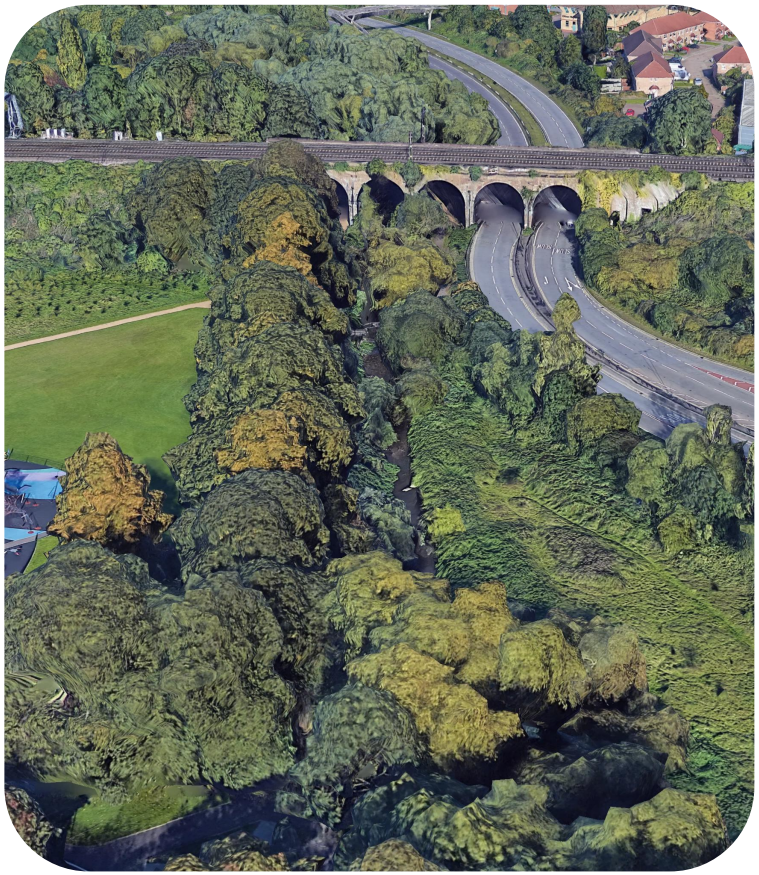
Waterfields Recreation Ground

River Improvement Plan



GROUNDWORK
CHANGING PLACES
CHANGING LIVES

WATFORD BOROUGH COUNCIL
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Contents

Introduction

The Rediscovering the River Colne Project

Rediscovering the River Colne is a ground breaking project that aspires to bring the River Colne to the heart of Watford and its people. The project will see the Colne corridor become a positive asset within the borough, enabling it to reach its full potential for both local people and wildlife.

The project aims to provide sustainable solutions to resolve the issues affecting the river and to regenerate the public spaces it flows through, providing a healthy river corridor, with clean water, diverse wildlife and low flood risk that is accessible to all and of high amenity value to local people.

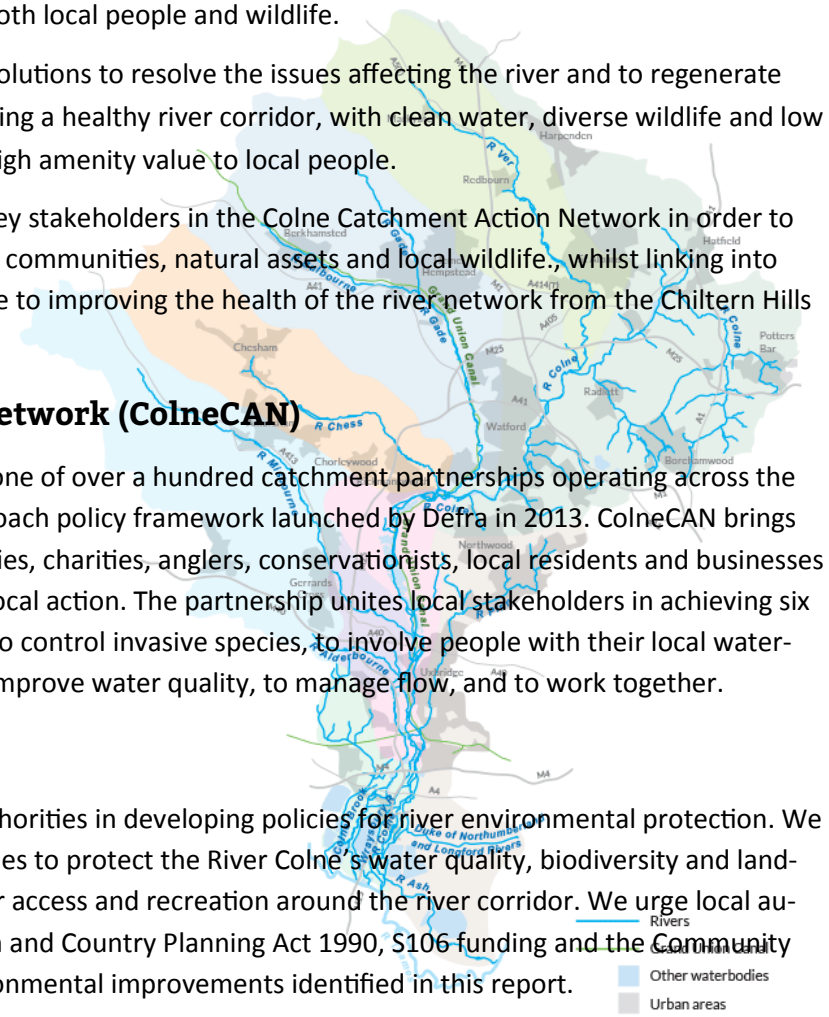
The project builds on the knowledge of key stakeholders in the Colne Catchment Action Network in order to remain in keeping with Watford's diverse communities, natural assets and local wildlife., whilst linking into catchment wide initiatives that contribute to improving the health of the river network from the Chiltern Hills to the River Thames.

The Colne Catchment Action Network (ColneCAN)

The Colne Catchment Action Network is one of over a hundred catchment partnerships operating across the UK as part of The Catchment Based Approach policy framework launched by Defra in 2013. ColneCAN brings together water companies, local authorities, charities, anglers, conservationists, local residents and businesses to ensure catchment-wide thinking and local action. The partnership unites local stakeholders in achieving six aims for improving the river catchment: to control invasive species, to involve people with their local waterbodies, to improve wildlife corridors, to improve water quality, to manage flow, and to work together.

Note to Local Planners

This plan aims to assist local planning authorities in developing policies for river environmental protection. We encourage local planners to include policies to protect the River Colne's water quality, biodiversity and landscape in addition to making provisions for access and recreation around the river corridor. We urge local authorities to consider the role of The Town and Country Planning Act 1990, S106 funding and the Community Infrastructure Levy to facilitate the environmental improvements identified in this report.

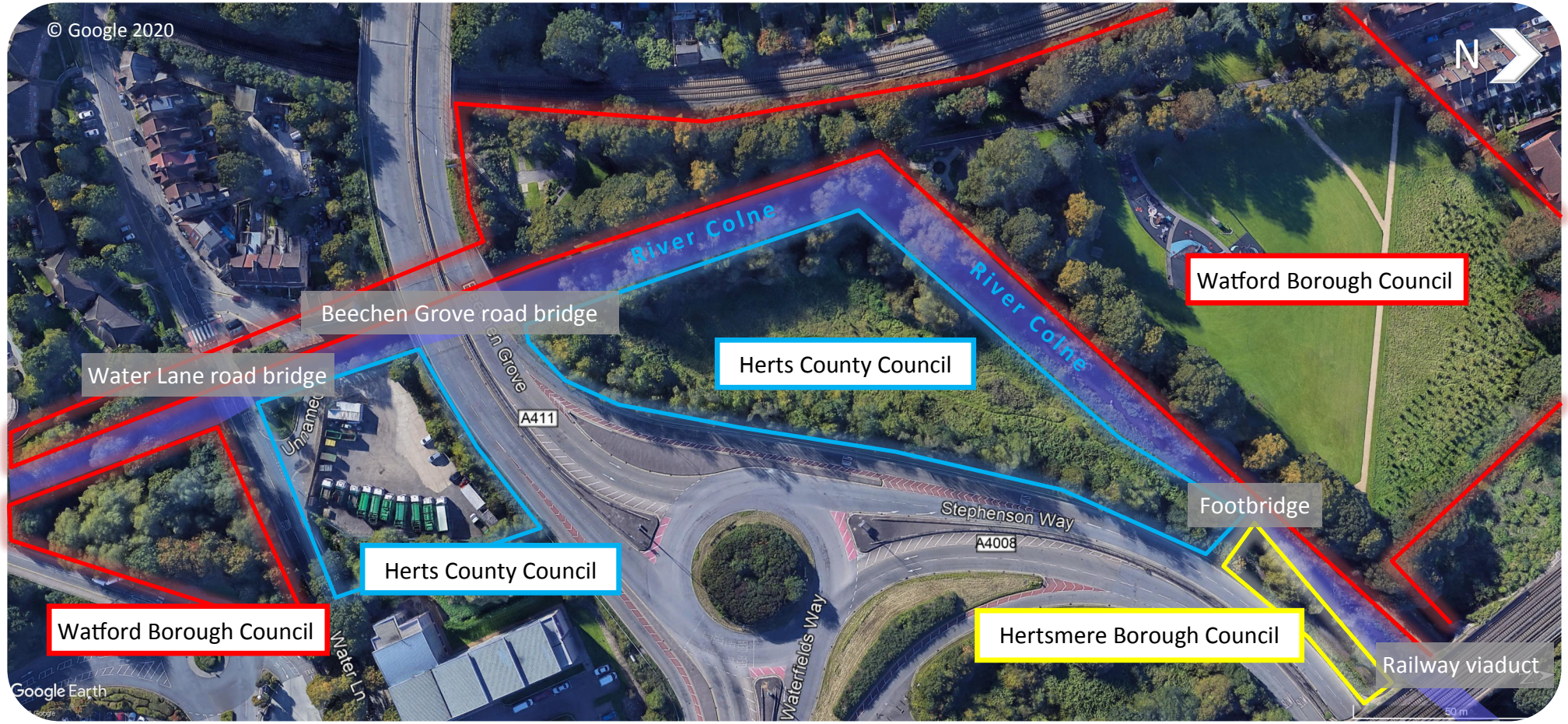


Waterfields Recreation Ground

Waterfields Recreation Ground is a Green Flag winning open space situated on the River Colne, just to the north of Watford Town Centre. The eastern floodplain is owned by Watford Borough Council and provides the community with leisure facilities including a playground, a football pitch, table tennis and plenty of green open space. The western floodplain is owned by Herts County Council and provides a contrasting area of informal green space. The River Colne is a central feature of the site, but has a neglected appearance due to the historic realignment of the watercourse and the occurrence of regular pollution incidents. Urgent intervention is required to ensure deterioration is reversed and The Colne reaches its full ecological potential. This plan also includes the area immediately downstream of the site, owned by Herts County Council and Watford Borough Council.

The section of the river is designated as a Local Wildlife Site 84/014 for Flowing waters (rivers and streams); species.' Local Wildlife Sites are non-statutory sites designated at a county level as being of conservation importance and often recognised in Local Authority development plans. The aim of this identification is to protect such sites from land management changes, which may lessen their conservation interest, and to encourage sensitive management to maintain and enhance their importance.

Site Plan



Radlett Road Recreation Ground land ownership

Habitat and Geomorphology

The following text summarises the results of the botanical survey and modular river surveys undertaken by the project team. The full results of each survey can be found within the appendices of this report.

Land Use

Riverside path and avenue of limes

The land appropriated for Waterfields Recreation Ground is shown on the Watford Plan of 1842 as pasture and intersected by the River Colne. By 1897 urban infrastructure had began to encroach on the surrounding landscape and the iconic five arched railway viaduct was created at the northern end of the site to facilitate the former London to Birmingham railway. The site was used for landfill purposes as the town of Watford grew and is now a registered historic landfill site. The recreation ground was eventually laid out by 1910 and was formed of two triangular shaped plots offering a range of facilities for the residents of Watford, such as outdoor public swimming baths. Trees were planted around the boundaries of the the park, as well as an avenue that lines up with Shaftesbury Road, most of which are still present today.

Today the western floodplain is owned by Watford Borough Council and provides leisure facilities for the community, formal green space and a riverside footpath, with links to the centre of Watford and other riverside green spaces. The site is usually busy, with locals straying from the centre of the town in search of recreation and respite near the River Colne. The eastern floodplain is owned by Herts County Council and is accessible via a footbridge spanning the width of the river. The area offers informally managed open space, with no formal footpaths and provides a more secluded area for wildlife to dwell without being disturbed.

The land to the south of Waterfields Park and Beechen Grove marks the beginning of the Colne's journey through the urban centre of Watford. The river is bordered by a recycling centre owned by Herts Country Council, a footpath leading to the town centre and an area of unmanaged greenspace owned by Watford Borough Council.

The river corridor is bisected by three bridges: The Five Arches railway Viaduct to the north of the site, the Beechen Grove road bridge to the south of the site and a minor footbridge at the centre of the site.

River Profile and Course

Heavily modified river channel

The river does not follow its original course through the site and was extensively modified in the mid 19th century to create a feature known as *The Watford Cut.* The Cut was a brick banked leat that diverted away from the original course of the river in the location where the five arches viaduct now stands. The feature flowed south through Watford, providing power to important industrial sites, such as Watford Mill. The cut eventually re-joined the main River Colne in what is now Oxhey Park. The majority of the Watford Cut was filled in during the 1980s following the decommissioning of its watermills and other industrial sites in the early 20th century. The only section of the feature that remains today, is what is now the main River Colne running through Waterfields Recreation Ground.

Legend:

1	2	3	4	5	6			
Floodplain woodland	Rank grassland	Hedgerow & scrub	Formal trees	Amenity grassland	Tree planting area	Flowing water	Sheet piling	Brick/concrete

Waterfields Recreation Ground habitat map

Downstream of this section, the river joins its original course which flows to the west of Watford Town Centre and onto Oxhey Park.

As a result of the historic modifications, the river now has an enlarged and artificial profile, which is more similar to that of a canal rather than a natural watercourse. The banks of the river are three meters high in places and range from having a steep (>45°) profile to a vertical profile. The eastern bank is clad with hard revetment for its total length (concrete, stone and sheet piling). The western bank is also clad with sheet piling towards the south of the site, but is comprised of earth elsewhere, providing a more natural appearance. The wetted width of the river is an average of 10m throughout the site, which far exceeds that of unmodified areas of the river nearby in the catchment. The depth of the river ranges between 0.3-0.5 meters with little variation across the width of the watercourse.

In the 1990s, a river restoration project was delivered by the National River Authority (now Environment Agency) to improve the watercourse. This involved the creation of pools, riffles and rock deflectors, designed to recreate the natural geomorphology of the River Colne. The features that were installed have had varying success, with some functioning as intended and others now obsolete.

Ordnance Survey 25-inch map. Hertfordshire Sheet XLIV.6 1896 (detail). Showing the location of the Watford Cut and main river Colne.

Floodplain Habitat

Western Floodplain

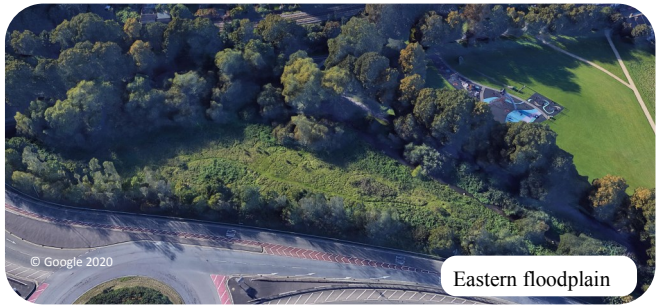
The Western floodplain is comprised of historic landfill resulting in the topography of the site being significantly raised in relation to the river corridor. As a result of this, the river is not able to laterally expand onto the majority of the floodplain during times of high flow. This has resulted in an elevated floodplain that is dry in nature, with no wetland features.

The floodplain is managed for sport and recreation purposes and therefore does not present many opportunities for habitat improvement. An avenue of mature Common Lime borders the formal path along the river, but the river is sparsely vegetated in comparison with other parks to the north of Watford, reflecting its more formal nature.

There is a notable exception within the amenity area, where there is a newly planted coppice of mixed native species to the North of the site. Although the trees are still young, this compartment will develop into an important area for biodiversity.

Eastern Floodplain

The Eastern floodplain is not comprised of landfill but still appears elevated due to the incised nature of the river channel. The area offers informal open space comprised of rank grassland, nettle, bramble and other ruderals, pockets of developing scrub and a wooded fringe along the border of the Stephenson's way. The compartment provides seclusion and refuge for wildlife which contrasts the formal nature of the Western Floodplain.

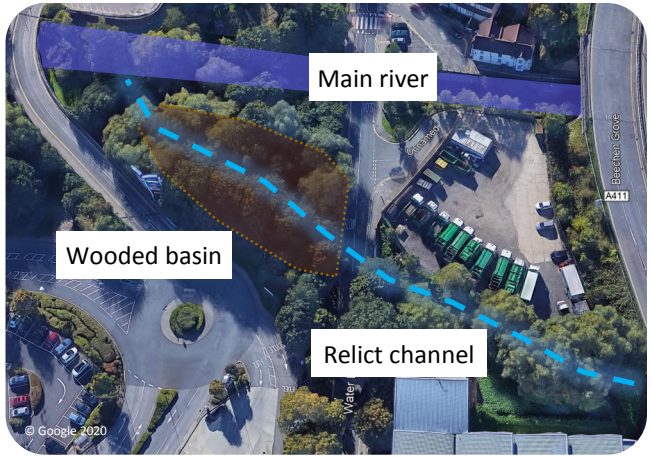


Land to south of Beechen Grove Bridge

The land immediately to the south of the Beechen Grove road bridge is owned by Hertfordshire County Council and is used as a recycling depot. Due to the current use of this site, few opportunities exist for habitat improvement. In 2019 Groundwork and Community Connections Project CIC worked collaboratively to install a kingfisher nesting box within the artificial bank face of the river channel bordering the site. The project aimed to provide kingfisher nesting locations in areas that were otherwise devoid of suitable habitat. The nest box will be monitored over the next few years to gauge the success of the project.

Land to the south of Water Lane

The land to the south of Water Lane contains a relict feature of the former river channel that ran alongside the Watford Cut. The relict channel can be observed passing through a culvert, beneath Water Lane, before emerging within an earth basin adjacent to the current course of the river. The basin is now overgrown with trees, filled with silt and is of little interest to freshwater ecology. The feature receives no management currently and is a popular spot for the homeless due to its secluded nature. The feature has potential for restoration for both biodiversity and natural flood risk management purposes.



Bank Face Habitat

The western bank of the river has a steep gradient and is clad with two forms or revetment; concrete and brick to the north of the site; and metal sheet piling to the south of the site. A limited range of

plant species have managed to establish on the concrete and brick bank over the years due to cracks in the revetment and the accumulation of soils on the bank face. Stinging nettle, bramble and crack willow saplings are commonplace along the bank face, with very few aquatic plant species present. The metal sheet piling towards the south of the site offers very little botanical interest aside from occasional sprigs of nettle, moss and lichens.

The western bank of the river is comprised of earth throughout the north of the site and is clad with metal sheet piling throughout the southern section. The earth bank face offers the best diversity of species on site but is still extremely limited in comparison to other sections of river in the area. The bank is predominantly characterised by Crack Willow with a Stinging Nettle understorey. Invasive non-native, Himalayan Balsam is also present and is likely to thrive due to the lack of competition with other native plant species. Similarly to the eastern bank,

Earth bank (left), concrete bank (right)

the area of sheet piling to the south of the site offers little botanical interest. River banks such as these offer little habitat for native wildlife, such as water voles, kingfishers and fish. Water voles prefer gently sloping earth banks with abundant emergent vegetation, kingfishers prefer secluded earth bank faces with nearby tree cover and fish prefer complex littoral habitats with abundant cover from predators. Intervention is required to re-naturalise the river's banks to provide the correct conditions for a diverse range of wildlife to thrive and to ensure habitat connectivity to sites upstream and downstream.

Metal sheet piling

Efforts have recently been made to adapt the metal sheet piling to the south of the site to provide Kingfisher nesting habitat. This was achieved by creating a hole in the sheet piling and installing a kingfisher nesting box. The box will be monitored in years to come to assess how often it is occupied. If successful, this enhancement will be replicated elsewhere on site.

River Bed Habitat, Substrate and Flow.

Throughout the majority of the site, the river is a low energy watercourse with a uniformly smooth flow type. The river is most shallow (0.3m) and fast flowing towards the north of the site, with occasional areas of rippled flow, but becomes increasingly deeper (<0.5m) and slow flowing as it progresses southwards. The river's substrate also reflects this change, with sand and occasional gravels predominantly found to the north of the site and with silt substrate and organic debris dominating the southern section.

Sand/gravel substrate

The dominance of fine substrate reflects that the river has a poor ability to appropriately sort and grade sediment into morphological features and that the river is still recovering from the impacts of modification. Areas such as these do not provide favourable conditions for diverse fish and invertebrate populations to thrive, which require clean well

oxygenated gravels. Intervention is required to catalyse morphological processes and to provide a self-sustaining, dynamic water course.

Occasional areas of good flow and substrate are intermittently dispersed throughout the length watercourse, with many of these areas being the product of the river restoration project undertaken by the NRA in 1996. Most areas such as these provide artificially created riffle habitat and contain rock deflectors and imported substrate (gravel flint reject stone). Some features function better than others in respect to their ability to increase flow and to provide self-cleaning gravels. Some deflectors have done very little to increase scour and flow, but have worked to narrow the width of the watercourse and have increased in-stream habitat complexity.

Rock deflector installed by the NRA (EA)

The river bed provides very little diversity in regards to aquatic vegetation, with most areas offering filamentous algae covering otherwise bare substrate. The algae is indicative of slightly eutrophic conditions, caused by residual pollution resulting from both agricultural and urban runoff. Emergent plant species also struggle to establish in the littoral zone due to the modified nature of the watercourse. The river's cross-sectional profile is of a uniform depth and its banks are tall and steep, meaning that the margins of the river are exposed to high flows and offer very little shelter for young plants. The areas improved by the NRA restoration scheme offer more favourable conditions, with artificial rock deflectors helping to vary depth and to provide occasional shelter for emergent plant to take hold.

Artificial Structures

Surface Water Outfalls

Three outfalls are present along the river channel and have been observed to regularly pollute the watercourse (CVFC Pollution Monitoring Application, 2019). The locations of the outfalls are illustrated on page 4. The worst offending outfall is located directly beneath the Beechen Grove road bridge. Site users regularly complain about the foul smell and visual signs of pollution as they enter the recreation ground from upstream.

The pollution can be attributed to domestic sewerage misconnections and links between the foul and surface water sewerage system. Thames Water have identified that the outfall is served by a catchment area of over 2,500 properties and have committed to conducting tracing exercises to locate the sources of pollution. Until the sources are identified and rectified, the river will continue to receive persistent pollution in this location. Poor water quality may have an even larger impact on the river at this site than poor habitat quality and is directly responsible for limiting the diversity and abundance of riverine wildlife at Waterfields Recreation ground.

Beechen Grove outfall showing signs of regular pollution

Bridges

Three bridges span the river: the five arches railway viaduct to the north of the site; the Beechen Grove road bridge to the south of the site and a small footbridge towards the centre of the site. The two major bridges cause a high degree of shading and the watercourse beneath them is devoid of plant life, but should not cause any severe habitat connectivity issues as they are short in length and do not impede the passage of wildlife.

Invasive Species

Himalayan balsam is present throughout the river channel on site, but does not dominate over native species due to diligent regular management from the

Knutsford Green Gym and Community Connections Projects CIC. If the regular management were to cease, Himalayan balsam would rapidly recolonize and spread throughout the site. The site should be surveyed for invasive plant species each year using the CVFC invasive species reporting application and management works carried out accordingly.

American signal crayfish burrows were found within the small area of earth bank to the north of the site. The species is common place in the Colne Catchment. Crayfish Burrowing mobilises sediment which has a negative impact on both water quality and habitat. If deemed a priority, the species should be monitored via the Rediscovering the River Colne Environmental Monitoring Project.

American Mink are known to be present throughout Hertfordshire and the Colne Catchment. Mink are aggressive predators that predate on the endangered water vole. One reason that mink cause such a problem for the species is that female and young mink are small and agile enough to follow a water vole into its burrow, leaving very few areas of refuge for the species. It is widely accepted that the presence of American Mink is one of the primary reasons for the decline of water vole populations across the catchment.

Himalayan Balsam

©Snowdonia National Park Authority

American Mink

American Signal Crayfish

Site Ecology

Site Criteria

The section of the river is designated as a Local Wildlife Site for Flowing waters (rivers and streams); species.' Local Wildlife Sites are non-statutory sites designated at a county level as being of conservation importance and often recognised in Local Authority development plans. The aim of this identification is to protect such sites from land management changes, which may lessen their nature conservation interest, and to encourage sensitive management to maintain and enhance their importance.

The site is designated for the following features: A long stretch of the River Colne with well vegetated margins supporting a good diversity of emergent and submerged flora. Species recorded include Reed Sweet-grass, Purple Loosestrife, Lesser Pond-sedge, Branched Bur-reed, Fool's Water-cress and of particular interest are Common Club-rush and Flowering-rush, both uncommon in the county. Lining the river banks there are occasional trees and shrubs, mainly Hawthorn willow, Alder, Hybrid Black Poplar and Sycamore Water Voles have been recorded along the river.

Bats

Herts and Middlesex Wildlife Trust installed remote bat detectors at four different locations adjacent to the river in Watford. The detectors were deployed for four nights from 01/07/2019 to 05/07/2019. The detectors upstream and downstream of Waterfields Recreation Ground detected three species of bat: common pipistrelle, soprano pipistrelle and daubentons. The presence of common pipistrelle and soprano pipistrelle are to be expected and are common throughout the Colne Valley. A higher number of species were recorded at sites further away from the town centre. The bat population is likely to be limited at Waterfields Recreation Ground due to its urban nature, associated light pollution and poor water quality.

Water Voles

No signs of water voles were recorded during the most recent survey undertaken by the project team (HMWT, 2019). The nearest known population of water voles is about 3km downstream, at Croxley Hall Fishery. Overall, there is probably enough reasonable habitat to allow water voles to move through Watford, but relatively few places that would allow a population to establish and thrive. Waterfields park is devoid of suitable bankside habitat for the species and efforts must be made to recreate viable habitat if a water vole population is to be sustained at this site in future.

Otters

The otter survey conducted by the project team (HMWT, 2019) did not identify any evidence of otters at the site. Otter spraint was recorded at two sites downstream however, one being less than a kilometre away near Watford Tescos. It is presumed that the spraint was deposited by Otters prospecting up the River Colne from what is believed to be an established population in the mid-Colne Valley. Otter populations are likely to increase in Watford should the Colne's fish populations become more resilient.

Coarse Fish

The 2017 EA fisheries surveys conducted at the site upstream (Radlett Road) found that chub, dace, gudgeon, perch, roach and pike were present. The results showed that the average density of fish at the site had declined to just a quarter of the density recorded in 2015. This is believed to be the result of a major pollution event in 2015 which resulted in a fish a kill. Intervention is required to resolve reoccurring water pollution issues at the site, in addition to improving spawning and recruitment habitat for all fish species.

Bird Life

At the time of survey, the project team identified the following bird species at the site: Blackbird, Wren, Blue Tit, Great Tit, Blackcap, Robin, Chaffinch, Wood Pidgeon, Magpie (HMWT, 2019).

Site Water Quality

River flies

A range of aquatic invertebrates are present and emerge in their flying form in spring and summer to provide an essential food source for fish, birds and bats. The river fly population is currently limited due to poor water and habitat quality.

River fly Monitoring

Water quality is monitored on a monthly basis at the site via the Anglers Riverfly Monitoring Initiative (ARMI). ARMI is a citizen science initiative that facilitates regular monitoring of river water quality by trained volunteer monitors, to complement the more detailed work carried out by the EA.

The method involves taking a three minute kick sample using transects that are reflective of the habitat available at the monitoring site. Eight target groups of aquatic invertebrate 'indicator species' are monitored and a score is generated based on their abundance and the number of individuals recorded. The score can be used to detect any severe perturbations in river water quality providing an evidence base to address sources of pollution.

Waterfields Recreation Ground Results

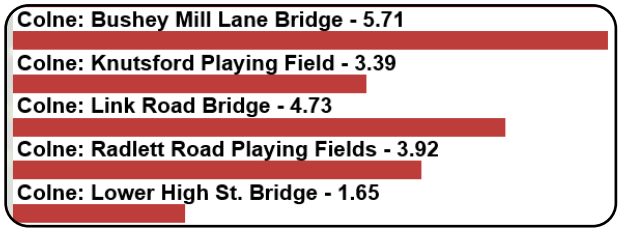
The two monitoring sites upstream and downstream of Waterfields return some of the poorest ARMI results in the Colne Catchment. Radlett Road (0.3km upstream) scores an average of 3.64 and the Lower Highstreet Bridge (1km downstream) scores an average of 1.67. This illustrates there is a significant decline in water quality from upstream of the site to downstream of the site which is reflective an overall trend of declining water quality throughout Watford.

There are three outfalls present at Waterfields (see habitat map on page 4 for location), the outfalls have been observed to pollute the river on a regular basis (CVFC, 2019) and will contribute to the progressive decline in ARMI scores as the river flows through Watford. The outfall that most frequently pollutes the river is located beneath the Beechen Grove Road Bridge. Regular checks have shown that the outfall shows signs of pollution on most days and there is often a strong smell of sewerage beneath the road bridge.

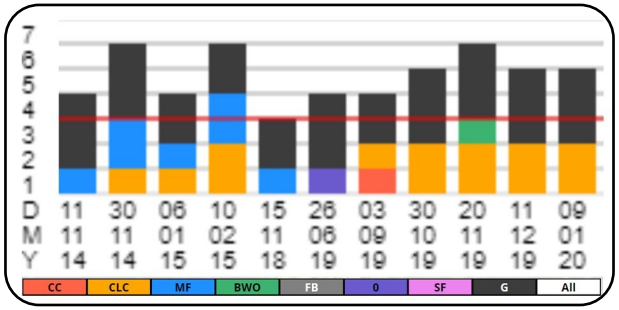
The pollution can be attributed to domestic sewerage misconnections and links between the foul and surface water sewerage system. Thames Water have identified that the outfall is served by a catchment area of over 2,500 properties and have committed to conducting tracing exercises to locate the sources of pollution. Until the sources are identified and rectified, the river will continue to receive persistent pollution in this location. Poor water quality is likely to have an even larger impact on the river at this site than habitat quality and is directly responsible for limiting the diversity and abundance of riverine wildlife .

Additional Monitoring Activities

The *Rediscovering The River Colne Project* intends to extend the river fly monitoring network to reflect all sites in Watford and to facilitate additional monitoring activities to improve understanding of pollution in Watford. The project facilitates a regular meeting, known as *Watford Water Quality Forum*, between Watford Borough Council, Thames Water, The Environment Agency, Groundwork, The CVFC and Community Connections Projects CIC. The forum works to identify and deliver improvements to surface water and wastewater infrastructure in Watford.



ARMI results for all sites (upstream to downstream)



ARMI results for closest site downstream (LHSB)

Water Framework Directive (WFD)

What is the WFD?

During the 1990s the European Commission recognised that we needed an integrated and comprehensive way of managing the water environment and so the Water Framework Directive (WFD) came into existence. It has been part of UK law since 2003.

The original aim of the WFD was for all rivers, lakes, reservoirs, streams, canals, estuaries, coastal and groundwater (known as water bodies) to be in good ecological health by 2015. However, the EU has recognised that it will be an almost impossible task to reach this goal by 2015, so in most cases this deadline has been extended to 2021 or 2027.

What is a healthy water body?

A healthy water body has thriving populations of fish, invertebrates, plants and diatoms (microscopic algae). They depend upon a healthy flow of water and a variety of natural habitats. All of these are affected by the levels of pollution and nutrients in the water, and the shape and structure of the water body. The Environment Agency uses many different measures to assess the ecological health of a water body. They include:

- the variety and numbers of different types of animals and plants living in the water body
- the state of the water itself, such as the temperature.
- the amount of oxygen, how acidic or alkaline it is (the pH), and the concentration of nutrients like ammonia and phosphate
- the concentration of polluting chemicals from human activity, such as arsenic, cyanide and the breakdown products of pesticides
- and for Heavily Modified and Artificial Water Bodies, whether it could be made more natural without interfering with the way it is used.

These are combined to come up with an overall classification for each water body. The classifications are:

High	Good	Moderate	Poor	Bad

When the status of a water body is Moderate, Poor or Bad, the Environment Agency investigate the reasons why it is not in good ecological health.

Current WFD Status

- The overall WFD classification for *The Colne (Ver to Gade)* waterbody is **moderate.**
- It's chemical classification is **good.**
- Its ecological classification is **moderate.**

Reasons for Not Achieving Good Status

The Colne (Ver to Gade) waterbody is currently not achieving *good status* due to the following factors:

1. Changes to the river's natural flow and water levels due to abstraction from the water industry.
2. Continuous pollution from waste water related to the water industry.
3. Physical modifications to the watercourse arising from urban transport and infrastructure.

Activities Listed in this plan which address these issues

1. Low flow channel creation (P16)
   Wooded debris installation (P16)
2. Improved Water Quality Monitoring (P17)
   Watford Water Quality Forum (P17)
3. Pondscape creation (P13)
   Backwater creation (P15)
   Wet Woodland Creation (P15)
   Bank scalloping (P16)
   Wooded debris installation (P16)
   Low flow channel creation (P16)
   Pool / Riffle creation (P16)

Habitat Improvement Recommendations

Western Floodplain

The majority of the Western floodplain is amenity grassland used for public recreation and therefore does not provide many opportunities for improvement for wildlife. Due to the floodplains high topography and classification as historic landfill, it is not possible to create any significant wetland features to complement the river corridor.

Tree Planting Area

The tree planting area would benefit from active management such as coppicing. Coppicing is a traditional woodland management technique that benefits wildlife and biodiversity.

Trees within the tree planting area should be coppiced based on their preferred coppice cycle: Alder, Ash, Beech, Birch (3-4 year cycle), Hazel (7 year cycle), Hornbeam, Oak (50 year cycle), Sycamore Sweet Chestnut (15-20 year cycle). The trees should be cut during the winter and the branches are all cut low to the ground. By repeatedly cutting the trees their lifespan can be greatly increased and light levels are increased to encourage a higher diversity of groundcover species.

The materials won from coppicing could be used to create brush berms and flow deflectors in the river channel at the site or at other river improvement sites in Watford.

Eastern Floodplain

The land to the east of the river channel is also of high topography, meaning that the floodplain is disconnected from the main river, even when river levels rise. Wetland features would be unlikely to retain water, if created, due to their high topography unless they were lined. A network of lined ponds could be installed to create a pond scape of different depths and shapes. Excavated soil could be spread evenly across the site and seeded with a wetland mix, such as Emorsgate EP2, to avoid excessive colonisation by ruderal species. Excavated soil could also be used in combination with the wood arising from tree coppicing, to create amphibian hibernacula adjacent to the pond network and river channel. Once completed, this compartment would become a dragonfly and amphibian refuge with regularly mown paths cut between the ponds to provide informal public access.

The ponds could be excavated by local volunteers, led by staff from an environmental organisation, providing an active worksite for the ten year duration of the Rediscovering The Colne project. Alternatively a contractor could be procured to create some of the larger wetland features and volunteers could create smaller ponds.

As the river takes its angular turn at the centre of the site, the eastern bank becomes lined with willows. The willows provide a rare area of riparian tree cover, providing shelter for river dwelling wildlife against avian predation. Due to a lack of management the willows have become overgrown, with some causing obstructions in the river channel. The willows should be coppiced and pollarded on annual rotation, with a quarter of the trees being cut each year. This will retain important riparian cover for the river channel, whilst allowing sufficient light levels to aid the establishment of aquatic plant life, whilst reducing the likelihood of blockages occurring in the main river channel.

Land to South of Beechen Grove Road Bridge (Herts County Council)

The land to the south of Beechen Grove is used as a recycling depot for Hertfordshire County Council. Although the site does not offer opportunities for habitat improvement, a kingfisher nesting box has recently been installed in the area of metal sheet piling bordering the river by Groundwork and Community Connections Projects CIC. The nest box should be monitored each season to see if it is occupied. The occupancy rate should also be compared to other sites where nest boxes have been installed in the catchment to deduce which site parameters lead to the highest occupancy rates.

Legend:

1	2	3	4	5	6	7	8	9
Brush berm	Deflector/pool/riffle	Aquatic shelf	Scallop bank	Pond creation	Coppice willows	Backwater	Wet woodland	Coppice on rotation

Waterfields Recreation Ground habitat improvement map

Land to the south of Water Lane

The Land to the South of Water Lane contains relict features of the former river channel that was by-passed by the creation of the Watford Cut. These features have the potential for restoration for both biodiversity and natural flood risk management purposes. The wooded basin, adjacent to the river channel could be enhanced as backwater to the River Colne, a flood storage area and as an area wet woodland habitat.

Backwater Scope

The most obvious, but not necessarily the most appropriate improvement for this area, is the creation of a backwater. This could be achieved by lowering the bed level of the basin to match that of the riverbed. This would provide a constant connection between the two features, ensuring that the backwater remained wet throughout the year. The backwater would provide an important refuge for aquatic wildlife sheltering from disturbances such as pollution events and high flows. The feature would also provide valuable habitat for juvenile coarse fish and eventually water voles, should they return to this part of the catchment. Despite these benefits, there are factors that affect the viability of a backwater in this location. The basin is linked to a small part of the former river channel which still shows signs of residual flow when water levels rise. This was evident from first hand observation as the channel was deep in sediment which is slowly migrating down the channel to fill the basin. This would mean that any backwater created would be susceptible to filling with silt.

A more viable option would be to create a small backwater adjacent to the main river channel, away from areas with high accumulations of sediment and to utilise the wider basin for other habitat improvements such as wet woodland creation.

Wet/Floodplain Woodland Scope

Wet woodlands are woods which are frequently or seasonally wet either through the action of flooding; from streams or rivers (floodplain woodlands); from springs; from geological features which 'pool' water (e.g. clay soils); or from surface water runoff. Floodplain woodlands are one of the most dynamic natural habitats in the UK but, along with wet woodlands, they are almost extinct in lowland Britain. Wet woodlands are not just a dense wall of trees. They have between 30 and 70% tree cover and include open areas and other dry and wet habitats such as scrub, reedbeds and seasonal ponds.

Wet woodland is important nationally and locally for a number of priority species including the Otter, the Black poplar tree, Marsh warblers, Spotted flycatchers, Common cranes, Lesser spotted woodpeckers, Woodcock, Nightingale, Willow tit, the Weevils Melanapion minimum and Thynchaenus testaceus, the Craneflies Lipsothrix ecucullata, L.nervosa, L.errans and L.nigristigma and the Netted carpet moth Eustromia reticulate.

Wet woodlands are also host to a wide range of plant species and are particularly important for mosses, and liverworts.

In order to identify sites where wet woodland creation is viable the following criteria should be met:

1. Sites with naturally occurring springs or where rivers flood onto the floodplain.
2. Sites which are obviously trying to revert to woodland and scrub naturally.
3. Sites with little or no existing conservation interest such as improved grassland, species poor grazing marsh or intensive arable land.
4. Sites which are obviously waterlogged (low lying land).
5. Sites near to existing hedgerows, copses or ancient woodland.
6. Sites where (wet) woodland is shown on old or tithe maps.
7. Sites which have no value as farm land.
8. Old river meanders / field corners which are hard to farm and can be fenced off

The compartment meets all of the above criteria and therefore wet woodland creation appears to be the most viable option for this location. The following actions should be undertaken to create wet woodland at the site.

1. The existing trees at the site (mainly willow) should be thinned to provide 30% tree cover

and for access purposes.

2. Amphibian hibernacula should be created with materials arising from tree works.

3. The bed level of the basin should be lowered to form shallow and deep zones to provide areas for tree planting and pond creation.

4. An appropriate mix of wet woodland whips should be introduced to all designated tree planting areas. Trees should be planted with 5m spacings, including some clumps. It is recommended that planting takes place at the start of autumn, after the dry season but before flooding is likely to occur. Different species should be utilised to match dryer 'edge' habitats and wetter pond habitats.

   The following species should be considered for the canopy: Alder (Alnus glutinosa); Crack Willow (Salix fragilis); Oak (Quercus robur); Black Poplar (Populus nigra ssp.betulifolia); Ash (Fraxinus excelsior); and White Willow Salix alba.

   The following species should be considered for the understorey: Grey willow (Salix cinerea); Elder (Sambucus nigra); Osier (Salix viminalis); Hawthorn (Crataegus monogyna); Goat Willow (Salix caprea); Holly (Ilex aquifolium); Hazel (Corylus avellana); Blackthorn (Prunus spinosa); and Guelder Rose (Viburnum opulus).

Natural flood risk management scope

Lowering the bed level of the basin and enhancing the woodland in this area will benefit natural flood risk management by increase water storage.

Materials arising from excavation works could be used to create bunds around the existing basin to contain flood water and to further increase the water storage capacity of the feature.

River Channel

The following issues affecting the river channel have been identified in this location:

1. The river lacks marginal and riparian vegetation due to its modified crossectional profile and enforced banks.

2. There is little variation in the depth and little sinuosity due to the channel's straightened longitudinal profile.

3. There is little variation in flow type, with the flow of the river being predominantly smooth and slow flowing due to the enlarged nature of the river channel.

4. The river channel is not suited to low flow conditions and is susceptible to the effects of climate change.

5. The riparian zone lacks suitable habitat for bat roosting.

6. The river suffers from reoccurring pollution issues that limit aquatic biodiversity.

In order to improve the river in this location the following interventions are required:

1. A mixture of brushwood berms and constructed aquatic ledges should be installed in the margins of the river to create a sinuous low flow channel. This will significantly improve the rivers crossectional profile, providing a narrower and faster flowing central channel where morphological processes occur freely and sheltered areas in the margins of the river for aquatic plants to grow.

2. The newly formed banks should be planted with an appropriate array of native aquatic plant species. This will provide suitable habitat for water voles, nesting wildfowl and complex littoral cover for juvenile coarse fish.

3. Flow deflectors should be created with materials arising from tree works to encourage the scouring of the river bed. This will reduce the deposition of silt on the river bed in addition to providing sheltered areas in the margins of the river for plant life to establish.

4. A long reach excavator should be used to redistribute gravels from the river bed to form riffles and pools, thus creating greater variation in depths and flow type. Locally sourced gravel substrate could also be introduced to the river channel if exiting materials are too fine.

5. The area of the eastern bank comprised of earth should be regraded to provide a gentle gradient sloping towards the river. The bank should also be scalloped infrequently to provide marginal backwaters for fish fry and sheltered areas for aquatic plants to colonise. Materials arising from bank regrading can be used to backfill the aquatic ledges created elsewhere on site.
6. Tree removal work should be carried out in areas where the river is over shaded and prone to siltation. This will encourage both submerged and emergant aquatic plant species to establish within the river channel.
7. The encroachment of the remaining woodland should be prevented by periodic coppicing of self-set material i.e. maintain the current vegetative margin balance and prevent increase in shading to the channel.
8. Bat boxes should be erected on suitable trees by the water course. Bat boxes should be Schwegler 2F-DP and located in deep shade and dappled sunlit glades, with good flight access, to attract target species e.g. Daubenton's, soprano pipistrelle and Nathusius' pipistrelle.

Further Management Recommendations:

1. Eradicate the Himalayan Balsam by constant pulling during summer months.
2. Introduce mink monitoring rafts within the river. These should be sited away from public areas to avoid disturbance.
3. Undertake a river clean up once a year to keep the channel free from litter and fly tipping.

Water Quality

Improved Water Quality Monitoring

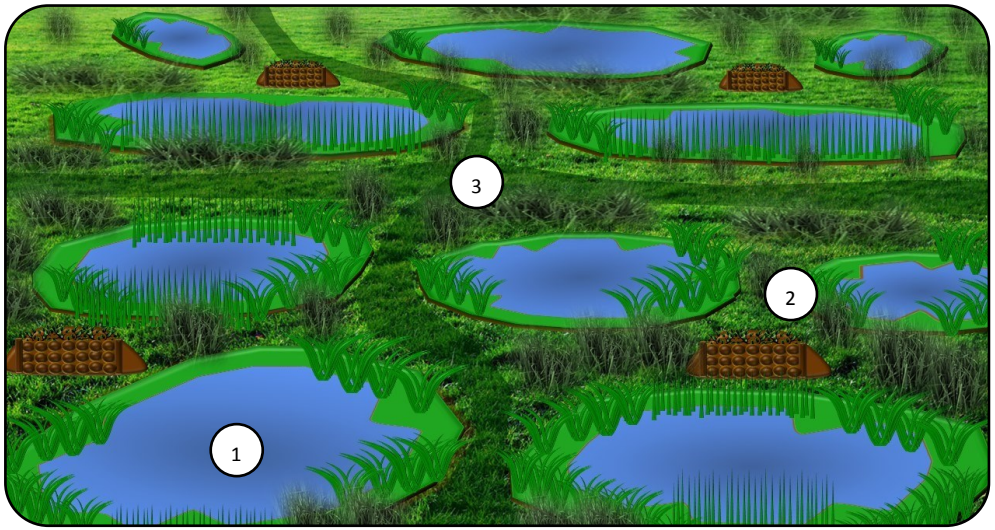
The three outfalls at the site should be included within The Rediscovering The River Colne's Environmental Monitoring Project. It is recommended that an annual outfall safari should be undertaken for all surface water outfalls in the Watford area to ascertain their baseline condition. This should be followed up with monthly river fly monitoring and chemical analysis at key sites within the project area to ascertain the regularity in which pollution incidents occur and their effect on the aquatic environment. Please see the Rediscovering the River Colne's Environmental Monitoring Feasibility Study report for further information.

Watford Water Quality Forum

A forum has been created through the rediscovering the Colne Project to provide a long term strategy for resolving water quality issues in Watford. The Watford Water Quality Forum provides a regular meeting between Thames Water, The Environment Agency, Watford Borough Council, Groundwork, The Colne Valley Fisheries Consultative and Community Connections Projects CIC in order to identify and rectify issues with waste water infrastructure in Watford.

Design Considerations

Pondscape



1. Ponds should be created in close proximity to one another and should be of varying depths, shapes and sizes. This will promote connectivity between each pond and will provide niches for differing species to occupy.
2. Amphibian hibernacula should be created in close proximity to each pond. This is achieved by digging a shallow trench, piling brushwood within the trench lengthways and then covering the structure over with soil. This will provide an insulated refuge for amphibians to seek shelter during winter months.
3. The peripheries of each pond should be sewn with Emorsgate EP2 to help the wetland establish. Paths should be mown to provide access to key areas so the pondscape can be maintained and appreciated by site users.

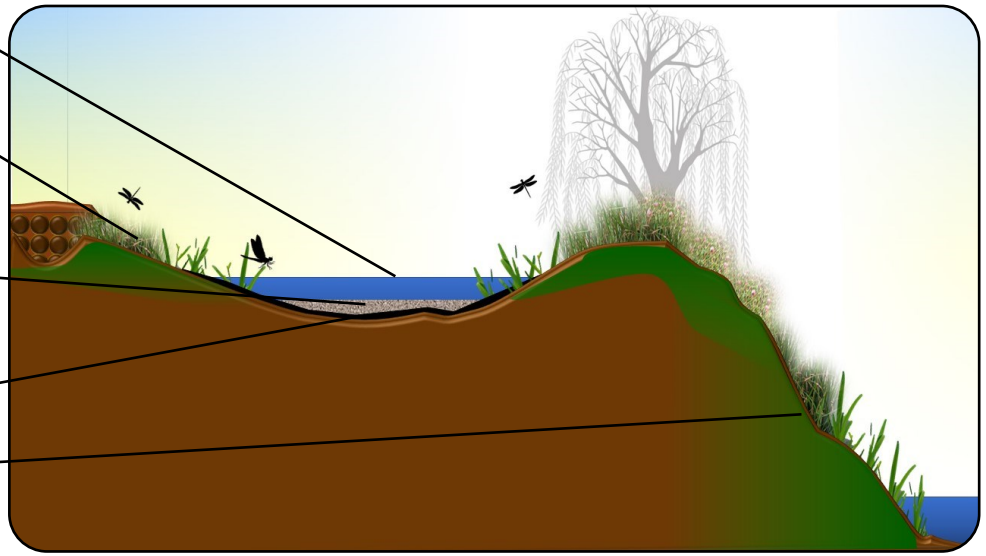
The ponds water depth should vary between 0.3-1 meter. They can be dug by hand or with the assistance of a mini digger.

The banks of the ponds should slope gently to allow the colonisation of aquatic plant species and to allow safe ingress/egress for wildlife. Native plug plants may also be introduced to provide diverse littoral habitat.

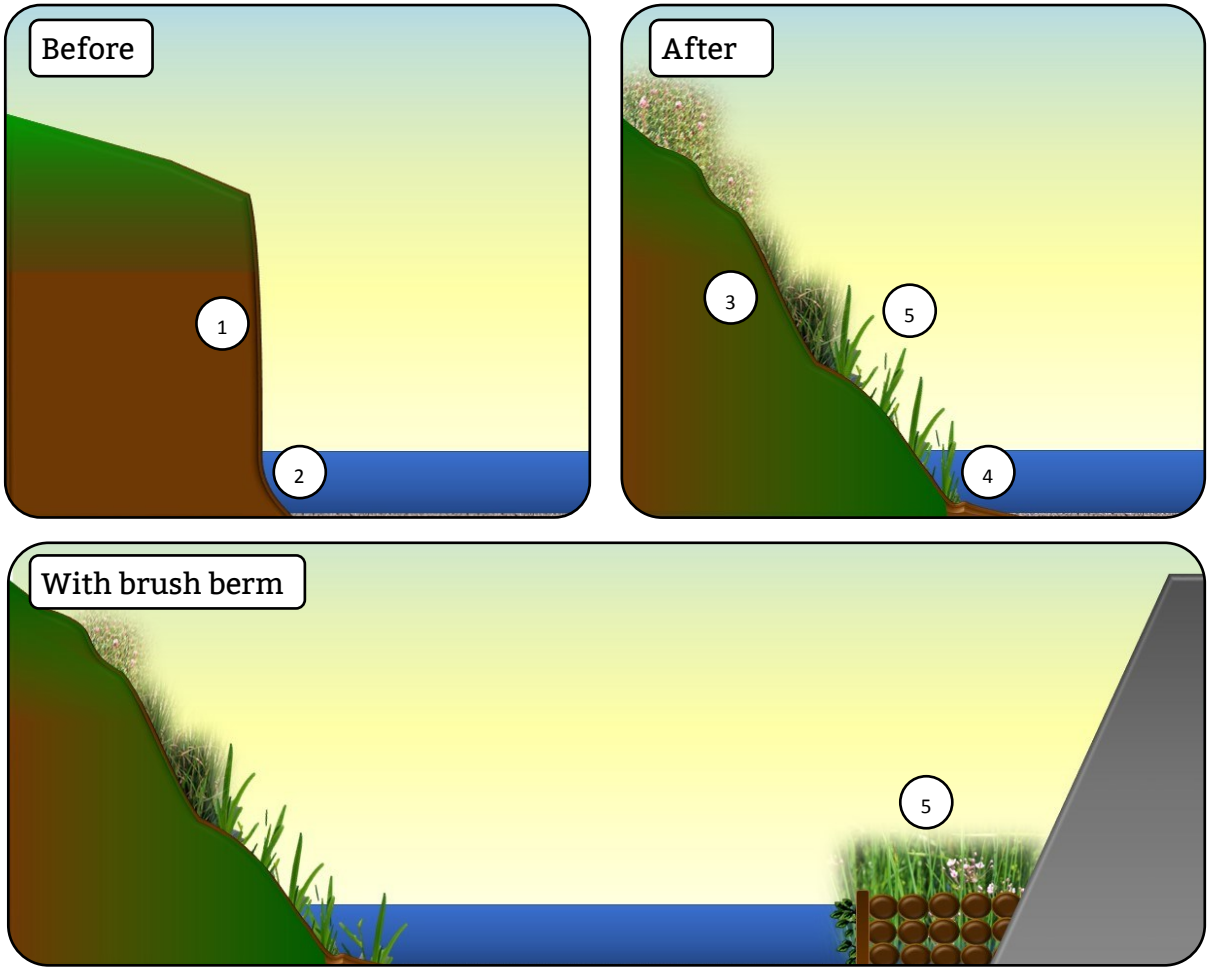
Gravel substrate should be introduced to each pond in order to help settle solids and to provide media for beneficial benthic organisms to colonise.

A butyl liner should be installed to enable each pond to retain water.

The pondscape should be located adjacent to the area of scalloped river bank in order to promote connectivity to the river corridor.



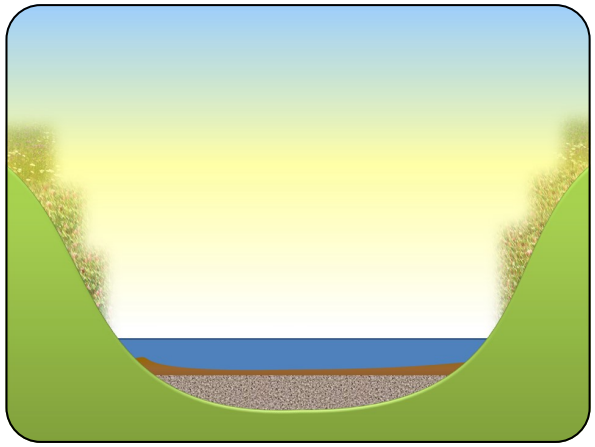
Bank Scalloping



1. Steep and bare river banks are susceptible to erosion and do not support diverse arrays of riparian and littoral plant life. The are also unsuitable for key species, such as water voles.
2. The river channel is of a uniform depth and flow, meaning that there are few, sheltered, shallow areas in the margins of the river where aquatic plants can colonise.
3. Steep banks can be scalloped using a long reach excavator in order to provide a more shallow gradient. This provides the right conditions for plants to establish and promotes improved connectivity for wildlife between the river channel and flood plain.
4. Scalloping the bank will also provide shallow, protected areas within the margins of the river for emergent plants to colonise.
5. Native plug plants should be introduced to the scalloped bank face to improve botanical diversity and to protect the newly scalloped bank from erosion. Planting density = 6 per squared meter with species introduced in clumps.

5. Brush berms should be installed on the opposite bank to each scalloped area. This will provide a natural edge to the western concrete bank , ensuring that plant life is present in both margins of the river. The effect of pulling back one bank away from the channel and extending the other into the channel should also help mimic natural sinuosity and will provide a central channel which is better suited to low flow conditions.

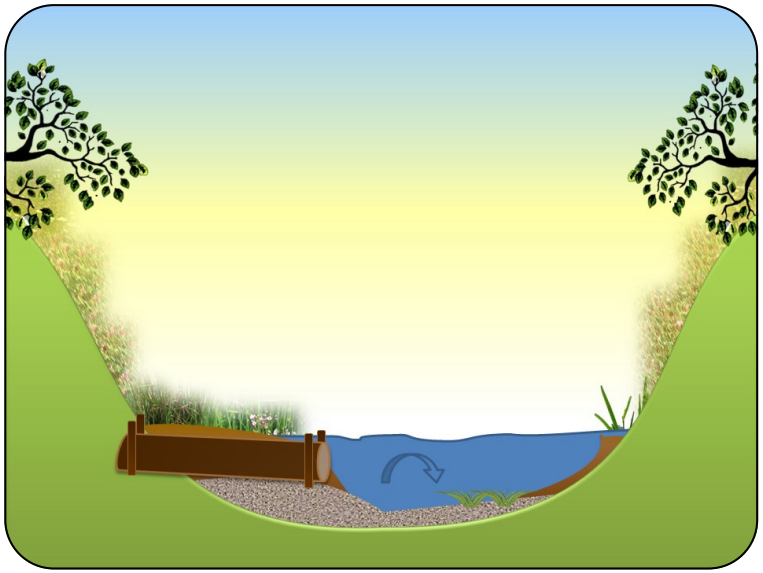
Brush Berms and Flow Deflectors



The river channel has a modified profile and uniform depth. Siltation occurs in over shaded areas where emergent plant species are not present to stabilise loose silt in the margins of the river.

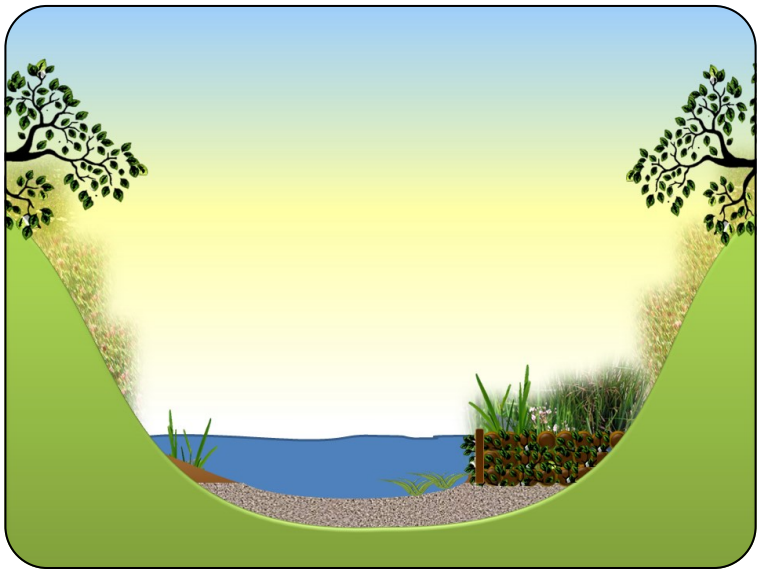
Over shading trees can be coppiced and repurposed to create brush berms and flow deflectors within the channel to mimic natural sinuosity, stabilise sediment and to create a variety of depths and flow types.

These features can be easily installed by local volunteer teams. An environmental permit must be obtained from the Environment Agency in order to undertake this activity.



Flow deflectors are used to pinch the width of the river which reduces siltation, creates scour and facilitates a variety of different flow types.

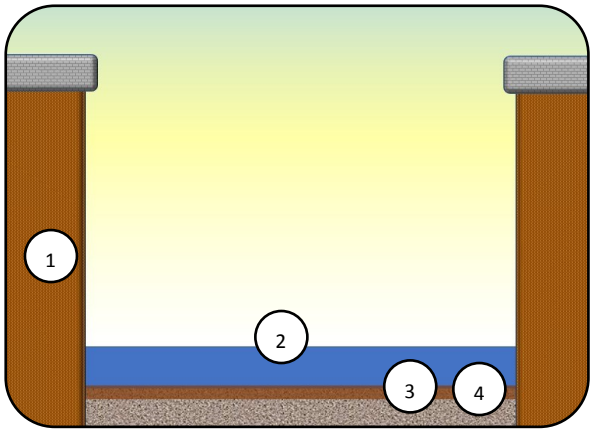
They are created by securing tree trunks to the bed of the river with chestnut posts and galvanised steel wire. A pool feature can also be created downstream of each deflector's location to provide a variety of depths. Materials won from excavating pools can be repurposed to create riffles or side bars, which further increase physical habitat complexity.



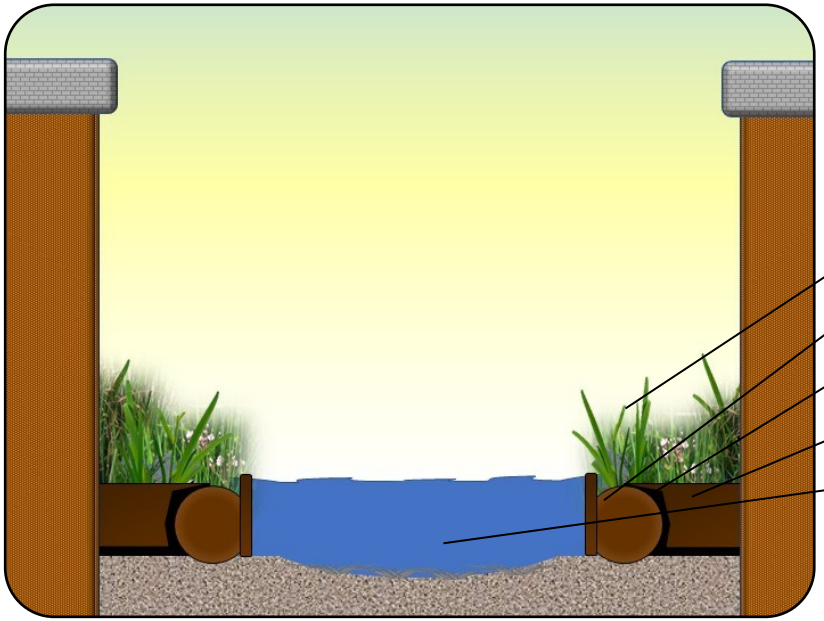
Brush berms can also be installed to pinch the width of the river and can be used to mimic natural sinuosity. They provide useful low lying areas for aquatic plants to colonise in addition to providing physical structures for aquatic wildlife to shelter.

They are created by using tree branches to reshape the river, which are secured in place with chestnut posts and beams or galvanised steel wire.

Aquatic Shelves / Low Flow Channel



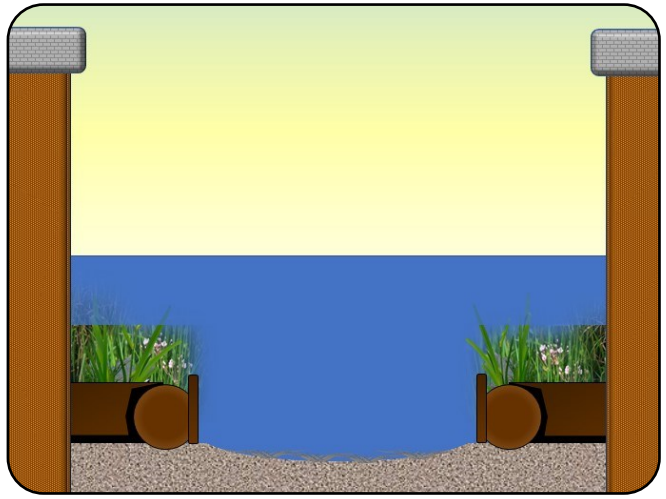
1. Sheet piling provides little cover for wildlife and is not readily colonised by aquatic plant species.
2. There is little variation in depth due to the modified nature of the river channel. It is too wide.
3. Due to the rivers enlarged profile, it is a low energy watercourse with little variation in flow. Morphological processes do not freely occur and the river bed is covered in layer of silt.
4. The enlarged channel is not well suited to low flow conditions and is susceptible to the effects of climate change.



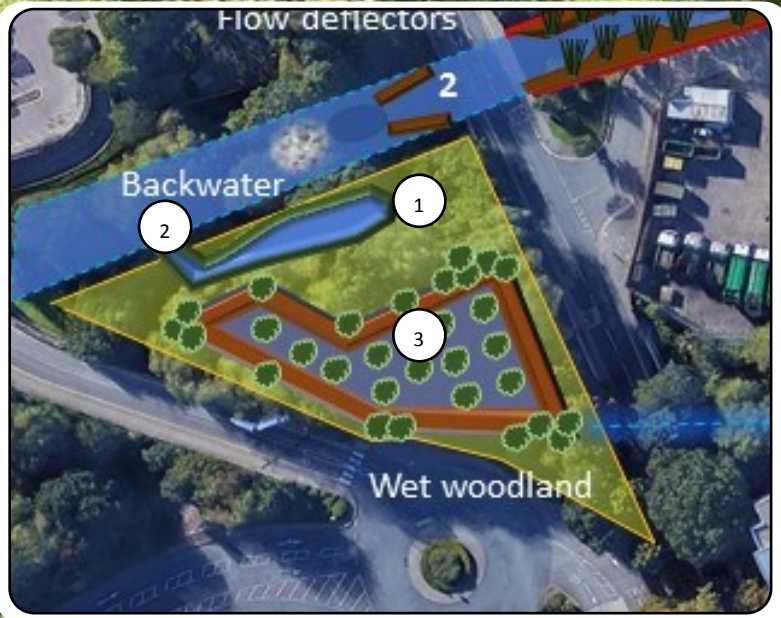
- Pre planted coir pallets
- Brushwood faggots
- Coir liner (if required)
- Backfilled with locally sourced materials
- Pool and riffle habitat created mid channel. Materials from pool creation to be used as backfill for planting shelf.

The provision of a low flow channel will ensure that the river continues to offer good habitat and geomorphology during times of low flow. Faster flowing water in the centre of the channel will prevent siltation from occurring and promote the growth of beneficial submerged plant species.

The banks of the low flow channel should be low in profile, and sit just above the normal water level of the river. This will enable the wider channel to be utilised for water storage during high flow events.



Backwater and Wet Woodland



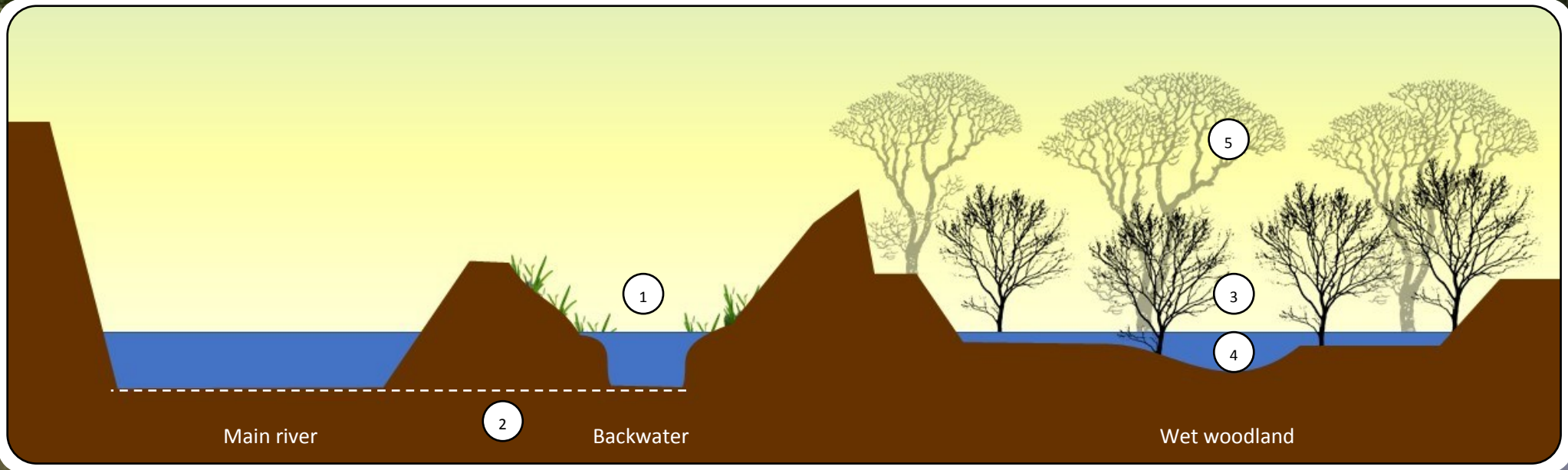
1. The backwater should be created within the area of sloped bank adjacent to the river and should run parallel to the channel with a downstream connection point. Its banks should gently slope to form marginal planting shelves. Plug plants should be introduced after completion.

2. The bed level of the backwater should be identical to that of the main river channel to provide a constant connection between the two features, allowing for the ingress/egress of wildlife.

3. The bed level of the wet woodland area should be lowered to create wetter ground.

4. Deeper and shallower areas should be created to provide niches for a range of wildlife.

5. Select native species should be used to provide both an understory (Grey willow, Elder, Osier, Hawthorn, Goat Willow, Holly, Hazel, Blackthorn, Guelder Rose) and canopy (Alder, Crack Willow, Oak, Black Poplar, Ash, White Willow) to the woodland. Trees should be planted with 5 meter spacings, with occasional clumps of identical species.



Site Action Plan

River channel improvements: Bank scalloping, aquatic shelves, pools/riffles, wooded debris features, tree works

Activity	Action		Comments	Delivered by:
All	1.	Procure contractor to undertake project design and permitting.	Three contractors to tender for the initial phase of the project. The tender should cover the following activities: 1. Bank Scalloping 2. Installation of aquatic planting shelves 3. Creation of pools and riffles 4. Installation of wooded debris features (berms and deflectors). 5. Willow clearance and pollarding	Groundwork
Bank scalloping	2.	Undertake sediment analysis to establish whether bank materials are contaminated.	• The results should establish whether or not works can proceed in this location. • If works can proceed, the results of the analysis should establish whether materials can be reused on site or disposed of in landfill.	Contractor
All	3.	Undertake topographical survey of river banks and bed.	The results of the survey should be used to the following construction drawings: • **Bank scalloping:** Two cross sections of the bank should be produced illustrating the current profile of the bank VS the profile of the proposed scalloped bank. • **Aquatic shelf & wooded debris features:** Cross sections should be produced to illustrate the currently profile of the river channel vs the proposed enhanced river channel. • **Pools/riffles:** Long sections should be produced to illustrate the current levels of the river bed vs the proposed enhanced river bed.	Contractor

All	4.	Produce designs for all in channel enhancements.	The following construction drawings should be produced should be produced	Contractor
	5.	Obtain landowner permissions	1. Site plan *Illustration showing the location of each improvement proposed on site.* 2. Topographical Survey *Survey of site topography around key construction areas.* 3. Cross sections and longitudinal sections for backwater area and connection point with river corridor. *As listed previously.* All relevant land owners (Watford Borough Council and Herts County Council) should be consulted during the design phase to ensure the pro-	
All	6.	Apply and obtain bespoke environmental permit to cover works.	The following documentation is required for an Environmental Permit application. 1. The construction drawings listed previously. 2. Site management plan *Document containing all aspects of site management.* 3. Construction Methodology *Method of construction for each activity proposed.* 4. Sediment analysis results *With interpretation illustrating what materials can be used for.* 5. Water Framework Directive Compliance Assessment *WFD compliance evaluated for each activity proposed.* 6. Environmental Risk Assessment *Environmental risk and mitigation identified for each activity.* 7. Site Risk Assessment *Risk to workers/site users and appropriate mitigation identified.*	Contractor

Activity	Action		Comments	Delivered by:
All	7.	Procure contractor to undertake construction of permitted activities.	Three contractors to tender for the construction phase of the project. The tender should cover the following activities: 1. Bank Scalloping 2. Installation of aquatic planting shelves 3. Creation of pools and riffles 4. Installation of wooded debris features (berms and deflectors). 5. Willow clearance and pollarding	Groundwork
Bank Scalloping Works	8.	Undertake bank scalloping work to eastern earth bank.	1. A temporary crossing over the river channel should be created in order for plant to access the eastern floodplain. 2. A long reach excavator should be used to appropriately regrade the bank as per the design specification. 3. If uncontaminated, materials arising from bank regrading should be retained as backfill for the aquatic planting shelf. 4. The newly graded bank should be planted with an appropriate array of plug plants (UK native river species).	Contractor
Construction of: Aquatic Shelves Pools / Riffles	9. 10.	Install aquatic planting shelves to south of site. Create pool and riffle habitat. Using pool and bar technique.	1. Marginal shelves should be marked out with brushwood faggots and chestnut posts. 2. If conditions require, the shelves should be lined with a coir membrane to prevent materials escaping. 3. The marginal shelves should be backfilled with materials won from elsewhere on site or sourced from elsewhere if unavailable. 4. Preplanted coir pallets are fastened on top of backfilled material with nylon cord. 5. A long reach excavator should be used to redistribute materials within the channel to form pools, riffles and bars. If required, locally sourced gravel substrate may also be used to create features.	Contractor

Tree works	10.	Undertake tree works as per permitted design.	1. Trees are cut and cleared as per design. *Willow to be used to create hibernacula for reptiles, amphibians and invertebrates on eastern floodplain. Thinner branches to be chipped and used to backfill marginal shelf. Other, non-fast-sprouting species to be used for brush berms and deflectors.*	Contractor
Wooded debris features	11.	Install brush berms and flow deflectors with local volunteer groups.	**Likely Construction Methodology** Trees in shaded locations of the river channel should be coppiced to provide materials for the creation of brash berms and flow deflectors. Willow should not be used as it will regrow and require persistent management. Hazel brushwood faggots may be used if materials cannot be sourced locally. **Brush Berms** Design Considerations: In order to ensure that brash berms do not cause blockages or excessively limit the water storage capacity of the channel they should be installed following these specifications: 1. Brash berms should extend no further than one third of the width of the river channel in any location. 2. Brash Berms should be no higher than 25% of the river's banks in any location they are placed. 3. Brash berms should be spaced at least 10meters apart to avoid creating pinch points in the river. 4. All berms should be installed via the method specified overleaf. **Installation method** 1. The area of the berm is marked out by two rows of chestnut or hazel posts. *Continued on next page...*	Contractor

Activity	Action	Comments	Delivered by:
Continued from previous page...		2. This area is backfilled with wooded debris (hawthorn). The heavy trunk ends of branches are placed facing upstream. The light 'leaf' ends are faced downstream so that the berm is hydrodynamic. As the berm is filled, new pieces of wood are locked and woven in behind existing pieces so that the berm will hold together as one structure when river levels rise. 3. When the berm is positioned correctly, it is secured by looping galvanized steel wire over each pair of posts surrounding the berm (bank side to river side). Additional steel staples are also used to secure the wire to the posts. 4. The loops of wire are then strained so that they are held tightly over the berm. 5. Each row of chestnut posts is hammered down with a fencing maul, permanently securing all material positioned in the berm under the loops of strained wire they are attached to. 6. Finally the berm is checked for material that may come loose and cause blockages elsewhere in the river channel. Excess wood sticking out from the berm is also trimmed to improve hydrodynamics. **Flow Deflectors** **Design considerations** 1. In order to ensure that flow deflectors do not cause blockages or excessively limit the water storage capacity of the channel they should be installed follow these specifications: 2. Deflectors should extend no further than one third of the width of the river channel in any location.	

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3. Deflectors should be no higher than 25% of the river's banks river in any location they are placed.

4. All deflectors should be installed via the method specified below.

Installation Method

2. A cross section of tree trunk/branch is obtained and positioned facing upstream from the margins of the river.

3. Deflectors should extend no further than one third of the width of the river channel in any location.

4. Deflectors should be no higher than 25% of the river's banks river in any location they are placed.

5. All deflectors should be installed via the method specified below.

6. Installation Method

7. A cross section of tree trunk/branch is obtained and positioned facing upstream from the margins of the river.

8. Every meter, two pairs of posts are hammered into the river bed on either side of the deflector so that it is secured firmly along its length.

9. Galvanized steel wire is looped around both sets of posts and secured with heavy duty metal staples. The wire is then strained so that it is strung tightly between each pair of posts, with no slack.

10. Each pair of posts is then hammered further into the river bed so that the strained galvanized steel wire pins the deflector permanently to the bed of the river.

Floodplain enhancement works: pondscape, backwater and wet woodland

Activity	Action	Comments	Delivered by:
Pondscape	1. Produce design illustrating locations, area and depth of new ponds. 2. Obtain landowner permission,	1. A design should be produced illustrating the locations, area and depth of the proposed ponds. It should be noted that a flood risk assessment is not required for this activity if ponds are located over 8 meters away from the river channel. 2. Each pond should vary in size and should have a maximum depth varying between 0.3-1m. 3. The landowner (Herts CC) should be consulted in regards to the design in order to obtain their support for the project.	Herts & Middlesex Wildlife Trust
Pondscape	3. Order tools and materials for pond creation as required through out the project.	Tools and materials required: 1. Digging tools (spades, pick axes) 2. Grading tools (rakes, tampers) 3. Sharp sand 4. Butyl liner 5. Planting baskets 6. Plug plants 7. Tape measure	Community Connections Projects CIC
Pondscape	4. Install ponds as an ongoing activity for local volunteers throughout the ten year duration of the *Rediscovering The Colne Project* .	1. The location of the pond should be marked out on the using a spray can. Features such as marginal shelves should also be marked. 2. The pond should be excavated to the size and depth specified in the project design. 3. After the pond is excavated to the required depths, the feature should be dressed with sharp sand in order to allow the butyl liner to 'bed in'.	Community Connections Projects & Knutsford Green Gym.

			4. The butyl liner should be laid following the contours of the profile of the pond. 5. Once the butyl liner is in place, it should be covered with a layer of topsoil and a layer of pea gravel to provide substrate for plants to colonise. 6. The edges of the liner should be trimmed once they are secured under enough weight. 7. Plug plants should be introduced to the pond either directly into the substrate of within planting baskets. 8. The peripheries of each pond should be sewn with 9. The pond can either be filed with water from the river channel or left to fill naturally with rain water. 10. Amphibian hibernacula should be created on the peripheries of the pond This can be achieved by making stacks of logs (laid horizontally) within shallow (0.3m) trenches before covering over each structure with topsoil and cut vegetation.	
Backwater Wet Woodland	5.	Procure contractor to undertake project design and permitting.	Three contractors to tender for the initial phase of the project. The tender should cover the following activities: 1. Backwater Creation 2. Wet woodland creation	Groundwork
Backwater Wet Woodland	6.	Undertake sediment analysis to establish whether bank materials are contaminated.	• The results should establish whether or not works can proceed in this location. • If works can proceed, the results of the analysis should establish whether materials can be reused on site or disposed of in landfill.	Contractor

Activity	Action		Comments	Delivered by:
Backwater Wet Woodland	7.	Undertake topographical survey of river banks and bed.	The results of the survey should demonstrate whether the creation of the backwater and wetwoodland area is possible. The results of the survey should be used to the following construction drawings: • **Existing landscape :** A cross section of the existing landscape should be produced showing river channel, backwater and wet woodland. • **Backwater:** One cross section, one long section. And one plan-form diagram. • **Wet woodland:** One cross section, one long section and one plan-form diagram.	Contractor
Backwater Wet Woodland	8. 9.	Produce designs for all in channel enhancements. Obtain landowner permissions	The following construction drawings should be produced should be produced 1. Site plan *Illustration showing the location of each improvement proposed on site.* 2. Topographical Survey *Survey of site topography around key construction areas.* 3. Cross sections and longitudinal sections for backwater area and connection point with river corridor. *As listed previously.* All relevant land owners (Watford Borough Council) should be consulted during the design phase to ensure the proposals are supported.	
Backwater Wet Woodland	10.	Apply and obtain bespoke environmental permit to cover works.	The following documentation is required for an Environmental Permit application. 1. The construction drawings listed previously. 2. Site management plan *Document containing all aspects of site management.*	Contractor

			3. Construction Methodology *Method of construction for each activity proposed.* 4. Sediment analysis results *With interpretation illustrating what materials can be used for.* 5. Water Framework Directive Compliance Assessment *WFD compliance evaluated for each activity proposed.* 6. Environmental Risk Assessment *Environmental risk and mitigation identified for each activity.* 7. Site Risk Assessment *Risk to workers/site users and appropriate mitigation identified.*	
Backwater Wet Woodland	11.	Procure contractor to undertake construction of permitted activities.	Three contractors to tender for the construction phase of the project. The tender should cover the following activities: 1. Backwater creation 2. Wet woodland creation	Groundwork
Back water creation	12.	Construct back water as per consented design.	1. A pond should be excavated adjacent to the river channel. 2. The bed level of the pond should be identical to that of the main river to allow a constant connection between the two features. 3. The pond should be connected by an inlet/outlent channel. The channel should be at least 2m wide to enable the ingress/egress of wildlife and should be angled downstream so that the feature is unaffected by disturbances such as high flow or pollution events . 4. The backwater should have a marginal planting shelf to enable the establishment of aquatic plant species. 5. Plug plants should be introduced to the planting shelf and adjacent banks. 6. Excavated materials may be used for construction purposes elsewhere if shown to be free from contamination.	

Activity	Action		Comments		Delivered by:
Wet woodland Creation	13.	Construct wet woodland as per consented design.	1.	A proportion of the existing trees on site should be felled or coppiced to make room for planting a more diverse range of species. Materials arising from tree works should be repurposed to form hibernacula.	Contractor
			2.	The bedlevel of the basin where the feature is proposed should be lowered to expose wetter ground. Shallow and deep areas should be created to provide niches for a range of wildlife.	
			3.	A range of whips should be planted (canopy and understory species) with 5 meter spacing and occasional clumps of identical species.	
			4.	Excavated materials may be used for construction purposes elsewhere if shown to be free from contamination.	

Ongoing management actions

Coppice tree planting area	1.	Coppice tree planting area as required	Coppice trees and shrubs in late winter or early spring, just before they come into active growth and in accordance with the recommendations for each species.	Knutsford Green Gym / Community Connections Projects
Control INNS	2.	Survey and control invasive species each year.	The site should be surveyed using the CVFC INNS application and control work conducted accordingly.	KGG/CCP
Maintain light to the river corridor	3.	Coppice riparian vegetation as required.	Periodically coppice riparian tree cover to let sunlight on to the river channel.	KGG/CCP
Clear litter	4.	Conduct annual river clean up	Undertake a litter pick of the river channel once a year	KGG/CCP
Monitor Water Quality	5.	Conduct RMI, chemical analysis and outfall safari	Continue to monitor water quality at the site in accordance with the recommendations of the Environmental Monitoring Project.	KGG/CCP

Estimated Costs

River channel improvements: Bank scalloping, aquatic shelves, pools/riffles, wooded debris features, tree works

Activity	Items	Cost	Total
Design and Permitting for all river channel enhancements	Survey Work	£2,000	£9,000
	Design Work	£5,000	
	Sediment Analysis	£1,000	
	Permitting	£1,000	
Tree Works	Tree clearance, coppicing, treatment of stumps	£5,000	£5,000
Bank Scalloping	Labour	£2,000	£9,500
	Materials (plants).	£1,500	
	Plant hire, fuel and insurance	£2,000	
	Site security and welfare	£1,000	
	Track matting & Temporary Crossing	£3,000	
Aquatic Shelf and Pool/Riffles	Labour	£5,000	£47,000
	Materials (plants).	£30,000	
	Plant hire, fuel and insurance	£10,000	
	Site security and welfare	£2,000	
Wooded Debris installation	Staff time (10 days)	£2,500	£3,500
	Materials	£1,000	
TOTAL			**£74,000**

Floodplain enhancement works: pondscape, backwater and wet woodland

Design and Permitting for backwater and wet woodland.	Survey Work	£1,000	£5,000
	Design Work	£2,000	
	Sediment Analysis	£1,000	
	Permitting	£1,000	

Activity	Items	Cost	Total
Tree Works	Tree clearance, coppicing, treatment of stumps	£3,000	£3,000
Backwater and Wet Woodland Construction	Labour	£2,000	£12,000-£37,500
	Materials (plants).	£5,000	
	Plant hire, fuel and insurance	£2,000	
	Site security and welfare	£1,000	
	Scenario 1: Disposal of materials (if required). Disposal of materials to landfill (if contaminated) Approximate disposal cost = £85 per m^3 Approximate volume = $300m^3$	£25,500	
	Scenario 2: Movement of materials (if uncontaminated)	£2,000	
Pondscape	Design	£1,000	£19,500
	Materials (tools, liners, sand, plants).	£5,000	
	Staff time (50 days)	£12,500	
	Volunteer expenses	£1,000	
TOTAL			**£39,500—£65,000**

Total Project Costs

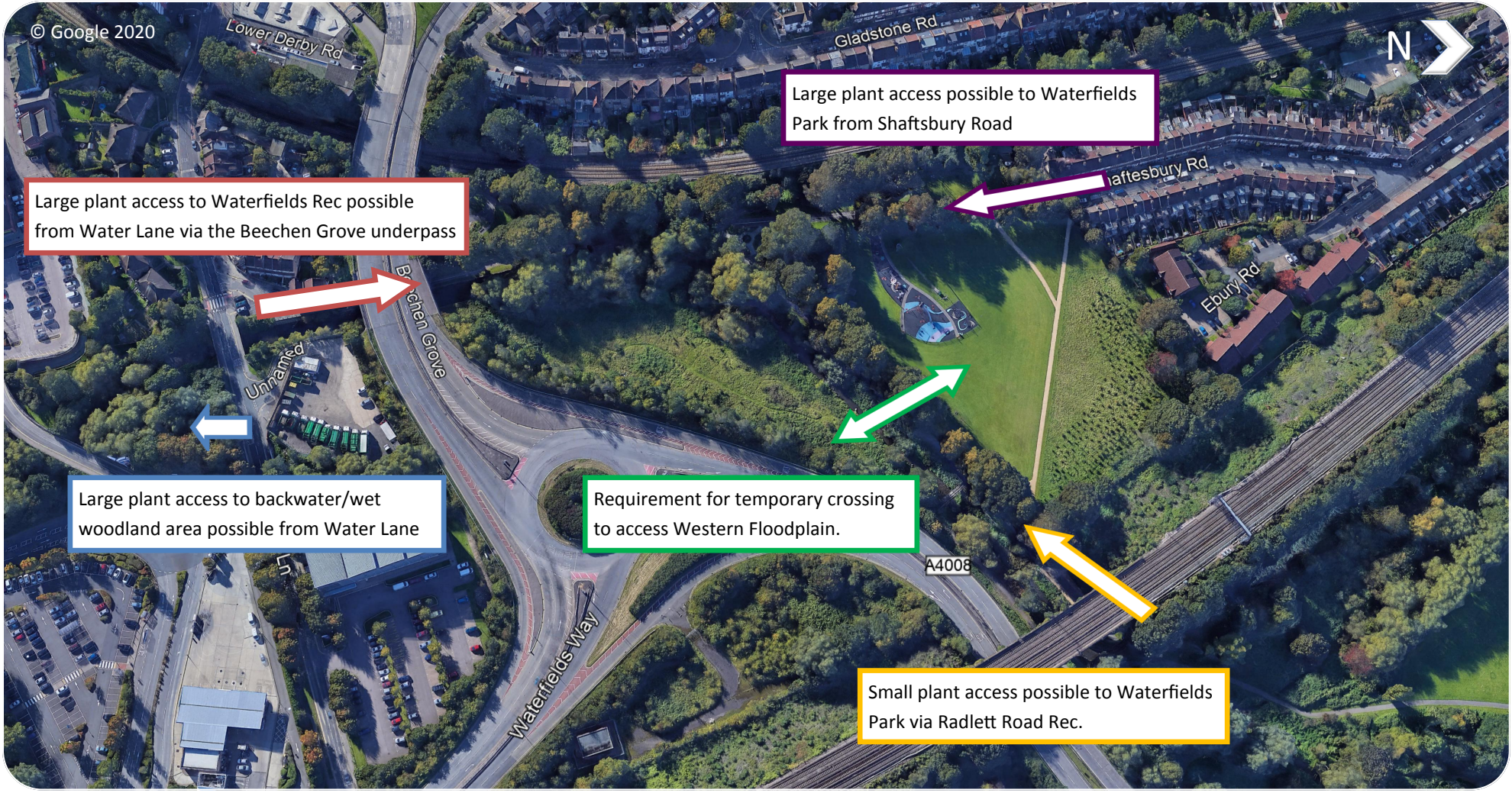
Activity	Lower estimate	Upper estimate
River channel improvements: Bank scalloping, aquatic shelves, pools/riffles, wooded debris features, tree works	£74,000	£74,000
Floodplain enhancement works: pondscape, backwater and wet woodland	£39,500	£65,000
TOTAL	**£113,500**	**£139,000**

Ongoing Annual Maintenance Costs

Contractor maintenance	Tree works	£2,500	£3,500
	Invasive species removal	£1,000	
Volunteer maintenance	Coppice Woodland	£250	£500
	River clean up	£250	
TOTAL			**£4,000**

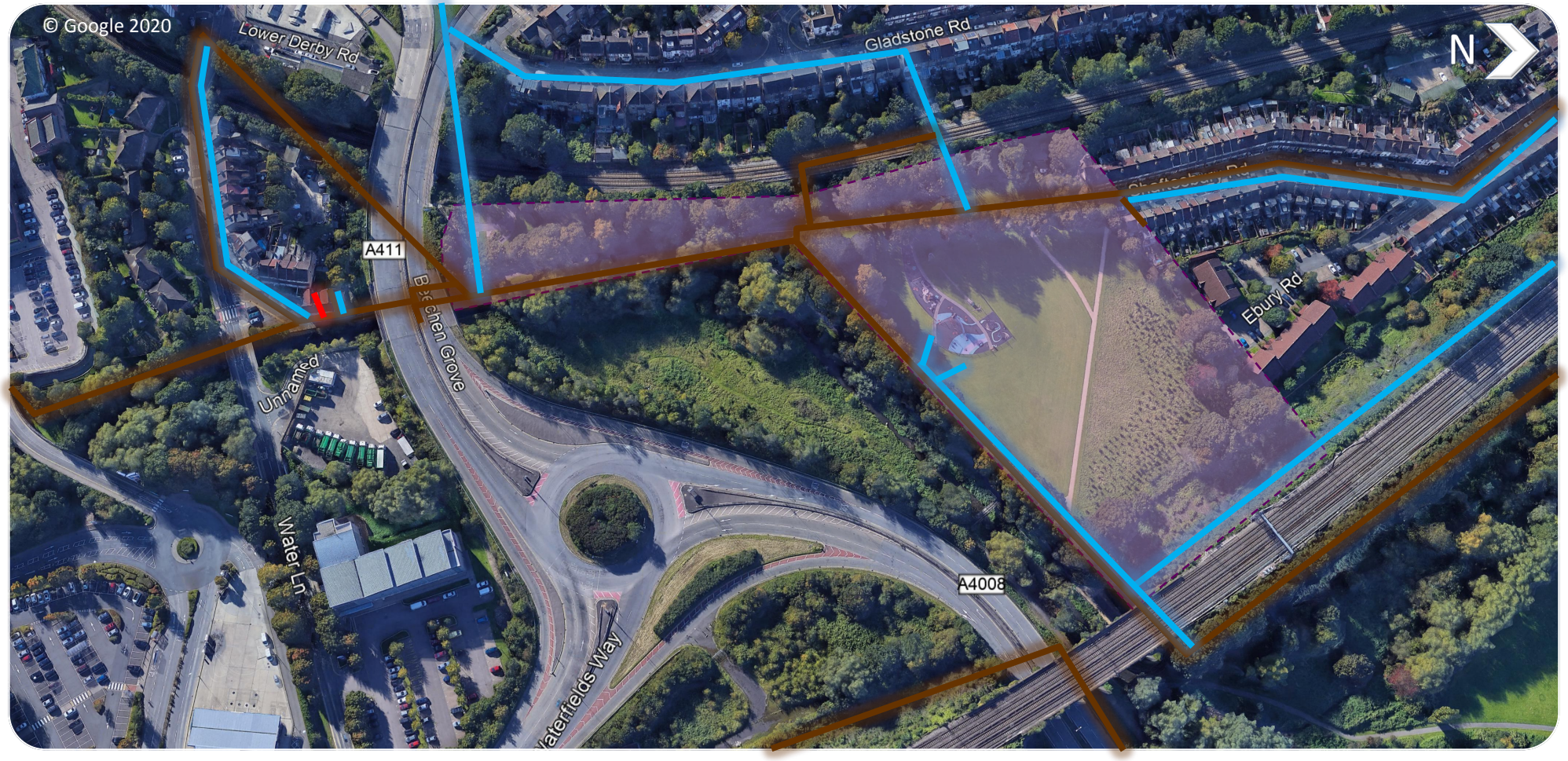
*All estimated costs are based on recent quotes from local contactors for similar activities but should be regarded as approximate figures

Site Access Plan



There are three entry points to the Western floodplain. The Eastern floodplain is currently inaccessible and a temporary crossing over the main river would be required to provide plant access.

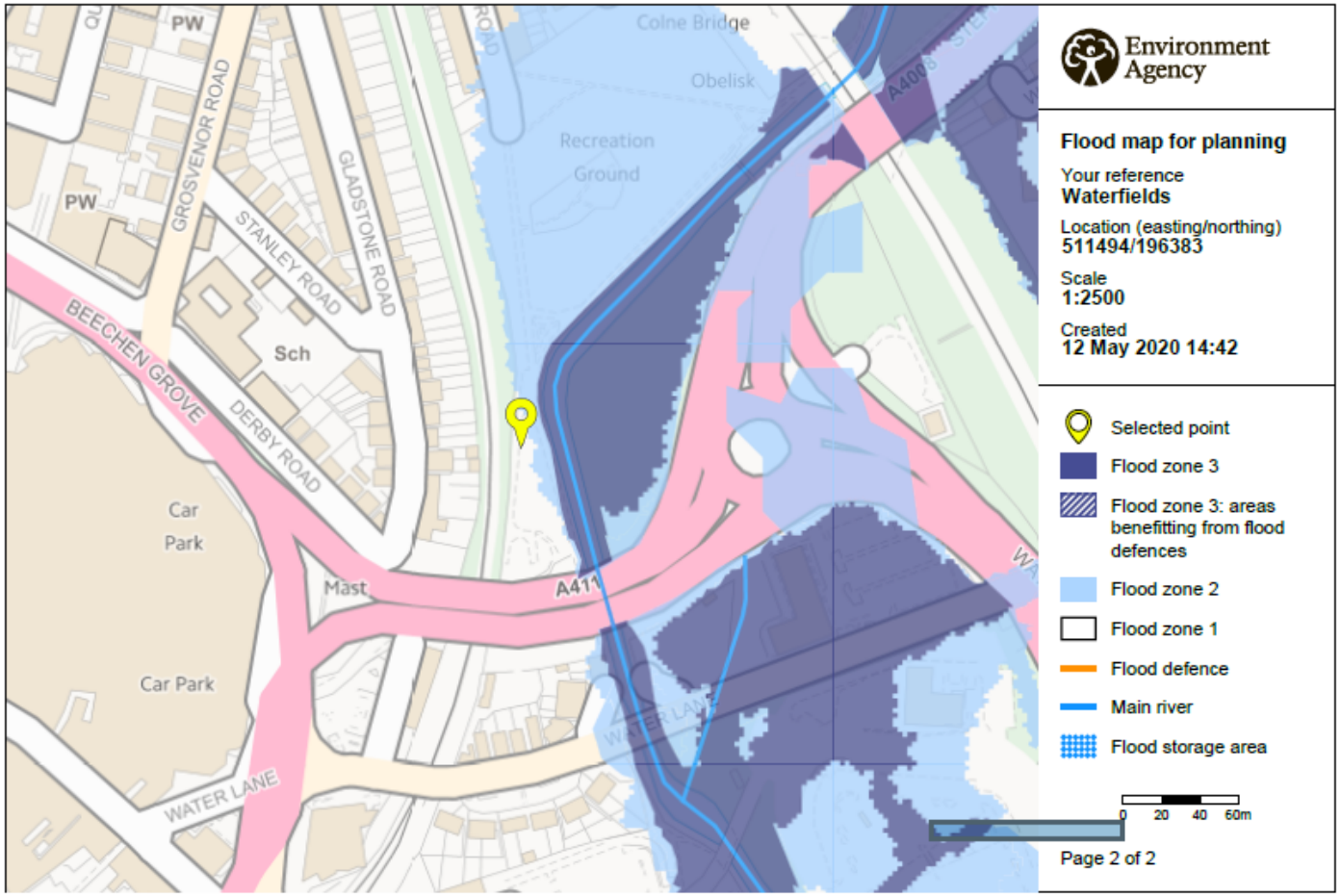
Utilities Search



Sewers—Surface | Sewers—Foul | Sewers—Combined | Historic Landfill

The locations of utilities should be interpreted as an initial guide in order to inform further design work. It is recommended that a new utilities search is conducted by the appointed contractor before construction works commence

Flood Map



The majority of the Western floodplain is in flood zone 1 due to its high topography. Parts of this area, including the land around the constructed wetland, could be used to relocate materials arising from construction works elsewhere on site. Any proposals of this nature will have to be agreed with Watford Borough Council.

The majority of the Eastern floodplain is in flood zone 3. The backwater, wet woodland and pondscape improvement works proposed in this area should help to increase floodwater storage capacity. Materials arising from construction must be redistributed elsewhere or sent to landfill.

Any works proposed within the main river channel should not encourage out of channel flow and should not cause any significant obstruction or impoundment.

References

1. Herts and Middlesex Wildlife Trust (2019) Water Vole survey of the River Colne through Watford.
2. Herts and Middlesex Wildlife Trust (2019) Botanical survey and management for River Colne in Watford
3. Groundwork South (2019) Waterfields Park modular river survey 2019.
4. Community Connections Projects CIC (2019) Riverfly Monitoring Report.

Acknowledgements

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