Upper River Witham: Great Ponton

v2 (04.01.19)

(including the Grange Farm channel re-alignment to create a naturalised river channel)

Location: Great Ponton, Lincolnshire (south of Grantham)

Upstream Grid Refs: Phase 1: SK930305; Phase 2: SK930290; Phase 3: SK926280

Length: Phase 1: c450m; Phase 2: c2.5km; Phase 3 (channel re-alignment): 620m

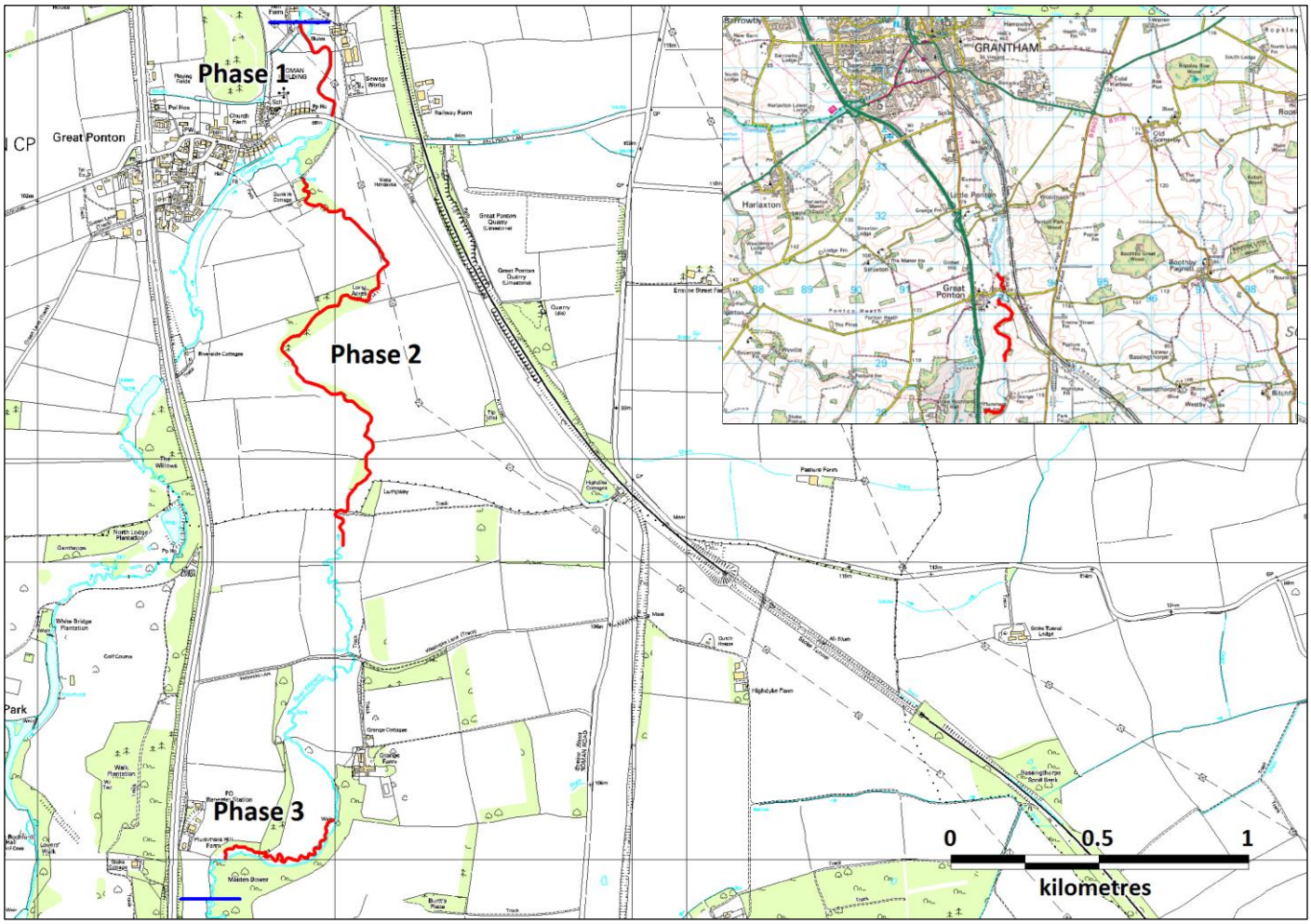
Completion Date: Phase 1: February 2013; Phase 2: July 2014: Phase 3 (channel re-alignment): August 2015

Cost: Phase 1: c11K; Phase 2: c£30K; Phase 3 (channel re-alignment): c£80K

Partners: These schemes were implemented by the Environment Agency in partnership with the Wild Trout Trust and Grantham Angling Association Fly Fishing Section (GAAFFS). They were made possible by the co-operation and agreement of the adjacent landowners (Stephen Jackson, Stoke Rochford Estate, Buckminster Estate)

Summary of Techniques: Channel narrowing and flow deflection to create flow variation and beneficial bed scour using a variety of techniques: log flow deflectors (vanes), open and enclosed log/faggot and brushwood mattresses (silt-traps); increasing in-stream woody habitat by securing existing deadwood and hinging and pinning (layering) live riverside trees; creation of sections of 2-stage channel and enhancing marginal wetland habitat by excavating of bays/berms; and the reduction of sediment inputs by ford refurbishment and riverside fencing. The final phase involved major works to restore a section of the river to a more natural planform.

Location Map



Background

The Upper River Witham rises west of South Witham and flows for more than 65 km northwards through Colsterworth, Great Ponton, Grantham, Long Bennington, Bassingham and North Hykeham towards Lincoln. More than 165 km of river and tributary streams drain the c573 km^2 catchment.

The landscape of the catchment is varied in character, ranging from the livestock-dominated limestone valleys upstream from Grantham, through the mixed farming terrain of the middle reaches, to the flat-lying arable farmlands downstream from Long Bennington. Over recent centuries, and particularly the last 100 years, the once naturally meandering river channels have been straightened, deepened, widened, impounded and embanked to reduce flood risk and improve land drainage. These modifications, together with catchment land management practices, have contributed to a decline in river corridor habitat quality.

The Upper Witham and its tributaries are divided into 19 separate waterbodies for Water Framework Directive assessment and only 3 are assessed as having Good Ecological Status. The section of the Upper Witham which includes the Great Ponton reach is currently assessed as "Moderate" due to high phosphate levels, excessive algae (diatoms) and poor fish populations. The enhancement works at Great Ponton seek to address these issues as part of the wider *Upper Witham River Corridor Habitat Plan.*

Pre-project Survey Work

Phase 1: Walkover surveys to scope the enhancement works were undertaken.

Phase 2: Brown trout and native white-clawed crayfish are known to be present in this reach from the annual fish and crayfish surveys that are undertaken downstream of Dunkirk Cottage. There is an established invertebrate and turbidity survey sampling upstream of Dunkirk Cottage (SK 92930 30220) and a baseline channel cross-section has also been established here to monitor changes in the channel profile as a result of recently introduced in-stream woody material.

Phase 3: In addition to initial walkover surveys by Environment Agency staff and the Wild Trout Trust, which identified the fish passage and morphological issues caused by the weir and that restoration of the river to its original course was a potential option, levels/topographical surveys were undertaken to inform the design of the realigned river channel.

Project Objectives

The initial downstream phases were primarily designed to

- Stabilise eroding river banks to reduce sediment inputs caused by fluvial processes and livestock.
- Trap mobile fine sediments already in the river.
- Improve conveyance during higher flows and reduce flood risk.
- Improve in-stream habitats for fish and invertebrates, including white-clawed crayfish.

The final phase, at Grange Farm, set out to restore a degraded section of the river to its original course, such that the naturalised section of river would function in an ecologically and geomorphologically improved form.

Designs for phases 1 and 2 prepared by Environment Agency staff in consultation with Grantham Angling Association Fly Fishing Section (GAAFFS) and the riparian landowners. Phase 3 was designed by the Environment Agency and the Wild Trout Trust.

Consultation and Consents

Phase 1: An internal Environment Agency application for Flood Defence Consent to refurbish the ford was consented on 18th January 2013 (Internal Consent No. L/002626/12). Phase 2. GAAFFS was granted consent to undertake this phase of the scheme on 5th August 2013 (Consent No. L/002772/13). Phase 3: Another internal Environment Agency Flood Defence Consent application was approved on 29th January 2014 (Consent No. ANG_N-L_2014_3103).

The Enhancement Schemes

The initial enhancement work to improve the existing river channel was completed in two phases: the first (between Dallygate Lane and Great Ponton Mill) was completed in February 2013 and the second (between Washdike Lane and Dallygate Lane) in July 2014. Prior to the enhancement works the channel was suffering sedimentation as a result of eroding cattle crossings and bankside poaching, particularly in the downstream (Phase 1) reach, which was causing the loss of water-crowfoot (*Ranunculus*) and degradation of spawning gravels. Several sections of the upstream (Phase 2) reach were heavily shaded by riverside trees, preventing fine sediment that was accumulating at the margins from being colonised and consolidated by wetland vegetation.

In August 2015 the final phase of enhancement work was completed. Located at the top of the reach, this involved an ambitious project to bypass the redundant Grange Farm Weir by restoring the river to a more natural planform.

The drawings in Annex 1 show the detailed layouts of each enhancement scheme and the techniques used in phases 1 and 2 are described below, several of which have multi-functional benefits. Finally there is a more detailed description covering phase 3, the channel re-alignment at Grange Farm.

Tree Management

Several sections of the upstream (Phase 2) reach were heavily shaded by riverside trees. An important element of the scheme was to increase light levels to encourage the growth of emergent vegetation on the fine sediment that is accumulating at the channel margins - the growth of vegetation consolidates the silt as well as providing a trap for more fine sediments mobilised during high flows. Riverside trees were either coppiced to open up the channel and generate woody material which was used to create channel narrowing structures (see below), or hinged and pinned into the channel to create live flow deflectors. Some existing instream deadwood was also secured.

Fig 1 and 2. Examples of hinged and pinned bankside trees narrowing the channel

Channel Narrowing Structures

Brushwood mattresses and enclosures

A variety of techniques were used to create brushwood mattress and enclosures to protect vulnerable banks from erosion, to narrow the channel and trap suspended silt during high flows. These included:

Open (unenclosed) brushwood mattresses: small branches firmly secured with posts and wire bindings to create a mattress;

Log/faggot-faced mattresses: as above, but fully enclosed with either secured logs (generated from the riverside tree management) or faggots;

Log-fronted mattresses: brushwood mattresses partially enclosed by secured logs leaving the downstream end open to create a "backwater" which provides a valuable fish/fry refuge;

Faggot enclosures: secured faggots without any infill, which create slack pools within the channel and provide a repository for silt.

Log Flow Deflectors/Vanes

Logs derived from riverside tree management were used to construct flow deflectors and vanes. Flow deflectors are partially exposed above the water level, but slope down at a very shallow angle towards the centre of the channel, and are designed to deflect the flow during typical flow conditions, effectively narrowing the channel. Vanes, however, are permanently submerged. Deflectors and vanes create localised flow variation, helping trap and retain gravels; improve flows over/through gravel beds to keep them free from fine sediment; and improve the bed structure through scouring. Both types of structure, either in pairs or singles, are normally angled upstream to direct the flow towards the centre of the channel and minimise the potential for bank erosion.

Fig 3. Log-faced brushwood mattress under construction

Fig 4. Completed log-faced brushwood mattress

Fig 5. Log-fronted brushwood mattress (left bank)

Fig 6. Log vane

Excavated Bays/Berms

This technique was used where the banks were high, eroded and/or where the river was over widened. A new bank toe was formed using secured logs or faggots to create a new bank toe and a narrower channel. The adjacent bank was then reprofiled to create a more gently sloping riverbank. This resulted in a bay/low berm behind the new toe and the creation of 2-stage channel, which was narrow during typical flows, but provides increased channel capacity as the water level rises.


Fig 7. Sections of 2 stage channel created by reprofiling the bank against a new (a) faggot and (b) log bank toe.

Fig 8. New berm stabilised by vegetation.

Ford Refurbishment

Between Dallygate Lane and Great Ponton Mill the river is crossed by a ford which also functions as a cattle drinker for both banks. Prior to refurbishment the ford was in poor condition with bare, severely poached and eroded earth access ramps and nothing to prevent cattle access to the river upstream and downstream. Refurbishment involved reprofiling the access ramps and consolidating the slopes and crossing point with crushed limestone to create a porous hard-standing. Post and rail fencing was erected to control access to the ford and electrified “scare-wires” now cross the river to discourage cattle access to the river channel.

A second ford, in the upstream (Phase 2) reach, was refurbished more simply by resurfacing the ramps with limestone.

Figs 9. The ford downstream of Dallygate Lane (a) before and (b) as the refurbishment was nearing completion

Fencing

Accumulation of sediments along the banks has naturally narrowed the channel upstream of the mill and bypass channel and, as a result wide, vegetated, wet berms are developing along both banks. To prevent cattle from overgrazing and poaching these important wetland margins the banks have been fenced with post and 3 lines of barbed wire and a section of post and rail fencing in the paddock closest to the farm buildings. Post and wire fencing was also erected along the right bank either side of the refurbished ford. No additional fencing was installed during Phase 2 of the scheme.

Fig 10. Wide, wet, vegetated berms protected by (a) post and wire and (b) post and rail fencing

Grange Farm Weir: Restoration of Natural River Channel

Grange Farm Weir was constructed in the mid-19th century. Its purpose was to impound a section of straightened river channel to provide a head of water to power a, now redundant, hydraulic-ram water supply to Grange Farm. The Grange Farm project involved the bypassing of this weir by restoring the river to a more natural planform.

Prior to the restoration work the straightened channel, impounded by the weir, was ecologically degraded, morphologically uniform and suffering from heavy sedimentation, with fine silt bed deposits in excess of 1m thick. The degraded condition of the impounded reach contrasted sharply with the unmodified, meandering and morphologically diverse gravel bed of the reach immediately upstream.

Fig 11. Grange Farm Weir

Fig 12. The course of the river prior to realignment

To create a naturalised section of river, which functions in an ecologically and geomorphologically sustainable manner, the dimensions, gradient and planform of the channel were carefully designed, taking into account the available space, the character of the floodplain, the amount of flow expected through the new channel and the natural river morphology that would be expected in this location.

Landscape evidence also informed the design. Site walkovers and LiDAR survey data identified clear evidence of the former course of the river and this information was used to design the shape of new, meandering river channel. The new channel design also incorporated an extended pool-riffle sequence. This is the natural form that would be expected of the river here and it provides the basic frame of the new channel.

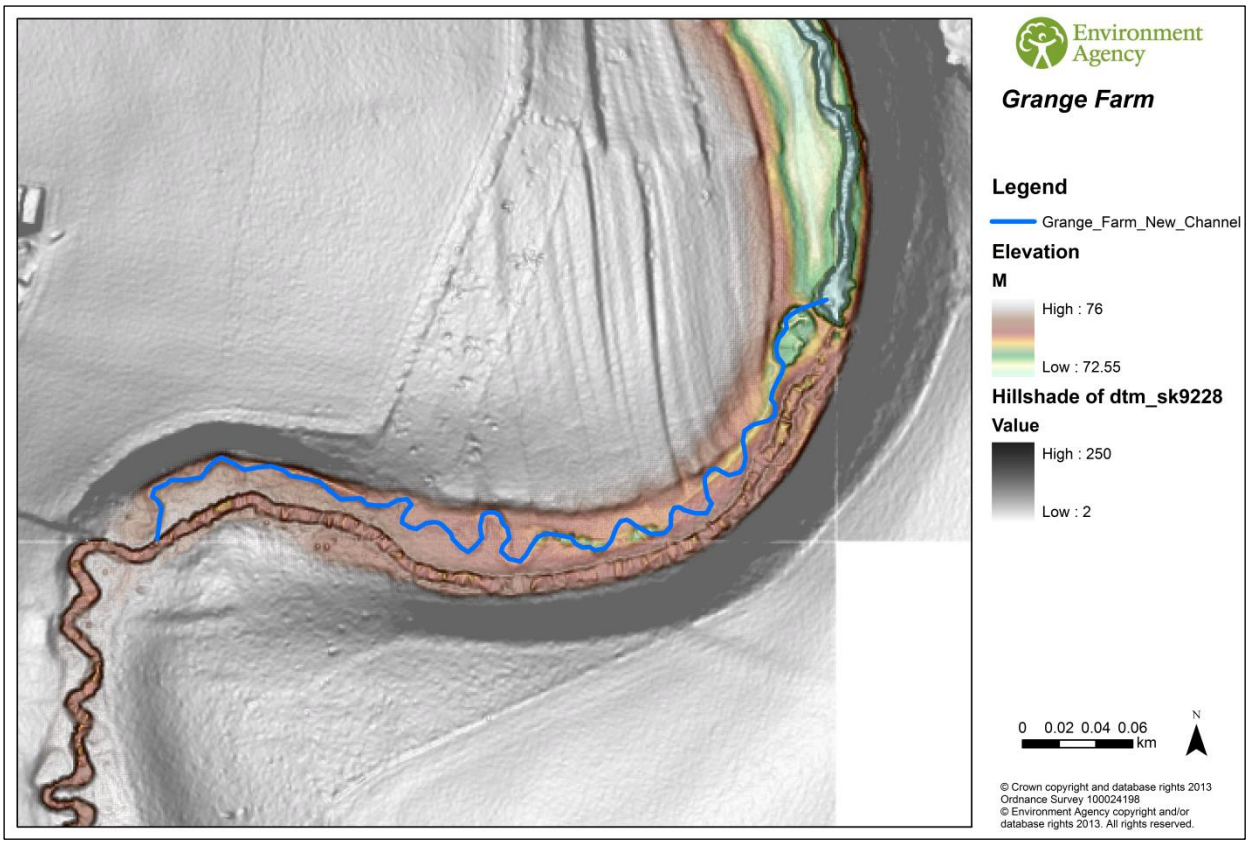


Fig 13. Topographical image generated from LiDAR data showing the designed alignment of the restored channel

The fields were mown prior to the works and the new planform of the river and the locations and levels of the riffles and berms were set out on the ground. The excavation of the new channel took 9 weeks, with excavated material being stockpiled either side of the new course and along the length of the straightened channel above the weir. With the new channel still dry, gravel was introduced to create a series of 26 riffles, before the connection was made at the upstream end and water was introduced into the new channel for the first time. Finally, with the river now running over its new course and leaving the weir in situ, excavated soils were used to infill the former channel and excess material was reprofiled higher up the floodplain.

Fig 14. Initial mowing of the working area

Fig 15. Start of the channel excavation following pegging out of the planform on the ground

Fig 16. The meanders and berms are taking shape

Fig 17. Gravel was introduced at predetermined locations while the channel was still dry to form the pool- riffle sequence

The new riffles are carefully located to control the flow over the now shallower bed gradient – the length of the channel has been increased by 150m (c30%) as a result of the works - and the riverside berms create a 2-stage channel that increase connectivity between the river and its floodplain.

The completed scheme delivers multiple environmental and ecological benefits, including re-establishment of fish passage (a Water Framework Directive priority), increased geomorphological continuity, and a diverse and healthy aquatic environment for fish and other aquatic life, in particular white-clawed crayfish.

Fig 18. One of the new riffles

Fig 19. The meandering channel and berms (2-stage channel)

Fig 20. Reprofiling the excavated soils

Fig 21. The completed scheme

Monitoring

For all phases, visual inspections and regular fixed-point photographs are being undertaken to monitor the integrity and performance of the enhancement works and record any changes they are making to river morphology. Specific to Phase 2, modifications to the channel profile as a result of the woody material introduction upstream of Dunkirk Cottage can be determined by comparison with a baseline cross-section in this location and the effects on turbidity and invertebrate populations will also be monitored here. For phase 3, in addition to an annual redd (trout spawning "nest") survey of the new riffles, the established annual fish monitoring downstream of Easton Walled Garden and invertebrate sampling at Easton Lane Bridge will be used to detect any changes as a result of the works.

Management

Future management of the fencing and fords is the responsibility of the riparian landowners and GAAFFS will monitor and maintain the integrity of the new in-stream features. GAAFFS will also undertake the management of riverside trees as required so that the mix of marginal woody habitat and occasional shade trees is maintained.

Suppliers of Services and Materials

Channel realignment, other machinery works (ford refurbishment and bank reprofiling) plus tree works and in-stream structures
P&R Plant Hire, Fleet, Spalding, Lincs. PE12 8NG. Tel 01406 422669. www.pandrplanthire.co.uk

Fencing and additional tree works and in-stream structures
Woodland and Water Management Ltd: dom@woodland-water.co.uk or Tel. 01327 349073

Further Information

For further information about Phase 1 contact:

Matt Parr, Technical Officer, Fisheries, Biodiversity and Geomorphology Team. Environment Agency, Lincoln
T. 0203 025 5014. E. matthew.parr@environment-agency.gov.uk

For further information about Phases 2 and 3 contact:

Katie Murphy, Technical Officer, Fisheries, Biodiversity and Geomorphology Team. Environment Agency, Lincoln
T: 0203 025 4996. E: katherine.murphy@environment-agency.gov.uk

The Water Framework Directive

The Water Framework Directive (WFD) is a major area of work for the Environment Agency. The WFD aims to get all water bodies - lakes and groundwater aquifers as well as rivers - into 'good ecological status' - or better - by 2027, with a series of 'landmarks' (2015 and 2021) to check progress.

The Water Framework Directive became UK law in December 2003. It provides an opportunity for the Environment Agency to plan and deliver a better water environment with the focus on ecology.

The Water Framework Directive will help to protect and enhance the quality of: surface freshwater (including lakes, streams and rivers); groundwater; groundwater-dependent ecosystems; estuaries and coastal waters out to one mile from low water.

The Environment Agency is the lead authority in England and Wales to carry out:

- Improvements on inland and coastal waters through better land management and protect them from diffuse pollution in urban and rural areas
- Drive wiser, sustainable use of water as a natural resource
- Create better habitats for wildlife in and around water
- Create a better quality of life for everyone

The Environment Agency is the leading organisation for protecting and improving the environment in England and Wales. We are responsible for making sure that air, land and water are looked after by today's society, so that tomorrow's generations inherit a cleaner, healthier world.

Glossary

Berm: A low, often wet, ledge or terrace at the edge of the stream that constricts the flow and allows a vegetated wetland margin to develop.

Brash: fine woody material including thin branches and twigs.

Coppicing: cutting of a tree just above ground level resulting in the regrowth of a number of shoots. The shots are allowed grow to provide long straight poles which are re-coppiced on rotation.

Faggot: a bundle of brushwood (or brash) tied together into a cylindrical shape. Used as bank revetment; to form flow deflectors; and to promote the deposition of sediment in marginal areas.

Fish pass: Structure to enable fish to gain access past a weir, sluice or other structure that would otherwise be impassable.

Flood Defence Consent: consent issued by the Environment Agency to carry out works in, over, under or near a watercourse or flood defences. An application for Flood Defence Consent is needed to ensure that any works do not endanger life or property by increasing the risk of flooding or cause harm to the water environment.

Floodplain: Area of land bordering a river that is prone to flooding.

Flow deflector (groyne): a structure projecting in to the river which is designed to constrict water flow and promote scouring and deposition of sediment.

Glide: a section of stream characterised by moderately shallow water with an even flow that lacks pronounced turbulence. Although most frequently located immediately downstream of pools, glides are occasionally found in long, low gradient streams with stable banks and no major flow obstructions. The typical substrate is gravel and cobbles.

Layering (also laying or pleaching): A technique where a small tree is partially cut at the base leaving a narrow bark and sapwood hinge which enables the tree to be laid down. The tree remains alive and able to continue growing.

Large woody material: pieces of naturally derived timber generally held to have dimensions greater than 10cm in diameter and 1m in length.

Left/right bank: the left/right hand bank of a watercourse as observed whilst facing downstream.

Meander: a meander is a bend in a watercourse formed as water erodes the outer bank and deposits the eroded sediments on the inside of the bank.

Poaching: river bank damage caused by the hooves of livestock resulting in the loss of vegetation and soil erosion.

Pollarding: similar to coppicing, except that the tree is cut at approximately head height to prevent damage by grazing animals. Trees managed in this way are known as **pollards**.

Pool: a deep section of stream bed with very little surface flow, typically located at the outside of a bend.

Revetment: works to protect the bed or banks of a channel against erosion.

Riffle: a length of stream with a steep gravel, pebble and/or cobble dominated bed, a fast flow and a broken water surface, where the water flows swiftly over the completely or partially submerged substrate.

Riparian: along the banks of a watercourse.

Run: differs from a riffle in that, although the water surface is broken, the water depth is typically greater and the slope of the bed is less.

Scour: Erosion of the bed or banks of a watercourse by the action of moving water.

Sediment: material ranging from clay to gravel (or even larger) that is transported in flowing water and that settles as the flow slows down.

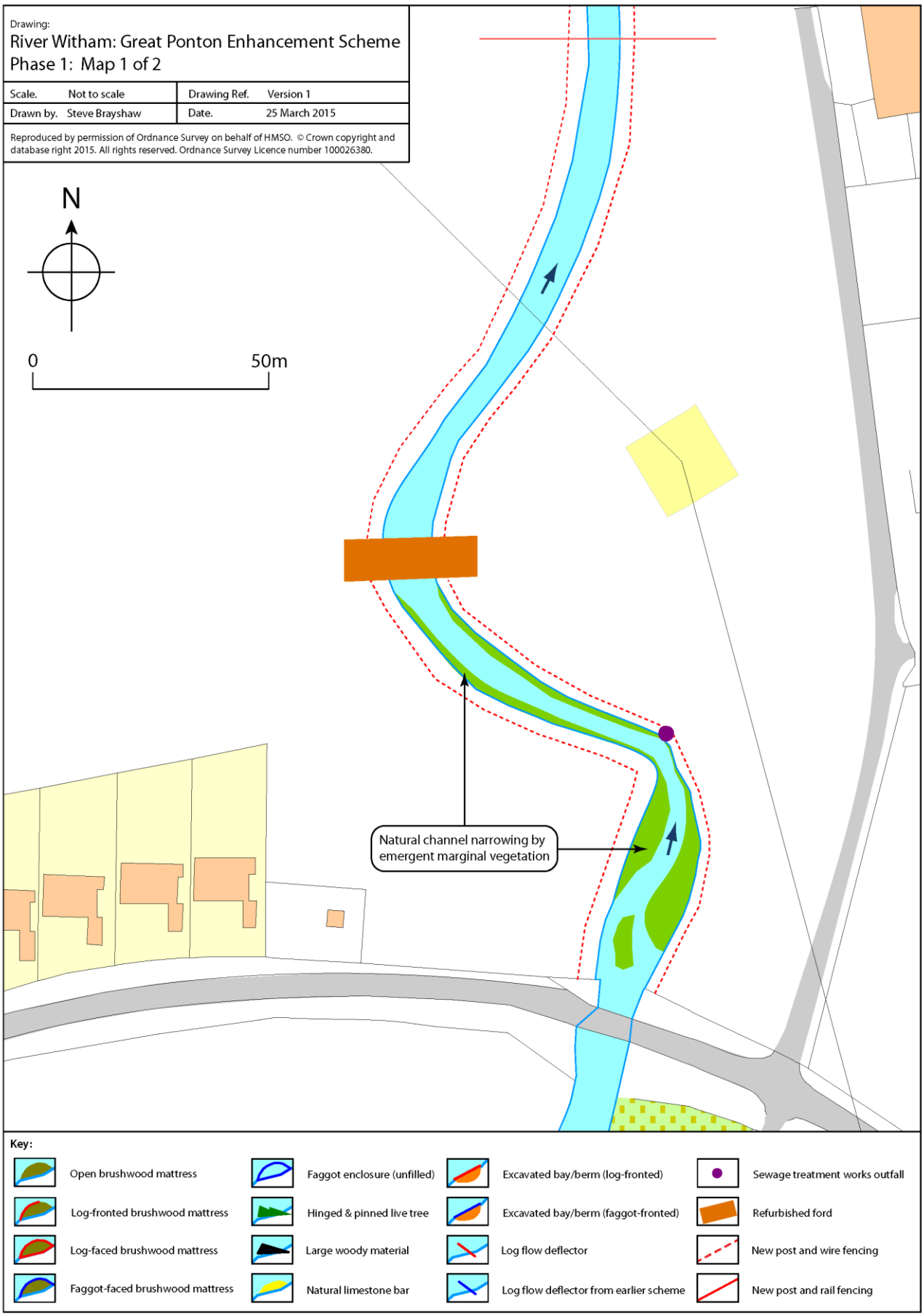
Shoal: sedimentation within or extending into a stream or other waterbody, typically composed of sand, silt and/or gravels.

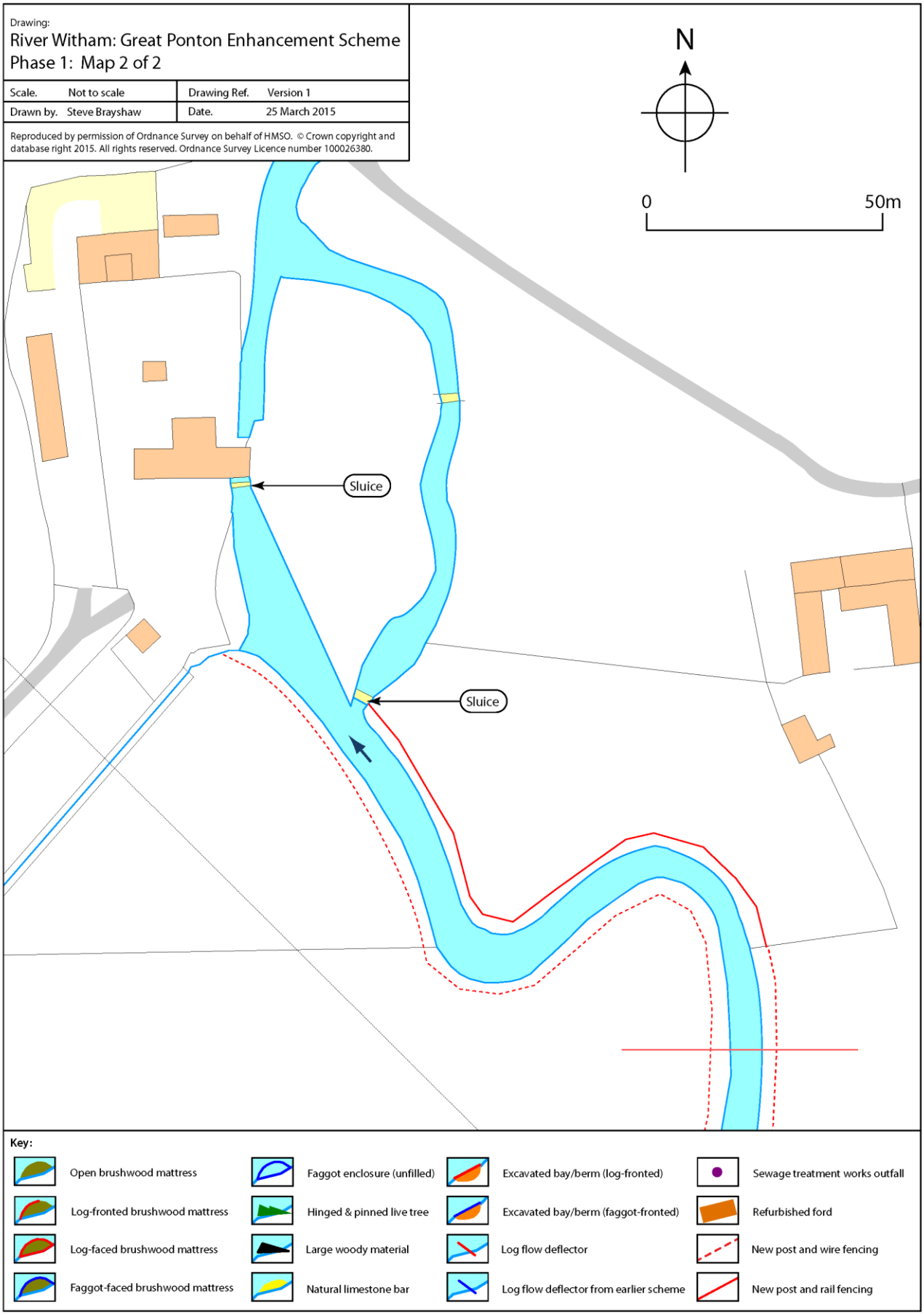
Spate (freshet): a period of fast river flow and raised water levels caused by heavy rain (or melting snow).

Spiling: the use of thin branches to create a woven ‘fence’ that protects the bank from erosion.

Toe (of the riverbank): where the river bed meets the bank.

ANNEX 1: The Completed Enhancement Scheme

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Open brushwood mattress
Log-fronted brushwood mattress
Log-faced brushwood mattress
Faggot-faced brushwood mattress
Faggot enclosure (unfilled)
Hinged & pinned live tree
Large woody material
Natural limestone bar
Excavated bay/berm (log-fronted)
Excavated bay/berm (faggot-fronted)
Log flow deflector
Log flow deflector from earlier scheme
Sewage treatment works outfall
Refurbished ford
New post and wire fencing
New post and rail fencing

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River Witham: Great Ponton Enhancement Scheme
Phase 2: Map 1 of 8

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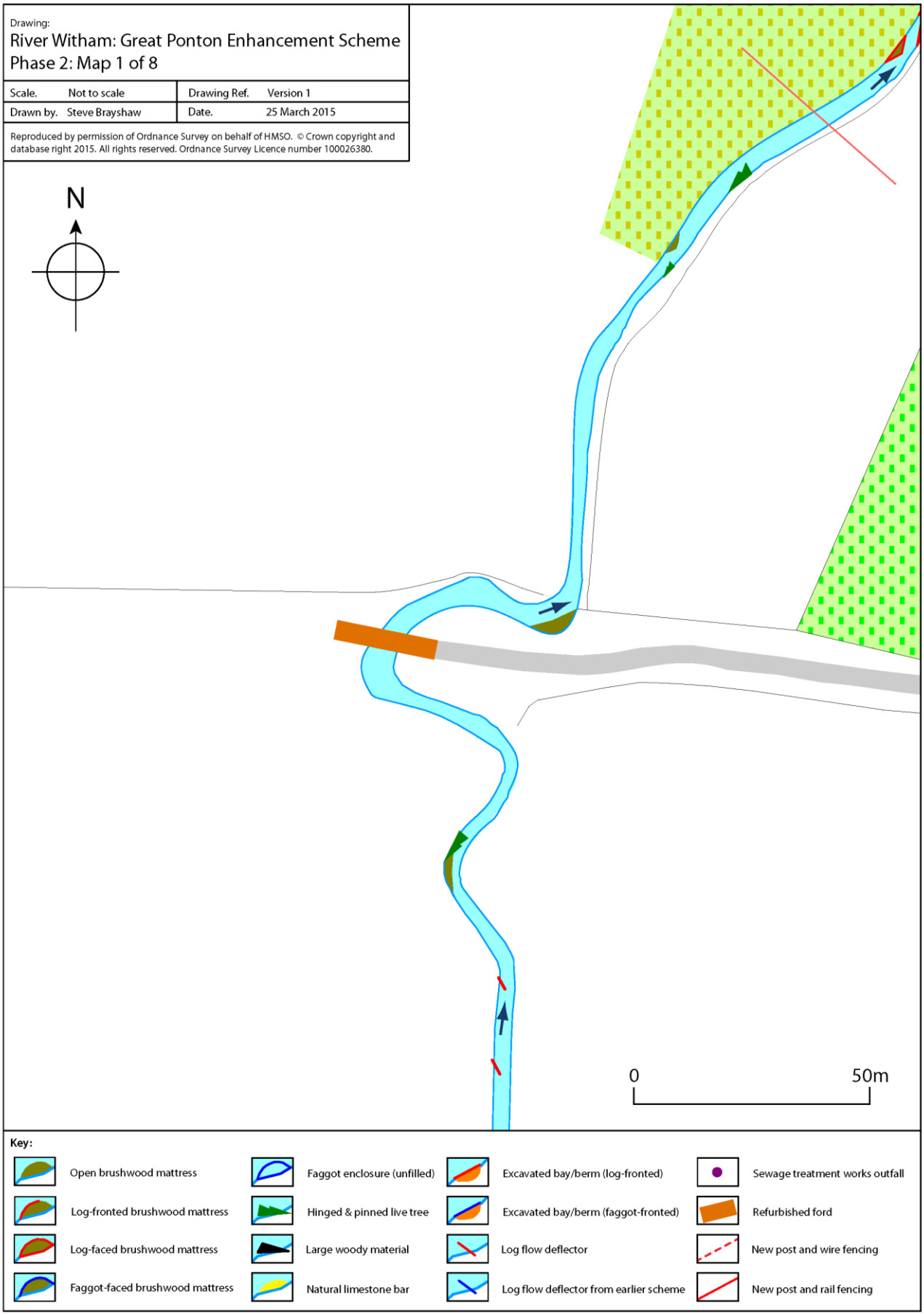

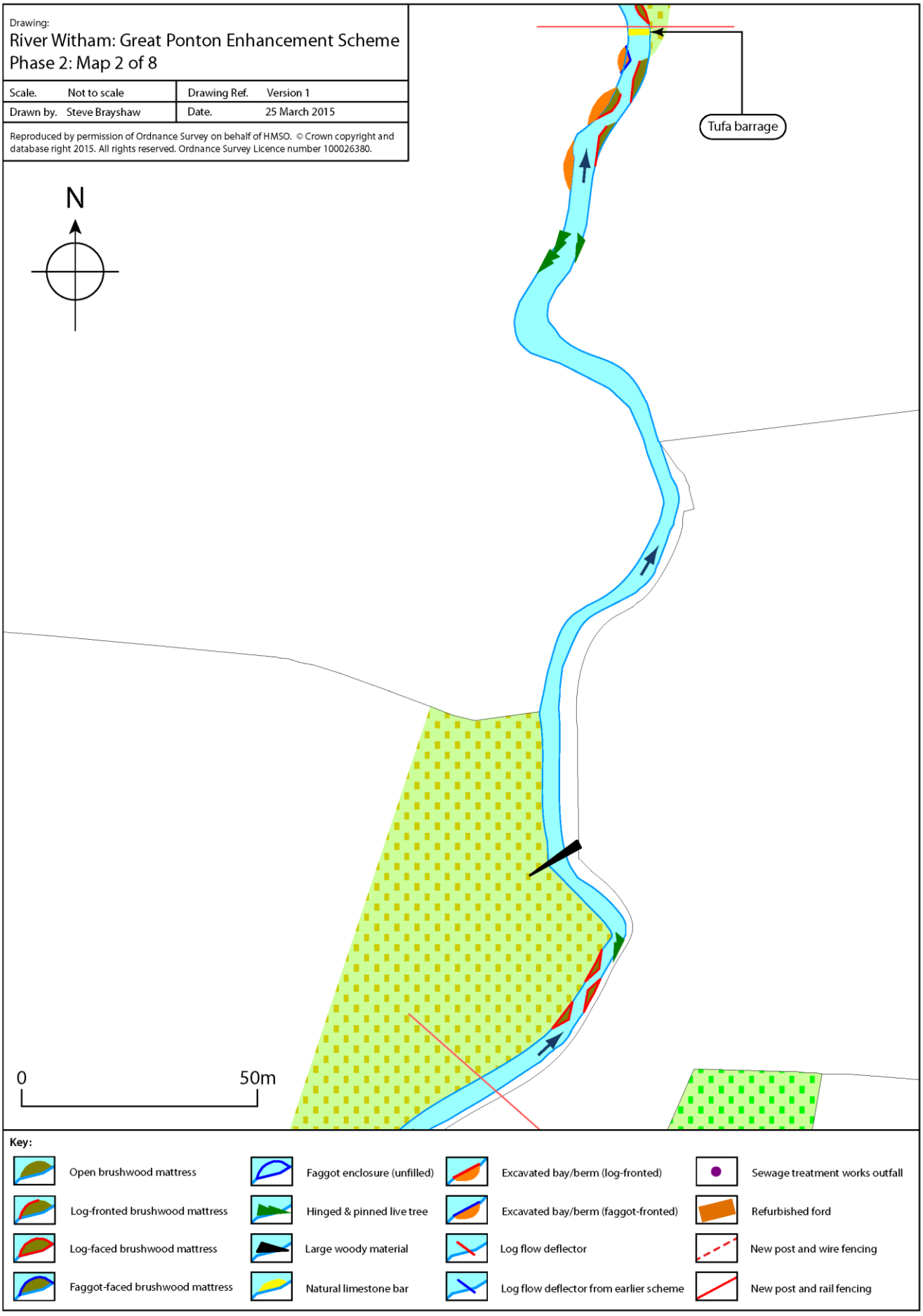
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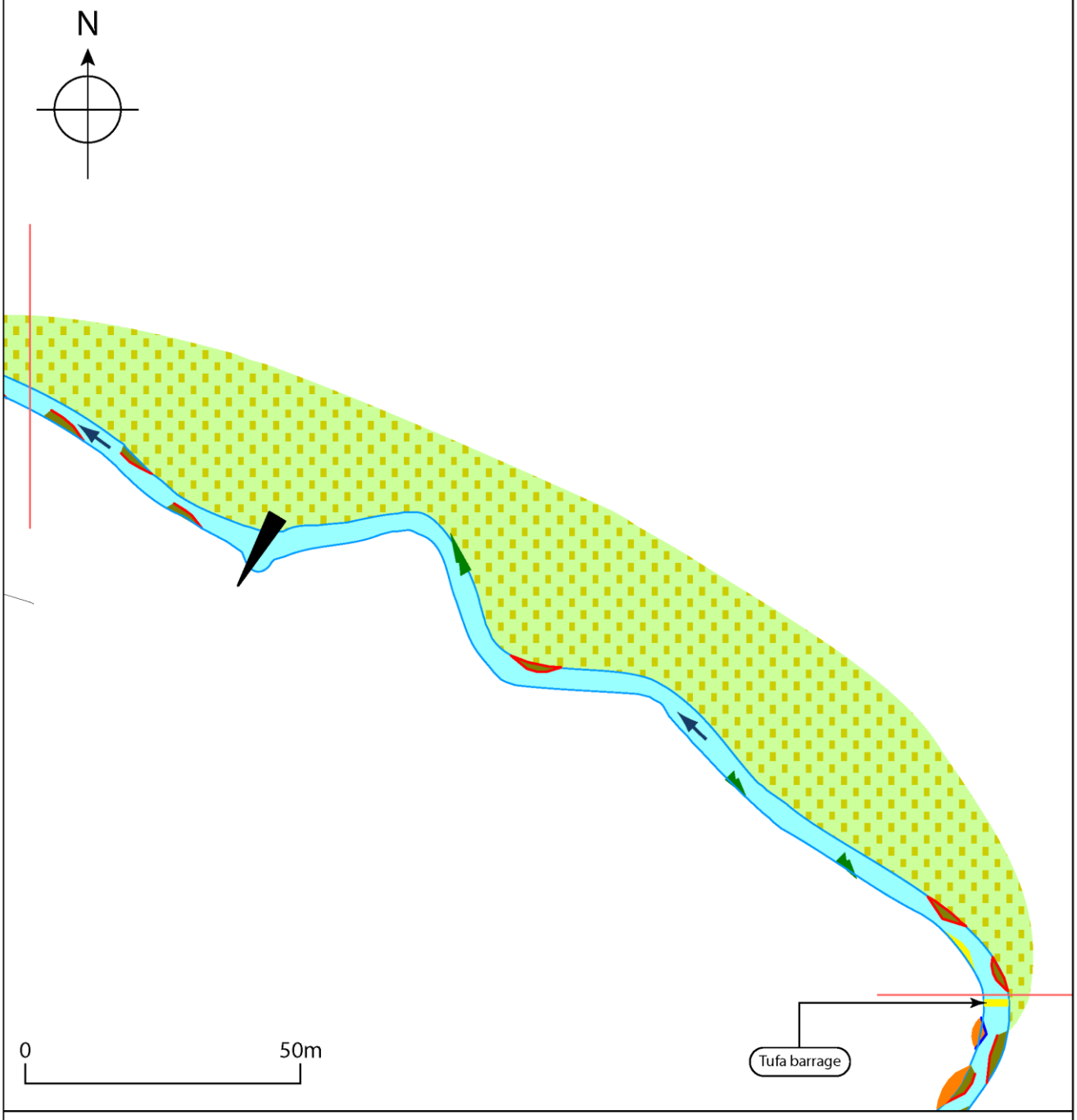

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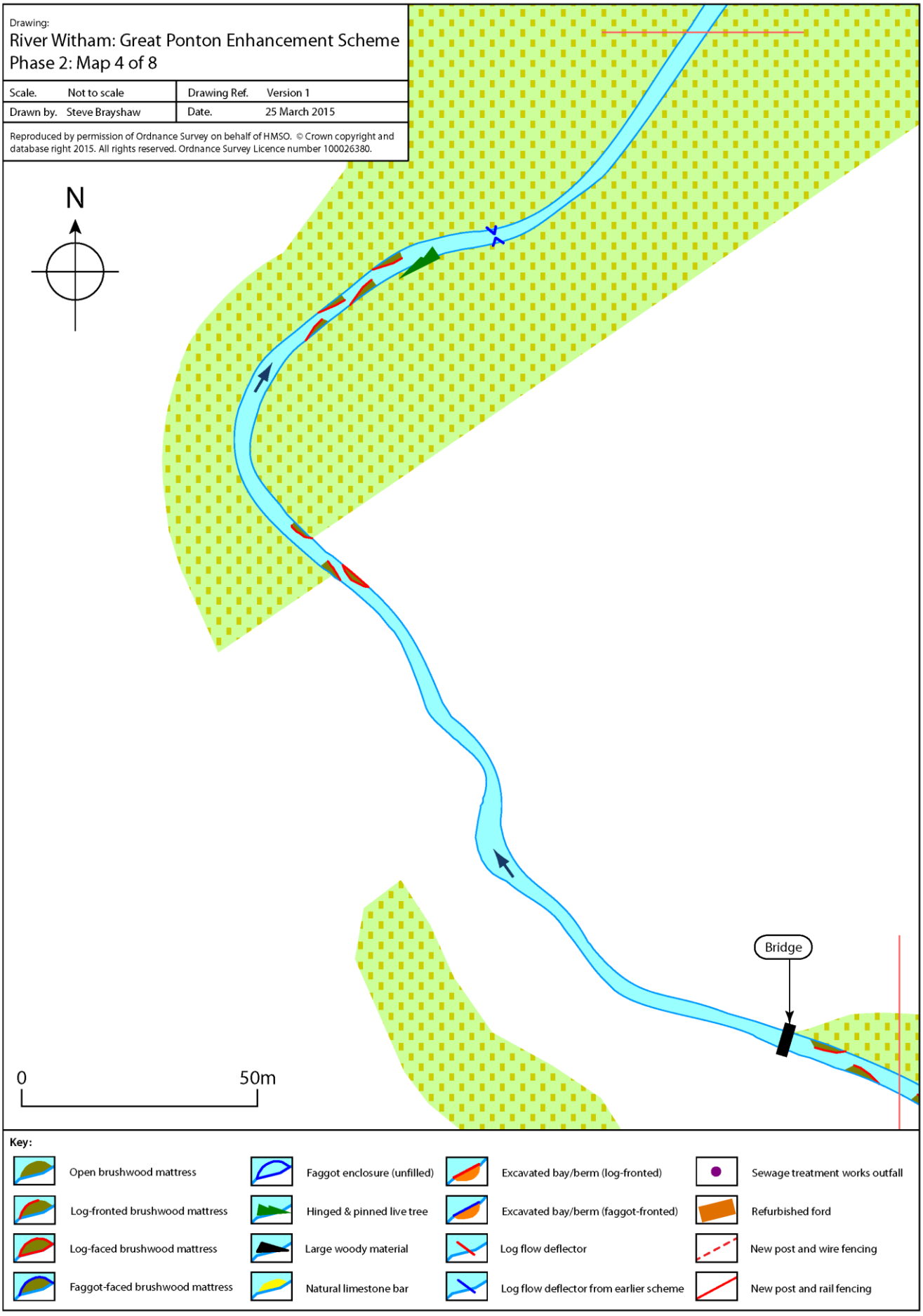
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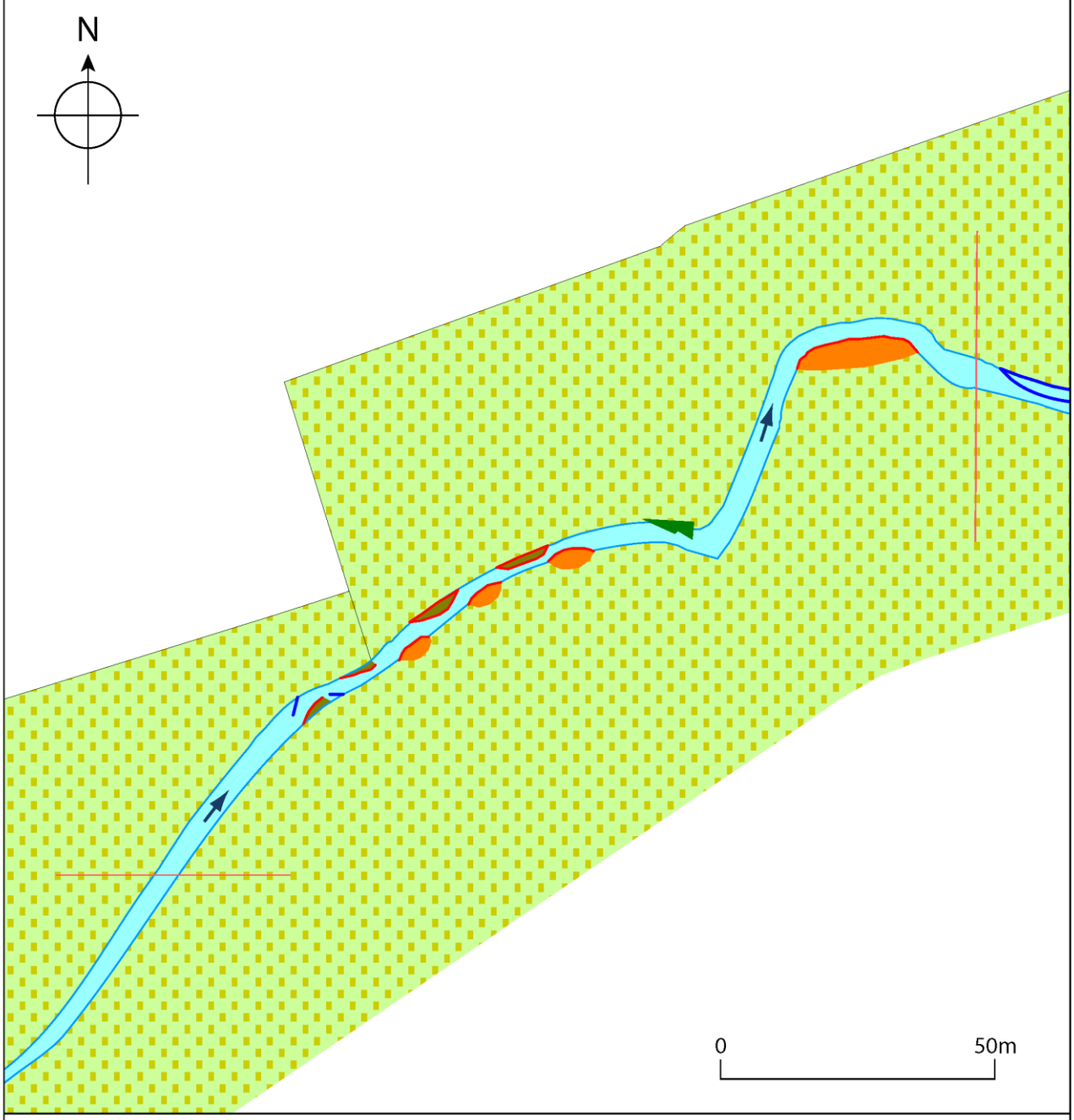

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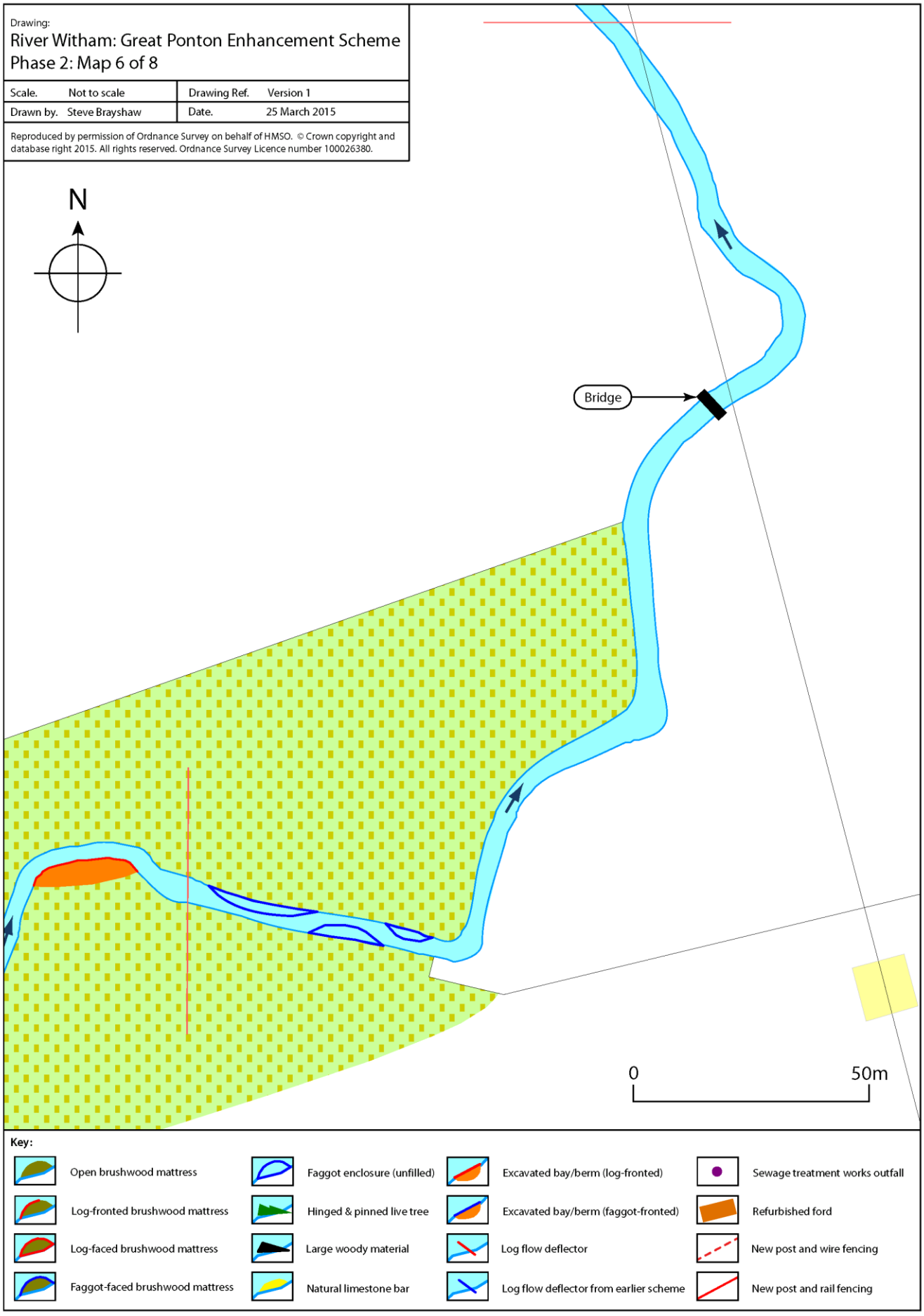
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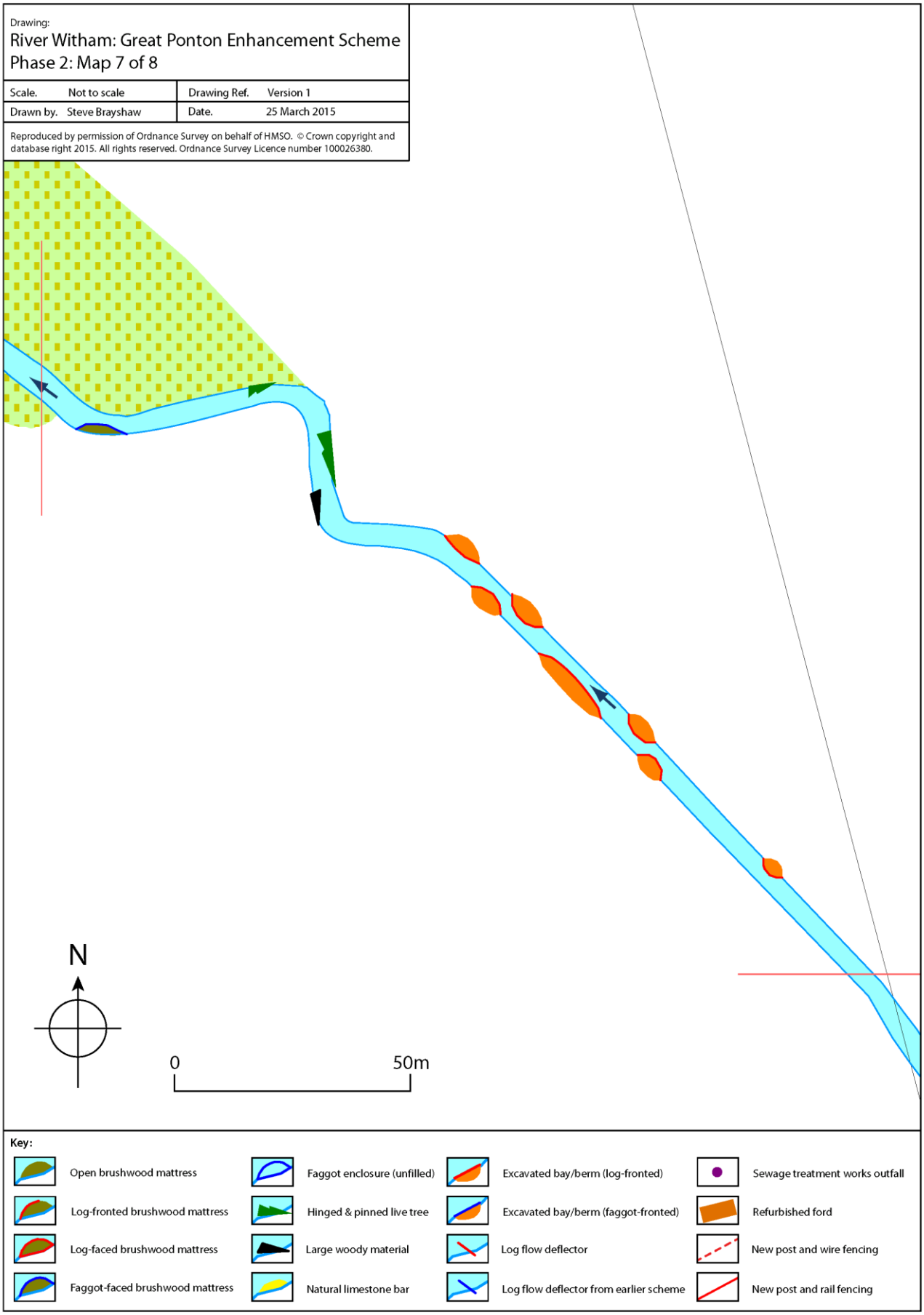
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Log flow deflector from earlier scheme
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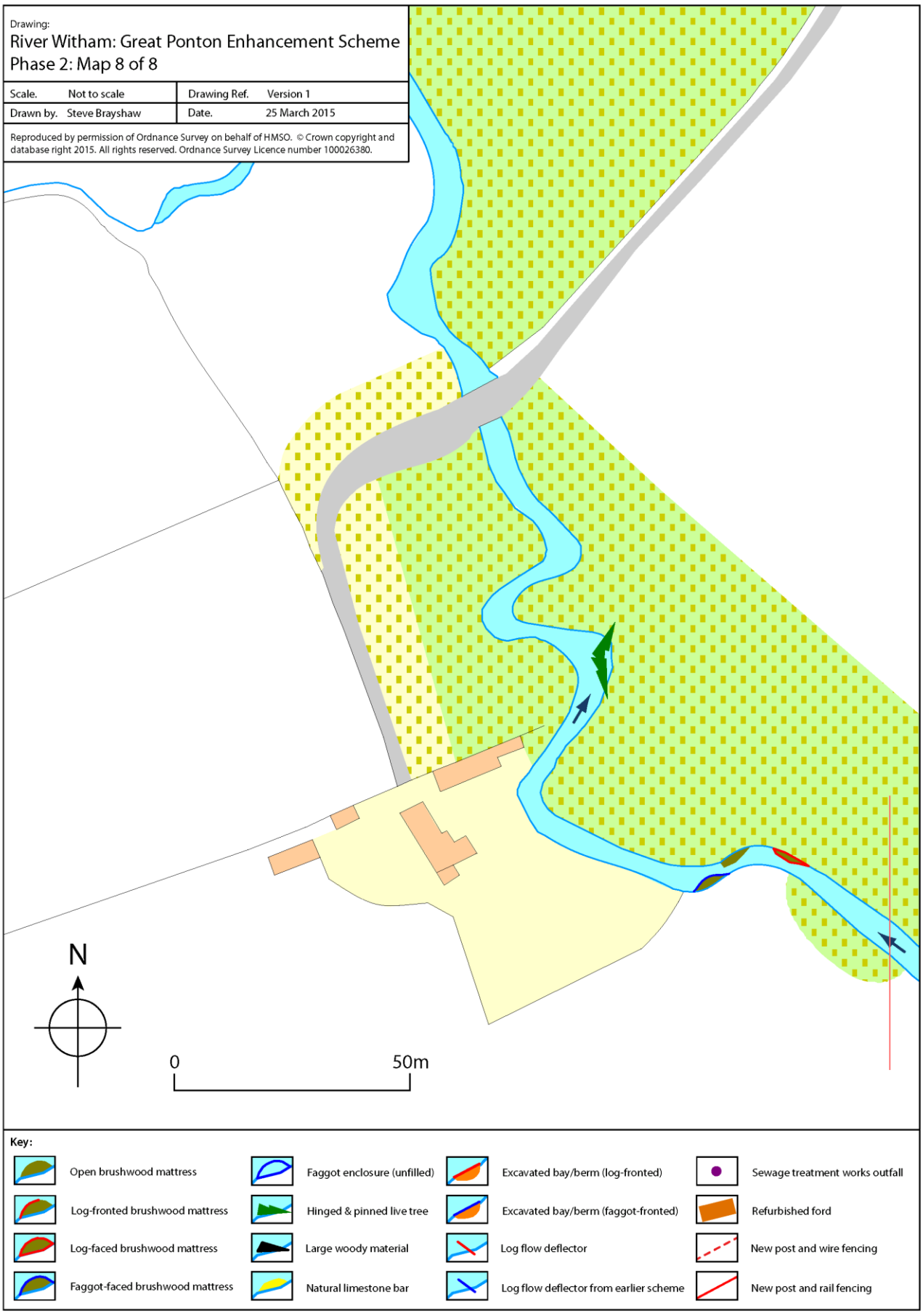
Refurbished ford
New post and wire fencing
New post and rail fencing


Drawing:
River Witham: Great Ponton Enhancement Scheme
Phase 2: Map 8 of 8
Scale. Not to scale
Drawing Ref. Version 1
Drawn by. Steve Brayshaw
Date. 25 March 2015
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N
0
50m
Key:
Open brushwood mattress
Log-fronted brushwood mattress
Log-faced brushwood mattress
Faggot-faced brushwood mattress
Faggot enclosure (unfilled)
Hinged & pinned live tree
Large woody material
Natural limestone bar
Excavated bay/berm (log-fronted)
Excavated bay/berm (faggot-fronted)
Log flow deflector
Log flow deflector from earlier scheme
Sewage treatment works outfall
Refurbished ford
New post and wire fencing
New post and rail fencing