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Making sense of landscape change: long-term perceptions among local residents following river restoration

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Abstract

Efforts to restore rivers are increasingly concerned with the social implications of landscape change. However, the fundamental issue of how people make sense of local riverine environments in the context of restoration remains poorly understood. Our research examined influences on perception among local residents 14 years after a restoration scheme on the River Dearne in the north of England. Human-landscape relationships emerging from semi-structured interviews with 16 local residents were analysed using an interpretive research framework. Nine recurring factors influenced perception among local residents: scenic beauty; the condition of riparian vegetation and of river channel morphology; opportunities to observe flora and fauna; cleanliness of the riverine environment; access available to the river; connections between the river and the surrounding landscape; disturbance and change in the familiarity of the landscape following restoration. These factors were not solely related to tangible outcomes of the restoration scheme, but were also influenced by history, memories, traditions and practices associated with the river. Critically, these factors also interacted rather than operating in isolation and two idealised perceptual frameworks were developed to map these interactions. Our research contributes to theoretical understanding of the relationships between humans and landscape change, whilst also considering how restoration practice may better reflect these relationships. The importance of a social dimension to the template of possibilities for restoring any given river emerges, underpinning place-based design and implementation of river restoration schemes.

Keywords: river rehabilitation; river enhancement; interpretive social science; landscape perception; sustainable water management.

1. Introduction

River channels and the immediately surrounding riparian land are valuable features within many landscapes (e.g. Millennium Ecosystem Assessment, 2005; UK National Ecosystem Assessment, 2011). However, human action frequently disturbs riverine environments, alongside the environmental, social and economic benefits derived from these ecosystems (Montgomery, 2008; Smith et al., 2014; Tockner et al., 2010). Disturbance is the subject of public and political concern, leading to efforts across the globe to restore riverine environments (e.g. Postel and Richter, 2003; Smith et al., 2014; Wharton and Gilvear, 2006) and significant investment in river restoration schemes within the USA (e.g. Bernhardt et al, 2005; Clarke and Dalrymple, 2003), Europe (e.g. Buijse et al., 2002; Gilvear et al., 2013), China (e.g. Stone, 2008), Japan and Australia (Smith et al., 2014). In parallel, the conceptual and practical basis to river restoration has evolved, moving from a sole focus on ecological improvement towards schemes which also consider the economic and social implications of landscape change. Realising multifunctional riverine environments through restoration is increasingly important, being recognised within international legislation, such as the Water Framework Directive in Europe (European Community, 2000), and within national public policy arenas such as in the UK (e.g. Defra, 2011; Environment Agency, 2013).

Whilst the ecological validity and success of river restoration remain contentious (e.g. Kondolf, 2006; Montgomery, 2008; Palmer, et al. 2010), there is also particular concern that the social dimensions of the river restoration process are neglected (Åberg and Tapsell, 2013; Buijs, 2009; Junker et al., 2007; Selman et al., 2010; Westling et al., 2009). Purist definitions of restoration draw on a natural-cultural dichotomy in which human influence is perceived negatively and in which restoration should seek to return landscapes to natural, pre-disturbance states defined by the absence of significant human influence. However, defining and realising a pre-human disturbance state is problematic, due to long periods of human activity within landscapes and uncertainty regarding the exact timing of initial human disturbance (e.g. Walter and Merritts, 2008). This dichotomy is challenged, both by alternative theoretical frameworks arguing for the relevance of natural-cultural hybrid models for restoration (Eden et al., 2000), and by pragmatic perspectives that take restoration to be the balancing of ecological and human goals through rehabilitating or enhancing landscapes, rather than seeking return to a redundant, historical reference state (e.g. Davis, 2000; Dufour and Piegay, 2009; Nilsson et al., 2007).

Understanding the expectations and desires that members of the public hold regarding rivers and drawing on this knowledge to support public participation in the process of river restoration, are central to natural-cultural hybrid models and to notions of river rehabilitation and enhancement. Engaging members of the public in decisions regarding the restoration of rivers can increase the sense of public ownership and pride in local river environments (Eden and Tunstall, 2006), counteract feelings of alienation by promoting connection between people and restored riverine environments (Junker et al., 2007;

Selman et al., 2010), and ultimately increase the likelihood that restoration schemes will be implemented and maintained (Nassauer et al. 2001; Nilsson et al., 2007). However, past technocratic approaches to river management have limited public participation in many restoration schemes (e.g. Eden and Tunstall, 2006; Smith et al., 2014; Spink et al., 2010) and constrained the extent to which local knowledge and experience is seen as valid and valuable (e.g. Higgs, 2003). Although more recent examples of enhanced public engagement in river restoration exist (e.g. Åberg and Tapsell, 2013; Petts, 2007), future restoration practice would benefit from better understanding of the nature of, and influences on, public perception of rivers and their restoration.

Perception regarding the outcomes of river restoration can differ substantially across academic, practitioner, local resident and visitor communities, but also with the wider context of riverine environments, for example whether rivers exist within urban or rural landscapes (e.g. Buijs, 2009; Spink et al., 2010). However, moving beyond a description of differences in perception to explore the underlying causes of these differences requires a focus on the factors and processes which shape public perception (Jacobs and Buijs, 2011). Perception following river restoration has been variously ascribed to changes in place attachment, aesthetic values, biodiversity, recreational and educational opportunities (e.g. Åberg and Tapsell, 2013; Findlay and Taylor, 2006; Gobster et al., 2007; Jacobs and Buijs, 2011; Jungwirth et al., 2002; Junker and Buchecker, 2008; Tapsell, 1995). However, the social impacts of river restoration have primarily been viewed as indicators for the success of a scheme, with research seeking to establish whether attitudes towards a river environment, including those associated with wildlife (e.g. Åberg and Tapsell, 2013),

aesthetic values (Junker and Buchecker, 2008) and recreational opportunity (e.g. Seidl and Stauffacher, 2013), change as a consequence of restoration.

The fundamental issue of how people make sense of local riverine environments in the context of landscape change remains more poorly understood. Some previous research has explored public perception related to interconnected, tangible elements of river environments (e.g. Åberg and Tapsell, 2013; Junker and Buchecker, 2008). Despite such research, the complex networks of influence that govern perception of riverine landscapes have received little attention. These networks likely include intangible alongside tangible landscape elements, associated with the deeper meanings and emotions attached to places (Selman et al., 2010). For example, historical relationships between local residents and a river have been argued to influence perception of contemporary restoration schemes (e.g. Eden and Tunstall, 2006; Spink et al., 2010). Such intangible elements are place-dependent rather than universal, meaning that their impacts on public perception may differ significantly between individual restoration schemes. Therefore, establishing in-depth understanding of public perception across the range of river types, landscapes and socio-political contexts within which restoration has been undertaken is a significant challenge (Buijs, 2009). Addressing this challenge requires new insights from social science approaches to support both the practice (Smith et al., 2014) and research (Eden and Tunstall, 2006) of river restoration.

In this paper, we draw on the wider landscape literature and specifically on the Cultural-Values-Model (CVM, Stephenson, 2008) to understand how local residents make sense of

137 their riverine environment and changes in that environment following restoration. Below
138 we describe the core elements of the CVM, before considering our empirical research.
139
140 ## 2. The Cultural Values Model: A framework for understanding
141 ## interconnectedness in perceptions of landscape change
142 Whilst the physical characteristics of landscapes strongly influence visual perception and
143 preference, characteristics of the individual perceiver are equally important in the
144 landscape experience. Such characteristics relate, for example, to previous knowledge,
145 experience and familiarity with respect to a landscape (Kearney et al, 2008). Interpretation
146 and perception of a landscape is therefore a constant interaction between humans and their
147 environment (e.g. Nassauer et al., 2001; Stephenson, 2008; Terkenli, 2001). The CVM
148 provides a theoretical framework through which human-landscape interactions can be
149 analysed. In this paper, we draw on the CVM in the specific case of riverine landscapes,
150 contributing more broadly to understanding of public perception of landscape change.
151
152 The CVM incorporates three elements: forms, relationships and practices, which interact
153 in the construction of any given landscape. The forms element considers the physical,
154 tangible aspects of a landscape, including natural features, such as riparian vegetation or
155 river morphology, and human interventions such as footpaths or buildings. Therefore, the
156 forms element captures both natural and cultural objects and the values associated with
157 these objects. The relationships element of the CVM considers the notion that perception
158 of a landscape is partly based on human relationships with and within that landscape.
159 These relationships can be represented in various ways, including through sense of place,

myths, stories and memories. The third element of the CVM considers human and natural practices, including past and present action and traditions. This component also encompasses ecological processes, but rather than separating nature and culture, practices 'capture the continuum of valued cultural practices and natural/human processes of the landscape' (Stephenson, 2008: 134).

Our application of the CVM extends past studies of perception among local residents following river restoration in three specific ways. Firstly, based on the hypothesis that public perception of river restoration is not solely influenced by forms, but also by relationships and practices, we draw on each individual element of the CVM to interpret the influences on perception of a river restoration scheme. Secondly, because perception is expected to be influenced by interacting rather than isolated elements of the CVM, the research focusses strongly on the nature of these interactions. Thirdly, the research examines public perception 14 years after completion of a river restoration scheme. Previous research has examined public perception of proposed restoration schemes (e.g. Buijs, 2009; Junker and Buchecker, 2008), or of schemes within a few years of completion (e.g. Eden and Tunstall, 2006; Tapsell, 1995), with significant changes found when comparing perception before and immediately after implementation of some restoration schemes (e.g. Tunstall et al., 1999). However, relatively little is known about longer-term public perception following river restoration (although see Åberg and Tapsell, 2013 for an example of research addressing longer-term effects). Rivers in general, alongside the relationships between people and rivers, are temporally dynamic. Therefore, public

perception of restoration schemes before or immediately after implementation may evolve significantly over longer timescales.

Our specific aims were therefore to: i) enhance theoretical understanding regarding public perception of river restoration schemes, by examining the influence of interconnected elements of the CVM on perception; and ii) consider the implications of our findings for researchers and practitioners engaged in river restoration projects with members of the public.

3. Case study and methodology

A case study approach was adopted, using a restoration site on the River Dearne approximately 10 km to the west of Doncaster in Yorkshire, England (Figure 1a). Case studies capture 'on-the-ground' complexities and contradictions, allowing for 'concrete context-dependent knowledge' (Flyvbjerg, 2006:224) to be obtained and providing detailed insights into public perception of river restoration. The river in the area of the restoration site was straightened in the 1970s due to changes in the natural channel gradient resulting from mining activities in the area. The straightened channel provided efficient conveyance of flood water, but physical uniformity, poor water quality and low channel gradient limited the ecological value of the river.

FIGURE 1

Closure of local mining operations and enhanced treatment of waste water led to improvements in water quality of the River Dearne during the 1980s, providing an opportunity to enhance the ecological value of the river. However, poor in-stream physical habitat conditions constrained this opportunity, in particular by limiting the potential for fish to spawn. A restoration scheme was implemented in 1995 to maximise the existing fishery and increase the longer-term value of the river for spawning (Figure 1b). A 500 m long sinuous channel planform was created by installing stone barriers within the boundaries of the existing over-widened channel, designed to increase the diversity of water velocity, water depth and substrate within the river channel. Low-lying berms were created alongside the new channel and seeded with a standard grass community. Additional vegetation enhancement included planting berm and bank areas with live willow stakes and other tree species, and transplanting emergent macrophytes from the channel to areas surrounding the stone barriers. The photographs in Figure 2 show the river channel and riparian zone within the restored reach and within a non-restored reach immediately upstream. The non-restored reach was assumed to provide a reasonable analogue for conditions within the restored reach prior to the restoration scheme.

FIGURE 2

Research was conducted in January and February 2009, 14 years after completion of the restoration scheme. Interpretive research techniques based on semi-structured interviews were used to understand how residents perceived their local riverine environment in general and the specific changes associated with the restoration scheme. Qualitative

227 research using an interpretive framework provides a strong basis for exploring the
228 complexity and richness of human-landscape relationships (e.g. Brandenburg and Carroll,
229 1995; Miles and Huberman, 1994). An interpretive approach focusses 'on meaning that is
230 situated in a particular context' (Yanow, 2003: 228) and embraces the subjectivity of real
231 world problems (Davenport and Anderson, 2005). Therefore, interpretive research
232 considers how phenomena are understood by actors, and how these different
233 understandings are expressed 'in terms of policy and practice to produce 'rich' and
234 'situated' narrative accounts' (Westling et al, 2012:10). Instead of attempting to describe
235 public perception of river restoration in generalised terms, the research approach adopted
236 here focusses on the development of deeper understanding of the relationships between
237 people and a river in a specific context.
238
239 Because of the relatively small scale of the restoration scheme and the absence of
240 recreational facilities at the site, local residents rather than visitors were judged most likely
241 to be affected by the restoration scheme. Residents living within approximately 600 m of
242 the restoration site were considered, based on a similar spatial scale to past research
243 examining perception of river restoration among local residents (e.g. Tunstall et al., 1999).
244 Initially, 83 households were contacted by leaflet and invited to participate in the research.
245 After 2-3 days, the leafleted households were visited and arrangements made with those
246 wishing to participate. If no answer was obtained, the household was visited on one further
247 occasion in an attempt to arrange participation. In total, interviews were conducted with 16
248 people from 11 households. All participants had access to the river and the restoration site
249 from their homes via public footpaths, and all had lived in the same residential area since

250 before the restoration scheme was implemented in 1995. Table 1 provides summary
251 information regarding the interviewees. Drawing on Glaser and Strauss (1967), the
252 sampling approach did not seek a statistical representation of the wider population and is
253 therefore not concerned with maximising the number of interviews conducted. Instead, we
254 focussed with greater depth and care on a smaller number of interviewees in order to fully
255 explore the perspectives of each participant (Lewis, 2008).
256
257 **TABLE 1**
258
259
260
261
262 The semi-structured interviews used open-ended questions to allow for additional
263 questions or subjects to be raised and discussed (Denscombe, 2007). The same questions
264 were asked as part of the semi-structured component of each interview, but different
265 follow-up questions were used depending on initial responses from interviewees. In this
266 approach, what is and what is not important information is not entirely pre-determined by
267 the interviewer, as it would be within a structured interview or questionnaire, but emerges
268 as part of the conversation. The interviews included questions that covered the uses made
269 of the local riverine environment by local residents, their likes and dislikes regarding this
270 environment, and their aspirations for the river in the future. The interviews lasted
271 approximately one hour and were conducted within the homes of local residents.
272 Photographs of restored and non-restored reaches of the River Dearne were included as
273 prompts to explore perceptions regarding the different river reaches (see Figure 2,

although colour versions were used for the interviews). Previous research has shown that the outcomes of landscape perception studies based on photographs are often highly correlated with the perceptions expressed by on-site respondents (e.g. Shuttleworth, 1980 in Gregory and Davis, 1993), and similar use of photographs has been made in research that examines public perception of river restoration (e.g. Junker and Buchecker, 2008). The interviews were recorded and fully transcribed. The transcripts were analysed through iterative and reflexive reading, using NVivo 8.0 as part of a thematic analysis of the relationships between people and their local river environment. The thematic analysis generated the factors described in Table 1 and the interrelationships between these factors that are illustrated within the frameworks in Figures 3 and 4. To maintain the confidentiality of participants, all quotations taken from the interviews are reported anonymously.

4. Results and discussion

4.1 Cultural values and public perception of river restoration

Table 2 synthesises outcomes from the empirical research reported in this paper. Nine recurring factors emerged from the interviews that influenced the way in which residents made sense of their local riverine environment and the changes in that environment following restoration. These factors are reported in Table 2, alongside descriptive characteristics used by interviewees when discussing each factor. Table 2 also maps each individual factor onto the forms, relationships and practices elements of the CVM. Finally, interactions between individual factors are identified. These interactions are further considered in section 4.2. Below, we draw on the CVM to interpret how the nine factors

297 reported in Table 2 influence long term perceptions of the restoration scheme on the River
298 Dearne.
299
300 **TABLE 2**
301
302 4.1.1 Forms
303 The forms component of the CVM considers both the physical, tangible aspects of a
304 landscape and human interventions within that landscape. Our research confirms that
305 disruption during the engineering phase of a restoration scheme is an important, adverse
306 influence on public perception, associated with changes to biophysical forms, including
307 vegetation and wildlife, but also to human interventions within a landscape, particularly
308 the availability and condition of footpaths. Residents also understood that vegetation
309 within the restored reach of the River Dearne took several years to recover following the
310 engineering work, indicating that adverse impacts on biophysical forms associated with
311 disturbance continued beyond completion of the engineering phase of the scheme.
312
313 Riparian vegetation and channel morphology influenced perception of the contemporary
314 condition of the River Dearne. The majority of residents perceived the grass community
315 within the non-restored reach to be neat, tidy and desirable, in contrast to the diverse and
316 less heavily managed vegetation of the mixed shrub-tree community within the restored
317 reach. However, a preference for more diverse and less heavily managed riparian
318 vegetation, alongside a sinuous channel morphology, was expressed by fewer residents,

associated with a more scenically beautiful landscape and the notion of a natural or wild river.

Many residents perceived the presence of litter within the riverine environment to be an indicator of the cleanliness of the River Dearne, rather than water clarity, colour or chemical quality that have previously been identified as important influences on perceptions of river cleanliness (e.g. Gobster and Westphal, 2004; Gregory and Davis, 1993; House and Fordham, 1997; Smith et al., 1995). Residents expressed concern that the presence of litter was a significant threat to the general condition of the riverine environment:

Empty cans, drink cans, empty corn beef cans […] they leave all sorts down there. It really is bad.
(De4: Female, aged 50, resident for 25 years, visits the river daily).

Positive associations between the presence of infrastructure (footpaths) and the value of the environment were identified in our research. The condition of infrastructure, particularly seasonal and longer-term degradation to footpaths, influenced perception regarding access to the River Dearne. Our research suggests that maintenance of infrastructure must be planned as part of river restoration schemes, in order to sustain positive public perception regarding a river. In common with research in other landscapes (e.g. Davenport and Anderson, 2005; Gobster and Westphal, 2004), visual access to the River Dearne was also important for local residents and was perceived by some to be

342 reduced by changes in vegetation diversity, channel width and channel sinuosity that
343 followed restoration.
344
345 4.1.2 Relationships
346 The relationships element of the CVM considers human relationships with and within a
347 landscape, covering aspects such as stories, memories and sense of place. Although
348 changes to forms associated with river restoration may explain the tangible, direct impacts
349 of schemes on public perception, they do not capture impacts upon deeper values that are
350 often underpinned by traditions, memories and human interaction through time with a
351 particular landscape. These values, and how they are affected by change in riverine
352 environments, can be interpreted through the relationships element of the CVM.
353
354 Familiarity with a landscape represents an important component of the CVM. A reduced
355 sense of attachment to an unfamiliar restored landscape may contribute to public resistance
356 towards plans for restoration prior to implementation (e.g. Junker and Buchecker, 2008).
357 However, local residents in our research did not consistently express a different strength or
358 nature of attachment to the restored compared to the non-restored reach of the river.
359 Personal memories among local residents regarding historical change within the River
360 Dearne may have underpinned this finding. Prior to channelization in the 1970s, the river
361 naturally meandered and was characterised by diverse and less heavily managed riparian
362 vegetation. Memories of this historical state may have generated a sense of familiarity
363 with the restored reach. In addition, the relict course of the River Dearne continues to exist
364 alongside the restored reach (Figure 1b), providing a contemporary experience of the

historical state of the river that many local residents described as the 'original' state. Finally, familiarity with the restored reach may be a function of the 14 years since completion of the restoration scheme. The standard ecological model for river restoration, represented by the single-thread meandering channel, has been criticised for having no historical, ecological resonance within many landscapes (e.g. Kondolf, 2006; Montgomery, 2008). A universal model for river restoration that ignores the importance of local context also risks generating negative public perception by implementing schemes that have no connection with the memories or experiences of local residents. Our research emphasises that familiar landscape elements could be drawn from historical conditions, alongside those present in contemporary local landscapes, to be included within restoration schemes.

Memories and stories regarding the historical state of the River Dearne also provided references through which local residents interpreted the contemporary riverine environment. This was particularly true for perceptions of the cleanliness of the River Dearne. For some residents who expressed concern regarding the accumulation of litter within the contemporary river, this was compounded by stories of a cleaner river in the past:

> My Father who is 86 will tell tales of when he used to swim in the river. I would hate to think anybody was doing that these days.
> (De1: Female, aged 50, resident for 20 years, visits river daily)

In contrast, other interviewees considered the river to be generally clean, based on their understanding of historical improvements in chemical water quality within the River Dearne, although these improvements were not directly associated with the restoration scheme.

The local riverine environment was identified as beautiful, peaceful and tranquil by the majority of residents, underpinning a strong sense of pride and attachment associated with the scenically-attractive environment that existed within their local area:

So, you know we're surrounded by beautiful countryside and the river. I think that's what we like.
(De13: Female, aged 70, resident for 41 years, visits river weekly)

It's so peaceful. I mean you can walk down there and well, on a night, it doesn't have to be a hot, sunny day or anything, it's just so peaceful because of what you can see. [...] If you can walk at the side of a river it's so peaceful and calm and you can think a lot you know.
(De14: Male, aged 70, resident for 41 years, visits river weekly)

The sense of attachment between local residents and the riverine environment was particularly strengthened by the opportunity to view wildlife:

409 T*here's so many swans at certain times of the year when they will have had their young*
410 *and then next time you see them they're bringing them up. There have been about 4 or 5*
411 this year and then one will go mis*sing and you'll think something's had* one.
412 (De14: Male, aged 70, resident for 41 years, visits river weekly)

413

414 The vast majority of interviewees also valued being surrounded by, and interacting with,
415 nature and an environment that was seen as natural. In the broader landscape literature it
416 has been argued that perceptions regarding naturalness in western Europe and North
417 America draw on a historical, cultural attachment to 18th Century ideals of picturesque
418 landscapes (Nassauer, 1995; Nassauer, et al., 2001). Within riverine environments, the
419 ideal of a single thread, meandering channel derived from the same historical period has
420 become widely adopted as the standard model for a natural riverine environment (Kondolf,
421 2006; Montgomery, 2008). At the heart of these ideals, or myths, of a landscape is strong
422 evidence of control through tidiness, neatness and maintenance. However, the importance
423 of control is often the source of disagreement amongst members of the public during
424 landscape restoration (Buijs, 2009; Nausseur et al., 2001), and our research indicates that
425 the notion of control can be an important influence on long-term perceptions following
426 river restoration. For some local residents, the messy, poorly organised physical character
427 of the restored reach was indicative of neglect and a lack of control. In contrast, the neat
428 and tidy character of the non-restored reach provided evidence that the riverine
429 environment was maintained and cared for, and added to the scenic beauty of the river:
430

It's well *looked after because I've noticed, I'm not sure if it's the River Board that do it but* the flood banks are mowed and in the summer the lovely smooth grass banks looks attractive.

(De16: Male, aged 65, resident for 20 years, visits river weekly)

A preference for control, organisation and maintenance may also emerge from the role of landscapes as communication systems that symbolically reflect local residents themselves (Greider and Garkovich, 1994). In this context, a desire for neat, tidy and orderly landscapes may be linked to the historically- and culturally-defined norms associated with the relationships component of the CVM. The way in which controlled landscapes positively reflect on local residents themselves may have contributed to a preference among some interviewees for the non-restored reach of the River Dearne.

4.1.3 Practices

This element of the CVM considers human and natural practices, including past and present action and traditions alongside ecological processes. Because most of the interviewees had lived in the area surrounding the restoration site on the River Dearne for several decades, they had experience of the river before it was straightened for flood control purposes in the 1970s, the river after channelization but before restoration, and the river during and after implementation of the restoration scheme. Perception among the interviewees was influenced by knowledge and experience regarding how the function of the river had changed during this time, based on ecological processes as well as on traditional and contemporary human activities within the landscape. Interviewees

understood that the river had been straightened in the 1970s for flood risk management purposes and that this represented a significant morphological change compared to historical conditions. However, these changes in channel morphology were not widely recognised as a source of degradation that necessitated restoration of the river. Indeed, for some interviewees the restoration scheme itself represented a purely artificial feature associated with human action that would not occur naturally within the River Dearne:

It always has looked strange, how they created those obviously man- made curves and twists and little islands.

(De3: Male, aged 50, resident for 25 years, visits river daily)

A number of residents described ecological connections between the more diverse morphology and less heavily managed riparian vegetation within the restored reach, improved habitat conditions and greater potential to observe wildlife, compared to the non-restored reach:

There are still some areas you know looking west that are a little bit straight and you *don't see as much wildlife on those areas as you d*o on those areas where the bends are and the trees are.

(De9: Male, aged 65, resident for 36 years, visits river daily)

T*he further you get down they've put some little twists in it and I think it's for the fish when they're spawning and that type of thing or frogs, it just alters the course a little bi*t instead of it being just a gradual round, it just alters the course of the river.
(De14: Male, aged 70, resident for 41 years, visits river weekly)

These ecological processes were perceived as positive effects of a more natural, wild river system on flora and fauna, although the connections between the restoration scheme, ecological processes and opportunities to observe flora and fauna were not widely recognised. Improvements in the potential for human activity in the riverine environment, particularly the potential for fishing, were identified in the interviews. However, local residents often associated these with broader improvements in chemical water quality with the River Dearne, rather than being driven by the specific changes introduced by the restoration scheme. Infrastructure that facilitated human access to the riverine environment for recreational purposes was argued to disturb wildlife by a number of interviewees, who believed that areas of restricted public access should be established within the riverine environment to minimise disturbance. This finding is consistent with public support for nature conservation areas in riverine environments, even if physical access to these areas is limited or absent (e.g. Buijs, 2009).

Many residents considered accumulation of litter to have increased following restoration, due to physical trapping of litter following changes to river channel morphology and riparian vegetation:

The two w*illow trees are trying to join up to each other and because they're not managed, they're just left there, […] they just collect the rubbish*.

(De3: Male, aged 50, resident for 25 years, visits river daily)

Whilst litter itself strongly influenced perceptions of river cleanliness, the quotation above highlights connections between the forms and practices elements of the CVM that commonly emerged when discussing the restoration of the River Dearne. Litter accumulation, linked to processes operating within the restored river reach, was seen as the most severe threat to the overall condition of the River Dearne by some residents. In contrast, other interviewees considered the river to be generally clean, based on their understanding of historical improvements in chemical water quality resulting from human action that was unrelated to the restoration scheme, for example due to the closure of mines or improvements in waste water treatment.

In general, the river was also perceived as an important feature within the wider landscape. The river provided connectivity between places within this landscape, both from an ecological perspective (e.g. the movement of material and organisms longitudinally within the river channel) and also from the perspective of human activity:

We can walk from the bottom of the field and we can walk to Bolton-upon-Dearne or Wath-upon-Dearne and the other way we've walked to Sprotbrough, so you can walk for miles along the riverbank.

(De5: Female, aged 70, resident for 22 years, visits river monthly)

4.2. Mapping interconnections between elements of the CVM to understand influences on long-term perceptions of river restoration

The individual elements of the CVM were not discussed in isolation during the interviews, but interacted to define a range of direct and indirect influences on public perception. Figures 3 and 4 map the most prominent interactions between elements of the CVM that emerged during the interviews. Identifying these interactions underpins a more complete understanding of the influences on long-term perception of restoration on the River Dearne, compared to treatment of individual elements in isolation. However, these frameworks only represent illustrative examples of the interconnected nature of influences on public perception. Figures 3 and 4 should be interpreted as idealised perceptual frameworks. Further, the frameworks are not presented as a basis for static categorisation of the perception of individuals or groups of individuals. Such categorisations do not remain constant, but will be continuously renegotiated and redefined by and between individuals. When dealing with dynamic, long-term perceptions of rivers and their restoration, static categorisation may prove of limited use. Finally, although some interviewees aligned more closely with one of the two frameworks, individual residents were not polarised between the frameworks and often borrowed from each at different points during an interview.

Figures 3 and 4

The framework in Figure 3 underpins predominantly positive perception regarding the restoration scheme. Enhanced scenic beauty of the riverine environment, and thereby of the wider landscape, alongside increased naturalness are directly and positively associated with the restoration scheme. These interactions highlight an important role for the relationships element of the CVM in this framework.

Beyond the direct impact due to the intrinsic value of more natural landscapes, the increased diversity of riparian vegetation and channel morphology following restoration is perceived to have indirect benefits through enhanced habitat quality for flora and fauna and through scenic beauty of the river. The interaction between vegetation/morphology and flora and fauna represents a positive interaction between forms and practices within CVM. Physical and visual access are perceived positively and can be improved through incorporating infrastructure within the restoration scheme, reflecting a further important role for the forms element of the CVM. Interactions between physical and visual access occur, for example if infrastructure such as footpaths along flood defence embankments simultaneously promotes both forms of access. However, the benefits of enhanced access are tempered by an indirect relationship between access and perception reflecting concern over potential disturbance to flora and fauna resulting from human access. This interaction represents a tension between the forms and practices elements of the CVM in this framework.

Figure 4 maps a contrasting framework in which there was frequently tension between the changes associated with the restoration scheme and perception among local residents.

567 Changes in riparian vegetation and channel morphology following restoration are
568 understood to reflect reduced control over the riverine environment and are interpreted as
569 evidence of a neglected and desolate riverine environment that is perceived negatively by
570 local residents. This reflects tensions between the forms and relationships elements of the
571 CVM. The accumulation of litter, exacerbated by changes in riparian vegetation and
572 channel morphology, defines a less clean riverine environment following restoration and is
573 also perceived negatively, reflecting tension between the forms and practices elements of
574 the CVM. The unclean and poorly organised condition of the restored river is also
575 perceived to be less scenically beautiful. Reduced scenic beauty of the riverine
576 environment may also adversely affect perceptions of the beauty of the wider landscape
577 within which the river is a key feature, representing important interactions within the
578 relationships element of the CVM. Access to the river is perceived positively if
579 infrastructure is enhanced as a result of restoration, without concern regarding human
580 disturbance to flora and fauna. However, less heavily managed riparian vegetation and
581 reductions in channel width following restoration may adversely affect visual access to the
582 river, reflecting negative interactions within the forms element of the CVM.
583
584 Figures 3 and 4 emphasise that change to an individual feature within a riverine
585 environment following restoration may be interpreted in contrasting ways by local
586 residents, depending on how elements of the CVM interact to influence perception of any
587 particular change. Three examples from Figures 3 and 4 illustrate this point. Firstly,
588 vegetation and morphology are important features within both frameworks. Changes in
589 these features following restoration lead to largely positive perceptions in Figure 3,

590 interpreted through naturalness, scenic beauty and habitat conditions that reflect positive
591 interactions between forms, relationships and practices elements of the CVM. However,
592 Figure 4 defines a contrasting position in which changes in vegetation and morphology
593 introduced through restoration are perceived negatively, this time interpreted through
594 adverse impacts on control, cleanliness and access, reflecting tensions between forms,
595 relationships and practices. Secondly, whilst scenic beauty is important for both
596 frameworks, Figure 3 reflects a construction of scenic beauty driven predominantly by
597 vegetation and morphological characteristics, whilst in Figure 4 the construction is
598 strongly influenced by the accumulation of litter. This example illustrates how different
599 forms may be drawn upon by residents to determine their perception of a common feature
600 of the riverine landscape (scenic beauty). Finally, whilst the benefits of enhanced access
601 are common to both frameworks, these benefits are tempered by concern over human
602 disturbance to flora and fauna in Figure 3. This concern is absent from Figure 4, reflecting
603 a more general lack of recognition of the ecological impacts of restoration within this
604 perceptual framework and therefore of the ecologically-relevant interactions between
605 forms and practices elements of the CVM.
606

607 ## 5. Conclusions and implications

608 Moving from designing and implementing ecologically-driven restoration schemes within
609 a technocratic framework, towards delivering ecological and social benefits in the context
610 of multiple, often contested, perceptions regarding riverine environments, presents
611 significant challenges. Understanding the way in which riverine environments are
612 perceived by members of the public, alongside the influences that shape these perceptions,

613 is therefore important. Our research contributes to this field, extending the scope of past
614 research to consider long-term perceptions of restoration analysed through a cultural
615 values framework to provide insight into the deeper meanings that residents attach to
616 riverine environments. Our research emphasises strongly that perception among local
617 residents cannot simply be understood through the tangible, direct impacts of river
618 restoration, for example associated with changes in riparian vegetation or channel
619 morphology. Instead, these changes influence perception through the deeper values held
620 by local residents, underpinned by history, traditions, myths and practices related to a
621 particular riverine landscape.
622
623 Our research draws on the Cultural Values Model developed by Stephenson (2008) to
624 provide a theoretical framework through which to better understand public perception of
625 river restoration. The interviews reported here revealed that interactions between the
626 forms, relationships and practices elements of the CVM are common, leading to diverse
627 perception among local residents regarding the restoration of the River Dearne. These
628 interactions have been summarised using two idealised perceptual frameworks. The
629 frameworks suggest that change within a riverine environment can generate a cascade of
630 predominantly positive interactions between forms, relationships and practices (Figure 3),
631 or may lead to significant tensions between these same elements (Figure 4). Understanding
632 the nature and causes of such interactions is essential if river restoration schemes are to
633 maximise the resonance with place-meanings of local residents (Benford and Snow, 2000),
634 providing a stronger basis for the design and implementation of river restoration schemes
635 that seek both social and ecological benefits. However, almost a decade ago Eden and

636 Tunstall (2006) concluded that social science theory and research did not play a central
637 role in efforts to understand public perception of river restoration. Although a limited
638 number of more recent contributions from social science have emerged, we believe there
639 remain significant opportunities for further theoretical and empirical development in this
640 area.
641
642 Recognising and making explicit how perception regarding rivers and their restoration
643 varies among local residents, alongside the potential tensions between these perceptions, is
644 important for future restoration practice. This requires conversations that focus on the way
645 in which local communities make sense of riverine environments and their aspirations for
646 these landscapes, rather than simply eliciting attitudes towards proposed or completed
647 restoration schemes. These conversations must be based on recognition that both tangible
648 and more intangible elements of riverine environments influence public perception. By
649 mapping contrasting perspectives regarding the outcomes of river restoration, idealised
650 perceptual frameworks, such as those reported in Figures 3 and 4, that draw on theoretical
651 frameworks such as the CVM offer the potential to support these conversations. For
652 example, defining these contrasting perspectives could help participants to agree on an
653 appropriate balance between different goals and aspirations during the development of a
654 restoration scheme. Further, these frameworks provide an opportunity for participants in a
655 restoration process to define their own perspectives, to recognise those held by other
656 participants and to subsequently engage in dialogue as part of a river restoration process.
657

Ultimately, future restoration practice should seek agreement between participants over a collective way forward, if both ecological and social benefits are to be achieved through schemes. Recognising the existence of a spatially-variable biophysical template for rivers when determining feasible restoration activities is important for practice. However, the social dimension to the template for river restoration also requires greater recognition. Context-dependency in the social component of this template exists, defined by the place-dependent perceptual frameworks used by residents to make sense of their local riverine environment and restoration within these landscapes. Understanding the nature of residents' place-dependent perceptual frameworks, alongside ensuring that they inform river restoration processes, remain critical challenges for future river restoration science and practice.

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Ethical statement

The research reported above involved human subjects and was performed in compliance with relevant laws and with the ethical guidelines of the University of Sheffield, and was approved by the research ethics committee at the University of Sheffield.

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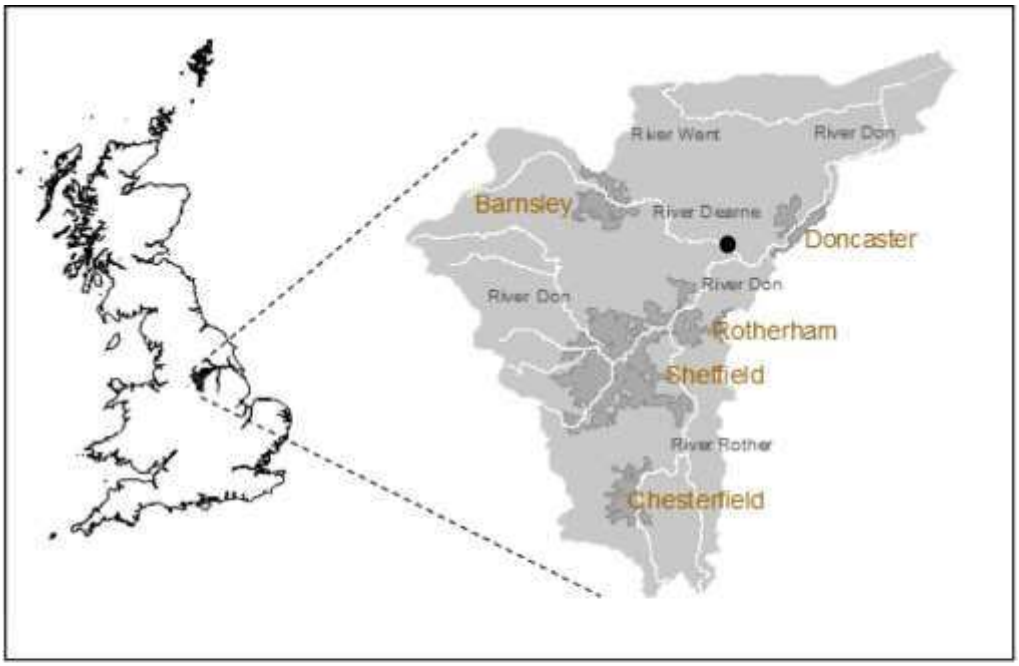
FIGURES



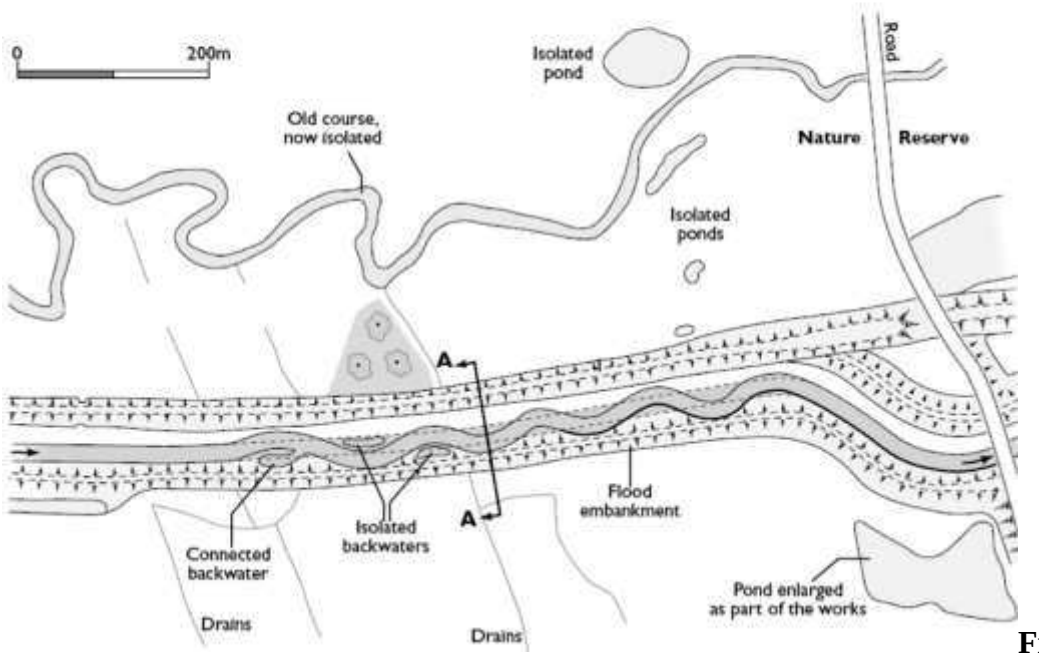


Figure 1. (A) Location of the Don catchment within Great Britain. Insert shows the location of the river restoration site (black marker) on the River Dearne, the principal rivers (white) and major urban areas (dark grey) within the Don catchment. **(B)** Schematic diagram detailing the restoration scheme as implemented in 1995, taken from River Restoration Centre (unpublished data). Note that the original course of the River Dearne remains adjacent to the restored reach to the north east. Locations identified from which photographs of non-restored and restored reaches (see Figure 2) were taken. See text for further description of the changes introduced by the restoration scheme.

Figure 2. Photographs of restored (a, c) and non-restored (b, d) reaches of the River Dearne. Images taken in winter 2009 from immediately adjacent to the river channel (a, b) and from a public footpath through the adjacent riparian zone (c, d).

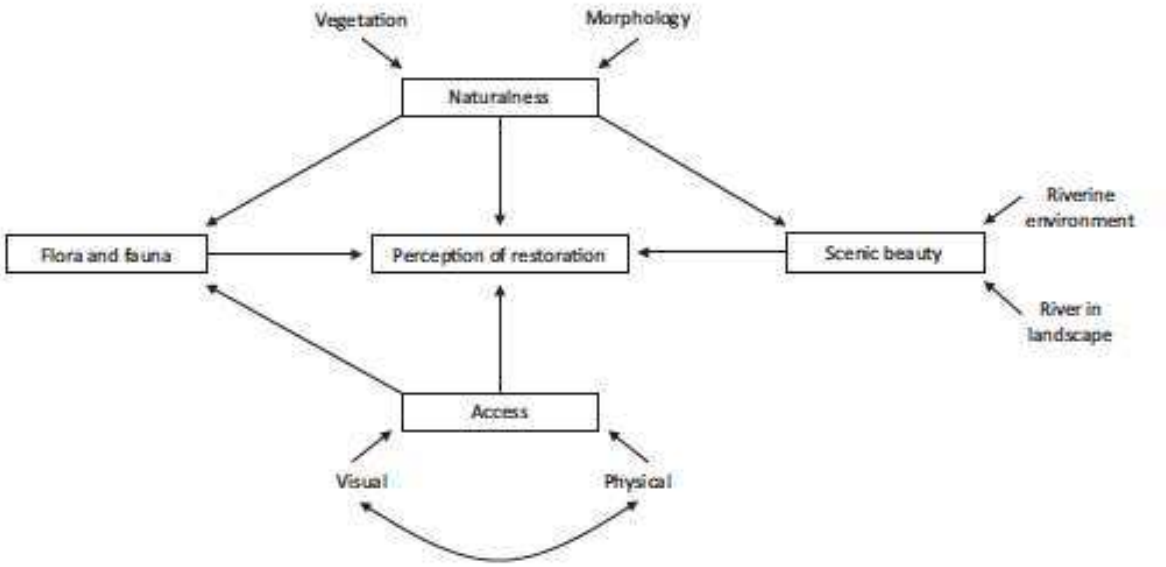


Figure 3. The virtuous diamond: mapping positive perceptions towards river restoration through key interactions between influencing factors. Interactions between individual factors and public perception represented by directed arrows, see text for further discussion of these interactions.

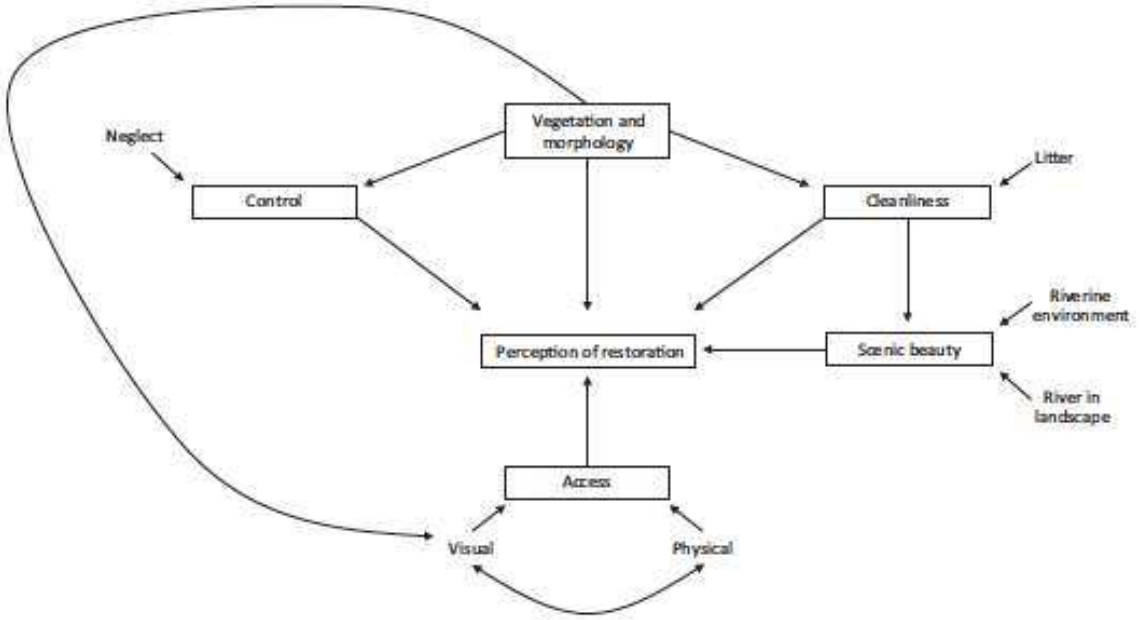


Figure 4. The negative matrix: mapping negative perceptions towards river restoration through key interactions between influencing factors. Interactions between individual factors and public perception represented by directed arrows, see text for further discussion of these interactions.

TABLES

Table 1. Summary characteristics for the 16 interviewees at the River Dearne restoration site.

Interviewee number	Gender	Approximate age	Household structure	Years of residence	Visits the river
De1	Female	50	1 adult	20	Daily
De2	Female	55	2 adults: married	26	Monthly
De3	Male	50	2 adults: married	25	Daily
De4	Female	50	2 adults: married	25	Daily
De5	Female	70	2 adults: married	22	Monthly
De6	Male	70	2 adults: married	22	Monthly
De7	Male	20	2 adults: mother and son	20	Rarely
De8	Female	65	2 adults: married	36	Daily
De9	Male	65	2 adults: married	36	Daily
De10	Male	88	1 adult	25	Rarely
De11	Female	62	2 adults: married	26	Couple of times a year
De12	Male	65	2 adults: married	26	Couple of times a year
De13	Female	70	2 adults: married	41	Weekly
De14	Male	70	2 adults: married	41	Weekly
De15	Female	65	2 adults: married	20	Weekly
De16	Male	65	2 adults: married	20	Weekly

Table 2. Synthesis of key factors influencing perception of the River Dearne and of the restoration scheme. Descriptive terms related to the factors are given, alongside the relationships between each factor and the Cultural Values Model. Finally, interactions between individual factors are identified.

Factor	Descriptive characteristics	Cultural values			Interactions with other factors
		Forms	Relationships	Practices	
Scenic beauty	Peacefulness, tranquility, pride, diversity, wilderness, tidiness, control		Pride, belongingness and sense of place associated with the river Beauty of a natural riverine landscape Beauty of a tidy, organised and controlled riverine landscape		Riparian vegetation River channel morphology Cleanliness Naturalness
Riparian vegetation	Neatness, tidiness, overgrown, poorly managed, wild, diverse	Distinction made between grass versus mixed shrub-tree vegetation communities	Historical references influence current perception of riparian vegetation	Diverse, unmanaged riparian vegetation associated with greater habitat value, particularly for birds Unmanaged vegetation accumulates litter	Scenic beauty Flora and fauna Cleanliness Access (visual)
River channel morphology	Flooding, diversity, accumulation of litter, artificial	Distinction made between sinuous versus channelized morphology	Historical references influence current perception of channel morphology	Humans have historically managed channel morphology for flood defence purposes Morphological diversity supports flora and fauna Sinuous channel accumulates litter	Scenic beauty Flora and Fauna Cleanliness Naturalness
Flora and fauna Cleanliness	Wildlife, birds, fish Litter, improved water quality, dirty, messy	Presence of litter in the riverine environment	Opportunities to observe wildlife in the riverine environment Historical references influence current perception of river cleanliness	Litter accumulation a severe threat to river quality Improved chemical water quality supports flora and fauna	Riparian vegetation River channel morphology Scenic beauty Riparian vegetation River channel morphology
Access and recreation	Physical and visual access, footpaths, footpath condition, disturbance	Presence of infrastructure (footpaths) is valuable Limited visual access, due to vegetation and morphology		Human access via footpaths disturbs wildlife	Riparian vegetation River channel morphology Flora and fauna
Naturalness	Human intervention, artificial, care, control, diverse, wild, neglect		Natural, wild riverine landscape intuitively desirable Neat, tidy and organised landscapes signify care and maintenance Landscapes are symbolic representations of local communities	More natural system supports flora and fauna The restoration scheme produces an artificial riverine environment	Scenic beauty Riparian vegetation River channel morphology Flora and fauna
Surrounding landscape	Feature within broader landscape, connection, pathway		Pride, belongingness and sense of place associated with the river as part of the wider landscape	River provides an ecological and human pathway through the wider landscape	Riparian vegetation River channel morphology Cleanliness
Disturbance and familiarity	Access, vegetation recovery	Vegetation and wildlife disrupted during and following engineering works Footpath access to the riverine environment unavailable during engineering works	Physical disconnection from the riverine environment during the engineering works		