Australian Government

Department of the Environment, Water, Heritage and the Arts

A Framework for Determining Commonwealth Environmental Watering Actions

A discussion paper

Department of the Environment, Water, Heritage and the Arts

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This paper has been drafted and circulated for consultative purposes. It is done so without prejudice to future decisions on the use of environmental water or the ultimate approach to decision-making to be adopted by the Commonwealth Environmental Water Holder.

Contents

1. Introduction

The purpose of this paper is to outline a proposed framework for determining Commonwealth environmental watering actions in the Murray-Darling Basin. This framework will be developed over the period 2009-2011, prior to the development of the Environmental Watering Plan (EWP) by the Murray Darling Basin Authority, and be adapted in accordance with the EWP once that is available.

1.1. Water Reform in the Murray-Darling Basin

The *Water Act 2007* established the Commonwealth Environmental Water Holder (CEWH) as part of broader water resource management reforms within the Murray Darling Basin. These reforms are fundamentally about ensuring sustainable use of a valuable water resource. Consumptive use must be within the long-term sustainable limit so that ecosystems have sufficient water to perform key ecological functions into the future. To facilitate this outcome new arrangements are being put into place. These will ultimately be characterised by:

- a new basin-wide cap that covers both surface and groundwater extractions for consumptive use, and thereby allows flows to return to rivers and wetlands to restore the health of the system;
- a significant increase in the quantity of water entitlements that are being actively managed to provide ecologically beneficial wetting/drying and variable flow regimes;
- an Environmental Watering Plan to enable the environmental water of all holders and managers to be coordinated in a complementary basin-wide manner; and
- integration of environmental flow requirements with salinity, water quality and natural resource management arrangements.

Within this framework the CEWH has been established as a holder and manager of tradeable water entitlements, rather than as a manager of a water reserve with specific environmental characteristics or as a manager of environmental flow rules. The aim of this approach is to add a significant amount of water to the environment over and above what is currently available and with the same security of property right as consumptive users. It offers some degree of flexibility to act as a market participant and so adjust the portfolio of water entitlements as circumstances change. It is important to consider managed entitlements as one component of an integrated environmental watering approach across the Basin; an approach that will also include adaptive rules-based environmental flows in conjunction with a new sustainable basin-wide cap.

The *Water Act 2007* also establishes the Murray-Darling Basin Authority (MDBA), which must develop a plan for the management of the Basin's water resources. The Basin Plan must include an Environmental Watering Plan (EWP), which will have the objective to protect and restore rivers, wetlands and other environmental assets, and to protect biodiversity dependent on the Basin's water resources. The CEWH must manage the Commonwealth environmental water holdings in accordance with the EWP. The first EWP is expected by 2011 and to be operational in some parts of the Basin by 2014. Under Section 28(2) of the *Water Act*, the EWP must specify:

(a) the overall environmental objectives for the water-dependent ecosystems of the Murray-Darling Basin;
(b) targets by which to measure progress towards achieving the environmental objectives specified in accordance with paragraph (a);

(c) an environmental management framework for planned environmental water and held environmental water;
(d) the methods to be used to identify environmental assets in the Murray-Darling Basin that will require environmental watering;
(e) the principles to be applied, and methods to be used, to determine the priorities for applying environmental water (including applying that water to environmental assets that are identified using the methods specified under paragraph (d));
(f) the principles to be applied in environmental watering.

1.2. Making decisions on environmental watering actions

In addition to the EWP, the CEWH will require a process for making determinations on the use of available water in any given year. This process will need to be more specific than the EWP about matching water availability with water demand and should be based on a robust, scientifically defensible decision framework, in accordance with multi-year ecological and operational considerations, and flexible to changing conditions and knowledge.

A framework for determining environmental watering actions will help ensure that the Commonwealth's water is used for the best environmental outcomes that can be achieved with the volume of water that is expected to be available, and under the operational constraints that will limit options on its use. It will be based on clear ecological and management objectives and be supported by a consistent decision making process; one that allows a prioritisation of actions to occur in consideration of both immediate and longer-term needs. The Department is working to obtain important information which will input into this process, including a determination of the key environmental assets and ecosystem processes across the basin, where such information exists.

The framework described in this paper is presented as a draft for further consideration and for consultative purposes. It will be used to inform the 2009-2010 CEWH Business Plan and the approach to environmental watering for that year. It will be progressively developed over the period 2009-2011 and will help the Department provide input to the development of the Murray-Darling Basin Authority's EWP.

1.3. 2009-11 Outlook

Over the next two years a range of different scenarios that will define the context in which the Commonwealth must use its water, are possible. Depending on environmental and market conditions there will be a significant difference in the volume and type of water available to the CEWH than is currently the case.

Water in the Commonwealth environmental water holdings will be from a variety of sources and with a range of different characteristics. It will include high security and low security entitlements, regulated allocation that can be called from storage, and unregulated flow that cannot be actively managed. The exact combination of assets is not yet known but will ultimately have a significant impact on the approach to environmental watering that is possible across the Basin.

2. Overall objectives and scope of Commonwealth water use

The *Water Act 2007* prescribes that within the Basin, Commonwealth water must be managed for the purpose of protecting or restoring the environmental assets of the Basin, so as to give effect to relevant international agreements. Relevant international agreements include the Ramsar, Bonn, Desertification, Biodiversity and Climate Change Conventions, and Migratory Birds agreements with Japan, China and the Republic of Korea.

These agreements cover a broad range of issues. For example, the Biodiversity Convention requires Parties to rehabilitate and restore degraded ecosystems, and adopt measures for the recovery and rehabilitation of threatened species. It also promotes the protection of ecosystems, natural habitats and maintenance of viable populations of species in natural surroundings.

The Ramsar Convention aims to have listed wetlands (Ramsar sites) managed in a manner that preserves their ecological character. It also includes a more general objective of promoting the wise use of all wetlands. A broad range of environmental watering actions could therefore usefully give effect to these sorts of outcomes.

The *Water Act 2007* defines environmental assets as water-dependent ecosystems, ecosystem services, and sites of ecological significance. Water-dependent ecosystems include wetlands, streams, floodplains, lakes and other bodies of water, salt marshes, estuaries, karst, and groundwater systems.

In protecting or restoring these assets, we are seeking to contribute to the sustainable use of the Basin's water resources. Defining a sustainable water resource from an environmental perspective is not without its challenges and the Basin Plan is expected to provide guidance on this. In the meantime the Department will be seeking to describe the characteristics that define a sustainable basin-wide system in order to provide a framework under which the Commonwealth can prioritise, and explain on a scientific basis, our watering actions. Determining the optimum levels and ecological equilibrium points will be limited, in some cases seriously so, by available scientific knowledge. In many cases these may never actually be known with certainty. Learning to operate with scientific uncertainty in an appropriate risk management framework will be a central component of Commonwealth environmental watering.

A sustainable basin-wide system is one which is able to provide a long-term balance between maintaining the ecological resilience of its water-dependent ecosystems and continuing to meet human needs. It is about recognising that as a system it exists not as a series of independent, albeit high value sites or river reaches, but rather as a network of interdependent life supporting connections and processes, and that watering needs and opportunities vary significantly at different times and in different parts of the basin.

Although it does recognise that some sites or river reaches may contribute disproportionately to overall system health through the richness of their biodiversity or the strength of their ecosystem processes, maintaining the health of such sites is also about supporting their dependent processes and the health of related sites and river reaches; assets which may when considered in isolation, be seen to be of lesser value.

The Basin's rivers and streams typically exhibit high variability of flow. This variability is essential for maintaining the health and function of its ecosystems. The dependent flora and fauna have adapted to, and are often dependent on, the highly variable flows which result from the region's variable and unpredictable climate. Population booms accompany floods, with floodwaters triggering breeding events and seed germination. As floodwaters recede and drier conditions prevail, many species die, leaving their eggs or seeds for the

next flood, while others will become dormant or migrate. Some mobile species retreat to permanent waterholes which provide refuges when other parts of the floodplain dry out.

The expanding and contracting floodwaters also provide important ecosystem connectivity between the main river channel and the floodplains. The floodwaters supply the floodplains with nutrients and sediments from the river, accelerate the breakdown of organic matter and replenish and refill disconnected floodplain water bodies, in addition to stimulating animal and plant life. As the waters recede, the floodplains provide the main river channel with organic matter (which is decomposed to produce carbon) as well as living organisms. The floodplains also rid the water of excess nutrients, in effect, reducing the risk of blue-green algal blooms.

In this context and from the perspective of setting the parameters under which environmental water should be provided to the Basin, a sustainable basin-wide system exhibits the following characteristics:

- Ecological processes functioning across the basin are as close as possible to natural given the constraints extant in each catchment (i.e. other water users, climate change, existing land-use, etc).
    - Energy and nutrient exchange processes between the rivers and floodplains are as close as possible to natural given the environmental conditions that persist in each catchment;
    - Sediment transport processes are as close as possible to natural given the environmental conditions that persist in each catchment;
    - As much as possible of the natural diversity of water-dependent habitats exists in any given river reach or catchment;
    - Physical and chemical water properties across the basin are as close as possible to natural for the ecosystems that prevail in each catchment;
    - Soil formation, primary production and other metabolic processes are as close as possible to natural given the environmental conditions that persist in each catchment.
- Water-dependent ecosystems support diverse communities and are resilient across the Basin.
    - Distribution and abundance of species within a given ecosystem are at or approaching their potential carrying capacity given prevailing environmental conditions;
    - Ecological communities contain available and healthy refuge sites when drier conditions prevail;
    - Native species have access to suitable habitat at each stage of their life-cycle and recruitment levels are sustained;
    - Connectivity pathways between water-dependent ecosystems occur at optimum frequencies and durations given prevailing environmental conditions.
- There is a diversity of functional and resilient water-dependent ecosystem types across the Basin.

- Society's awareness and understanding of how the Basin functions as an ecological system is constantly improving and constraints to a healthy ecological system are continually identified and addressed.

In practice these overall parameters for a sustainable basin-wide system will define the scope under which the Commonwealth will use its water. For the CEWH's environmental watering decisions it will mean:

- Water is provided to aquatic ecosystems in consideration of natural variability, seasonality (and other temporal patterns), flow velocity and volumes;
- Prioritisation of environmental watering actions must consider the ecological opportunity costs of otherwise using that water at a basin-wide scale;
- Providing water to critical connecting processes that support ecosystem health is in many cases as important as providing water to high-value sites themselves;
- Prioritisation of environmental watering must consider using water for multiple benefits and multiple uses wherever possible;
- In using water for any particular objective, how that water is made available, the impediments to delivery including transmission losses, cost effective use and wider ecological impacts, are considered from a systems perspective;
- Water is used for a diversity of ecological outcomes throughout the Basin;
- Measures are put in place to ensure that learning from environmental watering takes place and that impediments to desired ecological outcomes are identified and addressed.

It is important to note that the Commonwealth's use of water will be only one of a number of initiatives aimed at achieving a sustainable basin-wide system. The reforms of the National Water Initiative, the establishment of the MDBA, the Basin plan, a basin-wide sustainable diversion limit, water-sharing plans, land-use practices, and natural resource management activities amongst other components, will all play a crucial part and in many cases also impact upon the effectiveness of the use of environmental water.

Question 1: Does the scope of Commonwealth environmental watering as outlined, meet your expectations of the range of ecological parameters that should be considered in the use of Commonwealth environmental water?

3. Specific water use objectives

In the current extreme dry period the management objectives agreed by the Living Murray's environmental watering group and used by the CEWH in 2008-09 are:

- to avoid critical loss of threatened species;
- to avoid irretrievable damage or catastrophic events; and
- to maintain key refuges to allow recolonisation when conditions improve.

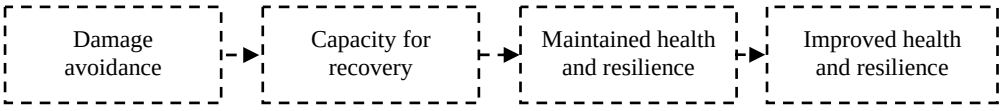
Different management objectives will be required under different conditions. In the coming spring (2009) it is likely that the Commonwealth will have substantially more water available to achieve environmental objectives. As noted above this means that a range of opportunities that are not currently available to the CEWH will become so.

In addition to the ecological objectives under extreme dry conditions, table one presents a proposed set of objectives for conditions in: a dry year; a year close to the long-term

median; and a wet year, that is, greater than median rainfall and runoff. It is important to bear in mind that shifts in climate, such as the apparent shift to a drier regime in the last ten years, will have a significant impact on what is possible and an historical assessment of rainfall and runoff will also need to consider the conditions relative to more recent history.

Table 1: Proposed ecological watering objectives under different water resource availability scenarios

	Extreme Dry	Dry	Median	Wet
Ecological watering objectives	Avoid damage to key environmental assets	Ensure ecological capacity for recovery	Maintain ecological health and resilience	Improve and extend healthy and resilient aquatic ecosystems
Management objectives	- Avoid critical loss of threatened species and communities - Maintain key refuges - Avoid irretrievable damage or catastrophic events	- Support the survival and growth of threatened species and communities including limited small-scale recruitment - Maintain diverse habitats - Maintain low flow river and floodplain functional processes in sites and reaches of priority assets	- Enable growth, reproduction and small-scale recruitment for a diverse range of flora and fauna - Promote low-lying floodplain-river connectivity - Support medium flow river and floodplain functional processes	- Enable growth, reproduction and large-scale recruitment for a diverse range of flora and fauna - Promote higher floodplain-river connectivity - Support high flow river and floodplain functional processes
Management actions	- Water refugia and sites supporting threatened species and communities - Undertake emergency watering at specific sites of priority assets - Use carryover volumes to maintain critical needs	- Water refugia and sites supporting threatened species and communities - Provide low flow and freshes in sites and reaches of priority assets - Use carryover volumes to maintain follow-up watering	- Prolong flood/high-flow duration at key sites and reaches of priority assets - Contribute to the full-range of in-channel flows - Use carryover to provide optimal seasonal flow patterns in subsequent years	- Increase flood/high-flow duration and extent across priority assets - Contribute to the full range of flows incl. over-bank - Use carryover to provide optimal seasonal flow patterns in subsequent years



The objectives in Table 1 seek to provide guidance as to how water should be used under different climatic and flow conditions. These conditions will impact upon how much water is available in the system, including how much is available to the Commonwealth. Subject to system constraints, in some cases water would be used in conjunction with natural flows and in some cases with water made available by delivery partners. The system as a whole would be more reflective of the prevailing climatic conditions, which would not only be impacting on the volume of held environmental water, but on the total volume of water flowing through the system.

As conditions progress from extreme dry through to wet and more environmental water becomes available, the ecological objectives in Table 1 progress from damage avoidance to maintenance of refugia and the capacity for recovery, to maintaining health and resilience, to an expansion of healthy ecosystem. Longitudinal and lateral connectivity are progressively provided to a greater range of habitats as channel flows and flood volumes and frequencies increase, so that a greater range of watering options becomes possible.

In progressively wetter conditions a more holistic, systems approach becomes more feasible. However, it is important that such an approach be considered in all scenarios. For example, under dry conditions a systems approach might involve using water at sites spread broadly across the Basin to ensure the capacity for broad system-wide recovery. Water for refugia would be provided in consideration of the number of other refuge sites in the vicinity and across the Basin for the relevant species or ecological community.

Under **dry** conditions, where allocations are below the median, the objective is to maintain refugia, supporting the survival and growth of threatened communities to ensure a capacity for recovery when wetter conditions return. In-channel flows and wetland regimes would be focused on the lower end of the hydrograph. Watering actions would be spread across the Basin to help ensure capacity for system-wide recovery, and recovery in as many ecosystem types as possible. Some limited small-scale recruitment could be supported.

Under **median** conditions, the ecological health and resilience of the system should be maintained by supporting not only survival and growth, but also reproduction and small-scale recruitment. Flows would be focused in-channel but on higher, less frequent flows delivered at the optimum time of year. Some limited river-floodplain connectivity and flooding may be desirable for low-lying floodplain areas at the highest priority assets.

Under **wet** conditions, larger natural flow volumes should enable the CEWH to contribute to an expansion of the area of healthy ecosystem across the Basin and to larger-scale recruitment. This would be achieved by increasing the frequency, volume, duration and floodplain extent of flooding events. Contributing to the full-range of natural flow variability should become possible, in particular flows at the upper end of the hydrograph, including bank-full and perhaps some limited over-bank flows for more sites than just the highest priority ones. River-floodplain connectivity would be provided to higher-lying areas than is possible under drier conditions.

As a larger volume of water is available to be managed in wetter conditions it becomes appropriate to make greater use of carryover options to ensure that water can be used at the optimum time of year. This approach could, for example, be used to enable winter/spring flows to be allowed to pass through ‘translucent’ storages to the river downstream.

The actual approach that is implemented will need to be determined on a catchment-by-catchment basis and in some cases on a sub-catchment basis, subject not only to the water resource outlook but also to the individual requirements of the environmental assets located there. The biogeographic, topographic, resource use, and climatic context, as well as the volume of water that can actually be delivered, will all need to be considered. The provision of environmental water will also need to be made in consideration of previous watering decisions, flow history and follow-up water requirements at each environmental asset.

Question 2: Do you agree with the proposed ecological objectives under different water availability scenarios outlined in the table above, or can you offer suggestions for improvement?

4. Prioritisation process

The key component of a framework for determining environmental watering actions is the decision making process upon which a prioritisation of actions and the matching of priorities with available water occurs. In 2008-09, a set of nine criteria was used to prioritise watering actions (Attachment A). As more water becomes available and climatic conditions change these criteria will need to be enhanced, including with the development of associated decision support tools. It is expected that several iterations will be required over the course of the *Water for the Future* initiative, particularly once the Basin Environmental Watering Plan has been developed.

A robust decision framework that matches available water to the highest priority requirements given prevailing conditions and within the parameters set by the watering objectives should be capable of considering multi-year ecological needs and be flexible to changing circumstances. Multi-year considerations include stochastic hydrological variability, wetland wetting-drying cycles, breeding/recruitment cycles, the need for follow-up flows, the condition of the asset, and complementary works and natural resource management arrangements which may help to maximise outcomes.

The diagram below (Figure 1) seeks to illustrate how a decision framework may arrive at an appropriate matching of available water with priority watering actions. It incorporates the elements of the nine criteria used for prioritising watering actions in 2008-09 and would be governed by the overall objectives, and the practical application of those, outlined above.

The process starts from two points. To the left, is an *environmental asset register*, which would contain a prioritised list of all environmental assets that could potentially be targeted by Commonwealth water. The environmental asset register would exist as a database of all possible watering options in each catchment of the Basin as guided by the definition of environmental assets set out in the Water Act. It would encompass watering options at various spatial scales from individual refuge sites and wetlands, through to series of wetlands, to individual river reaches and to entire rivers, depending on what is in-scope, given overall water availability.

The asset register would need to be established in consideration of the Commonwealth's legislative obligations and the international agreements referred to in the Water Act. Each environmental asset would have one or more ecological values/attributes which would inform the specific ecological objectives for watering actions and establish the basis for determining their ecological significance. The register would contain information necessary to establish the multi-year watering requirements of the ecological values of each asset, so that planning can consider the longer-term requirements of specific assets.

To the right, are the Commonwealth's water holdings. Arriving at an alignment between the priority environmental assets and the water holdings is the purpose of the framework and it consists of four main steps. A brief description of each follows:

1. *Forecast total water availability*. In determining how much water is available for use it is important to understand the characteristics of that water. In particular where it is located and where it can be delivered given any constraints (e.g. channel capacity; transmission losses; trading limitations; other water users), and whether or not it can be controlled or used in combination with different types of environmental water. The timing of water availability is also an important consideration. Earlier in the season, less water allocations will have been made by the water authorities and so fewer watering options will be open to the

Commonwealth. This constraint can be offset to some extent by carryover water (subject to different conditions in different parts of the basin) but not eliminated entirely and will be a limiting factor to consider.

The forecast water availability should also include consideration of the projected water availability of delivery partners as cooperative watering will be key to achieving the overall objectives.

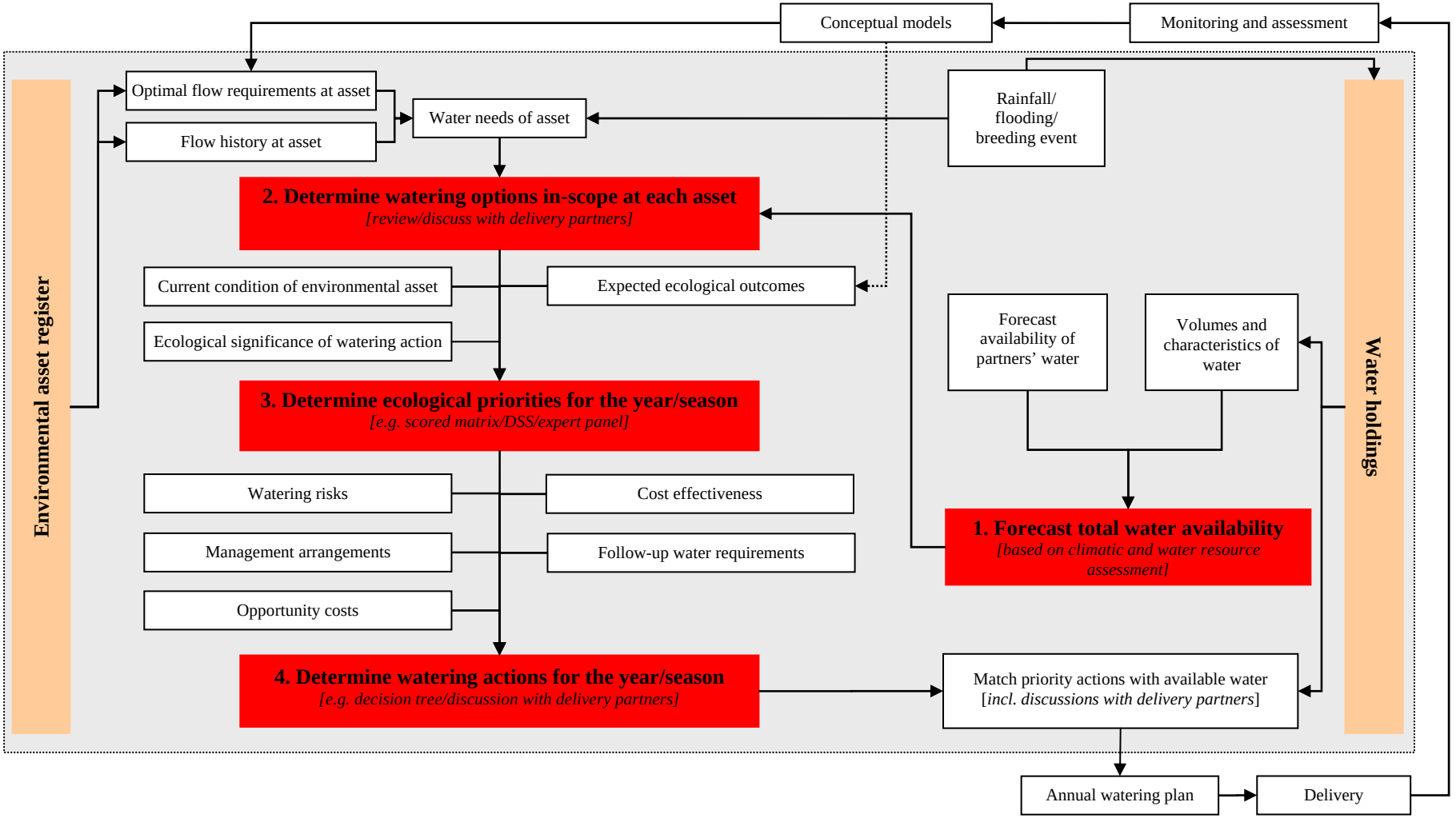
2. *Determine the watering options in-scope at each asset*. To ensure a system-wide approach to environmental watering, at the start of the watering year it will be important that there is understanding of all the options in-scope across the Basin. This will depend on an assessment of current water needs at each priority asset and the forecast of total water availability. Current water needs will vary seasonally and will be determined based on the known optimum flow requirements and recent flow history at each asset, as well as the conceptual models which identify the ecological responses that can be expected. These conceptual models will present the scientific hypotheses linking water regimes to ecological outcomes. They are critical to setting objectives and to understanding and monitoring expected responses.
3. *Determine ecological priorities for the year.* Once all the options that are in-scope have been identified, a prioritisation based on the ecological significance of each location, its ecological functions in the basin-wide context and the nature of the biodiversity affected, can be undertaken. This might be done initially by use of a rating scale based on, for example, the criteria of criticalness, distinctiveness, representativeness, diversity, the magnitude and expected benefit from the watering action, the current condition of the asset, and the history of watering and the urgency of its water requirements. Ultimately it might involve a more sophisticated Bayesian model or similar tool, or possibly the use of an expert panel.

   The criticalness, distinctiveness, representativeness and diversity of assets are criteria developed as part of the national policy framework for the identification, classification and management of High Conservation Value Aquatic Ecosystems (HCVAE). There may be value in using similar criteria to determine ecological significance given that many listed HCVAE are likely to be high priorities for environmental water.

   In any consideration of its ecological priorities the Commonwealth will need to ensure it is meeting its legislative responsibilities, particularly those that contribute to fulfilment of international obligations. These obligations include promoting the conservation of Ramsar listed wetlands, rehabilitating or restoring degraded ecosystems, promoting the recovery of threatened species, and protecting the habitat of certain migratory birds.

   An assessment of ecological priorities should also consider the current condition of the asset and the likelihood of achieving the objective of watering, whether that involves restoring a degraded site or river reach, or maintaining an already healthy site or river.

Figure 1: Commonwealth prioritisation framework for matching environmental water with environmental assets



4. *Determine watering actions for the year*. The priority list of ecological objectives will then need to be assessed based on a number of criteria to determine the feasibility and most effective use of the available water. This process would be expected to involve the use of a decision tree with threshold tests and discussions with delivery partners and on-ground environmental managers. These criteria would include:

    a. *Watering risks*. The possible threats that may result from a watering action. These might include threats such as salinity and other water quality issues, flood damage, acid-sulfate soils, and invasive species amongst others. Any assessment will need to be based on a comprehensive risk management framework and consider the mitigation and contingency plans of site managers and delivery partners;

    b. *Management arrangements*. An assessment of arrangements (both for watering and for broader natural resource management) that are in place is critical to ensuring that water is used where it will be most effective. Management arrangements include those to mitigate any risks identified in the previous step, the adequacy of delivery and monitoring arrangements, ongoing site management, the presence of complementary natural resource management activities, and a commitment to adaptive learning;

    c. *Cost effectiveness.* An assessment of cost effectiveness would be based on the amount of Commonwealth water and resources needed to enable delivery; other factors affecting the watering, such as transmission losses; opportunity to leverage off other water releases (e.g. ability to use environmental water with stock and domestic releases) and to realise multiple use/benefits;

    d. *Follow-up water requirements*. An assessment of the need for follow-up water is important for determining whether or not a particular watering action is a feasible option in the longer-term; and

    e. *Opportunity costs*. The process as outlined would enable a prioritised list of watering actions. However, such a list is based on comparing one watering action with other actions on an individual basis. It is important to compare options not just as one event versus another but as one event versus all others that could otherwise be achieved with the same volume of water. An assessment of the basin-wide opportunity cost of using water for any one option therefore needs to be undertaken. This would include an assessment of the opportunity cost of carrying over the water to the following year.

In developing a priority list of watering actions it is important that it is flexible enough to consider changing circumstances and the opportunities that those changes provide. For instance an unexpected flooding event might push one particular priority action higher on the list and make others redundant. As a result the framework will require the capacity to take into account a range of contingencies. Trigger points and cut-off dates will need to be established for options associated with natural flows.

Question 3: Do you have a view on how the four main steps outlined above should be further developed?

The tools that enable this framework to be implemented, including the means to prioritise based on ecological significance, require further development. In the meantime decisions will be based on a qualitative review undertaken using the information sources outlined in table two.

Table 2: Basis for determination, possible criteria and current information sources for each decision step

Step 1	Basis for determination	Information sources
What is the forecast water availability? [*Volume by catchment*]	- water entitlement availability, characteristics and deliverability	- water holdings register - trading rules - known channel capacity and river operations restrictions
	- long-range water resource forecasts/ seasonal outlook	- Bureau of Meteorology forecasts
	- historical allocations	- historical allocation data
	- volumes available to delivery partners	- advice of delivery partners and water authorities

Step 2	Basis for determination	Possible Criteria	Information sources
Is the watering option in scope? [*Yes/No*]	- projected water availability (incl. ability to deliver)	- ability to deliver sufficient water to the environmental asset to meet ecological objectives	- from step one - on ground expertise (e.g. CMAs & water authorities) - MDBA modelling on water deliverability and multiple use
	- need for water	- optimal water requirements to achieve ecological objectives at the asset	- studies undertaken on flow requirements - on ground expertise (e.g. CMAs) - conceptual models - EWSAC advice
		- flow history at the asset	- MDBA and water authority flow gauge data - watering history reports
		- likelihood of natural flow/event trigger points	- hydrological history - MDBA and water authority flow gauge data
		- consistency with ecological and management objectives at the asset	- site management plans - Commonwealth environmental watering policy / objectives

Step 3	Basis for determination	Possible Criteria	Information sources
What is the ecological priority of the watering action? [*High/medium/low*]	- ecological significance of the watering action	- diversity of habitat, species and communities to benefit from the watering action	- *EPBC Act* database - DEWHA wetlands database - HCVAE list and supporting documentation - site description reports - EWSAC
		- criticalness of habitat or ecological process to be watered, in terms of: conservation status of species and communities, refuge and recruitment needs	- *EPBC Act* database - DEWHA wetlands database - HCVAE list and supporting documentation - site description reports - EWSAC
		- distinctiveness of habitat or species and communities to benefit from watering action	- *EPBC Act* database - DEWHA wetlands database - HCVAE list and supporting documentation - site description reports - EWSAC

		- representativeness of habitat or species and communities to benefit from watering action	- *EPBC Act* database - DEWHA wetlands database - HCVAE list and supporting documentation - site description reports - EWSAC
		- contribution to broader ecological processes/ ecosystem services	- conceptual models based on scientific studies - EWSAC
	- expected ecological outcome of the watering action	- magnitude and importance of the expected ecological response (area watered, recruitment magnitude, connectivity provided) and the likelihood of success	- conceptual models - site management plans - on-ground expertise - EWSAC
	- current condition of the asset	- overall health of asset and degree of degradation - nearness to known critical watering thresholds and long-term sustainability	- on ground expertise - MDBA and water authority flow gauge data - watering history reports - site condition reports

Step 4	**Basis for determination**	**Possible Criteria**	**Information sources**
Is the watering action a priority? [*Ordered list*]	- ecological priority	- high/medium/low priority	- from step 3
	- negative risks	- likelihood and consequences of negative outcomes from watering	- site management plans - on ground expertise
	- management arrangements	- consistency with site management plans	- site management plans
		- presence of complementary NRM activities	- NRM reports and planning documents – CMAs
		- adequacy of monitoring and assessment arrangements	- monitoring and assessment plans of delivery partners
	- cost effectiveness	- magnitude of transmission losses	- MDBA transmission loss data
		- magnitude of delivery costs	- discussions with delivery partners
		- ability for multiple use and opportunity to leverage off other water	- MDBA modelling on water deliverability and multiple use
		- presence of plans to reduce delivery costs in future	- works and measures plans
	- Follow-up requirements	- likely ability to be able to provide follow-up water, as required	- advice of delivery partners - watering history reports - conceptual models
	- Opportunity costs	- basin-wide trade-offs (including multi-year) for the watering action	- volume of water require - other priority actions and their water requirements

Question 4: Do you have a view on the adequacy of the 'basis for determination', 'possible criteria' and 'information sources' for each step as outlined in the above table?

4.1 The scientific basis for determining environmental watering actions

The Commonwealth is committed to a science-based approach to the prioritisation process. It will work with the Department's Environmental Water Scientific Advisory Committee (EWSAC) to establish methods for determining relative priorities for environmental watering within the context of this framework. It is expected that two components in particular will be the initial focus of this work: i) the conceptual models on which watering decisions are based; and ii) the methods for ranking different watering options based on their ecological significance.

4.1.1 Conceptual models

The proposed framework for determining environmental watering actions relies on the establishment of conceptual models which will describe the relationships between components of the flow regime and ecological outcomes that underpin the objectives being sought. For instance, the expected response from a community of macrophytes resulting from wetland inundation of a certain depth; or the expected response from a target community of riparian vegetation from an over-bank flow.

Given the complexities and uncertainties involved, it will be necessary to start with some relationships at a first principles level based on the advice of on-ground environmental managers and the EWSAC. For example, a medium spring flow in a certain river reach creates conditions suitable for native fish breeding; or, a bank-full flow creates conditions for habitat formation suitable for invertebrates, native fish, and aquatic plants. Models might initially focus only on fish, vegetation, and waterbirds. Of course conditions vary from one river reach to the next but in the initial stages it is unlikely that sufficient information will exist to take account of all variables across all potential watering sites. As we progress, more complex models involving probabilities and higher order outcomes could be considered.

4.1.2 Ecological priorities

Once the ecological objectives that are in scope have been established there is a need to prioritise the watering actions that will achieve the objectives in order to align available water with the highest priority needs. In the first instance a determination of the significance of the ecological function being assessed will need to be undertaken. In other words on what basis, from a scientific perspective, can we determine whether to put water towards ecological objective A versus ecological objective B? The prioritisation process is likely to need to consider the significance of the biodiversity and ecological functions affected by the watering actions and the values of the asset itself based on a standard set of criteria such as those indicated in table two above.

4.2 Information requirements

The scope of a decision framework as described will ultimately require a significant amount of information and data. This will progressively be available at varying levels of detail and quality and include:

- identification of the priority environmental assets across the basin, including their specific ecological values and where possible the linkages between them;
- the range of ecological processes that impact upon the condition of each ecological asset in relation to flow regime at different temporal and spatial scales;
- the optimum watering regimes, including variability and seasonality, required to support specific ecological values and dependent processes;
- the hydrological history (both natural and e-watering) of each asset;
- hydrological models for considering likely flow outcomes from watering events at individual sites/reaches;
- the conceptual models upon which ecological objectives can be based;
- an understanding of the likely impacts of climate change on water availability with respect to each environmental asset; and

- the capacity to deliver Commonwealth environmental water to environmental assets across the basin.

Further work is required to synthesise available information including from sources such as the National Water Commission (e.g. Ecological outcomes of flow regimes study – for conceptual models), the CSIRO (e.g. Sustainable yields study – for hydrological data incl. climate change impacts), the MDBA (e.g. Sustainable Rivers Audit), and Land and Water Australia (e.g. Ecohydrological regionalisation of Australia – for flow regime classes and related landscape characteristics across the basin). Relevant information is also likely to be incorporated from the Victorian FLOWS methodology used in the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP), and the hypotheses used in New South Wales' Integrated Monitoring of Environmental Flows (IMEF) program.

In developing the framework it is likely that tools such as the Murray Flows Assessment Tool (MFAT), the eWater CRC's River Manager and Ecological Modeller, and the Ecological Limits of Hydrologic Alteration (ELOHA) framework, could be drawn upon to generate some inputs to a decision support tool.

A review and synthesis of all these studies/tools/frameworks will need to be undertaken to determine which elements can most usefully inform the development of the framework and also be consistent with the development of the Basin environmental watering plan.

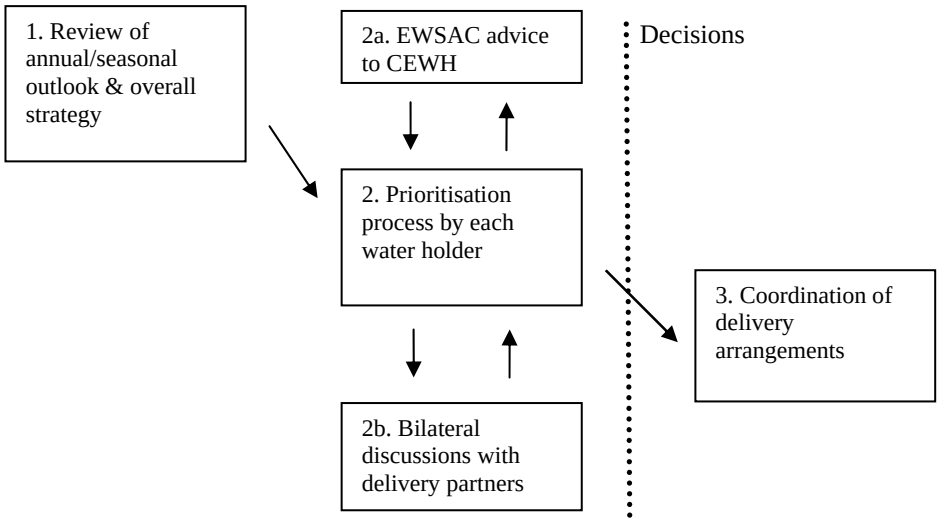
Question 5: Do you have a view as to how the various studies/tools/frameworks mentioned should be used to develop the Commonwealth's framework for prioritising watering actions?

5. Cooperative environmental water use

A central element of the proposed Commonwealth approach to environmental water use involves cooperative watering with other environmental water holders and managers throughout the Basin. As described in the *Water Act*, it is expected that the MDBA will coordinate this cooperative water use in accordance with the EWP once that comes into effect.

There are likely to be three key steps for determining environmental watering actions in a cooperative process. These are outlined in figure 2 below: i) scoping and consultation phase involving a strategic overview; ii) prioritisation phase; and iii) delivery coordination phase.

Figure 2: Proposed process for cooperative environmental watering



Step 1: Scoping and consultation phase – strategic overview

This step would clarify the amount of water expected to be available for environmental watering across the Basin. It would set out and refine the ecological aims and objectives for each delivery partners' watering program and scope possible watering options across the Basin in light of these parameters.

The purpose of this step would be for all water holders and managers to obtain a strategic overview of watering options across the Basin given the expected volumes of all environmental water for the next year and the specific ecological requirements for the next season. It would involve both a seasonal outlook and a strategic discussion based on that outlook and would consider the multi-year requirements of priority environmental assets.

Based on the seasonal outlook for all environmental water across the Basin, all water holders and managers would need to outline the range of watering options they would be able to consider in the coming year and season. The range of options would need to be developed in consideration of:

- the volumes of all environmental water likely to be available (all sources, not just Commonwealth water);
- expected outcomes, risks and contingency allowances for each option;
- multiple-use scenarios across jurisdictions;

- trigger points and cut-off dates associated with natural events;
- basin-wide strategies for specific species/communities (e.g. hardyhead); and
- constraints to water delivery (e.g. trading rules; channel capacity).

The outcome of this step would be a common understanding of the volume and types of water available for cooperative watering across the Basin and the range of options open to each environmental water holder and manager. Each delivery partner would then be in better position to identify priority watering actions that are consistent with overall objectives and priorities from a basin-wide perspective. Ultimately it is expected that this phase would be guided by the MDBA's Environmental Watering Plan.

Step 2: Prioritisation phase

The purpose of this step would be to provide each watering partner with the opportunity to prioritise specific actions based on the volume that they expect to have available to them through their own water entitlements. It would involve each partner determining priorities in the context of the overall ecological goals and the scope of watering options outlined under Step One.

Information requirements would be met by the *environmental asset register*. The register would include information on priority assets and their watering needs and would be stored in a central, spatially–defined database.

Although each delivery partner would prioritise actions with respect to their own volume of water, it will be necessary to work collaboratively to take advantage of efficiency savings and the more effective outcomes that could be achieved by pooling water together. The Commonwealth's prioritisation of options would be undertaken using the framework as described above, and in consultation with the EWSAC.

The outcome of this step would be a consolidated basin-wide list of priority actions to be undertaken by each watering partner. Some of these actions may include trigger points for use associated with natural flows and cut-off dates if those flows did not eventuate.

Step 3: Delivery phase

The purpose of this step would be to ensure complementary and cost-effective use of water. Discussions would occur on the nature and location of use and the opportunity for multiple uses. These discussions would need to ensure that water from a variety of sources can be provided in appropriate volumes to achieve the agreed ecological objectives and that sufficient contingency water is available across the Basin for follow-up watering. The outcome of this step would be that water is provided in appropriate volumes to meet agreed objectives and to manage risks.

As the outcome of step two would be an agreed contribution of each partner to watering actions, many of which may be subject to specific conditions (e.g. natural flow events), it will be important to coordinate closely with all partners, including The Living Murray (TLM) program, when triggers and cut-off points eventuate. Ultimately it is expected this phase will be guided by the schedules of the Environmental Watering Plan.

Question 6: Do you have a view on how the process for cooperative environmental watering as described could be improved?

6. Prioritising environmental watering actions in 2009-10

In 2009-10 the Commonwealth will use a similar set of criteria for prioritising watering actions as used in 2008-09 and which are incorporated into the framework as described above. This will be adapted to consider larger volumes of water and possibly different water resource scenarios as described earlier in this paper. With larger volumes available it will be necessary to consider multi-year objectives and carryover needs subject to whether water resource availability is characterised as extreme dry, dry, median or wet.

The Commonwealth expects to be able to consider a greater range of environmental assets for water delivery as a result of the availability of further information, ongoing engagement with our delivery partners, and larger volumes of Commonwealth water throughout the Basin, including a significant volume in unregulated rivers.

Question 7: Do you have any suggestions on improving the criteria for short-listing watering priorities at Attachment A, for use in 2009-10?

Comments and suggestions can be provided to:

Dr Benjamin Docker
Environmental Water Policy Section
Water Governance Division
Department of the Environment, Water, Heritage and the Arts

Email: benjamin.docker@environment.gov.au

Tel. (02) 6275 9129

Attachment A

Criteria for short listing watering priorities in 2008-09

1. Must meet the requirements of section 105 of the *Water Act 2007* and the approach articulated in section 3.2 of the Business Plan.

2. The ecological significance of the asset (includes matters such as Ramsar or DIWA listing, presence of nationally listed threatened, migratory or rare species).

3. The expected ecological outcomes from the proposed water use, based on:
    a. the current health of assets, antecedent conditions, and the likely response to watering (based on previous experience or expert opinion);
    b. other factors which may affect ecological health; and
    c. the existence of a site management plan.

4. Any potential risks resulting from the proposed watering action, including the likelihood and significance of:
    a. negative outcomes from the watering action and measures taken to minimise these;
    b. negative outcomes of *not* undertaking the watering action this year (i.e. related to the urgency of the need); and
    c. not achieving the expected ecological outcomes.

5. The degree to which Commonwealth water is likely to make a substantial contribution to protecting or restoring the ecological significance of the asset.

6. The contribution of the delivery partner to the watering event (e.g. water volume, financial, monitoring, management).

7. The cost effectiveness of undertaking the watering, based on:
    a. the amount of Commonwealth water and resources needed relative to the contribution of the State and delivery partner to the watering event;
    b. other factors affecting the watering, such as transmission losses;
    c. opportunity to leverage off other water releases (e.g. ability to use environmental water in concert with stock and domestic releases) and to realise multiple benefits.

8. The long-term likelihood of sustaining the ecological values of the asset (including information on the general inundation frequency of the area, i.e. whether the asset will survive with natural watering plus occasional supplementary environmental watering, or whether it be totally reliant on environmental watering for survival).

9. The adequacy of the governance and management arrangements, including the monitoring and evaluation activities, in place to ensure effective outcomes from the watering action.