

Monitoring and evaluating outcomes

Overview

- 3.1 Demonstrating environmental outcomes is essential for the management of environmental water.¹ More broadly, this provides Basin communities and taxpayers with confidence that the Australian Government's investment in environmental water has been worthwhile.² The Murray-Darling Basin is a large area, which poses challenges for measuring and demonstrating outcomes.³
- 3.2 Monitoring and evaluating environmental water takes three main forms:
- operational monitoring – gathering information on current river system conditions, water flows and verifying environmental water delivery;
 - intervention monitoring – observing and verifying how environmental water has changed rivers, wetlands, the surrounding environment and fulfilled Basin Plan objectives; and
 - knowledge and research – to improve the understanding of ecological processes.⁴
- 3.3 During the inquiry, witnesses and submissions discussed:
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1 Department of the Environment and Energy, *Submission 38*, p. 33. There is also further information on the Department's website: <http://www.environment.gov.au/water/cewo/monitoring>.

2 Australian Academy of Technology and Engineering, *Submission 11*, p. 2; Bureau of Meteorology, *Submission 12*, p. 1.

3 Dr Stuart Barrow, Senior Policy Analyst, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 2.

4 Department of the Environment and Energy, *Submission 38*, p. 34; see also Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 10 (CEWH response to Question 8).

- improvements to the way environmental outcomes are measured and demonstrated;
 - areas where more research and development would be beneficial;
 - views on accounting for environmental water and ensuring it reaches the intended places and provides expected benefits; and
 - consideration of broader social and economic impacts.
- 3.4 Mr Mark McKenzie (CEO, NSW Irrigators' Council), for example, noted that the Murray-Darling Basin Plan is partly fulfilled and is due to be fully implemented in 2024.⁵ The National Irrigators' Council observed that environmental watering outcomes should be judged on long-term results.⁶

Roles and responsibilities

- 3.5 Evaluation and monitoring tasks are shared among several government agencies. As the Ricegrowers' Association of Australia's submission noted, the respective roles and responsibilities of agencies involved in monitoring and reporting outcomes can be unclear. The Association suggested that this poses challenges for communities seeking to understand and engage with environmental watering.⁷
- 3.6 The Murray-Darling Basin Authority's (MDBA) submission provided an overview of arrangements for monitoring and evaluating environmental water outcomes:
- the Murray-Darling Basin Authority is responsible for reporting on the achievement of the environmental objectives of the Basin Plan at a Basin scale.
 - Basin States are responsible for reporting on the achievement of environmental objectives of the Basin Plan at a local or site (asset) scale (via long-term environmental watering plans).
 - the Commonwealth Environmental Water Holder is responsible for reporting on the contribution of Commonwealth environmental water to the environmental objectives and achievement of Basin scale environmental outcomes of the Basin Plan.⁸
- 3.7 The MDBA also outlined how environmental water is monitored:

5 Mr Mark McKenzie, CEO, NSW Irrigators' Council, *Committee Hansard*, Sydney, 22 June 2018, p. 20.

6 Mr Steve Whan, CEO, National Irrigators' Council, *Committee Hansard*, Canberra, 23 May 2018, p. 7.

7 Ricegrowers' Association of Australia, *Submission 19*, p. 6.

8 Murray-Darling Basin Authority, *Submission 34*, pp. 13-14; see also Department of the Environment and Energy, *Submission 38*, p. 33.

- each year, the MDBA releases the Basin Plan Annual Report... This report includes a section dedicated to environmental outcomes.
 - every five years the MDBA conducts an evaluation of the Basin Plan, which includes a more detailed examination of the environmental outcomes that have been achieved over the previous five years. The first Basin Plan Evaluation was completed and released in late 2017.
 - the MDBA also annually monitors the environmental outcomes associated with The Living Murray (TLM) program, which is a joint venture between Commonwealth and state agencies to deliver water to icon sites along the River Murray.⁹
- 3.8 Environmental flows are monitored using gauges (maintained and operated by the Basin States). Monitoring extends to the depth, duration, inundation and hydraulic habitat created from environmental water use. River operators assist with tracking water in the river system and accounting for its use.¹⁰
- 3.9 The Bureau of Meteorology submitted that it collates, assesses and reports information on water resources in Australia:
- This information informs public policy, programs and practices for better management of the nation's water resources. The Bureau also makes available to the public standardised data with national coverage that underpins a range of water resources analyses and assessments.¹¹
- 3.10 The Commonwealth Environmental Water Holder (CEWH) relies on third parties for primary data relating to operational delivery.¹² The Department of the Environment and Energy submitted:
- We continue to work with delivery partners and river operators to review delivery arrangements and establish a future model of best practice accounting and reporting for environmental water use.¹³
- 3.11 Around 40 to 45 per cent of the CEWH's staff are involved in operational monitoring and engagement on environmental water delivery. Around 10 to 15 per cent contribute to evaluating outcomes and research.¹⁴ At the

9 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 9 (MDBA response to Question 9).

10 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 9 (MDBA response to Question 9).

11 Bureau of Meteorology, *Submission 12*, p. 1.

12 Department of the Environment and Energy, *Submission 38*, p. 26.

13 Department of the Environment and Energy, *Submission 38*, p. 26.

14 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 10 (CEWH response to Question 8).

MDBA, around 10 to 15 staff are involved in evaluating environmental outcomes, although there is seasonal variability.¹⁵

Accounting for environmental water

- 3.12 During the inquiry, a number of witnesses and submissions suggested that environmental watering lacks precision and, by implication, the outcomes may be uncertain. The Committee was told that these doubts affect confidence in how environmental water is being managed.
- 3.13 The CEWH agreed that ‘public accountability requires accurate, reliable and credible information that demonstrates how Commonwealth resources are used’.¹⁶
- 3.14 The Committee received evidence that if water cannot be measured, it cannot be managed.¹⁷ Murray Irrigation expressed concern that there is inadequate rigour applied to environmental water use:
- the use of environmental water continues to be poorly measured and there is no accountability for its destination.
 - there is no transparency supporting assumed-use models and loss data is not effectively collected and analysed.
 - environmental water managers have not set robust, location-specific environmental water management targets against which key performance indicators can be applied.¹⁸
- 3.15 Murray Irrigation submitted that environmental water is ‘not measured nor subject to the same rigours applied to commercial users’, with overbank events,¹⁹ usage and losses based on assumptions and modelling.²⁰ The submission stated:

15 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 9 (MDBA response to Question 8).

16 Department of the Environment and Energy, *Submission 38*, p. 26.

17 Southern Riverina Irrigators, *Submission 21*, p. 6; Murray-Darling Association, *Submission 27*, p. 3.

18 Murray Irrigation, *Submission 30*, p. 2.

19 Overbank flow events are ‘the larger flow events that fill the river channel and may inundate channel benches, the riparian zone, anabranches/flood-runners and low parts of the floodplain, and replenish local groundwater’. Murray-Darling Basin Authority, ‘Basin-wide environmental watering strategy’, November 2014, p. 21, at <https://www.mdba.gov.au/managing-water/environmental-water/basin-wide-environmental-watering-strategy>.

20 Murray Irrigation, *Submission 30*, p. 9. The submission noted that the CEWH would utilise water meters where they are available. See also Ms Emma Bradbury, CEO, Murray Darling Association, *Committee Hansard*, Albury, 30 April 2018, p. 25.

If any assumptions or loss factor calculations are incorrect, integrity suffers and faith in the system falters. These failures represent a major commercial risk to water users who instead would respond positively to increased equity and accountability. Water users need to be confident that they are not wearing the losses incurred by environmental water managers.²¹

- 3.16 The submission added that Murray Irrigation uses water metering that transfers its data in real time.²²
- 3.17 Southern Riverina Irrigators submitted that the CEWH does not have to ‘deliver their water through an approved or compliant meter’, report losses or report on how much water reached the end of the river system.²³ The submission added that with the practice of return flows being trialled, this issue should be resolved so ‘the community can have faith that the water held is being used efficiently and responsibly with no adverse risk to third parties’.²⁴ Mrs Gabrielle Coupland (Chair, Southern Riverina Irrigators) said that environmental water ‘must be measured to the same standard as for consumptive water’.²⁵
- 3.18 Mr Mark Winter (Vice Chair, Gwydir Valley Irrigators Association Inc) said there should be ‘a lot more transparency’ on environmental watering targets and results to ascertain whether the water ‘could be in production, or that water is doing a job for the environment and communities further down the system’. Mr Winter said that ‘a lot of the time it’s very difficult to find out the results – what an event of the environmental water has achieved’.²⁶ Cotton Australia submitted that the CEWH and other environmental water managers have a responsibility to communicate with communities before, during and after environmental water releases:

That is, the purpose/expected environmental outcome from a release should be specifically communicated. The progress to achieving the specific outcome/s should be also communicated, and the actual outcomes should be objectively measured and reported on. All three elements need to occur to keep the community informed.²⁷

21 Murray Irrigation, *Submission 30*, p. 9.

22 Murray Irrigation, *Submission 30*, p. 9.

23 Southern Riverina Irrigators, *Submission 21*, p. 3.

24 Southern Riverina Irrigators, *Submission 21*, p. 4.

25 Mrs Gabrielle Coupland, Chair, Southern Riverina Irrigators, *Committee Hansard*, Albury, 30 April 2018, p. 22 and p. 29.

26 Mr Mark Winter, Vice Chair, Gwydir Valley Irrigators Association Inc, *Committee Hansard*, Canberra, 30 May 2018, p. 9.

27 Cotton Australia, *Submission 5*, p. 3.

- 3.19 Mr Daryl Buckingham (CEO, Mildura Regional Development) said the community would value clearer and real-time information about ‘what exactly is going on’ with environmental water, adding that this would ‘take away some of the political angst as well’.²⁸
- 3.20 The Environmental Defenders Office Australia agreed that there is ‘insufficient information... regarding the fate of environmental water after it is released from public storages’. The submission stated that there could be greater clarity on the percentage of water reaching targeted environmental assets.²⁹ The submission added that easily accessible information about environmental water management would assist with improving community awareness.³⁰
- 3.21 Some evidence referred to the benefits of receiving information from volunteers and using local knowledge. For example, Murray Irrigation suggested:
- Increasingly, mobile phone apps are being used to monitor bird and wildlife populations. A similar approach can be taken to working with community groups who can provide monitoring services to the CEWO in return for funding a specific environmental project.³¹
- 3.22 The Murray Darling Association submitted:
- The impacts of environmental watering events are complex and differ from wetland to wetland, community to community and government to government ... Environmental water management could be enhanced by greater investment in and reliance on local knowledge to develop solutions to unintended and adverse consequences inherent in environmental watering events.³²
- 3.23 There is further discussion of citizen science in Chapter 4 in relation to community engagement.
- 3.24 The Australian Academy of Technology and Engineering submitted that managing environmental water is a technically challenging process and the science is ‘relatively immature’.³³ The submission added:
- Australia requires stable and adequate investment in strategic research and science to support improved environmental water

28 Mr Daryl Buckingham, CEO, Mildura Regional Development, *Committee Hansard*, Mildura, 1 May 2018, p. 9.

29 Environmental Defenders Office Australia, *Submission 28*, p. 7.

30 Environmental Defenders Office Australia, *Submission 28*, p. 9.

31 Murray Irrigation, *Submission 30*, p. 12.

32 Murray Darling Association, *Submission 27*, p. 2.

33 Australian Academy of Technology and Engineering, *Submission 11*, p. 1.

management, solve its many unique water challenges, and to develop and maintain its expertise and research capacity. The current level of research funding allocated to this area is very low.³⁴

3.25 Mr Denis Flett (Victorian Environmental Water Holder) said that while measuring water flow along a pipe or channel is relatively easy, overland flows are ‘much more difficult and the water measurement methods have to become far more sophisticated’.³⁵ Mr Flett said that in these circumstances, ‘the assumptions made in the water accounting are appropriately conservative’.³⁶

3.26 A submission from the Bureau of Meteorology noted that open access to its water information and data promotes efficiency and transparency. The submission added:

Our products and services related to the use of environmental water include assessments of past water use and standardised water accounts, near-real-time collation and publication of water flow measurements from multiple agencies, and forecasts of daily and sub-daily flow volumes in rivers out to seven days ahead.³⁷

3.27 The Department of the Environment and Energy’s submission stated that environmental water use is not necessarily comparable to consumptive water, ‘which is taken at a particular location and predominately measured through metered pumps and gauges on engineered channels’.³⁸ The submission stated that the CEWH:

...uses the best available methods for each watering, but they vary depending on how and where the water is delivered. Examples of methods used to account for environmental water are: metered pumps, channel delivery, river gauging stations and floodplain models.³⁹

3.28 The submission continued:

34 Australian Academy of Technology and Engineering, *Submission 11*, p. 1.

35 Mr Denis Flett, Chairperson, Victorian Environmental Water Holder, *Committee Hansard*, Albury, Albury, 30 April 2018, p. 4.

36 Mr Denis Flett, Chairperson, Victorian Environmental Water Holder, *Committee Hansard*, Albury, 30 April 2018, p. 2.

37 Bureau of Meteorology, *Submission 12*, p. 1.

38 Department of the Environment and Energy, *Submission 38*, p. 26.

39 Department of the Environment and Energy, *Submission 38*, p. 26.

We continue to work with delivery partners and river operators to review delivery arrangements and establish a future model of best practice accounting and reporting for environmental water use.⁴⁰

- 3.29 The Department of the Environment and Energy advised that the CEWH ‘continues to invest in new information to make sure all decision-making is supported by the best possible evidence sources’.⁴¹

Measuring and demonstrating outcomes

- 3.30 Witnesses and submissions agreed that outcomes are important and, generally, recommended investing more in monitoring and scientific research. Evidence received during the inquiry showed there is also significant interest in validating that environmental water is serving its purpose.
- 3.31 Although the outcomes of environmental watering will take many years to be realised, the CEWH submitted that environmental water is yielding positive results.⁴²
- 3.32 Professor Robyn Watts (Charles Sturt University) said environmental water monitoring has had four benefits:
- determining the effectiveness of the Basin Plan;
 - reporting the outcomes of individual environmental watering actions;
 - contributing to community engagement and the CEWH’s knowledge of Basin communities; and
 - improving knowledge of the river system and thereby its management into the future.⁴³
- 3.33 The Australian Academy of Science submitted that recent water reforms in the Murray-Darling Basin are ‘critical to the ongoing environmental health of the region and downstream areas’.⁴⁴ The submission continued:
- For this reason, it is critical these reforms be informed by the best and most rigorous scientific assessments, and their impacts are studied in detail and used to inform future water policy.⁴⁵

40 Department of the Environment and Energy, *Submission 38*, p. 26.

41 Department of the Environment and Energy, *Submission 38*, p. 26.

42 Department of the Environment and Energy, *Submission 38*, p. 41. The Department’s submission contains further detail, with examples and case studies.

43 Professor Robyn Watts, Charles Sturt University, *Committee Hansard*, 30 April 2018, pp. 10-11.

44 Australian Academy of Science, *Submission 8*, p. 1.

45 Australian Academy of Science, *Submission 8*, p. 1.

3.34 The submission added:

A key goal is to provide integrated assessments of water planning and management in Australian river basins, especially the Murray Darling.⁴⁶

3.35 Other witnesses regarded monitoring, evaluation and explaining outcomes as being important to dispel misrepresentations of the Murray River's condition.

3.36 For example, Mr Gavin McMahon (Chairman, National Irrigators' Council) said he had heard comments made to the effect that 'everything's dead'. He said this is a 'long way' from the experience of living and working in the Basin and 'areas of it are quite vibrant'.⁴⁷ Mr Jeremy Morton (President, Ricegrowers' Association of Australia) said that variation of river and wetland conditions is normal and natural. He noted:

Think about what has happened recently in the Darling. It hasn't rained much up there for nearly 18 months or two years. The river has basically dried up. Then the rain will come again and life will go on and fish will breed and your aquatic life will all occur.⁴⁸

3.37 He added:

We can't get caught up on what is happening right here and right now when it's perhaps a really dry spell. It is normalising the variability for the community and the public in general and longer term monitoring.⁴⁹

46 Australian Academy of Science, *Submission 8*, p. 1.

47 Mr Gavin McMahon, Chairman, National Irrigators' Council, *Committee Hansard*, Mildura, 1 May 2018, p. 17.

48 Mr Jeremy Morton, President, Ricegrowers' Association of Australia, *Committee Hansard*, Canberra, 20 June 2018, p. 8.

49 Mr Jeremy Morton, President, Ricegrowers' Association of Australia, *Committee Hansard*, Canberra, 20 June 2018, p. 8.



The Committee tours the Hattah Lakes area

Current evaluation and monitoring activities

3.38 Mr Denis Flett (Victorian Environmental Water Holder) explained that the outcomes of environmental watering are accounted for with empirical evidence. He said:

The measurement of those benefits... is basically then the subject of observation and measurement in a scientific sense: did we get the benefit? Did the colonial waterbirds get through nesting and fledge the young? Did the vegetation improve?⁵⁰

3.39 Mr Flett said that watering decisions are based on a combination of scenario planning, community input and observation.⁵¹ The NSW Government submitted:

Due to the complexities in determining the incremental benefit of managed and planned environmental water, it is important to monitor the long-term trends in condition as well as the short-term responses to each watering event.⁵²

3.40 The NSW Government submission added:

50 Mr Denis Flett, Chairperson, Victorian Environmental Water Holder, *Committee Hansard*, Albury, 30 April 2018, p. 6.

51 Mr Denis Flett, Chairperson, Victorian Environmental Water Holder, *Committee Hansard*, Albury, 30 April 2018, p. 5.

52 NSW Government, *Submission 17*, p. 8.

While monitoring and reporting of ecological outcomes is currently focused at the asset and catchment scale, NSW is working with the Commonwealth to develop local and basin scale monitoring programs so that improved system health can be demonstrated at the Basin Scale.⁵³

- 3.41 The CEWH advised the Committee that monitoring and evaluation is a 'critical component of the effective and efficient use of environmental water'.⁵⁴ In addition:

The outcomes of the monitoring and evaluation form a key part of adaptive management and is incorporated into the annual planning and the operational delivery of environmental water.⁵⁵

- 3.42 The CEWH reiterated that a 'significant proportion' of time and resources (around \$42 million) are being invested into short-term and long-term monitoring.⁵⁶

How to measure outcomes

- 3.43 The Australian Academy of Engineering and Technology recommended that the CEWH establish 'a strategic relationship with the Bureau of Meteorology to leverage the Bureau's water information reporting service'.⁵⁷

- 3.44 Mr Neil Bull (Environmental Projects Manager, Ricegrowers' Association of Australia) said that monitoring needs to consider the long-term outcomes and changes to landscapes, including on privately held land.⁵⁸

- 3.45 Deakin University submitted that monitoring programs should include a mix of scales and targets:

A holistic suite of monitoring that spans the Basin at the largest scale, with detailed biological monitoring at high-value sites, will provide the best basis for ongoing management of the Basin as a whole.⁵⁹

53 NSW Government, *Submission 17*, p. 8.

54 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 9 (CEWH response to Question 8).

55 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 9 (CEWH response to Question 8).

56 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 10 (CEWH response to Question 8).

57 Australian Academy of Technology and Engineering, *Submission 11*, p. 2.

58 Mr Neil Bull, Environmental Projects Manager, Ricegrowers' Association of Australia, *Committee Hansard*, Canberra, 20 June 2018, p. 8.

59 Deakin University, *Submission 10*, p. 2.

3.46 In relation to fish population levels, Dr Clayton Sharpe (private capacity) said ‘evaluating the actual targeted response’ is the best approach. Dr Sharpe said the habitat and flow requirements for spawning Murray cod are known and monitoring could involve verifying how many survived and grew into small fish.⁶⁰ He said fish species respond depending on whether they are ‘generalist’ fish or ‘specialist’ fish that rely on distinct conditions.⁶¹ He said:

On a recent examination of Gunbower forest under managed flooding, using infrastructure to inundate around 5,000 hectares, we saw only two native species proliferate while 11 others weren’t even present on the flood plain.⁶²

3.47 Deakin University also observed that monitoring tends to focus on vegetation, birds and fish. The submission suggested that a more transparent approach would be to monitor the ‘processes that support biodiversity’, which includes recruitment (organism survival), decomposition and nutrient cycling.⁶³

3.48 Professor Nick Bond (La Trobe University) said that long-term outcomes will take ‘considerable time to accrue and then... be detected’. He said this includes changes to native fish populations and plant diversity in wetlands.⁶⁴ Mr Hugo Hopton (CEO, Nature Foundation SA) and Mr Garry Hera-Singh (Chairman, Southern Fishermen’s Association) said that the river system had been highly modified from its original form and the results of environmental watering would take time to become evident.⁶⁵

Investing in monitoring

3.49 A number of witnesses and submissions commented on the need to invest in monitoring environmental outcomes. The NSW Irrigators’ Council submitted:

If we are to have a comprehensive picture and hard data on the effectiveness of the Plan in returning environmental assets to better health, we need to invest in a monitoring and evaluation network in greater depth.⁶⁶

60 Dr Clayton Sharpe, private capacity, *Committee Hansard*, Mildura, 1 May 2018, p. 12.

61 Dr Clayton Sharpe, private capacity, *Committee Hansard*, Mildura, 1 May 2018, pp. 14-15.

62 Dr Clayton Sharpe, private capacity, *Committee Hansard*, Mildura, 1 May 2018, p. 15.

63 Deakin University, *Submission 10*, p. 2.

64 Professor Nick Bond, La Trobe University, *Committee Hansard*, Albury, 30 April 2018, p. 10.

65 Mr Garry Hera-Singh, Chairman, Southern Fishermen’s Association and Mr Hugo Hopton, CEO, Nature Foundation SA, *Committee Hansard*, Murray Bridge, 2 May 2018, p. 7.

66 NSW Irrigators’ Council, *Submission 32*, p. 4.

3.50 The submission continued:

If we cannot measure progress against the Plan objectives it is too easy for critics to claim no progress has been made, but an even greater imperative should be in instilling public confidence... that the significant investment by Government in water recovery is paying environmental dividends.⁶⁷

3.51 Professor Lin Crase submitted that 'some in government actively seek to suppress the creation of scientific evidence, else their political options are narrowed'.⁶⁸ The National Farmers' Federation submitted that 'in such a continually emotive and politically charged debate more and more reliance on quality and reliable data is inevitable'.⁶⁹

3.52 The Australian Academy of Technology and Engineering submitted:

It is essential that the CEWH and allied agencies... have adequate resources to undertake effective monitoring and evaluation activities incorporating the best available science and technology. A long-term commitment to monitoring and evaluation is necessary because ecosystems respond in complex ways to variable cycles of climate and water use.⁷⁰

3.53 Professor Michael Stewardson (University of Melbourne) said that a 'small portion' of the CEWH's watering actions are monitored and investment in monitoring is needed to inform water management decisions.⁷¹ He said:

For example, in the Goulburn River, winter flows have been delivered in some years to improve bank vegetation. This watering event alone represents about \$10 million of water each year, but there's no funding to monitor its environmental effects.⁷²

3.54 Dr Grant Trantor (Executive Officer, Macquarie River Food and Fibre) said that the environmental water portfolio is a sizeable asset and 'it would be somewhat silly to underspend on monitoring and evaluation'.⁷³

67 NSW Irrigators' Council, *Submission 32*, p. 4.

68 Professor Lin Crase, *Submission 1*, p. 4.

69 National Farmers' Federation, *Submission 29*, p. 5.

70 Australian Academy of Technology and Engineering, *Submission 11*, p. 2.

71 Professor Michael Stewardson, University of Melbourne, *Committee Hansard*, Albury, 30 April 2018, p. 9.

72 Professor Michael Stewardson, University of Melbourne, *Committee Hansard*, Albury, 30 April 2018, p. 9.

73 Dr Grant Trantor, Executive Officer, Macquarie River Food and Fibre, *Committee Hansard*, Sydney, 22 June 2018, p. 18; see also Professor Lin Crase, *Submission 1*, p. 4.

- 3.55 The Nature Conservation Council NSW suggested that more funding could be made available for monitoring and evaluation, by taking funding away from 'very expensive and unproven infrastructure projects'.⁷⁴

Satellite imagery

- 3.56 The Committee received evidence on how satellite imagery could be used to monitor environmental watering. The Australian Academy of Technology and Engineering submitted:

Automated digital measurements, and monitoring using satellite and drone imagery offer great potential for improved monitoring.⁷⁵

- 3.57 Dr Stephen Turton (Chair, National Committee for Geographic Sciences, Australian Academy of Science) agreed that satellite imagery could be used with geographic information systems. He said:

We would take this enhanced spatial resolution, integrated with information about market actions, hydrology and agricultural responses to water availability, to provide modelling of environmental water releases under different scenarios. This would allow for extremely efficient targeted, optimised water releases by the water holder.⁷⁶

- 3.58 Dr Turton added that while there is a role for satellite technology, 'ground truthing' practices would also be required, such as remote sensing and measurements of stream flow and ecological change.⁷⁷

Knowledge and research

- 3.59 The Committee received evidence that there may be uncertainties or gaps in relation to evaluating environmental outcomes. More generally, the Committee heard that to some extent information is always going to be incomplete and decisions have to be improvised.⁷⁸ Furthermore, the future poses challenges – for example, the next major drought or the effects of climate change on the environment.

74 Nature Conservation Council NSW, *Submission 24*, p. 5.

75 Australian Academy of Technology and Engineering, *Submission 11*, p. 2.

76 Dr Stephen Turton, Chair, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 1.

77 Dr Stephen Turton, Chair, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 3.

78 Dr Stuart Barrow, Senior Policy Analyst, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 4.

- 3.60 Dr Stuart Barrow (Senior Policy Analyst, National Committee for Geographic Sciences, Australian Academy of Science) said having a deeper understanding and knowledge of the river system is always beneficial. He added that a 'strong role' exists for scientific advice to guide policy settings.⁷⁹ He also noted:
- As a principle, you should be making decisions on the best and most accurate information available. But there is also the consideration that you are almost always going to be making decisions on incomplete information.⁸⁰
- 3.61 In cases where accuracy is a challenge, Dr Barrow said data could be reviewed, gaps identified and processes improved.⁸¹
- 3.62 Dr Stephen Turton (Chair, National Committee for Geographic Sciences, Australian Academy of Science) said climate change could create uncertainties in the future for managing the Basin area:
- The Darling system is fed more by tropical or subtropical events, and the southern system is more to do with winter rainfall, spring rainfall and, of course, snow melt. All of those things are going to change, and it may well be that the hydrology of the system in the future relies more on the summer input into the Darling system.⁸²
- 3.63 Dr Turton continued:
- Whether that affects the total flow, no-one really knows, but that research is also important if we're thinking decades down the track.⁸³
- 3.64 The National Farmers' Federation observed that while environmental water builds resilience, 'most ecosystems are also dependent on a dry spell' and 'no plan will stop the Lower Lakes from drying up'.⁸⁴
- 3.65 The Ricegrowers' Association's submission encouraged further research and development needed for long range weather forecasting capability, as rainfall and climate largely correlate with water supply.⁸⁵
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79 Dr Stuart Barrow, Senior Policy Analyst, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 2.

80 Dr Stuart Barrow, Senior Policy Analyst, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 4.

81 Dr Stuart Barrow, Senior Policy Analyst, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 4.

82 Dr Stephen Turton, Chair, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 5.

83 Dr Stephen Turton, Chair, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 5.

84 Mr Les Gordon, Chair, Water Taskforce, National Farmers' Federation, *Committee Hansard*, Canberra, 23 May 2018, pp. 4-5.

- 3.66 The Department of the Environment and Energy submitted that the CEWH is applying adaptive management practices that are ‘drawing from the best available science... and the experiences of those people living and working in the Basin’.⁸⁶
- 3.67 There are currently two notable projects, discussed below:
- The *Murray-Darling Basin Environmental Water Knowledge and Research Project* relates to on-ground monitoring and research projects for vegetation, waterbirds, fish and food-webs.⁸⁷
 - The *Long-Term Intervention Monitoring Project*, to monitor and evaluate the outcomes of Commonwealth environmental water in the Basin over 5 years from 2014 to June 2019.

Knowledge and research project

- 3.68 Dr Stephen Turton (Chair, National Committee for Geographic Sciences, Australian Academy of Science) said the CEWH’s Environmental Water Knowledge and Research Project should continue beyond 2019.⁸⁸ The Australian Academy of Technology and Engineering submitted that the project should be reviewed and consideration given to ‘follow-on arrangements of some kind to ensure the continuity of research and development activity in this area’.⁸⁹
- 3.69 The Committee asked the CEWH whether this project would be continued beyond 2019. In response, the CEWH advised that investment in research would continue, as indicated in the Department of the Environment and Energy’s forward budget estimates. The CEWH also noted that ‘continuity will be a major consideration in our procurement so understanding and knowledge can continue to build over time’.⁹⁰

Long-Term Intervention Monitoring project (LTIM)

- 3.70 The CEWH is conducting long-term monitoring in seven areas (or regions), over a five year period from June 2014 to June 2019. This monitoring is intended to establish whether environmental water is

85 Ricegrowers’ Association of Australia, *Submission 19*, p. 7.

86 Department of the Environment and Energy, *Submission 38*, p. 37.

87 Department of the Environment and Energy, *Submission 38*, pp. 36-37.

88 Dr Stephen Turton, Chair, National Committee for Geographic Sciences, Australian Academy of Science, *Committee Hansard*, Canberra, 30 May 2018, p. 2.

89 Australian Academy of Technology and Engineering, *Submission 11*, p. 2.

90 Department of the Environment and Energy, *Supplementary Submission 38.1*, pp. 10-11 (CEWH response to Question 9).

achieving outcomes at both a local level and across the Basin.⁹¹ The MDBA noted:

There is a lag between the use of environmental water, changes to ecological conditions and measurable changes to social and economic outcomes.⁹²

- 3.71 Professor Nick Bond (La Trobe University) said the LTIM program has been ‘absolutely critical in providing an information base’ around ecological outcomes and environmental watering. He said the project should continue for a further phase beyond 2019. The South Australian Government submitted that in a future phase, the LTIM should include the Lower Lakes, Coorong and Murray Mouth.⁹³
- 3.72 Deakin University submitted that while the LTIM project is a critical investment, there should be an integrated strategy that involves high-level and broad monitoring over many years, combined with spatial and temporal scales.⁹⁴

Measuring social and economic trends

- 3.73 The Australian Floodplain Association’s submission observed that monitoring efforts have been directed towards how flows improve the environment, rather than broader impacts on Basin communities. The submission recommended adopting the term ‘community water’ and added:

We all own and benefit from this community water; it is not just for the birds, bees, trees, frogs and fish. A paradigm shift will result in truly healthy rivers and healthy communities.⁹⁵

- 3.74 Mrs Gabrielle Coupland (Chair, Southern Riverina Irrigators) said that Basin communities had ‘suffered very real pain’ and people want to be assured of the outcomes being achieved with environmental water.⁹⁶ She

91 Department of the Environment and Energy, *Submission 38*, p. 35. There is further information on the Department’s website, including the locations selected for monitoring: <<http://www.environment.gov.au/water/cewo/monitoring/ltim-project>>.

92 Department of the Environment and Energy, *Supplementary Submission 38.1*, p. 11 (MDBA response to Question 10).

93 South Australian Government, *Submission 40*, p. 10.

94 Deakin University, *Submission 10*, p. 3.

95 Australian Floodplain Association, *Submission 20*, pp. 1-2.

96 Mrs Gabrielle Coupland, Chair, Southern Riverina Irrigators, *Committee Hansard*, Albury, 30 April 2018, p. 29.

added that 'volume alone will not achieve the environmental outcomes that we all need'.⁹⁷

- 3.75 Similarly, the National Irrigators' Council submitted that water acquisition has been 'devastating for many communities as a result of the removal of water'.⁹⁸ The National Irrigators' Council submitted that people and communities are being given a lower priority than the environment:

The trajectory of reform... has traditionally been heavily biased towards water as the only environmental management solution to address environmental decline in our river systems. ...volume of water has taken precedence over the welfare of people, communities and agriculture food and fibre production with... questionable environmental outcomes.⁹⁹

- 3.76 Greater Shepparton Council advised that 'further loss of water from the region will see irreparable devastation'.¹⁰⁰

- 3.77 Dr Clayton Sharpe (private capacity) commented on the importance of recreational fishing in the Basin area:

I think there are over 400,000 anglers that generate \$1.3 billion to the economy of the Murray-Darling Basin, and there are a number more that live outside the Murray-Darling Basin. So it's important that we consider the impacts of environmental water on promoting fish populations from their point of view.¹⁰¹

- 3.78 Dr Sharpe said fish populations are good in some locations, but 'precarious in the majority'.¹⁰² He said:

This is not because of environmental water managers not operating at their maximum efficiency; it is because we are a long way off achieving balance between the consumptive use of our water and the sustainability of our system.

...

This is none more evident than in the Darling River, which has run dry for almost as long as it has flowed in the past five years

97 Mrs Gabrielle Coupland, Chair, Southern Riverina Irrigators, *Committee Hansard*, Albury, 30 April 2018, p. 22; see also Dr Grant Trantor, Executive Officer, Macquarie River Food and Fibre, *Committee Hansard*, Sydney, 22 June 2018, p. 12.

98 National Irrigators' Council, *Submission 23*, p. 3; see also Mrs Gabrielle Coupland, Chair, Southern Riverina Irrigators, *Committee Hansard*, Albury, 30 April 2018, p. 29. Mrs Coupland said that in the Finley township in southern NSW, 'half of the shops are vacant now'.

99 National Irrigators' Council, *Submission 23*, p. 3.

100 Greater Shepparton Council, *Submission 35*, p. 1.

101 Dr Clayton Sharpe, private capacity, *Committee Hansard*, Mildura, 1 May 2018, p. 14.

102 Dr Clayton Sharpe, private capacity, *Committee Hansard*, Mildura, 1 May 2018, p. 11.

because of water extraction, consumptive use and mismanagement.¹⁰³

- 3.79 Mr Frederick Hooper (Chairperson, Northern Aboriginal Nations Limited) said that ‘for Aboriginal people, water is water’. He continued:

It’s water that comes down the system and it’s water that sustains us. We don’t put labels on the water. ... We don’t say that’s environmental water or that’s coal seam gas water or that’s cultural water. Water, for us, is water. The benefits that come from that water sustain us as well. So it’s not just the water that is coming down the system. It is the plants that rely on that water. It’s the fish that are in that river system that we catch to sustain us as well.¹⁰⁴

- 3.80 The Australian Academy of Sciences suggested that there could be more analysis of the ‘social and economic impacts of the continuing structural changes in the economies of rural areas’.¹⁰⁵ Furthermore:

Geographical sciences provide the ability to integrate knowledge from the natural and social sciences, research grounded in field work, and a focus on places and their communities.¹⁰⁶

- 3.81 Mr Denis Flett (Victorian Environmental Water Holder) said shared benefits are given due consideration. He said:

While we are environment first... We now take into account the implementation of and report on all those shared benefits – be it Aboriginal connection to country, be it recreational or be it anything to do with water quality...¹⁰⁷

Committee comment

- 3.82 While the Committee understands that environmental watering objectives can take time to materialise and some results are intangible, reporting outcomes is important for public confidence. The Commonwealth’s environmental water holdings represent a significant financial investment.

103 Dr Clayton Sharpe, private capacity, *Committee Hansard*, Mildura, 1 May 2018, p. 11.

104 Mr Frederick Hooper, Chairperson, Northern Basin Aboriginal Nations Ltd, *Committee Hansard*, Canberra, 20 June 2018, p. 4; see also Australian Floodplain Association, *Submission 20*, p. 3.

105 Australian Academy of Sciences, *Submission 8*, p. 2.

106 Australian Academy of Sciences, *Submission 8*, p. 3.

107 Mr Denis Flett, Chairperson, Victorian Environmental Water Holder, *Committee Hansard*, Albury, 30 April 2018, p. 5.

Water is a limited resource and there is an expectation that environmental water use will be efficient and effective.

- 3.83 Continued improvements to operational monitoring, real-time tracking, metering and public disclosure can provide ongoing confidence in the way environmental water is being used and managed. Nevertheless, environmental watering is a relatively new concept and notions of best practice may evolve over time.
- 3.84 Monitoring of long-term outcomes shows how environmental water releases are contributing to broader improvements to rivers and wetlands. The CEWH and other agencies involved in environmental water should continue to invest in these areas. A range of pathways are available that could be explored further:
- Examining social and economic variations related to environmental watering.
 - Analysing aerial or satellite imagery, linking it to environmental water events and related ecological changes.
 - Coordinating with other government agencies on contingency planning, forecasting and anticipating impacts from climate change.

Recommendations

Recommendation 5

The Committee recommends that the Commonwealth Environmental Water Holder's Knowledge Management Project and Long-Term Intervention Monitoring Project (or similar projects) be continued.

Recommendation 6

The Committee recommends that the Commonwealth Environmental Water Holder investigate additional monitoring techniques, including:

- **aerial or satellite imagery; and**
- **observations and reports from experienced volunteers, including land holders, State authorities and other groups such as the Southern Fishermen's Association.**