CSIRO Submission to the South Australian Royal Commission into the Murray-Darling Basin, October 2018

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1. CSIRO's role

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) operates under the provisions of the *Science and Industry Research Act 1949* (Act).

CSIRO's primary functions under the Act are to carry out scientific research for Australia, and to encourage the application or utilisation of the results of such research. As outlined in the Act, CSIRO's role includes cooperating with organisations, industries, authorities and associations involved in scientific research.

Consistent with the Act, CSIRO performs mission-directed research that is focused on addressing specific problems or opportunities, and which delivers a range of benefits (including economic, environmental and social benefits).

CSIRO's success in delivering to its legislative mission is grounded in its scientific integrity and longstanding public trust of the organisation. CSIRO works hard to ensure its:

- adherence to scientific method including the critical role of peer review as the accepted test of the validity of scientific research and the cornerstone of science quality and publication;
- adherence to Australian Codes for responsible conduct of research; and
- transparency as to the science that CSIRO is conducting and the results from that research, and of the stakeholders who are involved in supporting or conducting the research.

In order to maintain focus on its primary functions and scientific integrity CSIRO has a Science and Delivery policy which can be found here https://www.csiro.au/en/About/Policies-guidelines/Our-core-policies/Science-and-Delivery-Policy

This policy includes a statement of CSIRO's commitment to developing, implementing and maintaining practices to ensure it:

- applies high standards for the responsible conduct of scientific research;
- maintains its reputation for integrity and scientific impartiality and independence;
- publishes quality scientific information based on robust peer review, in papers, reports and otherwise; and
- provides independent, expert, technical advice to government and community as appropriate to inform relevant policy processes and program activities.

2. CSIRO research for the Murray-Darling Basin

CSIRO has a long history of delivering research for the Murray-Darling Basin (MDB) (see Annex), primarily focused on:

- working with government, industry and communities to provide a sustainable future for the MDB without compromising important environmental sites and ecosystems;
- assisting water-dependent industries and communities to understand and adapt to a changing environment; and
- supporting the adaptation to a future with less water, more frequent and severe droughts, and increasing water demands, all of which will continue to put pressure on water management in the Basin.

A summary of key MDB projects delivered since 2006 follows. These projects were undertaken for the Commonwealth National Water Commission, the MDB Authority (MDBA), the MDB Commission (MDBC) and the South Australian Government through the Goyder Institute partnership between CSIRO, Flinders University of SA, the University of Adelaide, University of South Australia and WaterEd Australia Pty Limited (trading as the International Centre of Excellence in Water Resources Management). This CSIRO work has contributed extensively to the development of several

management initiatives in the MDB, such as the Murray-Darling Basin Plan (Basin Plan), the MDB Salinity Management Strategy and others.

CSIRO stands behind the quality and integrity of the research it has conducted and the integrity of the review and approval processes that took place prior to the delivery and the public release of these reports. CSIRO has organisational-scale governance mechanisms to ensure quality and integrity of scientific process and delivery. Over this period CSIRO also had in place project-scale governance mechanisms for all of its major MDB projects with review teams comprised of eminent scientists of national and international standing to advise and evaluate outcomes.

The MDBA is an independent expertise-based statutory agency with responsibility for planning the MDB's water resources. CSIRO's research, models and data contributed to the MDBA's development of the Basin Plan. CSIRO delivered methods, systems and some input data (such as climate scaling factors and groundwater assessments) that contributed to the MDBA's development of sustainable diversion limits (SDLs) for the Basin Plan. This work was delivered in the context of agreed contractual arrangements.

With respect to policy development, CSIRO is not charged with any statutory responsibilities for the development or delivery of policy in its Act. However, as Australia's national science agency CSIRO is the government's primary provider of research and other science and technology services. The government may call upon CSIRO for information and advice including contributing to the government's need for informed policy development. CSIRO delivers science into policy-relevant government processes, and as outlined in Section 1 above, CSIRO does so in a way that is independent and apolitical, yet mindful of the policy context including that, in general, science may be one of the many inputs into a policy process. For this reason, CSIRO reports are typically fit-for-purpose and may be prepared in consultation with government clients. Certainly information contained in draft reports could and should be changed to ensure the results are presented in a style that presents them fit for the purpose they are intended. This is neither unusual nor any form of corruption of the scientific process.

In conducting its past work for the MDB, CSIRO used the best available science at the time that was appropriate to the particular research questions of the projects. Scientific knowledge is continually evolving and improving, as demonstrated by the research conducted as part of the series of water assessments delivered over the past decade. For example, the Murray-Darling Basin Sustainable Yields project that commenced in 2007 led to a series of basin-scale assessments across Australia and internationally. Over the decade that these assessments have been conducted, both scientific understanding and technology have developed and improved, such that there are number of areas where the methodologies and approaches have evolved, and the certainty in information provided is much improved (for example, the contribution of transpiration to the water balance).

CSIRO has provided integrative inter-disciplinary and independent research based on the MDB. CSIRO has also coordinated these projects in partnership with other institutions, including universities and government bodies. This work has provided governments, industry and communities with scientific information including the potential costs and benefits of alternative water resources and salinity management initiatives across the MDB to guide future resource planning, management and investment.

CSIRO notes that the submission from the MDBA to the Royal Commission provides information regarding the role of peer-reviewed science (pages 10-11 of the MDBA submission) in informing the Basin Plan.

a. 2006 South East Australian Climate Initiative for the National Water Commission

The South Eastern Australian Climate Initiative (SEACI) was established in 2005 to improve understanding of the nature and causes of climate variability and change in south-eastern Australia in order to better manage climate impacts http://www.seaci.org/

SEACI was a partnership between CSIRO, the Australian Government's Department of Climate Change and Energy Efficiency, the MDBA, the Australian Government's Bureau of Meteorology and the Victorian Department of Sustainability and Environment. CSIRO and the Bureau of Meteorology carried out research in several key areas, with management and funding provided by the other agencies.

The study was led by key authors supported by a number of R&D contributors, overseen by a Steering Committee including representatives of the MDBA, Victorian Department of Sustainability and Environment, then Department of Climate Change and Energy Efficiency, Bureau of Meteorology and CSIRO. In addition to the normal CSIRO internal review processes, work from SEACI was reviewed by a Science Panel comprising an independent chair and experts and researchers from the MDBA, Victorian Department of Sustainability and Environment, Department of Climate Change and Energy Efficiency, Bureau of Meteorology, CSIRO, and state governments.

SEACI's research found that that south-eastern Australia has experienced a range of climate extremes in recent times (both drought and floods). These conditions reflect both the inherent natural variability of the climate system, as well as an underlying drying trend which appears to be partly attributable to climate change. Future conditions across the region are expected to be warmer and drier, although there is considerable uncertainty about the magnitude and timing of projected changes. The research found that water resource managers need to ensure their planning and management processes are robust and adaptive across a wide range of future climate and streamflow scenarios.

b. 2007 MDB Water Assessment (Sustainable Yields Project) for the National Water Commission

Following the November 2006 Summit on the southern MDB, the then Prime Minister and MDB state Premiers commissioned CSIRO to report on sustainable yields of surface and groundwater systems within the MDB. This report from the CSIRO MDB Sustainable Yields Project summarises the assessments for 18 regions that comprise the Basin.
https://www.csiro.au/en/Research/LWF/Areas/Water-resources/Assessing-water-resources/Sustainable-yields/MurrayDarlingBasin

All project reports provide comprehensive citation details of materials used for the project which was a world first for rigorous and detailed basin-scale assessment of the anticipated impacts of climate change, catchment development and increasing groundwater extraction on the availability and use of water resources. It represented the most comprehensive hydrologic modelling ever undertaken for the entire MDB, including modelling of rainfall-runoff and groundwater recharge, fully linked modelling of all major river systems and modelling of the major groundwater systems of the MDB and their connections to the surface water system.

This work relied on existing river and groundwater models developed by state agencies and the MDBC, and new models developed by the project.

The project was led by CSIRO and used the expertise of government agencies in Queensland, New South Wales, Victoria, the Australian Capital Territory and South Australia. The MDBC and leading industry consultants were also involved. The project relied on the cooperative participation of nearly 200 people from more than 15 organisations. It established comprehensive and efficient quality assurance processes including the external peer-review of project methods and modelling. All

modelling results were captured, documented and translated into project reports.

c. 2009 Expert advice to the MDBA on the overall framework and approach to assessment of economic and social impacts of reducing the Sustainable Diversion Limit (SDL)

To support the Draft Basin Plan, CSIRO and Sinclair Knight Merz (SKM) undertook groundwater assessments covering all of the major aquifers in the Basin. This work drew on data collected by States and involved:

- setting of planning boundaries for groundwater;
- developing a rapid risk assessment method for the whole of the Basin, to evaluate risks such as groundwater salinity, groundwater ecological assets, base flow impacts, and impacts of groundwater resource itself for a given 'environmentally-sustainable level of take'; and
- numerical modelling for priority groundwater areas to enable refined risk assessment.

This work was delivered to MDBA in its capacity as the independent expertise-based statutory agency with responsibility for planning the MDB's water resources. In their publication regarding methodology for Sustainable Diversion Limits (SDLs), the MDBA states that "Where numerical models were not available the MDBA used the recharge risk assessment method (RRAM), developed for this project to inform the proposed SDLs."

Subsequently, a methodology for adjustment of SDLs was also developed by CSIRO (see below).

d. 2009 and 2010 Climate scenarios, groundwater and river modelling to support the Basin Plan for the MDBA

Throughout 2009 and 2010, CSIRO conducted research to support and inform decision making by the MDBA with regard to scenarios for climate, groundwater and river flows.

The technical report "Advice on defining climate scenarios for use in the MDB Authority Basin Plan modelling" https://www.mdba.gov.au/sites/default/files/pubs/Defining-climate-scenarios-report-from-CSIRO.pdf was produced to provide the MDBA advice on defining climate scenarios for use in the MDBA modelling to guide development of the first Basin Plan.

Specifically, the MDBA requested advice on three aspects of climate and climate change envisaged for the modelling:

- a definition of a 'baseline' climate scenario to provide the basis for describing the size, extent, connectivity and condition of the Basin water resources
- a definition of future climate scenarios to enable determination of long-term average SDLs in the context of risks to the availability of Basin water resources that arise from the effects of climate change.
- a definition of climate scenarios for use in modelling to assess the water resource, environmental and socio-economic implications of proposed diversion limits over the expected period of implementation of the first Basin Plan (2009 to 2024).

The report provided advice on these three aspects, drawing heavily on work from SEACI, as well as extension of some models and beyond the team of authors, at least 10 other researchers provided review and comment.

The report "Proposed River Modelling Methods and Integrated River System Modelling Framework Design for use in Basin Plan Modelling" developed the Integrated River System Modelling Framework

(IRSMF) to link the separate models (surface water and groundwater, and models from different jurisdictions) https://publications.csiro.au/rpr/download?pid=csiro:EP103102&dsid=DS3.

The framework supported a number of different models, allowing them to interact and be run as a whole-of-basin model – a significant scientific achievement. IRSMF also allowed adjustment of some parameters; known as tweaking, so that water sharing plans could be explored under different climate and development conditions. It was used to study individual valleys, then to explore linked valleys and finally the entire Basin.

The preparation of this report was led by CSIRO as a part of contracted work for MDBA but was a collaborative effort involving staff of the Basin Plan Modelling section of MDBA, river modellers from three state agencies (Victorian Department of Sustainability and Environment, NSW Office of Water – Department of Environment Climate Change and Water; Queensland Department of Environment and Resource Management), and assistance from sub-consultants to CSIRO (SKM, Barma Water Resources, and eWater CRC). All of these groups contributed to the technical content of the report.

The report was subjected to an internal CSIRO peer review process and also underwent an external peer review process managed by MDBA.

e. 2011 Review of the MDB Ecologically Sustainable Level of Take method for the Basin Plan for the MDBA

At the invitation of the MDBA, CSIRO led a review of the environmental and hydrologic science, modelling and analyses used by the MDBA to help determine SDLs. CSIRO assembled a team of leading Australian water scientists from several institutions to undertake the review www.mdba.gov.au/sites/default/files/archived/proposed/CSIRO_ESLT_Science_Review.pdf .

The review stressed that the hydrologic and environmental modelling and analyses was an important input, but not the only input, to the MDBA's determination of SDLs.

In the context of an adaptive management approach and more than 30 years of Australian water research, the review found there was sufficient science available to make an informed decision about an environmentally sustainable level of water that could be taken from the Basin for irrigation.

It also found that the substantial body of work being done by the MDBA represented a sufficient basis to begin an adaptive process for managing the level of consumptive water use.

The review identified areas where existing knowledge was limited and where aspects of the modelling work could be strengthened in the future to reduce uncertainties in the modelling results. Overall, the review was generally supportive of the scientific and technical modelling work undertaken by the MDBA.

f. 2011 Multiple Benefits Project for the MDBA

This project was guided by a Steering Committee comprising representatives of MDBA, ANU, the then Department of Sustainability, Environment, Water, Population and Communities, CSIRO, eWater CRC, National Irrigators' Council, MDBA Basin Community Committee.

CSIRO used the best available science in combination with new work to calculate the multiple benefits of returning more water to the environment in this project, which was the first time ecosystem services and human benefits that could stem from a healthy river environment had been valued on a Basin-wide scale. (https://www.mdba.gov.au/sites/default/files/archived/basinplan/2017-Assessment_Ecological_Economic_Benefits.pdf)

CSIRO estimated that the enhanced, Basin-wide habitat ecosystem services that could be delivered under the conditions outlined in the proposed Basin Plan were worth between $3 billion and $8 billion, relative to the baseline (ie. “steady-state”) scenario. Some ecosystem services could not be monetised and the monetary value was expressed as a range because of the difficulty of converting broad descriptions of ecosystem states to a more precise figure. At the time authors noted that additional research would be required to refine these estimates.

The CSIRO report was subject to CSIRO’s standard internal peer review by two suitably qualified non-authors prior to its release. It was then reviewed before publication by an Independent Scientific Review Panel comprising a number of environmental consultants and university experts with relevant expertise.

The report discloses that the MDBA provided: data; outputs and results from hydrologic models; information on environmental water requirements; and, comments on drafts of this report.

Valuable feedback on the report was provided by attendees of a technical workshop on 8 March, 2012. Attendees included representatives of the following organisations: Australian Bureau of Agricultural and Resource Economics and Sciences; Australian Conservation Foundation; Australian Government Department of Agriculture, Fisheries and Forestry; Australian Government Treasury; Australian Government Department of Regional Australia, Regional Development and Local Government; Australian Department of Sustainability, Environment, Water, Population and Communities; Basin Community Committee; New South Wales Office of Environment and Heritage; New South Wales Office of Water; Queensland Department of Employment, Economic Development and Innovation; Queensland Department of Environment and Resource Management; South Australian Department for Water; and Victorian Department of Primary Industries.

g. 2011 Goyder Institute MDB Plan Science review

At the request of the SA Government, the Goyder Institute conducted a science review of the Guide to the Proposed MDB Plan, led by CSIRO. The review was subject to both internal and external review.

The review was subject to both internal and external review, and found that overall, the Guide scenarios increased the likelihood of maintaining or improving ecological condition. It found there was potentially sufficient average annual volume under each of the Guide scenarios to meet both the MDBA and South Australian Government’s environmental water requirements for the Coorong, Lower Lakes and Murray Mouth, but that while some of the environmental water requirements would be met some of the time, they were unlikely to always be met.

A key finding was the amount of water required to meet the South Australian Government’s environmental water requirements.

The findings of this report since became superseded, as subsequent modelling by the MDBA addressed the limitations of this study.

h. 2012 Goyder Institute Ecological Outcomes of proposed Basin Plan

CSIRO understand that the Royal Commission approached CSIRO researchers about this study in particular, so more detail is provided.

At the request of the SA Government, CSIRO contributed to an expert panel through the Goyder Institute for Water Research on the likely ecological consequences for South Australia of the then proposed Basin Plan (in particular the BP2750 and BP2800 water recovery scenarios). The Panel included representatives from several institutions and expertise in the fields of river, floodplain and estuarine ecology. The primary task of the Panel was to review the technical assessment by SA Government staff of the proposed Basin Plan. The Panel was also invited to further comment on

potential biodiversity risks. The Panel's findings were also discussed at a workshop with an Ecological Reference Group primarily consisting of additional state government experts.

The Expert Panel agreed with the findings of the SA Government analysis, which concluded the BP2750/2800 scenarios would provide some ecological benefits for the SA section of the River Murray. This included, for example, through a greater frequency of inundation of lower elevation wetlands and floodplains, as well as a decreased risk of low water level and high salinity events in the Lower Lakes. However, overall the Expert Panel concluded BP2750/2800 would not maintain the ecological character of key ecosystems in this region *as these are currently defined* because the benefits are too spatially limited. For example, the flow scenarios considered would provide little to no benefits for medium and high elevation wetlands and floodplains, which represent the bulk of the riverine floodplain ecosystem in SA in terms of surface area. Thus, ongoing vegetation decline in medium and high elevation floodplain areas would continue. Likewise, benefits for the Coorong and Murray Mouth region would likely be restricted to the Murray Mouth area which, in terms of surface area, is a small component of the overall ecosystem.

The Panel did not support the use of additional infrastructure in South Australia to improve ecological benefits but suggested further investment upstream in the basin could be considered to improve the delivery of environmental flows.

The Panel identified several limitations that may have overestimated the potential ecological benefits of BP2750/2800 using the tools then available. These included:

- The flow regimes provided by the MDBA for the analysis of the proposed Basin Plan were only one out of many possible outcomes for a given water recovery level;
- The MDBA hydrological model for the Lower Lakes is inaccurate under very low flow conditions, compromising its ability to evaluate water level and salinity targets in the lakes or flows into the Coorong during droughts;
- Several potential environmental stressors (e.g. floodplain salinity and climate change) were not considered in the current assessment provided by the MDBA; and
- The inability to evaluate the impact of flow regime change on the salt balance of the South Australian River Murray, in particular for floodplains.

Because of the existing degraded state of the ecosystems being evaluated, the Panel also highlighted additional 'repair' flows would be initially required to bring the ecosystems back to their desired state. The Environmental Water Requirements defined for these ecosystem (the basis for the evaluation of potential benefits from various flow recovery scenarios) only represent 'maintenance' to a certain state. Flushing the excess salt accumulated in many floodplains and wetlands is one example for the need of 'repair flows'.

The Panel noted than even in a degraded state the ecosystems of the region were still providing useful ecological services, as exemplified by the extensive use of the Coorong and Lower Lakes by Murray-Darling Basin waterbirds during the Millennium Drought. However, the Panel invited a reflection for what ecosystems to manage for in the region in the future if the ecological character of the current ones cannot be maintained as currently defined in management plans. The currently defined desired ecological characters are not the 'natural' state but the minimal conditions required to meet obligations under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and international conventions for the protection of wetlands (Ramsar) and migratory waterbirds (CAMBA, JAMBA and others). A switch in ecological character does not mean the new systems would not provide some degree of ecological services. However, because of the harsh environmental conditions in the lower River Murray even under natural conditions, a change in ecological character would very likely correspond to a significant loss of biodiversity.

i. 2013 Sustainable Diversion Limits (SDL) Adjustments Ecological Elements Method for the MDBA

CSIRO conducted work to establish whether an Ecological Elements Methodology for adjustment to SDLs was fit for purpose. The project found that the assessments undertaken using demonstration reaches and sensitivity testing provided confidence that the proposed Ecological Elements method was fit for purpose for supporting implementation of the SDL adjustment mechanism. It was recommended that further testing of the method was undertaken for the entire southern Basin. This work was provided as an input to the MDBA in its consideration of adjustments to SDLs.
https://www.mdba.gov.au/sites/default/files/pubs/CSIRO-summary-of-the-scoring-method_0.pdf

The work was led by CSIRO and coordinated across CSIRO, La Trobe University and ANU, supported by the MDBA. An Independent Review Panel reviewed technical progress, approach and reporting for the project and comprised representatives of eWater, University of Adelaide, University of Melbourne and a private consultant. An Ecological Elements Technical Reference Committee and SDL Adjustment Technical Working Group also provided input.

3. Capability contributions

CSIRO also provided capability in support of the Murray-Darling Basin outside contracted R&D projects. This included:

Secondment of Dr Bill Young to MDBA to lead the application of the improved Sustainable Yields river system modelling framework in Basin Plan modelling, and to act as an interface between the river modelling work and policy development process.

CSIRO Land & Water Computing Infrastructure (formerly WRON project) where CSIRO, under contract, supplied the MDBA with access to the WRON computing power to run the MDBA modelling framework and generate data to support development of the Plan. Under the contract CSIRO transferred the data and models back to the MDBA.

Secondment/sub-contract of Dr Jeff Connor to MDBA to help (together with ABARE and other experts) provide advice to the MDBA on how to assess the social and economic impacts of SDLS scenarios. Modelling of social and economic impacts was undertaken by ABARE and by a consortium led by John Marsden (from John Marsden and Associates) not by CSIRO. Both ABARE and the consortium were awarded the work through a tender process.

4. Public submissions

a. Submission on the Guide to the Proposed Basin 2010

CSIRO provided feedback to the MDBA on the Guide to the Proposed Basin Plan in 2010, noting some concerns with the technical underpinning of the plan and this was published on the MDBA website at the time. Subsequently CSIRO conducted research as outlined above which improved understanding prior to the release of the proposed Basin Plan.

b. CSIRO Submission on the Proposed Murray Darling Basin Plan 2012

CSIRO provided a formal submission in response to the MDBA's call for public comment on their proposed Basin Plan.

CSIRO's submission challenged some of the proposed Plan's assumptions regarding groundwater, SDLs and the Environmentally Sustainable Level of Take parameters.

CSIRO suggested more research be done to better inform and improve adaptive management of the Environmentally Sustainable Level of Take.

c. Parliamentary Inquiries

CSIRO provided a submission to the Parliamentary Inquiry into Management of the MDB and to the Inquiry into the impact of the MDB Plan in Regional Australia (the Windsor Inquiry) suggesting that:

- The future management of the MDB requires careful consideration of the complex range of social and economic values associated with water, the environment and agriculture.
- The full range of social and economic values associated with water are yet to be identified; and
- Comprehensive assessments of potential reform options are needed to fully identify and understand the likely impacts of different future scenarios for the Basin.

http://www.aph.gov.au/DocumentStore.ashx?id=4a09f06d-699c-4aac-9a51-2835aa233471
https://www.aph.gov.au/Parliamentary_Business/Committees/House_of_Representatives_Committees?url=ra/murraydarling/report.htm

5. Annex – CSIRO R&D for the MDB

Year commenced	Client and project (Bold indicates Key Project)
2006	**NWC – South East Australian Climate Initiative (SEACI)** MDBC – salt interception; rainfall chemistry
2007	**NWC – MDB Water Assessment (Sustainable yields)** MDBC – Afforestation project; soil and sediment assessment MDFRC – various WQ and ecological projects SA MDB NRM Board – Environmental values and investment prioritisation in the SA MDB (stage 1)
2008	MDBC – Acid sulphate soils (ASS) SA MDB NRM Board – Acid Sulphate Soil investigations; Environmental values and investment prioritisation in the SA MDB (stages 2 and 3)
2009	**MDBA – climate scenarios, GW and river modelling to support the MDB Plan** **MDBA – Provision of expert advice on the overall framework and approach to assessment of the economic and social impacts of reducing SDL** MDBA – SEACI 2 MDBA – Scoping adaptation strategies MDBA – Environmental watering requirements for Coorong MDBA – ASS assessments SA MDB NRM Board – ASS investigations; Environmental values and investment prioritisation in the SA MDB (stage 4)
2010	**MDBA - GW and river modelling to support the MDB Plan** MDBA – ASS assessments of priority MDB wetlands MDBA – Forest hydrology under climate change MDBA – effects of changes in water availability on indigenous people SA MDB NRM Board – ASS assessment of priority wetlands; wetland metal analyses SKM – Groundwater under climate change
2011	**MDBA – Review of MDBA ESLT method for MDB Plan** **MDBA – Multiple Benefits project – multi-valuation of MDB Plan** **MDBA – Rivers system modelling for SDLs as reported in MDB Plan guide** **Goyder Institute – MDB Plan Science Review** NWC – Review of water trading impacts RIRDC – Climate change and risks of weed invasion (research) SKM – Water quality modelling framework for MDB
2012	**Goyder Institute – Ecological Outcomes of proposed MDB Plan** MDBA – River Murray – Flood Inundation Model (RiM-FIM) DoCC-DSE – SEACI 2
2013	**MDBA – SDL Adjustments Ecological Elements Method** MDBA – Physio-chemical data trend analysis MDBA – Basin Salinity Management Strategy QLD MDBC – Vegetation and carbon dynamics in Poplar Box woodlands
2014	SA MDB NRM – Investing the influence of environmental water on Black Box
2015	MDBA – Constraints management strategy MDBA – National Collaboration Framework (head agreement) MDBA – Source model documentation MDBA – Review of phytoplankton monitoring data
2016	MDBA – Ecohydrology project DAWR – MDB environment review
2017	**MDBA – Complementary measures review** MDBA – Blue-green algae in Lake Hume FRDC – Carp biocontrol
2018	MDBA - Assessment and mitigation options of blackwater risk in the Murray River system