Valley chokes in the upper Wimmera River catchment are playing key roles in mitigating the threats of erosion – a model case study

Martin Hillemacher[1] and Brian S. Seymour[2]

1 Sinclair Knight Merz, P.O.Box 2500 Malvern, VIC, 3144. Web: www.skmconsulting.com, Email: mhillemacher@skm.com.au
2 Aquatic Systems Management Pty Ltd, 27 Summerlea Rd Mt. Dandenong, VIC, 3767. Email: bss.asm@bigpond.net.au

Abstract

In a recent study of the upper Wimmera River near Ararat, Victoria a model case study was found which presents the consequences of unchecked land management practices that have had a long-term impact on the condition of waterways. This paper details the key role that three discrete valley chokes are playing in arresting threats due to past practices and the importance of protecting their integrity. At three locations the valley sides impinge on the floodplain and form considerable geomorphological controls. Upstream of these rock controls, the catchment retains many of its historic features such as a small channel, an engaged floodplain, permanent deep pools and many remnant environmental values. Downstream of theses chokes the river is oversized, continuing to degrade, has a disassociated floodplain and significantly fewer environmental values. These natural rock controls are exposed to increased pressures and it appears that one of these controls is becoming incised and is threatening to fail. This process is a response to historic catchment and stream disturbances. Breaking through these chokes will expose the upper catchment streams and instream values to a wave of degradation that will endanger highly valued remnant vegetation and native fauna species such as platypus, native fish and water rat populations. This is an observational study that is based on applied management techniques. Detailed investigation is ongoing and appropriate management options are yet to be determined.

Keywords

Valley choke, European settlement, river health, remnant values, upper Wimmera River

Introduction

The consequences of unchecked land management practices have had a long term and ongoing impact on the condition and health of waterways. This paper identifies a major threat to remnant waterway values and the health of the upper Wimmera River.

The presence of three discrete natural valley chokes in the upper Wimmera River catchment are playing key roles in arresting the threats of erosion and other channel degradation processes caused by past land management practices (Figure 1). The success these chokes are having in preserving pre European channel forms and remaining environmental values highlights the need to protect their integrity. However, on closer inspection, it appears that one of these key features is under threat of failure as a result of advancing headward erosion. If this occurs, the current condition and remaining values contained in the upper Wimmera River will be irreversibly changed. If no action is taken, incision processes will significantly threaten many of the remaining refuge areas that native fish, turtles, platypus, and water rat populations rely on, which do not occur to any significant degree further downstream due to a lack of suitable habitat (Williams & Serena, 2006).

This paper details the major changes that have affected the catchment of the upper Wimmera River, the key role that the valley chokes are playing in mitigating the threats caused by past land management practices and the importance of protecting their integrity. This case study is based on site observations and application of applied waterway management techniques. Detailed investigation is ongoing and appropriate management options are yet to be determined.

Overview of the catchment

The Wimmera River is located in central western Victoria and extends from the granitic slopes of the Pyrenees Ranges down to the terminal Lakes Hindmarsh and Albacutya. The River is predominantly a lowland plain stream and is the focus of many social, recreational, cultural and environmental values. In the upper reaches, the river is fed by tributaries that flow from the Pyrenees mountain ranges. The subject of this paper refers to the area upstream of Glenorchy which is commonly referred to as the upper Wimmera River.

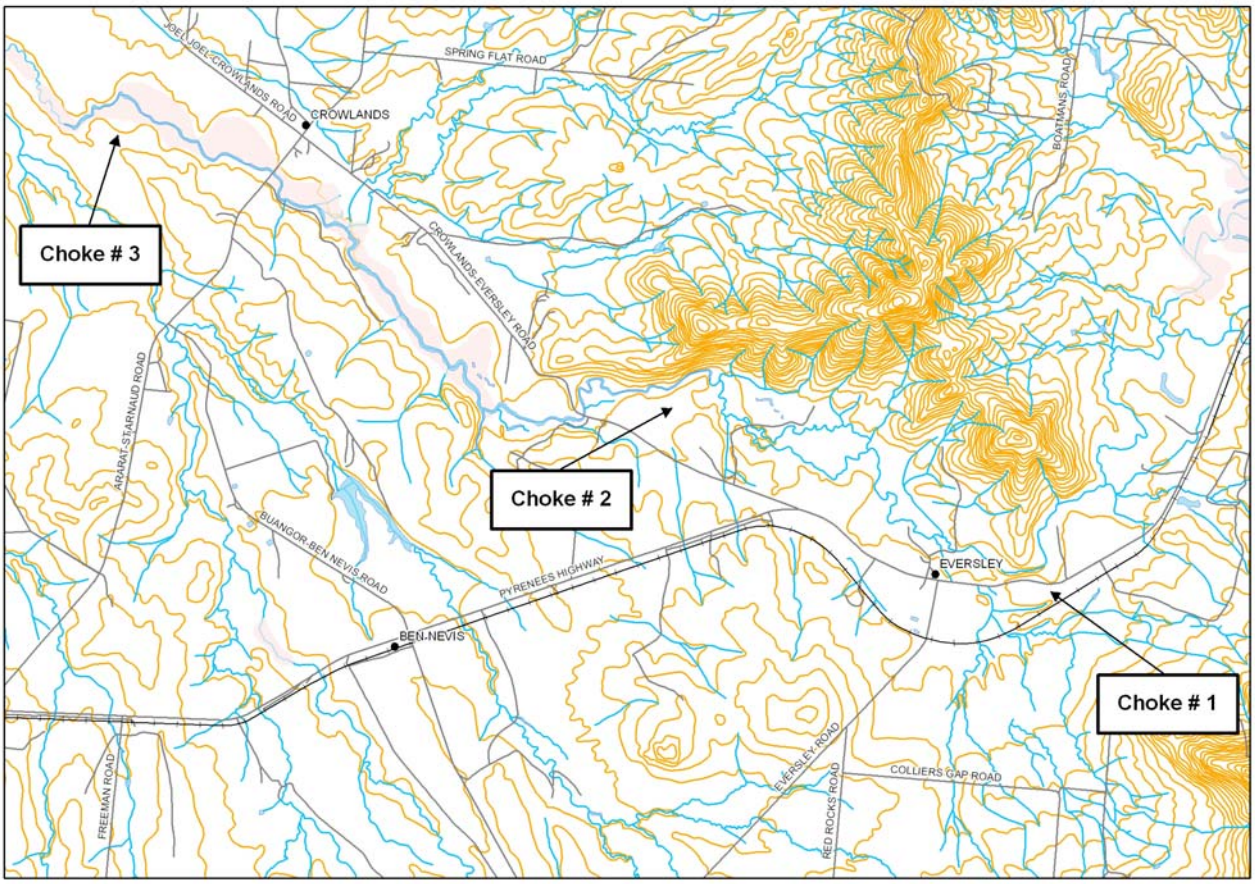

Figure 1. Site location map showing the three valley chokes near Crowlands and Eversley.

Prior to European settlement, the Wimmera River was likely to have consisted of multiple discontinuous shallow well vegetated waterways on a series of broad floodplains, chain of ponds and swamps (ID&A 2002). However, following the introduction of European-style agriculture in the mid 1840's, the Wimmera River and its floodplain were subject to widespread clearing (and later more extensive wood cutting for fuel). The River was also cleared of logs and straightened and also widened in sections to help drain the landscape and provide ready access to the fertile floodplains (Wimmera Waterway Health Strategy, 2006).

The reduction in valley floor vegetation combined with the introduction of hard hoofed stock decreased the erosion resistance of the catchment and changed the equilibrium between channel dimension and the flow dynamics. As a result, a massive wave of erosion processes including channel widening and incision, tunnelling and gullying was triggered. Subsequent lateral and headward erosion in many of the tributaries that flow into the Wimmera River has led to a substantial volume of sediment being deposited into the river, effectively smothering many habitats. Some of these tributaries are still actively eroding today and are in need of rapid intervention to stop further degradation.

Agriculture, particularly grazing, is the dominant landuse along the upper Wimmera River and a large proportion of the river and its tributaries remain accessible to stock. In recent years, the Wimmera River has suffered from salinity, weed infestations, impacts from stock, eutrophication and significantly reduced flows. Much of the river and its tributaries are considered to be in marginal to very poor condition (Doeg, 2000).

Much of the Wimmera River is now a continuous enlarged channel with some pools and significantly fewer environmental values. While many of the rivers remnant values have been lost, some still remain, but these are under increasing pressure and threat. Despite the massive changes that the catchment has experienced, segments of the upper Wimmera River still retain a number of high value environmental attributes that are remnants of the former healthy stream system. In particular, the river is a refuge for remnant native fish populations (mountain galaxias, river blackfish and southern pigmy perch), turtles (Eastern snake-necked) platypus and water rats which do not occur to any significant degree further downstream. These remnant populations remain due to the availability of key habitat systems such as pool and run habitats, reasonably low salinity levels and good quality riparian vegetation. Many of these remnant high value areas coincide with and exist upstream of three valley chokes near Eversley and Crowlands.

What is a valley choke?

A valley choke is where there is a constriction in the floodplain, usually resulting from a combination of steep terrain that impinges on the floodplain comprised of harder material than the surrounding alluvium. These choke points restrict the amount of water that can travel through these points in times of flood and high flows. The presence of chokes usually forces flows to seek an alternative path or alternatively, result in extremely high energy transition zones. In the case of the upper Wimmera River, the chokes have been created by confinements in the valley morphology through geological intrusions of resistant slate and shale rock seams. Typically, the river has a steeper gradient at the outlet of the chokes and a large floodplain at the inlet.

Discussion

In 2006, Wimmera CMA engaged a team with technical skills in the areas of geomorphology, waterway engineering and vegetation to assess the condition of the upper Wimmera River between Elmhurst and Joel South. Three natural valley chokes were identified during the fieldwork component of the project.

The first and most upstream of the three chokes is approximately 1 km upstream of the Eversley township. The choke provides a control to an upstream floodplain which extends through to the junction of Glenlofty Creek and the Wimmera River. The choke appears to comprise of a relatively resistant rock and it appears to be in good condition. Although in good condition, ongoing protection is required to limit the impacts of stock and help secure and enhance the site.

The second valley choke is located upstream of the Eversley-Crowlands Road bridge, where the bed controls consist of a series of weathered shale bars in the valley floor. The choke extends over a distance of approximately 800 m. A series of pools remain through the valley constriction which have excellent structure and habitat complexity and are likely to also serve as vital refuge ponds during times of drought. With variable morphology, large woody debris and excellent habitat complexity (provided by instream macrophytes such as Swamp Lilly), the ponds are an example of what existed on a wider scale throughout the catchment

There is a distinct change in channel cross sectional area either side of the choke whereby the downstream channel capacity (refer to Figure 3) is four to five times the capacity of the channel at the upper end of the choke (refer to Figure 2). It is clear that the channel deepening and incision from the downstream reach is in the process of migrating upstream and resistance is being provided by the rock controls at the valley choke. The extent of erosion and resultant channel enlargement is also evident under the Eversley-Crowlands Road Bridge which has recently undergone structural upgrade works to the abutment piers which were being undermined. A deep scour pool exists at the downstream end of the choke which coincides with a sudden change in bed grade.

Figure 2. Typical channel dimension upstream of the second valley choke.

Figure 3. Typical channel dimension downstream of the second valley choke.

Some of the shale and slate rock controls appear to be incising through the choke section which indicates that headward erosion is migrating upstream. This segment at the lower end of the choke and valley constriction was also subject to a channel avulsion in a major flood in 1974.

The relatively high resistance of the rock bars in this choke compared to that of the surrounding alluvial plain segments is evident and has slowed the advancing headward erosion processes. However, erosion caused by historical and ongoing disturbances to the catchment together with changed flow regimes are threatening the integrity of this choke. The imminent loss of the bed control provided by the rock bars is threatening to severely alter the high value ecosystem and habitats that exist upstream.

The third and most downstream of the three chokes is located, approximately 2 km downstream of the Crowlands township. The integrity of the choke was observed to be in a stable condition, with extruding rock outcrops evident at both sides of the constriction. The floodplain upstream of the choke is subject to frequent inundation, and supports a small stable stream section characterised by a series of well connected

pools as well as a vast swamp. This fairly natural system provides excellent habitat for platypus and native fish species.

Recommended actions

The observed incision and associated wearing of the rock bars at the second choke is a major concern. Failure of this choke has the potential to undermine all upstream values. A detailed investigation is required to determine the extent and rate of change occurring at the site. It will be necessary to conduct detailed assessment of the hydrologic, geomorphic and geologic features. A detailed survey of the site will also be required to obtain sufficient data to facilitate hydraulic modelling, under a variety of flow scenarios to help quantify key assessment parameters such as stream powers, flow rates, velocities, extent of bedrock, and the likely rate of change in stream morphology. This type of assessment will enable informed decisions to be made in relation to remedial actions that may be required to help secure the site.

Subject to the results of future investigations, it is conceivable that intervention will be required to help secure the integrity of this vulnerable choke at a mid or upper location. Remedial actions may include the construction of a highly resistive cut-off wall and/or grade control to reinforce the resistance of the choke against headward erosion and prevent the channel from enlarging or incising further.

Conclusion

The upper Wimmera River's valley chokes are major geomorphic features that lend significant control to the upstream channel form. Their control has maintained a stable channel grade and some elements of the original pool and run form.

The first step in protecting and rehabilitating these valley chokes is to recognise the existence of these landscape features, the role they play, and their current condition. Recent inspection of the second of the three chokes suggests that progressive failure of the key bed and valley constriction controls is likely at some point in the future if intervention is not taken. The likely impacts of failure would be:

- significant increase in channel dimension and capacity;
- loss of remnant pools;
- disassociation of the currently engaged floodplains;
- loss of valued native habitat; and
- increased rates of erosion in tributary streams which would exacerbate the transfer of sediment into the Wimmera River.

To date the valley chokes have successfully resisted many of the degenerative impacts caused by European-style farming. Although the catchment remains vulnerable to the impacts of stock and improved farming technologies, the chokes provide sound control points on which many important habitats rely. In order to protect and enhance the remaining environmental values in the upper Wimmera River it is essential that the integrity of these chokes be protected and retained.

In a catchment that has been so heavily disturbed and where so few high value remnant habitats remain, this case study highlights the importance of orientating management goals with actions that protect remaining high value remnant river reaches.

Acknowledgments

The authors gratefully acknowledge the support and opportunity provided by Wimmera CMA to investigate and assess the condition of the upper Wimmera River.

References

Doeg, T. J. (2000). *Regional development and water resource management plan for the upper Wimmera and Avoca catchments: Upper Wimmera case study*. Phase 1 Environmental assessment for the project Timothy J. Doeg Environmental Consultant, Northcote.

ID&A, (2002). *Wimmera River Geomorphic Investigation, Sediment Sources, Transport and Fate*. Prepared for Wimmera CMA.

SKM (Sinclair Knight Mertz)(2006). *Waterway Action Plan; Wimmera River Reaches 3, 4, 5 & 6.1*. Prepared for Wimmera CMA.

Williams, G.A., & Serena, M. (2006). *Ecology and conservation of platypus in the Wimmera River Catchment: VIII. Results of population surveys, November 2005.* (Report to Project Platypus). Australian Platypus Conservancy: Whittlesea.

Wimmera Catchment Management Authority (2006). *Wimmera Waterway Health Strategy*. Wimmera Catchment Management Authority, Horsham, Victoria.