# WENTWORTH GROUP

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Murray-Darling Basin Authority
GPO Box 1801
Canberra City, ACT 2601

3 November 2017

To the Murray-Darling Basin Authority,

The Wentworth Group welcomes the opportunity to provide a submission on the *Sustainable Diversion Limit Adjustment Mechanism: Draft Determination Report* released by the Murray-Darling Basin Authority on the 3rd October 2017.

The Murray-Darling Basin Plan is an agreement to recover 3,200 GL of environmental water or equivalent outcomes to help restore the health of the Murray-Darling Basin. Under Chapter 7 of the Basin Plan, this volume may be reduced if state governments can demonstrate alternative ways of delivering similar outcomes for the environment, as part of a process known as the Sustainable Diversion Limit (SDL) adjustment. The SDL adjustment process also allows for the easing or removal of constraints to environmental water delivery and the addition of 450 GL per year of environmental water above the 2,750 GL target to deliver outcomes of 3,200 GL (Basin Plan s7.09 (e)).

In June 2017, the Wentworth Group provided a set of recommendations to the Murray-Darling Basin Authority that we believe are necessary to honour the commitment by the Prime Minister in December 2016 to deliver the Basin Plan 'in full and on time.' A key recommendation was ensuring environmental outcomes are equivalent or better as a result of any adjustment to the sustainable diversion limit (Basin Plan s7.09 (b)). We have compiled a set of twelve conditions that we believe any proposal submitted for SDL adjustment would need to comply with to meet this requirement.

The Wentworth Group has undertaken an analysis of the 37 projects against these conditions, using information available on government websites and in business cases provided by South Australia and Victorian Governments. The New South Wales Government declined our request for business cases.

Our assessment shows that:

1. Only one project, the *South Australian Murray Key Focus Area* meets the necessary conditions for approval. Approval of this project for SDL adjustment is however, contingent on upstream constraints proposals meeting targets in the Constraints Management Strategy.

2. Eleven of the projects (representing in the order of 150-270 GL water savings) require additional information before a proper assessment can be undertaken. With such


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information it might be possible for some or all of the projects to satisfy the 12 conditions for approval. However, all projects would need to ensure there is no significant change in environmental flows reaching the Lower Lakes and Coorong (Condition 3).

3. Twenty five projects (representing in the order of 316-436 GL) do not satisfy these conditions and should not be approved in their current form. This includes The Living Murray works which, although they are able to be considered for an SDL adjustment, they are not likely to result in equivalent environmental outcomes because of the environmental risks identified.

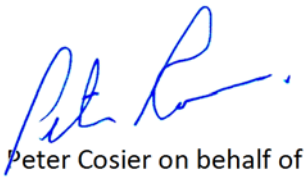
A full assessment of projects is provided in the report attached to this letter. On the basis of our assessment we recommend that the Murray-Darling Basin Authority should:

1. Approve the *South Australian Murray Key Focus Area* project;
2. For those projects that don't satisfy the necessary conditions, the proponent should be invited to demonstrate that conditions can be met prior to approval for funding and SDL adjustment; and
3. Projects that fail to meet the conditions should be removed from the SDL adjustment determination and should not proceed to implementation.

In addition, of the six nominated constraints proposals, only three were found to be consistent with the Constraints Management Strategy. Constraints proposals that do not satisfy the 12 conditions should not be considered in the SDL adjustment determination. These measures are, however, essential to the successful implementation of the Murray-Darling Basin Plan. Constraints proposals need to be modified in line with the Constraints Management Strategy and funding should be reallocated to support the amended projects.

We look forward to working with you to ensure the long term benefits of the Basin Plan are realised for communities and environment of the Murray-Darling Basin.

Kind regards,



Peter Cosier on behalf of the Wentworth Group of Concerned Scientists

**WENTWORTH GROUP OF CONCERNED SCIENTISTS**

# ASSESSMENT OF PROJECTS PROPOSED FOR SDL ADJUSTMENT

**3 November 2017**

The Murray-Darling Basin Plan is an agreement to recover 3,200 GL of environmental water or equivalent outcomes to help restore the health of the Murray-Darling Basin. Under Chapter 7 of the Basin Plan, this volume may be reduced if state governments can demonstrate alternative ways of delivering similar outcomes for the environment, as part of a process known as the Sustainable Diversion Limit (SDL) adjustment. The SDL adjustment process also allows for the easing or removal of constraints to environmental water delivery and the addition of 450 GL per year of environmental water above the 2,750 GL target to deliver outcomes of 3,200 GL (Basin Plan s7.09 (e)).

New South Wales, Victoria and South Australia have brought forward a package of 37 projects to be considered for a reduction under the SDL adjustment process. This package includes engineering works, changes in river operations, evaporative savings, and enhancements to ease or remove constraints to the delivery of environmental water. The Murray-Darling Basin Authority has estimated the outcomes that could be achieved by this package is equivalent of up to 605GL of environmental water.

In June 2017, the Wentworth Group provided a set of recommendations to the Murray-Darling Basin Authority that we believe are necessary to honour the commitment by the Prime Minister in December 2016 to deliver the Basin Plan 'in full and on time.' A key recommendation was ensuring environmental outcomes are equivalent or better as a result of any adjustment to the sustainable diversion limit (Basin Plan s7.09 (b)).

We have compiled a set of twelve conditions that we believe any proposal submitted for SDL adjustment would need to comply with to meet this requirement (Table 1). Eleven of these conditions were taken from the Basin Plan itself, as well as policies that have been adopted by the Authority. The Wentworth Group has added one further condition which is that any water savings from rules-based projects will be converted into a water entitlement (Condition 8). We believe that all twelve conditions are necessary to ensure projects are designed and operated in a way that is likely to deliver equivalent environmental outcomes.

*Table 1. Conditions of approval for projects and their original source.*

| Condition of Approval | Source |
|---|---|
| 1. Works-based projects must align with Basin Plan targets. | Basin-wide environmental watering strategy (MDBA, 2014a) (see Table 7 in Appendix A) |
| 2. All works-based projects must be assessed using a scientifically robust method. | Basin Plan S6.05 |
| 3. Any adjustment of the sustainable diversion limit must ensure that there is no change in flow indicators. | Basin Plan S6.07 |
| 4. Sustainable diversion limit must not change by more than ±5% overall. | Basin Plan s7.19 |
| 5. Environmental risks must be mitigated to acceptable levels. | Phase 1 Assessment Guidelines for Constraint and Supply Proposals, Overarching Evaluation Criteria #4. |
| 6. Long-term governance arrangements must be secured. | Phase 1 Assessment Guidelines for Constraint and Supply Proposals, Overarching Evaluation Criteria #3. |
| 7. Environmental water must be able to reach works projects and the broader floodplain in the future. | Basin-wide environmental watering strategy (MDBA, 2014a) |
| 8. Any water savings from rules-based projects will be converted into a water entitlement | Recommended in a report commissioned by MDBA "Converting savings to licence entitlements is |

| | |
|---|---|
| | required to achieve a supply contribution" (Martin and Turner, 2015) |
| 9. Projects must deliver value for money. | *Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin*, and Phase 1 Assessment Guidelines for Constraint & Supply Proposals, Overarching Evaluation Criteria #2 (See 2.7 in Table 8 in Appendix A) |
| 10. Projects must be monitored to ensure outcomes are delivered. | Basin-wide environmental watering strategy (MDBA, 2014a) |
| 11. Projects are consistent with the Constraints Management Strategy. Constraint levels as at 2012 must be used as a benchmark to compare changes. | Constraints Management Strategy (Table 5), Phase 2 Assessment Guidelines for Supply & Constraint Measure Business Cases #3.2.2 (See 1.2 in Table 8 in Appendix A). |
| 12. Pre-requisite policies proposed by states for managing environmental water must be configured in the model used to calculate an adjustment. | Basin Plan s7.15 (1) (ii) |

The Wentworth Group has undertaken an analysis of the 37 projects against these twelve conditions. In formulating our analysis, we used information available on government websites and business cases provided by the Victorian and South Australian Governments. The New South Wales Government declined our request for business cases.
For each project, we determined whether the conditions were met, conditions were not met, further information was required, or the conditions were not applicable (Table 11). On the basis of this assessment, we have identified those projects that meet all conditions and should be approved; those projects where further information is required; and those projects that should not be approved in their current form.

The results for each project are summarised in Table 2. Our assessment shows that:

1. Only one project, the *South Australian Murray Key Focus Area* meets the necessary conditions for approval. Approval of this project for SDL adjustment is however, contingent on upstream constraints proposals meeting targets in the Constraints Management Strategy.

2. Eleven of the projects (representing in the order of 150-270 GL water savings) require additional information before a proper assessment can be undertaken. With such information it might be possible for some or all of the projects to satisfy the 12 conditions for approval. However, all projects would need to ensure there is no significant change in environmental flows reaching the Lower Lakes and Coorong (Condition 3).

3. Twenty five projects (representing in the order of 316-436 GL) do not satisfy these conditions and should not be approved in their current form. This includes The Living Murray works which, although they are able to be considered for an SDL adjustment, they are not likely to result in equivalent environmental outcomes because of the environmental risks identified.

On the basis of this assessment, we recommend that the Murray-Darling Basin Authority should:

1. Approve the *South Australian Murray Key Focus Area* project;

2. For those projects that don't satisfy the necessary conditions, the proponent should be invited to demonstrate that conditions can be met prior to approval for funding and SDL adjustment; and

3. Projects that fail to meet the conditions should be removed from the SDL adjustment determination and should not proceed to implementation.

In addition, of the six nominated constraints proposals, three were not consistent with the Constraints Management Strategy and should not be considered in the SDL adjustment determination. Constraints measures are, however, essential to the successful implementation of the Murray-Darling Basin Plan. Constraints proposals need to be modified in line with the Constraints Management Strategy and funding should be reallocated to support the amended projects.

*Table 2. Assessment of projects based on twelve conditions necessary for delivering the Basin Plan outcomes.*

| Project | Estimated Adjustment (GL) |
|---|---|
| **1. Projects that should be approved** | 0 |
| • South Australian Murray key focus area | |
| **2. Projects requiring further information** | 195-340 |
| • 2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions | |
| • Computer Aided River Management (CARM) Murrumbidgee | |
| • Flexible Rates of Fall in River Levels Downstream of Hume Dam | |
| • Hume Dam airspace management and pre-release rules | |
| • Structural and operational changes at Menindee Lakes and Lower Darling key focus area | |
| • South East Flows Restoration Project | |
| • Flows for the Future | |
| • Hume to Yarrawonga key focus area | |
| • Murrumbidgee key focus area | |
| • Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure | |
| • Nimmie Caira Infrastructure Modifications Proposal | |
| **3. Projects that should not be approved** | 271-366 |
| • Barmah-Millewa Forest Environmental Water Allocation | |
| • Enhanced environmental water delivery (Hydro Cues) | |
| • Improved Regulation of the River Murray | |
| • SDL offsets in the Lower Murray NSW | |
| • Yarrawonga to Wakool junction key focus area | |
| • New Goulburn key focus area | |
| • Lindsay Island (Stage 2) Floodplain Management Project | |
| • Wallpolla Island Floodplain Management Project | |
| • Belsar-Yungera Floodplain Management Project | |
| • Guttrum and Benwell State Forests Floodplain Environmental Works Project | |
| • Hattah Lakes North Floodplain Management Project | |
| • Gunbower National Park Floodplain Management Project | |
| • Burra Creek Floodplain Management Proposal | |
| • Nyah Floodplain Management Project | |
| • Vinifera Floodplain Management Project | |
| • Gunbower Forest TLM Project | |
| • TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal | |
| • Mulcra Island Environmental Flows TLM Project | |
| • Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project | |
| • Hattah Lakes Environmental Flows TLM Project | |
| • Chowilla Floodplain TLM Project | |
| • Improved Flow Management Works at Murrumbidgee River – Yanco Creek Offtake | |
| • Modernising Supply Systems for Effluent Creeks – Murrumbidgee River | |
| • Riverine Recovery Project | |
| • South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP) | |

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## Background

The Murray-Darling Basin Plan is an agreement to recover 3,200 GL of environmental water or equivalent outcomes to help restore the health of the Murray-Darling Basin. Under Chapter 7 of the Basin Plan, this volume may be reduced if state governments can demonstrate alternative ways of delivering similar outcomes for the environment, as part of a process known as the Sustainable Diversion Limit (SDL) adjustment. An objective of the SDL adjustment process is to achieve "equivalent environmental outcomes … with a lower volume of held environmental water than would otherwise be required" (Basin Plan 7.09 (b)).

Another objective of the SDL adjustment process is to allow for the "easing or removal of constraints and the addition of 450 GL per year of environmental water above the 2,750 GL benchmark conditions of development" (Basin Plan 7.09 (e)). Constraint management and the addition of 450 GL per year of environmental water through projects to improve water efficiency is to be achieved through a Commonwealth program to spend $1.77 billion over 10 years from 2014-15 under the Water for the Environment Special Account (Basin Plan 7.09 (e)). This program will allow the enhanced environmental outcomes to be pursued as set out in Schedule 5 of the Basin Plan, including maintaining Lower Lakes levels above 0.4m AHD for 95% of the time and above 0.0m AHD all of the time, and exporting 2 million tonnes of salt from the Murray-Darling Basin each year on average.

In May 2016, Basin Ministers put forward to the Murray-Darling Basin Authority a package of 36 projects to be considered for a reduction in water recovery under the SDL adjustment process. A further project was notified in June 2017. The package of projects consists of operational rule changes, system enhancements (i.e. constraints measures) and engineering works in river channels and on floodplains (Table 10 in Appendix B).

- **Operational rule changes:** Changes to river operation and management rules to improve water efficiency, for example, re-configuring suitable lakes or storage systems to reduce evaporation.
- **System enhancements (i.e. constraints measures):** Changes to the methods of environmental watering in such a way that equivalent environmental outcomes can be achieved with a smaller quantity of water than was required under the benchmark conditions of development. Many of these were proposals to relax constraints to the delivery of water on floodplains.
- **Engineering works:** Proposals to re-engineer river channels and floodplain to reduce the quantity of water required to deliver environmental outcomes.

## Conditions of approval and why they are necessary

In June 2017, the Wentworth Group provided the Murray-Darling Basin Authority with a set of recommendations that we believe are necessary to implement the Basin Plan 'in full and on time.' These included twelve conditions for approval of supply measures for SDL adjustment. We recommended that the Murray-Darling Basin Authority ensure that all conditions are met prior to the approval of projects for funding and SDL adjustment (Table 6 in Appendix A). Eleven of these conditions were taken from the Basin Plan itself, as well as policies that have been adopted by the Authority (Table 1). The Wentworth Group has added one further condition which is that any water savings from rules-based projects will be converted into a water entitlement (Condition 8). We believe that all twelve conditions are necessary to ensure projects are designed and operated in a way that is likely to deliver equivalent environmental outcomes.

Ensuring these conditions are met prior to project approval will substantially improve the likelihood of delivering the necessary outcomes of the SDL adjustment mechanism without adverse impacts on communities and the environment. Failure to properly ensure the conditions are met, or delaying consideration of these conditions until a later date (e.g. reconciliation process in 2024), could result in perverse outcomes for the SDL adjustment mechanism and have adverse impacts on the Basin's environment and communities. We use a case study below of the Koondrook-Perricoota flood enhancement work to justify why it is essential that conditions are met before any project is approved for funding and SDL adjustment.

### Case Study: Koondrook-Perricoota flood enhancement work failed to secure governance arrangements prior to approval

The $80 million Koondrook-Perricoota flood enhancement works were completed under The Living Murray Program in 2013. The existing works are now part of the package of proposals put forward by New South Wales to be considered for SDL adjustment. The Koondrook-Perricoota works were only partially commissioned in 2014. The works did not operate to full capacity because private landholders refused to let environmental water on their floodplains at the inlet creek as well as on the downstream outlet on Barbers Creek.

Landholder consent for operating the Koondrook-Perricoota works at capacity was not secured prior to project approval. Constraints on the inlet and outlet flow capacity could result in overwatering of the lower part of the Koondrook-Perricoota floodplain, with the potential for up to several metres of water pooling behind infrastructure, causing waterlogging of the floodplain forests and significant risks of hypoxic blackwater situations – particularly if flows downstream of the outlet creek are low.

The Koondrook-Perricoota works example highlights the importance of securing long term governance arrangements, including landholder consent, prior to approving the works for funding and SDL adjustment. These arrangements are critical considering the complex planning, operational and management of projects, involving the collaboration and cooperation of Commonwealth and state government agencies.

The governance issues affecting Koondrook-Perricoota could have been mitigated if long-term governance arrangements were secured prior to project approval (Condition 6). This condition requires proponents to agree that, for each project:

1. Ownership and management responsibilities are clearly defined and operations and maintenance are borne by the owner;
2. Projects must be independently audited and periodically re-licenced;
3. Funding must be committed in advance for ongoing operation, risk mitigation measures, long-term monitoring and auditing; and
4. Agreement must be secured from landholders affected by the project (e.g. by acquiring easements, upgrading roads or building bridges to enable delivery of flows), and if necessary, the Commonwealth and state governments should use existing legislation to compulsorily acquire the right to achieve targets specified in the Constraints Management Strategy.

## Assessment of supply measures

We assessed projects proposed for SDL adjustment against each of the conditions in Table 11. For each project, we determined whether the (1) conditions were met; (2) conditions were not met; (3) further information was required; or (4) the conditions were not applicable. On the basis of this assessment, we identified those projects that meet all conditions and are recommended for

consideration for SDL adjustment, and those projects where further work is needed prior to approval for SDL adjustment.

We used publicly available information from government websites for our assessment. We also requested business cases from state governments, which were not publicly available. The Victorian Government provided us with business cases for ten project proposals and the South Australian Government provided us with business cases for five proposals. New South Wales refused to provide business cases, opting instead to provide us with 'fact sheets' for a few selected projects. Queensland did not put forward any supply measure proposals for SDL adjustment.

# Results of assessment

## Overall results

The results for each project are shown in Table 11 in Appendix C. We have provided accompanying notes in Table 12 however given the complexity of projects it was not possible to fully explain the rationale in all cases. We are able to provide further information upon request. In summary, our assessment showed that:

1. Only one project, the *South Australian Murray Key Focus Area* meets the necessary conditions for approval. Approval of this project for SDL adjustment is however, contingent on upstream constraints proposals meeting targets in the Constraints Management Strategy.

2. Eleven of the projects (representing in the order of 150-270 GL water savings)[1] require additional information before a proper assessment can be undertaken. With such information it might be possible for some or all of the projects to satisfy the 12 conditions for approval. However, all projects would need to ensure there is no significant change in environmental flows reaching the Lower Lakes and Coorong (Condition 3).

3. Twenty five projects (representing in the order of 316-436 GL)[1] do not satisfy these conditions and should not be approved in their current form. This includes The Living Murray works which, although they are able to be considered for an SDL adjustment, they are not likely to result in equivalent environmental outcomes because of the environmental risks identified.

Approval of the package of projects in their current form is a risk to delivering the Basin Plan. Funding of projects for SDL adjustment that are not guaranteed to deliver the expected Basin Plan outcomes will be a waste of millions of taxpayer dollars with little return to the Australian public. Moreover, approval of projects with residual risks that are known and are beyond acceptable limits are likely to harm Basin's environment and communities, and could reduce or cancel out their expected benefits.

## Results for specific conditions

We have provided examples of the results of our assessment for four conditions of approval (Condition 5, 8, 9 and 11).

### Example 1. Condition 5 – Environmental risks must be mitigated to acceptable levels

Condition 5 requires environmental risks to be mitigated to acceptable levels. This includes risks to third parties, adverse water quality and salinity impacts, threats to water-dependent species and

[1]Estimate based on 2015 assessment of projects. Estimate does not account for interaction effects between project nor limits of change rules. Modelling of the specified projects is required for a more accurate estimate.

ecosystems, risk of invasive species, cumulative risks, and likely effects of climate change over the lifetime of the project. Condition 5 also requires that where that risks are identified in proposals and mitigation options are presented, there is an obligation on the Commonwealth Government to also fund the mitigation and monitoring measures. Further, the mitigation measure should not be claimed as an SDL adjustment, and environmental water recovered under the Basin Plan should not be used to mitigate the environmental risks.

Condition 5 is essential because environmental risks introduced by proposed engineering works are not currently penalised when determining the SDL adjustment. The CSIRO Ecological Elements method assesses the equivalence of benefits, but does not ensure that the risks of works are equivalent to the risks of environmental watering. That is, the method does not penalise for the risks of salinity impacts, poor water quality and other adverse impacts on environmental outcomes (Overton et al., 2015).

We assessed projects against Condition 5 by examining the environmental risks identified in available business cases for Victorian works projects (Proposal 18 - 26 in Table 11) and South Australian works projects (Proposal 9, 14, 32, 37 and 38 in Table 11). For NSW projects, an assessment was carried out based on fact sheets and other information available online. For other projects we did not have enough information available for this assessment. We made the assumption that the proposal was modelled as if it operated every year or every year available. Our analysis focused on the environmental risks, noting that risks to third parties and operational risks are covered by Condition 6 concerning governance and landholder approval**.** Our analysis also focused only on those risks that were documented by proponents in business cases, and thus we recommend undertaking further evaluation of the quality of the risk assessment itself.

For each available project proposal, we categorised the number and severity of documented environmental risks after mitigation (i.e. residual risk). Risks were defined as the consequence of exposure (occurrence) x likelihood of exposure (occurrence). We considered the project to have an acceptable level of environmental risk if all risks were Very Low, Low or Low/Medium. We considered the project to have an unacceptable level of environmental risk if the project had at least one Medium, Medium/High or High residual risk (i.e. expected risk after proposed mitigation strategy).

| Risk | Definition |
|---|---|
| Very Low | There is no reasonable prospect the project objectives will be affected by the event. |
| Low | Risk management measures should be considered. |
| Moderate | Risk management measures should be undertaken. |
| High | There is reasonable likelihood risk will occur and will have harmful consequences. Risk management is essential. |
| Very high | The risk is likely to occur and will have very harmful consequences. Risk management is essential. |

The results of our risk assessment are summarised in Table 3 and described in Appendix D. Of the 14 projects where we had sufficient information for assessment, we found that project, the South East Flows Restoration Project, had an acceptable level of risk after mitigation because risks were identified as low or low/moderate. We assumed that proposals to relax constraints have no long-term environmental risks. Sixteen projects had one or more Moderate to High residual risks making them unacceptable in their current form. Fifteen projects did not have sufficient information to complete the assessment.

*Table 3. The number and severity of environmental risks expected after risk mitigation as identified in Business Cases made available by Victoria and South Australia.*

| Project name | Number of environmental risks after mitigation | | |
|---|---|---|---|
| | Very Low, Low or Low/Moderate | Moderate or Moderate/High | High |
| 1. 2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions | MIA | | |
| 2. Barmah-Millewa Forest Environmental Water Allocation | Risk that a bird breeding event in December would not be supported following 4 month flood | | |
| 3. Computer Aided River Management (CARM) Murrumbidgee | MIA | | |
| 4. Enhanced environmental water delivery (Hydro Cues) | MIA | | |
| 5. Flexible Rates of Fall in River Levels Downstream of Hume Dam | MIA | | |
| 6. Hume Dam airspace management and pre-release rules | MIA | | |
| 7. Improved Regulation of the River Murray | MIA | | |
| 8. Structural and operational changes at Menindee Lakes* | MIA | | |
| 9. South East Flows Restoration Project[#] | 8 | 0 | 0 |
| 10. Flows for the Future | MIA | | |
| 11. SDL offsets in the Lower Murray NSW | MIA | | |
| 12. Hume to Yarrawonga key focus area | No long term risks assumed in relaxing constraints | | |
| 13. Yarrawonga to Wakool junction key focus area | No long term risks assumed in relaxing constraints | | |
| 14. South Australian Murray key focus area | No long term risks assumed in relaxing constraints | | |
| 15. New Goulburn key focus area | No long term risks assumed in relaxing constraints | | |
| 16. Lower Darling key focus area* | No long term risks assumed in relaxing constraints | | |
| 17. Murrumbidgee key focus area | No long term risks assumed in relaxing constraints | | |
| 18. Lindsay Island (Stage 2) Floodplain Management Project | 5 | 2 | 0 |
| 19. Wallpolla Island Floodplain Management Project | 6 | 2 | 0 |
| 20. Belsar-Yungera Floodplain Management Project | 3 | 1 | 0 |
| 21. Guttrum and Benwell State Forests Floodplain Environmental Works Project | 3 | 1 | 1 |
| 22. Hattah Lakes North Floodplain Management Project | 4 | 1 | 0 |
| 23. Gunbower National Park FMP** | 0 | 0 | 1 |
| 24. Burra Creek Floodplain Management Proposal | 3 | 1 | 0 |
| 25. Nyah Floodplain Management Project | 4 | 1 | 0 |
| 26. Vinifera Floodplain Management Project | 4 | 2 | 0 |
| 27. Gunbower Forest TLM Project | 0 | 0 | 1 |
| 28. TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal | See Pittock, J., Finlayson, C., & Howitt, J. (2013). Beguiling and risky: 'environmental works and measures' for wetland conservation under a changing climate. Hydrobiologia, Volume 708, Issue 1, pp 111–131 | | |
| 29. Mulcra Island Environmental Flows TLM Project | | | |
| 30. Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project | | | |
| 31. Hattah Lakes Environmental Flows TLM Project | | | |
| 32. Chowilla Floodplain TLM Project** | 2 | 1 | 0 |
| 33. Improved Flow Management Works at the Murrumbidgee River – Yanco Creek Offtake | MIA | | |
| 34. Modernising Supply Systems for Effluent Creeks – Murrumbidgee River | MIA | | |
| 35. Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure | MIA | | |
| 36. Nimmie Caira Infrastructure Modifications Proposal | MIA | | |
| 37. Riverine Recovery Project | 5 | 5 | 0 |
| 38. South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP) | 7 | 11 | 0 |

*We assessed the *Structural and operational changes at Menindee Lakes* and the *Lower Darling key focus area* as separate projects, even though they were formally submitted as a single project by NSW.

**Additional risks identified in business cases with unspecified/unknown residual risk rating.

[#]Water quality risks were assessed by the proponent however an ecological risk assessment was not available.

The following environmental risks were common to the proposals we assessed:

1. Adverse water quality impacts when water ponded on floodplains eventually returns to the channel (salt migration; anoxic blackwater; eutrophication);
2. Increases in carp and other pest fish species;
3. Stranding of native fish during/after watering or lack of flow cues for exit. General adverse impacts on ecological function and connectivity for aquatic species;
4. Limited protection of outer floodplain communities, like black box floodplain forests, failing the Basin Plan for representative conservation of different ecosystems (Basin Plan s8.05 (3) (b));
5. Demands on water infrastructure design to operate effectively through a wide range of hydrological regimes including under climate change (even though climate change projections have not been used in their design). Associated episodic reduction in hydrodynamic diversity (e.g. lentic habitat creation, prolonged inundation of vegetation);
6. Works projects may compete for available environmental water with other works projects. It is also possible that some non-works proposals could compete for water (Martin and Turner, 2015).
7. Some proposals state that environmental water recovered under the Basin Plan is to be used to mitigate risks of SDL projects (e.g. anoxic blackwater). Were environmental water to be used in this way it would need to be debited against the volume claimed as part of the SDL adjustment; being water needed to ensure the appropriate operation of the measure.

These additional environmental risks (above the Benchmark Model) must be mitigated to acceptable levels to satisfy the Basin Plan objective for supply measures that "equivalent environmental outcomes are achieved with a lower volume of held environmental water than would otherwise be required" (Basin Plan s7.09 (b))." If environmental risks cannot be mitigated to acceptable levels, the project should not be approved for SDL adjustment.

### *Case Study. Salinity risk for the Belsar Yungera Floodplain Management Project*

Salinity was identified as one of the key risks for the Belsar Yungera project proposed by the Victorian Government. The business case for the project stated that a "key driver to salinity in Lindsay River is discharge of saline groundwater along gaining reaches during a flow recession. Increases in salinity (measured as EC units at Morgan) may breach Basin Salinity Management Strategy requirements and also exceed Basin Plan salinity targets. This may result in poor water quality for downstream users." If management of environmental water through use of works projects reduces water quality then environmental water holders may be reluctant to allow natural flows to pass through such sites in fear of releasing water of poor quality into the main river channel.

The salinity risk associated with the Belsar Yungera works proposal was classified in the business case as 'moderate' without mitigation and 'low' with mitigation. Mitigation measures specified in the business case included "provision of dilution flows in the Murray River during and following drawdown". The business case stated "it is expected that Basin plan flows will more than meet any dilution flow requirements of proposed and existing works as well as delivering environmental and water quality benefits along the full length of the river." Depending on Basin Plan flows for dilution is problematic because there will be less environmental water recovered if the Belsar Yungera project results in an SDL adjustment. Furthermore, using environmental water for dilution is not appropriate unless the salinity represents an ecological threat. Further, environmental water cannot be guaranteed for mitigation because availability is highly variable and there are competing priorities over its use.

Environmental flows recovered under the Basin Plan should not be used to mitigate risks of SDL adjustment projects. Were environmental water to be used in this way it would need to be debited against the volume claimed as part of the SDL adjustment; being water needed to ensure the appropriate operation of the measure. Water recovered under the Basin Plan is to be used for achieving objectives in Chapter 5 of the Basin Plan related to environmental outcomes such as "protect and restore water-dependent ecosystems" (s5.03 (1) (a)) and "ensure that water-dependent ecosystems are resilient to climate change and other risks and threats" (s5.03 (1) (d)). While environmental water is to be delivered to works sites for environmental benefit, delivering water recovered under the Basin Plan to mitigate risks of supply measures is not consistent with these objectives because it could divert effort away from achieving Basin Plan outcomes.

### Example 2. Condition 8 – Any water savings from rules-based projects should be converted into a water entitlement

Proposals that save / claim evaporation or operational surplus flow saving may result in extra flow in the river, however as there is currently no way to designate this extra flow to the environmental water allocation, there is a risk that it is added to the total available water to meet systems demands. This is likely when these proposals have very little observational data on which to justify relationships, represent an optimisation of the model rather than a quantifiable change in the real world, or they cannot guarantee that the new mode of operation will be followed in the future. There is therefore significant risk that the savings will not be realised, will not be enduring or are likely to be substantially different than expected. This increases the reliability of water allocations to consumptive and environmental users.

If the proponent is confident that the saving will be realised, then Condition 8 states that any water savings from rules-based projects should be converted into a water entitlement. The entitlement should be issued to the environment by the proponent of the proposal that is equivalent to the claimed water savings, noting this may not be on a one-for-one basis due to third party impacts. Without this condition, there is significant risk that water savings for the environment will not be realised entirely.

Of the proposals considered to include a rule change component, we have identified thirteen proposals which appear not to have met this condition or have insufficient information for assessment (Table 11 in Appendix C). This would mean that the water savings associated with these proposals cannot be guaranteed for the environment without conversion to an entitlement. We recommend that the projects are not approved for SDL adjustment until there is guarantee that water savings will be converted into entitlements.

### Example 3. Condition 9 – Projects must deliver value for money

Condition 9 states that projects estimated to cost more than $1,900 per megalitre should not be approved as per the Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin. We examined the estimated cost of proposed projects by assessing the estimated cost of each project against the supply contribution (Martin and Turner, 2015). We also documented the area of the floodplain watered.

It is important to consider the cost benefit in terms of floodplain watered. Table 13 in Appendix E describes the estimated supply contribution, the additional area watered compared to pre-Basin Plan, and the estimated costs for implementation and maintenance for proposed projects. This is summarised in Table 4 below which compares The Living Murray environmental works to the proposed environmental works nominated by Victoria in terms of the MDBA Stocktake estimate of SDL adjustment, area watered and costs.

Using the Stocktake estimate of the SDL adjustment for TLM environmental works the cost was approximately $1.8 Million per gigalitre saved ($1,800 per ML) while watering approximately 53,000 Ha. In contrast the new Victorian works proposals will cost approximately $5.4 million per gigalitre saved ($5,400 per ML) while watering 14,247 Ha. It can also be seen in Table 4 that on-going costs for the Victorian proposals are slightly less than the approximate ongoing costs of The Living Murray projects, while only watering approximately 27% of the area.

*Table 4: Comparison of TLM environmental works to new Victorian environmental works proposals*

| Environmental works project | Status | Area floodplain or wetland inundated / watered (Ha) | Implementation Costs $ millions | On-going costs $Millions/Yr | Stocktake estimate of SDL adjustment (GL) | Cost $millions per GL saved (not counting on going costs) |
|---|---|---|---|---|---|---|
| Gunbower Forest TLM Project | Approved and built | 4800 | ~$245 | ~$14 | 136 | 1.8 |
| TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal | Approved and built | 32000 | | | | |
| Mulcra Island Environmental Flows TLM Project | Approved and built | 820 | | | | |
| Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project | Approved and built | ~30 Ha of Streams inundated assuming streams are 10m wide | | | | |
| Hattah Lakes Environmental Flows TLM Project | Approved and built | 6000 | | | | |
| Chowilla Floodplain TLM Project | Approved and built | 9000 | | | | |
| | **TOTAL FOR TLM** | **52620** | **~245** | **~14** | **136** | **1.8** |
| Lindsay Island (Stage 2) Floodplain Management Project | Awaiting approval | 5152 | 72.8 | 2.7 | 40-50 | 5.4 |
| Wallpolla Island Floodplain Management Project | Awaiting approval | 2650 | 59.5 | 2.5 | | |
| Belsar-Yungera Floodplain Management Project | Awaiting approval | 2370 | 55.6 | 2.3 | | |
| Guttrum and Benwell State Forests Floodplain Environmental Works Project | Awaiting approval | 1200 | 28.4 | 1.1 | | |
| Hattah Lakes North Floodplain Management Project | Awaiting approval | 1130 | 8.8 | 0.5 | | |
| Gunbower National Park Floodplain Management Project | Awaiting approval | 500 | 12.8 | 0.6 | | |
| Burra Creek Floodplain Management Proposal | Awaiting approval | 407 | 12.1 | 0.5 | | |
| Nyah Floodplain Management Project | Awaiting approval | 488 | 10.9 | 0.5 | | |
| Vinifera Floodplain Management Project | Awaiting approval | 350 | 9.1 | 0.4 | | |
| | **TOTAL FOR new VIC env works** | **14247** | **270** | **11.1** | **40-50** | **5.4** |

The costs of the Victorian proposals do not satisfy Condition 9 that projects with water recovery exceeding $1,900 per megalitre should not be approved as per the *Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin*.

## Example 4. Condition 11 – Projects are consistent with the Constraints Management Strategy. Constraint levels as at 2012 must be used as a benchmark to compare changes

Constraints projects need to reconnect the river with its floodplain, move ecologically appropriate volumes downstream, and deliver environmental benefits to an additional 35,000 Ha of floodplain forests along the Murray River. This is critical, particularly where floodplains and the ecosystems they support are in poor health. The Murray-Darling Basin Authority's Constraints Management

Strategy in 2013 sets out the approach for easing or removing constraints on the delivery of overbank flows into South Australia and allowing environmental watering of floodplain wetlands in the mid-Murrumbidgee and the lower Goulburn River by providing higher flow rates than were permissible in 2012 (MDBA, 2013). Modelling by the Murray-Darling Basin Authority in 2012 showed that a flow of 80,000 ML/d into South Australia resulted in 75% of wetlands and flood dependent vegetation being inundated compared to just 40% with the river system constraints possible in 2012 (MDBA, 2012a). This target is necessary to allow environmental water to reach the floodplain forests and achieve improved outcomes with the water available. Implementing the Constraints Management Strategy can involve building bridges (including where low level causeways exist), upgrading roads, upgrading levee banks and purchasing easements. These actions can also benefit privately owned land and towns along the river during managed and natural flow events.

Constraint levels at 2012 as described by the Murray-Darling Basin Authority in the Constraints Management Strategy (Table 5) should be used as the target for constraints relaxation as they represent flow rates that could be delivered at the commencement of the Basin Plan according to state water sharing plans and state and Commonwealth river operators. Any illegal constraints (e.g. unlicensed levees) should be removed.

The level of constraint relaxation being proposed by Victoria and New South Wales through the notified supply measures is not sufficient to achieve the targets in the Constraint Management Strategy nor the enhanced environmental outcomes in Schedule 5 of the Basin Plan.

Of the 6 nominated constraints proposals, only 3 were found to be consistent with the Constraints Management Strategy or the required flow rates to achieve 80,000 ML/d into South Australia and Basin Plan Schedule 5 outcomes (Table 5).

Of the 3 projects found to be consistent with Condition 11, the Lower Darling constraint relaxation is dependent on approval of the Menindee water savings project, and the South Australian proposal cannot deliver the anticipated benefits because the upstream constraint proposals do not relax constraints sufficiently to deliver the required volumes.

In some cases the constraint level represents a return to what could be delivered prior to the Basin Plan, reflecting the fact that constraints in these areas have worsened since the 2012. Consequently, it will be difficult for environmental water holders to deliver water to key floodplains and wetlands in the southern connected system to achieve the Basin Plan objectives. Under the current proposals, 78,000 ML/d of flow is achievable at the South Australian border, assuming perfect coordination of flows which is highly unlikely. This is considerably short of the 111,000 ML/d target in the Constraints Management Strategy which would give some chance of success for flows of 80,000 ML/d to reach the South Australian border.

If constraints are not relaxed to allow flow levels higher than could be delivered in 2012, environmental water holders will be delivering most if not all environmental water inside the river channel. The current proposals result in a 30% shortfall of the targets set in the Constraints Management Strategy. Failure to remove constraints to the level set out in the 2012 Constraints Management Strategy will deprive floodplain wetlands along the mid-Murray and in South Australia from receiving environmental water. Such result would undermine the Basin Plan outcome of “healthy and resilient ecosystems with rivers and creeks regularly connected to their floodplains and, ultimately, the ocean”(Commonwealth of Australia, 2012, MDBA, 2013).

*Table 5. Physical constraints must be addressed to permit delivery of water to floodplains and wetlands in the southern Murray-Darling Basin. Constraints highlighted in red are proposed levels that will fail to meet the Murray-Darling Basin Authority's target as specified in the Constraints Management Strategy.*

| Region | Location | PRE-BASIN PLAN: Constraint in 2012(MDBA, 2013) (ML/d) | TARGET: Target in MDBA Constraints Management Strategy (ML/d) | PROPOSED BY STATES: Constraint in business case(Murray-Darling Basin Ministerial Council, 2016) (ML/d) |
|---|---|---|---|---|
| Murray | Hume to Yarrawonga | 25,000 | 40,000 | 40,000 |
| | Downstream of Yarrawonga | 40,000 (but effectively 22,000* due to upstream constraint of 25,000) | 40,000 (50,000 for reaching disconnected wetlands and ephemeral creeks)(MDBA, 2014b) | 30,000 |
| Darling | Weir 32/Increase Menindee outlet capacity | 9,300 | 18,000 | 14,000 |
| | Darling anabranch | Water flows into anabranch over 9,300ML/d | Regulator added and closed above 9,300ML/d when environmental water is supplied from Menindee | n/a |
| Murrumbidgee | Gundagai | 30,000 | 50,000 | 40,000 at Wagga (~30,000 at Gundagai) |
| | Balranald | 9,000 | 13,000 | 9,000 |
| Goulburn | Seymour | 12,000 | 15,000 | n/a |
| | McCoys Bridge | 20,000 | 40,000 | 20,000 |
| Total flow at South Australian border | | 66,000 **(assuming 26,000 from Goulburn) | 111,000 **assuming Menindee allowed 18,000 | 78,000** |

*10,600 ML/d in regulated periods in summer and in other periods Hume to Yarrawonga constraint of 25,000 ML/d was in place meaning that flows downstream of Yarrawonga were effectively restricted to 22,000 ML/d.
**This number assumes perfect co-ordination of flows between the Murray and tributary flows, something which is highly unlikely. The 111,000ML/d target is most likely to achieve the outcomes in schedule 5 of the Basin Plan (i.e. 80,0000 ML/d).

There is a further concern about the representation of proposals in the model for calculating the supply contribution. For the Yarrawonga to Wakool focus area, the current supply measure proposal is for a target flow of 30,000 ML/d with a buffer to 50,000 ML/d. The model should be based on the 30,000 ML/d flow target not the 50,000 ML/d buffer because the buffer is to protect both landholders and dam operators in the event that the target is accidently exceeded because of unregulated inflows from tributaries between Hume and Yarrawonga being larger than forecast by operators. However, to be consistent with the Constraints Management Strategy and achieve Basin Plan Schedule 5 outcomes, flow rates downstream of Yarrawonga should be relaxed to 50,000 ML/d with a 70,000 ML/d buffer. This 50,000 ML/d target would also be consistent with that used in the MDBA Hydrologic modelling of the relaxation of operational constraints in the southern connected system (2012).

Both the Yarrawonga to Wakool and Goulburn constraints proposals are suggesting constraint relaxation back to what was permitted prior to the Basin Plan and in that sense could be regarded as

anticipated measures at s7.12(3)(b) of the Basin Plan. In other words they are lower or equal to that assumed in the Benchmark for SDL adjustment.

From the assessment we have completed, the Hume to Yarrawonga key focus area meets all conditions of approval. Other proposals should not be approved until Basin States can demonstrate that targets in the Constraints Management Strategy can be achieved (including upstream/dependent projects).

Of the six nominated constraints proposals, only three were found to be consistent with the Constraints Management Strategy. Constraints proposals that do not satisfy the 12 conditions should not be considered in the SDL adjustment determination. These measures are, however, essential to the successful implementation of the Murray-Darling Basin Plan. Constraints proposals need to be modified in line Constraints Management Strategy and funding should be reallocated to support the amended projects.

The current 'good neighbour policy' (CEWO, 2015) cannot guarantee the passage of critical flows for the environment. Permanent solutions are required, including acquiring rights to inundate floodplain land through covenants and easements, to compensate landholders for any reduction in the value of their land, while enabling landholders to use their lands for flood resilient activities, such as grazing and timber production. Where all reasonable options are exhausted, existing or new Commonwealth or state legislation could be used to compulsorily acquire easements, upgrade roads and build bridges to enable delivery of flow rates up to the Bureau of Meteorology's minor flood levels as at 2012 on just terms. Unless these steps are taken, we are not confident that Basin governments will be able to deliver the Constraints Management Strategy and achieve Basin Plan objectives for "easing or removal of constraints and the addition of 450 GL per year of environmental water above the 2750 GL benchmark conditions of development" (Basin Plan 7.0 (e)).

## Recommendations

On the basis of this assessment, we recommend that the Murray-Darling Basin Authority should:

1. Approve the *South Australian Murray Key Focus Area* project;
2. For those projects that don't satisfy the necessary conditions, the proponent should be invited to demonstrate that conditions can be met prior to approval for funding and SDL adjustment; and
3. Projects that fail to meet the conditions should be removed from the SDL adjustment determination and should not proceed to implementation.

In addition, of the six nominated constraints proposals, three were not consistent with the Constraints Management Strategy and should not be considered in the SDL adjustment determination. Constraints measures are, however, essential to the successful implementation of the Murray-Darling Basin Plan. Constraints proposals need to be modified in line with the Constraints Management Strategy and funding should be reallocated to support the amended projects.

## Appendix A. Conditions of approval of supply measure projects

The following tables describe the conditions of approval required for supply measure projects to ensure they deliver equivalent outcomes and are consistent with the Basin Plan:

- Table 6 shows the conditions of approval put forward by the Wentworth Group to ensure all projects are operated in a way which will deliver 'equivalent' environmental outcomes with less water.

*Table 6. Recommended conditions of approval of supply measure projects proposed by state governments to ensure all projects are operated in a way which will deliver 'equivalent' environmental outcomes with less water.*

| Condition | Test |
|---|---|
| **1.** Works-based projects must align with Basin Plan targets. | All works-based project proposals must specify quantitative targets that contribute to outcomes set out in the Basin Plan or Basin-wide Environmental Watering Strategy.(MDBA, 2014a) The required operating practices and procedures to meet these targets must be clearly specified and consistent with modelling assumptions. |
| **2.** All works-based projects must be assessed using a scientifically robust method. | All works-based projects assessed using the agreed Ecological Elements scoring system developed by CSIRO(Overton et al., 2014) and independently reviewed in 2014. This is the default method specified in Schedule 6 of the Basin Plan that measures whether a project is able to produce equivalent environmental outcomes with less water. Any adjustment must be once-off with no further push to use alternative methods or proposals that do not fall under the default method (e.g. carp herpes, fish ladders and other complementary projects) to justify future reduction in environmental water. |
| **3.** Any adjustment of the sustainable diversion limit must ensure that there is no change in flow indicators. | There is no change to river flow indicators within the main channel and no more than a 10% change in flow indicators for overbank flows (consistent with the limit of change rules as per section 6.07 of the Basin Plan). |
| **4.** Sustainable diversion limit must not change by more than ±5% overall. | When combined with irrigation efficiency measures, the overall net change in sustainable diversion limit is no more than ±5% across the whole Basin, as per section 7.19 of the Basin Plan. |
| **5.** Environmental risks must be mitigated to acceptable levels. | Environmental risks are mitigated to acceptable levels and funded as part of the proposed project, rather than as separate supply measures justifying less environmental water. This includes risks to achieving objectives in the Basin Plan, risks to third parties, adverse water quality and salinity impacts, threats to water-dependent species and ecosystems, risk of invasive species, cumulative risks, and likely effects of climate change over the lifetime of the project. |
| **6.** Long-term governance arrangements must be secured. | The following conditions must be met:<br>1. Ownership and management responsibilities must be clearly defined and operations and maintenance must be borne by the owner;<br>2. Projects must be independently audited and periodically re-licenced;<br>3. Funding must be committed in advance for ongoing operation, risk mitigation measures, long-term monitoring and auditing; and<br>4. Agreement must be secured from landholders affected by the project (e.g. by acquiring easements, upgrading roads or building bridges to enable delivery of flows), and if necessary, the Commonwealth should use existing legislation (e.g. the Lands Acquisition Act 1989) to achieve constraints targets specified in the Constraints Management Strategy.(MDBA, 2013) |
| **7.** Environmental water must be able to reach works projects and the broader floodplain in the future. | Proposed projects must be able to operate (1) in a natural way with all structures open during regulated and unregulated river flows, and (2) under a range of future water availability scenarios, based on an assessment of climate change impacts. The use of environmental works should not substitute for the aim of watering the broader floodplains and wetlands to achieve the outcomes in the Basin-wide Environmental Watering Strategy. |
| **8.** Any water savings from rules-based projects should be converted into a water entitlement | Any water savings from rules-based projects should be converted into a water entitlement. The entitlement should be issued to the environment by the proponent of the proposal that is equivalent to the claimed water savings to ensure the savings will be realised in the real world. |
| **9.** Projects must deliver value for money. | Projects estimated to cost more than $1,900 per megalitre should not be approved as per the *Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin*. |
| **10.** Projects must be monitored to ensure outcomes are delivered. | Careful monitoring of projects is needed to ensure the actual outcomes match what was expected, starting with a review of existing The Living Murray projects against their expected outcomes. If there are discrepancies that cannot be addressed by management actions, a review of sustainable diversion limits will be required. |
| **11.** Projects are consistent with the Constraints Management Strategy. Constraint levels as at 2012 must be used as a benchmark to compare changes. | Constraint levels at 2012 in Table 3, as described by the Murray-Darling Basin Authority,(MDBA, 2012b, MDBA, 2012a) should be used as the benchmark as they represent flow rates that could be delivered at the commencement of the Basin Plan according to state water sharing plans and state and Commonwealth river operators. Any illegal constraints (e.g. unlicenced levees) should be removed. |
| **12.** Pre-requisite policies proposed by states for managing environmental water must be configured in the model used to calculate an adjustment. | Prerequisite policy measures for crediting return flows and calling environmental water from storage (section 7.15 (b) (ii), including shepherding arrangements) proposed by states should be configured into the model when calculating the adjustment to the sustainable diversion limit, to avoid the risk that policies presented by Basin governments do not enable the same outcome as the benchmark model for sustainable diversion limit adjustment. |

The following tables provide further detail of the conditions required in Table 6.

- Table 7 provides further detail for **Condition 1** by describing the quantitative targets in the Basin-wide Environmental Watering Strategy that need to be consistent with the proposed outcomes of supply measures.
- Table 8 presents the guidelines that were developed by Basin States as part of the three-phase process set out in Schedule 1 of the Intergovernmental Agreement (IGA).
- Table 9 describes additional Basin Plan requirements for implementing the SDL adjustment mechanism.

*Table 7. Expected outcomes of the Basin Plan after 2019 for key environmental components, as described in the Murray-Darling Basin Authority's Basin-wide environmental watering strategy (MDBA, 2014a). Proposed projects for SDL adjustment need to be consistent with these outcomes (see **Condition 1** in Table 6).*

| Component | Expected outcome |
|---|---|
| **River flows and connectivity:** Improved flow connections along rivers, and between rivers and their floodplains | **BWS1.** Maintain base flows at least 60% of natural levels<br>**BWS2.** Improve overall flow by 10% more into the Barwon–Darling, 30% more into the River Murray and 30–40% more to the Murray mouth which opens to the sea 90% of the time<br>**BWS3.** Maintain connectivity in areas where it is relatively unaffected, between rivers and floodplains in the Paroo, Moonie, Nebine, Warrego and Ovens<br>**BWS4.** Improve connectivity with bank-full and/or low floodplain flows by 30–60% in the Murray, Murrumbidgee, Goulburn and Condamine–Balonne, and by 10–20% in remaining catchments<br>**BWS5.** Maintain the Lower Lakes above sea level<br>**BWS6.** Adequate flushing to export an average 2 million tonnes of salt from the River Murray system into the Southern Ocean each year |
| **Native vegetation:** Maintain the extent and improve the condition of native vegetation in the Murray-Darling Basin. | **BWS7.** Maintain the current extent of about 360,000 hectares of river red gum, 409,000 ha of black box, 310,000 ha of coolibah forest and woodlands, existing large communities of lignum, and non-woody communities near or in wetlands, streams and on low-lying floodplains<br>**BWS8.** Maintain the current condition of lowland floodplain forests and woodlands of river red gum, black box and coolabah<br>**BWS9.** Improve the condition of southern river red gum |
| **Waterbirds:** Maintain current species diversity, improve breeding success and numbers. | **BWS10.** Maintain current species diversity of all current Basin waterbirds and current migratory shorebirds at the Coorong<br>**BWS11.** Increased abundance of waterbirds by 20–25% by 2024<br>**BWS12.** Improved breeding with up to 50% more breeding events for colonial nesting species and a 30–40% increase in nests and broods for other waterbirds |
| **Fish:** Maintain current species diversity, extend distributions, improve breeding success and numbers. | **BWS13.** Improved distribution of key short and long-lived fish species across the Basin<br>**BWS14.** Improved breeding success for short-lived species (1–2 years), long-lived species in at least 8/10 years at 80% of sites, mulloway in at least 5/10 years<br>**BWS15.** Improved populations of short-lived species (numbers at pre-2007 levels), long-lived species (with a spread of age classes represented), Murray cod and golden perch (10–15% more mature fish at key sites)<br>**BWS16.** Improved movement with more native fish using fish passages |

*Table 8. Phase 1, 2 and 3 guidelines used in the assessment of proposals by Southern Basin governments.*

| Guidelines | Applicable to Supply or Constraint |
|---|---|
| **GL1.1** The proposed measure is likely to be technically feasible | Supply |
| **GL1.2** The proposed measure is likely to be cost effective considering the qualitative estimate of the potential supply contribution or likely improved delivery of environmental water | Supply |
| **GL1.3** The proposed measure is likely to achieve its intended outcomes | Supply |
| **GL1.4** The risks and impacts associated with the proposed measure are manageable and acceptable | Supply |
| **GL2.1** Operate 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 | Supply |
| **GL2.2** Achieve equivalent environmental outcomes with a lower volume of held environmental water than would otherwise be required | Supply |
| **GL2.3** Have no detrimental impacts on reliability of supply of water to holders of water access rights that are not offset or negated | Supply |
| **GL2.4** Measures not included in the benchmark conditions of development | Supply |
| **GL2.5** Remove or ease a physical or other constraint on the capacity to deliver environmental water to the environmental assets of the Murray-Darling Basin | Constraint |
| **GL2.6** When combined into a package of supply, efficiency and constraint measures, allow environmental water to be used to maximum effect | Constraint |
| **GL2.7** In order for the measure to satisfy the criterion, the proponent will have to demonstrate the consistency with the Constraints Management Strategy | Constraint |
| **GL2.8** The criterion reflects the requirement of the Basin Plan and the IGA Protocol that all supply and constraint measures must be ready to enter into operation by 30 June 2024 | Supply and Constraint |
| **GL2.9** Funding available is dependent on whether full funding has already been provided or committed by the Commonwealth (such as pre-existing Commonwealth Funded projects); or that have already been approved for funding by another organisation | Supply and Constraint |
| **GL2.10** Consistent with purposes of the Water for the Environment Special Account | Constraint |
| **GL3** Proponent able to demonstrate that funding for the measure is agreed in principle | Supply and Constraint |

*Table 9. Additional Basin Plan requirements for the SDL adjustment mechanism.*

| Condition |
|---|
| **BP1.** The indicator sites, and corresponding river reaches and associated floodplains, that are to be used are those used in the development of the Environmentally Sustainable Level of Take (ESLT) method (the ESLT method) for which detailed assessments of environmental water requirements were done. Note: Refer to MDBA 2011, 2012a, 2012b. (Basin Plan Sch6.03 (1)) |
| **BP2.** Hydrologic modelling under the method to establish a supply contribution will start with the benchmark environmental flow events and these will only be modified as necessary to reflect the outcomes of the proposal and potential supply contribution (Basin Plan Sch6.06 (3)). i.e. the environmental demands in the model must be changed by the minimum amount necessary. |
| **BP3.** A measure may only be notified if it is not an anticipated measure (Basin Plan 7.12 (3) (b)) |

## Appendix B. Projects proposed by states for SDL adjustment

*Table 10. Package of supply measures agreed by the Murray–Darling Basin Ministerial Council on 16 June 2017*

| Operational rule changes | Proponent state(s) | Project description |
|---|---|---|
| 1. 2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions | New South Wales / Victoria | Amendments to Snowy Hydro licence in 2011 allow the water recovered by the River Murray Increased Flows (RMIF) to be held and called out. Previously the release of the water was at the discretion of Snowy Hydro and was generally at times suited to Snowy Hydro's commercial outcomes. The proposal intends to provide a means to control the timing of RMIF water releases from the Snowy Scheme, allowing more flexibility to achieve environmental outcomes targeted in the Murray River below Hume Dam. |
| 2. Barmah-Millewa Forest Environmental Water Allocation | Victoria / New South Wales | Rule change to vary the rules associated with the water set aside by Victoria and New South Wales in an environmental account (the Barmah-Millewa Forest Environmental Watering Account or BMFEWA) to water the Barmah-Millewa Forest proposed to allow the use of other environmental entitlements to target the environmental requirements specified in the Basin Plan. This measure proposes to not initiate or continue release from BMFEWA if a four monthly flood has already occurred. |
| 3. Computer Aided River Management (CARM) Murrumbidgee | New South Wales | The CARM project aims to use better information in the form of metering, inundation models and more accurate loss estimates to allow operators to more accurately make releases to meet downstream orders. The saved operational loss may then be calculated and set aside to achieve environmental outcomes. A callable entitlement as a result of the envisaged saving will allow delivery of previous losses (which were also contributing to environmental outcomes) in a more managed way. |
| 4. Enhanced environmental water delivery (Hydro Cues) | New South Wales / Victoria / South Australia | This project will achieve enhanced environmental outcomes by increasing environmental water holders' ability to time releases of environmental water from dams with increases in natural flows caused by rainfall. Proponents and environmental water holders will work together to explore opportunities to better mimic natural conditions without impacting long and short term reliability. The environmental benefits, in part, will be dependent on the extent to which constraints projects are implemented. Any changes will be tested progressively and monitored in an adaptive management process consistent with agreed constraints outcomes. Proponents acknowledge the need for focussed engagement and consultation with communities on this project. |
| 5. Flexible Rates of Fall in River Levels Downstream of Hume Dam | Victoria / New South Wales | Rule change to allow Hume releases to be reduced more quickly when flows have not been elevated for an extended period beforehand, with the water saved released at a different point in time or in a different flow pattern that would provide additional environmental benefits. The additional flexibility improves Hume Dam operational efficiency. |
| 6. Hume Dam airspace management and pre-release rules | Victoria / New South Wales | Rule change to allow future environmental water releases in airspace management. |
| 7. Improved Regulation of the River Murray | Victoria / New South Wales | The proposal locks in place recent observed improvements in operational loss performance. The agreement to proceed with the project as a supply measure is subject to resolution by the Basin Officials Committee (BOC) by September 2017 of an approach that secures enduring environmental outcomes, which may include environmental water entitlements or equivalent arrangements. |
| 8. Structural and operational changes at Menindee Lakes | New South Wales | This project is a package of operational changes and infrastructure works designed to improve the efficiency of the Menindee Lakes system. The enhanced Menindee project introduces some new works and measures to incorporate a wider range of infrastructure, operations, regulatory and adjustment options which in combination will deliver greater water efficiency savings. The proponent acknowledges the need for consultation with communities and the need to set out transparent governance arrangements. |
| 9. South East Flows Restoration Project | South Australia | The project will use a combination of newly constructed drains and widened existing drains within the Upper South East drainage system to divert additional water that currently flows to the sea from the Blackford Drain in the Upper South East into the Coorong South Lagoon. The diverted water will provide significant environmental outcomes for en route wetlands of the Upper South East through the provision of additional water of suitable quality, as well as salinity improvements in the Coorong South Lagoon. |
| 10. Flows for the Future | South Australia | The project proposes activities that reduce the interception of low flows and result in additional flows to riverine environments in the Eastern Mount Lofty Ranges (EMLR) and to the Murray River including the Coorong, Lower Lakes and Murray Mouth in South Australia. The project will help restore the natural low flow patterns within the EMLR through measures that will improve the passage of low flows and freshes to improve ecological habitat conditions. |
| 11. SDL offsets in the Lower Murray NSW | New South Wales | The project aims to improve environmental water delivery and achieve better environmental and operational outcomes than achieved under the SDL benchmark model. This is to be done through the manipulation of weir pools, construction of a replacement pump station for Lake Cullulleraine (in Victoria), and works in the Carrs, Capitts and Bunberoo Creek systems to provide evaporative and seepage water savings. Weir pools can create unnatural inundation of connected wetlands when the river is held artificially high. Lowering the weir pool can be used to return wetlands to a more natural wetting/drying regime, while raising it can allow water to reach areas that would be difficult to water under most conditions. The strategy of raising and lowering the weirs should provide an environmental benefit compared to an artificially constant weir pool level. |
| **System enhancements (i.e. Constraints measures)** | **Proponent state(s)** | **Project description** |
| 12. Hume to Yarrawonga key focus area | Victoria / New South Wales | 40,000 megalitres per day from Hume Dam). Investigations will include the potential effects of higher flows on third parties and mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects. |
| 13. Yarrawonga to Wakool junction key focus area | New South Wales | Investigation of opportunities to address physical and policy constraints to enable the delivery of higher flows (up to 30,000 megalitres per day downstream of Yarrawonga Weir, with a buffer for flows up to 50,000 megalitres per day). New South Wales will consult communities on mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects. |
| 14. South Australian Murray key focus area | South Australia | Investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows up to 80,000 megalitres per day at the South Australian border. Higher flows are important for maintaining longitudinal connectivity from the border to the Coorong, Lower Lakes and Murray Mouth and promoting lateral connectivity to deliver water to the wetlands, floodplains, creeks and anabranches connected to the main river channel. Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects. |
| 15. New Goulburn key focus area* | Victoria | Investigation of opportunities to address in-channel constraints to the delivery of higher regulated flows up to 25,000 megalitres per day at Shepparton. Allowing the delivery of flows to the top of the bank would improve river health outcomes. This work will be done in a staged and bottom-up way with communities to understand the risks, impacts and costs, and develop feasible, practical and acceptable solutions to mitigate third party impacts. Building on this work, in close consultation with landholders and communities, further improvements to environmental water delivery will also be investigated. Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects. |

| | | |
|---|---|---|
| 16. Lower Darling key focus area | New South Wales | As part of the 'Structural and operational changes at Menindee Lakes' project, investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows (up to 14,000 megalitres per day at Weir 32). Investigations will include the potential effects of higher flows on third parties and mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects. |
| 17. Murrumbidgee key focus area | New South Wales | Investigation of opportunities to address physical and policy constraints to the delivery of higher regulated flows (up to 40,000 megalitres per day at Wagga Wagga). Investigations will include the potential effects of higher flows on third parties and mitigation options to address unacceptable impacts (including easements and/or infrastructure) to allow the delivery of these flows (to support improved river and wetland health outcomes). Landholder acceptance of potential works will be critical. This project must be considered in relation to the other southern connected Basin constraints projects. |
| **Engineering works** | **Proponent state(s)** | **Project description** |
| 18. Lindsay Island (Stage 2) Floodplain Management Project | Victoria | The Lindsay Island Floodplain Project will inundate 5,152 hectares of the floodplain and connect many parts of the floodplain through tiered watering events, including areas of unique fast-flowing aquatic habitat, through to sections of black box, lignum and onto the higher alluvial terraces. The proposed works will be operated in tandem with the recently completed TLM works at this site (Lindsay State 1) and Lock 7 to mimic flows of 40,000 megalitres per day to 120,000 megalitres per day. |
| 19. Wallpolla Island Floodplain Management Project | Victoria | Wallpolla Island is part of TLM's Lindsay-Wallpolla Islands Icon Site. The proposed works will complement existing TLM works at this icon site. This project will increase the frequency and duration of floodplain inundation across 2,650 hectares, providing significant benefit to nationally important species, threatened vegetation communities, ecological values, carbon cycling and downstream water quality. This will benefit both Wallpolla Island and the broader Lower Murray region. The proposed works include four major regulators, 22 smaller containment regulators and 4.5 kilometres of levees (raised tracks). The works have been designed to complement weir pool manipulation activities (Locks 8 and 9) and connect areas of flowing aquatic habitat with sections of black box, lignum and higher alluvial terraces. This will enable watering at a landscape scale, mimicking flows of 30,000 megalitres per day to 120,000 megalitres per day. |
| 20. Belsar-Yungera Floodplain Management Project | Victoria | This proposed supply measure will maintain and improve flora and fauna habitat values and provide periodic breeding opportunities for wetland species, such as fish, frogs and waterbirds. Managed flows will be able to be delivered to 2,370 hectares of highly valued floodplain, representing one third of the total area. The works can be operated flexibly to meet the water requirements of different vegetation communities, mimicking a broad range of River Murray flows up to 170,000 megalitres per day. Through the construction of three large regulators, a series of smaller supporting regulators, track raising (levees) and a pipeline (to allow use of temporary pumps), this project will connect extensive areas of floodplain through tiered watering events. These works will make use of natural flow paths to increase the extent, frequency and duration of inundation from either Basin Plan flows or pumping during low flow events. |
| 21. Guttrum and Benwell State Forests Floodplain Environmental Works Project | Victoria | The project will reinstate a more natural flooding regime for the Guttrum and Benwell Forests, addressing, in particular, the reduced frequency and duration of floods. The proposed works will water 1,200 hectares via pump stations, including semi-permanent wetlands and 82% of the river red gum forest with flood dependent understorey. The works will include two separate pump stations to deliver environmental water into Guttrum Forest, one pump station in Benwell Forest and containment works (regulators and levees) in both forests to contain water on the floodplain. The works have been designed to meet the environmental watering requirements of the ecological values by mimicking a 26,000 megalitres per day flood event in the River Murray for Guttrum Forest and a 24,000 megalitres per day flood event for Benwell Forest. |
| 22. Hattah Lakes North Floodplain Management Project | Victoria | This project will complement TLM works at the Hattah Lakes Icon Site by enhancing flooding across higher floodplain terraces. The project will also increase the flexibility for environmental water management across the lakes. The proposed works will water an additional 1,130 hectares of floodplain through the construction of two new regulators, a causeway across an existing track and 1.7 kilometres of levees along track alignments. |
| 23. Gunbower National Park Floodplain Management Project | Victoria | The project has been developed to enable the delivery of environmental water to the wetlands and forest of the Gunbower National Park. It will mimic a natural flood event of up to 50,000 megalitres per day across 500 hectares. This includes almost half of the permanent and temporary wetlands in the project area and 20% (250 hectares) of river red gum with flood dependent understorey. The package of works include regulator and creek enhancement works. The mid forest works will consist of a 100 megalitres per day pump station location on the Murray River and a number of regulators. This will enable the provision of water to approximately 500 hectares of Gunbower National Park, currently unable to be watered by any other infrastructure. |
| 24. Burra Creek Floodplain Management Proposal | Victoria | The proposed works will enable inundation of an area of 407 hectares. This represents 33% of the total forest area and almost all of the flood dependent communities found within the forest, and provides a greater extent of watering than is possible under Basin Plan flows. The works involve the construction of three large regulators, raising tracks to form levees, and the removal of barriers to flow on the floodplain. |
| 25. Nyah Floodplain Management Project | Victoria | The proposed works will water almost 500 hectares of floodplain within Nyah Forest, replicating River Murray flows of up to 25,000 megalitres per day. The works will influence over 53% of the total forest area and almost all of the flood dependent communities. The works consist of four regulators, three on the downstream end of Parnee Malloo Creek and one on the upstream end. Additional works to contain water within the forest include 1.7 kilometres of low level track raising, forming a levee at the downstream end of the forest. |
| 26. Vinifera Floodplain Management Project | Victoria | The Vinifera Floodplain project will water up to 350 hectares of floodplain within Vinifera Forest. This represents 55% of the total forest area (638 hectares) and almost all of the flood dependent communities. The proposed works involve construction of four regulators and 1.1 kilometres of low level track raising to enable control of both flood and pumped flows into and out of Vinifera Creek. Water will be delivered to the site through a combination of natural inflows or temporary pumping when river flows are insufficient. |
| 27. Gunbower Forest TLM Project | Victoria / New South Wales / South Australia | A suite of engineering works have been built through TLM to deliver environmental water to the Gunbower Forest Icon Site, watering up to 4,800 hectares. These works and associated operating regime have been designed to achieve the ecological objectives that have been set for the forest. The works include two main components:<br>• Lower Landscape Works — target the forest wetlands and use relatively small volumes of water. Works included refurbishing existing regulators within the forest, constructing new regulators and decommissioning of a single regulator. These regulators deliver water from either Gunbower Creek or the River Murray (when flows exceed 14,000 megalitres per day).<br>• Hipwell Road Channel — targets large areas of river red gums and can create the conditions required for large colonial waterbird breeding events. Works include construction of a channel to deliver water from Gunbower Creek to the forest, a new weir in Gunbower Creek and associated works. |
| 28. TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal | New South Wales / Victoria / South Australia | Koondrook-Perricoota Forest is a highly significant floodplain ecosystem on the Murray River in New South Wales. The Koondrook– Perricoota Forest is a large mosaic of river red gum, black box and grey box communities, interspersed by wetland ecosystems in New South Wales. Covering 32,000 hectares the state forest (Crown land) is managed by Forests NSW and is listed on the Register of the National Estate. The structures have been built and partially commissioned by NSW Water and MDBA River Murray Operations. |
| 29. Mulcra Island Environmental Flows TLM Project | Victoria / New South Wales / South Australia | Mulcra Island is part of the Lindsay-Wallpolla Islands Icon Site. The works have been funded through TLM and will assist in achieving the ecological objectives that have been set for the icon site by increasing the frequency, duration and extent of wetland and floodplain inundation, improving fish access to the creek and introducing flows to the upper Potterwalkagee Creek. The works enable watering of 820 hectares included the construction of seven environmental regulators and associated works, including sill lowering, stream rehabilitation and upgrading access tracks. |
| 30. Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project | Victoria / New South Wales / South Australia | Lindsay Island is part of the Lindsay-Wallpolla Icon Site. The Stage 1 works were funded by TLM and aimed to maintain existing high quality habitat for native fish, increase the extent of flowing habitat on Lindsay Island by about 28 kilometres, improve fish passage between the Lindsay Island anabranches and the River Murray and improve the condition of riparian vegetation. These works will contribute to achieving the ecological objectives that have been set for the site, focusing on in-stream habitat. The works include three new regulators: • Upper Lindsay River regulators (north and south inlets) • Mullaroo Creek regulator and fishway. |

| | | |
|---|---|---|
| 31. Hattah Lakes Environmental Flows TLM Project | Victoria / New South Wales / South Australia | The project aims to deliver a watering regime that will achieve the ecological objectives for the Hattah Lakes Living Murray Icon Site. The on-ground works have been designed to increase the frequency, duration and extent of flooding across the lakes and surrounding floodplain. The package of works enables watering of 6,000 hectares and includes:<br>• A new pumping station at Messenger's Crossing<br>• Sill lowering in Chalka Creek South<br>• Four new regulators (Messenger's, Oatey's, Cantala, Kramen) and associated works<br>• Refurbishment of an existing regulator (Little Hattah)<br>• Three new stop banks or levees. |
| 32. Chowilla Floodplain TLM Project | South Australia / New South Wales/ Victoria | The Chowilla Floodplain works is part of a program of The Living Murray (TLM) works at icon sites along the River Murray to ensure that environmental water recovered as part of TLM is used efficiently and ecological elements are maintained. The Chowilla Floodplain project involves a major environmental regulator on the Chowilla Creek and a range of complementary works. The environmental regulator will allow flows to be managed to enable flooding across the floodplain under relatively low river flow conditions. |
| 33. Improved Flow Management Works at the Murrumbidgee River – Yanco Creek Offtake | New South Wales | This proposal aims to return the Yanco Creek system closer to a pre-development wetting/drying regime, while improving infrastructure that supplies irrigation and stock and domestic water. Upgrades to Yanco Weir on the Murrumbidgee River would result in more control over flows through the proposed Yanco Creek regulator. This may provide the Commonwealth Environmental Water Holder and the Office of Environment and Heritage with more flexibility in managing flows within the Murrumbidgee River system. |
| 34. Modernising Supply Systems for Effluent Creeks – Murrumbidgee River | New South Wales | This proposal involves returning parts of three creek systems closer to a pre-development wetting/drying regime, while improving infrastructure that supplies irrigation and stock and domestic water. This project may provide the Commonwealth Environmental Water Holder and the Office of Environment and Heritage with more flexibility in managing flows within the Murrumbidgee River system. |
| 35. Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure | New South Wales | The proposal is for a suite of works across the national park estate in the Murray and Murrumbidgee valley. It aims to deliver more targeted environmental watering than achieved under benchmark conditions of development and benefit public land areas exceeding 70,000 hectares. Benefits identified include improved native fish outcomes and a reduction in the frequency and level of flooding on private land holdings and blackwater events. |
| 36. Nimmie Caira Infrastructure Modifications Proposal | New South Wales | Reconfigure water delivery infrastructure to more effectively deliver environmental flows to the Nimmie-Caira floodplain and other parts of the Lowbidgee. This project, along with the Murray and Murrumbidgee Valley National Parks SDL adjustment supply measure, has the potential to supply significant additional environmental benefit to the area. |
| 37. Riverine Recovery Project | South Australia | This project aims to return a number of wetlands to a more natural wetting/drying regime which results in evaporative savings. These savings are assigned to the Commonwealth Government as a South Australian Class 9 water access entitlement. This entitlement can be used for environmental purposes either within or upstream of the South Australian/Victorian border. |
| 38. South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP) | South Australia | The project aims to create an integrated and resilient floodplain along the South Australian River Murray, between the border and Lock 1, through a package of works and measures that enable floodplain inundation and freshening of groundwater lenses with particular focus on the Pike and Katarapko floodplains. Environmental works on the Pike and Katarapko floodplains will optimise the frequency, duration and extent of inundation events to protect and restore these floodplain ecosystems and contribute to Basin Plan environmental outcomes. Salinity management measures will complement the floodplain inundation works to manage ecological risk, enhance ecological condition by maximising the area of soil salinity that is within the tolerances of target vegetation and to manage any long term and real time in-stream salinity risk. |

## Appendix C. Assessment of proposed supply measure projects against conditions of approval

*Table 11. Assessment of SDL adjustment projects against conditions necessary for delivering Basin Plan (Key Y = Project satisfies condition N = Project does not satisfy condition MIA = Information not available NA = Condition not applicable)*

| | Project | Condition of Approval | | | | | | | | | | | | Results by project | | | Overall Status | Estimated contribution (GL) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | Y | | MIA | | N | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Y+NA | MIA | N & N* | | Min | Max | Min | Max | Min | Max |
| Operational rule changes | 1. 2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions | NA | NA | Y | NA | MIA | MIA | NA | Y | MIA | MIA | NA | NA | 8 | 4 | 0 | MIA | | | 30 | 60 | | |
| | 2. Barmah-Millewa Forest Environmental Water Allocation | NA | NA | Y | NA | N | MIA | NA | N | Y | MIA | NA | NA | 8 | 2 | 2 | N | | | | | 40 | 40 |
| | 3. Computer Aided River Management (CARM) Murrumbidgee | NA | NA | Y | NA | MIA | MIA | NA | Y | NA | MIA | NA | NA | 9 | 3 | 0 | MIA | | | 10 | 20 | | |
| | 4. Enhanced environmental water delivery (Hydro Cues) | NA | NA | Y | NA | MIA | MIA | NA | N* | MIA | MIA | NA | NA | 7 | 4 | 1 | N | | | | | NA | NA |
| | 5. Flexible Rates of Fall in River Levels Downstream of Hume Dam | NA | NA | Y | NA | MIA | MIA | NA | Y | Y | MIA | NA | NA | 9 | 3 | 0 | MIA | | | 0 | 30 | | |
| | 6. Hume Dam airspace management and pre-release rules | NA | NA | Y | NA | MIA | MIA | NA | MIA | MIA | MIA | NA | NA | 7 | 5 | 0 | MIA | | | 70 | 70 | | |
| | 7. Improved Regulation of the River Murray | NA | NA | Y | NA | MIA | MIA | NA | N* | Y | MIA | NA | NA | 8 | 3 | 1 | N | | | | | 30 | 100 |
| | 8. Structural and operational changes at Menindee Lakes | N* | Y | Y | NA | MIA | MIA | MIA | N* | MIA | MIA | NA | NA | 5 | 5 | 2 | N | | | | | 50 | 80 |
| | 9. South East Flows Restoration Project | NA | NA | Y | NA | Y | MIA | NA | Y | Y | MIA | NA | NA | 10 | 2 | 0 | MIA | | | NA | NA | | |
| | 10. Flows for the Future | NA | NA | Y | NA | MIA | MIA | NA | Y | Y | MIA | NA | NA | 9 | 3 | 0 | MIA | | | NA | NA | | |
| | 11. SDL offsets in the Lower Murray NSW | MIA | MIA | MIA | NA | MIA | MIA | MIA | N | MIA | MIA | NA | NA | 3 | 8 | 1 | N | | | | | 5 | 10 |
| System enhancements (Constraints) | 12. Hume to Yarrawonga key focus area | NA | NA | Y | NA | Y | MIA | Y | NA | MIA | MIA | Y | NA | 9 | 3 | 0 | MIA | | | NA | NA | | |
| | 13. Yarrawonga to Wakool junction key focus area | MIA | MIA | MIA | NA | Y | MIA | MIA | MIA | MIA | MIA | N | NA | 3 | 8 | 1 | N | | | | | 0 | 0 |
| | 14. South Australian Murray key focus area | Y | Y | Y | NA | Y | Y | Y | Y | Y | Y | Y | NA | 12 | 0 | 0 | Y | 0 | 0 | | | | |
| | 15. New Goulburn key focus area* | MIA | MIA | MIA | NA | Y | MIA | MIA | MIA | MIA | MIA | N | NA | 3 | 8 | 1 | N | | | | | 0 | 0 |
| | 16. Lower Darling key focus area | MIA | MIA | MIA | NA | Y | MIA | MIA | MIA | MIA | MIA | Y | NA | 4 | 8 | 0 | MIA | | | NA | NA | | |
| | 17. Murrumbidgee key focus area | MIA | MIA | MIA | NA | Y | MIA | MIA | MIA | MIA | MIA | MIA | NA | 3 | 9 | 0 | MIA | | | 10 | 20 | | |
| Engineering works | 18. Lindsay Island (Stage 2) Floodplain Management Project | N | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 8 | 0 | 4 | N | | | | | | |
| | 19. Wallpolla Island Floodplain Management Project | N | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 8 | 0 | 4 | N | | | | | | |
| | 20. Belsar-Yungera Floodplain Management Project | N | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 8 | 0 | 4 | N | | | | | | |
| | 21. Guttrum and Benwell State Forests Floodplain Environmental Works Project | Y | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 9 | 0 | 3 | N | | | | | 40 | 50 |
| | 22. Hattah Lakes North Floodplain Management Project | Y | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 9 | 0 | 3 | N | | | | | | |
| | 23. Gunbower National Park Floodplain Management Project | Y | Y | Y | NA | MIA | N | Y | NA | N | Y | NA | NA | 9 | 1 | 2 | N | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 24. Burra Creek Floodplain Management Proposal | Y | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 9 | 0 | 3 | N | | | | | | | |
| | 25. Nyah Floodplain Management Project | Y | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 9 | 0 | 3 | N | | | | | | | |
| | 26. Vinifera Floodplain Management Project | Y | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 9 | 0 | 3 | N | | | | | | | |
| | 27. Gunbower Forest TLM Project | Y | Y | Y | NA | N | N | Y | Y | Y | Y | NA | NA | 10 | 0 | 2 | N | | | | | | | |
| | 28. TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal | Y | Y | Y | NA | N | N | Y | Y | Y | Y | NA | NA | 10 | 0 | 2 | N | | | | | | | |
| | 29. Mulcra Island Environmental Flows TLM Project | Y | Y | Y | NA | N | N | Y | Y | Y | Y | NA | NA | 10 | 0 | 2 | N | | | | | | | |
| | 30. Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project | Y | Y | Y | NA | N | N | Y | Y | Y | Y | NA | NA | 10 | 0 | 2 | N | | | | | 136 | 136 | |
| | 31. Hattah Lakes Environmental Flows TLM Project | Y | Y | Y | NA | N | N | Y | Y | Y | Y | NA | NA | 10 | 0 | 2 | N | | | | | | | |
| | 32. Chowilla Floodplain TLM Project | Y | Y | Y | NA | MIA | N | Y | Y | Y | Y | NA | NA | 10 | 1 | 1 | N | | | | | | | |
| | 33. Improved Flow Management Works at the Murrumbidgee River – Yanco Creek Offtake | MIA | MIA | MIA | NA | MIA | MIA | MIA | N* | MIA | MIA | NA | NA | 3 | 8 | 1 | N | | | | | 10 | 15 | |
| | 34. Modernising Supply Systems for Effluent Creeks – Murrumbidgee River | MIA | MIA | MIA | NA | MIA | MIA | MIA | Y | MIA | MIA | NA | NA | 4 | 8 | 0 | MIA | | | 5 | 10 | | | |
| | 35. Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure | MIA | MIA | MIA | NA | MIA | MIA | MIA | MIA | MIA | MIA | NA | NA | 3 | 9 | 0 | MIA | | | 5 | 10 | | | |
| | 36. Nimmie Caira Infrastructure Modifications Proposal | MIA | MIA | MIA | NA | MIA | MIA | MIA | MIA | MIA | MIA | NA | NA | 3 | 9 | 0 | MIA | | | 20 | 50 | | | |
| | 37. Riverine Recovery Project | Y | Y | Y | NA | N | Y | Y | Y | Y | Y | NA | NA | 11 | 0 | 1 | N | | | | | 5 | 5 | |
| | 38. South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP) | Y | Y | Y | NA | N | N | Y | NA | N | Y | NA | NA | 9 | 0 | 3 | N | | | | | NA | NA | |
| | **Y+NA** | 25 | 29 | 29 | 0 | 7 | 2 | 19 | 14 | 13 | 18 | 3 | 0 | 1 | 12 | 25 | **Total** | 0 | 0 | 150 | 270 | 316 | 436 | |
| | **Results by condition** **MIA** | 9 | 9 | 9 | 0 | 15 | 20 | 10 | 7 | 14 | 20 | 1 | 0 | | | | | | | | | | | |
| | **N & N*** | 4 | 0 | 0 | 0 | 16 | 16 | 0 | 6 | 10 | 0 | 2 | 0 | | | | | | | | | | | |

*Note: We assessed the Structural and operational changes at Menindee Lakes and the Lower Darling key focus area as separate projects, even though they were formally submitted as a single project by NSW.*

**Assumes entitlements are not issued.*

| **Condition of Approval** | |
|---|---|
| 1. Works-based projects must align with Basin Plan targets. | 7. Environmental water must be able to reach works projects and the broader floodplain in the future. |
| 2. All works-based projects must be assessed using a scientifically robust method. | 8. Real water savings must be guaranteed from rules-based projects. |
| 3. Any adjustment of the sustainable diversion limit must ensure that there is no change in flow indicators. | 9. Projects must deliver value for money. |
| 4. Sustainable diversion limit must not change by more than ±5% overall. | 10. Projects must be monitored to ensure outcomes are delivered. |
| 5. Environmental risks must be mitigated to acceptable levels. | 11. Projects are consistent with the Constraints Management Strategy. Constraint levels as at 2012 must be used as a benchmark to compare changes. |
| 6. Long-term governance arrangements must be secured. | 12. Pre-requisite policy measures proposed by states for managing environmental water must be configured in the model used to calculate an adjustment. |

*Table 12. Notes accompanying assessment of projects in Table 11.*

| Project | Notes for selected conditions |
|---|---|
| 1. 2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions | 5 - Need information on how accurate MDBA model assumptions are given issues with availability and access to flow.<br>8 - Water can now be called from storage as a result of this change.<br>9 - Unknown costs associated with the entitlement to be used by the environment. Who pays charges etc |
| 2. Barmah-Millewa Forest Environmental Water Allocation | 5 - Based on the information available, if there was previously a 4 month flood, there is a risk that a bird breeding event in December would not be supported. Need the capacity to support a bird breeding event if it happens.<br>8 - the proposal is not issuing an entitlement to the environment associated with the claimed saving to safeguard against the proposal not operating as intended or not operating in every year available. |
| 3. Computer Aided River Management (CARM) Murrumbidgee | 3 - We dont have enough information to assess whether the number/character of entitlements are sufficient to cater for the lost surplus flow, and ensure environmental outcomes are equivalent.<br>8 - Entitlements are being issued for savings, however we dont have enough information to assess whether the number/character of entitlements are sufficient to cater for the lost surplus flow. |
| 4. Enhanced environmental water delivery (Hydro Cues) | 8 - it doesnt appear that the proposal is issuing an entitlement to the environment associated with the claimed saving to safeguard against the proposal not operating as intended or not operating in every year available. Further, there is no guarantee the CEWO will operate in this fashion every year, yet for the purposes of the adjustment it may have been assumed so. If this is the case then the intended outcome may not be achieved. If this proposal significantly alters or replaces the environmental events in the Benchmark then it is not clear how it is consistent with the Basin Plan s6.06(3) clause. This clause protects against optimising the environmental demands in the model for the sake of an SDL adjustment. |
| 5. Flexible Rates of Fall in River Levels Downstream of Hume Dam | 5 - None known unless the more rapid reduction in releases from Hume causes bank slumping or other unforeseen detrimental environmental consequences.<br>8 - No entitlements issued but confident that savings will be realised if the rule is implemented and enshrined in documentation. |
| 6. Hume Dam airspace management and pre-release rules | 5, 6 - Details on how this proposal interacts with the Natural Cues project and the necessity for constraint relaxation was not available. It is possible that the changed pre-release strategy in this proposal could result in additional flooding risk downstream which has not been mitigated by an adequate operational flow constraint relaxation program downstream. |
| 7. Improved Regulation of the River Murray | 5, 8 - if the proposal is not issuing an entitlement to the environment associated with the claimed saving in surplus flow to safeguard against future changes in operations. This proposal seems to be optimising one aspect of the model based on recent observations which may change in the future. Additionally if the proposal has not been modelled by itself it is not possible to determine if the saving is sufficient to counter the negative impact on the environment from lost surplus flow events. This also appears to be an anticipated measure as it was represented in Benchmark model. |
| 8. Structural and operational changes at Menindee Lakes | 8 - Applies if the proposal is not issuing an entitlement to the environment associated with the claimed evaporation saving. Condition 1 also applies if the proposal does not meet the environmental watering requirements of Lake Cawndilla. The proponent must guarantee the environmental values at Lake Cawndilla as part of the calculated evaporation saving. |
| 9. South East Flows Restoration Project | 5 - Water quality risks were assessed by the proponent however a risk assessment on the ecosystem was not available.<br>9 - This proposal was previously funded and only affects the CLLMM. |
| 10. Flows for the Future | 9 - This proposal was previously funded and only affects the CLLMM |
| 11. SDL offsets in the Lower Murray NSW | 8 - this proposal is claiming a loss saving through modelled operation, so an entitlement should be issued associated with the claimed saving |
| 12. Hume to Yarrawonga key focus area | 11 - Project consistent with the CMS and the Hydrologic modelling of the relaxation of operational constraints in the southern connected system. |
| 13. Yarrawonga to Wakool junction key focus area | 8 - 50,000 ML/d has been modelled for estimating the SDL adjustment when the target is 30,000 ML/d<br>8 - the proposal is not issuing an entitlement to the environment associated with the claimed saving to safeguard against the proposal not operating as intended or not operating in every year available.<br>11 - 30,000 ML/d does not allow flows greater than were able to be delivered prior to the Basin Plan and in the Benchmark model. |
| 14. South Australian Murray key focus area | 11 - Project is consistent with the Constraints Management Strategy however the 80,000 ML/d flow target at the South Australian border cannot be met with the current upstream constraint proposals |
| 15. New Goulburn key focus area* | 11 - 20,000 ML/d at Shepparton is not consistent with the Constraint Management Strategy or the Hydrologic modelling of the relaxation of operational constraints in the southern connected system. This may not allow flows greater than were able to be delivered prior to the Basin Plan and in the Benchmark (see Basin Plan S7.12(3)(b)) |
| 16. Lower Darling key focus area | 11 - Project is consistent with the aim of achieving 80,000 ML/d into South Australia, the CMS and the Hydrologic modelling of the relaxation of operational constraints in the southern connected system |
| 17. Murrumbidgee key focus area | 11 - Uncertainty as to whether 40,000 ML/d at Wagga represents an increase from 30,000 ML/d at Gundagai in the Benchmark or if this is sufficient to water the Mid-Murrumbidgee wetlands. If there is very little difference then condition 11 is met. |
| 18. Lindsay Island (Stage 2) Floodplain Management Project | 1 - Uncertainty about why areas of floodplain (described as higher alluvial terraces) associated with flows of 120,000 ML/d are being targeted when these flows would only have occurred less than 1 in 10 years even under natural conditions.<br>5 -risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for. Projects should not be assumed to be operated every year, we recommend works are used as a last resort |
| 19. Wallpolla Island Floodplain Management Project | 1 - Uncertainty about why areas of floodplain (described as higher alluvial terraces) associated with flows of 120,000 ML/d are being targeted when these flows would only have occurred less than 1 in 10 years even under natural conditions.<br>5 -risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for |
| 20. Belsar-Yungera Floodplain Management Project | 1 - Uncertainty about why areas of floodplain (described as higher alluvial terraces) associated with flows of 170,000 ML/d are being targeted when these flows would only of occurred less than 1 in 10 years even under natural conditions. |

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| 21. Guttrum and Benwell State Forests Floodplain Environmental Works Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for |
| 22. Hattah Lakes North Floodplain Management Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for |
| 23. Gunbower National Park Floodplain Management Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for |
| 24. Burra Creek Floodplain Management Proposal | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for |
| 25. Nyah Floodplain Management Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for |
| 26. Vinifera Floodplain Management Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for |
| 27. Gunbower Forest TLM Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for<br>7 - Should operate naturally (e.g. all regulators open) except during periods of stress |
| 28. TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for<br>7 - Should operate naturally (e.g. all regulators open) except during periods of stress |
| 29. Mulcra Island Environmental Flows TLM Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for<br>7 - Should operate naturally (e.g. all regulators open) except during periods of stress |
| 30. Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for<br>7 - Should operate naturally (e.g. all regulators open) except during periods of stress |
| 31. Hattah Lakes Environmental Flows TLM Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for<br>7 - Should operate naturally (e.g. all regulators open) except during periods of stress |
| 32. Chowilla Floodplain TLM Project | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for<br>7 - Should operate naturally (e.g. all regulators open) except during periods of stress |
| 33. Improved Flow Management Works at the Murrumbidgee River – Yanco Creek Offtake | Insufficient information available but<br>5 - Risks of environmental works proposals are not part of the environmental equivalence test<br>8 – Condition not met if the proposal is not issuing an entitlement to the environment associated with the claimed evaporation saving. |
| 34. Modernising Supply Systems for Effluent Creeks – Murrumbidgee River | Insufficient information available but<br>8 – Condition not met if the proposal is not issuing an entitlement to the environment associated with the claimed evaporation saving. |
| 35. Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure | Insufficient information available |
| 36. Nimmie Caira Infrastructure Modifications Proposal | Insufficient information available |
| 37. Riverine Recovery Project | 8 - Entitlement must represent new water added to system |
| 38. South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP) | 5 - Risks of environmental works proposals are not part of the environmental equivalence test and many risks are not sufficiently managed for. |

# Appendix D. Assessment of environmental risks documented in business cases for Victorian and South Australian proposals

Green = Low/moderate risk after mitigation

Orange = Moderate/high risk after mitigation

White = Information not available

**Belsar Yungera**

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Adverse salinity impacts or water quality outcomes as a result of watering actions; particularly hypoxic blackwater events<br><br>-Rise in river salinity from salt migration from floodplain soils as a result of works is considered a high risk without mitigation and a moderate risk with mitigation. Involves additional groundwater monitoring bores | Likely | High | -Involves planning, operations and managing consequences phases<br><br>-Firstly, a consideration of seasonal conditions and monitoring of antecedent floodplain conditions are taken into account before watering events<br><br>-Secondly, during a watering event through-flows will be maintained where possible, DO and water temperature will be monitored to identify hypoxic areas and watering will commence as early as possible to move organic matter from the floodplain<br><br>-Finally, if blackwater events do occur this will be managed by delaying outflows if river flows are low or | Moderate |

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| | | | otherwise managing outflows and river flows to dilute low DO water, disposing of hypoxic water by pumping to higher wetlands and agitating water using infrastructure to increase aeration | |
| Increase in pest species | Certain | Very High | -Tailor watering regimes to provide competitive advantage for native fish over carp<br><br>-Dry out wetlands that contain large numbers of carp<br><br>-Use time water manipulations to drown non-native seedlings, minimise growth, germination and seed set and to promote native species<br><br>-Control current populations of pest plants and animals via existing management strategies and support partner agencies to seek further funding for targeted weed control programs if necessary | Moderate/Low (moderate risk of an increase of carp and pest animals and low risk of proliferation of pest plants) |
| The potential to favour certain species to the detriment of others or to adversely affect certain species<br><br>-Through the destruction of habitat or habitat disturbance or invasion of | Certain | Moderate to Very High | -Utilise existing access tracks, ensure clear on-site delineation of construction zones, ensure adequate supervision during works and design and locate infrastructure to minimise the extent of clearing wherever possible to minimise construction impacts on habitat<br><br>-Remediate site on completion of construction activities | Low to moderate |

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| river red gum in open wetlands/watercourses | | | | |
| Adverse impacts on ecological function and connectivity<br><br>-Prolonged inundation of vegetation, increase in fire frequency/intensity, flow regimes do not match requirements for key species, stranding of fish on floodplains, barriers to fish and other aquatic fauna movement | Possible | Moderate | -No mitigation actions identified for fire management<br><br>-Assess the response of certain species of concern to watering events and adjust operations if required<br><br>-Target different taxa at different times<br><br>-Ensure through-flows replicate a more natural hydraulic gradient<br><br>-Design structures for maximum operational flexibility<br><br>-Develop a 'fish exit strategy' to ensure a fish passage is maintained for as long as possible for fish to move off the floodplain during the drawdown stage | Low |

***Burra Creek (same as Belsar Yungera)***

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Adverse salinity impacts or water quality outcomes as a result of watering actions; particularly hypoxic blackwater events | Likely | High | -Involves planning, operations and managing consequences phases<br><br>-Firstly, a consideration of seasonal conditions and monitoring of antecedent floodplain conditions are taken into account before watering events | Moderate |

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| | | | -Secondly, during a watering event through-flows will be maintained where possible, DO and water temperature will be monitored to identify hypoxic areas and watering will commence as early as possible to move organic matter from the floodplain<br><br>-Finally, if blackwater events do occur this will be managed by delaying outflows if river flows are low or otherwise managing outflows and river flows to dilute low DO water, disposing of hypoxic water by pumping to higher wetlands and agitating water using infrastructure to increase aeration | |
| Increase in pest species | Certain | Very High | -Tailor watering regimes to provide competitive advantage for native fish over carp<br><br>-Dry out wetlands that contain large numbers of carp<br><br>-Use time water manipulations to drown non-native seedlings, minimise growth, germination and seed set and to promote native species<br><br>-Control current populations of pest plants and animals via existing management strategies and support partner agencies to seek further funding for targeted weed control programs if necessary | Moderate/Low (moderate risk of an increase of carp and pest animals and low risk of proliferation of pest plants) |
| | Certain | | | Low to moderate |

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| The potential to favour certain species to the detriment of others or to adversely affect certain species<br><br>-Through the destruction of habitat or habitat disturbance or invasion of river red gum in open wetlands/watercourses | | Moderate to Very High | -Utilise existing access tracks, ensure clear on-site delineation of construction zones, ensure adequate supervision during works and design and locate infrastructure to minimise the extent of clearing wherever possible to minimise construction impacts on habitat<br><br>-Remediate site on completion of construction activities | |
| Adverse impacts on ecological function and connectivity<br><br>-Prolonged inundation of vegetation, increase in fire frequency/intensity, flow regimes do not match requirements for key species, stranding of fish on floodplains, barriers to fish and other aquatic fauna movement | Possible | Moderate | -No mitigation actions identified for fire management<br><br>-Assess the response of certain species of concern to watering events and adjust operations if required<br><br>-Target different taxa at different times<br><br>-Ensure through-flows replicate a more natural hydraulic gradient<br><br>-Design structures for maximum operational flexibility<br><br>-Develop a 'fish exit strategy' to ensure a fish passage is maintained for as long as possible for fish to move off the floodplain during the drawdown stage | Low |

***Gunbower***

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Abundance of pest fish species | Almost certain | Very high | -Watering regime will provide temporary inundation of areas which will be dried out and targeted flows rather than a single large flow means pest fish cannot disperse from the forest into Gunbower Creek or the River Murray downstream and will be retained in the temporary wetlands as food for wetland birds<br><br>-Proposed screening of adult pest fish for forest inlets<br><br>-Carp screen on the inlet regulator to Black Charlie Lagoon/Baggots Creek area<br><br>-Young carp are still able to enter the system and grow to adult size<br><br>-Residual risk after the addition of a carp screen on one inlet regulator is still high as other crossings have fish passages which would be blocked by a screen | High |
| Adverse impacts on water quality and salinity downstream | High | Low | -Salinity impact at Morgan under the operating scenarios was estimated at <0.01 µS/cm EC) (negligible)<br><br>-Potential of blackwater events due to floodplain watering scenario but the risk of causing ecological impacts is considered low<br><br>-No formal understanding of any potential cumulative impacts | Not stated |

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| | | | -No mention of mitigation strategies to avoid or manage blackwater events | |
| Impaired river connectivity | None | - | -Project does not alter the existing connectivity between the River Murray and Gunbower National Park<br><br>-All through-flows and return flows to the River Murray are retained at their current rates/levels<br><br>-Important to note that delivery of environmental water to the central forest floodplain will be from Old Cohuna Main Channel rather than the River Murray (this option was investigated under TLM) which means it will not provide connectivity with the River Murray<br><br>-This connectivity will occur through natural and hybrid events (where environmental water tops up natural inflows) | N/A |

***Guttrum and Benwell***

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Abundance of pest fish species | Almost certain | Very high | -Due to semi-permanence of wetlands the risks of carp are temporary and short-lived as the floodplains will dry<br><br>-Screening of adult pest fish for forest inlets | High |

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| | | | -Carp screens with rotating screens (self-cleaning) will be considered for installation to minimise operational maintenance requirements<br>-Main mitigation measure will be control of water releases and consideration of drying/wetting patterns and pest fish species habitats | |
| Fish stranding | Likely | High | -Coarse screens at the inlets to prevent entry of large-bodied fish into forests<br><br>-Sequencing water to maximise cues and exit routes<br><br>-Recent evidence from Gunbower Forest suggests the above style of fish exist strategy is very successful with flow changes cueing native fish to leave the floodplain<br><br>-Routine monitoring | Low |
| Giant Rush colonisation | Possible | High | -Maintain strong seasonal profile to flooding regimes with peaks in spring and a recession over late spring and summer will reduce risk as giant rush invasion is influenced by seasonal conditions<br><br>-Monitoring and consideration of other plans/modifications to operating scheme | Moderate |
| River Red Gum encroachment | Unlikely | High | -Can reduce diversity and is influenced by damp soils and warm temperatures | Low |

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| | | | -Flooding regimes that include prolonged inundation, high temperatures over summer and frost during the winter provide the best conditions for preventing encroachment<br><br>-Extending the drawdown period to late summer/early autumn in lie with natural drawdown periods will counteract encroachment<br><br>-Red Gum's could also be physically removed but this is labour intensive and a last resort | |
| Water quality/Blackwater/Salinity downstream<br><br>-High risk of blackwater events, however, these are unlikely to affect water quality in the Murray River due to small outflows and a full assessment of impacts on downstream water quality would be undertaken should the project be approved | Likely | High | -Estimated salinity impact expected to be negligible at Morgan<br><br>-Blackwater events would be localised and this would be managed through the operating and watering scheme<br><br>-Managing inflows/outflows and dilution from the River Murray<br><br>-Cumulative impacts and downstream impacts cannot be ascertained | Low |

***Hattah Lakes North (same as Belsar Yungera)***

Mitigation measures to be undertaken are detailed and have been effective in previous environmental infrastructure projects undertaken in the region under TLM scheme

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Salinity<br><br>-A preliminary salinity assessment has been completed which suggests groundwater levels are currently higher than historic levels and that successive watering events coupled with natural floods would not significantly increase salt loads | Likely | Moderate | -Avoid watering salinity hotspots identified through the use of AEM datasets, instream nanoTEM and other salinity investigations<br><br>-Monitor the salinity of ground and surface water salinity before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as dilution | Low |
| Adverse water quality outcomes as a result of watering actions; particularly hypoxic blackwater events | Likely | High | -Involves planning, operations and managing consequences phases<br><br>-Firstly, a consideration of seasonal conditions and monitoring of antecedent floodplain conditions are taken into account before watering events<br><br>-Secondly, during a watering event through-flows will be maintained where possible, DO and water temperature will be monitored to identify hypoxic | Moderate |

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| | | | areas and watering will commence as early as possible to move organic matter from the floodplain<br><br>-Finally, if blackwater events do occur this will be managed by delaying outflows if river flows are low or otherwise managing outflows and river flows to dilute low DO water, disposing of hypoxic water by pumping to higher wetlands and agitating water using infrastructure to increase aeration | |
| Increase in pest species | Certain | Very High | -Tailor watering regimes to provide competitive advantage for native fish over carp<br><br>-Dry out wetlands that contain large numbers of carp<br><br>-Use time water manipulations to drown seedlings, minimise growth, germination and seed set and to promote native species<br><br>-Control current populations of pest plants and animals via existing management strategies and support partner agencies to seek further funding for targeted weed control programs if necessary | Moderate/Low (moderate risk of an increase of carp and pest animals and low risk of proliferation of pest plants) |
| The potential to favour certain species to the detriment of others or to adversely affect certain species | Certain | Moderate to Very High | -Utilise existing access tracks, ensure clear on-site delineation of construction zones, ensure adequate supervision during works and design and locate infrastructure to minimise the extent of clearing | Low to moderate |

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| -Through the destruction of habitat or habitat disturbance or invasion of river red gum in open wetlands/watercourses | | | wherever possible to minimise construction impacts on habitat<br><br>-Remediate site on completion of construction activities | |
| Adverse impacts on ecological function and connectivity<br><br>-Prolonged inundation of vegetation, increase in fire frequency/intensity, flow regimes do not match requirements for key species, stranding of fish on floodplains, barriers to fish and other aquatic fauna movement | Possible | Moderate | -No mitigation actions identified for fire management<br><br>-Assess the response of certain species of concern to watering events and adjust operations if required<br><br>-Target different taxa at different times<br><br>-Ensure through-flows replicate a more natural hydraulic gradient<br><br>-Design structures for maximum operational flexibility<br><br>-Develop a 'fish exit strategy' to ensure a fish passage is maintained for as long as possible for fish to move off the floodplain during the drawdown stage | Low |
| Consideration of significant, threatened or listed species | N/A | N/A | -The project is expected to benefit these species by increasing the frequency, duration and extent of floods<br><br>-Construction will result in temporary and permanent vegetation removal and habitat disturbance<br><br>-Detailed ecological assessments will be carried out during the design process to inform construction activities | |

***Lindsay Island***

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Salinity | Likely | Moderate | -Avoid watering salinity hotspots identified through the use of AEM datasets, instream nanoTEM and other salinity investigations<br><br>-Monitor the salinity of ground and surface water salinity before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as dilution | Low |
| Adverse water quality outcomes as a result of watering actions; particularly hypoxic blackwater events | Likely | High | -Involves planning, operations and managing consequences phases<br><br>-Firstly, a consideration of seasonal conditions and monitoring of antecedent floodplain conditions are taken into account before watering events<br><br>-Secondly, during a watering event through-flows will be maintained where possible, DO and water temperature will be monitored to identify hypoxic areas and watering will commence as early as possible to move organic matter from the floodplain<br><br>-Finally, if blackwater events do occur this will be managed by delaying outflows if river flows are low or | Moderate |

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| | | | otherwise managing outflows and river flows to dilute low DO water, disposing of hypoxic water by pumping to higher wetlands and agitating water using infrastructure to increase aeration | |
| Increase in pest species | Certain | Very High | -Tailor watering regimes to provide competitive advantage for native fish over carp<br><br>-Dry out wetlands that contain large numbers of carp<br><br>-Use time water manipulations to drown seedlings, minimise growth, germination and seed set and to promote native species<br><br>-Control current populations of pest plants and animals via existing management strategies and support partner agencies to seek further funding for targeted weed control programs if necessary | Moderate/Low (moderate risk of an increase of carp and pest animals and low risk of proliferation of pest plants) |
| The potential to favour certain species to the detriment of others or to adversely affect certain species<br><br>-Through the destruction of habitat or habitat disturbance or invasion of | Certain | Moderate to Very High | -Utilise existing access tracks, ensure clear on-site delineation of construction zones, ensure adequate supervision during works and design and locate infrastructure to minimise the extent of clearing wherever possible to minimise construction impacts on habitat<br><br>-Remediate site on completion of construction activities | Low to moderate |

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| river red gum in open wetlands/watercourses | | | | |
| Adverse impacts on ecological function and connectivity<br><br>-Prolonged inundation of vegetation, increase in fire frequency/intensity, flow regimes do not match requirements for key species, stranding of fish on floodplains, barriers to fish and other aquatic fauna movement | Possible | Moderate | -No mitigation actions identified for fire management<br><br>-Assess the response of certain species of concern to watering events and adjust operations if required<br><br>-Target different taxa at different times<br><br>-Ensure through-flows replicate a more natural hydraulic gradient<br><br>-Design structures for maximum operational flexibility<br><br>-Incorporate fish passage requirements into regulator design which includes a vertical slot fishway at Berribee regulator and fish-friendly designs to allow passive passage at other regulators | Low |
| Episodic reduction in hydrodynamic diversity<br><br>-Installation of regulators within waterways will affect flows and create lentic ones in regulator pools when in operation which may reduce the extent and variety of aquatic habitat and change the structure and diversity of | Likely | High | -Design structures to minimise waterway obstruction<br><br>-Develop operational protocols to maintain hydraulic diversity<br><br>-Assess the response of species of concern during and after managed watering events and adjust operational arrangements if required | Moderate |

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| wetland floodplain communities<br><br>-In particular, regulator operation is likely to reduce or eliminate fast-flowing habitat that is particularly important to some fish species e.g. Murray cod | | | | |
| Prolonged inundation of vegetation within the Berribee Regulator pool<br><br>-May damage vegetation health and result in death of less tolerant species | Possible | Moderate | -Ensure through-flow when operating structures to more closely replicate a more natural hydraulic gradient<br><br>-Incorporate information on operations, potential impacts and tolerance of inundation regimes and the role of natural floods in ecosystem function into operational plans to minimise impact | Low |
| Consideration of significant, threatened or listed species | N/A | N/A | -The project is expected to benefit these species by increasing the frequency, duration and extent of floods<br><br>-Construction will result in temporary and permanent vegetation removal and habitat disturbance<br><br>-Detailed ecological assessments will be carried out during the design process to inform construction activities<br><br>-The Mullaroo Creek and Lindsay River are widely acknowledged for their significant native fish populations (particularly Murray Cod) which may be affected by operation | |

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| | | | -The design of minor regulators allow for passive fish passage and a vertical slot fishway that matches the specification of the fishway on the Mullaroo Creek Regulator (under construction through TLM) is proposed at the Berribee Regulator<br><br>-The hydraulic model mirrors the approach taken for the recently commissioned Chowilla Floodplain Living Murray works where fish ecologists have worked in conjunction with hydraulic modellers to develop appropriate operational scenarios | |

***Nyah Floodplain***

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Salinity | Likely | Moderate | -Avoid watering salinity hotspots identified through the use of AEM datasets, instream nanoTEM and other salinity investigations<br><br>-Monitor the salinity of ground and surface water salinity before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as dilution | Low |
| Adverse water quality outcomes as a result of | Likely | High | -Involves planning, operations and managing consequences phases | Moderate |

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| watering actions; particularly hypoxic blackwater events | | | -Firstly, a consideration of seasonal conditions and monitoring of antecedent floodplain conditions are taken into account before watering events<br><br>-Secondly, during a watering event through-flows will be maintained where possible, DO and water temperature will be monitored to identify hypoxic areas and watering will commence as early as possible to move organic matter from the floodplain<br><br>-Finally, if blackwater events do occur this will be managed by delaying outflows if river flows are low or otherwise managing outflows and river flows to dilute low DO water, disposing of hypoxic water by pumping to higher wetlands and agitating water using infrastructure to increase aeration<br><br>-Should water quality be affected, water can be disposed within the site (pump to higher wetlands) | |
| Increase in pest species | Certain | Very High | -Tailor watering regimes to provide competitive advantage for native fish over carp<br><br>-Dry out wetlands that contain large numbers of carp<br><br>-Use time water manipulations to drown seedlings, minimise growth, germination and seed set and to promote native species<br><br>-Control current populations of pest plants and animals via existing management strategies and support partner agencies to seek further funding for targeted weed control programs if necessary | Moderate/Low (moderate risk of an increase of carp and pest animals and low risk of proliferation of pest plants) |

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| The potential to favour certain species to the detriment of others or to adversely affect certain species<br><br>-Through the destruction of habitat or habitat disturbance or invasion of river red gum in open wetlands/watercourses | Certain | Moderate to Very High | -Utilise existing access tracks, ensure clear on-site delineation of construction zones, ensure adequate supervision during works and design and locate infrastructure to minimise the extent of clearing wherever possible to minimise construction impacts on habitat<br><br>-Remediate site on completion of construction activities | Low to moderate |
| Adverse impacts on ecological function and connectivity<br><br>-Prolonged inundation of vegetation, increase in fire frequency/intensity, flow regimes do not match requirements for key species, stranding of fish on floodplains, barriers to fish and other aquatic fauna movement | Possible | Moderate | -No mitigation actions identified for fire management<br><br>-Assess the response of certain species of concern to watering events and adjust operations if required<br><br>-Target different taxa at different times<br><br>-Ensure through-flows replicate a more natural hydraulic gradient<br><br>-Design structures for maximum operational flexibility<br><br>-Develop a 'fish exit strategy' to ensure a fish passage is maintained for as long as possible for fish to move off the floodplain during the drawdown stage | Low |

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| Consideration of significant, threatened or listed species | N/A | N/A | -The project is expected to benefit these species by increasing the frequency, duration and extent of floods<br><br>-Construction will result in temporary and permanent vegetation removal and habitat disturbance<br><br>-Detailed ecological assessments will be carried out during the design process to inform construction activities | |

***Vinifera Floodplain (same as Lindsay Island)***

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Salinity | Likely | Moderate | -Avoid watering salinity hotspots identified through the use of AEM datasets, instream nanoTEM and other salinity investigations<br><br>-Monitor the salinity of ground and surface water salinity before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as dilution | Low |
| Adverse water quality outcomes as a result of | Likely | High | -Involves planning, operations and managing consequences phases | Moderate |

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|---|---|---|---|---|
| watering actions; particularly hypoxic blackwater events | | | -Firstly, a consideration of seasonal conditions and monitoring of antecedent floodplain conditions are taken into account before watering events<br><br>-Secondly, during a watering event through-flows will be maintained where possible, DO and water temperature will be monitored to identify hypoxic areas and watering will commence as early as possible to move organic matter from the floodplain<br><br>-Finally, if blackwater events do occur this will be managed by delaying outflows if river flows are low or otherwise managing outflows and river flows to dilute low DO water, disposing of hypoxic water by pumping to higher wetlands and agitating water using infrastructure to increase aeration | |
| Increase in pest species | Certain | Very High | -Tailor watering regimes to provide competitive advantage for native fish over carp<br><br>-Dry out wetlands that contain large numbers of carp<br><br>-Use time water manipulations to drown seedlings, minimise growth, germination and seed set and to promote native species<br><br>-Control current populations of pest plants and animals via existing management strategies and support partner agencies to seek further funding for targeted weed control programs if necessary | Moderate/Low (moderate risk of an increase of carp and pest animals and low risk of proliferation of pest plants) |

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| The potential to favour certain species to the detriment of others or to adversely affect certain species<br><br>-Through the destruction of habitat or habitat disturbance or invasion of river red gum in open wetlands/watercourses | Certain | Moderate to Very High | -Utilise existing access tracks, ensure clear on-site delineation of construction zones, ensure adequate supervision during works and design and locate infrastructure to minimise the extent of clearing wherever possible to minimise construction impacts on habitat<br><br>-Remediate site on completion of construction activities | Low to moderate |
| Adverse impacts on ecological function and connectivity<br><br>-Prolonged inundation of vegetation, increase in fire frequency/intensity, flow regimes do not match requirements for key species, stranding of fish on floodplains, barriers to fish and other aquatic fauna movement | Possible | Moderate | -No mitigation actions identified for fire management<br><br>-Assess the response of certain species of concern to watering events and adjust operations if required<br><br>-Target different taxa at different times<br><br>-Ensure through-flows replicate a more natural hydraulic gradient<br><br>-Design structures for maximum operational flexibility<br><br>-Incorporate fish passage requirements into regulator design which includes a vertical slot fishway at Berribee regulator and fish-friendly designs to allow passive passage at other regulators | Low |

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| Episodic reduction in hydrodynamic diversity<br><br>-Installation of regulators within waterways will affect flows and create lentic ones in regulator pools when in operation which may reduce the extent and variety of aquatic habitat and change the structure and diversity of wetland floodplain communities<br><br>-In particular, regulator operation is likely to reduce or eliminate fast-flowing habitat that is particularly important to some fish species e.g. Murray cod | Likely | High | -Design structures to minimise waterway obstruction<br><br>-Develop operational protocols to maintain hydraulic diversity<br><br>-Assess the response of species of concern during and after managed watering events and adjust operational arrangements if required | Moderate |
| Consideration of significant, threatened or listed species | N/A | N/A | -The project is expected to benefit these species by increasing the frequency, duration and extent of floods<br><br>-Construction will result in temporary and permanent vegetation removal and habitat disturbance<br><br>-Detailed ecological assessments will be carried out during the design process to inform construction activities | |

***Wallpolla Island***

| *Risk* | *Likelihood* | *Risk without mitigation* | *Mitigation* | *Risk after mitigation* |
|---|---|---|---|---|
| Adverse salinity impacts including saline mounds<br><br>-High risk that increases in salinity may breach Basin Salinity Management Strategy requirements | Likely | Moderate | -Avoid watering salinity hotspots identified through the use of AEM datasets, instream nanoTEM and other salinity investigations<br><br>-Monitor the salinity of ground and surface water salinity before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as dilution<br><br>-5 new bore sites and upgrades and maintenance of existing water monitoring systems | Low |
| Adverse water quality outcomes as a result of watering actions; particularly hypoxic blackwater events | Likely | High | -Involves planning, operations and managing consequences phases<br><br>-Firstly, a consideration of seasonal conditions and monitoring of antecedent floodplain conditions are taken into account before watering events<br><br>-Secondly, during a watering event through-flows will be maintained where possible, DO and water temperature will be monitored to identify hypoxic areas and watering will commence as early as possible to move organic matter from the floodplain | Moderate |

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| | | | -Finally, if blackwater events do occur this will be managed by delaying outflows if river flows are low or otherwise managing outflows and river flows to dilute low DO water, disposing of hypoxic water by pumping to higher wetlands and agitating water using infrastructure to increase aeration | |
| Increase in pest species | Certain | Very High | -Tailor watering regimes to provide competitive advantage for native fish over carp<br><br>-Dry out wetlands that contain large numbers of carp<br><br>-Use time water manipulations to drown seedlings, minimise growth, germination and seed set and to promote native species<br><br>-Control current populations of pest plants and animals via existing management strategies and support partner agencies to seek further funding for targeted weed control programs if necessary | Moderate/Low (moderate risk of an increase of carp and pest animals and low risk of proliferation of pest plants) |
| The potential to favour certain species to the detriment of others or to adversely affect certain species | Certain | Moderate to Very High | -Utilise existing access tracks, ensure clear on-site delineation of construction zones, ensure adequate supervision during works and design and locate infrastructure to minimise the extent of clearing wherever possible to minimise construction impacts on habitat | Low to moderate |

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|---|---|---|---|---|
| -Through the destruction of habitat or habitat disturbance or invasion of river red gum in open wetlands/watercourses | | | -Remediate site on completion of construction activities | |
| Adverse impacts on ecological function and connectivity<br><br>-Prolonged inundation of vegetation, increase in fire frequency/intensity, flow regimes do not match requirements for key species, stranding of fish on floodplains, barriers to fish and other aquatic fauna movement | Possible | Moderate | -No mitigation actions identified for fire management<br><br>-Assess the response of certain species of concern to watering events and adjust operations if required<br><br>-Target different taxa at different times<br><br>-Ensure through-flows replicate a more natural hydraulic gradient<br><br>-Design structures for maximum operational flexibility<br><br>-Incorporate fish passage requirements into regulator design which includes a vertical slot fishway at Berribee regulator and fish-friendly designs to allow passive passage at other regulators | Low |
| Episodic reduction in hydrodynamic diversity<br><br>-Installation of regulators within waterways will affect flows and create lentic ones in regulator pools when in operation which may reduce | Likely | High | -Design structures to minimise waterway obstruction<br><br>-Develop operational protocols to maintain hydraulic diversity<br><br>-Assess the response of species of concern during and after managed watering events and adjust operational arrangements if required | Moderate |

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| the extent and variety of aquatic habitat and change the structure and diversity of wetland floodplain communities<br><br>-In particular, regulator operation is likely to reduce or eliminate fast-flowing habitat that is particularly important to some fish species e.g. Murray cod | | | | |
| Mismatch between vegetation requirements and internal regulator pool operation<br><br>-Vegetation in the deepest part of the Mid-Wallpolla Weir pool may receive excessive inundation (duration and depth) if the inundation requirements of vegetation at the perimeter of the pool are met→ this would cause localised impacts on vegetation health and possible death of less tolerant species | Possible | Moderate | -Ensure through-flow when operating structures (including consideration of raising the upstream head via Lock 9) to more closely replicate a more natural hydraulic gradient<br><br>-Incorporate information on operations, potential impacts and tolerance of inundation regimes and the role of natural floods in ecosystem function into operational plans to minimise impact | Low |

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|---|---|---|---|---|
| Consideration of significant, threatened or listed species | N/A | N/A | -The project is expected to benefit these species by increasing the frequency, duration and extent of floods<br><br>-Construction will result in temporary and permanent vegetation removal and habitat disturbance<br><br>-Detailed ecological assessments will be carried out during the design process to inform construction activities<br><br>-Operation of the project could have adverse impacts on threatened species as the waterways and wetlands of Wallpolla island support significant native fish populations<br><br>-Design allows for passive fish passages through minor structures and a vertical slot fishway at the structure 1 regulator and these measures will allow the movement of small and large bodied fish during a range of operational scenarios<br><br>-All structures designed to allow fish movement even when not in operation<br><br>-The approach to hydraulic modelling is taken from the Chowilla Floodplain Living Murray works | |

***South Australian Proposals***

| Project | Risk | Residual risks identified |
|---|---|---|
| 9. South East Flows Restoration Project | Risks related to over freshening | Low |
| | Risks related to increased particulate organic carbon (POC) deposition in the mixing zone | Low |
| | Risks related to increased turbidity | Low |
| | Risks related to increased loading of total nutrients (nitrogen and/or phosphorus) | Low |
| | Risks related to increased loading of bioavailable nutrients (nitrogen and/or phosphorus) | Low |
| | Risks related to increased loading of dissolved organic carbon (DOC) | Low |
| | Risks related to changed water temperature | Very Low |
| | Risks during construction | Very Low |
| 14. South Australian Murray key focus area | Blue-green algae | |
| | Geomorphic impacts | MIA |
| | Hypoxic blackwater | MIA |
| | Salinity and groundwater recharge | MIA |
| | Spread of disease (particularly chytrid fungus) | MIA |
| | Spread of pest flora species | MIA |
| | Spread or population increase of pest fauna species | MIA |
| 32. Chowilla Floodplain TLM Project | **Hydrology** | |
| | Drawdown of impounded area is too fast | MIA |
| | Period of inundation is too short | MIA |
| | High flow velocity causes channel bed and floodplain scour | MIA |
| | Desynchronisation of river flows with inundation period | MIA |
| | Aseasonal flooding resulting from timing of inundation either due t(i) availability of water for operations, or (ii) attempts to minimise other risks | MIA |
| | Reduction of hydrodynamic diversity and fast flowing habitats during regulator operations | MIA |
| | High reliance on hydrodynamic model for scenario testing | MIA |
| | High proportion of QSA is directed in impounded area | MIA |

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| | Sedimentation within anabranch creeks and/or deposition of sediments on floodplain | MIA |
| | **Fish** | |
| | Decrease in availability of preferred habitat for large bodied native fish | MIA |
| | Reduced quality/availability of spawning sites and nursery habitats for Murray cod | MIA |
| | Alteration of hydrological cues for native fish | MIA |
| | Native fish are trapped in wetlands if wetland regulators are closed on flood recession | MIA |
| | Restricted fish passage during operations | MIA |
| | Temporary increase in lentic habitats that provide habitat suitable for carp spawning and recruitment | MIA |
| | Increased interactions between carp and freshwater catfish | MIA |
| | **Invasive Plants** | |
| | Increased abundance/distribution of exotic plants | MIA |
| | **Increased predation** | |
| | High abundance of predatory exotic fish | MIA |
| | **Water quality** | |
| | Pulse of carbon and nutrients from inundated soil and natural organic material generates hypoxic blackwater event | MIA |
| | High concentration of nutrients and/or harmful/nuisance algal bloom from impounded area drains the river | MIA |
| | Deep, slow moving water immediately upstream of regulator when in operation - increased likelihood of stratification | MIA |
| | Nutrients released from inundated soils and plant material are utilised by non-desirable phytoplankton groups and harmful/nuisance algal bloom(s) develops in wetlands that become isolated during drawdown | MIA |
| | **Groundwater-surface water interactions** | |
| | Salt wash off from upper soil profile leads to increased surface water salinity | MIA |
| | Mobilisation/entrainment of salt from dead storage areas leads to increased surface water salinity | MIA |
| | Groundwater discharge from floodplain aquifers leads to increased surface water salinity | MIA |
| | Development of groundwater mounds beneath inundated areas lead ta rise in groundwater levels beneath the floodplain | MIA |

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| | Fringe degradation in areas where depth to groundwater varies with Chowilla Regulator operations in the absence of inundation | MIA |
| | Shallow depth to saline groundwater combined with evapotranspiration causes soil salt content to increase | MIA |
| | **Operations designed primarily to minimise risk** | |
| | Reduced ability to detect negative outcomes and achieve benefits | MIA |
| | **Operations conducted with insufficient resources** | |
| | Inability to alter structures to maintain water quality in timely manner | MIA |
| | Insufficient resources for monitoring | MIA |
| | Political pressure to utilise infrastructure despite insufficient resources | MIA |
| | **Acid sulfate soil (ASS) material** | |
| | Risks associated with acidification | Low |
| | Risks associated with contaminant mobilisation | Medium |
| | Risks associated with deoxygenation | Low |
| 37. Riverine Recovery Project | | |
| | Uncertainty of conceptual model inputs/outputs and/or parameters | Low |
| | Results of the conceptual modelling are not in line with expectations result in environmental harm | Low |
| | Unexpected ecological or environmental impacts are identified during construction | Moderate |
| | Unexpected ecological or environmental impacts post construction | Medium |
| | Mobilisation of saline groundwater during wetland management | Medium |
| | Increased salinity load to river | Low |
| | Acid sulphate soils are exposed during wetting/drying regime | Medium |
| | Negative impacts on water quality as a result of operational change | Low |
| | Contamination identified during site works causing release of contaminants into receiving waters | Low |
| | Ecological monitoring discontinued after project closure | Medium |
| 38. South Australian Riverland | Low dissolved oxygen (DO) levels | Moderate |
| | Poor water quality affecting floodplain ecology | Moderate |
| | Inability to discharge poor quality water | Moderate |

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| Floodplain Integrated Infrastructure Program (SARFIIP) | Groundwater mobilization across floodplain as a result of changed hydraulic gradients from managed inundation | Low |
| | Increased groundwater levels that persist long after the managed inundation event (i.e. permanent changes to groundwater, not temporary changes during and shortly after a managed inundation event). | Low |
| | Increased pest fish populations (Carp) | Moderate |
| | Proliferation of pest plants | Low |
| | Increase in pest animals | Low |
| | Transport or proliferation of invasive weeds due to construction activity | Low |
| | Not being able to achieve benefits due to compromised existing vegetation condition, diversity and capacity to respond. | Low |
| | Broad scale lack of vegetation response to managed inundation due to soil salinization. | Moderate |
| | Stranding and isolation of native fish on floodplains | Low |
| | Barriers to fish and other aquatic fauna movement during managed inundation. | Moderate |
| | Barriers to fish and other aquatic fauna during natural floods | Moderate |
| | Reduction in preferred habitat for large bodied native fish during operation | Moderate |
| | Managed inundation regimes do not match water requirements for key species | Moderate |
| | Increase in fire frequency, extent and intensity | Moderate |
| | Geomorphology changes | Moderate |

# Appendix E. Assessing value for money

*Table 13. Estimate of supply contribution, area watered compared to pre-Basin Plan, estimated costs for implementation and maintenance for proposed projects.*

| Project title | Proponent state(s) | Stocktake estimate of Supply Contribution (GL) | Additional Area Watered compared to Pre-Basin Plan (Ha) | Estimated Implementation Cost exc GST $ Million | Estimated On-going costs exc GST $ Million |
|---|---|---|---|---|---|
| 1. 2011 Snowy Water Licence Schedule 4 Amendments to River Murray Increased Flows Call Out Provisions | New South Wales / Victoria | 30-60 | 0* | 0 or Minimal administrative costs | 0 or Minimal administrative costs |
| 2. Barmah-Millewa Forest Environmental Water Allocation | Victoria / New South Wales | 40 | 0* | 0 or Minimal administrative costs | 0 or Minimal administrative costs |
| 3. Computer Aided River Management (CARM) Murrumbidgee | New South Wales | 10-20 | 0* | 0 Previously funded by NSW Government | 0 Previously funded by NSW Government |
| 4. Enhanced environmental water delivery (Hydro Cues) | New South Wales / Victoria / South Australia | Not assessed | 0* | Unknown but to make full use of any delivery strategy constraints must be lifted beyond current proposals | Unknown but to make full use of any delivery strategy constraints must be lifted beyond current proposals |
| 5. Flexible Rates of Fall in River Levels Downstream of Hume Dam | Victoria / New South Wales | 0-30 | 0* | 0 or Minimal administrative costs | 0 or Minimal administrative costs |

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| 6. Hume Dam airspace management and pre-release rules | Victoria / New South Wales | 70 | 0* | Unknown No Business case provided | Unknown No Business case provided |
| 7. Improved Regulation of the River Murray | Victoria / New South Wales | 30-100 | 0 | 0 or Minimal administrative costs | 0 or Minimal administrative costs |
| 8. Structural and operational changes at Menindee Lakes | New South Wales | 50-80 | Unknown No Business case provided | No information provided but up to $400 Million previously. Further decommissioning is likely to save more water for less money. | Unknown No Business case provided |
| 9. South East Flows Restoration Project | South Australia | Assists limits of change maintenance to support overall supply contribution | 0* | 0 Already funded by SA government | 0 Already funded by SA government |
| 10. Flows for the Future | South Australia | Not assessed expected to Assists limits of change maintenance to support overall supply contribution | 0* | 0 Already funded by SA government | 0 Already funded by SA government |
| 11. SDL offsets in the Lower Murray NSW | New South Wales | 5-10 | Uncertain Business case not provided | Uncertain Business case not provided | Uncertain Business case not provided |

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| 12. Hume to Yarrawonga key focus area | | Not assessed | Unknown Business Cases not provided | Unknown Business Cases not provided | Unknown Business Cases not provided |
| 13. Yarrawonga to Wakool junction key focus area | New South Wales | Should be no adjustment as constraint downstream of Yarrawonga not lifted to 50,000 ML/d and 30,000 ML/d could be delivered in Benchmark. If operational target lifted from 30,000 ML/d to 50,000 ML/d adjustment could lift to 100 GL as per Stocktake estimate. It appears MDBA modelling 50,000 ML/d even though this is not the target. If this is the case this would exaggerate the SDL adjustment substantially. | 0 because Constraints not relaxed beyond Pre-Basin Plan operational constraint with the possible exception of the Mid-Murrumbidgee | Operational constraints have tightened since 2012 and so costs are mostly associated with returning operational constraints back to what they were prior to the Basin Plan for minimal or no increase in the area inundated. Victoria's Business case estimates costs for the Goulburn at $140 Million to deliver 25,000 ML/d at Shepparton. . This represents minimal or no change from what could be delivered in 2012. | Unknown Business Cases not provided with the exception of SA |

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| 14. South Australian Murray key focus area | South Australia | 0 because upstream States have not relaxed constraints sufficiently as per CMS and MDBA (2012) Hydrologic modelling of the relaxation of operational constraints in the southern connected system: Methods and results | | | |
| 15. New Goulburn key focus area* | Victoria | 0 because constraint not relaxed sufficiently to exceed benchmark constraint of 20,000 ML/d. This represents no change from what could be delivered prior to the Basin Plan | | | |
| 16. Lower Darling key focus area | New South Wales | Included in Stocktake estimate of Menindee savings | Unknown Business Case not provided | Unknown Business Case not provided | Unknown Business Case not provided |

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| 17. Murrumbidgee key focus area | New South Wales | 10-20 with high uncertainty as previous constraint set at 30,000ML/d at Gundagai not Wagga | Uncertain as previous constraint was 30,000 ML/d at Gundagai | Unknown Business Case not provided | Unknown Business Case not provided |
| 18. Lindsay Island (Stage 2) Floodplain Management Project | Victoria | 40-50 | 5152 | 72.8 | 2.7 |
| 19. Wallpolla Island Floodplain Management Project | Victoria | | 2650 | 59.5 | 2.5 |
| 20. Belsar-Yungera Floodplain Management Project | Victoria | | 2370 | 55.6 | 2.3 |
| 21. Guttrum and Benwell State Forests Floodplain Environmental Works Project | Victoria | | 1200 | 28.4 | 1.1 |
| 22. Hattah Lakes North Floodplain Management Project | Victoria | | 1130 | 8.8 | 0.5 |
| 23. Gunbower National Park Floodplain Management Project | Victoria | | 500 | 12.8 | 0.64 |

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|---|---|---|---|---|---|
| 24. Burra Creek Floodplain Management Proposal | Victoria | | 407 | 12.1 | 0.5 |
| 25. Nyah Floodplain Management Project | Victoria | | 488 | 10.9 | 0.5 |
| 26. Vinifera Floodplain Management Project | Victoria | | 350 | 9.1 | 0.4 |
| 27. Gunbower Forest TLM Project | Victoria / New South Wales / South Australia | 136 | 4800 | ~$245 million | ~ $14 million |
| 28. TLM environmental works and measures – Koondrook-Perricoota Forest Flood Enhancement proposal | New South Wales / Victoria / South Australia | | 32000 | | |
| 29. Mulcra Island Environmental Flows TLM Project | Victoria / New South Wales / South Australia | | 820 | | |
| 30. Lindsay Island (Stage 1) Upper Lindsay watercourse Enhancement TLM Project | Victoria / New South Wales / South Australia | | ~30 Ha of Streams inundated assuming streams are 10m wide | | |
| 31. Hattah Lakes Environmental Flows TLM Projects | Victoria / New South Wales / South Australia | | 6000 | | |
| 32. Chowilla Floodplain TLM Project | South Australia / New South Wales/ Victoria | | 9000 | | |
| 33. Improved Flow Management Works at the | New South Wales | 10-15 | 0 | Unknown Business Case not provided | Unknown Business Case not provided |

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| Murrumbidgee River – Yanco Creek Offtake | | | | | |
| 34. Modernising Supply Systems for Effluent Creeks – Murrumbidgee River | New South Wales | 5-10 | 0 | Unknown Business Case not provided | Unknown Business Case not provided |
| 35. Murray and Murrumbidgee Valley National Parks SDL Adjustment Supply Measure | New South Wales | 5-10 | Some areas watered previously assumed 35,000 Ha here | Unknown Business Case not provided | Unknown Business Case not provided |
| 36. Nimmie Caira Infrastructure Modifications Proposal | New South Wales | 20-50 | This is bridging the Gap water now being considered as an SDL adjustment. Should have been included as part of Nimmie Caira Heads of Agreement. Commonwealth has already paid 185 million dollars for Nimmie Caira. | Unknown Business Case not provided | Unknown Business Case not provided |
| 37. Riverine Recovery Project | South Australia | 5 | 0* | Unknown not in Business case provided | Unknown not in Business case provided |
| 38. South Australian Riverland Floodplain Integrated Infrastructure Program (SARFIIP) | South Australia | Not assessed in Stocktake | 2019 | Unknown not in Business case provided but not seeking Commonwealth funds | Unknown not in Business case provided but not seeking Commonwealth funds |

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