

**TECHNICAL REPORT** Science Group

# Natural character assessment guidelines for braided rivers

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June 2018



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## Summary

**Background:** Statutory documents require that the natural character of braided rivers be assessed when applying for resource consent within the environs of the river. To assess the natural character of a braided river it is necessary to compare the natural state of the system with the current condition.

**The problem:**

Previously there was no suitable assessment tool with which to make an assessment of natural character specifically for braided rivers. Hughey & Baker (2010a) provided a tool for the general assessment of predominantly single channel rivers, but due to the dynamic structure and processes of multi-channel braided rivers the tool was not entirely appropriate.

**What we did:**

We adapted the 'Marlborough Tool' (Hughey & Baker 2010a) to suit braided rivers by retaining the general format, but providing definitions of braided river specific characteristics and altering assessment criteria and thresholds accordingly.

**What we found:**

The new tool retains the scoring format and scale of Hughey & Baker (2010a) such that the narrative descriptions of 'naturalness' remains the same. However, caution should be exercised when comparing the natural character values of rivers assessed with the two different methods. Natural character assessed by experts from different disciplines, such as ecologists and landscape architects, may differ slightly in methodology and results. It is likely that landscape architects also consider perceptual aspects of natural character in addition to scientific attributes outlined in this report.

**What does it mean?**

The adapted natural character assessment tool provides the necessary definitions and a framework with which to consistently assess the natural character of braided rivers. This will make the process of applying for and assessing resource consents around braided rivers simpler, more consistent, and more efficient.



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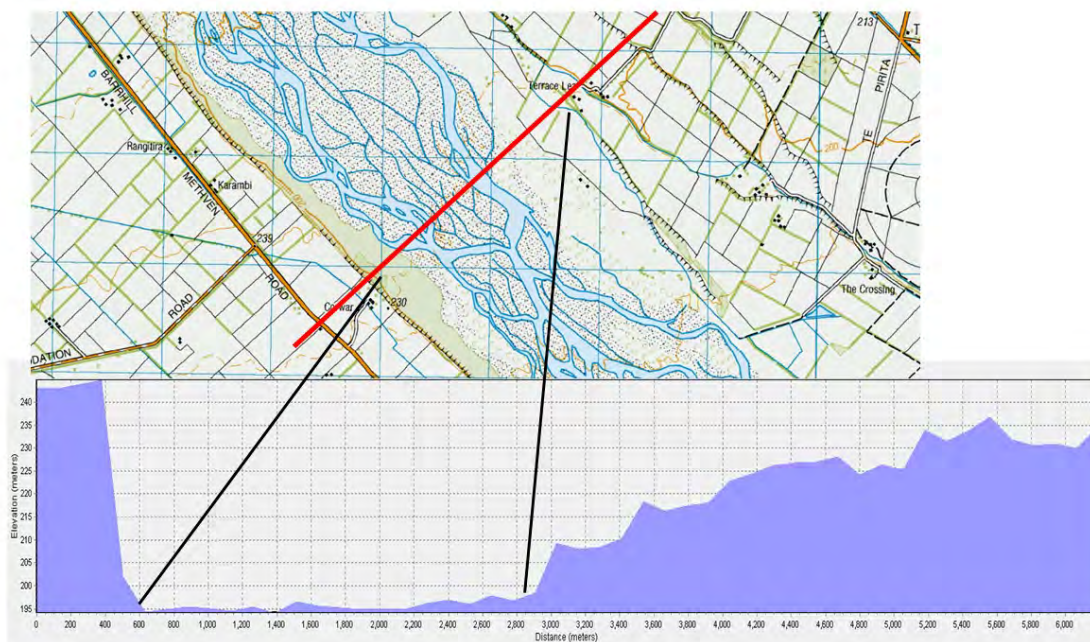
# 1 Introduction

The natural character of braided rivers is referred to by the Canterbury Water Management Strategy, Canterbury Regional Policy Statement and the Land and Water Regional Plan. To assess the natural character of a braided river it is necessary to compare the natural state of the system with the current condition. However, previously there has been no specific guidance for the assessment of the natural character of braided rivers. Available resources cater for rivers in general (e.g. Hughey & Baker 2010a, Hughey & Baker 2010b, Martin *et al.*, 2010), but because braided rivers work in a very different way to single-channel watercourses, specific guidance for assessing them is required. This guidance is intended for use by resource managers, landowners, consent applicants and their consultants.

This guide is envisaged to replace the Marlborough tool (Hughey & Baker 2010a) when assessing natural character of braided rivers in Canterbury. The attribute clusters defined by Hughey & Baker (2010a) consider the active river channels separately from the riparian zone. However, in a braided river the active channel of the river is constantly moving across the breadth of the river braidplain, resulting in the riparian zone and channel in a braided river being interchangeable. It is important to note that while 'braidplain' is the scientific term for the natural extent of braiding of a braided river it is not necessarily the same as the Resource Management Act (RMA) definition of the bed of a river. The braidplain may extend beyond the RMA riverbed and beyond the limit of actively eroding river gravels or river control infrastructure such as stop banks.

This is important to consider, for example, when assessing the impact of structures and modifications. A stop bank or groyne on a braidplain might be considered under either the 'channel' or 'riparian' attribute clusters using Hughey & Baker (2010a) depending on the current location of the wetted channels. However, in a braided river such a structure should be considered in terms of its effect on both the channel and riparian zone (the braidplain), including the historic extent of both and the potential for the two to be interchangeable.

This natural character assessment guide focusses on morphological and ecological attributes that can be identified in a largely objective manner. Perceptual aspects of natural character, which may be perceived differently by various parts of the community, have not been included in this assessment methodology.



**Figure 1-1: Aerial photo of the Rakaia River showing the extent of the braidplain which has been delineated using high resolution contours based on LiDAR data and an elevation profile**

Determining the extent of the braidplain is critical to undertaking this assessment of natural character and is discussed in further detail in Section 3. In addition, the reader is encouraged to explore the worked examples at the end of this document. Figure 1-1 provides an excerpt from the worked examples where high-resolution contour data has been used to determine the lateral extent of the braidplain. The natural difference in elevation between the braidplain and surrounding landforms may be as little 2-4 m, but will typically take the form of a continuous edge or terrace rather than a discrete high point such as an island. Lobes of gravel and islands in the braidplain may aggrade to quite some height relative to the active surface, but typically less than 4 m. Individual elevation profiles will also often show flood banks and localised mounding and so it worth generating several profiles and also inspecting any available high resolution contours. If you are unsure about how to determine the braidplain extent contact Environment Canterbury Customer Services.

## 2 What is natural character?

The term 'natural character' is referred to throughout Environment Canterbury policies, plans and strategies and with respect to rivers incorporates:

- Water quality
- Water quantity
- Bed substrate
- Natural processes (movement of sediment, water and biota)
- Natural life-supporting capacity
- Ecosystems and biodiversity
- Landscapes and landforms

In many cases we already assess some of the component factors of natural character, but don't consider them in terms of natural character, i.e. water quality and quantity, biodiversity, etc. This guideline method attempts to assess overall naturalness of a braided river by amalgamating several factors. The application of natural character assessments to braided rivers are particularly helpful because these systems are so complex and dynamic. If the broad appearance of the river is intact many of the features incorporated by 'natural character' will be intact.

Natural character can be assessed on a continuum of modification that describes the expression of natural elements, patterns and processes (or the 'naturalness') in a landscape/ ecosystem where the degree of 'naturalness' depends on:

- The extent to which natural elements, patterns and processes occur and are legible;
- The nature and extent of human modifications to the landscape, riverscape and ecosystems;
- The fact that the highest degree of natural character (greatest naturalness) occurs where there is least modification/ uncluttered by obvious or disruptive human influence; and

When assessing natural character consideration should be given to whether:

- Elements are a product of nature or of human construction e.g. native plant communities will be strongly natural whereas stopbanks and groynes would not.
- Patterns in the composition of elements e.g. trees planted in straight lines with geometric boundaries will be less natural in appearance than the same plants occurring in natural patterns following the topography and soil types. Artificial structures may also vary in their appearance i.e. depending on their shape and materials.
- The naturalness of processes underpins elements and patterns. The modification or replacement of natural processes such as erosion, deposition, plant succession and so on with human processes e.g. cultivation, flood control, dewatering will result in reduced natural character.

### 3 Braided form and function

Braided rivers are physically characterised by having a number of channels separated by bars and islands that look from the air to have the intertwining effect of a braid (Lane, 1957). However, this description only incorporates the recently active surfaces of the river when in fact these rivers are also characterised by their tendency to migrate across a wider area known as a braidplain. Our definition of a braidplain is 'the area of land covered currently and historically by the active river surfaces within the current hydrological and geomorphic context in the absence of flood defences or invasive weeds'. This is quite distinct from the area of land that may be inundated by a flood, or floodplain and may also be different to the area considered to be included under the RMA definition of riverbed. A braidplain incorporates the area inundated, but also the potentially wider breadth of land across which the active surfaces may migrate over tens to hundreds of years. The braidplain is not necessarily inundated in its entirety, even during large floods. A braidplain may be constrained within the terraces of an older alluvial plain, such as the Canterbury Plains, or by the bedrock flanks of a confining valley (Shumm, 2005).

**The braidplain is the area of land covered potentially, currently and historically by the active river surfaces within the current hydrological and geomorphic context in the absence of flood defences or invasive weeds**

Figure 3-1 shows the movement of the active surfaces across the braidplain and the turnover of aquatic and terrestrial habitats that occurs over time. Across the entire braidplain there are many different types of ecological habitat: from stable spring streams to flood prone main channels; from mature forested islands to bare gravels (Gray & Harding, 2007). All of the habitats found across the braidplain have their own distinct character and together contribute to the very high biodiversity values associated with braided rivers. The active surface of the braided river moves back and forth over the braidplain destroying and re-creating habitats as it goes. Cycles of aggradation and degradation can occur at various scales and timescales, for example sediment supply can be influenced by large seismic events that can make large quantities of sediment available for the river to transport.

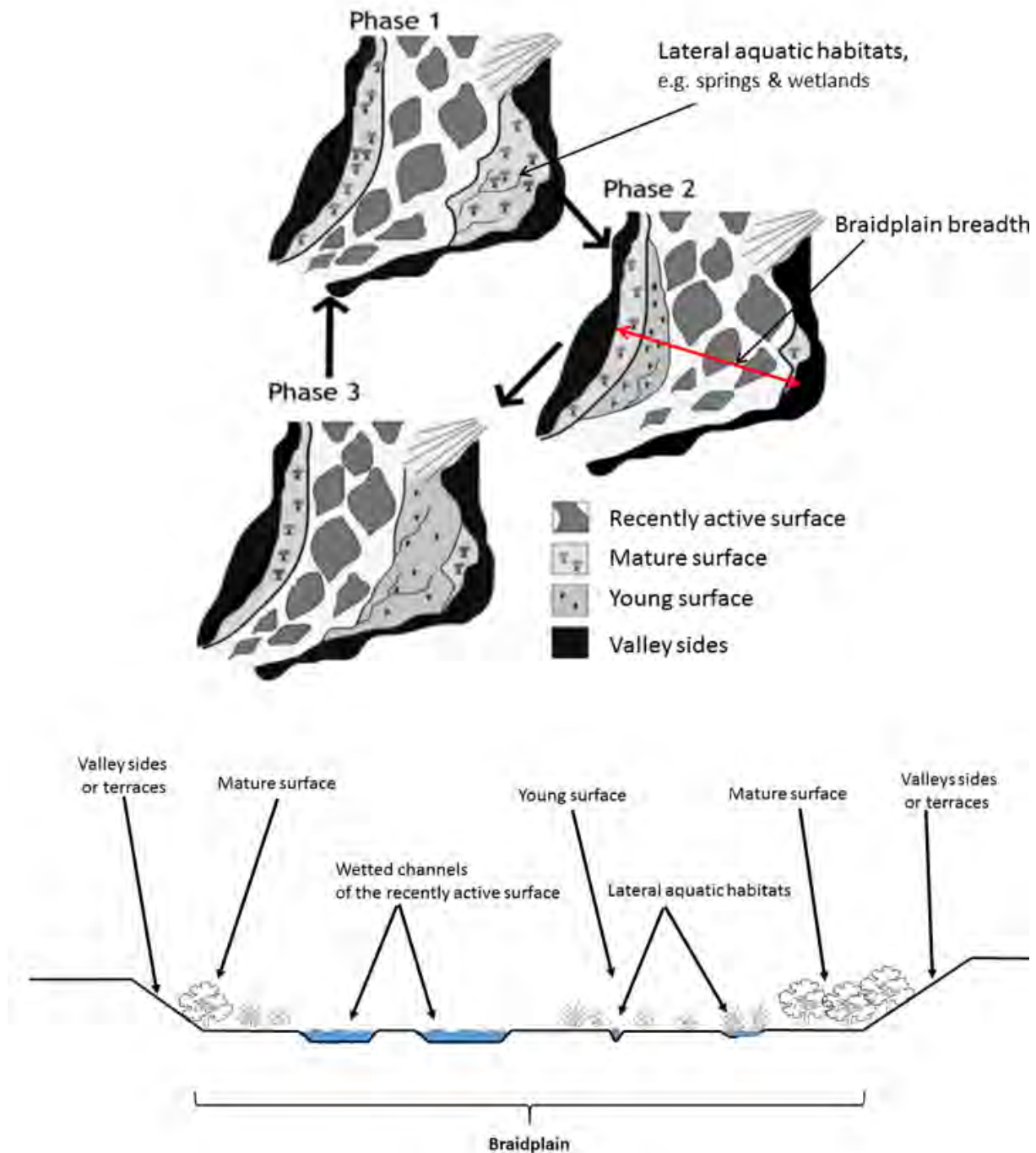


Figure 3-1: Top. Schematic of a braided river showing the full extent of the braidplain and migration of the recently active surface over time. Adapted from Reinfelds & Nanson (1993). Bottom. Transverse view of a braided river showing the recently, active, mature and young braidplain surfaces of phase 3 as a component of the entire braidplain over which the recently active surface may travel

River braiding is primarily controlled at two spatial scales; the catchment and the reach. At the catchment scale, braiding is regulated by the magnitude and frequency of high energy flooding and an adequate supply of sediment. Orographic rain and the erodible nature of the Southern Alps provides these conditions in Canterbury (Griffiths, 1979 a, b; Duncan & Woods, 1992; Mosely, 2004). At the reach scale braiding is regulated by the available width of the flat valley floor. Braiding cannot occur within a river channel incised into bedrock (natural state) or can no longer occur when confined between stopbanks or erosion resistant vegetation (man-made modification). Other reach scale conditions such as the valley slope and vegetation communities also combine to determine the precise character of any braidplain (Gray *et al.*, 2016).

## 4 Natural character assessment

In order to assess the natural character of a braided river system the current state of the river has to be assessed against the inferred natural state of the river under the methodology outlined in this report. In order for this to occur the original braidplain extent must be identified, so that the man-made modification to the geomorphology of the braidplain can be determined. Bearing in mind the above description of braided rivers, an assessment of natural character requires an adjustment to the attributes and attribute clusters of Hughey & Baker (2010a). This guideline suggests that the following attribute clusters are more applicable to the braided riverscape (Figure 4-1);

**Braidplain:** This is the area of land potentially covered currently and historically by the active river surfaces irrespective of human modification such as stopbanks.

**Aquatic environments:** The current location of the active river channel and any lateral aquatic habitats such as creeks, springs, wetlands and ponds. Attributes relating to water and habitat quality and exotic aquatic flora should be considered.

**Wider landscape context:** This considers the river in its wider landscape setting and looks at land use and broader geomorphic qualities that contribute to the river's natural and landscape character. It is acknowledged that the wider landscape, particularly its land use may be influential to a river's degree of natural character.

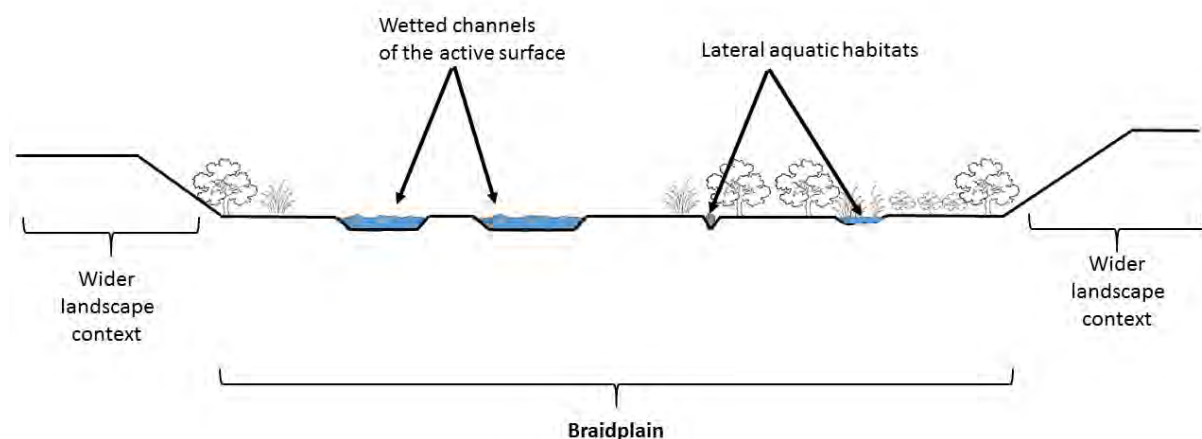


Figure 4-1: Diagram illustrating the 3 river attribute clusters

In accordance with the format of Hughey & Baker (2010a) the assessment of braided river natural character uses eight primary attributes (Table 4-1) and within each attribute a five point scale to rank the attribute on a continuum of naturalness from 1 (heavily modified) to 5 (overwhelmingly natural) (Table 4-2). Half scores are acceptable when a situation cannot satisfactorily be put into either absolute category. The attribute descriptions in Table 4-1 and Table 4-3 have been changed to suit braided rivers

although many of the primary indicators and data sources for river information remain the same as in Hughey & Baker (2010a).

The critical first step in an assessment is to determine the width or extent of the natural braidplain, i.e. in the absence of human modification or invasive weeds. This will provide the context for the assessment of man-made modifications to the natural morphology and breath of the river. There is guidance for this process in the worked examples (Appendix 1), however it is recommended in the case of any doubt that the applicant contact Environment Canterbury Customer Services for support.

**Table 4-1: Attributes and attribute clusters used for the assessment of natural character in braided rivers**

Braided river specific	
River attribute clusters	Primary attribute
Braidplain	Braidplain breadth
	Structures and human modification
	Vegetation cover
	Degree of flow regime modification
	Active surface channel shape
Aquatic habitats	Water and habitat quality
	Exotic aquatic flora and fauna
Wider landscape	Landscape character modifications

The maximum score a river can achieve is 40 and the lowest is 8. Because the number of attributes and scoring scale of Hughey & Baker (2010a) has been retained, the naturalness categories presented therein are assumed to be appropriate for braided rivers (Table 4-2). Therefore, comparing naturalness scores between different braided rivers is a straightforward comparison of categories and scores. However, comparisons of naturalness scores between braided and non-braided rivers or the same river using Hughey & Baker (2010a) and this guide should be made with caution.

**Table 4-2: Naturalness categories and scores**

Naturalness categories	Score ranges
Very high levels of natural character	35 - 40
High levels of natural character	29 -34
Moderate levels of natural character	23 – 28
Low levels of natural character	17 - 22
Very low levels of natural character	Up to 16

Assessments should be made at two spatial scales; the river reach and the individual property. Along their length rivers may show a diversity of types shifting between braided and single channel for example. However, it is typically possible to identify a reach or section of river that has the same broad characteristics, i.e. braided or gorged (See Appendix 1 for worked examples). This is a river reach and the natural character should be assessed initially at that scale to provide context for a property or resource consent scale assessment. As a result it will be possible to describe the degree to which the river along a property is representative of the wider river reach. In addition to providing a wider landscape context to an assessment of natural character, the dual assessment provides information on the potential accumulative effects of many small modifications to a braided river in addition to the modification being proposed. It is important to describe at some point the extent of river being considered under both the reach and property scale assessments using a map.



Table 4-3: Assessment criteria, descriptions, indicators and data sources

Attribute cluster	Attribute	Description	Indicator	Indicator significance threshold	Data sources
Braidplain	Braidplain breadth modification	<p>Modification to the available breadth of the braidplain cross section for active channel migration (e.g. stop banking, groynes, strategic planting, or invasive weeds).</p> <p>For comparison, the extent of the natural braidplain may be demarcated by alluvial terraces or significant changes in soil type (see worked examples in Appendix 1).</p>	Assessment of braidplain width or constraint. Location of stopbanks, groynes, strategic planting, invasive weeds or other un-natural constraints on lateral migration of the active surface.	<p>Judgement made on a five-point scale:</p> <p>1= Very highly modified braidplain, i.e. active surface straightened and channelised, while wider braidplain has undergone urbanisation or land use intensification. Effective braidplain significantly reduced.</p> <p>2= Highly modified, but with semi natural braided reaches in some areas; remnant patches of braidplain. Braidplain narrowed by at least 1/2</p> <p>3= Braidplain displaying a longitudinal patchwork with moderate natural character in places together with many human influences such as long stretches of stopbanks, groynes, weed invasion, strategic planting or agricultural encroachment; Braidplain has been narrowed by ~1/3</p> <p>4= A highly natural braidplain displaying occasional pockets or individual minor modifications to its channel shape (i.e. small stopbanks or groynes); Limited narrowing of the braidplain.</p> <p>5= A very highly natural river with no or very few modifications to its channel shape or braidplain width.</p>	Regional and local Councils, resource consents, soil or geological maps, aerial photography or maps showing vegetation, river cross-sections, high resolution topography data. Draft riverbed lines. Site visits
	Structures and human modifications in the braidplain	Includes dams, groynes, diversions, gravel extractions, irrigation infrastructure, roads, bridges, transmission lines or boat ramps.	Occurrence of structures or modifications	<p>Judgement based on a five-point scale:</p> <p>1= Braidplain completely modified or artificial (i.e. by a dam, weir or flood defence structure);</p> <p>2=Significant parts of the braidplain have been affected or encroached upon by human intervention (i.e. suburban/highly managed agricultural land, including: gravel workings, part channelisation)</p> <p>3=Occasional 'reaches' with human modifications (i.e. a settled rural landscape with bridge/ aqueduct supports, pylon footing)</p> <p>4= Limited human intervention (i.e. occasional bridge abutments/ power pole within the river channel);</p> <p>5=Overwhelmingly natural with no/ very limited evidence of human interference</p>	Regional and local Councils. Aerial photography, maps, designs, drawings, site visits.
	Vegetation cover of the braidplain.	Dominance of native communities in natural patterns. The presence of exotic species in natural patterns will reduce	Proportion of native vegetation against other vegetation.	<p>Judgement based on a five point scale:</p> <p>1= Absence of vegetation occurring in natural patterns due to human induced changes or limited presence (in pockets) of managed exotic vegetation;</p>	Regional and local Councils. Aerial photography or maps showing vegetation.



Attribute cluster	Attribute	Description	Indicator	Indicator significance threshold	Data sources
		natural character, but is of higher naturalness than managed vegetation or plantings. The assessment includes all braidplain vegetation such as cushion communities, grasses, scrub and trees at any location in the braidplain. In some instances, the natural elements and patterns indicate limited vegetation cover would be natural (i.e. high country rivers), where native grasses or herbs are the only form of vegetation in the area. Proliferation of exotic flora reduces natural character.	Extent to which river processes have generated natural vegetation patterns versus managed vegetation patterns.  % of exotic vegetation	2= Managed exotic vegetation with predominant absence of native species; 3=Predominantly exotic vegetation in natural patterns (i.e. willows/ gorse) and/ or patches of remnant indigenous vegetation; 4= Fragmented areas of native and exotic vegetation in natural patterns. Predominance of native vegetation; 5= Overwhelmingly indigenous vegetation with no or few introduced species.	GIS databases, site visits.
	Degree of flow regime modification	The flow regime characteristics of a river with a given catchment size and location	Occurrence of impoundments or large diversions of flows particularly flood harvesting. Proportion of flows diverted or impounded. Change to critical flow statistics relative to naturalised flow. Proportion of available allocation abstracted.	Judgement made on a 5 point scale: 1=Very highly modified or diverted flow/water take (e.g. large-scale dams and diversions that drastically alter flood, fresh and low flow statistics relative to natural flows. Surface water takes over-allocated. 2=Highly modified or diverted flow (e.g. small scale dams, substantial flood harvest irrigation takes or flood bypass channels. Surface water takes at or close to allocation. High level of alteration to flood, fresh and low flow statistics relative to natural flows. 3=Moderately modified or diverted flow (e.g. several irrigation takes taking a moderate proportion of 7DMALF or targeting flood flows. Moderate alteration of flow statistics. 4=Relatively low levels of modified or diverted flow (e.g. few irrigation takes taking a minor proportion of low surface water takes <50% of allocation, or no takes focussed on flood harvest. 5=Highly natural flow regime with no/very limited modifications to flow statistics.	Regional Council, NIWA or other water data. Aerial photography or maps. Flow plans and flow and allocation guidance documents
	Active surface channel shape	Modification to the breadth and braiding characteristics of the active surface. This includes the influence of river channel training through engineering, strategic planting, invasive	Extent of change to active surface profile	Judgement made on a five-point scale: 1= Very Highly modified active surface, (i.e. straightened and channelised, often with concrete or rock fill banks; 2= A highly modified channel shape or width but with semi natural reaches or channel shapes in some areas often	Regional council, NIWA, river engineers. Aerial photographs, river cross sections, changes in river width/ length and water

Attribute cluster	Attribute	Description	Indicator	Indicator significance threshold	Data sources
		weeds and vegetation removal but also changes to flow regimes through impoundment or abstraction. Changes to active surface sediment should be considered here.		<p>strategic planting and vegetation removal used to train the active surface.</p> <p>3= A river displaying a patchwork with moderate natural active channel shape in places together with many human influences such as long stretches of stopbanks, groynes, invasive weeds and strategic planting.</p> <p>4= A highly natural river displaying occasional pockets or individual minor modifications to its active surface shape (i.e. small stopbanks or groynes or occasional areas of invasive weeds);</p> <p>5= A very highly natural river with no or very few modifications to its channel shape.</p>	allocation resource consents (where available).
Aquatic habitats of the braidplain including both main channels and lateral habitats such as wetlands and spring creeks.	Water and habitat quality	Water quality; clarity, nutrient and bacterial levels etc. This should account for both the main channels of the river as well as lateral aquatic habitats if any (Including those outside of flood defences). Habitat changes due to fine sediment, stock trampling or choking by exotic trees/ shrubs	Water and habitat quality degraded. Compare water quality and ecological data to national and regional standards and river type statistics. Degree of connectivity between lateral habitats and active surfaces or ability of the active surface to migrate through or flood an area of braidplain and reset habitats.	<p>Judgement made on a five-point scale:</p> <p>1= Very highly contaminated or permanently discoloured water displaying very high levels of human induced changes to the water quality with limited life supporting capacity (e.g. within polluted urban/industrialised areas or intensive farming); Lateral habitats drained, removed or separated from the active channel.</p> <p>2=Water usually displaying high levels of contamination mainly from adjacent diffuse sources from land use activities (agricultural leaching etc); Lateral streams and wetlands are diminished in area, unnaturally silted and/or choked with exotic weeds. Lateral channels not exposed to lateral migration of flooding by the active surface.</p> <p>3=Water displaying reasonable levels of naturalness although contains occasional high-moderate levels of human induced changes to part of the waterway or at some times; Some impact to habitat quality but lateral habitats generally intact and subject to active surface migration and flooding.</p> <p>4=Water displaying relatively high levels of water quality with small or rare amounts of impurities caused further upstream (e.g. by occasional stock crossing or forest harvesting); Lateral habitats in good condition despite occasional stock ingress or exotic vegetation. Lateral habitats subject to active channel migration and flooding.</p> <p>5= Highly natural water and lateral habitat quality. Displaying no human induced changes.</p>	Regional Council, NIWA or other water data, Site Visits, Aerial photographs and reports.

Attribute cluster	Attribute	Description	Indicator	Indicator significance threshold	Data sources
	Exotic aquatic flora and fauna	Presence of exotic aquatic flora and fauna within the river channel or lateral habitats (including waterweeds, exotic fish, and invasive alga e.g. didymo) can reduce the natural character of the river. This does not include vegetation on 'islands' within the river channel. This is contained under 'braidplain vegetation'. Algal blooms may be evident in some rivers due to seasonal low flows. Expert ecological judgement will be required to assess extent and may have a bearing on the degree of naturalness of this primary attribute.	Occurrence of exotic aquatic flora and fauna	Judgement based on a five-point scale: 1=River system choked with exotic aquatic flora and fish communities dominated by exotic species 2= Large areas of introduced flora and fauna (including exotic fish) evident (in approximately 75% of river); 3=Occasional stretches (some quite long) of introduced flora and fauna evident within waterway (approx. 50% of river); 4=Small, often isolated pockets of introduced flora and fauna evident (less than 20% of total river), however river displaying very high levels of naturalness, Fish communities dominated by native species. 5=No evidence of introduced flora or fauna within the water channel.	Regional council and NIWA data bases, site visits
Wider landscape context	Landscape character modifications	Broader scale landscape modification beyond the immediate braidplain, leaching from agricultural land, intensification of land use, including urban areas, all impact on natural character. Protected natural areas such as reserves, parks and estates managed by Department of Conservation may indicate a higher natural character. Include catchment modifications if ecologically or visually linked to the waterway.	Extent of intensification of land use adjacent to braidplain (includes more distant views beyond braidplain).	Judgement based on a five-point scale: 1= Heavily modified landscape (urban or highly intensive setting) with limited natural vegetation; 2=Suburban/ highly managed agricultural landscape or large scale forestry 3=Settled pastoral landscape with areas of commercial forestry and pockets of indigenous vegetation; 4=Fragmented indigenous and rural landscape; 5= Overwhelmingly indigenous landscape with no or very little human modification	District or regional wide Landscape Assessments, Regional Council and NIWA databases

## 5 Acknowledgements

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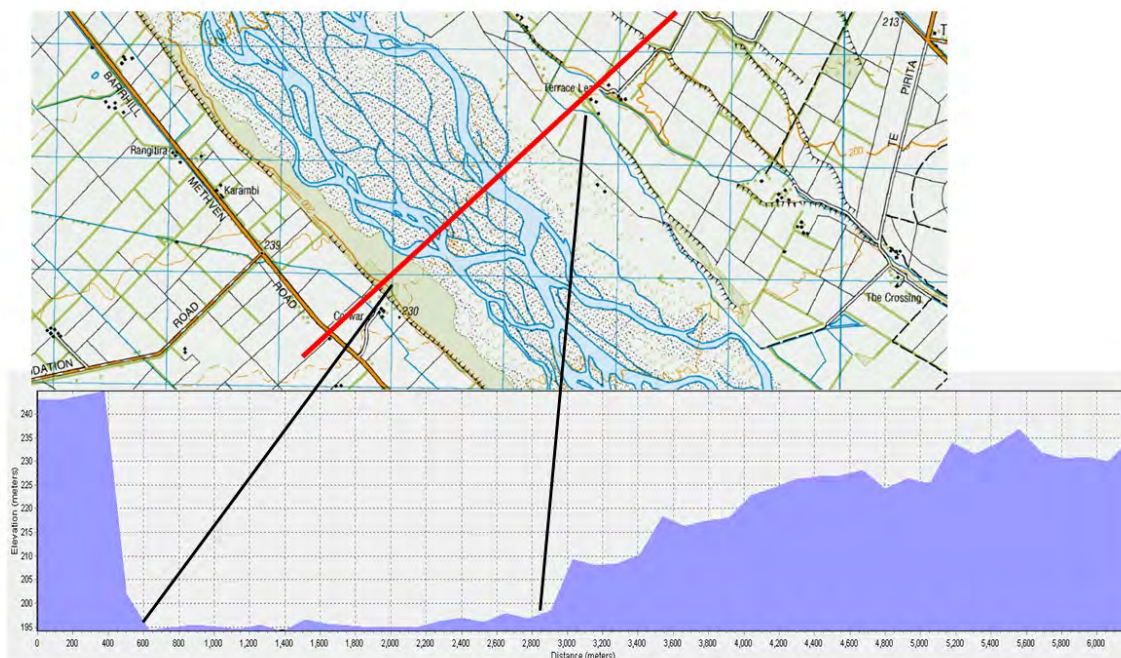
## APPENDIX 1: Worked examples

### A1.1 Introduction

Assessing the natural character of a braided river requires the integration of multiple sources of information. However, a critical first step is to identify the likely spatial extent or width of the braidplain, irrespective of land use or flood defences. This can be a difficult and controversial process, but the influence of this assessment to the rest of the process means it is worth spending some extra time. Technical experts at Environment Canterbury are available to assist with this assessment and can be contacted through [Customer Services](#).

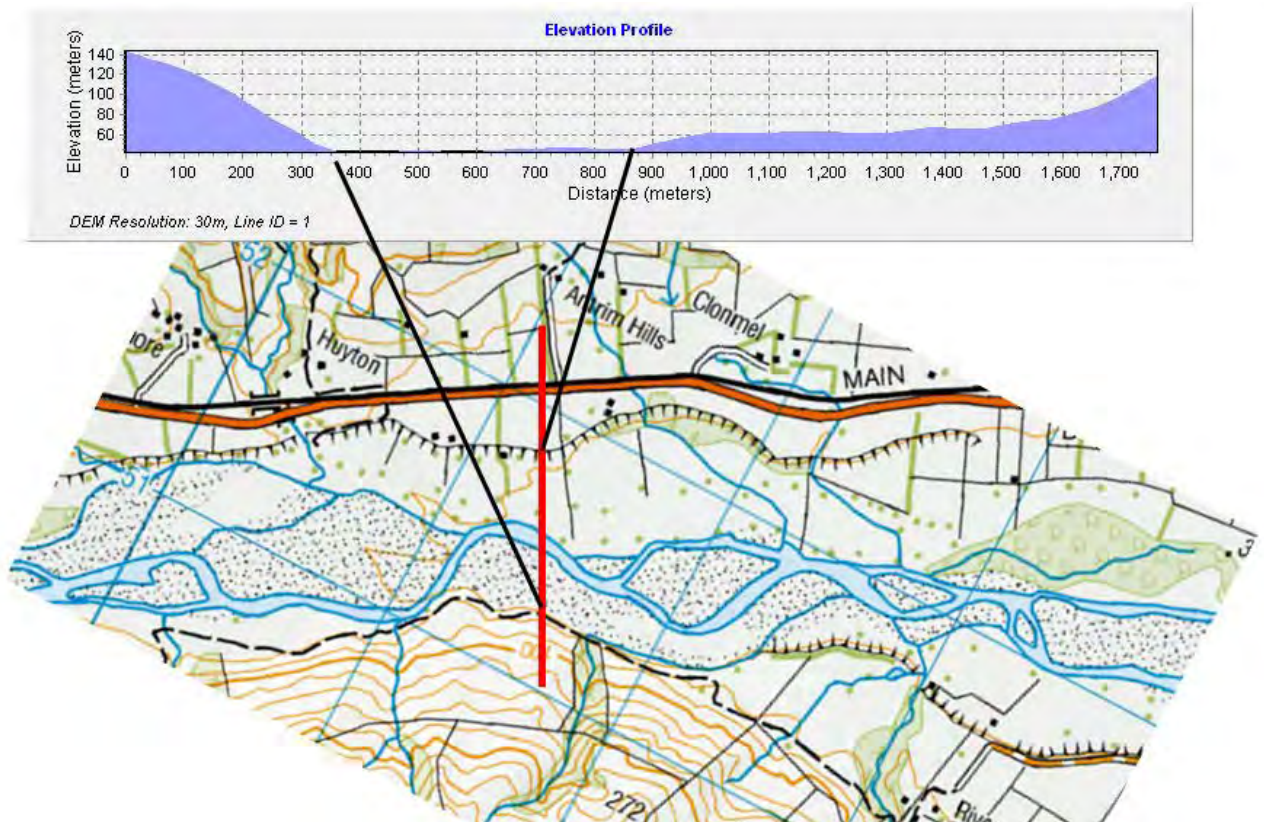
[Canterbury Maps](#) is an online mapping tool created by Environment Canterbury that can be used to generate elevation profiles from LIDAR or contour data that are very useful for assessing braidplains (Figure A-1 and Figure A-2). Topographic maps and aerial photographs or a site visit are also possible ways of determining the braidplain width. In the lower reaches of some rivers the braidplain may be many kilometres wide and rather than an absolute width users should estimate a reasonable width in the absence of constraints. Different users may arrive at various 'reasonable widths'. This is acceptable provided that width is clearly articulated in the assessment and illustrated on a map

Figure A-1 shows a reach of the lower Rakaia River that is constrained by natural terraces. Both the topographic map and elevation profile clearly show the width where the active channels might migrate in the absence of human intervention. This area would be subject to lateral migration of the active surface. Similarly, in Figure A-2, the braidplan of the Hurunui River can be determined using maps and elevation profiles. Other useful sources of information are soil maps which are influenced by the age and composition of soils. Braidplain soils are typically young and thin having being relatively recently worked over by the river.



**Figure A-1: Map and elevation profile of the Rakaia River at Steeles Rd. The profile line is shown in red and the black lines denote the outer edges of the braidplain**





**Figure A-2: Map and elevation profile of the Hurunui River at Dommett Rd. The profile line is shown in red and the black lines denote the outer edges of the braidplain**

The natural difference in elevation between the braidplain and surrounding landforms may be as little 2-4 m, but will typically take the form of a continuous edge or terrace rather than a discrete high point such as an island. Lobes of gravel and islands in the braidplain may aggrade to quite some height relative to the active surface, but typically less than 4 m. Individual elevation profiles will also often show flood banks and localised mounding and so it worth generating several profiles and also inspecting any available high resolution contours.

Once the width of the natural braidplain has been identified it is necessary to also determine the extent of the active surface. The active surface will show signs of being recently impacted by flood waters and channel migration, typified by early successional state vegetation or bare gravels. There may be islands of mature vegetation within the active surface. The water quality assessment then considers both aquatic habitats within the active surface and those found laterally on the wider braidplain.



## **A1.2 Rakaia River at SH1**

A worked example assessment of the natural character of the Rakaia River at Rakaia Township (Figure A3).



**Figure A-3: The Rakaia River at State Highway 1. The local section to assess is upstream of, and includes, the State Highway Bridge**

## **A1.3 Reach scale assessment**

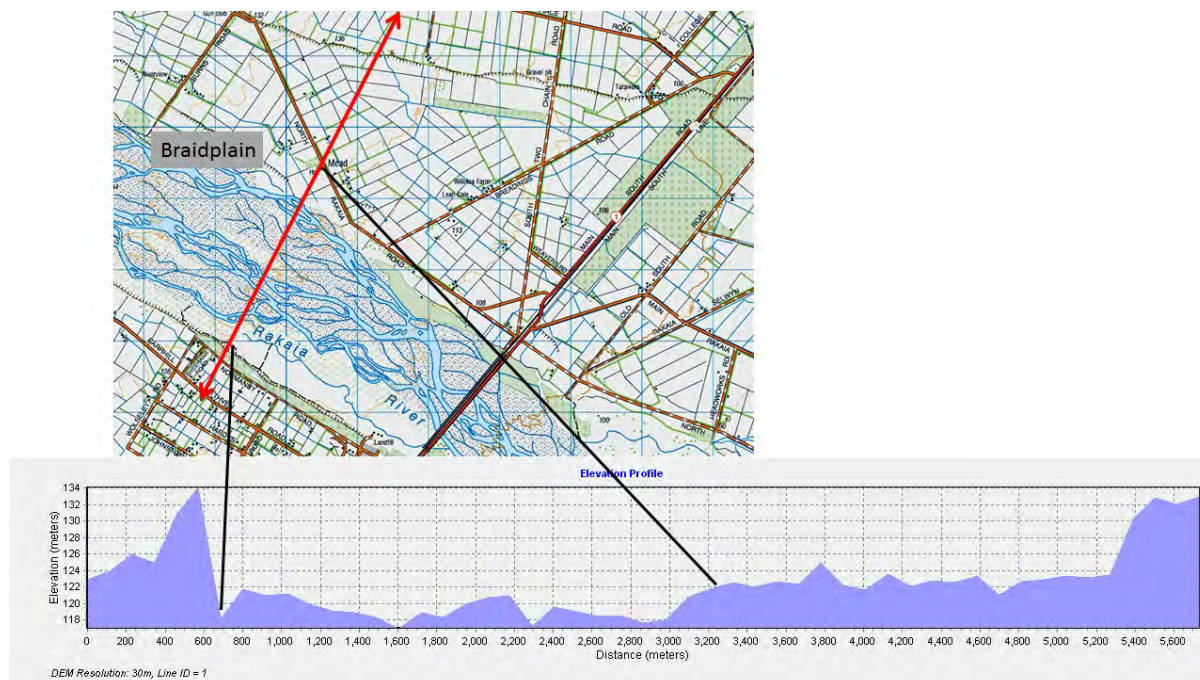
The reach of the Rakaia River under consideration is between the Gorge Bridge and the river mouth. Although the river does change in form and character between these two points the only substantial transition point is approximately at the assessment reach. Therefore, it was considered appropriate to assess the entire Canterbury Plains reach of river.

**Table A-1: Reach scale assessment of natural character in the Rakaia River**

Attribute cluster	Attribute	Data sources	Comments	Score
Braidplain	Braidplain breadth	Aerial photos, LiDAR, Topomap	This assessment considers the river reach between the gorge and the ocean. Upstream of SH1 the river is naturally constrained by alluvial terraces. However, there has been agricultural development within the braidplain. Downstream of SH1 the braidplain is naturally wider, but the active surface has been constrained to a greater degree to provide for farmland. Exotic weeds are the predominant vegetation type on undeveloped land throughout. There remain substantial areas of undeveloped braidplain particularly upstream of the Rakaia Island.	4
	Structures and human modification		Various structures and planting schemes exist along the length of the plains reach, however the river remains broad and clearly braided	4
	Vegetation cover		Vegetation cover is predominantly exotic weeds on undeveloped land. Occasional areas of remnant natives and regeneration occur throughout particularly on the Rakaia Island at Te Pirita.	3
	Flow regime modification		The Rakaia River is subject to considerable abstraction of both base flows and some flood harvesting. However, the large channel forming flows are mostly intact and the abstractions that do exist have been scrutinised through an RMA process. There is a Water Conservation Order in place on the upper Rakaia.	3
	Channel shape		Due to the flood prone nature of the Rakaia River the active surface appears quite natural being broad and subject to few interventions except where flowing channels approach the margins. There are considerable areas of invasive weeds in the active surface but these appear mostly sparse. However, it seems quite likely that the active surface would in places be wider in the absence of human intervention.	3.5
Aquatic habitats	Water and habitat quality	Aerial photos, LiDAR, Topomap, ECan water quality data	Along the entire reach of the braidplain there are numerous lateral habitats, particularly around Rakaia Island and associated with terrace springs further inland. However, many of these habitats are affected by land development. Main stem water quality is very good. Score reflects impacted lateral habitats	3
	Exotic aquatic flora and fauna		Didymo is present in the Rakaia River but rarely blooms due to frequent surface moving floods. Trout and salmon are common exotic fish, but there is adequate aquatic habitat across the braidplain to provide refugia for native fish	3
Wider landscape	Landscape character modifications	Aerial photos, LiDAR, Topomap	The apparent landscape of this reach of the river includes the Alps and the intensively developed plains. While the headwaters are predominantly natural the immediate surrounds of the river would constitute a highly managed agricultural landscape	2.5
Total				26 / 40

## A1.4 Local scale assessment

The local scale assessment considers the length of river ~1.5 km upstream from the SH1 Bridge (Figure A4).



**Figure A-4:** The Rakaia River upstream of the State Highway 1 Bridge showing the width of the braidplain based on LiDAR data. The red line denotes the elevation profile while the black lines show the extent of the braidplain

**Table A-2:** Local scale assessment of natural character in the Rakaia River.

Attribute cluster	Attribute	Data sources	Comments	Score
Braidplain	Braidplain breadth	Aerial photos, LiDAR, Topomap Site visit	LiDAR and topo map indicates a significant terrace on the south bank at the outer edge of the undeveloped land and a lower, less distinct terrace on the north bank ( <b>Error! Reference source not found.</b> ). There appears to have been some agricultural development of the braidplain on the north side. Strategic planting and earthworks are also present on the north bank. There is some agricultural development on the south side of the river but no obvious sign of flood defences. Exotic vegetation is well established throughout the braidplain especially willow along either side. Nonetheless there is a broad effective braidplain (~1.8km) with natural patterns.	4
	Structures and human modification		The State Highway and railway bridges represent considerable modifications as do flood defences particularly on the north bank. There are also two irrigation takes within the reach and numerous roads and tracks within the braidplain	3
	Vegetation cover		Vegetation cover of the braidplain ranges from exotic species in natural patterns to intensified farmland. Within the active surface there is sparse exotic vegetation which is bordered laterally by thick belts of trees, gorse and broom. This area is within a river rating district* and so vegetation within and adjacent to the fairway is managed to restrict the river to its current active surface. Thus, while there are considerable areas	2.5

Attribute cluster	Attribute	Data sources	Comments	Score
			of exotic vegetation in natural patterns, particularly on the north bank, vegetation is managed to constrain the river.	
	Flow regime modification		The Rakaia River is subject to considerable abstraction of both base flows and some flood harvesting. However, the large channel forming flows are mostly intact and the abstractions that do exist have been scrutinised through an RMA process. There is a Water Conservation Order in place on the upper Rakaia.	3
	Channel shape		Due to the flood prone nature of the Rakaia River the active surface appears quite natural being broad and appears to have few interventions except where flowing channels approach the margins. There are considerable areas of invasive weeds in the active surface, but these appear mostly sparse.	3.5
Aquatic habitats	Water and habitat quality	Aerial photos, LiDAR, Topomap Site visit	There do not appear to any obvious lateral aquatic habitats on the braidplain of this reach of the river and it may be that it is predominantly losing surface water to ground. Any lateral habitats that did occur on the north bank will either be within the flood defence areas or intensive farmland and potentially impacted. The water quality of the main channels of the river is very good being predominantly sourced from the Alps.	4
	Exotic aquatic flora and fauna		Didymo is present in the Rakaia River but rarely blooms due to frequent substrate moving floods. Trout and salmon are common exotic fish but there is adequate aquatic habitat across the braidplain to provide refugia for native fish.	3
Wider landscape	Landscape character modifications	Aerial photos, LiDAR, Topomap Site visit	The apparent landscape of this reach of the river includes the Alps and the intensively developed plains. While the headwaters are predominantly natural the immediate surrounds of the river would constitute a highly managed agricultural landscape and the SH and bridge are obvious modifications.	2
Total				25 / 40

\*River ratings districts are areas managed for flood risk by Environment Canterbury engineers.

## A1.5 Summary

The section of the Rakaia River directly upstream of State Highway 1 appears to have a slightly lesser degree of natural character than the rest of the plains reach due to the occurrence of structures in the braidplain and absence of remnant native vegetation. The braidplain adjacent to Rakaia township has been reduced on the northern bank by strategic planting whereas there exists a natural terrace on the south bank. Exotic weeds are common in the active surfaces although typically sparse. Bridges and numerous rough tracks occur on the active surface.



## A1.6 Opihi River at Pleasant Point

A worked example of an assessment of the natural character of the Opihi River at Pleasant Point (Figure A5).



Figure A-5: Opihi River immediately downstream of Pleasant Point

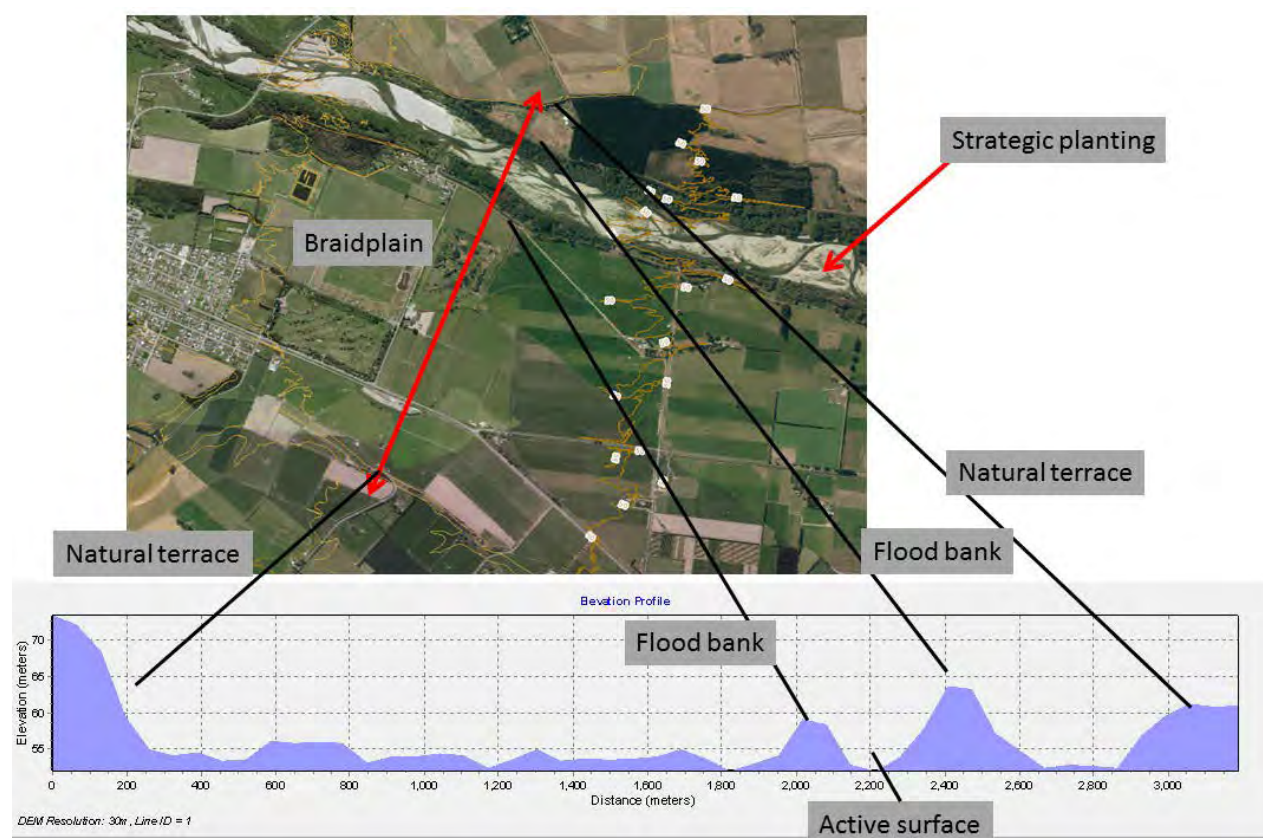


Figure A-6: Aerial photo of the Opihi River showing high resolution contours based on LiDAR data and an elevation profile



Figure A-7: 1:50,000 TopoMap of the Opihi River showing stop banking and various structures within the active surfaces

### A1.7 Reach scale assessment

This assessment applies to the reach between Hanging Rock and the Ocean which is fairly uniformly braided throughout.

Table A-3: Reach scale assessment of natural character in the Opihi River

Attribute cluster	Attribute	Data sources	Comments	Score
Braidplain	Braidplain breadth	Aerial photos, LiDAR, Topomap	This assessment applies to the reach between Hanging Rock and the Ocean. This reach of the river is stop banked throughout restricting the river to a small proportion of the braidplain as indicated by LiDAR	1.5
	Structures and human modification		Continuous flood defences and strategic planting alongside fairway vegetation clearance occur throughout. A number of bridges, fords and powerlines cross the river	1.5
	Vegetation cover		Vegetation cover is predominantly exotic and managed to prevent lateral migration of the river	2
	Flow regime modification		A major tributary of the Opihi River is impounded and no longer subject to channel forming flows. Smaller dams and a number of irrigation takes occur throughout the rest of the system. The river is impacted by low flows in summer.	1.5
	Channel shape		The active channel shape is impacted by extensive flood defences and vegetation management. The loss of sediment supply from impounded tributaries affects river processes.	2.5
Aquatic habitats	Water and habitat quality	ECan water quality data	Lateral habitats are either smothered by willow within strategic plantings or surrounded by intensive land use. Water quality is typical of foot hill fed rivers amongst intensive agriculture	2
	Exotic aquatic flora and fauna	ECan reports	Didymo and phormidium blooms occur throughout. Trout and salmon are also found when adequate flows are present.	2
Wider landscape	Landscape character modifications	Aerial photos, Topomap	The surrounding landscape is intensively farmed although some of the headwaters are extensively grazed only	2.5
Total				15.5 / 40

## A1.8 Local scale assessment

**Table A- 4: Local scale assessment of natural character in the Opihi River**

Attribute cluster	Attribute	Data sources	Comments	Score
Braidplain	Braidplain breadth		This assessment applies to the section directly downstream of the Pleasant Point Bridge ( <b>Error! Reference source not found.</b> ). This section of the river is stop banked throughout restricting the river to a small proportion (<1/3) of the braidplain as indicated by LiDAR ( <b>Error! Reference source not found.</b> ). Strategic planting and fairway clearance prevent river migration	1.5
	Structures and human modification		This section of the river is stop banked throughout ( <b>Error! Reference source not found.</b> ). Strategic planting and fairway clearance prevent river migration. A bridge and transmission line occur	1.5
	Vegetation cover		Vegetation cover is predominantly exotic and managed to prevent lateral migration of the river	2
	Flow regime modification		A major tributary of the Opihi River is impounded and no longer subject to channel forming flows. Smaller dams and a number of irrigation takes occur throughout the rest of the system. The river is impacted by low flows in summer.	1.5
	Channel shape		The active channel shape is impacted by extensive flood defences and vegetation management. The loss of sediment supply from impounded tributaries affects river processes.	2
Aquatic habitats	Water and habitat quality		Lateral habitats are either smothered by willow within strategic plantings or surrounded by intensive land use. Water quality is typical of foot hill fed rivers amongst intensive agriculture	2
	Exotic aquatic flora and fauna		Didymo and phormidium blooms occur throughout. Trout and salmon are also found when adequate flows are present.	2
Wider landscape	Landscape character modifications		The surrounding landscape is intensively farmed.	2.5
Total				15 / 40

## A1.9 Summary

The braidplain of the Opihi River is highly constrained by stopbanking and strategic planting. There are numerous structures in the active surfaces and intensive agriculture beyond the flood defences. A major tributary is impounded and receives no channel forming flows. The reach between Hanging Rock and the ocean as well as the assessment reach at Pleasant Point are considered to have low natural character.



