



Working to restore & enhance our rivers

ENHANCING STRAIGHTENED RIVER CHANNELS

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

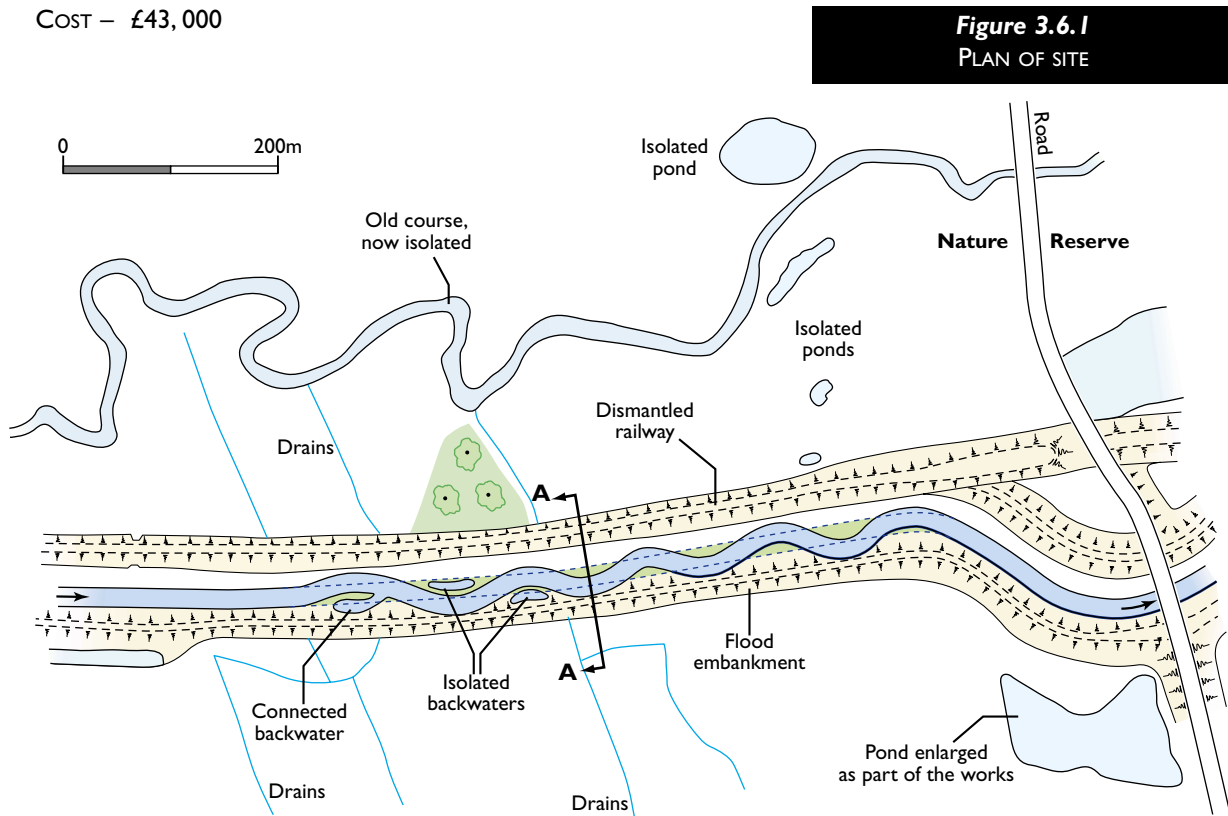
RIVER DEARNE

LOCATION – Mexborough, West of Doncaster, South Yorkshire SE 484012

DATE OF CONSTRUCTION – Summer 1995

LENGTH – 500m

COST – £43,000



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 1970's to ensure efficient evacuation of floodwater. The design standard for the channel was calculated to be approx. 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 floodbanks. 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 an 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 1980's 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 (mainly chub and dace) 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 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.

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RIVER CHANNELS



River Dearne. Wide and straight, choked in summer

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.

DESIGN

The sinuous low-flow channel was defined by placing stone in the river to form the 'inside' of each bend.



New sinuous reed-fringed course

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 300 and 700mm. Work started upstream and looked initially to increase velocities in the first two bends to 0.5 m/s, reducing the increase to near existing flows (approx. 0.2m/s) at the final bend.



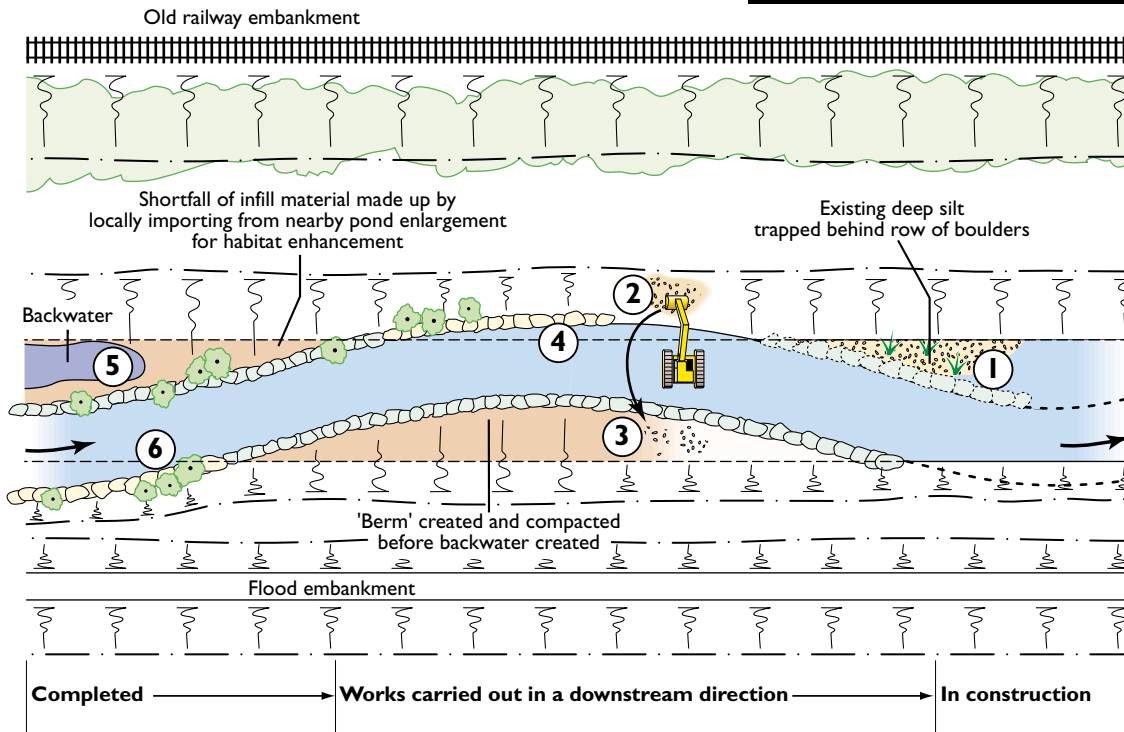
Placement of limestone boulders and berm back-filling





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Figure 3.6.2
PLAN OF WORKS



Key

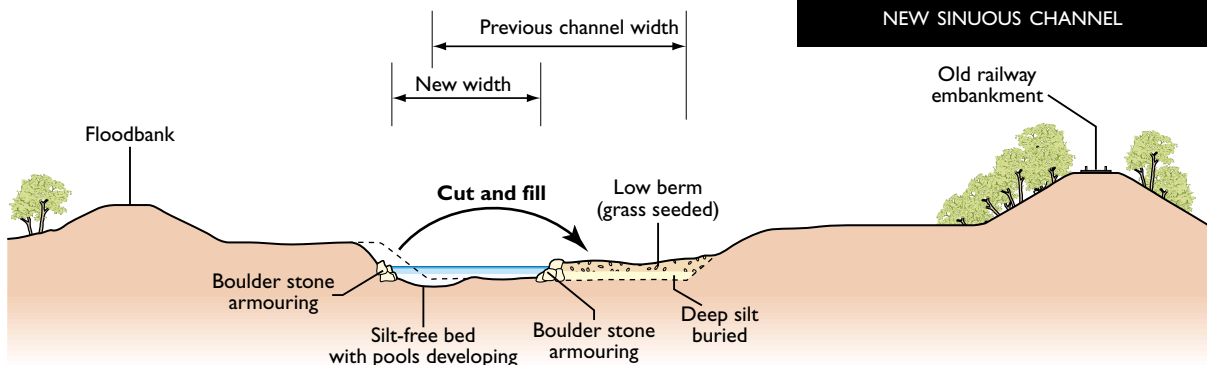
- Stone boulders placed 'in' river
- Stone boulders placed on bank toe
- ①-⑥** Numbers appear in text 'design sequence'

Figure 3.6.2 shows the construction process in 6 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 armoring 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.

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.

Figure 3.6.3
SECTION A THROUGH NEW SINUOUS CHANNEL



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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.



Main channel and backwater
5 years on, Summer 2000

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, dace, barbel, roach and gudgeon 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 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 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 100mm dia. 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.

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