What's stopping the water? Identifying influences on environmental water releases in the Wimmera

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Abstract

The return of water to rivers through environmental water releases (EWRs) is becoming increasingly widespread and the implementation of the Bulk Entitlement (Flora and Fauna) in Victoria provides the environment with a legislated right to water. Recommended environmental flow rates have been set for many of Victoria's rivers and the challenge, once water becomes available, is the effective delivery of the water. There are operational constraints as well as natural and anthropogenic features that may influence the delivery of water to a river or a reach. Such features may prevent the delivery of the water (for example constrained release capacity from a dam) or simply slow the passage of water to an important site (for example a high loss zone in the upper reaches of a stream network may require additional water to be released to enable the watering of an icon site). In order to effectively manage the delivery of EWRs, these constraints or influences need to be identified. This paper presents the process undertaken in the Wimmera region of western Victoria for identifying the natural and anthropogenic features that may influence the passage of EWRs. This involved detailed field assessment, the development of mitigation options and prioritisation of potential works. This process is unique, in particular the scale at which it has been applied – entire waterways flowing through a low relief landscape dominated by broad scale agriculture. The results have given the Wimmera CMA a prioritised means of addressing issues that may reduce the effectiveness of EWRs – on a catchment, waterway and reach basis.

Keywords

Environmental water releases, management, regulation, constraint, water delivery

Introduction

The return of water to rivers through Environmental Water Releases EWRs is becoming increasingly widespread and correspondingly, the way in which the rivers are supplied with their environmental water is changing. In the past, the environment has typically received the 'excess water' i.e., the water that is left after the paying customers have taken their portion. Now and in the future, the environment is being given an allocation that is actively released in a pattern determined by catchment and waterway managers for a specified environmental purpose (cf, EWRs in the Cotter River, ACT; (Environment ACT, 2006) & the River Murray (MDBC, 2005)). Recommended environmental flow rates are being set for many of Australia's rivers, but the challenge, once allocated water becomes available to the environment, is the effective delivery of that water. This requires that the catchment and waterway managers have an understanding of the way the water will travel between the regulation point and areas of environmental need downstream.

In Victoria, the implementation of the Bulk Entitlement (Flora and Fauna) (DSE, 2004) provides the environment with a legislated right to water. The rivers of the Wimmera were the first to have a formal allocation of regulated water through the Bulk Entitlement (Wimmera and Glenelg Rivers Flora and Fauna Conversion Order 2004). Furthermore, with the construction of the Wimmera-Mallee Pipeline to replace the current inefficient earthen channel system, further water savings will be transferred back to the Flora and Fauna Bulk Entitlement. Consequently the Wimmera Catchment Management Authority (CMA) are able to make regulated releases into the waterways for the environment and as the pipeline progresses, the volume of water they will be responsible for managing will increase markedly.

This project comprises an important step in the strategic management of rivers in the Wimmera region to maximise the benefits obtained from the delivery of environmental water. Previous reports noted the potential for EWRs to be impeded by a number of anthropogenic and natural features along the waterways e.g. the inability of several road crossings on Burnt Creek to pass the recommended flow rates as identified in the Burnt Creek Waterway Action Plan (Earth Tech, 2005a) and the inability of the MacKenzie River downstream of Dad and Dave Weir to pass the recommended annual high flow (Dyer & Roberts, 2006). These impediments are real and potentially significant – particularly in times of limited water availability and when small volumes of environmental water are released for a specific environmental objective.

This project aimed to identify and document all of the natural or anthropogenic features that could influence the delivery of the Environmental Water Reserve along seven of the Wimmera's waterways. Operational and infrastructure constraints had previously been identified (Earth Tech, 2005b) and are being addressed by the Wimmera CMA and Grampians Wimmera Mallee Water through collaborative works.

Study Area

This investigation was undertaken along seven of the Wimmera's waterways (Table 1 and Figure 1) and was directed at the length of the waterways into which regulated environmental water can be released. These waterways represent the main regulated waterways within the Wimmera and encompass all of those, outside the Wimmera River, that are a priority for the receipt of EWRs. The seven waterways investigated comprise a variety of stream types, locations and landuse. From the high energy, low sinuosity cobble bed reaches of the upper sections of Fyans Creek, Mt William Creek and the MacKenzie River flowing through sections of national park to the low gradient distributary alluvial streams flowing across broad acre cropping land of Yarriambiack and Dunmunkle Creeks.

Environmental flow recommendations

Environmental flow recommendations for the waterways of the Wimmera are provided by the *Wimmera Bulk Entitlement Conversion Study – Environmental Flows Study* (SKM, 2003). In this report, recommendations are provided on a reach by reach basis for a standard set of flow components which are considered to be key to the ecological functioning of the reach. Reaches are also identified as either Priority A or Priority B and this classification defines the degree of quantification given for the recommended environmental flow components; recommendations for Priority A reaches are clearly defined in terms of magnitude and timing, whereas the recommendations for Priority B reaches are not explicitly defined. Consequently the environmental flow recommendations for the Priority A reaches are clearly defined and it is relatively straight forward to determine the flow components that may be influenced by a particular feature. In contrast the recommendations for Priority B reaches are more generic and the influence of a particular feature is therefore less clearly determined.

Table 1. The seven waterways of this study, their length and environmental flow priority.

Waterway	Length (km)	Priority Classification
MacKenzie River	63	A
Burnt Creek	55	A
Bungalally Creek	26	B
Fyans Creek	18	B
Mount William Creek	86	B/A
Yarriambiack Creek	147	A
Dunmunkle Creek	90	n/a*

* Formal Environmental Flow recommendations are yet to be made for Dunmunkle Creek. Field assessments were based on approximately 80% of the flows recommended for Yarriambiack Creek. This is considered to be a conservative approach.

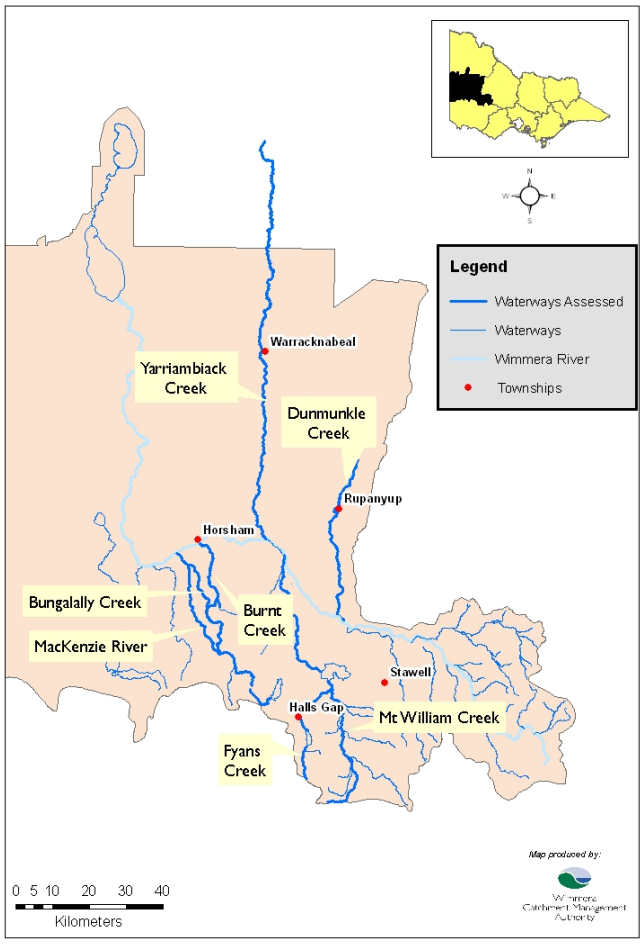

Figure 1. The Wimmera Catchment and the location of the 7 waterways investigated

Methods

The approach used to identify and locate the influences along the seven waterways was a combination of desk based analysis and field inspections with the majority of the information provided from the field inspections.

Desktop analysis

The desktop analysis comprised a review of previous reports and documents, the interrogation of the high resolution aerial photographs and topographic maps, and the review of information from GWMWater regarding licensed extractors along each of the waterways. This information was used to identify obvious and potential constraints such as road crossings, fire and farm crossings, weirs, potential diversion points and areas which may naturally affect the passage of water (eg. swamps or anabranches).

The desktop analysis indicated differing densities of potential influencing features depending on the nature of the waterway and the density of the local settlement and this defined the way in which the field inspections were conducted for each waterway. Very few potential features were identified in the upper reaches of the MacKenzie River, Mt William Creek and Fyans Creek consistent with these waterways being located in the Grampians National Park. Within the lower sections of the MacKenzie River, and Fyans Creek as well as Burnt and Bungalally Creeks a high density of potential sites were noted. These were predominantly crossings and diversion points and are consistent with the large number of properties around these waterways. In contrast, a smaller density of potential features were noted along Yarriambiack Creek and Dunmunkle Creek as well as the lower sections of Mt William Creek.

Field inspection

Field inspections were conducted in May and November 2006 by teams of people travelling on foot, mountain bike and by four wheel drive. All of the potential features identified in the desktop analysis were inspected in the field to determine if, and to what extent, that feature would influence the passage of environmental water. The field inspections were also used to identify if there were influencing features that had not been noted in the desktop analysis. Because a large proportion of Burnt Creek and Bungalally Creek is privately owned and portions of these waterways have historically been used as part of the water supply network, the entire length of these waterways was inspected either on foot or from mountain bike. The MacKenzie River and Fyans Creek are contained within crown land or National Park and the majority of these waterways were inspected from a 4 wheel drive or mountain bike either travelling on adjacent tracks or accessing the creek from crossing points. Inspection of Mt William, Yarriambiack and Dunmunkle Creeks was targeted by the desktop analysis and these waterways were assessed from vehicles accessing the creek at crossing points and adjacent tracks and roads.

The field inspection noted all natural and anthropogenic features along the waterways which may potentially influence the delivery of the EWR. At each feature, a standard description was recorded using hand held GPS units with an inbuilt database and a set of standard photographs were taken. A brief assessment was made regarding the potential of the site to impede or constrain the components of the environmental flow

recommendations. Where flow components were expected to be impeded or constrained, the site was surveyed to quantify the degree of constraint or impediment. The level of detail of the survey varied, depending on the feature and ranged from simple measures of slope across the pipes of a road crossing, or the size of the feature causing the impediment to more detailed cross-sectional area determination.

Results

A total of 474 features were identified during the field inspections which may potentially influence, or be influenced by, the passage of the EWR (Table 2). Of these, just under half were observed along Burnt and Yarriambiack Creeks reflecting the density of development (and use of the waterway as a supply channel) along Burnt Creek and the sheer length of Yarriambiack Creek. In contrast, only 25 features were observed along Fyans Creek reflecting its shorter length and the lack of water resource development..

The features were classified into 5 categories illustrating the different style of features present along each waterway (Table 2). The majority of features identified were those associated with Water Resource Utilisation (such as diversion points and pumping pools) and of these a third was located on Burnt Creek reflecting its use as a water supply channel. Of the 474 influencing features found, only 32 natural features were observed that may potentially affect the passage of the EWR. Only a small proportion of these were the channel dimensions which indicates that the process adopted for setting the EWRs was well performed as it appears to consider the different types of channel characteristics present with flows set accordingly.

Table 2. Features identified in the field that may potentially influence, or be influenced by, the passage of the EWR along waterways of the Wimmera.

Waterway	Bridge[1]	Ford Style Crossing[2]	Natural Features[3]	Pipe/Culvert Crossing[4]	Water Resource Utilisation[5]	Total
Dunmunkle Creek	14	2	2	38	22	**78**
Fyans Creek	5	6	5	5	4	**25**
Mt William Creek	22	15	5	11	14	**67**
Yarriambiack Creek	15	24	5	47	19	**110**
Bungalally Creek	2	7	3	7	21	**40**
Burnt Creek	12	18	9	11	55	**105**
MacKenzie River	14	22	2	0	11	**49**
Total	**84**	**94**	**32**	**119**	**145**	**474**

[1] all types of bridges: pedestrian, stock and vehicular
[2] all low level crossings
[3] e.g. Large woody debris jams, swampy areas, sections of constricted channel
[4] All crossings that have pipes or culverts to pass the flowing water
[5] e.g. weirs, all evidence of diversion points such as deepened pumping pools and pipes into the waterway

While a large number of features were noted and recorded along the inspected waterways, only a small proportion of them (just over 20%) will influence the passage of environmental water (Table 3). Two thirds of these features are located on Yarriambiack and Burnt Creeks and the main types of features to influence the passage of environmental water are structures associated with Water Resource Utilisation and Pipe & Culvert Crossings.

Discussion

Only one of the influencing features noted will prevent the passage of the EWR. This was the pipes in the levee bank between the Wimmera River and Yarriambiack Creek that are unable to pass the recommended high flows into Yarriambiack Creek and the levee is considered to be of sufficient height and length that it will not easily overtop. All the remaining influencing features will, instead, slow the passage of the initial water release. Once sufficient water has been released, most of the features will be overtopped and all subsequent flows will pass unimpeded.

Theoretically, while pumping from the waterways for domestic and stock purposes will influence the passage of environmental water, the reality is that unless there are many pumps within the waterway in close proximity, it is unlikely that the pumping rates will have significant impact on the passage of environmental water, even at low flow rates. Thus, it is only in the lower reaches of Burnt Creek that a high concentration of pumping points is likely to influence the passage of environmental water.

Table 3. Features noted during field inspections of Wimmera waterways that will influence the passage of the EWR.

Waterway	Bridge	Ford Style Crossing	Natural Features	Pipe/Culvert Crossing	Water Resource Utilisation	Total
Dunmunkle Creek	0	0	1	9	9	**19**
Fyans Creek	0	0	0	3	1	**4**
Mt William Creek	2	0	0	0	3	**5**
Yarriambiack Creek	3	3	6	17	9	**38**
Bungalally Creek	0	0	1	2	1	**4**
Burnt Creek	1	2	2	6	19	**30**
MacKenzie River	1	0	2	0	1	**4**
Total	**7**	**5**	**12**	**37**	**43**	**104**

Although it has been noted that the majority of the influencing features will act to slow the passage of the initial release of environmental water, the delay caused is likely to be negligible in the context of the travel times along each of the waterways. For example, a hypothetical culvert crossing that causes flows to back up to a depth of 0.5 m for 300 m of stream length, 3 m wide requires approximately 0.5 ML before it will overtop. Even at the lowest of the recommended flow rates (2 ML/day) this would result in a 6 hour delay in the passage of water. By comparison, 25 mm of rain along the MacKenzie River equates to a volume of about 5 ML falling on the main channel of the waterway and 2 to 3 times that when allowing for backwaters and anabranches. Thus, the influence exerted by most features is simply a short delay in the passage of the flows and greater influence will be exerted by the wetness of the channel prior to the release of the flows.

Social impacts

For many features noted during the field inspection there may be a social impact associated with the feature and the release of environmental water. For example, a ford will be impassable during the passage of high flows and if this crossing is regularly used by the landholder to access parts of a property, the release of environmental water will have a social impact. There are two types of social impacts – those where access is prevented because of environmental water flowing over a ford style crossing and those that may occur where summer diversions are prohibited. There are 94 crossings across the 7 waterways which may be impassable during some components of the EWRs. These are predominantly fire crossings along the MacKenzie River and low level crossings on Yarriambiack Creek. It is likely that the greatest impact will be on the MacKenzie River as most of the low level crossings on Yarriambiack Creek appear to be less permanent and more opportunistic (temporary crossing points used during periods of drought) than those on the MacKenzie River and the recommended frequency of high flows is greater on the MacKenzie river than Yarriambiack Creek. Environmental flow recommendations for Fyans Creek, Bungalally Creek and the upper sections of Mt William Creek are not defined quantitatively, rather defined in terms of preventing summer diversions and passing freshes. The potential social impact that may arise along these waterways is more to do with the community's perception of the EWR. Discussions with the local landholders in a variety of forums indicate that there is likely to be negative community feeling regarding the EWR if water is seen to be freely flowing and diversions for stock and domestic use are prohibited.

Compliance points

All rivers typically experience some loss in the transmission of flow – through natural seepage and evaporation. As a consequence most environmental flow recommendations for a reach of a waterway are provided for a compliance point. To deliver the specified environmental flow to the compliance point, the losses expected between the delivery point and the compliance point need to be taken into account. This means that the channel upstream of the compliance point should be expected to pass a flow that is higher than the recommended environmental flow and the channel downstream of the compliance point will be

passing smaller volumes of water than the recommended environmental flow. Ideally, this should be taken into account when determining the influence of a particular feature on the passage of the EWR. However, the environmental flow recommendations for reaches of the waterways of this investigation have been provided without compliance points (SKM, 2003). As such it has not been possible to assess each feature on the basis of its location in relation to a compliance point. Instead, all assessments were made on the basis of the feature having to pass the recommended flow components. This is of particular concern in distributary (losing) systems such as Yarriambiack and Dunmunkle Creek where the section of the waterway closest the Wimmera River would naturally be able to pass considerably higher flows than the lower reaches.

Remediation options
While the majority of the features identified in this study will not stop the passage of environmental water, nor introduce significant delays, the greatest benefit will be achieved if the release of the EWR is unimpeded. Consequently remediation options were provided to address each feature considered to influence the passage of the EWR, as well as options to address the social impacts that may arise. These options ranged from simply cleaning out blocked pipes to the replacement and realignment of culverts through to the installation of flood depth markers on ford style crossings. These options were prioritised by reach, waterway and the overall system on the basis of the flow components the feature was considered to affect.

Conclusion

This study showed that while a large number (474) of features were identified across seven of the Wimmera's waterways as having the potential to influence the passage of environmental water, only a small proportion of these (104, around 20%) would exert some influence and only 1 would prevent the delivery of the EWR. The influence exerted by most features is simply a short delay in the passage of the flows; greater influence is likely to be exerted by the wetness of the channel prior to the release of the flows. The study also noted that there is likely to be a social impact associated with the release of the EWR – in terms of loss of community access and community perceptions of water use. The study also identified that single compliance points on distributary systems do not provide an adequate representation of the hydrologic characteristics of these systems. Multiple compliance points will provide managers with more realistic targets and provide a more intuitive basis for discussing EWR's with the community. The identification of influencing features will enable the water manager to make more informed decisions about the release of environmental water and undertaking remediation options will improve the efficacy of flows and delivering the resultant environmental benefits.

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