

Demonstration Reach Toolbox – Addendum

Consideration of a 'Whole of Catchment' context to help identify Demonstration Reaches

- Linkages with the River Styles Framework

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Summary

- The demonstration reach model is an effective approach to rehabilitating riverine or wetland habitats for native fishes at the reach scale.
- It can readily be incorporated into existing management frameworks and initiatives.
- On its own, it does not address the linkages between the demonstration reach and the whole catchment in any formal way. Neither does it address fluvial geomorphology questions or how the river is behaving or is expected to behave over time.
- The River Styles Framework developed in New South Wales provides both a “whole of catchment” framework and provides temporal linkages to geomorphic processes. It is an important tool in prioritizing reaches for rehabilitation action.
- Both the River Styles and the demonstration reach approach incorporate strong community linkages and ownership.
- There is significant potential to use the demonstration reach model to facilitate river rehabilitation actions within priority reaches identified by the River Styles Framework.
- It is important to note however that prioritisation of reaches for fish should not simply rely on the River Styles approach but should incorporate knowledge of the fish species present, their movement patterns and their life history requirements. Preferable, whole of catchment fish surveys should be undertaken.

Note

This paper should be seen as an addition to the Demonstration Reach Toolbox which can be found on the Finterest website (www.finterest.com.au)

It does not provide a detailed description or methodology for the River Styles framework. Rather it explores the potential use of River Styles to help select demonstration reach sites within a broad catchment context.

River Styles ® is a registered Trademark held by Macquarie University and Land and Water Australia. The trademark is administered through Access Macquarie. Details regarding the framework can be found on the comprehensive www.riverstyles.com website. The site includes details of upcoming accreditation courses.

1. Introduction

A demonstration reach is a reach of river or area of wetland where multiple management interventions are undertaken simultaneously to showcase the cumulative benefits of rehabilitation actions for native fish. The model has been trailed successfully at seven sites across the Murray-Darling Basin over the last 10 years. As a result of these trials, a Demonstration Reach Toolbox was compiled (Jackson and Clunie, 2014) to assist the adoption of the model at other sites both within and outside the Murray- Darling Basin. This toolbox is available on the Finterest website (www.finterest.com.au).

During 2015, the authors of the toolbox attended a number of meetings across the basin to promote demonstration reaches and the availability of the toolbox with potential practitioners. During meetings in New South Wales questions were asked about the potential relationships between the demonstration reach approach and the River Styles framework which is used extensively in that state. The River Styles framework provides a geomorphic template allowing a whole of catchment consideration of the spatial and temporal linkages of biophysical processes (Brierley et al. 2002).

Developed by geomorphologists in the Department of Physical Geography at Macquarie University in collaboration with the New South Wales Department of Land and Water Conservation, it is increasingly being used in a range of river management applications including identifying priority river rehabilitation sites.

This paper has been written as an appendix to the demonstration reach toolbox to provide further consideration of factors that may influence the choice of a demonstration reach site and in particular how the River Styles approach may provide a geomorphic framework for decision making. It does not provide a detailed description of the River Styles framework as this can readily be found in existing references (see reference list) or by visiting the River Styles website (www.riverstyles.com).

2. Background

2.1 Recap of Key Selection Criteria for selecting a Demonstration Reach Site.

There are six selection criteria that are the minimum requirements for selecting a demonstration reach site. They are:

- *The site should be accessible, visible and close to a significant population centre.* This encourages community ownership and helps raise awareness of the value of rehabilitation activities.
- *The site should contain a range of threats to river health and native fish that are treatable through management interventions.* Demonstration reaches are designed to show the benefits of treating multiple threats within a single reach or wetland area. However, the threats must be treatable and the project must represent a cost effective use of resources.
- *It should be suitable for trialling a range of rehabilitation techniques with the results transferable to other sites.*

Demonstration reaches are important learning tools for river rehabilitation techniques.

- *Ideally there should be untreated sites nearby that can be used as controls to monitor changes.*
Rigorous monitoring is a key component of the demonstration reach model.
- *The demonstration reach site should be in an area where it can easily fit into existing tenures and management.*
Demonstration reaches should be seen as complimentary to existing land and water management programs.
- *The site should be of sufficient size but not so large that it is unmanageable.*
The size needs to reflect the scale of the threatening processes and the scale of the interventions needed to positively impact on river health and targeted fish populations.

2.2. Two other important Selection Criteria

There are two additional considerations related to selecting a demonstration reach site that should be addressed. Whilst both have formed part of the deliberations for existing demonstration reaches, neither have been considered in a structured or systematic sense. They are:

2.2.1. The demonstration reach in a whole of catchment context

River reaches sit in and are influenced by the broad landscape of the catchment in which they occur. For example sediment sources from poor land management practices upstream of a demonstration reach site can result in blanketing of the river bed and reduced habitat diversity in the demonstration reach. Artificial barriers either upstream or downstream of the site may significantly impact on target fish species. Ultimately rehabilitation activities are likely to be more successful when planned at a catchment scale (Langhans et al., 2014).

Demonstration reaches can act as catalysts for further rehabilitation activities throughout the catchment and this approach has been taken in the Condamine River where the Dewfish Demonstration Reach is a key component of the Condamine River Rescue Program. Furthermore demonstration reach projects have considered off-site catchment issues when developing Whole of Life Plans. For example, the Loudon Weir ineffective fishway was seen as a significant impediment to fish passage in and out of the Dewfish Demonstration Reach and was addressed.

However, there has to date been no systematic process for choosing a demonstration reach within a catchment context or linking the results back to the catchment to provide ongoing guidance for river rehabilitation within that catchment.

2.2.2. Fluvial geomorphology considerations

Rivers are not static in form or function nor are they unidirectional in their behaviour, they are dynamic evolving systems. Rehabilitation works are best tailored to suite the particular reach and the current fluvial processes taking place. To quote Fryirs and Brierley (2009), “Rather than presenting rehabilitation in terms of static expectations, rehabilitation should be framed in terms of dynamics.....Practitioners must recognise the inherent capacity of the

system to adjust and change in response to stimuli and disturbance events, and frame rehabilitation strategies accordingly”. In short we should be working with nature in order to ensure the most cost effective approach to river rehabilitation.

Certainly fluvial processes have been considered in developing intervention plans for demonstration reaches (for example the use of engineered log jams in the Upper Murrumbidgee Demonstration Reach) but geomorphology of rivers has not been an integral component of the demonstration reach model to date.

3. What is the River Styles Framework?

To quote from www.riverstyles.com :

“The catchcry for the River Style framework is ‘know your catchment’ that encompasses four key principles:

- *Respect river diversity*
- *Work with river dynamic and change*
- *Work with linkages of biophysical processes*
- *Use geomorphology as an integrative physical template for river management activities.*

The River Styles process involves examining river character and behaviour at four different but integrated scales. These are the catchment level, landscape units, River Style and geomorphic units (see Fig 1). Finally linking reach-scale geomorphic structure to the local hydraulic habitat provides a basis for small scale habitat assessment and potential linkages with biota. River Style identifies lengths of river channel that can be characterized by their particular assemblage of geomorphic units (pools, riffles, levees, benches etc.). The range of River Styles identified in a particular sub-catchment is an outcome of the interactions between the channel and floodplain forming processes (Thomson et al. 2001). For a river valley a set of procedures is implemented to determine the particular river character and behaviour and the River Style.

Implementation of the River Styles Framework involves four distinct stages (Brierley et al. 2011). These are summarised in Fig 2 and briefly discussed below. The reader is referred to www.riverstyles.com for comprehensive outline of the framework. The summary below is distilled directly from the website.

Stage One: Catchment-wide baseline Survey of River Character and Behaviour

This is the “know your catchment” stage where background information, reports and scientific papers together with aerial surveys and ground truthing surveys etc. are used to obtain catchment-wide data on river character and behaviour.

- *Step One* is an assessment of regional and catchment setting controls resulting in a summary of regional setting information
- *Step Two* defines and maps the River Styles across the catchment producing a catchment-specific River Styles tree and an explanation of river behaviour for each River Style.

- *Step Three* investigates the controls on character, behaviour and downstream patterns of River Styles resulting in a summary table illustrating the catchment wide controls on river character and behaviour.

Stage Two: Catchment-framed assessment of river evolution and geomorphic river condition

This stage assesses and explains the current river condition throughout the catchment.

- *Step One* determines the capacity for adjustment within each River Style by assessing how they can adjust within their valley setting under prevailing flow and sediment characteristics. Channel attributes, channel platform and bed character are investigated and the sensitivity of a River Style to change is determined. A set of “desirable criteria” are also determined and used to develop a reference condition of each River Style.
- *Step Two* assesses geomorphic river evolution as a way of identifying irreversible geomorphic change and reference condition. Four types of reference condition are identified:
 - Minimum anthropogenic disturbance, changes *reversible*.
 - Anthropogenic disturbance has occurred but remains *reversible*.
 - Indirect anthropogenic disturbance resulting in *irreversible* change.
 - Direct anthropogenic disturbance resulting in *irreversible* change.
- *Step Three* constructs a table of good, moderate and poor conditions reaches for each River Style within the catchment. This table provides a template for repeat surveys to determine levels of improvement and the geomorphic parameters that require management intervention.

Stage Three: Assessment of the future trajectory of change and the geomorphic river recovery potential.

This stage identified the potential future trajectory of change within a reach and the potential for recovery.

- *Step One* positions each reach on the evolutionary sequence for that River Style and determines the trajectory of change for each reach in the catchment (i.e. is it degrading or restoring?).
- *Step Two* assesses the recovery potential for each reach and places them within their catchment context and assesses limiting factors to recovery.

Stage Four: Catchment-based vision, target conditions and management scenarios.

Here the information gathered in the first three stages is used to identify target conditions for river rehabilitation within the different River Styles and establishes a “catchment vision” and prioritization of management efforts.

- *Step One* Collaborate with all relevant stakeholders to determine a physical catchment framed vision for a river course over a long time frame (50-100 years).
- *Step Two* determine the types of management interventions required. Develop short and medium term target conditions.

- *Step Three* Priorities reaches according to conservation/rehabilitation status and develop a catchment-wide program.
- *Step Four* Monitor and audit adjustments to geomorphic river condition

4. River Styles and Biota

The potential linkages between River Styles and biota arise from the expected correlations between biological communities and physical habitat (Thomson et al., 2001, Chessman et al., 2006). A Study in the Bega River (Chessman et al., 2006) has shown correlations existed between assemblages of diatoms, aquatic and semi-aquatic macrophytes, aquatic macroinvertebrates and fish and River Styles. However, for diatoms and fish, differences between River Styles could have been attributed to geographic clustering of sites in the same River Style. For fish there was an overriding influence of altitude variation in water temperature and distance from the ocean.

The linkages between River Styles and aquatic biodiversity conservation are still to be fully developed but linkages between fish biodiversity and physical habitat are well established. However, distribution of fish species within a catchment may be influenced by a number of other abiotic and biotic factors including altitude, temperature, water quality, passage requirements, interactions with alien species etc. Results of fish surveys (preferably conducted over a full seasonal cycle), together with existing knowledge of the life history requirements of the species concerned, should be used to assist in selecting potential demonstration reach sites.

5. Where has the River Styles Framework been implemented?

According to the River Styles website (www.riverstyles.com), over 150,000 km of stream length have been “river styles” in New South Wales including 90% of all streams greater than 3rd order. Over 60 River Styles have been identified. It has been used to develop links with habitat availability, river health, aquatic ecosystem structure and function and water management. The Department of Primary Industries (Office of Water) and New South Wales local land services have used River Styles as a basis for river rehabilitation, water flow planning and ecological surveys. The framework has also been used in Queensland, South Australia, Victoria and Tasmania. Overseas it has been used in New Zealand as well as the USA, Europe and China. Details of its implementation in the Bega catchment NSW can be found in the E-book (Fryirs and Brierly, 2005) which can be downloaded from the River Styles website.

6. River Styles Framework and the Demonstration Reach Model

A broad comparison between the River Styles framework and the Demonstration Reach model is shown in Table 1. Key Points are listed below:

Similarities

- Both have a high level of community involvement.
- Both develop a vision and have long-term goal setting and planning.
- Both are compatible with existing tenures and management.
- Both involve long-term monitoring.

- Both have reach scale interventions.

River Styles Framework advantages

- Provides an assessment of the geomorphic structure of the river and thus provides knowledge of how the river is behaving now and into the future.
- Provides a catchment-wide assessment of river geomorphology.
- Prioritises reaches for conservation and rehabilitation.
- Better adoption than demonstration reach model.

Demonstration Reach Model advantages

- Rehabilitation activities designed with knowledge of fish biology.
- Hypothesis testing in relation to impacts of rehabilitation activities on fish.
- Rehabilitation activities go beyond instream habitat interventions to include biological interventions (e.g. alien fish control).

7. Conclusions

The River Styles Framework and the demonstration reach model are highly compatible.

The framework offers two key components missing from the Demonstration Reach model, namely a whole of catchment assessment of river condition and a geomorphological framework to enable understanding of river behaviour. Where River Styles assessments have been undertaken and priority river reaches have been identified, the Demonstration Reach model can be used to assist implementation of management interventions along these reaches. Fish can be used as a “hook” to engender community interest and involvement.

The Demonstration Reach Model can be used to add to the knowledge gained from the River Styles approach by overlaying biological data over the physical monitoring and in the longer-term help assess the relevance of different River Styles to fish biology.

However, surveys (preferably “whole of catchment”) of fish communities and knowledge of the life history requirement of fish species remains essential when selecting demonstration reach sites.

Fig. 1 Hierarchical basis of River Styles Framework (modified after Thomson *et al.* 2001)

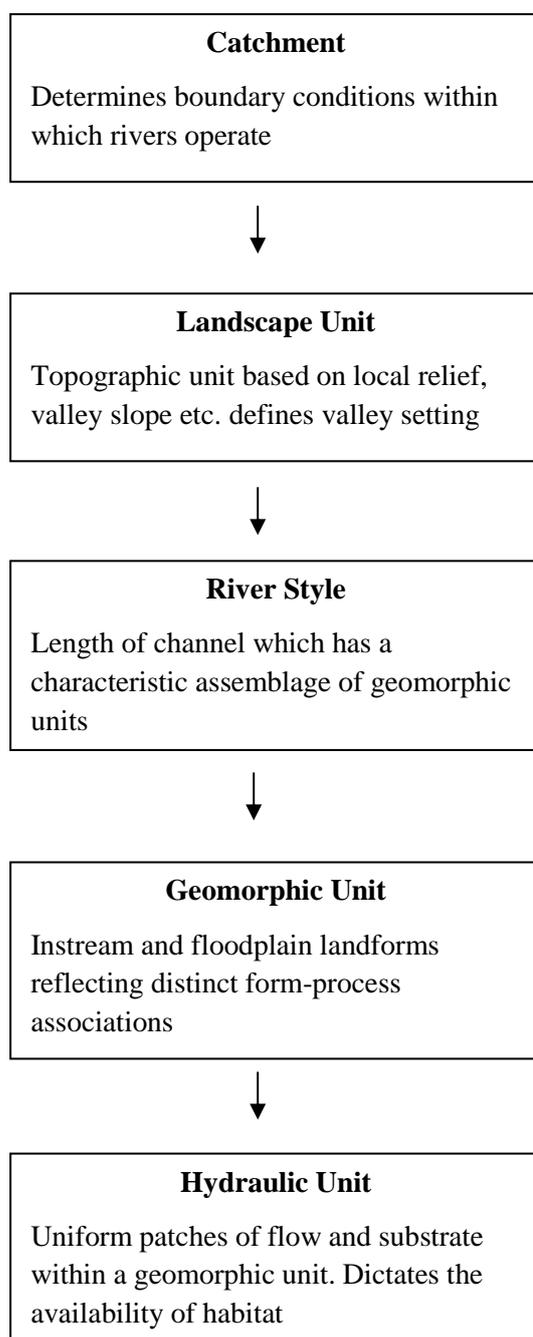


Fig. 2 Four Stages of River Styles Framework (modified after www.riverstyles.com. and Brierley *et al.* 2011)

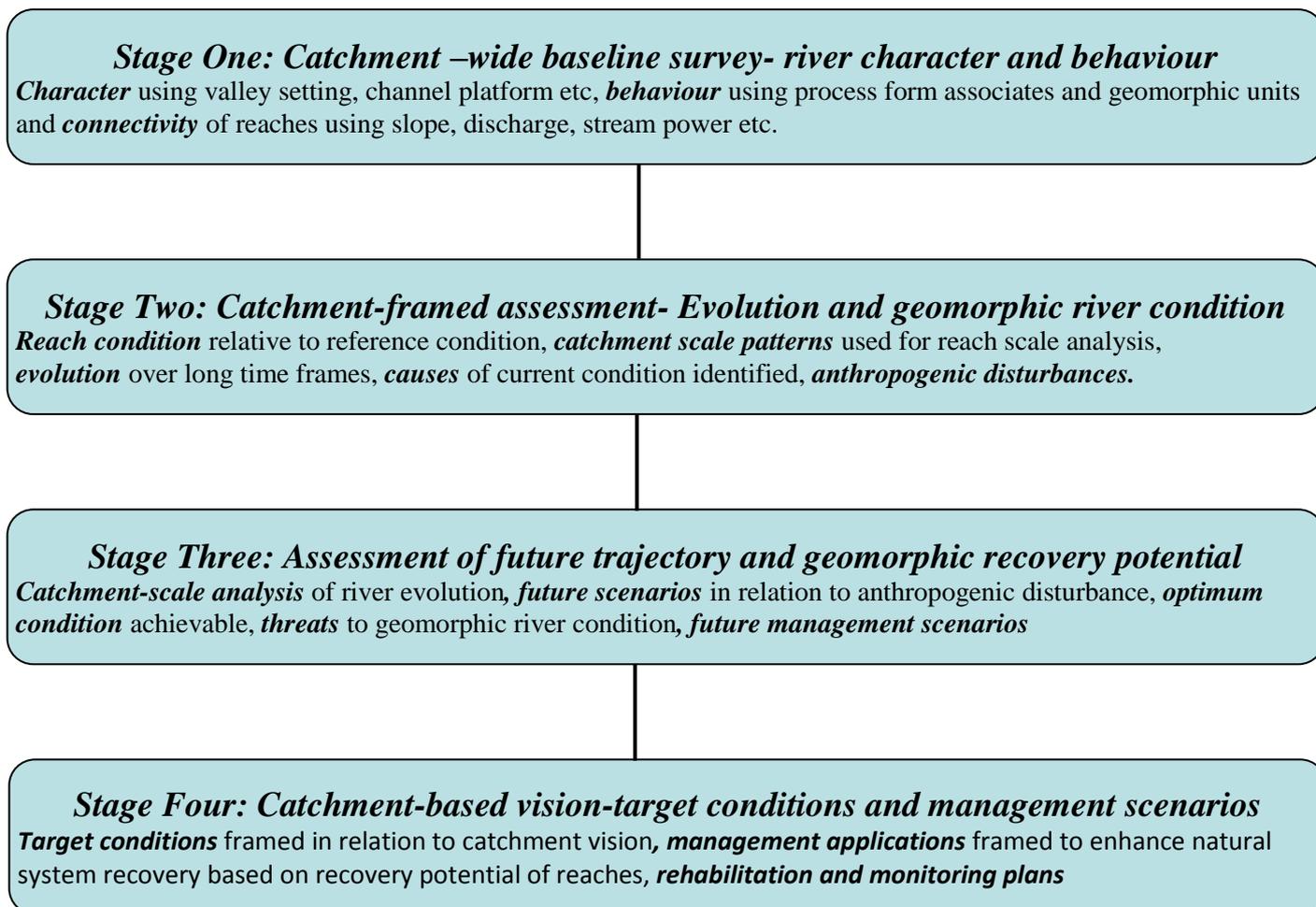


Table 1. Comparison of River Styles Framework and Demonstration Reach Model.

		River Styles	Demonstration Reach
Scale	<i>Whole of Catchment</i>	A “whole of Catchment” approach allows River Styles framework to be used for catchment-scale information management and rehabilitation decision making.	Catchment-scale issues are considered particularly in relation to fish biology (e.g. migration etc.) but not in a structured way.
	<i>Reach scale</i>	Reach scale used for management intervention related to rehabilitation but prioritized in relation to knowledge of River Styles within the whole catchment.	Fundamentally a reach scale model where multiple interventions are undertaken to rehabilitate fish habitat. Reaches vary considerably in length varying from about 20km up to about 200km. Longer Demonstration Reaches are likely to encompass a number of River Styles. Size of reach based on likely impact on native fish populations.
Basis	<i>Geomorphic structure of the river</i>	Based on fluvial geomorphology principles and provides a catchment-wide coherent physical template for rehabilitation activities.	Does include any existing geomorphological information in development of “whole of Life” Plans (e.g presence of sand slugs upstream of potential demonstration reach etc.). However geomorphological understanding of the type of river is not formally incorporated.
	<i>Biota</i>	Provides a physical template upon which biophysical processes can be overlaid.	Driven largely by knowledge of fish biology and physical and biological factors that require rehabilitation to positively impact on fish populations.
Community Involvement	<i>Stakeholder Involvement</i>	Consultation and collaboration with all stakeholders in developing catchment	High level of stakeholder input throughout from choosing a demonstration reach site through to

		framed vision, developing management priorities and priority reaches for action.	rehabilitation programs etc. Steering and Community Consultative Committees formed.
Planning	<i>Vision and Planning</i>	Includes catchment-framed vision over a long-term timeframe with short and long-termed targets and identification of priority reaches and management actions.	Development of Whole of Life Plan for demonstration reaches including vision. Development of Implementation Plan and Communication and Engagement Plan.
	<i>Compatibility with existing tenures and management</i>	Has proved highly compatible with existing management in NSW and is providing a physical template for a wide range of management activities.	Part of the selection of a demonstration reach site is a requirement for compatibility with existing tenures and management. Chances of success are much greater if the demonstration reach can build on existing management activities (e.g. riparian zone management etc.)
Rehabilitation	<i>Reach Scale Rehabilitation</i>	Rehabilitation works largely undertaken at the reach scale to rehabilitate physical attributes compatible with physical river behaviour.	Rehabilitation works at reach scale to benefit fish populations. Varies from physical instream habitat (e.g. snag replacement) to reducing impacts of artificial barriers to fish movement (installation of fish ladders) to reduction of impacts of alien species.
	<i>Multiple interventions</i>	Yes depending on interventions required.	Yes, a prerequisite of choosing a site is to be able to demonstrate the Impacts of undertaking multiple management interventions simultaneously’
Monitoring and Evaluation	<i>Monitoring and Evaluation</i>	Yes, short-and long-term monitoring of physical attributes.	Yes, development and implementation of a monitoring and evaluation plan of the response to of fish populations to river rehabilitation. Includes developing hypotheses, conceptual models and both condition (reach scale) and

			intervention monitoring.
	<i>Transferability</i>	Yes, allows results to be compared across the same River Styles.	Allows for transferability of learnings related to rehabilitation methodologies and impacts on fishes to other reaches but lacks the geomorphic platforms developed in the River Styles approach.
	<i>Adoption</i>	Widely adopted across NSW and some other states. Now well established as a useful technique for managing physical river rehabilitation.	There are seven demonstration reaches across the Murray-Darling Catchment but currently not widespread adoption.

1. References and Further Reading

Website

A comprehensive outline and methodology for the River Styles Framework can be found on the following website: www.riverstyles.com

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