3

Enhancing Straightened River Channels

3.6 Creating a sinuous low flow channel in an over-widened river

RIVER DEARNE

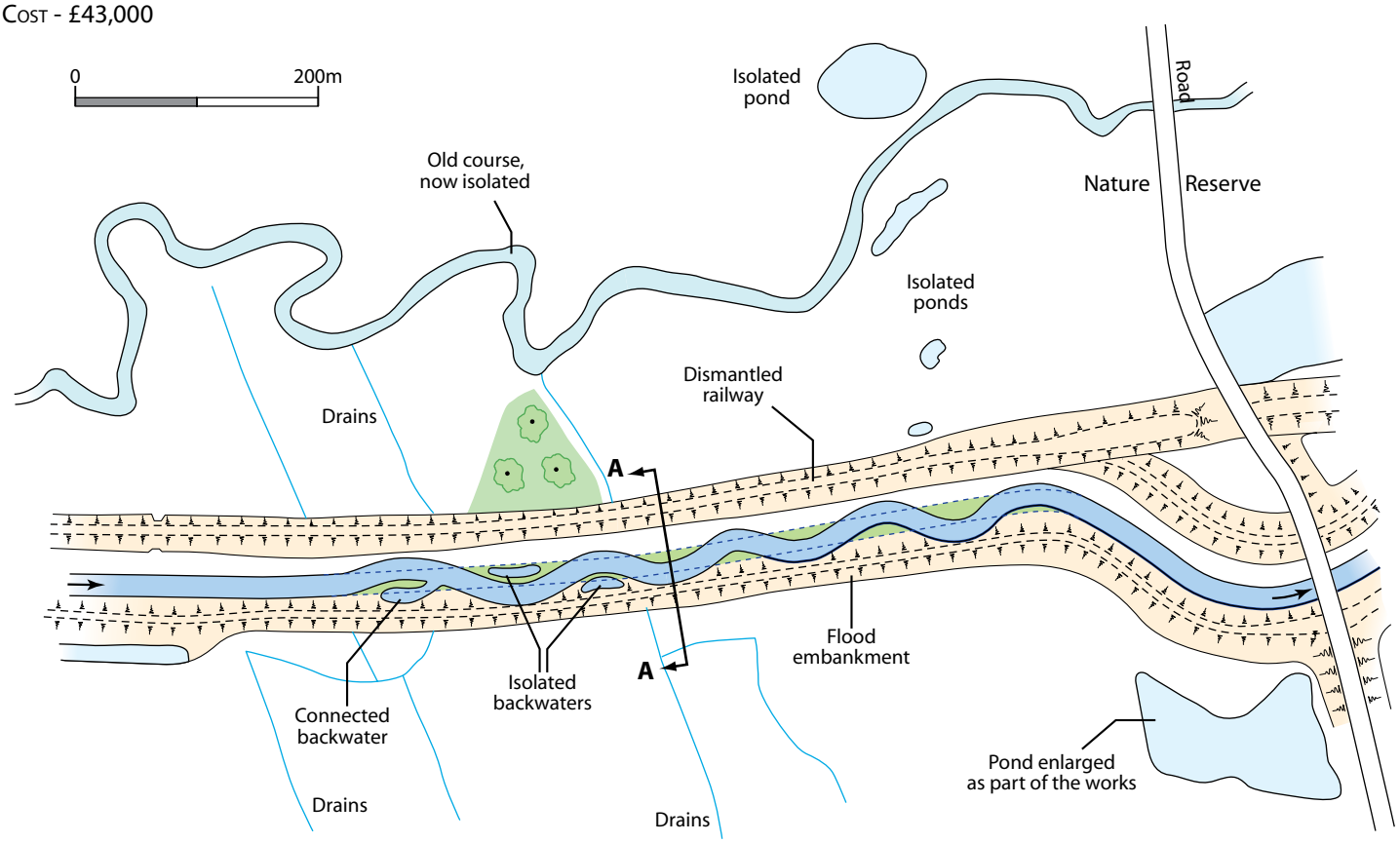
LOCATION - MEXBOROUGH, WEST OF DONCASTER, SOUTH YORKSHIRE SE484012

DATE OF CONSTRUCTION - SUMMER 1995

LENGTH - 500M

COST - £43,000

Figure 3.6.1
PLAN OF SITE



Description

The lower River Dearne had suffered substantial changes to its natural gradient as a result of subsidence problems caused by deep mining operations. To alleviate this problem, a new, straight and featureless river was created in the 1970s to ensure efficient evacuation of floodwater. The design standard for the channel was calculated to be approximately 1 in 150 years (50% greater than required). The lack of physical diversity resulted in excessive emergent vegetation growth which extended across the channel and further impeded flow. Prior to the works, high terrestrial berms rose up to the flood banks. The river bed substrate was composed predominantly of nutrient-rich silt, overlaying some transported gravels.

Some of the subsided land adjacent to the abandoned old channel formed wetland habitat, which has subsequently been designated as a SSSI. However, the wildlife value of the canalised river was very low due to its physical uniformity, poor water quality and low gradient. Water quality began to improve in the 1980s due to mine closures and improved sewage treatment, and the river became valued as a coarse fishery. Its potential was however limited by the lack of in-stream physical habitat diversity, which left few opportunities for fish to spawn.

Meandering was not a viable option, and so the creation of a low-flow channel was deemed beneficial for all interests. A narrow channel would create a self-sustaining coarse substrate with greater water velocity, which in turn should reduce the extent of siltation and reed (*Phragmites spp.*) growth.

A scheme was developed which would maximise the present fishery and the wider spawning potential of the river by introducing sinuosity into the straight, over-widened channel. It would also demonstrate reduced maintenance benefits whilst having no detrimental effect on flood protection.

The proposed scheme was a drastic reduction in width, with a very sinuous course created by constraining the low-flow width by large boulders. The previous over-design of the straight course allowed for such work to be undertaken and still provide the necessary flood protection standards.

These techniques were developed to suit site specific criteria and may not apply to other locations

Enhancing Straightened River Channels

3

River Dearne. Wide and straight, choked in summer

New sinuous reed-fringed course

Design

The sinuous low-flow channel was defined by placing stone in the river to form the 'inside' of each bend. Locally occurring magnesium limestone was chosen. The decision to armour was taken to provide a defined channel and to be removable in the event that flood defence concerns arose.

Placement was carried out by an excavator from within the channel as water levels only varied between 0.3m and 0.7m.

Work started upstream and looked initially to increase velocities in the first two bends to 0.5m/s, reducing the increase to near existing flows (approximately 0.2m/s) at the final bend.

In this way the narrowing of the low-flow channel was determined by a combination of estimating the reduction required and measuring the velocity after placement of the boulders.

Placement of limestone boulders and berm back-filling

3 Enhancing Straightened River Channels

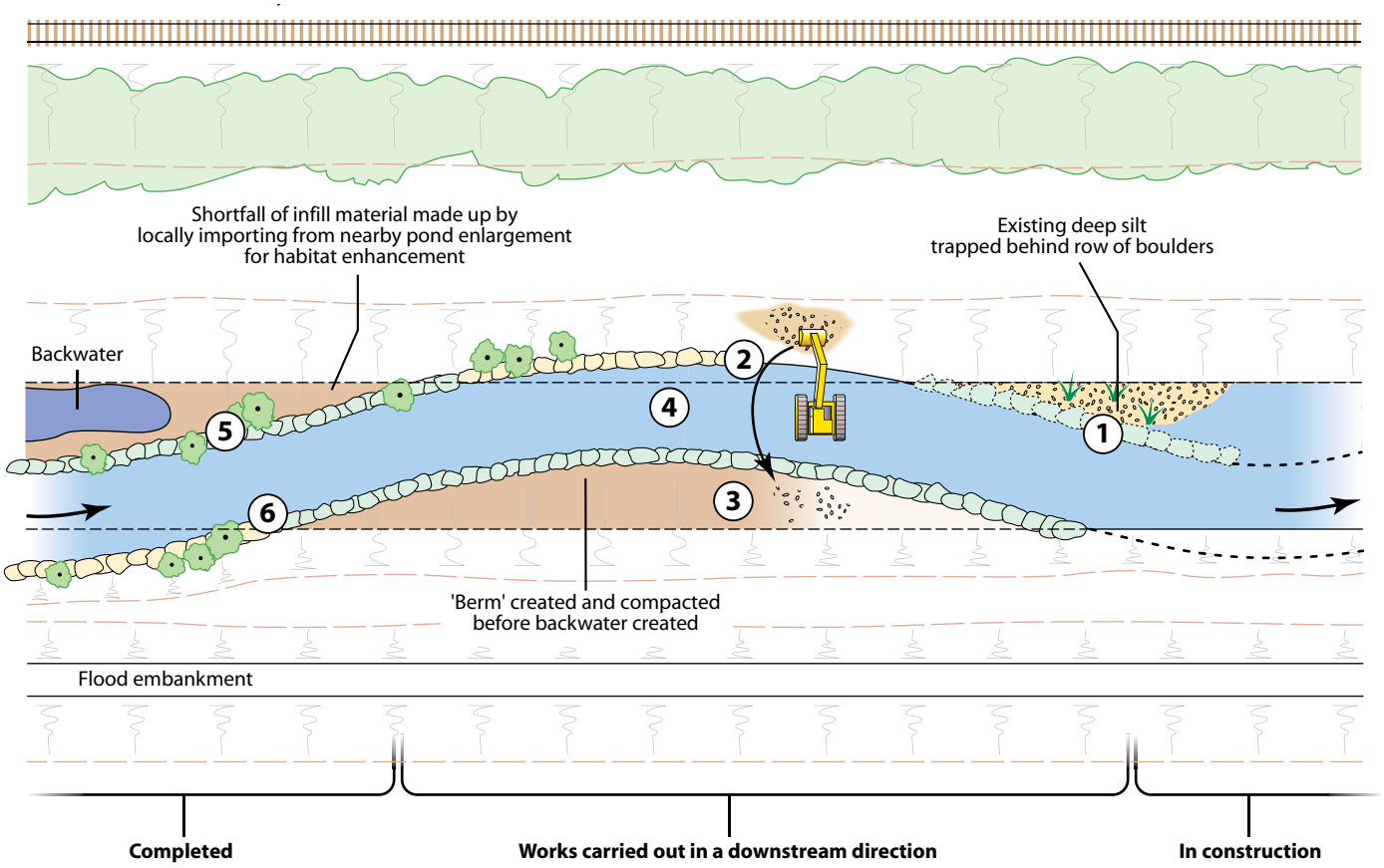
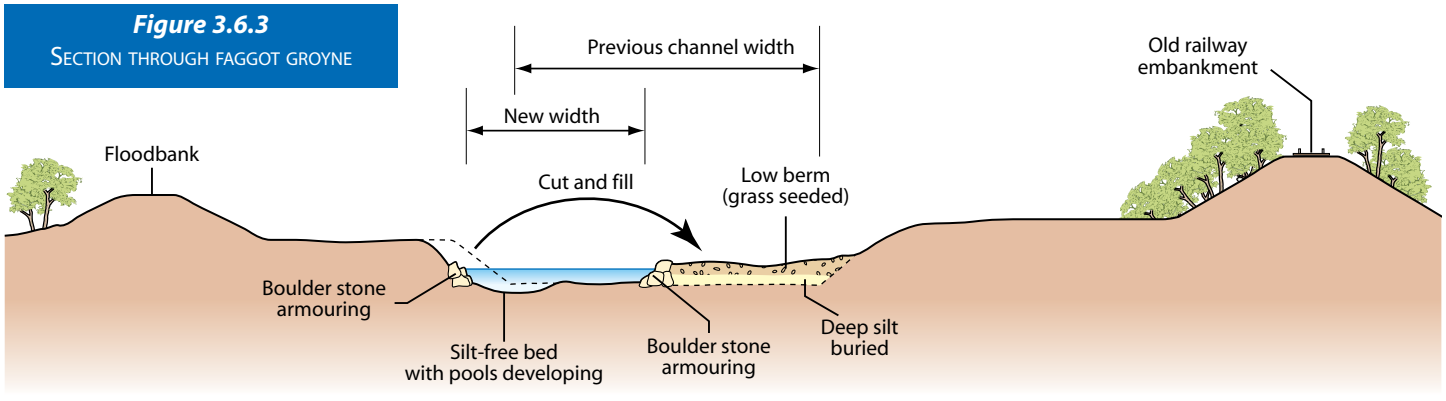


Figure 3.6.2
PLAN OF WORKS

Figure 3.6.2 shows the construction process in six phases:

1. 'Inside' of bend defined by placing limestone boulders into the channel;
2. 'Outside' of bend shaped by excavating material from the opposite steep bank;
3. Material from 2 used to backfill the 'inside' bend forming a low berm;
4. Additional limestone boulder armouring placed on toe of 'outside' bend;
5. Backwaters excavated within the low berms created;
6. Berms and banks seeded with a grass mix and later planted with standard trees.

Figure 3.6.3
SECTION THROUGH FAGGOT GROYNE



These techniques were developed to suit site specific criteria and may not apply to other locations

Enhancing Straightened River Channels

3

Narrowing increased velocities and created riffles used for fish spawning

The low-flow channel included three small backwaters and scrapes, and the low berms were created at a variety of levels to enable the establishment of a range of riparian communities, from swamp to dry grassland.

The former 10m wide channel was narrowed by up to 5.5m in this way, but maintained flood capacity by equating cut and fill and ensuring that the in-channel structures were kept to a low level. The new low-flow berms, were designed to be submerged during floods.

The berms and banks were seeded as soon as the earthworks had been completed so that the root system would consolidate the new earth banks before winter floods. Seeding was completed by late summer and growth was well advanced before the end of the autumn. This also limited potential erosion through heavy rain.

Some transplanting of emergents from the channel was carried out, both in front of and within the rock armouring, to promote vegetation of the berm edge.

The successful completion of the first 500m section prompted a rapid implementation of a similar length in 1996/97.

Subsequent performance 1995 – 2001

By creating a sufficiently narrow low-flow channel the effect on the silty bed was immediate. Within two weeks of completion the majority of the silt had been cleared. Deposition of gravel and silt occurred rapidly on the inside of the bends with pools (up to 2m deep) having since developed at the apex. The silty areas have promoted the colonisation of marginal plant species.

Fisheries surveys since the works were completed show the beneficial effect of the scheme. Numbers of chub (*Squalius cephalus*), dace (*Leuciscus leuciscus*), barbel (*Barbus barbus*), roach (*Rutilus rutilus*) and gudgeon (*Gobio gobio*) have all increased, but more importantly there is now successful spawning and recruitment of juvenile fish.

The limestone was rapidly colonised by algae and lichen once in place and silt deposition between the stones allowed a variety of waterside plants, including reeds and sedges (*Cyperaceae spp.*) to quickly become established. By summer 1996 marginal reeds were beginning to grow and by autumn 1996 the reed growth had masked the armouring.

A small amount of erosion occurred in two areas, which were not protected. In one location rock armouring and willow (*Salix spp.*) planting was used to address this problem, but in the other the river was allowed to widen into a pool.

Live willow stakes were inserted along both banks and on the new berms to provide cover and supplement the self-set trees already establishing at the margins.

The two unconnected backwater pools dried out due to the hydraulic draw of the river through the loosely compacted fill material. To mitigate this effect upstream connections were made using 0.1m diameter plastic pipes.

Two years post-works, an audit of the scheme reported an annual saving of between £2,500 and £3,000 in reduced maintenance costs as a direct result of the work carried out.

Original Information Provider.:
Chris Firth OBE.

Main channel and backwater 5 years on, Summer 2000

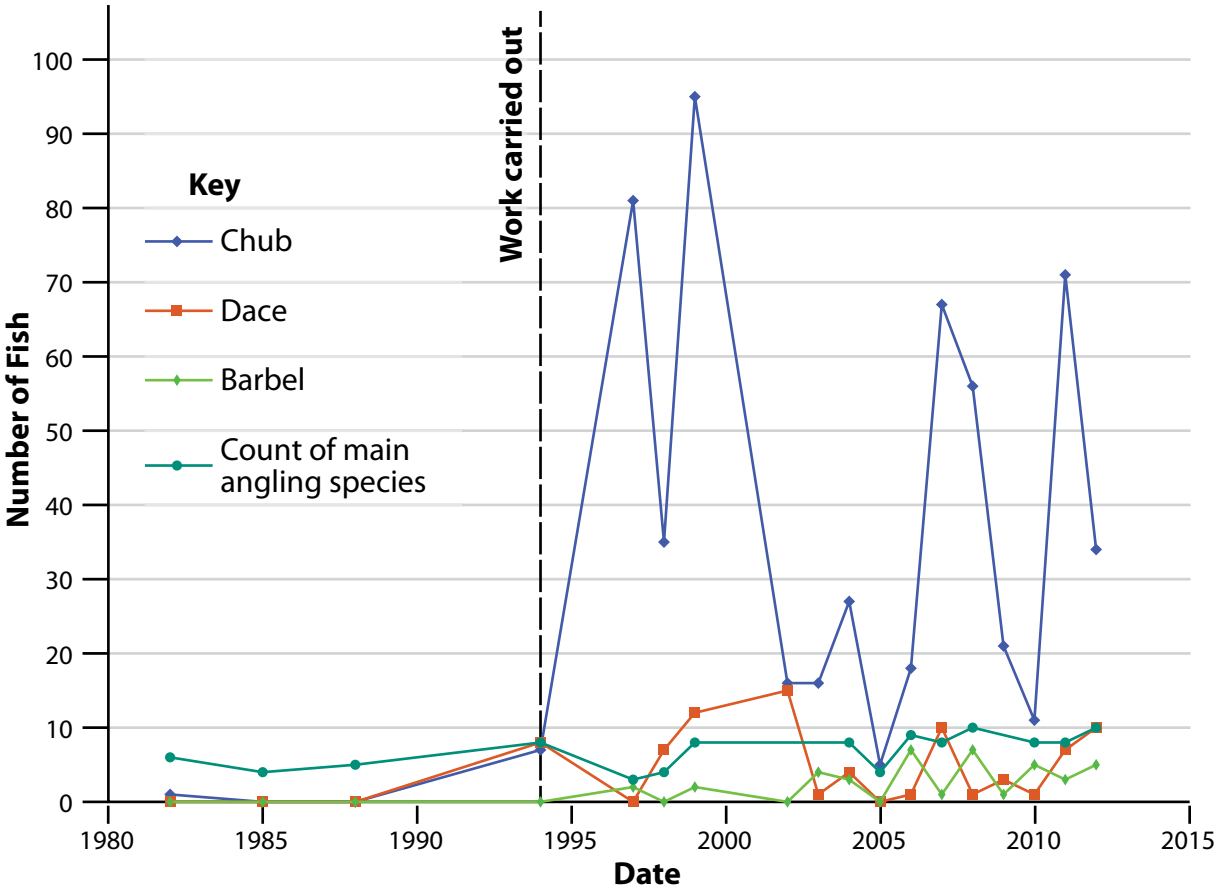
3

Enhancing Straightened River Channels

3.6 River Dearne 2013 Update

The narrowed channel has increased velocities and as a result sediment has been transported downstream, maintaining clean gravel spawning grounds in the restored reach. Anglers are happy with the results of the scheme and have commented on improved fish size in the area. Two particularly successful seasons for recruitment and spawning, 2010 and 2008, are cited as the reason for this. In 2012 a Barbel of over 10lbs was recorded at this site. Fish populations are monitored annually and both the number and diversity of fish species has increased following the works.

River Dearne	Low energy, gravel
WFD Mitigation measure	**Click Here** to view details
Waterbody ID	GB104027063173
Designation	SSSI
Project specific monitoring	Fish



Fisheries data showing changes in the count of species of anglers over time.
The data indicates improvement in the count of the main angling species and significant increases in the numbers of some individual species.
(*Pastures Bridge site, EA data)*

These techniques were developed to suit site specific criteria and may not apply to other locations

Of the three backwaters created along the channel, two have now silted up and only operate in very high flows. The third was breached at its top end and has formed a secondary channel. This provides a relatively sheltered environment that anglers indicate holds fish fry under normal conditions. If the breach had not occurred it is highly likely that this backwater would also have silted up. Whilst the silted backwaters are not functioning as fish habitat as they were intended, they do have wider biodiversity benefits.

© Environment Agency

Main channel and operational backwater – October 2012

Occasional tree management continues to be necessary along the banks and involves pollarding of willows. When one section is cut, the adjacent section is left to ensure that some cover is always available.

The scheme has been successfully replicated at two upstream locations on the same watercourse. The use of similar backwater features located within the low flow berm areas were not included by the Rivers Trust at these sites, due to the risk of rapid siltation. Whilst the backwaters created for this scheme are not functioning as fish habitat, they have wider benefits to biodiversity and as such any Environment Agency schemes would probably still include them. This project has demonstrated the need to design accordingly depending on the desired aim of the backwaters. Building a maintenance plan would also be beneficial to address the likely siltation of backwaters.

Contacts

Chris Firth OBE, Don and Rother Rivers Trust
chris.firth@dcrt.co.uk, 01302 539489

Andrew Virtue, Environment Agency (*North East*)
andrew.virtue@envrionment-agency.gov.uk, 08708 506506