efficiency measures, which lower the SDL, are required to achieve a reduction in consumptive water use with neutral or improved socio-economic outcomes. This report is primarily focused on supply measures under the SDL adjustment mechanism, which can offset the 2,750 GL water recovery target by up to 650 GL.

Panel findings

The Panel observed that a trust deficit has emerged between the MDBA and the jurisdictions in relation to the benchmark model and its application. The SDL adjustment mechanism and the associated benchmark model (the 'default method') is highly complex. The MDBA is the custodian of the benchmark model, and there is very limited expertise outside the MDBA to enable wider operation of this model and interpretation of results. It has been necessary for the MDBA to manage the benchmark model and related elements of the SDL adjustment mechanism on behalf of the Commonwealth and Basin States, therefore limiting transparency.

The Panel also found that there is too much focus on the detail of the benchmark model and the SDL adjustment mechanism assessment method, rather than the broader objectives and outcomes sought by the Plan. Over time, the SDL adjustment mechanism assessment method has become overly deterministic. In effect, the process has become reliant on the benchmark model's ability to provide 'the answer'. Instead, the outputs from this model should be seen as a reasonable, approximate representation of a complex system. While the benchmark model can establish the upper and lower limit estimates of an optimised system, the model itself is not capable of delivering defined environmental outcomes. Instead, optimised environmental outcomes will be achieved as high-level decision makers interface intelligently with benchmark model capabilities and associated results.

In undertaking its review, the Panel found that while the Plan seeks to establish an adaptive management framework to optimise Basin water resources, current arrangements do not reflect that objective. In particular:

- the benchmark model has no agreed and stable baseline
- critical sub-elements of the model (such as limits of change and ecological equivalence scoring) are constraining supply contributions with unknown influence on ecological outcomes
- the 'limits of change' approach within the benchmark model leads to a binary trigger which has little relationship to actual ecological responses
- benchmark model and real-world interpretations vary (e.g. constraints, improved river operations etc.), meaning there is uncertainty attached to the SDLs and supply contributions generated by the model.

As a result of these and other issues, the adequacy of the SDL adjustment mechanism assessment method has been brought into question by the NSW and Victorian Governments. Progress towards an agreed suite of SDL adjustment mechanism supply measures and an associated supply contribution has effectively stalled. Compounding this, governance arrangements established by the Plan have been inadequate to effectively assess packages of measures and resolve matters in a timely manner.

The most recent work led by the MDBA claims that a supply contribution in the order of 650 GL could be achieved with the current assessment method, if certain new projects are added. These new projects notably include a lifting of constraints; a changed approach to environmental water demands ('Hydro cues operation'), and a reconfiguration of the Menindee Lakes proposal.

These projects are much less well developed than other proposed supply measures and do not yet have detailed business cases. They therefore present uncertainties and risks that could result in them failing to achieve the level of supply contribution currently estimated as feasible. Without these new projects, current work by MDBA suggests that the supply contribution will only reach 400 to 450 GL before widespread limits of change breaches occur, if the current deterministic approach set out in this report continues to be adhered to.

While noting that the MDBA regards the 650 GL supply contribution as potentially achievable, the Panel recommends that, rather than continuing to debate the benchmark model and the validity of its results, it is now time to recognise the model's shortcomings in the context of both the complexity of the system and the ultimate outcome sought. The model is necessary, but, in isolation, incapable of presenting a workable solution.

The Panel recommends that:

1. Governance structures to enable effective decision making in relation to the SDL adjustment mechanism should be reviewed and improved in a way that intelligently interfaces with benchmark model results to allow a package of supply measures to be assessed, and an associated supply contribution to be determined and agreed.

2. In assessing the supply contribution of a proposed package, technical domain specialists should be engaged to provide detailed, qualitative risk commentary to inform decision making, in particular for elements such as limits of change and ecological equivalence scoring. This would require moving away from the binary nature of these elements as currently applied in the model and would arguably be more consistent with the environmental outcomes focus of the Plan.

3. In addition to a qualitative risk commentary, technical domain specialists should provide recommendations on options to eliminate or mitigate risk, in particular through the coordinated use of 2,028 GL of existing contracted recovery of environmental water entitlements along with associated environmental works and measures.

4. A coordinated approach to system performance management should be established, founded on the adaptive management objective of the Plan. Evaluation and reporting of performance should be driven from the top down with an emphasis on achievement of quantifiable ecological objectives.

The Panel is of the view that adopting these recommendations will improve the effectiveness of the SDL adjustment mechanism, which will in turn contribute to achievement of the core objectives of the Plan: namely, to establish a sustainable and long-term adaptive management framework that optimises social, economic and environmental outcomes from the use of Basin water resources in the national interest.

Responses to questions in the Terms of Reference

The subsections below show the Panel's responses to specific questions contained in the Terms of Reference established to guide the Panel's work.

What is the Panel's view on options to achieve the maximum offsets, bringing together scientific rigour with practical knowledge of the Basin?

- The supply contribution from the suite of potential supply measure projects will be increased if the following changes are instituted:
    - allowing flexibility in the limits of change for site-specific flow indicators
    - incorporating an improved ecological significance weighting data set
    - implementing some or all of the following supply measures, which will improve the volume of flow and/or flow patterns within the southern connected Murray-Darling system:
        - Menindee
        - improved river operations (formally called Improved Regulation of the River Murray)
        - hydro cues operation with relaxation of some constraints.

Additional detail is provided in Section 3.

What is the Panel's advice on actual environmental risk, looking in particular at the materiality of thresholds for limits of change?

- Due to a lack of evidence, the Panel is unable to determine the materiality of the environmental risk as a consequence of exceeding limits of change.
- The Panel is of the view that the relationship between limits of change and ecological outcomes and risks is gradational, and not binary as specified within the SDL adjustment mechanism, and that there is no evidence of sudden change in outcomes when limits of change are exceeded.
- The Panel recommends that as part of any potential solution, an individual limit of change should inform decision making but should not be treated as an absolute limit.
- The Panel recommends that an expert panel be tasked with evaluating the relationships between magnitudes of ecological outcomes and risks for both
    - limits of change magnitudes
    - magnitudes of changes in ecological scores derived using the CSIRO method.

Additional detail is provided in Section 4.

What is the Panel's assessment of the validity of assumptions, interpretation and application of the SDL AM?

Benchmark model

- The Plan prescribes the development of an agreed benchmark model. While developed in preliminary draft form, the benchmark model has not been agreed, finalised and published.
- The governance process that is the basis of establishing a published benchmark has, to date, been unable to resolve areas of contested change. As a consequence, there is a level of uncertainty as to what constitutes an agreed set of assumptions and parameters.
- This uncertainty constrains the ability to assess supply measures in a timely manner, and has contributed to an erosion of trust in the process and a low level of confidence in the modelled supply contribution.
- Two major contested changes are the assumptions in relation to flow constraints at key locations on the Murray, Murrumbidgee and Goulburn Rivers, and improvements in river operations (delivery efficiency) throughout the system. In the absence of MDBA modelled data, the Panel is unable to quantify in detail the extent to which resolving these key benchmark assumptions will influence supply contributions. However, improved river operations is likely to provide a significant supply contribution.

Limits of change

See response above to question regarding 'advice on actual environmental risk'.

Environmental significance

- Being able to manage the relative significance of "priority environmental assets and ecosystem functions" (s. 8.05 and 8.06 of the Plan) is fundamental to maximising environmental outcomes.

The default method requires “science based, independently reviewed, fit for purpose metrics for weighting environmental significance of the flood dependent area”.

- In the absence of fit for purpose data and an agreed methodology, the component of the default method that was developed by CSIRO (the CSIRO method) did not adequately address this issue when using multiple site-specific flow indicators (SFIs) combined with SFI-targeted scoring by default. The Panel understands that this was largely due to the absence of an agreed methodology and suitable Basin-wide datasets.
- Neither the CSIRO method, nor use of land tenure/reservation status, provides a weighting by relative environmental significance that is defensible.
- The Panel considers that a comprehensive, systematic and integrated weighting on the basis of relative ecological significance is needed in order to maximise environmental outcomes for given volumes of available water. However, the Panel notes that if existing limits of change remain in place, then environmental significance is unlikely to strongly influence supply contributions, unless ecological elements scoring becomes a constraint (rather than the limits of change).

1. Introduction

The Basin Plan (the Plan) is a commitment by all Basin governments to reset the balance and sustainably manage the water requirements of industry, communities and the environment, in accordance with the triple bottom line objectives of the *Water Act 2007* (Cth).

It is less than five years since the Plan was signed into law but already much has been achieved, most notably that the Commonwealth and partner governments have so far contracted at least 2,028 GL of water recovery, some 74% of that required to meet the 2,750 GL surface water recovery target outlined in the Plan (MDBA, 2012). Other achievements include:

- in addition to environmental water provided by states over 6,158 GL of Commonwealth environmental water has been delivered to rivers, wetlands and floodplains in the Murray-Darling Basin (DEE, 2017)
- over $8 billion has been committed in water infrastructure across the Basin, the most significant investment in water infrastructure in Australian history (DAWR, 2017).

Notwithstanding this and other significant achievements, the Victorian and NSW governments are concerned about the current situation with respect to one of the Plan's core components, the Sustainable Diversion Limit (SDL) adjustment mechanism. The SDL is the cumulative total of the maximum long-term annual average volumes of water that can be taken from the Basin and as required under the *Water Act 2007* (Cth) they must represent an Environmentally Sustainable Level of Take (ESLT). The SDL adjustment mechanism enables the Basin SDL to be changed up or down by no more than five per cent (i.e. approximately 544 gigalitres for surface water SDLs), as long as environmental, social and economic outcomes are not compromised (CoA, 2014).

A lack of clarity and transparency around some of the key assumptions which underpin the adjustment mechanism is creating uncertainty and eroding confidence and trust. The SDL adjustment mechanism is summarised in Appendix B.

The Independent Expert Panel (the Panel) was asked to review and provide advice on the assumptions, interpretation and application of the SDL adjustment mechanism, to assess whether the Plan is taking full account of the value of supply measure projects which aim to achieve the target ecological benefits using less water. More specifically the Terms of Reference (Appendix A) requested that the Panel:

1. report to the NSW and Victorian Ministers on options to achieve the maximum offsets, bringing together scientific rigour with practical knowledge of the Basin

2. provide advice on actual environmental risk, in particular looking at the materiality of thresholds for the limits of change

3. assess the validity of the assumptions, interpretation and application of the SDL adjustment mechanism, established under the Plan.

In completing this task the Panel held meetings and workshops with representatives from the NSW and Victorian governments, the Murray-Darling Basin Authority (MDBA, the Authority) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), as well as reviewing prior reports and other documentation. A reference list is included in Section 6 and other information considered through the process is listed in Appendix D.

Given the size and complexity of the SDL adjustment task there are many processes and assumptions identified in the discovery phase of this engagement which could have been reviewed by the Panel. It is the Panel's view that these issues for most part fall into the category of "continuous improvement" and can be addressed over time under an adaptive management approach. By applying a threshold of materiality with respect to the Terms of Reference however, three key aspects of the SDL adjustment mechanism emerged as requiring some more considered attention:

1. Benchmark model – the processes and key assumptions which define the benchmark model run against which supply contributions are assessed

2. Limits of change – the influence and ecological importance of "limits of change" adopted in the mechanism

3. Environmental significance weighting – the prioritisation criteria for determining the significance of ecological assets in the mechanism.

This report considers how each of these three issues impacts on the questions raised in the Terms of Reference, providing quantitative data where available. It also considers changes to Plan implementation that will help to assess if the objectives of the Plan are being met.

Supplementary to the Terms of Reference, the States requested that the Panel provide a list of questions in relation to identified information gaps at the time of the report. These questions are contained in Appendix E.

2. Issue 1: System performance

There is currently a wide and fragmented range of monitoring, evaluation and reporting conducted by many parties across the Basin. Existing approaches, while largely necessary in their own right, do not provide clarity on the performance of the system as a whole and are not building confidence for all stakeholders. As a result, it is unclear whether the objective of the Plan is being met, namely to optimise social, economic and environmental outcomes.

2.1. Summary of key points

The Panel recommends that performance monitoring and reporting for the Plan be approached strategically by:

- establishing a centralised, coordinated office for strategically investing in and managing system knowledge, modelling and assessment – with workplans determined with input from all relevant state and federal jurisdictions. That the entity responsible for this office have accountability for system-wide reporting on a quarterly basis.
- approaching assessment of system performance strategically, rather than being purely led by a science-based monitoring and evaluation program. As part of that strategic approach, environmental monitoring and evaluation should be driven 'top down' from the policy need to achieve and manage risks to ecological objectives and outcomes of the Plan and demonstrate "ecological success", with science-based monitoring and evaluation design servicing that need program logic approach.
- focusing system performance reporting on assessing progress against quantified objectives (so-called "S-M-A-R-T" targets) for environmental, social and economic values and adoption of effective proxies and associated datasets that give feedback on the system performance in a timely manner to facilitate quarterly reporting. This should include effective and defensible assessment and reporting of ecological performance, requiring a refocus of current monitoring and evaluation activities to assess performance against quantitative ecological objectives.
- using short time-step reporting to communicate progress and build increasing confidence in the program of works through ongoing adaptive management.

2.2. Observations

Unlike the issues that follow in subsequent sections, system performance was not a discrete part of the Panel's Terms of Reference. However given that adaptive management is a fundamental objective of the Plan and for the effective management of a complex system, the Panel decided that some commentary was justified.

One of the core objectives of the Plan is "…to establish a sustainable and long-term adaptive management framework for the Basin water resources" (s. 5.02 (1)(b)). Adaptive management is taken to include the following steps:

a) setting clear objectives

b) linking knowledge (including local knowledge), management, evaluation and feedback over a period of time

c) identifying and testing uncertainties

d) using management as a tool to learn about the relevant system and change its management

e) improving knowledge

f) having regard to the social, economic and technical aspects of management (s. 1.07(1) of the Plan).

Programs and investments that embed robust adaptive management processes tend to be more resilient to change; more often return maximum value on every dollar spent, and allow for greater demonstration of this value. Effective adaptive management enhances system performance, but is also critical to ensuring the availability of data on outputs and outcomes that can help answer a range of important questions for decision-makers such as:

- Has the management plan and associated actions been successful in achieving the desired objectives?
- How can things be done better, more efficiently, or more effectively?
- What should we continue doing, what should we stop doing?
- Is the overall target still achievable and appropriate?

Effective management programs embed an adaptive approach inclusive of stronger and more immediate feedback loops to maximise investment value over the duration of the program. That is, adaptive programs are ultimately more effective at achieving the outcomes desired from the investment in the most cost effective manner.

In addition, it is important to be clear about which parties have responsibility for different aspects of system performance monitoring, evaluation and reporting across the investment and delivery spectrum. This will only be achieved through clear accountability. Without clear accountability and sanctions for inadequate performance then it is likely that the challenges in relation to monitoring and evaluation and effective adaptive management of the system will continue.

The Panel observed a historical practice of a lack of continuity and integration in method and knowledge development, with a series of occasionally independent engagements in science. The absence of a policy-driven and strategic knowledge strategy has led to reactive acquisition of expert scientific input to ‘fill gaps’. This has not addressed the long term need for a cumulative learning process, where monitoring is used as the test of the approach.

There is a need for monitoring and evaluation to become an integral part of a system-wide, integrated knowledge strategy. Such a strategy would ensure that there is a continuous and cumulative approach to knowledge, testing causal links and filling known gaps. The Panel notes the significant volume of existing knowledge and recommends that this knowledge, combined with the objective of an optimised Basin, form the basis of an initial strategy.

3. Issue 2: Benchmark model

3.1. Summary of key points

- The Plan prescribes the development of an agreed benchmark model. Whilst developed in preliminary draft form, the benchmark model has not been agreed, finalised and published.
- The governance process that is the basis of establishing a published benchmark, has to date been unable to resolve areas of contested change. As a consequence, there is a level of uncertainty as to what constitutes an agreed set of assumptions and parameters.
- This uncertainly constrains the ability to assess supply measures in a timely manner. The uncertainty has also contributed to an erosion of trust and confidence in the process and a low level of confidence in the modelled supply contribution.
- Two major contested changes are the assumptions in relation to flow constraints at key locations on the Murray, Murrumbidgee and Goulburn Rivers, and improvements in river operations (delivery efficiency) throughout the system. In the absence of MDBA modelled data, the Panel is unable to comment on the extent to which resolving these key benchmark assumptions will influence supply contributions. However, improved river operations is likely to provide a significant supply contribution.
- The establishment of a stable, agreed, clear and accessible benchmark as the basis upon which to assess a range of proposed supply measures is critical. Without this the uncertainty about environmental equivalence will be greater than necessary and the modelled supply contribution will continue to be contested.

3.2. Background

3.2.1. Why is the Benchmark model important to the SDL adjustment mechanism?

The Benchmark model is the basis for the calculation of the supply contribution (volume of offsets).

3.2.2. Issues raised or apparent

Ambiguity in relation to the Benchmark model and benchmark conditions of development

The Plan states that the benchmark model run will comprise the MDBA model run 847, described in (MDBA, 2012b), with a series of seven refinements (s. S6.02). These seven refinements have been coined the “mandated changes”. In order to provide an effective baseline, the MDBA were tasked with “…preparing and publishing a report detailing the benchmark conditions of development as soon as practicable after the Basin Plan is made” (s. 7.02).

In accordance with this requirement, the MDBA produced a preliminary draft report “Benchmark conditions of development for adjustment of SDLs” (MDBA, 2014). This report was never finalised and published, and does not appear to be publicly available. The MDBA advised that finalisation of the report was placed on hold, in consultation with the Basin jurisdictions at both the SDL Adjustment Technical Working Group (TWG) and SDL Adjustment Assessment Committee (SDLAAC), on the understanding that the benchmark model may need to change in the future to better represent new supply measures as they come forward.

The benchmark model is largely based on how the system operated in 2009, however the model parameters related to river operations have been based on the rules, practices and skills that were applied by operators in the years prior to the commencement of the Millennium Drought or about the year 2000. Following a decade of drought many lessons were learned including significant improvements in river operations, none of which are included in the benchmark model.

The benchmark model also includes some modelled flow constraints that don't reflect the physical constraints that dictated how the river was operated in or before 2009, or how the river is currently operated. Some physical constraints are assumed to be relaxed.

These are two key examples which, although different in nature, demonstrate the ambiguity in relation to how the benchmark model is constraining the ability to accurately determine a supply contribution.

Governance arrangements in relation to refinements to MDBA model run 847

Schedule 6 of the Plan notes that the refinements to the benchmark model listed in s. S6.02(1) "…will be undertaken in consultation with Basin jurisdictions through the Basin Officials Committee" (s. S6.02). These refinements have become known as the "mandated changes".

Beyond the mandated changes, a range of other ("non-mandated") changes have been incorporated to ensure the benchmark model is "fit for purpose" and enable the assessment of supply measures. There are known to be in the order of 30 – 40 non-mandated changes. The MDBA advised the Panel that Basin states and the Authority need to agree any of these changes. Proposed changes are discussed by TWG. Protocol requires that changes from this group need to be agreed and recommended to SDLAAC, then passed to the Basin Officials Committee (BOC) for endorsement.

The MDBA advised the Panel that BOC members were provided with the full list of these "non-mandated" changes at Meeting 44 in December 2016. BOC members did not agree to changes at that point.

3.3. Observations

The inability to reach agreement on the benchmark parameters and publish a report has contributed to continuing uncertainty in relation to some important model assumptions. Without a clear baseline in the form of an agreed benchmark, the subsequent calculation of the supply contribution is contested and will continue to limit the ability to assess the supply contribution associated with a suite of supply measures.

The existing governance process to make non-mandated changes is constraining the ability to "lock down" additional changes and reach agreement on supply contributions generated by the adjusted model run[1]. In effect, new proposals are being assessed against a moving platform, creating uncertainty in the process.

[1] The adjusted model run is …a run with an SDL adjusted for the supply contribution together with the improved environmental outcomes associated with the supply measures being considered (s. S6.06(1)(b) of the Plan).

3.3.1. Improved system operations

Reductions resulting from improved river operations should be recognised and the benefits counted towards the supply contribution (Bewsher, 2017). Total improvements in operations are believed to be significant with reduced operating losses estimated to be around 110 GL/year, however only a proportion of this volume is likely to contribute to the supply contribution.

3.3.2. Constraints to flow

Model run 847 and the associated preliminary report (p.53 “regulating capacity” and Tables E1 and E2) defines some of the flow constraints in the benchmark model. The Panel was not able to find a readily available, easy to interpret, single source of truth describing the flow constraints incorporated into model run 847.

Not all of the flow constraints in the benchmark model reflect the physical constraints that currently dictate the way in which the river may be operated (i.e.: it assumes that some of the identified physical constraints have been remedied). There is a low level of understanding of the impact that physical constraints are having on the modelled supply contribution.

3.3.3. Supply contribution

The establishment of a stable, agreed, clear and accessible benchmark as the basis upon which to assess a range of proposed supply measures is critical. Without this any modelled supply contribution will be robustly contested.

For consistency, the benchmark model should reflect the physical constraints in the system, unless it is clear that the existing sub-set of incorrect constraints in the model do not have a material effect on the supply contribution. Advice to the Panel from the MDBA is that updating the benchmark to reflect real-world constraints is unlikely to have a material impact on the benchmark or 19-pack results. However, the MDBA advise that changing physical constraints in the model to reflect the physical constraints that currently dictate the way in which the river is operated may decrease the contribution of some supply measures to the supply contribution (e.g.: “hydro cues operation”). Conversely, if real-world constraints aren’t reflected in the benchmark model it will be difficult to accurately quantify the full supply contribution associated with relaxing constraints – a task involving significant cost and requiring significant engagement with communities.

Recognising improved river operations as a supply measure is likely to increase the supply contribution.

3.3.4. Environmental significance

The establishment of a stable, agreed, clear and accessible benchmark as the basis upon which to assess a range of proposed supply measures is critical as this is the basis for testing environmental equivalence. Without this the uncertainty about environmental equivalence will be greater than necessary.

4. Issue 3: Limits of change

4.1. Summary of key points

- The potential supply contribution of supply measures towards the target is being impacted by negotiated limits of change.
- Without new supply measures that contribute additional water or improve the flow patterns, the MDBA suggest that the SDL adjustment mechanism cannot exceed a supply contribution of 450GL under current limits of change.
- The current 19-pack is limited to a supply contribution of 400GL. This supply contribution could be increased by at least 50-100GL if limits of change upstream of the lower lakes are relaxed. This additional supply contribution could be further increased if there was a commitment to allow the relaxation of the limits associated with the Coorong, Lower Lakes and Murray Mouth (CLLMM).
- The Panel is unable to determine the materiality of the environmental risk as a consequence of exceeding limits of change because an evidence base is lacking.
- The Panel is of the view that the relationship between limits of change and ecological outcomes and risks is gradational and not binary as specified within the SDL adjustment mechanism, and that there is no evidence of sudden change in outcomes when limits are exceeded.
- The Panel recommends that as part of any potential solution, individual limits of change should inform decision making and not be treated as an absolute limit.
- The Panel also recommends that an expert panel be tasked with evaluating the relationships between:

- ecological outcomes and risks and limits of change
- ecological outcomes and risks and ecological scores derived using the CSIRO method.

4.2. Background

When dealing with multiple ecological values over a vast geographic footprint there is the potential for supply measures to concurrently have beneficial impacts on some sites and detrimental impacts on others.

In order to mitigate the extent to which some assets might be compromised for the greater good, the jurisdictions negotiated limits of change for various assets or sites. There are four sets of limits used under the adjustment mechanism:

- Coorong, Lower Lakes, Murray Mouth (CLLMM) – described in river flow volumes, depths and water quality limits
- upstream reaches – described in terms of limits on the percentage change in the frequency that a flow indicator is achieved
- baseflows and freshes– frequency of minimum flows and freshes
- ecological score as determined by the SDL adjustment mechanism.

The limits of change adopted are not directly linked to ecological thresholds or magnitudes of ecological outcomes and risks and were a negotiated outcome during the development of the Plan. Upstream of the CLLMM, the percentage thresholds selected are tolerance limits placed on top of the flow indicators for ecological assets developed through the ESLT process.

The limits of change rules are binary in nature. The modelling results show that the suite of supply measures either 'successfully achieved' or 'failed to achieve' the targets at each site without necessarily having regard to any 'real world' thresholds or tipping points which threaten the ecological values.

The limits of change rules have been hard-wired into the default method which is used to assess the impacts of the supply measures compared to the baseline and benchmark model results. The MDBA's most recent modelling results of the 19-pack indicate that for a supply contribution of 400GL:

- half of the streamflow indicators across all sites are within 1% of their limit of change
- two of the streamflow indicators have exceeded their limit of change.

In other words, the limits of change are determining the supply contribution achievable through the SDL adjustment mechanism, rather than any ecological score. It should also be noted that the materiality of changes in real world ecological outcomes as a result of changes in the ecological scores, derived using the "CSIRO Method" for the SDL adjustment mechanism, is also unknown.

4.2.1. Basin Plan requirements

Schedule 6 of the Plan sets out the default method for calculating the supply contributions from supply measures unless an alternative method is agreed. Subsection 6.07 of Schedule 6 details the application of limits of change within the modelling framework, the requirements of which are summarised in Appendix C.

4.2.2. Issues raised or apparent

NSW and Victoria have raised concerns that benefits accruing from the suite of proposed supply measures are being discounted as a result of modelling rules adopted from a negotiated outcome rather than known impacts on environmental outcomes. At the time that this negotiation occurred Victoria and NSW were advised that a 650 GL supply contribution was achievable (this is noted in the Plan (s. 7.09)).

The most recent modelling available to the Panel indicates that the 19-pack delivers 400GL in offsets. The implication and concern is that any failure to reach 650GL from projects will necessitate additional water recovery through market mechanisms, further impacting on rural and regional communities.

4.3. Observations

4.3.1. Supply contribution

Without new supply measures that contribute additional water or improved flow patterns, the MDBA suggest that the supply contribution is unlikely to exceed 450GL under current limits of change.

MDBA modelling is indicating that the supply contribution for the current 19-pack is limited to 400GL due to the limits of change.

Preliminary model testing by the MDBA indicates that with some relaxation of limits of change upstream of the Lower Lakes, the 19-pack has the ability to generate a supply contribution at least 50-100GL greater than is currently achievable. This assumes CLLMM limits are maintained and not exceeded.

4.3.2. Environmental significance

Notwithstanding the prescriptive requirements of s. S6.07, there is little evidence to support the link between the default limits prescribed in the Plan and ecological impacts, nor is there any evidence to support the position that ecological impacts are typically binary in nature. For most assets the impacts are gradational and therefore a simplistic pass / fail test in the adjustment mechanism is inappropriate. Indeed, the final note at the conclusion of s. S6.07 suggests that ‘these limits of change are for the purpose of modelling SDL adjustment and do not necessarily represent environmental watering or management targets’.

The limits of change adopted are not directly linked to specific ecological thresholds, outcomes or levels of risk and were a negotiated outcome, based on a precautionary approach. While a pass/fail approach may be appropriate for limits of change where there is a clear threshold of change that must not be triggered (e.g. salinity trigger points), failing to meet some other limits of change (e.g. number of days of inundation) by relatively small magnitudes is unlikely to breach ecological thresholds or lead to substantive ecological risk.

For example, the 19-pack results indicate a failure of the SDL supply measures to achieve one of seven flow targets for the Hattah Lakes *[50GL for 60 days is achieved 29% of the time instead of 31% of the time]*, despite the overall ecological score being improved for the site. Although this constrains the supply contribution of the 19-pack, there is no evidence to support the view that this results in the breach of an ecological threshold. In fact, the 19-pack delivers a substantial improvement on baseline conditions for the 50GL for 60 days flow target, aimed at supporting the health of semi-permanent wetlands.

As noted in the ESLT report for Hattah Lakes, “eleven of the twelve Ramsar listed wetlands are either semi-permanent or persistent temporary. Ecological Associates identified semi-permanent and persistent temporary wetlands as the highest priority water regime class based on their conservation significance and the degree to which their water requirements are threatened” (MDBA, 2012a).

The relationship between limits of change and magnitudes of ecological risk and outcomes for specific ecological elements requires assessment. Due to a dearth of suitable data to define these relationships, conducting an expert assessment should assist in defining the bounds of ecological response to changes in limits of change. This could provide a relative measure of confidence in the environmental implications of relaxing limits of change, both upstream and within the CLLMM.

Extending such an expert assessment to include semi-qualitative assessment of both the nature and levels of confidence in relationships between ecological scores derived using the “CSIRO Method” for the SDL adjustment mechanism and measures of ecological state or condition might also assist in exploring the implications of differences in scores for causing ecological change.

5. Issue 4: Weighting of environmental significance

5.1. Summary of key points

- Being able to manage the relative significance of "priority environmental assets and ecosystem functions" (s. 8.05, 8.06 of the Plan) is fundamental to maximizing environmental outcomes. The default method requires "science based, independently reviewed, fit for purpose metrics for weighting environmental significance of the flood dependent area" (s. S6.05(2)).
- In the absence of fit for purpose data and an agreed methodology, the approach developed by CSIRO (the "CSIRO method") used an area-based weighting as a default. The Panel understands that this was done largely due to the absence of an agreed methodology and of suitable Basin-wide datasets.
- Neither the CSIRO method, nor a use of land tenure/reservation status provides a weighting by relative environmental significance in a defensible manner.
- The Panel considers that a comprehensive, systematic and integrated weighting on the basis of relative ecological significance is needed in order to maximise environmental outcomes for given volumes of available water.
- The Panel notes that if the existing limits of change remain in place, then environmental significance is unlikely to strongly influence supply contributions, unless ecological elements scoring becomes a constraint rather than the limits of change.

5.2. Background

5.2.1. Description

The Plan articulates the need for a systematic environmental weighting of assets and functions. The first objective of the Plan ("…to give effect to relevant international agreements" s. 5.02(1)) provides further support for such a weighting.

In the Plan, Schedule 6 states that the "Default method for calculation of supply contribution" – "…will use a scoring method, including preference curves and weightings for environmental significance" (s. S6.01(2)(e)). The ecological elements component of the scoring method is required to include "…science based, independently reviewed, fit for purpose metrics for weighting environmental significance of the flood dependent area" (s. S6.05(2)).

In addition, the Independent Review Panel for the CSIRO method recommended "…the adoption of some form of universal scheme for representing relative conservation value amongst sites" during the implementation phase of the CSIRO method (IRP, 2014).

To do this, a systematic methodology to assign and rank relative environmental significance to assets (and, if possible, functions) across the basin floodplain 'footprint' is required. A number of possible 'prioritisation' approaches can be used, especially those algorithms within the broad family of 'Systematic Conservation Planning' methodologies. The MDBA commenced development of such an approach in 2013, initially to support its 'evolved' method for identifying Basin Wide Annual Environmental Watering Priorities.

A pilot method was developed and trialled by the MDBA in 2015, using a modified component of the *Marxan* software package along with existing and new data on channel and floodplain assets, and the distribution of fish species, waterbird breeding areas, NVIS vegetation classes, floodplain forest types and ANAE wetland types. This produced a preliminary systematic ecological significance ranking of aquatic and floodplain assets for the Basin at a relatively fine spatial scale. This product ('Pilot ecological significance data layer') was not developed in time to be included during the development of the CSIRO method. Some key data elements are currently being further developed. A first comprehensive analysis is planned for 2017/18, resources permitting, in order to support annual watering prioritisation across the Basin. While the 'pilot' version is available for use, this refined version is unlikely to be available during the immediate SDL adjustment mechanism assessment timeframe.

5.2.2. Basin Plan requirements

- **Basin Plan overall environmental outcome:** Healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and, ultimately, the ocean (s. 5.02(2c))
- **Outcome in relation to environmental outcomes:** Restoration and protection of water-dependent ecosystems and ecosystem functions in the Murray-Darling Basin with strengthened resilience to a changing climate (s. 5.03(2))
- **Environmental sub-outcomes:**

- Protection and restoration of water-dependent ecosystems (s. 8.05)
- Protection and restoration of ecosystem functions of water-dependent ecosystems (8.06)
- Ensuring water-dependent ecosystems are resilient to climate change and other risks and threats (s. 8.07)

- Identify and select priority environmental assets and functions and the associated establishment of objectives and targets:

- An environmental asset that requires environmental watering, and its environmental watering requirements, must be identified having regard to the information on the environmental assets and ecosystem functions database, using the following method (s. 8.49(1))
- An ecosystem function that requires environmental watering to sustain it, and its environmental watering requirements, must be identified having regard to the information on the environmental assets and ecosystem functions database, using the following method (s. 8.50(1))

- Determine environmental watering requirements of environmental assets and ecosystem functions (s. 8.51)
- Apply the default method detailed in Schedule 6, with particular reference to Indicator sites and regions that are to be used (s. S6.03) and the Ecological elements of the scoring method (s. S6.05)
- Schedule 6 Default method for calculation of supply contribution: - "…will use a scoring method, including preference curves and weightings for environmental significance."

5.3. Observations

While the CSIRO method was found to be “scientifically fit for the SDL-adjustment purpose”, the Independent Review Panel noted that there “are significant ecological and management risks involved in its application” (IRP, 2014). CSIRO also noted that the method “…is constrained by its inputs, such as annual SFI (site-specific flow indicator) outcomes. The broad range of hydrologic drivers (e.g. depth, retention of water in wetlands, seasonality, inundation patterns and return paths to channels, flow velocity) that can influence outcomes are not represented” (Overton IC et al., 2014).

The SFIs, developed as part of the ESLT method, were used to express environmental water requirements at hydrologic indicator sites. In order to be used within the computer modelling environment, achievement of SFIs was reduced to a relatively binary form. Indeed the CSIRO noted “…it is recognised that there are modelling constraints that have been imposed that prevent proper stochastic analysis…Stochastic analyses would enable better characterisation of inevitable uncertainties and variability in the system. To make the most of such analyses, however, would also require changes in policy instruments and implementation practices. In particular, more sophisticated multi-stakeholder deliberation navigating trade-offs could accommodate probabilistic information rather than binary yes/no or pass/fail indicators” (Overton IC et al., 2014).

Further caution to a binary approach to indicators at the site-scale was articulated by the MDBA in relation to floodplain vegetation communities that “…would have experienced significant variability in their inundation frequency under pre development conditions which subsequently makes specification of a single frequency metric deceptively certain. For many species and ecological communities the relationship between water provisions and environmental outcomes may not be threshold based, rather there could be a linear relationship between flow and the extent of environmental outcomes or the condition of a particular ecological species/community” (MDBA, 2012c).

Finally, the Independent Review Panel also noted, “…to our knowledge, a formalised evaluation of the marginal environmental costs and benefits arising from of structural and operational measures to improve the effectiveness of environmental flow delivery, as proposed in Schedule 6 of the Plan, has never been attempted anywhere in the world. Hence, the SDL adjustment process described in the Plan is policy operating in ‘uncharted waters’ from both a scientific and management perspective. No one should assume that adoption of the SDL-EE method is without significant uncertainty or risk” (IRP, 2014).

5.3.1. Supply contribution

If the existing limits of change remain in place, then environmental significance is unlikely to be a material issue in relation to supply contributions, unless the ecological elements score becomes the constraint and not the limits of change. This is because supply contributions using the current 19-pack, or larger “Pack Mix” of supply measures are already constrained by the limits of change.

By contrast, use of environmental significance is likely to increase supply contributions if the limits of change are relaxed, as discussed in more detail in Section 4 (Issue 2).

5.3.2. Environmental significance

Since commencement of the Plan process, there has been a consistent recognition of the need for a basin-wide assessment of relative ecological/conservation significance of assets and functions. During the development of the SDL, 24 representative ESLT ‘Umbrella Environmental Assets’ were selected using, in part, a high level proxy for ecological significance that was broadly in accordance with Plan requirements.

The “CSIRO Method” for ecological elements incorporated an area-weighted proxy for ecological value, but did not progress this further due to the lack of consistent data at the appropriate scales and of an agreed method for ecological prioritisation.

Unless limits of change are relaxed, the ecological elements scores are not a limiting factor in relation to supply contributions and hence will not drive deliberations under the SDL adjustment mechanism. However as limits of change are relaxed, the scoring will increasingly become a limiting factor. Under these circumstances, it would be highly desirable to conduct the scoring using an improved weighting system for relative ecological significance. Once developed, an improved weighting should be readily incorporated into the “CSIRO Method” analysis.

Defensible data on relative environmental significance is seen by the Panel as a key requirement for optimising the application of environmental water to achieve ecological outcomes for the SDL adjustment mechanism process, but also for a range of operational and planning activities. The Panel is of the view that it is pragmatically feasible to develop an improved ecological significance weighting data set for the current SDL adjustment mechanism process, even in the absence of a full suite of desirable, consistent datasets.

Ideally, such a data set should contain relative significance ratings for environmental assets across the Basin developed using a systematic prioritisation process based on systematic and comprehensive Basin-wide data on key components such as biodiversity, ecological condition, and various ‘special values’ (listed/high value communities/species, key functional nodes, refuges, treaty obligation sites etc.).

The MDBA recently conducted a ‘pilot’ ecological significance prioritisation to accompany its evolving Basin Annual Environmental Watering Priorities identification process, and is actively assembling improved data to continue its development. Building on the outputs of that pilot prioritisation is a potential pragmatic solution to the issue of including improved ecological significance ratings in the current SDL adjustment mechanism analysis.

6. References

Bewsher, D. (2017). *Improved Regulation of the River Murray, Independent Review Report.* Melbourne: Report prepared for the Victorian Department of Environment, Land, Water and Planning.

CoA. (2014). *The Sustainable Diversion Limit Adjustment Mechanism - Joint Government Communications Booklet.* Canberra: Commonwealth of Australia.

DAWR. (2017, March 8). *Minister for Agriculture and Water Resources media releases.* Retrieved from Australian Government Department of Agriculture: http://minister.agriculture.gov.au/joyce/Pages/Media-Releases/$30m-for-nsw-irrigators-to-modernise-farms.aspx

DEE. (2017, February 20). *About Commonwealth environmental water*. Retrieved from Australian Government Department of the Environment and Energy: https://www.environment.gov.au/water/cewo/about-commonwealth-environmental-water

IRP. (2014). *SDL Adjustment Ecological Elements Method Development Report.*

MDBA. (2012). *Basin Plan.* Canberra.

MDBA. (2012a). *Assessment of environmental water requirements for the proposed Basin Plan: Hattah Lakes.* Canberra: Murray-Darling Basin Authority.

MDBA. (2012b). *Hydrologic modelling to inform the proposed Basin Plan - methods and results.* Canberra: Murray-Darling Basin Authority.

MDBA. (2012c). *Assessment of environmental water requirements for the proposed Basin Plan: Barmah-Millewa Forest.* Canberra: Murray-Darling Basin Authority.

MDBA. (2014). *Benchmark conditions of development for adjustment of SDLs, Preliminary draft version 2 based on benchmark model used for the trial implementation of the default method.* Canberra: Murray-Darling Basin Authority.

Overton IC et al. (2014). *Development of the Murray-Darling Basin Plan SDL Adjustment Ecological Elements Method.* Canberra: Murray-Darling Basin Authority.

Appendix A – Panel Terms of Reference

Introduction

The NSW and Victorian Governments are committed to managing the Basin sustainably and balancing the water requirements of industry, communities and the environment, in accordance with the triple bottom line objectives of the *Water Act 2007* (Cth).

All Basin jurisdictions have agreed "to build upon existing achievements by implementing in good faith the next tranche of water reforms to further improve the health of the Basin and secure a future for its communities."[2]

The Ministerial Council has agreed to a package of supply, efficiency and constraints measures that will result in changes to the sustainable diversion limits (SDL) of the Murray–Darling Basin Plan. The package will achieve environmental outcomes under the Murray-Darling Basin Plan with the same amount or less water (delivering 'offsets'). Key to delivering on this commitment will be to ensure that measures are able to be implemented by river operations and in line with an adaptive management approach.

The Panel will review and provide advice on the assumptions, interpretation and application of the Sustainable Diversion Limit (SDL) adjustment mechanism. The Basin Plan's adjustment mechanism allows for the Basin Plan water recovery of 2,750 GL target to be offset by up to 650 GL, by projects that deliver equivalent environmental outcomes with less water. The SDL is the maximum amount of water that can be taken for consumptive use.

This work will directly contribute to assisting the MDBA and Basin jurisdictions as they continue to work together to refine the SDL offsets assessment framework within the parameters of the Basin Plan, timeframes and expectations of governments for robust science to inform Basin Plan implementation.

Purpose

The Panel is to:

- Report to the NSW and Victorian Ministers on options to achieve the maximum offsets, bringing together scientific rigour with practical knowledge of the Basin;
- Provide advice on actual environmental risk, in particular looking at the materiality of thresholds for the limit of change; and
- Assess the validity of the assumptions, interpretation and application of the SDL adjustment mechanism, established under the Basin Plan.

[2] Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin, June 2013, p. 2

The findings will be used to inform Ministers in making decisions about remaining Basin Plan implementation activities, associated with the SDL Adjustment Mechanism, in a way that optimises economic, social and environmental outcomes, consistently with the *Water Act 2007* (Cth).

Independent Expert Panel members

Dr Don Blackmore AM, Mr Brett Tucker, Mr Chris Arnott and Professor Peter Davies AM have been appointed to the Panel to provide a range of Murray-Darling Basin water policy, river operations, ecological and socio-economic skills.

Panel Members

Dr Don Blackmore AM

Don Blackmore was Chief Executive of the Murray–Darling Basin Commission (MDBC) from 1990 to 2004 and has been Deputy Chair of Land and Water Australia. In 2004, he was made a Member of the Order of Australia for his services to the environment. Don has advised the World Bank on river basin management.

Don has had 40 years' experience in water and natural resources management both in Australia and in many countries around the world. He was the Chief Executive of the Murray Darling Basin Commission for 15 years until he retired in March 2004. In this role, he was a leading proponent and architect of water reform in the Murray-Darling Basin. In the public domain, he was a leading practitioner and advocate of a more holistic and integrated approach to river basin management, and remain so to this day. Don was a Commissioner on the World Commission on Dams, an independent group established by over 50 international agencies and companies to review the development effectiveness of large dams. Internationally, Don remains a trusted senior advisor to the World Bank on the governance and management of large river basins. He has recently worked on the Nile, Indus, Mekong, Irrawaddy and Ganges Rivers, and for the UN on the Euphrates and Tigris Basin.

Don became a Fellow of the Australian Academy of Technological Sciences and Engineering in November 1998 and in May 2000 he was awarded the degree of Doctor of Science (honoris causa) by La Trobe University. In 2004 he was made a Member of the Order of Australia (AM) for his service to the environment, particularly through the Murray-Darling Basin Commission and through the development of sustainable water management practices. He currently chairs the International Water Management Institute (IWMI) in Sri Lanka, the Advisory Council of CSIRO's Water for a Healthy Country flagship program, and the eWater Board in Australia.

Brett Tucker

Brett Tucker's career in water resource management and agriculture has spanned more than 25 years across a broad range roles and organisations, including 15 years' experience as a Chief Executive and Board Director in both public and private sector. In 2016 Brett established Blackwatch Consulting, specialising in the provision of strategy, governance and operations advice to Government agencies, State-Owned Corporations, Private sector Corporations, industry groups and project consortia. As a Director of Blackwatch and the Peter Cullen Trust, Brett also provides mentoring and coaching support to a number of Senior Managers and prospective industry leaders. Brett holds an Honours Degree in Rural Science and a Graduate Certificate in Accounting and

Finance. Brett was awarded a Churchill Fellowship in 1998 and is a Member of the Australian Institute of Company Directors.

Chris Arnott

Having worked across the Murray Darling Basin since 1994, Chris has seen the evolution of water policy and investment programs through engagements for state and federal governments and peak agencies such as the National Water Commission (NWC). Following the completion of numerous environmental flow assessments, Chris led the development of the first national snapshot of environmental water in the form of the Australian Environmental Water Management Report 2010. Since co-founding Aither in 2012, Chris has increasingly specialised in establishing, implementing and evaluating effective public policy and associated performance frameworks. He has served on the Victorian Catchment Management Council for two terms, including as its Deputy Chair for three years and is an inaugural fellow of the Peter Cullen Trust. Chris Arnott is a founder and Director of Aither, a policy and economics advisory firm specialising in the water sector.

Professor Peter Davies AM

Peter Davies is an aquatic environmental scientist with 35 years' experience in aquatic environmental issues nationwide and internationally. He is director of Freshwater Systems, an independent aquatic environmental consultancy. He has acted as Science Advisor to the Murray Darling Basin Authority on environmental issues and as chair of the Environmental Watering Science Advisory Panel for the Commonwealth Environmental Water Holder, and of the Independent Sustainable Rivers Audit of the health of the Murray Darling Basin for over two decades, and Australian observer and reviewer to the European Water Framework Directive and the European Commission. He has worked on environmental management issues across public and private sectors, from local to federal government and for a range of industries, and is actively involved with environmental education and restoration with schools and community groups.

Appendix B – SDL adjustment mechanism

Intent of the Basin Plan

The Plan is the legislative basis for the sustainable and adaptive management of Basin water resources. It is made under the Commonwealth's *Water Act 2007*. The objectives for the Plan (s. 5.02) as a whole are:

(a) to give effect to relevant international agreements through the integrated management of Basin water resources; and
(b) to establish a sustainable and long-term adaptive management framework for the Basin water resources, that takes into account the broader management of natural resources in the Murray-Darling Basin; and
(c) to optimise social, economic and environmental outcomes arising from the use of Basin water resources in the national interest; and
(d) to improve water security for all uses of Basin water resources.

Core to achieving these objectives is the need to determine the long-term average (SDL).

Sustainable Diversion Limit (SDL)

Under the Plan, SDLs are established that set environmentally sustainable limits on the amount of surface and groundwater that can be taken for consumptive use from Basin water resources. SDLs ensure that water use for production and by communities does not have adverse effects on the health of Basin ecosystems.

The SDLs were determined using a 'building block' method that:

- identifies important ecological values and functions (assets) across the Basin
- determines the watering requirements of those assets in order for them to be maintained in a long-term, sustainable condition
- uses a hydrologic and hydraulic model of the system to determine how much additional water, compared with current conditions (known as the Baseline Diversion Limit, BDL) is needed to achieve the watering requirements of those assets.

The process is broadly encompassed by:

- determining the BDL – all water pumped, diverted or intercepted for consumptive purposes at 2009 (13,623 GL per year)
- determining watering requirements for important environmental assets defined as a flow event with the following components:

- volume (ML/d)
- duration (number of days)
- timing (seasonality)

- frequency (number of events within a time period)
- maximum period between flow events (intervals between watering events)
- extent and thresholds for groundwater dependency
- required inundation depth at the site.

- determining the SDL – the amount of water that is determined to be an environmentally sustainable limit that can be taken for consumptive use from Basin water resources, having regard to social and economic impacts.

Based on these known points, the SDL for the Basin surface water resources as a whole was, at the time of writing the Plan, estimated as 10,873 GL per year (s. 6.04). As a result of setting the SDL at 10,873 GL, there is a need to reduce the BDL from the existing 13,623 GL by 2,750 GL. These volumes are determined using three important elements:

- benchmark conditions of development (s. 7.02)
- benchmark environmental outcomes (s. 7.15)
- benchmark model (s. S6.02)

SDL adjustment mechanism

The Plan (s. 5.06(1)) describes the objective of operation of the SDL adjustment mechanism as to *'adjust SDLs in a way that increases environmental outcomes while maintaining or improving social or economic outcomes'.*

In effect, operation of the SDL adjustment mechanism allows for continued achievement of a healthy and working Murray-Darling Basin by enabling surface water SDLs to be adjusted to take account of changes to infrastructure and other measures that increase the supply of water or the efficiency of water use.

The SDL adjustment mechanism has two major components.

Implementation of efficiency measures means less water is required for use by towns, industry and irrigators and allows for the SDL to be decreased (and target water recovery increased) provided there is neutral or improved socio-economic outcomes.

Improved supply of water to the environment, through implementation of supply measures, provides an opportunity to achieve environmental outcomes using less environmental water, thereby reducing the total volume of water needed to achieve the benchmark environmental outcomes. Hence the SDL will be increased (and target water recovery reduced) via the SDL adjustment mechanism, provided that infrastructure or measures result in:

- equivalent environmental outcomes
- no detrimental impacts on reliability of supply for rights holders.

Where this is the case, the MDBA must propose adjustments to the SDL on the behalf of Basin states, and assess proposals against the building block model.

The Panel are considering the supply measure component of the SDL adjustment mechanism.

The net change in the SDL from application of supply and efficiency measures must not exceed ±5%, i.e. ±544 GL.

Description of method to determine the supply contribution

The supply measure component of the SDL adjustment mechanism is intended to function according to the process set out in Schedule 6 – *Default method for calculation of supply contribution*[3].

The method is summarised by the following steps.

- **S6.02** – Benchmark model
- **S6.03** – Indicator sites and regions that are to be used
- **S6.04** – Things that are to be measured or assessed
- **S6.05** – Ecological elements of the scoring method
- **S6.06** – How the method is to be applied
- **S6.07** – Limits of change in score or outcomes.

Assumptions for each step of the SDL adjustment mechanism are outlined below.

Benchmark model (Section S6.02)

The benchmark model is a means of estimating the volume of water within the Basin across time and space and is defined as comprising the MDBA model run 847, described in MDBA (2012b), with a series of refinements to be undertaken in consultation with Basin jurisdictions through the Basin Officials Committee. Over time, these refinements have come to be known as “mandated changes”.

The benchmark model is fundamental to the calculation of the SDL and the calculation of any adjustments (both up and down) to the SDL that may result from a range of changes including, but not necessarily limited to:

- the seven refinements defined in s. S6.02 (“mandated changes”)
- ongoing updates to address identified errors in model run 847
- enhancements to enable the model to assess supply measures (or packages of supply measures) to adjust the SDL.

The benchmark model is discussed in more detail in Section 2.

Indicator sites and regions that are to be used (S6.03)

The indicator sites that are to be used in the SDL adjustment mechanism method are those used in development of the environmentally sustainable level of take (ESLT) method for which detailed assessments of environmental water requirements were done for input into the building block method.

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[3] The Plan does permit the MDBA and Basin Officials Committee to agree to use another method (s. 7.15(2))

Each reach is to incorporate one hydrologic indicator site used in the ESLT method.

The regions to be used in the SDL adjustment mechanism are:

- the Northern Basin region
- the Southern Basin region
- the disconnected Lachlan and Wimmera Rivers, if supply contributions are proposed within these valleys.

Things that are to be measured or assessed (S6.04)

The flow regime characteristics that are assessed include:

- frequency of flow events
- duration of dry spells (i.e.: intervals between watering events)

Scores are generated for each flow regime characteristic at the reach and region scale.

Ecological elements of the scoring method (S6.05)

The method will use science based, independently reviewed, fit for purpose:

- preference curves to describe the relationship between an environmental outcome and flow statistic
- metrics for weighting environmental significance of the flood dependent area

Metrics to be used for weighting environmental significance may include:

- water dependent ecosystems
- the relative area of water dependent ecosystems
- ecosystem functions provided by flow regimes.

Weighting for environmental significance is discussed in more detail in Section 4.1.

How the method is to be applied (S6.06)

The method is based on the achievement of the same overall environmental scores for each region under the benchmark model run, and a run with a SDL adjusted for the supply contribution together with the improved environmental outcomes associated with the supply measures being considered.

Limits of change in score or outcomes (S6.07)

- no reduction in benchmark environmental score
- for each reach, a number of tests assessing the model run (including proposed measures) against the benchmark model run to ensure that they are within defined tolerance limits (e.g.: must not vary by more than 10%)

Appendix C – Limits of change

For assets other than Lower Lakes, Coorong and Murray Mouth

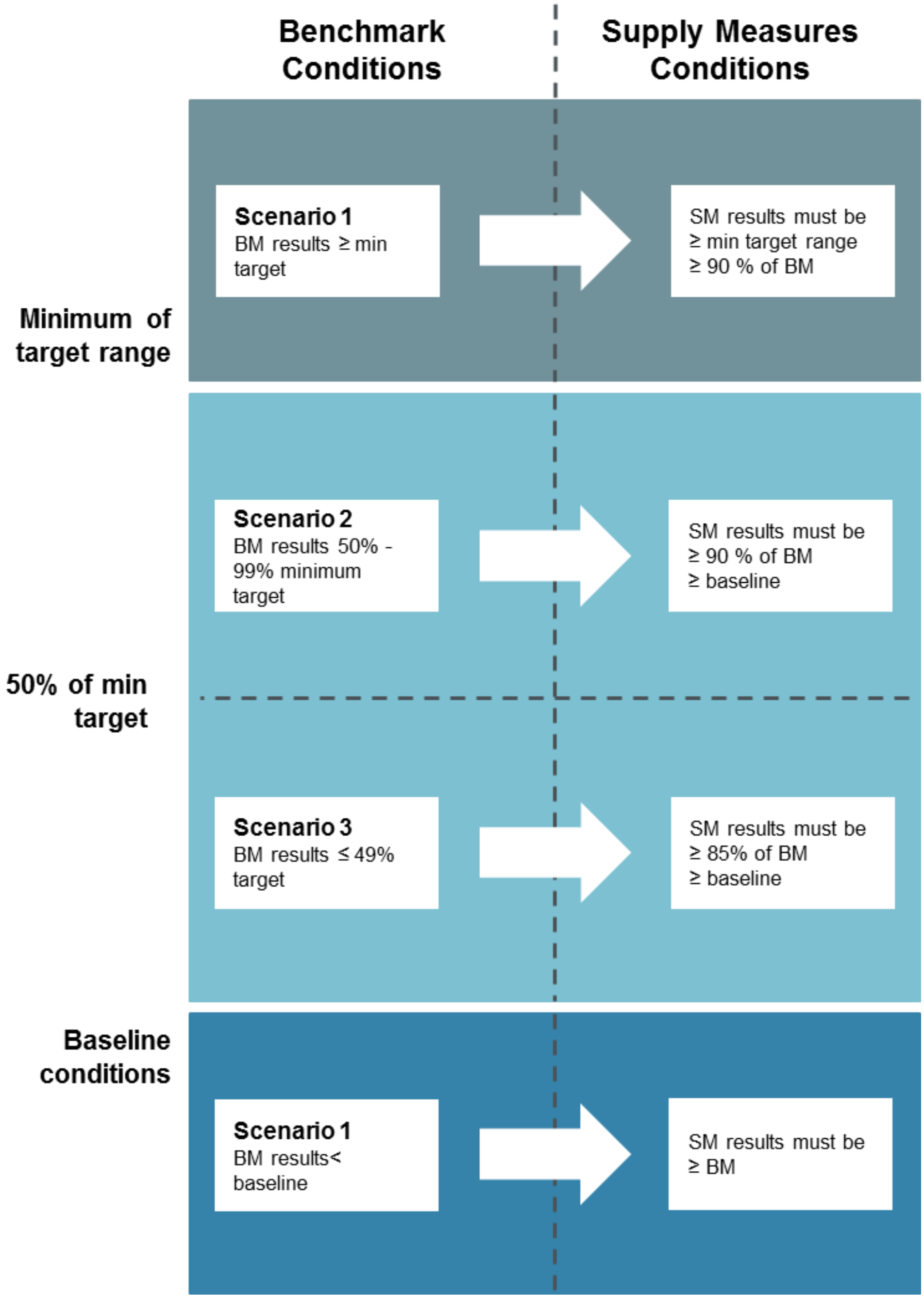

Figure 1. For assets other than the Lower Lakes, Coorong and Murray Mouth

For the Lower Lakes, Coorong and Murray Mouth the targets are fixed (no allowance for variance)

Table 1 Limits of change requirements / assumptions for the Lower Lakes, Coorong and Murray Mouth

Characteristic sought	Minimum hurdles that modelled supply measures package must achieve		
	Lake Alexandria	Coorong	Murray Mouth
Salinity	< 1,500 EC 100% of the time and < 1,000 EC for 95% of days	South Lagoon average daily salinity less than 100 grams per litre for 96% of days	N/A
Barrage flows	> 2,000 GL / per year on a three year rolling average basis with a minimum of 650 GL in any year, to be achieved for 95% of years and > 600 GL over any two year period, to be achieved for 100% of the time	N/A	N/A
Connection to ocean	N/A	N/A	Mouth open to an average annual depth of 1 metres (-1.0 m AHD) or more for at least 90% of years and 0.7 metres (-0.7 m AHD) for 95% of years;

Source: Basin Plan, s. S6.07

Appendix D – Information considered

The Panel considered a range of information through the process as detailed in the following sections in relation to each of the core issues. In addition to these information sources, references are listed in Section 6.

Benchmark model

- prior reports and submissions from jurisdictions and the MDBA
- responses from interviews with MDBA, CSIRO, NSW and Victorian agency staff
- MDBA (2012), adopted under subparagraph 44(3)(b)(i) of the *Water Act 2007* (Cth).

Limits of change

- MDBA model output from the suite of supply projects included in the 19-pack
- prior reports and submissions from jurisdictions and the MDBA
- the SDLAAC Stocktake Report – commissioned July 2015
- responses from interviews with current and past MDBA and CSIRO staff.

Weighting of environmental significance

- the “default method” detailed in Schedule 6 of the Plan, in particular the details outlined in s. S6.05 Ecological elements of the scoring method
- the Plan’s approach to identification and selection of priority environmental assets and functions, in particular s. 8.49 (and Schedule 8) and s. 8.50 (and Schedule 9)
- reports associated with the establishment of an Environmentally Sustainable Level of Take (ESLT)
- CSIRO reports on the development of the SDL Adjustment Ecological Elements Method
- The Independent Review Panel’s commentary on the CSIRO Methodology
- Responses from interviews with MDBA and CSIRO staff and material provided on the BAEWP (Basin Annual Environmental Watering Priorities) project.

Appendix E – Information gaps

1. The benchmark model is based on aspirational thresholds for system constraints such as flows downstream of Yarrawonga. It remains unclear what the upper bound of supply contributions from the 19-pack would be if the benchmark model was based on existing real-world system operating constraints. States should request that existing conditions be modelled in order to understand the benefits of the 19-pack under such conditions.

2. The MDBA indicates that “some relaxation” of upstream “limits of change” can deliver between 50 and 100GL of supply contributions. However there is no robust modelling data to quantify the full extent to which limits of change are constraining the outcomes. States should request that model runs be prepared which progressively remove limits of change in order to understand the trade-offs within and between the individual ecological assets / sites.

3. The MDBA advises that the addition of new measures to the 19-pack (i.e.: hydro cues operation, lifting constraints and improved river operations and Menindee) will enable the adjustment mechanism to achieve the targeted 650GL of supply contributions. The States should request that each of these elements be modelled incrementally to understand the relative contributions from each.

4. Due to original data limitations, a decision was made to use “area” to categorise ecological significance instead of “conservation value” as recommended. In the absence of limits of change there is potential for this decision to limit the supply contributions. Recognising the current state of data and the pilot research in this area, the States should ask whether the MDBA intends to remodel the outcomes using a weighting by relative environmental significance as proposed in section 5.

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