NSW GOVERNMENT

SCOPING REVIEW

Translucency rules in NSW inland rivers

Effectiveness and alternative scenario review

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Contents

Figures

Tables

Summary

This review of translucent flows was announced by The Hon. Niall Blair, the then Minister for Primary Industries and Minister for Lands and Water, on 6 July 2016 (Appendix A6) in response to community interest, particularly from water users. Translucent rules have been in operation in NSW for well over a decade. Water sharing and delivery regimes have changed over that time, including the introduction of the environment as a legitimate water user. It is therefore timely to review the flow rules to check that they are usefully serving their intended purpose.

This report represents a stock-take of the current rules in inland NSW regulated rivers; their diversity and intended purpose and an overview of options and implications for change.

Types of environmental water

The *Water Management Act 2000* (WMA 2000) and its associated valley-specific water sharing plans define two classes of environmental water:

- Planned environmental water, which is water committed to the environment by the rules within a water sharing plan (WSP).
- Licensed environmental water which is water held through a water access licence (WAL), also known as a water entitlement, and is exclusively used for the purposes of the environment.

Transparent and translucent releases are two types of planned environmental water. Translucency rules can result in relatively large flows and are present in a number of valleys in NSW while transparent releases are typically small and less common. This report therefore focuses primarily on translucent releases. NSW inland river valleys that have translucent flow rules include the NSW Border Rivers, Macquarie, Cudgegong, Lachlan and Murrumbidgee valleys. Some think of planned environmental these water releases as 'standing water orders' that are activated when pre-defined trigger levels are met, as opposed to irrigators who submit their water orders when needed.

Water user and Stakeholder considerations

The key issues identified by water users relating to translucent flow provisions can be summarised as follows:

- Increased flexibility of rules may achieve better environmental outcomes.
- Concern of unintended impacts rules have on allocations or water security.
- Recognition that changes since the rules were first developed may require updated planning solutions (e.g. based on more data, changing circumstances and needs, the Basin Plan and a significantly larger environmental water portfolio).
- The complexity of some rules may warrant simplification for ease of interpretation and operational implementation.
- Competing concerns relating to the inundation of private property and more effective environmental outcomes on the floodplain (e.g. flooding concerns juxtaposed with concerns of insufficient floodplain wetting).
- Competing priorities due to differing climatic conditions (e.g. calls for increasing focus on flood mitigation actions during wet periods to help reduce subsequent flood peaks).

Murray Darling Basin Plan implications

Subsequent to transparent and translucent release rules being implemented in NSW WSPs, the 2012 Murray Darling Basin Plan required additional water recovery for environmental purposes for long term system sustainability in the Basin. The Murray Darling Basin Authority (MDBA) 'baseline' modelling, which considered all the existing environmental watering provisions, including transparent and translucent releases, identified that an extra 2,750 gigalitres (GL) was required annually.

The relevant legislation and agreements associated with the Basin Plan restrict a jurisdiction's ability to reduce its existing commitments to environmental outcomes. While there is some flexibility to consider a change in translucency rules under the MDBAs Water Resource Plan accreditation role, any proposed changes by NSW to amend, suspend or remove translucent releases will be reviewed by the MDBA to ensure that the changes are consistent with the "no net reduction" requirement of the Basin Plan.

However, this does not preclude a review of the current rules to identify opportunities to improve the effectiveness of planned environmental water and to better account for the intersection between planned and held environmental water. Efficiencies and improved environmental outcomes can likely be gained from managing the two types of environmental water more effectively. Similarly, such a review may reveal ways to modify current planned environmental rules to provide equivalent or more effective ecological outcomes while also increasing reliability of allocations – a win-win situation for the environment and water users.

The NSW Government will continue to work with the MDBA through the Water Resource Plan (WRP) accreditation process to ensure that a clear approach to adaptive management of planned environmental water is adopted. This will enable appropriate changes to be included in the WRPs that continue to deliver on the intent of the translucent and transparent flow rules, while also allowing improved outcomes for general water users and the environment.

Translucency releases – environmental benefit

Planned environmental water rules such as translucent releases are used to balance the need to harvest water within the dam for consumptive use, while also protecting the long term sustainability of the downstream riverine ecosystem.

Translucent release rules mimic the variability of daily, monthly and seasonal patterns of the natural river system by 'passing through' a portion of dam inflows. This helps support hydrologically driven ecological processes in the system such as habitat protection/maintenance, nutrient availability, reproduction/recruitment and dispersal.

There is a growing body of evidence regarding the benefits of environmental watering for rivers in NSW, both within and outside the Basin. Examples of these benefits include flushing algal blooms, bird breeding and improved fish passage (Arthington and Pusey 2003). However even when the environmental flow outcomes are clearly measureable, the effects of individual components of an environmental watering regime, such as translucent flows, cannot always be isolated or discerned separately (Acreman et al. 2014, Davies et al. 2014).

Long term monitoring programs have been established in recent years with the assistance of Commonwealth funding; however, it is too early to be definitive about the trends in environmental improvements that are emerging due to the 'noise' of data from natural seasonal variation of the NSW inland systems.

Outcomes - modelling impacts of changing translucency rules

Long term modelling with translucent rules switched on/off (Section 6) shows that translucent releases in valleys such as the Lachlan are most important for environmental benefit during drier periods as they increase the number of critical environmental flow events; whereas during wet periods it is the unregulated flow events that provide the most environmental benefit.

While eliminating translucency can increase general security allocations, for example 3.0 per cent in the Murrumbidgee valley, 5.1 per cent in the Lachlan valley and 10.6 per cent in the Macquarie valley, it can also have interrelated effects such as reducing access to supplementary flows and failure to meet ecological flow targets. In the Murrumbidgee, removal of translucency rules decreased supplementary access in the mid-Murrumbidgee by 4.9 per cent but access in the Lowbidgee was found to increase by 1.4 per cent. The reason for this is that the additional volume retained in storage tends to lead to more, and larger, uncontrolled spill from storage, and it is these larger events that increase Lowbidgee supplementary access.

Removal of translucency was found to generally decrease the frequency of meeting particular ecological flow indicators used by MDBA to formulate Sustainable Diversion Limits (SDLs), particularly in the Lachlan, Macquarie and lower Murrumbidgee (Lowbidgee) valleys. However, in the mid-Murrumbidgee valley, the frequency of meeting required ecological flow indicator triggers tended to increase, particularly for higher flow targets.

As noted above, eliminating translucency potentially conflicts with the Basin Plan requirements of "no net reduction" by States in planned environmental water protection. Under this requirement, reducing the volume of translucency water could mean a commensurate increase in other environmental water to ensure that environmental outcomes are maintained or improved.

Next steps

The status of the review of translucency rules in each valley and the likely scope of change is summarised in Table 1.

This translucency review suggests that it is timely for the delivery of all planned environmental water to be examined, in collaboration with environmental water managers, to ensure that the environmental outcomes sought are being optimised and effectively integrated with the, now large, licensed environmental water holdings, and – where identified – avoid the potential to adversely affect consumptive users.

This review offers an opportunity to simplify the more complicated environmental flow rules in the WSPs while still achieving or improving the long term outcomes. The review recognises that translucency rules, especially those within NSW rivers of the Basin Plan, do not operate in isolation to the other rules within the water sharing plans. Such considerations require an integrated approach to recognise local social and economic concerns, and also balance the benefits and impacts of (i) planned environmental water provisions, and (ii) held environmental water with (iii) consumptive water use.

It is proposed, therefore, that further in-depth analyses of translucent rules, and the testing of potential improvements, be included in consultations with environmental water managers and other stakeholders as part of the development of NSW's Water Resource Plans (WRP), which will include reviews and updates of the current water sharing plans.

WRPs are a requirement under the Basin Plan, and NSW has been establishing Stakeholder Advisory Panels (SAP) to consult widely with stakeholders. The SAPs generally contain representatives from private water users including irrigators, the Office of Environment and Heritage (OEH), DPI Fisheries, WaterNSW, the local Environmental Water Advisory Group (EWAG), the Regional Organisation of Councils, Aboriginal Traditional Owners, the Commonwealth Environmental Water Office (CEWO), the Murray Darling Basin Authority (MDBA) and an independent facilitator.

These panels provide suitable local forums to undertake a wider review of WSP planned environmental water within a realistic timeframe, and ensure that a diverse mix of stakeholders are involved in working through these complex issues. Additionally, further targeted consultation may be undertaken in the WRP process in response to matters raised during the public submission periods.

Table 1. Status of translucency rule review / likely scope of change

NSW Border Rivers	Macquarie	Cudgegong	Lachlan	Murrumbidgee
No analysis to date.	Preliminary options available and some modelling has been undertaken. Consultation on preliminary options with SAP has occurred.	Preliminary options available and some modelling has been completed.	Options for changing the rule have been identified and extensive modelling has been completed. Results of modelling have been presented to the Lachlan SAP. Results to date indicate that across the board changes to the rule has minimal impact on irrigator diversions due to constrained irrigator behaviour. Investigating changes to the rule in dry times when irrigators have received minimal allocations. A change in the translucent flow rules is one of several options being considered to assist in improving allocation reliability.	Options exist and some modelling has been done. Simplified translucency rules were developed in 2003 but a lack of agreement amongst river management committee members meant that they were not included in WSP. Preliminary sensitivity modelling shows removal of translucent rule would have only minor impact on allocations.

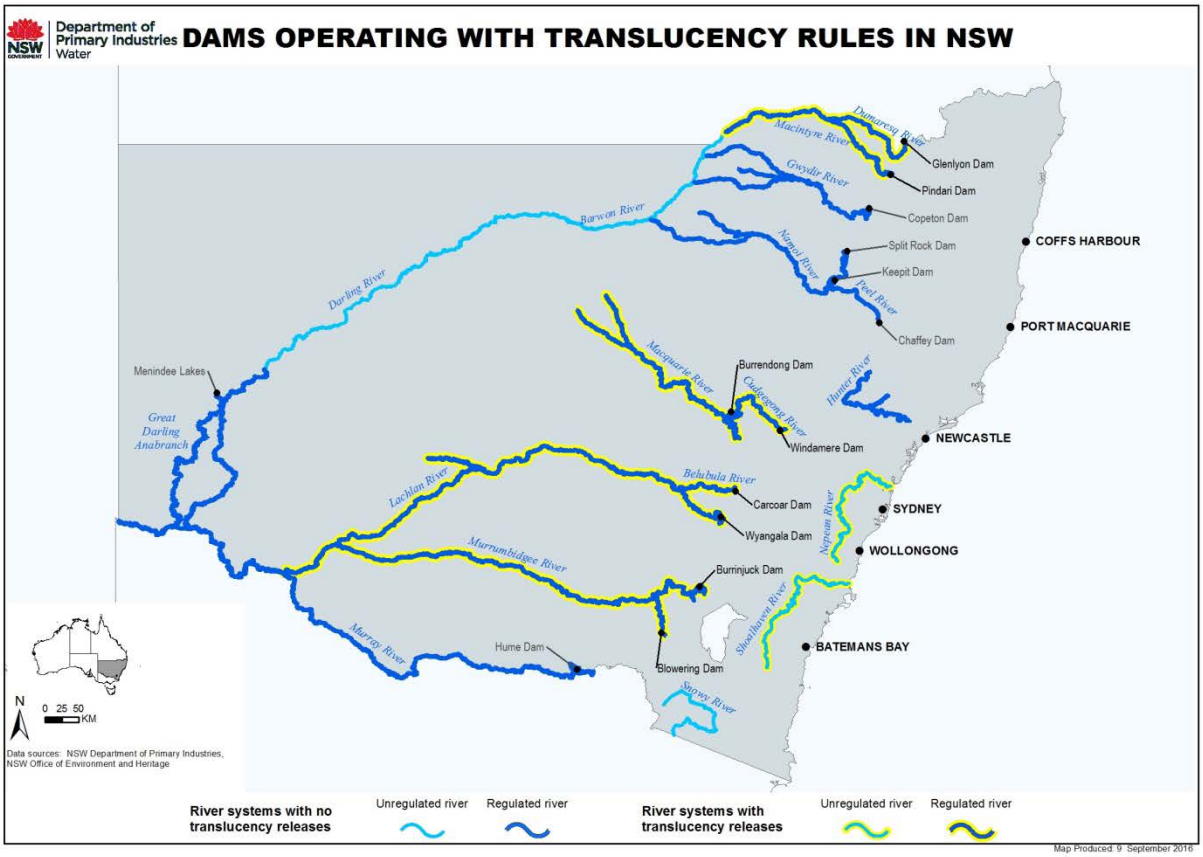
1. Introduction

This document provides a preliminary assessment and review of the provisions for translucent flow releases from NSW inland regulated river storages, as announced on 6 July 2016 by The Hon. Niall Blair, the then Minister for Primary Industries, Lands and Water. The Minister noted that "the provisions for translucent flow releases were originally designed to mimic natural flows, improve river health and connectivity prior to large scale water recovery in the Murray Darling Basin" (Blair 2016).

Although there is general support for the broad aims of translucent flows, the details of the rules in the context of changed conditions means that these flows continue to be questioned by rural communities. Their concerns are to ensure environmental water use efficiency and effectiveness, maximise water available for consumption and thus maximise agricultural productivity, and avoid unintended impacts from the operations of translucent flows. As such, the Minister concluded that it is time to review translucency rules and determine whether the intended environmental outcomes could be achieved with a more flexible approach to water delivery. Accordingly, DPI Water has committed to review:

- The effectiveness of translucent flows.
- Whether or not other forms of environmental water holdings can achieve the same outcomes while minimising potential negative impacts to river communities.

Figure 1. Map showing NSW rivers



Note: Valleys with fixed-rule translucency rules within the Water Sharing Plan are those of the Murrumbidgee, Lachlan, Macquarie-Cudgegong and NSW Border Rivers

Translucency rules in NSW inland river systems (Figure 1) are gazetted and operational in Water Sharing Plans (WSPs) for the Lachlan, Macquarie-Cudgegong, NSW Border Rivers and Murrumbidgee Valleys (NOW 2010; NOW 2011a,b; NOW 2012).

This preliminary review aims to examine the:

- Policy and planning context for environmental water, including translucent flow rules, to inform the viability of changing these rules.
- Ecological basis and purpose of translucency flows.
- Operational considerations, including flooding limitations, to deliver environmental water.
- Available ecological evidence of translucency rule effectiveness.
- Long term hydrological modelling of translucent flows for selected valleys against a regime without translucent flows, to determine the 'water take' and the efficiency and effectiveness of the mechanism in delivering environmental events.
- Stakeholder and landholder considerations.
- The status of valley translucency rule reviews (detailed in Appendices 1-4).
- Socio-economic, environmental and operational considerations to accompany a change in translucency rules.

While there is some flexibility to consider a change in translucency rules, any proposed changes are required to be consistent with the prescribed Sustainable Diversion Limits in the Murray Darling Basin Plan.

The intent of this scoping review is twofold:

- To inform the Minister and the community of the background to the current rules and highlight key issues for consideration.
- To assist in setting terms of reference for consultation with key stakeholders, as any proposed changes to translucency flow rules will be discussed with communities and stakeholders.

Input to this review has been received from the policy and planning, science, hydrologic modelling and water management areas of DPI Water. Socio-economic input was not available at this time. Nevertheless, the WRP process will be informed by the detailed socio-economic analysis commissioned by the MDBA as part of the Northern Basin Review and now also underway for the Southern Basin.

2. Policy background

2.1. Classes of environmental water

The *Water Management Act 2000* (WMA 2000) defines two classes of environmental water. These being:

- Planned environmental water
- Licensed environmental water

Planned environmental water is water committed to the environment by the rules within a water sharing plan (WSP), whereas licensed environmental water is water held through a Water Access Licence (WAL) that is dedicated exclusively for environmental purposes. Planned environmental water is often referred to as 'rules-based', whereas licensed environmental water is often referred to as 'held' environmental water as its use is regulated by license.

In accordance with the WMA 2000, all WSPs in NSW contain planned environmental water and associated rules for accrual and use. During the development of the first round of WSPs for the inland regulated rivers (commenced in 2004), a range of planned environmental water rules were established, including translucent and transparent flow rules. The presence and characteristics of these rules vary significantly across the different inland WSPs. This is a function of geographical differences between systems and the fact that the WSP rules were developed by different regionally based stakeholder committees.

Translucent and/or transparent flow rules have been established for the Macquarie-Cudgegong, Lachlan, Murrumbidgee and NSW Border Rivers Regulated River WSPs. Each WSP contains details of when and how these flows are released (as outlined in the Appendices).

2.2. Types of planned environmental water

Planned environmental water can be represented in several ways within a WSP including, but not limited to, valley-based total extraction limits, end of system flows, minimum releases, limits on taking high/low flows, water remaining after extraction, volumes of water set aside for release, and translucent and transparent flow rules.

NSW uses two fundamentally different flow release mechanisms to achieve environmental outcomes from planned environmental water:

- **Non-discretionary planned environmental water**: or '**fixed rules**' water, involves fixed rules that prescribe 'automatic' water release actions (e.g. transparency/translucency releases) or specified system operations (e.g. limits on extraction) based on set criteria.
- **Discretionary planned environmental water**: involves rules directing that water be set aside into bulk account/s (often referred to as an environmental water allowance (EWA) or environmental contingency allowance (ECA)), once certain conditions are met. Once accrued, delivery is decided by environmental water managers. With the ability to order releases from such account/s, environmental managers have flexibility in determining when and how watering actions should occur to optimise outcomes.

These two types of planned environmental watering can be contained in a single WSP.

It is noted that environmental water allowance accounts differ from licensed environmental water entitlement accounts, as they do not accrue usage charges and have varying conditions placed upon them. Each WSP sets valley-unique conditions on the crediting, carryover and debiting (release behaviour) of the environmental water allowance account(s). These conditions are a negotiated outcome based on the WSP consultation process that considered the hydrological, ecological and socio-economic requirements within the valley.

2.2.1 Limits on extraction

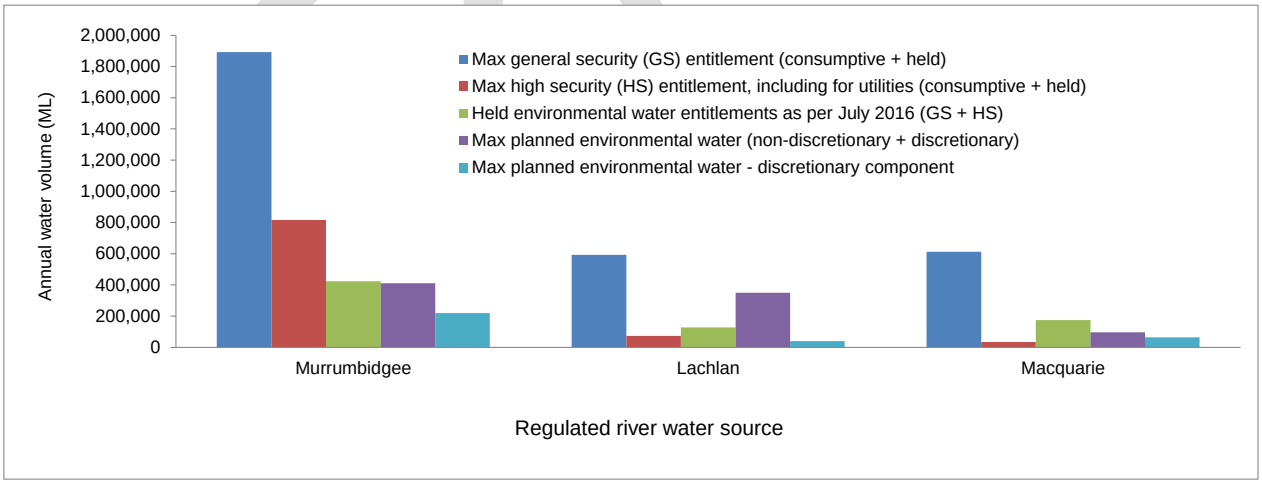
Planned environmental water that involves the establishment of an annual valley-based volume limit on total extraction, called the Long Term Average Annual Extraction Limit (LTAAEL) or Plan Limit, is a mechanism to ensure a sustainable volume of water remains in the system after extraction, sufficient to protect the environment. LTAAELs for each WSP were established during the development of the first round of inland regulated water sharing plans. For example, in the regulated Murrumbidgee River the LTAAEL (1,890 GL/year) is less than half of the long term average annual flow (4,360 GL/year). In other words, under the water sharing plan, less than half of the Murrumbidgee River average annual flow is available for extraction. The rest remains in the river providing further benefits.

The WSPs outline the methodology for monitoring extractions and comparing against the LTAAEL, limiting any unsustainable growth in water use to ensure planned environmental water (water remaining after extraction) is protected. The Murray Darling Basin Plan broadly requires a similar process to assess compliance with its own long term extraction limits (Sustainable Diversion Limits (SDLs)), as described in Section 2.4.

2.3. Current mix of consumptive and environmental water

The current mix of entitlements versus planned environmental water within each of the regulated river water sources with transparent or translucent flow rules is shown in Figures 2 and 3 below. The figures show both the total volume of entitlements (both general security and high security categories) and the portion of entitlements that are held environmental water. For planned environmental water, they show the maximum amount of planned environmental water[1] that can be made available within a water year (if the relevant WSP triggers are met) and the portion of that water that is associated with a discretionary planned environmental water account, such as an environmental water allowance. The figures also illustrate that planned environmental water often represents significantly larger volumes of water than held environmental water in NSW, particularly in this case for the Lachlan, NSW Border Rivers and Cudgegong valleys.

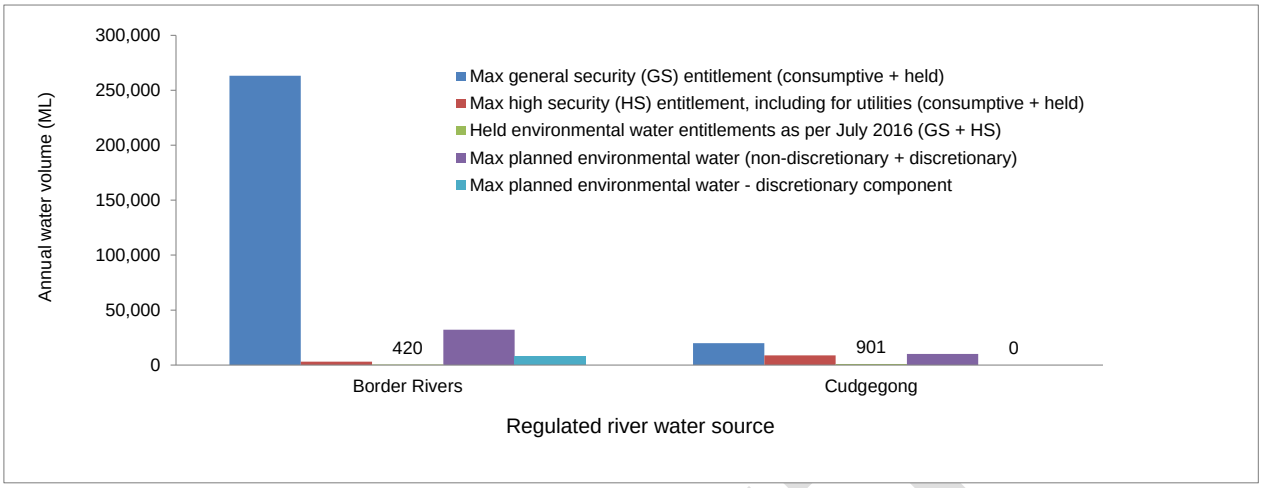
Figure 2. Main water uses in the Lachlan, Murrumbidgee and Macquarie valleys



Sources: DPI Water water register and General Purpose Water Accounting reports.
Note: Held environmental water entitlements are almost exclusively general security in these valleys.

[1] Note that planned environmental water in the Macquarie and NSW Border Rivers both include limits on taking high (supplementary) flows. Such volumes are not illustrated in the following figures and tables as these are not explicitly measured – they are based on inflows which can be highly variable in terms of volume and are irregular in frequency.

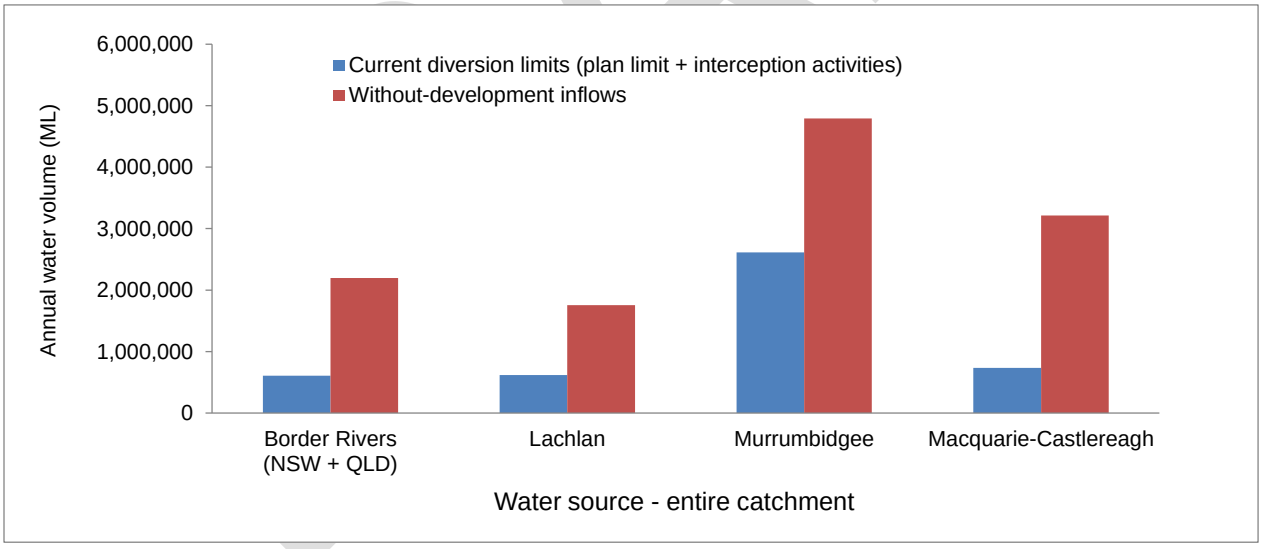
Figure 3. Main water uses in the NSW Border Rivers and Cudgegong valleys



Sources: DPI Water water register and General Purpose Water Accounting reports.
Note: Held environmental water entitlements are almost exclusively general security in these valleys.

The total inflow across the entire catchments (including unregulated sections) is provided for respective catchments in Figure 4, giving some sense of the proportion of water that is being actively managed. The 'without-development inflows' represents the long term annual estimate of the water available for the environment under natural conditions. The current diversion limits represents the valley's Plan Limit, which is the estimated maximum amount of water that can be sustainably diverted (including both consumptive and held environmental water diversions), plus an estimate of water "intercepted" by farm dams and forestry plantations.

Figure 4. Average annual diversion limit versus pre-development inflows for entire catchments



Note: inflows include regulated and unregulated water sources. Source: MDBA 2010.

2.4. Murray Darling Basin Plan

The Basin Plan's Sustainable Diversion Limit (SDL) target requires the recovery of 2,750 gigalitres (GL) of water in order to achieve specified environmental outcomes across the basin. These outcomes are predicated on baseline modelling that incorporates the current planned environmental water rules in NSW, including the transparent and translucent flow release rules.

The Basin Plan under section 10.28 establishes that there shall be "no net reduction in the protection of planned environmental water from the protection provided for under state water management law immediately before the commencement of the Basin Plan." The MDBA has

commenced engaging with the states to clarify how consistency with this provision will be assessed.

The reduction or removal of translucent releases could potentially cause an impact under section 10.28. However, this does not preclude a review of the current rules to identify opportunities to improve the effectiveness of planned environmental water and to better account for the intersection between planned and held environmental water. Efficiencies and improved environmental outcomes can likely be gained from managing the two types of environmental water more effectively. Similarly, such a review may reveal ways to modify current planned environmental rules to provide equivalent or more effective ecological outcomes while also increasing reliability of allocations – a win-win situation for the environment and for water users.

Reducing the volume of translucency water without increasing planned environmental water to maintain or improve environmental outcomes could trigger the need for further water recovery.

NSW has provided a formal response to the MDBA indicating that:

- NSW is committed to the protection of planned environmental water.
- NSW needs the flexibility to optimise all rules, including planned environmental water, as part of adaptive management.
- In relation to the effectiveness of planned environmental water, this is a matter that NSW will assess and provide evidence to the MDBA that the provision is satisfied.

It is the NSW position that it is responsible and prudent to periodically review and update translucent release rules. Indeed they could be removed or replaced if warranted, provided environmental outcomes are maintained or improved and the SDL target of 2,750 GL is not increased to require further water recovery from productive use.

3. Ecological basis

3.1. Basic approach

Translucent and transparent environmental flow releases can operate individually or in tandem, as well as in conjunction with other flow type rules allowed within WSPs.

- **Transparent releases** are provided by rules that define thresholds whereby 100 per cent of dam inflows are released to the river downstream as if there was no dam present. Transparency rules typically provide minimum and lower flow rates that sustain the most basic needs of aquatic ecosystems up to a dedicated threshold that has been locally defined. Importantly, they also mimic the range and timing of natural flows. The rules protect in-channel habitats and their dependent biota and provide pool connectivity and freshening particularly in reaches immediately below dam structures.
- **Translucent releases** provide higher flow variability and operate above low flow or transparency flow thresholds. Such flows are necessary to mimic the natural hydrological cues and to re-instate many river processes that aquatic biota are dependent upon, especially those relating to breeding (e.g. of waterbirds) or recruitment (e.g. of river red gums), and movement necessary for effective feeding and breeding (e.g. for fish). Above the dedicated low flow threshold, translucent flow releases are commonly expressed as a percentage of dam inflows.

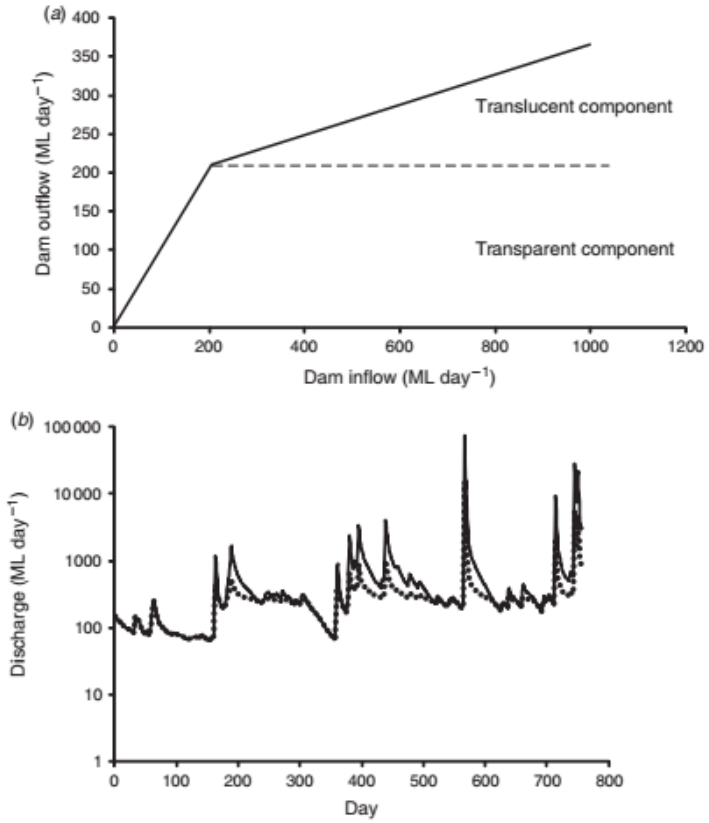
When combined they form a simple hydrological approach to sustain minimum and lower flow rates, and pulses of moderate magnitude flows that introduce greater variability to the flow regime. In terms of ecological outcomes, transparency provides minimum ecosystem protection by mimicking the natural range of low flows at seasonal, monthly and daily time scale, and translucency provides flow pulses of moderate flows that are needed for many riverine processes (Boyes 2006).

Transparent and/or translucent flow rules are therefore often used to balance sustainable water harvesting within a dam (for consumptive use) with the protection of downstream riverine ecosystems. The transparency and translucency rules for a particular valley or catchment are usually tailored by a representative committee of water users to reflect operational constraints and social values as well as ecosystem needs.

It is worth noting that “quasi” translucency/transparency releases also operate in the Murray River, under the discretion of the River Murray System annual operating plan (Campbell et al. 2014, MDBA 2015b), and the Snowy River (Williams 2014; Williams 2015; Williams 2016). These rules operate slightly differently due to differences in policy settings. However, the same philosophy applies in that these approaches attempt to reinstate the variability in key hydrological metrics to improve river health, and the desired hydrological and ecological outcomes are similar.

Differences in the operation and implementation of translucency and transparency rules across the inland NSW river systems are discussed in detail in subsequent sections of this report. Much of the focus of this document is on translucency rules, given that the use of transparency is relatively uncommon in inland NSW rivers.

Figure 5. Conceptual transparency translucency tandem rule set



Notes: (a) dam inflow and outflow rates with a transparency threshold set at 200 ML/day combined with a 20% translucency rule and (b) hydrograph of dam inflows (solid line) and outflows (dotted line) for the above transparency and translucency rule set (logarithmic scale on the y-axis).

3.2. Ecological purpose

The purpose of applying transparency and translucency rules to inland NSW regulated rivers is to mimic natural flows to the environment within the societal and operational constraints of the system (DIPNR 2004 a, b, c; HNRMF 2004; Growns and Reinfelds 2014). For the majority of the inland regulated rivers, translucency rules are used in combination with other types of planned environmental water, for example end-of-system flows and environmental water allowances, as well as licensed environmental water to create environmental flow regimes.

The main ecological concept underlying transparency and translucency flows is that riverine biota are adapted to the historical flow regime, including the range and patterns of flows that existed before any anthropogenic modifications were made (Bunn and Arthington 2002, Blühdorn and Arthington 1994). By providing or restoring components of the natural variability of flows in an environmental flow regime, the principal premise is that the effects of flow regulation may be minimised or ameliorated.

Translucency rules provide some randomness to regulated flow regimes that may otherwise be lost with more prescriptive approaches to environmental flow regimes. The hydrological driven environmental processes that benefit from translucent release are:

- **Habitat protection / maintenance:** Higher flow inundation, water mixing, and scour of in-channel habitats including the maintenance of nutrient translocation sites.
- **Food availability:** Provision of basal food resources (i.e. nutrients such as carbon) via the inundation of natural features to stimulate production and the aquatic food chain.
- **Reproduction / recruitment**: Provide hydrological cues to stimulate reproduction and recruitment of aquatic biota.

- **Dispersal**: Provide opportunities for the movement and dispersal of aquatic biota, either through active or passive dispersal strategies.

One ecological limitation of regulated flows in lowland floodplain rivers is the ability to inundate all the elements of the floodplain that would have been naturally inundated. Translucency rules can offset, but do not remove, the magnitude of this impact of flow regulation. Inundation of the floodplain is an important consideration to provide basal resources (i.e. carbon) and to ensure the transfer of energy flow from low trophic levels (i.e. biofilms[2]) to higher trophic levels such as fish, platypus, turtles and birds. The inundation of carbon sources on the floodplain allows a greater carrying capacity of higher trophic organism such as fish (i.e. more and bigger fish) (Baldwin et al. 2016).

The limited ability to deliver greater volumes and higher flow rates to inundate the floodplain, based on social and economic considerations, has been a key limitation of the existing translucency rules. Muted translucent flow releases from Burrinjuck Dam in the Murrumbidgee River in June 2016 were the most recent example (see Appendix A4.4 for a case study on this event). More broadly, this limitation has seen the purchase of water entitlements to supplement translucency rules, to achieve the flow magnitude required to repair river processes.

Translucent flow rules target different portions of the flow regime, depending on the intended ecological outcomes in each valley. For example, Murrumbidgee, Cudgegong and NSW Border Rivers mainly target outcomes at lower flow regimes, while Lachlan and Macquarie additionally provide for natural seasonality at high flows (refer also to Appendices for a description of each WSP translucency rule). It is not unusual for licensed environmental water to be called from storage in conjunction with planned environmental water, including translucent releases, to enhance environmental outcomes.

A discussion on the intended ecological outcomes and evidence for the ecological effectiveness of translucency rules in these valleys is provided in Section 5.

[2] A biofilm is a complex aggregation of microorganisms (e.g. algae, bacteria and fungi) as well as organic and non-organic particulate material that coats aquatic plants, rocks, logs and other surfaces. Healthy microbial biofilms in aquatic environments are actively involved in degradation of plant and animal debris and cycling of nutrients, and thus are beneficial for aquatic ecosystem maintenance. High levels of biofilm can have detrimental effects on stream biodiversity and recreational use of waterways (Chessman 2003, Gray 2013).

4. Operational considerations

The key operational considerations for translucency rules in meeting the desired ecological objectives include:

- The ability of the infrastructure to deliver the desired flow variability on a daily time-step.
- The maximum flow threshold available to be delivered, given the infrastructure, social and economic settings within a valley.
- The volume of available planned water available in any year to meet the various natural hydrological cues, which is in turn strongly driven by climate.
- The policy settings to deliver the water in the desired manner.
- The extent to which translucency flows can be combined with other types of environmental and other water, to achieve maximum ecological benefit.

These limitations are not a reflection of the method in meeting ecological targets, but reflect societal trade-offs. These constraints include the need to clearly construct rules that have considered social and economic concerns identified by the local community.

4.1. Licensed water versus planned environmental water

As described in Section 2.1, the *Water Management Act 2000* defines two classes of environmental water - planned environmental water and licensed environmental water. This discussion compares the characteristics of these two sub-types of environmental water in the context of regulated river operations. **Licensed environmental water**, also known as held environmental water, involves the active delivery of specifically designed environmental releases from an account. **Planned environmental water** (e.g. translucency) involves water associated with fixed rules such as explicitly defined flow release triggers, and discretionary water such as environmental allowances that requires a decision for a release to occur. Each type of environmental water has certain characteristics within the operation of regulated rivers, as described below.

Licensed environmental water is held by entitlement holders and typically managed collectively by environmental water managers. The category of licence held defines the volume and reliability of the water right.

- The entitlement is managed on a day-to-day basis via an account which operates much like a bank balance. Accounts are credited when either an available water determination (or ‘allocation’) is made to that category of licence within the water source, or water is bought (traded) into the account. Account balances are debited when water is sold or as water is ordered from the river operator (WaterNSW) and ‘used’ (either extracted or, in the case of some environmental water, delivered to a location along the river).
- This approach involves substantial planning and consultation but also offers a high degree of discretion to environmental water managers to achieve ecological objectives. This approach is facilitated in NSW by an online Environmental Water Portal developed in 2016 by DPI Water.
- Licenced environmental water releases are generally designed to integrate with and supplement other system flows – including natural high flows, planned environmental water and water delivered for irrigation and domestic purposes – in order to optimise water use and provide a more natural water delivery pattern. This includes providing water to increase magnitude, extend duration and provide a more natural pattern (e.g. provide a more gradual, natural recession to high flows than the sharper operational drops that may occur when only water supply aims are considered).

Planned environmental water is defined in statutory water sharing plans that are prepared in consultation with stakeholders and communities, with volumes determined by fixed rules.

- For the ***fixed rules*** water, bulk water accounts are used to track accrual and usage of water and there is little discretion involved in their operation. If triggers are met on any particular day, WaterNSW is required to release water consistent with the plan rules. These rules can be likened to a 'standing water order' on behalf of environmental water managers. Rather than making specific decisions each year about the size and timing of environmental releases, trigger release rules reflect the local hydrology that will provide environmental benefit.
- For the ***discretionary*** planned environmental water rules, bulk water accounts are also used to track water accrual and usage (e.g. environmental water allowances). However, based on account balances, environmental managers can direct the timing, size, and other characteristics of the release, to achieve targeted environmental outcomes.

Neither type of planned environmental water incurs usage charges. Obligation for WaterNSW to adhere to water sharing plan rules, including planned environmental water rules, are given effect through its 'Water Supply Works Approvals'. Similar to licence conditions that water users must comply with, WaterNSW is issued such works approval licences by DPI Water for each valley. They contain both the conditions from the applicable water sharing plan as well as other conditions that address how the works in the river system may be used. DPI Water conducts Annual Compliance Reviews against these works approvals and reports the level of compliance.

In summary, fixed-rules planned environmental water reinstates a subset of natural hydrological cues. Licensed environmental water and discretionary planned environmental water requires a higher degree of active management; and targets specific environmental objectives. As part of managing environmental releases, potentially affected parties are identified and consulted ahead of watering actions and kept informed during the events to minimise any adverse impacts.

4.2. Flooding concerns

4.2.1 Murrumbidgee

The WSP notes (Clause 65(c)) a maximum channel capacity for the Murrumbidgee River at Gundagai of 32,000 megalitres per day (ML/d). River operators would historically aim to be within this physical constraint to ensure efficient delivery of regulated water.

When translucent flows were triggered in June 2016, WaterNSW was reluctant to release the daily flow rates (up to 40,500 ML/day) required by the translucent flow rules in the WSP. While historically the main flow target would have been limited to the known channel capacity at Gundagai of 32,000 ML/day, due to the expressed concerns of a small number of landholders downstream in proximity to Wagga Wagga, and valve capacity constraints at the dam, releases were limited to only 13,000 ML/day. This ensured flows did not exceed 20,000 ML/day at Wagga Wagga remained well within channel. During the June event, the Burrinjuck translucency dam releases (up to 13,000 ML/day) combined with minimum Blowering dam releases (about 560 ML/day) and some tributary inflows to result in a maximum flow during the event of about 16,300 ML/day at Gundagai and about 16,900 ML/day at Wagga Wagga. More details of this event can be found in the case study at Appendix A4.4.

A balance needs to be struck between the stated concerns of local landholders and the ecological benefits of floodplain inundation (refer to Section 3.2). Further modelling and consultation with affected landholders is needed to optimise the efficiency and effectiveness of this environmental water delivery, while ensuring that appropriate flow levels and mitigation options are developed with relevant landholders. This consultation with landholders will initially be through the Constraints Management Strategy, which is exploring how the many environmental benefits of delivering slightly higher flows to reach low-lying floodplains might be undertaken in the future, while mitigating effects this water may have on private property and people.

4.2.2 Cudgegong

In December 2010 and March 2012, the translucent flow rule from Windamere Dam was suspended when downstream Burrendong Dam was in flood. The suspensions were in response to community concerns about possibly exacerbating flooding downstream in the Macquarie River. In reality these actions did not meaningfully influence the peak downstream flows or affect Burrendong Dam operations. The suspension was mainly to meet public expectations regarding managed flows.

In each case, the Cudgegong River still received substantial downstream flows. Peak flow rates remained unaffected, but the suspension resulted in a quicker flow recession and blocked the passage of subsequent minor dam inflow events.

The total unreleased volume remaining in Windamere Dam from the suspensions is slowly being 'repaid' on an on-going basis by increasing daily discharge triggers by 25 per cent, up to operational constraints. The balance as of June 2017 is about 10,350 ML, and is being tracked on a daily basis by WaterNSW. Future suspensions of such translucent flows are less likely to be supported because of the negligible impact on downstream flooding and the onerous complexity of 'repayments' over extended periods. Further details are included in the consultation paper provided as a case study in Appendix A2.4.

4.3. Water availability

Translucent flow releases in inland NSW regulated rivers have been designed to balance the harvesting of water for productive use with the protection of downstream riverine ecosystems. While these rules can slow the increase in general security allocations, the effect is often small and varies from year-to-year. The limited impact is confined to a window where conditions are wet enough to satisfy release triggers, but not so wet that the dam fills sufficiently to provide full allocations.

Translucent flow rules in each valley were carefully developed with input from a broad stakeholder group. Each group – comprising irrigators, environment water holders, peak industry bodies and agencies – negotiated an outcome that sought to balance environmental outcomes and impacts on consumptive users. As a result, despite their complexity, the rules typically provide some concessions to augment water availability for consumptive users.

In both the Lachlan and Murrumbidgee valleys, translucency release volumes are limited when storage volumes are low. Furthermore in the Lachlan valley, a minimum inflow volume to the headwater storage was chosen in such a way that general security allocations begin to accrue at about the same time as translucent flows can be made.

In the Murrumbidgee valley, translucent flows are not quarantined for environmental purposes. Rather this water is available to users, including irrigators, usually through supplementary access. General security entitlement holders can also divert such water 'without debit'[3] when general security allocations are low. If any excess water flows out of the Murrumbidgee valley and is useful in the Murray River, this is credited as NSW resource, underpinning resource availability for NSW Murray irrigators.

Finally, there are some resource management benefits to simultaneous inflow-outflow relationships. For example, evaporation and transmission losses in association with these

[3] Murrumbidgee general security licence holders may pump water 'without debit' during a period of announced Supplementary Access if general security allocations are less than or equal to 70 per cent, as long as annual account usage limits are not exceeded. The maximum usage limit in the Murrumbidgee is 100 per cent of entitlement (excludes water traded in) and may consist of a combination of carryover, allocation water, water traded out and any supplementary water diverted under the 'without debit' provision. Due to the account limit restriction, 'without debit' water can convert to 'debit' water due to subsequent allocation announcements during the year. 'Without debit' water can be considered 'an advance' on possible future allocation announcements.

rainfall/runoff events are typically reduced. In other words, translucent releases, by default, also meet operational losses including end of system flow targets. In many instances this means less water needs to be set aside to ‘run’ the river and more can be allocated to water users.

If translucent flow rules were to be removed and replaced with an equivalent volume of account water for environmental purposes, storages are likely to be fuller for longer and the chance of spill increased, transmission losses likely higher, and less ability to capture water for allocation improvements. Therefore potential changes to translucent flow rules need to be considered carefully, to avoid any unintended consequences.

5. Ecological evidence of effectiveness

When describing how well translucency rules are applied, it is important to differentiate between efficiency and effectiveness. The term efficiency is applied to determine whether flows were delivered in accordance with the operational requirements under the WSP, and effectiveness is used to measure the extent to which ecological outcomes were achieved. Evaluations of both efficiency and effectiveness are being used to assess WSP implementation within NSW [4].

There is a growing body of evidence regarding the effectiveness of environmental watering for rivers in NSW, both within and outside the Basin. Examples of these benefits include flushing algal blooms, bird breeding and improved fish passage (Arthington and Pusey 2003). However even when the environmental flow outcomes are clearly measureable, the effects of individual components of an environmental watering regime, such as translucent flows, cannot always be isolated or discerned separately (Acreman et al. 2014; Davies et al. 2014). A translucency rule is only one part of an entire regulated river flow regime, which includes water released for human benefit (e.g. bulk water transfers for irrigation, or urban water supply), planned environmental rules (as defined under a water sharing plan) and licenced environmental water.

While translucency rules exist in both NSW and Queensland, many of the ecological responses to such translucency rules have yet to be fully assessed (Andrew McDougal [5], personal communication 24 March 2017; Foster 2013; Driver et al. 2013). However, there are several long term environmental flow studies that demonstrate that changes to the hydrological regime can result in ecological benefit (e.g., Scoppettone and Rissler 1995, Rood et al. 2003, Hall et al. 2011, Suren et al. 2011, Kiernan et al. 2012, Robinson 2012).

Ideally, decades of hydro-ecological data could be used as strong empirical evidence for the effectiveness of translucent flows (Driver et al. 2013). In the absence of this long term data, multiple lines of evidence are being used to assess the rules, including:

- **Formal scientific studies:** formal peer-reviewed studies, ideally within irrigation valleys, but also within non-irrigation driven valleys (e.g. the Metropolitan Rivers in the Hawkesbury Nepean and Shoalhaven Rivers) and, where relevant, studies outside of NSW (e.g. within Queensland).
- **Operational case studies:** case studies of beneficial implementation such as those developed from previous implementation e.g. the 2015 Lachlan event (DPI Water 2015b). Mixed benefit case study examples are also available, in which the translucency concept could not be fully implemented due to issues such as timing limitations, insufficient volume and maximum release rates. Examples include components of the Murrumbidgee and the Cudgegong River flow regimes.
- **Reporting of environmental watering outcomes:** information regarding the effectiveness for environmental watering overall in valleys that implement translucent flows can be drawn from Commonwealth and NSW annual reporting of environmental watering outcomes.
- **Counterfactual modelling:** scenario modelling of the river system to show changes in the hydrology with and without the translucency rules in place (refer also to Section 6).

[4] The detailed definitions are (DPI Water, in preparation):

- Efficiency – the level of implementation of plan rules, and whether their implementation was optimised. This element focuses on the water management activities required to implement a plan's rules and the resulting outputs (e.g. volumes of water made available for economic and social / cultural use, water trading statistics, and volumes supporting environmental outcomes). The outputs feed directly into the achievement of targeted outcomes.
- Effectiveness – Extent to which the objective outcomes were met, that is the level of success in achieving plan strategies which inform targeted and broad objectives.

[5] Project Leader - Aquatic Ecology, Queensland Government, Department of Natural Resources and Mines, Brisbane.

Conceptual relationships between hydrological parameters and ecological outcomes can then assist in determining likely relative impacts of different rules on observed monitored outcomes, or used in 'what if' scenarios to help evaluate different water sharing plan rules.

The ecological benefits of translucency and transparency rules have been clearly demonstrated in NSW, particularly in the Metropolitan Rivers of the Shoalhaven and Hawkesbury-Nepean valleys (refer to Appendix A5.1 for more details). Benefits included increased fish movement, improved water quality and better established aquatic biodiversity. Transparency rules in Queensland have also been shown to benefit fish passage (DSITIA 2013a; DNRM 2016) and prolong brackish habitat below tidal barriers where this habitat would have historically existed (DSITIA 2013b).

Below are short summaries of the ecological intent and associated evidence of effectiveness of planned environmental water in four NSW inland valleys, with a focus on translucency rules. Additional details on evidence for the effectiveness of translucent flows in Australian rivers outside of the Basin are provided in Appendix A5.1.

5.1. NSW Border Rivers

Environmental flow rules in the NSW Border Rivers WSP include translucent releases, limits on taking high flows, supplying minimum flows downstream of the dam, water set aside as an environmental water allowance (referred to as a 'stimulus flow') and the long-term average annual extraction limit.

These rules are intended to provide more natural flows downstream of Pindari Dam, including a continuous, seasonally appropriate low flow to support connectivity of downstream pools/riffles, and a large reserve of water to give 'stimulus' to the in-stream environment of the Severn River. Translucency and stimulus releases are protected from extraction downstream of Pindari Dam to the next tributary inflow point (Frazers Creek, about 22 kilometres downstream near Ashford).

The stimulus rule is intended to provide environmental benefits such as mirroring a naturally occurring hydrograph, adding benefit to any translucency environmental health releases, targeting pre-season cues to fish breeding, regularly wetting and inundating interconnected riparian areas downstream of the dam, and extending aquatic benefits further downstream to known sites of significance. Under some circumstances it can also be used for water quality issues such as algal blooms or other contaminant pollution.

There is limited ecological monitoring data available to inform the effectiveness of planned environmental water releases in the valley. Reviews that have occurred have mainly focused on the larger stimulus flow rule. In the last few years, such stimulus volume releases have been further supplemented with licensed environmental water to provide increased event volumes. Outcomes expected from the release include biofilm scouring, wetland inundation and, when cold water pollution effects can be mitigated, fish recruitment within the Severn River from Pindari dam to the junction with Frazers Creek (CEWO 2015).

During the 2012 stimulus event, Foster (2013) monitored a number of physical (velocity, temperature, bank stability) and water quality parameters (nitrogen, phosphorus, dissolved oxygen, electrical conductivity, turbidity and total suspended solids). While there was no specific fish monitoring undertaken, comparing temperature records from a number of sites to published tolerances of native fish for breeding and survival indicates that the release, which ranged between 10°C and 9°C lower than Severn River upstream of the dam, may have had short-term negative impacts on fish populations within the river (Foster 2013, DPI Fisheries 2014). These thermal affects were observed to moderate with increasing distance from the dam, potentially providing both short and longer-term benefits to fish communities in downstream reaches (DPI Fisheries 2014).

While Pindari Dam is equipped with a multi-level intake tower, physical conditions and management aims may present additional challenges in managing cold water pollution. Foster (2013) noted: strong stratification is typical in Pindari Dam between early spring to the following winter; depth profile water temperature data was not available to determine the depth of the thermocline during the 2012 release; intakes during the release were set at 6 to 15 meters below the surface with the intent of minimising potentially toxic blue green algae that congregate on the surface; and it appeared that entrainment of colder water from below the thermocline occurred during the event (Foster 2013).

A study by Rolls et al. (2013) on the flow regimes of numerous rivers in northern NSW showed that flows can be delivered to stimulate fish recruitment in northern rivers, but similarly found that cold water pollution was a major limiting factor within Pindari Dam. As the stimulus flow can be released from 1 August to 1 December each year, earlier releases (e.g. late winter) may reduce cold-water pollution impacts, as native species spawning windows begin later in spring and summer (DPI Fisheries 2014, CEWO 2015).

Monitoring of the physical and ecological responses of the recent 2015 stimulus release was undertaken by officers from DPI Water and NSW DPI Fisheries, with evaluation results still pending (DPI 2015a).

The above study examples indicate that unless multiple key factors are managed simultaneously, ecological benefits can often be elusive. Any assessment or future evaluation of the Border Rivers translucency rules should similarly consider how cold water pollution can be limited, in order to provide the most beneficial ecological flow outcomes in the long-term.

5.2. Macquarie and Cudgegong

Environmental flow rules in the Macquarie-Cudgegong WSP include translucent releases, limits on taking high flows, water set aside as an environmental water allowance (EWA) and the long-term average annual extraction limit.

The translucency rule in the Cudgegong River was developed to provide more natural flows in the reaches located downstream of Windamere Dam, with the intent to remove biofilm but also excessive sediments and vegetation within the river channel.

In the Macquarie, the EWA consists of two sub-allowances: a translucency rule component and an active, discretionary component (refer to Appendix A2.1 for details). The intent of the translucency rule component is to provide more natural flows downstream of Burrendong Dam. This includes providing larger flows that support the replenishment of floodplains, which is especially important for bird and plant responses. The translucency rule can also be used to enable fish recruitment within the river channel.

The intended benefits of the active discretionary component of the Macquarie EWA include native fish recruitment and dispersal in the Macquarie River and Macquarie Marshes, completion of colonial water bird breeding events, and the alleviation of severe, unnaturally prolonged drought conditions in the Macquarie Marshes (DIPNR 2004b).

Annual Office of Environment and Heritage (OEH) reporting of outcomes of environmental watering events indicates three short translucent flow events totalling 1.8 GL were delivered under the rules of the WSP in 2013/14 for the Cudgegong River for river maintenance flows (OEH 2014b). A review of WaterNSW operational data indicates that translucent release have also occurred in the Cudgegong valley in 2014/15 (0.7 GL), 2015/16 (3.8 GL) and 2016/17 (10 GL). In the Macquarie valley, the most recent years in which the translucency sub-allowance of the EWA was last triggered and debited included 2016/17 (3.2 GL) and 2013/14 (15.9 GL).

While translucency triggers were not met in 2015/16, an approval to use volume accumulated in the translucent sub-allowance was granted (10 GL) due to severe water shortage conditions in the Ramsar-listed Macquarie Marshes and the need to prevent significant ecological damage to

the marshes. In August 2015 the Minister approved the suspension of relevant clauses in the WSP, which then permitted the transfer of water from the translucent sub-allowance to the active sub-allowance of the Environmental Water Allowance (refer to Appendix A2 for more details on rules for accessing these two sub-allowances). Allowing access to the sub-allowance for environmental watering was assessed as unlikely to result in any third party impacts, and was undertaken as a 'one-off', without prejudice arrangement. Consultation for the action was also undertaken with stakeholders through the local Environmental Flow Reference Group and the Customer Service Committee. The scenario described here shows Ministerial intervention to achieve key environmental outcomes in the valley.

Most reported effectiveness information in the Macquarie-Cudgegong River centres around monitoring of the Macquarie River and Marshes. For example in 2013/14, the Commonwealth and NSW annual reporting of environmental watering outcomes indicates that 10 GL of Commonwealth environmental water, 11 GL of NSW licenced environmental water and 43.7 GL of EWA planned environmental water was delivered to wetland and in-stream targets across the Macquarie Valley (OEH 2014b). Of the EWA released, 15.8 GL was debited from the translucency component and 27.9 GL was debited from the active component.

Monitoring showed that environmental watering increased longitudinal hydrological connectivity along the river and with the Macquarie Marshes, contributing to the successful inundation of about 15,480 hectares of semi-permanent and woodland vegetation communities. This supported positive ecological outcomes for the valley's inner floodplain areas, despite drying conditions over spring and summer. Areas of the marshes not flooded during the water year remained in intermediate to poor condition, in comparison to areas that received sufficient flooding for consecutive years generally contained healthy vegetation communities. Positive responses were seen in winter growing vegetation and maintenance of healthy communities of water couch and mixed marsh. The watering also provided access to waterbird breeding and refuge habitat for a wide variety of bird species, with a moderate diversity of waterbird species observed in the Marshes during the event. Limited numbers of international migrant bird species and several threatened species were also observed (OEH 2014b, CEWO 2016).

In 2015/16, the latest year of published OEH outcome reporting available, and also a year in which translucency sub-allowance was used, 14.2 GL of Commonwealth licensed environmental water, 4.4 GL of NSW licenced environmental water, and 36.4 GL of EWA planned environmental water (which included the 10 GL transferred from the translucency sub-allowance) was delivered to wetland and instream targets. The main delivery was between August and October 2015, with smaller volumes delivered in an event in June 2016, the latter of which also included a further 2.5 GL delivered during a period of supplementary access (OEH 2017).

Monitoring showed that flows that inundated the northern Marshes river red gum woodlands improved the condition of the trees and the floodplain vegetation in these areas were deemed after the flows to be in intermediate to good condition. Waterbird diversity was observed to be moderate, with some noteworthy species, such as the Australian painted snipe and Australasian bittern being recorded (OEH 2017).

5.3. Lachlan

Environmental flow rules in the Lachlan WSP include translucent releases, environmental water allowances (EWAs), a water quality allowance (WQA) and a long-term average annual extraction limit.

The intent of the translucent flow rule is to improve lower system flows and winter/spring flow variability downstream of Wyangala Dam, and thereby increase watering in the lower river and wetlands, and help to restore aspects of ecosystem function. The larger flows allowed under the rule aid in the replenishment of floodplains, which is especially important for bird and plant responses. It can also be used to enable fish recruitment within the river channel.

EWAs were established in both Wyangala Dam and in Lake Brewster to allow discretionary releases when needed to support specific environmental purposes such as waterbird or fish breeding, wetland watering or increase flow variability. Similarly, a WQA provision was established in Wyangala Dam to be used when needed to reduce salinity levels or mitigate blue-green algae outbreaks (DIPNR 2004a).

In 1999/2000, translucent flows amounted to 47.8 GL with an initial nine per cent inundation of monitored wetlands attributable to translucent flows alone. A total of 100 per cent inundation of monitored wetlands was observed later that year due to a combination of the translucent flows, a dam spill and dam airspace release (Driver et al. 2000). Responses of the Lachlan monitored wetlands to flows released under the translucent flow rule during 2000/2001 showed all monitored wetlands had filled by August 2000 (Moore et al. 2002; under the IMEF program, Chessman et al. 2003, Driver et al. 2010). Monitoring of such events and subsequent modelling has shown that events driven by translucency flows are highly significant for ecological outcomes such as colonial waterbird nesting (e.g., Driver et al. 2004).

Other effectiveness information for the Lachlan valley can be drawn from Commonwealth and NSW annual reporting of environmental watering outcomes. A review of WaterNSW operational data indicates the most recent Lachlan translucent releases have occurred in 2012/13 (269.6 GL), 2015/16 (73 GL) and 2016/17 (341.4 GL).

In 2012/13, significant rainfall occurring early in the water year triggered translucent releases totalling 269.6 GL, allowing for the inundation of wetlands and effluent creeks on the lower Lachlan floodplain. Additionally, 51.3 GL of Commonwealth licensed environmental water and 15.4 GL of NSW licenced environmental water were delivered to wetland and in-stream targets within the valley. Monitoring observed a limited waterbird breeding response at the Booligal Wetlands, with greater than 1000 newly constructed nests, though many were subsequently abandoned. Licenced environmental water was used to ensure that water levels receded gradually to enable as many remaining young birds as possible to reach independence. Environmental water received at Burrawong Lagoon was also found to initiate frog and waterbird responses. Hot and dry conditions later in the water year caused many Lachlan wetlands to dry out. To support continued recovery of these areas, a significant release of licenced water, the largest release of held environmental water experienced in the valley, was coordinated with delivery of operational flows. These enhanced flows allowed for the inundation of over 63,000 hectares of river, wetland and floodplain habitats. Monitoring indicated a vigorous flowering response by vegetation and sightings of more than 20 species of waterbirds (OEH 2014a, CEWO 2013).

Translucent flows in the Lachlan were again triggered in 2015 and 2016 (Broadhurst et al. 2015, Dyer et al. 2015, 2016b,c).The ecological effects of these events included wetland filling across the lower Lachlan that was associated with positive vegetation and frog responses during the 2015/16 water year, a substantial colonial waterbird nesting event at Booligal Swamp and positive wetland plant community responses within the 2016/17 water year (Dyer et al. 2016b,c).

In 2015/16, the latest year of published OEH outcome reporting available, the Commonwealth and NSW annual reporting of environmental watering outcomes indicates that a total of 48.1 GL of managed environmental water was delivered to wetland and in-stream targets within the valley. This included 36.0 GL of Commonwealth environmental water and 12.1 GL of NSW licenced environmental water, with targets that included, water to key drought refuge areas including the Great Cumbung Swamp and Booligal wetlands and supporting endangered native frog populations at Lake Bullogal. In addition to held environmental water, 72 GL of translucent flows contributed flows to the system in August to September 2015 (Dyer et al. 2016a; OEH 2017).

The translucent flow event was triggered on 29 August 2015 and lasted about 15 days. Prior to this, NSW and Commonwealth environmental water was being delivered to the lower Lachlan

River, targeting fish and inundation of the Great Cumbung Swamp. This event was suspended while translucent flows were in the system. The magnitude of the translucent flows was sufficient to provide connection to a number of wetlands between Hillston and Great Cumbung Swamp. The use of held environmental water recommenced to augment the translucent event as it receded, both by helping to modify the rate of fall of the event (providing a more natural hydrograph shape with added benefits of minimising the risk of bank slumping and black water), as well as extending the duration of hydrological connection to the reed beds and lakes of the Great Cumbung Swamp (CEWO 2016; Dyer et al. 2016a; OEH 2017).

The combined translucency and managed flows inundated more than 9000 hectares of wetland habitat in the Great Cumbung Swamp, resulting in vigorous growth in core reed beds, improved condition of floodplain and riparian trees, observation of numerous species of birds and frogs, and subsequently supported frog breeding (Dyer et al. 2016a; OEH 2017).

As part of the Long Term Intervention Monitoring (LTIM) project in the Lachlan, 2015/16 surveys have indicated some evidence of response in the mobilisation of nutrients and subsequent increase in algal productivity to the large translucent flows. Indices used to evaluate overall condition of the native fish community were also found to of improved marginally in 2016 compared with the previous year. While the contribution to this improvement is difficult to determine, it is expected that the combination of translucent flows and managed environmental watering actions contributed to the change. Similarly, substantial spawning was observed for non-flow dependent species (e.g. Murray cod, flat headed gudgeon), and it is likely that the flow conditions produced by both the translucent releases and the delivery of managed water would have contributed to this outcome (Dyer et al. 2016a).

While it is well known that inundation and connection of wetlands promotes carp spawning, and there is concern that environmental watering actions may promote such an outcome, only a low level of common carp spawning was observed in the LTIM monitored reach. This suggests that the short duration of the translucent releases - causing short duration connection of wetlands - and subsequent environmental flows did not result in any significant alien fish recruitment events in the monitored reach (Dyer et al. 2016a).

In addition to targeting the Great Cumbung Swamp, additional portions of the held environmental water in 2015-16 were used between September and December 2015 in Merrimajeel Creek to support waterbird habitat in the area of Murrumbidgil Swamp, provide water for drought refuge in the Booligal wetlands, support endangered frog populations at Lake Bullogal and support native fish spawning in the river below Lake Brewster (Dyer et al. 2016a; OEH 2017).

5.4. Murrumbidgee

Environmental flow rules in the Murrumbidgee WSP include translucent releases, transparent releases, a continuous low flow rule, end of system flow (EOS) rule, water set aside as environmental water allowances (EWAs) and a long-term average annual extraction limit.

These rules are intended to provide: protection of low flows in the upper reaches of the river immediately below Blowering and Burrinjuck Dams; provision of winter flow variability; maintenance of flows in the lower reaches of the river to better reflect natural flows; and a reserve of water as EWAs (EWA1, EWA2, EWA3) for environmental purposes such as assisting with waterbird breeding, flooding of wetlands, fish passage or breeding, or to restore water quality (DIPNR 2004c).

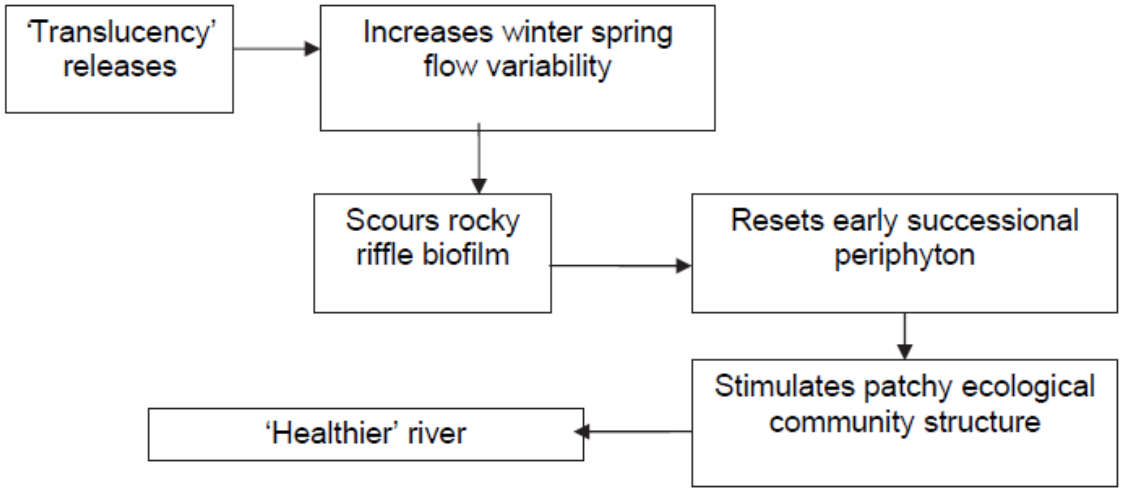
Prior to the translucency rules being introduced, winter and spring flows in excess of the minimum required for dam maintenance and for stock and domestic use downstream of Burrinjuck were retained for summer irrigation releases. Recognition that ecological functioning of the river could not be improved without restoration of part of the natural hydrograph led to the introduction of translucent flows starting in 1998 (Hardwick et al 2012a; DPI 2014).

The translucency rules, linked with tributary inflows, are designed to restore stony bed riffles downstream of Burrinjuck Dam. This includes the intent to restore some of the natural flow variability and provide sufficient velocity to scour in-channel habitats. The objective of this scouring action is to reduce and re-set biofilm quantity and composition to healthy levels. The material scoured off becomes part of downstream productivity, fuelling food webs. If this happens relatively often, there is an ongoing source of nutrients. The constant flows and high nutrient loads that often accompany regulation can favour thickened biofilms. When accrued into extensive mats they are often termed 'nuisance biofilms', and in regulated streams have been linked with impacts to aquatic organisms, altered water quality and aesthetic impacts (Biggs 2000b, DPI 2014).

The conceptual diagram in Figure 6 depicts the expected ecological response to the Murrumbidgee translucent flows. The scouring action is expected to lead to the resetting of riffle periphyton communities. Periphyton[6] in this report refers to the algal component of the biofilm. Early successional stages of this ecological community are a more palatable food source. Riffle invertebrate communities, particularly invertebrate scrapers and their predators, are expected to react favourably to associated compositional changes in the periphyton communities. This in turn stimulates higher trophic food webs, and leads to a 'healthier' river.

Monitoring of the effectiveness of transparent and translucent flow events in the Murrumbidgee system was undertaken by DPI Water through a series of studies between 1999-2002 under the Integrated Monitoring of Environmental Flows (IMEF) program (Chessman 2003; Hardwick et al. 2012a; Hardwick et al. 2012b; Hardwick et al. 2014). Monitoring in the study terminated in late 2001, after translucent releases became minimal during drought. Translucency releases subsequently ceased between 2006 and 2011 with the necessary suspension of the WSP during those years due to severe water shortage.

Figure 6. Conceptual model for expected ecological response to translucent flows (Hardwick et al. 2012a)



Key findings from the study relevant to translucency effectiveness are listed below:

[6] Periphyton is not defined consistently in the scientific literature. It is often defined as the community of all organisms living upon the surfaces of submersed objects in water, including algae, fungi and bacteria (Wetzel 1983), and can also be defined to include organic matter entrained from stream flow (e.g., Chessman 2003, Gray 2013). Under these definitions periphyton is the same, or nearly the definition for biofilm typically used in DPIW aquatic science (e.g., by Chessman 2003). In this report, the term periphyton is used as a separate term, and also to be consistent with the Murrumbidgee River translucency reports, which limit the definition to filamentous and diatomaceous algae components of biofilm (Hardwick et al 2012 a, b, 2014). This definition is also commonly used in the literature (e.g., Johnson et al 1978).

- Translucency flow releases introduce flow variability in the river below Burrinjuck Dam between April and October. Translucency releases ranged between 15 to 24 per cent of dam inflows between 1999 and 2001, and represented between 3 to 6 per cent of overall dam releases during those water years. The study noted the volumes varied by translucency flow rules represented a relatively small amount of flows in comparison to extensive irrigation flows later in summer, and that achieving flow variability within this constraint is difficult and can only be achieved during part of the year.
- As monitoring data was not available from before the translucency rules altered flows in the Murrumbidgee, it could not be directly tested whether biofilms shifted in response to the observed increase in flow variability. While the study did observe substantial reductions in biofilm mass following larger flow events, suggesting flow is important, these effects were short-lived and periphyton levels tended to reset within short time frames. Although little evidence was found of changes to periphyton in the Murrumbidgee over longer timescales, this may also be due to statistical power of the experiment rather than evidence for a lack of response.

  Statistical power of this experiment is determined in large part by the size of the transparency flows compared to overall flows (which is low as mentioned above), the experimental replication (such as number of samples) and system variability. This lack of experimental power in periphyton research is typical, owing to the patchiness of periphyton and its complex relationships to environmental variables (Larned 2010). Future study designs can partly address this power limitation by either sampling on more occasions or at more sites.
- The findings suggest that water quality could be as important as flow in regulating periphyton, with dissolved oxygen, ammonia, turbidity and temperature important factors in differentiating periphyton communities. Water quality downstream of Burrinjuck in the Murrumbidgee River is influenced both by regulation practices (e.g. cold water pollution and deoxygenated nutrients associated with bottom releases from the dam), as well as upland catchment practices which lead to dam inflows with elevated concentrations of nutrients and comparatively high turbidity and suspended sediments.
- The study recommended exploring modifications to current flow management to ensure that such flushing events had longer-term beneficial effects. Management modifications suggested include reducing nutrient content of dam releases (e.g. consider avoiding bottom releases from Burrinjuck Dam, which tend to be more nutrient rich), a higher threshold velocity to ensure successful scouring, and more frequent pulses of flow.

In summary it appears that some aspects of the flow regime often met efficiency requirements (see earlier sections on efficiency v effectiveness), but that some other aspects of the flow regime impacted on the effectiveness of the translucent flows. The main impacts on effectiveness were related to water quality including nutrients, suspended sediments and cold water pollution; and to reversed flow seasonality, namely large regulated summer flows for irrigation when a natural regime instead consists of high natural flows in winter/spring).

The benefits of translucent flows for scouring instream habitats hinge on the conditions required by primary producers (e.g. periphyton), which in turn impact the health of invertebrates and fish communities (see Davies et al. 2014). This study suggests that these food web interactions are affected by both local and broad-scale interactions. The solutions require further interrogation of the flow regime to see if it can be optimised, and water quality mitigation that must also consider upstream land management effects.

Other effectiveness information for environmental watering in the Murrumbidgee valley can be drawn from Commonwealth and NSW annual reporting of environmental watering outcomes. These outcomes are a result of both planned environmental water and licenced environmental

water releases in the valley. A review of WaterNSW operational data for the last three years indicates that translucent release have occurred each year, with 74 GL in 2014/15, 284 GL in 2015/16 and 169 GL in 2016/17.

In 2014/15, 152.6 GL of Commonwealth licensed environmental water, 68.7 GL of NSW licenced environmental water, 1.5 GL of The Living Murray (TLM) licenced environmental water and 73.1 GL of EWA planned environmental water were delivered to wetland and river targets across the Murrumbidgee Valley. As stated above, this was supplemented by about 74 GL of translucency releases. Monitoring showed that large volumes of water delivered to the Lowbidgee triggered successful colonial waterbird breeding events as well as provided breeding habitat for numerous frog species, including significant recruitment of southern bell frogs (listed as endangered in NSW) in the Nimmie-Caira system. Other water deliveries provided large areas of wetland habitat suitable for frogs and waterbirds, including various threatened bird species and migratory bird species listed under bilateral conservation agreements, and improvements of habitat and water quality in open water areas that benefited native fish (OEH 2015a).

In 2015/16, the latest year of published OEH outcome reporting is available, 108.3 GL of Commonwealth licensed environmental water, 16 GL of NSW licenced environmental water, and 103.6 GL of EWA planned environmental water were delivered to wetland and river targets across the Murrumbidgee Valley. This was supplemented by about 284 GL of translucency releases. Aquatic and semi-aquatic species in wetlands that had spring environmental water deliveries showed a strong response. In particular, the Yarradda Lagoon, located in mid-Murrumbidgee, showed a marked increase in spiny mud-grass coverage as a result of having received environmental water over the past two years. This is an important aquatic species that dominated the wetland in the late 1990s. In the Lowbidgee and Nimmie-Caira, aquatic native vegetation was found to be highly diversified, with the Spike rush species more dominant in the Lowbidgee and the nardoo and water milfoil more dominant in the Nimmie-Caira. Furthermore, southern bell frogs were found to be active throughout the Nimmie-Caira, with adults and tadpoles recorded at LTIM sites, and small numbers of calling frogs at several Lowbidgee wetlands. Across the Murrumbidgee, 32 species of waterbirds were also recorded, with pacific black ducks and grey teals confirmed to be breeding at wetland sites. Yarradda Lagoon and Piggery Lake recorded the largest counts of waterbirds (OEH 2017).

5.5. Counterfactual modelling and ecological effectiveness

The combined benefits of planned-fixed, planned-discretionary and held environmental delivery are often greater than the sum of the three environmental flow types. While it is difficult to separate the effectiveness of the different flow components, this can be addressed in part through scenario modelling with and without different rules in place using river flow models; this is also known as counterfactual modelling.

Counterfactual modelling uses the science of eco-hydrology, where known relationships between river hydrology and ecological responses such as birds, plants or fish (e.g. detailed eco-hydrology work by CSIRO, Colloff et al. 2010) are used to determine what the flow-ecology relationships would be with and without plan rules. Model results can assist in determining likely relative impacts of different water management rules on observed monitored outcomes, or used in ‘what if’ scenarios to help evaluate outcomes if the river management rules were changed.

The counterfactual modelling approach is used within basin and state level water planning (e.g., see MDBA 2016). Results from such modelling assist longer-term planning by testing potential planning rules, then assessing if the resulting hydrologic regime is likely to produce an effective ecological outcome.

To this end, NSW river flow models are progressively being updated to better reflect key environmental demand locations (previously models focused on consumptive demand locations) in order to deliver meaningful outputs to the SAPs, including for translucency flow representation. Some initial model updates and preliminary model runs to test translucency rules

have already occurred for some valleys. This is discussed further in Section 6. Further refinement of the models, to build on these initial updates, would be needed in order to allow the interacting effects of different flow rules to be meaningfully separated under various scenarios.

6. Long term river flow modelling

The main surface water model used in NSW to model river flow and water sharing is the Integrated Quantity and Quality Model (IQQM). IQQM models have been developed and used for planning and policy assessment in all major NSW MDB rivers, including the Border Rivers, Macquarie-Cudgegong, Lachlan and Murrumbidgee. These models were developed by DPI Water to simulate all key physical and water management processes that affect streamflow and water use. The simulation is a daily time step over a long term, and uses the historical climate sequence.

Key management processes simulated are those such as accounting systems, maximum annual usage, sharing arrangements, and environmental watering. The translucent flow arrangements that are the subject of this review were developed and tested in these models as input to the WSP planning process. These models have been updated significantly since the WSPs were initially developed, including 10-15 years of additional climate records, more detailed representations of current conditions, and accuracy improvements.

6.1. Modelling approach

These models have capability to review the full extent of potential rule changes, from removing them to refining them. As a preliminary step in this review the translucent rules have been 'turned off' such that no translucent releases are made. This does not represent a proposed option, but is simply a sensitivity test to determine the maximum potential impact of translucent flow rules on consumptive users and the environment.

Summary results have been prepared for each valley on changes to entitlement usage and to environmental outcomes. The information readily available for the Lachlan Valley is a little more detailed, as it has been workshopped more recently with the Lachlan SAP.

6.2. Modelling results for selected valleys

6.2.1 Lachlan Valley

The translucency rules of the WSP were simulated in the pre-Basin Plan Recovery conditions scenario of the Lachlan IQQM. This scenario was prepared as a baseline for developing the Lachlan WRP. An additional scenario was prepared where the translucent flow rules were rendered inoperative by setting inflow triggers that exceeded observed inflows.

The immediate impact of not making translucent releases was a significant reduction in the number of environmental events upstream of Booligal. The simulated streamflow at this location for sample periods is shown in Figure 7 and in Figure 8. Figure 7 shows a relatively dry period in the historical record (1906-1917), during which translucent releases would allow several flow pulse events to occur, in comparison to no such events occurring over the period without such rules in place. Figure 8 shows a relatively wet period (1959-1964) during which translucent releases were not significant, and unregulated inflows were responsible for the environmental events.

The significance of this release behaviour is that apart from increasing the number of events, it has its greatest impact in reducing the period of time between events during drier periods. An analysis of this inter-event period is shown at Figure 9. Translucent releases resulted in more events with short gaps (~ 1 year) between them, and fewer events with longer gaps (2-4 years) between them.

Figure 7. Impact of translucent releases on flows at Booligal for a dry period

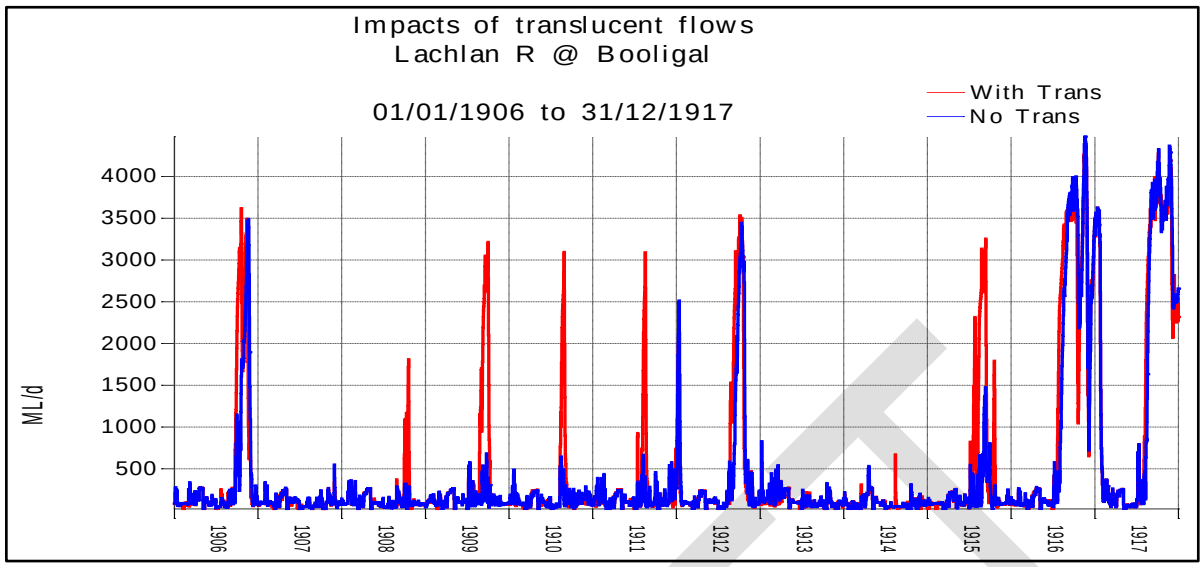


Figure 8. Impact of translucent releases on flows at Booligal for a wet period

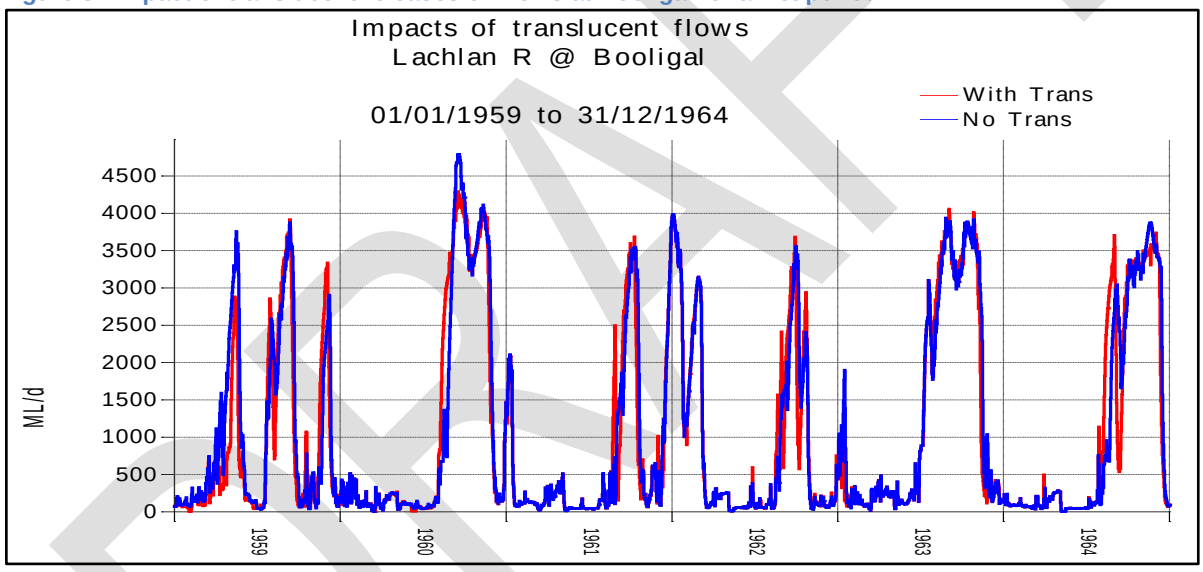
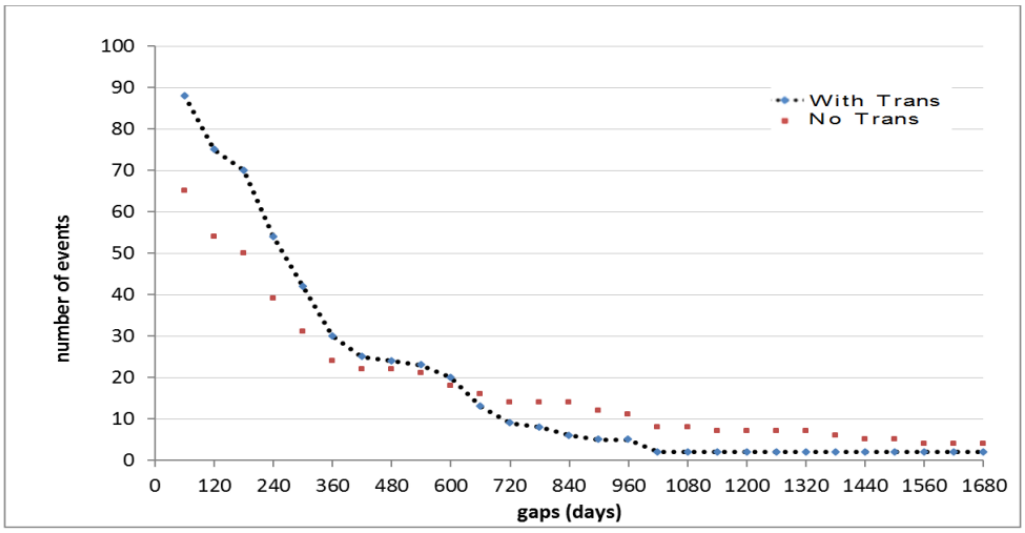


Figure 9. Impact of translucent releases on gaps between consecutive events of > 3,500 ML/d



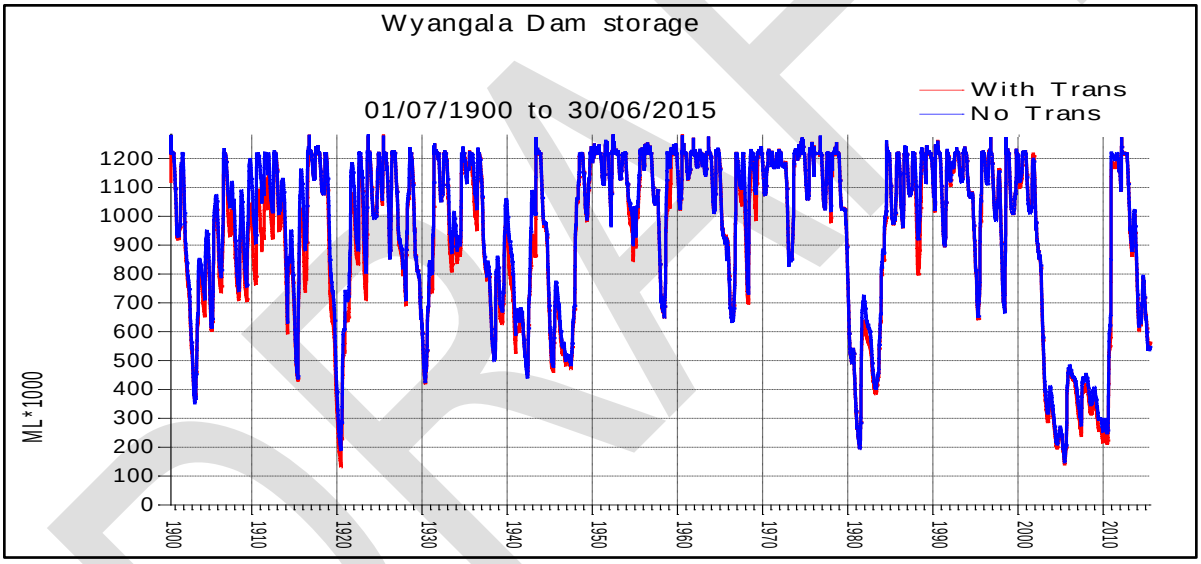
An assessment of the frequency of particular flow indicators used by MDBA to formulate the SDL for Lachlan River at Booligal Wetlands shows a reduction in two categories (Table 2), particularly those delivering lower flows.

Table 2. Impacts of translucent releases on Basin Plan flow indicators at Booligal Wetlands

Environmental events	Number of Events	
	With translucency	No translucency
300 ML/d for 25 consecutive days between Jun & Nov	61	49
850 ML/d for a total duration of 70 days (with min duration of 1 day) between Jun & Nov	29	29
2,500 ML/d for 50 consecutive days between Jun & Nov	24	22

As less translucent releases are made from Wyangala Dam, more water is retained in storage. This result is shown as a time series in Figure 10. The greatest differences in volumes are apparent in the dry period 1906-1917, corresponding to the releases responsible for the environmental events shown at Figure 7. Less significant differences are apparent across the full time period.

Figure 10. Impact of translucent releases on water stored in Lake Wyangala



The increases in the volume stored in Lake Wyangala results in increases in the amount of water that can be allocated to entitlement holders, and consequent increases in usage, as shown at Figure 11. The most obvious period of increased diversions, and therefore water available for consumption, is during the dry period 1906-1917. The application of translucent flows during this period results in the greatest increase in environmental events, mimicking natural hydrological events. The differences are less obvious during other periods.

With translucent flow rules removed, annual general security diversions, averaged over the full historical period, increase by 12 gigalitres per annum (GL/a), or 5.1 per cent as detailed below in Table 3.

Figure 11. Impact of translucent releases on General Security entitlement usage in Lachlan Valley

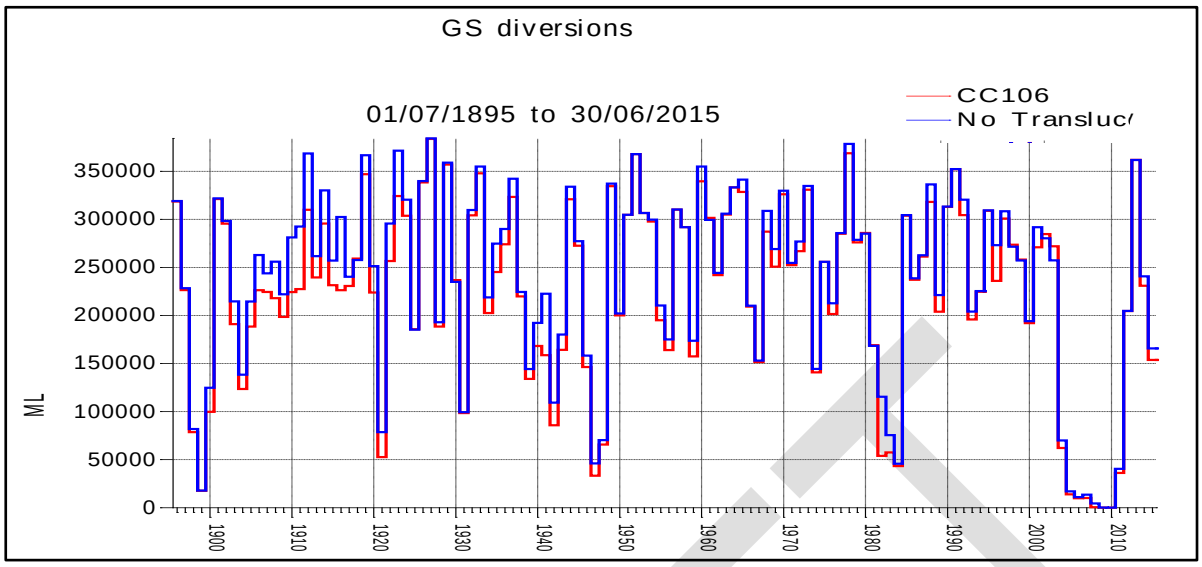


Table 3. Impact of removing translucent releases on Lachlan Valley long-term average general security usage

Scenario	Average entitlement usage (GL/a)	Additional usage (GL/a)
With translucent flows	234	12
No translucent flows	246	

6.2.2 Macquarie Valley

Translucent releases from Burrendong Dam are a component of the 160 GL Environmental Water Allowance (EWA), which accrues water commensurate with General Security allocations. The translucent release share of this EWA is 64 GL, with releases made according to the rules articulated in the WSP. The remaining 96 GL of the EWA is actively managed according to annual watering plans formulated by the Environmental Flows Reference Group (EFRG). The EFRG was formed in 2000 and formalised in 2004. Its members are comprised of a variety of local interest groups that provide advice to OEH on how environmental water in the mid and lower Macquarie Valley can be managed.

For the purposes of this modelling scenario, the translucent flow component of 64 GL was set to 0 GL, effectively suspending translucent releases. Releases from the 96 GL active component of the EWA remained unchanged and consistent with EFRG guidelines.

An assessment of the frequency of particular flow indicators used by MDBA to formulate the SDL for Macquarie Valley at Macquarie Marshes shows a reduction in three categories (Table 4). The events for the largest volume category actually increased, and this is likely because the increases in water stored would decrease airspace capacity for storing flood flows, and result in more spilling during particularly wet periods.

Less water flowing into the Macquarie Marshes means that less water will flow out to the Barwon Darling River. The model estimated that 15 GL/a, or 3.7 per cent less water would flow from the Macquarie River to the Barwon Darling River (Table 5).

As with the Lachlan Valley, the additional water stored in Lake Burrendong results in higher allocations and consequently higher usage against entitlement. Eliminating translucent releases increased general security entitlement usage by 33 GL/a, or 10.6 per cent (Table 6).

The Macquarie valley contains supplementary access entitlements, which currently represent about 10 GL of average annual usage. This value remains unchanged between the scenario model runs of with and without translucency. This is consistent with the WSP, which has much lower triggers for translucency releases than the triggers to announce supplementary access (refer to WSP for detailed rules), meaning that the translucency flows are not expected to contribute to unregulated flows during supplementary flow events.

Table 4. Impact of translucent releases on Basin Plan flow indicators at Macquarie Marshes

Environmental events	Number of Events	
	With translucency	No translucency
Total volume of 100 GL over 5 months between Jun & Apr	97	92
Total volume of 250 GL over 5 months between Jun & Apr	55	51
Total volume of 400 GL over 7 months between Jun & Apr	37	32
Total volume of 700 GL over 8 months between Jun & May	10	13

Table 5. Impact of removing translucent releases in Macquarie on average annual end of system flows (into the Barwon Darling River)

Scenario	Average end of system flow (GL/a)	Reduced outflows (GL/a)
With translucent flows	407	-15
No translucent flows	382	

Table 6. Impact of removing translucent releases on long-term average general security entitlement usage in Macquarie and Cudgegong valleys

Scenario	Average entitlement usage (GL/a)	Additional usage (GL/a)
With translucent flows	310	+33
No translucent flows	343	

6.2.3 Murrumbidgee Valley

Modelling scenarios investigated the impact of turning off the translucent flow rules in the Murrumbidgee regulated river, while the transparent flows from the storages were left on. This is because the transparent flow rules would otherwise have to be replaced with minimum releases from both dams, as operational protocols do not allow the rivers to run dry.

The impacts on Basin Plan flow indicators by turning off translucent releases are that the frequency of high flow events increased at Narrandera in the mid-Murrumbidgee (Table 7), and reduced at Lowbidgee (Table 8).

The increases at mid-Murrumbidgee are at first glance counter-intuitive. The translucent release serves as a de facto pre-release policy for Burrinjuck, reducing the number of uncontrolled spills from Burrinjuck by about 20 per cent when compared with 1993/94 conditions (used by the Basin Plan baseline modelling).This increase in uncontrolled spills is causing the increase in the larger environmental events at Narrandera.

Of note is the fact that controlled (translucent) releases are physically constrained by the Narrandera minor flood level (42 gigalitres per day (GL/d)) which, in combination with the channel capacity limit downstream of Gundagai (32 GL/d), makes it difficult to operationally achieve the lower flow indicators and impossible to meet the targeted higher flow rates of 44 GL/d and 63.25 GL/d without inundating private land. Therefore in reality, sufficient water to reach the upper targets is likely to come from unregulated flows and/or uncontrolled spills from storage, and not from targeted (regulated) releases.

The reduction in the number of events in Lowbidgee means that outflows from Murrumbidgee are also reduced by 26 GL/a, or 1.6 per cent (Table 9), resulting in minor water availability impacts in the Murray River.

The additional water retained in the storages results in higher allocations and consequently higher usage against entitlement. Eliminating translucent releases increased general security entitlement usage by 35 GL/a, or 3.0 per cent (Table 10).

The Murrumbidgee valley contains a large volume of supplementary access entitlements, which currently represent about 119 GL of average annual usage in the Supplementary Water licence category, and 287 GL/a in the Lowbidgee licence category. Without translucent flows, Murrumbidgee Supplementary Water entitlement usage in the mid-Murrumbidgee (excluding Lowbidgee) were found to decrease by 6 GL/a, or 4.9 per cent, and Lowbidgee entitlement usage was found to increase by 4 GL/a or 1.4 per cent.

The original intent of translucent release rules in the Murrumbidgee was to restore some of the natural flow variability to benefit the riverine environment between Burrinjuck Dam and the junction with the Tumut River. Consumptive demand along the river effectively begins below this junction. For this reason there is no prohibition in the water sharing plan on using translucent flows to meet access licence holder requirements (including to fill orders, offset transmission losses and contribute to supplementary access) as there are for releases made with EWA 1-3.

The translucent release rules operate as a de facto pre-release policy for Burrinjuck Dam, reducing the number of uncontrolled spills (Foreman 2000). Without translucency flows contributing to high flows during ‘borderline’ conditions, supplementary access is less likely to be triggered, which is consistent with the modelling results showing a reduction in mid-Murrumbidgee Supplementary Water access volumes.

Without translucency ‘pre-releases’, more water would be captured and fill the storage earlier in the season. This contributes to more uncontrolled spills, larger high flow volume events, and attendant downstream flooding impacts. The increase in Lowbidgee supplementary access seen in the ‘without translucency’ scenario is likely due to these factors, as Lowbidgee access is only triggered during larger flow events.

Table 7. Impact of translucent releases on Basin Plan flow indicators at mid-Murrumbidgee (Narrandera)

Environmental events	Number of Events	
	With translucency	No translucency
26,850 ML/d for a total duration of 45 days between Jul & Nov	12	12
26,850 ML/d for 5 consecutive days between Jun & Nov	47	49
34,650 ML/d for 5 consecutive days between Jun & Nov	33	35
44,000 ML/d for 3 consecutive days between Jun & Nov	22	29
63,250 ML/d for 3 consecutive days between Jun & Nov	8	11

Table 8. Impact of translucent releases on Basin Plan flow indicators at Lowbidgee

Environmental events	Number of Events	
	With translucency	No translucency
Total volume of 175 GL (flow > 5,000 ML/d) Jul → Sep	63	60
Total volume of 270 GL (flow > 5,000 ML/d) Jul → Sep	55	52
Total volume of 400 GL (flow > 5,000 ML/d) Jul → Oct	55	54
Total volume of 800 GL (flow > 5,000 ML/d) Jul → Oct	41	38
Total volume of 1,700 GL (flow > 5,000 ML/d) Jul → Nov	20	19
Total volume of 2,700 GL (flow > 5,000 ML/d) May → Feb	9	9

Table 9. Impact of removing translucent releases on average annual end of system flows at Balranald

Scenario	Average end of system flow (GL/a)	Reduced outflows (GL/a)
With translucent flows	1,609	-26
No translucent flows	1,583	

Table 10. Impact of removing translucent releases on long term average general security entitlement usage for the Murrumbidgee valley

Scenario	Average entitlement usage (GL/a)	Additional usage (GL/a)
With translucent flows	1,163	+35
No translucent flows	1,198	

7. Valley status and stakeholder considerations

This section summarises stakeholder considerations and the current status of translucent release rules in each valley. Key valley-specific issues and recommended next steps are summarised in Tables 3 to 7 below. Further details, including summaries of the rules themselves, are contained within the Appendices.

7.1. Stakeholders considerations

Stakeholders have raised a variety of matters in regards to translucent flow rules that apply in each of the inland NSW regulated rivers. These matters typically fall under five broad categories:

1. **Increase flexibility to achieve environmental outcomes**: suggestions include making refinements to the triggers, identifying the potential for conjunctive use for multiple benefits, and replacing translucent flow rules (either in full or in part) with discretionary account water.
2. **Reduce impacts on allocations or water security**: water users are concerned that translucent flow releases slow the increase of general security allocations or reduce the water security provided by holding water in storage.

3. **Recognise the changes since the rules were originally developed**: a number of significant changes, such as the Millennium Drought, the Basin Plan and particularly the increase in the collective held environmental water portfolio, have occurred over the last 15 years which could be impacting on the efficacy and suitability of these rules in respective valleys.
4. **The complexity of the rules**: the highly complex environmental flow rules are difficult to interpret and, at times, to implement. There have been intentions for some time to simplify rules, particularly those associated with the regulated Murrumbidgee water sharing plan.
5. **Inundation of private property:** Some stakeholders have expressed concern over the inundation of private property and infrastructure. Others are concerned that to limit the use of environmental water (including translucent flow releases) within the river banks would significantly limit the effectiveness of watering actions to repair and maintain critical river processes.

7.2. Review of translucent flows to date and recommended next steps

Reviews of environmental flow rules for both the Lachlan and Macquarie-Cudgegong regulated rivers have already commenced as part of their water resource planning processes required under the Basin Plan. In both cases, planning work commenced in mid-2015 with the establishment of Stakeholder Advisory Panels (SAP). Some long term hydrological modelling has been undertaken to test the implications of adopting different environmental flow rules, particularly in regards to translucency.

In the Macquarie valley, the current Environmental Water Allowance (EWA), which includes a component of translucency, does not operate as originally intended. Instead, a “deferred translucency” approach has been in place since 2005 when allocations were low and translucent flows would have achieved minimal, if any, inundation of the Macquarie Marshes. The EFRG proposed that translucent flows be “deferred” and accumulated so that larger volumes could be delivered to maximise transmission efficiency and inundation of the Marshes. Under this approach, translucent flows are only triggered during the date range nominated each year by the environmental water manager. These rules operate in conjunction with the active sub-allowance of the EWA and held environmental water in the valley to meet specified flow targets and durations, typically for flows to the Marshes.

DPI Water is working with OEH and other stakeholders to identify the limitations of the current rules and develop options to enable the EWA to be managed to achieve the best environmental outcomes with the water available.

Table 11. Status of translucency within the Macquarie valley and recommended next steps

Environmental water within the valley - category and scale			Agency and Stakeholder views	Status of review / likely scope of change	Gaps / next steps
WSP planned e-water	EWA (made up of an active component that is discretionary as well as a translucency component)	160GL account (GS)	• DPI Water/ Fisheries, OEH and some landowners/ communities suggest translucent component of EWA is too restrictive in dry years when small events do not reach the Marshes, and therefore does not operate as originally intended • Irrigators concerned e-water has been recovered beyond valley SDL requirement • Some irrigators like the certainty of translucency	*Preliminary options exist based on analysis and consultation, additional consultation on hold until WRP process:* • Review of environmental flow rules commenced July 2015 • Preliminary options identified by SAP and Agencies • Modelling of preliminary options completed and results presented to SAP • Update of WSP's EWA rule required to reflect current practice of "deferred transparency" operations • Translucency rule-based component may convert in part to more discretionary e-water	• Finish clarifying limitations in current rules • Further refine and model options • Continue with consultation to determine preferred option as part of WRP process
Held e-water	Licence-based	173GL			

Note: EWA = environmental water allowance; GS = General Security.

In the Cudgegong valley, a more flexible approach to the existing translucent flow rules is being investigated. Recent stakeholder feedback indicates that discretionary planned environmental water may be preferred in this valley, consistent with the more hands-on approach adopted in the Macquarie valley by the Environmental Flows Reference Group. DPI Water is the agency responsible for planned environmental water management in the valley, and has not yet determined a preferred approach.

Table 12. Status of translucency within the Cudgegong valley and recommended next steps

Environmental water within the valley - category and scale			Agency and Stakeholder views	Status of review / likely scope of change	Gaps / next steps
WSP planned e-water	Translucency	up to 10GL/yr	• DPI Fisheries & OEH suggest current translucent rules are too restrictive and therefore do not achieve intended outcomes. • More flexible and active managed e-water preferred.	*Preliminary options exist based on analysis, needs consultation:* • Review of environmental flow rules commenced July 2015. • Preliminary options identified by DPI Fisheries. • Modelling of initial options completed. • Substantial change to convert translucency to a discretionary account(s) is supported by DPI Fisheries.	• Present preliminary findings to SAP. • Further refine and model options. • Continue with consultation to determine preferred option as part of WRP process. • Consider additional stakeholder consultation needs given the current regional representatives are new to the process.
Held e-water	Licence-based	0.9GL			

In the Lachlan valley, water users strongly urged DPI Water to commence the review of the translucent flow rules ahead of any other issue raised in relation to the water sharing plan. SAP members presented proposed changes to the rules and reasons for the rule change. DPI Water has modelled a number of scenarios as proposed by the Lachlan SAP, including:

- changes to the annual inflow trigger (increase and decrease)
- use of tributary inflows as translucent flows
- a widening of the flow window and removal of the flow window
- targeting changes to translucent flows in dry periods when tributary inflows make up the translucent flows.

Preliminary results of the modelling have been presented to the SAP for discussion (refer to Section 6). These valley specific reviews of translucent flow rules are summarised in this report as part of the broader review of translucency rules. The state-wide review of translucency flows provides the broad context for how the details will be handled at the valley scale.

Table 13. Status of translucency within the Lachlan valley and recommended next steps

Environmental water within the valley - category and scale			Stakeholder views	Status of review / likely scope of change	Gaps / next steps
WSP planned e-water	Translucency EWA WQA	Up to 350 GL/yr 20GL account 20GL (HS)	• Translucent rules highly contentious. • Irrigators seek to increase reliability of GS allocations. • Irrigators disgruntled that translucent flows can be released when general security accounts have received minimal allocations. • Irrigators concerned that e-water has been recovered beyond valley SDL requirements. • Irrigators believe translucent flows no longer required given significant volume of e-water recovered. • A broad range of water users seek greater targeting of e-sites/ outcomes.	*Options exist based on consultation and analysis. Further consultation on hold until WRP consultation process recommences:* • Review of Lachlan translucency commenced April 2015. • Number of scenarios modelled and discussed with Lachlan SAP. • Results to date indicate that across the board changes to the rule has minimal impact on irrigator diversions due to constrained irrigator behaviour. Investigating changes to the rule in dry times when irrigators have received minimal allocations. Changes to other rules (e.g. accounting rules, encourage trade, spill and reset rules) are more likely if they prove more successful in improving water availability and encouraging more active water use.	• Explore other rule changes which will encourage more active water use. • Investigate better targeting of e-sites with available translucent flows (e.g. storing or directing water to specific targets).
Held e-water	Licence-based	128 GL			

Note: EWA = environmental water allowance; WQA = water quality allowance; HS = high security, GS = general security.

In the NSW Border Rivers, a review of environmental flow rules has not yet commenced. Discussions on water sharing issues have commenced however translucency rules are not expected to be particularly prominent in this valley.

Table 14. Status of translucency within the NSW Border Rivers valley and recommended next steps

Environmental water within the valley - category and scale			Stakeholder views	Status of review / likely scope of change	Gaps / next steps
WSP planned e-water	Translucency	Up to 32GL/yr	• Seek greater timing flexibility (esp. stimulus) • Consider allowing stimulus flow carryover • E-managers want stimulus flow volume increased; water users want no change • The WSP (2009) is more recent than other valleys and translucent flows have not been raised as a contentious or priority issue to date	*No analysis to date:* • Review of environmental flow rules not yet commenced	• Analyse all issues raised and identify stakeholder objectives • Develop options with SAP and Agencies • Model options • Determine preferred option
	Min daily release	4GL/yr			
	Stimulus flow	up to 4GL/ yr			
Held e-water	Licence-based	0.4GL			

In the NSW Murrumbidgee valley, a review of environmental flow rules has not yet commenced however the Stakeholder Advisory Panel has been formed and discussions on water sharing issues have commenced.

The planned environmental flow rules are quite complex and not well understood by water users. While a more simplified translucent flow rule was developed in 2002 through inter-agency collaboration, it was never incorporated into the 2004 WSP (refer to Appendix A4.1), probably because it differed significantly from the rules negotiated through the formal public consultation process and agreement could not be reached, despite both rule sets seeking similar outcomes.

As there is no clear community understanding around the intent and impacts of translucent releases, a range of views are likely to be expressed. However it is clear from initial feedback from stakeholders that additional clarity and education regarding existing translucent flow rules will be useful before meaningful consultation can be assured.

Table 15. Status of translucency within the Murrumbidgee valley and recommended next steps

Environmental water within the valley - category and scale			Stakeholder views	Status of review / likely scope of change	Gaps / next steps
WSP planned e-water	Translucency*	0.6-284GL/yr#	• Complex translucency rules • Irrigators seek to increase reliability of GS allocations • Landowner concerns of private property inundation • Irrigators are concerned that translucent flows do not consider total pool of e-water	*Preliminary analysis initiated:* • Simplified alternative translucency rules were developed in 2002, though never legislated • Preliminary modelling shows that translucent rules have only a minor impact on GS allocations (3.0%)	• Analyse issues raised and identify stakeholder objectives • Consider if simplified alternative translucency rules are supported • Develop options with SAP and Agencies • Model options • Determine preferred option
	Transparency	28-110GL/yr#			
	Min daily release	9-113GL/yr #			
	End of system flow releases	0-157GL/yr #			
	3 EWAs	55-220GL#			
Held e-water	Licence-based	319GL			

Note: EWA = environmental water allowance, GS = general security.

* In the Murrumbidgee, the WSP allows supplementary water users to extract translucency flows.

Murrumbidgee planned environmental releases generally do not have a defined maximum limit, rather are influenced by inflow conditions. Ranges listed here are historical values from General Purpose Accounting Reports for 2004/05 to 2015/16. End of system flow values here are additional volumes released to meet targets for the Murrumbidgee at Balranald and Billabong Creek.

Further details around the issues and status of the reviews for each valley are contained within the Appendices.

Discussion with environmental water holders has revealed two distinct preferences for the management of environmental water going forward:

- **'Rules-based' non-discretionary water.** This would involve converting current licensed environmental entitlements into an equivalent long term volume of rules-based water. Water would automatically accrue in bulk water accounts and be released when triggers are met, similar to the current translucent release rules. This reduces the 'hands-on' management of the portfolio and reduces administrative costs. It also aligns water delivery more closely with natural cues.
- **'Licensed-based' water (entitlement).** Conversely, this would involve converting current planned environmental rules-based water into an equivalent volume of licensed entitlement that can be actively managed and traded. This maximises flexibility in managing the environmental water portfolio.

This matter requires considerably more investigation and discussion before concluding to move away from the current mix of delivery mechanisms. However, it is likely that a mix of "products", namely, planned environmental and held water, is likely to provide the best overall outcome. It is intended that this will be reviewed and determined as part of the WRP development process for each regulated river water source and be incorporated into respective WRPs going forward.

8. Discussion of translucent rules

8.1. Environmental implications

Transparent and translucent rules have been applied to many river systems across western NSW and the Sydney metropolitan rivers (Driver et al. 2013; Growns and Reinfelds 2014). This planned environmental water management approach provides many ecological advantages by working with the natural hydrological cues of timing, duration and frequency, albeit often at a lower magnitude than would have occurred under pre-development conditions. Additionally, coded rules within plans provide "a consistent, deliverable and auditable arrangement" for all water users and planners, and for Water Sharing Plan evaluation (DWE 2009).

8.2. Basin Plan implications

If the NSW plans are not operated in accordance with the current planned environmental water rules, under the Basin Plan, the MDBA may deem additional water recovery is necessary to meet sustainable diversion limits, particularly if ecological outcomes are not maintained. This would need to be examined as part of the Water Resource Plan development. Additionally, if the volume from translucent flows is transformed into discretionary water rather than remaining as fixed rules (planned environmental water) this may introduce some unintended impacts in individual years. Long term modelling is required to determine the type and scale of likely impacts and potential remedies.

NSW has provided a formal response to the MDBA on its interpretation of the Basin Plan requirement for "no net reduction in the protection of planned environmental water" (Section 2.4). It will be important to ensure that the outcomes of this clause provides some flexibility on the management of the environmental water portfolio within each valley, to ensure practical and sensible adaptive management into the future, while meeting targeted ecological outcomes.

8.3. Operational and related social implications

8.3.2 Fixed rules vs. discretionary water

Two of the fundamental types of planned environmental water, fixed rules and discretionary, have characteristics which offer differing opportunities and challenges for regulated river management. The benefits of incorporating a mix of both approaches within each valley are likely to outweigh the benefits of applying each in isolation. The Lachlan River case study (DPI Water 2015b, Appendix A3.2) shows this clearly. To meet the desired ecological outcome, licensed water was required to supplement the translucency rule-based water, to limit the impact on the event's rate of flow recession. This illustrates the need to integrate various parcels of environmental water (i.e. planned fixed, planned discretionary and held licensed water) to manage the flow regime holistically rather than delivering water in a series of separate parcels of water.

Given the large growth over the last decade in the collective held environmental water portfolio, that is, licensed entitlements used for environmental purposes, it is timely that the continued applicability of the plan rules for environmental outcomes in each valley be checked.

8.3.3 Flooding concerns

A balance needs to be struck between the stated concerns of local landholders and the ecological benefits of floodplain inundation (Sections 3.2, 4.2 and 7.1). In addition, translucent releases can improve flood mitigation capacity under wet conditions. The process of discussing options in the preparation of water resource plans will provide an opportunity for this to occur.

8.3.4 Water availability

In some years, translucent flows can slow the increase of general security allocations. However a reduction or removal of translucent flow rules is likely to require some alternative planned environmental water to ensure consistency with NSW's commitments to "no net reduction" under

the Basin Plan. This could impact on allocations in other ways that may not necessarily provide earlier or larger allocations than the existing rules. Given that the current rules were designed with the considerations of productive water use in mind and that simultaneous inflow-outflow relationships tend to reduce system losses, impacts on water users are reduced. Nevertheless, long term modelling is required to determine the best mix of rules that will optimise the size and timing of allocations while still achieving the required environmental outcomes.

8.4. Issues raised by water users

The key issues identified by water users regarding translucent flows are summarised as:

- Flexibility of rules to achieve environmental outcomes.
- Impacts of rules on allocations or water security.
- Changes in customer requirements since the rules were originally developed.
- Complexity of the rules.
- Inundation of private property and infrastructure.

These issues can be addressed by:

(i) Providing a suitable stakeholder forum to discuss and optimise the existing rules to balance the consumptive and environmental water needs in each valley; and

(ii) Ensuring a suitable knowledge base to support policy, planning and implementation decisions. This is expanded in Section 9.5.

9. The way forward

9.1. Integrated approach

The following recommendations are offered with regard to informing ongoing consultation on translucency rules with external stakeholders. These recommendations recognise that translucency rules, especially those within NSW's Basin Plan rivers, do not operate in isolation to the other rules within the Water Sharing Plans. Such considerations require an integrated approach to recognise local social and economic concerns, and also balance the benefits and impacts of (i) planned environmental water provisions, and (ii) held environmental water with (iii) consumptive water use.

9.2. Consultation

Consultation around WSP rules, including translucency rules, has been occurring, and will be incorporated into the process for development of the Water Resource Plans (WRPs) for each valley (see proposed timetable at Figure 12). This includes consultation with Stakeholder Advisory Panels (SAPs) and any further targeted consultation needed to address matters that arise from the public exhibition of the Water Resource Plan. The provision of a suitable local forum comprising a diverse mix of stakeholders to work through these complex issues is considered vital to the long term success of changes to environmental flow rules and the new Water Resource Plans. Close consultation and integration with other Basin Plan related functions, such as the Constraints Management Strategy, will also be important in some valleys.

9.3. Communication

Stakeholder feedback and the events prior to the announcement of the review point towards the need to better communicate the nature and intent of these (at times complex) rules. This includes strategic use of various forms of media, engagement with key stakeholders at multiple forums, simplified reporting mechanisms, and the clear communication of scientific monitoring and evaluation activities and results. One recommended output is a brief, publically available document summarising the key messages from this initial scoping report.

Improved stakeholder relationships and agreements will reduce community concern about river operations, particularly the delivery of planned environmental water and specifically translucent flows. This in turn will improve understandings and open up further two-way communication that will lead to improved delivery outcomes.

Table 16 summarises the current status of translucency investigations in each valley and recommends the next steps in the context of WRP timeframes.

9.4. Simplification

This review offers an opportunity to simplify the more complicated environmental flow rules in the WSPs while still achieving or improving the long term outcomes. The Murrumbidgee environmental flow rules are particularly suited to revision due to their complexity. The alternate and more simplified translucency rules developed by inter-agency representatives in 2002 (refer to Section 7.2 and Appendix A4.1.2), or a variant may now garner support given their simplicity and that intended outcomes are consistent with current rules.

9.5. Evaluation

DPI Water is preparing evaluations reports to provide a knowledge base on the effectiveness of the existing WSPs. These will be used as a starting point for each WRP and will inform both stakeholder consultations and the design of improved monitoring, evaluation and reporting (MER) frameworks for the WRPs.

Triple bottom line (TBL) factors will be taken into account as part of the WRP process when evaluating the effectiveness of proposed planned environmental watering rules, including

translucent rules as appropriate. Socio-economic aspects will be informed both by the detailed socio-economic analysis as commissioned by the MDBA as part of the Northern Basin Review and which is now also underway for the Southern Basin, and by local concerns raised by stakeholders during the consultation process.

Figure 12. Timetable for water resource plan development

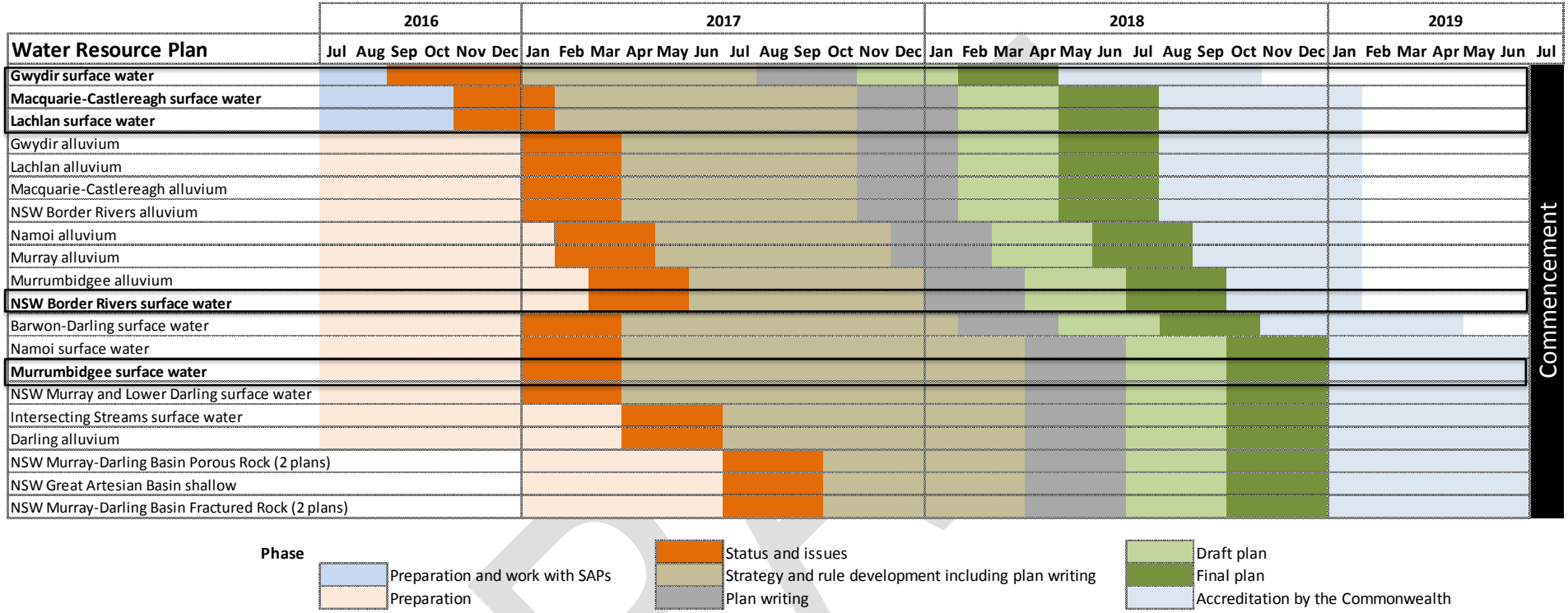


Table 16. Summary - translucency investigations status

Valley	Planned Environmental water within the valley		Measured e-benefit	Agency and Stakeholder views	Status	Next steps	WRP Timeframes (dates indicative and subject to change)
Cudgegong	Translucency	up to 10GL/yr	Anecdotal	Some Govt stakeholders see rules as too restrictive and not achieving intended outcome	Preliminary options exist and some modelling has been done	Consultation on options via WRP process with SAP. Refine options following consultation	Status & Issues Paper Nov 2016 Next SAP meeting Sep 2017 Rule finalisation target by Oct 2017
Macquarie	EWA (discretionary & translucency component)	160GL account (GS)	Anecdotal	Govt & Industry stakeholders see rules as too restrictive and not achieving intended outcome Irrigators concerned e-water has been recovered beyond valley SDL requirement	Preliminary options exist and some modelling has been done Consultation on preliminary options with SAP has occurred	Finish refinement following initial consultation and model options Continue with consultation to determine preferred option as part of WRP process	
Lachlan	Translucency	Up to 350GL/yr	Some evidence exists	Industry stakeholder concerned that translucent flows can be triggered when GS allocations are still low Industry stakeholder note valley is over recovered for SDLs and argue current held e-water negates need for translucent flows	Options identified and extensive modelling of options has been completed Consultation on options with SAP has occurred Significant changes to translucent rules unlikely as modelling shows limited change to water use. More targeted rule change (i.e. only in dry periods) is being reviewed. Changes to other rules may have desired effect	Investigate other rule changes which will encourage more active water use Continue with consultation to determine preferred option as part of WRP process	Status & Issues Paper Nov 2016 Next SAP meeting Aug 2017 Rule finalisation target by Oct 2017
	EWA	20GL					
	WQA	20GL (HS)					
NSW Border Rivers	Translucency	Up to 32GL/yr	Anecdotal	Translucency is not a contentious or priority issue to date Industry stakeholders want no change to stimulus flow. E-water managers want an increase Seek greater timing flexibility and carryover of stimulus flow	No analysis to date	Develop and model options with SAP to determine preferred option as part of WRP process	Status & Issues Paper Apr 2017 Next SAP meeting Sep 2017 Rule finalisation target by Dec 2017
	Min daily release	4GL/yr					
	Stimulus flow	up to 4GL/yr					
M'bidgee	Translucency	2-284GL[#]	Some evidence exists	Govt and Industry stakeholders agree that rules are complex and require review Industry stakeholders expect that changes to reduce complexity should increase GS allocations Operator reluctant to inundate private land due to liability concerns	Options exist and some modelling has been done Simplified translucency rules were developed in 2003 but not included in WSP Preliminary sensitivity modelling shows removal of translucent rule would have only minor impact on allocations	Finish refinement of existing options required before consultation with SAP through WRP process	Status & Issues Paper Feb 2017 Next SAP meeting Sep 2017 Rule finalisation target by Mar 2018
	Transparency	27-110GL[#]					
	Min daily release	9-113 GL/yr [#]					
	EoS flow releases	0-157 GL/yr [#]					
	3 EWAs	0-129GL [#]					

Note: EWA = environmental water allowance; EoS = End of system; GS = General Security; HS = High Security; WQA = water quality allowance.
[#] Murrumbidgee planned environmental releases generally do not have a defined maximum limit, rather are influenced by catchment and inflow conditions. Ranges listed here are historical values from General Purpose Accounting Reports for 2004/05 to 2015/16. End of system flow values here are additional volumes released to meet targets for the Murrumbidgee at Balranald and Billabong Creek.

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Appendices

A1. NSW Border Rivers
A2. Macquarie and Cudgegong Regulated Rivers
A3. Lachlan Regulated River
A4. Murrumbidgee Regulated River
A5. Australian rivers outside of the Basin - evidence for effectiveness of translucent flows

A1. NSW Border Rivers Regulated River

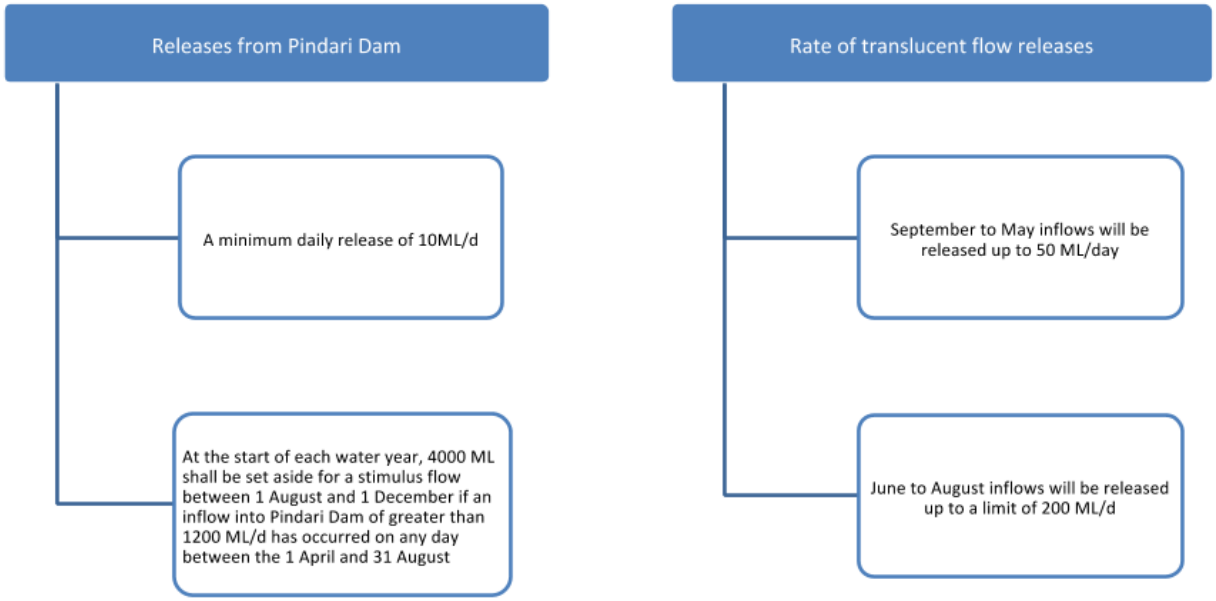
A1.1 WSP rules

Environmental flow rules in the *Water Sharing Plan for the NSW Border Rivers Regulated River Water Source 2009* include a translucency rule, limits on taking high flows, a continuous low flow rule, a stimulus flow rule (a type of environmental water allowance to provide a 'stimulus flow'), and the long-term average annual extraction limit (LTAAEL, refer to Section 2.2.1).

The translucency rule has a long history in the valley as it has been in place since Pindari Dam was enlarged in 1995. As part of the agreement between the NSW government and Border Rivers irrigators to jointly fund the infrastructure improvement, a translucency rule was required. The translucent flow arrangements were developed from recommendations made in the Environmental Impact Statement (EIS) for the dam enlargement (DWR, 1990; DWE 2009). The rule was originally given effect through yearly Water Allocation Plans, which were precursors to water sharing plans. The translucency rule was then carried over when the 2009 water sharing plan was established. As a result of this history, the translucency rule is not a controversial aspect of the water sharing plan in this valley.

The rules are summarised in Figure 13 below.

Figure 13. Summary of NSW Border Rivers stimulus flow (planned- discretionary water) and translucent flow rule



A1.2 Stakeholder issues

The following matters were raised about the translucent flows rules in the Border Rivers Regulated River WSP during the public exhibition of the 2009 replacement plan.

- Greater flexibility in timing:
  - During recent flow events, irrigators felt that water released under the translucency rule was wasted. They also feel that the Stimulus Flow should only be released when necessary or delayed in order to simultaneously support delivery of irrigation water.
  - Environmental water managers feel that the current rule, which limits Stimulus Flows to the months between July and October, is too restrictive. It unduly limits the ability of the Stimulus Flow to be used in conjunction with other natural events within the

system that may occur at other times during the year.

- The Stimulus Flow carryover:
  - Irrigators support that the upper limit remain capped at 4,000 ML to provide certainty for water users.
  - An increased volume will not be able to be re-regulated due to storage limitations.
  - Environmental water managers support increasing the upper limit to 8,000 ML to improve environmental outcomes.
- Cl. 14(j) is in conflict with Plan objective 10(b) and should be amended to allow for carryover of the Stimulus Flow.

A1.3 Progress to date

A review of environmental flow rules in the NSW Border Rivers has not yet commenced. A Stakeholder Advisory Panel for this valley has been formed with a Status and Issues paper presented early in 2017. It is expected to begin discussions around appropriate rules as part of the WRP process in 2017.

A2. Macquarie and Cudgegong Regulated Rivers

A2.1 WSP rules

Environmental flow rules in the *Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016* include a translucency rule in both the Cudgegong and Macquarie valleys, limits on taking high flows in both valleys, water set aside as an environmental water allowance (EWA) for the Macquarie River and a combined long-term average annual extraction limit (LTAAEL, refer to Section 2.2.1).

In the Macquarie valley, the translucency rule functions differently compared to other valleys. Firstly, it is nested within a broader EWA. This EWA is allocated water in a similar way to a Macquarie general security account. The amount of water that can be released at any time is limited to the balance of the allowance. However the balance relating to translucency is only one of two sub-allowances of the EWA – the other being an active (discretionary) sub-allowance. The two sub-allowances of the 160 GL EWA are proportioned three-fifths (96 GL) and two-fifths (64 GL) – which sub-allowance receives the larger proportion can be modified on an annual basis by the Environmental Flows Reference Group (EFRG).

Secondly, the date window within which translucent releases can be made has been actively shortened and modified on an annual basis by the EFRG – shorter than the 15 March to 30 November period allowed for the translucency sub-allowance by the water sharing plan.

Thirdly, EWA management practice since 2005 has been to implement 'deferred translucency' as opposed to 'pure translucency'. Deferred translucency does not exist as a term within any statutory document, but was coined to describe the operational method used to release the volumes associated with translucency flow events. Instead of releasing the EWA every time a translucency release threshold is satisfied – potentially creating a series of short intermittent/discontinuous events – the translucent sub-allowance balance is debited only when dam inflow triggers occur during ordered environmental water events.

In other words, dam releases are effectively unchanged by natural inflows that trigger the translucency rule, but are instead made to target a particular daily flow rate, as ordered by OEH. Inflow conditions will then determine which account is debited. Consider the example where a flow rate of 2,000 ML/d at Marebone Weir is targeted for a three-month period starting 1 September. During drier periods when natural inflows are not sufficient to trigger the translucency rule, the dam release volumes to meet the target are debited from either the active EWA sub-allowance or held environmental water accounts. If natural inflows are sufficient to trigger the translucency rule and meet or exceed the daily target flowrate, the translucency EWA sub-allowance would alone be debited. If the daily inflow volumes are smaller than the daily target flowrate, any remaining balance would be debited from either the active EWA sub-allowance or held environmental water accounts[7].

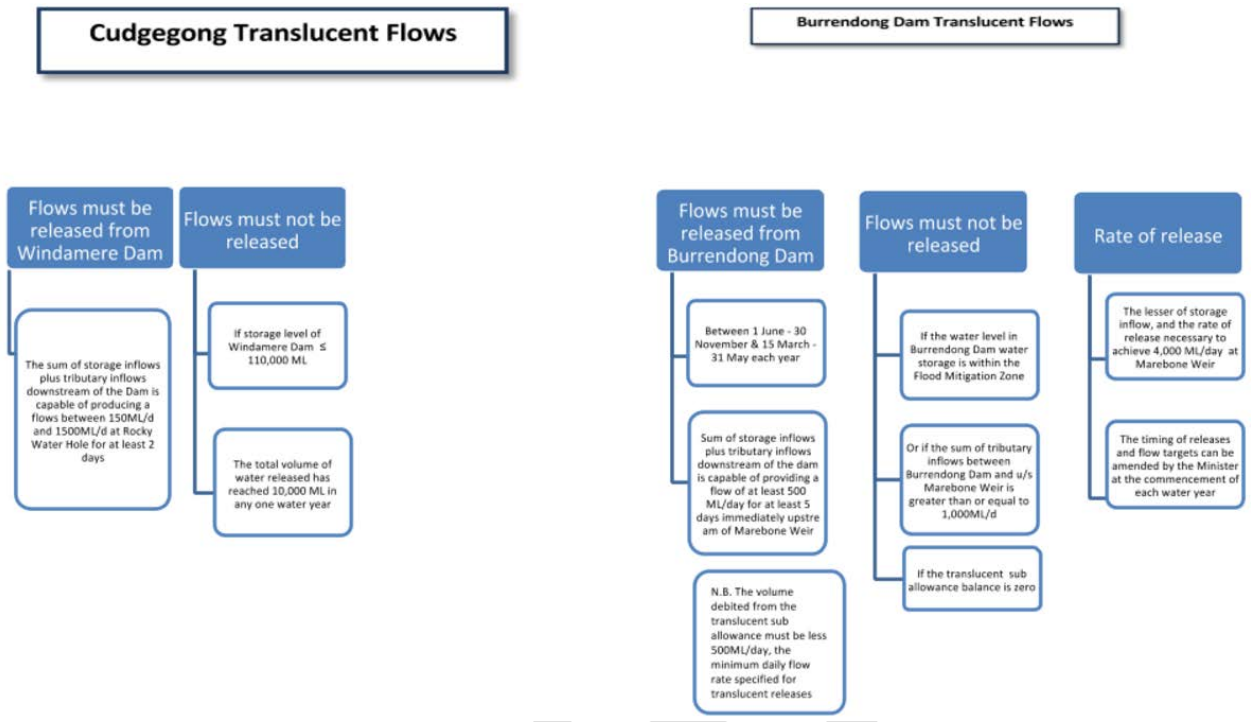
This approach arose out of the Millennium drought to maximise the inundation of (limited) water into the Macquarie Marshes. The EFRG proposed that translucent flows be "deferred" so that larger, more continuous volumes could be delivered, maximising transmission efficiency.

There is some debate about whether the 'deferred translucency' approach is strictly in accordance with the provisions in the water sharing plan (WSP). DPI Water has advised that if this type of approach is to be used in future then the EWA rules should be reviewed during the development of the WRP so the impacts of any proposed changes can be assessed.

[7] Note that the amount debited from the Active EWA sub-allowance and held environmental accounts is the full volume of the target flow rate at Marebone Weir minus the sum of other downstream orders. Note also that the WSP for the Macquarie and Cudgegong water source provides for the first 500 ML/d past Marebone Weir during a translucency trigger event and this volume is not debited from the EWA or any other account.

The translucent flow rules present in the WSP are summarised below in Figure 14.

Figure 14. Summary of Cudgegong (Windamere Dam) and Macquarie (Burrendong Dam) translucency rules



A2.2 Stakeholder issues

A2.2.1 Cudgegong

The NSW water agencies have previously requested a review of translucent rules for the Cudgegong River. The Department of Primary Industries (DPI) Fisheries and Office of Environment and Heritage (OEH) suggested the current flow rules are too restrictive and have not achieved the intended outcomes and should be reviewed during the water resource planning (WRP) process. DPI Water is the agency responsible for environmental water management in the valley, and has not yet determined a preferred approach.

A2.2.2 Macquarie

A review of the environmental flow rules for the Macquarie River was requested by a number of agencies (OEH, DPI Fisheries and DPI Water) to improve the flexibility and effectiveness of the EWA. It was suggested that the translucent sub allowance rules are quite restrictive, particularly in dry years and lower inflow summer/autumn months. The current application of the rules restricts access to water held in the translucent sub allowance to when dam inflows occur, despite significant environmental demand to maintain water-dependent assets through these dry periods.

These concerns were also stated by members of the local community, particularly landholders in the Lower Macquarie and effluent creeks.

Some water users have voiced their concerns about moving away from translucent rules as they are seen to provide some certainty around environmental releases, which water users can incorporate into their business operations. Some environmental water managers recognise the value of release triggers that automatically respond to natural events and may seek to retain a translucency component to the planned environmental water portfolio.

As part of a broader environmental watering concern, irrigators in the valley are concerned that held environmental water has been recovered beyond the valley's SDL requirement.

A2.3 Progress to date

The environmental flows rules for both the Macquarie and Cudgegong regulated rivers are being reviewed as part of the water resource planning process. Planning work commenced in July 2015 and potential options for change to the environmental rules in the Macquarie valley were tabled at the Stakeholder Advisory Panel meeting held in February 2016.

To further inform the development of appropriate options for changes to the EWA, a series of meetings have also been held with agency staff and water users.

Modelling has been undertaken to investigate impacts on water users and the environment of changing the volume set aside for translucent flows, along with varying the degree of the discretionary component of the planned environmental water. Scenarios include, but are not limited to:

- 100% active (fully available) EWA, with no translucent sub allowance
- EWA allocated based on 80% active, 20% translucent

The next step is to explore the modelling in more detail, identify the limitations of the current rules and develop options to enable the EWA to be managed to achieve the best environmental outcomes with the water available.

Consultation on Cudgegong valley environmental flow options is less developed than in the Macquarie and has not yet included stakeholders external to government. Preliminary options have been identified by DPI Fisheries, and modelling of initial options is being undertaken. DPI Fisheries supports substantial change to convert translucency into one or more discretionary accounts. DPI Water has not yet determined a preferred approach, which will require stakeholder consultation.

Appendix A2.4 provides an information paper on two recent translucent flows in the Cudgegong catchment - which occurred in 2010 and 2012 - and issues identified with the translucency rule as a result of those events.

A2.4 Case Study – Macquarie-Cudgegong 2010 & 2012 Translucent Release Events

EFRG | ISSUES FOR CONSIDERATION

February 2016

Purpose

This information paper was developed at the request of the Macquarie and Cudgegong Environmental Flows Reference Group (EFRG). It describes the suspension of translucent releases from Windamere Dam in December 2010 and March 2012 and the possible mechanisms for 'making good' that unreleased volume.

Long term options are being investigated as part of the development of the Water Resource Plan (WRP). This fact sheet outlines a proposed mechanism to apply during the interim period prior to the planned commencement of the WRP in 2017. Any feedback on the long term options should be directed to the Stakeholder Advisory Panel (SAP) representatives who sit on the EFRG.

Background

Historical events

In December 2010, the translucent flow rule from Windamere Dam (clauses 15(1) to (9) of the Plan) was suspended when Burrendong Dam was in severe flood. During this event, maximum releases from Burrendong Dam reached over 100,000 megalitres per day (ML/d) and storage peaked just above 150% of full supply. The suspension of Windamere Dam releases was recommended by the EFRG and the Macquarie Flood Mitigation Zone (FMZ) Reference Panel, made up of key water user representatives in the valley and convened by the then State Water. The then NSW Office of Water provided approval on a one-off basis.

In March 2012, suspension was again agreed, in discussion with the EFRG and the Macquarie FMZ Reference Panel, and approved by the NSW Office of Water. In this case, maximum releases were 18,000ML/d and storage peaked just above 130% of full supply.

These decisions were made primarily to address community fears about releasing additional water from Windamere Dam when Burrendong Dam was already under flood operations.

Suspension of translucent releases during the two flood events resulted in a total volume of 12,312ML of environmental water remaining in Windamere Dam that would otherwise have been released.

Environmental effects

Despite the suspension of releases, the Cudgegong River still received substantial downstream flows during the two events. Flows exceeded the 1,200ML/d operational capacity of the Rocky Water Hole crossing for six days in December 2010 and two days in March 2012. [Note that the Plan allows for up to 1,500ML/d at Rocky Water Hole – flows above 1,200ML/d are targeted as conditions permit.]

Had releases been made, peak flows at Rocky Water Hole would have been unchanged. The suspension affected the speed of the recession and the passage of subsequent minor events. The difference between the actual daily flow, and the daily flow if releases were made, is shown in Figures 1 & 2.

Figure 1. Comparison of Cudgegong River daily flows if translucent flows weren't suspended in Dec 2010

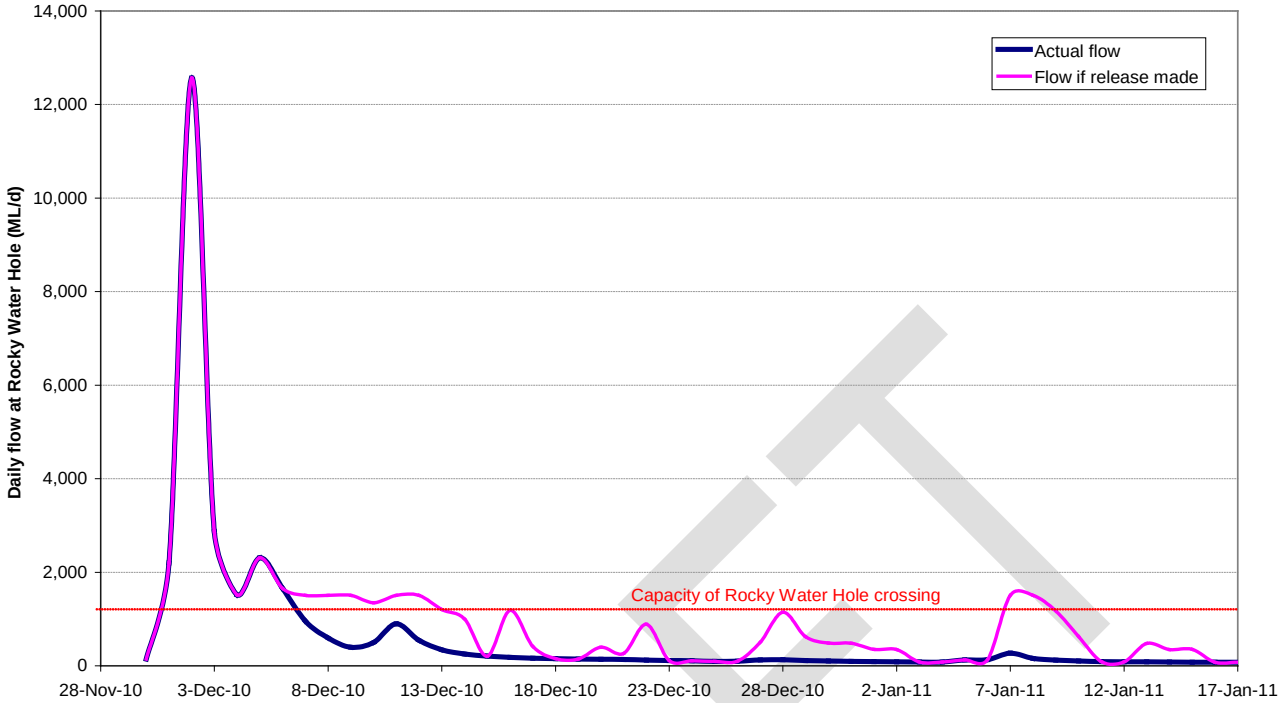
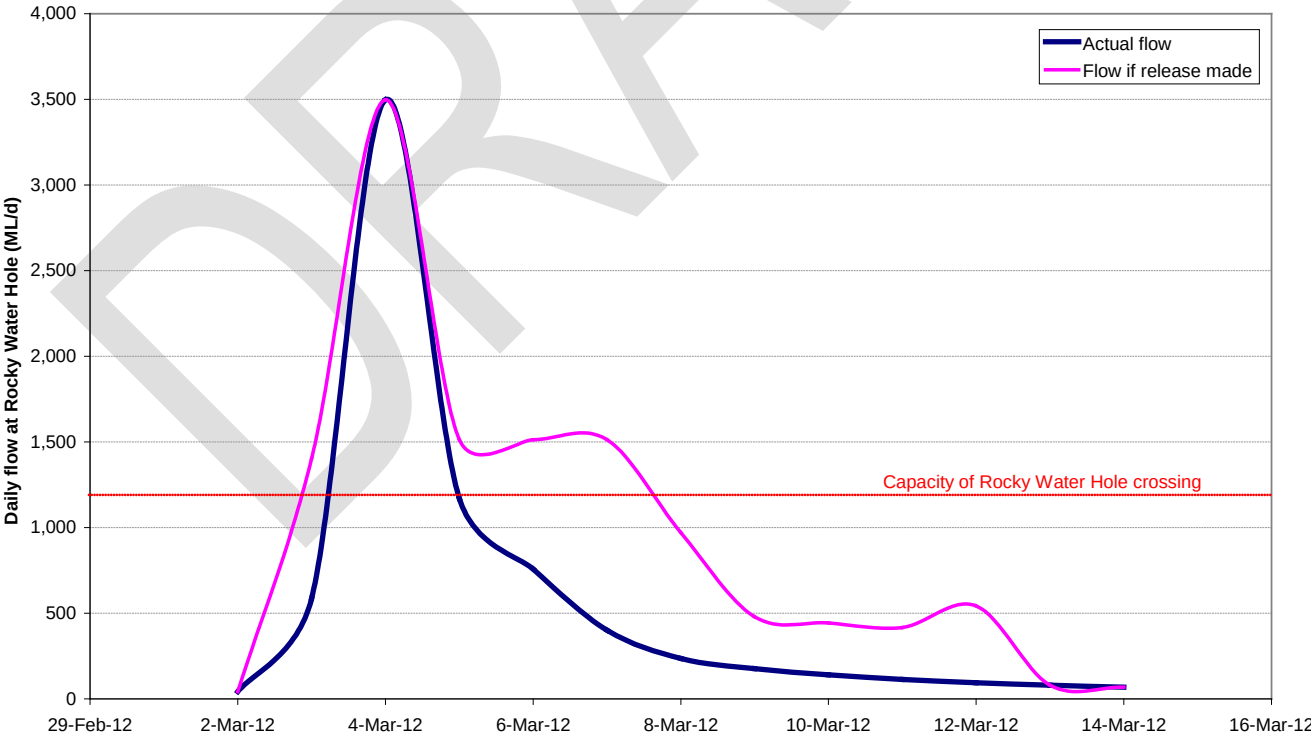


Figure 2. Comparison of Cudgegong River daily flows if translucent flows weren't suspended in Mar 2012



Reconciliation

Historical

To reconcile this unreleased volume, additional water was intended to be delivered as soon as possible in the 2012/2013 water year in accordance with State Water's Work Approval:

> *Any cumulative shortfall from [a] previous event is distributed evenly by increasing daily releases by up to 25% during the following event.* – Section 3, Note 5(iii)

Increased releases have been permitted for all subsequent events, up to the annual release limit of 10,000ML, with the aim of clearing the undelivered volume. In 2012/13, the 10,000ML annual limit was reached with the 25% increase in daily translucent flow releases, and would have also been reached even if the daily increase was not applied. So there was effectively no reduction in the outstanding balance during the 2012/13 water year. In 2013/14, the balance was reduced by 667ML over three events. In the 2014/15 water year, only one event was triggered, with a further reduction of 171ML. During the translucent flow event of November 2015 a further reduction of 629ML was achieved.

Therefore, as a result of increased releases from Windamere Dam corresponding to translucent flow triggers in the last three water years, the remaining volume still unreleased has reduced to 10,353ML.

Long term modelling indicates that this method cannot deliver large volumes of water in a timely manner. Wet conditions are required for the flow triggers to be met, but not too wet such that the annual limit of 10,000ML is reached.

Options

Short-term

DPI Water has limited capacity to undertaken any additional planning work as resources have been fully committed to meeting Basin Plan obligations in water resource planning activities which must be completed by 2019.

In recognition that only 16% (1,959ML) of this undelivered volume has been released in the 3.5 years since the 25% daily increase was applied a more effective interim option may be considered.

An 'interim option' involves allowing a daily flow trigger increase from the current 25% to a proposed 100%. The existing physical capacity constraints at the Rocky Waterhole Crossing would still apply, as would the annual volumetric limit in the WSP of 10,000ML. This would provide increased flows within limits and the opportunity to reduce the remaining balance more quickly. It is being considered because it is practical to implement, closely resembles the WSP's translucency release rules, and requires only a minor change to WaterNSW's Work Approval. Had this been applied since 2012/13, a volume of 4,608ML could have been released, reducing the total balance by 37%. Feedback on the above option is invited.

Long term

The suspensions in 2010 and 2012 did not measurably reduce downstream flooding or influence Burrendong Dam operations but were mainly to address perceptions of flood risk. However, there may be situations in the future where a suspension is necessary. This action should be specifically allowed for in the Plan, and be subject to guiding principles for such a decision, including a defined reconciliation methodology.

As part of the Water Resource Planning process, a number of options have been provided for the Macquarie Stakeholder Advisory Panel.

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A3. Lachlan Regulated River

A3.1 WSP rules

Environmental flow rules in the *Water Sharing Plan for the Lachlan Regulated River Water Source 2016* include a translucency rule, water set aside as an environmental water allowance (EWA) as well as for a water quality allowance (WQA) and a long-term average annual extraction limit (LTAAEL, refer to Section 2.2.1).

The flow rules improve lower system flows and winter/spring flow variability by allowing a portion of inflows from upstream and downstream of Wyangala Dam to be protected from extraction. Translucent flows can sum to a total of 350,000 megalitres per year (as of 2012, approximately 23 per cent of average total river system inflows (NOW 2012)) and in some years this represents the largest volume of environmental water in the river system.

The translucent flow rules presented in the WSP are summarised below in Figure 15.

A3.1.1 Environmental flow rules - river management committee

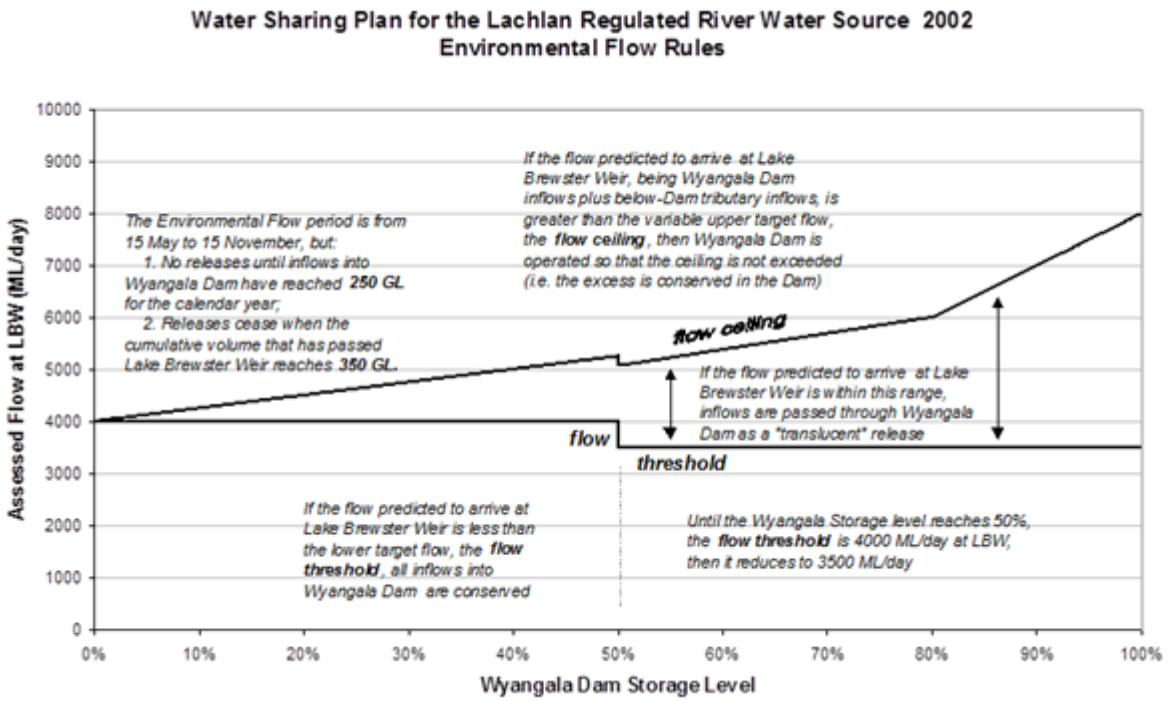
Management of environmental water allocations in the Lachlan valley has occurred since 1992. Initially this was managed as discretionary environmental water in response to an ecological trigger or water quality problem (LRMC 2002 as cited in Driver et al. 2004).

In 1997, the Lachlan River Management Committee (LRMC) was established to provide advice on environmental flow rules. The Committee included representatives of the irrigation industry, environmental interests, indigenous communities, the local Catchment Management Board, local councils and government agencies (the then Department of Land and Water Conservation, National Parks and Wildlife Service, Environment Protection Authority, NSW Agriculture and NSW Fisheries).

The Committee recognised the need to re-introduce elements of the natural flow regime, particularly providing more natural seasonality of high flows which support ecological outcomes such as wetland flooding and native fish breeding (DPI Water 2015b; LRMC 1999 as cited in Driver et al. 2004). The translucent flow rule was the primary mechanism to achieve this. The Committee's recommended rules were adopted and implemented by the Government in 1998 (DIPNR 2004a).

In 2001 the Committee was asked to recommend rules for the Lachlan Water Sharing Plan. The environmental flow rules recommended have similarities to the 1998 rules but with significant adjustments to protect irrigation in dry years. Following public comment on the draft plan, these adjustments were incorporated into the WSP that commenced on 1 July 2004. These same environmental flow rules continued in the replacement plan that commenced in July 2016.

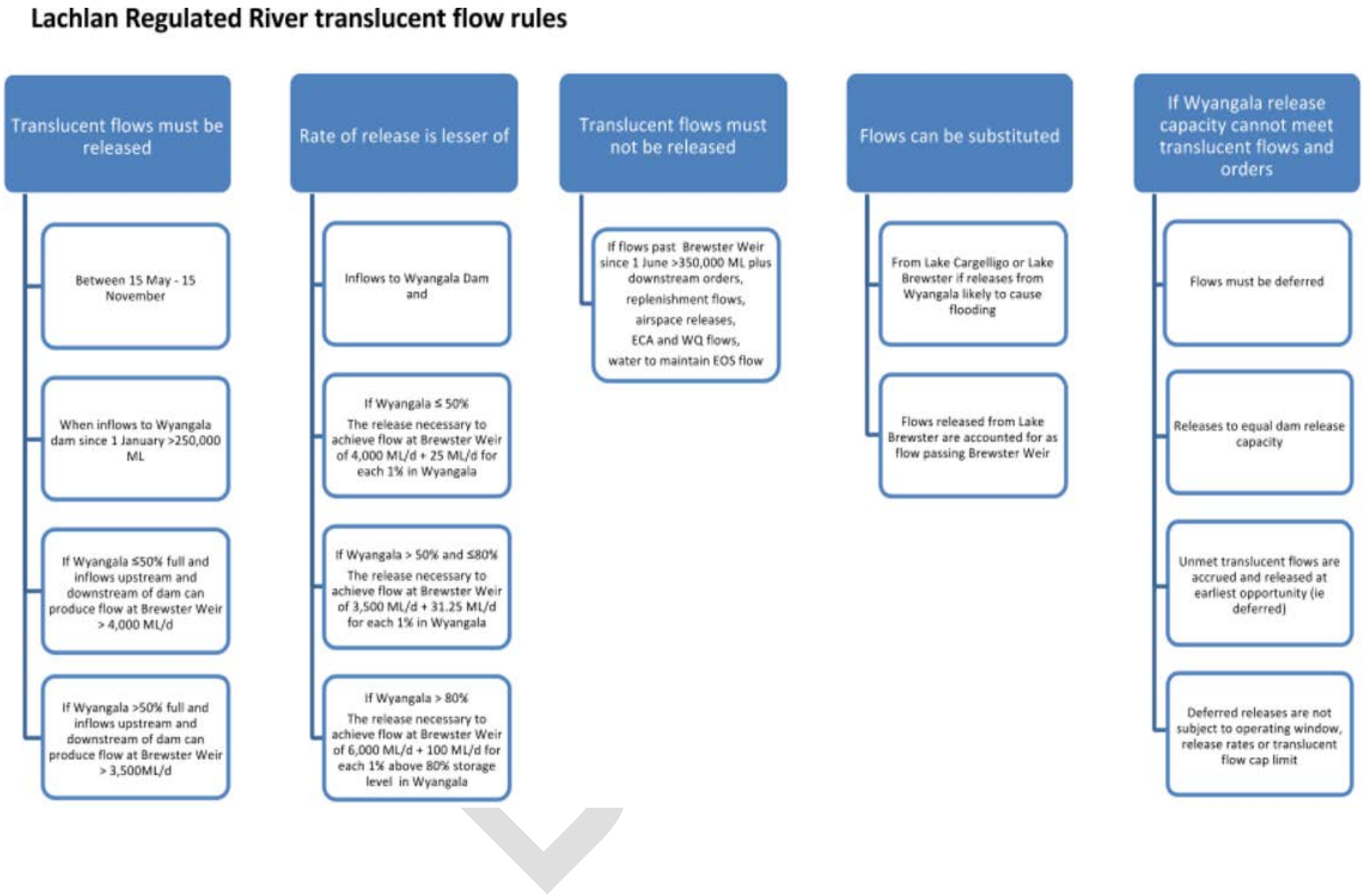
Figure 15. Translucent flows schematic developed for the Lachlan River Management Committee (unpublished)



In order to minimise the impacts on water security during dry years, the water sharing plan rules incorporate a minimum calendar year inflow trigger to Wyangala Dam of 250,000 ML. A flow of 250,000 ML approximately corresponds to the annual requirements of the regulated river system (excluding general security water delivery), meaning that general security allocations would typically commence at the same time as translucent flows could be triggered.

In addition to translucency allowance, every year, a 20,000 megalitre volume of water called an environmental water allowance (EWA), also often referred to as the environmental contingency allowance (ECA), is banked for environmental purposes when the general security allocation exceeds 50 per cent as at 1 July or reaches 75 per cent during a water year. This volume is split equally between Wyangala Dam and Lake Brewster. The water is intended to be released downstream of these storages for environmental benefits such as supporting waterbird or fish breeding, wetland watering or increase in flow variability. A water quality allowance (WQA) of 20,000 megalitres is also set aside each water year for the management of water quality, and released to reduce salinity levels or mitigate blue-green algae outbreaks.

Figure 16. Summary of Lachlan translucent flow rules



A3.2 Stakeholder issues

Stakeholders requested a review of the translucent flow rules in the Lachlan River valley as part of the 10 year review and replacement of the Lachlan Regulated River WSP 2004. The issues ranged from optimising existing rules to the relevance of existing arrangements, and included:

- looking at the impact of the rules on general security allocations with view to improve water availability for general security licence holders during dry periods and stimulate a change to water user behaviour to increase extraction up to the limit.
- accounting for the 120 GL of licensed environmental water entitlement acquired since the development of the WSP. Stakeholders have commented that this additional water will meet the objectives of the translucent flow rules.
- allowing for greater flexibility during a translucent flow release to achieve desired environmental outcomes. That is, the ability to prioritise the delivery of translucent flows to particular environmental sites rather than all sites receiving flows regardless of priority.
- accounting for changes that have occurred in the system including: upgrade of Lake Brewster; increased use of tributary flows by mines, stock and domestic users and urban water users; environmental objectives not met during the drought; and the upgrade of Willandra Weir.
- improving methods to meet fish migration and spawning requirements.

There was a further public call from water users for a review of the translucent flow rules following the trigger of a 74 GL translucent flow in September 2015 (refer to Appendix A3.4 for a description of the event). This flow followed a 4-year period of no allocation for general security licences in the Lachlan.

A3.3 Progress to date

As a result of the issues raised, DPI Water commenced a review of the translucent flow rules in the Lachlan in April 2015. A Stakeholder Advisory Panel (SAP) was established to provide feedback on issues and options. The water users represented on the SAP strongly urged DPI Water to commence the review of the translucent flow rules ahead of any other issue raised in relation to the water sharing plan.

SAP members presented proposed changes to the rules and reasons for the rule change. DPI Water has modelled scenarios as proposed by the Lachlan SAP. These scenarios include:

- changes to the annual inflow trigger (increase and decrease)
- use of tributary inflows as translucent flows
- a widening of the flow window and removal of the flow window
- targeting changes to translucent flows in dry periods when tributary inflows make up the translucent flows.

The results of the modelling have been presented to the SAP for comment. This modelling together with changes to other plan rules are being considered by the SAP members in terms of achieving improvements in water availability.

A3.4 Case study – Lachlan Valley 2015 Translucent Release Event

RULES BASED ENVIRONMENTAL WATER IN REGULATED RIVERS

Case Study: Transparent and Translucent flow in the Lachlan Valley

November 2015

This paper outlines a translucent dam release event occurred in the Lachlan Valley in late August 2015.

History of translucent flows in the Lachlan valley

The translucent flow rules in the *Water Sharing Plan for the Lachlan Regulated River Water Source 2003* (WSP) were agreed by the Lachlan River Management Committee. This stakeholder group recognised the need to restore elements of the natural flow regime changed by river regulation, particularly providing more natural seasonality of high flows. The translucent flow rule was the primary mechanism to achieve this.

In order to minimise the impacts on water security during dry years, a minimum calendar year inflow trigger to Wyangala Dam of 250,000 megalitres (ML) was introduced. This approximately corresponds to the annual requirements of the regulated river system (excluding general security water delivery), meaning that general security allocations would typically commence at the same time as translucent flows could be triggered.

On 25 August 2015, heavy rainfall fell on relatively damp catchments of the upper Lachlan, triggering high flows into parts of the regulated river system. The Belubula and Booroowa catchments, as well as low-lying areas near Jemalong, contributed to the high flows that reached just above minor flood level at Forbes and Jemalong. Translucent flows did not contribute to flooding.

Triggers

Despite the large daily inflows, translucent flows were not immediately triggered because the total Wyangala Dam inflow since 1 January 2015 up to and including 25 August was only 210,000ML, less than the ***minimum inflow total*** threshold.

Very large inflows of approximately 50,000ML on 26 August meant that the translucent flow rules in the WSP were satisfied. From that date, inflows that would result in flows at Brewster Weir between the ***minimum daily flow trigger*** and ***maximum daily flow target*** were accounted as translucent flows and allowed to pass through the river system.

Water Sharing Plan: Clause (15)(1)

- ✓ ***Date window:*** 15 May – 15 Nov at Wyangala Dam
- ✓ ***Minimum inflow total:*** since 1 January Wyangala Dam inflows must exceed 250,000ML
- ✓ ***Minimum daily flow trigger:*** summed inflows upstream and downstream of the dam equal to 3,500ML/d or 4,000ML/d at Lake Brewster weir
- ✓ ***Maximum total translucent volume:*** (including any surplus flows) since 1 June must be less than 350,000ML as measured past Lake Brewster weir

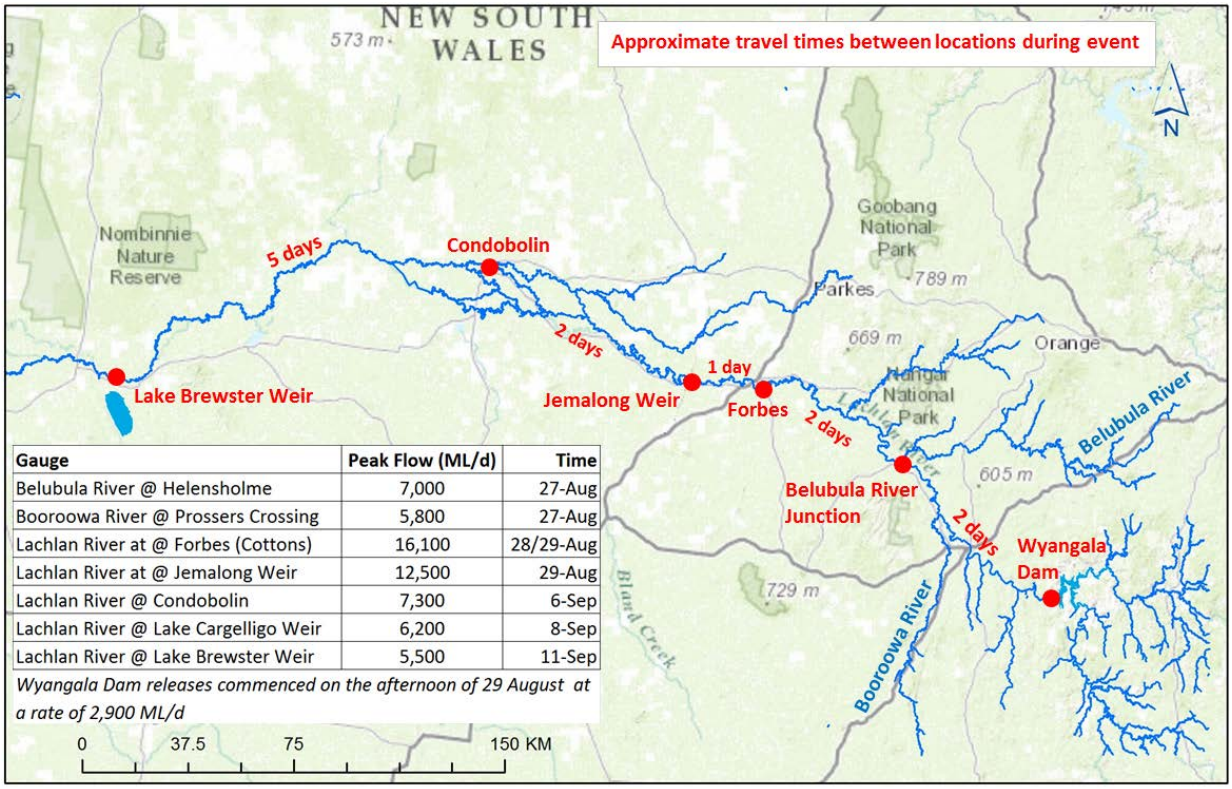
If above is met, release the inflow or a lesser volume to meet the ***maximum daily flow target*** at Brewster weir [between 3,500 ML/d to 8,000ML/d based on the level of Wyangala storage]

Dam releases were not initially required because the ***maximum daily flow target*** of 5,156 ML per day (when Wyangala Dam was 53 per cent of capacity) could already be met from flows downstream of the dam as a result of rainfall on 25 August. The ***maximum daily flow target*** subsequently increased to 5,400 ML per day (ML/d) when the Dam level increased to 61 per cent during the event.

The Belubula River at Helensholme (just upstream of the junction with the Lachlan River) recorded a peak flow of 7,000ML/d on 27 August while the Booroowa River at Prossers

Crossing peaked at 6,000ML/d almost simultaneously. Due to natural attenuation as the peak passed downstream, a flow rate on the Lachlan River at Lake Brewster Weir persisted at just above 5,400ML/d for several days (Figure 1).

Figure 1. Map of flow peaks and travel times



Gauge	Peak Flow (ML/d)	Time
Belubula River @ Helensholme	7,000	27-Aug
Booroowa River @ Prossers Crossing	5,800	27-Aug
Lachlan River at @ Forbes (Cottons)	16,100	28/29-Aug
Lachlan River at @ Jemalong Weir	12,500	29-Aug
Lachlan River @ Condobolin	7,300	6-Sep
Lachlan River @ Lake Cargelligo Weir	6,200	8-Sep
Lachlan River @ Lake Brewster Weir	5,500	11-Sep

Wyangala Dam releases commenced on the afternoon of 29 August at a rate of 2,900 ML/d

It was not until four days later on 30 August that dam releases were first recorded in the daily 24-hour readings to 9am. Minor flooding experienced on the Lachlan River at Forbes and Jemalong was entirely due to unregulated natural tributary flows from rivers downstream of the regulated storages. Translucent flow releases from the dam reached Forbes after 2 September by which time flows within the river channel were well below their peak.

Initially, only a portion of the dam inflows were passed and added to downstream tributary flows to meet the ***maximum daily flow target*** at Lake Brewster Weir, with the bulk of inflows being stored by the dam. Then towards the end of the event as total inflows had significantly declined, the whole dam inflow was passed through the storage. When predicted flows from the sum of upstream and downstream inflows fell below the ***minimum daily flow trigger*** of 3,500ML/d on 9 September, the translucent flow event ceased. Any remaining inflows to the dam were captured and stored for later use.

Figure 2 shows the Wyangala Dam inflows, releases and the storage volume in the lead up to and during the translucent flow event.

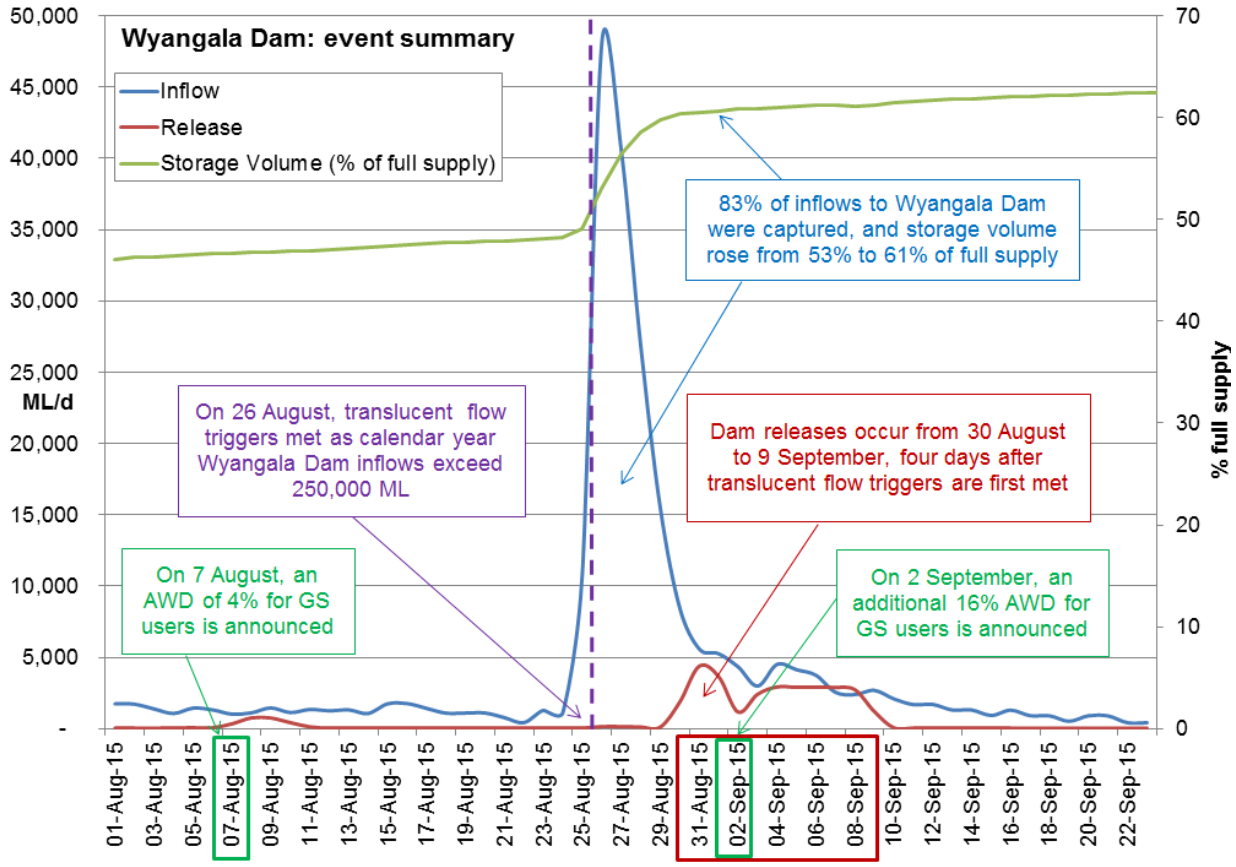
Accounting

In total, the event lasted 15 days and the ***total translucent volume*** was 72,824ML as accounted at Lake Brewster Weir. A total release of approximately 29,000ML over 11 days was made from Wyangala Dam, with the remainder being met from tributary flows downstream.

A large proportion of inflows (83 per cent) into Wyangala Dam were captured. Storage levels rose by 100,000ML from 53 per cent to 61 per cent of the full supply volume during the translucent flow event, with a further 22,000ML of inflow captured after the translucent flow had ceased until the end of September. Approximately 2,700ML of downstream tributary inflows that

were in excess to the ***maximum daily flow target*** were also captured in Lake Cargelligo and Lake Brewster storages for future regulated use. Another 1,000ML was stored when combined inflows fell below the ***minimum daily flow trigger.***

Figure 2. Wyangala Dam operations during translucent flow event



Environmental water use

Prior to the commencement of the translucent flow event, environmental water managers had begun a 20,000ML late-winter watering event to the lower Lachlan, as recommended by the Lachlan Riverine Working Group. From 9 August, a flow of 500ML/d was being targeted at Booligal for up to 45 days to support maintenance and recovery of riparian and wetland habitat along the course of the river and to refill low-lying wetlands in the Great Cumbung Swamp.

A total of 21,100ML had been debited to Commonwealth and state held environmental water accounts prior to the translucent flow event (first green section of Figure 3). When translucent flows commenced, the remainder of this event was suspended. The environmental watering of the lower Lachlan system meant that the flow of the translucent release was delivered efficiently.

A total of 12,550ML of additional held environmental water was used at the end of the translucent flow event until 9 October (final green section of Figure 3) to manage the recession. This slowed the otherwise rapid fall in flows and provided a more measured drawdown. In this way, held environmental water was integrated with translucent releases to maximise the outcomes for the environment and minimise risks.

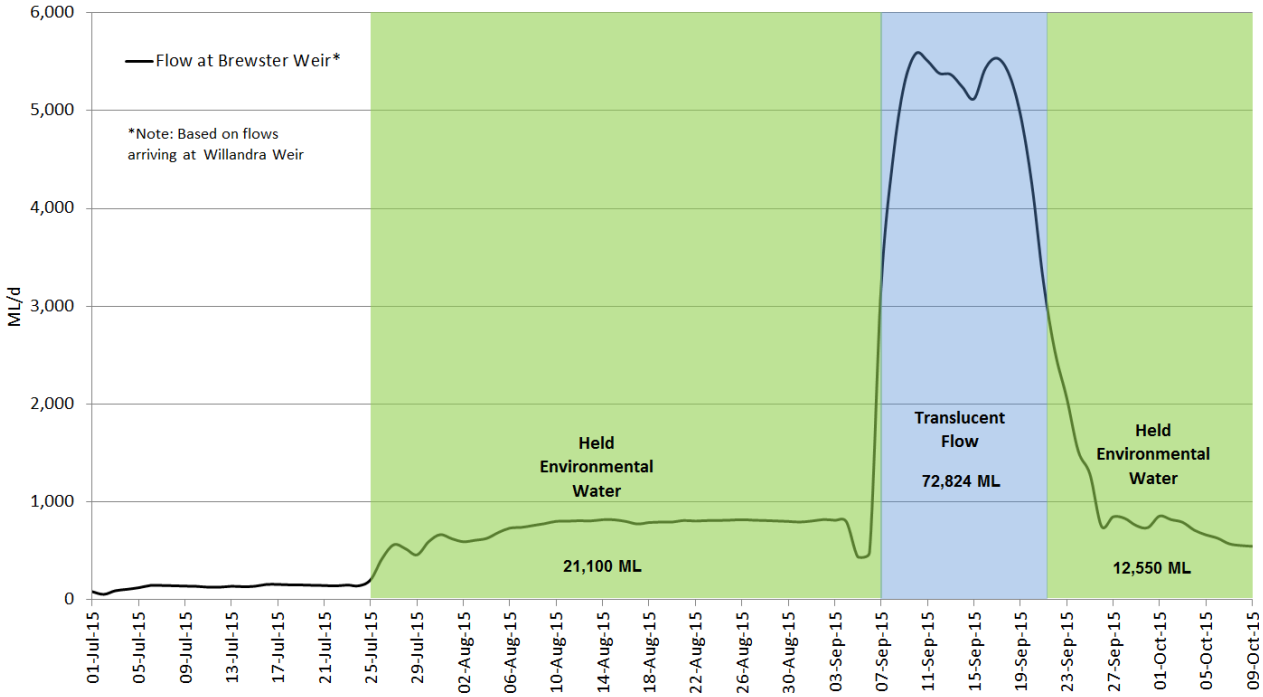
The environmental benefits that are anticipated as a result of the translucent release are: restoring natural peaks in flow; enabling connections between different parts of the river and the floodplain; contributing to ecosystem functions such as nutrient cycling; improving

vegetation condition; maintaining habitat and providing signals for native fish and waterbirds to breed; and improving the ability of the ecosystem to withstand drought and flood.

Translucent releases can return a larger natural pulse of water to the system for environmental benefits than held environmental water alone.

The event is depicted in Figure 3, summarising how environmental water was accounted.

Figure 3. Accounting of environmental water 2015/16



Other considerations

A general security available water determination (AWD) of 4 per cent was made on 7 August prior to any translucent flows being triggered. A further AWD of 16 per cent was made on 2 September following the inflows described above and another 5 per cent on 2 October from the ongoing recession. Total new AWD in 2015/16 to date has been 25 per cent. This is in addition to the 174,000ML in general security accounts at the commencement of the 2015/16 water year, of which 70,000 ML was held on environmental water licences. The valley as a whole has access to 55 per cent of entitlement.

It had been some time since inflows of this magnitude had been recorded. The last translucent flow event commenced in June 2012 and continued until October 2012 when the ***maximum total translucent volume*** past Brewster weir, which included surplus flows, exceeded 350,000ML. Wyangala Dam was spilling and water availability in accounts was well over 100 per cent.

Since then, conditions have been much drier than average so that neither translucent flows nor general security AWDs were made for over three years. In this instance the WSP rule operated to its original intended purpose – translucent flows were only made once general security AWDs could be commenced. The benefits of these large inflows have been shared between consumptive and environmental uses at a time when the needs of both are high.

The translucent flow rule is one of the key items to be reviewed as the Water Resource Plan is developed. It will be assessed alongside all other WSP rules to ensure that the best outcomes for both consumptive users and the environment can be achieved. A Stakeholder

Advisory Panel, including irrigator representatives, has been established to provide input to and comment on options.

More information

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Acknowledgments

Contributions to this paper have also been received from representatives of Water NSW, NSW Office of Environment and Heritage, Commonwealth Environmental Water Office and Lachlan Valley Water.

A4. Murrumbidgee Regulated River

A4.1 WSP rules

Environmental flow rules in the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2016* include a translucency rule, transparency rule, a continuous low flow rule, end of system flow (EOS) rule, water set aside as environmental water allowances (EWAs), and the long-term average annual extraction limit (LTAAEL, refer to Section 2.2.1).

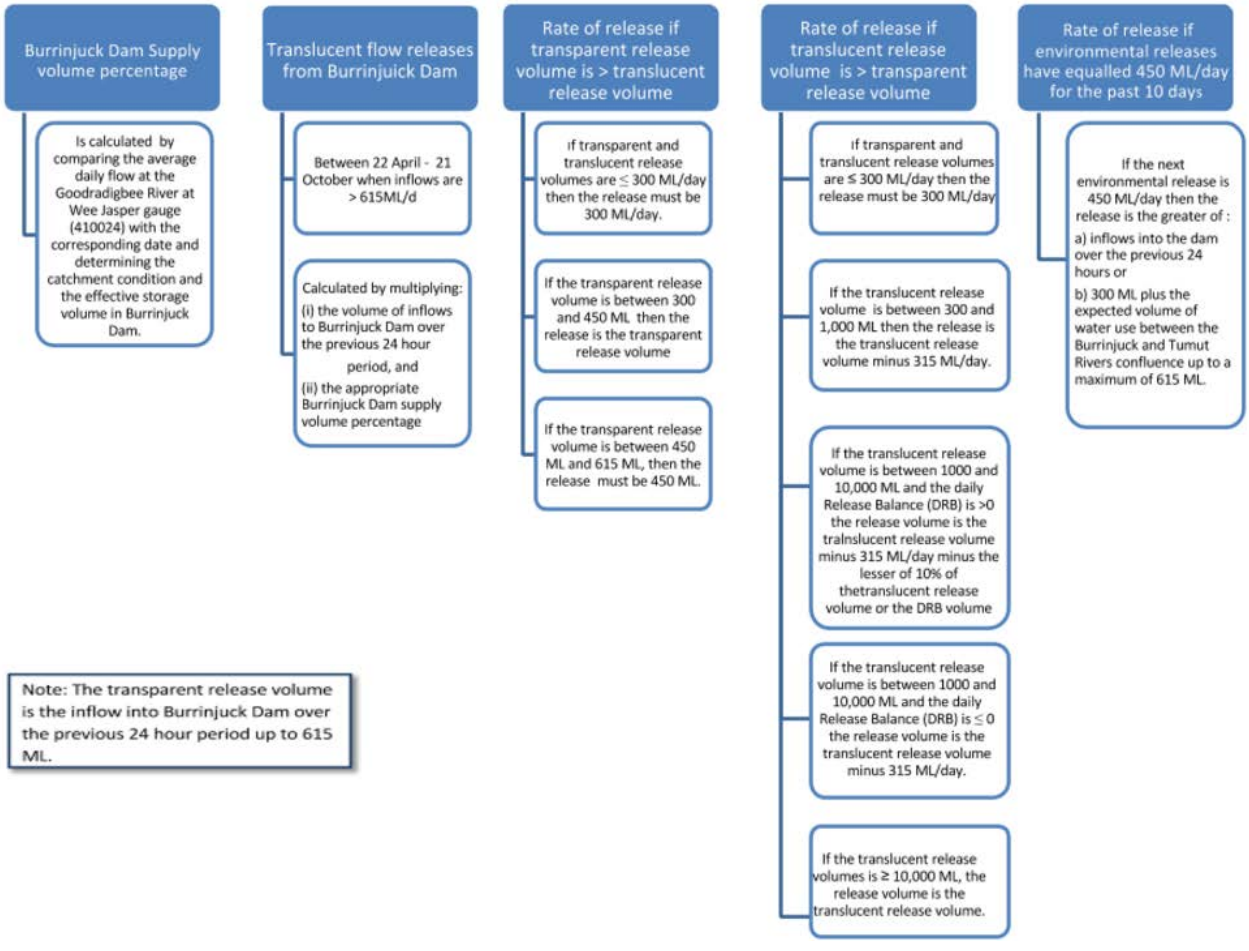
The transparent and translucent flow rules present in the WSP are summarised below in Figure 17.

A4.1.1 Environmental flow rules - river management committee

Environmental flow rules have been in place on the Murrumbidgee River since 1998. They were developed by the Murrumbidgee River Management Committee, which included representatives of the irrigation industry, environmental interests, indigenous communities, the local Catchment Management Board, local councils and government agencies (the then Department of Land and Water Conservation, National Parks and Wildlife Service, Environment Protection Authority, NSW Agriculture and NSW Fisheries).

In 2001 the Committee was asked to recommend rules for the Murrumbidgee Water Sharing Plan. The earlier rules, with some revisions, were developed into draft rules and put on public exhibition in 2002. Those draft rules, with some amendments, were incorporated into the WSP that commenced on 1 July 2004. These same environmental flow rules continued into the replacement water sharing plan that commenced in July 2016.

Figure 17. Summary of Murrumbidgee transparent and translucent flow rules



A4.1.2 Alternate environmental flow rules

Following the development of draft Murrumbidgee water sharing plan rules in 2002 arising from river management committee deliberations, agency representatives recognised that these draft environmental flow rules (i) might not achieve their intended outcome and (ii) could be problematic to implement. Priority areas for further investigation included:

- upriver variability
- low river wetlands inundation frequency and extent
- end of system variability and seasonality
- security of the Lowbidgee entitlement.

It was also widely recognised that the draft environmental flow rules were complex, confusing and in need of simplification.

With these aims in mind, NSW inter-agency representatives tested a large number of simplified rules using the long term model to determine whether a preferable suite of environmental flow rules could be identified. A total of 22 different scenarios were tested, the majority of which involved the following characteristics:

- a monthly varying end of system flow
- 40,000 megalitres per day flow limit at Gundagai
- a fixed translucency release proportion equal to 36 per cent of inflows
- two allocations to an environmental allowance: 50,000 megalitres at 60 per cent allocation and another 50,000 megalitres at 80 per cent allocation.

Based on this inter-agency work, a new EOS flow target rule and simplified translucent flow rule were developed.

The original gazetted 2004 WSP required the new EOS flow targets to commence in year 6 of its operation however the WSP was suspended in 2006 due to severe drought at the time and was not implemented until the drought broke and normal operations recommenced in 2011.

The simplified translucent flow rule, using a proportional sharing approach to new inflows, has never been implemented.

These simplified rules were able to achieve many of the same outcomes as the original draft rules without the complexity and potential for misunderstanding. At the time there was widespread support for this approach amongst agencies at the officer level; however when the WSP was formalised the majority of rules originally developed by the stakeholder committee were retained.

The current review of translucent flow rules throughout inland NSW is an opportunity to pursue again this simplified approach. Modelling would need to be undertaken to confirm the extent of any (likely minimal) long term impacts.

The Stakeholder Advisory Panel for the Murrumbidgee Water Resource Plan has been formed. The SAP could first address concerns around the translucent flow rules in advance of any other issues. In particular, the panel could consider whether this simplified approach is supported.

A4.2 Stakeholder issues

Issues were raised in relation to the translucent flow rules as part of the review and replacement process for the 2016 Murrumbidgee Regulated River WSP. Requests were made for a review of the translucent flow rules to help improve simplicity and effectiveness of the rules. Stakeholder views on this topic are summarised as:

- translucency rules are too complex and create difficulties in implementing the rules, leading to errors and problems in accounting for what was delivered
- their effectiveness is limited in providing for priority water dependent ecological assets, ecological function (e.g. fish breeding, drought refugia) and for health of particular reaches (e.g. Yanco, Lowbidgee)
- only delivered for six months of year (April – October) and replaced by irrigation releases for the other 6 months
- flows are only protected for 9 percent of the river (i.e. immediately below Burrinjuck Dam)
- absence of rules that apply during water shortage and plan suspension
- the rules do not allow for collective management of the total pool of environmental water.

In early June 2016 translucent flows were released in the Murrumbidgee from Burrinjuck Dam (refer to Appendix A4.4 for a description of the event). This release sparked significant stakeholder concern as dam levels only rose from around 40 to 50 per cent from this rainfall event due to the release of translucent flows.

Following the release of these flows, concern was raised regarding:

- how the translucent releases ‘tie in’ with the Murray Darling Basin Plan
- translucency releases may compromise productivity from irrigated agriculture
- the relevance of translucent flows given that large parcels of water shares have been purchased as ‘held environmental water’
- whether there were different ways to generate an environmental flush effect instead of having to spill unlicensed water that could better be directed towards irrigated agriculture.

In retrospect, the translucent flow releases had positive effects: for example, the environmental watering benefits during winter when demand was low, increased air space in the dam prior to spring flooding enabling general security allocations to reached 100 per cent of entitlement on 15 November 2016. A case study of this event is provided at Section A4.4.

A4.3 Progress to date

A review of environmental flow rules in the Murrumbidgee valley has not yet commenced. The Stakeholder Advisory Panel has been formed and discussions on WSP issues has commenced.

A4.4 Case study – Murrumbidgee 2016 Translucent Release Event

MURRUMBIDGEE REGULATED RIVER| INFORMATION PAPER

Management of translucent flow releases

July 2016

Introduction

In early-June 2016, heavy rainfall from an east coast low pressure system inundated eastern Australia, including the upper Burrinjuck Dam catchment, producing some of the largest flows observed since 2012. Burrinjuck Dam storage began to fill and translucent flow releases were triggered as required by the Murrumbidgee Regulated River Water Sharing Plan.

This paper defines (i) transparent and translucent planned environmental water rules, (ii) their application to the Murrumbidgee regulated river and (iii) the operation of translucent rules to the June 2016 high rainfall event. The paper also describes the context of planned environmental water rules in the management of resources within the Murrumbidgee regulated river system.

What are transparent and translucent releases?

The transparent and translucent flow rules are commonly used to allow sustainable water diversion and to protect the downstream riverine ecosystems. This type of planned environmental water management rule is implemented in many river systems. In the Murrumbidgee River the rules are formally defined in the *Water Sharing Plan for the Murrumbidgee Regulated River Water Source 2003* (WSP).

Transparent flow releases are low flow rules and pass 100 per cent of the low inflows, as if there were no dam, up to a maximum low flow threshold.

Translucency flow releases are typically designed to add flow variability above a low flow threshold. Above the dedicated low flow threshold the translucent flow releases are expressed as a percentage of the inflow (i.e. a similar but smaller event is passed downstream, and shows the characteristics of the natural inflow event). This approach still allows water to be harvested for later consumptive use.

These types of planned environmental water rules are commonly used in many rivers around the world and are designed to balance consumptive and environmental water requirements. In the case of the Murrumbidgee River valley this generic approach was modified to develop fit for purpose local rules. The local rules arose from the deliberations of a broad mix of stakeholders that made up the former Murrumbidgee River Management Committee, including water user and environmental water representatives.

The environmental flow rules were based on the broad river flow objectives that set out 12 aspects of flow considered to be critical for the protection or restoration of river health, ecology and biodiversity. The objectives were subject to extensive public consultation and endorsed by the NSW Government in 1999. The transparent and translucent flow rules are in response to the following key river flow objectives:

- Protect natural low flows;
- Protect or restore a proportion of moderate flows, 'freshes' and high flows;
- Maintain or restore the natural inundation patterns;
- Distribute floodwaters supporting natural wetland and floodplain ecosystems; and
- Maintain or mimic natural flow variability in all rivers.

Application of transparent and translucent rules to the Murrumbidgee valley

The regulated river water sharing plan converts this generic management approach and customises the planned rules to the specifics of the Murrumbidgee River based on local community input. The proportion of inflows required to be released under transparent and translucent flow rules is calculated each day and depends upon three factors: (i) the time of year, (ii) catchment inflows, and (iii) dam storage level.

Transparent releases can be made at any time of year. Daily inflows to Burrinjuck Dam are released in full if they are between 300 and 615 megalitres per day and there are no other larger release requirements.

Translucent releases are a variable percentage of inflows, dependent upon three factors:

1. **Date** - Releases are restricted to the period 22 April and 21 October. This is when, on average, high inflows to Burrinjuck Dam occur. For every day from 22nd April to 21 October, specific conditions and inflows are set out in Schedules 1 and 2 of the water sharing plan to determine the size of the releases.
2. **Natural antecedent catchment conditions** – The status is denoted as dry, normal or wet. This status is derived by comparing the daily flow rate of the Goodradigbee River, the most natural of the three rivers flowing into Burrinjuck Dam, with the historical lower, middle and upper third deciles of the Goodradigbee River at Wee Jasper. This assessment of catchment wetness determines what proportion of the inflows will be released.
3. **Burrinjuck Dam effective volume (%)** – A simple equation is used to estimate the effective volume. Effective volume (EV) is equal to the current storage volume (CV) at Burrinjuck Dam (in megalitres) minus half the volume of water in the Murrumbidgee valley carried over (CO) in general security accounts from the previous water year (in megalitres) divided by the full storage volume (FSV) of Burrinjuck Dam. [Note: carryover is notionally split between the two headwater storages: Burrinjuck and Blowering Dams].

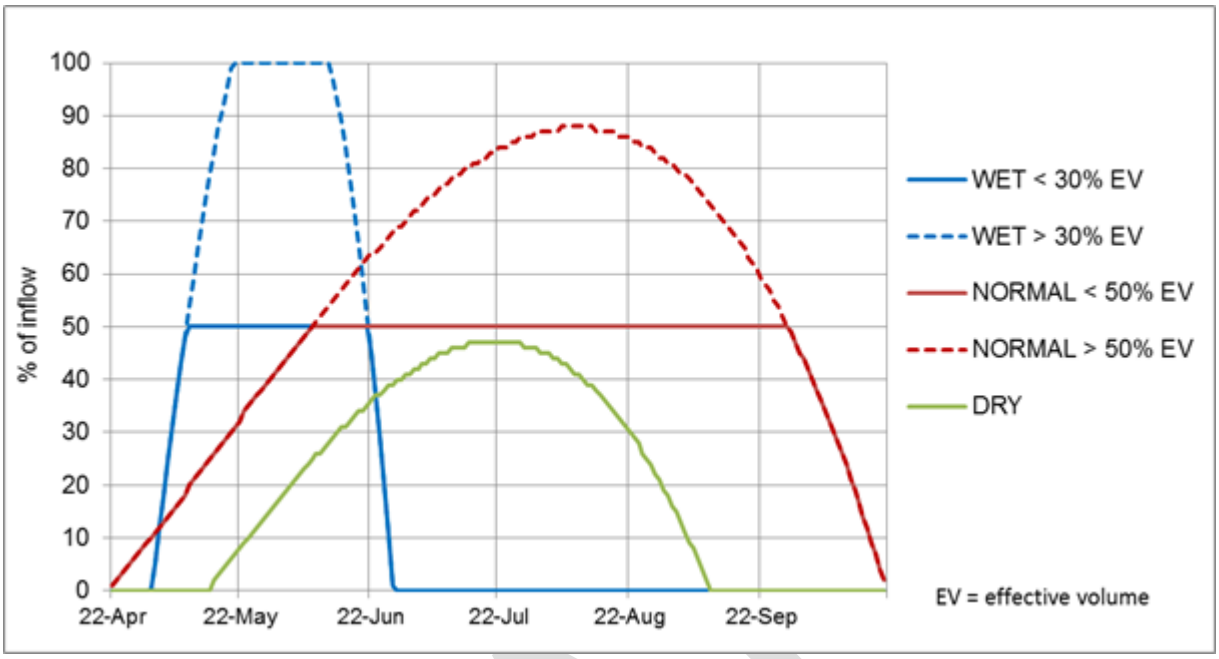
Balancing competing needs

The Murrumbidgee River translucent flow releases have been designed to **balance the consumptive needs of irrigators with the need for healthy riverine environments**. This is reflected in the **timing** of translucent release percentages as shown in Figure 1. The percentage of inflows that are released is determined using a schedule of daily flows. If prevailing conditions (based on flow in the Goodradigbee River at Wee Jasper) are already wet in autumn or early winter, natural flow releases are prioritised as shown by the dashed blue line in Figure 1. Given the early wetting of the catchment, there is a high likelihood that further improvements to storage levels and allocations will be received in late-winter or early-spring and Burrinjuck Dam will fill and spill. The potential medium-term impacts on allocations by these higher releases are mitigated when, after 27 June, no translucent flow releases are made under wet catchment conditions and the storage is more likely to fill and spill. Release patterns under normal and dry catchment conditions are spread more evenly over the translucent flow period, with highest releases targeting mid to late-winter.

Limits to maximum release percentages are applied when Burrinjuck storage volume is low, including a storage adjustment that prioritises new general security allocations. The effective storage volume represents the current state of water availability in the valley: the actual Burrinjuck storage volume offset by the volume of unused allocations from previous years split evenly between Burrinjuck and Blowering Dams. When effective storage is low, the translucent flow percentage is ‘clipped’ to a maximum of 50 per cent of inflows, so more inflows are stored (solid blue and red lines in Figure 1). The translucent releases are ‘clipped’ under wet conditions while the effective volume in Burrinjuck Dam remains below 30 per cent of capacity and under

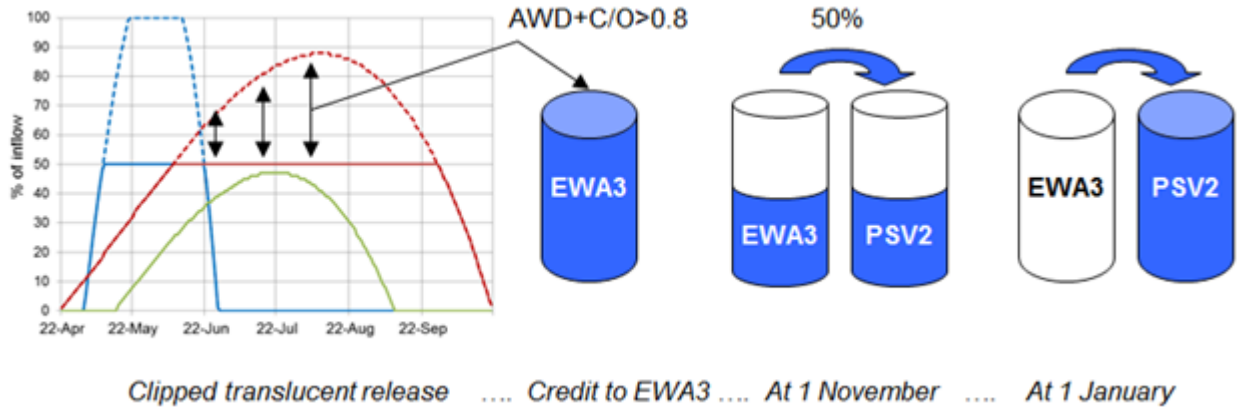
normal conditions translucent releases are clipped while Burrinjuck remains below 50 per cent of capacity. The translucent release percentages under dry conditions don't reach 50 per cent.

Figure 1. Translucent release percentages during periods of low effective storage



The limits described above are effectively **borrowed** from environmental flows when water availability is **low** and provided back for near-immediate discretionary environmental use if water availability improves sufficiently by late-spring. When effective storage is low, any volume of water clipped (i.e. the difference between the dashed lines and solid lines in Figure 2) is tallied and accumulated on a daily basis. If water availability subsequently improves such that the sum of general security allocations plus average carryover is greater than 80 per cent of general security entitlement, this accumulated tally is then credited to an Environmental Water Allowance (EWA3). On 1 November, half of any water remaining in this allowance is transferred to a provisional storage volume account (PSV2) to reserve early allocations in the next water year. On 1 January, any remaining water in EWA3 is transferred to PSV2. As a consequence of these rules, early season allocations are preserved but allocation improvements above 80 per cent are slowed.

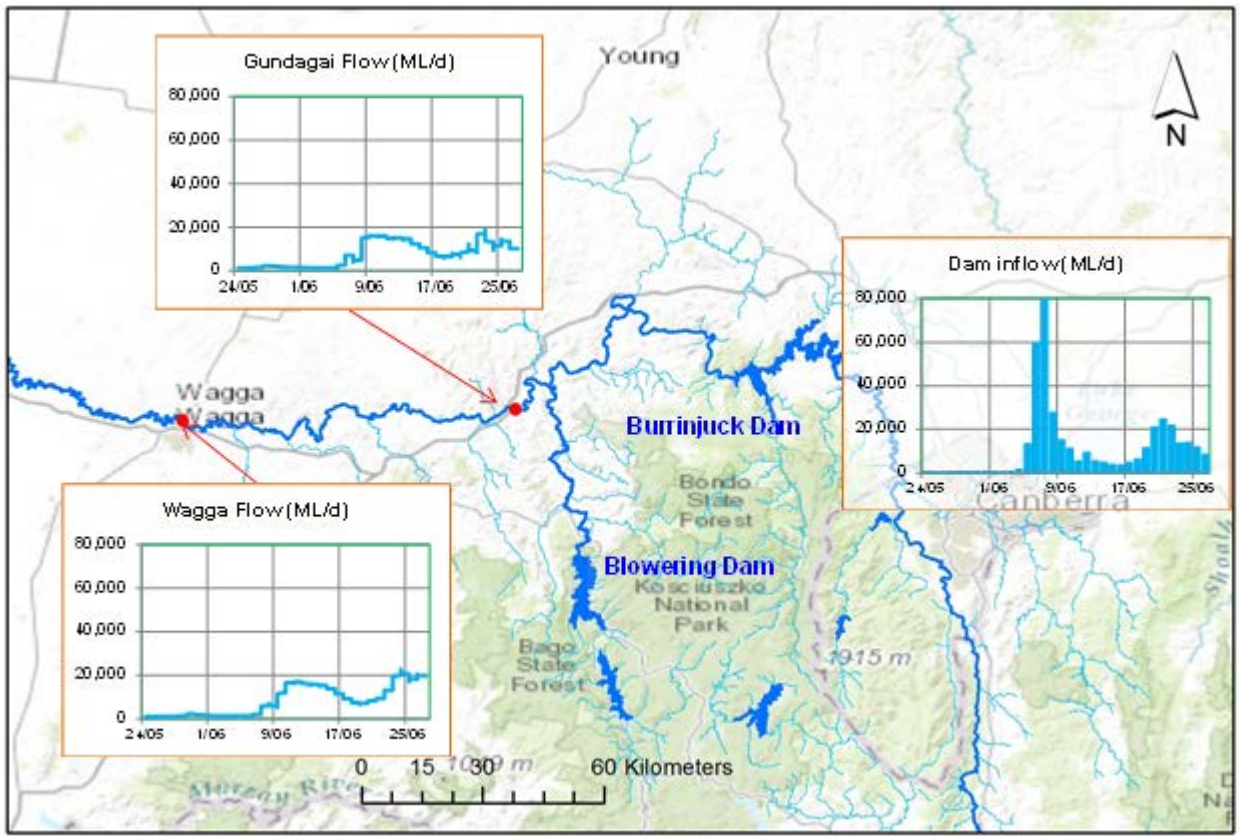
Figure 2. Crediting the EWA3/PSV2 plan provisions in the Murrumbidgee Valley



June 2016 event

On 5th to 6th June 2016, a low pressure system off the east coast of Australia triggered intense rainfall over the and eastern slopes of the Great Dividing Range and the catchments of the Upper Murrumbidgee River. Large inflows to Burrinjuck Dam totalling approximately 240,000 megalitres in volume were received over 12 days (Figure 3). Additionally, some minor inflows from tributaries of the Murrumbidgee River below Burrinjuck Dam occurred.

Figure 3. Map of peak flow rates and travel times, June 2016



Triggers

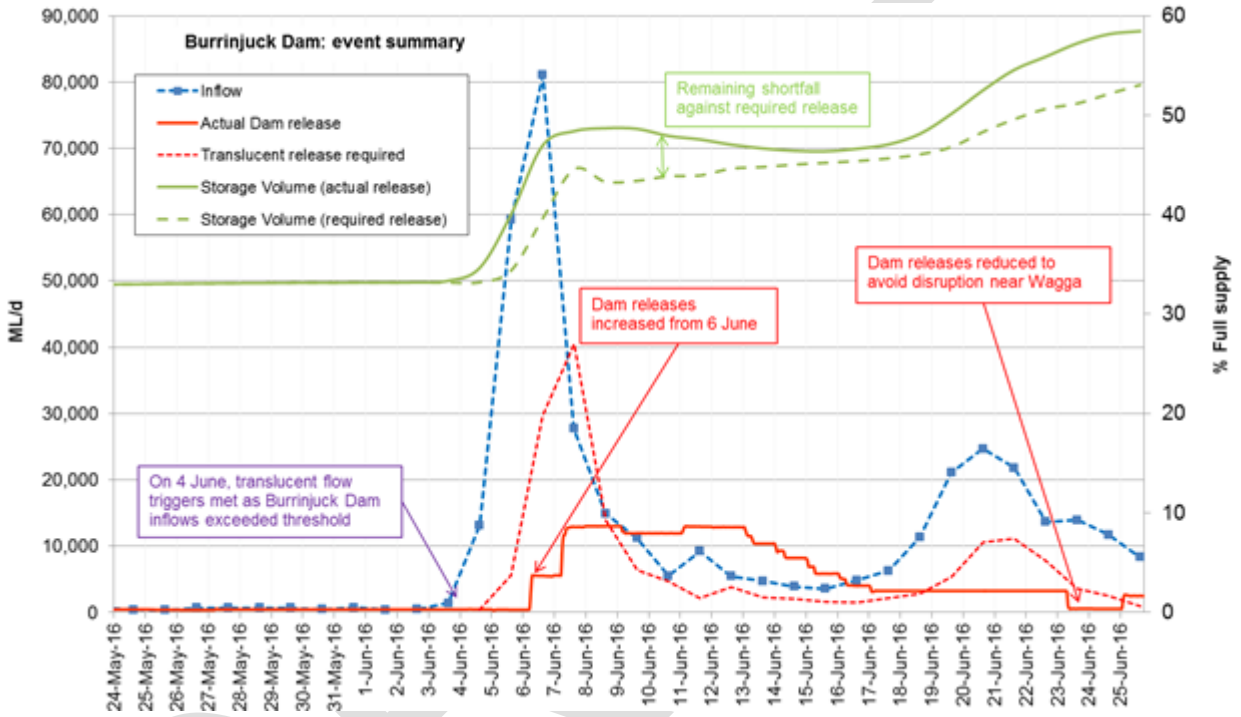
The downstream flow strategy switched from a low flow transparent release to the higher translucency releases on the 4th June 2016. Goodradigbee River flows also began to rise, triggering a wet antecedent condition for the period 5 to 16 June followed by 3 days of normal conditions before experiencing wet conditions again after 19 June with further rain in the upper catchments. Burrinjuck Dam began the event at 33 per cent of full supply volume which, when adjusted for half of the carryover volume from the previous year, resulted in an effective volume of only 10 per cent. The solid blue line in Figure 1 for 5 to 12 June indicates that 50 per cent of inflows was required to be released, having been 'clipped' from a maximum 100 per cent due to the low effective volume.

Release requirements peaked on 6th and 7th June, where daily inflows of 59,000 megalitres and 81,000 megalitres respectively were received. Translucent flow calculations in the water sharing plan required releases of 29,500 megalitres per day and 40,500 megalitres per day to be made on subsequent days, contingent on operational constraints. WaterNSW expressed concerns to DPI Water regarding inundation of private land and valve capacity constraints at such high flows and requested that the daily release requirements be eased. DPI Water approved the request that flooding be avoided under the proviso that any daily under-release be tallied and added to subsequent releases such that a balance of overall volumes was maintained.

The actual release is plotted alongside the required release in Figure 4. Peak daily flows rates downstream of Burrinjuck Dam were substantially reduced compared to a strict reading of the triggered flows and well below levels that cause any significant disruption. Note that the net position of the storage following the event remained unchanged whether the daily releases were reduced or not.

Further rainfall during the period 16 to 21 June triggered additional inflows, resulting in a second continuous translucent flow event from 17 to 27 June. Large tributary flow contributions in this second event meant that dam releases were again restricted to minimise disruptive high flows downstream. This increased the shortfall in overall releases, which is progressively being made good over subsequent days.

Figure 4. Burrinjuck Dam operations during the translucent flow event in June 2016



Multiple benefits

The primary purpose of the translucent flow release is to restore some natural flow fluctuation commensurate with the prevailing weather and inflow conditions, and provide environmental outcomes. However there are also some benefits that directly accrue to water users. The water released is not quarantined for environmental purposes. Rather it is available to water users, including irrigators, when a supplementary event is declared.

Supplementary access was progressively made available from 7 June 2016 event as flows made their way through the river system. This means that those with supplementary access entitlements can divert water. General security entitlement holders can also divert water without debit during this supplementary flow event given the current level of general security allocations.

In addition, water that flows from the Murrumbidgee valley and is useful for water supply purposes in the Murray is credited as NSW resource in the Murray valley, helping NSW Murray irrigators.

Despite the translucent release volume requirements, more than half of the inflows into Burrinjuck Dam were captured. Storage levels rose by 135,000 megalitres from 33 per cent to 46 per cent of the full supply volume during the first translucent flow event to 16 June, with approximately 100,000 megalitres of additional inflow captured in the second translucent flow event to 27 June.

Environmental benefits of transparent and translucent rules

Planned environmental water provisions, such as transparent and translucent rules have been applied to many river systems across Australia (Growns and Reinfelds 2014). Conceptually, this planned environmental water management approach provides many of the natural hydrological cues, of timing, duration, frequency but often at a lower magnitude. The benefits of this management approach often reflect the quality of the local rules and the ability to implement the method within an individual river system.

Transparent releases are predominately low flows rules that protect in-channel habitats and their dependent biota. For example, the provision of transparency water can increase the hydraulic diversity in running water in-channel habitats, such as riffles runs and glides or inundate low lying backwaters. These types of low flows generally protect the most susceptible habitats and biota to water diversion, but do not provide many of the required ecosystem processes that occur at higher flow rates.

Translucent releases is one management approach to providing a higher flow variability that is necessary to mimic the natural hydrological cues and to re-instate many river processes are that aquatic biota are dependent upon.

The hydrological driven environmental processes that benefit from translucent release are:

- **Habitat protection/ maintenance:**- Higher flow inundation, water mixing, or scour of in-channel habitats..
- **Resource availability**- Provision of basal resources (i.e. nutrients such as carbon) via the inundation of natural features to stimulate production and the aquatic food chain.
- **Reproduction /recruitment**: Provide hydrological cues to stimulate reproduction and recruitment of aquatic biota.
- **Dispersal**: Provide opportunities for the movement and dispersal of aquatic biota, either through active or passive dispersal strategies.

The success of such planned environmental water rules are dependent on selecting the appropriate eco-hydrological criteria, but such approaches provide a lower cost management approach to delivering environmental water to regulated river systems in a manner that reflects the local hydrology.

In the Murrumbidgee River, the environmental water rules commenced in 1999. Monitoring of the effectiveness of transparent and translucent has been undertaken by DPI Water in the Murrumbidgee system under the Integrated Monitoring of Environmental Flows (IMEF) program (Chessman 2003; Hardwick et al. 2012a; Hardwick et al. 2012b; Hardwick et al. 2014). Studies in the period 1999-2002 indicated that higher magnitude scouring flows remove silt and algae from stony riverbeds. This improves the habitat for fish and invertebrate communities. This indicates that both environmental water and consumptive water could potentially be delivered in a sympathetic manner to achieve in-channel ecological outcomes to the Murrumbidgee River.

Additionally, these eco-hydrological studies indicate complex relationships between flow, local hydraulics and the aquatic biota. Higher flow releases that wet the perimeter of floodplains are critically important for ecological habitat. The volumes and natural hydrological variability provided by transparent and translucent flows target improving instream and floodplain ecology.

Limitation of translucent rules

The key limitations to translucency rules in meeting the desired ecological objectives include:

- The ability of the infrastructure to deliver the desired flow variability on a daily time-step
- The maximum flow threshold available to be delivered, given the social and economic settings within a valley.
- The volume of available planned water available in any year to meet the various natural hydrological cues.

These limitations are not a reflection of the method in meeting ecological targets but reflect the broader social and economic settings that the local community have identified as important and need to be addressed collectively. However, the perceived ecological limitation of translucency rules in lowland floodplain rivers is the ability to inundate the floodplain. Inundation of the floodplain is an important consideration to provide basal resources (i.e. carbon) and to ensure the transfer of energy flow from low trophic levels to higher trophic levels such as fish, platypus, turtles and birds. The inundation of carbon sources on the floodplain, will allow a greater carrying capacity of higher trophic organism such as fish (e.g. simply more and bigger fish).

The limited ability to deliver higher flow rates to inundate the floodplain to stimulate river processes such as primary production, based on social and economic consideration has been a key limitation of the existing translucency rules. This limitation has seen the purchase of water entitlements to supplement translucency rules, to achieve the flow magnitude required to repair river processes (i) habitat maintenance, (ii) resource availability, (iii) reproduction/recruitment, and (iv) dispersal of aquatic biota.

Translucent releases and Basin Plan

The translucent flow releases are part of the suite of environmental flow rules for the Murrumbidgee River (i.e. (i) planned fixed rules (i.e. transparent/translucent), (ii) planned discretionary rules and (iii) held water). The existing planned rules establish the amount of total of environmental water that is part of the 2009 baseline scenarios modelled by the Murray Darling Basin Authority to establish the sustainable diversion limits (i.e. SDLs) of the Basin Plan 2012. Changing the fixed planned environmental water rules (i.e. translucent) would vary the baseline scenario, and influence the sustainable diversion limit for the Murrumbidgee River.

The Basin Plan (s10.28) establishes that there shall be “no net reduction in the protection of planned environmental water from the protection provided for under State water management law immediately before the commencement of the Basin Plan.” Revoking or altering the translucent environmental releases could therefore be inconsistent with the requirements of NSW under the Basin Plan. The MDBA have further developed a policy position statement further outlining the requirements to protect the planned environmental water provision of existing plans (MDBA 2015).

Additionally, environmental water managers make water use decisions assuming that transparent and translucent releases make up part of the suite of flow measures within the river system and, while a review of environmental watering practise would identify areas for improvement, a proposed reduction of planned environmental water could have an adverse impact on sustainable diversion limits and ultimately trigger reduced allocations for water users.

The Basin Plan and sustainable diversion limit target requires the recovery of 2,750 gigalitres of water for environmental outcomes. This is predicated on baseline modelling that incorporates the current transparent and translucent release rules. If the NSW plans are not operated to deliver current volumes of environmental water then greater recovery of water from NSW irrigators will be required under the Basin Plan. Any changes must be offset by other rules that maintain the overall environmental water share under the water sharing plan.

More information

www.water.nsw.gov.au

Acknowledgments

Contributions to this paper have also been received from representatives of Water NSW and the NSW Office of Environment and Heritage.

A5. NSW rivers outside of the Murray-Darling Basin - evidence for effectiveness of translucent flows

The ecological benefits of translucency and transparency rules are apparent in NSW, particularly in the Metropolitan Rivers of the Shoalhaven and Hawkesbury-Nepean Rivers. Some examples are given below. For dams in the Upper Nepean and Shoalhaven River systems, translucency rules allows capture and storage of 80 per cent of dam inflows greater than the transparency threshold resulting in a release of 20 per cent of these larger flow events as small pulses to the rivers downstream. This simple approach allows substantial water volumes to be captured and stored for consumptive use by Sydney but also provides for flow pulses to be released to the rivers downstream at times when large natural flows are occurring in the catchment.

The first example is on the Shoalhaven River downstream of Tallowa Dam. Hydraulic modelling results demonstrated that the previous 97th flow exceedance percentile flow regime was unsuitable for upstream migration by Australian bass. The natural barriers were considered to be overcome if an 80th percentile transparency threshold, varied according to the monthly pattern of natural flows, were to be adopted. Since its introduction, this approach substantially increased baseflows in the Shoalhaven River during the winter-spring bass migration season. Its effectiveness was confirmed by monitoring of actual fish movements and behaviour with acoustic telemetry (Reinfelds et al. 2012). Moreover, this helps generate more frequent flow pulses of a magnitude approximating the natural (in the absence of Tallowa Dam) median daily flow (50th percentile). The median daily flow is an observed threshold above which downstream migration in a proportion of Australian bass in the Shoalhaven River is stimulated (Reinfelds et al. 2013) and mixing of the water column along 80 to 90 per cent of the length of the Shoalhaven River below Tallowa Dam can be achieved (Reinfelds and Williams 2011).

Another example, in the Upper Nepean River system, also demonstrates the ecological benefits of transparency and translucency rules (Growns 2016). Aquatic macroinvertebrates in three habitat types were sampled at water supply and low flow sites and unregulated sites in 1995 and 1996. Environmental flows downstream of four dams and two weirs were provided over the next 13 years. This consisted of 10 years of a constant 95th flow percentile release and three years of a 80th flow exceedance transparency rule and 20th flow exceedance translucency release. Monitoring in 2013 and 2014 indicated that the macroinvertebrate assemblage structure was significantly different between regulated and reference sites and the number of taxa lower at water supply sites prior to the implementation of the environmental flows. Following the environmental flows the assemblage structure became more similar to, although still significantly different from, the unregulated sites and the number of taxa was not significantly different between regulated and unregulated sites. Approximately 30 per cent (thirteen) of taxa indicative of unregulated rivers increased in frequency at regulated sites following the environmental flows.

In the case of these Metropolitan Rivers, a different legal and policy setting (i.e. the Metropolitan Rivers are not legally defined as regulated) was in place compared to the western regulated rivers and allowed greater volumes of water to be allocated and higher releases to occur for these fixed rules. A significant discussion occurred in the Shoalhaven Scientific Advisory Panel (SAP) to consider whether fixed planned environmental rules (such as transparency/ translucency rules) were sufficient (Boyes 2006; HNRMF 2004). The SAP discussed the merit of discretionary planned environmental water, but determined that such active management was not required and would overly complicate the management arrangements. It was decided that a simpler arrangement of fixed transparency/translucency rules would provide sufficient and regular releases to deliver the desired ecological outcomes for the Shoalhaven River (Simon Williams[8], personal communication, 14 September 2016).

[8] Manager Environmental Water Management – Surface Water, NSW Government, Department of Primary Industry Water.

Snowy River indicates that tributary flows provide much more carbon to regulated rivers (Rholfs et al. 2015) than in-channel dam (Rholfs et al. 2016). As carbon is essential to ecosystem function, this highlights a need for environmental water management plans to give greater consideration of the critical importance of catchment generated runoff from tributaries in the delivery of carbon within inland river systems.

A6. Review Announcement

Niall Blair
Minister for Primary Industries
Minister for Lands and Water

NSW GOVERNMENT

MEDIA RELEASE

Wednesday, 6 July 2016

TRANSLUCENT FLOWS TO BE REVIEWED

Minister for Primary Industries, Lands and Water Niall Blair has ordered a review of the provisions for translucent flow releases from inland regulated river storages.

"These provisions were originally designed to mimic natural flows and improve river health and connectivity prior to large scale water recovery in the Murray Darling Basin," Mr Blair said.

"Environmental water holders now manage considerable water entitlement portfolios and translucent flow rules, although supported by some downstream water users, continue to be questioned by communities."

"It is time to review these rules and determine whether the intended environmental outcomes could be achieved with a more flexible approach."

DPI Water will undertake a review to investigate the efficacy of translucent flows, and whether other forms of environmental water are able to achieve those same outcomes while minimising potential negative impacts to river communities.

DPI Water will conduct the review in consultation with key stakeholders including the Department of Environment and Heritage.

The provisions for translucent water releases are made in many of the inland-regulated water sharing plans for NSW, including the Lachlan, Macquarie, Murrumbidgee and NSW Border Rivers.

Translucent flows occur when a portion of inflows from specific flow events are passed through a regulating structure – usually a dam – to enable a near-natural flow pulse into the river system.

These flows do not involve the use of licensed environmental water, but are a fixed rule that designates releases to reflect natural conditions at the time.

Any proposed changes will be discussed with communities and are required to be consistent with the Murray Darling Bain Plan.

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