

## **Stage 1 Report Appendix D**

# **INDEPENDENT EXPERT EVALUATORS' ASSESSMENT OF THE OUTPUTS AND OUTCOMES OF THE ENVIRONMENTAL WATER KNOWLEDGE AND RESEARCH (EWKR) PROJECT**

November 2020

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- Appointed National Land and Water Australia Senior Research Fellow – to 'Explore future scenarios for the Murray Darling Basin river ecosystems under climate change and water and land use scenarios'

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## 1 CONTEXT

This report is part of an independent evaluation for the Commonwealth Environmental Water Office (CEWO) of the outputs and outcomes of the Environmental Water Knowledge and Research (EWKR) project that ran from 2014-2019. The \$10M project aimed to improve the science available to support environmental water management in the Murray-Darling Basin, and addressed priority research questions structured around four themes: vegetation, fish, waterbirds and food webs. Details of the EWKR project, its objectives, goals, expected outcomes and legislative reporting requirements, and the evaluation strategy are presented in Butcher and Schreiber (2020).

## 2 APPROACH

The evaluation was structured around answering ten key evaluation questions (KEQs) aimed to assess the merit, worth and significance of the EWKR project across six focal areas:

1. the extent to which the objectives were achieved,
2. the extent to which the project supported the CEWO's legislative requirements,
3. how well the project's outputs and outcomes supported the achievement of environmental outcomes,
4. how well findings were communicated to all stakeholders,
5. the extent to which the project was fit for purpose, and
6. opportunities for improvements that could be incorporated into the CEWO's future monitoring, evaluation and research activities.

Merit, worth and significance were captured with evaluation criteria prescribed in the CEWO's Monitoring, Evaluation, Reporting and Improvement (MERI) Framework (CEWO 2013). Multiple lines of evidence were used by each evaluator (Andrew Boulton and Peter Davies) independently to answer the ten KEQs as well as numerous subsidiary KEQs (mid- and micro-level KEQs). For each high-level KEQ, its subsidiary mid-level KEQs aggregated relevant evidence across themes. Conclusions for micro-level KEQs were frequently used to provide aggregated evidence to inform their respective mid-level KEQs and often addressed specific research questions from each theme. The multiple lines of evidence included written and oral outputs (Appendix C) such as final reports, scientific papers and presentation slides as well as the results of an on-line survey (Butcher and Fenton 2020) and 428 pages of transcripts of open-ended interviews with project participants ('service providers'), the client and end users (n=44).

There were four evaluation criteria: effectiveness, appropriateness, impact and efficiency. Each evaluator used rubrics (listed in Appendix A and described in Butcher and Schreiber (2020)) that set out three levels of performance standards (e.g. 'Efficient', 'Moderately efficient' and 'Inefficient') to address and rate each KEQ and its associated mid- and micro-level KEQs. During the evaluation, two further performance standards were added. 'Insufficient evidence' was used when the evaluators agreed that there was too little evidence from the available material and transcripts to evaluate a mid- or micro-level KEQ. The self-explanatory 'Not attempted' was used when, for example, an initial objective or intended research activity was subsequently deemed during the project either to be out of scope because it could not have been achieved effectively with the available resources or not considered to be relevant to the core focus of the project.

Ratings were supplemented with specific comments by each evaluator independently documenting relevant evidence from the written material, survey responses and interview transcripts. On completion of the task, the two evaluators compared their ratings and, where differences occurred, discussed and reached a consensus on a single rating. These discussions were fully documented, along with each evaluator's initial evaluation comments and rating (Appendix B). Consensus on the ten KEQs was not based on simply averaging ratings of mid- and micro-level KEQs. Instead, the evaluators used their collective professional experience to weigh up the multiple lines of evidence, contextual factors such as financial and other logistic constraints, and the needs of the client to mutually agree on a rating that was as robust as possible given the varying availability and quality of evidence.











In the few cases where disparate initial ratings arose from different interpretations of a KEQ or its associated mid- and micro-level KEQs, the evaluators consulted with the core team who reworded the questions more precisely and then consensus was reached on these reworded questions. Similarly, some of the performance standards and sub-criteria in the rubrics (presented in Appendix A in their original form) were reworded to

improve their clarity and to refine their coverage of key aspects. Although this rewording was done after the evaluation (as evident from some of the evaluators' initial comments, Appendix B), the evaluators conferred with each other about how these revised rubrics might alter the final assessments. The final consensus is based on the revised versions of rubrics, KEQs and mid- and micro-level KEQs.

### 3 RESULTS AND DISCUSSION

Table 1 summarises the performance ratings of the ten KEQs. A brief rationale behind the rating for each KEQ is presented in the following text. For further details of each evaluator's initial ratings and comments and the documentation of the discussion for consensual ratings for all micro-, mid- and upper-level KEQs, see Appendix B and the summary report cards in Appendix D.

**Table 1. Performance ratings of effectiveness, appropriateness, impact or efficiency for ten KEQs assessing merit, worth and significance of the EWKR project. Ratings are also portrayed in a 'traffic light' format to indicate whether they were low (red), moderate (yellow) or high (green).**

KEQ	Performance rating	Rating
1. How well has EWKR achieved its objectives?	Moderately effective	
2. How well have the projects communicated findings to all stakeholders?	Moderately effective	
3. To what extent has the EWKR project improved understanding of how management or delivery of environmental flow influences environmental outcomes achieved over time?	Moderately effective	
4. How well has the EWKR project supported CEWO in meeting their legislative requirements?	Moderately appropriate	
5. To what extent is the EWKR project design fit for purpose?	Moderately appropriate	
6. How impactful has the EWKR project been in supporting adaptive management in the Basin?	Low impact	
7. How efficiently has the EWKR project achieved its objectives?	Moderately efficient	
8. How efficient was the EWKR project in managing and sharing data?	Inefficient	
9. How efficient was the collaborative process within the EWKR project?	Efficient	
10. How efficiently generated were the outputs from the EWKR project?	Moderately efficient	

#### KEQ 1. HOW WELL HAS EWKR ACHIEVED ITS OBJECTIVES?

Broad, unfocused, sometimes ambiguous and often overly ambitious objectives were set in the Grant Guidelines and foundation documents but many of these were not attempted because of financial and other logistic constraints. However, once the objectives had been tightened, better-focused and prioritised, the resulting subset was achieved moderately effectively given the available time, funding and researchers' capabilities. Factors hampering effective achievement of this subset of refined objectives included climatic challenges (drought), the long lead-in time while research questions were refined which then limited the time available for research, and the inevitable difficulties of initiating and coordinating multiple players in a large-scale and ambitious project.

The overarching aim of the EWKR project was to improve the science available to support environmental water management in the Murray-Darling Basin. By bringing together researchers and managers to discuss and share scientific information (that already existed in the scientific literature as well as original information derived from the project's research activities), the EWKR project was also moderately effective at making

some key scientific information more available to support environmental water management in the Murray-Darling Basin by the CEWO and other players.

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## KEQ 2. HOW WELL HAVE THE PROJECTS COMMUNICATED FINDINGS TO ALL STAKEHOLDERS?

Key findings of the EWKR project were effectively communicated in reports and scientific papers but less so in other media more routinely accessed by stakeholders such as most water managers and the general public. Multiple comments in the surveys and interviews often indicated dissatisfaction with the effectiveness of the communication of the project's findings to the majority of stakeholders, prompting a rating of 'Moderately effective' for this KEQ. Themes varied widely in their use of different media to present findings, and this often reflected the types of outputs and likely interests of the target audience. The waterbirds theme was especially praised for its efforts in promoting some of its findings (e.g. frequent updates on waterbird movements). The EWKR 'Story Space', instigated half-way during the project, was also applauded for its effectiveness in communicating findings to a wide audience.

However, there was a need for greater and better coordinated communication of findings to environmental water managers, planners and other stakeholders during the project and in its final stages. This communication needed to be in formats and media that were better targeted and more available to most end-users (e.g. updates and fact-sheets on appropriate digital communication platforms), and provided in as timely a way as possible to support the adaptive management of environmental water. Finally, as the project's main aim was to improve the science available to support environmental water management in the Murray-Darling Basin (see response to KEQ1), there needed to be effective communication strategies, a dedicated communication officer and appropriate knowledge brokers in place from the outset of the project. These initiatives are discussed further in 'Recommended improvements' (Section 5).

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## KEQ 3. TO WHAT EXTENT HAS THE EWKR PROJECT IMPROVED UNDERSTANDING OF HOW MANAGEMENT OR DELIVERY OF ENVIRONMENTAL FLOW INFLUENCES ENVIRONMENTAL OUTCOMES ACHIEVED OVER TIME?

This was rated as 'Moderately effective' because multiple lines of evidence indicated that many of the findings of the EWKR project would be valuable to improving understanding of how environmental flows influence environmental outcomes, especially if they were communicated more effectively to all stakeholders. Examples of notable improvements in understanding of how flow potentially influences environmental outcomes include various aspects of native fish and waterbird recruitment and survival, vegetation recruitment, growth and assemblage composition, and several aspects of foodweb energetics. However, the effectiveness of assessments of changes in ecological parameters (e.g. biodiversity, population size, recruitment) over time was often limited, and usually the knowledge came from limited data collection from only one or a few localised sites. It remains to be established which of these findings can be reliably extrapolated more widely (e.g. across northern and southern parts of the Murray-Darling Basin) or over time (e.g. longer than five years), which is a further significant constraint on the understanding of how management or delivery of environmental flow might influence environmental outcomes achieved over time in the Murray-Darling Basin.

The limited funding resources and time made available to such an important and ambitious program inevitably constrained the breadth and depth of matters that could be researched. In addition, the short duration of the program did not allow for active, designed research into mid- to long-term outcomes from real-world delivery of environmental flows.

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## KEQ 4. HOW WELL HAS THE EWKR PROJECT SUPPORTED CEWO IN MEETING THEIR LEGISLATIVE REQUIREMENTS?

Most of the information from the research activities of the EWKR project is relevant to the CEWO and could be used to support them in meeting some of their legislative requirements. The information was deemed 'Moderately appropriate' because although no specific examples were provided where information from the EWKR project had yet been used by the CEWO to help meet their legislative requirements, interviewees (including the CEWO staff) considered that this information was relevant and could be used in such a way. In particular, it was noted by some interviewees that this information complemented the monitoring data from



the LTIM project by helping to explain the likely mechanisms underlying some of the ecological responses to altered watering regimes, including those resulting from environmental water supplied by the CEWO.

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#### KEQ 5. TO WHAT EXTENT IS THE EWKR PROJECT DESIGN FIT FOR PURPOSE?

The central purpose of the EWKR project was to improve the science available to support the needs of environmental water managers in the Murray–Darling Basin, including the CEWO. This scientific information included synthesising existing material (e.g. scientific literature) as well as that generated by the project. The relatively long lead-in period enabled refinement of relevant and useful research questions within the four themes of the project, supported by extensive literature reviews to set context and identify knowledge gaps. The design of the overall project structure (e.g. relationships among the themes, spatial arrangement of sites across the Basin) and the designs for specific research activities within the themes were rated as ‘Moderately appropriate’ for the overall purpose of the project. However, there were elements of the design that compromised the appropriateness of the project being fully fit for purpose. These elements include the adequacy of spatial and temporal replication for assessing Basin-wide ecological processes over time (especially periods longer than five years), the extent to which the same sites were used for concurrent multiple research activities, and the timing of particular blocks of fieldwork so that their results better aligned with associated research activities. Many of these limitations to the design arose from financial and other logistic constraints beyond the control of the EWKR team.

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#### KEQ 6. HOW IMPACTFUL HAS THE EWKR PROJECT BEEN IN SUPPORTING ADAPTIVE MANAGEMENT IN THE BASIN?

At the time of assessment (June 2020), the EWKR project has had little impact in supporting adaptive management (as defined in the Glossary of Butcher and Schreiber 2020) in the Basin. This rating of ‘Low impact’, derived largely from comments provided in response to the survey and interviews, probably reflects two main factors. The first is the limited time that has elapsed since most of the key findings were communicated to managers and other stakeholders (mid-late 2019), meaning that there has been very little time for this information to be used to support adaptive management in the Basin and to be able to demonstrate the information’s impact. It is highly likely that both this impact and the capacity to demonstrate it will increase with time. The second factor is the limited effectiveness of the communication of many of the key findings to relevant managers in such a way as to change their behaviour and encourage active incorporation into adaptive management. Suggestions to improve the effectiveness of communication of key findings to support adaptive management in the Basin are made in ‘Recommended improvements’ (Section 5) below.

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#### KEQ 7. HOW EFFICIENTLY HAS THE EWKR PROJECT ACHIEVED ITS OBJECTIVES?

Putting aside the fact that several of the original objectives specified in the Grant Guidelines and foundation documents could not be achieved because of financial and other logistic constraints (see response to KEQ 1), the project was rated as ‘Moderately efficient’ in achieving the subset of objectives and related research questions that were addressed. Although the long lead-in time to refine the research questions greatly benefited the relevance and quality of the information generated by the EWKR project, it severely curtailed the scope of the program’s research and the remaining time for data collection and communication of findings. This substantially reduced the efficiency of the achievement of the objectives, and was identified as a major failing by multiple survey respondents and interviewees. Although project managers and the leadership team proposed several strategies to enhance the efficiency with which the EWKR project team might achieve its objectives (e.g. streamlined governance), these strategies were not always carried out fully. There also seemed to be gradual changes in the emphasis and scope of some of the objectives during the project which further constrained the efficiency of their achievement.

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#### KEQ 8. HOW EFFICIENT WAS THE EWKR PROJECT IN MANAGING AND SHARING DATA?

The Grant Guidelines and the Operations Strategy gave clear instructions about data management and how this was to be implemented, and the Phase 1 Project Plan specified that an important component of the research methodology would be a data management plan. Nonetheless, no data management strategy

eventuated that was consistently used across all four themes, there was no central repository for the project's many datasets (even for direct access by the client), access details varied widely across and within themes, and there did not appear to be any consistent scheme for metadata that was used to characterise each dataset in each theme. These collective failings resulted in a rating of 'Inefficient' for how the EWKR project managed and shared data. Sharing and managing data within individual research activities apparently sufficed for researchers within themes and seemed to be done according to individual preferences of each researcher or research team. When data were shared within the EWKR project, this was done using media such as Dropbox and its efficiency probably relied on personal communication among individual researchers instead of standard data-sharing protocols informed by consistent metadata and a project-wide data management plan.

#### KEQ 9. HOW EFFICIENT WAS THE COLLABORATIVE PROCESS WITHIN THE EWKR PROJECT?

Collaboration within the EWKR project was rated as 'Efficient', aided greatly by the consultative nature of within-theme (and occasionally between-theme) development of research questions and conceptual models. Researchers' responses were usually very positive to questions in the survey and interviews about the efficiency of the collaboration process within the EWKR project. Many examples were provided of scientific work by collaborative teams from multiple research institutions and agencies. It should be emphasised that the rating for this KEQ refers to the collaborative process within the EWKR project and focuses on collaboration among researchers as well as between researchers and selected water managers in several particular research activities.

#### KEQ 10. HOW EFFICIENTLY GENERATED WERE THE OUTPUTS FROM THE EWKR PROJECT?

Outputs from the EWKR project ranged from scientific papers and reviews aimed largely at fellow researchers and other peers through to short videos and media stories for the public about interesting aspects of the findings. There were also numerous workshops, talks to managers and at scientific conferences, and informal discussions with various stakeholders. All these outputs were rated as being generated in a 'Moderately efficient' way because they made reasonably effective use of limited time and resources to address the information needs of a diverse array of stakeholders. However, outputs would likely have been more efficiently generated if the project had got off to a more rapid and coordinated start, the final Communications and Adoption Strategy and Communications and Adoption Plan had been developed sooner, there had been greater attention to meeting deadlines during the project, and there had been more pooling of resources. In general, survey respondents and interviewees felt the project outputs were good value for money but could have been generated more efficiently if the research activities had commenced sooner and there had been more effective collaboration and communication with managers and other end-users.

## 4 A COMMENT ON GOVERNANCE

Although the brief for the evaluation excluded assessment of governance, the evaluators considered that brief discussion of this aspect is highly relevant for the client and for improvement in future related research initiatives.

As mentioned above, a key issue with the management of the EWKR project was the relationship between the Grant Guideline objectives and the evolution of the project's research focus. The Grant Guideline objectives addressed a broad range of issues tied to the management of environmental water and other drivers and risks in the Basin. They appear 'strategic', allowing flexibility for a research program with a vision of potentially multiple funding cycles. They were written in language relevant to the Department's policy environment but not readily transferable to a focused research program. This posed an immediate problem for the EWKR project team. In response, the team sought project proposals from its immediate pool of researchers. An overly diverse and poorly focused group of proposals was received, far exceeding the budget available. The response of the Scientific Advisory Group was to recommend triage and refinement, and to seek better stakeholder engagement in both research focus and output delivery. This was actioned by the La Trobe University team with endorsement from the CEWO. A valuable year was spent finalising the research questions, the baseline review work and project design. This delay cost the program dearly in terms of research deployment, development of outputs and communication.

Research-governing agencies play a key role in long-term adaptive management by government in supporting knowledge development and transferability. The Grant Guidelines should have been developed with a more concise set of carefully worded objectives that were better focused on stakeholder needs and able to deliver 'fit for purpose' products achievable within the contract period. In a case like the EWKR project, it would have helped if preliminary consultation had occurred with an independent group of water management stakeholders (to address key knowledge needs) and researchers (to ensure the direct translation/transfer of Guideline objectives into key research questions). It is also important for the Department and the CEWO to actively build on the EWKR project's knowledge legacy as part of the Commonwealth Government's adaptive management role.

## 5 RECOMMENDED IMPROVEMENTS

Eighteen recommendations for potential improvements that would likely enhance the effectiveness, efficiency, impact and appropriateness of future research to support CEWO's legislative requirements and inform adaptive management are presented below. Each recommendation is presented with its target audience and who needs to implement it ('Who'), suggested approaches ('How') and rationale ('Why'). These recommendations are largely derived from the evaluations of the multiple lines of evidence as well as discussions between the two expert evaluators.

### Recommendation 1: Use a collaborative project-design process to ensure effective research delivery

**Who** – Granting body, independent water management stakeholder and science review panel.

**How** – Ensure that the granting stakeholder develops the grant guidelines and program objectives in a context and with language that is relevant to both stakeholder needs and policy contexts, and to best scientific practice. Ensure terms within the document have clear definitions. Review the granting guidelines with independent stakeholder and scientific input. Make sure the grant stakeholder staff is literate in both scientific practice and terms and in the stakeholder (target audience) practices, from the outset and by regular engagement.

**Why** – To improve efficiency, cost-effectiveness and relevance by avoiding confusion over the scope and focus of the research activities as well as the key terms, concepts and contexts to be addressed.

### Recommendation 2: Have realistic 'SMART' (Specific, Measurable, Achievable, Relevant, Time-bound) objectives.

**Who** – Program managers, key stakeholders.

**How** – Set realistic, non-aspirational objectives and expectations for the research program that match the current program context and policy/management environment. Ensure that the objectives are framed in a manner that can be addressed scientifically and that the objectives are comprehensively 'SMART'. Where necessary, ensure the objectives have a logical relationship and 'line of sight' to environmental objectives specified in relevant policy instruments (e.g. the Basin Plan, Environmental Watering Strategy and related Plans) as well as to agreed key knowledge gaps. Specify precisely the expected outputs and outcomes (tied to the communication strategy and to contracted product delivery). Define terms like 'medium- and long-term' if they are to be used as adjectives in program objectives, and ensure such terms align in meaning and context with those commonly used in the policy/operational culture of key stakeholders such as water managers. Ensure the resulting research questions to address these objectives are carefully targeted, precisely phrased and also SMART. Set all these out in a logical framework which is appropriately mind-mapped (see Recommendation 7).

**Why** – To ensure consistency in research-framing with the current policy and management contexts, to improve targeting of research activities, and to enable better evaluation of the effectiveness, efficiency, appropriateness and impact of programs.

### Recommendation 3: Ensure all stakeholders clearly understand and explicitly adopt an adaptive management focus to research and its application.

**Who** – Program managers, researchers and relevant stakeholders.

**How** – Aim for truly adaptive management (see definition in the Glossary of Butcher and Schreiber (2020)), making sure everyone agrees on what this means and how to do it. Get managers, researchers and relevant stakeholders in the room together at the outset to achieve an optimal balance between agreeing on what needs to be done (consultative) and agreeing how it will best be directed (directive) by an experienced leader or steering group (not necessarily researchers) so that the work remains focused and deadlines will be met. As much as possible, ensure from the outset that research questions and designed activities and research outputs will directly service the priority applied knowledge needs for water managers, in a manner can readily be used ('fit for purpose'). Ensure the federal government's role in managing the research program also forms an active part of adaptive management in the long term by improving internal legacy in government research management for the Basin.

**Why** – To make all research questions and activities directly relevant and fit for purpose for the applied and strategic needs of targeted stakeholders (e.g. water managers).

**Recommendation 4:** Work closely with First Nations to plan, engage and undertake research and communicate its findings.

**Who** – Program managers, First Nations, key stakeholders.

**How** – Actively seek and promote First Nations involvement in planning and doing research, communicating findings and designing outputs and deliverables. Ensure that this is initiated during the planning stage in a suitably respectful way, and that shared expectations are realistic and clear.

**Why** – To address the essential need to work with and alongside First Nations in all aspects of the research program design, conduct and communications, to address First Nation objectives and cultural needs, and to appropriately respect country in conducting research. This need is also legally required in the Basin Plan.

**Recommendation 5:** Use watering events for 'real world experiments' to better inform adaptive water management

**Who** – Program managers, researchers and partner water managers.

**How** – Plan to do pre- and post-sampling of relevant ecological responses to natural and operational watering events, integrating parameters and sharing sites (as was originally planned for the EWKR project). Use watering events as much as possible as 'real world experiments'. Continue post-watering event sampling for time periods appropriate to the studied ecological responses, seeking to use remote-sensing methods for some variables (e.g. vegetation cover) where possible. Make ongoing arrangements where possible for sampling to continue in cases where responses continue beyond the project (potentially using citizen scientists and landholders to collect data). Note that this should form part of the federal government's research legacy support.

**Why** – To improve learnings from 'real world' watering events to guide subsequent water management and optimise impact of the research findings.

**Recommendation 6:** Integrate research activities effectively and optimally.

**Who** – Program managers and researchers, key water managers and First Nations.

**How** – Optimise integration of research activities from the outset, preferably funding the process separately with attractive financial incentives for effective and efficient outputs from selected collaborative projects (see Recommendation 7). Seek opportunities where researchers and key resource managers might work together during all the phases of planning, data collection and interpretation, and communication of findings – where this makes the research more efficient and effective. In particular, seek to integrate monitoring activities (e.g. LTIM) with research activities (e.g. EWKR) wherever possible. Ensure sufficient flexibility in the integration to allow incorporation of opportunistic research (e.g. in response to particular climatic events or unique collaboration opportunities).

**Why** – To improve research effectiveness, appropriateness and efficiency.

**Recommendation 7:** Mind-map the planned research, drawing up links between research questions, planned activities, communication strategies and intended outputs and outcomes.

**Who** – Program managers and researchers.

**How** – Initiate, maintain and actively share a mind-map of research questions and sub-questions, together with their links to each other and management questions/Basin objectives, etc. (including to similar current and planned initiatives external to the project). A mind-map portrays the relationships among entities (in this case, research questions) and illustrates the factors that may affect these relationships (e.g. watering events, new technology, changes in stakeholder focus, environmental events such as bushfires or drought). Amend the mind-map as research activities change or if a research activity is abandoned or compromised, and use the mind-map to identify the implications of changes in one research activity for the others. Be explicit about spatial and temporal scales of each research activity. Link each component of the mind-map explicitly to planned communication outputs (within an appropriate communication strategy), and specify how these outputs are expected to change behaviour (e.g. management approaches) to achieve desired outcomes. When collaborative work is proposed (see Recommendation 6), use the mind-map to assess the links, benefits (e.g. value-adding to concurrent research activities) and constraints. Specify on the mind-map where risks might exist so that suitable plans can be considered (see Recommendation 9).

**Why** – To improve the logic of planning, communication and management of research, to identify the implications on outputs and outcomes when planning to amend or remove a given research activity, and to track progress as research continues and is modified in response to findings and changing conditions (including access to funding and other resources). Overall, preparation and adherence of a mind-map of program logic for the full project and its constituent research activities will maximise the efficiency, effectiveness, impact and appropriateness of the project.

**Recommendation 8:** Encourage and plan for opportunism and ensure flexibility to respond to changing needs and circumstances.

**Who** – Program managers, researchers and partner water managers.

**How** – Keep funds aside for opportunistic work, and encourage this work where it adds value to the overall research objectives. Ensure that funds can be made available rapidly, especially to employ key staff or buy essential equipment. Where possible, plan for opportunities (including such possibilities in the mind-map proposed in Recommendation 7) and ensure flexibility to respond and adapt to evolving or changing needs and circumstances.

**Why** – To foster opportunism and flexibility in research design.

**Recommendation 9:** Do formal risk assessment and develop comprehensive plans to avoid or mitigate risks where possible.

**Who** – Program managers.

**How** – Do proper risk assessment following standard approaches (e.g. AS/ISO 31000:2018 [<https://www.standards.org.au/>]) and have back-up plans for changes in key staff, altered environmental conditions, altered site access, changed watering objectives etc. Update risk assessment frequently.

**Why** – To respond rapidly to changes, maximise efficiency by minimising the losses from risks that could have been predicted, and to optimise resilience in subsequent program management.

**Recommendation 10:** Plan and target communication carefully, being realistic about timelines and expectations

**Who** – Program managers, communication staff, researchers, policy makers, key water managers and other stakeholders.

**How** – Identify target audiences early, with an emphasis on natural resource managers and other crucial stakeholders and information users. Design communication methods, content and delivery to match the needs of target audiences such as water managers and policy makers. When planning individual research activities within the project, ensure that enough time and funds are allocated for effective and efficient communication of findings in appropriate media, and to then follow up the effectiveness of that communication.

**Why** – To ensure effective and efficient knowledge transfer to enhance impacts and desired outcomes.

**Recommendation 11:** Plan for comprehensive program evaluation, including several evaluations during the course of the project as well as on completion.

**Who** – Program managers, independent evaluators.

**How** – Scope and plan the program evaluation process at the outset. This should include timing, governance, the evaluation methodology and the forms of evaluation outcomes. Ensure that this evaluation process fully satisfies the needs of the key program stakeholders, acknowledging that these needs will change over time and evaluation processes may need to evolve accordingly. As well as several evaluations during the project, include hold-points in program management to address evaluation recommendations. Assign dedicated funding for the evaluation process and responses to the suggestions.

**Why** – To ensure appropriate independent program evaluation throughout the program lifecycle to maximise efficiency and effectiveness, and maintain appropriateness (i.e. the project remaining fit for purpose).

**Recommendation 12:** Ensure active program oversight by consistent and experienced project managers and independent steering committees that are adequately resourced.

**Who** – Granting body, senior project managers, members of independent water management stakeholder and science review panels.

**How** – Ensure that there is consistent, formal, structured, informed and active program of oversight by the relevant granting body (e.g. the Department), alongside one or more independent scientific and stakeholder advisory bodies (e.g. review panels). Conduct this through the entire project life-cycle. Initiate and maintain effective working and respectful relationships between the granting body, senior project managers, advisory bodies and project participants. Ensure that these relationships are adequately resourced, including accounting for staff turnover.

**Why** – To maximise efficiency (including cost-effectiveness), impact, effectiveness and program relevance through wise and active management throughout the program life-cycle.

**Recommendation 13:** Co-operate closely in data collection, interpretation of findings and communication of outputs.

**Who** – Program managers, communications staff, knowledge brokers, researchers, regional water managers, First Nations, participating stakeholders.

**How** - Where feasible, get everyone (including managers and field staff) involved in collecting data and in subsequent interpretation and communication (see Recommendations 4, 6 and 10). Although involving all players in planning may be unwieldy, there should be opportunities for input when the main research questions are being developed and finalised, and at this stage it should be possible to identify opportunities for co-operation and collaboration in data collection. Some forms of analysis require specialist training but general interpretation and discussion of findings by all stakeholders should be encouraged to derive a coherent and agreed set of core messages. These messages may be communicated as multiple outputs and, again, close co-operation in communication of these different outputs should be fostered. This will ensure stronger feelings of 'ownership' of the findings as well as enhancing consistency in messaging.

**Why** – To improve efficiency and effectiveness of data collection and message communication by optimising cross-program involvement in and understanding of the data collection experience and of communication needs and actions. Impact is likely to be maximised, especially for achieving desired outcomes and in planning future research activities.



**Recommendation 14:** Use robust, consistent, appropriate data management protocols across all research activities in the project, ensuring optimal storage and accessibility of quality-controlled data and metadata.

**Who** – Program managers, data managers, researchers and key stakeholders (especially those involved in data collection (see Recommendation 13)).

**How** – Establish and actively encourage (enforce) use of a robust, flexible, consistent and appropriate data management protocol supported by a reliable and accessible central data-base. Ensure that the data management protocol and data-base features meet the needs of the research program, the client and the target stakeholders. Ensure all protocols and data-bases meet industry standards for best practice, and are compatible with protocols and data-bases currently used in other research institutions and agencies (e.g. Geoscience Australia, Bureau of Meteorology, CSIRO). Data management protocols must be embedded within each individual research activity, and there should be strict procedures for submitting data to the central data-base. This data-base is to be maintained by the key program management agency at the end of the program, with suitable accompanying meta-data and clear, consistent rules for data access and recognition of intellectual property. It should also be part of the program evaluation (Recommendation 11).

**Why** – To increase efficiency and transfer of knowledge and data among all program participants and to key stakeholders, and to ensure a reliable and reputable data legacy that meets best-practice standards.

**Recommendation 15:** Explicitly assess and address all sources of uncertainty, ensuring that all stakeholders understand the implications of uncertainty when interpreting and applying the findings.

**Who** – Program managers, data managers, researchers, communication staff and key stakeholders.

**How** – Be explicit about uncertainty and its assessment (e.g. sources, interactions, management and implications). Use conceptual models where possible but specify the lines of evidence for each node and link in an associated narrative table that presents the levels of confidence and uncertainty for each line of evidence – even if these are only semi-qualitative. Where possible, quantifying the different sources and types of uncertainty. Capture uncertainty and its source(s) within each step of the program logic (see Recommendation 7). Ensure that all sources of uncertainty and their implications (e.g. for predicting ecological responses to environmental water management) are communicated effectively to all stakeholders, and fully understood by communication staff (see Recommendation 10). Explicitly build uncertainty messaging into all communication products.

**Why** – To assess and communicate the extent of confidence in findings, improve the validity of transferability (especially extrapolation in space and time) of program results and predicted outcomes, and identify possible opportunities to address knowledge gaps to reduce significant uncertainty in crucial aspects of the information needed to reach desired management goals.

**Recommendation 16:** Use and maintain a comprehensive decision-audit trail.

**Who** – Program managers, researchers, data managers, and any stakeholders involved in data collection.

**How** – Establish, use and maintain a comprehensive ‘paper trail’ of all decisions and outputs, including records of relevant one-on-one discussions between researchers and program managers. Incorporate this information within the data management framework and program data-base, ensuring that it is readily accessible. Continually integrate the decision-audit trail with the mind-map of program logic (Recommendation 7) over time. Use this to evaluate the effectiveness of all decisions and outputs frequently so that adjustments and refinements can be made during the project.

**Why** – To ensure a reliable and valid record of key decisions is available to describe and support program evolution, and for evaluators and stakeholders to follow the decision-audit trail and understand why changes and refinements to research activities and communication of their findings, if needed, were made.

**Recommendation 17:** Implement and manage all communication professionally, consistently, efficiently and effectively.

**Who** – Program managers, communication staff, knowledge brokers, researchers, First Nations and key stakeholders involved in data collection and communication.

**How** - Have experienced communication and engagement officers and knowledge brokers (including First Nations) engaged from the outset of the project, involved in project planning and mind-mapping (see Recommendation 7), and ensure there are sufficient resources to support effective, timely and efficient communication and engagement. Have and follow a planned strategy of what communication products (outputs) will come out and when, and ensure the strategy explicitly includes a First Nations inclusion plan (cf. MDBA Native Fish Recovery Strategy). Use a diversity of forms of communication, and frequently evaluate their effectiveness and impact (see Recommendation 11). Where possible, encourage communication of new findings but be careful not to overburden researchers and managers with over-reporting. Acknowledge limitations in dialogues and other communication processes - not all researchers are good communicators and not all managers and other stakeholders are good recipients. In both cases, limited time and other resources often constrain the effectiveness of communication and impact. Knowledge brokers should be used to assist researchers and managers to optimise the effectiveness of the outputs for different audiences, ensuring that all outputs delivered to water and NRM managers are appropriate and fit for purpose. Knowledge brokers must be 'briefed' in the language and context of the Grant Guidelines and the policy and resource management context of the program. Brokers should continually and actively engage with the research teams to ensure consistency of language and knowledge messaging.

**Why** – To ensure efficient, effective and well-targeted communication and engagement so that impact and adoption are maximised.

**Recommendation 18:** Be explicit about scales in time and space.

**Who** – Program managers, communications staff, knowledge brokers, researchers, and key stakeholders involved in data collection and communication.

**How** – In the planning and design of the objectives and research activities of the program and in all communication outputs, be explicit about the spatial and temporal scales of the context, research work and subsequent findings. Use consistent, defined terms around scale, and specify these in appropriate places on the mind-map of the program logic (see Recommendation 7). Ensure that these scales match the scales that are relevant to both the ecological responses and the key and legislative water management and policy contexts. Where results are likely to be scaled from a site to a broader region (maybe even the whole Basin) or extrapolated to longer time periods, clearly explain the caveats on such scaling and what evidence is needed to make the scaling more reliable (e.g. addressing uncertainty, Recommendation 15).

**Why** – To minimise confusion around scales of research actions and outputs (especially where mismatches may arise), and optimise transferability, relevance and reliable communication.



## 6 REFERENCES CITED

Butcher, R. and Schreiber, E.S.G. (2020). *Evaluation Strategy for the Long Term Intervention Monitoring and Murray-Darling Basin Environmental Water Knowledge and Research Projects*. Report to the Commonwealth Environmental Water Office, Water's Edge Consulting, Mooroolbark, VIC.

Butcher, R, Boulton, A.J., Cottingham, P., Davies, P.E.D., Fenton, A., Hart, B.T., Ladson, A., Robinson, W. and Schreiber, E.S.G. (2020) Technical Report: End of program outcome evaluation of the Long-Term Intervention Monitoring (LTIM) and Environmental Water Knowledge and Research (EWKR) projects for the Commonwealth Environmental Water Office.

CEWO (2013). *Commonwealth Environmental Water – The Environmental Water Outcomes Framework*. V1.0 Commonwealth Environmental Water Office, Department of Agriculture, Water and the Environment, Australian Government, Canberra, ACT.

## APPENDIX A: ORIGINAL RUBRICS

As mentioned in the main part of the text, the rubrics used in the evaluation are slightly different to those presented in Butcher and Schreiber (2020). The set of rubrics presented here are the ones which were used in the EWKR evaluation. Changes to the rubrics arose from feedback from CEWO and also advice from the evaluators having completed the EWKR evaluation. The updated rubrics were used in the LTIM evaluation. The changes are minor and do not change the intent of the performance standards.

### Effectiveness

- effectiveness in achieving objectives
- effectiveness in communication findings
- effectiveness in achieving desired environmental outcomes.

Effectiveness		Performance standards		
Sub-criteria	Minimally effective	Moderately effective	Effective	
<b>Achieving objectives (Rubric 1.1)</b>	<ul style="list-style-type: none"> <li>Majority of objectives, as specified in the head contract and foundation documents, at Basin and Selected Area scale partially achieved. Some unlikely to be achieved over longer timeframe.</li> </ul>	<ul style="list-style-type: none"> <li>Majority of objectives, as specified in the head contract and foundation documents, at Basin and Selected Area scale fully achieved. Some partially achieved, but likely to be achieved over longer timeframe.</li> </ul>	<ul style="list-style-type: none"> <li>All objectives, as specified in the head contract and foundation documents, at both the Basin and Selected Area scale fully achieved.</li> </ul>	
<b>Communicating key findings (Rubric 1.2)</b>	<ul style="list-style-type: none"> <li>Objectives specific to communicating key findings were minimally effective, with few of the planned/ approved outputs delivered fully.</li> <li>Communication of key findings failed to lead to changed water management practices.</li> <li>Evidence suggests that</li> </ul>	<ul style="list-style-type: none"> <li>Objectives specific to communicating key findings were mostly effective with the majority the planned/approved outputs delivered fully.</li> <li>Communication of key findings led to limited/minor changes in water management</li> </ul>	<ul style="list-style-type: none"> <li>Objectives specific to communicating key findings were highly effective, with all of planned/approved outputs delivered fully.</li> <li>Communication of key findings led to changes in water management practices.</li> </ul>	

<p><b>Demonstrating environmental outcomes (Rubric 1.3)</b></p>	<p>efforts were not targeted towards intended audience needs.</p> <ul style="list-style-type: none"> <li>• Very low end user uptake - intended users of key outputs only peripherally or not aware of outputs.</li> <li>• Communication of findings was somewhat late for its intended use and was below average quality.</li> <li>• Communication was rare over the life of the project, not interactive / responsive to audience feedback.</li> <li>• Overall communication / public awareness efforts have been largely ineffective in driving change towards results beyond outputs.</li> <li>• A weak communication plan/strategy was prepared but not implemented</li> </ul> <ul style="list-style-type: none"> <li>• Majority of environmental and managerial outcomes only partially achieved. Some unlikely to be achieved over longer timeframe.</li> <li>• Outcomes have resulted in minimal improvements to the capacity to predict outcomes of environmental flow allocations and their management over 1–5 years.</li> <li>• Predictive tools, conceptual models and frameworks to inform environmental watering regimes have not been delivered; or are mostly ineffective in terms of improving the knowledge basis and utility of such tools.</li> <li>• Line of sight from environmental outcomes to the Basin Plan EWP outcomes is limited. Outcomes unlikely to</li> </ul>	<p>practices.</p> <ul style="list-style-type: none"> <li>• Evidence suggests that some key audiences attained reasonable awareness of project's main messages.</li> <li>• Communication activities and channels were generally well-targeted, but missed some key audiences</li> <li>• Acceptable levels of end user uptake - intended users of key outputs aware of outputs in general.</li> <li>• Communication of findings was available on time for its intended use and was of average to good quality.</li> <li>• Overall communication / public awareness efforts have been moderately effective in driving change towards results beyond outputs.</li> <li>• Adequate but limited communication plan/strategy was prepared and was partially implemented</li> </ul> <ul style="list-style-type: none"> <li>• Majority of environmental and managerial outcomes fully achieved. Some partially achieved, but likely to be achieved over longer timeframe.</li> <li>• Outcomes have resulted in moderate improvements to the capacity to predict outcomes of environmental flow allocations and their management over 1–5 years. Further improvements will be gained with continued monitoring and research.</li> <li>• Predictive tools, conceptual models and frameworks to inform environmental watering regimes have mostly been delivered; and are mostly effective in terms of improving the knowledge basis and utility of such tools.</li> </ul>	<ul style="list-style-type: none"> <li>• Evidence suggests that all key audiences fully informed of the project's main messages.</li> <li>• Communication activities and channels were well-targeted, with all key audiences kept informed over the life of the project.</li> <li>• High levels of end user uptake – intended end users aware of and utilised outputs.</li> <li>• Communication of findings was available on time for its intended use and was of excellent quality.</li> <li>• Overall communication / public awareness efforts have been interactive and responsive to feedback.</li> <li>• A strong and comprehensive communication plan/ strategy was prepared and was fully implemented.</li> </ul> <ul style="list-style-type: none"> <li>• All environmental and managerial outcomes fully achieved.</li> <li>• Outcomes have resulted in significant improvements to the capacity to predict outcomes of environmental flow allocations and their management over 1–5 years.</li> <li>• Predictive tools, conceptual models and frameworks to inform environmental watering regimes have been fully delivered; and improve the knowledge basis and utility of such tools.</li> <li>• Line of sight from all environmental outcomes to the Basin Plan EWP outcomes is clear. Outcomes contribute to meeting legislative requirements.</li> </ul>
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	contribute to meeting legislative requirements.	<ul style="list-style-type: none"> <li>Line of sight from environmental outcomes to the Basin Plan EWP outcomes is clear for most of the outcomes. Most outcomes are likely to contribute to meeting legislative requirements.</li> </ul>	
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## Appropriateness

Appropriateness		Performance standards	
Sub-criteria	Inappropriate	Moderately appropriate	Appropriate
<b>Strategic relevance (Rubric 2.1)</b>	<ul style="list-style-type: none"> <li>The project's results show weak to limited alignment with:                             <ul style="list-style-type: none"> <li>a) CEWOs needs in satisfying Basin Plan reporting requirements</li> <li>b) Regional, sub-regional and / or national environmental priorities (e.g. Selected Area watering priorities, Ramsar obligations to maintain ecological character)</li> <li>c) Target group and beneficiary needs and priorities (e.g. MDBA needs for Basin Plan evaluation)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>The project's results show moderate/ appropriate levels of alignment with:                             <ul style="list-style-type: none"> <li>a) CEWOs needs in satisfying Basin Plan reporting requirements</li> <li>b) Regional, sub-regional and / or national environmental priorities (e.g. Selected Area watering priorities, Ramsar obligations to maintain ecological character)</li> <li>c) Target group and beneficiary needs and priorities (e.g. MDBA needs for Basin Plan evaluation)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>The project's results show explicit and full alignment with:                             <ul style="list-style-type: none"> <li>a) CEWOs needs in satisfying Basin Plan reporting requirements</li> <li>b) Regional, sub-regional and / or national environmental priorities (e.g. Selected Area watering priorities, Ramsar obligations to maintain ecological character)</li> <li>c) Target group and beneficiary needs and priorities (e.g. MDBA needs for Basin Plan evaluation)</li> </ul> </li> </ul>
<b>Design fit for purpose (Rubric 2.2)</b>	<ul style="list-style-type: none"> <li>Project logic and design in foundation documents lacks clarity, key assumptions and or drivers are not articulated, and/or exhibits poor alignment to the Basin Plan objectives and outcomes, reporting requirements not articulated.</li> <li>The project was not integrated with complementary recent, ongoing or planned interventions in the project area or on the same problem/issue resulting in considerable overlap and duplication.</li> </ul>	<ul style="list-style-type: none"> <li>Project logic and design in foundation documents is satisfactory with key assumptions and or drivers articulated, reasonable line of sight to Basin Plan objectives and outcomes, reporting requirements mentioned.</li> <li>The project was partially integrated with complementary recent, ongoing or planned interventions in the project area or on the same problem/issue resulting in some overlap and duplication.</li> </ul>	<ul style="list-style-type: none"> <li>Project logic and design in foundation documents is exemplary, with key assumptions and or drivers clearly articulated, direct line of sight of results to Basin Plan reporting requirements with outcomes aligned to those of the BWS and EWP.</li> <li>The project was fully integrated with complementary recent, ongoing or planned interventions in the project area or on the same problem/issue with no overlap or duplication</li> </ul>

## Efficiency

Efficiency	Performance standards		
	Inefficient	Moderately efficient	Efficient
<b>(Rubric 4)</b>	<ul style="list-style-type: none"> <li>Limited improvements over time, with little novel learning for the cost of the activities (i.e. adaptive management outcomes limited).</li> <li>Fails to produce the intended quality and quantity of most deliverables (including data), within the available resources in a timely fashion.</li> <li>No evidence of pooling of resources to take up opportunities for joint activities, or mutual learning with other organisations and networks.</li> <li>Evidence of limited effective collaboration and communication with appropriate organisations external to the project.</li> </ul>	<ul style="list-style-type: none"> <li>Moderate improvements over time, with some novel learning for the cost of the activities (i.e. adaptive management outcomes moderate).</li> <li>In most cases, but not all, succeeds in producing the intended quality and quantity of deliverables (including data), within the available resources in a timely fashion.</li> <li>Some evidence of pooling of resources to take up opportunities for joint activities, or mutual learning with other organisations and networks.</li> <li>Evidence of some effective collaboration and communication with appropriate organisations external to the project.</li> </ul>	<ul style="list-style-type: none"> <li>Obvious improvements over time, with novel learning across themes/scales for the cost of the activities (i.e. adaptive management outcomes efficient and represent good value for money).</li> <li>Succeeds in producing the intended quality and quantity of deliverables (including data), within the available resources in a timely fashion.</li> <li>Clear evidence of pooling of resources to take up opportunities for joint activities and mutual learning with other organisations and networks.</li> <li>Strong evidence of effective collaboration and communication with appropriate organisations external to the project (i.e. joint publications, conference papers etc).</li> </ul>

## Impact

Impact (influence)	Performance standards		
	Low impact	Moderate impact	High impact
<b>(Rubric 3)</b>	<ul style="list-style-type: none"> <li>The project did not result any significant direct or indirect outcomes that have led to improved, water management practices at either the Basin or regional scale.</li> <li>Some direct environmental outcomes partially achieved but do not include those most important to achieve desired impacts.</li> <li>Considerable underestimation of timeframe in which environmental outcomes and associated impacts would be observed.</li> <li>Unintended negative</li> </ul>	<ul style="list-style-type: none"> <li>The project resulted in direct or indirect, improved water management practices at the regional scale.</li> <li>Most direct environmental outcomes either achieved or on track to being achieved.</li> <li>Minor underestimation of timeframe in which environmental outcomes and associated impacts would be observed, due mainly to unpredictable external factors.</li> <li>Unintended negative environmental impacts</li> </ul>	<ul style="list-style-type: none"> <li>The project resulted in direct, improved water management practices at either the Basin and/or regional scale that will be sustained.</li> <li>All direct environmental outcomes fully achieved leading to desired impacts.</li> <li>No unintended negative environmental impacts observed.</li> </ul>

	environmental impacts observed of significant impact on achieving desired outcomes.	may be observed, but of minor impact on achieving desired outcomes.	
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## APPENDIX B: EWKR EVALUATOR RATIONALE AND CONSENSUS JUDGEMENT

### EFFECTIVENESS – ACHIEVED OBJECTIVES

- 1 high-level KEQ
- 7 mid-KEQs
- 34 micro-KEQs

High KEQ 1	How well has EWKR achieved its objectives?
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>The effectiveness with which each of these objectives and their subcomponents was met is discussed in detail in the responses to various mid and micro questions of this KEQ, along with the effectiveness of specific objectives outlined in the Multi-Year Research Plan. Many of these objectives were not addressed. A 'List of contextual factors for LTIM and EWKR Review' explained that funding constraints led to elements of the objectives becoming less of a focus. Research teams identified that there were so many knowledge gaps with understanding ecological species response to environmental flows alone, and that understanding threats and complementary natural resource management activities were less of a priority knowledge gap for some of the themes. Consequently, research questions were refined substantially to a much smaller subset. Further, the Queensland Floodplain Vegetation Project (described in DSITI 2017, cited in References as Senior et al. 2019) was a project that had already been designed and was funded by EWKR without needing to go through the EWKR prioritisation process so it, too, did not address many of the objectives. The 2019 Evaluation did not ask participants about the effectiveness with which the EWKR project achieved its objectives. However, a survey done for the current evaluation asked participants about their familiarity with the EWKR project objectives, and then 'To what extent do you think the EWKR project achieved its objectives? On what basis?'. There were also some questions about two specific objectives (how environmental water management influences ecosystem function and thereby sustains biodiversity, and the identification of incremental changes in ecological condition and their links with ecosystem responses to watering regimes (natural and/or managed events) in each of the themes). Over half the 35 respondents replied they were 'Very familiar' or 'Extremely familiar' with the objectives. To the question 'To what extent do you think EWKR project achieved its objectives?', of those who did not reply 'Don't know', over two-thirds selected the option 'Some objectives have been met, and more are likely to be met in the future.' Specific responses clarified this perception, with many respondents replying that although many of the broad objectives had not been addressed in detail, the real benefit was getting some contribution to the knowledge base from sound scientific research (e.g. 'The stated objectives were extremely broad though, so EWKR is contributing to this knowledge base, rather than 'answering' all the questions. Less progress made on communicating this understanding to end users, but it's probably arguable whether that should be the role of the science program'; 'The primary intent of EWKR was to improve the science available to support the needs of environmental water managers. EWKR certainly contributed to improving the knowledge base.'). There was also a strong feeling that the objectives were largely aspirational and broad, and would only be met in time with further research (e.g. 'By the nature of the research undertaken some of the objectives are more likely to be met in the future when there has been sufficient time to incorporate the outcomes of the research...'). Similar questions were asked during interviews. In contrast to the survey results, many interviewees admitted they were not very familiar with the original objectives. The majority of interviewees agreed that because they were not familiar with the original objectives, it was probably too difficult to assess the effectiveness with which they were met. Nonetheless, there were opinions that the work that had been done had met some of the objectives effectively even if the results had not been well communicated to managers. Interviewees were able to recall general aspects of the work (e.g. waterbirds being tracked) but none of the respondents specified an objective from the Grant Guidelines and presented evidence of its effective achievement. Some were quite critical of the management relevance of some of the work, and considered that elements of the EWKR research activities had not addressed objectives relevant to managing environmental water. Overall, as many of the objectives were either not addressed or only specific elements at one or a few</p>

	sites (often for a brief period) were addressed, the effectiveness was rated as minimal.
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>EWKR was only partially successful in achieving the project's overarching objectives, which are articulated in the Grant Guidelines and Multi Year Research Plan. This was in large part due to the shift in focus to targeted research questions addressing key knowledge gaps in the ecology-water space, and a move away from the overly aspirational, high level nature of these objectives which could not effectively be addressed by a program of the size and resources of EWKR. Comments are provided here against the project objectives, which were to improve understanding of the following seven matters: 1 how environmental flow management influences ecosystem function and thereby sustains biodiversity The influence of key aspects of environmental water (water regimes and events) and its delivery on selected aspects of ecosystem function (energy and food production via food webs) have been addressed. 2 how the major drivers of system condition (e.g. flow, land use, invasive species) interact to affect biodiversity, ecosystem function, resilience and water quality The influence of the set of major drivers on aquatic environmental responses has not been addressed – the focus has been substantially on environmental water. Resilience and water quality were not adequately addressed by EWKR. Selected aspect of biodiversity and ecosystem function and their responses to water regimes and events have been addressed. 3 how threats (hydrological, aquatic and terrestrial) may reduce or prevent the ecological improvement expected through the application of environmental water Threats to ecological improvement were addressed in EWKR in foundation reviews, conceptually, and in syntheses and conclusions. They were not addressed in research activities, with a few exceptions. 4 how the management or delivery of environmental flows influence environmental outcomes achieved over time. The management of environmental flows nor their mode of delivery were addressed by EWKR during consultations with selected water managers and during conceptual development activities. Management of eflows was partially addressed in research activities due to the focus on ecological responses to key aspects of water regime and event delivery. The resulting knowledge was presented as information on management relevance in each Theme final report, in the theme information for managers sections of the Synthesis report, and in that report's cross-theme synthesis. Overall, however, EWKR did not assess how recent or historical management and delivery of eflows influenced environmental outcomes. 5 the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition Links between ecosystem responses to watering regimes were well addressed by EWKR, using a theme structure centered around biodiversity components (fish, vegetation, waterbirds) and aspects of function (food webs and energy). They were not however integrated under an overall concept of ecosystem condition. 6 how complementary water management and natural resource management enhance the outcomes of environmental water management. Management complementary to water management was not specifically addressed by the EWKR project, though it was identified during various theme foundational activities, conceptual models and outputs of analysis and modelling. 7 the links between ecosystem responses to management interventions (water management and natural resource management) and incremental changes in the ecological condition. The links between ecosystem responses and changes in ecological condition were not specifically targeted or adequately addressed by EWKR. EWKR did however address key aspects of overall ecological condition in its investigation of specific theme-based ecological responses to water regimes and events – though not to multiple management interventions.</p>
<b>Revision comments Evaluator 1</b>	<p>I furiously agree with all your comments and I fully understand the reasons as to how and why the objectives changed. We are in close agreement with our comments and we'll be able to use a lot of this material in our eval report.</p> <p>But I cannot bring myself to call this 'Moderately effective' in light of the rubric's performance criterion: • Majority of objectives, as specified in the head contract and foundation documents, at Basin and Selected Area scale fully achieved. Some partially achieved, but likely to be achieved over longer timeframe. cf. the criterion for Minimally effective: • Majority of objectives, as specified in the head contract and foundation documents, at Basin and Selected Area scale partially achieved. Some unlikely to be achieved over longer timeframe.</p> <p>I would prefer 'Minimally effective' as we are judging the what rather than the why...</p>
<b>Revision comments</b>	<p>I agree. Minimally Effective is appropriate. Though I am conscious that this should reflect on the entirety of the project management - from conception to completion. This means that the assessment is of the Project "as managed by the Department and its contractees" rather than the only the contracted Management team of the EWKR</p>



<b>Evaluator 2</b>	project. The message here being that setting 'aspirational' poorly thought out objectives which do not match the funding reality nor the core needs of stakeholders, sets up an inefficient model of knowledge delivery, and a high likelihood of failure to deliver.
<b>Revised rating</b>	<b>Minimally Effective</b>
<b>Consensus final rating</b>	<b>Moderately Effective</b> This rating was revised after discussion about how best to deal with the two different sets of objectives: those initially specified in the Grant Guidelines (many of which were not achievable with the available resources) and those that were eventually addressed after consultation with the Scientific Advisory Group. It was agreed that this latter group was the more relevant group for this assessment, despite the wording of the performance criteria in the rubric that referred solely and explicitly to those objectives specified in the 'head contract and foundation documents'. With this amendment, the evaluators agreed that the objectives that were eventually addressed were achieved moderately effectively.

<b>Mid KEQ 1.1</b>	<b>How effectively did the EWKR project improve understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  The reports (particularly the food web theme final report (2019)) provided little evidence that research activities focused on how flows influence ecosystem functions (e.g. productivity, nutrient cycling) nor was there much work done on biodiversity (apart from in the vegetation theme). Although some of the reports on the food web theme claimed that foodwebs are an ecosystem function, this is not true – the transfer of energy among trophic levels is actually the functional process. There were no empirical data collected on how environmental flow management affects the transfer of energy among trophic levels and hence sustains biodiversity, although the research program did extol the importance of knowing this. To the program's credit, there was discussion of the importance of flows and ecosystem function (interpreted as food web dynamics) and an effort to build this into a conceptual model. However, there is doubt about effectiveness with which this message was communicated and then improved understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity. For water managers, the survey responses broadly agreed that communication with managers was less effective than it could have been (e.g. 'The links with water managers could have been stronger, for example through co-design of projects and involvement as team members in the project design and delivery'), seriously impacting on their understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity. Nonetheless, in response to the question 'How effectively did the EWKR project improve water managers' understanding of how environmental water management influences ecosystem function and thereby sustains biodiversity', well over three-quarters of the respondents replied 'Somewhat effectively' or better. Interviewees' perceptions about the effectiveness with the EWKR project improved understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity appeared to be a general feeling that knowledge had been gained and that that information would be relevant in management. However, a follow-up question to one respondent (a researcher) asked about work on how flow influences ecosystem function and therefore sustains biodiversity, and the reply was that the focus was not on biodiversity but how energy moved through the foodweb, where the energy came from and its quality. The respondent went on to say that findings had been more about identifying the gaps in the work rather than specifically linking flow to ecosystem functioning. No other interviewee's responses provided any specific examples of how environmental flow management influences ecosystem function, including the transfer of energy across trophic levels. It was clear that many interviewees defined 'ecosystem function' much more broadly than ecologists do, and it appeared to be a general term for any ecological process. Nonetheless, even with the broader definition, specific examples were not provided of how findings from research activities in the EWKR project had improved understanding how flow affects ecological processes. (I could be persuaded this was Moderate if we use the broader definition of ecosystem function)
<b>Evaluator 2</b>	<b>Moderately Effective</b>  The EWKR project has been effective at improving key aspects of the understanding of how environmental water events and regimes influence food and energetic aspects



	of ecosystem function, as they pertain to dietary needs of native fish and waterbirds. Thus, EWKR addressed this question within the limited constraints of the resources and time available and in the context of the theme structure it adopted. It did not address the broader issue of links between environmental water, ecosystem function and biodiversity, other than at a conceptual level. It also did not target current environmental water management actions as drivers of functional or biodiversity responses, focusing rather on improving the understanding of flow and water regime as drivers of specific ecological responses. Given these constraints and focus, which are broadly appropriate and understandable, I rate the project as moderately effective.
<b>Revision comments – Evaluator 1</b>	Will upgrade my assessment to Moderately effective, using your reasoning and my concession to the broader definition of ecosystem function
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Moderately effective</b>

<b>Micro KEQ 1.1a</b>	<p>How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan?</p> <p>1. What flow regimes best support food webs that transfer energy to support recruitment of native fish? 1A What are the main energy sources contributing to larval fish biomass in the field?</p>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Results from mesocosm and field experiments described in the final report for the foodweb theme indicated that green algae are a key basal resource for fish, providing a high-quality food. Essential fatty acids from green algae were traced through food webs from invertebrates to fish. However, this work was done only for Murray cod and carp gudgeon (i.e. not all fish), the experiments were not repeated and were done only at a few (non-overlapping) locations so the spatial and temporal replication is limited at best. There were no questions in the survey that related to this KEQ and none of the responses to other questions commented on this topic in passing. The same applied to the interviews, although there was a comment from one of the researchers that the focus of this aspect of the foodweb theme was on where the energy is coming from and its quality, rather than identifying changes in ecological condition in response to watering regimes.</p>
<b>Evaluator 2</b>	<p><b>Effective</b></p> <p>Main energy sources (and highest food quality and food web efficiency) provided to larval (and adult) fish clearly linked to production of green algal (sestonic) resources in wetlands and anabranches on inundation and reconnection. Energy and food resource provision, to support surrogates for fish recruitment, was clearly demonstrated and linked to inundation beyond the river channel.</p>
<b>Revision comments – Evaluator 1</b>	Will upgrade my assessment to Effective; but would have liked to see more convincing evidence that the larval biomass of the two species of fish was truly linked to the amount of green algae and that these results could reasonably be extrapolated to all native fish
<b>Revision</b>	Agree - Effective

<b>comments – Evaluator 2</b>	
<b>Consensus final rating</b>	<b>Effective</b>

<b>Micro KEQ 1.1b</b>	<p>How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan?</p> <p>1. What flow regimes best support food webs that transfer energy to support recruitment of waterbirds? 1A What are the main energy sources contributing to waterbird recruitment in the field?</p>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>The final reports for the foodweb and waterbirds theme described how royal spoonbills fed predominantly on fish and yabbies whereas straw-necked ibis fed primarily on beetles, centipedes and other indeterminate insects. However, this work was done on ibis and spoonbills (not all waterbirds), not replicated over time, and only on samples collected from a few locations. Further, the specific link of the energy sources contributing to recruitment was inferred rather than empirically demonstrated. No questions in the survey or interviews related specifically to this KEQ. The only passing comment on the topic was by a researcher who said that the focus of this aspect of the foodweb theme was on where the energy is coming from and its quality, rather than identifying changes in ecological condition in response to watering regimes.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>Main energy sources (and highest food quality) provided to two key bird species were clearly identified. Details of specific flow regimes required to transfer energy to support waterbird recruitment were not identified, other than the need to support wetland/anabranh (fish+yabby) and/or riparian/wetland margin (beetle+invertebrate) food production.</p>
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 1.1c</b>	<p>How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan?</p> <p>1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds? 1B Are there clear spatial patterns in the importance of different energy sources for fish?</p>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>McInerney et al. (in review) in their draft ms ‘Basal resource quality and energy flow in a lowland river food web’ in Appendix 1.2 of the Food Webs Theme Report appendices (2019) described how they had found clear differences in the quality of basal resources between the river channel and floodplain habitats. Floodplains were characterized by food resources with higher concentrations of essential fatty acids. This work was done only in the Ovens River, sampled once (summer 2017), and corroborated the initial literature reviews that also showed clear spatial patterns in different energy sources for fish in different areas. No questions in the survey or interviews related specifically to this KEQ, and there were also no passing comments on the topic of spatial patterns in the importance of different energy sources for fish.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>Spatial patterns in energy source importance were effectively demonstrated, especially at the scale of river channel, wetland and anabranh - information of clear utility to</p>

	on-ground operational managers and planners. Larger scale (from asset to valley and Basin) spatial patterning was not examined, and was likely beyond the scope and resourcing of the project. Spatial patterns in energy source production were only broadly and conceptually linked to flow regimes.
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 1.1d</b>	How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan? 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds? 1B Are there clear spatial patterns in the importance of different energy sources for waterbirds?
<b>Evaluator 1</b>	<b>Moderately Effective</b>  The final reports of the waterbird and synthesis themes both outline the finding that royal spoonbills rely primarily on aquatic prey whereas straw-necked ibis sources its energy from terrestrial prey. In particular, spoonbills were relying largely on fish whereas ibis relied on beetles. These results indicate clear spatial patterns in the importance of different energy sources for these two species of waterbirds but cannot be held to apply to all waterbirds throughout the Basin. Further, in the waterbird final report, it states 'However at present we have limited knowledge regarding the biomass or availability of appropriate food sources for waterbirds, spatially or temporally, or how these are affected by environmental flows and other pressures'. No questions in the survey or interviews related specifically to this KEQ, and there were also no passing comments on the topic of spatial patterns in the importance of different energy sources for waterbirds.
<b>Evaluator 2</b>	<b>Moderately Effective</b>
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 1.1e</b>	How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan? 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds? 1C Are there clear temporal patterns in the importance of different energy sources for fish?
<b>Evaluator 1</b>	<b>Moderately Effective</b>  Price et al. (Appendix 1.6 of the final fish theme report) in their ms titled 'Comparison of the thermal and nutritional regimes among main channel and floodplain habitat patches' state that densities of benthic microcrustaceans boomed in the wetlands following floodplain inundation and then decreased in February and March when the floodplain was drying. However, in anabranches, densities increased over time which was also the case for pelagic microcrustaceans. McInerney et al. (Appendix 1.2 of the Food Webs Theme Report appendices (2019)) in their ms titled 'Basal resource quality and energy flow in a lowland river food web' report changes over six-week periods in the abundances of invertebrates after wetting in three mesocosm trials using soil from two wetlands from the northern Murray Darling Basin. The patterns of changes in invertebrate abundances differed between taxa, wetland soils and the different trials. In general, abundances increased between the second and fourth weeks and then either declined or continued to increase. Peak abundances generally occurred in either the fifth or sixth weeks. Such short-term patterns in zooplankton abundances in mesocosms and field samples were already known for parts of the MDB and other locations but it was valuable to assess the links with food and energy sources for fish. The temporal patterns that have been described in the EWKR project are relatively short-term (weeks to months) rather than seasonal or inter-annual, and further work is needed to assess how these temporal changes affect which flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds.

	No questions in the survey or interviews related specifically to temporal patterns in the importance of different energy sources for fish, and there were also no passing comments on the topic.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The theme research activities did not address temporal aspects of energy provision and food resource quality for fish other than conceptually and acknowledging this as a knowledge gap.
<b>Revision comments Evaluator 1</b> –	I'll downgrade my assessment to Minimally effective as I like (and missed) the point you make about temporal changes in the quality of the food.
<b>Revision comments Evaluator 2</b> –	Agree
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.1f</b>	How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan?  1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?  1C Are there clear temporal patterns in the importance of different energy sources for waterbirds?
<b>Evaluator 1</b>	<b>Minimally Effective</b>  This question was not specifically addressed in the research program, and the waterbird final report (2019) concludes that 'at present we have limited knowledge regarding the biomass or availability of appropriate food sources for waterbirds, spatially or temporally, or how these are affected by environmental flows and other pressures'. It could reasonably be inferred that gross differences (e.g. aquatic vs terrestrial) in sources of energy for waterbirds are likely to show clear temporal patterns for habitats that undergo, for example, seasonal inundation. But no evidence was produced during the EWKR project to test this hypothesis or assess temporal patterns in the importance of different energy sources for waterbirds. No questions in the survey or interviews related specifically to this topic, and there were also no passing comments on temporal patterns in the importance of different energy sources for waterbirds.
<b>Evaluator 2</b>	<b>Not Applicable</b>  This was not addressed in the theme's research activities.
<b>Revision comments Evaluator 1</b> –	If we run with 'Not applicable', we should agree on a performance indicator criterion. How about: '• Objective, as specified in the head contract and foundation documents, at Basin and Selected Area scale not attempted. If we run with 'Not applicable', we should agree on a performance indicator criterion. How about: '• Objective, as specified in the head contract and foundation documents, at Basin and Selected Area scale not attempted. Highly unlikely to be achieved over longer timeframe.' If this is acceptable, then I concur with 'Not applicable' but would rather call it 'Not attempted'. Highly unlikely to be achieved over longer timeframe.' If this is acceptable, then I concur with 'Not applicable' but would rather call it 'Not attempted'
<b>Revision</b>	Not attempted or Not applicable need to be agreed as formal assessment criteria. Not attempted implies objective is reasonable/relevant and project failed to address it (=

<b>comments – Evaluator 2</b>	a down mark for project management). Not applicable implies objective was not relevant to the core focus of the project (= down mark for project oversight by Department). These are different interpretations.
<b>Consensus final rating</b>	<b>Not Attempted</b>

<b>Micro KEQ 1.1g</b> How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan? 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds? 1D Is there evidence of ‘energy bottlenecks’ preventing passage of energy to higher trophic levels for fish?	
<b>Evaluator 1</b>	<b>Minimally Effective</b>  Not attempted or Not applicable need to be agreed as formal assessment criteria. Not attempted implies objective is reasonable/relevant and project failed to address it (= a down mark for project management). Not applicable implies objective was not relevant to the core focus of the project (= down mark for project oversight by Department). These are different interpretations.
<b>Evaluator 2</b>	<b>Not Applicable</b>  This was identified as a priority research question via both the stakeholder engagement and the literature review, but was not carried forward.
<b>Revision comments – Evaluator 1</b>	If we run with 'Not applicable', we should agree on a performance indicator criterion. How about: '• Objective, as specified in the head contract and foundation documents, at Basin and Selected Area scale not attempted. Highly unlikely to be achieved over longer timeframe.' If this is acceptable, then I concur with 'Not applicable' but would rather call it 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Not attempted or Not applicable need to be agreed as formal assessment criteria. Not attempted implies objective is reasonable/relevant and project failed to address it (= a down mark for project management). Not applicable implies objective was not relevant to the core focus of the project (= down mark for project oversight by Department). These are different interpretations.
<b>Consensus final rating</b>	<b>Not Attempted</b>

<b>Micro KEQ 1.1h</b> How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan? 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds? 1D Is there evidence of ‘energy bottlenecks’ preventing passage of energy to higher trophic levels for waterbirds?	
<b>Evaluator 1</b>	<b>Minimally Effective</b>  Although the review by Rolls et al. (2017) acknowledged the significance of critical nodes in the flow of energy through the food web (‘bottlenecks’) and their existence was identified as a priority research question during the stakeholder engagement process, ‘energy bottlenecks’ for waterbirds were not explicitly assessed in the research

	program nor was this question addressed directly. No questions in the survey related specifically to this topic, and energy bottlenecks were never mentioned in any of the responses to any of the other survey questions. A couple of times during the interviews, bottlenecks were mentioned by the interviewer when phrasing questions but only once did this elicit a specific answer and that was one that said how useful it would be to have that kind of information.
<b>Evaluator 2</b>	<b>Not Applicable</b>  This was identified as a priority research question via both the stakeholder engagement and the literature review, but was not carried forward.
<b>Revision comments – Evaluator 1</b>	If we run with 'Not applicable', we should agree on a performance indicator criterion. How about: '• Objective, as specified in the head contract and foundation documents, at Basin and Selected Area scale not attempted. Highly unlikely to be achieved over longer timeframe.' If this is acceptable, then I concur with 'Not applicable' but would rather call it 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Not attempted or Not applicable need to be agreed as formal assessment criteria. Not attempted implies objective is reasonable/relevant and project failed to address it (= a down mark for project management). Not applicable implies objective was not relevant to the core focus of the project (= down mark for project oversight by Department). These are different interpretations.
<b>Consensus final rating</b>	<b>Not Attempted</b>

<b>Micro KEQ 1.1i</b>	How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan?  1. What flow regimes best support food webs that transfer energy to support recruitment of native fish?  1E How does provision of flow affect any patterns detected in 1.1A–D?
<b>Evaluator 1</b>	<b>Moderately Effective</b>  Although there were no direct experiments or field assessments of how flow provision affected spatial and temporal patterns in the importance of energy sources for native fish, inferences about likely flow effects could be drawn from results of the mesocosm and field experiments and from the simulation model derived in the food web theme. In general terms, it was proposed that flows can be used to encourage the growth of green algae (a high-quality food source for larval fish) (food web theme final report (2019)), to inundate floodplain habitats to promote zooplankton production (fish theme final report (2019)) and to provide hydrological connectivity to allow fish to access sites of high food abundance and quality (fish theme final report (2019)). The food web theme final report (2019) stated that environmental water can be used to regulate wetland energy subsidies that will determine food web responses and carrying capacity for wetland fish and bird recruitment (e.g. less water can be used to target inundation of areas known to support higher densities of high-quality green algae). The food web theme final report (2019) included a simulation-based quantitative food web model (Appendix 1.5) that uses characteristics of environmental watering events as inputs and ranks those watering events based on simulated larval fish biomass (using the Gwydir wetlands as a test case) to optimise the efficiency of the food web. Disentangling whether the diet quality or composition change with different watering scenarios is critical to the use of this model to support management. Targeting shifts in diet composition and producer quality allow watering events to be designed to disproportionately benefit fish. Green algae have the potential for high production rates and can contribute a large proportion of the energy used by fish. While we currently have few data to target watering events to the production of green algae, it is likely that managers on the ground may have local knowledge to achieve this. These results, highlighting the importance of green algae, complement findings from the Ovens and Gwydir. No survey questions specifically asked this KEQ but there were responses to other questions that indicated some respondents were aware of the associations of flows, food webs and native fish, and sought their better integration (e.g. 'Integrating the fish and food webs theme would be very useful to demonstrate the value of overbank flows to aquatic food webs and native fish (recruitment).'). There was also acknowledgement of the relevant of hydrological connectivity ('think that particularly the foodwebs and food resources findings, highlight the importance of

	connectivity and this ecosystem function to provide the building blocks for healthy populations of fish and waterbirds.') although the comment did not specifically link this to flows. Another comment by a manager indicated that there was some understanding of these hydrological links and that they were being used to inform flows management ('...the foodweb findings on the relative quality of food in channel, vs anabranch, vs billabong is driving thinking around where and how to connect critical off channel habitats via environmental water and the need to ensure return flows from those sites.'). When prompted, interviewees responded only in general terms about their understanding of how flow regimes affect the sources of energy, their quality, and spatial and temporal patterns in their distribution. Most of the references were to energy needs of waterbirds but there were a couple of mentions of fish. There was certainly recognition of the value of knowing this information but acknowledgement that more results are needed before the findings can be readily translated into management strategies to promote foodwebs and increase productivity.
<b>Evaluator 2</b>	<b>Moderately Effective</b>  Details of specific flow regimes required to transfer energy to support fish recruitment/populations were not identified beyond the need for anabranch and wetland inundation and reconnection targeting algal/sestonic production.
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 1.1j</b>	How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan?  1. What flow regimes best support food webs that transfer energy to support recruitment of waterbirds?  1E How does provision of flow affect any patterns detected in 1.1A–D?
<b>Evaluator 1</b>	<b>Minimally Effective</b>  Although the Annual Research Plan (2016-17) specified an objective 'What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?', this was never directly assessed for waterbirds. The waterbird forum presentation (2019) identified the likely energy needs for spoonbill chicks but this was not explored further in terms of flow needs. The final synthesis report (2019) stated 'still unsure how much food is available in a wetland, and which flows best support the provision of these resources'. A generic statement that 'consideration of specific waterbird species' trophic requirements are important when tailoring management of environmental watering to maximise food availability to support waterbird recruitment' was made in the waterbird theme final report (2019). For example, if royal spoonbills are known to breed in a particular location, watering should be targeted to maximise the abundance of aquatic food resources, such as small fish, yabbies and prawns. If, however, a location is known to support primarily straw-necked ibis, colonial breeding, environmental water might be better used to promote diverse floodplain, riparian and terrestrial foraging habitats that support a diverse array of vertebrate and invertebrate prey. However, these inferences were not linked back to specific components of any of the themes or to data sets from particular research activities. There was no modelling or further assessment for waterbirds. Although no survey questions asked about how flow regimes affect the sources of energy, their quality, and spatial and temporal patterns in their distribution with regards to waterbirds, there was one potentially relevant response to the question: 'How impactful have the outcomes from each theme been on providing new knowledge for water managers to better inform achievement of environmental outcomes from the use of environmental water?'. This response was: 'Its findings may have some application for ewater management - in better understanding how native waterbirds move and find food - but the research did not connect with ewater delivery or even inundation extent of key assets, to my knowledge'. Thus, while the relevance of the work was fully appreciated, the failure in the EWKR project to assess the links with flows detracted greatly from gaining more robust understanding of the potential benefits for environmental water management to promote foodwebs to support waterbirds. Similarly, in the responses to various interview questions, there were quite a few generic comments about the importance of flows for waterbirds and their foraging habitats, there were no specific mentions of evidence from the EWKR project about how flow regimes affect the sources of energy, their quality, and spatial and temporal patterns in their distribution with regards to waterbirds.

<b>Evaluator 2</b>	<b>Minimally Effective</b>  Details of specific flow regimes required to transfer energy to support water bird recruitment and/or populations were not identified beyond the need for appropriate watering of specific bird habitat locations for food production.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Mid KEQ 1.2</b>	<b>How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect biodiversity, ecosystem function, resilience and water quality?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  There was little evidence for direct research assessing how the interactions among major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) affected biodiversity, ecosystem function, resilience and water quality in any of the themes. However, interactions among some of the major drivers for individual parameters were inferred, and these are explored in more detail in the responses to KEQs 12a-e). In an informal assessment of the context and evolution of EWKR, it is claimed that funding constraints led to some elements of the objectives becoming less of a focus. Research teams identified that as there were so many knowledge gaps with understanding ecological species response to environmental flows alone, understanding threats and complementary NRM activities were less of a priority. This became evident during the refinement of research questions and conceptualisation activities, and applies to each of KEQs 12a-e – the interactions among drivers were never directly investigated and therefore empirical results from EWKR would not be able to improve understanding of these interactions at all. The survey did not ask specifically about how effectively the EWKR project improved understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect biodiversity, ecosystem function, resilience and water quality. Not surprisingly, none of the responses alluded to interactions among drivers, and water quality and resilience were never mentioned. Likewise, this specific question was not asked in the interviews. In a wider discussion about synthesis among themes, one respondent (a manager) mentioned the importance of assessing interactions among drivers, potentially by using a model, but there was no reference to any work done in EWKR. Resilience was mentioned in passing when discussing managing refugia but not in the context of how interactions among drivers affect it. There were no allusions to how water quality might be affected by one or more drivers.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The question of interactions between major drivers of system condition was addressed in foundational activities and conceptual models for the themes. It was not however specifically or effectively addressed in the subsequent theme research activities. Some themes (especially fish and vegetation) identified key drivers other than flow and watering regimes, that influence ecological responses to flow and water regimes, and explored likely interactions, but did not comprehensively target these in research activities. Overall, there was little improvement in understanding of major driver interactions in determining ecological outcomes. This is understandable, given the timeframe and resourcing of the project, and the identification of flow-ecology relationships as fundamental to the science required, but this should have been specifically removed from the project's objectives.
<b>Consensus final rating</b>	<b>Minimally Effective</b>



Micro KEQ 1.2a	How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect biodiversity based on all research activities of the project?
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Although acknowledged as a relevant objective, mentioned in the 2016-17 Annual Research Plan for vegetation, and identified by researchers as a priority (with 35 questions related to biodiversity in the preliminary identification of Level 1 research questions in 2014, Table 7), this objective was never specifically addressed in any of the subsequent research activities in any of the themes. Indeed, biodiversity was not a focal point in any of the themes apart from, for some groups, the vegetation theme – and even then, the potential effects of interaction of drivers were not addressed. In an informal assessment of the context and evolution of EWKR, it is claimed that funding constraints led to some elements of the objectives becoming less of a focus. Research teams identified that as there were so many knowledge gaps with understanding ecological species response to environmental flows alone, understanding threats and complementary NRM activities were less of a priority. This became evident during the refinement of research questions and conceptualisation activities. There were no questions in the survey or interviews on this aspect of the EWKR project, nor were any relevant comments provided in response to other questions. In the interviews, one researcher commented that there was not a strong focus in the EWKR project on biodiversity.</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>Despite discussion of biodiversity in EWKR objectives, and adoption of biodiversity-based themes, the project did not address responses or outcomes in biodiversity - as defined under the Water Act. In addition, the project did not attempt to evaluate the interaction between major drivers and the theme-based biodiversity elements (fish, birds etc.). There were no research activities focused on this objective, and funding constraints appeared to have led to a focus on environmental flow as a key driver for theme-based outcomes.</p>
<b>Consensus final rating</b>	<b>Minimally Effective</b>

Micro KEQ 1.2b	How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect ecosystem function based on all research activities of the project?
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Although acknowledged as a relevant objective and identified by researchers as a priority (with 39 questions related to ecosystem function in the preliminary identification of Level 1 research questions in 2014, Table 7), this objective was never specifically addressed in any of the subsequent research activities in any of the themes. Sometimes, food webs were stated to be 'ecosystem functions' (e.g. 'Food webs are one of several critical ecosystem functions believed to be important in sustaining patterns of diversity in the MDB.' - 2018-19 Annual Research Plan) but this is imprecise and should really refer to the transfer of energy across trophic levels. Even if we adopt this broader definition, the potential effects of the interaction among multiple drivers such as environmental flow, land use and invasive species on food webs were not addressed specifically. The food web theme final report (2019) produced a simulation-based quantitative food web model (Appendix 1.5) that uses characteristics of environmental watering events as inputs and ranks those watering events based on simulated larval fish biomass, using the Gwydir wetlands as a test case. However, this omitted quite a few drivers (e.g. land use, invasive species) and did not assess interaction effects of the others. In an informal assessment of the context and evolution of EWKR, it is claimed that funding constraints led to some elements of the objectives becoming less of a focus. Research teams identified that as there were so many knowledge gaps with understanding ecological species response to environmental flows alone, understanding threats and complementary NRM activities were less of a priority. This became evident during the refinement of research questions and conceptualisation activities. Neither the survey nor the interviews asked any specific</p>

	questions on how effectively research activities in the EWKR project improved understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect ecosystem function. Although some of the interview responses expressed opinions that the EWKR project had increased knowledge about ecosystem functions (defined broadly as ecological processes) and that some of this knowledge was filtering into management of environmental water, there were no specific mentions of findings from the research activities about the effects of interactions among drivers.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The project did not attempt to evaluate the interaction between major drivers and ecosystem function, and the research outputs do not refer to it. Funding and knowledge limitations seem to have led to a focus on flow as a key driver of selected ecosystem function responses, and this was mainly limited to resource provision for fish and conceptual exploration/modelling. In this limited context, the project has improved understanding of flow as a driver.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.2c</b>	<b>How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect resilience based on all research activities of the project?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  This was acknowledged as a relevant objective (related to protection of refugia) and identified by researchers as a priority (with 21 questions related to resilience in the preliminary identification of Level 1 research questions in 2014, Table 7). The Basin Plan and the BEWS also refer several times to resilience and its significance. Although there were no targeted research activities to address this objective in any of the themes, the final reports for the vegetation and fish themes both inferred that resilience was influenced by flow and non-flow drivers. The fish theme final report (2019) urged the need to appropriately manage these refuges during droughts, using both flow and non-flow related measures, to ensure resilience of the adult breeding stock so that strong recruitment can occur when suitable flow conditions return. In an informal assessment of the context and evolution of EWKR, it is claimed that funding constraints led to some elements of the objectives becoming less of a focus. Research teams identified that as there were so many knowledge gaps with understanding ecological species response to environmental flows alone, understanding threats and complementary NRM activities were less of a priority. This became evident during the refinement of research questions and conceptualisation activities. The survey did not ask specifically about how effectively the EWKR project improved understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect resilience, and none of the responses alluded to resilience. Likewise, this specific question was not asked in the interviews. Resilience was mentioned in passing when discussing managing refugia but not in the context of how interactions among drivers affect it.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  Though mentioned in objectives, the project did not attempt to evaluate the interaction between drivers and resilience. The research outputs do not refer to it, other than conceptually and by implication that ecological responses/outcomes of environmental watering may contribute to ecological resilience. Funding and knowledge limitations led to a focus on flow as a key driver of selected ecological responses, but no attempt was made to extend this to system resilience.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

Micro KEQ 1.2d How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect water quality based on all research activities of the project?	
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Water quality was less of a priority to researchers (only 4 questions related to water quality in the preliminary identification of Level 1 research questions in 2014, Table 7) but the fish theme final report (2019) identified its significance to larval survival and the vegetation theme final report (2019) extolled the roles that plants play in enhancing water quality. Background measures of water quality were collected during some research activities for the fish and waterbird themes but these data were never used as a dependent variable for addressing the objective (and indeed, probably would have been inadequate for this purpose). How the drivers of system condition such as environmental flow, land use and invasive species interact to affect water quality was never addressed directly by any research activities despite the relevance of water quality being acknowledged (e.g. in the conceptual model depicting the influence of flow on the growth and survival of larval riverine fish, Figure 4.2 in the Multi-Year Research Plan 2016-19). In an informal assessment of the context and evolution of EWKR, it is claimed that funding constraints led to some elements of the objectives becoming less of a focus. Research teams identified that as there were so many knowledge gaps with understanding ecological species response to environmental flows alone, understanding threats and complementary NRM activities were less of a priority. This became evident during the refinement of research questions and conceptualisation activities. No questions in the survey asked specifically about how effectively the EWKR project improved understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect water quality, and water quality was never mentioned in responses to other questions. Likewise, this specific question was not asked in the interviews. There were no allusions to how water quality might be affected by one or more drivers.</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>Water quality, and its interaction with major drivers, was not addressed by any research activity.</p>
<b>Revision comments – Evaluator 1</b>	Maybe this ought to be 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Agree – Not Attempted
<b>Consensus final rating</b>	<b>Not Attempted</b>

Micro KEQ 1.2e How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect food webs?	
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>The food web theme focused mainly on flow-related drivers (including relevance to hydrological connectivity) and sometimes referred to the roles of invasive species such as carp. However, the effects of invasive species and/or land use on food webs were never investigated directly nor was the interaction among these drivers and environmental flows. The reviews by Rolls et al. (2017) and Robson et al. (2017) focused mainly on hydrological drivers. In an informal assessment of the context and evolution of EWKR, it is claimed that funding constraints led to some elements of the objectives becoming less of a focus. Research teams identified that as there were so</p>

	many knowledge gaps with understanding ecological species response to environmental flows alone, understanding threats and complementary NRM activities were less of a priority. This became evident during the refinement of research questions and conceptualisation activities. There were no questions in the survey that asked specifically about how effectively the EWKR project improved understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect foodwebs, and none of the responses alluded to this topic. In the interviews, although there were no specific questions about how drivers interacted to affect foodwebs, there were several responses from interviewees that they saw this interaction as being important to know. Some interviewees commented that it was useful to have the insights about the effects of water temperature and other variables on foodwebs but that this research needed to go further (and several derivative projects were mentioned). It was also felt that although the models were a useful start, more work was needed on validating them and the drivers.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The foodwebs research activities improved understanding of the roles of inundation and reconnection in provision of quality food resources for fish, and tied this to environmental water management. No substantive improvement in understanding occurred for the waterbirds component for the research. No foodwebs research activity specifically addressed the influence of interactions of major drivers on foodwebs.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Mid KEQ 1.3</b>	<b>How effectively did the EWKR project improve understanding of how threats (hydrological, aquatic and terrestrial) may reduce or prevent the ecological improvement expected through the application of environmental water?</b>
<b>Evaluator 1</b>	<b>Moderately Effective</b>  The foundation literature reviews identified the importance of one or more threats to the success of ecological outcomes expected from the application of environmental water. For example, the review by McGinness (McGinness, H. M. (2016) Waterbird responses to flooding, stressors and threats. CSIRO, Australia. Literature review report) synthesised local and international literature on how various threats (e.g. habitat loss, fragmentation and change, predation, climate change, pollution, disease, human disturbance, competition) affect waterbirds and how these interact with the effects of flow. The fish theme final report (2019) also acknowledged that threats such as cold water pollution, for example, would impact on fish recruitment and larval survival. There was also some research in the vegetation, fish and waterbird themes that assessed the absolute or relative contributions of one or more threats to the ecological improvement expected through the application of environmental water. For example, in the vegetation theme final report (2019), it was acknowledged that identifying management actions to promote desired vegetation outcomes requires an understanding of the effects or predicted effects of flow on vegetation responses, and consideration of how non-flow drivers (e.g. climatic conditions, grazing, invasive species) influence predicted vegetation responses to the application of environmental water. Analysis of the relative importance of hydrological and climate variables on four wetland vegetation response metrics (i) native wetland plant species richness; ii) native wetland plant species abundance; iii) native dryland plant species richness; and iv) native dryland plant species abundance) from the Hattah Lakes revealed that the primary drivers were hydrological. Germination trials also indicated that responses of vegetation to watering were strongly influenced by location, and this was inferred to indicate that climatic and other stressors modified the responses to watering. Inferences about the effects of flow as well as factors such as climatic conditions, grazing pressure and invasive species were outlined in the Resource Availability Scenarios (Table 2 in the vegetation theme final report (2019)) to explain the management relevance of this work. The fish theme final report (2019) included conceptual models of threats and stressors on drivers such as water temperature (e.g. Figure 3) and there was a systematic literature review (Price and Gawne in Appendix 1.1. of the fish theme final report (2019) undertaken to assess evidence for the impact of flow and non-flow related stressors on drivers of fish recruitment (Figure 4, fish theme final report (2019)). Although the stressors identified in this conceptual model and the literature review were not all directly assessed, inferences about how these stressors may modify key variables such as water temperature and food quality were drawn when assessing the likely success of flow management to optimise native fish recruitment. In the waterbird theme final report (2019), satellite tracking of waterbird movements provided preliminary data on the relative importance of various drivers of mortality for

	<p>juveniles and adults. The main factors associated with mortality in the 38 deceased satellite-tracked birds were: heat exhaustion/cold/exposure (weather extremes) (28%); predation (e.g. raptors, foxes) (26%); shooting (6%); disease (e.g. botulism) (4%); vehicle impact (4%); and unknown (26%) causes. Mortality drivers that may fall into the 'unknown' class may include any of the above causes, or other diseases, poisoning and toxins, starvation/malnutrition, parasites and entanglement in fencing or powerlines. In another research activity on waterbirds, cameras were used to assess egg and chick survival and to capture data on possible effects of other pressures, stressors or threats such as predation, disturbance, starvation, competition and other bird behaviour. Overall, other than the unknown causes of mortality, the greatest driver of mortality in the 2015-16 pilot study was predation of eggs by raptors. In the 2016-17 survey year, the leading cause of mortality was abandonment of eggs, with the cause of abandonment often unclear or mixed. In the 2017-18 survey year, the leading cause of mortality was again predation of eggs. Other documented factors influencing mortality included nest exposure, anthropogenic disturbance, egg rejection, conspecific damage, competition and starvation. Thus, there was quite a bit of information about how threats (hydrological, aquatic and terrestrial) may reduce or prevent the ecological improvement expected through the application of environmental water. To assess how well this translated into understanding, the responses from the surveys and interviews are crucial. Only one question in the survey asked about threats: 'To what extent do you think the EWKR project has led to improved understanding by water managers' of medium- and long- term changes in ecological condition, including the effects of threats (hydrological, aquatic and terrestrial) which may reduce or prevent the ecological improvement expected?'. Of the researchers (n=10), 80% replied 'A moderate amount' or more. The proportion was much less for managers (n=13); after removing the ones who replied 'Don't know' (which was a high proportion ranging from 38-69%, and is indicative in itself), percentages replying 'A moderate amount' or better for the three different threats were: terrestrial (0%), aquatic (49%) and hydrological (37%), indicating that there was limited improvement in understanding for the end-users. Only one specific comment referred to threats and observed that assessment of threats at an asset scale were not necessarily relevant to the whole Basin ('I am coming from a Basin scale perspective. The threats to a Basin are very different to the threats to an asset. The EWKR work was at asset scale so has little relevance to the Basin scale.'). In response to the same question, and also in responses to other questions, comments by most interviewees reiterated that assessing threats was not a priority of the EWKR project. Several went on to say that results on threats were typically opportunistically obtained and not an element of the design of particular research activities. A few interviewees mentioned the threats observed to waterbirds (e.g. pigs raiding nests) as being interesting and helping to illustrate that factors other than flows could be relevant to management. Minimally effective [if we apply the performance criteria strictly, but I would prefer to rate this as Moderately effective]</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>The question of threats to ecological improvement responses to environmental water was addressed in several theme foundational activities and conceptual models. It was not specifically or effectively addressed in theme priority research questions research activities. Some themes identified key threats to ecological responses to flow and water regimes. Overall, there was little to no improvement in understanding of threats to ecological outcomes from environmental watering. This is understandable, given the timeframe and resourcing of the project, and the identification of flow-ecology relationships as fundamental to the science required, but this should have been specifically removed from the project's objectives.</p>
<b>Consensus final rating</b>	<p><b>Minimally Effective</b></p>
<b>Micro KEQ 1.3a</b>	<p>How well did the EWKR food web theme outputs answer the following question and subsidiary research questions posed in the Multi-year Research Plan?</p> <p>2. How do other stressors (e.g. land use change, invasive species) impact on food web processes and the achievement of native fish and waterbirds outcomes?</p> <p>2A Is there evidence for energy being diverted away from native fish (e.g. by carp)?</p>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>There was no investigation by the research activities of the fish or food web themes of energy diversions from native fish. Although the significance of carp as a threat was</p>

	acknowledged and it was hoped that Keller's postdoc would provide information on this threat, this was not part of EWKR and the effects of carp on energy use by native fish were not studied in the program. No survey responses referred to evidence for energy being diverted away from native fish (e.g. by carp) nor were carp mentioned. Similarly, there were no responses by interviewees on this topic although several commented favourably on the benefits of having a perspective on energy and productivity when managing the MDB.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The impacts of landuse change and invasive species as stressors on food web processes, native fish or waterbird outcomes and responses formed part of the set of research questions (for fish and waterbirds). They were not however addressed in Foodweb, Waterbird or Fish theme research activities or outputs. There is no evidence presented of energy being diverted away from native fish.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.3b</b>	How well did the EWKR food web theme outputs answer the following question and subsidiary research questions posed in the Multi-year Research Plan?  2. How do other stressors (e.g. land use change, invasive species) impact on food web processes and the achievement of native fish and waterbirds outcomes?  2A Is there evidence for energy being diverted away from waterbirds (e.g. by carp)?
<b>Evaluator 1</b>	<b>Minimally Effective</b>  This question was repeatedly posed (the Annual Research Plans for 2016-17, 2017-18 and 2018-19 and the Multi-year Research Plan) but never addressed directly in the waterbird or food web themes. For waterbirds feeding on aquatic prey, one might infer that carp would compete for energy but this was never demonstrated or proposed as a potentially important mechanism impacting on the achievement of waterbird outcomes. There were no responses in the survey or interview transcripts that referred to evidence for energy being diverted away from waterbirds (e.g. by carp). As mentioned in the response to KEQ13a, several interviewees commented favourably on the benefits of having a perspective on energy and productivity when managing the MDB.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The impacts of landuse change and invasive species as stressors on food web processes, native fish or waterbird outcomes and responses formed part of the set of research questions (for fish and waterbirds). They were not however addressed in Foodweb, Waterbird or Fish theme research activities or outputs. There is no evidence presented of energy being diverted away from waterbirds.
<b>Revision comments – Evaluator 1</b>	Agree - not attempted
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

Micro KEQ 1.3c	<p>How well did the EWKR food web theme outputs answer the following question and subsidiary research questions posed in the Multi-year Research Plan?</p> <p>2. How do other stressors (e.g. land use change, invasive species) impact on food web processes and the achievement of native fish and waterbirds outcomes?</p> <p>2B Is there evidence that productivity in the channel is limited by other factors (e.g. water turbidity, availability of productive substrates)?</p>
Evaluator 1	<p><b>Minimally Effective</b></p> <p>This question was repeatedly posed (Annual Research Plans for 2016-17, 2017-18 and 2018-19 and the Multi-year Research Plan) and was addressed directly in the fish theme. Humphreys et al. (Section 2.7 in the fish theme final report (2019)) assessed food production (as zooplankton production) in the main channel of the Ovens River in relation to flow, physical complexity and the associated retentiveness of different river reaches within a river segment. Although reach retentiveness significantly influenced density and composition of zooplankton, water temperature and conductivity were found to be the most influential factors affecting density and composition of the zooplankton fauna in the Ovens River. Factors such as turbidity were not assessed but were inferred as potentially affecting production (e.g. Robson et al. 2017). Although the food web theme final report (2019) generated a simulation-based quantitative food web model that included productivity, hydrological drivers were highlighted in the model and it was acknowledged that limitations of productivity by other factors were a source of uncertainty. There were no specific questions in the survey on this topic although several respondents, in their answers to other questions, praised the insights that had come from the EWKR project on potentially incorporating productivity into management (e.g. 'Key EWKR findings such as..., the productivity of flows along anabranches and flood runners and the energy requirements (number of Big Macs) to fledge waterbirds have been noted by us and appear in the draft 2020 Basin Plan evaluation documentation.'). However, none of these comments related specifically to findings on how productivity in the channel may be limited by other factors. Likewise, there were no specific questions on this topic in the interviews. Several interviewees said they would have liked to have seen more information on this topic to help guide their management activities and one researcher described how channel shape affects productivity responses to varying flows in the Goulburn. Many of the managers who were interviewed appreciated the information on productivity from the EWKR project. There was no mention of turbidity at all. <b>Moderately effective (borderline – I could be persuaded it was actually minimally effective).</b></p>
Evaluator 2	<p><b>Minimally Effective</b></p> <p>This was not addressed by any research activity, despite being mentioned in research plans.</p>
Revision comments – Evaluator 1	<p>Happy to call this 'Minimally effective' I think it was attempted in terms of zooplankton production in the channel so it is not a 'Not attempted'</p>
Revision comments – Evaluator 2	<p>Agree</p>
Consensus final rating	<p><b>Minimally Effective</b></p>

<b>Mid KEQ 1.4</b>	<b>How effectively did the EWKR project improve understanding of how management or delivery of environmental flow influences environmental outcomes achieved over time?</b>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>I've interpreted this question literally, focusing on the 'or' so that how either management or delivery of flows influences environmental outcomes is encompassed, and also the temporal component (which was best assessed in the vegetation theme where existing data sets over time were analysed). For example, the DSITI (2017) report describes the analysis of satellite-image time-series data of patches of the floodplain that maintained high vegetation vigour, a surrogate for vegetation condition, that showed most of the vigorous patches closely fringe the river channels and maintained vigour during dry periods too, implying groundwater-dependence. However, these responses were not subsequently then matched to delivery of flows or management in detail. The fish theme final report (2019) presented a conceptual model that predicted that a doubling of the flow pulse during the prescribed spawning season (October–March) resulted in a 64% increase in golden perch year-class strength (95%CI 14% to 136%) in the southern MDB. Activities in the waterbird and fish themes also suggested how different flows over time might affect waterbird and fish recruitment, respectively, leading to temporal changes in environmental outcomes. Finally, the food web theme final report (2019) also addressed how flows and management potentially alter pathways of energy through food webs, and this would also have a temporal component. For all four themes, broad suggestions of watering regimes and flow management were made that would potentially influence environmental outcomes over time. Responses to the surveys reiterated the pragmatic limitations of assessing temporal trends in the EWKR project but did agree that results of the EWKR project improved understanding of how management or delivery of environmental flow influenced those environmental outcomes (e.g. vegetation condition, waterbird recruitment, fish recruitment, zooplankton production) even if the understanding was largely based on inference and modelling instead of long time series of empirical data. There was also a comment that 'Most water delivery is focussed on asset/catchment level and involves explicit actions - can be tricky to pull out what is relevant/important to those actions from the broader process based info of EWKR. May often need an expert interpretation of how EWKR's process understanding might apply to/influence a particular action' indicating recognition of the importance of interpreting scientific advice for particular situations. Many interviewees from different backgrounds claimed that information from EWKR was relevant to their understanding of how delivery of environmental flow influences environmental outcomes achieved over time but that there were fewer insights about the effects of other management activities. Moderately effective</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>Evidence for the influence of management delivery of environmental flow on environmental outcomes in the project period (i.e. 1 to 5 years) is not evaluated nor presented. The context and design of EWKR effectively prevented such evaluations being conducted as research activities were targeted at addressing fundamental knowledge gaps about flow-ecology relationships. However, outcomes of research on vegetation, fish and functional processes to hydrological connection provides some improved understanding of management influences on related vegetation and fish outcomes at this time scale.</p>
<b>Revision comments Evaluator 1</b>	<p>– Let us discuss this one; I am not able to make a call on it. The question is actually asking about improvement in understanding so, to me, the evidence is primarily from the survey and interviews where quite a few interviewees thought it helped.</p>
<b>Revision comments Evaluator 2</b>	<p>– My response was based on the absence of a formal demonstration of environmental outcomes 'over time' that resulted from environmental flow management/delivery i.e. the absence of a research-based evaluation of response to historical/experimental eflow delivery/management actions</p>



<b>Consensus final rating</b>	<p><b>Minimally Effective</b></p> <p>The core team clarified that the focus of this question was on changes over time. It was also agreed that the definition of 'understanding' meant more than there simply being information available; there needed to be evidence that this information was understood and possibly led to changed behaviour or explicit use of the information. As a result of these clarifications, the evaluators agreed on 'Minimally effective' for this mid KEQ.</p>
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<b>Micro KEQ 1.4a</b>	<b>How effective were the EWKR theme outputs and their synthesis in improving understanding of how management influences environmental outcomes achieved over time?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Despite my broad interpretation of this question (see comments on KEQ14), I was not able to find much evidence in the reports of the four themes where influence of management (rather than delivery of environmental flows) on environmental outcomes was assessed directly. Not surprisingly, there were also few inferences that were drawn about how management influences environmental outcomes achieved over time for any of the themes. The EWKR final project report (2019) stated that 'The intent of MDB EWKR was to improve the science available to support the needs of environmental water managers in the Murray–Darling Basin. Research focused on: • improved identification, assessment and understanding of the links between the ecological responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition (the state of ecological systems including physical, chemical and biological characteristics and the processes and interactions that connect them (US EPA 2018)). • medium and long-term changes in ecological condition, including the effects of threats (hydrological, aquatic and terrestrial) which may reduce or prevent the ecological improvement expected. • how management or delivery of environmental flow influences environmental outcomes achieved over time.' [my italics]. Later this report goes on to say 'In final reporting, theme coordinators were unfamiliar with converting science outcomes to water management recommendations. In some cases, unable to apply research outcomes to environmental water management'. This certainly seems true in this case. This question was not asked in the survey but responses to other questions did not indicate any improvement in the understanding of how management (as distinct from environmental watering) influences environmental outcomes achieved over time. Interviewees' responses mirrored those in the survey, indicating that results from the EWKR project had very little if any effect on improving their understanding of how management influences environmental outcomes achieved over time. Several interviewees mentioned that this topic had dropped off the list of priorities and that where information had emerged, it had been incidental rather than a focus of a given research activity.</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>Direct evidence of the influence of management on environmental outcomes in the long-term (i.e. <math>\geq 5</math> years; aka 'over time') is not presented. However, outcomes of research on fish and functional processes to hydrological connection provides some improved understanding of management influences on related fish outcomes at this time scale.</p>
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.4b</b>	<b>How effective were the EWKR theme outputs and their synthesis in improving understanding of how delivery of environmental flow influences environmental outcomes achieved over time?</b>
<b>Evaluator 1</b>	<b>Moderately Effective</b>

	<p>Accepting that there was limited assessments of environmental responses over time (and given that this is not the same as whether delivery of environmental flows would influence environmental outcomes over time), I have adopted the same broad interpretation as applied for KEQ14. Much of the same response applies here. For the vegetation theme, the DSITI (2017) report describes the analysis of satellite-image time-series data of patches of the floodplain that maintained high vegetation vigour, a surrogate for vegetation condition, that showed most of the vigorous patches closely fringe the river channels and maintained vigour during dry periods too, implying groundwater-dependence. However, these responses were not subsequently then matched to delivery of flows or management in detail. Nonetheless, a recurrent theme in the vegetation theme final report (2019) was 'What are we watering for and why?' and it was concluded that the project provided knowledge that would help managers refine objectives, define function and value, and select indicators across a range of spatial and temporal scales to inform environmental watering. In general terms, this was true and led to some recommendations such as that watering lignum once in every 1–3 years would help generate the greatest clump size that, in turn, supports waterbird recruitment. This is an outcome with a temporal component. The waterbird theme final report (2019) also came up with recommendations on environmental water delivery. For example, satellite tracking suggested that ibis and spoonbills target watered foraging sites within 1-3 km of appropriate roosting or nesting habitat. Environmental water could be used to increase the number or area of foraging sites available after breeding, potentially extending watering for foraging into autumn and winter and possibly staggering inundation of foraging sites to maximise food productivity over a period of months to support juvenile survival. The fish theme final report (2019) presented a conceptual model that predicted that a doubling of the flow pulse during the prescribed spawning season (October–March) resulted in a 64% increase in golden perch year-class strength (95%CI 14% to 136%) in the southern MDB. Activities in the waterbird and fish themes also suggested how different flows over time might affect waterbird and fish recruitment, respectively, leading to temporal changes in environmental outcomes. Finally, the food web theme final report (2019) also addressed how flows and management potentially alter pathways of energy through food webs, and this would also have a temporal component. For all four themes, broad suggestions of watering regimes and flow management were made that would potentially influence environmental outcomes over time. Responses to the surveys reiterated the pragmatic limitations of assessing temporal trends in the EWKR project but did agree that its results improved understanding of how delivery of environmental flow influenced those environmental outcomes (e.g. 'I suspect the project did contribute to water managers understanding of how environmental water influences outcomes. I think they have generally started from a high level of understanding though'). The interview responses were largely unanimous in praising the value of the information from the EWKR project in improving understanding of how delivery of environmental flow influenced those environmental outcomes although many interviewees felt the information could have been communicated to managers more effectively and that the process of learning was still continuing. There were fewer comments about the temporal aspect but most of those acknowledged that the EWKR project had not run long enough or focused on temporal changes to be able to provide many useful insights about the likely effects of environmental flows over time.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>Direct evidence of the influence of management on environmental outcomes in the long-term (i.e. <math>\geq 5</math> years; aka 'over time') is not presented. However, outcomes of research on vegetation, fish and functional processes to hydrological connection provides improved understanding of environmental flow influences on related vegetation and fish outcomes at this time scale. A rating of Moderately Effective is made here when considering the contextual factors for EWKR.</p>
<b>Revision comments – Evaluator 1</b>	<p>Agree - Moderately effective (we probably reached the same conclusion for different reasons)</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final rating</b>	<p><b>Moderately Effective</b></p>

<b>Micro KEQ 1.4c</b>	<b>How effective was the EWKR project in improving understanding of how management influences environmental outcomes achieved over the period of the project (i.e. 5 years)?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  The same answer and reasoning as in my response to KEQ 1.4a applies here.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  Evidence for the influence of management on environmental outcomes in the project period (i.e. 1 to 5 years) is not evaluated or presented. The context and design of EWKR effectively prevented such evaluations being conducted alongside research activities addressing fundamental knowledge gaps.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.4d</b>	<b>How effective was the EWKR project in improving understanding of how delivery of environmental flow influences environmental outcomes achieved over the period of the project (i.e. 5 years)?</b>
<b>Evaluator 1</b>	<b>Moderately Effective</b>  In terms of directly monitoring environmental outcomes that could be attributed to environmental flows delivered during the 5-y project, only the vegetation theme came close to assessing this – and it was indirect. In Appendix V1.1 of the vegetation theme final report (2019), the conceptualisation paper by Campbell et al. (undated) titled ‘Blue, green and in-between; setting objectives for and evaluating 5 wetland vegetation responses to environmental flows’ includes a very useful table (Table 2) that lists potential indicators of wetland vegetation responses to environmental flows across multiple hierarchical levels of ecological organization (individual, population, community, landscape and species) and temporal scales (flow pulse, short-term and long-term flow regimes). This table is drawn from literature sources and it would have been great if the EWKR project had gone on to assess how well some of these indicators responded to actual deliveries of environmental water at selected areas during the program. Instead, the main inferences were drawn from correlative information. For example, one inference is that maintaining lignum with structural qualities to support processes such as waterbird recruitment is likely to require flow regime characteristics, including flood-return-frequency in the range of 1 flow in every 1 – 3 years (vegetation theme final report (2019)). These inferences were used to inform expected vegetation outcomes to the Resource Availability Scenarios presented in Table 2 in the vegetation theme final report (2019) but it should be emphasised that many of these inferences are not based on empirical experimental data. For the other themes, most of the inferences about potential environmental outcomes from the delivery of environmental water were generic and high-level, and also were not derived from specific research activities that tracked temporal responses to watering events at one or more locations. In the survey, over 50% of the respondents who did not reply ‘Don’t know’, replied ‘A moderate amount’ or better to the question ‘To what extent has the EWKR project improved your capacity to predict outcomes of environmental flow allocations and management over 1-5 years?’. Specific comments acknowledged that there were few insights from the EWKR project about how delivery of environmental flow influences environmental outcomes achieved over the period of the project (i.e. 5 years), and that this was to be expected given the relatively short term of the project and its limited focus on temporal changes. Many interviewees claimed that information from the EWKR project had improved their understanding of how delivery of environmental flow influenced environmental outcomes. Where comments addressed the temporal aspect, they acknowledged the insights were mainly on short-term responses (< 5 years) and also that there were challenges in extrapolating information from the site scale to larger spatial scales such as Basin-wide.
<b>Evaluator 2</b>	<b>Minimally Effective</b>

	Evidence for the influence of delivery of environmental flow on environmental outcomes during the project period is not evaluated nor presented. The context and design of EWKR effectively prevented such evaluations being conducted alongside research activities targeted at addressing fundamental knowledge gaps. Understanding of vegetation, fish food resource and population responses to flow management has been improved for certain species and flow events.
<b>Revision comments – Evaluator 1</b>	Let us discuss this one; again, I am not able to make a call on it. The question is actually asking about improvement in understanding so, to me, the evidence is primarily from the survey and interviews where quite a few interviewees thought it helped. But I don't feel very strongly about it and could be readily argued down to 'Minimally effective'
<b>Revision comments – Evaluator 2</b>	My response was based on the absence of a formal demonstration of environmental outcomes 'over time' that resulted from environmental flow management/delivery i.e. the absence of a research-based evaluation of response to historical/experimental eflow delivery/management actions
<b>Consensus final rating</b>	<b>Minimally Effective</b> Based on the discussion of micro level questions for KEQ1.4, the evaluators agreed on 'Minimally effective'

<b>Mid KEQ 1.5</b>	<b>How effectively did the EWKR project improve understanding of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>How effectively did the EWKR project improve understanding of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition? Very few of the research activities in the EWKR project sampled repeatedly (over multiple years) or analysed existing time-series data, which hampered being able to assess links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition exceeding a year. Where individual themes were able to do this, their activities are captured in the responses to KEQs 15a-d. Collectively reviewing these outputs (KEQ 15e) indicate that the effectiveness of this activity was, overall, minimal. To the question 'How effectively do you think the EWKR project identified incremental changes in ecological condition and linked them with ecosystem responses to watering regimes (natural and/or managed events) in each of the themes?', two-thirds of the 11 respondents (in the researcher group; the managers were not assessed which was a pity) replied 'A moderate amount' or more when asked about the project overall. Oddly, many participants then went on to say that EWKR's research activities did not involve addressing changes over time (e.g. 'was never about "identifying change in ecological condition"; this was the domain of the LTIM', 'The project was too short to deal with temporal aspects well', 'was a short-term project with a limited budget (compared to its objectives). At most there were only a few years of data collected, and that was in a period of drought') and consequently it was not expected that the results would improve understanding of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition. Several researchers who were interviewed on this topic stated that their understanding was that the EWKR project was not about assessing incremental changes (that was what LTIM was doing) and so the focus was not on this aspect but instead was on mechanisms and, to some degree, the spatial dimension. The vegetation theme was mentioned as the one that delivered some information on likely changes over time although linking these changes to water regimes was difficult except in the cases of clear patterns like lignum responses to watering frequency. Most of the insights came from conceptual models rather than empirical information. A few respondents suggested that there was scope to use monitoring data (e.g. from LTIM) to test inferences about likely changes over time in response to watering but that this was</p>

	not effectively done in the EWKR project.
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>Ecosystem responses were not formally linked to changes in overall ecological condition in the theme research questions or activities, nor in the synthesis. No formal definition was provided of ecological condition that was tied to the key ecosystem responses targeted by the theme research activities. This objective seems to have been ignored, or assumed to have been addressed at the individual theme ecological response level. The opportunity to link these responses to an overall concept of condition, and provide a line of sight to Basin Plan objectives was missed. It should be noted that the terms ecological and ecosystem condition are not clearly defined in either the Basin Plan or the BWES.</p>
<b>Revision comments Evaluator 1</b>	– Given your rather damning comments, I am very surprised you rated this 'Moderately effective'. However, if you feel strongly that it is (by the criteria in the rubric), then I could probably be persuaded upward as I indicated.
<b>Revision comments Evaluator 2</b>	– Agree to modifying my rating downward.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.5a</b>	<b>How well did the EWKR project, in the vegetation theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</b>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>The vegetation theme final report (2019) and the DSITI (2017) report outline the results of vegetation sampling and time-series analyses of existing data describing vegetation changes in areas with different inundation frequencies. Field sites established at all four MDB EWKR assessment areas were stratified based on flood return frequency (near annual, 1.5 – 3 years, 3 – 5 years and 5 – 10 years) and vegetation structure (inland woodland, inland shrublands and non-woody wetlands). The seedling mesocosm component investigated the trait and strategy responses of river red gum, black box and coolibah to different watering treatments. The assessment of vegetation responses included measurements of species richness and composition, structural forms, structural cover (bare ground, groundcover, shrub and canopy cover), woody seedling recruitment, lignum condition and reproduction. These assessments sampled incremental changes in vegetation although their links with watering regimes (natural and/or managed events) were sometimes equivocal because of the challenge of disentangling multiple drivers, lagged and/or slow response times, and the short-term nature of the EWKR project relative to the time for vegetation responses to be readily detected. The abundance of non-woody vegetation was maximised when areas were dry for approximately 50% of the time, supporting the idea that regimes of wetting and drying are needed to support semi-arid wetland ecosystems. Maintaining lignum with structural qualities to support processes such as waterbird breeding and fledging is likely to require flow regime characteristics, including flood-return-frequency in the range of 1 flow every 1 – 3 years. On the Lower Balonne floodplain, time-series data on canopy greenness (derived from satellite images) were used to investigate how coolabah, the dominant asset species on the Lower Balonne floodplain, responded to flooding, and concluded that there was no evidence that flooding is a major driver of coolabah condition on this floodplain. Despite the equivocal data and the logistic constraints, the vegetation theme was moderately effective at deriving a model to describe potential incremental changes in vegetation in response to watering regimes. However, it was acknowledged that much work remained to be done to</p>

	consolidate this understanding (Final synthesis report (2019)). To the question 'How effectively do you think the EWKR project identified incremental changes in ecological condition and linked them with ecosystem responses to watering regimes (natural and/or managed events) in each of the themes?', almost 90% of the 11 respondents (in the researcher group; the managers were not assessed which was a pity) replied 'A moderate amount' or more when asked about the vegetation theme. Several comments in the survey responses applauded insights from the research activities of the vegetation theme that described incremental changes potentially linked to watering regimes (e.g. 'The vegetation theme investigated Eucalypt tree seedling strategies in response to different flooding regimes and found that constant flooding of seedlings will suppress their growth. It also found the inter-flood dry periods are important for seedling growth (especially root growth). Together these findings highlight the importance of flooding timing and duration for the management of woody seedlings, an important consideration for the stand condition of tree communities.' Interview comments also touched on insights from the vegetation theme about incremental changes potentially linked to watering regimes. They identified that although a space-for-time design was used to infer associations with flooding regimes, some interesting patterns emerged and these could be linked with responses to watering regimes. Insights from the seedling experiments were also mentioned. There were also quite a few comments about the need to better communicate these findings to managers.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  Incremental changes in vegetation attributes (species richness, structure etc.) were linked to watering events, tied to a strong influence of location. These vegetation responses were not formally linked to changes in overall ecological condition in the vegetation theme research activities. No formal definition was provided of ecological condition for vegetation.
<b>Revision comments Evaluator 1</b>	I actually thought the vegetation theme did a pretty good job on this and the responses to survey seemed to agree. I would like to push for 'Moderately effective' I take your point on the lack of definition of 'ecological condition' but, to me, I saw it as a shorthand term for the various metrics assessed in the vegetation theme and I wasn't too worried about the lack of formal definition in the reports (ditto for 'incremental changes').
<b>Revision comments Evaluator 2</b>	The use of the term 'ecological condition' requires provenance in this context - it was a formal term within the project objectives under the Contract and IMHO it was a failure of EWKR project management to adequately define and focus on it. This leaves it free for any ecological response/matter to be interpreted as an adequate/surrogate/partial measure of condition, which I feel is inadequate in the Basin Plan context.
<b>Consensus final rating</b>	<b>Moderately Effective</b>  After discussion of the evidence of the contribution of the vegetation theme to identifying and linking incremental changes in vegetation condition to watering regimes, this rating was mutually amended to 'Moderately effective'.

<b>Micro KEQ 1.5b</b>	<b>How well did the EWKR project, in the native fish theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  There was no work done on incremental changes in ecological condition of native fish and their links with ecosystem responses to watering regimes (natural and/or managed events). I did not consider the work on fish larvae or recruitment described in the fish theme final report (2019) to be 'incremental' in the sense that these could be described as ecosystem responses linked to water regimes. To the question 'How effectively do you think the EWKR project identified incremental changes in ecological condition and linked them with ecosystem responses to watering regimes (natural and/or managed events) in each of the themes?', 64% of the 11 respondents (in the researcher group; the managers were not assessed which was a pity) replied 'A moderate amount' or more when asked about the fish theme. The survey responses did not identify any work in the native fish theme that identified incremental changes in ecological condition and linked them with ecosystem responses to watering regimes. Similarly, there were very few comments in responses to interview questions about incremental changes in native fish measured in the EWKR project that could be linked

	to watering regimes. These rare comments were usually generic inferences about how watering regimes could enhance hydrological connectivity to promote river-scale movements by fish as well as access to productive habitats or refuges; they did not cite specific data from the EWKR project in support. Minimally effective
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The project did not evaluate changes in ecological condition in fish communities tied to responses to watering regimes. Due to resource constraints, the Theme research was re-focused on improving capacity to predict fish recruitment outcomes in response to different environmental flow conditions. This was a pragmatic and appropriate decision, addressing a key knowledge gap for environmental flow management. Within this context the fish theme succeeded in identifying incremental responses in fish recruitment to watering regime events.</p>
<b>Revision comments – Evaluator 1</b>	I was less convinced there was any identification of incremental responses in fish recruitment to watering (but I may have missed it!). I agree with you that they focused on fish recruitment and not on ecological condition so that's why I think they were minimally effective in addressing the objective. I see this as 'Minimally effective' (but I don't deny the pragmatism of the decision; to me the issue here is not why but what they did).
<b>Revision comments – Evaluator 2</b>	Agree with AB's, and to modifying my rating downward
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.5c</b>	<b>How well did the EWKR project, in the waterbird theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Associations between incremental changes in water depth, foraging habitats and food sources, especially during and immediately following breeding events, were seen as important to waterbird populations over time (waterbird theme final report (2019)) but the data to support these contentions were spatially and temporally limited. Nonetheless, a conceptual model (Figure 9 in the waterbird theme final report (2019)) was derived to indicate that some factors influencing progression of stages of the waterbird life cycle from one stage to the next (which could be considered as incremental change) are independent of usual natural resource management, others are influenced by both flow and other management, and yet others by management alone. Almost all of these associations were derived from other studies and the literature rather than data collected during the waterbird theme in the EWKR project. This KEQ asks specifically about identified incremental changes in ecological condition that were linked with ecosystem responses to watering regimes (natural and/or managed events). I felt that the only relevant temporal data collected in the waterbird theme addressing this were on the potential association of water levels and nesting success. In the Barmah-Millewa forest, where camera monitoring of nests was focused, the dominant predators were native raptors which access nests from the air and are therefore not affected by water level. However, this conclusion was not tightly linked to natural or managed watering regimes. To the question 'How effectively do you think the EWKR project identified incremental changes in ecological condition and linked them with ecosystem responses to watering regimes (natural and/or managed events) in each of the themes?', 80% of the 11 respondents (in the researcher group; the managers were not assessed which was a pity) replied 'A moderate amount' or more when asked about the waterbirds theme. However, no specific examples of information on incremental changes in waterbirds and their association with water regimes were provided. Similarly, as interviewees did not consider that the EWKR project aimed to assess incremental changes, it was not surprising that there was no mention of insights gained on this topic from research activities in the waterbird theme.</p>
<b>Evaluator 2</b>	<b>Moderately Effective</b>



	The waterbird theme conducted key research on waterbird diet, movement, breeding and chick development responses to watering events. Conceptual models were also developed to predict food biomass requirements to support colonial waterbird breeding events, and the progression of waterbird life history in relation to watering events. These models have limited value without significant investment in knowledge development. Incremental changes in aspects of waterbird life history were identified and related to aspects of watering regime and other management actions.
<b>Revision comments – Evaluator 1</b>	If you're comfortable with the 'aspects of waterbird life history' as being equivalent to 'ecological condition' and that we agree that the literature review is enough evidence for linking these responses to watering regimes, then I can upgrade my assessment to 'Moderately effective'
<b>Revision comments – Evaluator 2</b>	Agree to modifying rating downward.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.5d</b>	<b>How well did the EWKR project, in the food web theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>There was no work done in the foodweb theme on incremental changes in ecological condition and their links with ecosystem responses to watering regimes (natural and/or managed events). Originally the food web theme had planned to replicate the summer 2016-17 field sampling in 2017-18, but discussion among the leadership group team resulted in the second field trip being deemed unnecessary, removing the opportunity for assessment of potential incremental changes in ecological condition in this field sampling. It was concluded that by targeting shifts in diet composition and producer quality, watering events can be designed to disproportionately benefit fish but this was inferred rather than directly measured as an ecological response to a watering event. Empirical data are needed to confirm this inference. Incremental changes in zooplankton community composition and abundance in the mesocosms described in the foodweb theme final report (2019) could be described as ecosystem responses potentially linked to natural or water regimes, but these associations have been known for two decades. The foodweb research did not substantially advance our understanding of how incremental changes in zooplankton communities as a measure of ecological condition were linked with ecosystem responses to watering regimes (natural and/or managed events). To the question 'How effectively do you think the EWKR project identified incremental changes in ecological condition and linked them with ecosystem responses to watering regimes (natural and/or managed events) in each of the themes?', 80% of the 11 respondents (in the researcher group; the managers were not assessed which was a pity) replied 'A moderate amount' or more when asked about the foodweb theme. However, no specific examples of information on incremental changes in foodwebs were provided. Almost all the interviewees considered that it was not an objective of the EWKR project to assess incremental changes, and therefore no insights were gained on how water regimes affected incremental changes in foodwebs.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>Incremental changes in food resource availability and quality for fish were related to changes in ecological responses to watering events. These changes were not explored across differing watering regimes, but the conceptual basis for evaluating this has been established, at least for high quality (algal) food resources. Broader consideration of process-driven changes in ecological condition beyond fish food provision was limited or absent.</p>
<b>Revision</b>	I agree with your reasoning but feel these add up to 'Minimally effective' because it is not clear what are the incremental changes in 'ecological condition' (as distinct from

<b>comments</b> <b>Evaluator 1</b>	– food availability and quality). TO DISCUSS
<b>Revision</b> <b>comments</b> <b>Evaluator 2</b>	– Agree to modifying rating downward.
<b>Consensus final</b> <b>rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.5e</b>	<b>How well did the EWKR project, overall, in its synthesis, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Not surprisingly, the synthesis was not able to identify many incremental changes in ecological condition that were assessed in the four themes of the EWKR project and link them with ecosystem responses to watering regimes (natural and/or managed events). Statements about the importance of multiple hydrological connections of the main river channel to the floodplain, wetlands and anabranches to promote productivity, quality of food resources, vegetation growth and fish and waterbird recruitment were high-level and generic, largely reflecting what was already known from the literature. To the question 'How effectively do you think the EWKR project identified incremental changes in ecological condition and linked them with ecosystem responses to watering regimes (natural and/or managed events) in each of the themes?', two-thirds of the 11 respondents (in the researcher group; the managers were not assessed which was a pity) replied 'A moderate amount' or more when asked about the project overall. As responses to the survey indicated, EWKR's research activities did not focus on addressing changes over time (e.g. 'was never about "identifying change in ecological condition"; this was the domain of the LTIM', 'The project was too short to deal with temporal aspects well', 'was a short-term project with a limited budget (compared to its objectives) and consequently it was not expected that the results would improve understanding of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition. Interviewees corroborated perspectives gained from the survey, stating that they considered that the EWKR project was not about assessing incremental changes (that was what LTIM was doing) and so the focus was not on this aspect. Any insights largely came from conceptual models rather than empirical information, and remained to be tested using monitoring data (e.g. from LTIM) on potential ecological responses to water regimes. However, these hypotheses were not tested in research activities of the EWKR project.</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>Poorly. Some high-level messaging around principles and learnings in relation to ecosystem responses to watering regimes were generated, but no formal evaluation of incremental changes in ecological conditions was conducted, and there was a strong emphasis on species-specific responses rather than a concept of ecological condition.</p>
<b>Revision</b> <b>comments</b> <b>Evaluator 1</b>	– Agree - Minimally effective
<b>Revision</b> <b>comments</b> <b>Evaluator 2</b>	– Agree
<b>Consensus final</b>	<b>Minimally Effective</b>

rating	
Mid KEQ 1.6	How effectively did the EWKR project improve understanding of how complementary water management and natural resource management enhance the outcomes of environmental water management?
Evaluator 1	<p><b>Minimally Effective</b></p> <p>Although there were recommendations about how complementary water management and natural resource management could enhance the outcomes of environmental water management (e.g. Balcombe et al. in Section 2.5 of the fish theme final report (2019) about maintaining refuges, protecting first flush events and removing redundant barriers), there were no specific assessments in any of the themes of the environmental outcomes of complementary environmental water management and natural resource management. This is understandable as it would be a challenging task to demonstrate such enhancement unequivocally. Nonetheless, it was listed in the final synthesis report (2019) as one of the four intentions of the EWKR project. In the informal assessment of EWKR's context and progress, it was pointed out that due to funding constraints, elements of the objectives become less of a focus. Research teams identified that there were so many knowledge gaps with understanding ecological species response to environmental flows alone, and that understanding threats and complementary NRM activities were less of a priority knowledge gap for some of the themes. This became evident during the refinement of research questions and conceptualisation activities. The literature review for the fish work indicated that most recruitment drivers appear more strongly influenced by non-flow related factors such as land use impacts (e.g. sedimentation, riparian alteration) and barriers than they are by flow alone. The fish theme final report (2019) went on to say 'Consequently, our capacity to improve fish recruitment outcomes by focussing on flow management alone is probably low. Complementary actions that may improve recruitment outcomes include riparian management, revegetation, removals of barriers and levee banks, mitigation of cold-water pollution, management of non-native species, and management of instream habitat'. This inference did not appear to be developed in detail in the final synthesis, and was not flagged in managers' responses to questions in the surveys or interviews. The survey did not ask this question. Responses to similar questions about natural resource management indicated that respondents did not consider the EWKR project addressed this objective or provided any information relevant to improving understanding of how complementary water management and natural resource management might enhance the outcomes of environmental water management. Similarly, this question was not asked in the interviews although several interviewees highlighted that it would be important to know the answer because, for example, feral pigs eating young plants potentially compromised one of the goals of environmental watering on the Lachlan River and complementary management of feral pests would likely have been a good approach to prevent this. Minimally effective</p>
Evaluator 2	<p><b>Minimally Effective</b></p> <p>This was not addressed in the research activities.</p>
Revision comments – Evaluator 1	May be a case for 'Not attempted'. If we decide to adopt this, then it applies to the next two micro KEQs too
Revision comments – Evaluator 2	Agree
Consensus final rating	<b>Not Attempted</b>

<b>Micro KEQ 1.6a</b>	<b>How effective was the EWKR project in improving understanding of how complementary water management and natural resource management enhance the outcomes of environmental water management over the period of the project (i.e. 5 years)?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b> See the response to KEQ16
<b>Evaluator 2</b>	<b>Minimally Effective</b> This was not addressed in the research activities.
<b>Revision comments – Evaluator 1</b>	Agree - Minimally effective (or 'Not attempted')
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

<b>Micro KEQ 1.6b</b>	<b>How effective was the EWKR project in improving understanding of how complementary water management and natural resource management enhance the outcomes of environmental water management by inferring from the project results to longer time periods?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b> See the response to KEQ1.6. As there were no project results relevant to understanding of how complementary water management and natural resource management enhance the outcomes of environmental water management, such inferences were not possible.
<b>Evaluator 2</b>	<b>Minimally Effective</b> This was not addressed in the research activities.
<b>Revision comments – Evaluator 1</b>	Agree - to change this to 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

Mid KEQ 1.7	How effectively did the EWKR project improve understanding of the links between ecosystem responses to management interventions (water management and natural resource management) and incremental changes in ecological condition?
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>As none of the themes involved activities that specifically investigated the links between ecosystem responses to management interventions (water management and natural resource management) and incremental changes in ecological condition and as the capacity of the EWKR project to assess incremental changes in condition was limited (see response to KEQ1.5), this objective was not addressed. KEQ1.4 asks how effectively the EWKR project improved understanding of how management or delivery of environmental flows influences environmental outcomes achieved over time which is a little similar to asking about links between water management and incremental changes in ecological condition so some of the insights from the responses to this question are also relevant here and were used in the evaluation. Neither the survey nor the interviews asked this question, and none of the responses to other questions in the survey were particularly relevant or referred to management interventions. As mentioned in the responses to KEQs 1.4 and 1.5 and their associated micro questions, assessing incremental changes was not seen as a focus of the EWKR project by many respondents to the survey or by many interviewees. Several of the interviewees' responses referred broadly to potential links between ecosystem responses such as vegetation (e.g. lignum growth) and waterbirds (e.g. nesting success) to water management but not to specific natural resource management.</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>Ecosystem responses were not formally linked to changes in overall ecological condition in the theme research questions or activities, nor in the synthesis. No formal definition was provided of ecological condition that was tied to the key ecosystem responses targeted by the theme research activities. In addition, research activities did not formally target individual water or natural resource management actions, or evaluate responses to them. This objective seems to have been ignored, or assumed to have been addressed at the individual theme ecological response level.</p>
<b>Consensus final rating</b>	<b>Minimally Effective</b>

Micro KEQ 1.7a	How well did the EWKR project, in the vegetation theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Research activities in the vegetation theme were able to collect or analyse data that could be used to assess incremental changes at some locations (see response to KEQ15a) and a model was developed to describe potential incremental changes in vegetation in response to watering regimes. However, this information could not be readily linked with ecosystem responses to management interventions (water management and natural resource management) except by inference from vegetation patterns in areas with different flooding histories. It is also likely that this objective was seen as less of a priority (see response to KEQ17) so was not pursued. There were no comments in the survey that referred to specific examples in the vegetation theme where incremental changes in ecological condition were linked with ecosystem responses to management interventions (water management and natural resource management). Several interviewees mentioned differences in vegetation composition and seedling survival associated with different water regimes, and said that these differences might be relevant for management but more work was needed. Such inferences were acknowledged as rather tenuous and did not involve specific incremental changes in ecological condition of vegetation that were clearly linked ecosystem responses to management interventions (water management and natural resource management).</p>

<b>Evaluator 2</b>	<b>Moderately Effective</b>  The vegetation theme focused on diversity, seed bank vegetation assemblage, lignum structure and seedling recruitment responses and relationships to watering events and history in the context of other natural resource management risks/actions and resource availability scenarios. While no integrated concept of condition was developed for vegetation, these four aspects are key components of condition, as well as management priorities. Combinations of potential NRM actions with water management were not fully explored.
<b>Revision comments</b> <b>Evaluator 1</b> –	Happy to upgrade my assessment to 'Moderately effective' because the vegetation theme did assess incremental changes (unlike some of the other themes) and there was a (limited) effort to link these with ecosystem responses to management interventions
<b>Revision comments</b> <b>Evaluator 2</b> –	Agree
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 1.7b</b>	<b>How well did the EWKR project, in the fish theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  There was no work done on incremental changes in ecological condition of native fish and their links with ecosystem responses to watering regimes (natural and/or managed events) (see response to KEQ15a). Consequently, this objective could not be addressed in the fish theme. It is also likely that this objective was seen as less of a priority (see response to KEQ17) so was not pursued. No comments in the survey or interview transcripts referred to specific examples in the fish theme where incremental changes in ecological condition were linked with ecosystem responses to management interventions (water management and natural resource management).
<b>Evaluator 2</b>	<b>Moderately Effective</b>  The fish theme succeeded in identifying natural resource management actions required to optimise and reduce constraints on fish community responses to environmental watering. The research did not articulate a concept of fish ecological condition, choosing, due to constraints, to focus on fish recruitment as a key response variable. This was highly appropriate to the overall EWKR objectives, and of substantial management and ecological importance.
<b>Revision comments</b> <b>Evaluator 1</b> –	As the KEQ asked about incremental changes and I felt that these were not assessed effectively in the fish theme, I am reluctant to upgrade my assessment.
<b>Revision comments</b> <b>Evaluator 2</b> –	Agree

<b>Consensus final rating</b>	<b>Minimally Effective</b>
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<b>Micro KEQ 1.7c</b>	<b>How well did the EWKR project, in the waterbirds theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Relevant temporal data to assess incremental changes of variables assessed in the waterbird theme included the potential association of water levels and nesting success (see response to KEQ15c). In the Barmah-Millewa forest, where camera monitoring of nests was focused, the dominant predators were native raptors which access nests from the air and are therefore not affected by water level. However, this conclusion was not tightly linked to natural or managed watering regimes nor to natural resource management. High-level recommendations about management options to protect foraging sites and movement routes (waterbird theme final report (2019)) were not associated with incremental changes in ecological condition, and so are not relevant here. Comments in the survey and the interviews both highlighted and praised the spatial insights from the waterbird theme but did not identify any examples where temporal data were linked with ecosystem responses to management interventions (water management and natural resource management). There was evidence for growing appreciation by managers of the importance of managing for more than simply bird breeding (i.e. subsequent development and survival) but there were no examples of information from the EWKR project that indicated incremental changes associated with relevant management interventions.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The waterbirds theme explored relationships between bird life stage progression and water management in the context of a range of natural resource management actions and risks (e.g. site conservation, structural vegetation and feral animal management). These management drivers were included in both the field research activities (though not qualitatively) and in conceptual modelling. It should be noted that neither the relationships or models have been quantitatively parameterised or evaluated with regard to incremental changes in condition or levels of NRM intervention.</p>
<b>Revision comments – Evaluator 1</b>	Prepared to upgrade my assessment to 'Moderately effective'. There is some work in the waterbird theme that explores incremental changes (unlike some of the other themes). I feel it was a very limited effort to link these with ecosystem responses to management interventions - a marginal call.
<b>Revision comments – Evaluator 2</b>	Agree to downgrading rating
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.7d</b>	<b>How well did the EWKR project, in the food web theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>



	There was no work done in the foodweb theme on incremental changes in ecological condition and their links with ecosystem responses to watering regimes (natural and/or managed events (see response to KEQ1.5d). Consequently, whether incremental changes in ecological condition could be linked with ecosystem responses to management interventions (water management and natural resource management) also could not be addressed in the food web theme. It seems that this objective was seen as less of a priority (see response to KEQ1.7) so was not pursued. No comments in the survey or interview transcripts referred to specific examples in the foodweb theme where incremental changes in productivity or transfer of energy across trophic levels were linked with management interventions (water management and natural resource management, although broad inferences were drawn by some interviewees about how this information could be associated with different degrees of hydrological connectivity.
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The concept of ecological condition was not explored in the food web theme, and was not a requirement as part of the theme research questions. Incremental responses in food resource provision to water management were explored and integrated within the research outcomes, including the niche indicator concept. However other management actions were not considered, given the primacy of water-driven responses and trophic dynamics. The waterbird component of this theme did not address this objective.
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 1.7e</b>	<b>How well did the EWKR project, in its synthesis, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  As per the response for KEQ15e, the synthesis was not able to identify many incremental changes in ecological condition that were assessed in the four themes of the EWKR project, nor was this seen as a priority objective for the research that was eventually done. Therefore, it was not possible for the synthesis to assess whether incremental changes in ecological condition could be linked with ecosystem responses to management interventions (water management and natural resource management). Neither the survey nor the interviews asked 'How well did the EWKR project, in its synthesis, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?'. As mentioned in the responses to KEQs 14 and 15 and their associated mid and micro KEQ, assessing incremental changes was not seen as a focus of the EWKR project by many respondents to the survey or by many interviewees. Several of the interviewees' responses referred broadly to potential links between some desired ecosystem responses such as vegetation (e.g. optimal lignum growth) and waterbirds (e.g. nesting success) to water management. However, there were no references to the synthesis or to overall incremental changes in ecological condition assessed by the EWKR project and how they might be linked to management interventions (water management and natural resource management).
<b>Evaluator 2</b>	<b>Minimally Effective</b>  The synthesis report failed to address this objective, despite some project theme activities attempting to address the need for combinations of management actions. In addition, the synthesis did not articulate or conceptualise ecological condition as a concept or response variable - despite including the concept and definition within the list of EWKR objectives.

<b>Consensus final rating</b>	<b>Minimally Effective</b>

## EFFECTIVENESS – COMMUNICATED FINDINGS

- 1 high-level KEQ
- 2 mid-level KEQs
- 5 micro-level KEQs

High KEQ 2	How well have the projects communicated findings to all stakeholders?
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>There was considerable variation among the themes in the extent, timing and formats (e.g. fact-sheets, workshops, scientific papers) used to communicate findings to stakeholders. Some activities in some themes (e.g. waterbird movements) were extremely well communicated and elicited enthusiastic feedback like 'I really enjoy and am learning a lot from the updates you are sending through (I work on both the Lachlan and Mid Murray regions in the CEWO). Your work is also informing the very early stages of our internal discussions/thinking re the need for e-water planning to be done/linked at the scale at which these flyways are operating.' (final project report (2019)). Others appeared to be largely restricted to presentations at scientific meetings and in peer-reviewed journals (e.g. the foodweb theme). This variation is to be expected and is driven by, among other things, the content, the pressures and values of the researchers, project governance and availability of resources. Respondents to the survey indicated greatest awareness of fact sheets, theme reports and the EWKR Story Space, and this latter medium attracted quite a lot of praise although there was regret that it had eventuated quite late in the program (Oct 2017). It was acknowledged that different stakeholders preferred different formats of communication (e.g. the Annual Progress Report 2016-17 stated that water managers indicated that their preferred form of communication was via one-on-one meetings, followed by easy to comprehend diagrams, models and summary tables followed by published scientific papers.). Annual reports for the last couple of years of the program reported that findings had been presented across a range of formats, and the range is commendable. However, it was probably not feasible to quantify the one-on-one meetings. The 2019 EWKR evaluation (most of whose respondents were directly involved in the project activities either as part of the research team or through roles in governance groups) stated that participants reported that the best relationships were built when researchers connected directly with local water managers and end users of the research. Some themes (i.e. waterbirds and vegetation) were reported to have had a high level of engagement throughout the project either through the development of new relationships, by involving water managers in the delivery of research or by drawing on the networks of individuals within project teams. The fish and foodweb themes reported less emphasis on establishing relationships beyond the planning stage, due to capacity and time constraints of the researchers. Survey responses indicated that the program has done well in targeting various products to various audiences (e.g. Story Space, magazine articles, online reports) but it was commented that one area for improvement was the content with less focus on 'methodology' and 'results' and more focus on implications for management - the 'so what'. Overall, survey results indicated that the various outputs were well targeted (i.e. &gt;50% ratings as moderately or better). Many of the points above were reiterated during the interviews. Interviewees praised the diversity of outputs because different media suited different needs. Story Space was often singled out as a leading source of attractive information for managers. However, almost everyone said that ultimately one-on-one discussions were the best way for them to get relevant information and that they had been generally appreciative of researchers putting the time and effort in to chat with them about their findings and to answer questions. A few interviewees believed</p>

	that a professional communicator should have been involved earlier in the project but they applauded the job done by Siwan Lovett who was brought in at Year 4 and helped prepare some very useful outputs.
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>EWKR delivered findings that addressed key knowledge gaps in the ecohydrological information space. It delivered these findings well in the form of technical reports and selected other communication activities. However, EWKR did not effectively identify the full range of relevant stakeholders, nor design its research to address their needs or engage with them either during the research program well or follow through on communicating the findings to a wide range of water and NRM manager (and other stakeholders). This was partly due to the contextual factors, the overly aspirational nature of the project's objectives leading to delays in refining research questions and related activities, but also due to a lack of emphasis on stakeholder engagement early in the program's design and development. Selected technical and scientific stakeholders, as well as selected jurisdictional audiences were well served by EWKR's communication of findings, but few other stakeholder groups. More engagement with environmental water advisory groups (EWAGs) would have made delivery more efficient. The type of communication activities (personal contact, fact sheets, workshops, story space etc.) critical to awareness and adoption among water managers. This was identified in the Communications Strategy, but several activities were actioned too late in the project to be completely effective. An interview comment that "they package(d) the information in a variety of formats" may be seen as inefficient from a program management perspective, but efficient in terms of targeted output delivery and communication. Informal engagement was the most efficient form of ensuring outputs were relevant and communicated – the relationships between researchers and stakeholders could be more formalized to ensure more efficient adoption. A dedicated cross-theme communications role and/or knowledge broker would have improved comms management – communications being devolved to individual researchers without a strong central role during the program. Final comms products and Synthesis were developed near the end of the project, without strong enough cross-theme management. Examples of relevant interview responses: "I think towards the end of the project, I think they've done a really good job at trying to share findings. A lot of forums." "last kind of year or so they've actually done a really good job at sharing information." "last ... year ... a really good job at sharing information." BUT this was post EWKR contract ending Use of "email updates, or building web pages and videos and .... forums ... strikes me as reasonably efficient." "Deployment of "the different outputs, the Web sites and the stories and the videos and the more ... interactive comms .... they probably utilised the money well" EWKR needed "more regular indirect connections between the researchers and the people .. applying that knowledge" Communication of outputs beyond the core fish expert group was weak – "people in the MDBA have not heard anything about EWKR ... (also) DELWP ... New South Wales fisheries ... South Australia" Efficiency of producing and communicating outputs for stakeholders was highly dependent on one communications provider – brought in late into the program. "it got better as Siwan (Lovett) had a crack, but she was brought in just to clean up." "Siwan (Lovett) was paid to come in at the back end and try and tidy that stuff up." Once "Siwan Lovett and her crew got involved in things, things looked up and up, think it caught up a lot of ground later on." "compared to previous programs, I mean, at least you delivered lessons learned." "a lot of products, there's a lot of reports, a lot of online communication" – seen as efficient, but interactions between EWKR researchers and managers is more effective. "efficiency and effectiveness could be in conflict with one another" "little was spent on comms. And if you really want to be efficient, then you build that in early, because efficiency is as much about delivering a good product as it is about doing the work."</p>
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Mid KEQ 2.1</b>	<b>How effective was the EWKR project communication and adoption strategy?</b>
<b>Evaluator 1</b>	<b>Moderately Effective</b>

	<p>Not until mid-way through the EWKR project (May 2017) was a revised and updated project Communications and Adoption Strategy (long version) and a Communications and Adoption Plan (short version) approved by CEWO. By this time, communications and adoption activities had a stronger emphasis on knowledge transfer, as opposed to an earlier focus on consulting water managers on research questions and clarifying how information could best be provided (Annual Progress Report 2016-17). The 2019 EWKR evaluation (most of whose respondents were directly involved in the project activities either as part of the research team or through roles in governance groups) stated that a number of interview participants reported challenges in the planning, resourcing and timing of communication and sharing results. It was noted that the Communications Plan came late in the project, but it had provided a good platform for sharing of research outcomes, and that some themes found it challenging to communicate externally in the middle of the project (when there were no results to share) and the end of the project (when the focus was on finalising the results and preparing reports). Water managers and end users are making 'real time' decisions and require advice and information in a timely and easily consumable form which poses a challenge for traditional research programs that typically have long lag times between research activity and publication. The survey responses indicated that the EWKR project communication and adoption strategy had been moderately successful in that the research findings were mentioned during planning for environmental watering ('I have seen water planners and delivery personnel refer to EWKR research quite often - both on the front line of water planning, e.g. water delivery design, as well as the development of whole of Basin watering priorities and evaluation projects.'). However, there were also quite a few responses that indicated a lack of awareness by managers of results and outcomes of the program ('Environmental water reserve officers and CMAs are making decisions on the ground. The EWKR project research has not involved our team and we have had no direct access to or interaction with it'). Perhaps the main problem has been that there doesn't appear to be an output or package that synthesises all the EWKR research outcomes into relevant management objectives/actions/recommendations with appropriate caveats on transferability, scale and confidence. Such an output, carefully vetted by the researchers and assessed for feasibility by managers before circulation, would be a very useful output of this program to help operationalise the research findings; management recommendations could be directly linked to relevant research results to enhance their credibility and minimise the risk of merely listing high-level recommendations already likely to be familiar to managers. No responses in the interviews referred specifically to the EWKR project communication and adoption strategy but, as noted in the response to KEQ2, most interviewees appreciated the diversity of forms of outputs and the willingness of researchers to chat with them when contacted about specific issues. However, there were concerns expressed that most of the outputs were too wordy and detailed for many managers' needs. Many interviewees from the management group said it would have been good to have more fact sheets and brief summaries, especially some with specific and targeted recommendations about how the research findings could be translated into management actions. They also suggested recording presentations, collecting podcasts and curating all of the informal outputs as well, and keeping these in a readily accessible place that could be quickly searched by managers seeking the most up-to-date information. Most managers said that they would usually contact individuals if they had pressing questions.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The strategy was designed effectively (see comments under KEQ2.1a), though late in the project, but was not fully effectively carried out. Weak internal uptake of communication tools and approaches across themes was coupled with poorly organised and hasty delivery toward the end of the program. The strategy was developed too late to effectively shape and be shaped by the evolving research directions and allow proper engagement with potential end users of the research - especially water and NRM managers. Several external communication aspects of the strategy were effective - in particular such features as the Story space. Internal communication within themes and researchers and with those water and NRM managers involved in the specific research was effective, but this did not rely or effectively take up the tools developed under the communication strategy.</p>
<b>Consensus final rating</b>	<p><b>Moderately Effective</b></p>

Micro KEQ 2.1a	How well did the EWKR project communications and adoption strategy develop the approach to communicating key findings?
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>There was substantial effort and thought put into developing the approach to communicating key findings of the EWKR project, and the communications and adoption strategy was a well-planned document that sought to identify the best ways to communicate, and encourage adoption of, the key findings of the program. Figure 4 in the Communications and Adoption Strategy (2017) is a particularly helpful depiction of the relationship between the Communication and Adoption components of the Adoption and Communication Strategy, with Communication describing the processes and outputs designed to convey information, and Adoption seeking to facilitate the application of knowledge to management decisions. This figure also indicates the target audiences and the intention to tailor different products for different stakeholders. There was also awareness of the importance of ensuring that managers are actively engaged in the development of outputs. This engagement was intended to both facilitate adoption and help the researchers identify management implications, identify how knowledge will be applied to decisions, and how it might be adapted to different situations. Various media and settings for this engagement with managers were outlined. Communication protocols presented in Attachment D of the Communications and Adoption Strategy (2017) are also well planned (although it is not clear to what extent these were subsequently adopted and how well they were followed). The main improvement I would suggest would be highlighting the importance of the synthesis process (it was an attachment (F) late in the Communications and Adoption Strategy (2017)) and having that as a key plank in this document. This improvement relates to the suggested recommendation for an output or package that synthesises all the EWKR research outcomes into relevant management objectives/actions/recommendations with appropriate caveats on transferability, scale and confidence (see response to KEQ21). There were no relevant comments in the survey responses or interview transcripts on the development of the approach by the EWKR project communications and adoption strategy.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The communications and adoptions strategy effectively identified the three key adoption pathways - a combination of several already in play and some new innovations - key among them being the Story space which became an effective mode of communication, with good uptake, along with technical reports and selected workshops. The strategy clearly identified both internal and external communication pathways and the major stakeholder groups and their 'value propositions' which clarified their sets of interests and potential communication pathways. Thus, the strategy effectively developed effective approaches to communication, audiences and roles of key players. It was less effective at identifying adoption pathways, largely because of the uncertainty around EWKR research products and outcomes. This uncertainty, along with uncertainty in the early stages of defining EWKR's research focus and activities, ultimately led to the strategy not being effectively carried out. Weak internal uptake of communication tools and approaches across themes was coupled with poorly organised delivery toward the end of the program. The strategy was developed too late to effectively shape and be shaped by the evolving research directions and allow proper engagement with potential end users of the research - especially water and NRM managers.</p>
<b>Revision comments – Evaluator 1</b>	<p>As the KEQ is about the <i>development</i> of the approach, I would prefer we rate this as 'Effective'</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree to upgrade the rating</p>
<b>Consensus final rating</b>	<p><b>Effective</b></p>

Micro KEQ2.1b	How effectively did the EWKR project share research outcomes to enhance environmental water management, complementary NRM, and environmental watering outcomes?
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>From the outset of EWKR and based on the objectives, it was always intended that the research outcomes would enhance environmental water management and watering, and complementary natural resource management (NRM). Although not developed until half-way during the project, an effective Communications and Adoption Strategy (2017) was prepared (see response to KEQ21a). Outputs from the four themes, including their final reports, included management recommendations inferred from the research outcomes but these recommendations were usually high-level and/or not well integrated across the themes. For example, the waterbird theme final report (2019) stated that 'Actions that can be taken to complement environmental flows, reduce pressure on adults, eggs and chicks, and increase egg and chick survival include: feral predator control (pigs, foxes and cats); habitat modification and maintenance to provide a range of vegetation types and configurations to choose from; and disturbance control. It is likely that these pressures vary between different locations and will therefore require different levels of effort and investment across the Basin.' These sorts of recommendations could probably have been made before the EWKR project but were bolstered by evidence from the research (e.g. that predation on eggs and fledglings was a major source of mortality). The effectiveness was judged from the responses to the surveys and interviews. In the survey, responses to questions about how management had been influenced by the EWKR research outcomes were mixed, and ranged from 'not at all' and 'Some outcomes seem interesting, like CSIRO bird tracking, but they don't affect the decisions we can make' through to a more positive 'Most influence occurred through direct interactions between managers and researchers - particularly through deliveries targeting waterbirds and fish'. It is perhaps too soon to judge the full effectiveness of management responses to the research outcomes but there was certainly a strong effort by the EWKR project to share research outcomes to enhance environmental water and watering management and complementary NRM. When asked about how effective was the EWKR project at sharing research outcomes to enhance environmental water management, complementary NRM, and environmental watering outcomes, interviewees varied in their perceptions. Most interviewees from the management group expressed concerns that too much information was 'buried' in reports and scientific papers that managers were too busy to read and that it would have been more effective to have had more fact sheets and other summaries of relevant information. Knowledge brokers were also suggested frequently as a way to increase the effectiveness with which research outcomes were shared. Other interviewees were satisfied with the outputs but questioned their value in influencing management directly, commenting that most information supported what was already known.</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>EWKR did not effectively share research outcomes to enhance water management or NRM. The approach to consultation and communication did not effectively or consistently engage water or NRM managers across the targeted research areas or a regional scale. Engagement about research outcomes was piecemeal, developed late (though effectively through the Story space) and not followed through effectively, resulting in patchy uptake by managers. This was a consistent complaint in the survey results. Locally, some effective sharing and engagement took place, but this was not consistently apparent across EWKR's footprint.</p>
<b>Revision comments – Evaluator 1</b>	<p>I concede I have been too generous in my assessment and your commentary is a fair one. Happy to downgrade my assessment to 'Minimally effective'</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final rating</b>	<p><b>Minimally Effective</b></p>

Micro KEQ2.1c How effectively did the EWKR project share research outcomes and emerging knowledge gaps, and associated research priorities to provide direction for future investment in research?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Almost all of the more formal outputs (e.g. scientific papers, theme reports, annual progress reports) outlined knowledge gaps along with their key research outcomes, and many also provided guidance on direction for future investment in research. This aspect was also commented on in the 2019 EWKR evaluation (bearing in mind the caveat of its limited pool of relevant participants) which noted that even two articles in RipRap (both the articles by McGinness et al. 2017) also identified knowledge gaps explicitly. Participants in this survey were also confident that the project had clearly identified future research needs and priorities. Some of the outputs such as Koehn et al. (2019) focused on future research directions and described extensive consultation with managers and other stakeholders to derive these. Although questions in the current survey did not ask this exact question, responses to other questions indicated that sharing of information was still continuing (e.g. 'I don't believe there was enough work done in sharing the knowledge gained through the program more widely - this does not mean it is lost, it is being shared through working groups and connections between scientists and practitioners continuing to work through the Flow-MER program.') and this applies to priorities for future research. Interviewees also expressed opinions that research outcomes were still being shared and 'absorbed'. There were no comments about how effectively the EWKR project shared information on emerging knowledge gaps and associated research priorities, or any specific examples provided. Nonetheless, this information must have been shared in some form because of the development of derivative projects (e.g. Flow-MER) to fill some of the gaps and address particular research priorities.</p>
<b>Evaluator 2</b>	<p><b>Effective</b></p> <p>EWKR was highly effective at producing quality technical reports, publications and related scientific research communication products. The research teams were focused on producing publications of scientific merit as well as communications focused around the state of knowledge (foundational activity reviews etc.). The degree to which EWKR could use these to provide broader direction to future research was limited, given the project's institutional context and relationships. However, knowledge gaps identified during EWKR have informed the development of the new federal MER program which effectively takes up where EWKR left off.</p>
<b>Revision comments Evaluator 1</b> –	Happy to upgrade my assessment to 'Effective' in light of our agreed relaxation of this performance criterion.
<b>Revision comments Evaluator 2</b> –	Agree
<b>Consensus final rating</b>	<b>Effective</b>

Mid KEQ 2.2 How effective was the information produced by the EWKR project in supporting the CEWO in presenting achievements toward Basin Plan objectives to relevant stakeholders?	
<b>Evaluator 1</b>	<p>The Communications and Adoption Strategy (2017) emphasised that in order to apply the MDB EWKR outputs to management decisions, the Project's improvements in understanding and predictive capacity would need to be adapted to the specific managerial and environmental context in a way that improved outcomes. This would require an understanding of who will be adopting the information and what it will be used for, including by managers from the MDBA, CEWO and State agencies to improve</p>



	<p>their capacity to report on progress toward Basin Plan environmental objectives and targets. Most themes followed this advice to varying degrees and almost all the final reports included references to where information would be relevant to achieving Basin Plan objectives (see responses to KEQs 36 and 37). The 2019 EWKR evaluation (most of whose respondents were directly involved in the project activities either as part of the research team or through roles in governance groups) stated that communication appeared to have been effective with the MDBA and CEWO, and that participants reported that research and knowledge developed through EWKR would contribute to reporting on the Basin Plan outcomes by improving the foundational science around ecosystem function in the Murray Darling Basin. Survey responses in the current evaluation indicated that the information produced by the EWKR project was moderately effective in supporting the CEWO in presenting achievements toward Basin Plan objectives to relevant stakeholders, evidenced by comments such as 'some of the outcomes from EWKR have helped overall understanding, and CEWO and others can use that info in telling the story of environmental water to various audiences'. To the question 'How clearly has the EWKR project established that the outcomes from each theme are relevant to the Basin-wide Environmental Watering Strategy expected outcomes and the Basin Plan EWP objectives?', two of the four respondents in the group represented by CEWO staff replied 'Clearly, specific statements made', and specific comments indicated that the themes and the planning of the work had focused on ensuring the findings of the EWKR project were relevant to Basin Plan objectives. Responses by CEWO to this question during the interviews indicated satisfaction with the information produced by the EWKR project in supporting the CEWO in presenting achievements toward Basin Plan objectives to relevant stakeholders. It was considered that almost all of the information produced by the EWKR project was relevant to Basin Plan objectives and therefore effective in supporting the CEWO in presenting achievements toward Basin Plan objectives to relevant stakeholders.</p>
<b>Evaluator 2</b>	<p>EWKR was not designed to service this role, other than to provide new and re-packaged knowledge to help inform interpretation and evaluation of ecological outcomes in response to environmental watering that may then contribute to achieving objectives.</p>
<b>Revision comments Evaluator 1</b> –	<p>This is an example of the 'retrofitting' that occurred. The KEQ asks about the effectiveness of the information for CEWO rather than the original project design so I was strongly guided by CEWO's perception of this information. I cannot make a call on this except that I would be prepared to rate it at least 'Moderately effective' as a concession to your concerns. However, I would urge you to reassess the CEWO team's commentary in the interviews.</p>
<b>Revision comments Evaluator 2</b> –	<p>I feel that EWKR was effective in delivering information relevant to CEWO, but not specifically information that assists them in presenting achievements toward BP objectives (i.e. in evaluating progress), as this was not the purpose of EWKR and was not identified as a core role .i.e. there is no evidence of retrofitting in response to such a demand/perception on behalf of CEWO, if it occurred. I still feel that this was Not Applicable.</p>
<b>Consensus final rating</b>	<p><b>Moderately Effective</b></p> <p>It was agreed that the focus of this micro KEQ was on the effectiveness of the information produced by the EWKR project for broadly supporting CEWO. For this broad support, the evaluators agreed on ""Moderately effective""</p>

Micro KEQ 2.2a To what extent were the communication products of the EWKR project fit for CEWO's purpose?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>A diverse array of communication products was produced by the EWKR project and there is evidence from the annual reports that CEWO staff consistently attended presentations and workshops, showing a strong interest in the EWKR research outcomes. The 2019 EWKR evaluation (bearing in mind the caveat of its limited pool of relevant participants) also concluded that communication appeared to have been effective with the MDBA and CEWO. Survey responses in the current evaluation suggest</p>

	the communication products of the EWKR project were fit for CEWO's purpose because information produced by the EWKR project was claimed by respondents to have helped CEWO present achievements toward Basin Plan objectives to relevant stakeholders (see response to KEQ22). In the interviews, responses by CEWO staff on this topic generally indicated that the communication products were fit for their purpose although there was a strong feeling that the most effective communication occurred in one-to-one discussions and when scientists were present at workshops to discuss management strategies, plan water delivery and other goals of the CEWO. Individuals were singled out as being especially valuable because of their communication skills, capacity to interact and involvement in relevant workshops and meetings.
<b>Evaluator 2</b>	<b>Moderately Effective</b>  A reasonable proportion of EWKR's communication products were fit for purpose - notable among these were the Story space, selected internal and researcher-manager workshops and forums and the technical reports. The level of engagement and delivery associated with some of these was not sufficiently developed, in part due to the lateness of the project's focus on communication and delivery.
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 2.2b</b>	<b>To what extent did the information produced by each theme of the EWKR project and its synthesis encourage stakeholders to strive to maintain and improve their contributions to Basin Plan environmental objectives?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  It may be premature to answer this KEQ properly, and of course the answer relies heavily on responses to the surveys and interviews. Also, the phrase 'encourage stakeholders to strive to' is not the same as EWKR outputs providing supporting information; it's likely that motivation for stakeholders does not accrue so much from the information itself as from, perhaps, the personal interactions and collaboration during EWKR that may inspired such enthusiasm. So this is a tricky question to address precisely. Although the survey included responses like 'In my current role I have seen EWKR research influence discussions around Basin Plan targets, Basin Plan chapter 8 objectives, review of the Environmental Watering Plan', it is not clear whether these discussions encouraged stakeholders to strive to maintain and improve their contributions to Basin Plan environmental objectives. However, there were encouraging comments indicative of proactivity by stakeholders like 'I am working with Heather McGinness to try and plan water use at wetlands across northern Victoria to improve waterbird outcomes. I use knowledge about fish populations (particularly Golden Perch) to try and identify where in Victoria we should be trying to support fish breeding and where we should focus on fish movement. The foodweb findings on the relative quality of food in channel, vs anabranch, vs billabong is driving thinking around where and how to connect critical off channel habitats via environmental water and the need to ensure return flows from those sites'. Many interviewees' responses indicated that they considered the information from the EWKR research activities had been of varying degrees of relevance to the Basin Plan and had increased the capacity of some managers to be able to meet Basin Plan objectives. A few examples were given where information from EWKR had been incorporated into evaluating the Basin Plan. However, there were no specific examples presented of where stakeholders had been encouraged to strive to maintain and improve their contributions to Basin Plan environmental objectives.
<b>Evaluator 2</b>	<b>Not Applicable</b>  EWKR had essentially no influence on stakeholder commitment to maintain and improve their contribution to BP objectives. That was not EWKR's role, nor was it resourced for it. EWKR did however provide information that could underpin improved performance against the objectives, given sufficient uptake and operational commitment by various jurisdictions and management authorities.
<b>Revision</b>	This looks like a classic case of 'Insufficient evidence'. Although we've come up with different ratings, our assessment comments complement each other.

<b>comments</b> <b>Evaluator 1</b>	–
<b>Revision</b> <b>comments</b> <b>Evaluator 2</b>	– I still feel that this was not EWKR's role and is hence Not applicable
<b>Consensus final</b> <b>rating</b>	<b>Insufficient Evidence</b> The evaluators agreed that there was not enough evidence about how stakeholders maintained and improved their contribution to Basin Plan environmental objectives to be able to answer this micro KEQ.

Micro KEQ 2.2c How effectively did the information produced by the EWKR project build and support collaboration?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>It may be premature to answer this KEQ properly, and of course the answer relies heavily on responses to the surveys and interviews. Also, the phrase 'encourage stakeholders to strive to' is not the same as EWKR outputs providing supporting information; it's likely that motivation for stakeholders does not accrue so much from the information itself as from, perhaps, the personal interactions and collaboration during EWKR that may inspired such enthusiasm. So this is a tricky question to address precisely. Although the survey included responses like 'In my current role I have seen EWKR research influence discussions around Basin Plan targets, Basin Plan chapter 8 objectives, review of the Environmental Watering Plan', it is not clear whether these discussions encouraged stakeholders to strive to maintain and improve their contributions to Basin Plan environmental objectives. However, there were encouraging comments indicative of proactivity by stakeholders like 'I am working with Heather McGinness to try and plan water use at wetlands across northern Victoria to improve waterbird outcomes. I use knowledge about fish populations (particularly Golden Perch) to try and identify where in Victoria we should be trying to support fish breeding and where we should focus on fish movement. The foodweb findings on the relative quality of food in channel, vs anabranch, vs billabong is driving thinking around where and how to connect critical off channel habitats via environmental water and the need to ensure return flows from those sites'. Many interviewees' responses indicated that they considered the information from the EWKR research activities had been of varying degrees of relevance to the Basin Plan and had increased the capacity of some managers to be able to meet Basin Plan objectives. A few examples were given where information from EWKR had been incorporated into evaluating the Basin Plan. However, there were no specific examples presented of where stakeholders had been encouraged to strive to maintain and improve their contributions to Basin Plan environmental objectives.</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>EWKR-derived information has not had a substantive role in building and supporting collaboration. Substantial collaboration occurred during the research and management engagement activities conducted within EWKR, and some survey respondents remark on the value of this. However, EWKR has not produced information products that effectively influenced collaboration per se.</p>
<b>Revision</b> <b>comments</b> <b>Evaluator 1</b>	– I see you took this KEQ as drafted and commented on the value of the <i>information</i> itself. I assessed a reworded KEQ (see my comments) because I thought the KEQ was in error. Agree with the sentiment of 'Ineffective' if we address the KEQ as it is worded but we'll need to follow the rubric terms and call it 'Minimally effective'.
<b>Revision</b> <b>comments</b> <b>Evaluator 2</b>	– If question applies to the Process and not just the Information, then I agree to modify my rating to Minimally Effective

<b>Consensus final rating</b>	<b>Minimally Effective</b>
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## EFFECTIVENESS – ACHIEVING OUTCOMES

- 1 high-level KEQ
- 6 mid-level KEQs
- 18 micro-level KEQs

High KEQ 3	To what extent has the EWKR project improved understanding of how management or delivery of environmental flow influences environmental outcomes achieved over time?
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Each of the final theme reports includes inferences about the potential influence on environmental outcomes of management or delivery of environmental flow. For example, the fish theme final report (2019) infers that as the population dynamics of Murray cod operate at scales of tens to hundreds of kilometres, environmental water management to support cod population growth could potentially be undertaken at the individual catchment scale. In contrast, the population dynamics of golden perch occur at the scale of the whole Basin's catchment which means that environmental water management must operate at larger scales. In answer to this question, the survey responses in the current evaluation varied little across the four themes and were generally positive (omitting those who replied 'Don't know', &gt;50% replied 'a moderate amount' or better). It was acknowledged that this improvement in understanding is still taking place, evidenced by the statement 'EWKR made some good progress extending the experts' understanding of these things; I think it will take some time for that understanding to transfer to managers, which will happen via ongoing communication between scientists and managers'. Quite a few respondents queried the 'over time' aspect, and felt the project was too short-term to have been able to make much of a contribution to understanding temporal aspects (e.g. 'The project was too short to deal with temporal aspects well'). Nonetheless, it seems that there has been an improvement of understanding of how management or delivery of environmental flow influences environmental outcomes and that this is translating into shifts in perspectives (e.g. 'I think the waterbird theme and fish theme are helping shift the focus to managing systems at a landscape scale rather than at individual sites') and delivery of water (e.g. 'I have seen water planners and delivery personnel refer to EWKR research quite often - both on the front line of water planning, e.g. water delivery design...'). Many interviewees in the management group provided either general assertions or, sometimes, examples of where information from the EWKR project had improved understanding of how management or delivery of environmental flow influences environmental outcomes. Often these examples were couched as confirming inferences or adding further evidence to support associations that were already known rather than dramatically altering management or delivery of environmental water. As seen in the responses to the survey, interviewees reiterated that the EWKR project was too brief to be able to provide useful information on environmental outcomes over time.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>EWKR has significantly improved understanding of how the delivery of environmental flow as event and watering regimes will drive ecological outcomes for native fish, waterbirds, vegetation and food webs in the Basin's rivers. Some of these understandings (and derived outputs such as models) are localised and require validation and further development to ensure transferability both geographically (among regions, locations on the floodplain and wetland systems) and structurally (across species,</p>

	populations and communities) in order to be broadly applicable at Basin scale. The temporal scale of responses to flows demonstrated by EWKR is variable - from single events (inundation and connection) to annual and multi-year watering regimes (for floodplain vegetation and waterbirds), and again cannot yet confirm the temporal sequence of ecological responses over time (e.g. > 5 years). However, EWKR has substantially advanced the understanding of how flow drives certain key ecological responses, including native fish recruitment and survival, waterbird breeding and recruitment, vegetation recruitment, growth, condition and structure, and key aspects of food web energetics and food supply for fish and waterbirds. These are all essential for the interpretation of responses to flows over time, and in the formulation of management decisions around managing individual events and event sequences. The formulation of management recommendations across different Resource Availability Scenarios is a particular strength in the management relevance sections of each theme report.
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Mid KEQ 3.1</b>	<b>How well has the EWKR project improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures (Note: outcome in Multi-year Research Plan only, not in Grant Guidelines)?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Not surprisingly, evidence for this was scant in the reports. The survey did not ask this question specifically but responses to related questions indicated that the EWKR project had 'improved knowledge of mechanisms' and that 'there are elements of each theme that will help with formulating the expected outcomes of specific water action objectives.'. Nonetheless, I found no evidence or specific examples that the EWKR project had improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures. This was a function of the challenge, at this juncture, in demonstrating that the effectiveness of environmental water has been improved by the application of science; perhaps it is too premature to answer this question. Responses in the interviews were more enlightening. Most respondents considered that information and knowledge from the EWKR project was still being absorbed and, in some cases, yet to be suitably communicated to managers so it was too early to see improved environmental water effectiveness through the application of EWKR science to the development and operation of environmental works and measures. However, respondents were confident that this science would be useful, and it was already broadly referred to in planning and design of future environmental watering. It may be a little early to be able to judge whether the science has been effective in improving the effectiveness of the development and operation of environmental works and measures because we are yet to see the results, whether the desired outcomes have eventuated, and how closely these outcomes reflect expectations based on the science from the EWKR project.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>Objective not addressed - set aside due to budget and time constraints</p>
<b>Revision comments – Evaluator 1</b>	Probably 'Not attempted' is better than 'Insufficient evidence'.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

Micro KEQ 3.1a How well has the EWKR project demonstrated improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures?	
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>There was no evidence presented in any of the reports that demonstrated improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures, nor were any specific examples of demonstrated improvement informed by science given in the responses to the survey. Part of this lack of evidence probably reflects the changes in objectives during the project that led to many being abandoned or ranked as low priority (see responses to mid and micro KEQs of KEQ1). It would be surprising if science were not being applied to the development and operation of environmental works and measures. However, the EWKR project was not able to demonstrate this effectively. Responses in the interviews also pointed to the rather nebulous nature of being able to demonstrate this improvement but feeling that there has been an addition to the science being applied to the development and operation of environmental works and measures (e.g. 'I think each theme has definitely contributed to the broader knowledge that's being applied.') None of the interview responses presented examples where the EWKR project demonstrated improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures. Several interviewees commented that it was also very hard to demonstrate this process because of the difficulty in identifying when new knowledge enters the decisions and what impact it makes. Again, there were opinions expressed that most of the EWKR work was 'foundational' and exploratory so it was perhaps not quite ready for effective application to the development and operation of environmental works and measures.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>This objective was set aside due to contextual factors (budget and time constraints)</p>
<b>Revision comments – Evaluator 1</b>	Suggest we call this 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

Mid KEQ 3.2 How effectively have the research activities in each theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Within the constraints imposed by the refined objectives that narrowed the research activities to specific aspects (e.g. recruitment, food requirements) in light of the logistic limitations of times and money, there has been useful scientific information gleaned from each theme (see responses to KEQ 3.2a-d) that is relevant to the capacity to predict outcomes of environmental flow allocations and their management over 1–5 years. Demonstrating that this scientific information has improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years over what the capacity was before the EWKR project is more difficult. This</p>

	challenge also applies to the responses to KEQ 3.2a-d. Another point to make (and it emerged in some of the responses to interview questions) is that this capacity is still being realised and so the improvements may not be evident for a while. Again, this is applicable to the responses to KEQ 3.2a-d. Ideally, we would have a line of evidence that involved specific predictions about one or more intended outcomes of environmental flow allocations and their management, and what the science from EWKR was that led to these predictions. The survey asked 'To what extent has the EWKR project improved your capacity to predict outcomes of environmental flow allocations and management over 1-5 years?' Although half the respondents who did not reply 'Don't know' felt that their capacity to predict outcomes of environmental flow allocations and their management over 1-5 years had improved a moderate amount or more, there were about a third who did not consider there had been any improvement in capacity. Specific responses included 'My capacity to predict outcomes from environmental water use and management is limited. Not sure EWKR has contributed to it.' but several that referred to improved understanding of mechanisms and other elements of the research. Surprisingly, none of these responses expressed an opinion on the specification of a time scale of 1-5 years. This question was asked of interviewees and received mixed responses. Some interviewees considered that the research activities in each theme had improved their capacity to predict outcomes of environmental flow allocations and their management over 1-5 years but only at a few local sites and not at the Basin scale. This was seen as a major drawback for those managers whose interests were at the Basin scale. Other interviewees replied 'Not much'. Others opined that information from the EWKR project had helped consolidate their ideas about what might occur (e.g. in terms of waterbird or fish responses) but had provided new insights into potential responses in productivity and aspects of fish foodwebs. However, the point was made that much of this was based on conceptual models rather than empirical data and remained to be rigorously tested so it had not yet translated into changed capacity. Given the wide range of responses, I rated this as moderately effective.
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>Research activities across the themes have improved capacity to project (though not predict) likely outcomes of flow allocations in the 1 to 5-year time frame, though in the absence of constraints and interactions with other contextual factors, drivers or risks. The viability of the models developed to do this varies among themes. Key examples of value are: Vegetation: a well-developed wetland response model based on data local to Hattah Lakes system, though with unknown transferability. Native fish: a fish recruitment model to project responses to watering events across the Basin. Food webs: a fish and food production response model to project likely production responses to watering scenarios. The viability and generality of these tools remains to be evaluated.</p>
<b>Revision comments – Evaluator 1</b>	Agree - Moderately effective
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 3.2a</b>	<b>How effectively have the research activities in the fish theme improved capacity to predict outcomes of environmental flow allocations and their management over 1-5 years?</b>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>The fish theme final report (2019) concluded that flow was a relatively minor driver of fish recruitment success. Therefore, fish recruitment per se is not likely to be an obviously predictable outcome of environmental flow allocations – or if it is, the mechanisms responsible are still not clear and will probably be species- and location-</p>



	<p>specific. However, research on golden perch indicated a significant positive effect of spawning flow pulse (change in flows during the core spawning period) on year-class strength in the southern Basin. Specifically, for the southern MDB, the model produced by the fish theme researchers predicted that a doubling of the flow pulse during the prescribed spawning season (October–March) resulted in a 64% increase in year class strength (with a 95%CI of 14% to 136%). Results of the research activities in the fish theme also showed that golden perch population dynamics operate at scales of up to thousands of kilometres which means that environmental water management that aims to promote this fish’s population growth needs to consider the scale at which this metapopulation operates, and the need for hydrological and physical connectivity for all life stages. This is also pertinent for monitoring environmental flow outcomes. This information from the research activities in the fish theme potentially can improve the capacity to predict outcomes of environmental flow allocations and their management. One of the responses in the current survey was ‘I think the waterbird theme and fish theme are helping shift the focus to managing systems at a landscape scale rather than at individual sites’ and this would apply to predicting and monitoring outcomes of environmental flow allocations and their management over 1–5 years. Two interviewees referred broadly to work from the fish theme when discussing their responses to this question, saying that it was relevant from the perspective of adopting different scales for different species in light of each species’ population dynamics (e.g. golden perch vs Murray cod). However, there was also concern that other fish information was preliminary, site-specific and harder to scale up to the whole Basin to predict broader-scale outcomes of environmental flow allocations and their management over 1–5 years.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>Comments same as those of A Fenton: The EWKR fish theme has advanced the conceptual understanding of flow and some non-flow driver influences on native fish recruitment and survival. The new Riverscape Recruitment Synthesis Model requires inputs requiring substantial investment for prediction of fish recruitment responses to management actions, and do not address timescales of response. Future CEWOs M&amp;E activities should include the model input parameters at appropriate sites and scales.</p>
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 3.2b</b>	<b>How effectively have the research activities in the waterbirds theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?</b>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Quite a few research activities in the waterbirds theme (summarised in the waterbird theme final report (2019)) generated results that can potentially improve capacity to predict outcomes of environmental flow allocations and their management over 1–5 years. For example, based on dietary preferences (e.g. aquatic vs terrestrial dependency), desired nesting and foraging habitat (especially along movement routes) and the water requirements of vegetation such as lignum which is favoured by some species of waterbird, there is improved predictive capacity for waterbird-related outcomes of environmental flow allocations and their management over 1–5 years. The waterbird theme also provided information on the drivers of short-term phenomena like mortality of eggs and fledglings of some species so that those drivers related to flow could be distinguished from other non-flow related drivers. This information helps improve predictions of the outcomes of environmental flow allocations and their management on some species of colonial waterbirds over the short term (1–5 years). As further improvements will be gained with continued monitoring and research, I rated this as ‘moderately effective’ rather than ‘effective’. Responses to the survey corroborated this improved capacity, specifically mentioning the greater appreciation of spatial scale and the importance of food quality to improving the outcomes (and their prediction) of environmental flow allocations and their management. Results from the waterbird theme were also specified as helping prediction of outcomes as targets (e.g. ‘I have been using information from the vegetation and waterbird themes with regards to objective and target-setting in the future and also for MER reporting’). Like the survey, there were several responses to interview questions that referred broadly</p>

	to work from the waterbird theme when discussing improvements to capacity to predict outcomes of environmental flow allocations and their management over 1–5 years. Aspects of relevant insights from the waterbird theme included greater appreciation of spatial scales of bird movement and the importance of food quality, but there were no specific examples given to show how this information improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years.
<b>Evaluator 2</b>	<b>Effective</b>  Research outputs from the waterbird theme will increase managers' capacities to predict waterbird outcomes for different locations across the Basin, different species and at a range of scales and durations. Non-water related risks and management actions have also been considered as part of the outputs, as well as options across resource availability scenarios.
<b>Revision comments – Evaluator 1</b>	Happy to upgrade my assessment to 'Effective' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Effective</b>

<b>Micro KEQ 3.2c</b>	<b>How effectively have the research activities in the vegetation theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?</b>
<b>Evaluator 1</b>	<b>Moderately Effective</b>  The capacity to predict outcomes of environmental flow allocations and their management over 1–5 years was improved by outputs of the vegetation theme. For example, on the Lower Balonne floodplain although the role of flooding in providing water to asset species could not be directly investigated due to a lack of flood events during the life of the project, multiple indirect lines of evidence suggested that inundation via floods or ponded rainfall are unlikely to cause significant groundwater recharge over much of the floodplain nor was there direct evidence to suggest that overbank flood events maintain the condition of the floodplain vegetation asset species considered (DSITI 2017). The vegetation theme final report (2019) presented results that showed that maintaining lignum with structural qualities to support processes such as waterbird recruitment is likely to require flow regime characteristics, including a flood-return-frequency in the range of 1 flow every 1–3 years. Models were used to predict that environmental water deliveries are likely to result in a diversity of responses by understory vegetation according to differences in location, recent flow conditions (e.g. water depth, time since last inundation, proportion of time wet), vegetation structure, and medium- to long-term flow regimes, and that these responses are likely to vary temporally. Further research is needed to extend these findings and predictions as they were based on one location (Hattah Lakes). The response of plant communities to watering actions varies from place to place, leading to a diversity of outcomes from the same watering treatments spatially. Across the Basin, the variation in response to the same watering actions, leads to a diversity of 'vegscapes'. This diversity of responses (heterogeneity) is a Basin-scale outcome, and outcomes should be planned to encompass this diversity and the outcomes assessed over time. Research activities in the vegetation theme improved the capacity to predict outcomes of environmental flow allocations and their management over 1–5 years for some areas and some plant communities but given the heterogeneity in response in different parts of the Basin, more information is needed to refine this predictive capacity (hence, a rating of 'moderately effective' rather than 'effective'). Survey responses indicated an awareness of this predictive capacity in the vegetation theme (e.g. 'The vegetation theme investigated eucalypt tree seedling strategies in response to

	different flooding regimes and found that constant flooding of seedlings will suppress their growth. It also found the inter-flood dry periods are important for seedling growth (especially root growth). Together, these findings highlight the importance of flooding timing and duration for the management of woody seedlings, an important consideration for the stand condition of tree communities.), including in predicting outcomes (e.g. 'I have been using information from the vegetation and waterbird themes with regards to objective and target setting in the future and also for MER reporting'). Some interviewees mentioned insights from the vegetation work may be relevant for helping them predict outcomes of environmental flow allocations and their management over 1–5 years but that they would probably contact the scientists directly and ask their opinion instead. This may be because there was considerable site-specific variation in how vegetation responded to different watering regimes, making it difficult to make blanket recommendations that would reliably apply at a Basin-wide scale, especially between the northern and southern basins.
<b>Evaluator 2</b>	<b>Effective</b>  Modelling of understory responses to watering regimes has been conducted successfully for one habitat type in one Basin environmental asset (Hattah Lakes wetlands), addressing the influence of in location, recent flow history and medium to long-term flow regimes and temporal scales of responses – especially on the scale of 1-5+ years. Analysis of existing data from other Basin assets/locations is required to capitalise on the value of this product. Key factors influencing species richness and seedling establishment, germination and survival in relation to inundation and watering have also been articulated. In addition, understanding of long-lived woody vegetation responses to managed water regimes has been advanced, and will support management decisions on the scale of 1-10 years.
<b>Revision comments – Evaluator 1</b>	Happy to upgrade my assessment to 'Effective' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Effective</b>

<b>Micro KEQ 3.2d</b>	<b>How effectively have the research activities in the food web theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  There is currently insufficient information from the research activities in the food web theme to improve capacity to reliably predict outcomes of environmental flow allocations and their management over 1–5 years, although some of the early indications are promising. The food web theme final report (2019) recommended that by targeting shifts in diet composition and producer quality, watering events can be designed to disproportionately benefit fish (e.g. by promoting green algae). This would imply that green algae and subsequent fish production could be predictable outcomes of environmental flow allocations but there was not enough information from the food web theme to be able to quantify this for different areas in the Basin or different watering events. One output from the foodweb theme was a 'trophic niche indicator' that is claimed to provide a cost-effective annual monitoring tool to assess the influence of environmental flows on food sources of native fishes, and this may also support qualitative predictions. Relative to the other themes, the foodweb theme was not particularly effective at improving the capacity to predict outcomes of environmental flow allocations and their management over 1–5 years. Survey responses indicated that this may reflect the early stage of this research (e.g. 'Some elements also more foundational than others (e.g. the food web theme) so may have less immediate impacts on management even though will undoubtedly be important in the long-term') and the complexity of some of the methods ('the food web theme is complex and more difficult to quantify'). There were no examples presented in the

	interview responses that described how research activities in the food web theme had improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years. One respondent mentioned that productivity was obviously relevant but the general consensus was that much of the work from the foodweb theme was still preliminary and it was too early to use this information to predict outcomes of environmental flow allocations.
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>The food web theme has improved the capacity to predict food resource provision outcomes of flow delivery and connection to areas of high food density and quality, with an emphasis on algal production as a food resource for fish (and by implication some waterbird species). The research outputs cannot (yet) be used to predict foodweb driven outcomes of water management and flow allocations within the 1-5-year time frame. Significant investment in data collection and further experimental observation is required to capitalize on the conceptual outcomes of this project.</p>
<b>Consensus final rating</b>	<b>Minimally Effective</b>

Mid KEQ 3.3 How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes? In general, each theme (see responses to KEQs 33a-33d) developed predictive tools, conceptual models and frameworks that could be used to help inform environmental watering regimes and/or that indicated how other drivers may modify the predicted outcomes. Each theme commenced with a review of the relevant literature to establish the context and extant knowledge for the research activities, and these usually underpinned at least one conceptual model or framework for the theme. In most cases, the predictive tools, conceptual models and frameworks to inform environmental watering regimes still require further corroboration and proof of their effectiveness. The survey responses, when they referred to the value of the conceptual models developed in the EWKR project, were optimistic about their development (e.g. 'For example the NSW Long-term Water Management Plans (LTWP) are currently being implemented and the first 5 year evaluation will occur in 2024 - this will provide an opportunity to incorporate EWKR research outcomes with regards to improving capacity to predict outcomes from environmental water actions, build on conceptual models, review objectives and targets, and increase capacity to report against Basin Plan environmental objectives and targets'). Caveats were expressed about the asset-scale value of conceptual approaches (e.g. 'By largely taking a broad / conceptual approach I think EWKR does meet water manager needs at the Basin scale and in relation to each theme. Though I suspect there may not always be a direct / clear link to the requirements at individual assets.') but in general there was praise for the ones that came out of the EWKR project (e.g. 'There are some very good conceptual frameworks to come out of EWKR'). References to conceptual models in the interview responses were often tempered with the wish that more quantitative data had been generated to confirm the models, frameworks and predictive tools because currently that constrained their confident application to management. Having said that, most interviewees were appreciative of the predictive tools, conceptual models and frameworks that had been developed but were less convinced that these were sufficiently robust yet to substantially inform environmental watering regimes.[for this and the following KEQs, I focused on the development of the tools, conceptual models, etc rather than their effectiveness in informing water regimes; if I went with this alternative definition, I would rate all these as 'Minimally effective']</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>All four themes adapted, modified or freshly developed theme-centred conceptual models relating key ecological outcomes to environmental water and other key drivers. The fish theme developed several conceptual models relating to fish recruitment and its key drivers. The vegetation theme developed multiple conceptual models relating vegetation responses at different scales to services and flow regimes. Multiple models were developed relating waterbird recruitment, population size and species diversity, as well as for waterbird life stages and food sources. Three predictive tools were developed for fish recruitment, wetland vegetation and fish and food production</p>

	responses to flows or watering scenarios. Frameworks and rule sets were also developed relating fish and waterbird recruitment outcomes to management scales, risks, context and knowledge requirements for different RAS's. The vegetation theme developed guiding principles, indicators and a framework relating responses to flow and nonflow drivers across scales and levels of organisation. A trophic niche indicator is proposed as a monitoring tool to evaluate changes in fish community trophic position. None of these models or frameworks are currently fully fit for purpose for application across the Basin – they all require further investment and testing to validate and transfer them for application in other regional and/or hydro-ecological contexts.
<b>Consensus final rating</b>	<b>Moderately Effective</b>

Micro KEQ 3.3a How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for vegetation?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Early in the vegetation theme, a conceptualisation was developed to set the direction of the theme's research questions by providing a structured approach for defining targeted vegetation responses, selecting indicators and considering the influence of flow regimes across multiple temporal scales. This led to a vegetation response model to assess the main drivers of plant species richness and abundance. The model assessed the relative importance of hydrological and climate variables on four wetland vegetation response metrics: i) native wetland plant species richness; ii) native wetland plant species abundance; iii) native dryland plant species richness; and iv) native dryland plant species abundance, and is described in the vegetation theme final report (2019). However, as this model has been developed in semi-arid systems, the final synthesis report (2019) acknowledged that it would benefit from testing in different environments to improve its applicability across the Basin. Including additional environmental metrics such as soil type, soil moisture and canopy condition would also improve understanding of wetland dynamics. As the vegetation theme also identified the importance of location as a major modifier of plant responses to environmental watering, these predictive tools, conceptual models and frameworks should be considered as indicative and should be used cautiously to inform environmental watering regimes for vegetation as they still require testing and corroboration with empirical data. In the survey, managers were asked 'To what extent have you adopted or used knowledge/guidance/tools generated by the project?'. For the vegetation theme, 23% of the respondents (n=9) replied 'Don't know' and 23% replied 'Not at all'; none replied 'A lot' or 'A great deal'. No specific examples of the use of tools or conceptual models from the vegetation theme were provided in the accompanying comments. The same applied to responses in the interviews; interviewees were not able to specify any tools or frameworks from the vegetation theme that were being used to inform environmental watering regimes but they did appreciate the vegetation theme's conceptual models for setting context and assisting communication.</p>
<b>Evaluator 2</b>	<p><b>Effective</b></p> <p>The EWKR vegetation theme developed an overarching vegetation - response conceptual framework to support development of objectives, a library of potential indicators of wetland vegetation responses to environmental flows, and guidance for environmental water management for vegetation outcomes. The theme produced a model of wetland vegetation species richness and abundance relationships with hydrology and climate at Hattah Lakes. Transferability of this valuable model framework to other locations needs further development and testing using existing datasets.</p>
<b>Revision comments – Evaluator 1</b>	Happy to upgrade my assessment to 'Effective' in light of our agreed relaxation of this performance criterion.
<b>Revision</b>	Agree

<b>comments – Evaluator 2</b>	
<b>Consensus final rating</b>	<b>Effective</b>

Micro KEQ 3.3b How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for fish?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>The fish theme made good use of conceptual models to summarise information from the literature but these models had limited utility for informing environmental watering regimes. For example, the conceptual framework for fish recruitment in rivers described in Section 2.3 of the fish theme final report (2019) highlighted how fish recruitment was determined by the spatial and temporal coincidence of optimal conditions (high food, low predation, optimal temperature) with the presence of larvae (movement and retention). However, it did not extend this to recommendations of specific water regimes to promote fish recruitment beyond suggesting that flows could be manipulated during peak spawning times to maximise retention capacity of the main stem of rivers while ensuring structural, hydraulic and geomorphic diversity. The fish theme final report (2019) also described a model based on the spatially reconciled age structure for golden perch (stocked fish removed and migrants assigned to their birth river) to assess flow-related recruitment dynamics across the MDB. This model predicted a significant positive effect of a flow pulse on golden perch spawning in the southern Basin (specifically, that a doubling of the flow pulse during the prescribed spawning season (October–March) resulted in a 64% increase in year-class strength (with a 95%CI of 14% to 136%)). These predictive tools, conceptual models and frameworks developed in the fish theme to inform environmental watering regimes for fish appear to be relatively limited in their applicability to species other than the few that were investigated and, depending on the species, the predicted responses may not be widely transferrable across the Basin. In the survey, managers were asked ‘To what extent have you adopted or used knowledge/guidance/tools generated by the project?’. For the fish theme, 42% of the respondents (n=9) replied ‘Don’t know’ and 17% replied ‘Not at all’; only one respondent replied ‘A lot’ or ‘A great deal’. No specific examples of the use of predictive tools, conceptual models and frameworks to inform environmental watering regimes from the fish theme were provided in the accompanying comments. The same applied to responses in the interviews; interviewees were not able to specify any tools or frameworks from the fish theme that were being used to inform environmental watering regimes.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The EWKR fish theme has strongly enhanced the conceptual understanding of fish recruitment and survival responses to flow and non-flow drivers. The Riverscape Recruitment Synthesis Model is potentially useful, but will need further investment (existing and new data) to reliably predict fish recruitment outcomes to flow and non-flow management. and support scenario-based management decision making.</p>
<b>Consensus final rating</b>	<b>Moderately Effective</b>

Micro KEQ 3.3c How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for waterbirds?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Although this theme derived a broad conceptual model of the variables influencing waterbird recruitment, population size and species diversity (Figure 1 in the waterbird</p>

	<p>theme final report (2019)), this is not explicitly aimed at informing environmental watering regimes for waterbirds and so could not be considered as a predictive tool or framework that is ready to use for this purpose. Similarly, models to predict growth of spoonbill chicks and energetic models of Australian waterbird chick energy requirements were not sufficiently refined to be suitable for at informing environmental watering regimes for waterbirds. None of these is a predictive tool but, with further information and refinement, there is potential for them to become tools that would help inform environmental watering regimes for waterbirds. However, the waterbird theme final report (2019) outlined how crucial waterbird foraging and nesting habitats are affected by both environmental flows and threats such as habitat change, and identified the significant potential for environmental flows to be managed to better support foraging habitats and food sources, especially during and immediately following breeding events. A conceptual model (Figure 9 in the waterbird theme final report (2019)) illustrated how environmental flows, vegetation management and pressures and threats such as predation interact with habitat characteristics to affect juvenile and sub-adult movements, condition, growth, survival and mortality and to affect adult breeding initiation and frequency. This framework identified that some factors influencing progression of waterbirds from one life stage to the next are independent of usual natural resource management (NRM) while others are influenced by both flow and other NRM, only by other NRM or by flow alone (Figure 9 in the waterbird theme final report (2019)). With refinements and corroboration with more data, this conceptual model possibly could be refined to inform environmental watering regimes for waterbirds. In the survey, managers were asked 'To what extent have you adopted or used knowledge/guidance/tools generated by the project?'. For the waterbird theme, 38% of the respondents (n=9) replied 'Don't know' and 8% replied 'Not at all'; only one respondent replied 'A lot' or 'A great deal'. No specific examples of the use of predictive tools, conceptual models and frameworks to inform environmental watering regimes from the waterbird theme were provided in the accompanying comments. The same applied to responses in the interviews. No interviewees specified any tools or frameworks from the waterbird theme that were being used to inform environmental watering regimes.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The waterbird theme has produced an energetics-based conceptual model to explore food biomass requirements for colonial waterbird breeding events. The utility of this is limited due to lack of knowledge of food biomass production responses to watering regimes and events in different habitats across the Basin. A conceptual model of drivers of waterbird life stage development also shows dependencies on water and non-water management interventions. Both model frameworks require significant investment to be developed and tested as fit for purpose in ewater management decision making.</p>
<b>Revision comments – Evaluator 1</b>	Agree - Moderately effective
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 3.3d</b>	<b>How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for food webs?</b>
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Figure 5-5 in the Annual Research Plan 2017–18 conceptualises how season and flow interact to influence the basal resources supporting large-bodied native fish. Although this figure is a useful conceptual model to generate hypotheses, very few of these hypotheses ended up being tested in the food web theme which severely limited the capacity to refine this conceptual model into a valid predictive tool to inform environmental watering regimes for food webs, specifically fish. Subsequently, a</p>

	<p>model that linked environmental flows to ecological outcomes was developed which produced a quantitative food web that ranked watering events based on fish biomass produced. The model predicted that fish biomass was proportional to the area and duration of inundation; however, biomass was also strongly influenced by diet quality and composition. By targeting shifts in diet composition and producer quality, watering events can theoretically be designed to benefit fish by favouring green algae which contribute a large proportion of the energy used by the invertebrates eaten by fish. This model was used to compare a set of watering scenarios guided by local water managers for the Gwydir to provide information and illustrate the sorts of questions the model could address (food web theme final report (2019)). For a given amount of environmental water, increasing the inundation duration yielded better fish outcomes than increasing the daily flow rate. Increases in the total amount of environmental water provided tend to have diminishing returns, likely due to the shape of the floodplain, which may explain why longer durations were more effective in producing fish biomass than higher daily flow rates. Although this model requires corroboration with more data from other locations and food webs collected at different times, it shows great potential for refinement as a useful predictive tool to inform environmental watering regimes for foodwebs, especially fish. In the survey, managers were asked 'To what extent have you adopted or used knowledge/guidance/tools generated by the project?'. For the foodweb theme, 42% of the respondents (n=9) replied 'Don't know' and 17% replied 'Not at all'; only one respondent replied 'A lot' or 'A great deal'. No specific examples of the use of predictive tools, conceptual models and frameworks to inform environmental watering regimes from the foodweb theme were provided in the accompanying comments. The same applied to responses in the interviews. Although many interviewees praised the foodweb theme for helpful insights into productivity and food quality, no interviewees could specify any tools or frameworks from the foodweb theme that were being used to inform environmental watering regimes.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The foodwebs theme has developed the capacity to project outcomes of water delivery (via and/or inundation and connection) for food provision in areas of higher density or higher-quality (green algal) food resources. Quantitative native fish food web simulation models were developed and showed native fish biomass outcome dependency on flow scenarios. A lack of data on food source composition responses to watering regimes and events will limit the management utility of this approach without further investment. The waterbird theme has produced an energetics-based conceptual model to explore food biomass requirements for colonial waterbird breeding events. The utility of this is limited (as for fish) due to a lack of knowledge of food biomass production responses to watering regimes and events in different habitats across the Basin.</p>
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Mid KEQ 3.4</b>	<b>How effectively has the EWKR project improved water management and complementary natural resource management?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>This objective was not fully addressed by the EKRW project (see response to KEQ 16), largely because, according to the informal assessment of the project's context and progress, funding constraints led to some elements of the objectives becoming less of a focus. Research teams identified that there were so many knowledge gaps with understanding ecological species response to environmental flows alone, and that understanding threats and complementary NRM activities were less of a priority knowledge gap for some of the themes. Some themes inferred high-level options and recommendations to improve water management and complementary natural resource management (see responses to KEQs 34a-d) but these were seldom strongly supported with empirical data, applicable Basin-wide, and sufficiently detailed to predict outcomes reliably (a notable exception is some elements of the waterbird theme). None of the survey responses indicated that the EWKR project had significantly improved water management and complementary natural resource management. One comment acknowledged that 'Objectives in relation to threats and complementary NRM activities evolved to be less a priority during research refinement as so much knowledge was unknown with ecological responses of species to environmental flow' which might be why this objective was not particularly effective. Interview responses reiterated that the EWKR project's objectives evolved away from addressing water management and complementary natural resource management. Other interviewees considered that the briefs of the four themes were to focus on research rather than improving water management and complementary natural resource management which was another reason why this objective was not addressed in detail. A few of the</p>



	responses to the interviews mentioned insights from different themes that identified situations where complementary NRM might be relevant (e.g. to control threats to waterbirds) and these specific examples are outlined in the responses to KEQs 34a-d. However, none of these responses included examples of effective improvements in water management and complementary natural resource management that could be shown to be based on EWKR research activities in any given theme.
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>The absence of a strong management focused output delivery framework, and especially addressing complementary natural resource management, has made EWKR minimally effective against this KEQ. Specific aspects of environmental water delivery and water needs have been improved, especially in the fish, vegetation and waterbird themes, and effective interaction with some water managers has led to improved capacity and integration of new ecological knowledge into decision making around environmental watering actions, and to a degree, planning. However, the overall objective has been poorly addressed - though much of this is due to the project's contextual and resource constraints, as this objective requires a much more substantial investment than was made available to EWKR.</p>
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 3.4a</b>	<b>How effectively have the EWKR project's vegetation theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of vegetation?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>This was not specified as an objective in the vegetation theme and there were no targeted analyses or field sampling to demonstrate a link between changes in water management and complementary natural resource management and measures of vegetation. Where these links were identified, it was usually a plant response predicted to a given water regime (e.g. maintaining lignum with structural qualities to support processes such as waterbird recruitment is likely to require flow regime characteristics, including a flood-return-frequency in the range of 1 flow every 1–3 years, inter-flood dry periods are important for promoting seedling establishment in the species assessed in the mesocosm experiments). The vegetation theme final report (2019) did not include any references to complementary natural resource management at all. None of the survey responses or interview transcripts indicated that the research activities of the vegetation theme had significantly improved water management and complementary natural resource management nor did they provide any relevant specific examples. Minimally effective</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>While the vegetation theme successfully developed understanding of vegetation responses to watering regimes, the focus in the research effort was not extended to include complementary natural resource management activities.</p>
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 3.4b</b>	<b>How effectively have EWKR's fish theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of fish?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Conceptual modelling and the literature review in the fish theme concluded that most recruitment drivers are more strongly influenced by non-flow related factors such as</p>

	land use impacts (e.g. sedimentation, riparian alteration) and barriers than they are by flow alone. Consequently, it was recommended that flow management involve complementary actions that may improve recruitment outcomes such as riparian management, revegetation, removals of barriers and levee banks, mitigation of cold-water pollution, management of non-native species and management of instream habitat (fish theme final report (2019)). However, there were no empirical data collected in the fish research activities that demonstrated a link between changes in water management and complementary natural resource management and measures of fish recruitment or other attributes. None of the survey responses indicated that the research activities of the fish theme had significantly improved water management and complementary natural resource management nor did they provide any relevant specific examples. During the interviews, a literature review done for the fish theme was mentioned as indicating that many drivers other than flow affected the success of native fish recruitment (and perhaps more so) but the link to the need for complementary NRM was not explicitly made. No other relevant examples were given based on research activities from the fish theme.
<b>Evaluator 2</b>	<b>Moderately Effective</b>  The fish theme successfully developed understanding of fish recruitment and survival responses to watering regimes. It qualitatively described those complementary natural resource management activities needed to enhance fish outcomes, though without quantitatively demonstrating the links to water management.
<b>Revision comments – Evaluator 1</b>	Happy to upgrade my assessment to 'Moderately effective' but, for me, it is a line call
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 3.4c</b>	<b>How effectively have EWKR's waterbirds theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of waterbirds?</b>
<b>Evaluator 1</b>	<b>Moderately Effective</b>  How effectively have EWKR's waterbirds theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of waterbirds? The waterbird theme researchers developed a conceptual model (Figure 9 in the waterbird theme final report (2019)) that illustrated how environmental flows, vegetation management, and pressures and threats such as predation interact with habitat characteristics to affect juvenile and sub-adult movements, condition, growth, survival and mortality and to affect adult breeding initiation and frequency. This conceptual model concluded that some factors influencing progression of waterbirds from one life stage to the next are independent of usual natural resource management (NRM) while others are influenced by both flow and other NRM, only by other NRM or by flow alone. Subsequent work in the waterbird theme inferred some of these links between changes in water management and complementary natural resource management and some of the measures of waterbird recruitment and movements. For example, data on foraging habitats used by nesting straw-necked ibis showed they included marsh/wetland environments, nature conservation areas, grazing pastures (native and modified, irrigated and dryland), rivers, roadside verges, and production native forests (including parts of Barmah-Millewa Forest). Differences in the habitat preferences (e.g. aquatic vs terrestrial) of prey of different waterbirds also led to inferences about the complementary management needed to protect these different habitats appropriately. However, demonstrating

	unequivocal links between changes in water management and complementary natural resource management and measures of waterbirds was challenging given the objectives, duration and spatial scope of this project. None of the survey responses indicated that the research activities of the waterbird theme had significantly improved water management and complementary natural resource management nor did they provide any relevant specific examples. Several interviewees mentioned situations where the research activities of the waterbird theme demonstrated threats to waterbirds (e.g. impacts of feral animals, botulism) that could be potentially ameliorated by complementary NRM to water management. There was also a reference to the importance of managing for food quality (the ubiquitous 'Big Mac') to support waterbirds, and presumably this would have involved appropriate water management and complementary natural resource management. However, none of these responses went on to describe examples of effective improvements in water management and complementary natural resource management that drew on information from the waterbird theme's research activities.
<b>Evaluator 2</b>	<b>Moderately Effective</b>  The waterbirds theme explored relationships between bird life stage progression and water management in the context of a range of natural resource management actions and risks (e.g. site conservation, structural vegetation and feral animal management). These management drivers were included in both the field research activities (though not qualitatively) and in conceptual modelling. It should be noted that neither the relationships or models have been quantitatively parameterised or evaluated with regard to incremental changes in condition or levels of NRM intervention.
<b>Revision comments – Evaluator 1</b>	Agree - Moderately effective
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Moderately Effective</b>

<b>Micro KEQ 3.4d</b>	<b>How effectively have EWKR's food web theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of food webs?</b>
<b>Evaluator 1</b>	<b>Minimally Effective</b>  The food web theme final report (2019) did not include any references to complementary natural resource management, and demonstrations of links between changes in water management and complementary natural resource management and measures of food webs were not presented in any of the other reports either. Instead, the focus was almost entirely on water management; this was another example of where funding constraints led to some elements of the objectives becoming less of a focus, and that understanding threats and complementary NRM activities was deemed less of a priority knowledge gap. None of the survey responses or interview transcripts indicated that the research activities of the foodweb theme had significantly improved water management and complementary natural resource management nor did they provide any relevant specific examples.
<b>Evaluator 2</b>	<b>Minimally Effective</b>

	Responses in food resource provision to water management were explored in the food web theme and integrated within the research outcomes. However other management actions (land use and habitat management) were not considered, largely due to the primacy of water-driven responses and trophic dynamics
<b>Consensus final rating</b>	<b>Minimally Effective</b>

<b>Micro KEQ 3.4e</b>	<b>How effective has the EWKR project been in building capacity to set realistic objectives and targets for water management and complementary natural resource management?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Some of the responses to the survey praised the EWKR project in building capacity to set realistic objectives and targets for water management and complementary natural resource management, largely in terms of helping explain why some of the outcomes occur (e.g. 'Capacity to set objectives is definitely improving as more and more actions are undertaken and EWKR info is helping to explain why we are seeing some of the outcomes from particular actions and patterns in monitoring'). However, other responses did not feel this had been fully effective ('No I don't think capacity has been improved') because of either lack of funding ('Funding constraints didn't enable this to full extent') or that it was not an objective of the EWKR project ('the intent was to build the science base rather than water manager capacity'). Interview responses indicated that respondents did not consider that the EWKR project had been effective in building capacity to set realistic objectives and targets for water management and complementary natural resource management. Most interviewees stated that the work was still too preliminary and was in conceptual models rather than sufficiently quantitative and at a broad enough spatial and temporal scale to be useful for setting targets and planning water and NRM management. However, responses also considered that, despite this not being an objective that was formally addressed, there had been useful information to emerge from the EWKR project and that it would probably be useful in the future. Some interviewees said it was just too early to tell. In the absence of this capacity, managers stated that they would contact relevant scientists and researchers directly and ask their advice. Given these responses and the responses to KEQs 34a-d, I concluded this was minimally effective.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>The EWKR program has partially succeeded in building capacity for realistic objective and target setting. Further work is required to translate EWKR outcomes into refinements of objectives and targets for water management, potentially as inputs to the BWS and LTWP reviews. EWKR's focus has however largely remained in the water management arena (ecological responses to watering events and regimes). Despite some project theme activities attempting to address the need for combinations of management actions, non-water management has not been sufficiently addressed to satisfy this objective – largely due to contextual and resourcing constraints.</p>
<b>Revision comments – Evaluator 1</b>	Given that your comments are also not especially enthusiastic, I would prefer to see this rated as 'Minimally effective'. I base this on the responses to surveys and interviews where there was scant evidence for much new capacity being developed.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Minimally Effective</b>

Mid KEQ 3.5 How well did the EWKR project address climate change in its research activities?	
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Although climate change was occasionally mentioned (e.g. the waterbird theme's analysis of threats listed in the literature, some of the conceptual models in the fish theme such as Fig 3 in the fish theme final report (2019)), climate change per se was not investigated in any of the research activities. Survey responses also did not refer to any examples where climate change was addressed in EWKR's research activities. Climate change was mentioned several times in the interviews, mainly admitting there was no work on this topic in the EWKR, perhaps because it was addressed by other programs and also because of the need to drastically focus the priorities due to funding and other logistic constraints. However, climate change was acknowledged as relevant and one of the main reasons for the interest in promoting resilience.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>EWKR did not address climate change in its research activities. While climate change was repeatedly referred to as context for the interactions between water management or watering regimes and ecological outcomes, and mentioned in foundation literature reviews, no single research question or research activity effectively addressed the issue of climate change (with some small exceptions such as water temperature as a driver of fish outcomes). Climate change could not, in fact, be effectively addressed within the contextual setting and resources of EWKR.</p>
<b>Revision comments – Evaluator 1</b>	Suggest we call this 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Agree, though I think this is a problem with the overblown Grant objectives rather than with EWKR project management.
<b>Consensus final rating</b>	<b>Not Attempted</b>

Mid KEQ 3.6 How effectively has the EWKR project improved the information to support reporting on progress toward the Basin Plan environmental objectives and targets?	
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>The 2019 EWKR evaluation (bearing in mind the caveat of its limited pool of relevant participants) asked 'To what extent has the project contributed or could be expected to contribute to improved reporting on Basin Plan outcomes?' and got mixed responses. Two participants indicated that the project was not set up for this purpose or it was not the role of EWKR to contribute to improved reporting, but instead was to provide information to further knowledge of ecosystem function and options to inform management decisions. In contrast, four of the interview participants indicated that the project would contribute to improved reporting by improving the foundational science around ecosystem function in the Murray Darling Basin and they gave several examples. These included that EWKR was providing some of the basic science that is missing from the Basin Plan and contributing some of the fundamental concepts and messages about ecosystem function and options for management decisions. For the vegetation theme, it was considered that the research outcomes would assist managers to report on different vegetation metrics such as structure and function into the future, and that the research highlighted the challenges in reporting at a basin scale on vegetation because of the heterogeneity (spatial and temporal) of understory vegetation communities. It was also claimed that the project has contributed to improved understanding of one of the Basin Plan's key targets, waterbirds, because the science from EWKR helped explain the reasons behind the outcomes of water management for waterbirds at multiple scales within the Basin. The current survey also</p>

	<p>elicited mixed responses to 'To what extent do you think the EWKR project will contribute to Basin Plan objectives?' with over a quarter of the respondents who did not reply 'Don't know' opting for 'A little'. However, overall, there were no responses 'Not at all' which indicated that the respondents did not feel the EWKR project had been completely ineffective at improving reporting on progress toward the Basin Plan environmental objectives and targets. Some specific responses praised the value of having science to help understand ecological responses and to refine management (e.g. 'Better understanding re: ecological responses to watering is great and helps managers fine-tune watering actions') and giving a better idea of the scales of responses and management needs (e.g. 'Helping to shift attention to managing at a landscape scale to achieve necessary outcomes'). Other responses highlighted that problems in knowledge transfer still hindered the effectiveness of this process (e.g. 'I think there's a lot of research out there that could inform the management of environmental water to achieve Basin Plan objectives, the trouble seems to be in transferring that research to information, and that information to knowledge, and that knowledge to understanding, and that understanding to action'). Most interviewees did not consider that a prime focus of the EWKR research activities was to improve reporting on progress toward the Basin Plan environmental objectives and targets. Thus, while they acknowledged that the scientific knowledge would be likely be broadly relevant, there were no specific examples presented where progress toward the Basin Plan environmental objectives and targets was demonstrated using information from the EWKR project. Instead, progress toward the Basin Plan environmental objectives and targets was seen as the role of the LTIM project which was intended to be complemented by the scientific knowledge derived from EWKR (hopefully that would help explain 'why' a target was achieved or not).</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>EWKR did not address the issue of reporting, or reporting needs in relation to progress toward Basin Plan objectives or targets. CEWO and MDBA evaluation activities will certainly be improved as a result of some of the knowledge outcomes from EWKR, but the reporting activities per se have not been within EWKR's research priorities or activities.</p>
<b>Revision comments – Evaluator 1</b>	<p>I would prefer to rate this as 'Minimally effective' based on the rubric's definitions of this criterion and the evidence from the evaluations so far.</p>
<b>Revision comments – Evaluator 2</b>	<p>Min Effective might be OK, though I don't think this was a core role of EWKR, despite improved capacity in reporting being one of the desired outcomes in the Grant Guidelines. In large part this role is dependent on CEWO's capacity to pick up on EWKR outputs and turn them into useful supporting knowledge for their reporting, to me this demand of EWKR is tangential at best, and EWKR was not formally requested nor designed to service it.</p>
<b>Consensus final rating</b>	<p><b>Minimally Effective</b></p> <p>Part of the disparity between the evaluators arose from the wording of this micro KEQ and so a revised wording was agreed with the core team to clarify the micro KEQ. As a result of the altered wording the evaluators agreed on a rating of 'Minimally effective'</p>

<b>Micro KEQ 3.6a</b>	<b>How effectively has the EWKR project linked the outcomes of research activities to reporting on progress towards Basin Plan Environmental objectives?</b>
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>Only three of the 18 documents reviewed by the 2019 Evaluation explicitly mentioned Basin Plan objectives, and only four of them provided information on reporting against those objectives. One explanation for this low number was the diversity of types of documents; for some of them, it simply was not appropriate to refer to Basin Plan environmental objectives. Our more comprehensive review of a greater number of documents revealed that although many of them referred to the Basin Plan environmental objectives, explicit linking of the relevant findings of each theme's research activities to specific objectives was very rare. The only example I could find was in the food web theme final report (2019) which claimed that the trophic niche indicator provides a cost-effective annual monitoring tool relevant to the Basin Plan</p>

	<p>objective ‘to protect and restore the ecosystem functions of water-dependent ecosystems’ (Basin Plan, Chapter 8, Part 2, 8.04(b)). The fish theme generated a table of research questions about native fish that mapped these questions to Basin Plan objectives but most of these research questions were later abandoned when the theme was refined and focused in light of funding constraints. The waterbird theme also tabulated its research questions alongside the Basin Plan objectives but specific links were not drawn between objectives and research questions or activities. Furthermore, matching of research activities to objectives was very high-level. Thus the recruitment research activities were matched to the high-level objective ‘To ensure that water-dependent ecosystems are resilient’. The vegetation theme final report (2019) did not mention the Basin Plan or its objectives but did present a framework (Figure 1 in vegetation theme final report (2019)) that was believed to provide the structure to support managers to identify, among other things, more explicit vegetation management objectives that are linked to values. However, none of the vegetation theme’s findings were subsequently explicitly linked to reporting towards Basin Plan objectives. Although the waterbird theme final report (2019) and the fish theme final report (2019) mentioned the objectives of the Basin Plan in their introductions, it was only as a context for justifying research on waterbirds or fish in these reports. The final project report (2019) acknowledged this limited transfer of relevant research findings to explicit management needs in its table of ‘lessons learned’ (Table 9), concluding that ‘In final reporting, theme coordinators were unfamiliar with converting science outcomes to water management recommendations. In some cases, unable to apply research outcomes to environmental water management’. The survey responses, as mentioned in the response to KEQ 36, were mixed, and none of them presented explicit examples of links between the outcomes of specific research activities to reporting on progress towards particular Basin Plan environmental objectives. However, some responses indicated an awareness of more general links and benefits for the Basin Plan objectives (e.g. ‘The science that EWKR contributes to underpins our capacity to monitor and evaluate BP objectives, as well as inform watering design that aims to achieve environmental BP outcomes. Currently I think it does this in a largely unquantifiable way - by making small advancements in science relevant to ewater management...’ and ‘In my current role I have seen EWKR research influence discussions around Basin Plan targets, Basin Plan chapter 8 objectives’) although these comments did not specify progress in reporting. Another response opined that the links between EKR’s research activities and the Basin Plan objectives were not well made (‘I don’t believe the EWKR has examined the long term BP objectives with a view to applying its findings, though this would be valuable across themes’) and in the recommendations for improvements there was the comment ‘Better connection to Basin Plan objectives, targets and planning frameworks’. Interviewees reiterated the responses from the survey that the EWKR project did not effectively link the outcomes of research activities to reporting on progress towards Basin Plan environmental objectives. However, the comment was often made that the scientific insights and knowledge from all the themes in the EWKR project were still useful and relevant for setting targets and objectives rather than assessing progress towards them. Issues of scale also came up quite often, identifying that much of the work in the EWKR project was done at one or a few sites, and the applicability of the findings to the whole Basin was yet to be demonstrated. Minimally effective</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>The outcomes of the research activities were focused on links between ecological outcomes and watering regimes and events, and cannot be readily linked to reporting on progress in achieving BP objectives This was not a core design aspect of the research activities, and should be considered outside the domain of EWKR’s core tasks, due to contextual and resourcing constraints.</p>
<b>Revision comments – Evaluator 1</b>	<p>I found it hard to call this one: ‘Not attempted’ vs ‘Minimally effective’. I got the feeling that this was sometimes attempted (e.g. the foodweb theme, partly the fish) but rather superficially.</p>
<b>Revision comments – Evaluator 2</b>	<p>As above. I feel strongly that this was not part of the original contractual requirement of EWKR and has been sloppily ‘added to’. In fact, the responsibilities for reporting and evaluation in relation to BP objectives and targets lie with all three of the Department/MDBA/CEWO and their capacities, and not EWKR.</p>
<b>Consensus final rating</b>	<p><b>Minimally Effective</b></p>

	The evaluators agreed that where this was attempted, it was minimally effective as judged by the lines of evidence originally cited.
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Micro KEQ 3.6b How effectively has the EWKR project linked the outcomes of research activities to reporting on progress towards Basin Plan Environmental targets?	
<b>Evaluator 1</b>	<p><b>Minimally Effective</b></p> <p>None of the reports on research activities in any of the four themes linked the outcomes of specific research activities to reporting on progress towards Basin Plan environmental targets nor did they refer to these targets, even in a general sense. One of the survey responses referred to the use of science to inform a review of Basin Plan targets but the reference was only a general one ('We will be conducting a review of the Basin watering strategy shortly, and using the latest scientific knowledge to inform a review of Basin Plan ecological targets will be central to this') and did not specify any particular EWKR research activity or activities. Recommendations for improvements to the EWKR project included the comment 'Better connection to Basin Plan objectives, targets and planning frameworks' although there was also a positive response 'In my current role I have seen EWKR research influence discussions around Basin Plan targets, Basin Plan chapter 8 objectives.' Neither of these referred to reporting on progress. No interview responses provided examples where the outcomes of research activities were specifically linked to reporting on progress towards Basin Plan environmental targets although, as outlined in the response to KEQ36a, scientific insights and knowledge from all the themes in the EWKR project were still useful and relevant for setting targets and objectives rather than assessing progress towards them.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>EWKR has built capacity to interpret the interactions between environmental watering and ecological responses, and to improve aspects of water management to achieve certain Plan objectives and targets. It did not evaluate reporting needs, requirements or designs to build the capacity to report against Basin Plan objectives and targets.</p>
<b>Revision comments – Evaluator 1</b>	I suggest 'Not attempted'
<b>Revision comments – Evaluator 2</b>	As above for KEQ 3.6 and 3.6a
<b>Consensus final rating</b>	<b>Not Attempted</b>

Mid KEQ 3.7 How effectively has the EWKR project built capacity to report against Basin Plan environmental objectives and targets?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>Despite the limited extent to which the EWKR project explicitly linked the outcomes of research activities to reporting on progress towards Basin Plan environmental objectives and targets (see responses to KEQ 36, 36a and 36b), the reports and other outputs from the research activities of the four themes present valuable scientific</p>



	<p>knowledge and insights into recruitment processes, foodweb links, and associations of vegetation, fish, waterbirds and foodwebs with environmental water regimes, and in some cases, scale issues that influence distribution and population dynamics of particular groups. This research knowledge, if it could be effectively translated into useful information for managers with appropriate acknowledgement of uncertainty and limits to its transferability, has great potential for improving reporting against Basin Plan environmental objectives and targets. It is also likely that the collaborations between researchers and managers during the 5-year EWKR project (see responses to KEQs 91 and 91a-e) have contributed substantially to building capacity to report against Basin Plan environmental objectives and targets even if these contributions are difficult to quantify or demonstrate. Much of this built capacity likely arises from a 'diffusion' of ideas, information and attitudes during workshops, one-on-one discussions and other interactions. Survey responses indicated that although knowledge transfer has not been optimal (e.g. 'I think there's a lot of research out there that could inform the management of environmental water to achieve Basin Plan objectives, the trouble seems to be in transferring that research to information, and that information to knowledge, and that knowledge to understanding, and that understanding to action'), there has been capacity built to better report against Basin Plan environmental objectives and targets (e.g. '...For example, the NSW Long-term Water Management Plans (LTWP) are currently being implemented and the first 5 year evaluation will occur in 2024 - this will provide an opportunity to incorporate EWKR research outcomes with regards to improving capacity to predict outcomes from environmental water actions, build on conceptual models, review objectives and targets, and increase capacity to report against Basin Plan environmental objectives and targets'; 'The science that EWKR contributes to underpins our capacity to monitor and evaluate BP objectives, as well as inform watering design that aims to achieve environmental BP outcomes'). Interview responses corroborated those from the survey, and many interviewees praised the potential value of the scientific information and insights in building capacity to report against Basin Plan environmental objectives and targets. However, the point was made repeatedly that this process was far from complete because information was still being communicated. Inadequate communication of some of the scientific findings to managers has contributed substantially to reducing the effectiveness of building their capacity to report against Basin Plan environmental objectives and targets. This has probably been partly countered by the enhanced capacity for managers to confidently contact scientists for advice and guidance. [line call, but I think 'Minimally effective' is too harsh given that the material is there but needs to be better conveyed]</p>
<b>Evaluator 2</b>	<p><b>Minimally Effective</b></p> <p>EWKR has built capacity to interpret the interactions between environmental watering and ecological responses, and to improve aspects of water management to achieve certain Plan objectives and targets. It did not evaluate reporting needs, requirements or designs to build the capacity to report against Basin Plan objectives and targets.</p>
<b>Revision comments – Evaluator 1</b>	<p>I shall reluctantly concede to 'Minimally effective' but it's pretty harsh. I guess the clincher is really that the capacity has NOT been very effectively built because of the limited communication of findings. But in my comments, I did acknowledge my rating as a line call.</p>
<b>Revision comments – Evaluator 2</b>	
<b>Consensus final rating</b>	<p><b>Minimally Effective</b></p>

<b>Micro KEQ 3.7a</b>	<b>How effectively has the EWKR project built capacity to report against Basin Plan environmental objectives?</b>
<b>Evaluator 1</b>	<b>Moderately Effective</b>

	<p>Within the constraints imposed by funding and other logistical limitations, findings from the research activities in the EWKR project are relevant to the Basin Plan objectives associated with protection and restoration of ecosystems and their functions (specifically energy transfer across trophic levels in some foodwebs) and resilience of water-dependent ecosystems (especially recruitment of vegetation, fish and waterbirds). Unfortunately, this capacity is probably not fully realised or developed yet, largely because of failings in knowledge transfer. This is captured in the one of the survey responses: 'I think there's a lot of research out there that could inform the management of environmental water to achieve Basin Plan objectives, the trouble seems to be in transferring that research to information, and that information to knowledge, and that knowledge to understanding, and that understanding to action'. It was also acknowledged in the final project report (2019) which, in its table of 'lessons learned' (Table 9), concluded that 'In final reporting, theme coordinators were unfamiliar with converting science outcomes to water management recommendations. In some cases, unable to apply research outcomes to environmental water management'. There is certainly room for optimism: 'Capacity to set objectives is definitely improving as more and more actions are undertaken and EWKR info is helping to explain why we are seeing some of the outcomes from particular actions and patterns in monitoring.' It is also likely that the collaborations between researchers and managers during the 5-year EWKR project (see responses to KEQs 91 and 91a-e) have contributed substantially to building capacity to report against Basin Plan environmental objectives even if these contributions are difficult to quantify or demonstrate. Much of this built capacity likely arises from a 'diffusion' of ideas, information and attitudes during workshops, one-on-one discussions and other interactions. Similar conclusions arose from the interview responses. Interviewees often praised the potential value of the scientific information and insights in building capacity to report against Basin Plan environmental objectives but considered that information was still being communicated and its full value had not yet been realised. Inadequate communication of some of the scientific findings to managers has contributed substantially to reducing the effectiveness of building their capacity to report against Basin Plan environmental objectives but this has probably been partly countered by the enhanced capacity for managers to confidently contact scientists for advice and guidance.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>EWKR has built capacity and understanding (conceptually, qualitatively and/or quantitatively) the links between ecological outcomes of key matters addressed by the BP environmental objectives (and hence of direct relevance to them) and watering regimes and events. These relationships should, either immediately, or after further evaluation and development, support the capacity to report against the BP objectives for the relevant matters. The quality of the science has been (in large part) of high quality and relevance to matters addressed by the BP targets. The activity of reporting and evaluating progress against the objectives is, however, a technical and analytic domain outside the scope of the EWKR program, and of more direct relevance to the MDB MER and Evaluation programs, for which EWKR has (and hopefully may continue to) provide vital understanding and tools.</p>
<b>Consensus final rating</b>	<b>Moderately Effective</b>

Micro KEQ 3.7b How effectively has the EWKR project built capacity to report against Basin Plan environmental targets?	
<b>Evaluator 1</b>	<p><b>Moderately Effective</b></p> <p>The same reasoning presented in the response to KEQ37a applies here too. However, there are several tangible examples of outputs from the EWKR research activities that contribute to capacity to report against Basin Plan environmental targets. One of these is the trophic niche indicator developed in the foodweb theme that provides a monitoring tool for managers to evaluate changes in the trophic position and diversity of carbon sources fuelling top predators and fish communities in the Murray-Darling, and was extolled as a cost-effective annual monitoring tool relevant to assessing targets in the Basin Plan. Another example is the work on Murray cod and golden perch reported in the fish theme final report (2019) that inferred that, as the population dynamics of Murray cod operate at scales of tens to hundreds of kilometres, environmental water management to support cod population growth could potentially be undertaken at the individual catchment scale. In contrast, the population</p>

	<p>dynamics of golden perch occurs at a whole of Basin scale which means that environmental water management must operate at larger scales. Research activities in the waterbird theme provided similar insights into the scales over which waterbirds were moving and the importance of their movement routes. These insights into scale-dependency of particular species or ecological processes are crucial because they help define the scale at which targets should be set and measured; without them, there is a risk that assessments of targets will be inadequate or misleading. A final example is from the vegetation theme final report (2019) which describes how the responses of plant communities to watering actions varies from place to place, leading to a diversity of outcomes from the same watering treatments spatially. This diversity of responses (heterogeneity) means that Basin Plan vegetation targets should be assessed in ways that encapsulate this diversity appropriately. As stated in the response to KEQ37, both the surveys and the interviews acknowledged the great potential value of the scientific information in building capacity to report against Basin Plan environmental objectives but considered that communication of much of this information to managers had been inadequate. This inadequate communication contributed to reducing the effectiveness of building their capacity to report against Basin Plan environmental targets. However, this has probably been partly countered by the enhanced capacity for managers to confidently contact scientists for advice and guidance.</p>
<b>Evaluator 2</b>	<p><b>Moderately Effective</b></p> <p>EWKR has built capacity and understanding (conceptually, qualitatively and/or quantitatively) the links between ecological outcomes of key matters addressed by the BP environmental targets (and hence of direct relevance to them) and watering regimes and events. These relationships should, either immediately, or after further evaluation and development, support the capacity to report against the BP targets for the relevant matters. The quality of the science has been (in large part) of high quality and relevance to matters addressed by the BP targets. The activity of reporting and evaluating progress against the targets is, however, a technical and analytic domain outside the scope of the EWKR program, and of more direct relevance to the MDB MER and Evaluation programs, for which EWKR has (and hopefully may continue to) provide vital understanding and tools.</p>
<b>Consensus final rating</b>	<p><b>Moderately Effective</b></p>

## APPROPRIATENESS – STRATEGIC RELEVANCE

- 1 high-level KEQ
- 1 mid-level KEQ
- 4 micro-level KEQs

High KEQ 4	How well has the EWKR project supported CEWO in meeting their legislative requirements?
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>There were few references in the final reports to tangible examples of the outputs from the four themes' research activities that supported CEWO in meeting their legislative requirements. The food web theme final report (2019) specified that the trophic niche indicator provides a cost-effective annual monitoring tool relevant to the CEWO watering objective of enhancing 'ecosystem function'. None of the other final reports explicitly linked any of the outputs to supporting CEWO in meeting their legislative requirements. (See responses to KEQ2.2 and micro questions for further details). Appendix B of the Evaluation (Phase 2) report (2019) (and bearing in mind the caveat of its limited pool of relevant participants) stated that the CEWO was already using the research outputs to update watering plans and refine watering programs such as to better support waterbird populations after breeding events. Responses from the current evaluation's survey also indicated opportunities for uptake of the outputs of EWKR's research activities by CEWO (e.g. 'some of the outcomes from EWKR have helped overall understanding and CEWO and others can use that info in telling the story of environmental water to various audiences'). However, there were no specific examples presented to show how the EWKR project supported CEWO in meeting their legislative requirements. This question was asked of the CEWO staff during the interviews. Responses indicated that the legislated reporting obligations were considered largely independent of EWKR (and LTIM). Nonetheless, respondents considered that EWKR's aims to improve knowledge that could help guide environmental water management were highly relevant in helping the CEWO report back to the MDBA and others. No specific examples were provided.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>The focus of EWKR on addressing key knowledge gaps in the area of ecological outcome responses to watering events, regimes and actions, and related contextual factors and management has addressed key knowledge needs which can support the CEWO's interpretation and evaluation of monitoring results derived from LTIM and other sources - a key part of CEWO's environmental management requirements, with a direct line of site to CEWO's legislated role. The degree to which CEWO has been active in taking up the results of EWKR outcomes is unclear. It has not been one of EWKR's core roles to directly contribute to CEWO's legislative requirements such as reporting, and the EWKR correctly did not attempt to service this need.</p>
<b>Revision comments Evaluator 1</b>	<p>Perhaps there is middle ground here. I am reluctant to answer a high-level KEQ with 'Not applicable' but perhaps we could agree with on 'Minimally appropriate'? I accept your reasoning that this was not a core role of EWKR but, to me, that doesn't mean that information from the project and the actual existence of the effort to collect this knowledge has not gone some way towards supporting CEWO in meeting their legislative requirements. From their website, it says "Intervention monitoring, evaluation and research results are used by the CEWO to demonstrate outcomes, inform management of Commonwealth water for the environment and meet our legislative reporting requirements."</p>
<b>Revision comments Evaluator 2</b>	<p>You've echoed both my points - that this was not a formal role of EWKR, and that EWKR has supplied valuable knowledge to support reporting requirements for performance evaluation. However, the answer to this question needs information on CEWO about the processes they used to conduct their evaluation and reporting and the adequacy of their application - which we have not had access to.</p>

<b>Consensus final rating</b>	<p><b>Moderately Appropriate</b></p> <p>After some discussion confirming the relevance of information from the EWKR project for supporting CEWO's legislative obligations, it was agreed that much of this information was moderately appropriate for CEWO to use for a range of purposes, including in any reporting required under legislation."</p>
<b>Mid KEQ 4.1</b>	<p><b>How appropriate is the information provided by the EWKR project for supporting the CEWH in meeting its Water Act and Basin Plan reporting requirements (including annual reporting to Commonwealth Minister, annual reporting to MDBA, 5-yearly reporting to MDBA)?</b></p>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>As indicated in the response to KEQ4, the reports and surveys did not give any specific examples of information provided by the EWKR project that had been used to support the CEWH in meeting its Water Act and Basin Plan reporting requirements (including annual reporting to Commonwealth Minister, annual reporting to MDBA, 5-yearly reporting to MDBA). This is not to say that there has been no appropriate information produced by the EWKR project. Instead, it is another situation where the information is there but much of it needs suitable packaging and communication to improve its accessibility and perhaps relevance to CEWH in meeting its Water Act and Basin Plan reporting requirements. This was well-captured in the one of the survey responses when referring to relevance of the EWKR outputs to Basin Plan objectives: 'I think there's a lot of research out there that could inform the management of environmental water to achieve Basin Plan objectives, the trouble seems to be in transferring that research to information, and that information to knowledge, and that knowledge to understanding, and that understanding to action'. In the interviews, CEWO staff stated that EWKR's aims to improve knowledge that could help guide environmental water management were highly relevant in helping the CEWO report back to the MDBA and others. No specific examples were provided. As the KEQ and performance criteria ask about the appropriateness of the support and alignment rather than the knowledge transfer and current use, I would say the information is 'moderately appropriate' but probably underused currently. It is a pity more effort to explicitly specify the alignments was not made in each final report.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>The focus of EWKR on addressing key knowledge gaps in the area of ecological outcome responses to watering events, regimes and actions, and related contextual factors and management has addressed key knowledge needs which can support the interpretation and evaluation of monitoring and assessment results by the CEWO. Thus, EWKR has made substantial contributions to the capacity of CEWO to interpret M&amp;E results which form a key part of the environmental management framework. The degree to which CEWO has been active in taking up the results of EWKR outcomes is unclear. It has not been one of EWKR's core roles to directly contribute to CEWH reporting, and the EWKR correctly did not attempt to service this need.</p>
<b>Revision comments – Evaluator 1</b>	<p>Taking the KEQ as written (i.e. the appropriateness of the information for supporting CEWH in reporting), I think that by the rubric's criteria (and agreeing with your reasoning), this is 'moderate' alignment with CEWO's needs. Hence, I would prefer to see it rated 'Moderately appropriate' because I see the information as being appropriate even if it were not communicated effectively</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final rating</b>	<p><b>Moderately Appropriate</b></p>

Micro KEQ 4.1a	To what extent has the EWKR project supported CEWO to be able to "....include in the report particulars of the following: (a) achievements against the objectives of the environmental watering plan" (Sec 114(2a)) of the Water Act?
<b>Evaluator 1</b>	<p><b>Minimally Appropriate</b></p> <p>It is likely that the LTIM will be of more value than the EWKR project in terms of supporting achievements against the objectives of the environmental watering plan. Nonetheless, some of the EWKR results supported current targets and objectives. For example, the waterbird theme final report (2019) stated that the identified flow requirements for colonial waterbird breeding at Reed Beds had a positive linear relationship between the two flow thresholds for breeding (total volume July-December &gt;2,300,000 ML per day and &gt;30 consecutive days &gt; 15,000 ML per day). Analyses of data by the waterbird theme researchers showed that Australian white ibis and straw-necked ibis bred on average 7 out of 10 years, coinciding with periods of high flow in the River Murray. This long-term study presents a baseline and target against which long-term water management plans can be developed. Survey responses indicated that it was probably too early to be able to judge the appropriateness of EWKR research for reporting achievements against objectives of the environmental watering plan (e.g. 'By the nature of the research undertaken some of the objectives are more likely to be met in the future when there has been sufficient time to incorporate the outcomes if the research and as the environmental water management cycles progress. For example the NSW Long-term Water Management Plans (LTWP) are currently being implemented and the first 5 year evaluation will occur in 2024 - this will provide an opportunity to incorporate EWKR research outcomes with regards to improving capacity to ... report against Basin Plan environmental objectives and targets'), and it was also acknowledged that the results of LTIM was more suitable for this purpose in the short term. In the interviews, CEWO staff reiterated that data from LTIM rather than EWKR were more directly relevant to addressing achievements against the objectives of the environmental watering plan but that the EWKR project increased knowledge about the likely reasons and mechanisms underpinning responses to environmental watering, and therefore would be relevant for planning and setting objectives for future environmental watering. Given the limited relevance of EWKR outputs and the likely particulars needed when reporting achievements against the objectives of the environmental watering plan, I rated this as Minimally appropriate. Also, the only annual report I could find on the web was the 2017-18 Annual CEWH report, and this did not cite EWKR results in reporting achievements of the environmental watering for that period.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>EWKR has built capacity and understanding (conceptually, qualitatively and/or quantitatively) the links between ecological outcomes of key matters addressed by the EWP environmental objectives (and hence of direct relevance to them) and watering regimes and events. These relationships should, either immediately, or after further evaluation and development, support the capacity to report against the EWP objectives for the relevant matters. The quality of the science has been (in large part) of high quality and relevance to matters addressed by the BP targets. The activity of reporting and evaluating progress against the EWP objectives is, however, a technical and analytic domain outside the scope of the EWKR program, and of more direct relevance to the CEWO LTIM, MDB MER and Evaluation programs, for which EWKR has (and hopefully may continue to) provide vital understanding and tools.</p>
<b>Revision comments – Evaluator 1</b>	<p>May be a case for 'Insufficient evidence' if not 'Minimally appropriate'.</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final</b>	<p><b>Minimally Appropriate</b></p>

rating	
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Micro KEQ 4.1b	To what extent has the EWKR project supported CEWO to annually report to the MDBA on Schedule 12, item 6: the extent to which local knowledge and solutions inform the implementation of the Basin Plan?	
Evaluator 1	<b>Minimally Appropriate</b>	As research activities in EWKR were conducted in specific locations, the resulting data are local and, in some instances (e.g. vegetation responses to flooding), illustrate site-specific responses that highlight the importance of gathering and understanding the value and limitations of local information and knowledge. More vexed is the issue of the extent to which findings from specific sites or drawn from local knowledge and solutions can be applied more widely, especially between the northern and southern Basins. CEWO staff did not touch on this topic during the interviews, perhaps because the results of the EWKR research activities were not seen as relevant to this aspect of their reporting. Other interviewees pointed out that much of the field research done during EWKR (often at only one or a few sites) was likely to produce quite site-specific results that would be difficult to reliably scale up to Basin-scale inferences that would be appropriate for informing implementation of the Basin Plan. Given the apparently limited relevance of EWKR outputs and use of local knowledge and solutions for informing the implementation of the Basin Plan, I rated this as Minimally appropriate.
Evaluator 2	<b>Not Applicable</b>	Specific EWKR research datasets and site/location specific models are products that can directly and indirectly support CEWO in reporting on locally-derived knowledge of ecological responses to watering regimes, events and actions. Examples include results and studies derived from site-specific data collected in locations such as Hattah Lakes (wetland vegetation), the Lower Balonne Floodplain (floodplain vegetation) and the Goulburn River (fish recruitment). Other data sets (fish, waterbirds, vegetation) are derived from data collected across many Basin sites. EWKR did not specifically address the issue of locally derived solutions for management of aspects of the plan, as it was outside the scope of program and research activities (see EWKR contextual statement).
Revision comments – Evaluator 1	Your comments provide quite a few examples of where local knowledge could be used which, along with my own comments, lead me to consider that there is some information here to support the CEWO in reporting the use of local knowledge and solutions. I would prefer to stick with 'Minimally appropriate'.	
Revision comments – Evaluator 2	Agree	
Consensus final rating	<b>Minimally Appropriate</b>	

Micro KEQ 4.1c	To what extent has the EWKR project supported CEWO to be able to annually report to the MDBA on Schedule 12, item 10: the implementation of the environmental management framework (part 4 of ch 8 of the Basin Plan)?	
Evaluator 1	<b>Minimally Appropriate</b>	

	During the interviews, CEWO staff stated that their annual reporting obligations to the MDBA were considered largely independent of EWKR. As detailed in the responses to KEQs 4 and 41, the scientific knowledge gained from the EWKR research activities was valuable and greatly appreciated by CEWO. However, there appeared to be limited relevance of these results for annual reporting on the implementation of the environmental management framework compared with the LTIM outputs. Given the apparently limited relevance of EWKR outputs for annual reporting on the implementation of the environmental management framework, I rated this as Minimally appropriate. Minimally appropriate
<b>Evaluator 2</b>	<b>Not Applicable</b>  The focus of EWKR on addressing key knowledge gaps in the area of ecological outcome responses to watering events, regimes and actions, and related contextual factors and management has addressed key knowledge needs which can support the interpretation of monitoring and evaluation results by CEWO. Thus, EWKR has made substantial contributions to the capacity of CEWO to interpret M&E results which form a key part of the environmental management framework. The degree to which CEWO has been active in taking up the results of EWKR outcomes is unclear. It has not been EWKR's role to directly contribute the CEWO reporting under Schedule 12, item10, and the EWKR report correctly do not attempt to service this need.
<b>Revision comments – Evaluator 1</b>	Again, as per my comments, I consider there is some information here to support the CEWO but it is not especially relevant (hence 'weak/limited alignment') as befits the rating 'Minimally appropriate'.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Minimally Appropriate</b>

<b>Micro KEQ 4.1d</b>	<b>To what extent has the EWKR project supported CEWO for five yearly reporting to MDBA on the contribution of Commonwealth environmental water to environmental outcomes at a Basin-scale? By reference to the targets that measure progress towards the environmental objectives in Schedule 7: there is no loss or degradation in the following:</b>  <b>(c) river, floodplain and wetland types including the condition of priority env assets &amp; priority ecosystem functions;</b>
<b>Evaluator 1</b>	<b>Moderately Appropriate</b>  It is likely that the LTIM will be of more value than the EWKR project in terms of assessing whether that has been any loss or degradation in the river, floodplain and wetland types, including the condition of priority environmental assets and priority ecosystem functions. This is especially the case where research activities did not gather data over time periods long enough to be able to measure incremental changes associated with degradation or losses of aquatic habitats, ecosystems or ecosystem functions. Instead, the research activities of the EWKR project are more value in explaining potential mechanisms underlying observed outcomes or losses and degradation in river, floodplain and wetland types, their assets and ecosystem functions. The EWKR project developed at least one tool that will potentially help measure progress towards the environmental objectives in Schedule 7. The trophic niche indicator described in the food web theme final report (2019) provides a cost-effective annual monitoring tool that is relevant to reporting changes in the 'ecosystem function' of trophic transfer of energy in fish foodwebs. However, this tool may need further testing to ensure its value and applicability across the Basin. During the interviews, CEWO staff stated that the research had an informing role whereas the monitoring (LTIM) was more directly relevant to reporting on progress against the targets that measure progress towards the environmental objectives. Given the knowledge that emerged from



	the EWKR project on energy transfer across trophic levels in foodwebs and about some of the flow-related drivers of productivity at several sites in the Basin (relevant to assessing ecosystem function), there is scope for this information to be used to measure the condition of priority ecosystem functions and so it is likely to be appropriate (in future). This general perspective about the applied value of information from the EWKR project on ecosystem functions (specifically foodwebs and productivity) was echoed indirectly by other respondents. During the interviews, the interviewer asked multiple respondents about their perception of the relevance of EWKR's findings for Schedule 7 environmental objectives. Replies generally indicated that although this was not seen as a priority objective of EWKR, there was a retrospective attempt to determine what information would be relevant and from that, it appeared that quite a lot of the general knowledge would probably be appropriate to help guide context and improve predictions of likely ecological responses to environmental watering, including progress towards the environmental objectives in Schedule 7.
<b>Evaluator 2</b>	<b>Not Applicable</b>  EWKR's research outcomes are highly strategically relevant to the successful implementation of environmental watering actions under the EWP, the evaluation of the role of environmental water in supporting those outcomes and the interpretation of key aspects of CEWO's M&E data. Thus, several key EWKR outcomes and outputs can support CEWO's evaluation process. However, the EWKR project itself has not played the role of providing or conducting the evaluation, as it is outside the role of the project. The degree of uptake by CEWO in the use of EWKR results in the evaluation required for the reporting is beyond the scope of this review.
<b>Revision comments Evaluator 1</b> –	Maybe there is middle ground here with 'Minimally appropriate'? I am hesitant to say this is out of scope (we wouldn't have been asked this KEQ if it were) and while I feel sure the LTIM is far better suited for this KEQ, I still believe there is some (albeit limited) information in explaining mechanisms.
<b>Revision comments Evaluator 2</b> –	Agree, though I feel strongly that we are only being presented with half of the equation (i.e. no CEWO-related information)
<b>Consensus final rating</b>	<b>Minimally Appropriate</b>

#### APPROPRIATENESS – FIT FOR PURPOSE

- 1 high-level KEQ
- 7 mid-level KEQs
- 20 micro-level KEQs

<b>High KEQ 5</b>	<b>To what extent is the EWKR project design fit for purpose?</b>
<b>Evaluator 1</b>	<b>Moderately Appropriate</b>  The intent of the EWKR project was to improve the science available to support the needs of environmental water managers in the Murray–Darling Basin. The Grant Guidelines set out objectives to improve understanding of: (1) How environmental flow management influences ecosystem function and thereby sustains biodiversity, (2) How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect biodiversity, ecosystem function, resilience and water

	<p>quality, (3) How threats (hydrological, aquatic and terrestrial) may reduce or prevent the ecological improvement expected through the application of environmental water, (4) How management or delivery of environmental flow influences environmental outcomes achieved over time (what are the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition? ) and (5) How complementary water management and natural resource management enhance the outcomes of environmental water management (what are the links between ecosystem responses to management interventions (water management and natural resource management) and incremental changes in ecological condition?). These objectives were not met effectively by the EWKR project (see responses to mid and micro KEQs in KEQ1), largely because the design of the project changed over time and was focused (because of funding and other logistic constraints) to such an extent that many of the objectives were rated as of lower priority and therefore were not addressed or only done so superficially. Within the themes, research activities sometimes had to be abandoned or modified substantially which adversely affected the outputs and their fitness for purpose. However, these were changes that affected the final outcomes and their fitness for purpose rather than failures of the initial or revised designs. An evaluation of the planning phase (Watts 2017) concluded that, by the end of 2016, the MDB EWKR project still remained 'appropriately aligned to key drivers and project objectives' and noted that all stakeholder groups felt that the research planning ultimately ended up being stronger and more supported through the conceptualisation phase. (The 2019 evaluation did not explore whether the EWKR project was fit for purpose). Responses to the survey in the current evaluation indicated that most respondents felt the project was appropriately designed to supported water managers to manage environmental water (over 75% of those who did not reply 'Don't know' replied with 'A moderate amount' or better). Specific responses highlighted the amount of effort there was initially to align the project design with managers' needs (e.g. 'there was an early effort and extensive process, that relied primarily on state managers, to identify and prioritise the EWKR research questions in a way that connected with ewater needs'; 'As clients we emphasised the need for all research in EWKR to be management-relevant and where possible management-focussed'). Many interviewees did not consider that the EWKR project design was fit for purpose because a lot of the objectives were dropped, much of the resulting information was poorly integrated and communicated, there were seldom clear links between research findings and their direct relevance to environmental water management at a Basin scale, and funding and other constraints limited the work to a few specific aspects (mainly recruitment and foodwebs) in specific sites for only a limited period of time. A few respondents perceived a change in stated purpose over time from one focusing on research to one that sought management guidance, and this added further challenges to assessing whether the project, as designed, was ultimately fit for the perceived changed purpose. These respondents, mostly managers, considered that the EWKR project was not fit for the purpose of supporting water managers to manage environmental water. Accepting that the final design was not ideally fit for all the purposes and objectives outlined in the Grant Guidelines and that there was considerable refinement and alteration of the objectives, the project designs for the subsets of work that were eventually chosen within each theme and their alignment with Basin Plan objectives (see responses to KEQs 51a-51d) were considered moderately fit for purpose.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The overall project design, with the hierarchical theme, research questions and research plan structure, was appropriate to the then state of knowledge in the ecological-environmental water space, the context and resourcing of the project. The design lacked an adequate treatment of non-water drivers of ecological outcomes - largely due to inadequate resourcing. It also lacked an adequate integrative framework for addressing key management information delivery needs across the themes, which may have improved the overall project design if applied at the outset.</p>
<b>Consensus final rating</b>	<p><b>Moderately Appropriate</b></p>

<b>Mid KEQ 5.1</b>	<b>To what extent was alignment with Basin Plan objectives taken into consideration during planning?</b>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>Alignment with Basin Plan objectives was a priority during planning and the research activities in each theme sought to align with these objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (see responses to KEQs 5.1a-5.1d). Across all four themes, the relationship between the</p>

	<p>EWKR priority research areas and questions, expected outcomes in the Basin-Wide Environmental Watering Strategy (BEWS) and Basin Plan objectives were tabulated (Table 2-1 in the Multi-year Research Plan (2016-19)) to illustrate the line of sight across them. This arose from the intentions expressed in the preliminary identification of research questions (Burns and Gawne 2014a) that research priorities were to be identified by: consulting with environmental water managers to identify their knowledge needs and research priorities associated with the achievement of Basin Plan objectives and aligned with the objectives of MDB EWKR; consulting with researchers to identify their suggested priority research questions associated with the achievement of Basin Plan objectives and aligned with the objectives of MDB EWKR; and then integrating the outcomes of these consultation processes to identify potential research priorities and get consensus on them. Figure 2-1 in the Multi-year Research Plan (2016-19) illustrates the relationship between the MDB EWKR research themes, Basin-Wide Watering Strategy - Expected Outcomes and Basin Plan objectives. However, it would have been good to be more precise here; the arrows seem generic and the text, especially in the lowermost set of boxes, indicates very different levels of precision across themes. Given the importance of this figure, it needed more thought - and perhaps this reflects the thinking of the team at that time. Importantly, this line of sight needed to be revisited in the final theme reports so the research findings for each research activity could be linked explicitly to either Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. Specific comments in the survey indicated an intention for the EWKR project to be relevant to Basin Plan objectives (e.g. 'The EWKR projects were designed to input to key Basin Plan themes and objectives. EWKR is one of many inputs to Basin Plan'), implying consideration of alignment during the planning of the project ('All themes in developing the logic and rationale needed to reflect a line of sight to BWS. This was outlined in research planning'). However, there was some disagreement (e.g. 'I don't feel this was a strong component of the EWKR Project, and reference to the BP was loose at best. Better alignment with Basin Plan objectives, and environmental water planning knowledge gaps and needs would benefit the project'; 'I believe the EWKR work to be very specific and targeted work rather than broad and overarching (i.e. like the BWS or EWP objectives)'). In the interviews, some respondents who were researchers considered that initially there was an effort to consider Basin Plan objectives during planning but that this was not a major factor compared to perceptions of important knowledge gaps or priority questions. Most of the situations where outputs were seen as relevant to Basin Plan objectives appeared to be after retrospective examination rather than an intentional alignment with a clear line of sight maintained the whole way through a given theme or research activity. In summary, alignment with Basin Plan objectives was taken into consideration during planning but there was not always a direct line of sight of results to Basin Plan reporting requirements, with outcomes aligned to those of the BWS and EWP. [perhaps the closest to Appropriate but when I reread the performance criteria, there was not always a direct line of sight of results to Basin Plan reporting requirements]</p>
<b>Evaluator 2</b>	<p><b>Appropriate</b></p> <p>EWKR objectives were clearly aligned with Basin Plan objectives during planning. A line of sight between Plan objectives and EWKR objectives, both in their original form and as the project developed, can be drawn. It should be remembered that Plan objectives are high-level, aspirational and broad in their remit. EWKR focused its research activities, with their questions sitting under the EWKR objectives, on specific aspects of ecological responses to environmental water games and events. These all sit within the remit of the Plan objectives, but necessarily address selected and specific aspects of the knowledge requirements underpinning the Plan objectives.</p>
<b>Revision comments Evaluator 1</b>	<p>Happy to upgrade my assessment to 'Appropriate ' in light of our agreed relaxation of this performance criterion.</p>
<b>Revision comments Evaluator 2</b>	<p>Agree</p>
<b>Consensus final rating</b>	<p><b>Appropriate</b></p>

Micro KEQ 5.1a	To what extent are the research questions for the vegetation theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>The vegetation theme ultimately focused on two priority research topics: (1) diversity of non-woody (understory and wetland) plants, and (2) recruitment of four species of long-lived woody vegetation (river red gum, black box, coolibah and lignum (vegetation theme final report (2019))). The research activities and research questions for these research topics aligned well with the Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs), portrayed in Table 2-1 and 3-1 in the Multi-year Research Plan (2016-19) (and to some degree in Figure 2-1). Some of the broader issues and principles associated with this alignment of objectives with environmental watering in the vegetation theme are further discussed in 'Blue, green and in-between; setting objectives for and evaluating wetland vegetation responses to environmental flows' by Campbell et al. in Section V1.1 of the Vegetation Theme Report Appendices (2019). However, the vegetation theme final report (2019) and other final outputs did not detail the direct lines of sight between the key results of each research activity in this theme and the Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. Failure to do this made it difficult to then draw out the management importance of each finding to achieving either the relevant Basin Plan objective or Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcome. Respondents to the survey indicated that there was broad alignment at the theme scale for the vegetation theme with Basin Plan objectives, the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes, or both (e.g. 'Project themes - fish, vegetation and birds are key BEWS themes'; 'The themes align with the BWS, that's all'). The research questions were considered as potentially less well aligned ('...These research questions may not have specifically aligned with the BWS expected outcomes because the BWS objectives are limited to very specific outcomes for River flow/connectivity, Vegetation, Fish and Waterbirds') but there was also reference to tables in the management relevance sections that were stated to 'establish clear links between the theme outcomes and BWS expected outcomes'. Interview responses reiterated that themes were chosen to be relevant to the Basin Plan and the BWS, and this included the vegetation theme. Some respondents considered that some of the research questions for the vegetation theme were reasonably well aligned with the BWS (e.g. the Queensland work with floodplain tree species that are also mentioned in the BWS) whereas other research activities such as the mesocosm experiments and assessment of recruitment strategies appeared less well aligned. Other respondents acknowledged that the Basin Plan objectives were not divided thematically and, being so broad, were likely to be generally aligned with at least some research questions in the EWKR project, including those in the vegetation theme. Specific examples from the vegetation theme included the information on spatial and temporal variation among sites as well as some of the differences associated with flooding regime.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>There is strong alignment between the EWKR vegetation theme research questions and the knowledge needs underpinning the Basin Plan objectives. The EWKR project did not adequately describe the alignment of research focus and outcomes with the Expected Environmental Outcomes (EEOs) of the Basin-wide Environmental Watering Strategy (BEWS), in the final vegetation theme report or in the synthesis report. However, in the targeted research matters (outcomes and responses of long-lived woody vegetation and non-woody vegetation), and in initial and final research questions there was alignment with selected BEWS EEO matters. The evolution of research questions, combined with the identification of priority knowledge gaps associated with key EEO ecological responses to watering regimes, events and actions, and the contextual and resource constraints on the EWKR project have admittedly caused the alignment to not be as strong as initially intended. The main focus of the vegetation theme became the relationships between key vegetation outcomes (structure, recruitment, diversity etc.) and watering (regimes and events) - with an emphasis on information for water management rather than informing objectives. However, EWKR vegetation outputs for all themes have provided key underpinning knowledge, as well as conceptual, and qualitative model tools (the wetland response model), which could partially support refinement of the BEWS EEOs in the BEWS review process, as well as evaluation of the role of Commonwealth environmental water in driving the key ecological outcomes. It will be important for CEWO to ensure future integration of the CEWO M&amp;E vegetation evaluation process with selected vegetation outputs and outcomes from EWKR.</p>
<b>Consensus final</b>	<b>Moderately Appropriate</b>

rating	
<b>Micro KEQ 5.1b</b>	<b>To what extent are the research questions for the fish theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?</b>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>There was considerable consultation with managers during the early stages of prioritising research questions for the fish theme. Although ultimately many of these questions could not be addressed because of funding and other constraints (as described in the informal contextual blurb), this initial scoping phase was thorough and well-reported (Burns and Gawne 2014), and followed a number of clearly specified principles. Alignment with Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes was a high priority (the first principle as listed in Table 4, Burns and Gawne 2014). Distilling the outcomes of this consultation and application of the principles indicated that fish survival/condition and recruitment were the priority research topics due to their alignment with the EWKR project's objective of examining long-term responses to flow, importance in achieving management objectives and the interest for researchers. This process is described more broadly in Koehn et al. (2019). The upshot was a series of research questions that, although narrowed down to only two broad areas, aligned well with some of the Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (Table 2-1 in the Multi-year Research Plan (2016-19)). The fish theme did not follow the groupings of species outcomes adopted under the BEWS (i.e., 'moderate to long-lived species') instead going with specific iconic species (e.g. Murray cod and golden perch) as these species were identified as important during the stakeholder consultation. The subsequent reporting in the fish theme final report (2019) and other outputs, unfortunately, did not detail the direct lines of sight between the results of the fish theme research activities and the Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. The survey included responses that there was broad alignment at the theme scale for the fish theme with Basin Plan objectives, the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes, or both (e.g. 'Project themes - fish, vegetation and birds are key BEWS themes'; 'The themes align with the BWS, that's all'). However, the research questions were considered as potentially less well aligned ('...These research questions may not have specifically aligned with the BWS expected outcomes because the BWS objectives are limited to very specific outcomes for River flow/connectivity, Vegetation, Fish and Waterbirds'). Nonetheless, specific examples from the fish theme were used to illustrate the importance of managing at a landscape scale to achieve necessary outcomes ('for fish the otolith work has demonstrated importance of select nursery habitats across basin and large watering events in driving fish populations') and this is highly relevant to the Basin Plan objectives. Many of the responses to interview questions indicated that themes were chosen to be relevant to the Basin Plan and the BWS, and this included the fish theme. Some respondents considered that some of the research questions for the fish theme were reasonably well aligned with the BWS but also acknowledged this was challenging because of the high variation across the Basin in factors affecting fish populations. It was also pointed out that the science knowledge from EWKR was helpful in explaining why some ecological responses were not as predicted (e.g. watering for golden perch) and that the research activities on this species were relevant to the Basin Plan objectives.</p>
<b>Evaluator 2</b>	<p><b>Appropriate</b></p> <p>There is strong alignment between the EWKR fish theme research questions and the knowledge needs underpinning the Basin Plan objectives. The EWKR project did not adequately describe the alignment of the fish research focus and outcomes with the Expected Environmental Outcomes (EEOs) of the Basin-wide Environmental Watering Strategy (BEWS), in the final theme report for fish or in the synthesis report. In Annual Research Plans there was reasonably strong alignment with the matters of the BEWS EEOs. The evolution of research questions, combined with the focus on priority knowledge gaps for key fish responses to watering regimes and events, and the contextual and resource constraints on the theme caused the EWKR fish research activities to be focused on selected responses (mainly recruitment). The final and synthesis reports do not link research activities to BEWS EEOs. However, EWKR outputs for fish provide key knowledge, as well as conceptual, qualitative and quantitative model tools, which can support further development of the BEWS fish EEOs in the BEWS review process, as well as support for evaluation of the role of Commonwealth environmental water</p>

	in driving selected fish outcomes.
<b>Revision comments – Evaluator 1</b>	Happy to upgrade my assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Appropriate</b>

<b>Micro KEQ 5.1c</b>	<b>To what extent are the research questions for the waterbird theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?</b>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>Evaluation of the possible waterbird research questions during the initial scoping phase followed a number of clearly specified principles (Burns and Gawne 2014). Alignment with Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes was a high priority (the first principle as listed in Table 4, Burns and Gawne 2014). Consensus settled on addressing waterbird recruitment (breeding success) as it was the priority research topic due to its importance in achieving management objectives and the opportunity to improve predictive capacity. Ultimately, the broad questions guiding the research activities in the waterbird theme were: 'Which flow regimes best support recruitment of waterbirds?' and 'How do threats and pressures affect recruitment outcomes for waterbirds?', and these were presented in Table 2-1 in the Multi-year Research Plan (2016-19) (and to some degree in Figure 2-1) to show their general alignment with Basin Plan objectives and/or Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. However, specific research activities within these two broad questions were not mapped out with the same detail or illustrating clear lines of sight between each one and relevant Basin Plan objectives and/or Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. Furthermore, subsequent reporting in the waterbird theme final report (2019) and other outputs did not detail the direct lines of sight between the results of each research activity in the waterbird theme and their associated Basin Plan objectives and/or Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. The survey included responses that there was broad alignment at the theme scale for the fish theme with Basin Plan objectives, the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes, or both (e.g. 'Project themes - fish, vegetation and birds are key BEWS themes'; 'The themes align with the BWS, that's all'). However, the research questions were considered as potentially less well aligned ('...These research questions may not have specifically aligned with the BWS expected outcomes because the BWS objectives are limited to very specific outcomes for River flow/connectivity, Vegetation, Fish and Waterbirds'). Nonetheless, specific examples from the waterbird theme were used to illustrate the importance of managing at a landscape scale to achieve necessary outcomes ('...for birds it highlights the importance of helping chicks survive to become breeding adults not just helping them fledge...') and this is highly relevant to the Basin Plan objectives. Many interviewees indicated that themes were chosen to be relevant to the Basin Plan and the BWS, and this included the waterbird theme. However, there were no specific examples presented of research questions for the waterbird theme that were aligned with either Basin Plan objectives or the BEWS QEEOs.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR waterbird theme research questions describe the alignment of research questions with the BP Schedule 8 Objectives and the BEWS Expected Environmental Outcomes (EEOs). The targeted research matters (ecological outcomes of waterbird recruitment and survival) were aligned with several matters of the BEWS EEOs. This</p>

	alignment was not however revisited in the final theme report for waterbirds or in the synthesis report. The evolution of research questions, combined with the identification of priority knowledge gaps and the contextual and resource constraints caused the waterbird theme research activities to focus on key waterbird responses to watering regimes and events rather than BP or BEWS objectives. However, EWKR outputs for waterbirds have provided key knowledge, as well as conceptual and qualitative model tools, which can support further development of the BEWS waterbird EEOs, as well as support for evaluation of the role of Commonwealth environmental water in driving waterbird outcomes.
<b>Consensus final rating</b>	<b>Moderately Appropriate</b>

<b>Micro KEQ 5.1d</b>	<b>To what extent are the research questions for the food web theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?</b>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>Basin Plan objectives refer specifically to the relevance of protecting and restoring foodwebs ('An objective is to protect and restore ecological community structure, species interactions and food web...' Item 7 in 'Protection and restoration of ecosystem functions of water-dependent ecosystems'), and this was picked up during the development of questions for this theme and reiterated in the food web theme final report (2019). Also, this theme was somewhat derivative, and its relevance to Basin Plan objectives and/or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes was associated with the relevance of the fish and waterbird themes (see responses to KEQs 51b and 51c). After evaluation of the various potential questions associated with foodwebs (Burns and Gawne 2014), two broad questions guiding the research activities in the foodweb theme emerged: 'What flow regimes best support food webs that contribute to positive outcomes for native fish and waterbirds?' and 'How do other stressors impact on food web processes and the achievement of native fish and waterbirds outcomes?'. These were subsequently refined to 'What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?' and 'How do other stressors (e.g. land use change, invasive species) impact on food web processes and the achievement of native fish and waterbirds outcomes?' and their relevance to the Basin Plan objectives are explored in more detail in the responses to KEQ52, 52a and 52b. Table 2-1 in the Multi-year Research Plan (2016-19) outlines the general alignment of these two refined foodweb questions with Basin Plan objectives and/or Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. Unfortunately, the sub-questions and associated research activities within these two broad questions were not mapped out in detail nor were there clear lines of sight shown between each sub-question and its relevant Basin Plan objectives and/or Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. The foodweb theme final report (2019) and other outputs also did not detail the direct lines of sight between the results of each research activity addressing each sub-question in the foodweb theme and their associated Basin Plan objectives and/or Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes. Unlike the other three themes, foodwebs did not align with a key BWS theme. However, survey responses indicated that research questions from this theme were still seen as relevant to providing crucial supporting information and context (e.g. 'I've focused on the Basin wide environmental watering strategy objectives. I think that particularly the foodwebs and food resources findings, highlight the importance of connectivity and this ecosystem function to provide the building blocks for healthy populations of fish and waterbirds'). Specific examples from the foodweb theme were used to illustrate the importance of managing at a landscape scale to achieve necessary outcomes ('...for foodwebs it is increasing attention on this previously neglected area focusing on quality as well as quantity of food and relative importance of connection to floodplain, which is important in considerations of constraints management') and this is highly relevant to the Basin Plan objectives. Interviewees reiterated that the foodweb theme was not aligned with the key themes in BWS but valuable supporting information was generated by the research activities in this theme that were relevant to Basin Plan objectives. However, some interviewees considered that some of the research questions in the foodweb theme were not especially well aligned with either Basin Plan objectives or the BEWS QEEOs, and that where relevance was eventually found, it was through retrospective assessment in the final stages of the project and usually less well-defined than fish or waterbirds. Nonetheless, there was a feeling that there would be more focus on ecosystem functions in future iterations of the BWS and that information from the foodweb theme would then be more useful.</p>



<b>Evaluator 2</b>	<b>Appropriate</b>  The food webs theme research questions and activities, along with the multiyear research plan, were directly relevant to the functional components of the Basin Plan objectives. The research focused on functional aspects of food webs (food provision in relation to food abundance and quality) as relevant to the needs of fish and waterbirds. There was no alignment to the BEWs EEO set, as this did not include functional or food web outcomes in their 2014 or 2019 versions. Ecosystem function outcome descriptions are planned for inclusion in the next BEWS version – and EWKR research outcomes are likely to be of direct utility in developing these.
<b>Revision comments – Evaluator 1</b>	Happy to upgrade my assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Appropriate</b>

<b>Mid KEQ 5.2</b>	<b>How relevant were the priority research questions for food webs to the first Grant Guideline objective and the 3 Basin Plan objectives?</b>
<b>Evaluator 1</b>	<b>Moderately Appropriate</b>  The first Grant Guideline objective (Section 1.4 of the Grant Guidelines) was to assess how environmental flow management influences ecosystem function and thereby sustains biodiversity; the three Basin Plan objectives are to protect and restore water-dependent ecosystems, protect and restore ecosystem functions, and to ensure that water-dependent ecosystems are resilient. As the flow of energy across the trophic levels of a food web represent an ecosystem function and the first foodweb question explicitly referred to assessing which flow regimes best support foodwebs favouring fish and waterbirds, this question was highly relevant for the first Grant Guideline objective and the first two Basin Plan objectives. Arguably, intact foodwebs and associated biodiversity also promote resilience so there is relevance of the first question to the third Basin Plan objective as well. The second question is less relevant to the first Grant Guideline objective but still important because it should indicate whether the effectiveness of environmental flow management might be compromised by other threats and stressors. As the achievement of fish and waterbird outcomes (broadly speaking) or the integrity of ecosystem functions as represented by the transfer of energy among trophic levels are highly relevant to all three Basin Plan objectives, the second question was highly relevant for all three Basin Plan objectives. Although this question was not asked in the survey, one comment pertained to the relevance of the foodweb research questions to the Basin Plan objectives where they pertain to ecosystem functions ('I think that particularly the foodwebs and food resources findings, highlight the importance of connectivity and this ecosystem function to provide the building blocks for healthy populations of fish and waterbirds'). Similarly, many interviewees considered that valuable supporting information relevant to Basin Plan objectives arose from the activities addressing the foodweb research questions.
<b>Evaluator 2</b>	<b>Appropriate</b>  The food webs theme developed highly appropriate research questions after considerable review (and guidance by the SAG) pertaining to KEQ 52a, but following the resulting delay in commencing research activities (and due to contextual factors), the theme was unable to adequately address KEQ2b.



<b>Revision comments</b> – <b>Evaluator 1</b>	Happy to upgrade my assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments</b> – <b>Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Appropriate</b>

<b>Micro KEQ 5.2a</b>	<p>How well did the EWKR project establish the relationship between (and hence relevance of) the high priority research questions for food webs below, this first objective of the grant guidelines and the 3 Basin Plan objectives (protect &amp; restore water dependent ecosystems, protect &amp; restore ecosystem functions, ensure water dependent ecosystems are resilient)?</p> <p>High priority food web research questions:</p> <p>1. What flow regimes best support food webs that contribute to positive outcomes for native fish &amp; waterbirds?</p>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>Although the food web theme final report (2019) did a very good job of introducing foodwebs and their ecological relevance, the relevance of the two high-priority food web research questions to the grant guidelines and the three Basin Plan objectives was not well explained in this report or other final outputs (e.g. Rolls et al. (2017), Robson et al. (2017)). Instead, there was broad reference to the Basin Plan, and the reader was left to infer the relevance of the first high-priority food web research question. Nonetheless, a reasonable explanation of this relationship was given in the Multi-year Research Plan (2016-19) in Section 6-2 with respect to the Basin Plan objectives but not to the objectives in the Grant Guidelines. There were no specific comments from either the survey or the interviews on how well the EWKR project established the relevance of the research question 'What flow regimes best support food webs that contribute to positive outcomes for native fish and waterbirds?' with the first objective of the grant guidelines and the three Basin Plan objectives.[line call with Minimally appropriate]</p>
<b>Evaluator 2</b>	<p><b>Appropriate</b></p> <p>The EWKR food web project established a sound line of sight between the higher-level research question – 'what flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds' and the Basin Plan objective of 'protect &amp; restore ecosystem functions', but did not evaluate the relationship with the other 2 BP objectives. The relationship with the grant guidelines first objective of 'How environmental flow management influences ecosystem function . . .' was clearly related to the high-level question, though the link to biodiversity outcomes was not established due to contextual and resource constraints of the project.</p>
<b>Revision comments</b> – <b>Evaluator 1</b>	I feel it is already generous to call this 'Moderately appropriate' so I am not willing to relax the criterion in this case as I don't think the relationship for this particular question was well established.
<b>Revision comments</b> –	Agree

<b>Evaluator 2</b>	
<b>Consensus final rating</b>	<b>Moderately Appropriate</b>

<b>Micro KEQ 5.2b</b>	<p>How well did the EWKR project establish the relationship between (and hence relevance of) the high priority research question for food webs below, this first objective of the grant guidelines and the 3 Basin Plan objectives (protect &amp; restore water dependent ecosystems, protect &amp; restore ecosystem functions, ensure water dependent ecosystems are resilient)?</p> <p>High priority Food web research questions:</p> <p>2. How do other stressors impact on food web processes and the achievement of native fish &amp; waterbirds outcomes?</p>
<b>Evaluator 1</b>	<p><b>Minimally Appropriate</b></p> <p>The relevance of this second high-priority food web research question to the grant guidelines and the three Basin Plan objectives was not well explained in the food web theme final report (2019) or other final outputs (e.g. Rolls et al. (2017), Robson et al. (2017). This may be because this question was not addressed in detail by the research activities of the theme, and there were too few relevant results to draw upon. The Multi-year Research Plan (2016-19) did not establish the relevance of this second high-priority food web research question to the grant guidelines and the three Basin Plan objectives in detail at all; the focus was almost entirely on flow-associated aspects. This lack of explanation of the relationship may stem from the poorly defined nature of the question (e.g. relevant stressors were not specified nor were their likely mechanisms hypothesised) and the non-specificity of 'fish and waterbird outcomes'. There were no specific comments from either the survey or the interviews on how well the EWKR project established the relevance of the research question 'How do other stressors impact on food web processes and the achievement of native fish and waterbirds outcomes?' with the first objective of the grant guidelines and the three Basin Plan objectives.</p>
<b>Evaluator 2</b>	<p><b>Inappropriate</b></p> <p>The EWKR food webs research activities and outcomes did not address the impact of, or interactions with, other stressors on the achievement of native fish and waterbird outcomes. The need for productive substrates in key habitats was mentioned, but not substantially addressed in research activities.</p>
<b>Revision comments – Evaluator 1</b>	Agreed - Minimally appropriate (I am assuming you meant Minimally appropriate)
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Minimally Appropriate</b>

<b>Mid KEQ 5.3</b>	<b>How relevant were the lowest level research question for food webs to the priority research questions?</b>
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<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>From the Multi-year Research Plan (2016-19), the foodweb priority questions and their low-level research questions were: 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds? 1A What are the main energy sources contributing to larval fish biomass and waterbird recruitment in the field? 1B Are there clear spatial patterns in the importance of different energy sources? 1C Are there clear temporal patterns in the importance of different energy sources? 1D Is there evidence of 'energy bottlenecks' preventing passage of energy to higher trophic levels? 1E How does provision of flow affect any patterns detected in 1.1A–D? 2. How do other stressors (e.g. land use change, invasive species) impact on food web processes and the achievement of native fish and waterbirds outcomes? 2A Is there evidence for energy being diverted away from native fish and waterbirds (e.g. by carp)? 2B Is there evidence that productivity in the channel is limited by other factors (e.g. water turbidity, availability of productive substrates)? Subquestions 1A-E are relevant for Question 1, logical and the results would have been very helpful if the questions had been successfully answered (the phrase 'energy source' never appears in the food web theme final report (2019) and these questions and their answers and management implications are never fully presented). Subquestions 2A and 2B are relevant for Question 2 and continue the focus on energy (rather than, say, loss of particular elements of foodwebs). 2B is quite specific but still relevant. Again, the answers to these were not particularly clearly provided. Neither the responses to the survey nor the interview transcripts included any relevant comments on this KEQ.[The questions were relevant even if they were not addressed very well]</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>See details under commentary description for KEQ5.3a.</p>
<b>Consensus final rating</b>	<p><b>Moderately Appropriate</b></p>

<b>Micro KEQ 5.3a</b>	<p><b>How effectively did the EWKR project establish the relationship for food webs between the lowest level of food web research questions and the higher-level food web questions?</b></p>
<b>Evaluator 1</b>	<p><b>Minimally Appropriate</b></p> <p>Although the benefits of taking an energetics approach are well presented in the Multi-year Research Plan (2016-19) and the food web theme final report (2019), the relationship between the lowest level of food web research questions and the higher-level food web questions was not particularly effectively established. This may have been because it could be readily inferred that for the first question, one needed to establish the main energy sources contributing to larval fish biomass and waterbird recruitment, their spatial and temporal patterns, where bottlenecks may occur and how flow affected all of these. Nonetheless, a simple flow diagram would have greatly helped illustrate these links, present hypotheses as to how they may vary in, for example, different parts of the Basin or different habitats with different flow regimes, and more clearly establish the relationship between the lowest and highest levels of food web research questions. Similar reasoning applies to the second high-level question, perhaps even more so as 2B seems to be based on the assumption that one or more key food resources are produced in the channel – an assumption that was not well explained. Neither the responses to the survey nor the interview transcripts included any relevant comments on this KEQ. [The EWKR outputs did a poor job of establishing the relationship between the lowest level of food web research questions and the higher-level food web questions]</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR food web project was able to establish the relationships between the higher-level research question (question 1) – 'what flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds' in part for the lower level questions 1A and 1B and 1 E, but not 1C or 1D. The main energy sources for larval fish biomass were identified, and by inference this relates to those waterbirds with strong food dependency on fish. Energy sources for insect-dependent</p>

	waterbirds were not identified. An insufficient diversity of waterbird diets was evaluated to establish the link to the higher-level question for waterbirds. Spatial patterns in energy sources were identified at the level of habitat type, for low quality vs high quality (green algal) food production. Flow provision for patterns in low level questions 1A and 1B were addressed, but only at the broad level of event type. Temporal patterns and energy bottlenecks were not adequately addressed.
<b>Revision comments – Evaluator 1</b>	Encouraged by your comments which also criticise the extent to which these relationships were established, I would urge we go with 'Minimally appropriate'
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Minimally Appropriate</b>

<b>Mid KEQ 5.4</b>	<b>How relevant was the EWKR project to improving understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect biodiversity, ecosystem function, resilience and water quality?</b>
<b>Evaluator 1</b>	<p><b>Minimally Appropriate</b></p> <p>Interactions among major drivers that may affect biodiversity, ecosystem function, resilience and water quality were not well-researched by the activities in the EWKR project, especially for water quality. Instead, focus was largely on flow-dependent drivers although each theme did acknowledge the relevance of non-flow drivers and, in a few cases, explored these with dedicated research activities. For example, the fish theme final report (2019) observed that fish recruitment success is related to many drivers, of which flow is only one. Physical and hydraulic complexity, food and temperature suitability and dispersal ability were listed as other key drivers of recruitment for riverine fishes, and it was stated that these non-flow drivers, and their interaction with flow, need to be more fully considered in future research. Although the fish theme reviewed the literature to identify the importance of non-flow drivers for fish recruitment (including the development of the Riverscape Recruitment Synthesis model that combines key discharge-related environmental factors (e.g. energy, nutrient concentration, temperature), fish species traits (e.g. life history) and levels of food and predation to predict recruitment strength of riverine fish), interactive effects and impacts on ecosystem function and water quality were not assessed in detail. In the vegetation theme, DSITI (2017) and the vegetation theme final report (2019) describe how non-flow drivers affect some components of vegetation biodiversity and recruitment (this latter is relevant to resilience) but again, there was not a strong focus on interactive effects and the influence of some drivers such as invasive species and land use were not addressed in detail. The food web theme final report (2019) focused almost entirely on flow-related drivers (elements of the first high-level question) whereas there was much less information in answer to the second high-level question which asked whether other stressors (e.g. land use change, invasive species) might impact on food web processes and the achievement of native fish and waterbirds outcomes. Interactions among drivers were never mentioned in the food web theme final report (2019). The review by McGinness (2016) identified that a major knowledge gap existed in the understanding of the effects of interactions between flow-related drivers of waterbird responses and other stressors, pressures or threats, especially habitat loss, fragmentation and change; predation - rates, species, and timing; climate change and adverse or extreme weather. However, there was limited direct research on this topic in the waterbird theme although useful data emerged on sources of mortality that indicated the relative roles of some of these stressors. There were no survey responses that indicated that the EWKR project improved understanding of how the major drivers of system condition interacted to affect biodiversity, ecosystem function, resilience and water quality. Although this question was not asked explicitly, there were related questions about improved understanding of drivers and threats. To these, there were no responses that referred to insights about interactions among drivers. Interviewees acknowledged that the EWKR project did not address in any detail how the major drivers of system condition (e.g. environmental flow, land use, invasive species, etc.) interacted to affect biodiversity, ecosystem function, resilience and water quality. Some respondents believed this was a pity as it</p>

	made it difficult to explain when expected responses to environmental watering or floods did not occur. A few conceptual models were mentioned that looked at multiple drivers (e.g. on fish recruitment) but the interactions among these drivers was not addressed. Overall, in terms of improving understanding of the interactions, the EWKR project research activities were not very relevant although the foundational literature reviews probably have contributed to high-level understanding of the importance of these interactions.
<b>Evaluator 2</b>	<b>Minimally Appropriate</b>  The project lacked a cross-theme synthetic component which addressed the integrated impact of multiple drivers of biodiversity, ecosystem function, resilience and water quality. While individual themes addressed water and flow regimes as a major driver, the inclusion of other non-water drivers was patchy at best - partially due to a lack of synthetic focus but also due to the major contextual and resource constraints on this ambitious program.
<b>Consensus final rating</b>	<b>Minimally Appropriate</b>

<b>Micro KEQ 5.4a</b>	<b>How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:</b>  “How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of vegetation, the relevant Basin Plan objectives and the priority research questions?
<b>Evaluator 1</b>	<b>Moderately Appropriate</b>  The effects of interactions among major drivers of system condition (especially land use and invasive species) on biodiversity, ecosystem function, resilience and water quality were not ultimately addressed in detail in the vegetation theme and therefore this aspect was not outlined in the vegetation theme final report (2019). However, the relationship between this objective, relevant Basin Plan objectives and the initial priority research questions was well established during the planning phase (see also response to KEQ51a). In particular, consultation during the planning phase in the vegetation theme identified the following threats as most significant in terms of their potential impact on vegetation outcomes across the Basin: invasive species, grazing, habitat loss/land use, climate change, groundwater/salinisation and water quality (Burns and Gawne 2014, Section 2.3.4), and this clearly linked well with this objective in the Grant Guidelines. Conceptual models derived from literature reviews supported the relevance of these links and of threats (e.g. to seedlings, Section 7.5 in Durent et al. 2016 ‘Recruitment of long-lived floodplain vegetation: Literature review’). The planning phase resulted in relevant priority questions like: How do threats impact on the drivers and diversity outcomes (of understorey and wetland plant communities)?, How do threats (increased temperature, changes in rainfall seasonality) influence flow requirements (of long-lived floodplain vegetation (Red Gum, Black Box, Coolibah, Lignum)? and How do threats impact on the drivers and recruitment outcomes (of long-lived floodplain vegetation (Red Gum, Black Box, Coolibah, Lignum)? All these were mapped to appropriate Basin Plan objectives and would be relevant to this objective in the Grant Guidelines. Unfortunately, subsequent research activities in the vegetation theme did not focus on these three questions or assessing how the major drivers of system condition interact to affect vegetation biodiversity, ecosystem function, resilience and water quality. This KEQ refers to the theme itself (and I assume, the products and outputs) rather than the initial research questions so I have not been able to give it as high a rating as if all the research questions had been fully addressed as planned. Responses to the survey and the interview questions did not include any relevant comments on this KEQ. [well established relevance even if not addressed]
<b>Evaluator 2</b>	<b>Appropriate</b>  The EWKR vegetation theme's research questions were strongly aligned with the 2nd grant guidelines objective, as well as with two of the 3 BP objectives. It was able to establish relationships between the key driver of water regime and events with vegetation-based biodiversity outcomes, though was not able to address other major non-water related stressors due to contextual and resource constraints.

<b>Revision comments</b> – <b>Evaluator 1</b>	Happy to upgrade my assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments</b> – <b>Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Appropriate</b>

<b>Micro KEQ 5.4b</b>	<p>How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:</p> <p>“How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of Fish, the relevant Basin Plan objectives and the priority research questions?</p>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>During the early stages of prioritising research questions for the fish theme, there was considerable consultation with managers which was thorough, followed a number of clearly specified principles and led to a series of priority questions that included assessing how threats impact on the drivers, and survival and condition outcomes of native fish as well as their recruitment and reproduction (Burns and Gawne 2014). The links of these questions with Basin Plan objectives were well established (see response to KEQ51b). It was also clearly established how these questions related to fish biodiversity and resilience, two of the four elements of the Grant Guideline objective. Substantial refinements to these research questions (due to limited funding and other constraints) led to a much greater focus on recruitment and less attention to the threats or drivers, and their interactions, that might affect biodiversity, ecosystem function and water quality. This is evident from the final results presented in the fish theme final report (2019). As this KEQ refers to the theme itself (and I assume, the products and outputs) rather than the initial research questions, I have not been able to give it as high a rating as I would if all the research questions had been fully addressed as planned. Responses to the survey and the interview questions did not include any relevant comments on this KEQ. [well established relevance even if not addressed]</p>
<b>Evaluator 2</b>	<p><b>Appropriate</b></p> <p>The EWKR fish theme's research questions were strongly aligned with the 2nd grant guidelines objective, as well as with one of the three BP objectives. It was able to establish relationships between the key water regime and events driver of fish-recruitment based biodiversity outcomes. It also addressed other major non-water related drivers of fish outcomes, though not in any depth due to contextual and resource constraints. The fish theme also successfully targeted key drivers of biodiversity and resilience as they pertained to responses and management of native fish ecology in the Basin rivers.</p>
<b>Revision comments</b> – <b>Evaluator 1</b>	Happy to upgrade my assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments</b> – <b>Evaluator 2</b>	Agree

<b>Consensus final rating</b>	<b>Appropriate</b>
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<b>Micro KEQ 5.4c</b>	<p>How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:</p> <p>“How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of Waterbirds, the relevant Basin Plan objectives and the priority research questions?</p>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>The waterbird theme benefited from a timely literature review (McGinness 2016) that identified the drivers affecting waterbird biodiversity and, to a lesser degree, resilience. This helped greatly during the scoping phase and led to the research questions being heavily focused on recruitment, including potential threats and interactions among drivers (e.g. How might environmental flows, vegetation management and pressures and threats, such as predation, interact with nesting habitat characteristics to affect recruitment? How might critical foraging habitats during and after breeding events be affected by environmental flows and threats such as habitat change? How do threats and pressures affect recruitment outcomes for waterbirds?). These questions are clearly related to waterbird biodiversity and resilience, two of the four elements of the Grant Guideline objective, and they were also well mapped to Basin Plan objectives (see response to KEQ51c). As the waterbird theme was strongly focused on recruitment (and movement), there was greater scope to assess interactions among drivers of, for example, egg and fledgling mortality and nesting success. The results of this work, although preliminary and often inferential, were relevant to addressing the Grant Guideline objective in terms of effects on waterbird resilience and, to a lesser extent, biodiversity. Responses to the survey questions did not include any relevant comments on this KEQ. One interview comment indicated that several research activities in the waterbird theme produced some interesting data on how various drivers and threats (e.g. feral pigs) might affect waterbird recruitment but there was not a strong focus on interactions among these drivers and their effects on waterbird biodiversity, ecosystem function and/or resilience and/or water quality [well established relevance even if not addressed]</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR waterbird theme's research questions were aligned with the 2nd grant guidelines objective, as well as with one of the three BP objectives. It was able to establish relationships between the key water regime and events driver of waterbird outcomes. It conceptually addressed other major non-water related drivers of waterbird outcomes, though not in sufficient depth due to contextual and resource constraints.</p>
<b>Consensus final rating</b>	<b>Moderately Appropriate</b>

<b>Micro KEQ 5.4d</b>	<p>How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:</p> <p>“How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of Food Webs, the relevant Basin Plan objectives and the priority research questions?</p>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>The foodweb theme encompassed the transfer of energy across trophic levels, an ecosystem function, and was also relevant to biodiversity but less so to resilience or</p>

	water quality. It was a 'derivative theme' to some extent that drew heavily on material from the fish and waterbird themes, and therefore its priority research questions were influenced by the ones selected in those themes. Nonetheless, the links of the foodweb questions with Basin Plan objectives were well established during the scoping phase of the project (see response to KEQ51d). The question most relevant to the Grant Guideline objective was 'How do threats impact on food web processes and the achievement of native fish and waterbirds outcomes?' but unfortunately this was not addressed in detail in the subsequent research activities of this theme. The remaining research questions were much less relevant to the Grant Guideline objective. Because they focused almost entirely on flow-associated drivers, these research questions also did not address in detail how other drivers of system condition such as land use or invasive species might interact to affect biodiversity, ecosystem function, resilience and water quality. Modelling did explore what role carp may play in affecting energy transfer in fish foodwebs but these conclusions were largely inferential. Responses to the survey and the interview questions did not include any relevant comments on this KEQ.[well established relevance even if not addressed]
<b>Evaluator 2</b>	<b>Moderately Appropriate</b>  The EWKR food web theme's research questions were aligned with the 2nd grant guidelines objective, as well as with one of the three BP objectives. It was able to establish relationships between the key water regime and events driver of food web outcomes. It did not address other major non-water related drivers of food web outcomes.
<b>Consensus final rating</b>	<b>Moderately Appropriate</b>

Mid KEQ 5.5	To what extent was the program logic and associated conceptual models fit for purpose?
<b>Evaluator 1</b>	<b>Moderately Appropriate</b>  One of the strengths of the EWKR project was the initial phase of reviewing relevant literature and developing conceptual models to outline likely links among drivers, environmental watering and the four themes. This revealed knowledge gaps and helped focus subsequent work. Inferences from these literature reviews and conceptual models have also been used extensively in the final reports and outputs, especially where empirical data were sparse or lacking. Program logic was generally good (once research priorities had been decided) and was improved by input from the Scientific Advisory Group. The program logic for each theme is addressed in the responses to KEQs 5.5a-5.5d, and was generally appropriate and fit for purpose. Unfortunately, some elements and research questions in each theme were either abandoned or not addressed in the required detail which compromised their capacity to fulfil the objectives or the Grant Guidelines or be completely fit for purpose to provide the sort of information needed by managers. There does not seem to have been an overarching program logic that specifically linked each research subquestion in each theme to associated research questions, specific objectives and, later, potential management recommendations. This would have been a valuable process that should have been maintained and modified during the EWKR project and may have prevented lapses where the loss of information from one theme limited progress in a dependent one (particularly the foodweb theme). A diagram of this program logic, although complex, would have greatly assisted the client, managers and researchers to see the links among research questions and, as they emerged, the main findings. This would also have enhanced communication and collaboration with other stakeholders. Finally, it would have illustrated the repercussions on the 'big picture' of removing or altering particular research activities, changing field sites, etc. Another project-wide failing in the program logic was the frequent mismatch of related activities in space and time. Ideally, data on, for example, seedling growth, invertebrate emergence from flooded sediments, food source quality and energy content, and fish and waterbird recruitment would have been collected from the same, multiple locations and concurrently. Instead, and largely for logistic reasons associated with opportunity, site access and available personnel, this sampling was not coordinated and almost never replicated in time. This lack of concurrent sampling within and across themes, and combined with the limited spatial and temporal replication, had severe repercussions for the transferability and generality of the information collected, and compromises the fitness for purpose of the EWKR project. Where multiple sites were sampled, location-specific effects were often observed to be very important (e.g. vegetation theme final report (2019)). The survey did not ask specifically about the extent to which the program logic and associated conceptual models were fit for purpose. However, there were some comments that acknowledged the value of the conceptual models (e.g.



	<p>'There are some very good conceptual frameworks to come out of EWKR' and some managers expressed satisfaction with the quality of the science (e.g. 'EWKR has been a successful project and has contributed well to the body of science that environmental watering relies on to advance and improve. I understand that the project could have better 'applied' the science to the benefit of water planners - so put more effort into the 'implications' of the findings for adaptive management purposes' which relates broadly to the value of the program logic and conceptual models. Interviewees were not asked directly about program logic and conceptual models although occasionally these topics arose during responses to other questions. Responses acknowledged the failings of not have matched up sites (for logistic and other reasons), of the limited program logic across and within themes, of missed opportunities to take advantage of natural or managed watering, and of the need for an overarching conceptual model that linked research activities and insights. However, there were many comments that indicated high confidence in the quality of the science even if there were some serious lapses in the program logic.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR project did not articulate a dedicated program logic for its activities or the individual themes. Despite this, several elements of a sound program logic emerged within each theme, and, though imperfectly, in the final project synthesis. There was inconsistency in the development of management outcomes from the themes and in the cross-theme synthesis, resulting in a lack of focus and concrete broad-scale solutions and applications for water managers. This was however to be expected given the contextual factors and the limited time and funding resources for a program expected to have an over-ambitious breadth and scope.</p>
<b>Consensus final rating</b>	<b>Moderately Appropriate</b>

Micro KEQ 5.5a How appropriate was the vegetation theme program logic?	
<b>Evaluator 1</b>	<p><b>Appropriate</b></p> <p>The program logic for the vegetation theme was very sound, although it differed between the two components: the Lower Balonne study reported in DSITI (2017) and the southern Basin work summarised in the vegetation theme final report (2019). Conceptual models of response traits and levels of ecological organisation (e.g. Fig 3-2 in the Multi-year Research Plan 2016-19) were combined with functions and services, and temporal scales of flow regime into a framework to promote adaptive management but that also included key components of program logic to define temporal and spatial bounds for the research activities. In the southern Basin work, proposed research aimed to use existing literature, knowledge and data, investigate causal relationships in controlled environments, and incorporate flow conditions experienced over the life of MDB EWKR. This mixed portfolio approach of conceptualisation, data analysis, field assessments and mesocosm experiments was seen as a way to compensate for unpredictable environmental conditions (Multi-year Research Plan 2016-19) and was a sensible precaution. Figure 3-6 in the Multi-year Research Plan 2016-19) illustrates the program logic of the vegetation theme, and indicates the relationship among key research components in this theme. There were no specific comments in the survey about the appropriateness of the vegetation theme program logic. Several interviewees praised the conceptual models from the vegetation theme but there was also criticism of the limited fit between the work done in the Lower Balonne and the work done in the southern Basin. Nonetheless, the use of existing data sets, multiple samples over time from several sets of sites with different flooding history, and the use of supplementary mesocosm experiments on the effects of different watering regimes were all seen as contributing valuable scientific insights embedded within a program logic that, to some degree, captured multiple levels of functional organisation.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR project did not articulate a dedicated program logic for its activities or the individual themes. Despite this, several elements of a sound program logic emerged in the vegetation theme, with clear objectives (directly linked to BP objectives and BWS EEOs), and a scientifically defensible research plan including logical inputs, research questions, defensible activities and outputs with a focus on drivers at different scales of non-woody and woody vegetation recruitment, function and structure. Priority research questions were developed in relation to an adaptive management conceptual model, addressing the key stages of planning, doing, evaluating and learning. A</p>

	range of research tools were used including large data set analyses, field surveys and experimental trials.
<b>Revision comments – Evaluator 1</b>	Suggest we upgrade our assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Appropriate</b>

Micro KEQ 5.5b How appropriate was the fish theme program logic?	
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>How appropriate was the fish theme program logic? The basis for the fish program logic was sound and is outlined in the fish theme final report (2019). Based on a series of key requirements (e.g. that causal processes and mechanisms were able to be identified; the research be based on a testable conceptual framework; the role of critical non-flow related threats and stressors be investigated; that drivers, processes and responses are considered within a multi-scale context; and the research provided outputs that had clear management relevance), three key foundational activities were undertaken prior to the development of the research plan: 1. A review, synthesis and assessment of the relative importance of non-flow related threats and stressors on key fish recruitment drivers. 2. A review of the current knowledge and management needs of fish recruitment within the MDB. This included consultation with managers regarding knowledge gaps and priority species. 3. The development of a conceptual framework for fish recruitment in rivers. This included reviewing existing fish (both marine and freshwater) and riverine functional models in the scientific literature. The outcome from this process led to three key research questions with a number of subcomponents whose objectives, methods, outputs and the way the outputs would be used were all described in the Multi-year Research Plan 2016-19. Details of the methods varied widely but this is understandable given the different levels of complexity of each component. Ideally, a diagram showing how each research question and component of the fish theme related to each other and those of other themes (especially the foodweb theme) would have been provided to illustrate the theme's program logic and facilitate synthesis. There were no specific comments in the survey about the appropriateness of the fish theme program logic, although several comments applauded the work done on broad spatial scales because they could see the relevance for Basin-wide management. This was interpreted as a good aspect of the program logic. Similarly, there were no specific comments on program logic of the fish theme although several interviewees acknowledged the value of the otolith research activities that showed how the spatial scales of population dynamics of Murray cod and golden perch differed, and others praised the usefulness of the assessments of recruitment and foodweb work on native fish. However, some interviewees criticised the fact that the various bits of work were done in different places and at different times which made it difficult to link up components of the fish theme and disentangle spatial (site-specific) effects from other drivers. This appeared to be a problematic lapse in program logic that arose for logistic reasons. There were also concerns expressed about the appropriateness of the Ovens River for the sorts of inferences that some interviewees wished to make, and that might also be seen as a flaw in the program logic.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR project did not articulate a dedicated program logic for its activities or the individual themes. Despite this, several elements of a sound program logic emerged in the fish theme, with focused objectives (directly linked to BP objectives and BWS EEOs), and a scientifically defensible research plan including logical inputs, activities and outputs. As with the other EWKR themes, outcomes and impacts relied not only on research products (the Riverscape Recruitment Synthesis Model etc.) but also on EWKR</p>

	synthesis and communication activities, which are referred to under the mid level KEQ. Priority research questions and objectives, data inputs and research activities evolved during the early stages of the project (refer to MYRPs), in part due to contextual and resource issues, but also in response to identifying highest priority research questions (fish recruitment dynamics) from foundational activities, inputs from SAG commentary and project reviews. A clear, defensible and logical theme program structure was developed with a focus on drivers at different scales of fish recruitment and dispersal, growth and survival - especially food density and retention, temperature, physical structure and flow.
<b>Consensus final rating</b>	<b>Moderately Appropriate</b>

Micro KEQ 5.5c How appropriate was the waterbird theme program logic?	
<b>Evaluator 1</b>	<p><b>Appropriate</b></p> <p>Waterbird breeding is a key process targeted by environmental watering in the MDB and so it was logical that research questions to be addressed by the waterbird theme would relate specifically to recruitment (Which flow regimes best support recruitment of waterbirds? How do threats and pressures affect recruitment outcomes for waterbirds?). Aided by a timely literature review (McGinness 2016) that identified the drivers affecting waterbird biodiversity and distribution, knowledge gaps in the understanding of drivers of colonial waterbird recruitment were identified and formed the basis of the research questions in the waterbird theme. Critical Knowledge Gap 1 (from the Multi-year Research Plan 2016-19) was: Where and what are the critical foraging habitats during and after breeding events for recruitment? How might these be affected by environmental flows and threats such as habitat change? Critical Knowledge Gap 2: What are critical nesting habitat characteristics we need to maintain and how do these affect recruitment? How might environmental flows, vegetation management and pressures and threats, such as predation, interact with nesting habitat characteristics to affect recruitment? The Multi-year Research Plan 2016-19 then goes on to use a high-level conceptual model (Figure 5-1) to outline the links among factors that may directly or indirectly affect waterbird recruitment and, ultimately, species persistence and diversity. This report outlines the final research questions and their subcomponents, along with their objectives, methods, outputs and the way the outputs would be used. Contingency plans were also proposed which is a sensible addition to the program logic of this theme as was the table listing major programs within the MDB collecting waterbird data. Finally, response variables and methods, many of them standard, are tabulated in the Multi-year Research Plan 2016-19 for each of the knowledge gap questions, and this is also a useful part of the theme's program logic. This theme's overall program logic would have benefited from being illustrated with a diagram showing how each research question and component of the waterbird theme related to each other and those of other themes (especially the foodweb theme). Such a diagram would facilitate communication and synthesis of the research findings and help managers and other stakeholders see 'the big picture'. There were no specific comments in the survey about the appropriateness of the waterbird theme program logic. Similarly, there were no specific comments on program logic of the waterbird theme. Several interviewees applauded the insights gained into the spatial scales of waterbird movement, and many interviewees praised the way that this work built on existing data to amplify its usefulness. This was interpreted as a further plus of the theme's program logic.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR project did not articulate a dedicated program logic for its activities or the individual themes. Despite this, several elements of a sound program logic were developed in the waterbird theme, with a focus on drivers of bird movement, recruitment success and survival. Overarching questions and objectives related to BP Objectives and BEWS EOs. Priority research questions were developed in relation to a life-history based conceptual model and key management questions. Research was logically focused on bird movement, foraging, roosting, drivers of and threats to recruitment, priority habitat features, mortality causes. A range of relevant research tools were used including movement tracking, and surveys of nest success, and of chick growth, energy costs and survival. Research outcomes were translated into management recommendations of direct relevance to the key management audiences.</p>

<b>Revision comments – Evaluator 1</b>	Suggest we upgrade our assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Appropriate</b>

Micro KEQ 5.5d How appropriate was the food webs theme program logic?	
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>The foodweb theme considered a range of possible research questions and, having consulted with the researchers of the other EWKR themes, settled on two broad research questions with subquestions nested within them (see response to KEQ53). The program logic, described in the Multi-year Research Plan 2016-19, includes plans to share data collection activities with the LTIM and the fish and waterbird themes to ascertain likely energy sources supporting recruitment in these groups. Compared with the program logics of the other three themes, there is not as much detail on the various methods in this theme nor is there a clear outline of which methods would be used for each subquestion. For example, the section in the Multi-year Research Plan 2016-19 describing Component W3 (Identifying important sites of production) gives a very superficial description of the approach, identifies no contingency plans if there are problems with this approach, and appears to focus entirely on microinvertebrates and omit assessing important sites of production of other food sources. The bioenergetics and modelling approaches are commendable and the program logic outlining these is good. Like the other themes, this theme would have benefited from its overall program logic being illustrated in a diagram showing how each research question and component of the foodweb theme related to each other and those of the fish and waterbird themes on which it strongly relies. This is especially important as the foodweb theme was a 'derivative' one with close links to at least two of the other themes. There were no specific comments in the survey or the interview transcripts about the appropriateness of the foodweb theme program logic. Some interviewees were critical of what they perceived as poor integration and insufficient linkages between the foodweb theme and the fish and waterbird themes, putting much of this down to planning and, by inference, inappropriate program logic.</p>
<b>Evaluator 2</b>	<p><b>Moderately Appropriate</b></p> <p>The EWKR project did not articulate a dedicated program logic for its activities or the individual themes. Despite this, several elements of a sound program logic were developed in the food webs theme, with a focus on food provision for native fish and waterbirds, its sources, quality and quantity, and its links to environmental water as a key driver of responses and outcomes. Overarching questions and objectives have a line of sight to BP functional Objectives and targets. Research activities were developed logically and jointly across the food webs, native fish and waterbirds themes as relevant. A range of relevant research tools were used including river surveys, isotopic and fatty acid compositional studies, mesocosm experiments, development of conceptual and semi-quantitative energetics-based model. Research outcomes were translated into broad, high level management recommendations for environmental watering in relation to food resource provision to support native fish and waterbirds.</p>

<b>Consensus final rating</b>	<b>Moderately Appropriate</b>
<b>Mid KEQ 5.6</b>	<b>How well has the EWKR project improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures (Note: outcome in Multi Year Research Plan only, not in Grant Guidelines)</b>
<b>Evaluator 1</b>	<p><b>Minimally Appropriate</b></p> <p>How well has the EWKR project improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures (Note: outcome in Multi Year Research Plan only, not in Grant Guidelines) The 2019 EWKR evaluation (bearing in mind the caveat of its limited pool of relevant participants) indicated a mixed response to whether the outputs of the EWKR project had been useful and taken up by water managers. Barriers to this uptake were identified as a lack of synthesis of research outcomes across themes (in work published to date), the time lag between project and publication of papers, and the lack of consultation with end users (local water managers) to ensure resources are in an appropriate format. It should be reiterated that this survey had a very low number of 'end user' participants. The current evaluation's survey indicated a similarly mixed response to the appropriateness of the project design in supporting water managers to manage environmental water. Excluding those who replied 'Don't know', over a third of the respondents believed it was 'A lot' or more whereas less than a quarter believed it was 'A little' or not at all). Most respondents were very confident or better that the science was relevant to the needs of environmental water managers within the framework of adaptive water management in the Murray-Darling Basin. Specific responses identified similar barriers to uptake as the 2019 evaluation (e.g. 'Adoption and engagement with water managers was a key activity in the design of EWKR but it wasn't implemented effectively') which would compromise whether the program has improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures. There was also a feeling that the potential for improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures may be more applicable in some parts of the Basin than in others because of the influence of water managers during the design phase (e.g. 'the design of some themes were influenced by a handful of ewater managers and so the project may provide suitable support to them but possibly not to others'). It was also pointed out that this is a challenging question to address because 'Most water delivery is focussed on asset/catchment level and involves explicit actions - can be tricky to pull out what is relevant/important to those actions from the broader process based info of EWKR'. There were no tangible examples presented in responses to the surveys to show improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures, probably because time (and suitable monitoring) is needed to show whether such development and operation has indeed been effective. Although respondents were generally confident in the quality of the science from the EWKR project, there was a prevalent impression that many findings were not yet presented sufficiently well to managers to allow many of them to readily apply the science to optimally develop and operate environmental works and measures. Interviewees were almost unanimous in praising the quality of the science. However, many interviewees considered that much of it had not been communicated very well to managers which had limited its application to improving environmental water effectiveness in the development and operation of environmental works and measures. Professional communicators and knowledge brokers were suggested several times as being needed in this process. The comment was also made that a lot of the science was 'foundational' and largely confirmed or explained the likely mechanisms underlying managers' current operations of environmental water rather than improving their effectiveness or changing them. Nonetheless, several examples were given where changes were being planned that incorporated insights based on the science (e.g. optimising productivity, considering larger spatial scales) but it was too early to judge whether these were effective. No specific case studies or examples were presented to show improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures. Minimally appropriate [I could be argued upward if there are some better examples or evidence]</p>
<b>Evaluator 2</b>	<p><b>Minimally Appropriate</b></p> <p>This outcome was inadequately addressed, unrealistic and frankly beyond the scope of EWKR, as the suite of environmental works and measures under the Basin Plan was</p>

	much too large, complex and multi-driver in nature for EWKR to apply sufficient scientific understanding to influence the outcomes given the timing and resources available to EWKR.
<b>Consensus final rating</b>	<b>Minimally Appropriate</b>

<b>Micro KEQ 5.6a</b>	<b>How well has the EWKR project demonstrated the relevance and significance of the additional outcome in the Multi-year research plan (in addition to the outcomes specified in the Grant Guidelines)?</b>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>There is no specific document produced by the EWKR project which lists the additional research questions and outputs from the Multi-year Research Plan (2016-19) in addition to those specified in the Grant Guidelines, and then goes on to describe their relevance and significance, and that of their outcomes. Further, some of the objectives and outcomes initially sought in the Grant Guidelines were later rated, after consultation with managers and other stakeholders, as being of low priority and therefore not addressed in detail or at all. These seemed to largely relate to objectives associated with assessing incremental changes, impacts of threats and interactions with other drivers, and the effects of natural resource management unrelated to flow management. Some of the research questions identified in the Multi-year Research Plan 2016-19 also did not eventuate due to various reasons (e.g. environmental constraints, lack of personnel). Additional research questions and outcomes have focussed heavily on recruitment processes and foodwebs, and to a lesser extent, movements and large-scale dispersion patterns of fish and waterbirds. The relevance and significance of these additional outcomes are reasonably well demonstrated in terms of their scientific value and context to published literature but less so in their direct relevance to environmental management, especially operations and strategies in the MDB not involving flow. Their relevance and significance to omitted components such as threats, water quality, and the effects of interactions with drivers such as land use and invasive species is also poorly demonstrated. This question was not asked during the survey. Responses to other questions praised the insights gained from the work on large-scale dispersion patterns of fish and waterbirds (e.g. 'Helping to shift attention to managing at a landscape scale to achieve necessary outcomes'). This question was also not asked directly in the interview. In response to other questions, there were mixed but mostly positive comments about the relevance and significance of elements of work from the additional outcomes in the Multi-year Research Plan. The main concerns centred on the transferability of results to other parts of the Basin (especially northern versus southern), the limited spatial and temporal scale of the work, the relevance of some results that were seen as 'academic' and the widespread impression that the relevance and management significance of much of the work was considered retrospectively rather than always from the outset. [I may be being generous here; I've interpreted this as being the 'extra' work that was done when many of the original objectives were dropped]</p>
<b>Evaluator 2</b>	<p><b>Minimally Appropriate</b></p> <p>This outcome was inadequately addressed, unrealistic and frankly beyond the scope of EWKR, as the suite of environmental works and measures under the Basin Plan was much too large, complex and multi-driver in nature for EWKR to apply sufficient scientific understanding to influence the outcomes given the timing and resources available to EWKR.</p>
<b>Revision comments Evaluator 1</b>	Happy to concede I was being generous and can downgrade my rating to 'Minimally appropriate'
<b>Revision comments Evaluator 2</b>	Agree

<b>Consensus final rating</b>	<b>Minimally Appropriate</b>
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<b>Mid KEQ 5.7</b>	<b>How appropriate were the research and evaluation plans for each research theme?</b>
<b>Evaluator 1</b>	<p><b>Moderately Appropriate</b></p> <p>In general, the research plans for each theme were well-designed and followed suitable program logics (see responses to KEQs 55 and 55a-d). All of the themes commenced with comprehensive reviews of the literature, often leading to useful conceptual models that were then used to guide the research and evaluation plans. Methods to address the research questions were usually standard approaches although there was often limited spatial and temporal replication as a result of funding and other logistic constraints. The phrase 'evaluation plans' was defined (from emails with Sabine [19 April 2020]) as to 'include addressing whether the conclusions drawn from the data are reasonable - it doesn't include data analysis per se though – more a discussion of the appropriateness of a particular approach to analysing the data – e.g. the appropriateness of small scale experiments versus satellite imagery'. Specific plans for these sorts of evaluations were not presented for any of the themes. However, some outputs from the themes discussed appropriateness and limitations of methods and designs (e.g. waterbird theme final report (2019)). As recommended by the Core Team, I have done a brief analysis of the research and evaluation plans for each research theme (mainly relying on the Multi-year Research Plan 2016-19 and its Addendum (MDFRC (2017)) and the results of this analysis are summarised below. Vegetation theme: clear objectives, appropriate and justified response variables standard methods, good replication at multiple (and often nested) spatial scales, good temporal replication, good use of existing data, limited evaluation plans Fish theme: variable clarity in objectives, appropriate and justified response variables, standard methods, limited spatial and temporal replication, little use of existing data, limited evaluation plans Waterbird theme: generally good clarity in objectives, appropriate and justified response variables, standard methods (and some technical ones – e.g. satellite tracking approaches), some spatial and temporal replication, good use of existing data, limited evaluation plans Foodweb theme: variable clarity in objectives, appropriate and justified response variables, standard methods and good use of modelling approaches, limited spatial and temporal replication, good attempt to use data from other themes and LTIM, limited evaluation plans Although the surveys and interviews asked about the quality of the science (which usually received warm praise), there were no questions expressly about the appropriateness of the research and evaluation plans for each research theme. Several interviewees expressed concerns about some theme's research designs where spatial replication was poor, there was no or limited temporal replication, a lack of concurrent sampling across themes compromised the capacity to share data, and where some key drivers appeared to be omitted.</p>
<b>Evaluator 2</b>	<p><b>Appropriate</b></p> <p>Both the research plans (including the adaptive development of research questions and MYRPs) and the evaluation approaches were appropriate to the nature of EWKR, given the contextual factors and the resourcing available to the program.</p>
<b>Revision comments – Evaluator 1</b>	Happy to upgrade my assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Appropriate</b>

Micro KEQ 5.7a To what extent were objectives SMART?	
<b>Evaluator 1</b>	<p><b>Minimally Appropriate</b></p> <p>‘SMART’ is an acronym that stands for ‘Specific, Measurable, Achievable, Realistic, and Timely’. Overall, none of the themes systematically went through each of their objectives to assess whether these objectives or associated research questions were SMART. The vegetation and waterbird themes broadly assessed these characteristics to justify some components (e.g. response variables for the vegetation theme, the choice of colonial waterbirds for the waterbird theme) while the fish theme included the criterion ‘causal processes and mechanisms were able to be identified’ when identifying research questions (fish theme final report (2019)). No responses in either the survey or interview presented specific examples of research activities whose objectives were SMART. Some interviewees were critical of the achievability of some theme’s objectives; others expressed concerns about the lack of specificity of some of the objectives which then made them difficult to measure unambiguously. One interviewee stated bluntly that the program’s objectives were very general and that when it came to the themes below, there were no SMART objectives or targets.</p>
<b>Evaluator 2</b>	<p><b>Minimally Appropriate</b></p> <p>The EWKR program objectives cited in planning documents (e.g. the MYRP) are the same as in the Grant Guidelines. The Grant objectives are broadly consistent with the knowledge needs required to support the BP objectives. However, not one of these objectives is fully SMART (Specific, Measurable, Achievable, Realistic/Relevant, Time-bound). The first objective ("How environmental flow management influences ecosystem function and thereby sustains biodiversity") is broadly consistent with the SMART principles, with a specificity sufficient for a high-level research objective, but has no defined time-frame (unless the contractual time frame of the Grant is relevant here). The objectives were not designed to be consistent with the SMART principles - presumably due to the desire for the program to have a broad research remit. No specific Theme-specific objectives were developed under the Grant objectives, as Themes were instead designed around a suite of research questions.</p>
<b>Consensus final rating</b>	<b>Minimally Appropriate</b>

Micro KEQ 5.7b Were evaluation methods clear and well articulated for each theme?	
<b>Evaluator 1</b>	<p><b>Minimally Appropriate</b></p> <p>As pointed out in the response to KEQ5.7, evaluation plans, and by extension, their methods, were not clear or well-articulated for the research questions and objectives within any of the four themes. Despite this lack of explanation of the evaluation methods, the final report of each theme did identify where limitations to particular methods or findings occurred in some cases. For example, in the fish theme final report (2019), it was explained that data on larval fish movement was only collected at a reach scale and only until fish had developed to the juvenile stage, and that further work was needed to assess longer-term and larger-scale movement patterns that followed larvae to recruitment into the adult population would provide more information to guide management actions. In the survey and during the interviews, there were no questions asked or specific responses about the clarity or articulation of the evaluation methods for each theme. No specific examples were presented of research activities or themes with especially clear or well-articulated evaluation methods.</p>
<b>Evaluator 2</b>	<p><b>Appropriate</b></p> <p>The Evaluation methods (as articulated in the Evaluation Strategy for Phase 1 and 2) are consistent with the methodological approach of the NRM MERI Framework, and considered clear and well-articulated. The methodology has been applied across all themes in Phase 1 and 2 and is considered appropriate.</p>



<b>Revision comments – Evaluator 1</b>	I think we may be at cross-purposes here about the definition of 'evaluation methods'. When I queried Sabine on this term [email, 19 Apr], she replied 'KEQ57b refers back to the research and evaluation plans for the themes in the project rather than data analysis – so it does include addressing whether the conclusions drawn from the data are reasonable - it doesn't include data analysis per se though – more a discussion of the appropriateness of a particular approach to analysing the data – e.g. the appropriateness of small scale experiments versus satellite imagery -depending on the question being addressed.' In light of this definition, you may be willing to reconsider 'Appropriate' and we can discuss options.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Moderately</b> After further clarification of this micro KEQ by the core team and expanding the assessment of evaluation methods to include evaluation as described in the Evaluation Strategy documents for Phases 1 and 2, a rating of 'Moderately appropriate' was agreed upon. <b>Appropriate</b>

Micro KEQ 5.7c To what extent were the scientific methodologies adopted in the EWKR project the most appropriate?	
<b>Evaluator 1</b>	<b>Appropriate</b>  Each theme used the most appropriate scientific methods (within pragmatic constraints of funding, personnel and access to equipment). These methods ranged from relatively simple survey methods through to techniques involving remote sensing and recent technologies. For example, in the vegetation theme, data were collected using standard field survey methods with transects and quadrats that involve minimal equipment. For another component of the vegetation theme, time-series data of canopy greenness were derived from satellite images to investigate condition response to rainfall and flooding. Where unconventional methods were to be used, these were usually trialled (e.g. the use of drones to map habitat, count nests and observe distances to water, described in the waterbird theme final report (2019)). In other cases, there were detailed justifications based on literature reviews of the methods that were finally chosen (e.g., the use of fatty acid profiles to assess the relative quality of food sources, McNerney et al. 'Basal resource quality and energy flow in a lowland river food web' in Appendix 1.2 of the food web theme final report (2019)). This use of appropriate methods probably contributed to the high levels of confidence in the quality of the science expressed by respondents of the 2019 evaluation and the current survey (e.g. 'the quality of the science is not in question. there is some fantastic work there'). In the survey, there were no questions asked or specific responses about the appropriateness of the scientific methodologies adopted in the EWKR project. No specific examples were presented of research activities or themes with especially appropriate methods. Occasionally during the interview, the questions touched on the appropriateness of the methods. One of the interviewees commented on the development of vegetation assessment methods and how they matched those used by other agencies, and another interviewee said that there was care to use identical methods when sampling vegetation in different areas of the Basin simultaneously. A third interviewee expressed satisfaction with the methods but admitted there had not been a detailed technical review of them. A fourth one commented that the scientists had spent a lot of time considering suitable methods.
<b>Evaluator 2</b>	<b>Appropriate</b>  Highly appropriate foundational activities were conducted for each theme, including comprehensive literature reviews, expert workshops and knowledge syntheses, to identify key knowledge areas and gaps and develop conceptual models. These activities underpinned the priority research questions and methodologies for the research activities. The resulting suites of research methodologies used within each theme were in general highly appropriate and relevant to the priority research questions. Vegetation: Analysis of large multi-location and long-term (single asset) vegetation and physico-chemical data sets to inform model development, field based multi-site data collection on vegetation composition, structure and seed banks, along with germination trials and mesocosm experiments evaluating woody-seedling responses to watering regime. Fish: A highly appropriate set of methodologies were used for the fish theme. These included analysis of large fish survey data set; targeted and designed

	comparative surveys of field habitat, hydraulics, and retention, fish otolith microchemistry, and fish larval and zooplankton abundance and composition; multi-site stable-isotope and related sampling for the development of a trophic niche indicator; and conducting experiments evaluating relationships between food density and temperature and growth and survival of early fish life stages, and short-term larval fish behaviour in flumes. Waterbirds: The waterbird theme used a highly appropriate set of methodologies (satellite remote sensing and tracking, motion-sensing time-lapse imagery and drone observations) to address data collection needs by research question and spatial and temporal scale of observations required. Food webs: The food web theme used a highly appropriate combination of field survey and sampling of water bird diets; mesocosm experiments to assess basal resource transfer through food webs (in the Gwydir wetlands); dietary molecular (fatty acid) and isotopic tracing in habitats of a single river floodplain system (the Ovens); and the development of a simulation-based quantitative food web model for the Gwydir wetlands. Broader application of the methodologies with a larger scale, multi-site design across multiple watering regimes and events - as well as multi-site and regime validation of the food web and trophic niche models - would have been highly desirable to support transferability of research outcomes. This was apparently not possible, due to resource and time constraints imposed after the lengthy initial re-structuring of this theme.
<b>Consensus final rating</b>	<b>Appropriate</b>

<b>Micro KEQ 5.7d</b>	<b>How well did the EWKR project, either at design stage or during the project implementation, consider/align with ongoing and planned initiatives implemented by other agencies that addressed similar needs?</b>
<b>Evaluator 1</b>	<p><b>Appropriate</b></p> <p>Each theme in the EWKR project did a very good job, either at the design stage or during the project implementation or both, at considering and/or aligning their research activities with ongoing and planned initiatives implemented by other agencies that addressed similar needs, and also – where possible – complementing LTIM. However, this process did not always seem to be particularly successful or consistent early in the program, as evidenced by survey responses like ‘One example of a weakness in this regard was the clear disconnect between LTIM and EWKR projects, which are now (positively), more closely aligned’. Nonetheless, in response to the question ‘To what extent was the design of the EWKR project integrated with complementary recent, ongoing or planned interventions in the project area or on the same problem/issue?’, over three-quarters of the respondents who did not reply ‘Don’t know’, replied ‘A moderate amount’ or more. To a second, related question in the survey ‘To what extent was the design of the EWKR project integrated with complementary recent, ongoing or planned interventions in the project area or on the same problem/issue?’, over three-quarters of the respondents (all researchers) replied ‘A moderate amount’ or more. Evidence for efforts at alignment with ongoing and planned initiatives implemented by other agencies that addressed similar needs is abundant. For example, one of the criteria for site selection was alignment with current and future monitoring programs (final synthesis report 2019). In the Multi-year Research Plan 2016-19 report, it is described that proposed research within the vegetation theme will be cognisant of, where possible, other research and monitoring programs occurring within the Basin, including the MDB EWKR Queensland vegetation project, LTIM, The Living Murray (TLM) monitoring, and monitoring and research undertaken as part of the Northern Basin Review, MDBA Basin-wide monitoring and state-based monitoring programs. In the waterbird theme, other research programs collecting or holding waterbird data from the Basin were tabulated, and it was clear that the researchers in that theme were aware of relevant ongoing and planned initiatives implemented by other agencies that addressed similar needs. There were some positive comments in the survey about the efforts to align with concurrent relevant initiatives (e.g. ‘Where possible there were definite efforts to do this, and there were a number of specific examples where components of work were done with co-investment from other sources of funding, to enable activities to occur that otherwise would not have been possible. However, as a large and complex project there were no doubt areas where opportunities might have been missed’) but others were more critical (e.g. ‘little connections to those in operations No connect to MDBA at all despite direction to do so- they had done heaps of work No connections to managing agencies such as NSW fisheries - who were ignored along with most other state agencies and their key staff’). In the interview, the same questions about consideration or alignment of the EWKR project with ongoing and planned initiatives implemented by other agencies that addressed similar needs were asked. Many comments expressed mixed responses to the extent of the alignment with LTIM although most interviewees agreed that alignment improved over time. There were quite a few examples of consideration of parallel</p>

	projects and, where possible, sharing of resources but there were also examples given where despite this awareness, collaboration with, for example, state agencies doing similar projects did not arise. Nonetheless, there was general agreement that, because of the networks of scientists in the EWKR themes, there was appropriate consideration of project with ongoing and planned initiatives implemented by other agencies that addressed similar needs and, where possible, shared resources and data.
<b>Evaluator 2</b>	<b>Moderately Appropriate</b>  There was a genuine attempt to develop broad thematic and conceptual consistency between EWKR and LTIM in the lead up to defining EWKR research questions. and the design and conduct of several research activities, including collaborative collection of site data. There were occasional conflicts over the purpose of managed watering interventions for achieving outcomes vs research (e.g. Hattah Lakes). Local collaboration between regional/asset-based MER activities and EWKR was also evident.
<b>Revision comments – Evaluator 1</b>	Suggest we upgrade our assessment to 'Appropriate' in light of our agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Line ball. EWKR management did OK but the formal guidance from the department/CEWO was weak.
<b>Consensus final rating</b>	<b>Appropriate</b>

## IMPACT

- 1 high-level KEQ
- 1 mid-level KEQ
- 5 micro-level KEQs

High KEQ 6	How impactful has the EWKR project been in supporting adaptive management in the basin?
<b>Evaluator 1</b>	<b>Moderate Impact</b>  The 2019 EWKR evaluation (bearing in mind the caveat of its limited pool of relevant participants) indicated that the EWKR project had had a positive impact in supporting adaptive management. In response to the question 'How likely are you to use the science and tools developed through EWKR to inform future management decisions', over three-quarters of the relevant respondents replied 'Moderately likely' or better (Figure 8 in Appendix B of the Evaluation (Phase 2) report (2019)). In the current survey, there was a similarly positive general response to the likely benefits and impacts of the EWKR project. For example, well over half of the respondents considered that it was likely or very likely that the EWKR project findings would influence their future water management practices. Respondents were already using some of the results (e.g. 'Key EWKR findings such as the heterogeneity of wetland vegetation, the productivity of flows along anabranches and flood runners and the energy requirements (number of Big Macs) to fledge waterbirds have been noted by us and appear in the draft 2020 Basin Plan evaluation documentation. We will take these findings into consideration as we continue to manage ewater into the future'; 'I am working with Heather McGinness to try and plan water use at wetlands across northern Victoria to improve waterbird outcomes. I use knowledge about fish populations (particularly Golden Perch) to try and identify where in Victoria we should be trying to support fish breeding and where we should focus on fish movement. the foodweb findings on the relative quality of food in channel, vs anabranch, vs billabong is driving

	<p>thinking around where and how to connect critical off channel habitats via environmental water and the need to ensure return flows from those sites'; 'At the moment I have been using information from the vegetation and waterbird themes with regards to objective and target setting in the future and also for MER reporting'). Others pointed out that this is likely in the future but that 'time will tell'. A few responses indicated that the impact was limited (e.g. 'I really have not seen much of it used by managers apart from the system scale project in the fish theme'; 'No information has been adopted. There are a variety of reasons for this'; 'Very few useful products for management and comms purposes'). Finally, quite a few responses admitted that it was difficult to judge ('It is difficult to assess this as it varies across managers and valleys') or replied that they did not know. To the question 'How impactful have the outcomes from each theme been on providing new knowledge for water managers to better inform achievement of environmental outcomes from the use of environmental water?', only a quarter of the 9 managers answered 'Somewhat impactful' or better. Many interviewees (both researchers and managers) agreed that the EWKR work had been impactful in broadening perspectives (especially about foodwebs and productivity) but that there was very little evidence for changes in behaviour or management yet. Reasons proposed included that it was too soon to tell, it was very difficult to measure impact and to ascribe changes to specific facets of EWKR, many research activities in EWKR had not really been focused on guiding adaptive management, and that findings had not been effectively communicated in a way that facilitated changes in management. Some interviewees also suggested that adaptive management was poorly understood or done, making it hard to address this question</p>
<b>Evaluator 2</b>	<p><b>Low Impact</b></p> <p>EWKR has successfully fulfilled a role in addressing several key knowledge gaps around ecological responses to watering regimes and events and key ecological processes driven by environmental water. Uptake of outputs and outcomes in management decision making and planning has been minimal to date. Many stakeholder interviewees indicated that EWKR did not specifically service an adaptive management purpose. However, many stakeholder comments also indicate that EWKR knowledge is and will be progressively adopted and is changing aspects of water management culture (especially regarding floodplain and anabranch productivity, non-woody vegetation heterogeneity and the scale of waterbird responses). Despite claims in the Communications plan, the Decision Support Tool Strategy (both the strategy's purpose and the foundation review on Existing Decision Making processes and DSTs (2015)) and the Operations Strategy (Section 4), EWKR outputs have had a weak immediate impact on outcomes (see also Final report – engagement and knowledge adoption sections 5.3 and 5.4) - other than knowledge and technique adoption and exchange with those managers engaged in the waterbirds and vegetation theme research, and three outputs of the Communications Plan (the story space, workshops and technical reports). The Synthesis Report was very weak in delivering knowledge at a level useful for direct uptake by CEWH, water managers and other management stakeholders. Adaptive management is dependent on several key steps in the AM cycle, with knowledge provision being only one small part. EWKR has served this role, among other projects in the Basin. Relevant interview responses: EWKR-derived fish, waterbird and productivity knowledge is more useful "at a conceptual level, but most of our watering actions are conceptual anyway." "I can't think of any examples where the EWAG has used the EWKR information to actually make a decision on the last few years" "hard to demonstrate when new knowledge enters into decisions and what impact it makes" "it didn't inform delivery. It confirmed what we would have thought, there might be some benefit in that. But it's fairly limited." Comment about the low uptake of EWKR findings not relevant to the immediate management concerns during the drought: "a lot of the work done relates to inundation of wetlands. We haven't had those. So, unless it was about deep drought fish refugia, it hasn't actually been relevant." "It is difficult to tease EWKR apart from other things that are going along, because a lot of the EWKR projects (are) overlapping with other things that some of the states are doing, things that LTIM does . . . each theme has definitely contributed to the broader knowledge that's being applied."</p>
<b>Revision comments – Evaluator 1</b>	<p>After reading your assessment and reconsidering my own, I am willing to downgrade my assessment to 'Low impact'</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final rating</b>	<p><b>Low Impact</b></p>

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Mid KEQ 6.1 To what extent have the environmental outcomes from the EWKR project had an impact on the CEWO's adaptive management of environmental water?	
<b>Evaluator 1</b>	<p><b>Moderate Impact</b></p> <p>In responses in the current survey, a comment was made that '...some of the outcomes from EWKR have helped overall understanding and CEWO and others can use that info in telling the story of environmental water to various audiences'. As this process of 'telling the story' to various audiences is a key part of adaptive management, this implies that information from the EWKR project has had and will have an impact on CEWO's adaptive management of environmental water. None of the other responses presented any specific examples where environmental outcomes from the EWKR project had had an impact specifically on how the CEWO adaptively manages environmental water. Three participants in the interviews represented the CEWO, and were asked broadly about relevance of the EWKR project's findings for CEWO's adaptive management of environmental water. There was a general consensus that outputs from the EWKR project had had a positive impact on the CEWO's adaptive management of environmental water and that this was what was intended all along. It was also opined that the EWKR outputs complemented those from LTIM in helping explain the 'why' of 'what' was observed. This is a key component of the adaptive management cycle in improving understanding of the process. There were also some examples given where the 'lessons learned' were being fed back into subsequent research programs into the MDB. However, there was also the recognition that the design of some of the research activities in the EWKR project were not ideally suited to directly researching ecological responses to environmental watering because they were not conducted in areas where environmental watering occurred during the project. This potentially limited their usefulness for informing wise adaptive management of environmental water. Further, it was also acknowledged that scaling research findings from a local area up to Basin scale needed to be done cautiously when extrapolating adaptive management options.</p>
<b>Evaluator 2</b>	<p><b>Low Impact</b></p> <p>EWKR has not had a substantive direct impact on CEWO's adaptive management of environmental water to date. It has addressed some key knowledge gaps that relate to hydroecological response understanding, food web processes, wetland heterogeneity, scale and types of watering responses of key life history stages of birds, fish and vegetation etc. It has not however targeted integrated outcomes from applied water management practices, and this was not its role. See my comments and evidence under KEQ6.</p>
<b>Revision comments Evaluator 1</b>	<p>– After reading your assessment and reconsidering my own, I am willing to downgrade my assessment to 'Low impact'</p>
<b>Revision comments Evaluator 2</b>	<p>– Agree</p>
<b>Consensus final rating</b>	<p><b>Low Impact</b></p>

Micro KEQ 6.1a To what extent has the information provided by the vegetation theme had an impact on the adaptive management of environmental water?
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<b>Evaluator 1</b>	<p><b>Moderate Impact</b></p> <p>The vegetation researchers made a conscious effort in the vegetation theme final report (2019) to present their information in an adaptive management context (e.g. Figures 1 and 3 in the vegetation theme final report (2019)). In line with adaptive management principles, the vegetation theme sought to consider how lessons from EWKR could be incorporated into future research or monitoring, particularly in terms of comparing patterns at larger spatial and temporal scales. For example, to obtain more knowledge from existing vegetation datasets, it was suggested that there is an urgent need for: i) available and easily accessible complementary data, such as hydrology and mapping of inundation patterns, ii) good data management processes to enable access to data in comparable formats, and iii) analytical expertise and accepted methods for the analysis of data from different sources (with different survey methods and sampling effort). Another example was the intention by the vegetation theme to improve predictive capacity and the underlying knowledge base by determining drivers of responses to watering actions, for i) understory communities; ii) seed bank diversity, iii) woody seedling establishment and iv) lignum structure. What is less clear is the extent to which these aspirations presented in the vegetation theme final report (2019) translated into the information that was provided by the vegetation theme and then whether it is actually having or has had an impact on the adaptive management of environmental water. In the survey responses to the question 'How efficiently do you think the EWKR project conveyed lessons learnt to improve adaptive management of environmental water?', over half the respondents who did not reply 'Don't know' believed that in the vegetation theme, this had been 'Somewhat efficiently' or better. There were some specific responses that illustrated a good awareness of the information provided by the vegetation theme and its management relevance (e.g. 'The vegetation theme investigated Eucalypt tree seedling strategies in response to different flooding regimes and found that constant flooding of seedlings will suppress their growth. It also found the inter-flood dry periods are important for seedling growth (especially root growth). Together these findings highlight the importance of flooding timing and duration for the management of woody seedlings, an important consideration for the stand condition of tree communities' but it was not clear whether these had then translated into impacts on adaptive management of environmental water. However, there was clearly an intention to do so (e.g. 'Key EWKR findings such as the heterogeneity of wetland vegetation... We will take these findings into consideration as we continue to manage ewater into the future.' To the question 'How impactful have the outcomes from each theme been on providing new knowledge for water managers to better inform achievement of environmental outcomes from the use of environmental water?', half of the 9 managers answered 'Somewhat impactful' or better for the vegetation theme. Interviewees agreed that the work done on vegetation in Queensland was very helpful to managers in that area and provided valuable insights into water requirements for several tree species. However, it was less clear whether this information was being used in an adaptive management framework in current environmental water management. There was less enthusiasm about the impact of the research activities done on vegetation in the southern Basin and how it had fed or was likely to feed into adaptive management. No specific examples were given by any interviewees where information from the vegetation theme had been used in adaptive management.</p>
<b>Evaluator 2</b>	<p><b>Low Impact</b></p> <p>The understory vegetation focus of the EWKR vegetation theme addressed a knowledge gap not addressed elsewhere. The high heterogeneity in responses to watering observed at local scales were less informative for managers across sites/regions and substantive uptake has not yet occurred. The resulting low clarity/simplicity and weak management engagement was in part compounded by a lack of SMART management objectives for non-woody vegetation - especially at the more appropriate scales of landscape/region. The Queensland floodplain vegetation study had a high impact, with "an outcome that definitely did change the way that we managed or thought about managing water" in relation to specific Qld environmental assets. "changed management because of the findings" and the relationships. Evidence from interview responses: "what is our environmental target for those communities? I don't think we've articulated that very well." The "finding of highly variable responses does not easily translate into support for water management decisions, but does set the foundation for future research". "The vegetation one's probably been the least impactful. I find vegetation hard to get a really good handle on. What are we trying to achieve at landscape scale with vegetation, other than we want to increase the area of red gum ..." "a lot of heterogeneity in response. And so the implication is that you need to water at large scales to get a range of responses and productivity outcomes." "So some of the vegetation work I don't think that it really contributed greatly" The theme "looked at the different regimes of flooding and how that would characterize different vegetation communities .... but the uptake hasn't occurred yet." "it's more about using what we have learnt from EWKR to try and refine some of the broader landscape scale targets and objectives that we're trying to achieve"</p>
<b>Revision</b>	<p>After reading your assessment and reconsidering my own, I am willing to downgrade my assessment to 'Low impact'</p>

<b>comments</b> <b>Evaluator 1</b>	–
<b>Revision</b> <b>comments</b> <b>Evaluator 2</b>	– Agree
<b>Consensus final</b> <b>rating</b>	<b>Low Impact</b>

Micro KEQ 6.1b To what extent has the information provided by the fish theme had an impact on the adaptive management of environmental water?	
<b>Evaluator 1</b>	<p><b>Moderate Impact</b></p> <p>Although adaptive management was not specifically mentioned in the fish theme final report (2019), the concept was prominent in Koehn et al. (2019) who stated that developing knowledge, such as relative rates of survival and growth for all life stages of MDB fish species to understand how to improve adult population, and implementing it in an adaptive management framework are fundamental to achieving the fish objectives of the Basin Plan and informing its associated watering strategies. Surprisingly, a key paper about conceptual models developed in the fish theme (e.g. Humphries et al. 2019 on the Riverscape Recruitment Synthesis Model) did not mention adaptive management although it is clear that much of the information in this paper would be relevant to managers and was partly intended that way. It helps managers to use information derived from research activities when the findings are explicitly expressed in an adaptive management framework, and this was one of the main messages in Koehn et al. (2019). In the survey responses to the question ‘How efficiently do you think the EWKR project conveyed lessons learnt to improve adaptive management of environmental water?’, well over half the respondents who did not reply ‘Don’t know’ believed that in the fish theme, this had been ‘Somewhat efficiently’ or better. Only one specific example was provided (‘...I use knowledge about fish populations (particularly Golden Perch) to try and identify where in Victoria we should be trying to support fish breeding and where we should focus on fish movement...’ although it was not framed in an adaptive management context as to whether responses to these management strategies would be monitored and changes made accordingly. To the question ‘How impactful have the outcomes from each theme been on providing new knowledge for water managers to better inform achievement of environmental outcomes from the use of environmental water?’, 40% of the 9 managers answered ‘Somewhat impactful’ for the fish theme. There were several general impressions that the fish information was being used (e.g. ‘From a fish ecology perspective I have seen uptake of this knowledge/concepts by envt water managers.’) or would be (e.g. ‘The fish theme researched the spatial patterns of food and temperature so as to identify which areas in the landscape will be important for successful fish recruitment. This has implications for the assets being targeted by ewater actions’), but again, not explicitly framed in an adaptive management context. In particular, the work from the fish theme encouraged a greater appreciation of the larger scale at which relevant processes occurred (e.g. ‘I think the waterbird theme and fish theme are helping shift the focus to managing systems at a landscape scale rather than at individual sites’; ‘The system scale project in the fish theme is being used now by managers’; ‘Helping to shift attention to managing at a landscape scale to achieve necessary outcomes. Specific examples... for fish the otolith work has demonstrated importance of select nursery habitats across basin and large watering events in driving fish populations’) and this appreciation of appropriate scales is crucial to effective adaptive management. Many interviewees praised the value of the information from the fish theme and considered it had had a substantial impact on managers’ perspectives of the spatial scales at which the effects of environmental watering should be assessed as well as providing insights into some of the factors affecting native fish recruitment. However, despite the accolades for this work, there were no specific examples provided where information from the fish theme had been used in adaptive management.</p>
<b>Evaluator 2</b>	<p><b>Moderate Impact</b></p> <p>The fish theme has had substantial impact on the knowledge required to understand recruitment, movement and population responses to aspects of</p>



	<p>environmental water. In addition, water management knowledge for fish recruitment and movement have been enhanced for the interconnection flows and for Golden Perch across the Basin. There is uncertainty about the state of development and utility of the fish models, which have to date had minimal impact on water management, but will support further research. Many simple (sometime overly simple) messages about fish responses to environmental water were delivered -often at the demand of the water managers. The difficulty in 'translating' EWKR knowledge was acknowledged, but not well addressed (other than by individual researchers) – and there was minimal program-wide guidance during the project to assist with this. Uptake of EWKR knowledge/learnings is hindered by difficulty in making those outcomes communicable at a level of complexity/simplicity suitable for managers. EWKR-derived fish, waterbird and productivity knowledge is more useful "at a conceptual level" rather than operationally. Interview responses of particular relevance: "the fish and waterbird themes, ..... are having high impact." "everything we have found is new" "there's a real focus on these interconnected Basin flows in the southern connected Basin, but also up in the Barwon-Darling and I think that fish work will really help with those kinds of flows." The fish "recruitment model ... is really excellent and helpful, but not so much for managers. ... But for researchers working on fish recruitment, it's an extremely valuable framework to structure research around"..." but it doesn't provide a tool for water management". Golden perch knowledge very useful (though small part of theme research); "we're seeing a shift in some of the watering actions that's building on that knowledge." "the large scale fish work, people now understand that, at least the golden perch, some of these things are occurring at a Basin scale and they need to be managed to that sort of scale." New knowledge "will be really useful for a water managers, but they might not have realized that yet." EWKR-derived fish, waterbird and productivity knowledge is more useful "at a conceptual level, but most of our watering actions are conceptual anyway." "... this is a connected up system and things move everywhere, and (the fish movement work) really made the case for why you want to do things at a Basin scale." EWKR-derived knowledge of "big breeding events in some years and then lots of years without, is what's driving the populations. .... that will influence the water planning that we do."</p>
<b>Consensus final rating</b>	<b>Moderate Impact</b>

Micro KEQ 6.1c To what extent has the information provided by the waterbirds theme had an impact on the adaptive management of environmental water?	
<b>Evaluator 1</b>	<p><b>Moderate Impact</b></p> <p>The waterbird theme final report (2019) does not specifically mention adaptive management but much of the information produced in that report and other outputs such as waterbird factsheets and presentations is packaged in a way to facilitate uptake and application by water managers. It is clear that waterbirds in the MDB are already being used as an indicator of the success of management of environmental water and monitoring data are being used to adaptively manage watering to promote particular species. Much of the information from the waterbird theme is relevant for explaining the mechanisms and processes underlying responses to environmental water management but it would be helpful for managers if this information was also packaged in an adaptive management framework as well. In the survey responses to the question 'How efficiently do you think the EWKR project conveyed lessons learnt to improve adaptive management of environmental water?', well over half the respondents who did not reply 'Don't know' believed that in the waterbird theme, this had been 'Somewhat efficiently' or better. There were no specific examples provided where it had already been used in adaptive management, seemingly reflecting lack of opportunity rather than desire (e.g. 'Waterbirds theme did the best in terms of getting info out there for use by managers - haven't been many waterbird breeding events since the project to really apply knowledge'). The waterbird information is clearly relevant to use in adaptive management, and several comments referred to its use in management that could be adaptive ('I am working with Heather McGinness to try and plan water use at wetlands across northern Victoria to improve waterbird outcomes'; 'Key EWKR findings such as... the energy requirements (number of Big Macs) to fledge waterbirds have been noted by us and appear in the draft 2020 Basin Plan evaluation documentation. We will take these findings into consideration as we continue to manage ewater into the future ') or where the potential exists (e.g. 'The waterbird theme investigated waterbird movements and found clear population connectivity between the northern and southern Basin which highlights the need for inter-valley co-ordinated ewater planning. It also found that foraging habitat availability needs to be managed both during and between breeding events which is an important factor for ewater managers to consider'). There were also examples of how the work from the waterbird theme is encouraging a greater appreciation of the larger scale at which relevant processes occurred (e.g. 'I think the waterbird theme</p>



	and fish theme are helping shift the focus to managing systems at a landscape scale rather than at individual sites'; 'Helping to shift attention to managing at a landscape scale to achieve necessary outcomes. Specific examples - for birds it highlights the importance of helping chicks survive to become breeding adults not just helping them fledge') which is relevant to effective adaptive management. However, it was also commented that there was a need for integration of the research into adaptive management (my inference) by assessing waterbird responses to actual watering events would have been desirable ('the waterbirds research, possibly the most well known of all activities, was not about ewatering but the foraging behaviour of native waterbirds more generally. Its findings may have some application for ewater management - in better understanding how native waterbirds move and find food - but the research did not connect with ewater delivery or even inundation extent of key assets, to my knowledge.'). To the question 'How impactful have the outcomes from each theme been on providing new knowledge for water managers to better inform achievement of environmental outcomes from the use of environmental water?', 20% of the 9 managers answered 'Somewhat impactful' for the waterbird theme. The waterbird theme was generally ranked as the one having the greatest impact of the four, and many interviewees appreciated the information on waterbird movement and on factors affecting recruitment. Despite this, no specific examples were provided where information from the research activities in the waterbird theme was being used in current adaptive management. Moderate impact
<b>Evaluator 2</b>	<p><b>Moderate Impact</b></p> <p>The waterbirds theme has contributed to adaptive management due to the combination of new knowledge, including a better understanding of the scale of water bird movements and responses to watering events, and due to the well-coordinated nature of the research with broad engagement with a range of managers and jurisdictions. Highly responsive communication activities in the waterbirds theme led to greater adoption than for other themes – this was largely personality-driven but also a product of the nature of the research. Changes in the thinking behind environmental watering for waterbirds at relevant scales as a result of EWKR research are evident. However, Waterbird theme outputs are not yet synthesized into a product that could be directly used for water management - this is tied to the problem of the large scale of bird movements and responses to water regimes across the Basin. The Basin-scale of waterbird responses is an impediment to adoption of new waterbird knowledge and requires cross-Basin coordination or a large scale 'experiment', the latter not being possible within EWKR. Links between the food resources required for birds and watering actions highlighted by EWKR have also not yet been made. There has been limited use of the large-scale movement database developed during EWKR by jurisdictions and managers to date – for both institutional and technical reasons. Problems of scale were evident in the research design - the scale of the bird tracking investment was too small to track the biggest breeding event in 30 years, at Booligal. The research design has to be tied to the appropriate scale of response either in magnitude of investment or flexibility in response to events. This small scale of investment limited the potential of the EWKR waterbird theme's research making a substantial and direct adaptive management contribution to water management actions. Example interview responses of relevance: "the fish and waterbird themes .... are having high impact." "the waterbirds (theme) had the biggest impact in terms of people really sort of understanding that this issue of recruitment is important and they need to be paying more attention to it." There is "ability to generate ongoing data from the investment" "starting to think about what needs to be done to provide resources for those birds over six months to three years to get them through to recruitment. .... It is not translating into watering actions yet, but I expect it will probably in another one or two years." "knowledge that it was not just breeding habitat, but foraging and movement patterns" "better contextual understanding of how that individual or group of birds they were tracking were using that landscape. And what that may mean re watering to providing refuge habitat etc"</p>
<b>Consensus final rating</b>	<b>Moderate Impact</b>

<b>Micro KEQ 6.1d</b>	<b>To what extent has the information provided by the food web theme had an impact on the adaptive management of environmental water?</b>
<b>Evaluator 1</b>	<p><b>Low Impact</b></p> <p>The term 'adaptive management' is not used anywhere in the foodweb theme final report (2019) or its appendices. However, both Rolls et al. (2017) and Robson et al. (2017) point out the importance of appropriate conceptual models in adaptive management, and the food web theme final report (2019) generated energetics models that</p>

	<p>would be useful for managers in predicting responses to environmental watering and then monitoring these in an adaptive management framework. Similarly, tools such as the trophic niche indicator was proposed as a cost-effective annual monitoring tool that can assess the influence of environmental flows on food sources of native fishes (food web theme final report (2019)) and would be useful for monitoring in an adaptive management framework. Despite the relatively novel approaches in this theme (compared with vegetation, fish and waterbirds where response variables for adaptive management are already quite well-established), there is great potential for the information from the food web theme to have an impact on the adaptive management of environmental water in the MDB. Relative to the other themes, more respondents believed that the food web theme final report (2019) had contributed 'Not so efficiently' or worse when they were asked 'How efficiently do you think the EWKR project conveyed lessons learnt to improve adaptive management of environmental water?', and did not reply 'Don't know'. This was also apparent in answers to the question 'How impactful have the outcomes from each theme been on providing new knowledge for water managers to better inform achievement of environmental outcomes from the use of environmental water?' where none of the 9 managers answered 'Somewhat impactful' or better for the foodweb theme; all answered 'A little' or 'Not at all'. Nonetheless, respondents clearly appreciated the value of information from the food web theme for management (e.g. 'The links between the waterbird, fish and food web theme about the quantity/quality of food resource were valuable. This is useful to consider how the quality of habitat influences quality of resources and energy requirements for survival of colonial waterbirds.'; '...the food web theme is critically important in increasing attention to this theme in particular the need to consider quantity as well as quality of food'; 'particularly the foodwebs and food resources findings, highlight the importance of connectivity and this ecosystem function to provide the building blocks for healthy populations of fish and waterbirds.'). It was acknowledged that the uptake of information from this theme into adaptive management of environmental water was potentially inhibited by the novelty of the topic and its methods and complexity (e.g. 'As the food web theme is complex and more difficult to quantify - more resources may be required to continue its development and to communicate concepts'). Interview responses corroborated the survey responses. Although many interviewees considered that the information was interesting and had broadened managers' perspectives in thinking about food quantity and quality when planning environmental watering, the prevalent view was that much of this information was not yet in a form where it could guide adaptive management. There were no specific examples provided where information from the research activities in the foodweb theme was being used in current adaptive management. Most interviewees ranked this theme as the least impactful in influencing current environmental water management in the MDB but considered there were future potential benefits and that the research activities had been worthwhile.</p>
<b>Evaluator 2</b>	<p><b>Moderate Impact</b></p> <p>The EWKR Food webs theme research has made a substantive contribution to the understanding of the importance of productivity and food webs within the Basin river environment and the relationships between watering actions and food production for fish and, to a lesser extent, waterbirds. This area of research and its implications for management are still maturing. As a result, the food webs chapter in the Synthesis Report makes only high-level 'motherhood' statements, and translation of the results from the food web stuff into water management decisions hasn't been well articulated. The direct contribution by this theme to active adaptive management of environmental water has been small. However, the shift in 'conceptual thinking' around watering for productivity and food production is evident and likely to have substantial ongoing repercussions. Managers have expressed a need to understand the food web model and indicator products and their management implications. The impact of this theme's activities is evident for a small number of water managers with direct contact to EWKR – but has not reached others due to poor communications and lack of broad awareness of the outcomes. Examples of relevant interview responses: "need to understand the model and indicator products and the management implications" "big impact because it sort of changed the thinking" "provided the case to increase interest in watering for food webs and ecosystem productivity." "building on the back of the EWKR program ... some of the productivity work that the CSIRO functions work is looking to build off some of those findings" "quite a broad based shift in the way we think about the system. Thinking about it more as a connected-up system, thinking more about fluxes of energy." "a lot more systems where we are talking about watering actions to support productivity" "productivity is more front of mind for everyone now, and particularly because when you got, you know, moving to the site, coordinated scale waterings, that's a really good, I guess, indicator of how the site's going ... these things often take a bit of time to uptake,(though) it was happening anyway at the local scale" Food webs theme outputs "will be quite impactful because we're trying to do a productivity theme for the BWS Three, which will draw upon some of these results."</p>
<b>Revision comments</b>	<p>– Given that your comments are not especially enthusiastic and you state the impact as 'small', I would prefer to see this rated as 'Low impact'. I agree totally with your comments and also the interviewees' sentiments that communication has probably largely hindered the impact.</p>

<b>Evaluator 1</b>	
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Low Impact</b>

Micro KEQ 6.1e To what extent has the information provided by the synthesis across all themes had an impact on the adaptive management of environmental water?	
<b>Evaluator 1</b>	<p><b>Low Impact</b></p> <p>The synthesis final report (2019) does not refer to 'adaptive management', perhaps assuming that this aspect has been covered fully in the final reports of the other themes. However, this synthesis aspect where the 'big picture' is drawn together is perhaps where presenting the collective findings in an explicitly adaptive management framework would have been very helpful for managers, and could be a key suggestion for future syntheses. This perception is reinforced by one of the survey comments in response to the question 'How efficiently do you think the EWKR project conveyed lessons learnt to improve adaptive management of environmental water': 'There was a genuine attempt by researchers to think about this - as evidenced in the final presentations that CEWO / MDBA folk attended. This could have been done better. A stand alone report that focussed solely on this - rather than a synthesis of research findings may have beneficial and more emphasis on the AM benefits of the research, rather than the research itself'. The synthesis focused on generating high-level messages, many of which were probably already familiar to most environmental water managers. Nonetheless, reiterating these messages does no harm and would contribute to encouraging and informing adaptive management of environmental water. In the survey responses to the question 'How efficiently do you think the EWKR project conveyed lessons learnt to improve adaptive management of environmental water?', well over half the respondents who did not reply 'Don't know' believed that, overall, this had been 'Somewhat efficiently' or better. There was the impression that information could have been better packaged to promote adaptive management ('EWKR has been a successful project and has contributed well to the body of science that environmental watering relies on to advance and improve. I understand that the project could have better 'applied' the science to the benefit of water planners - so put more effort into the 'implications' of the findings for adaptive management purposes.'). To the question 'How impactful have the outcomes from each theme been on providing new knowledge for water managers to better inform achievement of environmental outcomes from the use of environmental water?', 25% of the 9 managers answered 'Somewhat impactful' for the overall project. However, this was not based on the synthesis but was an overall impression across the four themes. Interviewees were critical of the synthesis, many seeing it as very different from an integration (which they seemed to have wanted and expected but instead got a summary of the main findings of the themes with some broad and general statements). Although there were no specific comments linking the synthesis to adaptive management, there was criticism that the synthesis did not go far enough in providing sufficient guidance for managers seeking new insights from EWKR to manage environmental watering. As this process is a key part of adaptive management, the inference is that the synthesis has not yet had a substantial impact on adaptive management in the MDB.</p>
<b>Evaluator 2</b>	<p><b>Low Impact</b></p> <p>The synthesis report provided a set of integrated learnings from the theme research activities. However, the cross-theme synthesis focused on higher level principles ("motherhood statements") that emerged from the project as a whole, and these were not targeted at a level or at an audience focused on water management other than at a planning level. Direct applied learnings for immediate uptake are not presented in the Synthesis Report (in contrast to some of the Theme Final Reports). Survey respondents echoed this and suggested that a more targeted delivery of cross-theme knowledge which involved water managers from the outset would have been more appropriate. End users also indicated that the impact of the integrated EWKR findings on applied adaptive management of environmental water was weak. Example</p>

	interview response: "motherhood statements not management recommendations that inform decisions"
<b>Consensus final rating</b>	<b>Low Impact</b>

## EFFICIENCY

- 4 high-level KEQs
- 6 mid-level KEQs
- 22 micro-level KEQs

High KEQ 7	How efficiently has the EWKR project achieved its objectives?
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>To the extent that the EWKR project achieved its objectives (see responses to KEQ1 and its mid and micro KEQs), the process was moderately efficient. For several themes, the initial phase of planning and literature review took a relatively long time but, in the long run, improved the focus of the research questions and the relevance and quality of the outputs. However, this came at a major cost to the time remaining for data collection and the project would have been more efficient if this initial scoping and review phase had already been done (as is often the case in more conventional settings where grants are applied for formally and the scoping and literature reviews are done when preparing the application). The limited time and other constraints probably compromised the quantity and, in some cases, the management relevance, of some of the work. Responses to the surveys corroborate this (e.g. 'I think the efficiency of the project could have been improved considerably, particularly in the planning phases, which took too long, and invested too many time and resources in trying to justify some of the planned research activities. This cut into the field-activities in a way that ultimately placed pressure on the themes to compress the work into a shorter timeframe than would have been ideal'; 'Planning process too long - objectives not well enough defined to quickly ID a scope that fit neatly within the available \$ - led to lost time'). Indeed, some respondents were quite scathing about this aspect. Nonetheless, there were also respondents who, having acknowledged this constraint and that of funding, considered the project to have been efficient (e.g. 'What was achieved with the funds was efficient'). In response to the question 'How efficient was the EWKR project, over all themes, in meeting its objectives?', well over half the respondents who did not reply 'Don't know', replied 'Somewhat efficiently' or better. There was evidence that project managers proposed strategies to enhance the efficiency of the EWKR project. For example, the Annual Progress Report 2015-16 describes how the Leadership Team developed strategies to minimise the material impact on the timeframe and outcomes of the project including: structuring and documenting the work flow to maximise efficiencies and synergies between different components of the project (e.g. using work generated during the Conceptualisation Phase to feed into SAG and JRG and Adoption (water manager) workshops, inform the project budget and updating of the Annual Research Plan and to provide content for the ASL conference in September), structuring the Conceptualisation Phase process in a way that enables data collection (including field work) to commence in Spring 2016, developing efficient processes for preparation of research plans and other outputs by providing easy-to-use templates, long lead-in times for Theme Coordinators to start work on research plans and quick feedback from the Project Leadership, dedicating time during fortnightly theme coordinator meetings to identify potential time saving synergies between theme work, identifying opportunities to share research, data and insights and to integrate research and field work, coordinating and streamlining project management tasks including streamlining the preparation (and payment) of sub-contracts for project partners, and streamlining project reporting by using monthly project reports prepared by Theme Coordinators and the Project Leadership to brief the Department, the MDFRC Executive and Board and for inclusion in Mid-year and Annual Progress Reports. These measures, if adopted, would have enhanced the efficiency with which the EWKR project achieved its objectives. In the 2019 evaluation, interview participants were asked to identify the approaches used to ensure the efficient use of the available project resources. Reported efficiency measures included developing theme level budgets and allocation of resources early in the project (waterbirds</p>

	<p>theme), regular budget monitoring with oversight from project committees by each of the themes, review of sub-contracts and removing dependencies to ensure sub-projects could be delivered efficiently, reducing the risk of lags and slippage, leveraging of funds and in-kind contributions (i.e. collection and analysis of otoliths for the fish theme using funds from the Long-Term Intervention Monitoring project and in-kind support from other research organisations), sole sourcing consumables for distribution across project teams (i.e. bulk purchase of satellite transmitters for the waterbirds theme), and scheduling and sharing field work across projects to save on accommodation and resourcing (i.e. waterbirds and foodwebs themes). It was admitted that some of the activities that would have enhanced efficiency (e.g. co-location of project sites across themes and more shared field work as planned) did not eventuate for various reasons and that would have compromised the efficiency with which the EWKR project achieved its objectives. The extent of collaboration and pooling of resources to enhance efficiency varied among themes (see responses to KEQs 9 and 10 and associated mid and micro KEQs) but was generally sufficient to enhance the quality and value of the outputs and improve their communication to stakeholders, especially when these people were actively involved in the process. Acknowledging the various challenges in projects like EWKR (e.g. getting large multi-institution teams together and coordinating their activities across multiple States), most interview responses considered that the project had been reasonably efficient in meeting its objectives and that efficiency increased over time as problems were ironed out. There was widespread awareness that communication of information had not been very efficient, and some responses indicated that some of the objectives associated with management (e.g. adaptive management) were not met very well, partly because of this failure in effective communication and that a professional communicator was only bought in quite late in the project. However, some interview responses were blunt and considered that the project had been inefficient at meeting its objectives. This was mainly blamed on some aspects of governance (not covered in this assessment) and the amount of money spent on desktop assessments and Phase 1 planning which detracted from the resourcing and efficiency of the subsequent research to meet the original objectives. There was also some acknowledgement that it may still be too soon to adequately assess the efficiency of meeting some of the project's objectives because information is still 'diffusing' through.</p>
<b>Evaluator 2</b>	<p><b>Moderately Efficient</b></p> <p>EWKR was not efficient nor completely effective in achieving the project's seven overarching objectives, as articulated in the Grant Guidelines and Multi Year Research Plan. This was in large part due to the shift in focus to targeted research questions addressing key knowledge gaps in the ecology-water space, a shift which took time and resources which were required in order to turn the overly aspirational, high level and multiple nature of these objectives into scientifically relevant questions and activities focused on those knowledge gaps. The Grant Guideline objectives could not effectively be addressed by a program of the size and resources of EWKR. Research activities designed to address the objectives would require a far more substantial investment of funding, time and institutional engagement than was made available to the project. The management team guiding research under EWKR were well aware of this problem and addressed it by honing down the research activities to address key knowledge gaps that could be addressed within the resources and intuitional skill set available. It appears that the department did not prevent this shift but encouraged it - perhaps in the hope that further funding would be forthcoming to allow the objectives to be addressed in the longer term. If the project were to efficiently address the stated objectives and desired outcomes, it should have designed one or two integrated research activities which focused on evaluating multiple sets of ecological responses to specific sets of management interventions in a program that combined investigative and surveillance monitoring with specific research techniques. As a result, EWKR did not address the desired objectives or outcomes either efficiently or effectively. It did however effectively conduct a research program that targeted fundamental questions underpinning those objectives, though not in an efficient manner due to the rapid adaptive management such a program shift required. Comments are provided against the individual project objectives in my response to KEQ1.</p>
<b>Consensus final rating</b>	<p><b>Moderately Efficient</b></p>

Mid KEQ 7.1 How efficiently, in terms of value for money, did the EWKR project improve understanding of incremental changes in ecological condition in response to multiple

management interventions?	
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>Very little of the EWKR project actually focused on measuring incremental changes in ecological condition in response to multiple management interventions (see also responses to KEQs 15 and 17 and their associated mid and micro KEQs) so, not surprisingly, none of the outputs present project-derived data on incremental changes in ecological condition in response to multiple management interventions. Consequently, this objective was not attained so I rated it as 'Inefficient' (but perhaps there should be a 'Not applicable' category). None of the survey responses commented on the efficiency with which the EWKR project improved understanding of incremental changes in ecological condition in response to multiple management interventions but there seemed to be an impression that this was never a major goal of the project anyway (e.g. 'To my understanding the EWKR project was never about "identifying change in ecological condition", this was the domain of the LTIM') and there was not enough time for the project to tackle incremental changes (e.g. 'The project was too short to deal with temporal aspects well'). Similarly, there were no specific interview responses that alluded to the value for money in improved understanding of incremental changes in ecological condition in response to multiple management interventions.</p>
<b>Evaluator 2</b>	<p><b>Moderately Efficient</b></p> <p>The EWKR project did not develop a framework or research focus around the concept of ecological condition per se and did not define or use the term condition in conceptual models or research questions. This is for sound scientific reasons, and also due to the thematic focus of water management, BEWS and LTWO objectives and evaluation through processes like LTIM. Also, EWKR did not specifically evaluate the impact of management interventions on ecological responses, rather the focus shifted to improving understanding of ecohydrological relationships and of responses of biota and functions to water regimes and watering events. As a result, EWKR did improve understanding of incremental changes in several key aspects of the structural and functional responses of water dependent biota, energy and food production in relation to water regimes and watering events that would be of direct value to managers, planners and policy makers. It did this with moderate efficiency, within the limited context and resources available to the EWKR project team, and with a pragmatic eye to addressing key knowledge gaps. The application of funding resources to research activities, once research questions and foundation activities had been resolved was effective and efficient – within the normal constraints of research practice. The development of research questions and designed activities was relatively inefficient due to the lateness in conducting foundation activities and re-design of theme-based projects after an overly broad and unfocused project 'call'. This resulted in a year of delay in commencing a number of core research activities, limiting the potential of that research to fully address the research questions. In addition, the lack of a coherent framework for designing and delivering research activities and outcomes for direct uptake to management and planning audiences ('user focus') was not fully addressed, resulting in a fairly inefficient message delivery via the final project synthesis. This was in large part due to the overly broad, aspirational and ultimately ineffective set of objectives set in the Grant Guidelines set by the department at the outset – these lacked a strong bedding in scientific language, and caused confusion and delays in focusing the project. In addition, the model of using a single service provider (with selected affiliates), while efficient administratively, and serving an organisational-jurisdictional need at the time, was not the most effective or efficient means of delivering targeted quality research to service the needs of the department or of water management in the Basin.</p>
<b>Revision comments – Evaluator 1</b>	<p>Given your comments, I am little surprised you rated this so highly. I would prefer to rate this as 'Inefficient' given the specification in the KEQ to 'improve understanding of incremental changes in ecological condition in response to multiple management interventions' which I don't think was achieved well.</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final</b>	<p><b>Inefficient</b></p>

rating	
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Micro KEQ 7.1a	How efficiently did the EWKR project improve understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity?
Evaluator 1	<p><b>Moderately Efficient</b></p> <p>The ecosystem function that received attention in the EWKR project was the transfer of energy across trophic levels, and this was mainly investigated in the foodweb theme, drawing on information from the fish and waterbird themes. Although this theme did not collect foodweb data directly in response to environmental flow management, there were useful inferences, insights and recommendations drawn from this work about water management options to favour foodwebs (productivity), especially for fish and waterbirds (food web theme final report (2019)). In response to the survey question 'How effectively did the EWKR project improve water managers' understanding of how environmental water management influences ecosystem function and thereby sustains biodiversity', well over three-quarters of the respondents replied 'Somewhat effectively' or better. However, specific responses indicated that the efficiency was compromised by poor communication of the findings to managers (e.g. 'The links with water managers could have been stronger, for example through co-design of projects and involvement as team members in the project design and delivery'; 'Closing the loop in terms of communication was perhaps a little limited'), particularly towards the end of the project when time was running short ('Ultimately, the end of the project was rushed...compromised the conveyance of the utility of the research to managers and potentially the essential integration across themes'). The interview responses reiterated this perception of less efficient communication compromising the overall efficiency of the process of improving managers' understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity. Some respondents also stated that they were still absorbing the messages from the foodweb theme. However, there were no specific examples given in the interview responses illustrating improved understanding of how environmental flow management influences transfer of energy across trophic levels in a foodweb or, for that matter, any other ecosystem function. Nonetheless, many interviewees considered that the science in the EWKR project was good value for money and that many researchers put in substantial in-kind contributions.[because at least some understanding of this accrued]</p>
Evaluator 2	<p><b>Moderately Efficient</b></p> <p>The EWKR project showed uneven efficiency in improving understanding of how eflow management drives function and biodiversity outcomes. There were marked improvements over time, particularly driven by an early process of project re-design and re-focus, which led to substantial reduction in time availability for certain research activities. Overall, the project succeeded in producing an appropriate quality and quantity of deliverables (including data and management relevant outcomes), within the available resources and time – once the initial foundation activities and theme re-focusing had occurred. There was limited evidence of pooling of resources for joint activities – in the case of waterbirds, fish and food webs collaborations. There is little reporting of joint mutual learning with other organisations and networks, with the exception of consultation and engagement with water and natural resource managers (e.g. for the waterbirds theme). There is evidence of effective collaboration and communication with appropriate organisations external to the project, particularly water managers and associated specialists, at a level appropriate to the conduct of research activities and the finalisation of priority research questions.</p>
Consensus final rating	<b>Moderately Efficient</b>

Micro KEQ 7.1b	How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect biodiversity?
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<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>Although acknowledged as relevant, this objective was never specifically addressed in any of the subsequent research activities in any of the themes (see response to KEQ1.2a). Indeed, biodiversity was not a focal point in any of the themes except some components in the vegetation theme (vegetation theme final report (2019)). Even then, the potential effects of interaction of drivers were not addressed. Consequently, it is not particularly logical to assess the efficiency of the EWKR project in improving understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect biodiversity. None of the survey responses referred to any improvement in understanding of interactions of drivers nor were there any direct references to insights about biodiversity provided by the EWKR project. The same applied to the interview responses, and there were no references to understanding of the effects of threats such as invasive species or land use on biodiversity. [no evidence any understanding of this accrued]</p>
<b>Evaluator 2</b>	<p><b>Inefficient</b></p> <p>The EWKR project effectively improved several key aspects of how flow affects theme-based aspects of biodiversity. It did not address interactions between major drivers at a level that substantially improved understanding, since the project was almost completely focused on the role of flow - with the exception of temperature and physical structure in the fish theme. When other drivers were addressed it was generally conceptual or as qualitative context to the effects of flow on biodiversity outcomes. The project's approach to driver interactions was inefficient, with little or no novel learning of the interactions, and no substantive evidence of collaboration or mutual learning with other organisations regarding non-flow driver effects.</p>
<b>Revision comments Evaluator 1</b> –	Agree to change to not attempted
<b>Revision comments Evaluator 2</b> –	This line of investigation was not attempted due to funding constraints
<b>Consensus final rating</b>	<b>Not attempted</b>

<b>Micro KEQ 7.1c</b>	<b>How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect ecosystem function?</b>
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>This objective was identified as a priority but was then never specifically addressed in any of the subsequent research activities in any of the themes, even in the foodweb theme (see response to KEQ12b). Although the food web theme final report (2019) presented a simulation-based quantitative food web model (Appendix 1.5), it omitted many drivers (e.g. land use, invasive species) and did not assess interaction effects of the others. Given this, it seems illogical to assess the efficiency of the EWKR project in improving understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect ecosystem function. None of the survey responses referred to any improvement in understanding of interactions of drivers nor were there any direct references to insights provided by research activities in the EWKR project about non-flow related drivers of ecosystem function. This also applied to all the responses to generic interview questions about</p>



	the efficiency with which the EWKR project achieved its objectives, enhanced adaptive management or fostered collaboration. [no evidence any understanding of this accrued. However, if we adopt the very broad definition of 'ecosystem function' to mean pretty well anything (as emerged in the CEWO interview), then perhaps this should be adjusted upward because some of the inferences about the effects of drivers referred to aspects covered in this much broader definition]
<b>Evaluator 2</b>	<p><b>Inefficient</b></p> <p>The EWKR project effectively improved several key aspects of how flow affects selected aspects of ecosystem function. It did not address interactions between major drivers at a level that substantially improved understanding, since the project was almost completely focused on the role of flow. When other drivers were addressed it was generally conceptually. The project's approach to driver interactions on functional outcomes was inefficient, with little or no novel learning of the interactions, and no substantive evidence of collaboration or mutual learning with other organisations regarding non-flow driver effects. The role of driver interactions on functional outcomes was absent in the priority research questions for the food webs theme, in part due to both contextual and knowledge constraints during project deployment. My assessment rating is inefficient for the project as a whole and 'Not Applicable' for the food webs theme.</p>
<b>Revision comments – Evaluator 1</b>	Agree to change to not attempted
<b>Revision comments – Evaluator 2</b>	This line of investigation was not attempted due to funding constraints
<b>Consensus final rating</b>	<b>Not attempted</b>

<b>Micro KEQ 7.1d</b>	<b>How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect resilience?</b>
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>Although there were no targeted research activities to address this objective in any of the themes, the final reports for the vegetation and fish themes both inferred that resilience was influenced by flow and non-flow drivers (see response to KEQ12c). Research activities assessed recruitment, a key component of resilience, by vegetation, fish and waterbirds but did not explore how major drivers of system condition (e.g. flow, land use, invasive species etc.) interacted to affect it. As a result, the EWKR project would not have been able to improving understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect resilience so it is not logical to try and assess its efficiency in doing so. None of the survey responses referred to any improvement in understanding of interactions of drivers nor were there any direct references to insights provided by research activities in the EWKR project about non-flow related drivers of ecosystem resilience. Indeed, resilience was not mentioned in any responses to the surveys. When it was mentioned by interviewees, it was in the context of managing for resilience (e.g. by promoting refuges) and not about the extent to which EWKR improved understanding of the drivers interacting to affect it. Similarly, there were no references or examples in the interview responses to the efficiency with which the EWKR project improved understanding of how major drivers of system condition such as flow, land use and invasive species interact to affect resilience. [no evidence any understanding of this accrued]</p>
<b>Evaluator 2</b>	<b>Not Applicable</b>

	The role of driver interactions on resilience was absent in the final priority research questions for any of the project themes. This may have been due to contextual, knowledge and resource constraints during project development. The concept of resilience was not addressed by a core research activity across the themes.
<b>Revision comments – Evaluator 1</b>	Maybe we should consider this as 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

<b>Micro KEQ 7.1e</b>	<b>How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect water quality?</b>
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>No research activities in the EWKR project addressed this objective (see response to KEQ1.2d) although water quality itself was mentioned as a potential driver for some of the processes that were investigated (e.g. fish recruitment, fish theme final report (2019)). As the EWKR project did not produce any results that could improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect water quality, it is not logical to try and assess its efficiency in doing so. None of the survey responses referred to any improvement in understanding of interactions among drivers that may affect water quality, nor was the term 'water quality' mentioned in any responses to the surveys or, in the context of this KEQ, in the interview transcripts. [no evidence any understanding of this accrued]</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>This was not addressed by the EWKR theme research questions and research activities.</p>
<b>Revision comments – Evaluator 1</b>	Maybe we should consider this as 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

Micro KEQ 7.1f How efficiently did the EWKR project improve understanding of how management influences environmental outcomes achieved over time?	
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>There was little evidence in the reports of the four themes where influence of management (as distinct from delivery of environmental flow, see response to KEQ7.1g) on environmental outcomes was assessed directly (see response to KEQ1.4a). Not surprisingly, there were also few inferences that were drawn about how management influences environmental outcomes achieved over time for any of the themes; where these inferences were drawn, they tended to be high-level, non-specific and probably already familiar to most managers. The survey did not ask specific questions about respondents' views of the efficiency of the EWKR project in improving the understanding of how management influences environmental outcomes achieved over time. However, in response to the related question 'How efficiently do you think the EWKR project conveyed lessons learnt to improve adaptive management of environmental water?', over half the respondents who did not reply 'Don't know' replied with 'Somewhat efficiently' or better. Of course, this question was more about communication rather than overall efficiency. All the examples that were provided to illustrate influences on management referred to environmental water management (discussed in the response to KEQ7.1g). However, the wider issue of the need for management strategies to be applied at broad scales was raised several times in specific responses (e.g. 'I think the waterbird theme and fish theme are helping shift the focus to managing systems at a landscape scale rather than at individual sites). Similarly, several different responses to the interview questions praised the insights from the EWKR project into demonstrating important ecological mechanisms and processes occurring at broader spatial scales that should be considered by managers rather than reach or river scales. A couple of responses also indicated that the EWKR project did not run long enough to gather significant temporal data (although there was no mention of the results from analysis of pre-existing long-term datasets like the ones done in the vegetation theme). No specific examples were given where information from the EWKR project had been efficient at improving understanding of how management influences environmental outcomes achieved over time. [if a better perception of scale was really the only improvement]</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>The EWKR project focused on flow influences on environmental outcomes, with an emphasis on key elements of hydrological regimes and watering events, rather than on an assessment of management actions associated with flow-driven outcomes. Management recommendations and messages for water delivery were clearly delivered across the themes, but a diagnostic assessment of management influence of outcomes was not addressed as a core research question or activity in any theme or cross-theme activity.</p>
<b>Revision comments – Evaluator 1</b>	Maybe we should consider this as 'Not attempted'
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

Micro KEQ 7.1g How efficiently did the EWKR project improve understanding of how delivery of environmental flow influences environmental outcomes achieved over time?

<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>The EWKR project was deemed to be moderately effective in improving understanding of how delivery of environmental flow influences environmental outcomes achieved over time (see response to KEQ14b for details). To the survey question 'How efficient was the EWKR project, in each theme, in meeting its objectives?', over a third of the respondents who did not reply 'Don't know' replied with 'Very efficiently' or better, and for three of the themes, this proportion exceeded or approached half. When asked specifically about cost-efficiency, three-quarters or more of the respondents considered the expenditure worthwhile. Most specific comments dealt less with efficiency of the project in improving understanding of flow delivery and more with the overall process. Comments were mixed and ranged from satisfaction (e.g. 'What was achieved with the funds was efficient') to dissatisfaction (e.g. 'the efficiency of the project could have been improved considerably, particularly in the planning phases, which took too long, and invested too many time and resources in trying to justify some of the planned research activities. This cut into the field-activities in a way that ultimately placed pressure on the themes to compress the work into a shorter timeframe than would have been ideal'). Responses to interview questions about the efficiency with which EWKR improved water management (interpreted to include delivery of environmental flow) were mixed. Some praised the science, especially the contributions to explaining the 'why' as well as the 'what' of water management and stated that EWKR results were referenced and used to inform watering design. However, most of these respondents were less complimentary about the efficiency of communication of the findings, and believed this compromised the overall efficiency of improving understanding of this aspect. Other interview responses were critical of the lack of direct assessments of ecological responses to water management in the field and considered the process was not as efficient as it could have been if there had been better collaboration with managers and coordination of fieldwork among the themes to track short-term responses to manipulated flows. Most of the responses prevaricated and were unable to answer the question either way because respondents (understandably) struggled to assess the efficiency itself. [some understanding accrued of the why and what of ecological responses to flow management]</p>
<b>Evaluator 2</b>	<p><b>Inefficient</b></p> <p>The question of achievement of environmental outcomes over the long term was not addressed specifically or efficiently in EWKR theme research activities. This was partially due to the absence of suitable long-term data sets, the absence of quantitative models of outcome trends over time, and the focus of the research questions on more fundamental knowledge gaps around the nature of responses to watering regimes. The EWKR project was not efficiently established to address the question of long-term outcomes and responses (other than for aspects of woody vegetation).</p>
<b>Revision comments – Evaluator 1</b>	<p>Happy to downgrade my assessment to 'Inefficient' after reading your reasoning (where effectiveness and efficiency are strongly linked). But think we should discuss this just to be sure that we're not being too harsh because there were quite a few insights that came from EWKR about mechanisms and expectations in response to environmental flows.</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final rating</b>	<p><b>Inefficient</b></p>

<b>Micro KEQ 7.1h</b>	<b>How efficiently did the EWKR project improve understanding of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition?</b>
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>Overall, the EWKR project was considered to be minimally effective in improving understanding of the links between ecosystem responses to watering regimes (e.g. natural</p>

	<p>and/or managed events) and incremental changes in ecological condition, except for the vegetation theme which was deemed to be moderately effective, relative to the other themes, in this regard (for details, see responses to KEQs 1.5 and the associated micro KEQs). Conversely, each theme in the EWKR project was moderately effective at developing predictive tools, conceptual models and frameworks to inform environmental watering regimes (see responses to KEQs 3.3 and the associated micro KEQs). The survey asked 'To what extent have you adopted or used knowledge/guidance/tools generated by the project?' and of those respondents who did not reply 'Don't know', about half replied with 'A moderate amount' or more for three of the four themes. The response was slightly less for the vegetation theme. Specific examples were provided of this use (e.g. 'I know some of the tools have been used in the Basin scale projects, such as the CSIRO Ecosystem modelling project'; '...I use knowledge about fish populations (particularly Golden Perch) to try and identify where in Victoria we should be trying to support fish breeding and where we should focus on fish movement. The foodweb findings on the relative quality of food in channel, vs anabranch, vs billabong is driving thinking around where and how to connect critical off channel habitats via environmental water and the need to ensure return flows from those sites.'; 'I have been using information from the vegetation and waterbird themes with regards to objective and target setting in the future...'). As mentioned in the response to KEQ7.1g, the responses by interviewees who expressed an opinion one way or the other were mixed about the perceived efficiency with which understanding of environmental watering was improved. The sentiments of these responses can probably be validly extended to the links between ecosystem responses to watering regimes and incremental changes in ecological condition although the term 'water regime' was never used explicitly. Given the evidence of the use of this knowledge and tools and the assessment that environmental flow delivery was moderately efficient and cost-effective in improving understanding of how delivery of environmental flow influences environmental outcomes achieved over time (KEQ7.1g), I rated this as 'moderately efficient' also.</p>
<b>Evaluator 2</b>	<p><b>Not Applicable</b></p> <p>The EWKR project did not develop a framework linking ecosystem responses to watering regimes and events to changes in ecological condition as a concept. The research questions and the project outcomes did not therefore address this issue.</p>
<b>Revision comments – Evaluator 1</b>	<p>I am reluctant to consider this as 'Not attempted' (as an equivalent to 'Not Applicable') because I think there was information gained in the EWKR project about watering regimes (especially natural ones) and ecosystem responses (e.g. vegetation theme). If we agree to downgrade KEQ7.1g to 'Inefficient', then I suggest we do the same for this one, as per the criteria in the Efficiency rubric.</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree. I was being a tad harsh, as it also depends on the definition of watering regimes and how they were handled as event sequences in EWKR analyses.</p>
<b>Consensus final rating</b>	<p><b>Inefficient</b></p>

<b>Micro KEQ 7.1i</b>	<p>How efficiently did the EWKR project improve understanding of the links between ecosystem responses to management interventions (water management) and incremental changes in ecological condition?</p>
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>The EWKR project did not specifically investigate the links between ecosystem responses to water management and incremental changes in ecological condition (for details, see response to KEQ1.7), largely because the capacity of the EWKR project to assess incremental changes in condition was limited (see response to KEQ1.5). Nonetheless, there were research activities that assessed associations between ecological responses and altered flows and watering from which inferences could be drawn</p>

	that were relevant to understanding possible links between ecosystem responses to water management and incremental changes in ecological condition. Water management includes delivery of environmental water (KEQ7.1g) and managed watering events (KEQ7.1h) so the assessments of efficiency of these two aspects apply equally here. The consensus from these assessments was that although the scoping and planning stage and literature reviews consumed more time and resources than expected which limited the time available for on-ground research, the outputs were efficiently generated given the time available. However, communication of these outputs was not optimal which restricted understanding and compromised the efficiency of this process to 'Moderately'. There were no further insights from the surveys or the interviews that were relevant to assessing how efficiently the EWKR project improved understanding of the links between ecosystem responses to water management and incremental changes in ecological condition. However, the reasoning used in my assessment of the evidence for KEQ7.1h applies here as well.
<b>Evaluator 2</b>	<b>Not Applicable</b>  The EWKR project did not develop a framework linking ecosystem responses to water management to changes in ecological condition as a concept. The research questions and the project outcomes did not therefore address this issue.
<b>Revision comments – Evaluator 1</b>	As above, depending on our discussions, this could be rated as 'Inefficient'
<b>Revision comments – Evaluator 2</b>	Agree. I was being a tad harsh, as it also depends on the definition of watering regimes and how they were handled as event sequences in EWKR analyses.
<b>Consensus final rating</b>	<b>Inefficient</b>

<b>Micro KEQ 7.1j</b>	<b>How efficiently did the EWKR project improve understanding of the links between ecosystem responses to management interventions (natural resource management) and incremental changes in ecological condition?</b>
<b>Evaluator 1</b>	<b>Inefficient</b>  None of the themes in the EWKR project involved activities that specifically investigated the links between ecosystem responses to natural resource management and incremental changes in ecological condition (see response to KEQ1.7). The capacity of the EWKR project to assess incremental changes in condition was limited (see response to KEQ1.5). The informal assessment of EWKR's context and progress pointed out that funding and other constraints led to elements of some objectives (including assessing responses to natural resource management) becoming less of a focus. The survey questions about project efficiency focused on water management rather than broader natural resource management, and so it was not surprising that no specific examples were given where information from the EWKR project was or had been used to improve understanding of the links between ecosystem responses to natural resource management and incremental changes in ecological condition. A similar situation occurred with the interviews. Interviewees were not specifically asked about how efficiently the EWKR project improved understanding of the links between ecosystem responses to natural resource management and incremental changes in ecological condition. However, responses to similar questions about lessons learned and adaptive management did not include any comments about the efficiency of understanding links between ecosystem responses to natural resource management and incremental changes in ecological condition. [as these links were not explicitly assessed in the EWKR project]
<b>Evaluator 2</b>	<b>Not Applicable</b>

	The EWKR project did not develop a framework linking ecosystem responses to natural resource management to changes in ecological condition as a concept. The research questions and the project outcomes did not therefore address this issue.
<b>Revision comments</b> <b>Evaluator 1</b> –	Suggest we consider this as 'Not attempted'
<b>Revision comments</b> <b>Evaluator 2</b> –	Agree
<b>Consensus final rating</b>	<b>Not Attempted</b>

<b>High KEQ 8</b>	<b>How efficient was the EWKR project in managing and sharing data?</b>
<b>Evaluator 1</b>	<b>Inefficient</b>  The EWKR project was inefficient in managing and sharing data. Evidence for this conclusion is presented in the responses to KEQs 8.1 and 8.2 and their associated micro KEQs.
<b>Evaluator 2</b>	<b>Moderately Efficient</b>  EWKR as a project entity was not efficient in the managing or sharing of data. Its systems for sharing and managing data were poorly developed, managed and executed. This reflects the lack of integration of research questions and data needs across themes, other than for hydrological data. By contrast, the management and sharing of data at the individual theme and project level was much more effective and, within most projects and linked project groupings, and with participating external researchers and organisations, was reasonably efficient. This partly reflects the targeted and individual nature of many of the research questions and their specific data needs.
<b>Revision comments</b> <b>Evaluator 1</b> –	I am very reluctant to consider this as 'Moderately efficient' and would prefer 'Inefficient' for all the reasons outlined in my answers to KEQs 8.1 and 8.2 as well as the reasons you present here. To me, sharing data effectively within a project as the only efficient aspect doesn't cut it compared to lacking a data management protocol, no central repository, etc. I feel strongly about this one as it is so fundamental.
<b>Revision comments</b> <b>Evaluator 2</b> –	Agree
<b>Consensus final rating</b>	<b>Inefficient</b>

Mid KEQ 8.1 How efficient was the EWKR project in sharing data?	
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>The EWKR project set out several mechanisms to manage and share data (see responses to KEQ82 and associated mid- and micro-level KEQs for details on data management). Where publicly accessible platforms were promoted, these appeared to be solely for project outputs rather than raw data. For example, Figshare, which went live in February 2019 at <a href="https://latrobe.figshare.com/cfe">https://latrobe.figshare.com/cfe</a> (Final Project Report(2019)), is a repository for project outputs such as research plans, presentations, reports and fact sheets but does not include any raw data (verified 2 June 2020). Public access to data is difficult as there is not a single access point and the data inventories (e.g. Appendix 2 in the Final Project Report(2019)) are inconsistent and contain broken links (see response to KEQ82). This inefficiency severely hampers data sharing outside the project. Within the project, there was limited evidence of data sharing. Usually this occurred when data were collected by one theme for another (e.g. waterbird and fish for the foodweb theme) to support a derivative research activity but these instances were very rare. Interview responses corroborated how few examples there were of data sharing and collaboration across themes within the project, citing differences in sampling sites and research philosophies among the themes as potential reasons. According to the annual and multi-year research plans, there were very few inter-theme research activities proposed during the EWKR project and even fewer carried out successfully. There were strong reservations expressed during the interviews about the success of integration across the project. Where it occurred, it was retrospective and interviewees suggested it was hampered by differences in, for example, scales of study and focus of research questions as well as relevance of data. Many interviewees agreed it would have been better to have planned the integration at the outset of the project, even having a 'stand-alone' component aimed at this aspect and funded separately. Consequently, data sharing was minimal across most project components and themes, probably for reasons in addition to the limited efficiency of the data management processes. Some interviewees also commented that researchers were reluctant to share their data because they saw it as their own intellectual property. In other cases, data sheets were too poorly organised and were too cryptic (e.g. unexplained codes and column headings) to be of use without substantial explanation. The survey did not ask any questions specifically about the efficiency of data sharing.</p>
<b>Evaluator 2</b>	<p><b>Inefficient</b></p> <p>Data was not shared effectively through a data management plan or framework. Individual platforms for internal data and information sharing not used efficiently. Most data sharing was done using Dropbox among individual research teams. Data sharing using Cloudstor was not effectively pursued and could not be readily accessed by CEWO staff.</p>
<b>Consensus final rating</b>	<b>Inefficient</b>

Micro KEQ 8.1a To what extent were data shared with collaborators between research themes?	
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>There was evidence that researchers in different themes were well aware of the work and research activities being done in other themes but as there were few collaborative projects across themes (see response to KEQ81), data were seldom shared with collaborators between research themes. Further, despite the clear data management protocols in the Operations Strategy (MDFRC 2014), including for sharing within the EWKR project, researchers under-used the mechanism provided (Final Project Report (2019)). This mechanism, CloudStor, is a collaborative space that is not accessible to the public. It went live in December 2018 and all research theme teams had access to 1TB of space. Its intention was so that resources would be easily accessible by all theme members and project managers (CEWO), and that researchers would be able to easily share, collaborate on and store documents related to the project, sharing documents through private links instead of emailing actual documents. However, researchers preferred to use Dropbox because they were more comfortable with this software, and so Cloudstor was underused for data sharing. Interview</p>



	responses gave only one example of data sharing and collaboration across themes within the project. Another response expressed the opinion that there was not good data sharing between themes, citing various reasons (see response to KEQ81).
<b>Evaluator 2</b>	<b>Moderately Inefficient</b>  Data sharing between themes was limited. Some hydrological data sharing occurred across themes. Data sharing occurred across the native fish, waterbirds and food webs theme due to shared research activities. There was little evidence of large-scale data sharing, and this was mainly due to the focused nature of the research activities which were within-theme centred and not strongly dependent on shared data sets.
<b>Revision comments – Evaluator 1</b>	Again, I feel strongly on this one too that data sharing across themes was inefficient. From the evidence I saw, I was unable to judge that hydrological data were shared (I assumed these were available to all the themes and were not collected by one theme for another). I'm underwhelmed by the integration among themes and suspect that if data had been more widely and efficiently shared, there may have been better synthesis of the work for 'the big picture'.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Inefficient</b>

Micro KEQ 8.1b How efficiently were data shared with end users such as the MDBA?	
<b>Evaluator 1</b>	<b>Inefficient</b>  At the outset of the project, there was clear awareness of the importance of ensuring that data could be shared with end users and across multiple organizations. For example, the Operations Strategy (2014) stated 'The successful delivery of the MDB EWKR project is reliant on multiple collaborators and stakeholders contributing data to the development of models and tools. Data will be shared by multiple organisations and used in combination with other complementary data sets to support an array of research, modelling and communication activities. It is therefore imperative that data being collected is of high quality, complete, compatible and available to data users in consistent and standardised formats to meet project needs.' However, it appears that end users had trouble when they attempted to access the data management mechanisms set up by the EWKR project. For example, CEWO staff had difficulties accessing and downloading information from Cloudstor (see response to KEQ81a) because of departmental IT policy restrictions (Final Project Report (2019)). There were no examples given in the responses to the surveys or interview questions of end users accessing data successfully or having data shared with them; it appears that all information that was shared with end users was either as reports, fact sheets, web media and other tailored outputs or were informal exchanges, such as through one-on-one conversations and during workshops. It may also be that there have not yet been any requirements by end users to access data. Interviewees agreed that researchers were very good at sharing information and other resources when asked but there were no examples provided of any end users seeking actual data.
<b>Evaluator 2</b>	<b>Not Applicable</b>

	There was no evidence of substantive data sharing with end users. The emphasis of EWKR was on sharing of research outputs and knowledge outcomes derived from the research activities.
<b>Revision comments – Evaluator 1</b>	Maybe this deserves 'Insufficient evidence'.
<b>Revision comments – Evaluator 2</b>	Not convinced
<b>Consensus final rating</b>	<b>Insufficient evidence</b> The evaluators agreed that there was not enough evidence about how data were shared with end users such as the MDBA to be able to answer this micro KEQ.

Mid KEQ 8.2	How efficient was the EWKR project in managing data?
<b>Evaluator 1</b>	Both the Grant Guidelines and the Operations Strategy (2014) gave clear instructions about data management and how this was to be implemented. The Phase 1 Project Plan (2014) was specific that an important component of the research methodology would be a Data Management Plan, and that this was to be established in conjunction with the Department and taking into account the Department's requirements, including the Department's Information Licensing and Acquisition Policies. It would include development of a managed central repository for data to ensure that they were available and of sufficient quality to meet both project needs and research and management needs beyond the life of the project. There was the intention that all research outputs would be publicly and freely accessible and available by electronic means to Government, end-users and the general public. There would also be EWKR Data Standards that detailed the basic requirements for various types of data (e.g. information about valid data ranges, units of measurement, lookup lists, schema for site naming) and defined the required fields and essential metadata that must be provided when data was submitted (Operations Strategy 2014). These standards universally apply to tertiary institutions, and many peer-reviewed journals insist on their existence because it is now common for papers that are accepted to also have their raw data stored on an associated database hosted by the journal. Only a few outputs from the EWKR project specified how their data were stored, managed and made available. For example, the DSITI (2017) report catalogued their different data sets in a data inventory (Appendix 4 and Appendix 5) which gives meta-data for the data sets collected, including their spatial and temporal context, method of collection, details of storage locations and archiving arrangements for remote sensing and field data respectively. The report also stated that, in accordance with the contractual agreements pertaining to the publication of project material, all data would be available via publically accessible websites or databases where possible, or be available through other means which were to be specified. Inspection of these appendices indicated that access to original data sets was often 'by arrangement' but the details for this access were unclear. This process of listing data sets and their details was not universal across all outputs of the EWKR project. Moreover, it was clear that there was no central repository for the data (even for direct access by the client) and the 'Data Inventory' given as Appendix 2 in the Final Project Report (2019) was internally inconsistent. Sometimes the data location was merely a generic reference to an institution's 'databases and publications' with only a single person's name given as the contact (e.g. on-ground tagged-nest and water depth monitoring datasets in the waterbird theme). As people come and go from an institution, this is inadequate. The core team was unable to find the data management plan advocated in the Phase 1 Project Plan (2014). Less than a year after the completion of the project, the team had difficulties accessing the data from the project. For example, the links provided in the Operations Strategy and in the Final Report (2019) to some of the repositories of outputs were broken (e.g. the link to FigShare given in the Final Project Report (2019) and for which access was attempted on 5 April 2020). Only the Storyspace for EWKR (which contains interest stories rather than data) was reliably accessible. The survey did not ask any questions specifically about the efficiency of data management. Interviewees did not mention any data management protocols or the efficiency with which data were managed but this may be because the focus of the interview questions was not on

	governance. The sole comment in the interview transcripts that referred to data sharing was critical, and expressed the opinion that data were not shared across themes very much at all.
<b>Evaluator 2</b>	<b>Inefficient</b>  Data was not managed through a data management plan or framework. Individual platforms for internal data and information management and exchange were not used efficiently. Most data exchange was done using Dropbox among individual research teams.
<b>Consensus final rating</b>	<b>Inefficient</b>

Micro KEQ 8.2a How efficient were the data management protocols within the EWKR project?	
<b>Evaluator 1</b>	<b>Inefficient</b>  This is very difficult to judge because protocols within a theme or research activity are likely to have been sufficiently efficient for the researchers who had set up the protocols for themselves and close collaborators to enter data and to access them for analysis. However, given the general lack of collaboration and data sharing among themes and, in some cases, among components within a theme, it is likely that data management protocols within the EWKR project were inconsistent, did not use the same software or metadata variables, and were not centrally located on a widely accessible platform but stored according to individual researchers' or teams' preferences (see response to KEQ8.2). Very few research outputs described details of the data management or storage of and access to the data sets underpinning the presented results. One exception was the DSITI (2017) report that stated "A large volume of data has been collected during the course of this project, and the different data sets generated have been catalogued within a data inventory (Appendix 4 and Appendix 5). These appendices give meta-data for the data sets collected including their spatial and temporal context, method of collection, details of storage locations and archiving arrangements for remote sensing and field data respectively. In accordance with the contractual agreements pertaining to the publication of project material, all data will be available via publically accessible websites or databases where possible, or be available through other means which will be identified." However, the publicly accessible websites and 'other means' for accessing data underpinning this particular research report were not subsequently specified in Appendix 2 of the Final Project Report, nor was the DSITI (2017) report cited. There were no references to the efficiency of data management protocols within the EWKR project in any responses to the survey questions, and no examples were presented of a specific data management protocol within a theme or research activity. In the interviews, some respondents were scathing about the lack of robust data management protocols, their inconsistency across themes and the poor structure and cryptic nature of many of the data sheets. It was claimed there was no central data management like LTIM. Some researchers who were interviewed were unaware of any data management protocol.
<b>Evaluator 2</b>	<b>Inefficient</b>  Data management requirements were stated in the EWKR project grant guidelines, the Phase 1 Project Plan and the Operations Strategy (2014). No data management plan appears to have been developed or made available to project research teams. Data sharing among and within theme research teams does not appear to have been centrally coordinated or managed. The attempt to adopt Cloudstor as a data sharing and management platform was not pursued and was unsuccessful. Reference is made to accessing data by contacting individual team members in the Final Report Appendix (2) without any clear protocols or management framework.
<b>Consensus final rating</b>	<b>Inefficient</b>

Micro KEQ 8.2b How accessible is the data generated by the EWKR project to end users?	
<b>Evaluator 1</b>	<p><b>Inefficient</b></p> <p>Access by end users (outside the project) to data generated by the EWKR project seems to vary but, overall, is not easy. This is judged from the lack of a central repository for the data (even for direct access by the client) and the inconsistencies in the 'Data Inventory' given as Appendix 2 in the Final Project Report (2019). The survey did not ask any questions specifically about the efficiency of access to data or whether respondents had attempted to obtain or use raw data (as distinct from other outputs such as reports, factsheets and presentation slides). None of the transcripts of the interviewees who were end users of the EWKR outputs describe accessing data and none of the researchers describe whether or how they made their data accessible to end users outside the project. The answer to KEQ82 about the limited evidence for robust data management protocols further indicates that data generated by the EWKR project are not very accessible to end users.</p>
<b>Evaluator 2</b>	<p><b>Inefficient</b></p> <p>Data sharing among and within theme research teams does not appear to have been centrally coordinated or managed. Reference is made to accessing data by contacting individual team members in the Final Report Appendix (2) without any clear protocols or management framework. The Figshare, Cloudstor and Storyspace platforms were established, but only the latter was efficiently set up and used. CEWO staff had difficulties accessing and downloading from Cloudstor due to departmental IT restrictions.</p>
<b>Consensus final rating</b>	<b>Inefficient</b>

High KEQ 9 How efficient was the collaborative process within the EWKR project?	
<b>Evaluator 1</b>	<p><b>Efficient</b></p> <p>Early in the project, there was considerable effort to promote collaboration among themes. The Annual Progress Report 2015-16 described activities to progress and improve integration between the themes, including fortnightly teleconferences with theme coordinators, fieldwork planning in consultation with other themes, and workshops. Specific plans for links in terms of field data collection and analysis had been formed between the waterbird and vegetation themes and was planned to continue for finalising site selection and shared data sheets. The food webs theme planned to investigate leachate quality from different vegetation to conceptually link to the vegetation theme in terms of maintaining distributions of different vegetation types in the landscape. Links between the vegetation theme and the fish theme were to be more theoretical and to be explored through conceptual models and articulation of the functions various aspects of vegetation play in the landscape. Unfortunately, many of these planned collaborations did not eventuate, and overall, there were surprisingly few truly collaborative research activities (compared to workshop discussions or conceptual perspectives). One example was field sampling in the Ovens River which provided data for the fish and foodweb themes (Annual Progress Report 2016-17). However, the proposed research to into regurgitate and scat sample collection by the waterbird theme for diet/bioenergetics in the foodweb theme was discontinued due to difficulty in obtaining regurgitate from birds but it should be noted that this was not a failing of collaboration but arose from a major practical constraint. One of the main initiatives to promote collaboration within the project was a collaborative model. Responses to the 2019 Evaluation indicated that this model was moderately effective, and worked better for some themes than others. The model was seen as valuable in that it brought together scientists from different institutions with a range of expertise and backgrounds for each theme and ensured that different perspectives and ideas were considered. Although the Final Project Report (2019) was effusive about the success of collaboration (see response to KEQ91), this was almost entirely in terms of involvement and collaboration with stakeholders and the public outside the project. Apart from listing the numerous researchers and support staff involved in specific research activities, there was no indication about the efficiency of the collaboration or how it might have been enhanced. Survey responses reiterated the strong encouragement for collaboration within the EWKR project. To the question 'Do</p>

	you think EWKR project processes encourage participants to collaborate, share resources and lessons learnt?', almost three-quarters of the respondents replied 'A moderate amount' or better. This perspective of successful collaboration seemed to be mainly among researchers; survey responses indicated concerns that collaboration with managers was less successful (e.g. 'there needs to be more discussion/collaboration between researchers and managers throughout the entirety of the project'). Interview responses were similarly mixed about the extent and success of collaboration within the project. Some cited drawbacks to the efficiency of collaboration among themes including differences in localities where work was undertaken, differences in the scales and project topics, differences among researchers' priorities within some themes, not enough time for effective cross-theme associations to mature, and a lack of funding earmarked for collaborative research activities. These all detracted from the efficiency of collaboration within the EWKR project. However, within some themes (e.g. the vegetation theme), the quality and extent of collaboration was praised by some interviewees, implying that it was also efficient.
<b>Evaluator 2</b>	<p><b>Efficient</b></p> <p>Collaboration within the EWKR project was efficient and effective at the level of theme-based conceptual model development, formulation of research questions and particularly, research activities. An active effort was made to engage key members of the research community in a number of theme research areas, though the opportunity for fully active engagement within the individual research activities was of course limited by the financial and time resources available and by the manner in which the project had been centrally structured around the MDFRC by the Department. Collaborations outside the project by the EWKR management team in the area of user driven knowledge and delivery needs, and the refinement of communication, data management and knowledge delivery were less effective and more limited. This was partly due to the contextual constraints on the project, and the delays in research delivery, but may have been addressed more effectively if driven centrally from the outset.</p>
<b>Consensus final rating</b>	<b>Efficient</b>

<b>Mid KEQ 9.1</b>	<b>To what extent was collaboration undertaken outside the EWKR project?</b>
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>To what extent was collaboration undertaken outside the EWKR project? There was considerable collaboration with researchers and institutions outside the EWKR project to obtain access to existing data sets, share resources (e.g. equipment and lab space) and undertake various other activities to improve the efficiency with producing outputs (see responses to KEQ10 and associated subquestions). This research-based collaboration was evident for all themes (see responses to KEQs 91a-d) and often involved a wide range of researchers, facilities and institutions (evidenced by the extensive acknowledgements, e.g. the DSITI (2017) report). The generally high quality of the outputs from these collaborative activities indicates the moderate efficiency of this collaboration. The 2019 evaluation asked participants to comment on any plans or intentions to collaborate on future research projects after the completion of EWKR. All indicated a willingness and intention to continue work together with other theme researchers, subject to funding opportunities and appropriate projects. Collaboration with managers was less universally successful or efficient. Although there was considerable initial consultation between researchers and managers to settle on priority research questions for each theme, there do not appear to have been many examples where managers were actively involved in collaboration with researchers to, for example, gather and/or analyse data nor was this evident in the authorship of resulting outputs such as scientific papers. One notable exception was the waterbird theme, where water managers were co-opted to participate in field activities, fostering less formal communication between research teams and managers (Evaluation report summary (phase 2) (2019). In Appendix B of the 2019 Evaluation Report, one comment was that communication would have been improved if there were more inclusion of natural resource managers and water managers in project teams as collaborators, rather than end users. Given the main objective of the research in EWKR was to support management activities in the MDB, this process of enhancing collaboration with managers could have been more efficient and would possibly have contributed substantially to the applied value (and its earlier recognition) of many of the findings and outputs. Survey responses expressed concerns that collaboration with managers was not very successful (e.g. 'there needs to be more</p>

	discussion/collaboration between researchers and managers throughout the entirety of the project'). This perspective was reiterated by many interviewees, and indicated that the efficiency of this collaboration was poor. Some interviewees' responses proposed that researchers' messages would have been far better conveyed to managers and therefore much more likely to be adopted if managers had been more actively involved in collaborative work in some of the research activities. [at least with other researchers; not so good with agency staff]
<b>Evaluator 2</b>	<p><b>Moderately Efficient</b></p> <p>Collaboration outside the EWKR project was efficient and effective at the level of theme-based conceptual model development, formulation of research questions and particularly, research activities. An active effort was made to engage key members of the research community in a number of theme research areas, though the opportunity for fully active engagement within the individual research activities was of course limited by the financial and time resources available and by the manner in which the project had been centrally structured around the MDFRC by the Department. Collaborations outside the project by the EWKR management team in the area of user driven knowledge and delivery needs, and the refinement of communication, data management and knowledge delivery were less effective and more limited. This was partly due to the contextual constraints on the project, and the delays in research delivery, but may have been addressed more effectively if driven centrally from the outset.</p>
<b>Consensus final rating</b>	<b>Moderately Efficient</b>

Micro KEQ 9.1a How efficiently did the vegetation theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?	
<b>Evaluator 1</b>	<p><b>Efficient</b></p> <p>The vegetation theme involved wide collaboration across multiple groups of stakeholders, institutions and states, evidenced by the extensive lists of names and institutions in the Acknowledgements sections of DSITI (2017) and the other final reports as well as excerpts from the annual research plans and other outputs. The theme also made considerable use of existing data, which would have involved further use of resources to collaborate but was much more effective than attempting to collect the data (which was not feasible anyway, given the time and spatial scales of the datasets that were accessed). This component, the data integration and synthesis component (DISC), was seen as not only an opportunity to combine and explore existing datasets for relationships between vegetation responses, flow and non-flow drivers such as rainfall but also an excellent opportunity to foster collaboration with external stakeholders (Annual Research Plan 2017-18). Data collection and field surveys involved numerous people outside the EWKR project, and included at least one traditional owner (Fiona Freestone and Rebecca Durant teamed up with Remy Smith, a Maraura man and young traditional owner working on Tar-Ru Land, to undertake vegetation surveys on Tar-Ru Land (Final Project Report 2019)). All of these collaborative efforts and their ultimate success in providing high-quality scientific outputs represent efficient use of resources and inputs in the vegetation theme to collaborate with other water managers and researchers external to the EWKR project. Although some collaborative projects did not succeed, this was seldom as a result of inefficient collaboration (e.g. use of the flood inundation model which was produced two years after it was supposed to and was not capable of translating volumetric flows at specific gauges into predictions of area of inundation, DSITI 2017). Appendix B of the Evaluation (Phase 2) report (2019) stated that the vegetation theme was one of the themes that was reported to have had a high level of engagement throughout the project either through the development of new relationships, by involving water managers in the delivery of research or by drawing on the networks of individuals within project teams. There were no relevant responses from the survey or interviews about how efficiently the vegetation theme used its resources to collaborate with other water managers or researchers external to the EWKR project.</p>
<b>Evaluator 2</b>	<p><b>Efficient</b></p> <p>Strong and effective collaboration was evident both within the Vegetation theme research team and between them and external parties. Exchanges were coordinated through project, Leadership Group and research team meetings and workshops, both internally and with external researchers, water managers, and (in the early stages)</p>

	the SAG. Effective collaboration was evident during conceptual framework development, research design, site selection, data collection, incorporation of learnings and conceptual ideas into management plans (LTWPs). Collaborative data exchanges from LTM sites, the LTIM and other MDFRC and external researchers occurred during the project. The theme leadership group included representation from the four Basin states.
<b>Consensus final rating</b>	<b>Efficient</b>

Micro KEQ 9.1b How efficiently did the waterbird theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?	
<b>Evaluator 1</b>	<p><b>Efficient</b></p> <p>The final outputs, especially the Final Project Report (2019), list the extensive number of external collaborators involved in the waterbird theme. This collaboration was in addition to the highly successful and extensive engagement activities of this theme. The two are closely related; often external collaborators and their active involvement in a project are the best example of optimally efficient engagement. Appendix B of the Evaluation (Phase 2) report (2019) singled out the waterbird theme as one that was reported to have had a high level of engagement throughout the project either through the development of new relationships, by involving water managers in the delivery of research or by drawing on the networks of individuals within project teams. There were no relevant responses from the survey about how efficiently the waterbird theme used its resources to collaborate with other water managers or researchers external to the EWKR project. Several interview responses praised the waterbird theme for the extent of external collaboration in field data collection (e.g. tracking waterbirds) and other research activities, and this was interpreted to have also enhanced the efficiency of the collaboration.</p>
<b>Evaluator 2</b>	<p><b>Efficient</b></p> <p>Effective collaboration was evident both within the Waterbirds theme research team and between them and a range of key external parties - private individuals, and staff from CMAs, OEH, Murray Wetlands Working Group, CEWO local engagement, NSW NPWS, LLS staff and Murray Water. This was especially in the area of waterbird GPS tracking. Exchanges were coordinated through project, Leadership Group and research team meetings and workshops, internally and with external researchers, water managers, and (in the early stages) the SAG. The team made extensive and effective use of presentations and workshops, websites, email updates and social media. Effective collaboration was evident during conceptual framework development, research design, data collection, and incorporation of learnings into water management planning.</p>
<b>Consensus final rating</b>	<b>Efficient</b>

Micro KEQ 9.1c How efficiently did the fish theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?	
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>There was laudably extensive consultation by researchers in the fish theme with managers to prioritise research questions associated with fish in the MDB but this did not develop into sustained collaboration for the rest of the project. Compared with other themes, there were relatively few examples presented of active collaboration in, for example, data collection and analysis with external researchers or water managers. One notable exception was the large number of people involved in collecting samples for the Basin-scale assessment of fish population dynamics of golden perch and Murray cod (fish theme final report (2019)). Appendix B of the Evaluation (Phase 2) report</p>

	(2019) stated that the fish and foodwebs themes reported less emphasis on establishing relationships beyond the planning stage, due to capacity and time constraints of the researchers. Although the survey responses included praise for the fish theme in forming good links with The Living Murray and various states, these responses did not go into details about how efficiently it used its resources to collaborate with other water managers or researchers external to the EWKR project. Interviewees' responses were mixed and, although not specifically commenting on efficiency, several were critical of the limited extent of external collaboration in the fish theme given the opportunities and potential scope.
<b>Evaluator 2</b>	<p><b>Efficient</b></p> <p>Effective and efficient collaboration was evident both within the Native Fish theme research team and between them and a range of key external parties. Exchanges were coordinated through project, Leadership Group and research team meetings and workshops, internally and with external researchers, water managers, and (in the early stages) the SAG. Effective collaboration was evident during development of the research priorities, the conceptual framework, research design, data collection, and incorporation of learnings into water management planning. Effective collaboration especially in the design stages occurred with staff and specialists from CSU, MDFRC, CMA's, OEH, MDBA, VEW, CEWO, and fish-flow and fish experts from all Basin states and the ACT.</p>
<b>Revision comments – Evaluator 1</b>	Happy to upgrade assessment to 'Efficient' in light of agreed relaxation of this performance criterion.
<b>Revision comments – Evaluator 2</b>	Agree
<b>Consensus final rating</b>	<b>Efficient</b>

Micro KEQ 9.1d How efficiently did the food webs theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?	
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>The foodweb theme was seen as one that drew together elements of the other three themes to help integrate the findings as they related to the ecosystem function of energy transfer across trophic levels in fish and waterbird foodwebs. Consequently, it called for collaboration within the project but there seemed to be less emphasis on collaboration with other water managers/researchers external to the EWKR project apart from some for data from the LTIM project (e.g. development of the trophic niche indicator, Appendix 1.4 of the food web theme final report (2019)). There were also technical analyses (e.g. analysis of fatty acids and stable isotopes, McInerney et al. in Appendix 1.2 of the food web theme final report (2019)). Appendix B of the Evaluation (Phase 2) report (2019) stated that the fish and foodwebs themes reported less emphasis on establishing relationships beyond the planning stage, due to capacity and time constraints of the researchers. Survey responses did not present any examples of collaboration between the foodweb theme and external managers or researchers, although there was recognition of its added complexity and potential need for more resources in its communication ('As the food web theme is complex and more difficult to quantify - more resources may be required to continue its development and to communicate concepts'). Responses to interview questions did not address the efficiency aspects of external collaboration in the foodweb theme but several respondents opined that the extent of this collaboration was not as great as would be expected for an integrative theme.</p>
<b>Evaluator 2</b>	<b>Moderately Efficient</b>



	<p>Effective and efficient collaboration was evident within the Food Webs Fish theme research team and between them, other theme researchers and external researchers. The theme was characterised by a close and effective collaborative research activities and conceptualisation between researchers and specialists from the Centre for Freshwater Ecosystems and the University of New England, La Trobe University, Charles Sturt University, University of Canberra, MDBA, AIMS, OEH and Deakin University. Exchanges were coordinated through project, Leadership Group and research team meetings and workshops, internally and with external researchers, water managers, and (in the early stages) the SAG. Effective collaboration was evident during development of the research priorities, the conceptual framework, research design, data collection, and model development. Effective collaboration was evident especially in the design and data collection and analysis stages with researchers from the Waterbirds and Native Fish themes. Active collaboration with managers external to the EWKR project was not extensive, and largely limited to water managers from the Gwydir system.</p>
<b>Consensus final rating</b>	<b>Moderately Efficient</b>

High KEQ 10	How efficiently generated were the outputs from the EWKR project?
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>Although focused on research, the EWKR project generated diverse outputs ranging from scientific papers and reviews for colleagues through to videos and media stories for the public about interesting aspects of the findings. There were also numerous workshops, talks to managers and at scientific conferences, and informal discussions with various stakeholders. These outputs were moderately efficiently generated by the four themes of the EWKR project. It is likely that the efficiency of generation of outputs would have been greater if the project had got off to a more rapid and coordinated start, if the final Communications and Adoption Strategy and Communications and Adoption Plan had been developed sooner (see response to KEQ2), if there had been greater attention to meeting deadlines and objectives during the project, and if there had been more pooling of resources. The efficiency of the generation of outputs varied among themes (see responses to KEQ10.1 and associated micro questions) but, in general, the overall products and their diversity were reasonable value for money, assisted by considerable in-kind support from the partner institutions. There were also efforts to align research activities with concurrent programs and monitoring to enhance efficiency, and this was used as a criterion for selecting sites (Final Synthesis Report (2019)). Appendix B of the Evaluation (Phase 2) report (2019) listed a number of efficiency measures used in the various themes (e.g. in the waterbird theme: developing theme-level budgets and allocation of resources early in the project, bulk purchase of satellite transmitters, scheduling and sharing field work across projects to save on accommodation and resourcing; in the fish theme: leveraging of funds and in-kind contributions such as for the collection and analysis of otoliths by using funds from the Long-Term Intervention Monitoring project and in-kind support from other research organisations). Interviewees also suggested several other measures that may have been used to increase efficiency such as co-location of project sites across themes and more shared field work (an element of the original project concept that did not eventuate), establishing an independent management committee to oversee budget allocations and reporting, and more regular external auditing to improve confidence in the management of the project funds. In the 2019 evaluation, efficiency was evaluated in terms of the question 'How well did the project make use of the allocated resources to generate outcomes?', and the criteria for assessing that question were in terms of budget expenditure and the meeting of agreed milestones. In general, all project activities had been submitted on time and were within the allocated budget. Theme leaders indicated that efficiency had been considered through measures such as budget monitoring, leveraging and sharing of resources across projects but identified the collaborative model as a factor that potentially limited efficiency because of the need to spread available funds thinly across the contributing institutions. Stakeholders considered there were insufficient resources allocated to project management and communication, and this potentially limited efficiency. In the current survey, to the question 'How efficient was the EWKR project, over all themes, in meeting its objectives?', well over half the respondents who did not reply 'Don't know', replied 'Somewhat efficiently' or better. Although this question was about objectives rather than outputs, it is relevant because the production of outputs is a crucial aspect of achieving most of the objectives. Two-thirds of the respondents also agreed that the expenditure over all themes of the project had been worthwhile. Specific responses, expressed several times, were that the efficiency of the project could have been increased and cited the slow start and the amount of money and time devoted to planning as major reasons. In the responses to the survey, some themes</p>

	<p>were praised for improving efficiency by forming effective links but there were also criticisms that this did not always occur. For example, one comment was 'There were good links with the LTIM projects at SA scale, and with TLM and state based work for fish' but there was another comment that 'No connections to managing agencies such as NSW fisheries - who were ignored along with most other state agencies and their key staff'. Interviewees were not asked specifically about their views on how efficiently specific outputs were generated. However, several responses to other questions echoed comments in the survey that the slow start to the project had had a serious impact on the overall efficiency and this would have affected the generation of outputs. It was also opined that the project would have been more efficient if collaboration with water managers had been greater, improving integration and the quality of the outputs. Also, there was criticism about the funds being spread fairly evenly across the themes when some themes were likely to cost more than others, and there was a feeling that more funds could have been leveraged. Nonetheless, most comments indicated that respondents considered the expenditure on the project was worthwhile for the science but less so for the generation and sharing of information with managers and other stakeholders.</p>
<b>Evaluator 2</b>	<p><b>Moderately Efficient</b></p> <p>The EWKR project was relatively inefficient at defining its research focus, with the 'foundational' phase one being drawn-out over nearly two years, prior to commencement of most research activities. This was in large part due to the high level, aspirational and poorly defined objectives developed by the Department for the project, along with the need to develop a research portfolio that matched the skill sets available in the grantee body (MDFRC). The SAG was brought into this process quite late, were presented with a large, "sub-standard project plan" which was poorly focused on the needs of end-users, and sought a better-framed and relevant set of research questions and sub-projects. This then took time, despite some foundation activities (reviews etc.) being conducted in parallel, reducing both the time and funding available for research. However, once research activities commenced, they were by and large quite efficient. From the end of the foundational stage, individual research projects were effectively managed and produced a range of products quite effectively and efficiently. Despite this, a lack of effective cross-theme integration was evident, with most research activities being quite 'siloe'd' and subject to a lack of strong theme-level central science leadership. This led to some inefficiencies in decision making and inflexibility in allocation of resources among projects within and among themes. The range of products produced varied substantially in stage of maturity and in relevance to water managers. These problems were largely a product of the poorly focused and over-ambitious objectives of the grant, the tight timeframe (exacerbated by the initial delays), an over-reliance on a core set of research providers with a specific set of skills, over-dispersed funding spread over a multiplicity of themes and projects, and poor end-user focus and engagement. As a result, EWKR developed a 'scatter-gun' approach to addressing knowledge gaps in the environmental water-ecology space, while avoiding duplicating research already underway, and not being able to define a clear purpose for its knowledge-based outputs. These contributed to a relatively low level of efficiency in terms of producing outputs of relevance to the environmental water management sector. At the same time, it efficiently addressed some core scientific knowledge gaps, producing some valuable research-oriented knowledge products. Examples of relevant interview responses: "Excessive delays", "wasted a lot of a lot of money." A "sub-standard project plan", and a lack of "planning what's actually needed with the end users." "recognizing the integration as a theme in its own right was something that would have been valuable with hindsight." "make sure that we have a better synthesis and integration function going forward. Because I don't think that was done very well either. But the idea of food webs was kind of the idea of a synthesis." "became pretty efficient at conveying the lessons learnt in the latter stages of the program. Overall, the efficiency of all aspects increased over time once areas of conflict and resourcing had been dealt with. In hindsight, it would have been better if issues related to roles, responsibility and management and reporting had been worked through sooner. It should also be recognised that new, large programs will always require 'storming and norming' stages." "a large network of researchers who have gone through the difficult 'storming and norming' processes and now have better understanding of their colleagues and of CEWO. Researchers' understanding of each other's work has also improved." "There should have been a lot more leveraging opportunities. And even with leveraging opportunities, I don't think it was very good value." "from a science perspective, value for money. Amazing. I think from a client or water manager's perspective, the job's half-done. So, if this is where it stops, there hasn't been value for money for them." "research can't be efficient. There is no benchmark." "as part of an evolution of a body of knowledge then probably pretty efficient because without that foundational stuff we can't do the things we're doing now."</p>
<b>Consensus final rating</b>	<b>Moderately Efficient</b>

Mid KEQ 10.1	How efficiently were the outputs for each theme generated? Were they value for money and or any evidence of pooling of resources?
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>Outputs from the various themes included presentations at conferences, workshops, forums and regional road shows, publication of news articles in ‘RipRap’ (a newsletter produced by the Australian River Restoration Centre), stories published on the EWKR ‘Story Space’ (launched in 2019), social media (Facebook and Twitter), articles on Latrobe University’s ‘Fig-Share’, and scientific papers in peer-reviewed journals. As presented in the responses to KEQs 10.1a-d, the crude cost per output relevant to stakeholders’ needs was calculated for the four themes, and ranged from \$23,842 (waterbirds) to \$125,755 (vegetation). It is important to acknowledge that this is a very crude assessment because it does not distinguish the complexity, length, quality or relevance of the outputs and ignores in-kind contributions. It is also likely that the summaries and registers of outputs by the different themes were not comprehensive and some outputs may have been omitted. In response to the question ‘Do you consider the expenditure worthwhile?’, almost 70% of the respondents replied ‘Yes’ when referring to the overall project (the remaining approximately 30% was divided equally between ‘No’ and ‘Don’t know’). These proportions changed only slightly when only the responses by researchers were compared. There were also only small differences among the themes, with the vegetation theme differing from the other three themes in being considered to have had slightly more worthwhile expenditure (83% of ‘Yes’ vs 75% for the other three themes). One specific response indicated that this was a difficult question to answer (‘Complex question to answer, particularly given the governance model used at the outset of the project. A simple yes or no answer is difficult!’) but, in general, the specific responses were positive (e.g. ‘Overall, I do, however, I also think there were areas where resources (funds) could have been used more effectively’, ‘Yes these are critical areas of work for e-water management and Basin Plan implementation.’). There was surprisingly little evidence for pooling of resources. This was possibly because each theme appeared to operate independently, apart from where researchers in the foodweb theme collaborated with the fish and waterbird researchers to generate pooled data. One survey comment stated ‘Themes were reluctant to share their resources to enable integration’ but there were no other comments about the pooling or sharing of resources across themes nor were any specific examples provided. Interviewees’ responses to whether the expenditure was worthwhile were usually positive and enthusiastic. In addition to generating tangible outputs, there was also a feeling that useful networks had been developed as well as a good springboard for future research. There were also several responses that there had been a large amount of in-kind support and that many high-quality researchers had provided their time and effort to enhance the quality and efficiency of the research and its outputs. A key sentiment that emerged from different interviewees was that the science produced was important and often foundational so that its true value for money may not be realised in the short term or be readily measured in outputs available now. However, there was also some criticism that spreading funds fairly evenly across the themes potentially disadvantaged the more costly themes and possibly compromised the efficiency of generating outputs. There was also a feeling that more funds could have been leveraged and more collaboration was possible, which further detracted from the efficiency of generating outputs. Some interviewees commented that the money was primarily meant for research rather than communication (which had a separate budget) and that this, plus the delay in involving professional communicators like Siwan Lovett, may have detracted from the efficiency of generation of outputs. Several responses by interviewees indicated that there was very little pooling of resources, partly because there were not many shared needs or opportunities (e.g. mismatches in field sites or timing of research activities) but also there was a certain degree of isolation of the themes into silos. A few specific examples were given where opportunities to pool resources were missed.</p>
<b>Evaluator 2</b>	<p><b>Moderately Efficient</b></p> <p>Some cross-theme pooling of resources and collaboration was evident for aspects of the fish, food webs and bird themes. Once individual research activities commenced after phase one of the project, they were generally quite efficient. From the end of the foundational stage, individual research projects were effectively managed and produced a range of products quite effectively and efficiently. Despite this, a lack of coordinated and efficient cross-theme integration was evident, with most research activities being quite ‘siloed’ and lacking strong theme-level central science leadership. This led to some inefficiencies in decision making and inflexibility in allocation of resources among projects within and among themes. EWKR’s knowledge products were numerous and generally value for money, including a variety of quality literature reviews, key data sets (e.g. on waterbird movement), models and indicators - especially noting the wetlands vegetation response model, the fish early-life stage growth and survival model, the fish larval settlements and retention model, the Basin scale trophic niche indicator, and the food web model. See KEQ10 for other comments and evidence.</p>

<b>Consensus final rating</b>	<b>Moderately Efficient</b>
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Micro 10.1a	KEQ	How efficiently did the vegetation theme use its resources/inputs to produce effective outputs relevant to stakeholder needs?
<b>Evaluator 1</b>		<b>Moderately Efficient</b> <p>Perusal of the acknowledgements of the vegetation theme's final outputs (e.g. DSITI 2017, vegetation theme final report (2019) and the papers and presentations in its appendices) indicates extensive use of existing data, facilities and personnel to generate outputs more efficiently. Overall, 28 outputs are listed (unnumbered table in the appendices of the vegetation theme final report (2019)), of which 9 are data sets or external workshop notes that may not necessarily be directly relevant to stakeholder needs. From Table 10 in the Final Project Report (2019), expenditure for research in the vegetation theme was \$1,617,344 with a further \$772,000 for the Queensland vegetation component. Using a very crude calculation of dividing the total by 19, this comes to \$125,755 per output when assessing possible value for money. In response to the survey question 'Do you consider the expenditure worthwhile?', 83% of the 13 respondents replied 'Yes' when referring to the vegetation theme, and this rose to 87.5% when only researchers' responses were analysed (n = 9). However, there were no specific responses about the vegetation theme on this aspect of worthwhile expenditure. One interviewee felt the vegetation research was well-resourced but that its communication was less so, and that this affected the efficiency of generating outputs. The same respondent commented that 'selling' vegetation results is harder than, for example, waterbirds that have more public appeal than plants.</p>
<b>Evaluator 2</b>		<b>Efficient</b> <p>The vegetation theme efficiently produced some key knowledge products, in part due to the strong collaborative nature of the research. The theme research activities were managed efficiently - with effective, well-coordinated field research across multiple sites with a consistent methodology. The outputs were relevant so stakeholders, especially the wetland vegetation response model. This model remains to be validated for use at multiple sites beyond Hattah Lakes. Examples of relevant interview responses: "four (large) components (with) ... fieldwork at four locations across the Basin and coordinated to be simultaneous using exactly the same methods." "Opportunity costs that were missed too, you know, the opportunities for a better integration with the Queensland floodplain work"</p>
<b>Revision comments Evaluator 1</b>	–	Happy to upgrade assessment to 'Efficient' in light of agreed relaxation of this performance criterion.
<b>Revision comments Evaluator 2</b>	–	Agree
<b>Consensus final rating</b>		<b>Efficient</b>

Micro 10.1b	KEQ	How efficiently did the waterbird theme use its resources/inputs to produce effective outputs relevant to stakeholder needs?
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<b>Evaluator 1</b>	<p><b>Efficient</b></p> <p>The waterbird theme was considered to have been highly successful in communication of its outputs (see response to KEQ22c), especially for the public and other stakeholders interested in waterbird movements. The 2019 Evaluation commented that 'The waterbirds theme was highlighted as a high performer in terms of communication and sharing of research outputs'. The acknowledgements sections of the various outputs of the waterbird theme also indicate substantial involvement of diverse people in producing the outputs, and this would have contributed to the efficiency and effectiveness of generating these outputs. The final presentation at the EWKR Forum listed the diverse outputs, including the website (<a href="https://research.csiro.au/ewkrwaterbirds/">https://research.csiro.au/ewkrwaterbirds/</a>), social media pages (Facebook, Twitter), regular email updates to subscription lists, a field guide: 'Waterbird chick development: A visual guide to selected Australian species', a booklet: 'Water management for waterbirds in Australia: Lessons learned', videos on ABC Open and websites, magazine and external website articles, general public presentations, stakeholder presentations, scientific presentations, radio interviews, newspaper interviews and scientific journal manuscripts. Estimating the outputs from Appendices 11 and 12 of the appendices of the waterbird theme final report (2019) and including the scientific papers that are in development generated an estimated 70 different outputs (some minor ones have been omitted, including workshop notes that may not necessarily be directly relevant to stakeholder needs). From Table 10 in the Final Project Report (2019), expenditure for research in the waterbird theme was \$1,668,995. Using a very crude calculation of dividing the total by 70, this comes to \$23,842 per output when assessing possible value for money. Appendix B of the Evaluation (Phase 2) report (2019) listed a number of efficiency measures used in the waterbird theme such as developing theme level budgets and allocation of resources early in the project, bulk purchase of satellite transmitters, and scheduling and sharing field work across projects to save on accommodation and resourcing. In response to the survey question 'Do you consider the expenditure worthwhile?', 75% of the 13 respondents replied 'Yes' when referring to the waterbird theme. This proportion did not change when only researchers' responses were analysed (n = 9). There were no specific responses about the waterbird theme on this aspect. Several responses in the interviews singled out the waterbird theme for special mention of the value of the outputs and the quality of their communication. This relates closely to efficiency and value for money because a cheap product that does not translate into altered attitudes or behaviours is poor value for money and inefficient.</p>
<b>Evaluator 2</b>	<p><b>Efficient</b></p> <p>The Waterbirds theme was effective and efficient partly due to the nature of the project, but also due to strong collaborative interactions fostered by the lead researcher. The data products and new knowledge (e.g. for bird movement) are of value for stakeholders. Products directly reacting to watering actions were not produced due to the current state of knowledge about large scale waterbird responses and watering needs (i.e. not a fault of EWKR). Some comments were made about the need for more cross-research/monitoring program coordination in waterbird research by EWKR program management. Examples of relevant interview responses: "with waterbirds, the information was there and readily available." "There should have been a lot more leveraging opportunities.... money being spent on WETmap birds. ... the TLM is trying to answer a lot of questions ... that EWKR could have helped answer. ...don't think some of those opportunities were built on</p>
<b>Consensus final rating</b>	<b>Efficient</b>

<b>Micro 10.1c</b>	<b>KEQ</b>	<b>How efficiently did the fish theme use its resources/inputs to produce effective outputs relevant to stakeholder needs?</b>
<b>Evaluator 1</b>	<b>Moderately Efficient</b>	<p>The final outputs from the fish theme acknowledge numerous people and institutions for assistance, especially for research activities such as the Basin-wide sampling for golden perch otoliths, indicating that efficiencies were enhanced with this collaboration. Appendix B of the Evaluation (Phase 2) report (2019) also listed a number of</p>

	<p>efficiency measures used in the fish theme such as leveraging of funds and in-kind contributions for the collection and analysis of otoliths by using funds from the Long-Term Intervention Monitoring project and in-kind support from other research organisations). There was also shared field sampling with the foodweb theme in the Ovens River. Estimating the outputs from the 'MDB EWKR Research Outputs Register' of the appendices of the fish theme final report (2019) and including the scientific papers that are in development generated 27 outputs (noting that some of these may be collective outputs and this list may not be comprehensive). From Table 10 in the Final Project Report (2019), expenditure for research in the waterbird theme was \$2,029,972. Using a very crude calculation of dividing the total by 27, this comes to \$75,184 per output when assessing possible value for money. In response to the survey question 'Do you consider the expenditure worthwhile?', 75% of the 13 respondents replied 'Yes' when referring to the fish theme, and this proportion did not change when only researchers' responses were analysed (n = 9). There were no specific responses about the fish theme on whether the expenditure on this theme was worthwhile. During the interviews, some respondents praised aspects of the fish theme for producing very useful outputs (e.g. results of the Basin-wide golden perch otolith study) which relates strongly to efficiency and value for money because products that translate into altered attitudes or behaviours are likely to be good value for money and efficient.</p>
<b>Evaluator 2</b>	<p><b>Efficient</b></p> <p>Development of the fish theme outputs was efficient due to the small, well-established network of fish experts involved. The production of most fish theme outputs was reasonably efficient, given the program context – though outputs were more relevant to researcher needs (see comments on KEQ6) than water management stakeholders, with the exception of fish knowledge for specific sites and for Golden Perch. Examples of relevant interview responses: "the resources were there. I think the output was probably not right." "... the connections to the right people, particularly in the fish sphere, were missing. They didn't get to the people that would actually could actually use it (and)... they didn't have the products to give to them"</p>
<b>Revision comments – Evaluator 1</b>	<p>Happy to upgrade assessment to 'Efficient' in light of agreed relaxation of this performance criterion.</p>
<b>Revision comments – Evaluator 2</b>	<p>Agree</p>
<b>Consensus final rating</b>	<p><b>Efficient</b></p>

Micro 10.1d	KEQ	How efficiently did the food webs theme use its resources/inputs to produce effective outputs relevant to stakeholder needs?
<b>Evaluator 1</b>		<p><b>Moderately Efficient</b></p> <p>Like the other themes, final outputs from the foodweb theme acknowledge numerous people and institutions for assistance. The foodweb theme was also more 'derivative' than the other three themes, and some of its research activities relied more heavily on resources and inputs from the fish and waterbird themes for shared data. Estimating the outputs from Appendices 3 and 4 of the appendices of the foodweb theme final report (2019), and including the scientific papers that are in development but excluding data sets, generated 32 outputs (noting that some of these may be collective outputs and this list may not be comprehensive). From Table 10 in the Final Project Report (2019), expenditure for research in the foodweb theme was \$1,352,782. Using a very crude calculation of dividing the total by 32, this comes to \$42,274 per output when assessing possible value for money. Appendix B of the Evaluation (Phase 2) report (2019) listed a number of efficiency measures used in the foodweb theme such as scheduling and sharing field work across projects to save on accommodation and resourcing (i.e. waterbirds and foodwebs themes). There was</p>

	also shared field sampling with the fish theme in the Ovens River. In response to the survey question 'Do you consider the expenditure worthwhile?', 75% of the 13 respondents replied 'Yes' when referring to the foodweb theme, and this proportion did not change when only researchers' responses were analysed (n = 9). There were no specific responses about the foodweb theme on this aspect. Interviewees who specifically mentioned the efficiency of the foodweb theme opined that although some of the outputs had been taken up and appeared influential (the example of Big Macs and waterbird productivity was provided), there still appeared to be a longer gestation time needed for this theme's findings to gain traction and that outputs had not gone out as widely as the other themes.
<b>Evaluator 2</b>	<p><b>Moderately Efficient</b></p> <p>The food webs theme was highly inefficient in its phase one period, taking excessive time and guidance to establish its research focus, questions and activities. However, once commenced, the research activities were efficiently conducted, and produced two main knowledge products of considerable potential value – the trophic indicator and the food web model. Neither of these are fit for purpose of water management stakeholders, and require further development and research. However, the knowledge products from this theme have had considerable impact on the purposes of environmental watering for some water managers.</p>
<b>Consensus final rating</b>	<b>Moderately Efficient</b>

Mid KEQ 10.2	How timely were the outputs from each theme and the synthesis output from the EWKR project?
<b>Evaluator 1</b>	<p><b>Moderately Efficient</b></p> <p>One of the objectives of the Communications and Adoption Strategy (2017) was to 'ensure research outputs are communicated effectively in a timely and useful way to stakeholders to inform water management decisions'. However, the project got off to a slow start and there were many delays (e.g. finalisation of the multi-year research plan was delayed until December 2016 caused by delays in the finalisation of the fish and food web plans (Annual Progress Report 2016-17)). Inevitably, these delays led to delays in timely production of outputs from the project. This was evident in comments in the Final Project Report (2019) that described how delays in research activities compounded as the project progressed. There was a high risk of non-completion by final project reporting due dates and little ability to enforce timely completion. Final reporting was overdue and the end of the project was pushed past contractual dates and the end of financial year. For the current evaluation (early 2020), final reports and the synthesis of the EWKR project were completed and so these outputs were timely in that respect. It is also clear that some scientific papers are still being generated or are in review so more of these types of outputs can be expected, and may be timely for future management. Responses to the 2019 Evaluation indicated concerns about the timeliness of outputs for managers. Water managers and end users are making 'real time' decisions, and require advice and information in a consumable form which poses a challenge for traditional research programs that typically have long lag times between research activity and publication. Survey participants identified a range of barriers to the uptake of knowledge from the EWKR project including a lack of synthesis of research outcomes across themes (in work published up to mid-2019 when the evaluation was done), the time lag between project and publication of papers, and a lack of consultation with end users to ensure resources are in an appropriate format. There were no responses in the current survey that related to the timeliness of outputs although several respondents expressed concern with the delays to the start of the project and how this had repercussions for subsequent timelines and research activities. Responses in the interviews corroborated this concern. There were no examples given of timely outputs where research results had been well-timed to support a given management activity; instead, most responses indicated that the findings were more likely to influence managers' perspectives (e.g. importance of larger scales) rather than a current pressing decision that needed to be made. It was also accepted there would be a time-lag for 'diffusion' of information to occur, further affecting the timeliness.</p>
<b>Evaluator 2</b>	<p><b>Moderately Efficient</b></p> <p>The EWKR project was very slow at defining its research focus, with the 'foundational' stages being drawn-out over nearly two years, prior to commencement of most research activities. This was in large part due to the high level, aspirational and poorly defined objectives developed by the Department for the project, along with the need</p>

	to develop a research portfolio that matched the skill sets available in the grantee body (MDFRC). The SAG was brought into this process quite late, were presented with a large, “sub-standard project plan” which was poorly focused on the needs of end-users, and sought a better-framed and relevant set of research questions and sub-projects. This then took time, despite some foundation activities (reviews etc.) being conducted in parallel, reducing both the time and funding available for research. Once research activities commenced, they were conducted in a timely fashion. From the end of the foundational stage, individual research projects were effectively managed and in a timely fashion.
<b>Consensus final rating</b>	<b>Moderately Efficient</b>



## APPENDIX C: DOCUMENTS REVIEWED

- Burns, I., and Gawne, B. (2014a). Murray–Darling Basin Environmental Water Knowledge and Research project: Selection of priority research questions and research sites. Final Report prepared for the Department of the Environment by The Murray–Darling Freshwater Research Centre, MDFRC Publication 114/2014, June, 34 pp. [<https://doi.org/10.26181/5c87a431d95e0>]
- Burns, I., and Gawne, B. (2014b). Murray–Darling Basin Environmental Water Knowledge and Research Project: Preliminary identification of research questions. Draft report prepared for the Department of the Environment by The Murray–Darling Freshwater Research Centre, MDFRC Publication xx/2014, June, 29 pp.
- Campbell, C., Capon, S., Gehrig, S., James, C., Morris, K., Nicol, J., Nielsen, D., and Thomas, R. (2019a). Murray–Darling Basin Environmental Water Knowledge and Research Project — Vegetation theme research report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater Ecosystems (formerly Murray–Darling Freshwater Research Centre), CFE Publication 226, June 2019, 29 pp. [<https://doi.org/10.26181/5d254ec5955ad>]
- Campbell, C., Capon, S., Gehrig, S., James, C., Morris, K., Nicol, J., Nielsen, D., and Thomas, R. (2019b). Murray–Darling Basin Environmental Water Knowledge and Research Project — Vegetation theme research report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater Ecosystems (formerly Murray–Darling Freshwater Research Centre), CFE Publication 226, June 2019, Appendices 519 pp. [<https://doi.org/10.26181/5d2c1b9e6d00b>]
- Campbell, C., Capon, S., Morris, K., James, C., Nicol, J., Thomas, R., Gehrig, S., and Nielsen, D. (2019c). Vegetation theme: predicting outcomes in response to flow and other drivers. Centre for Freshwater Ecosystems, La Trobe University. [<https://doi.org/10.26181/5cafdb7a50cd6>]
- Centre for Freshwater Ecosystems (2019). Waterbird theme EWKR project background and work program (Version 2). La Trobe University. [<https://doi.org/10.26181/5c622ebb242c5>]
- Commonwealth of Australia (2012). Murray–Darling Basin Plan, Federal Register of Legislative Instruments, F2012-L02240, Canberra.
- Hale, J., Boon, P., and Dickson, M. (2019a). Water Knowledge and Research (MDB EWKR) project: Evaluation of Phase 2, Research implementation. A report to the Centre for Freshwater Ecosystems, La Trobe University, Albury, 17 pp.
- Hale, J., Boon, P., and Dickson, M. (2019b). Water Knowledge and Research (MDB EWKR) project: Evaluation of Phase 2, Research implementation. Appendix A: A commentary on EWKR document evaluation. A report to the Centre for Freshwater Ecosystems, La Trobe University, Albury, 8 pp.
- Hale, J., Boon, P., and Dickson, M. (2019c). Water Knowledge and Research (MDB EWKR) project: Evaluation of Phase 2, Research implementation. Appendix B: Stakeholder survey and interviews. A report to the Centre for Freshwater Ecosystems, La Trobe University, Albury, 29 pp.
- Hale, J., Boon, P., and Dickson, M. (2019d). Water Knowledge and Research (MDB EWKR) project: Evaluation of Phase 2, Research implementation. Appendix C: EWKR Story space. A report to the Centre for Freshwater Ecosystems, La Trobe University, Albury, 6 pp.
- Hodge, W., Gomez-Bonnet, F., and Alexandra, J. (2015). Evaluation Strategy for the Murray–Darling Basin Environmental Water Knowledge and Research (MDB EWKR) project. Final report by ARTD Consultants submitted to the Murray Darling Freshwater Research Centre, February 2015, 55 pp.
- Humphries, P., King, A., McCasker, N., Kopf, R. K., Stoffels, R., Zampatti, B., and Price, A. (2020). Riverscape recruitment: A conceptual synthesis of drivers of fish recruitment in rivers. *Canadian Journal of Fisheries and Aquatic Sciences*, 77(2), 213–225. <https://doi.org/10.1139/cjfas-2018-0138>

- Koehn, J., Balcombe, S., and Zampatti, B. (2019). Fish and flow management in the Murray-Darling Basin: Directions for research. *Ecological Management & Restoration*, 20(2), 142–150. <https://doi.org/10.1111/emr.12358>
- McGinness, H., Brandis, K., Robinson, F., Piper, M., O'Brien, L., Langston, A., Hodgson, J., Wenger, L., Martin, J., Bellio, M., Callaghan, D., Webster, E., Francis, R., McCann, J., Lyons, M., Doerr, V., Kingsford, R., and Mac Nally, R. (2019a). Murray–Darling Basin Environmental Water Knowledge and Research Project — Waterbird theme research report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by CSIRO and La Trobe University, Centre for Freshwater Ecosystems (formerly Murray–Darling Freshwater Research Centre), CFE Publication 225, June 2019, 44 pp. [<https://doi.org/10.26181/5d2eb0ed77159>]
- McGinness, H., Brandis, K., Robinson, F., Piper, M., O'Brien, L., Langston, A., Hodgson, J., Wenger, L., Martin, J., Bellio, M., Callaghan, D., Webster, E., Francis, R., McCann, J., Lyons, M., Doerr, V., Kingsford, R., and Mac Nally, R. (2019b). Murray–Darling Basin Environmental Water Knowledge and Research Project — Waterbird theme research report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by CSIRO and La Trobe University, Centre for Freshwater Ecosystems (formerly Murray–Darling Freshwater Research Centre), CFE Publication 225, June 2019, Appendices 422 pp. [<https://doi.org/10.26181/5d2ec86d50089>]
- McGinness, H., Kingsford, R., Mac Nally, R., and Doerr, V. (2019c). Waterbirds theme: Drivers of and threats to recruitment, demographic rates, movements. Centre for Freshwater Ecosystems. La Trobe University. [<https://doi.org/10.26181/5cafdb579cc38>]
- McInerney, P., Bond, N., Kopf, K., Lester, R., Ryder, D., Thompson, R., Baldwin, D., Brandis, K., Butler, G., Drouart, R., Frost, L., Gawne, B., Growns, I., Holt, G., Koster, W., MacNally, R., Macqueen, A., McGinness, H., Petrie, R., Robson, B., Rolls, R., Thiem, J., Thurgate, N., Watson, G., and Zampatti B. (2019a). Murray–Darling Basin Environmental Water Knowledge and Research Project — Food webs theme research report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater Ecosystems (formerly Murray–Darling Freshwater Research Centre), CFE Publication 224, June 2019, 28 pp. [<https://doi.org/10.26181/5d2ebbb7afa48>]
- McInerney, P., Bond, N., Kopf, K., Lester, R., Ryder, D., Thompson, R., Baldwin, D., Brandis, K., Butler, G., Drouart, R., Frost, L., Gawne, B., Growns, I., Holt, G., Koster, W., MacNally, R., Macqueen, A., McGinness, H., Petrie, R., Robson, B., Rolls, R., Thiem, J., Thurgate, N., Watson, G., and Zampatti, B. (2019b). Murray–Darling Basin Environmental Water Knowledge and Research Project — Food webs theme research report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater Ecosystems (formerly Murray–Darling Freshwater Research Centre), CFE Publication 224, June 2019, Appendices 119 pp. [<https://doi.org/10.26181/5d2ebdf748be4>]
- McInerney, P., Bond, N., Ryder, D., Lester, R., Thompson, R., Macqueen, A., Robson, B., Keller Kopf, R., Gawne, B., Growns, I., Rolls, R., Brandis, K., Holt, G., and Baldwin, D. (2019c). Foodwebs theme: what are the processes which support fish and waterbirds. Centre for Freshwater Ecosystems. La Trobe University. [<https://doi.org/10.26181/5cafdb6a8a6cf>]
- MDFRC (2014a). Murray-Darling Basin Environmental Water Knowledge and Research Project. Project Plan – Phase 1. The Murray–Darling Freshwater Research Centre, MDFRC Publication xx/2014, June 2014, 53 pp.
- MDFRC (2014b). Murray-Darling Basin Environmental Water Knowledge and Research Project: Phase 2 Scoping Report. Draft Report prepared for the Department of the Environment by The Murray–Darling Freshwater Research Centre, MDFRC Publication XX/2014, May 2015, 18 pp.
- MDFRC (2014c). Murray–Darling Basin Environmental Water Knowledge and Research Project: Decision Support Tool Strategy. Final Report prepared for the Department of the Environment by The Murray–Darling Freshwater Research Centre, MDFRC Publication 60/2014, May 2015, 14 pp. [<https://doi.org/10.26181/5c87a45fc7047>]

- MDFRC (2014d). Murray-Darling Basin Environmental Water Knowledge and Research Project: Operations Strategy. Final Report prepared for the Department of the Environment by The Murray-Darling Freshwater Research Centre, MDFRC Publication 22/2014, June, 36 pp.
- MDFRC (2016a). Murray-Darling Basin Environmental Water Knowledge and Research Project: Communications and Adoption Strategy. Report prepared for the Department of Environment and Energy by The Murray-Darling Freshwater Research Centre, MDFRC Publication 134, May 2017, 35 pp. [<https://doi.org/10.26181/5c87a4d99eb5a>]
- MDFRC (2016b). Murray-Darling Basin Environmental Water Knowledge and Research Project Annual Research Plan 2016–17. Final Report prepared for the Department of the Environment and Energy by The Murray-Darling Freshwater Research Centre, MDFRC Publication 121/2016, December 2016, 45 pp. [<https://doi.org/10.26181/5c87a5ea2b76f>]
- MDFRC (2016c). Murray-Darling Basin Environmental Water Knowledge and Research Project: Multi-Year Research Plan 2016–2019. Report prepared for the Department of the Environment and Energy by The Murray-Darling Freshwater Research Centre, MDFRC Publication 129/2016, December 2016, 134 pp. [<https://doi.org/10.26181/5c87a490dc3c9>]
- MDFRC (2016d). Murray-Darling Basin Environmental Knowledge and Research Project: Annual Progress Report July 2015 – June 2016. Final Report prepared for the Department of the Environment and Energy by The Murray-Darling Freshwater Research Centre, MDFRC Publication 128/2016, August, 95 pp.
- MDFRC (2017a). Environmental Water Knowledge and Research. Communications and Adoption Plan. Murray-Darling Basin Freshwater Research Centre, 16 pp.
- MDFRC (2017b). Murray-Darling Basin Environmental Water Knowledge and Research Project Annual Research Plan 2017–18. Final Report prepared for the Department of the Environment and Energy by The Murray-Darling Freshwater Research Centre, MDFRC Publication 160/2017, June, 55 pp. [<https://doi.org/10.26181/5c87a605dee52>]
- MDFRC (2017c). Murray-Darling Basin Environmental Water Knowledge and Research Project: Multi-Year Research Plan 2016–2019 – Addendum 2017/18. Final Report prepared for the Department of the Environment and Energy by The Murray-Darling Freshwater Research Centre, MDFRC Publication 152/2017, June, 20 pp. [<https://doi.org/10.26181/5c87a47c10b6f>]
- MDFRC (2017d). Murray-Darling Basin Environmental Knowledge and Research Project: Annual Progress Report: July 2016 – June 2017 Final Report prepared for the Commonwealth Environmental Water Office by The Murray-Darling Freshwater Research Centre, MDFRC Publication 175/2017, August, 69 pp.
- Price, A., Balcombe, S., Humphries, P., King, A., and Zampatti, B. (2019a). Murray-Darling Basin Environmental Water Knowledge and Research Project — Fish Theme Research Report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater, CFE Publication 223, June 2019, 41 pp. [<https://doi.org/10.26181/5d2ec539a0639>]
- Price, A., Balcombe, S., Humphries, P., King, A., and Zampatti, B. (2019b). Murray-Darling Basin Environmental Water Knowledge and Research Project — Fish Theme Research Report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater, CFE Publication 223, June 2019, Appendices 203 pp. [<https://doi.org/10.26181/5d2ec86d50089>]
- Price, A., King, A., Zampatti, B., Balcombe, S., Humphries, P., Baumgartner, L. (2019c). Fish theme: drivers of and threats to recruitment, demographic rates, movements. Centre for Freshwater Ecosystems. La Trobe University. [<https://doi.org/10.26181/5ccac575a3603>]
- Robson, B., Lester, R., Baldwin, D., Bond, N., Drouart, R., Rolls, R., Ryder, D., and Thompson, R. (2017). Modelling food-web mediated effects of hydrological variability and environmental flows. *Water Research*, 124, 108–128. <https://doi.org/10.1016/j.watres.2017.07.031>

- Rolls, R., Baldwin, D., Bond, N., Lester, R., Robson, B., Ryder, D., Thompson, R., and Watson, G. (2017). A framework for evaluating food-web responses to hydrological manipulations in riverine systems. *Journal of Environmental Management*, 203, 136–150. [<https://doi.org/10.1016/j.jenvman.2017.07.040>]
- Senior, B. (2019). Factsheet: Improving the understanding of water availability and use by vegetation of the Lower-Balonne Floodplain. Centre for Freshwater Ecosystems. La Trobe University. doi:10.26181/5ca16b1edee36
- Senior, B., Biggs, A., Marshall, J., and Starkey, A. (2019). Improving the understanding of water availability and use by vegetation of the Lower-Balonne Floodplain. Final research report for the project 'Watering requirements of floodplain vegetation asset species of the Northern Murray-Darling Basin'. Centre for Freshwater Ecosystems. La Trobe University. [<https://doi.org/10.26181/5c62af2763443>]
- Smith, L., Thurgate, N., Price, A., McInerney, P., and Campbell, C. (2018). Murray–Darling Basin Environmental Water Knowledge and Research Project — Annual progress report for July 2017 – June 2018. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater Ecosystems (formerly Murray–Darling Freshwater Research Centre), CFE Publication 198, August 2018, 32 pp.
- Smith, L., Thurgate, N., Bond, N., McGinness, H., and Campbell, C. (2019). Murray-Darling Basin Environmental Water Knowledge and Research Project — Final Project Report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater Ecosystems, CFE Publication 231, December 2019, 30 pp.
- Thurgate, N., Price, A., McInerney, P., Gehrig, S., McGinness, H., and Smith, L. (2018). Murray– Darling Basin Environmental Water Knowledge and Research Project – Annual Research Plan 2018–19. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University (Murray–Darling Freshwater Research Centre), MDFRC Publication 181/2018, June 2018, 25 pp. [<https://doi.org/10.26181/5c862b9f48ede>]
- Thurgate, N., Mynott, J., Smith, L., and Bond, N. (2019). Murray-Darling Basin Environmental Water Knowledge and Research Project — Synthesis Report. Report prepared for the Department of the Environment and Energy, Commonwealth Environmental Water Office by La Trobe University, Centre for Freshwater Ecosystems, CFE Publication 230, August 2019, 41 pp. [<https://doi.org/10.26181/5d5ce6b3e1a8b>]
- Watts, H. (2017). Evaluation of the Planning Phase for the Murray–Darling Basin Environmental Water Knowledge and Research (MDB EWKR) Project. Evaluation Report for the MDB EWKR Project Management Team.
- Watts, H., and Butcher, R. (2015). Review of existing decision making processes and decision support tools in environmental watering. Report by Evaluation and Sustainability Services for the Murray-Darling Basin Environmental Water Knowledge and Research project, February 2015, 105 pp. [<https://doi.org/10.26181/5c87a4bedb871>]

## APPENDIX D: REPORT CARDS

### FOCAL AREA: HOW WELL HAS THE EWKR PROJECT ACHIEVED ITS OBJECTIVES?

A single high-level KEQ underpinned by seven mid-level and 34 micro-level KEQs addressed this focal area. The initial judgement by the evaluators was that the EWKR project was 'minimally effective' in achieving its objectives. This is clearly reflected in the report card with most of the micro-level questions being rated as either 'not attempted' or 'minimally effective'. These ratings reflect the KEQs which focused more on the original set of objectives as specified in the Grant Guidelines. The evaluators revised their rating, explaining:

*"This rating was revised after discussion about how best to deal with the two different sets of objectives: those initially specified in the Grant Guidelines (many of which were not achievable with the available resources) and those that were eventually addressed after consultation with the Scientific Advisory Group. It was agreed that this latter group was the more relevant group for this assessment, despite the wording of the performance criteria in the rubric that referred solely and explicitly to those objectives specified in the 'head contract and foundation documents'. With this amendment, the evaluators agreed that the objectives that were eventually addressed were achieved moderately effectively." (Boulton and Davies (2020), p19, consensus final rating for KEQ1).*

#### Key Evaluation Questions

##### 1 How well has EWKR achieved its objectives?

1.1 How effectively did the EWKR project improve understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity?

1.1a How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish?
- 1A. What are the main energy sources contributing to larval fish biomass in the field?

1.1b How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of waterbirds?
- 1A. What are the main energy sources contributing to waterbird recruitment in the field?

1.1c How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?
- 1B. Are there clear spatial patterns in the importance of different energy sources for fish?

1.1d How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?
- 1B. Are there clear spatial patterns in the importance of different energy sources for waterbirds?

1.1e How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?
- 1C. Are there clear temporal patterns in the importance of different energy sources for fish?

1.1f How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?
- 1C. Are there clear temporal patterns in the importance of different energy sources for waterbirds?

1.1g How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?
- 1D. Is there evidence of 'energy bottlenecks' preventing passage of energy to higher trophic levels for fish?

1.1h How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish and waterbirds?
- 1D. Is there evidence of 'energy bottlenecks' preventing passage of energy to higher trophic levels for waterbirds?

1.1i How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of native fish?
- 1E. How does provision of flow affect any patterns detected in 1.1A–D?

1.1j How effectively did the EWKR food web theme outputs answer the following question and subsidiary research question posed in the Multi-year Research Plan:

- 1. What flow regimes best support food webs that transfer energy to support recruitment of waterbirds?
- 1E. How does provision of flow affect any patterns detected in 1.1A–D?

1.2 How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality?

1.2a How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity based on all research activities of the project?

1.2b How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect ecosystem function based on all research activities of the project?

1.2c How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect resilience based on all research activities of the project?

1.2d How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect water quality based on all research activities of the project?

1.2e How effectively did the EWKR project improve understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect food webs?

1.3 How effectively did the EWKR project improve understanding of how threats (hydrological, aquatic and terrestrial) may reduce or prevent the ecological improvement expected through the application of environmental water?

1.3a How well did the EWKR food web theme outputs answer the following question and subsidiary research questions posed in the Multi-year Research Plan:

- 2. How do other stressors (e.g. land use change, invasive species) impact on food web processes and the achievement of native fish and waterbirds outcomes?
- 2A Is there evidence for energy being diverted away from native fish (e.g. by carp)?

1.3b How well did the EWKR food web theme outputs answer the following question and subsidiary research questions posed in the Multi-year Research Plan:

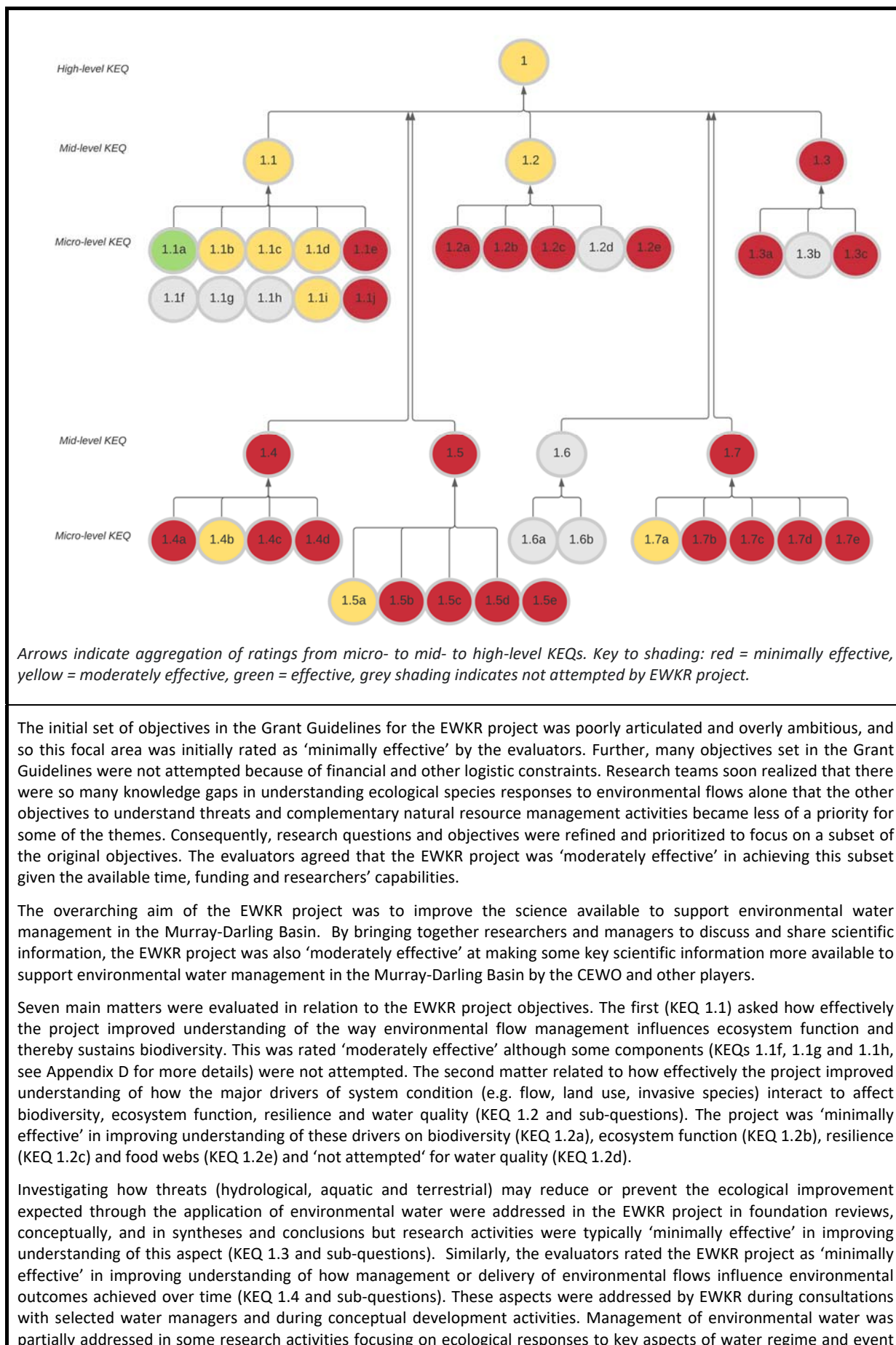
- 2. How do other stressors (e.g. land use change, invasive species) impact on food web processes and the achievement of native fish and waterbirds outcomes?
- 2A Is there evidence for energy being diverted away from waterbirds (e.g. by carp)?

1.3c How well did the EWKR food web theme outputs answer the following question and subsidiary research questions posed in the Multi-year Research Plan:

- 2. How do other stressors (e.g. land use change, invasive species) impact on food web processes and the



<p>achievement of native fish and waterbirds outcomes?</p> <ul style="list-style-type: none"> <li>• 2B Is there evidence that productivity in the channel is limited by other factors (e.g. water turbidity, availability of productive substrates)?</li> </ul> <p>1.4 How effectively did the EWKR project improve understanding of how management or delivery of environmental flow influences environmental outcomes achieved over time?</p> <p>1.4a How effective were the EWKR theme outputs and their synthesis in improving understanding of how management influences environmental outcomes achieved over time?</p> <p>1.4b How effective were the EWKR theme outputs and their synthesis in improving understanding of how delivery of environmental flow influences environmental outcomes achieved over time?</p> <p>1.4c How effective was the EWKR project in improving understanding of how management influences environmental outcomes achieved over the period of the project (i.e. 5 years)?</p> <p>1.4d How effective was the EWKR project in improving understanding of how delivery of environmental flow influences environmental outcomes achieved over the period of the project (i.e. 5 years)?</p> <p>1.5 How effectively did the EWKR project improve understanding of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition?</p> <p>1.5a How well did the EWKR project, in the vegetation theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</p> <p>1.5b How well did the EWKR project, in the native fish theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</p> <p>1.5c How well did the EWKR project, in the waterbird theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</p> <p>1.5d How well did the EWKR project, in the food web theme, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</p> <p>1.5e How well did the EWKR project, overall, in its synthesis, identify incremental changes in ecological condition and link them with ecosystem responses to watering regimes (natural and/or managed events)?</p> <p>1.6 How effectively did the EWKR project improve understanding of how complementary water management and natural resource management enhance the outcomes of environmental water management?</p> <p>1.6a How effective was the EWKR project in improving understanding of how complementary water management and natural resource management enhance the outcomes of environmental water management over the period of the project (i.e. 5 years)?</p> <p>1.6b How effective was the EWKR project in improving understanding of how complementary water management and natural resource management enhance the outcomes of environmental water management by inferring from the project results to longer time periods?</p> <p>1.7 How effectively did the EWKR project improve understanding of the links between ecosystem responses to management interventions (water management and natural resource management) and incremental changes in ecological condition?</p> <p>1.7a How well did the EWKR project, in the vegetation theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</p> <p>1.7b How well did the EWKR project, in the fish theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</p> <p>1.7c How well did the EWKR project, in the waterbirds theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</p> <p>1.7d How well did the EWKR project, in the food web theme, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</p> <p>1.7e How well did the EWKR project, in its synthesis, identify incremental changes in ecological condition and link them with ecosystem responses to management interventions (water management and natural resource management)?</p>	
<b>Evaluators' judgement by KEQ</b>	





delivery. The resulting knowledge was presented as information on management relevance in each theme's final report and in the synthesis reports. However, EWKR did not assess how recent or historical management and delivery of environmental flows influenced environmental outcomes.

The EWKR project objective of investigating the links between ecosystem responses to watering regimes (e.g., natural and/or managed events) and incremental changes in ecological condition (KEQ 1.5 and sub-questions) was explored for three biodiversity components (fish, vegetation and waterbirds) and a functional one (food webs) but failed to be integrated into an overall concept of ecosystem condition and was 'minimally effective' in improving understanding of this aspect. The objective of investigating how complementary water management and natural resource management enhance the outcomes of environmental water management (KEQ 1.6) was 'not attempted' by the EWKR project, although it was identified during various theme foundational activities, conceptual models and outputs of analysis and modelling.

For the seventh matter, how effectively the EWKR project improved understanding of the links between ecosystem responses to management interventions (water management and natural resource management) and incremental changes in ecological condition, the evaluators judged this to be 'minimally effective' (KEQ 1.7 and sub-questions) because these aspects were not specifically targeted or adequately addressed by the project. However, EWKR did address key aspects of overall ecological condition in its investigation of specific theme-based ecological responses to water regimes and events but not to multiple management interventions.

#### Cross referencing

Focal area final judgement: Boulton and Davies (2020) pp. 2-3.

Evaluation rationale for each KEQ: Boulton and Davies (2020), Appendix A, pp. 17-51.

### FOCAL AREA: HOW WELL FINDINGS WERE COMMUNICATED TO ALL STAKEHOLDERS?

Effectiveness of communication to stakeholders was assessed by one high-level KEQ, 2 mid- and 6 micro-level KEQ. Overall, the EWKR project was judged as 'moderately effective' in communicating findings to stakeholders.

#### Key Evaluation Questions

##### 2 How well have the projects communicated findings to all stakeholders?

2.1 How effective was the EWKR project communication and adoption strategy?

2.1a How well did the EWKR project communications and adoption strategy develop the approach to communicating key findings?

2.1b How effectively did the EWKR project share research outcomes to enhance environmental water management, complementary NRM, and environmental watering outcomes?

2.1c How effectively did the EWKR project share research outcomes and emerging knowledge gaps, and associated research priorities to provide direction for future investment in research?

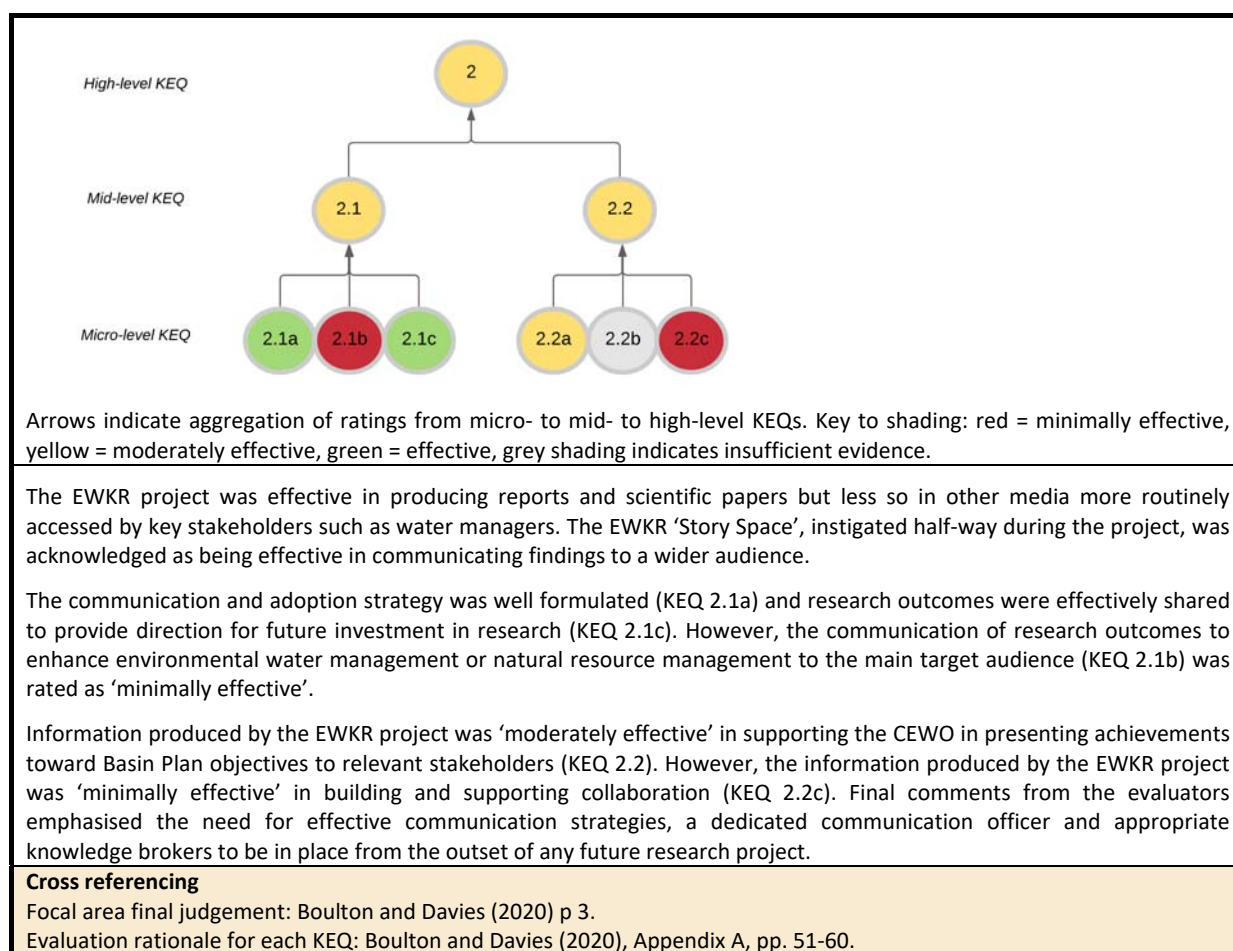
2.2 How effective was the information produced by the EWKR project in supporting the CEWO in presenting achievements toward Basin Plan objectives to relevant stakeholders?

2.1a To what extent were the communication products of the EWKR project fit for CEWO's purpose?

2.1b To what extent did the information produced by each theme of the EWKR project and its synthesis encourage stakeholders to strive to maintain and improve their contributions to Basin Plan environmental objectives?

2.1c How effectively did the information produced by the EWKR project build and support collaboration?

#### Evaluators' judgement by KEQ



## FOCAL AREA: HOW WELL WERE THE ENVIRONMENTAL OUTCOMES DEMONSTRATED?

This focal area was addressed with a single high-level KEQ, seven mid-level and 17 micro-level KEQs and was given an overall rating of 'moderately effective' by the evaluators.

### Key Evaluation Questions

**3 To what extent has the EWKR project improved understanding of how management or delivery of environmental flow influences environmental outcomes achieved over time?**

3.1 How well has the EWKR project improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures (Note: outcome in Multi-year Research Plan only, not in Grant Guidelines)

3.1a How well has the EWKR project demonstrated improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures?

3.2 How effectively have the research activities in each theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?

3.2a How effectively have the research activities in the fish theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?

3.2b How effectively have the research activities in the waterbirds theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?

3.2c How effectively have the research activities in the vegetation theme improved capacity to predict outcomes of environmental flow allocations and their management over 1–5 years?

3.2d How effectively have the research activities in the food web theme improved capacity to predict outcomes of

environmental flow allocations and their management over 1–5 years?

3.3 How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes?

3.3a How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for vegetation?

3.3b How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for fish?

3.3c How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for waterbirds?

3.3d How well has the EWKR project developed predictive tools, conceptual models and frameworks to inform environmental watering regimes for food webs?

3.4 How effectively has the EWKR project improved water management and complementary natural resource management?

3.4a How effectively have the EWKR project's vegetation theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of vegetation?

3.4b How effectively have EWKR's fish theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of fish?

3.4c How effectively have EWKR's waterbirds theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of waterbirds?

3.4d How effectively have EWKR's food web theme research activities demonstrated a link between changes in water management and complementary natural resource management and measures of food webs?

3.4e How effective has the EWKR project been in building capacity to set realistic objectives and targets for water management and complementary natural resource management?

3.5 How well did the EWKR project address climate change in its research activities?

3.6 How effectively has the EWKR project improved the information to support reporting on progress toward the Basin Plan environmental objectives and targets?

3.6a How effectively has the EWKR project linked the outcomes of research activities to reporting on progress towards Basin Plan Environmental objectives?

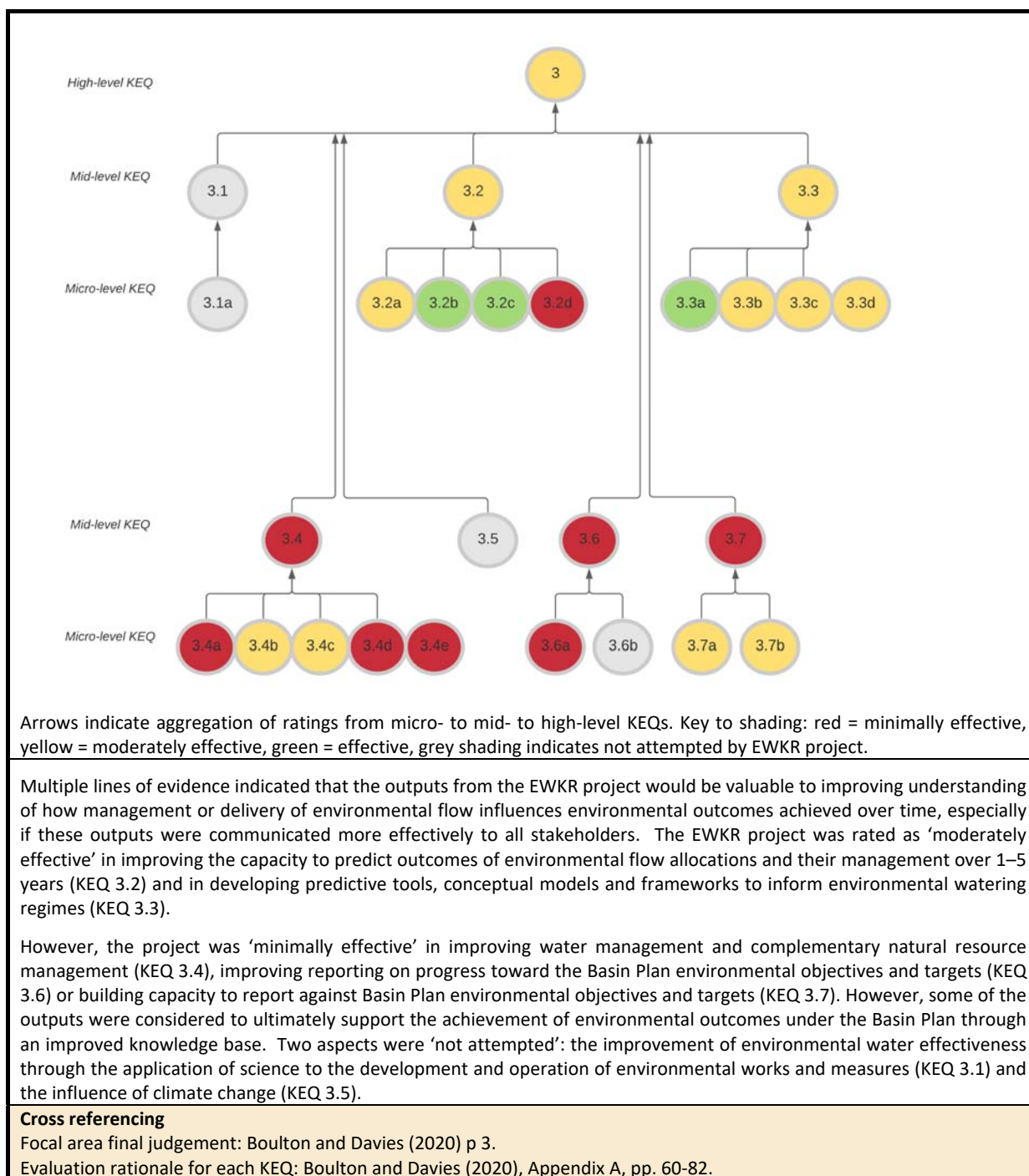
3.6b How effectively has the EWKR project linked the outcomes of research activities to reporting on progress towards Basin Plan Environmental targets?

3.7 How effectively has the EWKR project built capacity to report against Basin Plan environmental objectives and targets?

3.7a How effectively has the EWKR project built capacity to report against Basin Plan environmental objectives?

3.7b How effectively has the EWKR project built capacity to report against Basin Plan environmental targets?

**Evaluators' judgement by KEQ**



#### FOCAL AREA: TO WHAT EXTENT DID THE LTIM PROJECT SUPPORT THE CEWO'S LEGISLATIVE REPORTING REQUIREMENTS?

Overall, the evaluators judged the information produced by the EWKR project as being ‘moderately appropriate’ in supporting the CEWO in meeting their legislative requirements (KEQ 4). However, the capacity to use this information to report against particular items of legislation specified in KEQs 4.1a-4.1d was rated as ‘inappropriate’. This was largely because “The activity of reporting and evaluating progress against the EWP objectives is, however, a technical and analytic domain outside the scope of the EWKR program, and of more direct relevance to the CEWO LTIM, MDB MER and Evaluation programs, for which EWKR has (and hopefully may continue to) provide vital understanding and tools”. (Evaluator 2, Boulton and Davies (2020), p85).

## Key Evaluation Questions

### 4 How well has the EWKR project supported CEWO in meeting their legislative requirements?

4.1 How appropriate is the information provided by the EWKR project for supporting the CEWH in meeting its Water Act and Basin Plan reporting requirements (including annual reporting to Commonwealth Minister, annual reporting to MDBA, 5-yearly reporting to MDBA)?

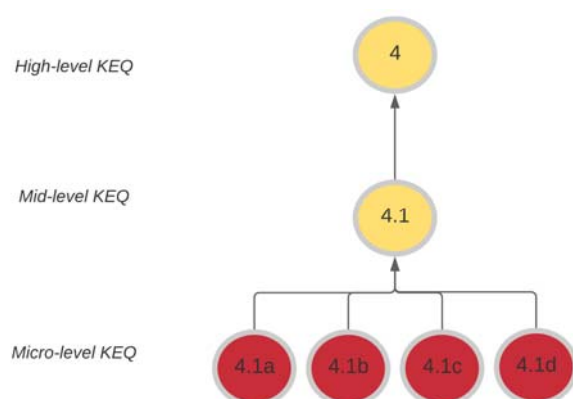
4.1a To what extent has the EWKR project supported CEWO to be able to "....include in the report particulars of the following: (a) achievements against the objectives of the environmental watering plan" (Sec 114(2a)) of the Water Act?

4.1b To what extent has the EWKR project supported CEWO to annually report to the MDBA on Schedule 12, item 6: the extent to which local knowledge and solutions inform the implementation of the Basin Plan?

4.1c To what extent has the EWKR project supported CEWO to be able to annually report to the MDBA on Schedule 12, item 10: the implementation of the environmental management framework (part 4 of Ch. 8 of the Basin Plan)?

4.1d To what extent has the EWKR project supported CEWO for five yearly reporting to MDBA on the contribution of Commonwealth environmental water to environmental outcomes at a Basin-scale, by reference to the targets that measure progress towards the environmental objectives in Schedule 7: there is no loss or degradation in the following: river, floodplain and wetland types including the condition of priority env assets and priority ecosystem functions?

### Evaluators' judgement by KEQ



Arrows indicate aggregation of ratings from micro-level KEQs to a mid- and a high-level KEQ. Key to shading: red = inappropriate, yellow = moderately appropriate.

Unlike the LTIM project, the research undertaken in the EWKR project was not specifically designed with the intent of supporting the CEWO's legislative reporting requirements. The EWKR project was focused on addressing knowledge gaps to improve environmental water management, and whilst there is line-of-sight to the CEWO's legislative requirements, the degree to which CEWO has been active in taking up the results of EWKR outcomes is unclear. Interview participants (including the CEWO staff) considered that the outputs from the EWKR project relevant to supporting the CEWO's requirements and that they complemented data from the LTIM project by helping to explain the likely mechanisms underlying some of the ecological responses to altered watering regimes, including those resulting from environmental water supplied by the CEWO.

#### Cross referencing

Focal area final judgement: Boulton and Davies (2020) pp. 3-4.

Evaluation rationale for each KEQ: Boulton and Davies (2020), Appendix A, pp. 83-88.

## FOCAL AREA: TO WHAT EXTENT WAS THE LTIM PROJECT FIT FOR PURPOSE?

This focal area was assessed by a single high-level KEQ with seven mid- and 20 micro-level KEQs. Whilst many of the KEQs were judged as being appropriate, the over all judgement was that the EWKR project was only moderately appropriate in terms of being fit for purpose.

## Key Evaluation Questions

### 5 To what extent is the EWKR project design fit for purpose?

5.1 To what extent was alignment with Basin Plan objectives taken into consideration during planning?

5.1a To what extent are the research questions for the vegetation theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?

5.1b To what extent are the research questions for the fish theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?

5.1c To what extent are the research questions for the waterbird theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?

5.1d To what extent are the research questions for the food web theme aligned with either Basin Plan objectives and or the Basin-wide Environmental Watering Strategy Quantitative Expected Environmental Outcomes (BEWS QEEOs)?

5.2 How relevant were the priority research questions for food webs to the first Grant Guideline objective and the 3 Basin Plan objectives?

5.2a How well did the EWKR project establish the relationship between (and hence relevance of) the high priority research questions for food webs below, this first objective of the grant guidelines and the 3 Basin Plan objectives (protect and restore water dependent ecosystems, protect and restore ecosystem functions, ensure water dependent ecosystems are resilient):

High priority food web research questions:

1. What flow regimes best support food webs that contribute to positive outcomes for native fish and waterbirds?

5.2b How well did the EWKR project establish the relationship between (and hence relevance of) the high priority research question for food webs below, this first objective of the grant guidelines and the 3 Basin Plan objectives (protect and restore water dependent ecosystems, protect and restore ecosystem functions, ensure water dependent ecosystems are resilient):

High priority Food web research questions:

2. How do other stressors impact on food web processes and the achievement of native fish and waterbirds outcomes?

5.3 How relevant were the lowest level research question for food webs to the priority research questions?

5.3a How effectively did the EWKR project establish the relationship for food webs between the lowest level of food web research questions and the higher-level food web questions?

5.4 How relevant was the EWKR project to improving understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality?

5.4a How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:

“How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of vegetation, the relevant Basin Plan objectives and the priority research questions?

5.4b How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:

“How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of Fish, the relevant Basin Plan objectives and the priority research questions?

5.4c How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:

“How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of Waterbirds, the relevant Basin Plan objectives and the priority research questions?

5.4d How well did the EWKR project establish the relationship between the following objective from the Grant Guidelines:

“How the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality” and the EWKR theme of Food Webs, the relevant Basin Plan objectives and the priority research questions?

5.5 To what extent was the program logic and associated conceptual models fit for purpose?

5.5a How appropriate was the vegetation theme program logic?

5.5b How appropriate was the fish theme program logic?

5.5c How appropriate was the waterbird theme program logic?

5.5d How appropriate was the food webs theme program logic?

5.6 How well has the EWKR project improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures (Note: outcome in Multi Year Research Plan only, not in Grant Guidelines)?

5.6a How well has the EWKR project demonstrated the relevance and significance of the additional outcome in the Multi-year research plan (in addition to the outcomes specified in the Grant Guidelines)?

5.7 How appropriate were the research and evaluation plans for each research theme?

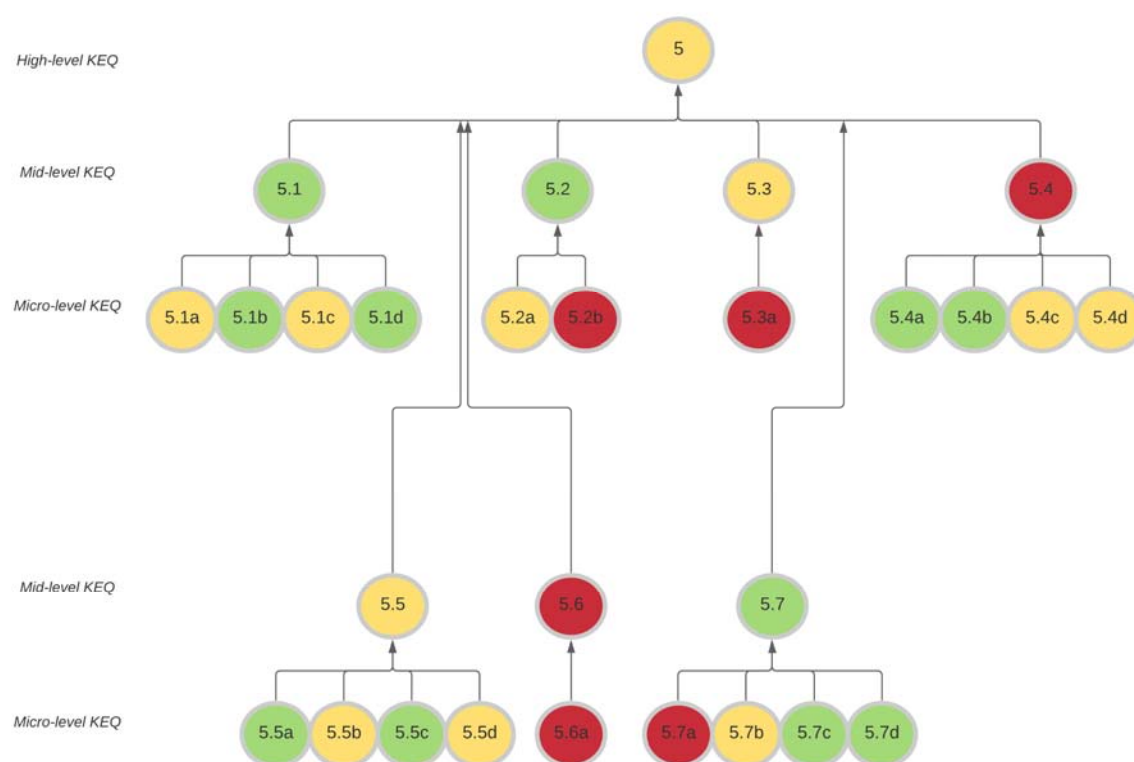
5.7a To what extent were objectives SMART?

5.7b Were evaluation methods clear and well-articulated for each theme?

5.7c To what extent were the scientific methodologies adopted in the EWKR project the most appropriate?

5.7d How well did the EWKR project, either at design stage or during the project implementation, consider/align with ongoing and planned initiatives implemented by other agencies that addressed similar needs?

## Evaluators' judgement by KEQ



Arrows indicate aggregation of ratings from micro- to mid- to high-level KEQs. Key to shading: red = inappropriate, yellow = moderately appropriate, green = appropriate.

The EWKR project was focused on improving the science available to support the needs of environmental water managers in the Murray–Darling Basin as well as the needs of the CEWO. The evaluators rated the design of the overall project as ‘moderately appropriate’, and the alignment with Basin Plan objectives during planning (KEQ 5.1), the relevance of the priority research questions for food webs to the three Basin Plan objectives (KEQ 5.2) and the research and evaluation plans for each research theme (KEQ 5.7) were all rated ‘appropriate’.

However, there were some elements of the design that compromised the appropriateness of the project being fully fit for purpose. These included the adequacy of spatial and temporal replication for assessing Basin-wide ecological processes over time (especially periods longer than five years), the extent to which the same sites were used for concurrent research activities across themes, and the timing of particular blocks of fieldwork so that their results better aligned with associated research activities (KEQ 5.2b). Many of these limitations to the design arose from financial and other logistic constraints



beyond the control of the EWKR team.

Two aspects were rated 'inappropriate'. The first was the relevance of the EWKR project to improving understanding of how the major drivers of system condition (e.g. environmental flow, land use, invasive species etc.) interact to affect biodiversity, ecosystem function, resilience and water quality rating (KEQ 5.4). Although the individual themes (KEQs 5.4a-d) addressed water and flow regimes as a major driver, the inclusion of other non-water drivers was patchy at best - partially due to a lack of synthetic focus but also due to the major contextual and resource constraints on this ambitious program. The second was the extent to which the EWKR project improved environmental water effectiveness through the application of science to the development and operation of environmental works and measures (KEQ 5.6), and this suffered from the lack of targeted research by the project into the ecological responses to these operations.

#### Cross referencing

Focal area final judgement: Boulton and Davies (2020) p 4.

Evaluation rationale for each KEQ: Boulton and Davies (2020), Appendix A, pp. 88-114.

## CRITERION: IMPACT

The impact of the EWKR project was assessed by a single high-level KEQ and mid- with five micro-level KEQs and judged to be 'low impact'. Impact is a measure of uptake of outcomes leading to improved management of water. However, most communication of findings to managers occurred after the period the evaluation focused on, so is perhaps a poor indication of the 'real' impact of the project.

### Key Evaluation Questions

#### 6 How impactful has the EWKR project been in supporting adaptive management in the basin?

6.1 To what extent have the environmental outcomes from the EWKR project had an impact on the CEWO's adaptive management of environmental water?

6.1a To what extent has the information provided by the vegetation theme had an impact on the adaptive management of environmental water?

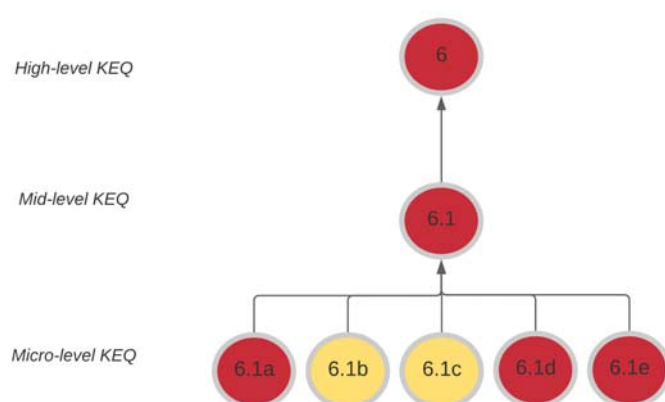
6.1b To what extent has the information provided by the fish theme had an impact on the adaptive management of environmental water?

6.1c To what extent has the information provided by the waterbirds theme had an impact on the adaptive management of environmental water?

6.1d To what extent has the information provided by the food web theme had an impact on the adaptive management of environmental water?

6.1e To what extent has the information provided by the synthesis across all themes had an impact on the adaptive management of environmental water?

### Evaluators' judgement by KEQ



Arrows indicate aggregation of ratings from micro-KEQs to the mid- and high-level KEQs. Key to shading: red = low impact, yellow = moderate impact.

The impact of the EWKR project on supporting adaptive management of environmental water in the Basin (KEQ 6) was



judged as 'low' based on the survey and interview responses. Impact varied among the themes and was rated 'moderate' for the fish and waterbird themes (KEQs 6.1b and 6.1c) but 'low' for the other two themes and their synthesis (KEQs 6.1a, 6.1d and 6.1e). Most of the key findings were communicated to managers and other stakeholders mid-late 2019, meaning that there has been very little time for this information to be used to support adaptive management in the Basin and to be able to demonstrate the information's impact. The evaluators considered it highly likely that both the impact of the EWKR project and the capacity to demonstrate it will increase with time. The low rating also reflected that the communication of key findings to relevant managers in such a way as to change their behaviour and encourage active incorporation into adaptive management was largely considered as ineffective.

#### Cross referencing

Focal area final judgement: Boulton and Davies (2020) p 4.

Evaluation rationale for each KEQ: Boulton and Davies (2020), Appendix A, pp. 114-123.

## CITIERION: EFFICIENCY

Efficiency was address by four high-level KEQ with six mid- and 22 micro-level KEQs. Overall collaboration was judged as being efficient, data management as inefficient, and achievement of objectives and generation of outputs as moderately efficient.

### Key Evaluation Questions

#### 7 How efficiently has the EWKR project achieved its objectives?

7.1 How efficiently, in terms of value for money, did the EWKR project improve understanding of incremental changes in ecological condition in response to multiple management interventions?

7.1a How efficiently did the EWKR project improve understanding of how environmental flow management influences ecosystem function and thereby sustains biodiversity?

7.1b How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect biodiversity?

7.1c How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect ecosystem function?

7.1d How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect resilience?

7.1e How efficiently did the EWKR project improve understanding of how the major drivers of system condition (e.g. flow, land use, invasive species etc.) interact to affect water quality?

7.1f How efficiently did the EWKR project improve understanding of how management influences environmental outcomes achieved over time?

7.1g How efficiently did the EWKR project improve understanding of how delivery of environmental flow influences environmental outcomes achieved over time?

7.1h How efficiently did the EWKR project improve understanding of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) and incremental changes in ecological condition?

7.1i How efficiently did the EWKR project improve understanding of the links between ecosystem responses to management interventions (water management) and incremental changes in ecological condition?

7.1j How efficiently did the EWKR project improve understanding of the links between ecosystem responses to management interventions (natural resource management) and incremental changes in ecological condition?

#### 8 How efficient was the EWKR project in managing and sharing data?

8.1 How efficient was the EWKR project in sharing data?

8.1a To what extent were data shared with collaborators between research themes?

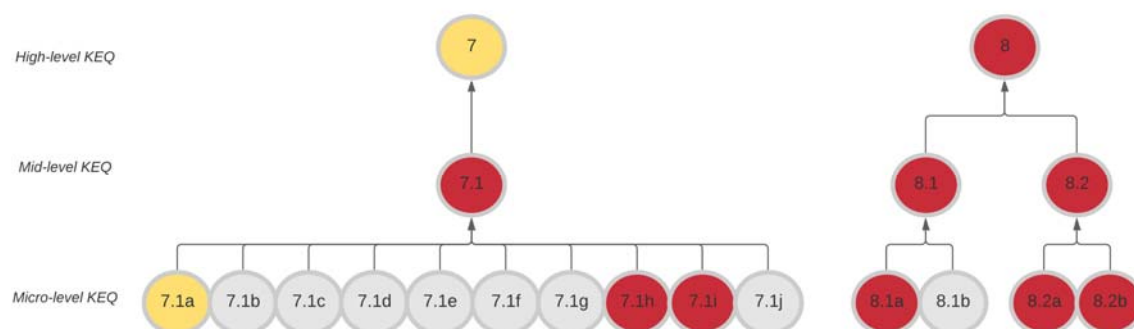
8.1b How efficiently were data shared with end users such as the MDBA?

8.2 How efficient was the EWKR project in managing data?

8.2a How efficient were the data management protocols within the EWKR project?

8.2b How accessible is the data generated by the EWKR project to end users?

## Evaluators' judgement by KEQ



Arrows indicate aggregation of ratings from micro- to mid- to high-level KEQs. Key to shading: red = inefficient, yellow = moderately efficient, grey shading indicates not attempted by EWKR project for sub-questions in KEQ 7, and insufficient evidence for KEQ 8.1b.

The evaluators found that whilst many of the original objectives specified in the Grant Guidelines were not attempted due to financial and other logistic constraints, the project was 'moderately efficient' in achieving the objectives and related research questions that were addressed. However, in terms of value for money, the EWKR project was 'inefficient' in improving understanding of incremental changes in ecological condition in response to multiple management interventions (KEQ 7.1) and of the links between ecosystem responses to watering regimes (e.g. natural and/or managed events) (KEQ 7.1h) and management interventions (water management (KEQ 7.1i) with incremental changes in ecological condition. A major source of this inefficiency was the prolonged planning phase that severely curtailed the time available for research.

The EWKR project was rated as 'inefficient' in managing and sharing data (KEQ 8). This inefficiency extended to sharing data with collaborators (KEQ 8.1a) and to the data management protocols (KEQ 8.2a) and data access to end users (KEQ 8.2b).

### Cross referencing

Focal area final judgement: Boulton and Davies (2020) pp. 4-5.

Evaluation rationale for each KEQ: Boulton and Davies (2020), Appendix A, pp. 123-139.

## Key Evaluation Questions

### 9 How efficient was the collaborative process within the EWKR project?

9.1 To what extent was collaboration undertaken outside the EWKR project?

9.1a How efficiently did the vegetation theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?

9.1b How efficiently did the waterbird theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?

9.1c How efficiently did the fish theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?

9.1d How efficiently did the food webs theme use its resources/inputs to collaborate with other water managers/researchers external to the EWKR project?

### 10 How efficiently generated were the outputs from the EWKR project?

10.1 How efficiently were the outputs for each theme generated? Were they value for money and or any evidence of pooling of resources?

10.1a How efficiently did the vegetation theme use its resources/inputs to produce effective outputs relevant to stakeholder needs?

10.1b How efficiently did the waterbird theme use its resources/inputs to produce effective outputs relevant to stakeholder needs?

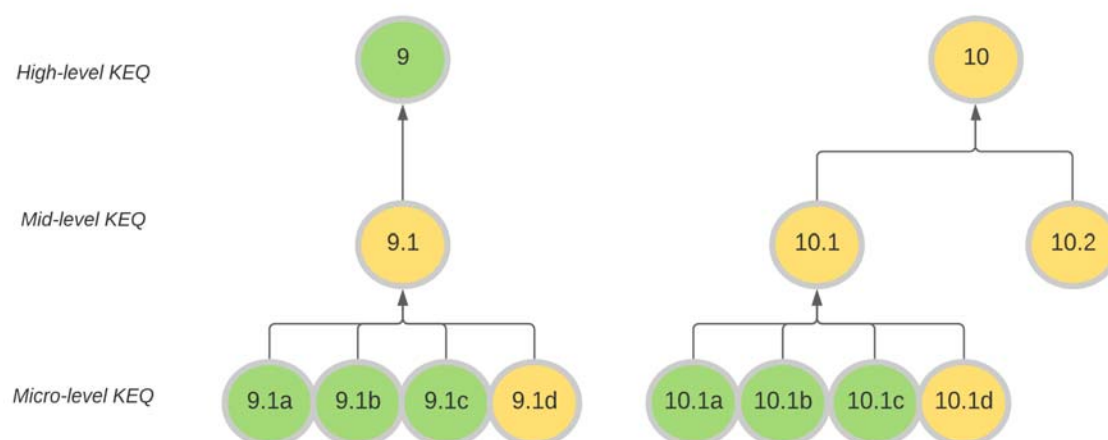
10.1c How efficiently did the fish theme use its resources/inputs to produce effective outputs relevant to stakeholder needs?

10.1d How efficiently did the food webs theme use its resources/inputs to produce effective outputs relevant to

stakeholder needs?

10.2 How timely were the outputs from each theme and the synthesis output from the EWKR project?

### Evaluators' judgement by KEQ



Arrows indicate aggregation of ratings from micro- to mid- to high-level KEQs. Key to shading: yellow = moderately efficient, green = efficient.

Collaboration within the EWKR project was rated as being 'efficient' (KEQ 9), and within the themes, resources and inputs were usually used efficiently to collaborate with other water managers and researchers external to the EWKR project (KEQs 9.1a-d). However, there was less evidence for collaboration with managers and other stakeholders outside the EWKR project so this was judged as only 'moderately efficient' (KEQ 9.1).

The EWKR project was assessed as being 'moderately efficient' in generating outputs (KEQ 10). The evaluators felt that efficiencies would have increased if there had been fewer delays in the planning phase of the project, earlier development of the Communications and Adoption Strategy, more pooling of resources and greater attention to meeting deadlines and objectives during the project. Inefficiencies were identified as arising from the 'silo' nature of the research themes which were subject to a "lack of strong theme-level central science leadership" which "...led to some inefficiencies in decision making and inflexibility in allocation of resources among projects within and among themes. The range of products produced varied substantially in stage of maturity and in relevance to water managers. These problems were largely a product of the poorly focused and over-ambitious objectives of the grant, the tight timeframe (exacerbated by the initial delays), an over-reliance on a core set of research providers with a specific set of skills, over-dispersed funding spread over a multiplicity of themes and projects, and poor end-user focus and engagement. As a result, EWKR developed a 'scatter-gun' approach to addressing knowledge gaps in the environmental water-ecology space, while avoiding duplicating research already underway, and not being able to define a clear purpose for its knowledge-based outputs". (Evaluator 2, Boulton and Davies (2020), p146).

Inefficiencies arising from the poorly focused start to the project were also reflected in interview responses. Evaluator 1 summed up by stating "The efficiency of the generation of outputs varied among themes (see responses to KEQ10.1 and associated micro questions) but, in general, the overall products and their diversity were reasonable value for money, assisted by considerable in-kind support from the partner institutions." (Boulton and Davies (2020), p145).

#### Cross referencing

Focal area final judgement: Boulton and Davies (2020) p 5.

Evaluation rationale for each KEQ: Boulton and Davies (2020), Appendix A, pp. 139-151.