River Blythe Restoration Plan

Draft for comment

May 2017

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft v1.0 / March 2017	First issue	Environment Agency
Draft v2.0 / April 2017	Updated with comments received from the Environment Agency	Environment Agency
Draft for comment v3.0 / May 2017	Updated with comments received from the Environment Agency	Environment Agency
Draft for comment v4.0 / May 2017	Update to Phase 1 Habitat Key following comments received from the Environment Agency	Environment Agency

Contract

This report describes work commissioned by Tim Brooks, on behalf of the Environment Agency, by a letter dated 10/10/2016. The Environment Agency's representative for the contract was Tim Brooks. Kieran Sheehan, Matthew Hemsworth, Kim Jennings and Rebecca Thrower of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

Tony Philp of the Earlswood Wildlife Partnership for supplying dragonfly and other species data along the Blythe corridor.

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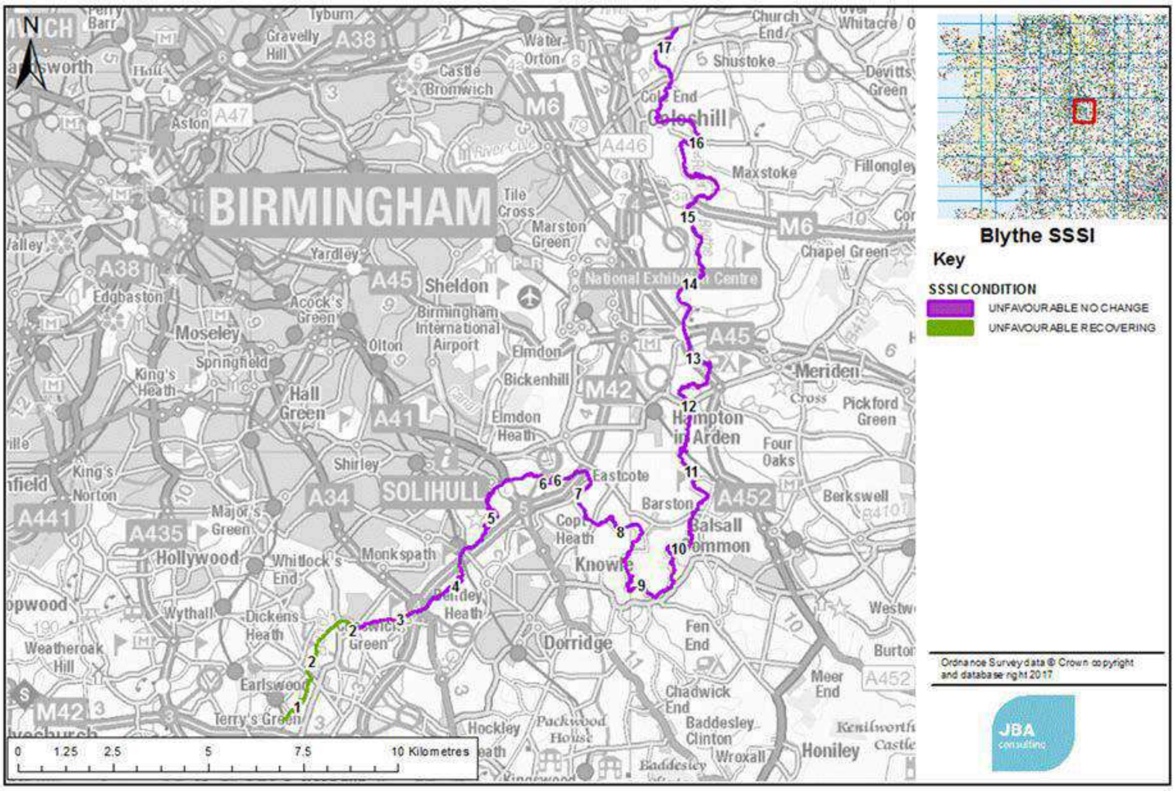
Executive Summary

Current state of the River Blythe SSSI

The River Blythe is a lowland river in Warwickshire rising principally at Spring Brook, near Earlswood Lakes, and flowing in a predominantly northerly direction before discharging into the River Tame north-east of Coleshill. The River Blythe is an exceptional and rare example of one of Britain's semi-natural lowland rivers on clay, supporting a diverse range of flora and fauna. In recognition of its ecological and morphological value, the river has been designated as a Site of Special Scientific Interest (SSSI) under the Wildlife and Countryside Act 1981. The variability and progression of hydromorphological features and diverse bed substrates found in the Blythe, are amongst the reasons for its designation, along with the diverse plant communities.



As with many British river SSSIs, physical modification to the watercourse and the riparian zone has impacted the functionality of the River Blythe. As a result, the River Blythe SSSI is currently in an 'unfavourable no change' condition, due to physical habitat modification, namely weirs, dams and other flow obstructions, and invasive non-native species. The current unfavourable physical habitat condition is as a result of previous historic management. The river has been straightened in many places and a number of physical modifications have been made to the channel and riparian zone which prevent it from functioning naturally, restricting its ecological health and lowering the overall SSSI condition. These factors are preventing the river from achieving 'favourable condition' status as a SSSI.

Current WFD status of the River Blythe SSSI

In addition to unfavourable SSSI status, the River Blythe is also experiencing a decline in the overall status of most of its waterbodies under the Water Framework Directive. Measures to alleviate pressures, namely from an excess of nutrients in the system, is needed to improve the current WFD status.

Natural England has responsibility, on behalf of the government, to oversee the management of all SSSIs that leads to their favourable condition. Natural England work with SSSI landowners and other stakeholders to improve the condition of unfavourable SSSIs, including the River Blythe SSSI. Natural England is working the Environment Agency, and the Tame, Anker & Mease Catchment Partnership to develop a river restoration plan for the River Blythe. Its delivery will be over a long-term period working with landowners, river managers and other stakeholders

	
An over-widened section of the River Blythe	**Active erosion enhanced by poaching**

Our Aims for the River Blythe SSSI

- The long-term vision for the SSSI is to return the river to a more natural condition and ecological health by restoring the river's natural form and function over the next 50 years.
- To work with local stakeholders to develop a robust river restoration plan which sets out a means to which through which the recovery of the SSSI can be achieved in the long term.
- To develop a detailed scientific understanding about of the river and the options that can restore it to favourable condition.

	
Sinuous, well-functioning section of the River Blythe.	**Well-connected section in the lower reaches of the River Blythe**

Achieving the future vision of the River Blythe SSSI

To achieve our vision there is a need to understand in more detail the morphology and ecology of the river and its floodplain and the processes controlling sediment and gravel redistribution along the system.

We have, therefore, produced a River Restoration Plan. This plan lays out several restoration options for the river and its riparian zone. These options will be refined further through a process of public engagement; we welcome the input of local stakeholders to help inform the plan.

Site action in the river restoration plan will be phased over short, medium and long term timescales, up to 50 years, working with local river owners and managers. We will have more detailed discussions about the site-specific actions with relevant stakeholders in the future. Further detailed work and feasibility of site specific actions may also be necessary to implement individual actions of the river restoration plan.

We will use comments received on this draft report to shape a final restoration plan that can be implemented with the catchment partnership, including landowners and managers. The final restoration plan will be used from 2017 onwards to guide the delivery of restoration projects on the ground to improve the habitat along the river. There will always be site specific detailed discussion with landowners and interested parties before any work takes place.

Over time, restoration of the river will improve it for the species and habitats that depend on it, and help the river become more resilient to future extremes of flow, temperature and other catchment pressures. This should in turn benefit the people who live and work by the river.

How can we deliver restoration?

- Continue positive management of reaches already in good ecological health
- Support and allow the river to recover where natural processes are already working well
- Assist the natural recovery by changing management or by undertaking river restoration works to improve natural channel shape, river processes and ecological habitat
- Remove or minimise the effect of manmade features where they damage the function of the river, whilst recognising the need to protect people and property
- Eradicate non-native invasive riverside plants and undertake a programme of removing them whenever they re-occur
- Working in partnership with river owners and managers.

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Abbreviations

BGS .... British Geological Survey

EA .... Environment Agency

INNS .... Invasive Non-native Species

SAC .... Special Area of Conservation

SSSI .... Site of Special Scientific Interest

WFD .... Water Framework Directive

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1 Introduction

1.1 Background

The River Blythe is a lowland river in Warwickshire rising principally at Spring Brook, near Earlswood Lakes, and flowing in a predominantly northerly direction before discharging into the River Tame north-east of Coleshill. The catchment is largely rural, despite including one of the Solihull suburbs and its proximity to Birmingham, and contains a number of large villages such as Dorridge and Balsall Common, and then smaller villages such as Cheswick Green and Hampton in Arden.

In 1990, 39km of the River Blythe, from its source near Earlswood Lakes to where it is joined by the River Cole as a left-bank tributary, was designated as a Site of Specific Scientific Interest (SSSI) under the Wildlife and Countryside Act 1981 for being a particularly fine example of a semi-natural lowland clay river. The variability and progression of hydromorphological features and diverse bed substrates found in the Blythe, are amongst the reasons for its designation. It is also very species-rich with diverse plant communities that demonstrate a clear succession from its source to the Tame confluence (English Nature). The importance of the Blythe is heightened by the considered rarity of preserved lowland clay rivers in Britain.

As with many British river SSSIs, physical modification to the watercourse and the riparian zone has impacted the functionality of the River Blythe. As a result, the River Blythe SSSI is currently in an 'unfavourable no change' condition, due to physical habitat modification, namely weirs, dams and other flow obstructions, and invasive non-native species. The current unfavourable physical habitat condition is as a result of previous historic management. The river has been straightened in many places and a number of physical modifications have been made to the channel and riparian zone which prevent it from functioning naturally, restricting its ecological health and lowering the overall SSSI condition. These factors are preventing the river from achieving 'favourable condition' status as a SSSI.

The long-term vision for the SSSI is to return the river to a more natural condition and ecological health by restoring the river's natural form and function over the next 50 years. To achieve this ecological and geomorphological vision a river restoration plan has been developed. This outlines the ecological vision for the naturalisation of the SSSI. The river restoration plan sets out a means through which the recovery of the SSSI can be achieved in the long term. The river restoration plan for the Blythe SSSI will provide a detailed scientific understanding of the river and the potential options that can restore it to 'favourable condition' status.

In order to achieve this, there is a fundamental requirement to understand in more detail the morphology and ecology of the river and its floodplain and the relationship of this form with the processes controlling sediment and gravel redistribution along the system. Along with an improved scientific understanding of the restoration options, the river restoration plan will take into consideration existing constraints and current land use along the river, when recommending site-based actions and implementation measures.

1.2 Engagement and Consultation

The draft River Blythe Restoration Plan is being developed with the Tame, Anker & Mease Catchment Partnership, which includes representatives from Severn Trent Water, Natural England, Environment Agency, Warwickshire Wildlife Trust, Birmingham and Black Country Wildlife Trust, NFU and the Trent Rivers Trust. The views and concerns of a wider range of interested parties are now being sought. The restoration plan will then be updated accordingly and finalised. Successful implementation of a restoration plan will require effective and positive working with all interested parties, particularly landowners. The final restoration report will inform and prioritize future decision making by the catchment partnership on the Blythe SSSI and should help the targeting and uptake of agri-environmental schemes and other potential funding.

1.3 Rationale behind the restoration of SSSI Rivers

In 2010, 95% of all nationally important wildlife and habitat sites (SSSIs) in England were classed as in, or moving towards, favourable condition. Work to improve the condition of SSSI rivers is continuing as part of a multi-driver process (including requirements arising from the Habitats Directive, the Water Framework Directive and Biodiversity 2020 Action Plans).

Natural England is responsible for notifying SSSIs in England, ensuring they are managed appropriately and assessing and monitoring their condition. The national guidelines for the physical restoration of rivers that are SSSIs (Natural England, 2010) identified the need to generate whole river restoration plans consistent with retaining or moving SSSI sites towards favourable condition. In principle, the plans should advocate whole-river restoration as opposed to *ad-hoc*, small-scale schemes that are likely to only achieve localised enhancements or assist in small-scale natural recovery processes. The restoration plan should also consider the potential existing and future impacts from upstream areas and their impacts on downstream reaches.

It should also take into account immovable constraints associated with people, infrastructure and the built environment. Additionally, it should enable restoration to encourage assisted natural recovery, reducing costs and the degree of intervention applied to the river. Finally, it should also enable the recovery of the habitat to support the characteristic flora and fauna typical of the River Blythe catchment. The UK conservation agencies set conservation objectives for SSSIs, using agreed national standards, and regularly assess their condition. These objectives are based on the ability of the habitat to support the characteristic flora and fauna of that habitat type; this is considered to be in 'Favourable Condition'.

The latest condition assessment for the Blythe SSSI, completed in 2010, found it to be in an 'unfavourable condition'. Most of the 17 units which make up the Blythe SSSI are classified as being unfavourable condition with no change; however, two units (approximately 7% of the SSSI) are considered unfavourable but recovering (Natural England, 2010). The SSSI units are not achieving 'favourable' condition for a range of reasons, including physical habitat modifications and in-channel modifications. As a result, Natural England and the Environment Agency must identify measures to improve the physical condition of the river. An agreed river restoration plan (i.e. this document) must be prepared and implementation progressed on the ground. This action will contribute to England Biodiversity 2020Strategy targets[1] for SSSI condition, and the Habitats Directive, and Water Framework Directive targets for Protected Sites. The reasons behind the current condition of the River Blythe SSSI include issues such as pollution, invasive species and inappropriate weirs, dams or other structures present in the watercourse impeding natural processes.

1.4 Aims and Objectives

The aim of this project is to appraise the geomorphological and ecological condition of the River Blythe, identifying what the condition of the river is in relation to 'natural' benchmarks, and from this to identify the river restoration, rehabilitation and conservation / enhancement actions that could be put in place to restore the SSSI and bring it into favourable or favourable (recovering) condition. This includes the following specific objectives:

- Determine the impacts of physical modifications on the geomorphology and ecology of the river
- Provide an outline restoration plan for the river on a reach by reach basis
- Identify potential delivery mechanisms to help achieve this

The focus of the restoration project is on ensuring the condition of habitats rather than the preservation of species directly, with the principle being that habitats that are characteristic, natural and unconstrained are more likely to support the characteristic flora and fauna.

Although this project is primarily aimed at in-river and riparian characteristics, it is recognised that the river and floodplain act as a single functional unit and the land management adjacent to river channels such as these has the potential to affect the quality of the in-river habitat. As such river – floodplain linkage has been given due consideration throughout this project.

It is also important to note that the term "River Restoration" does not mean returning the rivers to their natural course through the valley. The objective is to restore the rivers to a condition such that they can support a functional ecosystem that is characteristic of their river type, and thereby achieve favourable condition and good ecological status (or potential, given that some reaches have evidently been heavily modified, despite not being classified as such). By addressing

1 The aim of Biodiversity 2020 is that at least half of all SSSIs are in favourable condition by 2020, and that most of the remaining SSSIs are in recovering condition.

geomorphological processes, the physical form and functioning of the river, the in-channel features of the river are able to adapt to achieve this more naturally over time.

1.5 The Vision for the Restoration of the River Blythe

The River Blythe Restoration Plan sets out to improve the condition of the river by taking a catchment-scale approach to tackling the factors which contribute to the current unfavourable status of the river.

The plan sets out a long-term, aspirational approach to restoring the natural processes necessary to support the whole-river ecosystem of the Blythe. This 'process-based' approach will aim to restore / improve natural form and function of the river environment. It is a sustainable approach which allows the river to adapt to future changes so that the benefits of restoration can be maintained with minimal intervention over the long term.

Table 1-1: Example photos of well-functioning reaches

	
The River Blythe upstream of Blythe Valley Park (413214, 275539) - an example of what the river should look like; sinuous, well connected to the floodplain, bed substrate comprising gravels and sands and free of fine sediment, gentle gliding flows. Alder-lined banks, in -channel vegetation (Water Crowfoots).	*The River Blythe downstream of Blythe Bridge (421073, 289940) - although the channel is slightly wide initially owing to bridge, the channel in this reach is gently sinuous and well connected to its floodplain.*

The strategy reflects the range of river types in the catchment, how these have been modified, current land use and the actions needed to achieve 'favourable condition' for the SSSI. Actions will be designed to assist the natural recovery of the watercourse. Actions will seek to reduce man-made pressures on the river system. They will include, in some instances, removing modifications that are no longer needed and, where appropriate and acceptable, changing in-channel management, improving riparian land management and potentially undertaking channel or floodplain restoration.

The River Blythe directly influence the economic and social well-being of the area and actions to deliver the strategy will take this into account when looking at restoration outcomes. Successful implementation of the strategy will involve reaching consensus and working with landowners, stakeholders and local community to develop and implement improvement actions across the catchment.

The benefits of implementing the River Blythe Restoration Plan include:

- Improvement of the physical and ecological condition of the SSSI and eventual achievement of favourable condition status.

- Channel activity, morphological diversity and flow regimes which are characteristic of the river types in the catchment and which function as a connected river system.
- A complex mosaic of different habitat types.
- A greater degree of natural channel movement with a reduction in excessive erosion and deposition of sediment.
- Promoting a wider understanding and acceptance of how the active river and floodplain system responds more naturally to local and wider catchment processes and events.
- A longer term view of river management which helps landowners plan ahead.
- Opportunities for wider benefits such as reductions in flood risk and soil loss/erosion.
- Provision of supporting evidence for future funding.
- Improved resilience to future changes in the catchment caused by factors such as land use policies and climate change.
- Joint delivery of outcomes required by the Water Framework Directive

2 Methodology

2.1 Overview

In order to develop a sustainable, functional hydromorphology throughout the Blythe SSSI the restoration plan must recognise, understand and utilise the interlinkages between river form, function and ecology. Actions and activities outside of the SSSI can significantly influence the condition and response of the system within the SSSI. Similarly, local biotic-abiotic interactions (i.e. interactions between species, habitats and other factors such as climate) will, in part, be controlling the system character and development. As such a spatially integrated study is required to gain the understanding necessary to describe system form and behaviour, predict future change and focus efforts on enhancing natural processes within the SSSI.

The overall approach adopted to generate the restoration plan is summarised in Figure 2-1.

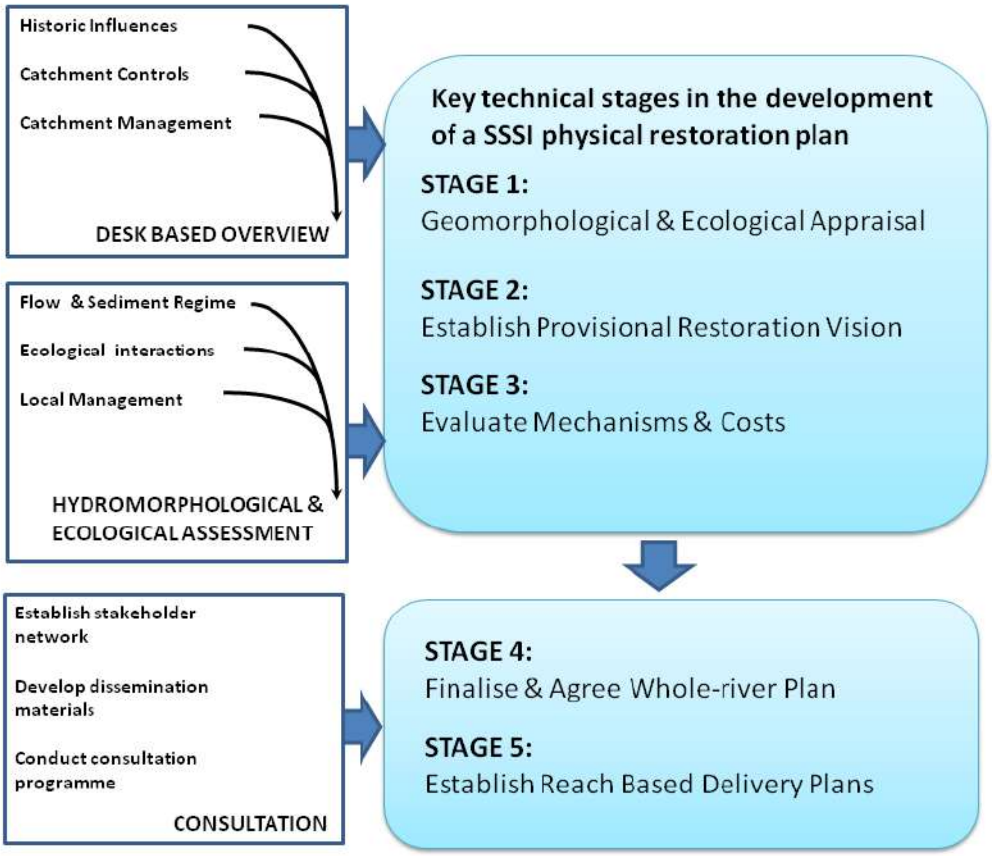

Figure 2-1 Project flow diagram for the development of a restoration plan for the River Blythe SSSI (JBA Consulting, 2010 p.10.)

2.2 Study area

The River Blythe rises from a number of brooks and springs to the south-west of Earlswood Lakes, with Spring Brook generally considered as the main source, near Terry's Green in Warwickshire. Spring Brook is fed by a combination of surface and groundwater feeders, including from the sewage treatment works (River Blythe DWP Plan: NE/EA).

The Blythe SSSI starts at Earlswood Lakes (410870, 272934) and extends 39km along the length of the Blythe; the downstream extent of the final SSSI unit is at the railway bridge, just upstream of the Tame confluence (421210, 291155).

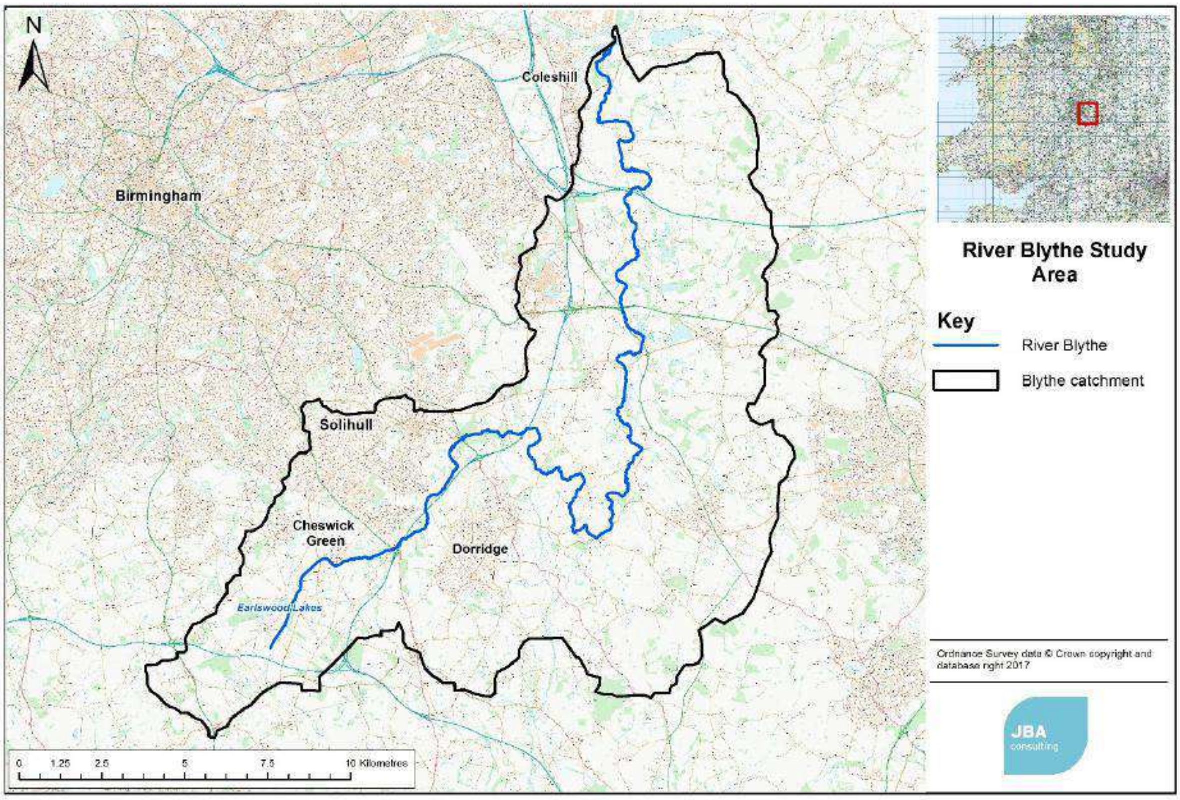

Figure 2-2: The Blythe Catchment study area

2.3 Desk based assessment

A review of background information has been undertaken to provide a baseline understanding of the character and functioning of the river and to document historic influences on the system.

A review of previous research on the River Blythe (Viswan 2016) suggests the river and riparian zone have undergone significant historic physical modifications, including straightening and widening of channels associated with mill ponds and mill leats during the 18th century, and significant straightening and realignment in places to accommodate the construction of major roads and railways. All of these have impacted fluvial and hydromorphological processes and have ultimately contributed to its unfavourable status. Viswan (2016) also points to a number of other pressures on the Blythe SSSI, including flow control structures and modification to the flow regime through construction of the Earlswood Lakes. At low flows the impact due to the impoundment of the lakes is considered to be very low, as the compensation flow released by the reservoir is largely similar to the natural flows that would occur without it. However, the impact at high to medium flows is considered high, owing to the reservoirs attenuating higher flows.

Viswan's (2016) report details the extent and nature of the physical modifications that have affected and continue to impact, the flow regime in the Blythe. A number of weirs, dams and other flow control structures impact local water levels and disrupt sediment transport processes. Dredging of certain reaches took place between 1998 and 2003 to de-silt the channel, and sections of the channel were diverted and canalised for the construction of the motorway; all of which affected the hydrological regime and hydromorphogical processes within the Blythe SSSI. Despite the extensive information on physical modification, it is evident that only limited knowledge exists detailing the character and functioning of key sub-reach functional channel types. This extends to both the ecological, geomorphological and local channel processes. It is at this level that the river processes are operating and it is at this level where the primary focus of this strategy, restoration work, is needed.

Devoy (2014) notes that river condition is influenced by physico-chemical, biological and physical factors; historic dredging and channel straightening has had a significant impact on the development of erosional and depositional features and this is very evident in certain reaches. Although it is noted that in some reaches the riparian strip is well-established and intact, this is variable and other reaches are not as well protected. Where vegetation, trees and any form of barrier such as fencing are absent from the banks, the riparian strip suffers through unfettered cattle access which degrades the banks and increases silt inputs to the channel. Furthermore, without protection of the riparian strip, there is no ability to buffer against silt and fertiliser runoff from adjacent arable fields.

Despite clear signs of recovery following good management in the upper reaches, such as observed flow diversity and variation in channel processes caused by features such as large woody debris, Devoy (2014) emphasises that significant pressures still impact the functioning of the river in localised reaches.

The ecology of the river is generally in good condition and the presence of Alder *Alnus glutinosa* trees along many reaches is producing Alder-root dams and diverse morphology within the channel. In addition, there are numerous gravel bars along much of the river and these are being colonised by vegetation. Through some of the more urban reaches such as in Cheswick Green, the channel has been reinforced with concrete banks although these appear to be *ad-hoc* and no designed trapezoidal channel appears to be present. Here too invasive species are numerous with many assorted specimens of *Cotoneaste*r spp. and Snowberry *Symphoricarpos alba* present along the streamside. Nevertheless, even here, there are gravels in the stream bed and Water Crowfoots are much in evidence. Dragonflies are a feature of the river corridor in the summer months and records have been provided for these species in the upper reaches of the catchment by the Earlswood Wildlife Partnership (Figure 2-3).

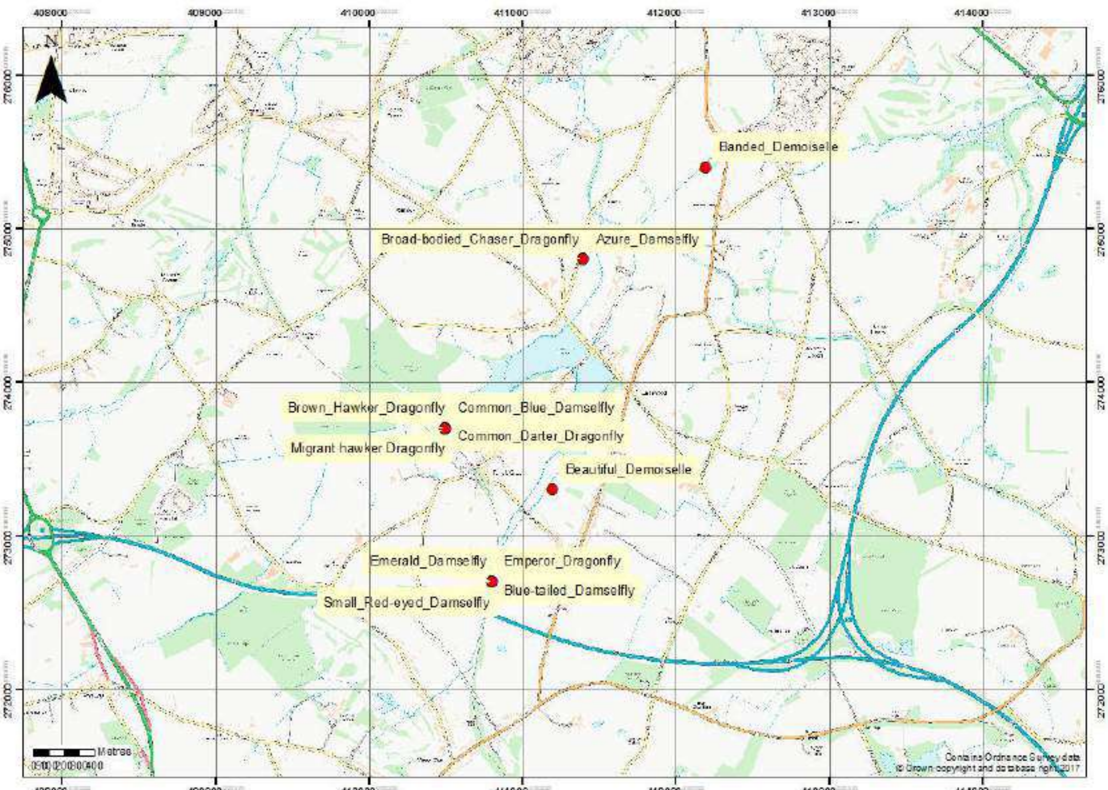

Figure 2-3 Dragonfly records in the upper Blythe catchment in 2016 (Tony Philp - pers. comm.)

The partnership has also recorded more than 100 species of birds around the lakes and they have evidence of Otter *Lutra lutra* having visited the lakes, using Spring Brook as a corridor. They have also reported that Water Vole *Arvicola amphibius* is present in the canal feeder and Harvest Mouse *Micromys minutus* are present near Windmill Pool. In addition, the partnership have recorded seven species of bats at Earlswood Lakes, including Leisler's Bat *Nyctalus leisleri* (Tony Philp - pers. comm.).

Downstream of the canal the river is straightened and here Alder Phytophthora Disease *Phytophthora alni* is prevalent; many Alder stems arising from coppice stools are dead. This is providing a large amount of standing dead wood, a rare habitat in the UK these days, which, in turn, is leading to a healthy supply of coarse woody debris in the channel. The fields on the left bank here are a mixture of fen types and are species-rich. Further investigation at a more opportune time of the year is likely to reveal a number of rare species. Pastureland is the dominant land use type over much of the rest of the catchment, although there is always a large amount of tree cover on the channel margins. That being said, there are areas where the trees have been cleared away and the banks are bare as a result. In a number of locations, livestock have unrestricted access to the channel and this is leading to bank poaching and the supply of fine sediment. The surrounding fields are generally composed of wet grassland, often with numerous palaeochannels which are typically colonised by Reed Canary Grass *Phalaris arundinacea*, where ungrazed or less grazed and Soft Rush *Juncus effusus*, where the grazing pressure is higher. Many of these areas show evidence of drainage schemes.

Throughout the middle reaches of the river, there is an old railway corridor which forms a significant linear feature through the landscape. This is criss-crossed by the river but forms a distinct tree-covered wildlife corridor along the floodplain which will be used by commuting bats, and by bats and birds for foraging and roosting. Other linear features, such as motorways and large roads also feature prominently across the catchment; however, generally these are unvegetated and species-poor, although in places there are wooded 'islands' between the carriageways, slip roads and junctions which are important areas of undisturbed habitat.

Fishponds are another feature of the catchment and these are prevalent along the river corridor. These are intimately linked to the river itself and provide a refuge for many bird species in particular. The nature of the management of these ponds means that their suitability to support diverse plant communities is limited; however, their presence does contribute to the overall habitat mix, especially in the wooded areas and, where land has been flooded due to the high water levels in the ponds, small areas of fen have developed. Many of these areas do indeed have diverse communities within them.

Towards the lower reaches of the Blythe, the river corridor becomes entirely pastoral for a while upstream of Blythe Bridge; here the river follows a natural course between two shallow river terraces with open areas of wet grassland on either bank. Downstream of the bridge, however, the situation becomes very different. Here quarrying has altered the topography floodplain completely and the area has suffered a series of river diversions, although recent projects have attempted to rectify some of this damage. Here the river is recovering but the banks are artificial and there are floodbanks in places, with invasive species growing on them in places, especially Himalayan Balsam *Impatiens glandulifera*. In general, given the peri-urban location of the river, the Blythe, does not have a severe problem with invasive non-native species (INNS); however, there are infestations in places and, if not treated, these will spread, damaging the ecology. The greatest extent of these, are locations in the middle and lower reaches of the river, although there a few patches of Japanese Knotweed *Reynoutria japonica* higher up the catchment.

The River Blythe SSSI Diffuse Water Pollution Plan (NE/EA) documents sources of pollution, namely phosphate, which are contributing to poor water quality in the Blythe catchment. Phosphate samples taken by the Environment Agency at key locations along the Blythe, all failed WFD standards in 2012; however, the majority of other water quality pollutants, including suspended solids, ammonia, dissolved oxygen and biochemical oxygen demand, generally met recommended SSSI targets.

2.4 Geomorphological Walkover and Ecological Survey

This involved a field and desk based evaluation of the geomorphological nature and dynamics of the River Blythe looking at local and wider linkages between the form of the river and floodplain and the flow, sediment transport and ecological controls. The audit concentrated on the whole Blythe SSSI area from its source to the confluence with the River Tame. This provides an understanding of wider system influences and ensures that proposed naturalisation options do not adversely impact on the wider river, potentially compromising Water Framework Directive (WFD) objectives. The wider assessment also looked at historic system functioning, legacy engineering and management issues, wider catchment factors and local influences on river system structure and behaviour. Contemporary morphology and processes were audited and mapped alongside the ecology (see below). Near pristine natural sites have been identified and used to determine the optimum geomorphological conditions for the river SSSI. Models of channel behaviour have been developed from the audit findings allowing channel reaction to natural and imposed change factors to be predicted alongside potential ecological responses.

The strongest links between the dynamics of the river and floodplain and the habitat mosaic are found at the morphologic unit level and the SSSI displays a wide variety of morphologic units extending beyond the river bank. Naturalisation must consider the process - form - ecological interlinkages across all the river and floodplain units present, rather than concentrating on the bankside / riparian zone. In this way wider improvements to the river and floodplain morphology can be suggested, consequently improving overall habitat structure and resilience. A full ecological survey of the bed, banks, morphological features and floodplain of the river has been conducted in tandem with the geomorphological walkover, to identify the flora and fauna present along the river noting functional relationships between the biota and the river morphology.

2.4.1 Development of a conceptual model of system function

The approach adopted allows explicit linkages to be made between the ecology, morphology and system controls. This provides a fully integrated model capable of predicting spatial ecological response to the naturalisation measures. Each naturalisation measure has been determined as appropriate for the SSSI based on the process-based hydromorphic assessment of the reach (or sub-reach) and conceptual modelling of the eco-hydromorphological response. The ecological response predicted is based on analogues upstream of the location of the proposed intervention and the presence or absence of species, more specifically their propagules and vectors, within the vicinity. This approach allows us to be very confident in how the ecology will respond to the naturalisation measures employed.

2.4.2 Unconstrained approaches to restoration through naturalisation

From the conceptual model and hydromorphic assessment, it is possible to identify appropriate morphologies across the area that will function under the present control conditions. It is also possible to predict their likely development given changes such as climate change.

2.4.3 Identification of constraints on naturalisation

A range of options for river and floodplain naturalisation have been identified in the Restoration Plan and have been evaluated with regard to the likely morphological response and development, ecological improvements linked to the new geomorphology and the impacts on flooding. This exercise also considered the wider system response both upstream and downstream of the SSSI.

In all cases consideration has been given to the current and future land use and in all cases restoration has been linked to contemporary and projected economic drivers to ensure sustainability. The options chosen facilitate natural recovery but these must be integrated into the wider usage of the river, floodplain and catchment.

2.4.4 Reach based action plan

Wider consultation and detailed discussion will take place with the catchment partnership and wider stakeholders, including individual landowners, on the range of options and locations identified in the draft plan. This will provide the opportunity to interrogate these options and identify issues and constraints that may become evident through detailed local consultation. Reach based action plan

The views and concerns of all landowners and stakeholders are being sought and will shape the final plan and prioritisation of reaches for restoration. Landowner agreement and participation will be a key part of developing and implementing reach specific projects. It is recognised that some actions are difficult, land management drivers change and new and different solutions may only become available with time therefore it has to be emphasised that this is a long term, 20 – 30 year plan.

The constrained naturalisation approaches agreed upon, following consultation, required analysis to ensure economic viability. Costs will be generated and based on previous project costings and supported by EA figures on river works and the SPONS engineering handbook. Following further review of the recommendations by the Steering Group, protocols for delivery and sequencing of the restoration options will be updated to maximise the role of natural system adjustment in achieving the desired restoration objectives.

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3 Wider Catchment Conditions

3.1 WFD Status

Under the Water Framework Directive, the River Blythe is part of the Humber River Basin Management Plan (RBMP) as it is a sub-tributary of the River Trent which, at its confluence with the River Ouse at Trent Falls, becomes the River Humber. Five water bodies make up the River Blythe catchment for the purposes of WFD classification; their current WFD classification can be seen in Table 3-1.

A decline in the overall status of most of the Blythe water bodies is observed between the two assessment cycles (2009 and 2015). On the Blythe, nutrients were identified as one of the pressures on the WFD catchment which is causing a decline in WFD ecology status. Diffuse pollution, originating from either arable farmland or surface water runoff, is contributing to higher levels of nutrients in the river channel, resulting in an increase in combined macrophytes and phytobenthos and levels of phosphate. Some point pollution sources were also listed as contributing to levels of phosphorous.

Although morphology is listed as a pressure on the two tributary waterbodies (Cuttle Brook and Temple Balsall Brook, which join the River Blythe south of Barston) the hydromorphology status, which includes the hydrological regime and morphology, is classified as 'support good' for all waterbodies in both cycles.

Table 3-1: WFD classification

Water Body	Overall Classification	
	Cycle 1 (2009)	**Cycle 2 (2015)**
Blythe from Source to Cuttle Brook	Moderate	Poor
Blythe from Temple Balsall Brook to Patrick Bridge	Moderate	Moderate
Blythe from Patrick Bridge to River Tame	Moderate	Poor
Cuttle Brook from Source to River Blythe	Poor	Poor
Temple Balsall Brook from Source to River Blythe	Moderate	Bad

The ecological status of a river is determined by the quality of the plant, invertebrate and fish communities it supports, the flow and physical habitat conditions, and the quality of chemical parameters such as pH, temperature and concentrations of various pollutants. These are assessed according to stringent standards. When a body of water does not reach these standards, the Environment Agency is the competent authority who works with the responsible parties, for example water companies, industry and landowners to improve its quality and aim to achieve compliance with the WFD in England.

The standards required to achieve favourable condition for SSSIs may be more stringent than those required to achieve Good Ecological Status (GES) and Good Chemical Status (GCS).

The Water Framework Directive requires protected sites including Special Areas of Conservation to be meeting their objectives by 2015 (or in cases where there are significant pressures to address, 2021 or 2027). For SSSIs the targets for Favourable Condition can be more stringent than for WFD due to the particular requirements of the wildlife or habitats at these sites and the WFD states 'where more than one objective relates to a given body of water, the most stringent shall apply' (Jenny Wheeldon - Pers. Comm.).

3.2 River Blythe Site of Scientific Interest

In 1990, 39km of the River Blythe from its source near Earlswood Lakes to just upstream of the Tame confluence, was designated as a Site of Specific Scientific Interest (SSSI) under the Wildlife and Countryside Act 1981 for being a particularly fine example of a semi-natural lowland clay river

(English Nature, 1989). The primary SSSI notification is for the Blythe's habitat; it's river channel, banks and part of the riparian zone (Viswan, 2016). The variability and progression of hydromorphological features and diverse bed substrates found in the Blythe, are amongst the reasons for its designation. The Blythe is considered to have a wide range of natural river type features, such as riffles, pools, river bluffs and meanders. It is also very species-rich with diverse plant communities that demonstrate a clear succession from the source to the Tame confluence. Species present include Water Crowfoots with *Ranunculus fluitans and R. penicillatus pseudofluitans* both recorded in the downstream extents of the watercourse. Other submerged species present include Lesser bur-reed *Sparganium emersum,* Spiked Water-milfoil *Myriophyllum spicatum* and the pondweed species; *Potamogeton pectinatus*, *P. perfoliatus* and *P. crispus*. The margins are also diverse in many places with the upper limits being heavily tree-lined and lower extents being characterised by margins of *Carex spp*. Reed Sweet-grass *Glyceria maxima* and Reed Canary Grass *Phalaris arundinacea*. The importance of the Blythe is heightened by the diversity of species present which is comparable to the traditionally richer lowland chalk stream habitats.

There are 17 units within the Blythe SSSI, all of which were found to be in an unfavourable condition during the most recent assessment (Natural England, 2010). Flow control structures, such as weirs and dams, and invasive non-native species are reportedly to blame for the adverse condition of all units within the SSSI. Channel modification such as canalisation and diversion to accommodate construction of major roads such as the motorways, have also led to its unfavourable status. Although most of these units are in an unfavourable no change condition, two units were found to be recovering; specifically, units 1 and 2 from Earlswood Lakes to Cheswick Green. In general, 'recovering'. Units/features are not yet fully conserved, but all the necessary management mechanisms are in place. Provided that the recovery work is sustained, the units will hopefully reach favourable condition.

In terms of addressing the unfavourable condition of the Blythe SSSI, there is a Diffuse Water Pollution Plan in development (NE/EA); however, further action is required to improve the status of the SSSI. There are also site-specific targets for the Blythe SSSI in place (Viswan, 2016); many of these focus on improving habitat function and structure through actions such as improving species composition and diversity, and reducing the impact from non-native invasive species. To improve structure, the issue of widespread siltation must be addressed and the channel structure should be representative of the channel type, i.e. the channel should be largely natural and the form should support a range of substrate types, features both in-channel and bankside, vegetation and flow variations.

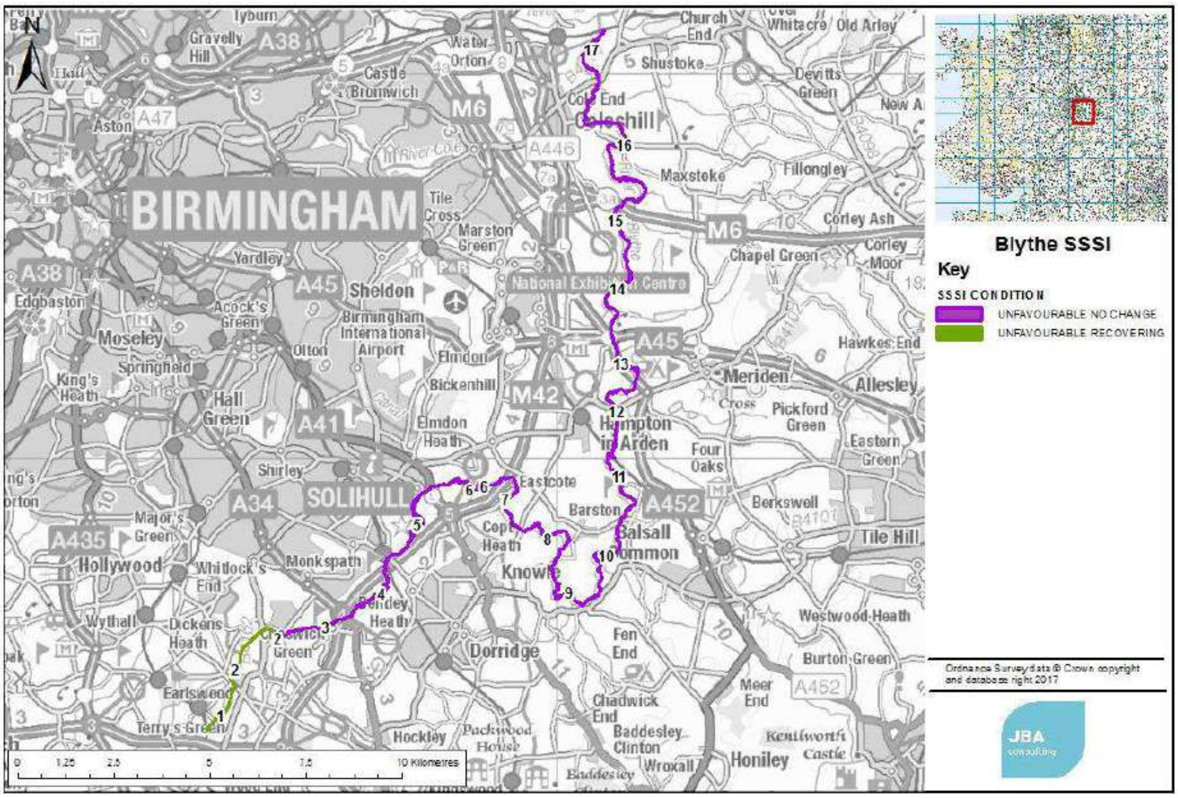


Figure 3-1: Blythe SSSI units and condition

3.3 Existing catchment character

3.3.1 Geology

The dominant bedrock geology through the catchment comprises the Mercia Mudstone group, sedimentary bedrock formed during the Triassic Period (BGS 2017). Arden Sandstone also underlays part of the catchment, although not as prominently. Glacio-fluvial deposits from the Mid Pleistocene, including sand and gravel, make up the superficial deposits. Alluvial terraces and old river terraces form a distinct and varied landscape in the Blythe catchment.

The catchment is prone to a rapid response in water levels owing to poor infiltration and subsequent generation of overland flows by the impervious clay soils.

3.3.2 Hydrology

The low-relief Blythe catchment drains an area approximately 190km^2 and has an average annual rainfall of 703mm (FEH CD-ROM). Two rainfall gauges in the catchment, at Coleshill and approximately 4km south of Whitacre, have recorded average annual rainfall of 763mm and 624mm, respectively (Viswan, 2016). The Blythe is mostly surface-water fed so much of this rainfall enters the channel either through overland flows from adjacent rural land or urban areas, and via the tributary springs and brooks themselves.

The main brooks in the catchment are: Spring Brook, Cuttle Brook, Temple Balsall Brook, Shadow Brook, Eastcote Brook and Holywell Brook.

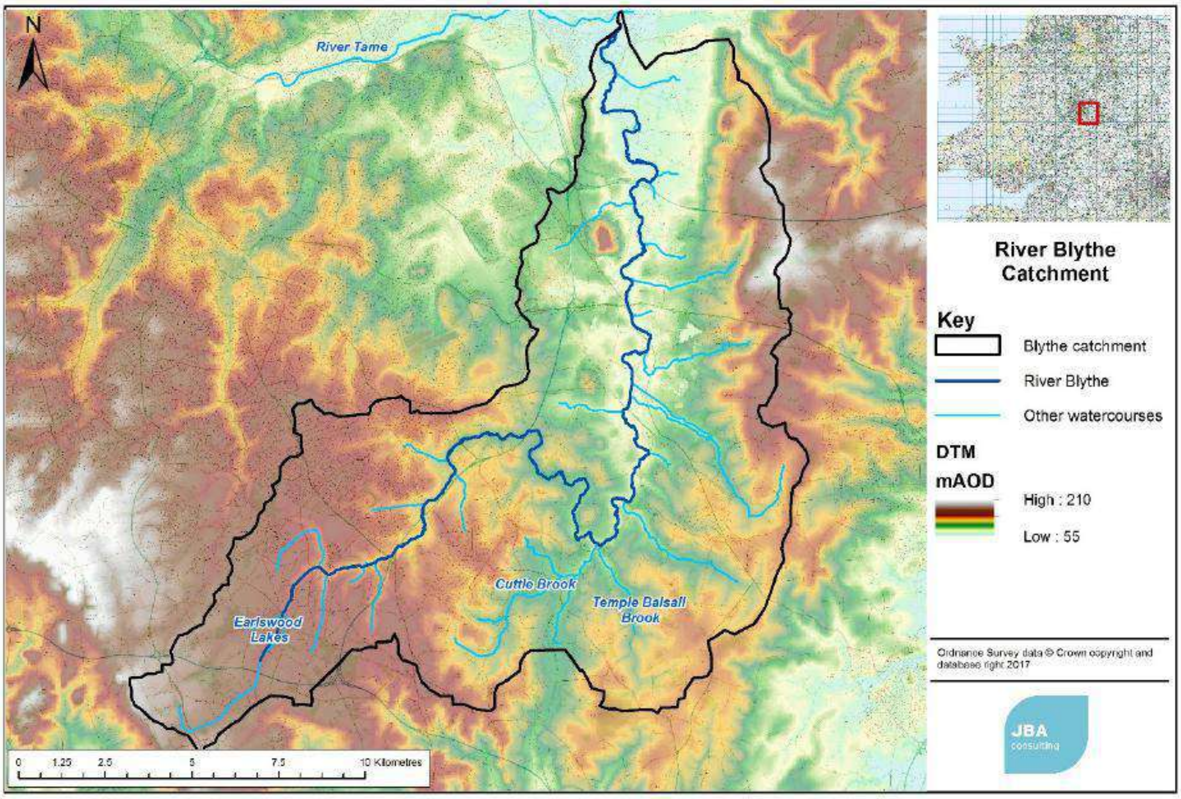


Figure 3-2: River Blythe catchment

3.3.3 Flood risk

The Environment Agency River Trent Catchment Flood Management Plan (CFMP - EA 2010) defines the Mid Staffordshire and Lower Tame catchment (sub area 6), within which the Blythe is situated, as an area of low flood risk. The CFMP states that while the River Tame channel has been heavily modified to improve flow capacity, elsewhere the watercourses are relatively natural. It does not specifically reference the Blythe catchment. The preferred policy option is:

"Policy Option 6 – Areas of low to moderate flood risk where we will take action with others to store or manage run-off in locations that provide overall flood risk reduction or environmental benefit.

Our long-term vision for this sub area is to set a framework to deliver a sustainable approach to flood risk management that considers the natural function of the river and reduces long term dependence on raised flood defences. This includes identifying opportunities to better utilise areas of natural floodplain to store floodwaters and to attenuate rainwater that will reduce flood risk within this sub area and downstream."

The River Blythe catchment is mostly impervious, owing to it being composed of mostly clay soils. Therefore, the catchment is fed in the main by surface water flows from adjacent agricultural land and urban areas, which reduce infiltration and increase the rate at which overland flows enter the river network. During heavy rainfall event the rise and fall of water levels would be expected to be rapid.

The catchment is predominantly rural and, whilst there are some urban areas which could be at risk of flooding, the majority of these are situated on higher ground and not on the Blythe floodplain. However, there are some exceptions to this. The village of Cheswick Green is situated on the Blythe's floodplain and is at risk of fluvial flooding from the Blythe; the village hall is reported to have flooded for the first time in 2007 (JBA Consulting, 2012). Low-lying agricultural and arable fields are also at risk of flood inundation.

3.3.4 Land use

Viswan (2016) provides a detailed account of the main land use found on the floodplain along the River Blythe, on a reach by reach basis. Whilst specific land use varies locally, it can be surmised that the Blythe SSSI catchment comprises arable fields and large areas of improved grassland. Whilst the catchment is predominantly rural, several major roads and railways cross the river at certain locations.

3.3.5 Water resources

Three large impounding reservoirs make up the Earlswood Lakes near the source of the River Blythe; these were constructed to maintain water levels in the Stratford upon Avon canal. The reservoir at Whitacre is used for public water supply (Ibid).

3.4 Historic catchment change

Analysis of historical maps to assess change in channel morphology, was undertaken and documented in Viswan (2016). The maps illustrate how the current position of the River Blythe has been altered in multiple places since the Victorian era. Figure 3-3 summarise and present this information, with a description of the observed change detailed in Table 3-2.

Table 3-2: Description of historical channel change (adapted from Viswan, 2016)

Reference	Description of change
1	During the construction of the railway the original position of the confluence of the canal feeder and Spring Brook was diverted via a weir and a bypass channel.
2	Whilst the Victorian maps show a similar river course to present day conditions, it is likely the channel was straightened pre-Victorian era.
3	The Victorian river course was slightly more sinuous here, indicating some channel straightening.
4	More sinuous channel shown by the Victorian river course; channel has since been diverted and straightened for the M42.
5	More sinuous channel shown by the Victorian river course; channel has since been diverted and straightened for the M42.
6	Victorian river course followed more sinuous, northern channel. Diverted likely for the construction of the motorway.
7	More sinuous channel shown by the Victorian river course; channel has since been diverted and straightened for the motorways.
8	Victorian river course appears to have been flowed down the paleo channels evident on the present-day floodplain.
9	Victorian river course appears to have been flowed down the paleo channels evident on the present-day floodplain.
10	Victorian river course appears to have been flowed down the paleo channels evident on the present-day floodplain.
11	Victorian river course appears to have been flowed down the paleo channels evident on the present-day floodplain.
12	Victorian river course is shown through where is now occupied by ponds; channel modification.
13	Abandoned sinuous Victorian river course shown in northern channel, suggesting channel modification pre-Victorian era.
14	Abandoned sinuous Victorian river course shown meandering across floodplain, indicating significant channel straightening pre-Victorian era.
15	Abandoned sinuous Victorian river course shown in northern channel, suggesting channel modification pre-Victorian era.
16	More sinuous channel shown by the Victorian river course; channel has since been diverted and straightened for the M6.
17	Abandoned sinuous Victorian river course shown following the course of the eastern meandering channel, indicating significant channel straightening pre-Victorian era.
18	Abandoned Victorian river course meander shown on northern floodplain, suggesting channel modification pre-Victorian era.

The most notably changes were to realign the river channel during the construction of the M42 motorway; for instance, where the river passes under Junction 4 of the M42, the maps in Viswan (2016) illustrate how the channel was straightened and diverted to flow adjacent to the motorway. Similarly, as the river flows back under the M42 downstream and then the A41 downstream, the maps show significant modification of the channel morphology.

Away from the motorways, the maps illustrate further canalisation at certain reaches, notably; south of Barston, west of Hampton-in-Arden, under the M6, and east of Arnolds Lane. Channel realignment and canalisation can have significant impacts on the functionality of in-channel processes and cause disturbance to riparian habitats.

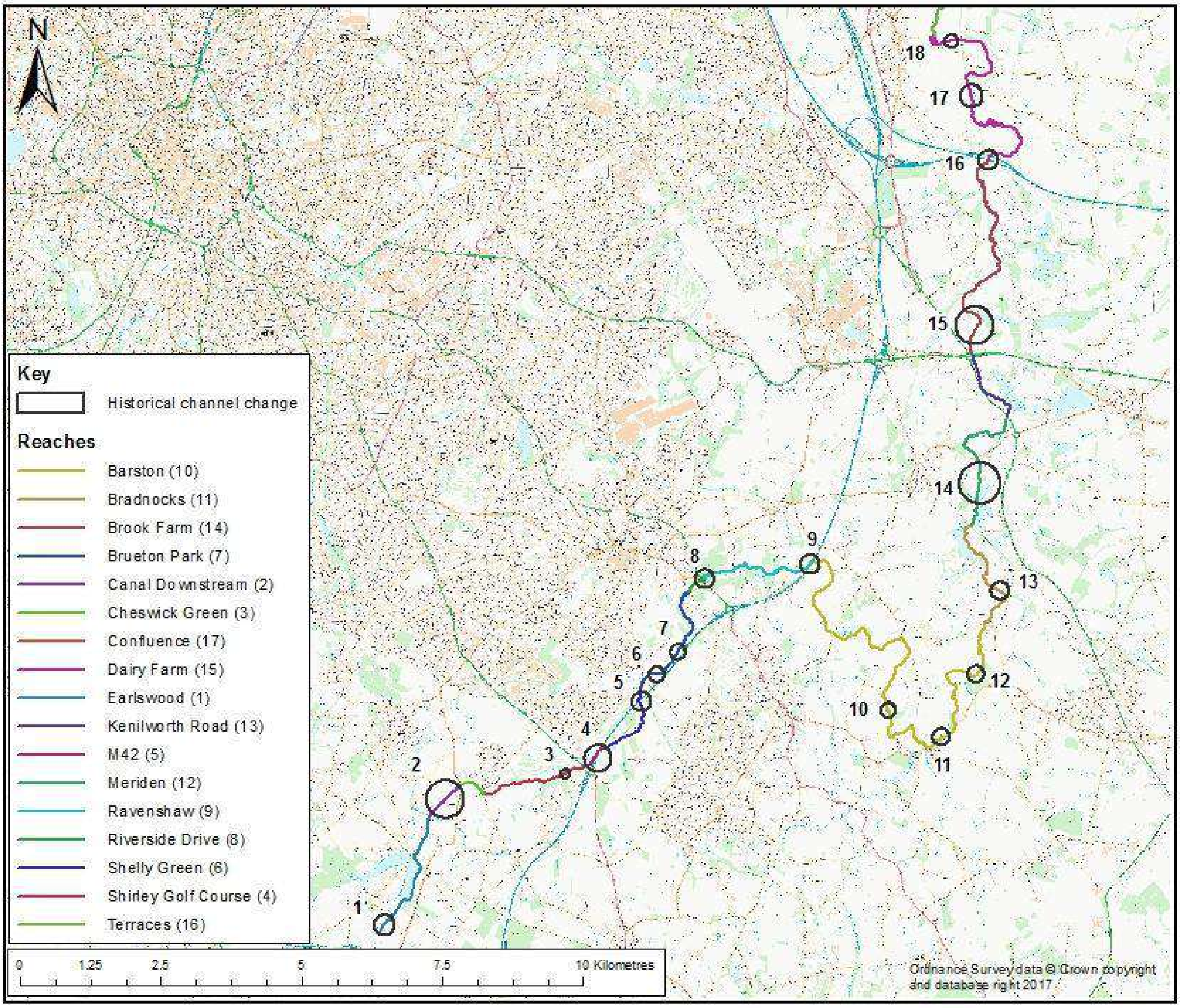


Figure 3-3: Areas of historic channel change during the Victorian era

Source: Adapted from Viswan, 2016

4 Reach Scale Assessment

4.1 Overview

The morphology of the River Blythe is typical of a lowland river system; relatively shallow gradient, low relief topography and a gently meandering channel network. The bed substrate tends to be clay-dominated, with some gravels and sands present in the channel. The overall primary river type of the Blythe is passive meandering (SEPA, 2012). The main characteristics of this river type tend involve a relatively sinuous, meandering planform and a low channel gradient. Some deposition and small-scale erosion is evident; however, there is insufficient energy for channel migration and consequently the meanders are mostly fixed. The floodplain is typically unconfined and, whilst there is evidence of active meandering from paleo channels observed in the floodplain, it is likely these reflect an earlier stage in the river's evolution, when levels of geomorphic activity were higher owing to less physical modification impacting natural processes, rather than present day morphology.

4.2 General controls on system functioning

In order to understand the form and function of the River Blythe SSSI, floodplain and catchment system, it is necessary to identify controls on behaviour, highlighting patterns of channel change in response to multiple drivers. In order to achieve this, the following must be recognised:

- Catchment processes strongly influence system hydromorphology with process linkages occurring across large scales.
- Considerable modification has occurred to the system form and process both in the past and now. The system is responding to these modifications.
- The channel and floodplain must be treated as a single functional unit ensuring that channel and floodplain processes are restored together to create a sustainable dynamic naturalising system.
- Interactions occur between the hydromorphology (geomorphology, hydrology, hydraulics) and ecology to influence the present state and dynamics of the system.
- The system is both sensitive and dynamic and interventions and alterations to its form and process will invoke a reaction which must be both predictable and acceptable within the context of wider river and catchment use.

As such it is vital to identify the process – behaviour linkages present in the catchment, identifying the controls on sediment movement and associated sedimentation and erosion along the watercourse (Figure 4-1).

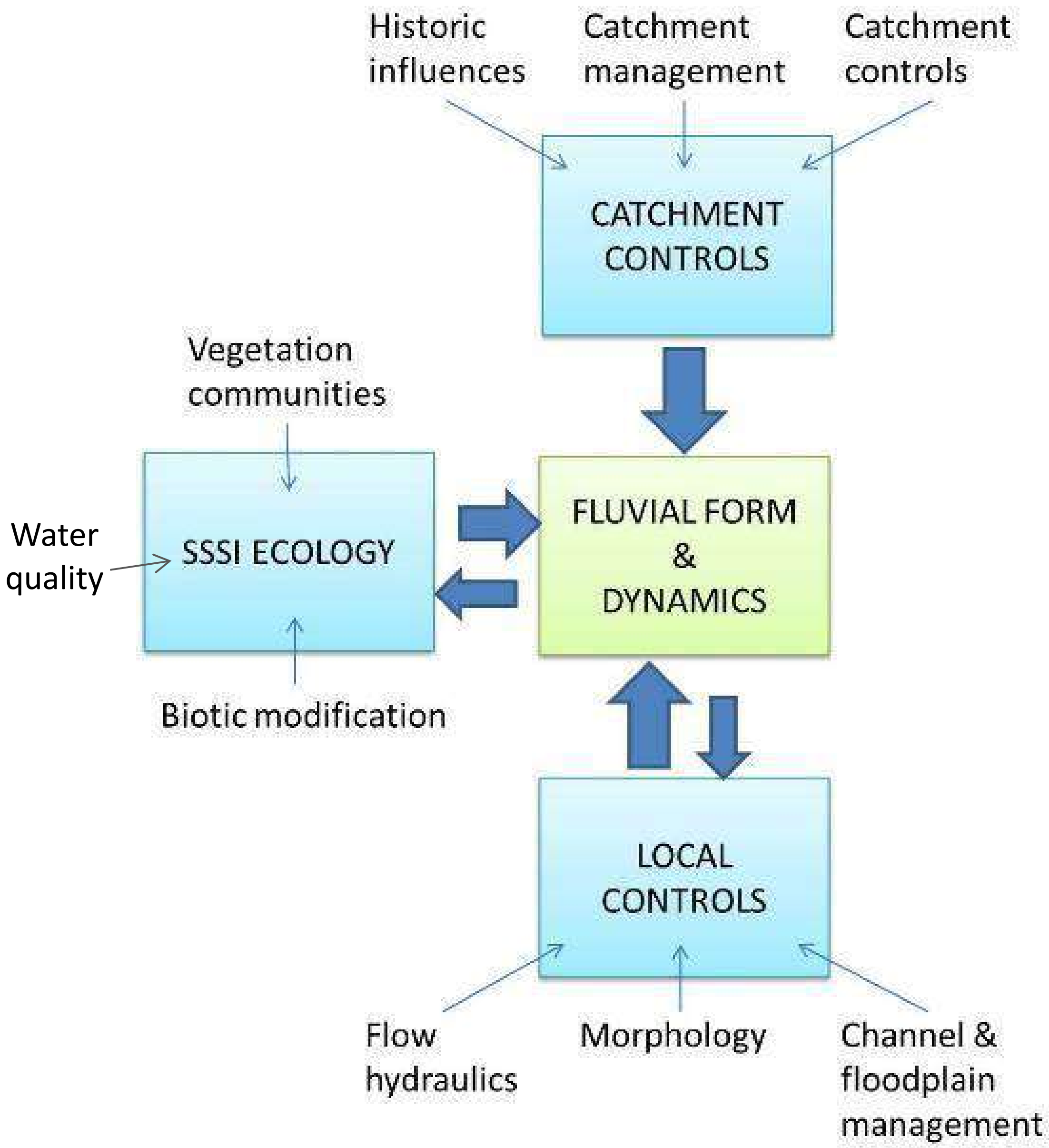


Figure 4-1 Principal controls on the character and dynamics of the River Blythe SSSI.

4.3 Reach Breakdown

This section summarises the existing state of the individual reach breaks which have been identified following the combined hydromorphic and ecological survey. Assessing river flow processes and defining ecological conditions observed at the localised, reach scale is essential in order to make recommendations on restoration measures which are appropriate to local conditions.

Given the homogeneity of the River Blythe in term of river types, reaches have been defined based on general infrastructure and land use constraints. There are a total of 17 reaches, the extent of which can be seen in Figure 4-2.

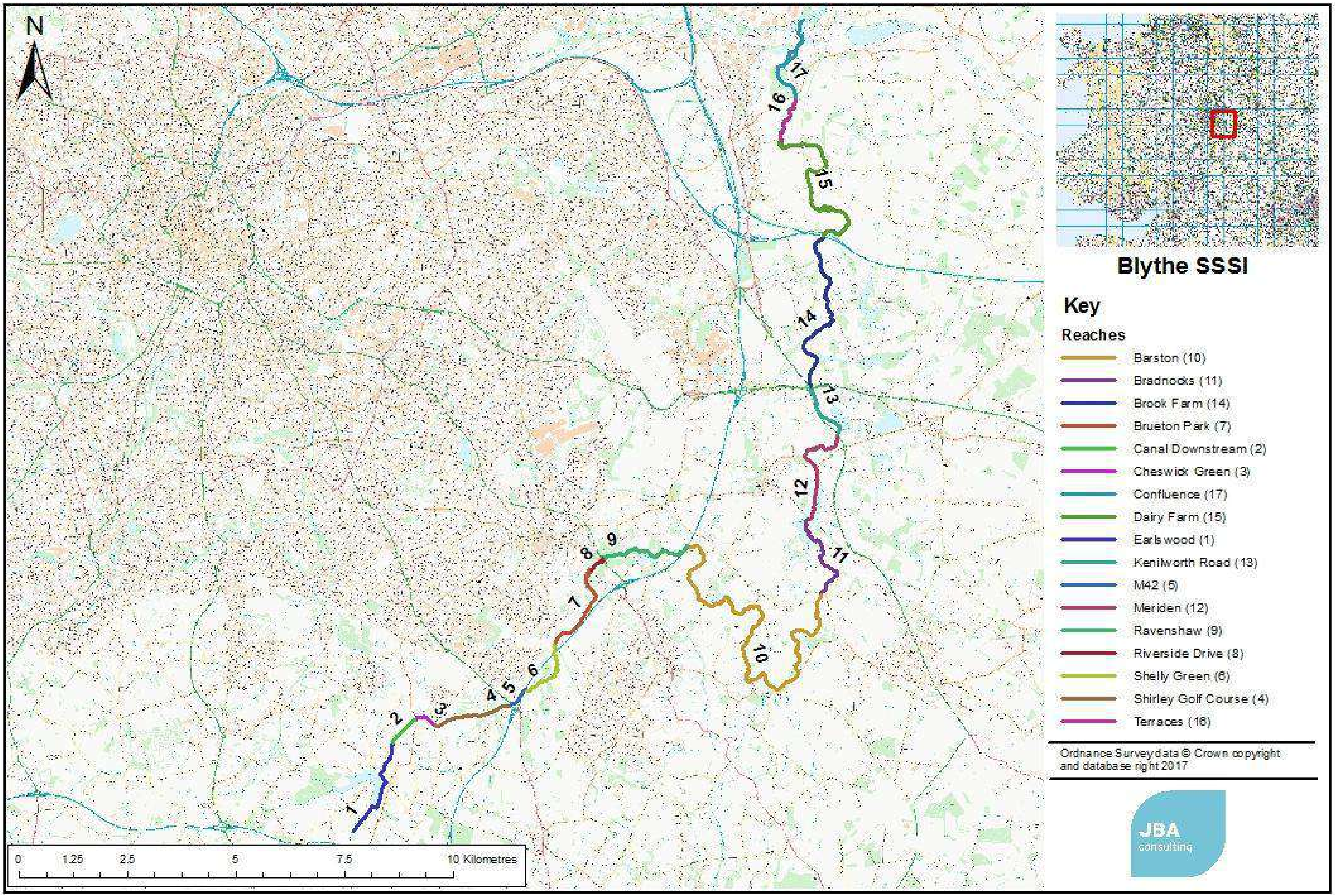
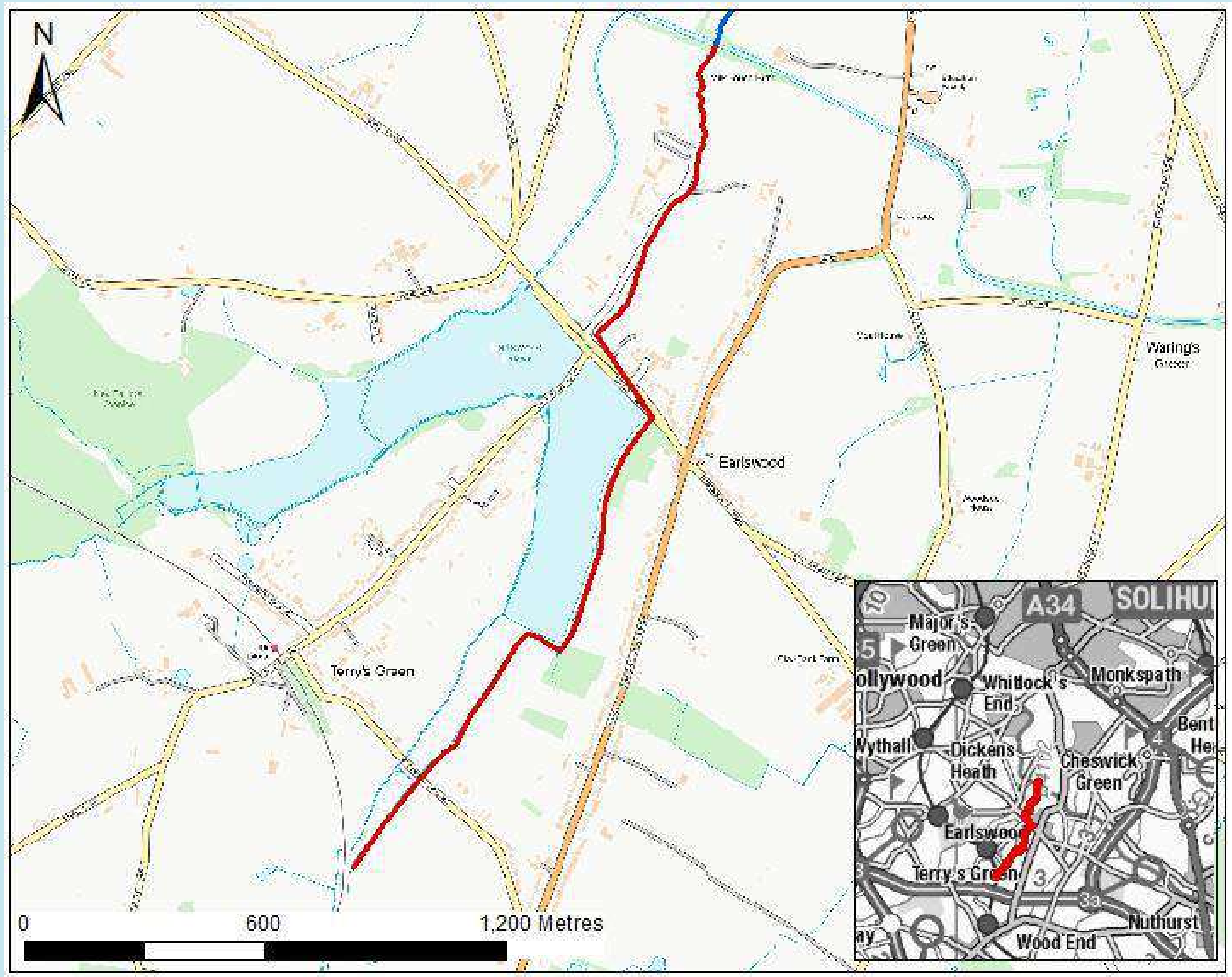
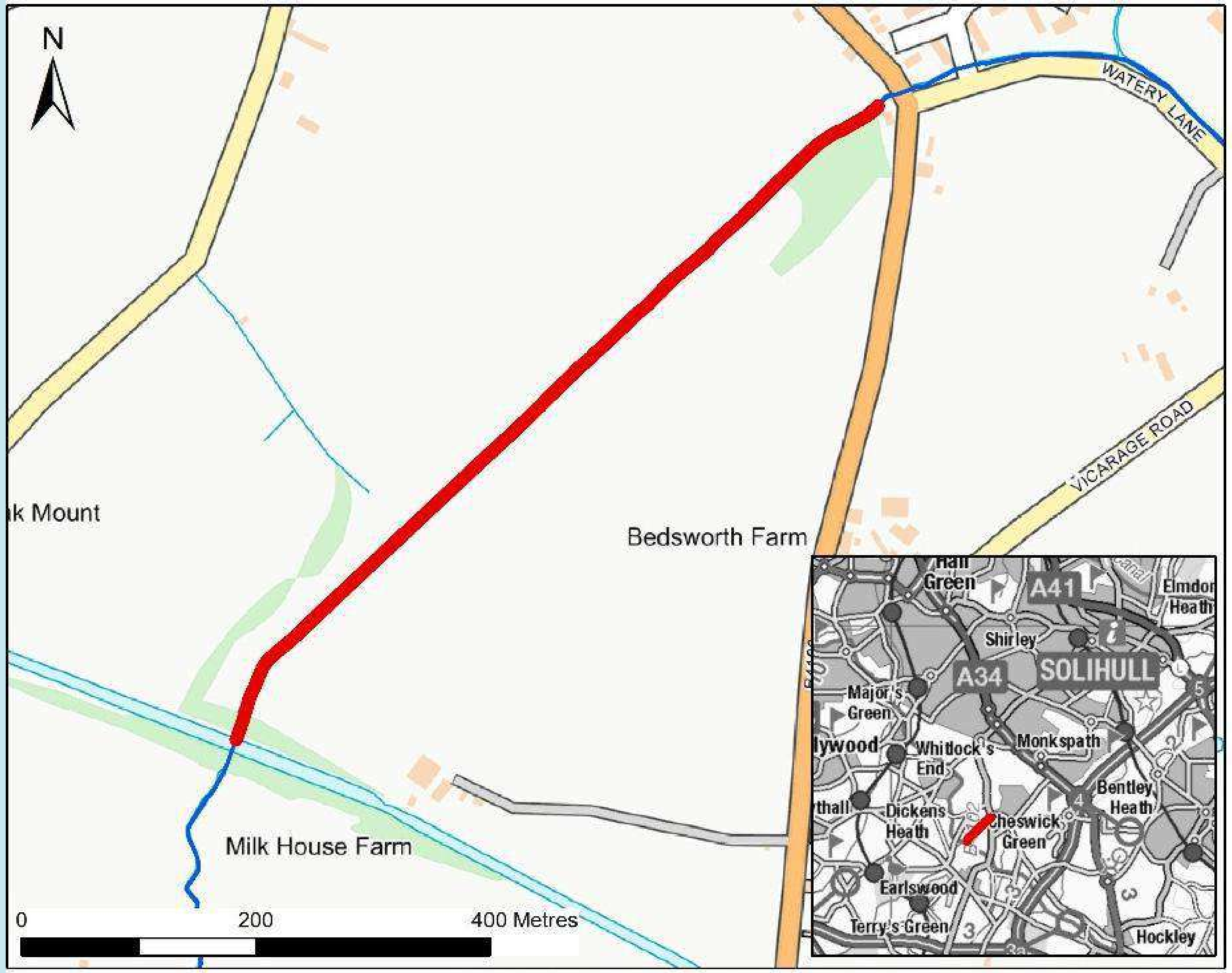


Figure 4-2: Reach scale catchment overview

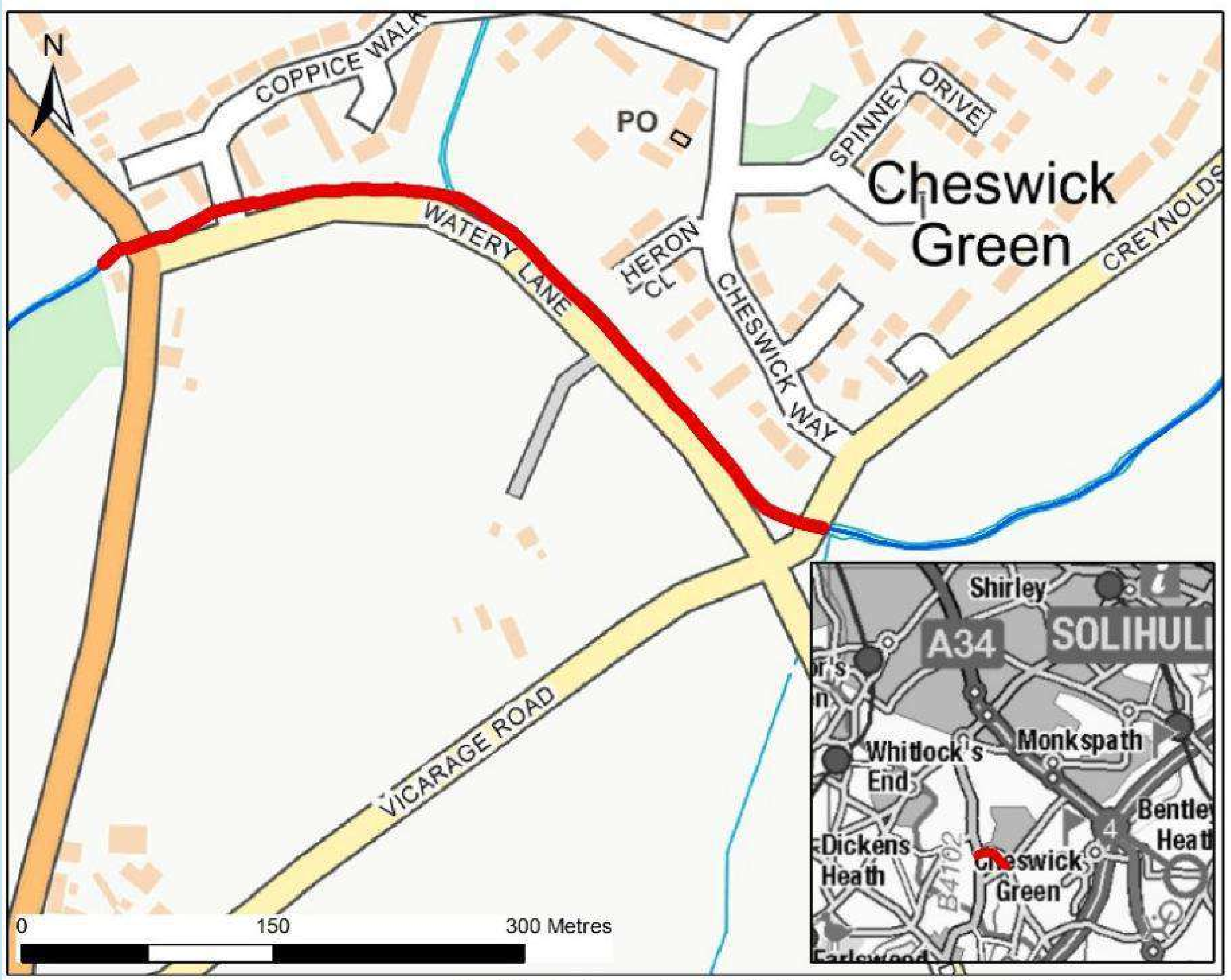
4.3.1 Reach 1: Earlswood

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 11471 74249** **End NGR:** **SP 11768 74976** **Reach Length:** **843m** **SSSI Unit:** **Unit 2** **SSSI Unit Condition:** **Unfavourable Recovering**	**Geomorphology:** • River type is passive meandering. • The channel has been significantly physically modified during the construction of the reservoirs, including channel straightening and diversion upstream. • A transporting reach with minimal areas of active deposition. • Primarily a riffle-glide sequence, with some pools behind natural dams. Flow variation created by natural dam features formed by large woody material. • Incised channel with moderate to poor floodplain connectivity, but localised impoundment caused by natural dams. • Armoured gravel bed with sands. **Ecology:** • Channel is Alder-lined with large amounts of large woody material. • Alder roots form small weirs creating varied morphology. • One stand of Japanese Knotweed associated with buried utilities. • Gravel bars being colonised by Fools Water-cress. • Land abandonment and reversion to wet grassland and fen along floodplain. • Potential pollution risks from industry.	 Contains Ordnance Survey data © Crown copyright and database right 2017	 Example natural dam formed from large woody material and leaf litter, creating flow variation.  Uniform channel width of approximately 2-3m.

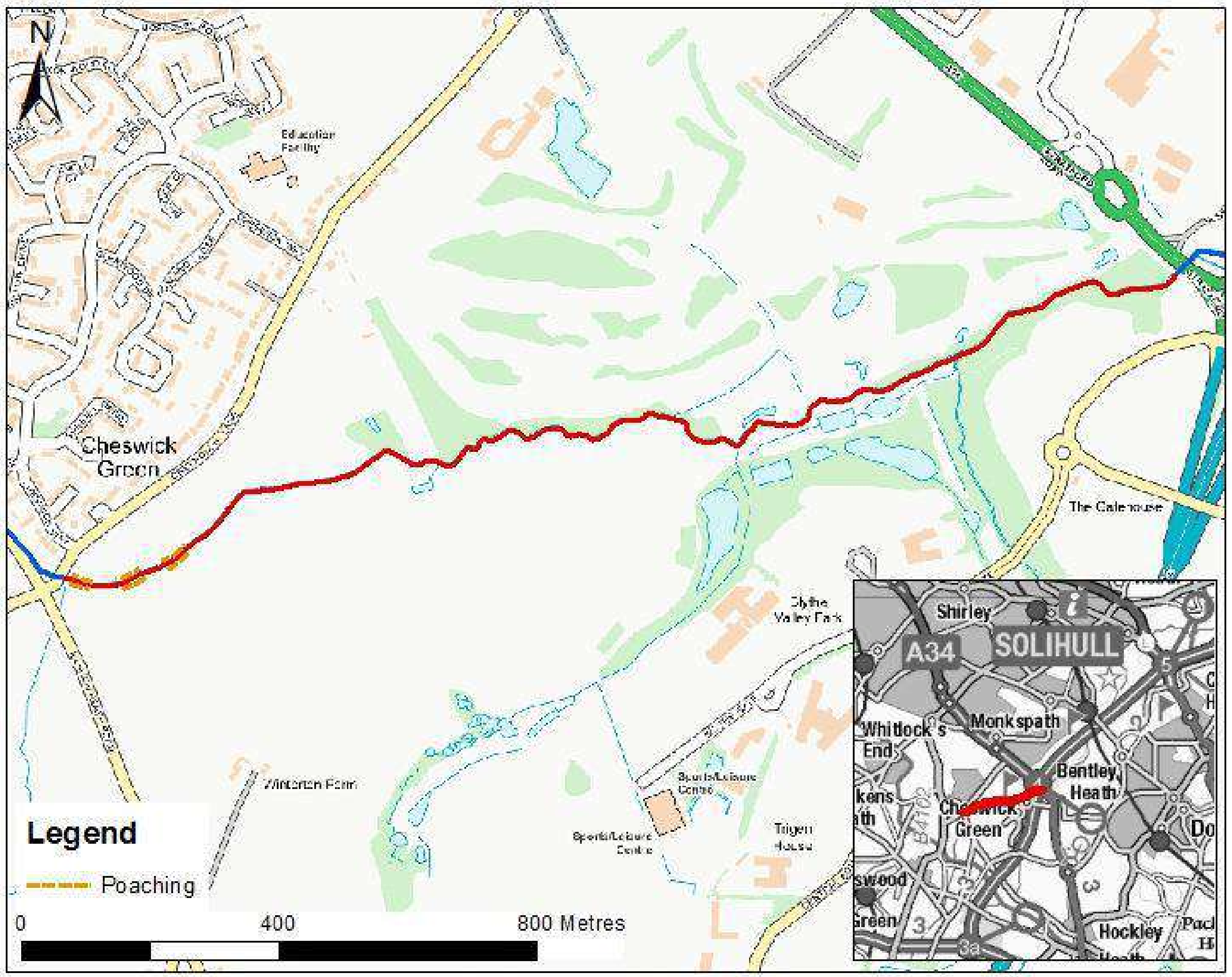
4.3.2 Reach 2: Canal Downstream

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 11768 74976** **End NGR:** **SP 12324 75524** **Reach Length:** **781m** **SSSI Unit:** **Unit 2** **SSSI Unit Condition:** **Unfavourable Recovering**	**Geomorphology:** • River type is likely passive meandering; however, channel straightening has altered its natural planform. • A transporting reach with minimal areas of active deposition. • Flow variation and in-channel sinuosity developing around natural dams and woody material. Primarily a glide/ pool reach. • Embanked channel with moderate to poor floodplain connectivity. • Armoured gravel bed with sands. **Ecology:** • *Phytophthora alni* disease of Alder predominant in this reach. • Dead Alder creating large woody material dams promoting channel migration, bar formation and colonisation by Fools Water-cress • Reverting (improved) grassland on right bank. • Poor fen and rich fen habitats on left bank. • Fen areas species-rich but under threat from field drainage	 Contains Ordnance Survey data © Crown copyright and database right 2017	 Reach is lined by trees and dense vegetation on both banks. Species-rich fens on left bank.  Channel is mostly deep but with some shallower sections, in which the bed substrate appears to be armoured with gravels and sands.

4.3.3 Reach 3: Cheswick Green

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 12324 75524** **End NGR:** **SP 12731 75370** **Reach Length:** **521m** **SSSI Unit:** **Unit 2** **SSSI Unit Condition:** **Unfavourable Recovering**	**Geomorphology:** • River type is passive meandering, constrained by road. • A transporting reach with minimal areas of active deposition. • Varying floodplain connectivity; moderate to poor in places but good where lined by formal gardens. • Glide/ riffle reach with minimal features, rippled biotope. **Ecology:** • Garden escapes (GEs) widespread, including a number of *Cotoneaster* species and Snowberry. • *Ranunculus pencillatus pseudofluitans* is present on channel bed gravels. • Concrete channel walls behind gardens and along Watery Lane negatively impact riparian habitats • *Carex pendula*, a GE, dominant along banks in many locations.	 	 Concrete-lined, entrenched channel near Coppice Walk. Channel width is uniform throughout reach.  *Carex pendula* dominant on left bank.

4.3.4 Reach 4: Shirley Golf Course

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 12731 75370** **End NGR:** **SP 14462 75824** **Reach Length:** **1995m** **SSSI Unit:** **Unit 3** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is passive meandering. • Primarily transporting reach, but some areas of temporary deposition. • Distinct riffle/ glide sequences, interspersed by runs. Variable channel width and depth. • Floodplain connection is moderate, channel is mostly entrenched. • Alder disease contributes large woody material in places. **Ecology:** • Cattle poaching prevalent in numerus locations along this reach. • Large areas of poor fen associated with palaeochannels on right bank. • Alder-lining of channel is discontinuous. • Bars become colonised by *Apium nodiflorum,* then *Phalaris* arundinacea then *Carex riparia* as they mature. • Paleochannels on left bank are conspicuous but species-poor.	 Contains Ordnance Survey data © Crown copyright and database right 2017	 Ford crossing over shallow, riffle, resulting in broken banks.  In addition to riffles, there are also deep, slow-moving areas of the channel, in which some suspended silts are evident.

4.3.5 Reach 5: M42

Reach Details

Start NGR:
SP 14462 75824

End NGR:
SP 14865 76163

Reach Length:
572m

SSSI Unit:
Unit 4

SSSI Unit Condition:
Unfavourable No Change

Existing Reach Conditions

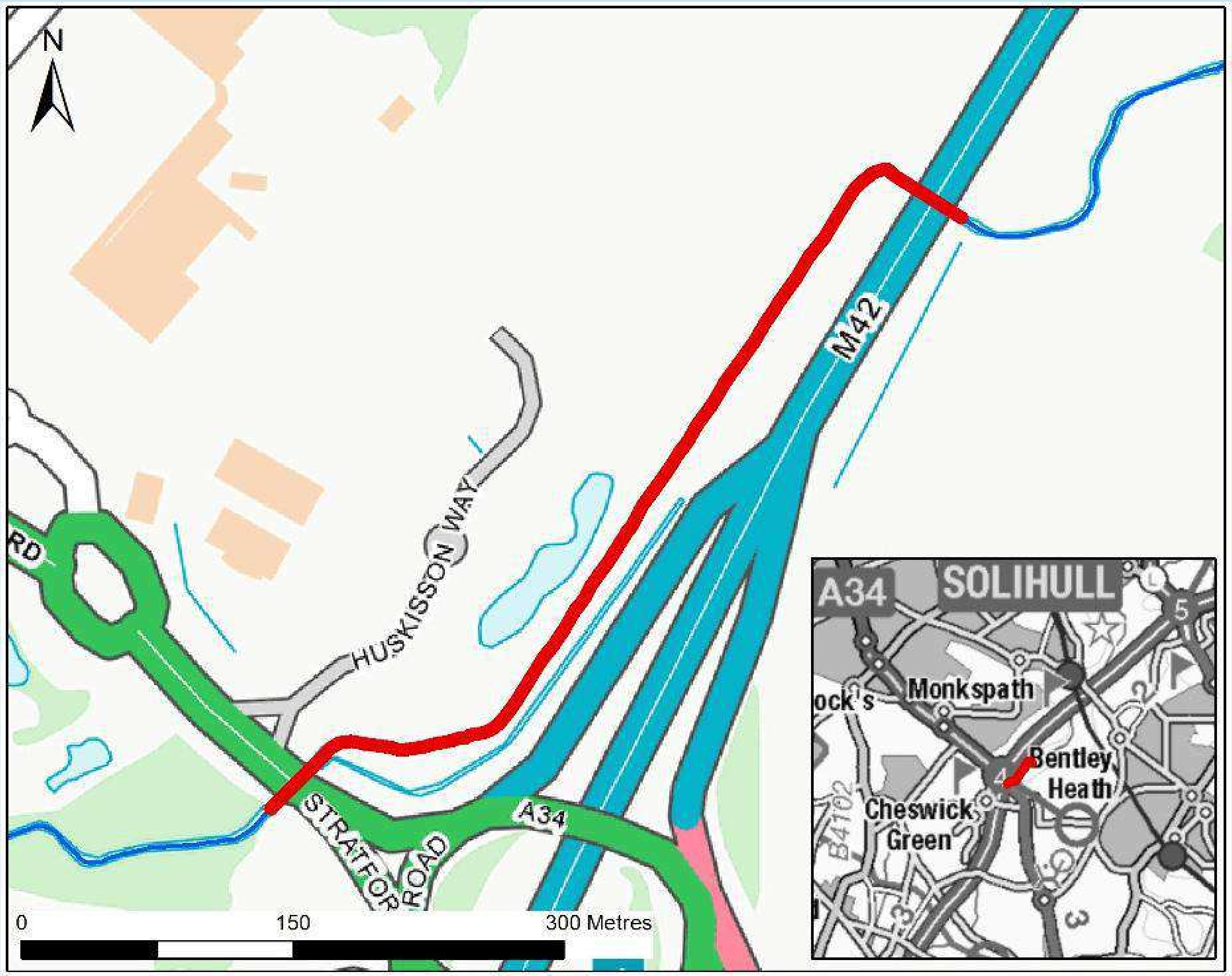
Geomorphology:

- River type is likely passive meandering; however, channel straightening has altered its natural planform.
- Primarily transporting reach, with few areas of active deposition.
- Relatively confined floodplain; M42 on right and gradual sloping valley on left.
- Channel banks are vertical, not trapezoidal.
- Heavily modified reach alongside the M42 with a narrow strip of floodplain on the left bank

Ecology:

- Crack Willow *Salix fragilis* is the dominant tree on this reach.
- Old course of river is now a group of ponds.
- Banks are unmanaged and land use has tumbled down to ruderal grassland with invading tree and shrub species.
- No in-channel vegetation.
- Off line ponds on left bank are less than 10 years old, connected to each other and main channel upstream.
- Much of channel is very shaded, with a silty bed.
- Angling is taking place and fishing line has been left lying about.

Reach Overview



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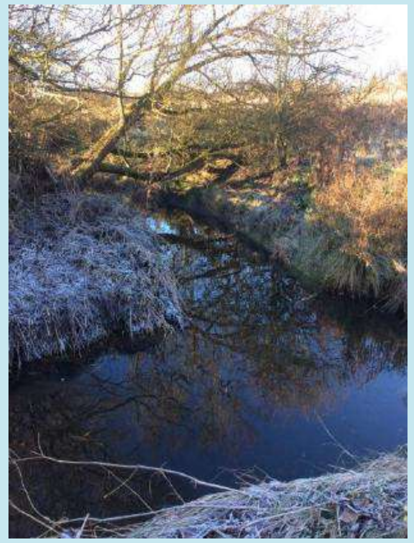
Photographs


Sharp-right hand bend in channel; over-widened through culvert and access ramp for large machinery.

4.3.6 Reach 6: Shelly Green

Reach Details

Start NGR:
SP 14865 76163

End NGR:
SP 15531 77313

Reach Length:
1719m

SSSI Unit:
Unit 4

SSSI Unit Condition:
Unfavourable No Change

Existing Reach Conditions

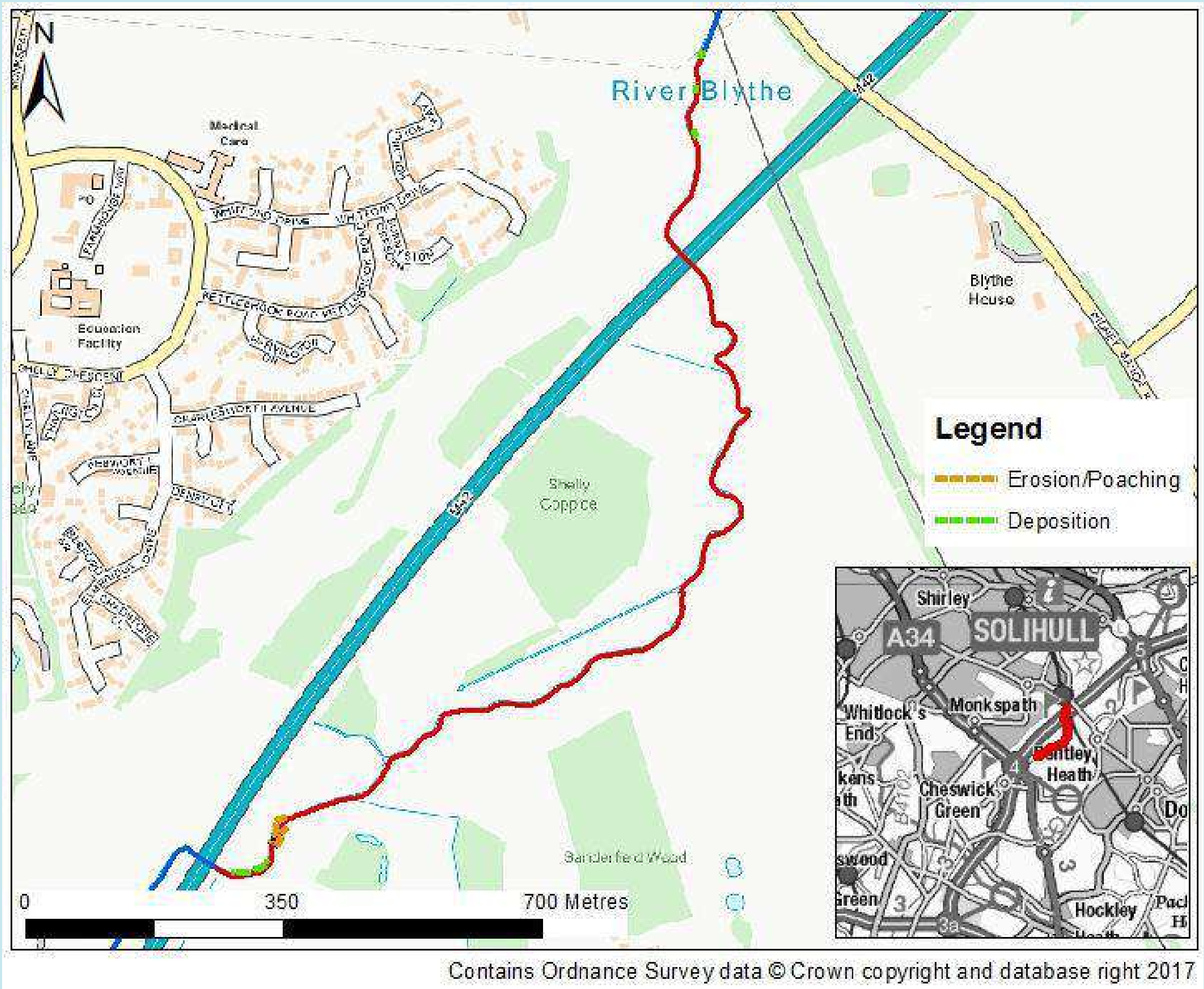
Geomorphology:

- River type is passive meandering.
- Primarily transporting reach, with some areas of temporary deposition.
- Floodplain connectivity is poor to moderate through the first half of the reach, but improves downstream of Shelly Coppice.
- Clear riffle/ glide/ pool sequence owing to variation in channel gradient. Armoured bed visible in riffles.
- Through the golf course, downstream of the M42, the reach is better connected to the floodplain and deposition of gravels is more prominent.

Ecology:

- Alder is again dominant in this reach with very large Crack Willow pollards in places.
- Land abandonment is a key feature of the floodplain in this reach.
- Straight drain (which could be a former leat or field drain) on left bank is Alder-lined.
- *Ranunculus pencillatus pseudofluitans* present on gravels in Widney Manor Golf Course.
- Chub present in this reach and Signal Crayfish seen in railway culvert.

Reach Overview



Photographs

Incised channel, Alder-lined for most of the reach with occasional Crack Willow pollards.

Bed substrate in riffles and shallow sections is shown to be mostly armoured gravels with sandy deposits and some fine sediments, colonised by Water Crowfoot in places.

4.3.7 Reach 7: Brueton Park

Reach Details

Start NGR:
SP 15531 77313

End NGR:
SP 16349 78947

Reach Length:
2558m

SSSI Unit:
Unit 5

SSSI Unit Condition:
Unfavourable No Change

Existing Reach Conditions

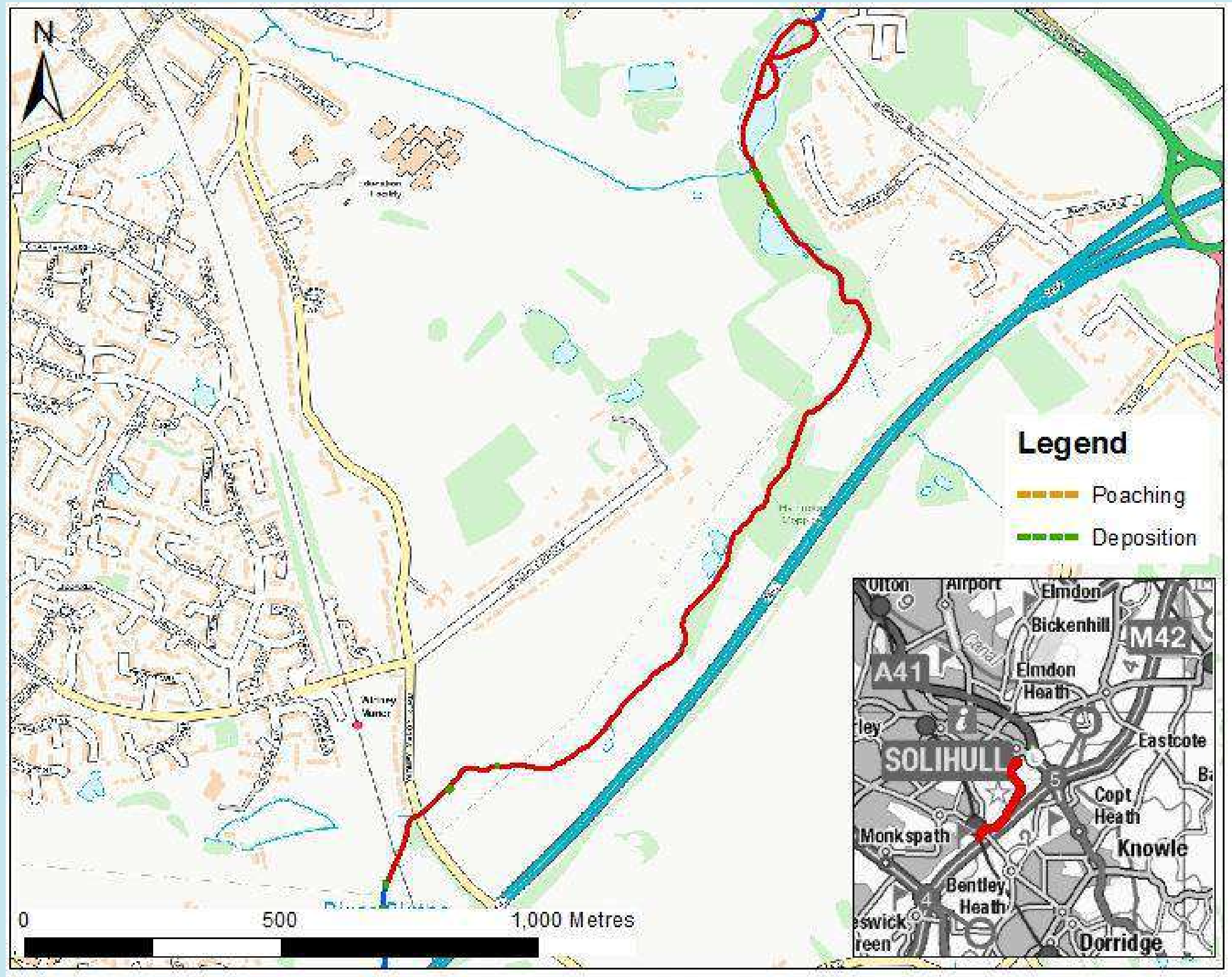
Geomorphology:

- River type is passive meandering.
- Primarily a transporting reach, but with increasing areas of stable and temporary gravel deposition, especially upstream of Brueton Park Lake.
- Floodplain connectivity is variable through reach; considered mostly moderate for the reach. Floodplain is unconfined.
- Large woody debris through the straightened section in Halfmoon Coppice wood has created natural dams.
- Historically active reach, paleo channels evident in floodplain.
- Artificial cobble rapids in former mill leat adjacent to Brueton Pond.

Ecology:

- Poaching evident on both banks in the upstream part of the reach.
- Evidence of old buildings (mill?) near the M42 footbridge with a silted-up pond, now colonised by *Carex riparia*.
- Paleochannels on right bank in particular colonised by Soft Rush *Juncus effusus*.
- Extensive gravel deposits, with large numbers of golf balls from the upstream golf course, being colonised by *Apium nodiflorum* and *Phalaris arundinacea*.
- Japanese Knotweed present where utilities have been buried.
- Land abandonment in the lower reach on the left bank, leading to the development of fen and wet woodland.
- Woodland has good ground flora and is clearly semi-natural and long-established
- Brueton Park is composed of an online lake with a new bypass channel. Lake has islands and the usual mix of feral and semi-domesticated wildfowl.

Reach Overview



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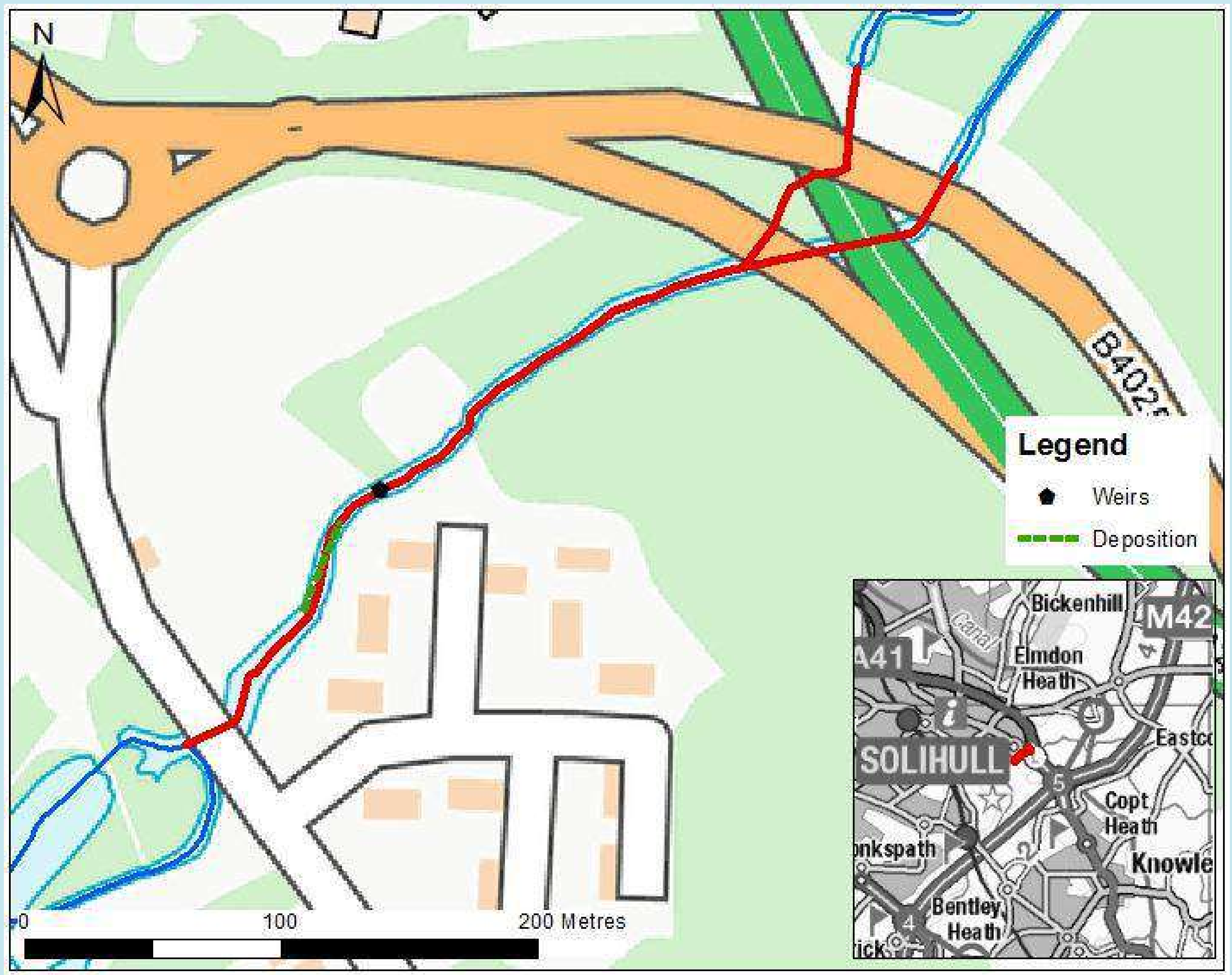
Photographs

Gravel mid-channel island in the upper reach, with colonising Foo's Water-cress.

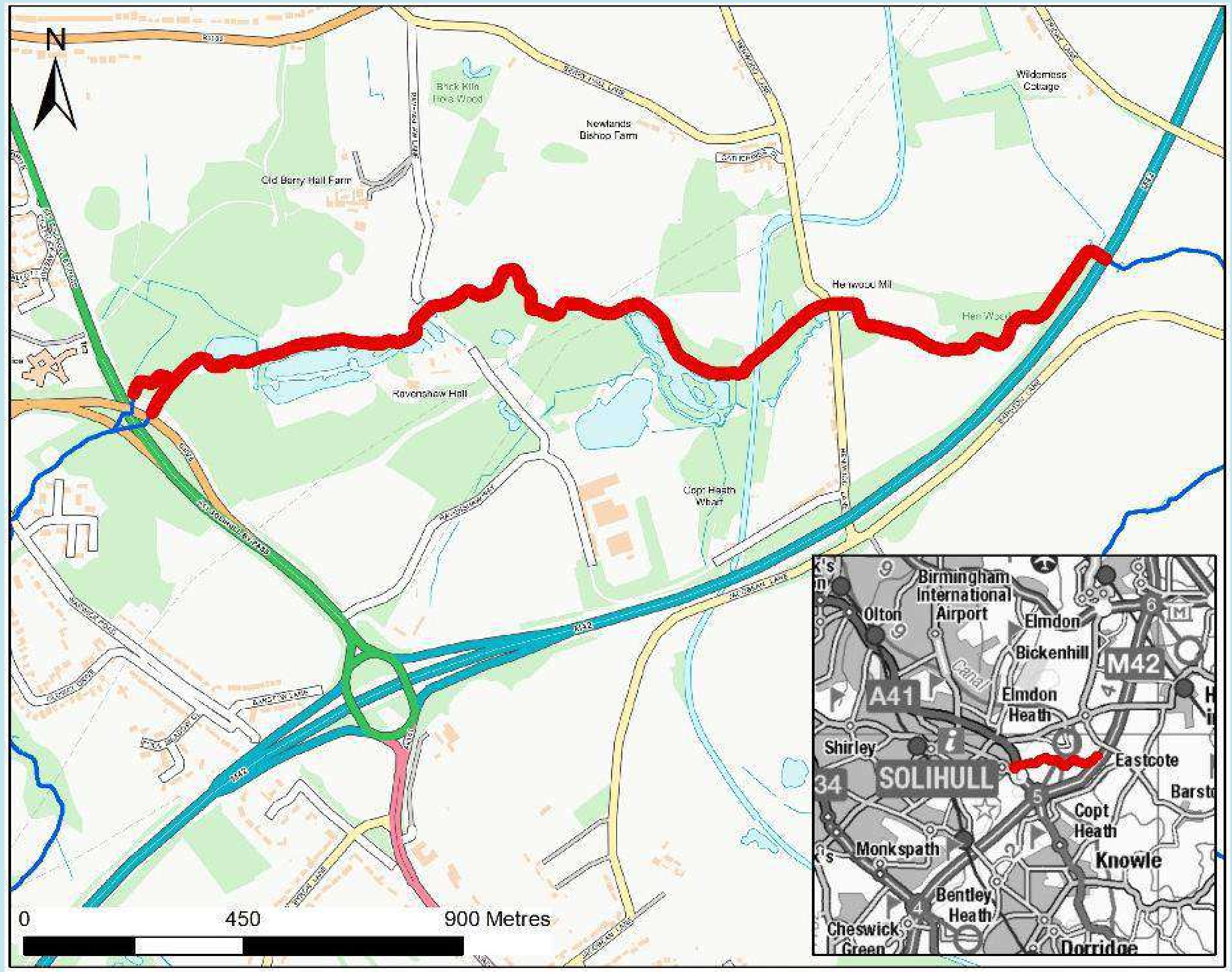
Although considered passive meandering, there are relatively straight sections characterised by gliding flows.

Through Halfmoon Coppice wood the channel is wide and slow-moving, owing to localised impoundment caused by natural dams. Floodplain connectivity is generally poor.

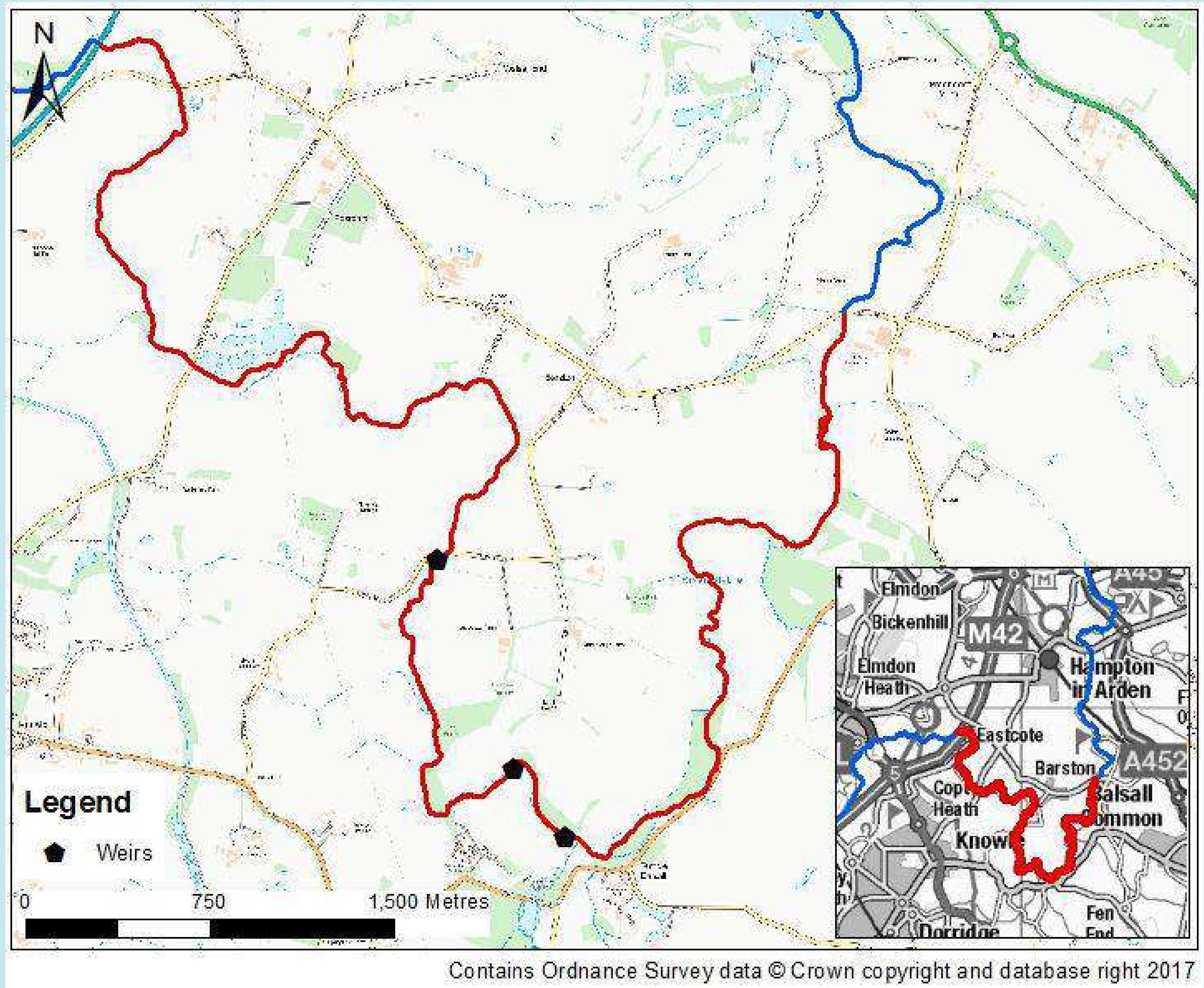
4.3.8 Reach 8: Riverside Drive

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 16349 78947** **End NGR:** **SP 16579 79140** **Reach Length:** **498m** **SSSI Unit:** **Unit 6** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is passive meandering. • Some accumulation of gravels is evident. • Deeply entrenched channel with made ground on both banks. • Glide/ pool reach with some riffles. **Ecology:** • Shaded channel with no vegetation evident on the gravels. • Secondary woodland has developed on both banks with some gardening on the right bank. • Japanese Knotweed stand on the left bank. • Deer damage evident on trees within the woodland.	 	  Gravel deposition on left-hand bank margin.

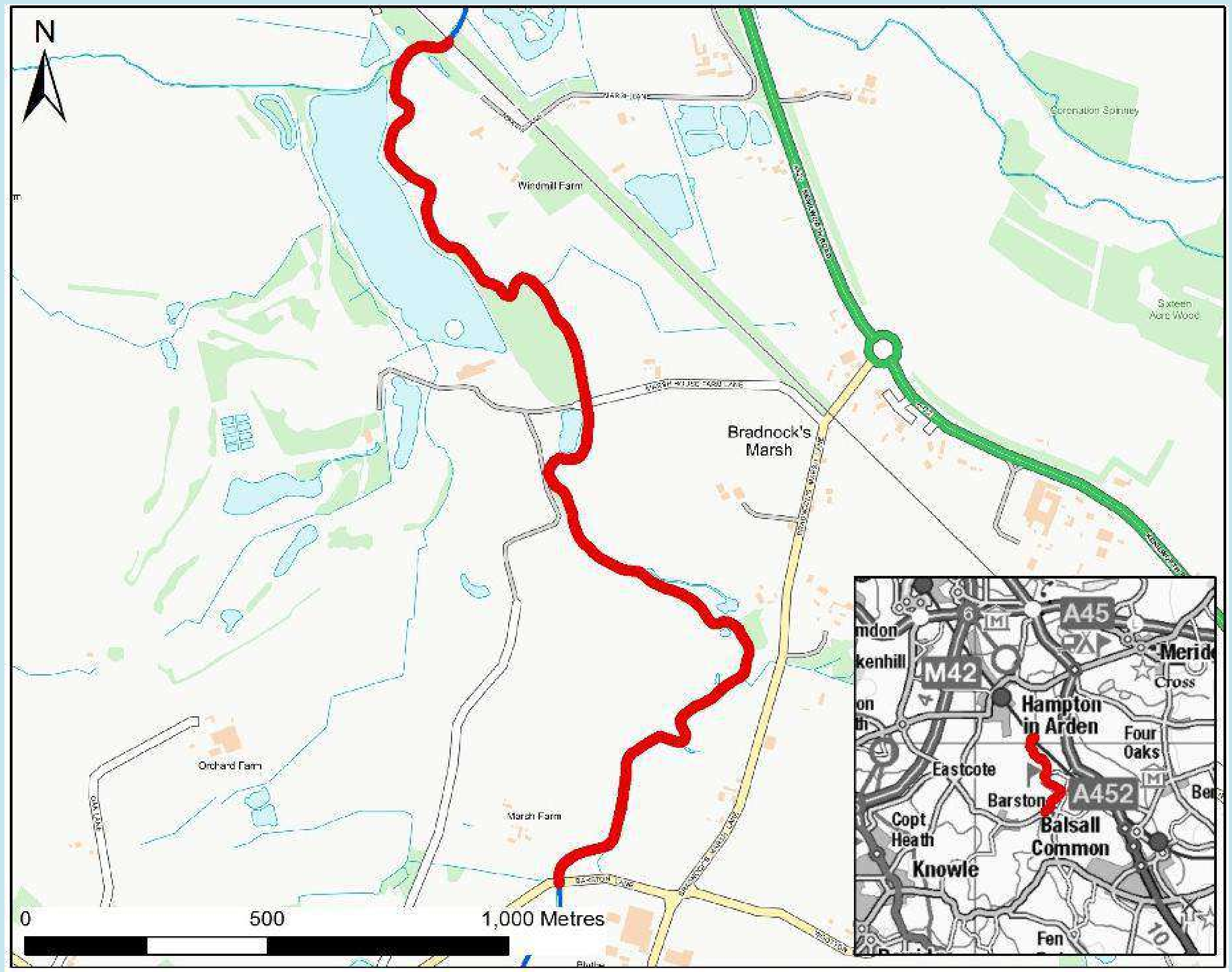
4.3.9 Reach 9: Ravenshaw

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 16579 79140** **End NGR:** **SP 18580 79496** **Reach Length:** **2578m** **SSSI Unit:** **Unit 6/7** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is passive meandering. • Some areas of temporary deposition. • Floodplain connectivity is moderate. • Palaeochannels evident on the left bank floodplain towards the middle of the reach. • Copious supply of large woody material from semi-natural and plantation woodland. • Right bank contains many ponds: maybe location of palaochannels where the current course is less sinuous. • Final part of reach has been straightened. **Ecology:** • Very wooded reach with different types of woodlands present on both banks. • Channel is Alder-lined but other species are present. • Little in-channel vegetation due to shading. • Paleochannels in the middle of the reach colonised by Soft Rush or Reed Canary-grass.	 Contains Ordnance Survey data © Crown copyright and database right 2017	 Wooded reach showing areas of deposition

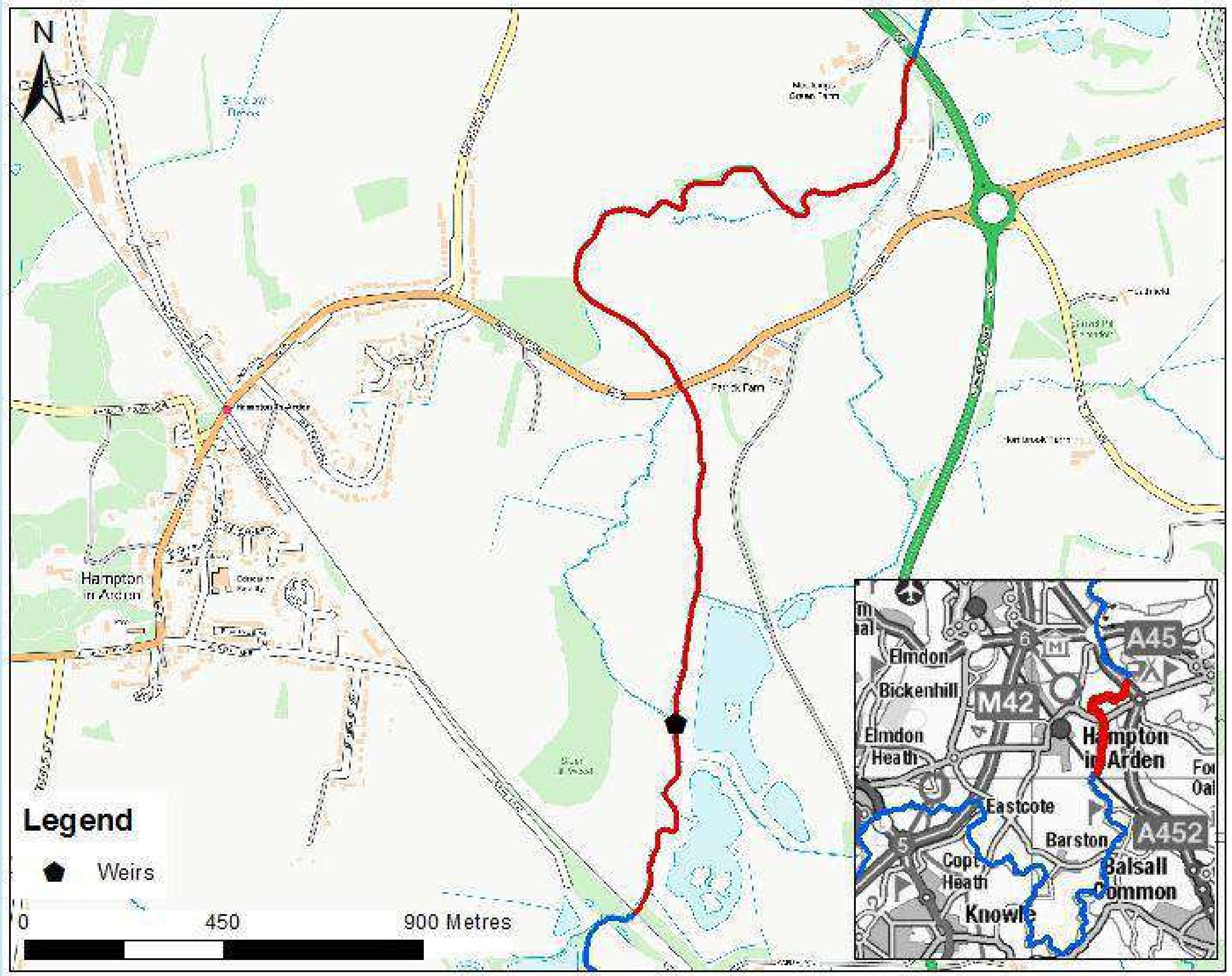
4.3.10 Reach 10: Barston

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 18580 79496** **End NGR:** **SP 21628 78390** **Reach Length:** **10656m** **SSSI Unit:** **Unit 7/8/9/10** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is predominantly passive meandering; however, there are signs of active meandering on some bends. • Areas of gravel and some fine sediment deposition, as well as areas of bank erosion on outside meanders. • Primarily a riffle/ glide/ run morphology, with some large woody material in channel contributing to flow variation. • Historically active reach, with paleo channels evident on floodplain. • Flow control structures such as weirs are present, and bank protection in places including blockstone. • Numerous fords. **Ecology:** • Line of trees along north of reach with high bat roosting potential. • Muntjac deer present. • Coarse woody debris/unmanaged woodland (The Gorse). • Himalayan Balsam south of The Gorse woodland. • Wet woodland adjacent to plantations.		 Some deposition in the form of mid-channel bars and point bars.  Grazed banks, poaching and lack of trees in places is assisting with erosion.  Straightened section with sluggish flow.

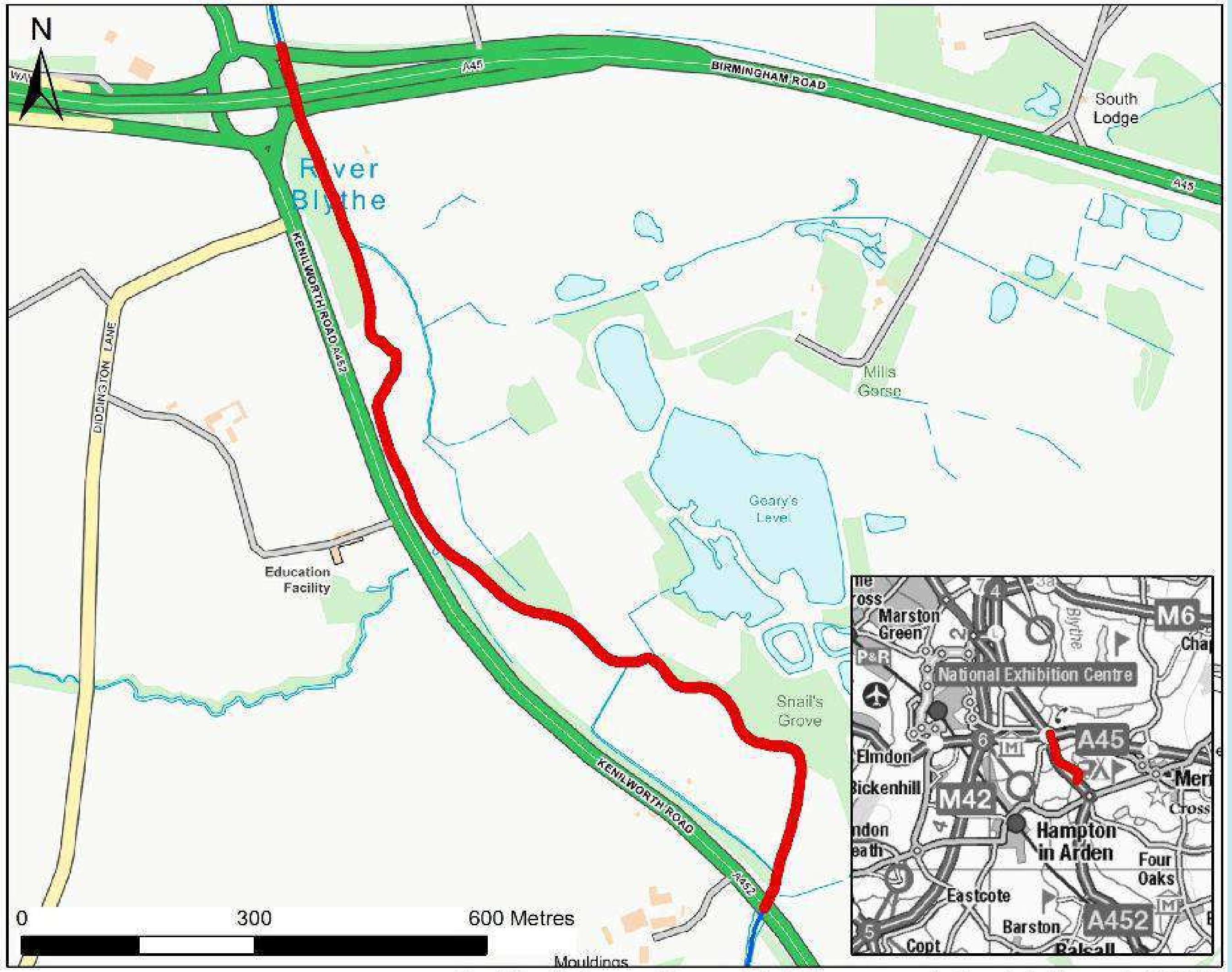
4.3.11 Reach 11: Bradnocks

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 21628 78390** **End NGR:** **SP 21388 80139** **Reach Length:** **2642m** **SSSI Unit:** **Unit 10/11/12** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is predominantly passive meandering. • The channel has been over-widened in several places and as a result is largely disconnected from the floodplain. • There are some erosional features and a few depositional features visible; however, it is mostly a low-energy reach with a dominant glide biotope and sparse riffle features. • Bed substrate is still predominantly clean, but armoured gravels and sands. **Ecology:** • Extensive Himalayan Balsam stands present in reach • High incised banks in places which offer potential Water Vole burrowing habitat • Banks dominated sporadically by trees lines as opposed to areas of established woodland • In general, riparian margins are not well formed with bare banks dominating, even where trees were noted. • Otter prints and spraint recorded in this section	 Contains Ordnance Survey data © Crown copyright and database right 2017	  Bank erosion and instability is evident in the reach.

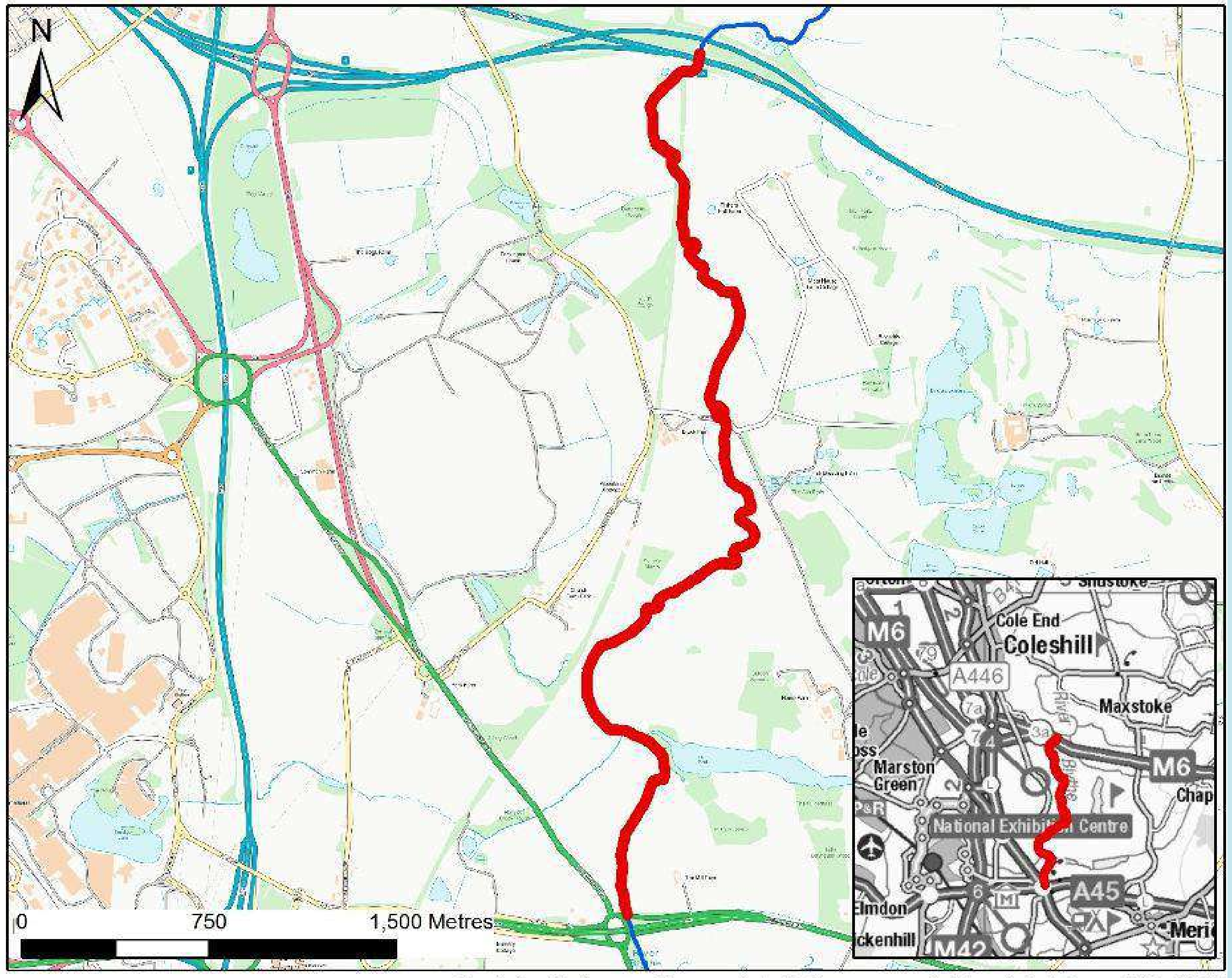
4.3.12 Reach 12: Meriden

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 21388 80139** **End NGR:** **SP 22010 82057** **Reach Length:** **2901m** **SSSI Unit:** **Unit 12** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is predominantly passive meandering; however, there are signs of active meandering on some bends (bank erosion on outside meander). • Historically active reach, with paleo channels evident on wide, flat floodplain. • Whilst channel connectivity to floodplain is good through the meanders, elsewhere it is generally poor to moderate owing to over-widening and straightening. • Bed substrate is gravels and sands with a thin veneer of silt **Ecology:** • Paleochannels and poaching present, particularly along the upstream part of this reach • Ground relatively saturated either side of channel attracting Canada Geese • Bank profile varies along reach; sometimes very shallow, other times quite steep • Wet woodland towards the north of the reach. • High potential for Otter within this reach	 Contains Ordnance Survey data © Crown copyright and database right 2017	 Extensive network of paleo channels evident in floodplain, some of which contain Soft Rush..  Areas of active deposition being colonised by heavily grazed grassland.

4.3.13 Reach 13: Kenilworth Road

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 22010 82057** **End NGR:** **SP 21437 83091** **Reach Length:** **1484m** **SSSI Unit:** **Unit 13** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is predominantly passive meandering; however, there are signs of active meandering on some bends (bank erosion on outside meander). • Channel is incised in some places and floodplain connectivity is moderate to poor. • Some large woody debris acts as a natural dam • Deposition composed of fine sediment, although overall, active deposition is limited. There are localised pockets of bank instability. • Flow biotopes are mostly characterised by pools and glides, with some runs. **Ecology:** • Fields un-grazed and overgrown with extensive areas of reed/saturated ground in old palaeochannels. • Wet woodland (un managed) with coarse woody debris. • Woodland immediately adjacent to River Blythe-steep banks to woodland suitable for Badger.	 Contains Ordnance Survey data © Crown copyright and database right 2017	 Bank erosion caused by grazing and formation of island from the former bank line.  Fine sediment deposition on relatively straight section. Different bank profiles resulting from differences in management practices.

4.3.14 Reach 14: Brook Farm

Reach Details	Existing Reach Conditions	Reach Overview	Photographs
Start NGR: **SP 21437 83091** **End NGR:** **SP 21656 86597** **Reach Length:** **4790m** **SSSI Unit:** **Unit 14** **SSSI Unit Condition:** **Unfavourable No Change**	**Geomorphology:** • River type is passive meandering, but with areas of active bank instability. • Characterised mostly by deep pools and glide morphology, but also runs and under-developed riffles. • Morphology dominated by mostly runs, glides and extended pools. • Channel is incised due to over-widening in places and floodplain connectivity is mostly moderate to poor. • Limited deposition of gravels in this reach, however, several vegetated bars suggesting fine sediment deposition. Several areas of active erosion and poaching. • Straightened reaches mainly associated with the railway line are present and there is typically instability where these join the natural sections. **Ecology:** • Reach that is dominated by pasture and grazing. • Old railway corridor is a significant feature of this reach. • Bank erosion and poaching is present in a number of locations. • Wet woodland in the Northern part of the reach. • Areas of fen on the left bank • Palaochannels on the left bank colonised by Soft Rush and other species. Some palaeos are still Alder-lined. • Alder cover of banks is discontinuous but, where present, CWD dams form. • Major ford in the centre of the reach with bank protection and deeply flooded road.	 Contains Ordnance Survey data © Crown copyright and database right 2017	 Areas of active bank instability and slumping on straightened reach suffering sheep grazing.  Cattle grazing and watering causing poaching on banks that are not tree-lined.

4.3.15 Reach 15: Dairy Farm

Reach Details

Start NGR:
SP 21656 86597

End NGR:
SP 20662 88842

Reach Length:
5662m

SSSI Unit:
Unit 15/16

SSSI Unit Condition:
Unfavourable No Change

Existing Reach Conditions

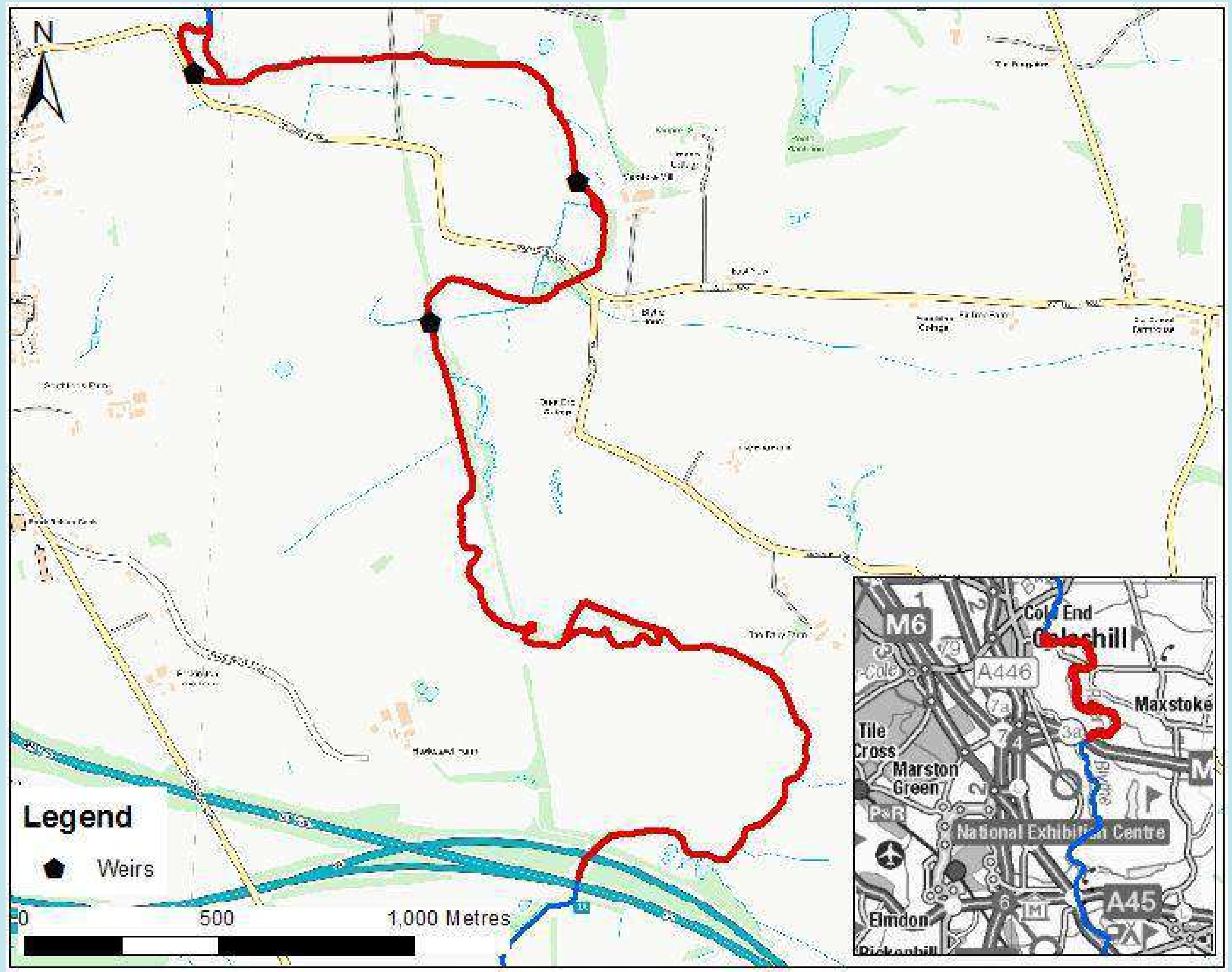
Geomorphology:

- River type is passive meandering. Variable channel width throughout reach.
- Floodplain connectivity is moderate to poor in places.
- Mostly characterised by a glide morphology, but with some mostly under-developed riffles and deep pools.
- Bed substrate not visible in deep pools/ runs. In shallower sections and at bank margins gravels are visible; clean in places but with fine sediment downstream of bank erosion.
- Deposition within this reach are limited to a few locations. Bank erosion occurs on certain prominent outside bends.
- Channel has been straightened in the middle of the reach; paleo channels evident on floodplain and embankments line part of the reach.
- Railway embankment constrains lateral channel movement in places.

Ecology

- Tall ruderal riparian margins dominate the banks throughout this reach with sporadic tree lines, species present include Great Willowherb, Cow Parsley, Herb Robert, Creeping Bent and Nettle. However, there are areas of bank slumping which may have been caused by livestock poaching.
- Some areas of bankside habitat are dominated by one ruderal species only, commonly Nettle.
- The bank gradient is considered suitable to support Water Vole within this reach.
- The non-native invasive species *Elodea sp.* was noted in Reach 15**.**
- Due to the time of year the survey was carried out, in-channel vegetation was limited to patches of Water Starwort *Callitriche sp***,** Water crowfoot *Ranunculus sp.* and Bent Grass *Agrostis stolonifera* within the shallower channel edges.
- Small areas of (remnant) reedbed were recorded throughout the reach containing Common Reed *Phragmites australis*, Greater Pond Sedge *Carex riparia* and Club Rush *Schoenoplectus lacustris.*
- Surrounding land use was dominated by improved grassland and arable fields. Some areas of improved grassland contained marshy areas with ephemeral pools present.
- Railway corridor is aconspicuous feature.

Reach Overview



Photographs

Sequence of glide morphology leading into deeper pools. Clean but armoured gravels visible in shallower glides.

Some small point bars have developed at bends in the channel; these contain small gravels and fines, colonised by Stream Water-crowfoot.

Gravel and sandy bed substrate covered by a layer of fine sediment. Likely originating from local sources; potentially the grazed fields behind.

4.3.16 Reach 16: Terraces

Reach Details

Start NGR:
SP 20662 88842

End NGR:
SP 21059 89838

Reach Length:
1265m

SSSI Unit:
Unit 16

SSSI Unit Condition:
Unfavourable No Change

Existing Reach Conditions

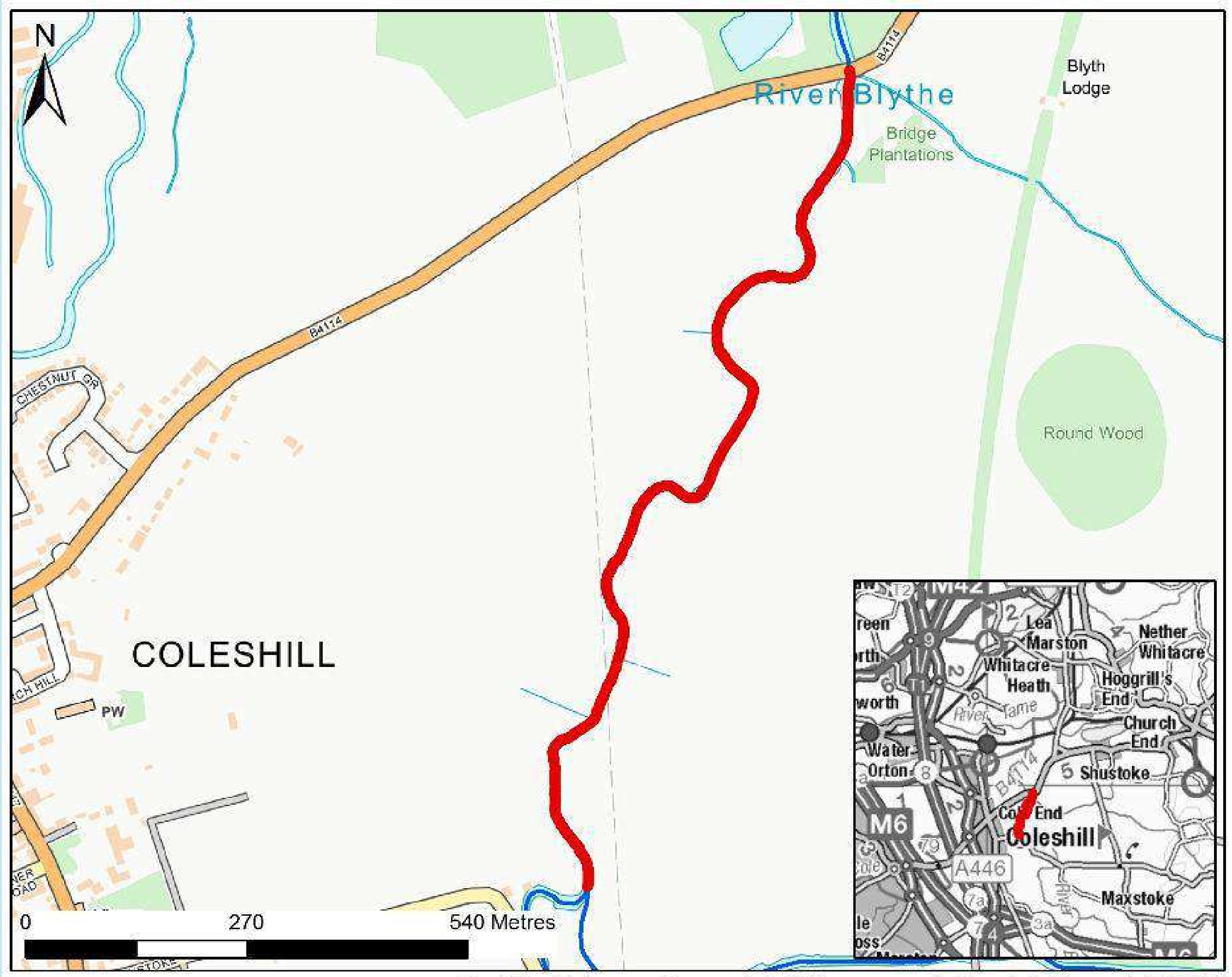
Geomorphology:

- River type is passive meandering.
- Dominated by slow moving flow, mostly glide biotopes.
- Channel is sinuous and the channel is generally well connected to its floodplain.
- Some clean gravels evident, but bed substrate is mostly dominated by fine silts. In some places the channel is overwide, however, there is evidence that some natural recovery is underway through the formation of natural bar features and mid channel islands.
- Analysis of historic aerial imagery appears to show severe poaching along this reach (2001 and 2012), however, the reach is now in a state of recovery.

Ecology

- Single thread channel running through pastureland, grazed by cattle.
- Areas of wet grassland on both banks within a fairly undisturbed floodplain.
- Palaeochannels on both banks some colonised by Soft Rush, creating areas of rushy pasture, ideal for Snipe.
- Other palaeochannels colonised by *Phalaris arundinacea*, creating a heterogenous matrix of habitat cutting through the heavily managed improved grasslands above the river terraces.
- Northern part of reach at Blythe Bridge has a large tributary on the right bank and there is an area of rich fen at the confluence with *Carex riparia* and large Crack Willows.
- The least treed reach on the entire River Blythe, however, this makes it excellent for farmland wader species.

Reach Overview



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Photographs

Lone tree on the right bank with open rushy pasture on the left bank.

Rushy pasture on the L bank and rich fen on the right bank looking South (upstream). Bridge Plantations represent virtually the only trees in this reach.

4.3.17 Reach 17: Confluence

Reach Details

Start NGR:
SP 21059 89838

End NGR:
SP 21296 91629

Reach Length:
2683m

SSSI Unit:
Unit 17

SSSI Unit Condition:
Unfavourable No Change

Existing Reach Conditions

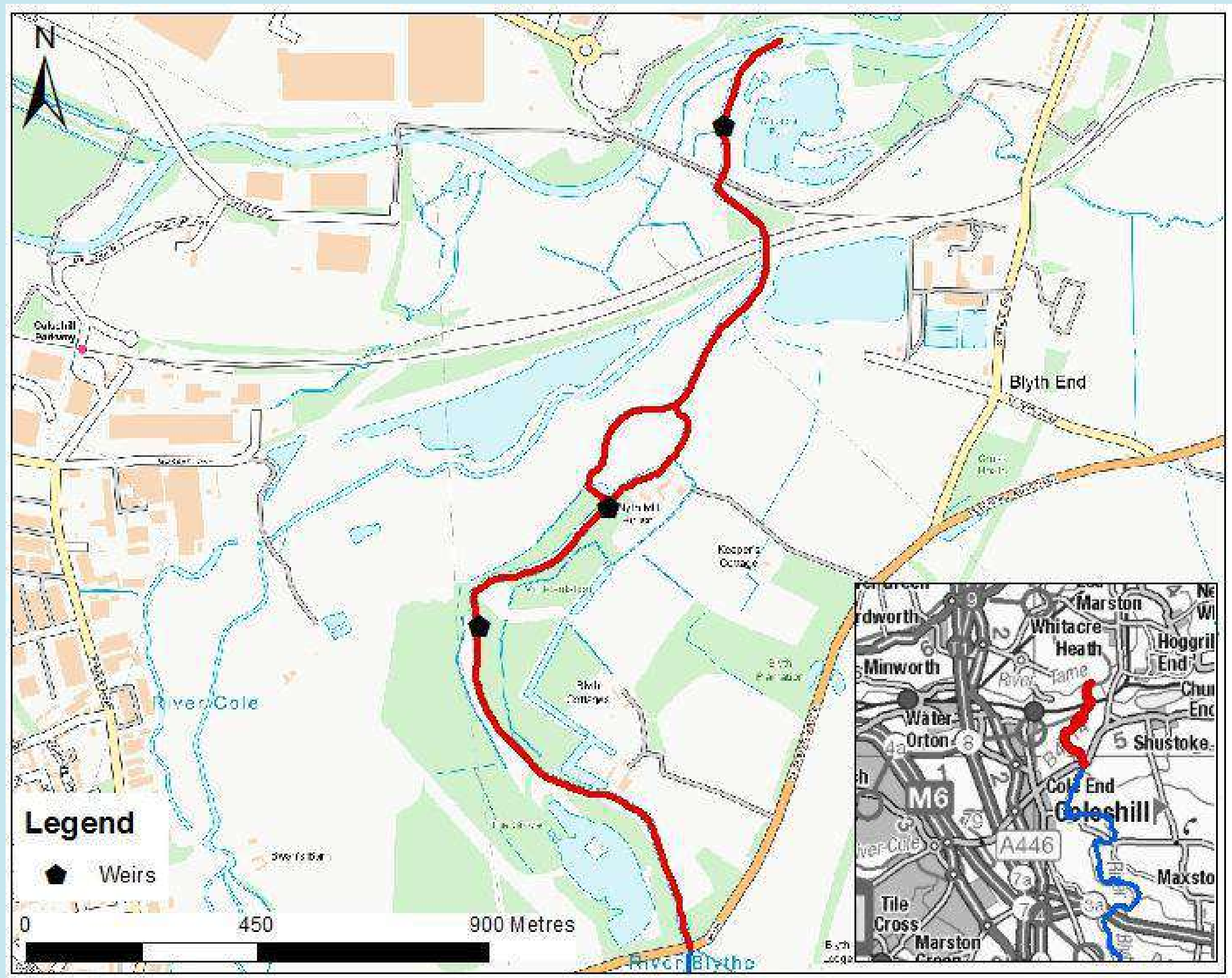
Geomorphology:

- River type is passive meandering.
- The channel is dominated by steep banks around Blythe Mill; floodplain connectivity is consequently poor.
- The channel has been largely modified for much of this reach; good connectivity at the start but banks become steep in straightened and modified reaches.
- Upstream of the first weir, flow is impounded.
- Second weir, upstream of Blythe Mill, is failing and the channel upstream is consequently incised by the lower water level.
- Downstream of Blythe Mill, there insufficient flow for the channel width and consequently the former mill leat contains a high volume of fine sediment.
- Limited in-channel features owing to the weir's impounding influence.
- Bed substrate is dominated by fine sediment, although some gravels are present.

Ecology

- The disconnected floodplain is in mixed agricultural use, with the area immediately north of the river (below the Colne) being characterised as a combination of marshy/semi-improved grassland which contains ephemeral pools.
- There are extensive stands of Himalayan Balsam adjacent to the Mill (and within the Mill).
- The non-native invasive species Nuttall's Waterweed *Elodea nuttallii*.is also present within the SSSI sections of the watercourse in Reach 17.
- The northern extent of the site is mainly tree-lined on the right bank by Willow.
- The southern site extent is dominated by plantation woodland in the wider vicinity.
- The areas surrounding the Mill has been previously dredged resulting in damage to the bank toe with limited riparian margins present.
- The area is considered suitable for Otter and Water Vole.

Reach Overview



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Photographs


Old sluice structure in channel


Upstream view of river morphology towards Mill


Himalayan Balsam in Mill building

5 System Functioning

5.1 Overview

This chapter seeks to develop the evidence and understanding of geomorphological and ecological function and processes, ascertained from the reach scale assessment and from the review of previous studies, to consider how the existing system is functioning as a whole.

5.2 System Pressures

5.2.1 Key pressures

The field survey along the River Blythe revealed various pressures along the length of the watercourse. Many features would be expected under natural conditions; however, as a result of human activities several reaches of the River Blythe display pressures. In some cases, the river has adjusted due to these pressures in ways that wouldn't be expected under natural conditions.

The following section details the pressures observed along the length of the River Blythe.

Table 5-1: Summary of the pressures found during the field survey of the River Blythe

Pressure	Consequence	Example
Lack of Trees and Woodland areas A few reaches have poor riparian vegetation cover.	Limits the amount of woody debris entering the channel which limits the cover for fish and creates less habitat diversity Banks will become more vulnerable to erosion, especially where grazed. An under-developed riparian strip enables a more direct pathway for diffuse pollution to enter the watercourse from adjacent fields.	
Lack of Floodplain Connectivity Several factors contribute to this including embankments concentrating in channel flows and channel incision and entrenchment as the surrounding floodplain has been partly built up around the channel.	A reduction in the frequency of floodplain inundation means that fine sediment is deposited within the channel and not on the floodplain. Excess fine sediment within the channel will reduce spawning habitats and also decrease the quality of the substrate for some taxa. Ultimately, excessive fine sediment is a major cause of in channel habitat degradation and leads to poor ecological condition.	
Bank Instability and Livestock pressures Bank instability as a result of poaching from livestock, poor farming practices in places, and entrenchment of the channel.	Livestock have utilised the collapsed banks to gain access to the river in a number of locations leading to enhanced erosion of the banks (poaching). Arable farming, where carried out up to the channel edge, has limited riparian vegetation cover and exacerbated bank erosion. Increased input of fine sediment into the channel which leads to increase in channel siltation. A more uniform channel reduces the habitats within the river (i.e. fewer refuges for shelter). Limited bankside vegetation due to erosion and as a result a decline in habitat.	

Pressure	Consequence	Example
		
Channel Realignment In many areas, the channel has been straightened as a result of infrastructure creation (canals, railways and motorways). In addition, it has been straightened in places for farming and land use purposes.	The river has responded to straightening in various ways. In some areas, where the channel has been over-widened, excessive fine sediment deposition has occurred across the bed. In other areas, minor incision has occurred, leading to some river and floodplain disconnectivity.	
Floodplain Management and Riparian Pressures Current and historic floodplain farming practices have altered the semi-natural habitats and vegetation on the floodplain and the channel in places.	The floodplain contains significant areas of wet grassland and rushy pasture, as well as areas of rich fen. There is a lot of riparian woodland, mainly Alder trees, but in one or two reaches (16 in particular) there is a lack of woody riparian vegetation. Farming practices have affected the floodplain in two ways: intensification of arable and pasture management and extensification through land abandonment.	
Invasive Species Including Japanese Knotweed, Himalayan Balsam, Cotoneaster, Snowberry and waterweeds (*Elodea sp.*) were noted along the watercourse	Dieback of invasive species during winter months' leaves banks exposed and prone to erosion. Some bankside areas are heavily colonised. Waterweeds can dominate in-channel vegetation leading to a monoculture and reduction in overall diversity within the channel. Quickly spread and can lead to a decline in native species	
Channel Training Bank revetment, which is a form of channel training, is present in certain reaches along the river in various forms ranging from walling to blockstone.	Reduced channel maintenance means that areas of historic protection are now failing and the channel response in the form of lateral erosion must be planned for.	

Pressure	Consequence	Example
Weirs and Barriers Although, relatively minor in comparison to other managed watercourses, historic weirs within the channel have led to increased bed degradation and disruption in sediment supply	Weirs can significantly alter the depth of water and velocity of flow, leading to over deepened impounded reaches upstream, altering the habitat characteristics. Secondly, structures affect the river's ability to transport sediment downstream, again altering habitat characteristics. Finally, structures in the channel impact upon the biological connectivity of the river, preventing fish and invertebrate passage	
Discharge: Abstraction, Diversion and Impoundment of flows Earlswood Lakes, constructed between 1822 and 1823 for the purposes of retaining water levels in the Stratford upon Avon canal via flow diversion, and the reservoir at Whitacre used for public water supply, certainly impact the flow regime of the River Blythe.	Whilst not considered to affect the low flows through the River Blythe, the large impoundment reservoirs at Earlswood Lakes attenuate large volumes of water and will impact by reducing high flows being released into the channel. Limiting the high flows in the upper catchment impacts upon sediment transport mechanisms.	
Climate Change Predicted decrease in summer precipitation and increase in winter baseflow.	Summer baseflow reduction impacts are likely to include: lowered hydraulic habitat diversity, increased water temperatures, increased risk of summer no-flow conditions, ingress of fine sediments into the coarse bed leading to choking and reduced marginal habitat extent and variability Winter High flow increase impacts are likely to include: increased frequency of geomorphologically effective flows, increased gravel transport, increased bank erosion associated with channel planform and gravel deposition, probable remobilisation of fines stored in the channel bed, potential bed armouring, development of wandering channel reaches, potential loss of adjacent flood bank and reduction in lower energy hydraulic refugia potentially offset by creation of new areas.	

5.3 Conceptual model of the Blythe SSSI

5.3.1 Channel / floodplain connectivity

Floodplain connectivity is variable across the Blythe SSSI. Figure 5-1 shows an assessment of the channel floodplain connectivity determined from the geomorphological walkover. A rating of either good, moderate, or poor has been assigned based on how well connected the floodplain was considered to be, although the majority of the watercourse is considered to be entrenched and consequently has poor connectivity to its floodplain.

Particularly poor connectivity appears to occur in reaches which have been historically modified. Reduced connectivity between the channel and its floodplain occurs either as a result of channel entrenchment, whereby the adjacent floodplain has been artificially raised or may be naturally high compared to the channel, or channel incision, which occurs when the channel responds to a modification by actively cutting down into its bed and eroding the substrate. Both channel entrenchment and channel incision affect floodplain connectivity in the Blythe SSSI.

In the upper reaches downstream of the reservoir, the river appears to have been straightened. During high discharge events, the river has responded to higher in-channel velocities by incising its bed substrates, consequently leading to poor connectivity with its floodplain. This is again evident in the reach downstream of the canal, which has also been embanked on both banks, further contributing to poor connectivity, increased in-channel energy and reduced floodplain inundation. In other reaches, particularly in the lower half of the Blythe SSSI, poor floodplain connectivity tends to occur where the channel has been historically over-widened as well as straightened and diverted, in most cases for the construction of infrastructure such as the motorways and railway.

Channel incision is shown to occur most prominently downstream of weirs, and whilst upstream the channel may be impounded for a short length which gives the impression of improved connectivity, many reaches are still considered to be disconnected, mostly owing to the channel being overly wide in many places downstream and east of the M42.

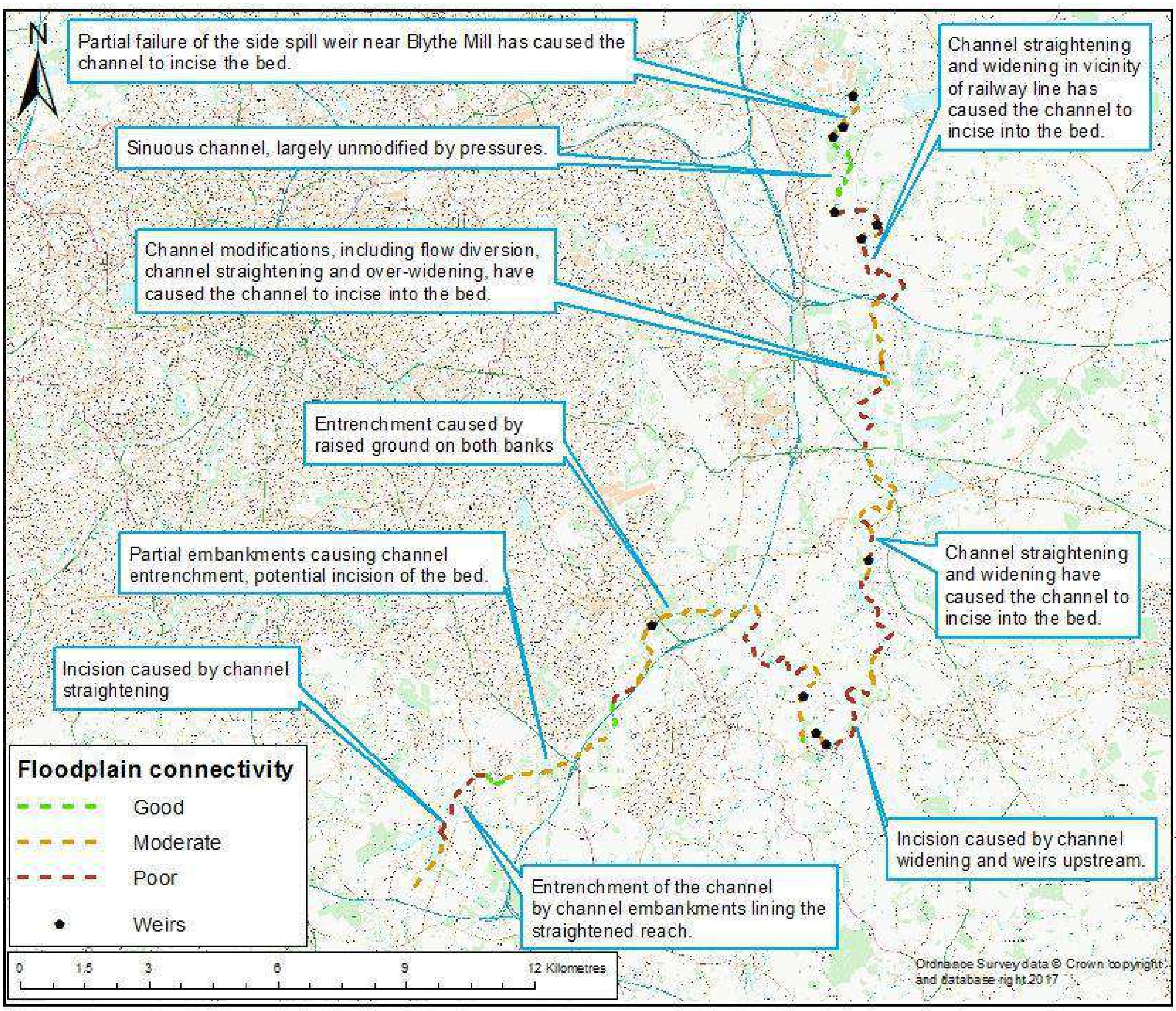


Figure 5-1: Channel floodplain connectivity through the Blythe SSSI

This is not the case in all reaches in the Blythe SSSI, however; some reaches which have not had their planform historically straightened or diverted, have good connection to their floodplain and would likely flood during the winter months. Figure 5-1 shows some sections of the channel which are considered to have good connectivity to its floodplain; for instance, the channel between Shelly Coppice and the Shelly Green golf course is well connected, and inundation of the floodplain would be expected.

The channel upstream and around Blythe Bridge in the lower reaches of the catchment, is nicely sinuous as it appears to be largely unmodified. Consequently, the banks are shallow and floodplain connectivity is good; this reach can be considered as an analogue site which illustrates the impacts channel modification such as straightening and dredging, can have on the functioning of the channel, as indicated by the downstream reach around Blythe Mill.

The presence of large woody material in certain reaches, such as through Coppice Wood, also contributes to better connectivity, by creating localised impoundment. Some reaches are reasonably sinuous and are actively forming vegetated berms through deposition; however, still have a way to go before connectivity is improved.

Figure 5-2: Photo example of good connectivity through Shelly Coppice

Figure 5-3: Photo example of good connectivity through Shelly Green golf club

5.3.2 Erosional and depositional features

Areas of significant bank erosion and depositional features have been mapped and shown in Figure 5-4. Whilst there are some localised pockets, bank erosion from hydraulic action does not occur prominently in the upper reaches from Earlswood Lakes to Ravenshaw. Active bank erosion, such as scour and undercutting, features more in the reach around Barston, Meriden and Brook Farm, typically occurring on the outside meanders. Whilst this suggests the channel is trying to increase its sinuosity on a very localised scale, it is not considered prominent enough to classify the river type as active meandering,

The observed areas of bank erosion, including erosion from hydraulic action and from poaching by livestock, are most prominent where the riparian zone is degraded, limited or completely absent. It also appears to be linked with land-use, occurring mostly in areas used for agricultural purposes. Poaching of the banks by livestock is a significant contributor to bank erosion in the Blythe SSSI, and provides a significant source of fine sediment to the watercourse.

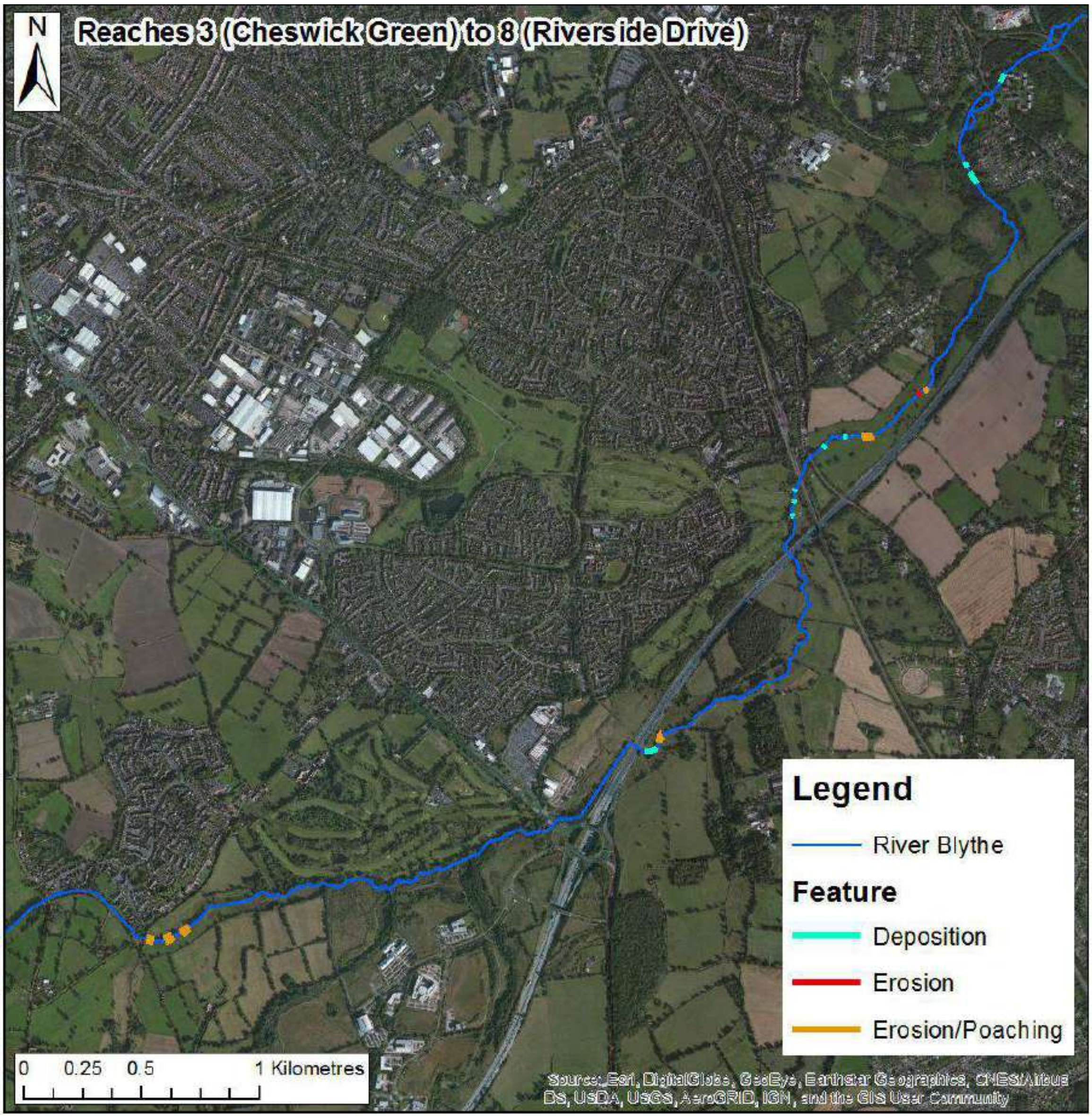
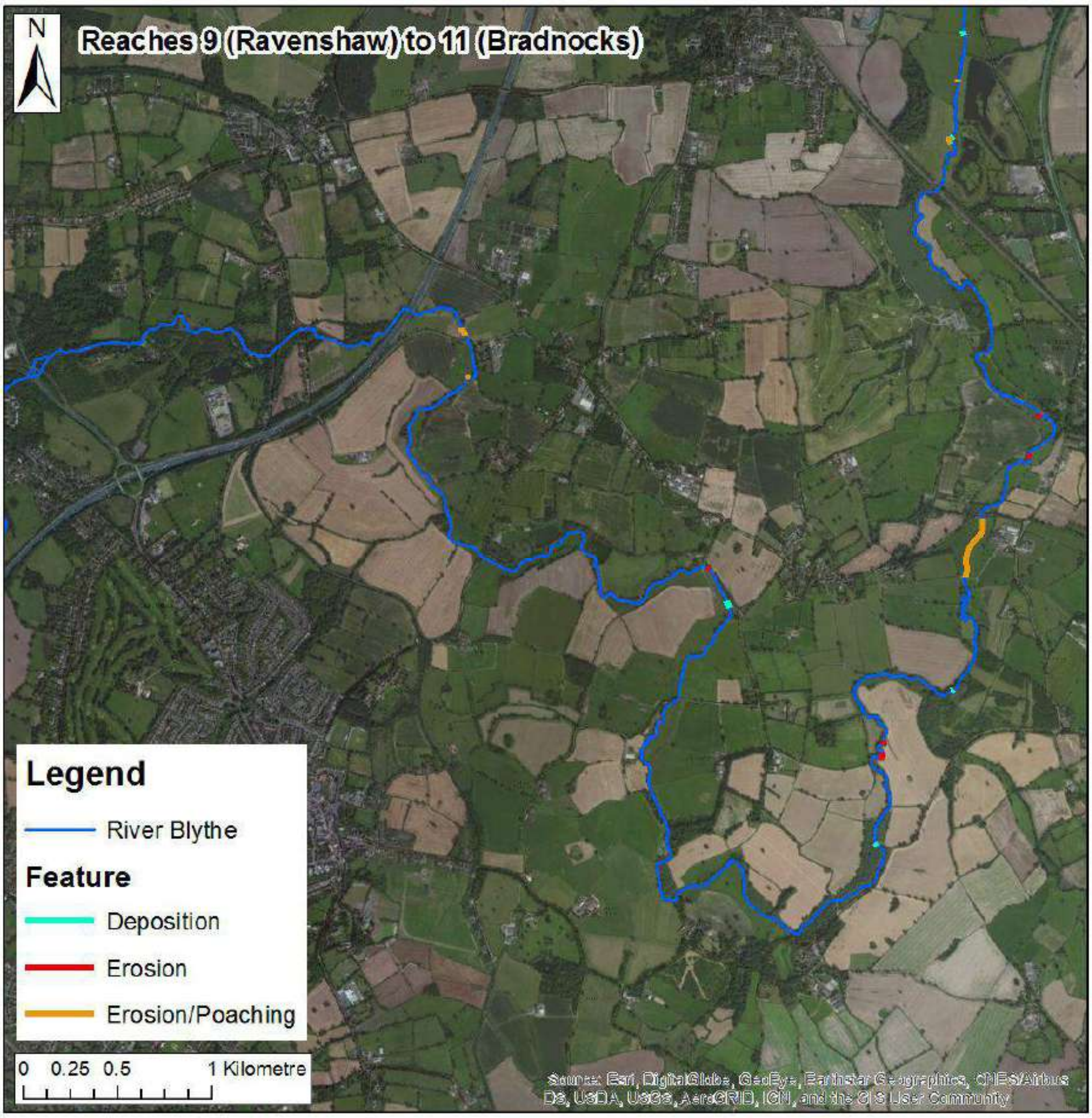


Figure 5-4: Key erosional and depositional features


N
Reaches 9 (Ravenshaw) to 11 (Bradnocks)
Legend
River Blythe
Feature
Deposition
Erosion
Erosion/Poaching
0 0.25 0.5 1 Kilometre
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Reaches 12 (Meriden) to 15 (Dairy Farm)
Legend
River Blythe
Feature
Deposition
Erosion
Erosion/Poaching
0
0.5
1
2 Kilometres

5.3.3 Overall functioning

The impact of system-wide pressures affect the functioning of the Blythe SSSI. Pressures such as over-widening, deepening and channel straightening have resulted in a disconnected floodplain in many reaches, causing sluggish flow with minimal in-channel features. In the upper reaches, channel widening is less prominent; however, channel straightening and partial embankment has still resulted in disconnection. Channel straightening is particularly evident in reaches which feature meandering paleo channels on the floodplain. The reaches largely untouched by channel modification function in a more natural way expected of a lowland river type.

Sediment transport mechanisms are affected by channel modification in certain reaches; reduced energy levels resulting from channel widening and over-deepening contribute to fine sediment deposition in the lower reaches. Most of the gravel bed reaches are armoured, suggesting the gravels are not easily mobilised. Whilst not particularly evident in the gauge record at Cheswick Green, which shows the flow regime of the River Blythe to be relatively natural with no obvious truncation of mid and high flows (JBA Consulting, 2012), this could be a localised effect from the unregulated Mount Brook tributary, and the Earlswood Lake reservoirs could be having an attenuating effect upstream. Whilst the reservoirs are not considered to greatly impact sediment supply, given their location in the upper reaches and the lack of abundant sediment sources in the gentle relief headwaters of the Blythe, they are considered to influence high flow events and thus may dampen the response of the watercourse to high energy flow events. This dampened response to high flow events indicates limited potential for lateral movement during high flow events; however, lateral movement by progressive deposition and vegetation growth would still be expected, and is indeed observed in certain reaches.

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6 Restoration Options

6.1 Overview

The SSSI river restoration plan for the Blythe sets out potential restoration measures which, if implemented, would contribute to achieving favourable SSSI condition in all 17 units.

The in-channel hydromorphic condition of the River Blythe in most places is generally very good, with the channel displaying a range of river flow processes which result in localised areas of deposition, and variability in flow biotopes. Typically, throughout its entire length the Blythe exhibits passive meandering conditions. The bed is characterised by an open gravel / sandy bed with limited evidence of coarse sediment transport; most sediment transport is restricted to finer sediments such as sand and silts. Several areas of lower quality are linked to historic channel engineering and management and contemporary land use issues. The majority of the floodplain associated with the SSSI River is currently non-functional due to disconnectivity.

This section contains an overview of the restoration opportunities identified during the Integrated Riparian Survey (IRiS) and should be read alongside the pressures and mitigation measures sections.

The following section presents small scale and large scale hydromorphic and ecological improvements that can be made along the River Blythe SSSI that will address the hydromorphic and ecological pressures, enhance biodiversity and promote system naturalisation.

Any potential changes in land use and floodplain connectivity would need to be agreed with landowners, with appropriate support in place e.g. (new) Countryside Stewardship. In certain locations, there is a need for existing modifications to remain to protect infrastructure and buildings from flood risk and excessive erosion.

6.2 Potential restoration measures

To restore the river channel to the condition described in the restoration visions, a series of restoration measures are suggested.

All measures involve riparian and floodplain naturalisation. No enhancement or restoration actions will be undertaken without consultation and agreement with the appropriate landowners and other relevant stakeholders.

The following section describes the potential restoration measures that could be implemented to enhance or restore the morphology of the River Blythe SSSI, in order to create a channel morphology that is consistent with favourable condition. The benefits and constraints of each measure are discussed.

It is important to note that not all of the recommend restoration features are suitable for every location. Local ecological and hydromorphic factors need to be considered to ensure the restoration measure functions as intended, and does not encourage any system process, form or functioning which may be detrimental to the system. For instance, re-connecting paleo channels in the floodplain to the channel may only be appropriate where the river channel is reasonably well connected to its floodplain. In addition to hydromorph and ecological functioning, there are numerous other constraints which may prevent the suitability of a restoration measure to a particular location. One of these will likely be land-use: restoration measures may require wide-spread or localised land-use change which may incur difficulties for farmers which utilise the floodplain for arable farming or livestock grazing. Potential impacts to flood risk and infrastructure may also constrain the suitability of restoration inventions in some locations. There are also numerous potential procedural requirements to consider, such as Environmental Permitting Regulations. Such requirements will be discussed in more detail once a feasibility study has helped establish a final restoration plan, and which the needs and thoughts of local stakeholders have been incorporated into each intervention measure.

6.2.1 Increasing channel sinuosity

Increasing channel sinuosity and localised morphological variation **Description: Installation of hydromorph in-channel features, such as berms, large woody material, log jams, to increase and develop channel sinuosity**	
Benefit	Constraints
Diversifies flow biotopes and creates more varied channel morphology, creating pockets of faster flow which can help 'flush out' fine sediment and re-instatement of clean gravels. Encourages development of natural depositional features, thus improving overall hydromorphic functioning. Creation of temporal and habitat variety within the channel. Helps reduce over-widened features and restore a more natural flow regime and variability.	Works to the bank may lead to a temporary release of sediment, however working methods can minimise this risk. If, during high flow events, the features become dislodged they could increase the flood risk associated with blocked structures. However, the risk of this occurring in a low-energy system such as the Blythe is low, combined with the fact the majority of the Blythe is rural. Potential spread of non-native invasive plant species

6.2.2 Reconnection of floodplain features

Reconnection of floodplain features **Description: Connection of old channels to the river by partially excavating new channels and reconnecting. New channel alignments would be developed to follow, as closely as possible, the natural (pre-modification) channel course as indicated by palaeo channels, topography or historical sources. Channel realignment carries a number of significant benefits. However, due to the scale of the work required there are also a number of potential constraints and it is important to consider the impact on sediment transport processes and whether full connection is appropriate, or whether partial connection would better suit the functioning of the watercourse.**	
Benefit	Constraints
Creation of high flow / overspill secondary channel with associated habitats. In terms of fisheries these will be particularly valuable for juvenile fish in higher flows as nursery habitat and refuge area. Variation in features and variation in flow within the re-connected paleo channel leading to development of clean gravel features and variation in flow biotopes. Increase in prevalence of clean gravel features in main channel likely to provide spawning opportunities, as well as providing more abundant prey species habitat. Opportunity to naturalise floodplain 'island' and introduce varied wetland, grassland and woodland habitats with consequent increase in diversity and abundance of invertebrate prey species. Creation of temporal and habitat variety across the floodplain. Improved local flood capacity.	Short term disruption to gravel transfer downstream may cause bed disruption, but unlikely to result in significant impacts, when undertaken with appropriate mitigation. Risk of sedimentation if the sediment flux is split between the two channels if the paleo channel is connected to the main channel at its upstream end. Minor, localised disturbance to species and habitats during works. Some land loss in order to control livestock Modified floodplain usage Potential spread of non-native invasive plant species

6.2.3 Riparian woodland creation

Riparian Woodland creation **Description: Woodland development within the river corridor**	
Benefit	Constraints
Reduce loss of land through erosion: tree roots bind soil and help protect river banks. Mitigate flooding: targeted woodland can delay flood flows, reducing downstream flood risk. Protect water quality by buffering from pollutants and nutrients. Moderate shade and water temperature, maintaining a suitable environment for fish, and improving rivers for	Land loss and a change of floodplain usage Potential impact on protected/ notable species during planting works Potential spread of non-native invasive plant species

fishing. Provide important habitats for wildlife and improve biodiversity, as well as creating attractive landscape features.	

6.2.4 Backwater areas and wet woodland

Creation of Backwater areas, Wetland and Wet Woodland (anastomosed systems) **Description: Similar to riparian vegetation improvement and woodland creation. However, where ground conditions suit a wet woodland vegetation community should be established to reduce excessive instability, whilst still allowing slower channel change**	
Benefit	Constraints
Wet woodland supports aquatic invertebrate and plant species. The retention of woody debris in streams will provide preferential habitat for fish species and invertebrates Reduce loss of land through erosion: tree roots bind soil and help protect river banks. Mitigate flooding: targeted woodland can delay flood flows, reducing downstream flood risk. Protect water quality by buffering from pollutants and nutrients. Moderate shade and water temperature, maintaining a suitable environment for fish, and improving rivers for fishing. Provide important habitats for wildlife and improve biodiversity, as well as creating attractive landscape features.	Marginal reed beds or wet woodland may not be effective in every situation and further feasibility work to determine the exact details of sediment interception techniques on a site specific basis is required May lead to a temporary release of sediment, however working methods can minimise this risk Will require a change in land management along the river channel (see riparian zone management); Will require adequate space into which to widen the channel, this may be a constraint in some locations. Potential spread of non-native invasive plant species

6.2.5 Removal and setting back of embankments

Removal or Setting back flood embankments **Description: The removal or realignment of flood embankments to allow the natural inter-relationship between the river channel and the floodplain to be reinstated**	
Benefits	Constraints
Provides connectivity between the river channel and the surrounding floodplain reducing flood impacts downstream. Limits the impact of flood flows on the river channel by allowing water to dissipate beyond the channel rather than remaining within the channel. Allows the deposition of fine sediment onto the floodplain thereby reducing the likelihood of the deposition of fine sediment within the river channel. Improves drainage of the floodplain by allowing surface water to drain freely into the river channel.	Will increase the frequency of floodplain inundation which may necessitate changes in farming practices on the floodplain. May generate a large amount of spoil which will need to be disposed of in an appropriate manner. Potential to impact on land use and farming. Potential spread of non-native invasive plant species

6.2.6 Development of vegetated bars

Natural development of vegetated bars **Description: Vegetating gravel bars will create a more stable environment and provide habitat within the channel. This development should occur linked to channel floodplain reconnection and methods designed to lower in-channel flow energy.**	
Benefit	Constraints
Increased vegetation will improve habitat diversity and this in turn will stabilise gravel deposits As a consequence of the stabilised gravels there will be an improvement for spawning sites and for invertebrates	Establishment dependent on flood regime Potential spread of non-native invasive plant species Consider location in relation flood risk and critical field drains.

Flood attenuation Large woody debris generation Development of vegetation offering protection from wash-out for smaller fish during high flow events	

6.2.7 Soft bank protection

Introduce soft bank protection for key infrastructure **Description: In instances where critical infrastructure needs to be protected, hard measures can be removed and replaced with soft measures such as woodland areas and appropriate bank side planting**	
Benefit	Constraints
Necessary level of protection provided	Hydromorphic degradation locally and potentially more widely Potential impact on protected/ notable species from works Potential spread of non-native invasive plant species

6.2.8 Weir removal

Weir removal **Description: This involves the complete weir removal. Removal or modification high level recommendations are presented where necessary, taking into account constraints.**	
Benefit	Constraints
Allows more natural water level variations upstream. Enables uninterrupted sediment transport. Allows the development of more varied flow types upstream of the former structure increasing the ecological value of the river channel. Allows the river channel to undergo natural morphological change in response to changes in flow and sediment supply creating diverse channel morphology (see Table 3.5 for examples of ecological benefits). Remove barriers or obstacles to fish migration (e.g. salmonid, Shad and lamprey migration) Allows movement of fish between suitable local habitats.	Requires works within the river channel and may result in a period of disturbance. Bed erosion can occur upstream in response to the increase in flow velocity following weir removal. Adjustments to the bed or banks of the channel could create the potential for undermining bridge foundations and the exposure of pipes or cables in the riverbed. Removing a weir may expose a step on the bed of the river (caused by the weir and the build-up of sediment upstream) which is vulnerable to erosion due to high flow velocities and turbulence across the step. The step (known as a knick point) migrates upstream eroding the bed until the original (pre-weir) bed slope is re-established. Bank erosion can occur upstream in response to the increase in flow velocity and fluctuations in water levels following weir removal. May allow migration of invasive species Weirs can be heritage features and this may preclude their removal in some instances.

6.2.9 Weir modification

Weir modification and fish passes **Description: In some cases it may be necessary to modify a weir rather than remove it. For example by lowering the weir crest level or adding a fish pass.**	
Benefit	Constraints
Allows more natural water level variations upstream. Reduces interruptions to sediment transport. Allows the development of more varied flow types upstream of the weir. Removes barriers or obstacles to fish migration (e.g. salmonid, Shad and lamprey migration)	Requires works within the river channel and may result in a period of disturbance. Does not allow natural processes to be fully reinstated. Bank erosion can occur upstream in

Allows movement of fish between suitable local habitats.	response to the increase in flow velocity and fluctuations in water levels following weir lowering. May allow migration of invasive species Riparian access may cause disturbance.

6.2.10 Removal of bank toe protection

Removal of bank toe protection **Description: The removal bank reinforcement is essential for allowing a section of river channel to develop a natural channel morphology which is able to adjust to changes in flow and sediment supply**	
Benefits	Constraints
Allows natural bank materials to be exposed. Enables a natural channel planform to develop via bank retreat. Enhancing natural bank profiles will support a more diverse range of habitats for many species, including potentially undercut banks and naturally vegetated banks (fish spawning and juvenile habitat). Allows the river channel to undergo natural morphological change in response to changes in flow and sediment supply. Enables more varied channel morphology to develop through bank erosion and changes in bank profile	Requires works within the river channel and may result in a period of disturbance to channel and riparian areas. Channel migration may impact on services which cross the floodplain such as drains, water mains, electricity cables (above or below ground) and gas mains. Short to mid term sediment release and potential impacts on lakes/sensitive locations. Some land owners will lose land. Potential impact on protected/ notable species from construction works Potential spread of non-native invasive plant species

6.2.11 Woody debris

Woody debris **Description: Woody debris is a natural feature of rivers where adjacent trees or branches fall into the channel. This provides a variety of important ecological and small-scale geomorphological functions. Woody debris (i.e. Fallen trees) should be left in place where possible instead of being removed from the river.**	
Benefits	Constraints
Creation of in-channel sinuosity and habitat niches but unlikely to cause significant erosion if managed correctly in a low energy system; Provides small-scale variations in flow velocity providing slower areas of flow and small pools that accumulate finer sediments and act as fish refuges and nursery sites, spawning habitat for bullhead; Creates areas of cover and shading that can reduce predation of fish, but also provide foraging sites for terrestrial species such as Otter; Valuable invertebrate and algae habitats, creating food sources for fish, helping to sustain aquatic/terrestrial food chain; Helps regulate sediment transfer and water quality by temporary trapping of mobile silts, reducing siltation of shallower gravels/riffles and turbidity; Introduced river gravels with woody debris improves bed structure, flow variation and habitat diversity.	Woody debris can become snagged on bridges and other structures and in exceptional events create blockages. When planning work involving the installation of woody debris, consideration should be given to the need to anchor the debris to prevent it being washed downstream and collecting on structures; Where the river channel is relatively narrow, woody debris may accumulate in significant quantities, for example where it collects on a fallen tree, which may create an obstruction which the natural flow of the river is incapable of moving. This may increase flood risk to the surrounding land or increase the risk of bank erosion. Where such obstructions occur it may be necessary to intervene to reduce the amount of woody debris in the channel, consent for reduction or removal of woody debris; Fallen willows, which can re-grow in the channel and lead to undesirable consequences such as excessive erosion, will require careful management. Consideration should be given to the need

	to anchor debris if there is a potential risk to bridges etc downstream. Where such obstructions occur it may be necessary for landowners to intervene to reduce the amount of woody debris in the channel, in which case consent will be required.

6.2.12 Tackle invasive species

Tackle invasive species
Description: Controlling invasive species such as Himalayan Balsam and Japanese Knotweed will enable native vegetation to re-establish, reducing rates of bank erosion (in the case of Himalayan Balsam) and the smothering of natural habitats. A range of methods for treating invasive species are outlined in the Environment Agency document Guidance for the control of invasive weeds in or near fresh water. It is important to clear upstream reaches from invasive species before downstream sections to reduce the risk of re-colonisation.
Removing invasive plants will allow a more diverse assemblage of species, including protected species to colonise areas which they have previously been excluded from due to the presence and vigorous growth of these plants.

6.3 Catchment-wide: Restoration measures

At the catchment-wide scale, the main pressures affecting the River Blythe catchment are fine sediment and diffuse pollution, with localised problems involving invasive species. The former two pressures arise partly from bank instability and livestock pressures, exacerbated by historic and present riparian management practices. Restoration measures that aim to address fine sediment and diffuse pollution inputs to the channel, such as through improved riparian zones and poaching from livestock prevention, if applied at the catchment-wide scale could contribute towards the Blythe SSSI achieving a more favourable condition, especially if they incorporate measures to tackle the spread of INNS.

6.4 Reach-scale: Restoration measures

At the reach-scale, there are a number of restoration measures that could be applied to target reach-specific pressures. The reaches, defined and described in section 0, have been assessed in terms of the restoration measures that could be implemented to improve channel morphology and riparian quality, in order to contribute to more favourable conditions in the Blythe SSSI.

The measures have been ranked based on the extent to which intervention is considered to be required in order to meet this restoration vision.

- Conserve and Enhance: minimal intervention measures intended to conserve and enhance existing features and reaches where the river character is already consistent with good morphology and ecology.
- Rehabilitate: medium intervention measures intended to rehabilitate degraded riparian zones to improve morphology and ecology and reduce the impact of pressures such as runoff and fine sediment supply.
- Restore: full intervention measures intended to improve the morphology and ecology in particularly degraded reaches and address physical modifications made to the channel that have affected its morphology and habitat diversity.

Figure 6-1: Phase 1 Habitat Codes

6.4.1 Reach 1: Earlswood

Classification

Conserve and Enhance

Reach Details

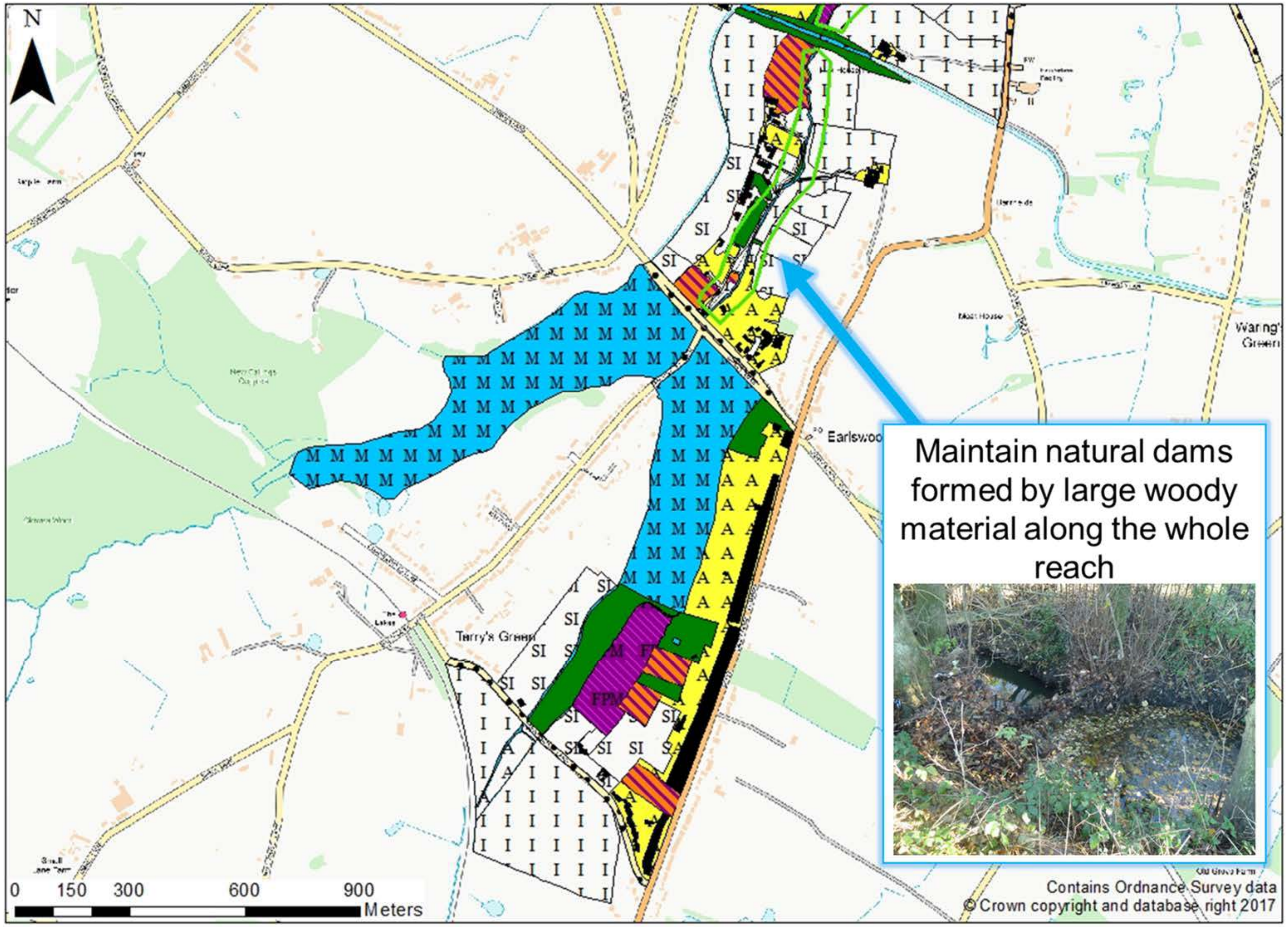
Start NGR:
SP 11471 74249

End NGR:
SP 11768 74976

Reach Length:
843m

SSSI Unit:
Unit 2

Constraints Map



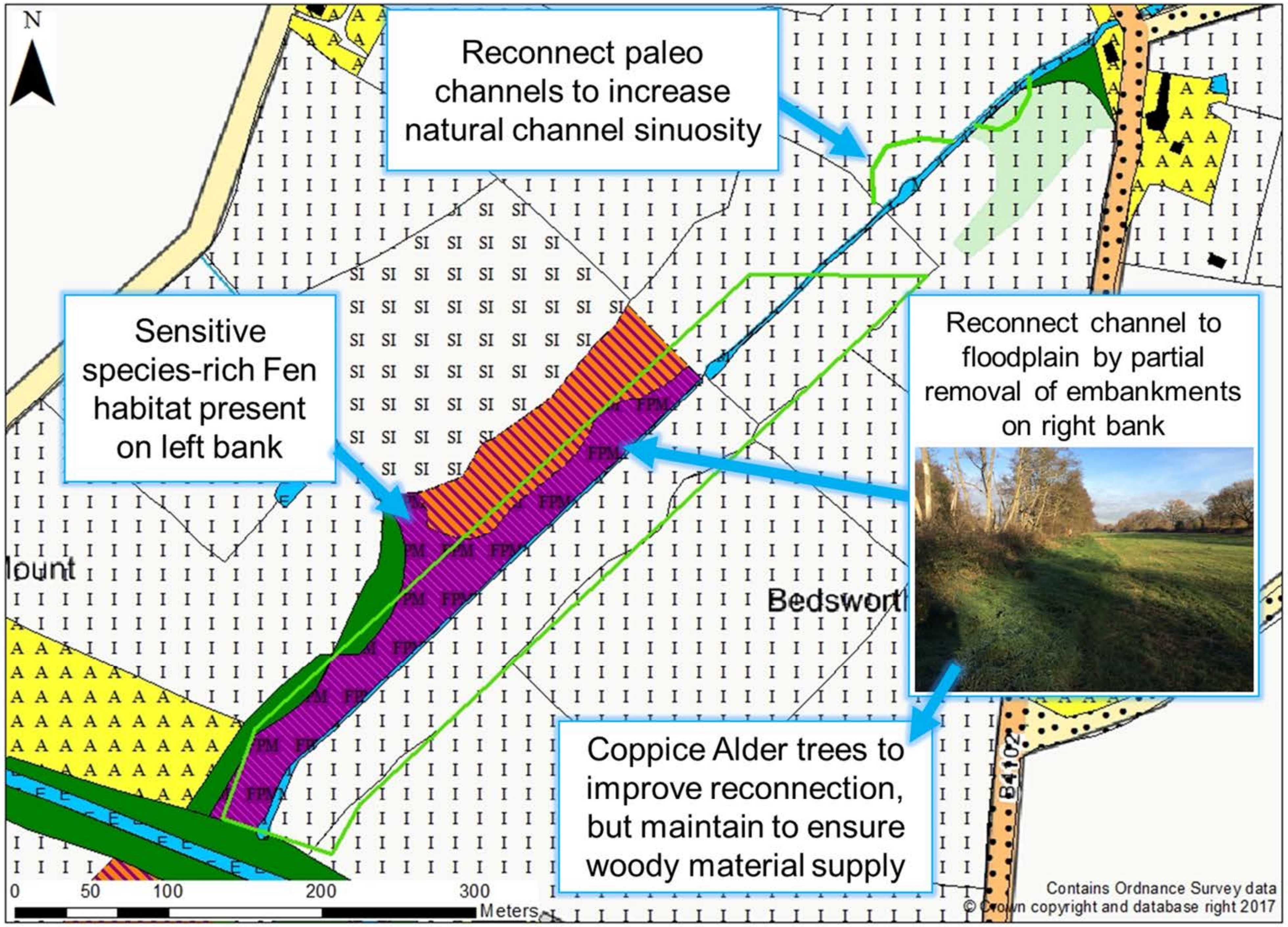
Key Reach Issues

- The channel is mostly entrenched in this reach and as a result there is a poor connection to the floodplain.
- However, there is plenty of large woody material and Alder root weirs in the channel creating natural dams and variation in flow.

Proposed Actions

- Due to land use constraints, it is unlikely that the channel could be improved further.
- Conserve and enhance existing natural dams/weirs
- Remove Japanese Knotweed patch

6.4.2 Reach 2: Canal Downstream

Classification:	Constraints Map	Key Reach Issues
Restore		• The channel has evidently been straightened historically, likely during the construction of the canals. • Embankments line the channel on both sides and consequently the channel is entrenched and poorly connected to its floodplain. • The riparian zone is well established with trees and vegetation; however, it is limited to a thin strip along the river's boundary.
Reach Details		**Proposed Actions**
Start NGR: SP 11768 74976 End NGR: SP 12324 75524 Reach Length: 781m SSSI Unit: Unit 2		• Re-connect the channel to its floodplain by partially removing the embankments, but without disrupting the tree line. • Increase channel sinuosity • Re-connect the channel to paleo channels evident in the floodplain

6.4.3 Reach 3: Cheswick Green

Classification:

No action

Reach Details

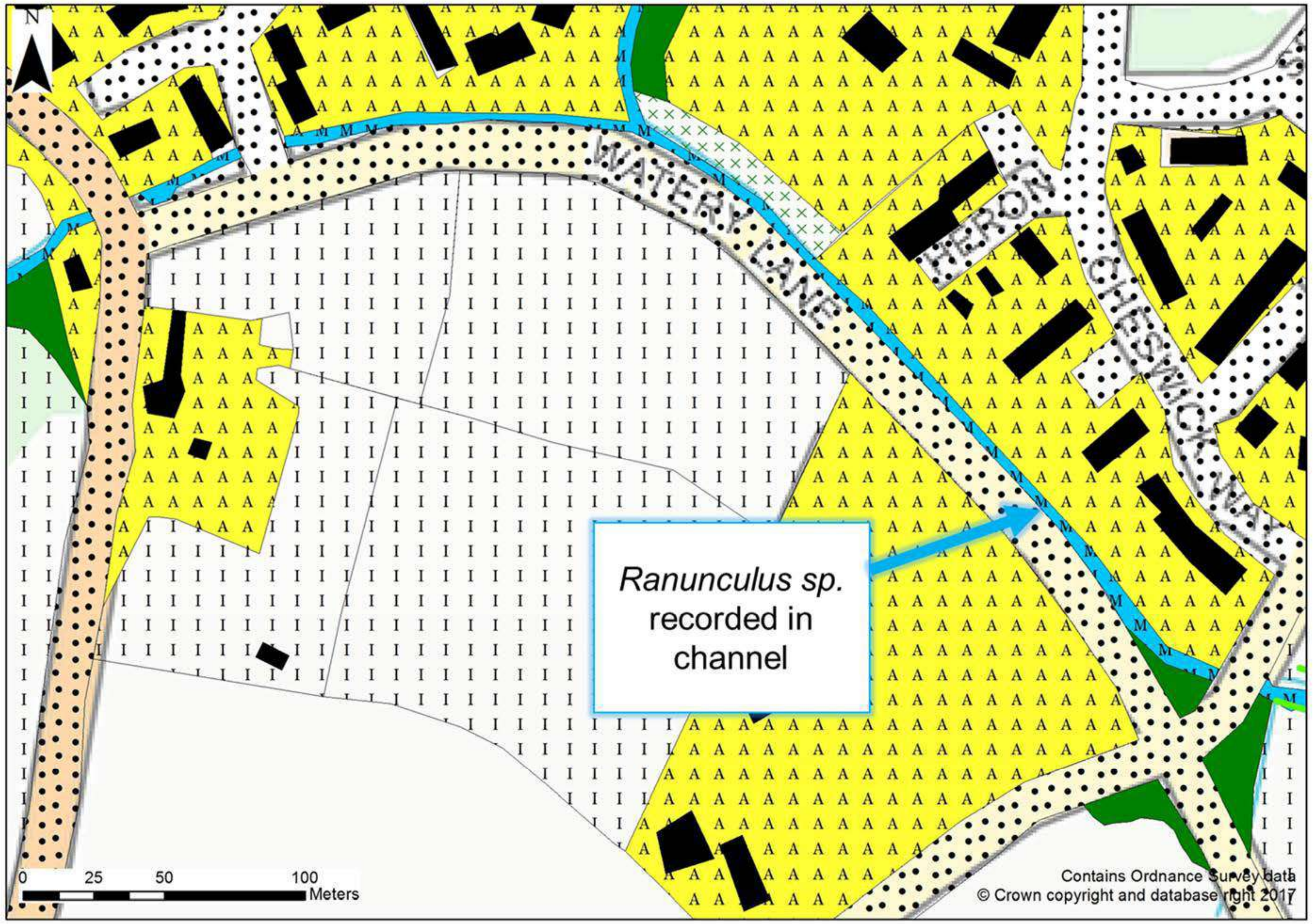
Start NGR:
SP 12324 75524

End NGR:
SP 12731 75370

Reach Length:
521m

SSSI Unit:
Unit 2

Constraints Map



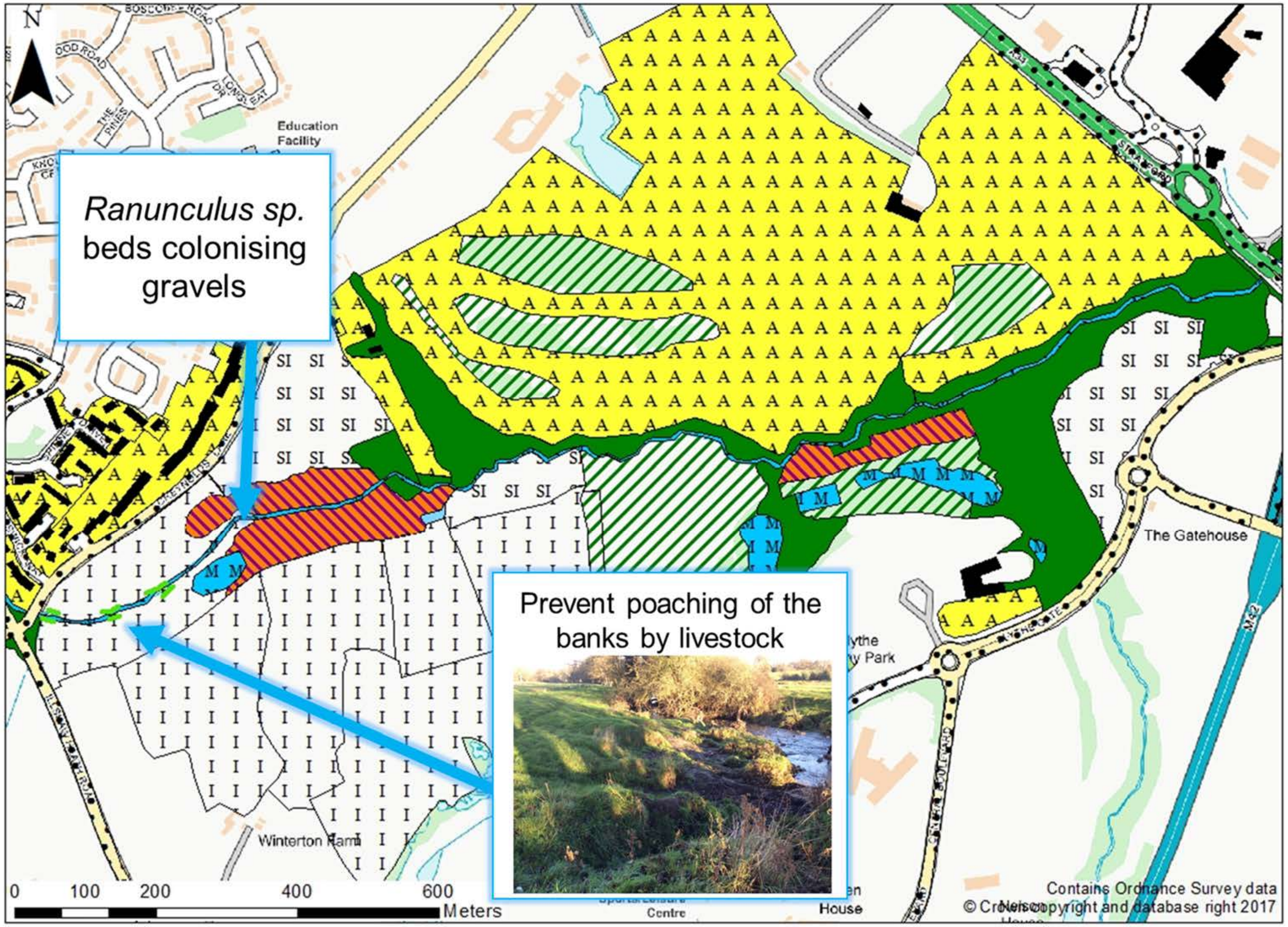
Key Reach Issues

- This reach is confined between residential gardens and a road.
- Bank revetment in places

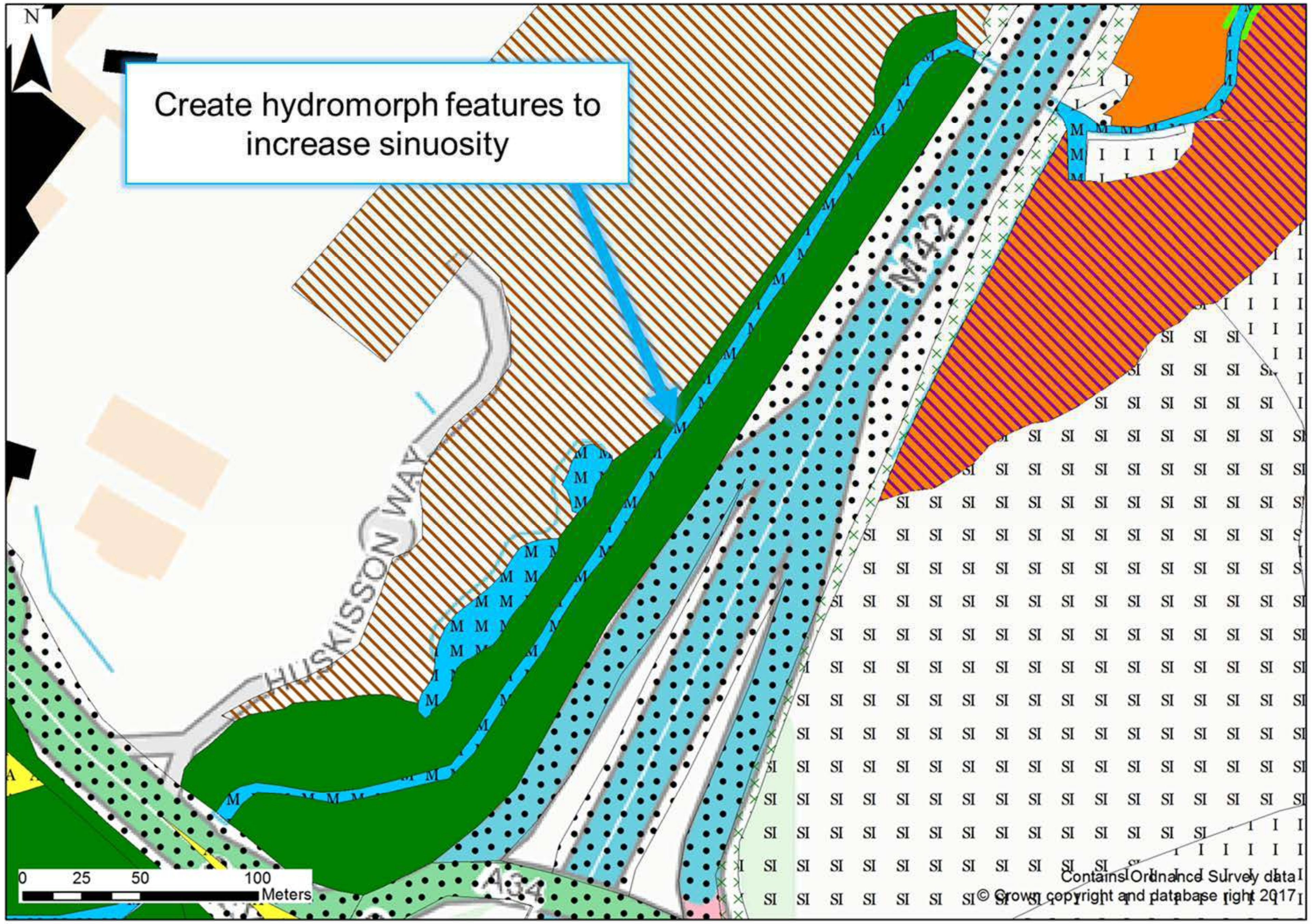
Proposed Actions

- Due to land use constraints, it is unlikely that the channel could be improved further.
- Control invasive species if problems occur

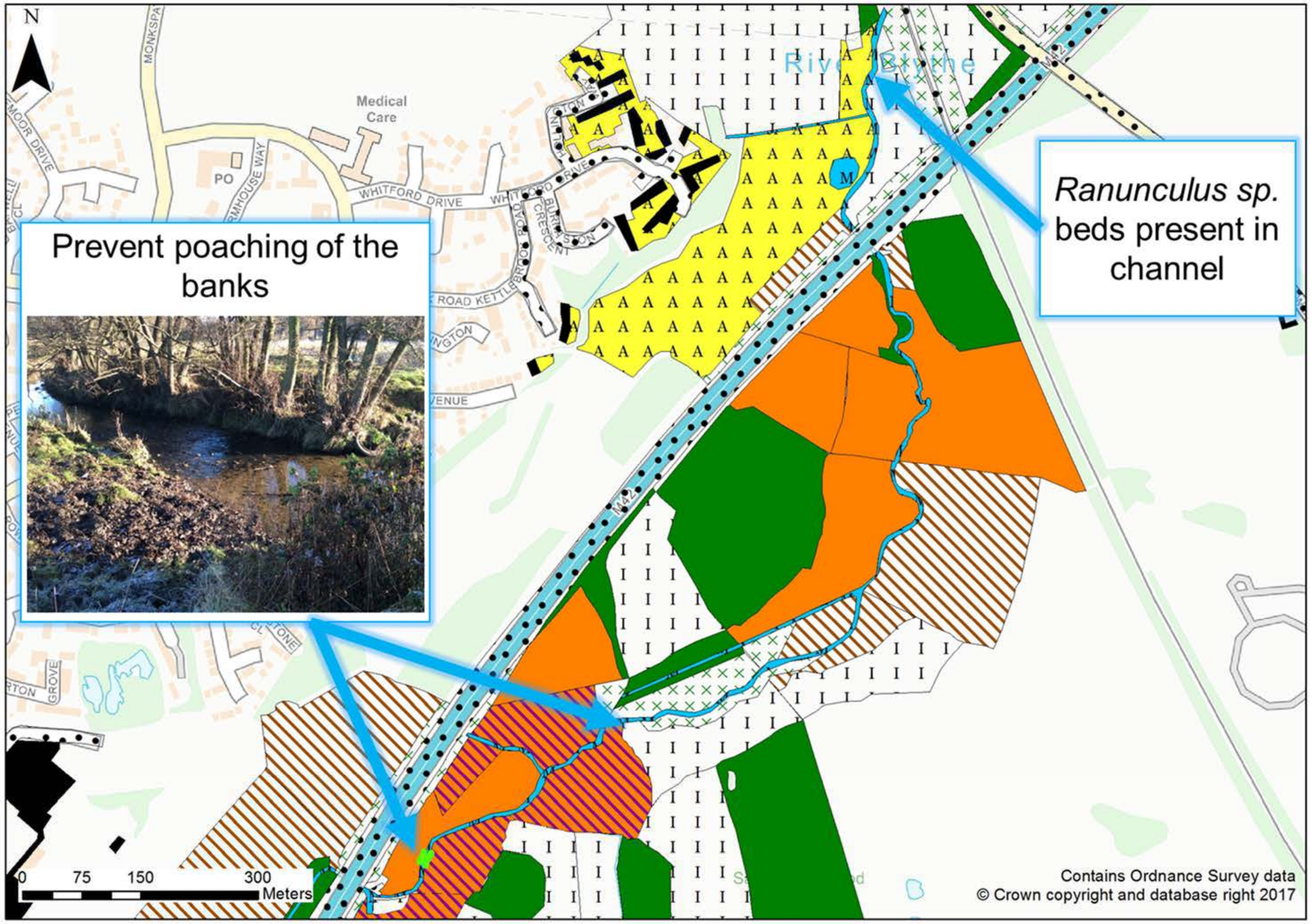
6.4.4 Reach 4: Shirley Golf Course

Classification	Constraints Map	Key Reach Issues
Rehabilitate		• Whilst some riparian cover is established, trees and vegetation are absent from the riparian zone in many places, i.e discontinuous. • Poaching of the banks by livestock
Reach Details		**Proposed Actions**
Start NGR: SP 12731 75370 End NGR: SP 14462 75824 Reach Length: 1995m SSSI Unit: Unit 3		• Prevent poaching of the river banks through better riparian management.

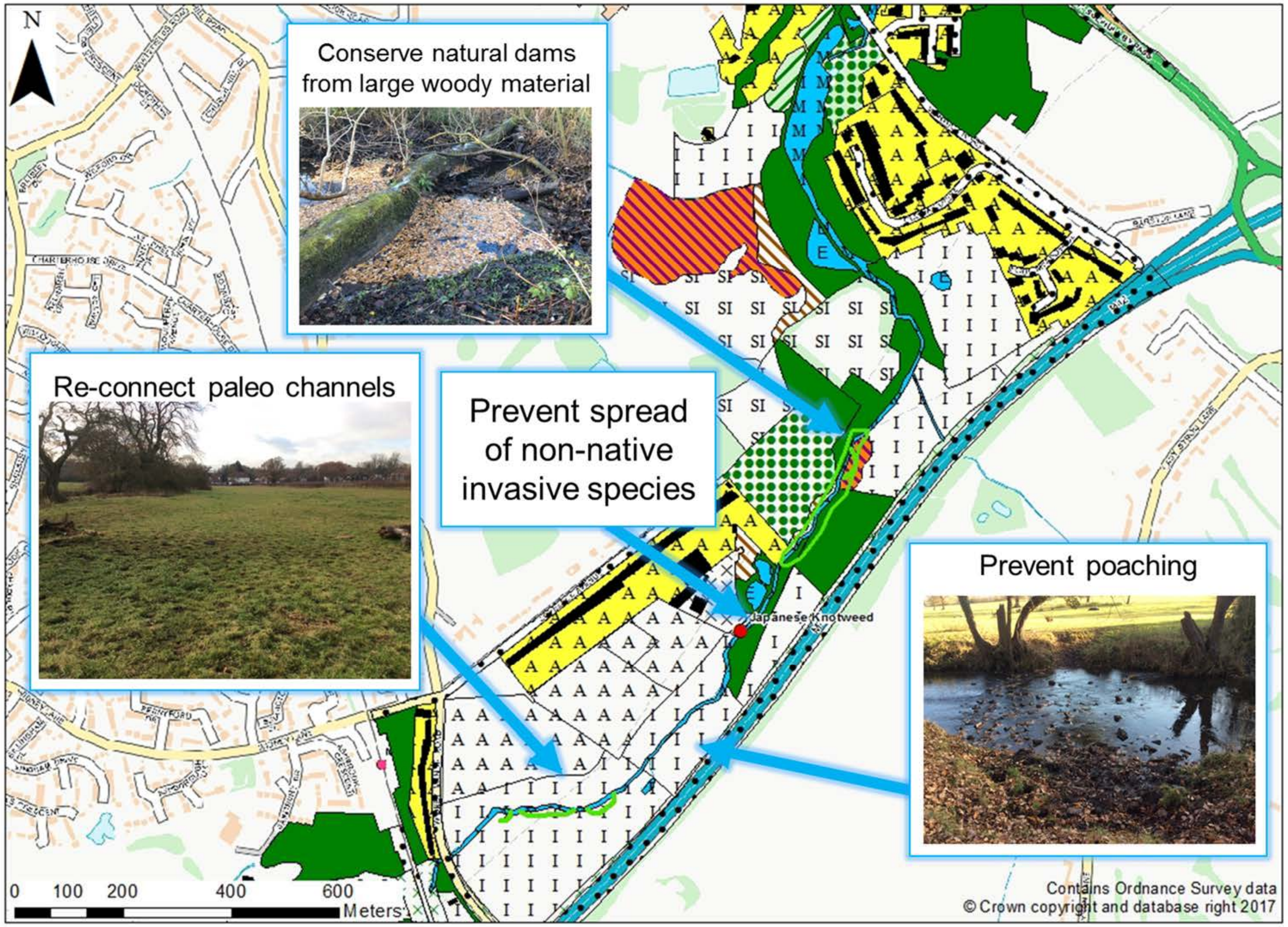
6.4.5 Reach 5: M42

Classification:	Constraints Map	Key Reach Issues
Restore		• Channel straightening following the construction of the M42. • Discontinuous riparian tree cover.
Reach Details		**Proposed Actions**
Start NGR: SP 14462 75824 End NGR: SP 14865 76163 Reach Length: 572m SSSI Unit: Unit 4		• Create localised hydromorphic features and increase channel sinuosity. • Allow trees to colonise the banks.

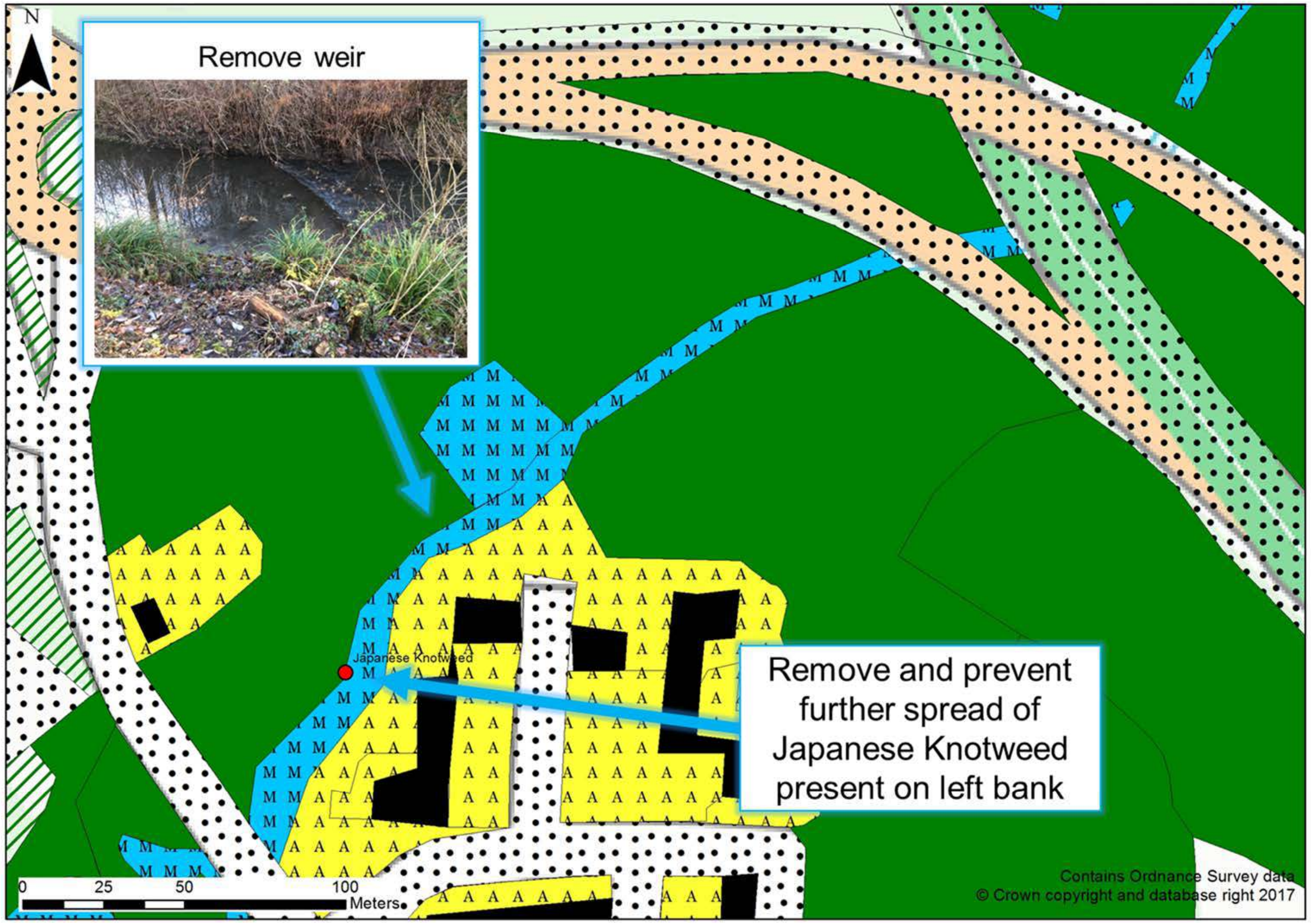
6.4.6 Reach 6: Shelly Green

Classification:	Constraints Map	Key Reach Issues
Rehabilitate		• Whilst some riparian cover is established, trees and vegetation are absent from the riparian zone in a number places. • Poaching of the banks by livestock.
Reach Details		**Proposed Actions**
Start NGR: SP 14865 76163 End NGR: SP 15531 77313 Reach Length: 1719m SSSI Unit: Unit 4		• Prevent poaching of the river banks through better riparian management.

6.4.7 Reach 7: Brueton Park

Classification:	Constraints Map	Key Reach Issues
Restore		• There is relatively poor connectivity with the floodplain in this reach. • Whilst some riparian cover is established, trees and vegetation are absent from the riparian zone in some places upstream. • Poaching of the banks by livestock • Invasive species; Japanese Knotweed
Reach Details		**Proposed Actions**
Start NGR: SP 15531 77313 End NGR: SP 16349 78947 Reach Length: 2558m SSSI Unit: Unit 5		• Re-connect channel to paleo channels in floodplain to enhance habitat diversity • Conserve and enhance natural dams formed from large woody material through the Halfmoon Coppice SSSI. • Creation of backwater features • Remove invasive species

6.4.8 Reach 8: Riverside Drive

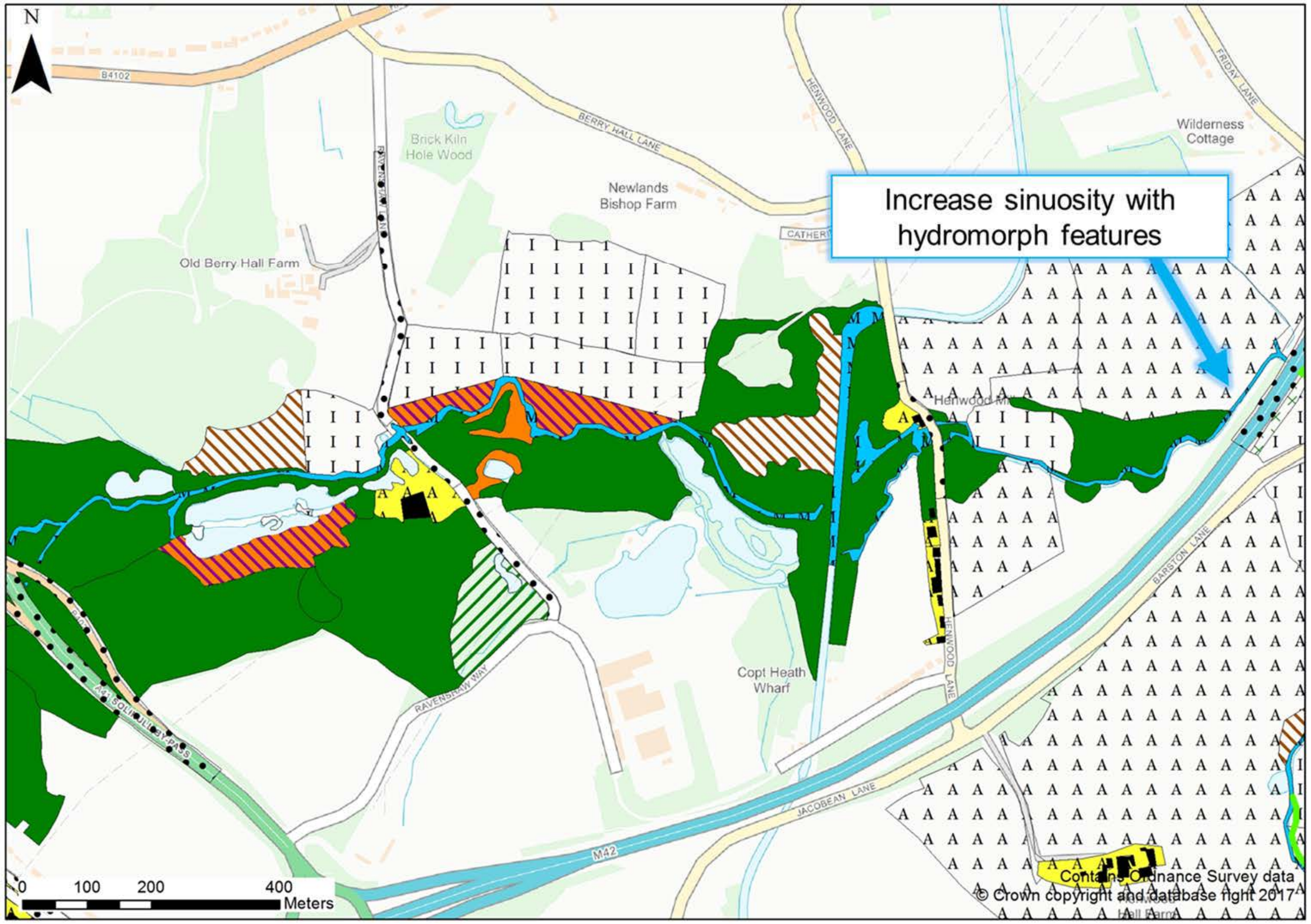
Classification:	Constraints Map	Key Reach Issues
Rehabilitate **Reach Details** Start NGR: SP 16349 78947 End NGR: SP 16579 79140 Reach Length: 498m SSSI Unit: Unit 6		• The channel in this reach is deeply entrenched through made ground and connectivity to the floodplain is very poor. • A small weir acts as a barrier to sediment transport processes to some degree. • The invasive species, Japanese Knotweed, is present on the bank margin. **Proposed Actions** • Re-connection to the floodplain would unlikely be possible and it would threaten infrastructure and residential dwellings. • Remove weir • Remove all Japanese Knotweed

6.4.9 Reach 9: Ravenshaw

Classification

Rehabilitate

Constraints Map



Key Reach Issues

- This reach is generally sinuous and appears better connected to its floodplain than elsewhere in the Blythe SSSI.
- However, some channel straightening has occurred where the channel is diverted under the motorway at the downstream end of the reach.

Reach Details

Start NGR:
SP 16579 79140

End NGR:
SP 18580 79496

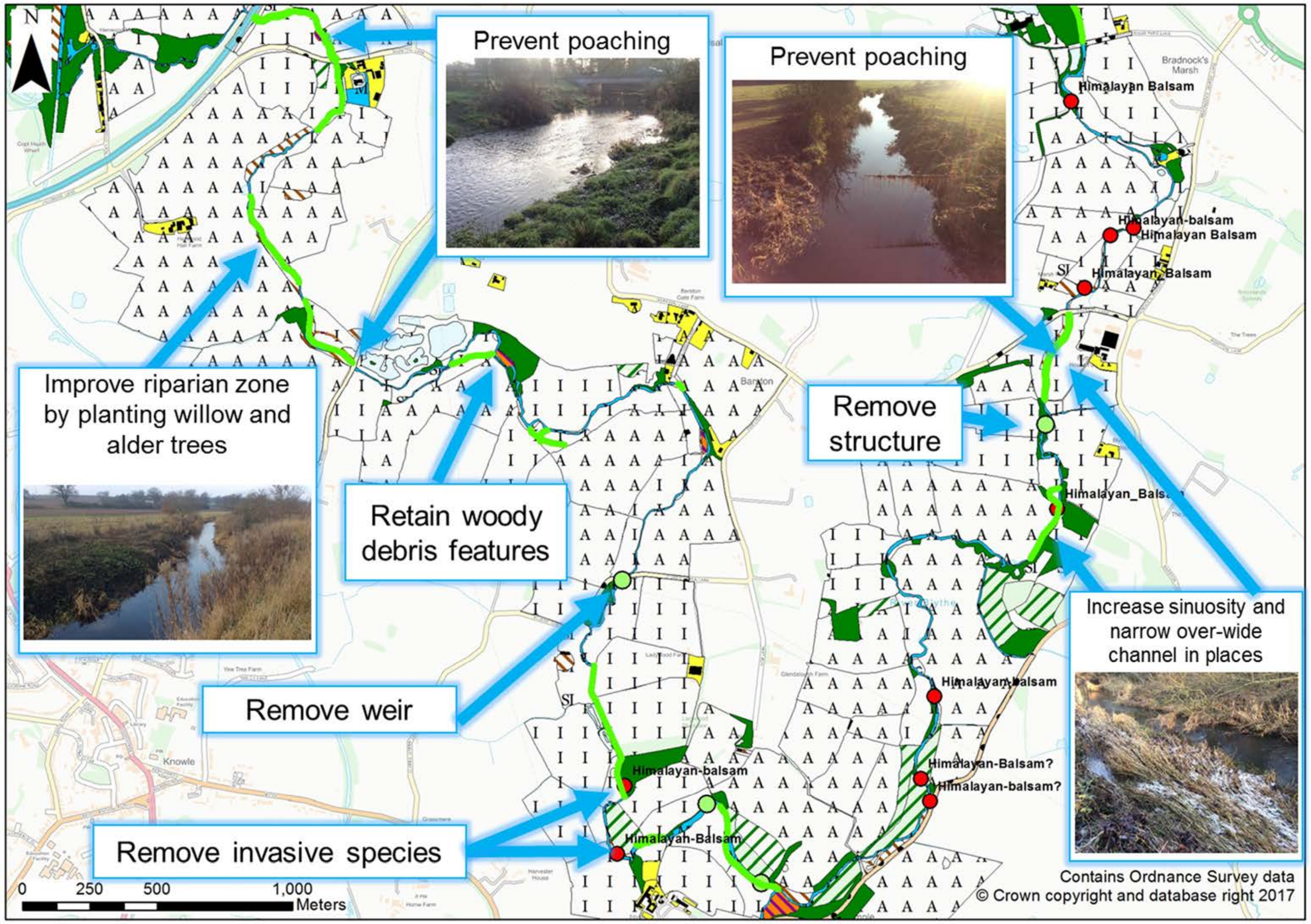
Reach Length:
2578m

SSSI Unit:
Unit 6/7

Proposed Actions

- Conserve and enhance potential backwater feature.
- Increase sinuosity by creating hydromorph features

6.4.10 Reach 10: Barston

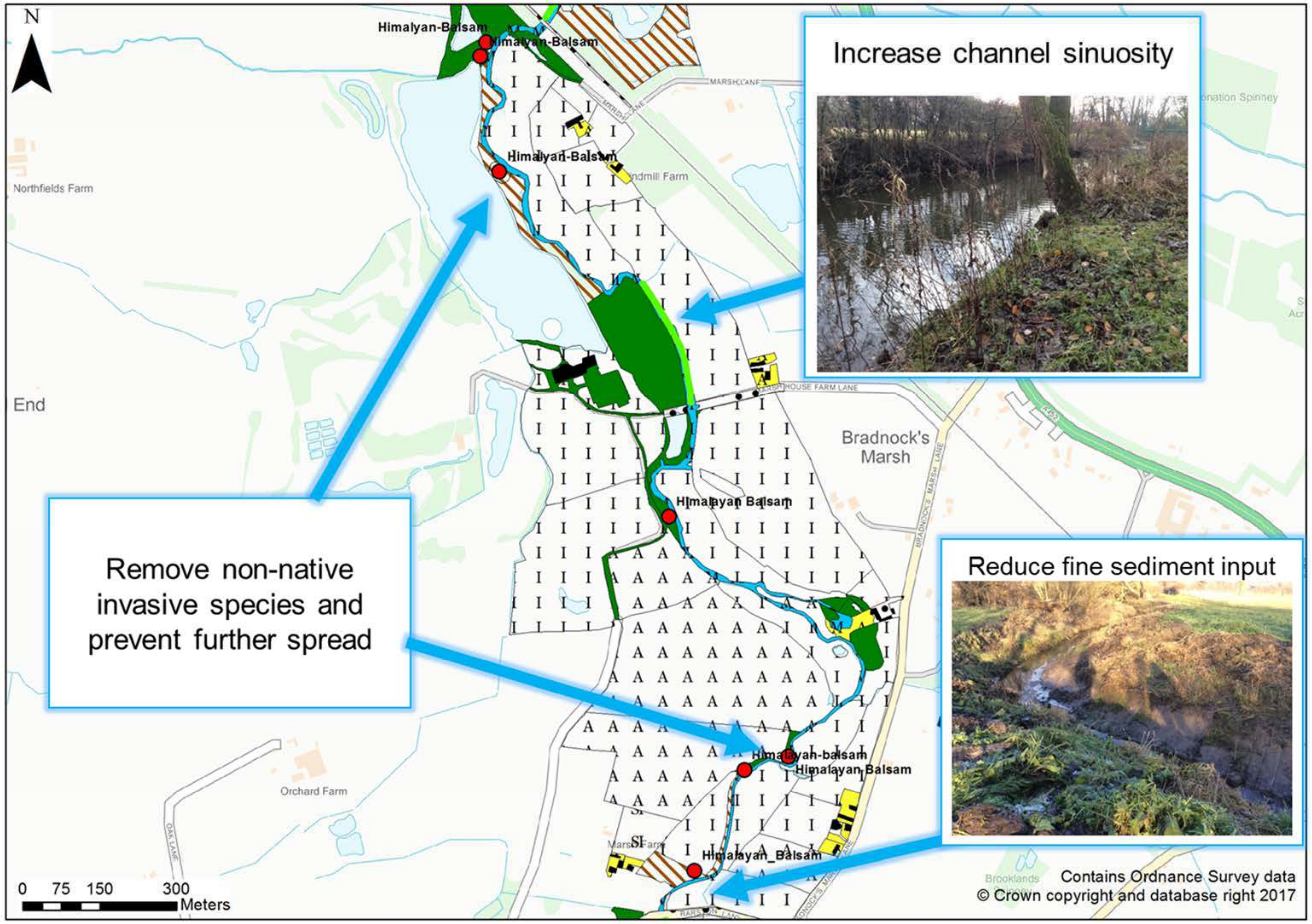
Classification	Constraints Map	Key Reach Issues
Restore		• Poaching of the banks by livestock • Bank instabilities causing bank erosion and fine sediment supply • Channel straightening • Flow barriers, namely weirs and failed structures • Some of the riparian zone is less developed with sparser coverage • Invasive species; Himalayan Balsam.
Reach Details		**Proposed Actions**
Start NGR: SP 18580 79496 End NGR: SP 21628 78390 Reach Length: 10656m SSSI Unit: Unit 7/8/9/10		• Prevent poaching through improved riparian management • Tree planting in riparian zone, namely Willow and Alder • Re-connect channel to paleo channels in floodplain to improve habitat diversity • Remove hard bank protection • Remove physical structures from channel. • Increase sinuosity and narrow channel where over-widened. • Control Himalayan Balsam

6.4.11 Reach 11: Bradnocks

Classification:

Rehabilitate

Constraints Map



Reach Details

Start NGR:
SP 21628 78390

End NGR:
SP 21388 80139

Reach Length:
2642m

SSSI Unit:
Unit 10/11/12

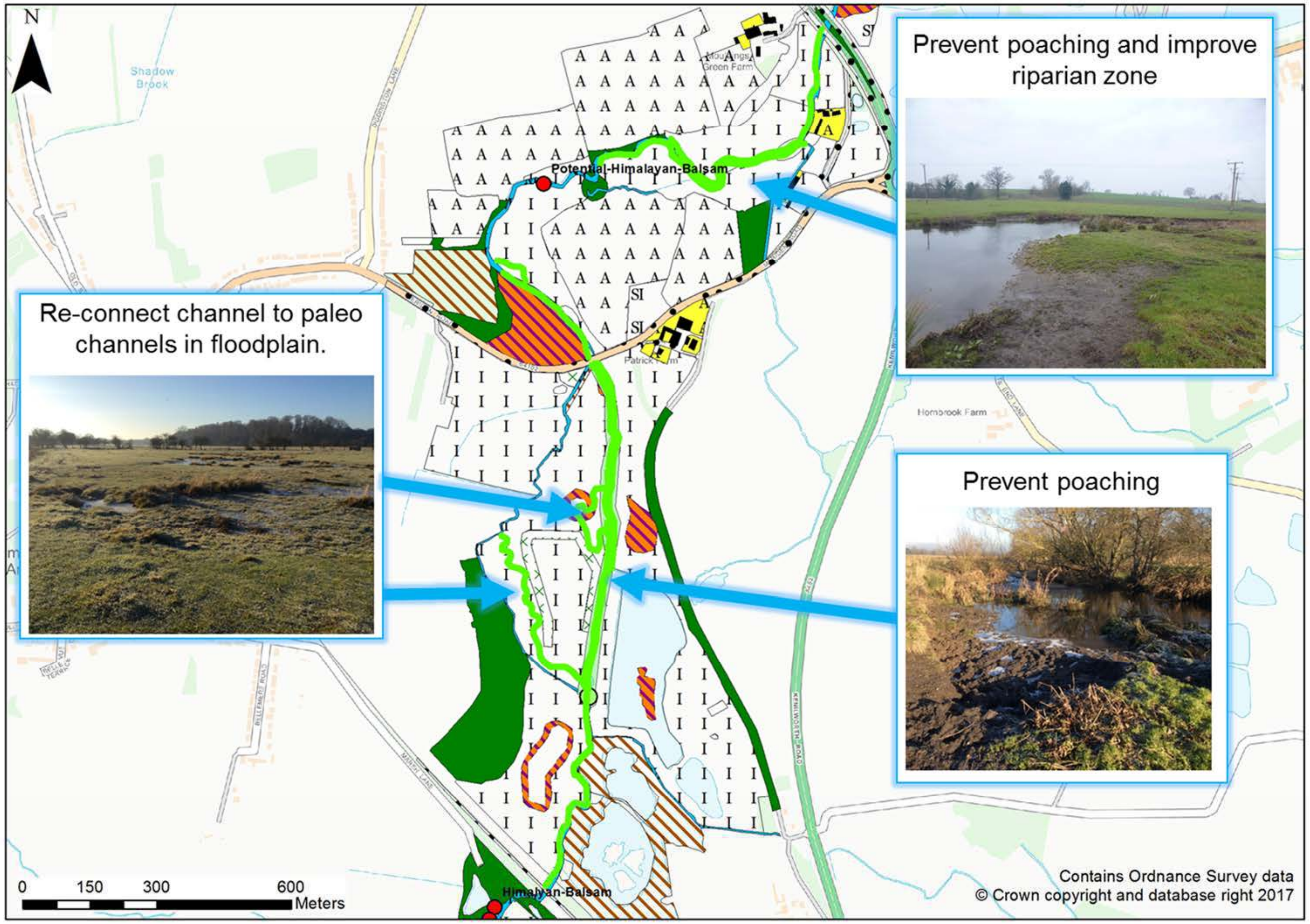
Key Reach Issues

- Reach has been over-widened in places.
- Poor connectivity between the channel and the floodplain.
- Fine sediment inputs in the form of a badly cut drain and some minor bank erosion.
- Invasive species; Himalayan Balsam

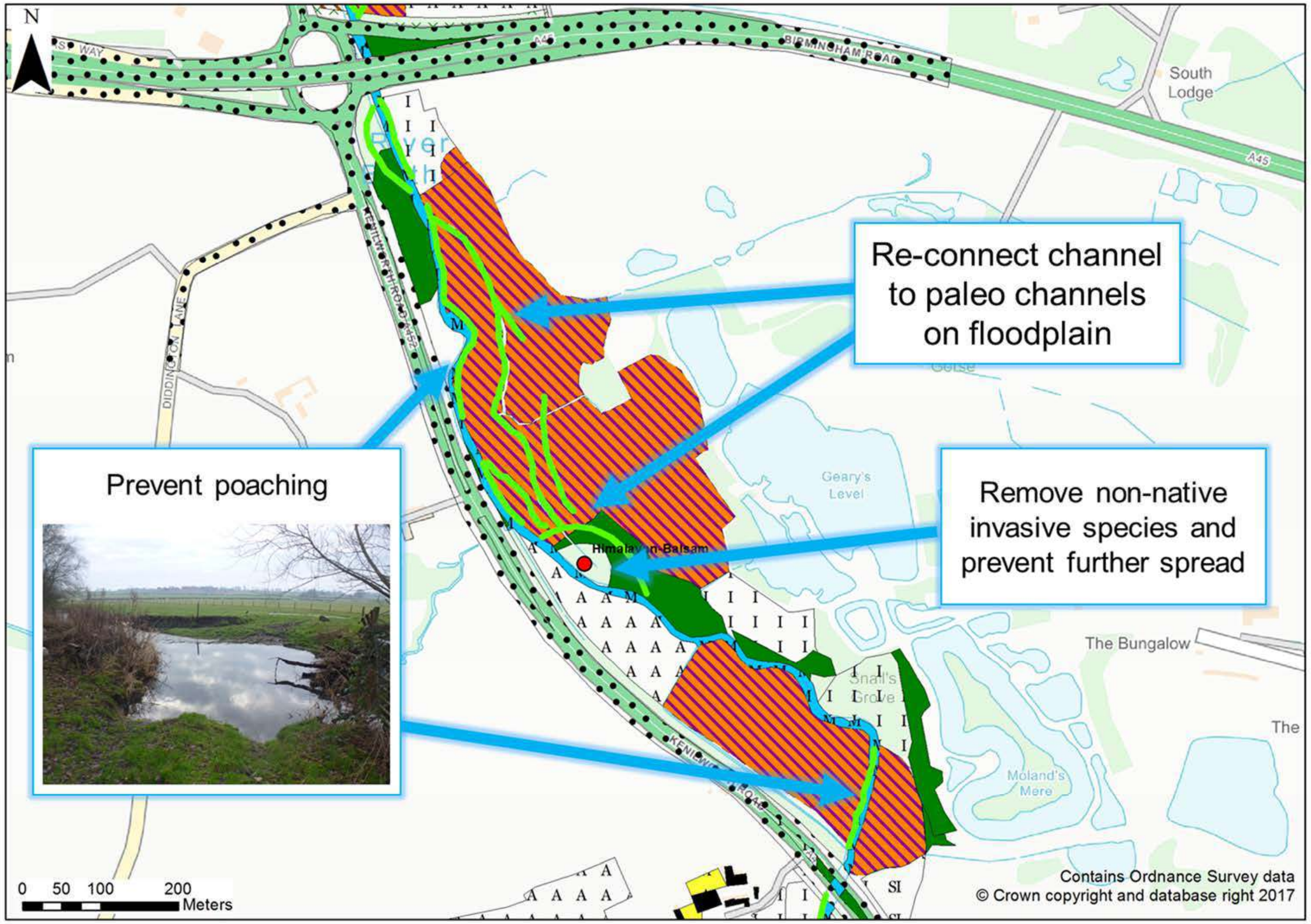
Proposed Actions

- Control, ideally remove invasive species
- Increase channel sinuosity

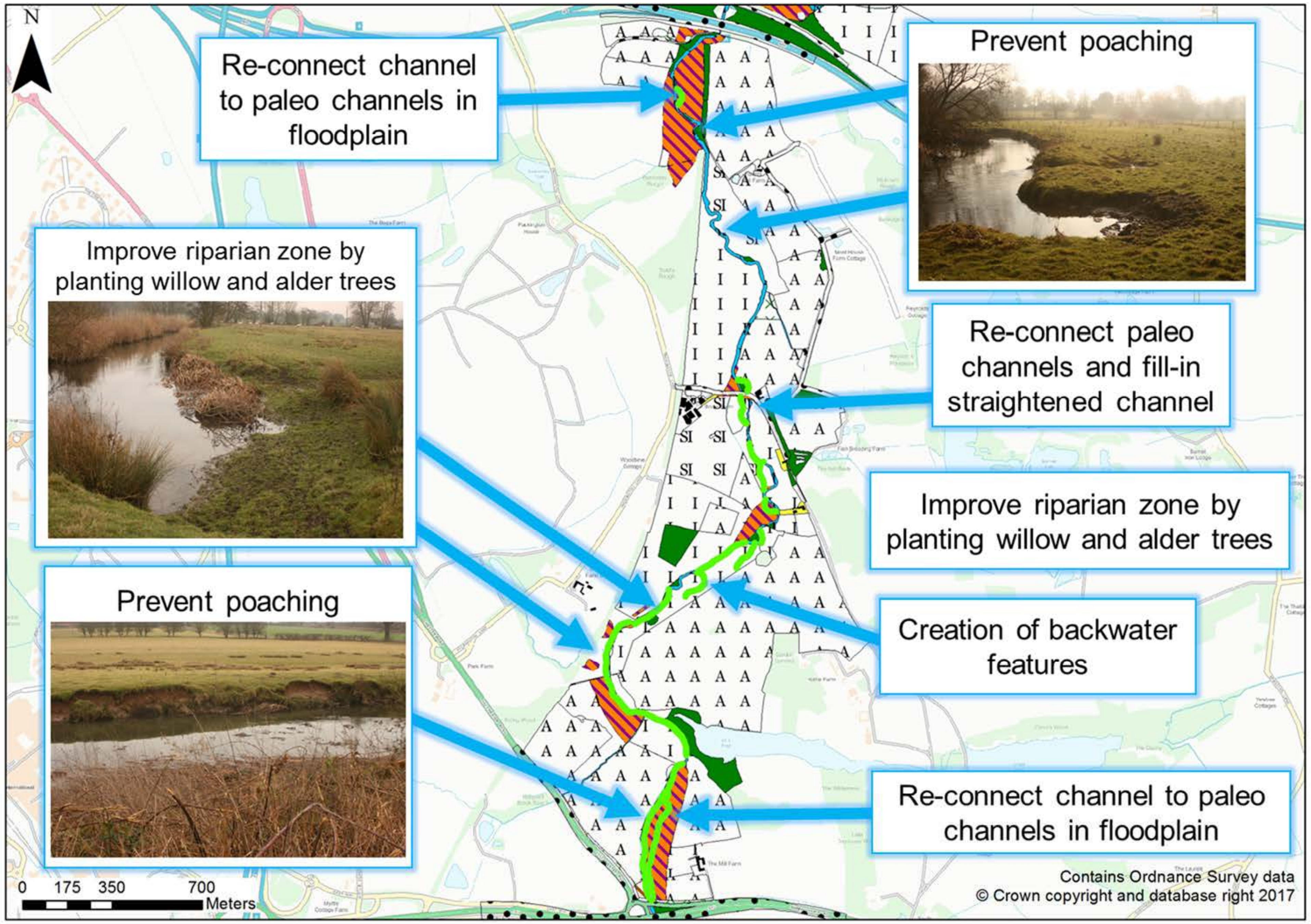
6.4.12 Reach 12: Meriden

Classification:	Constraints Map	Key Reach Issues
Restore		• Fine sediment; some in suspension but mostly as deposition • Poaching of the banks by livestock • Channel straightening; poor connectivity between the channel and the floodplain in straight sections • Bank instabilities causing bank erosion and fine sediment supply • Invasive species; Himalayan Balsam
Reach Details		**Proposed Actions**
Start NGR: SP 21388 80139 End NGR: SP 22010 82057 Reach Length: 2901m SSSI Unit: Unit 12		• Prevent poaching through improved riparian management • Re-connect paleo channels to improve habitat diversity • Increase channel sinuosity • Remove invasive species

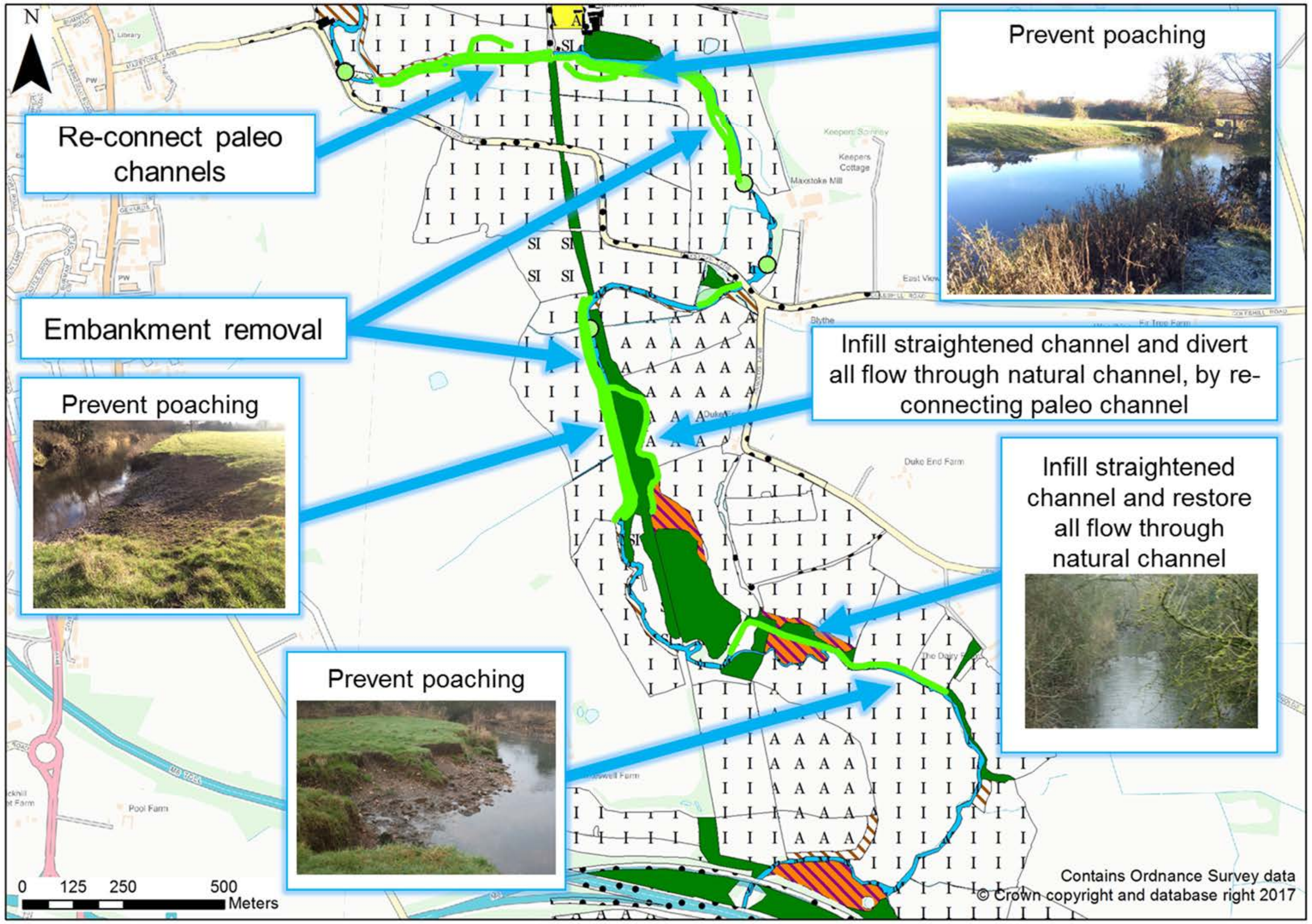
6.4.13 Reach 13: Kenilworth Road

Classification:	Constraints Map	Key Reach Issues
Restore		• The channel is mostly entrenched in this reach and as a result there is a poor connection to the floodplain. • Bank instabilities causing bank erosion and fine sediment supply Invasive species; Himalayan Balsam.
Reach Details		**Proposed Actions**
Start NGR: SP 22010 82057 End NGR: SP 21437 83091 Reach Length: 1484m SSSI Unit: Unit 13		• Prevent poaching through improved riparian management • Re-connect paleo channels to improve habitat diversity • Remove invasive species

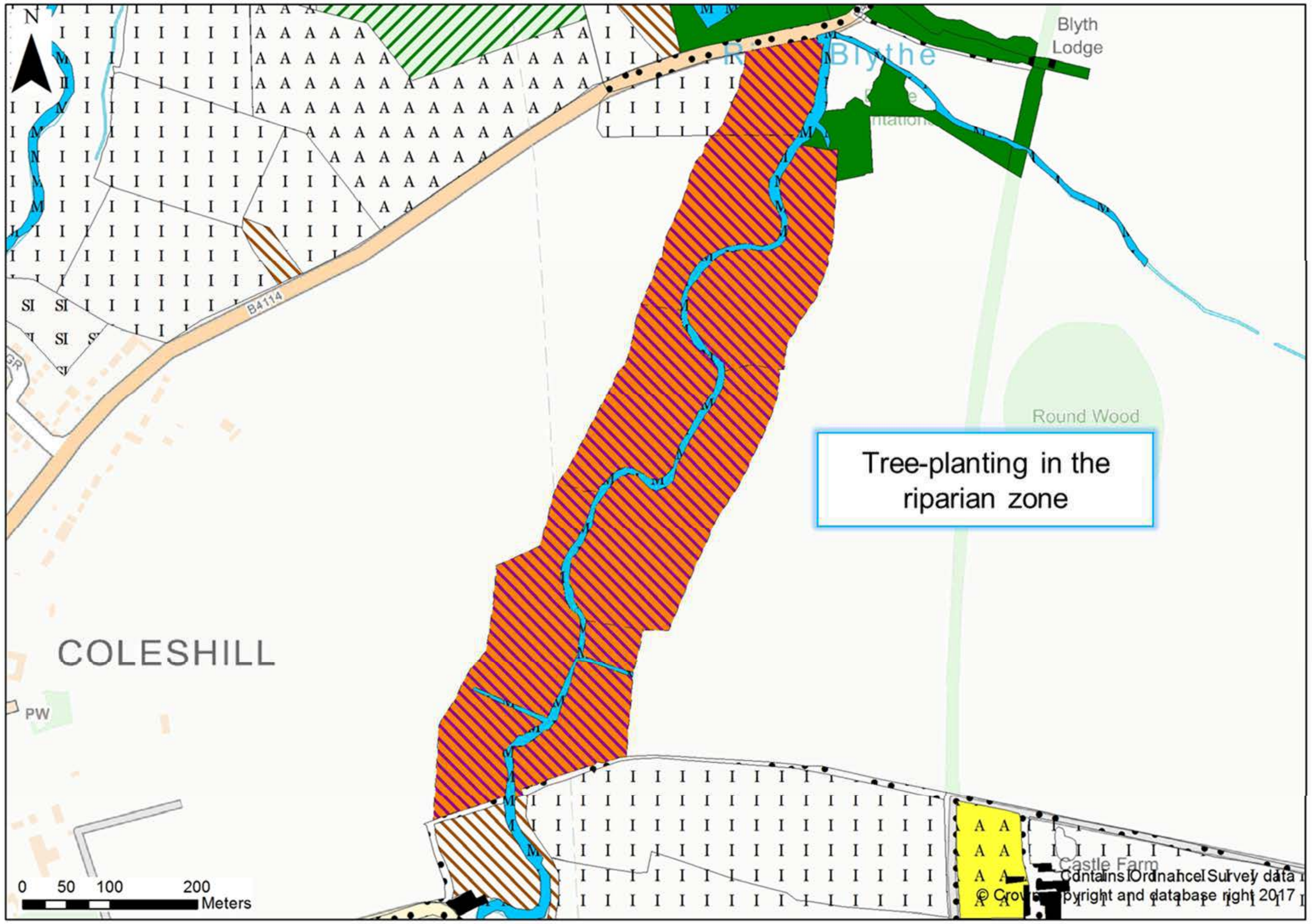
6.4.14 Reach 14: Brook Farm

Classification:	Constraints Map	Key Reach Issues
Restore **Reach Details** Start NGR: SP 21437 83091 End NGR: SP 21656 86597 Reach Length: 4790m SSSI Unit: Unit 14		• The channel is mostly entrenched in this reach and as a result there is a poor connection to the floodplain. • Channel straightening • Bank instability results in active bank erosion and fine sediment supply • Some of the riparian zone is less developed with sparser coverage • Poaching of the banks by livestock **Proposed Actions** • Prevent poaching through improved riparian management • Re-connect paleo channels to improve habitat diversity • Tree planting in riparian zone, namely Willow and Alder • Creation of backwater features

6.4.15 Reach 15: Dairy Farm

Classification:	Constraints Map	Key Reach Issues
Restore		• The channel is mostly entrenched in this reach and partly embanked; as a result there is a poor connection to the floodplain in most places. • Some of the riparian zone is less developed with sparser coverage • Poaching of the banks by livestock • Flow barriers, namely weirs, affecting river flow processes.
Reach Details		**Proposed Actions**
Start NGR: SP 21656 86597 End NGR: SP 20662 88842 Reach Length: 5662m SSSI Unit: Unit 15/16		• Prevent poaching through improved riparian management • Re-connect paleo channels to improve habitat diversity • Divert flow through natural channels and infill straightened channels • Improve channel connection to the floodplain • Increase sinuosity • Remove physical structures from channel, namely gabion baskets and weirs

6.4.16 Reach 16: Terraces

<table>
<tr><th>Classification:</th><th>Constraints Map</th><th>Key Reach Issues</th></tr>
<tr><td>Rehabilitate</td><td rowspan="4">
</td><td>Some of the riparian zone is less developed with sparser coverage of trees
Lack of riparian trees
Poaching of river banks by cattle.</td></tr>
<tr><td>Reach Details</td><td>Proposed Actions</td></tr>
<tr><td>Start NGR:
SP 20662 88842

End NGR:
SP 21059 89838

Reach Length:
1265m

SSSI Unit:
Unit 16</td><td>Osier planting in the riparian zone to stabilise banks, whilst not displacing wading birds
Encourage wading birds through appropriate land management practices.</td></tr>
</table>

6.4.17 Reach 17: Confluence

Classification:

Restore

Reach Details

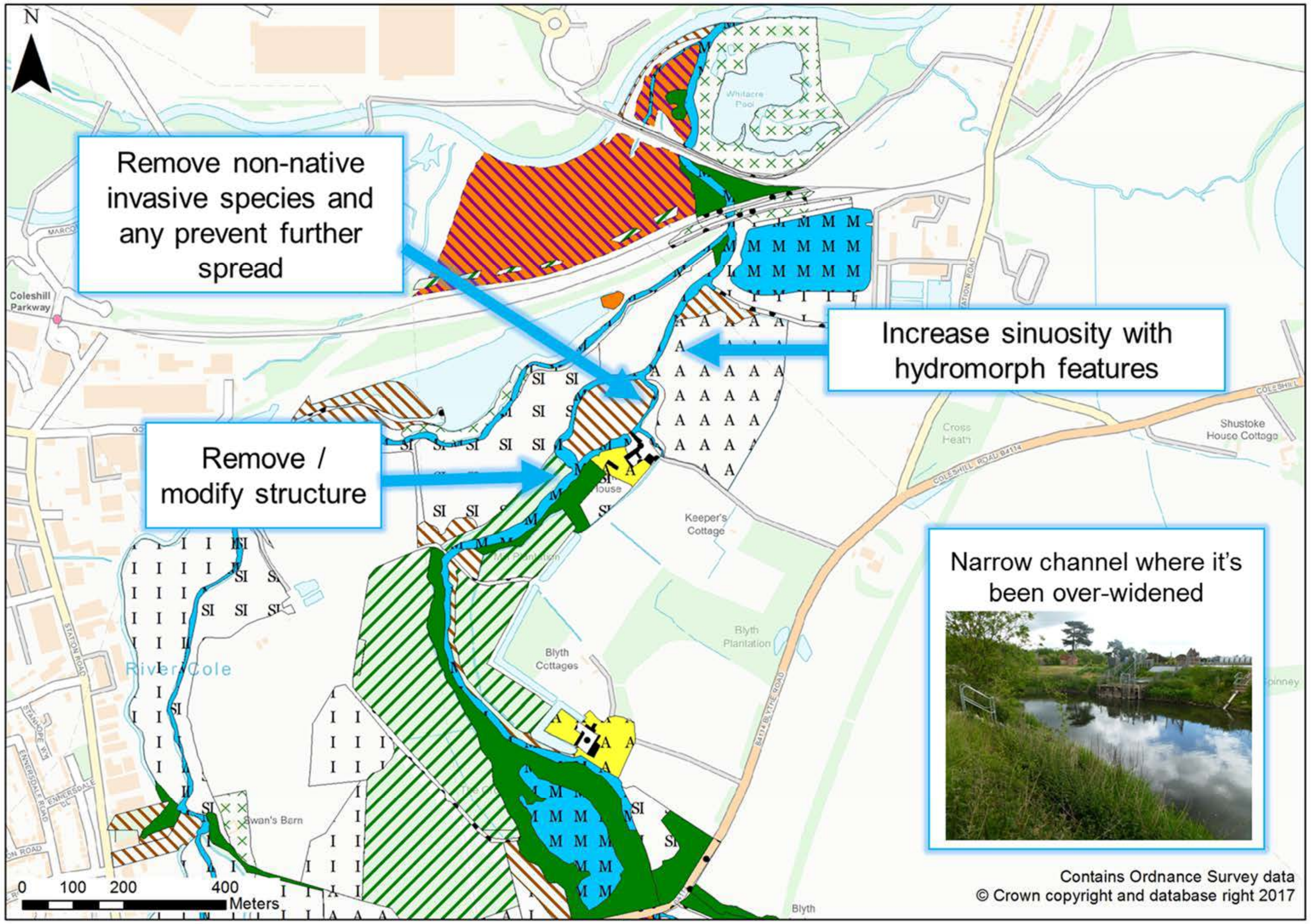
Start NGR:
SP 21059 89838

End NGR:
SP 21296 91629

Reach Length:
2683m

SSSI Unit:
Unit 17

Constraints Map



Key Reach Issues

- Flow modification structures, such as weirs and sluice gates, largely control river flow and sediment transport processes in this reach
- Channel diversion and modification, including dredging and channel clearance works
- Fine sediment
- Invasive species; Himalayan Balsam

Proposed Actions

- Remove physical structures from channel.
- Narrow channel where it has been over-widened
- Remove invasive species

7 Implementation

7.1 Further works and considerations

This study has outlined a series of high-level options for the River Blythe that aim to improve the hydromorphogical and ecological process, form and function. The options suggested would aim to improve its SSSI status and move it towards favourable condition. Further studies and investigation would be required to assess the feasibility of each option.

Once funding for 2017/18 has been confirmed, a final restoration plan will be commissioned and produced, which will incorporate the results of the further consultation exercises. The final restoration plan can then be used to inform future studies will investigate the feasibility of each of option on a more localised scale and during a more in-depth assessment.

7.2 Costings

The costs to carry out the restoration options outlined in the reach scale assessment, have been estimated based on past experience and on similar restoration measures in other projects. The costs provided in the table below are high level and have been provided as a likely indication only.

Reach	Classification	Restoration measure	Indicative cost range
Reach 1: Earlswood	Conserve and Enhance	Remove Japanese Knotweed patch	N/A - limited cost
Reach 2: Canal Downstream	Restore	Embankment removal and re-connection to floodplain	£50 - 150k
		Increase channel sinuosity	£30-50k
		Paleo channel re-connection	£30-50k
Reach 3: Cheswick Green	Conserve and Enhance	Monitor INNS	N/A
Reach 4: Shirley Golf Course	Rehabilitate	Prevent poaching	£3 - 7k
Reach 5: M42	Restore	Pond re-connection	£3 - 8k
		Increase channel sinuosity	£50 - 100k
Reach 6: Shelly Green	Rehabilitate	Prevent poaching	£20 - 60k
Reach 7: Brueton Park	Restore	Paleo channel re-connection	£100 - 300k
		Creation of backwater features	£13 - 30k
		Remove invasive species	N/A - limited cost
Reach 8: Riverside Drive	Rehabilitate	Weir removal	Further structural investigation required
		Remove invasive species	N/A - limited cost
Reach 9: Ravenshaw	Rehabilitate	Increase channel sinuosity	£40 -100k
Reach 10: Barston	Restore	Prevent poaching	£10 - 27k
		Tree planting	£800 - £2000
		Paleo channel re-	£300 - 700k

		connection	
		Remove hard bank protection	Further structural investigation required
		Remove structures	Further structural investigation required
		Increase channel sinuosity	£200 - 500k
		Remove invasive species	N/A - limited cost
Reach 11: Bradnocks	Rehabilitate	Remove invasive species	N/A - limited cost
		Increase channel sinuosity	£40 - 100k
Reach 12: Meriden	Restore	Prevent poaching	£16-41k
		Paleo channel re-connection	£600k - £1m
		Increase channel sinuosity	£200 - 500k
		Remove invasive species	N/A - limited cost
Reach 13: Kenilworth Road	Restore	Prevent poaching	£10 - 30k
		Paleo channel re-connection	£600k - £1m
		Remove invasive species	N/A - limited cost
Reach 14: Brook Farm	Restore	Prevent poaching	£600 - £1500p
		Paleo channel re-connection	£600 - £1m
		Tree planting	£50 - £100k
		Creation of backwater features	£50 - 100k
Reach 15: Dairy Farm	Restore	Prevent poaching	£10 - 27k
		Paleo channel re-connection	£600k - £1m
		Diversion of flow and infilling of straightened channel	£600k - £1m
		Improve channel connection to the floodplain	£100 - 200k
		Increase sinuosity	£100 - 200k
		Remove structures	Further structural investigation required
Reach 16: Terraces	Rehabilitate	Tree planting and fencing	£10 - 50k
Reach 17: Confluence	Restore	Remove structures	Further structural investigation required
		Narrow channel	£40 - 100k
		Remove invasive species	N/A - limited cost

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