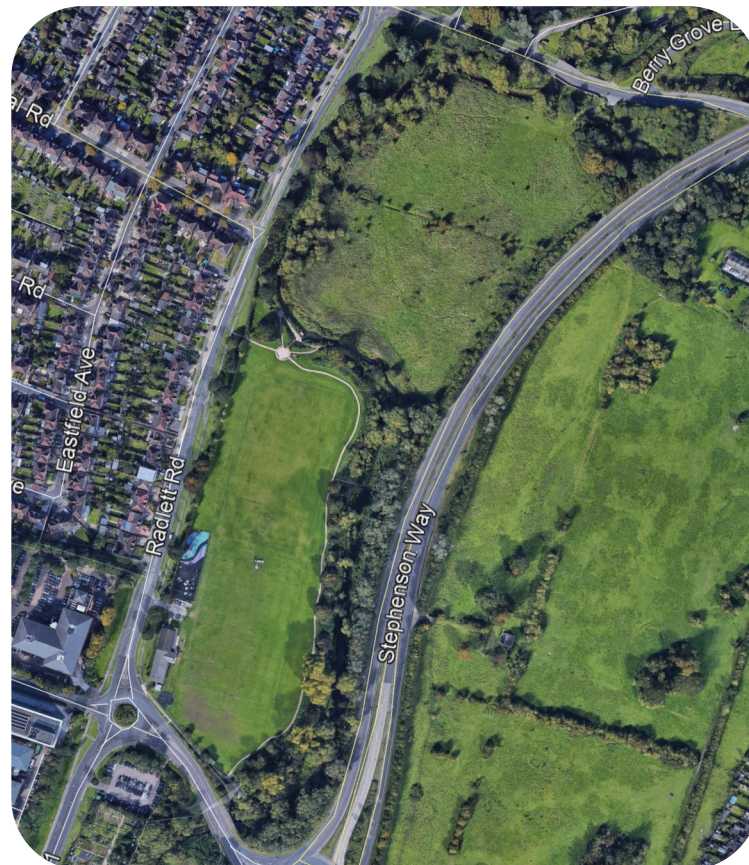


Knutsford Playing Fields

River Improvement Plan



WATFORD
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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 water-bodies, 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

Knutsford Playing Fields

Knutsford Playing Fields is an open space owned by Watford Borough Council on the River Colne in North Watford. The site is bordered by an area of land owned by Affinity Water which has also been included in this plan.

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 nature conservation interest, and to encourage sensitive management to maintain and enhance their importance.

For the purpose of this report, the site has been divided into two compartments (Northern and Southern) to enable detailed comment to be provided on each area.

Site Plan



Knutsford Playing Fields 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.

Northern Compartment

Land Use

The right bank of the river channel is bordered by a steep embankment leading directly to Radlett Road and Bushy Mill Lane. The floodplain has been heavily urbanised and is comprised of residential properties, gardens and transport infrastructure. Small strips of green space between the urban and riparian zones are present towards Bushy Mill Lane, but no formal access is provided to the river channel itself.

The site bordering the left bank of the river is owned by Affinity Water, but is currently unused in regards to the water company's operations. The site is of historic importance having formerly been part of the parkland estate of Bushy Mill Lodge. Today, no formal access is provided through the site, but it is regularly fly grazed by local horse owners. The area of land has the potential to be opened to the general public, acting as an extension of the open space on the adjacent bank and providing contrasting aesthetics and higher quality habitat for wildlife.

River Channel Profile and Course

The river follows its original course throughout the site, but its profile has been significantly altered over time. The river channel is incised and is bordered by steep (>45°) embankments, between three and four meters tall. The width of the river channel also appears enlarged throughout this section, with its wetted width being an average of seven meters and its bank-full width being an average twelve meters. The river's gradient has also been modified, with the river channel being of greater depth than the reaches found immediately up and downstream.

The historic modifications observed are most likely the result of works undertaken to increase the water storage capacity of the river channel. The result of this is a slow flowing reach of river, with poor flow dynamics and low levels of morphological activity. Sections of river such as this, are prone to habitat degradation during times of low flow. Low flow conditions are likely to occur with greater regularity in future due to the effects of climate change and therefore habitat degradation is likely to continue unless intervention is made to adapt the river to low flow conditions.

Floodplain Habitat

The topographic level of the flood plain is around

four meters higher than the bed. As a result of this, the river is not able to laterally expand onto the floodplain during times of high flow. This has resulted in an elevated floodplain that is dry in nature, with few wetland features.

The floodplain on the right bank of the river has been urbanised and represents an area of low habitat complexity. As the river flows from Bushy Mill Lane to Radlett Road, a strip of mown grass with occasional tree cover and a concrete footpath is present. The green strip gradually narrows as the river flows south, with the road running in close proximity to the top of the river bank.

The floodplain on the left bank is in stark contrast to the urban area previously described. The land compartment is comprised of a rank grassland field which is structurally varied, with longer areas of grass interspersed with short grazed sections and occasional developing scrub. The variability of the sward is also affected by the slowly undulating nature of the topography which adds complexity in terms of soil conditions and hydrological character. There is a damp ditch running across the field from north to south, predominantly offering scrub habitat in addition to areas of creeping herbs. A small area of developing secondary woodland bordered by hedgerow is also present in the north eastern corner of the field.



Knutsford Northern compartment habitat map

Bank face Habitat

The banks of the river are comprised primarily of earth, with occasional silt bars lining the bottom third of the bank face. Although they have been reshaped, they are not enforced with any hard revetment. The banks are steep in profile and are often over shaded by willow trees, which limit the range of emergent plant species that are able to establish. Stinging nettles are very common with Himalayan Balsam also dominating certain areas.

In the more open areas of the riverbank emergent vegetation is denser and more diverse with the predominant species being Sweet-grass, Hard Rush, Gypsywort, Branched Bur-reed and small patches of Water-cress.

Marginal features such as berms, unvegetated side bars and vegetated sidebars are present throughout the watercourse, which demonstrates that the river is slowly recovering from the effects of modification. Although sediment is beginning to stabilise in the river's margins, large areas of loose silt are also present, showing that intervention is required to catalyse the river's recovery.

River Bed Habitat, Substrate and Flow Type

As the river enters the site from above Bushy Mill Lane, it is energetic, shallow and displays a range of different flow types. The substrate of the river is comprised primarily of gravel pebble and sand, which

provides good habitat for aquatic invertebrates, spawning coarse fish and submerged aquatic plant species.

As the river progresses through the northern compartment, its substrate and flow type changes significantly, with deep silt becoming abundant and the river's flow being less energetic and uniformly smooth. The centre of the channel is often choked with emergent plant species including Common Club-rush and Branched Burr Reed which exacerbates the ponded conditions observed. This change in physical habitat results from the river's modified profile, in combination with the regularity of low flow conditions. The siltation of the river channel is likely to continue unless intervention is made to adapt the river channel to low flow conditions.

Southern Compartment

Land Use

The right bank of the river is bordered by publically accessible amenity grassland, owned and managed by Watford Borough Council. The main use of this area is for sport and recreation, with the site being home to Watford Rugby Club. The site contains a network of footpaths and a viewing platform adjacent to the river channel. Throughout the lower section, the river corridor is separated from the playing fields by an embankment, which provides a natural divide between formal parkland and the wild river corridor.

The left bank of the river is owned by Affinity Water

and comprises of a narrow strip of deciduous woodland which is bordered by Stephenson's Way. The strip of woodland screens the view of the road and improves the aesthetics of the river corridor. No formal access is provided through this area currently.

River Channel Profile and Course

The river follows its original course but its profile has been significantly altered over time. The channel displays little sinuosity and takes a straightened course from north to south and is bordered by a set bank embankment on the right bank and an embankment on the left bank. Although the banks of the river have been raised, the channel provides better habitat and geomorphology than that of the Northern Compartment. The river bed is of a narrower width and shallower depth, with most areas being around 5 meters wide and 40cm deep, with little variation.

Floodplain Habitat

The topographic level of the flood plain is around four meters higher than the bed of the river. As a result of this, the river is not able to laterally expand onto the floodplain during times of high flow. The floodplain on the left bank of the river comprises of amenity grassland. Due to its use as recreational playing fields, this represents an area of low habitat complexity with few options for improvement. The floodplain on the left bank of the river is comprised primarily of transport infrastructure and also represents an area of low habitat complexity with few options for improvement.



Knutsford Southern compartment habitat map

Bank face Habitat

The banks of the river are comprised of earth, with areas of loose silt at the toe of the bank. Vegetated side bars and occasional berms are also present in sun lit areas which help to increase the structural habitat complexity of the river channel.

The river adjacent to the viewing platform is open in nature with no tree cover. Both banks are populated with a diverse range of waterside plant species including Reed Sweet-grass, Reed Canary-grass, Great Willowherb and Himalayan Balsam, with less frequent Greater Pond-sedge, Branched Bur-reed, Gypsywort, Water Mint, Russian Comfrey and Common Club-rush. The channel is notable for small pockets of Water-cress and Blue Water-speedwell.

As the river progresses through the site it becomes increasingly over shaded with fewer aquatic plant species. The wet woodland that develops on the slopes contains some notable planted species such as Italian Alder, Sycamore and Hybrid Black Poplar but is otherwise comprised of natives (particularly on the southern bank) such as Crack Willow, White Willow, Osier and some self-set Hawthorn

Wet woods can provide cover for mammals such as otter, and support several bat species. Willow supports more species of moths and other insects than any other British tree except oak. Willow scrub provides cover for birds such as marsh tit and willow tit. Birch and alder woods favour species such as siskin, redpoll and crossbill.

River Bed Habitat, Substrate and Flow Type

The substrate of the river varies throughout the southern section. The open area adjacent to the viewing platform is comprised predominantly of gravel pebble and sand. Riffle and pool habitat is present in addition to a marginal backwater. These features provide a variety of flow types including rippled, smooth and more static areas. The variety in depth and flow provides different niches for a variety of aquatic wildlife to occupy, including spawning and recruitment areas for coarse fish and varied conditions for a range of aquatic invertebrate species.

As the river progresses through the Southern section, the flow type of the river becomes uniformly smooth. Due to the straightened nature of the channel, areas of loose silt can be observed extending from the margins. This silt would normally stabilise on the inside of meanders in a more sinuous river channel. The shaded nature of the river channel also prevents emergent plant species from colonising, the roots of which would also work to stabilise areas of loose silt. The channel offers little variation in depth and does not provide the complexity of habitats required for a full assemblage of fish or invertebrate species to thrive. Intervention is required in order to provide a more dynamic watercourse, where natural morphological processes occur freely.

Artificial structures

Three outfalls are present on site and have been observed to regularly pollute the Colne with foul water. The pollution can be attributed to domestic misconnections, where waste water infrastructure has been incorrectly connected to surface water infrastructure; or to combined sewerage overflows where surface water and waste water infrastructure are combined when the system reaches capacity during times of high rainfall.

A wooden viewing platform that extends into the river channel is also present, but has no significant environmental impact and provides an area for people to interact with the river.

Invasive Species

Areas of Himalayan balsam are sparsely apportioned throughout the site and are most prevalent in sunlit areas in close proximity to the river channel. Japanese knotweed is present in one location to the north of the site, near bushy mill lane. This area has been treated in recent years, but the Knotweed continues to persist. American signal crayfish are present and evidence of their burrows was recorded throughout the river channel.



River is open and showing good signs of recovery

River is slow flowing and prone to siltation

River choked where its profile is open and wide



Good habitat structure but increased shade as river progresses

Affinity Water's site offers grassland of varying quality

River is open & fast flowing as it enters the site



Site Ecology

Site Criteria

The section of the river which runs through the northern compartments 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 nature conservation interest, and to encourage sensitive management to maintain and enhance their importance.

Bats

The bat survey conducted by the project team (HMWT, 2019) identified six species of bat at the site: common pipistrelle, soprano pipistrelle, daubentons, nathusius' pipistrelle, noctule and leislers.

The presence of common pipistrelle and soprano pipistrelle are to be expected from this environment but the presence of Nathusius' pipistrelle is surprising as it is a much rarer bat but it is known from other water bodies on the Colne. Noctule and Leisler's are large, far ranging bats and can occur over suitable feeding areas or more likely in this case, passing over the site.

The bat population is likely to be limited by the urban nature of the site, light pollution and poor water quality.

Water Voles

There are no historic records of water vole at Knutsford Playing Fields, nor were any 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.

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. 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 established and resilient to disturbance.

Coarse Fish

The site is home to a number of coarse fish species including Chub, Roach, Dace, Gudgeon, Minnow and Stickleback. Although a number of species are present, there are many parameters that limit the fish population in terms of age class structure, species assemblage, density and biomass. These include: poor water quality, lack of spawning habitat, lack of recruitment habitat, lack of adult habitat and the presence of signal crayfish.

Once water quality and habitat are improved, the site would provide a good location for fish stocking undertaken in partnership with the Environment Agency.

Bird Life

At the time of survey the project team identified the following bird species at the site: Blackbird, Wren, Chiffchaff, Blue Tit, Goldfinch, Robin, Chaffinch, House Sparrow, Wood Pigeon, Collard Dove, Song Thrush, Mute Swan (HMWT, 2019).

Butterflies

At the time of survey the following species were observed: Small Skipper, Small Tortoiseshell, Marbled White, Meadow Brown, Red Admiral (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.

Knutsford Playing Field Results

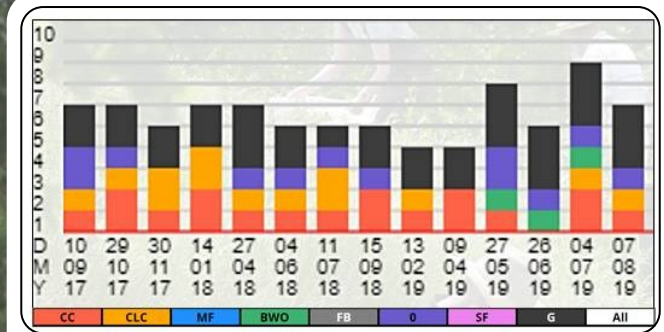
Knutsford Playing Fields returns an average ARMI

score of 3.31. This is significantly lower than the monitoring site located immediately upstream at Bushy Mill Lane which returns an average score of 5.57. The difference between the two scores reflects a shift in water quality over a relatively short area of river. Changes in water quality can usually be attributed to a source of pollution.

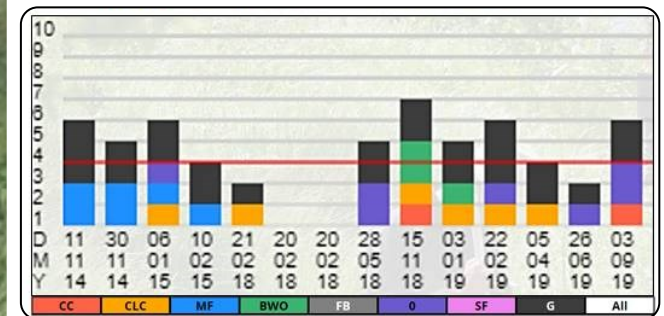
There are three outfalls present on site that have been observed to regularly pollute the river, with five pollution incidents recorded over the past three years (cvfc.org.uk). This number reflects the incidents reported via the CVFC pollution monitoring application. The total number of unrecorded incidents is likely to be much higher.

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 waste water infrastructure in Watford.



Bushy Mill Lane ARMI results



Knutsford Playing Fields ARMI results



Riverfly monitoring at Knutsford

Habitat Improvement Recommendations

Northern Compartment

Flood Plain

The floodplain is affected by a lack of botanical diversity. Fly grazing by horses in recent years has been beneficial but further intervention is required to improve the diversity of the sward. The following actions are recommended to achieve this:

1. Formalising and controlling the grazing regime at the site is likely to be the best option for increasing floral diversity. A more intense grazing regime is required with a break in June to enable flowering. Fencing the field along the ditch line would enable grazing to be alternated between the two paddocks to provide greater control. Adding cattle to the grazing regime would also help.
2. Spraying off small patches (1m squares) within the sward and seeding with Emorsgate EM4F would create more botanical diversity and colonisation points from which grassland flowers could spread.
3. Digging small ponds across both fields would increase the topographical complexity and therefore also improve the structural and botanical diversity on the site.

River Channel

The reach of river running parallel to Bushy Mill Lane requires little intervention as it is fast flowing with an appropriate ratio of light and shade. This ratio should be maintained in order to maintain floral diversity within the river. The provision of cattle grazing at the Affinity Water site will help to sustain the current environment.

The main area of river requiring intervention is the section running parallel to the Radlett Road. The following issues affecting the river have been identified in this location.

1. The river's profile has been deepened and widened resulting in a slow flowing section which is prone to siltation.
2. The river is prone to choking with vegetation in sunlit areas due to its slow flowing nature, which can be attributed to its modified profile.
3. The river lacks floral diversity in areas which are prone to over shading. The gradient of the river's banks also limit the diversity of flora that is able to establish.
4. The river corridor lacks suitable habitat for bat roosting.

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

1. A topographical survey should be undertaken to determine the gradient of the river bed.
2. Low lying marginal shelves should be installed to create a narrow and sinuous low flow channel. The shelves should be planted with an appropriate array of waterside plants to provide complex areas of marginal habitat for water voles, emerging river flies and coarse fish.
3. The bed of the low flow channel should be dressed with gravel to restore the river's natural gradient and substrate.
4. Pool and riffle habitat should be created in appropriate places.
5. The banks of the river should be regraded in areas where their gradient limits floral diversity.
6. Trees should be cleared in 10m sections to provide an appropriate ratio of light and shade. Trailing branches should be maintained to provide suitable refuge areas for coarse fish.
7. Bat boxes should be installed on appropriate trees along the river corridor.



Legend



Knutsford Northern compartment habitat improvement map

Southern Compartment

Floodplain

There are no recommendations for the majority of the floodplain due to the presence of the playing fields and transport infrastructure.

River Channel

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

1. Where the river channel is shaded, marginal vegetation is not present to stabilise sediment. This has resulted in some areas of the river becoming wide and slow flowing with visible areas of loose silt covering the gravel bed.
2. There is little variation in the depth and little sinuosity due to the channel's straightened profile.
3. There is little variation in flow type, with the flow of the river being smooth and slow flowing.
4. The river channel lacks suitable habitat for bat roosting.

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

1. Tree removal work should be carried out in areas where the river is over shaded and prone to siltation.
2. The encroachment of trees along the northern

edge of the river 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.

3. Wooded debris, in the form of brush berms and flow deflectors should be introduced to the river channel in appropriate locations to increase sinuosity, diversify flow, stabilise sediment, increase physical habitat complexity and to increase scour of the riverbed.
4. Small pools could be created downstream of each flow deflector installed. The gravel from each pool could be redistributed to form sediment bars or riffle features. This will increase variation in depth and diversify flow.
5. 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. These should be located on the southern bank of the river to avoid disturbance.

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 a baseline for the condition of all outfalls in Watford. 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.



Legend



Deflector & pool



Brush Berm



Hinged tree



Tree works



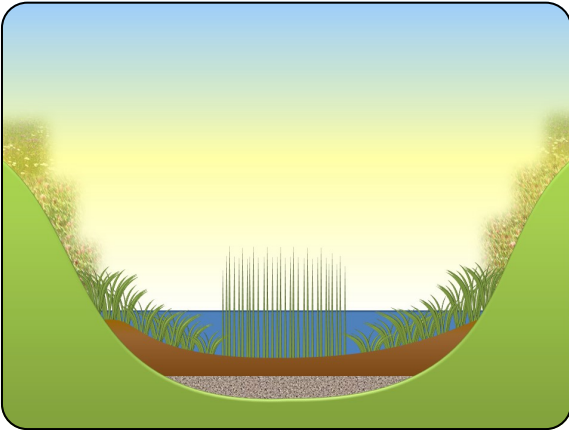
Bat box



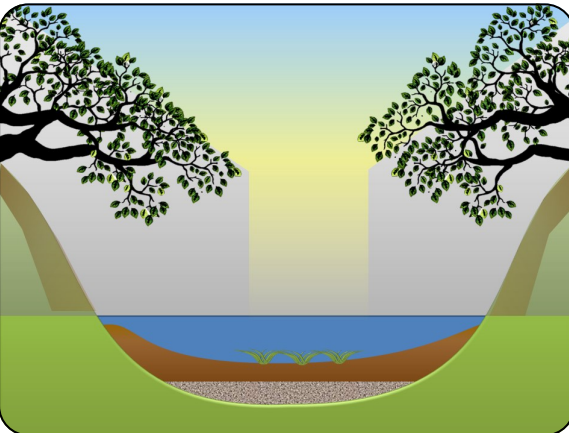
Resolve pollution

Knutsford Southern compartment habitat improvement map

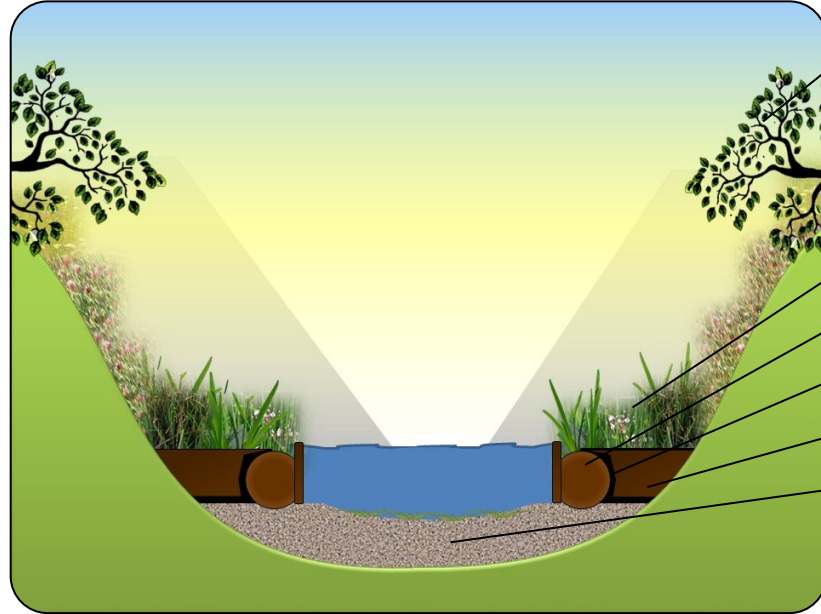
Low flow channels



Due to the rivers modified profile and slow flowing nature, sunlit areas become choked with aquatic plant s.



Over shading in some areas limit the plant life that is able to establish, resulting in bare banks and areas of loose silt covering the river's gravels.



60:40 light shade ratio

Pre planted coir pallets

Brushwood faggots

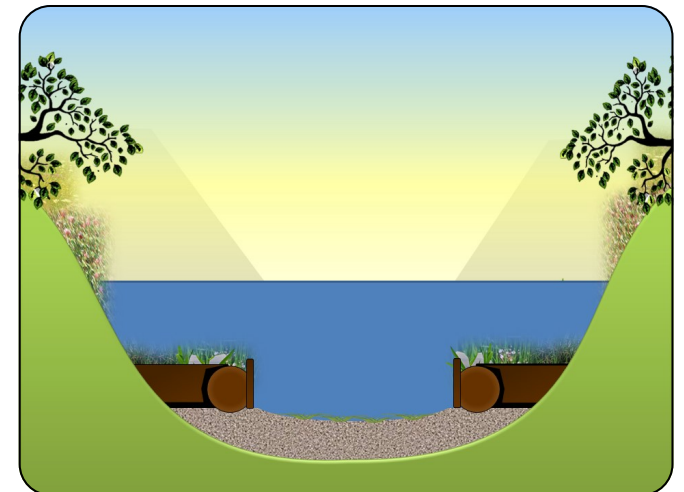
Coir liner (if required)

Backfilled with locally sourced materials

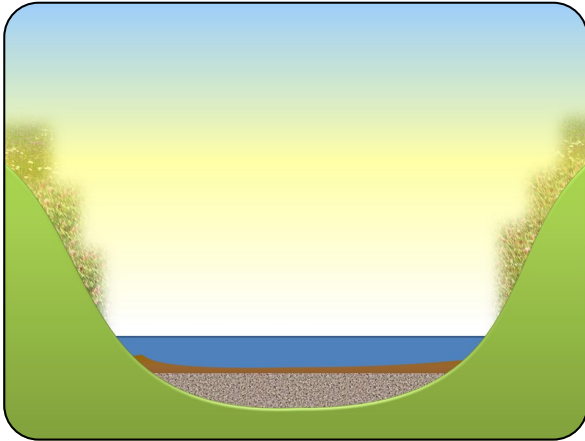
Natural gradient restored via introducing and grading gravels. Pool and riffle habitat also created.

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 and the encroachment of undesirable plant species. A 60:40 light shade ratio will ensure the river receives the right amount of light for diverse aquatic plant communities to establish, whilst still providing important structural habitat.

The banks of the low flow channel should be low in profile, enabling the wider channel to be utilised for water storage during high flow events.



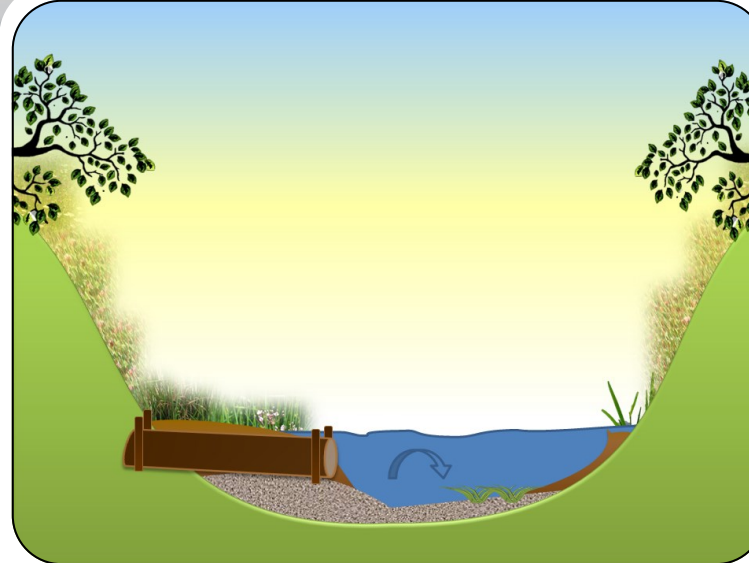
Brush Berms and Flow Deflectors



The southern section of the river channel has a straightened 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.

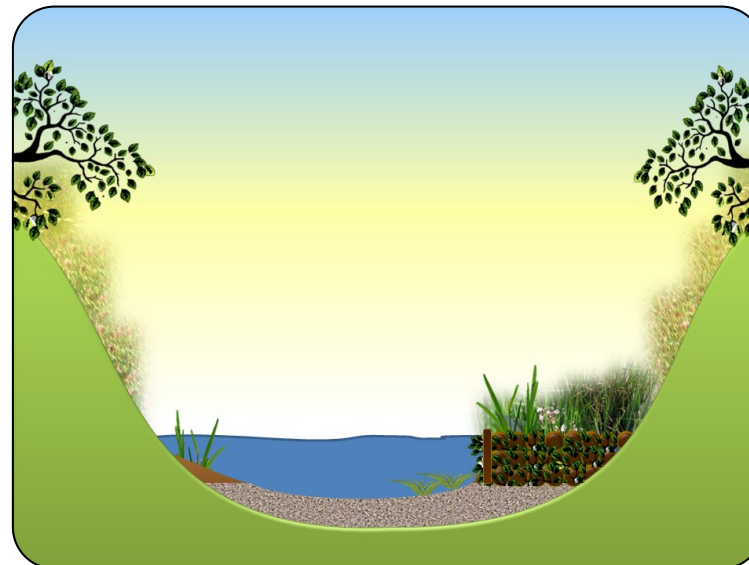
Over shading trees can be coppiced and repurposed to create brush berms and flow deflectors within the channel to mimic natural sinuosity, stabilise sediment and to create a variety of depths and flow types.

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 galvanised steel wire.

Bat Boxes

Schwegler 2F Bat Boxes

Species such as the Lesser Noctule and the Common Noctule, as well as Daubenton's, Nathusius's Pipistrelle and Bechstein's Bat, are typical representatives of Bats that live in woods and forests. They prefer Bat Boxes as closed systems, as in nature they prefer, for example, woodpecker cavities and hollow tree branches. However, as old, diseased or dead trees tend not to be available or rather are removed from managed forests, natural roosts for Bats have become scarce.

Bat Boxes can provide a remedy and are readily accepted by the animals. So-called "House Bats" are mainly those that like to roost in buildings, for example, in roller shutter boxes, behind window shutters, niches and gaps. These are, above all, Serotine, Mouse-Eared and Pipistrelle Bats. These Bats prefer, for example, flat boxes or round boxes with several hanging panel partitions.

The box has a special double front panel, made of long-term resistant, grooved wooden boards, which creates a particularly popular and readily acceptable roost for crevice-inhabiting Bats, for example Nathusius' Pipistrelle, Daubenton's and Pipistrelle Bats.

The Bat Box can be easily converted into a 2F Bat Box without double front panel or a 2M Nest Box for Birds at any time. The front panel can be removed for inspection and cleaning.



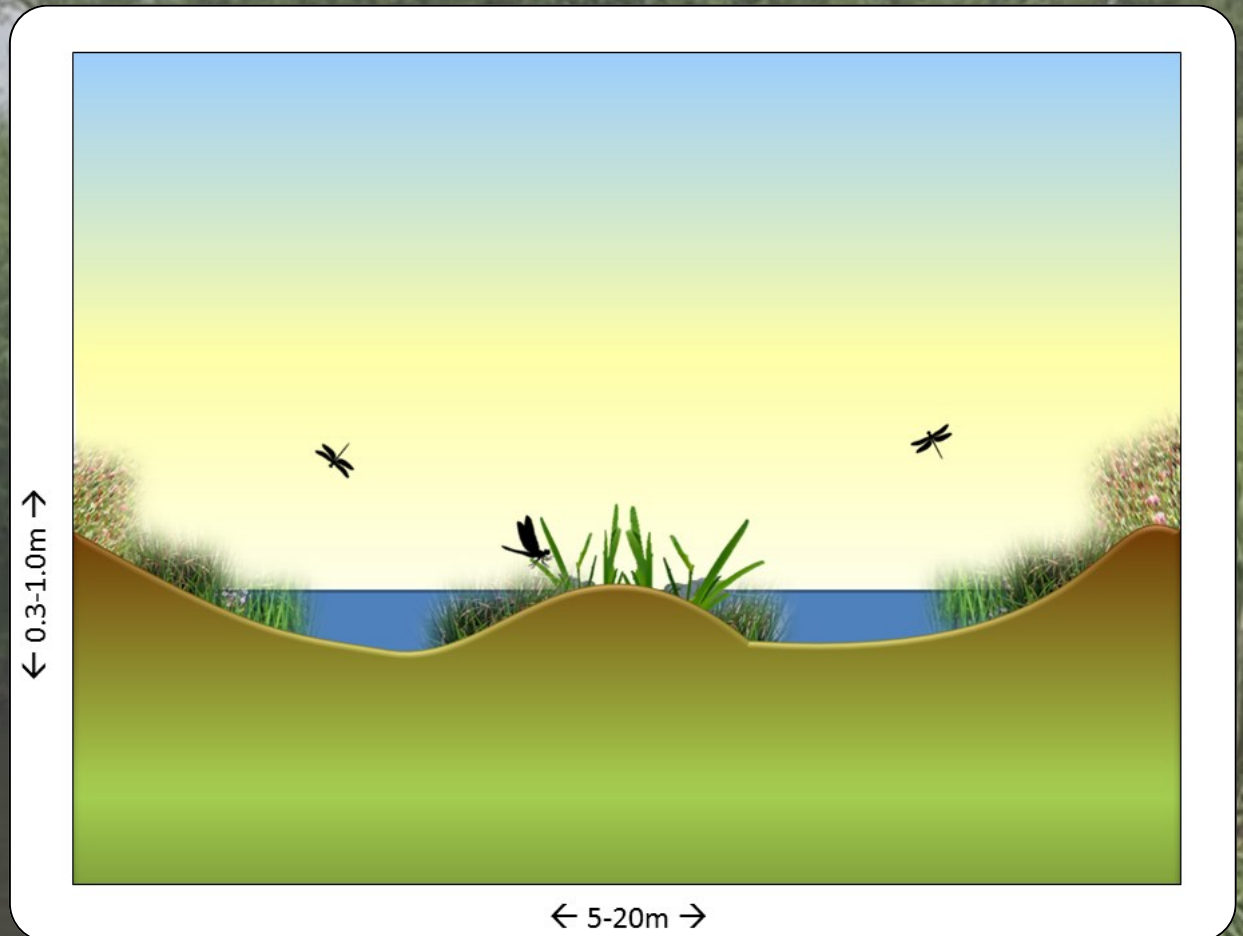
Wetland Scrapes

Scrapes are shallow ponds with gently sloping edges that hold rain or flood water seasonally and remain damp for the majority of the year. They provide valuable habitat for a range of wildlife and can be created in areas of damp grassland and floodplain.

Fields in wet areas have often historically been ploughed and drained resulting in uniform topography and few low lying areas. This has resulted in many important seasonal habitats for wildlife becoming lost. Wetland scrapes mimic these habitats, providing a space for wildlife to flourish during wet months of the year. They support high densities of invertebrates which provide an important food source for birds and amphibians and can provide a diverse range of plant species for the benefit of other species such as water voles and dragon flies.

Design Considerations

- Scrapes are created by using a digger to create shallow depressions of varying depth between 0.3 and 1.0 meters deep.
- The banks should slope gently to allow the colonisation of aquatic plant species and to allow wildlife to safely enter or exit.
- Each scrape should be a minimum of 20m².
- Cattle grazing provides good management providing it is not too intensive and does not coincide with the bird nesting season.



Site Action Plan

Low Flow Channel, Bank Regrading, Tree Work, Creation of Wetland Scrapes

Activity	Action	Comments	Delivered by:
All	1. Procure contractor to undertake project design and permitting.	<p>Three contractors to tender for the initial phase of the project. The tender should cover the following activities:</p> <ol style="list-style-type: none"> 1. Creation of low flow channel. 2. Bank regrading 3. Tree Work 4. Creation of wetland scrapes <p>The survey should highlight areas where bed raising is required to restore the natural gradient of the river.</p>	Groundwork
Low flow channel	2. Undertake topographical survey of longitudinal profile of river	The survey should highlight areas where bed raising is required to restore the natural gradient of the river.	Contractor
Low flow channel Bank regrading Wetland Scrapes	3. Undertake sediment analysis in areas where bank regrading and scrape creation is proposed.	The results of the analysis should establish whether or not the materials are contaminated and if they can be reused on site or should be disposed of in landfill.	Contractor
Low flow channel Bank regrading Wetland scrape creation Location of tree works	4. Produce designs for: <ul style="list-style-type: none"> • Low flow channel • Bank regrading • Pool/riffle creation • Wetland scrape creation • Location of tree works 	<p>The following construction drawings should be produced should be produced</p> <ol style="list-style-type: none"> 1. Site plan <i>Illustration showing the location of each improvement proposed on site.</i> 2. Topographical Survey <i>Survey of site topography around key construction areas.</i> 3. Cross sections and longitudinal sections for each improvement <i>A cross sectional diagram produced for key areas.</i> 	Contractor

Low flow channel Bank regrading Wetland scrape creation Location of tree works	5.	Apply and obtain bespoke environmental permit to cover works.	<p>The following documentation is required for an Environmental Permit application.</p> <ol style="list-style-type: none"> 1. The construction drawings listed above. 2. Site management plan <i>Document containing all aspects of site management.</i> 3. Construction methodology <i>Method of construction for all activities proposed.</i> 4. Sediment analysis results <i>With interpretation illustrating what materials can be used for.</i> 5. Water Framework Directive Compliance Assessment <i>WFD compliance evaluated for each activity proposed.</i> 6. Environmental Risk Assessment <i>Environmental risk and mitigation identified for each activity.</i> 7. Site Risk Assessment 	Contractor
Low flow channel Bank regrading Wetland scrape creation Location of tree works	6.	Procure contractor to deliver construction phase.	<p>Three contractors to tender for construction phase of project. The tender should cover the following activities:</p> <ol style="list-style-type: none"> 1. Creation of low flow channel 2. Bank regrading 3. Tree work 4. Creation of wetland scrapes: <p><u>Likely construction methodology for each activity:</u></p> <p>Tree Works:</p> <ol style="list-style-type: none"> 1. Trees are cut and cleared as per design. <i>Willow to be used to create hibernacula for reptiles, amphibians and invertebrates on Affinity Water Site. Thinner branches to be chipped and used to backfill marginal shelf. Wood with no reuse to</i> 	Groundwork

be burnt on site. Non willow branches to be retained for the creation of wooded debris features in the river channel.

Bank Regrading:

1. A long reach excavator should be used to regrade banks at Knutsford Playing Fields.
2. Materials arising from regrading should be retained to backfill marginal shelves forming the low flow channel.

Creation of Scrapes and Ponds:

1. A long reach excavator should be used to create scrapes on the Affinity Water site.
2. The scrapes should provide softly graded banks and be planted with a suitable array of native plant species.
3. Materials arising from excavation should be retained to construct the low flow channel.

Low flow channel:

1. Marginal shelves should be marked out with brushwood faggots and chestnut posts.
2. 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. The channel is dressed with locally sourced gravel substrate. Deepened areas are raised to restore the natural gradient of the river.
6. Pool and riffle habitat is created in appropriate locations within the low flow channel.

Wooded debris installation, Minor Tree Works, Bat Box Installation

Activity	Action	Comments	Delivered by:
Wooded Debris Installation Minor Tree Works	1. Produce design illustrating chosen locations of brash berms, flow deflectors, hinged trees, pools and riffles, minor tree works.	<p>The following construction drawings should be produced should be produced:</p> <ol style="list-style-type: none"> 1. Site plan <i>Illustration showing the location of each improvement proposed on site.</i> 2. Cross sections and longitudinal sections for each improvement 	Groundwork
Wooded Debris Installation Minor Tree Works	2. Apply and obtain bespoke environmental permit to cover works.	<p>The following documentation is required for an Environmental Permit application.</p> <ol style="list-style-type: none"> 1. The construction drawings listed above 3. Site management plan <i>Document containing all aspects of site management.</i> 4. Construction Methodology <i>Method of construction for each activity proposed.</i> 5. Water Framework Directive Compliance Assessment <i>WFD compliance evaluated for each activity proposed.</i> 6. Environmental Risk Assessment <i>Environmental risk and mitigation identified for each activity.</i> 7. Site Risk Assessment <i>Risk to workers/site users and appropriate mitigation identified.</i> 	Groundwork

Activity	Action	Comments	Delivered by:
Wooded Debris Installation Minor Tree Works	3. Undertake improvement works with local volunteers.	<p>Likely Construction Methodology</p> <p>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.</p> <p>Brush Berms</p> <p>Design Considerations:</p> <p>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:</p> <ol style="list-style-type: none"> 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. <p>Installation method</p> <ol style="list-style-type: none"> 1. The area of the berm is marked out by two rows of chestnut or hazel posts. 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. 	Knutsford Green Gym & Community Connections Projects CIC

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page*

3. When the berm is positioned correctly, it is secured by looping Contractor
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 stick-
ing 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.
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

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

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2. Deflectors should extend no further than one third of the width of the river channel in any location.
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.
- 5. Installation Method**
6. A cross section of tree trunk/branch is obtained and positioned facing upstream from the margins of the river.
7. 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.
8. 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.
9. 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.

Bat Boxes

4. Install bat boxes with local volunteers

Design Considerations

1. Bat boxes should be Schwegler 2F-DP
2. Should be located in deep shade and dappled sunlit glades, with good flight access, to attract target species.
3. Should be located on the southern bank of the river to avoid disturbance.
4. Bat boxes should ideally be placed between 3m-6m in height on a tree.
5. Bat boxes should be located approximately 20m apart across the site.

Herts and Middlesex Wildlife Trust

Bat Boxes	Installation Method <ol style="list-style-type: none"> 1. Batboxes should be installed by a minimum of two people (one to attach box to tree, one to hold ladder / supervise. 2. Bat boxes are attached to trees simply by mounting on a screw or nail. 	Herts and Middlesex Wildlife Trust
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Grazing Project

Activity	Action	Comments	Delivered by:
Permission to work.	1. Reach land use agreement with Affinity Water	1. Affinity Water should be approached by the project team to see if they would allow grazing on site.	Groundwork Watford Borough Council Affinity Water
Permission to work	2. Reach agreement with local tenant farmer to introduce cattle to site.	<ol style="list-style-type: none"> 1. Seek expressions of interest from local tenant farmers. 2. Agree on grazing regime 3. Decide on breed of cattle 4. Agree grazing intensity 5. Consult farmer in regards to specifications for livestock fencing and other livestock infrastructure. 6. Sign grazing agreement 	Herts and Middlesex Wildlife Trust
Install livestock fencing and other associated infrastructure	3. Procure contractor	1. Procure contractor to install livestock fencing and other infrastructure as per agreed design.	Herts and Middlesex Wildlife Trust

Activity	Action	Comments	Delivered by:
Install livestock fencing and other associated infrastructure	4. Install fencing , gates, pens, drinking troughs and signage.	5. Install livestock infrastructure as per agreed design.	Contractor
Enhance grassland	5. Spray and seed grassland	Method:	Contractor
	6. Control ragwort	1. Spray off small patches (1m squares) within the sward.	Local volunteers.
		2. Seed with Emorsgate EM4F.	
		3. Pull ragwort on site prior to the introduction of cattle.	
Facilitate cattle grazing	7. Introduce cattle	1. Introduce cattle as per grazing regime agreed with tenant farmer previously.	Tenant farmer

Ongoing Management Actions

Invasive species management	1. Survey and control invasive species annually.	The site should be surveyed annually using the CVFC INNS application and control work undertaken accordingly. Further information is provided on this activity in the Rediscovering The Colne Environmental Monitoring Project Feasibility Study.	Local volunteer groups Contractor
Minor tree works	2. Continue to maintain 60:40 light shade ratio along river corridor.	Coppice riparian woodland on rotation to ensure beneficial light shade ratio is maintained.	Local volunteer groups.
Wetland scrape maintenance	3. Maintain Wetland scrapes once created.	Ensure scrapes do not become degraded by maintaining light levels, floral diversity and silt levels	Knutsford Green Gym / Community Connections Projects CIC

Estimated Costs

Low Flow Channel, Bank Regrading, Tree Work, Creation of Wetland Scrapes

Activity	Items	Cost	Total
Tree Works	Tree clearance, coppicing, treatment of stumps	£15,000	£15,000
Design and Permitting for: Low flow channel Bank Regrading Wetland Scrapes	Survey Work	£1,000	£9,000
	Design Work	£5,000	
	Sediment Analysis	£2,000	
	Permitting	£1,000	
Construction of wetland scrapes	Plant hire & labour	£2,000	£2,000
Construction of Bank regrading	Plant hire & labour	£2,000	£2,000
Construction of low flow channel	Plant hire labour	£15,000	£50,000
	Materials	£28,000	
	Plant hire, fuel and insurance	£2,000	
	Site security and welfare	£3,000	
	Track matting	£2,000	
TOTAL			£78,000

Wooded debris installation, Bat Box Installation, Minor Tree Works

Activity	Items	Cost	Total
Design and Permitting for Wooded debris work	Design Work	£2,000	£3,000
	Permitting	£1,000	
Construction of wooded debris features and minor tree works	Staff time (20 days)	£5,000	£5,000
	Materials	£1,000	£2,000
Installation of bat boxes	Staff time (4 days)	£1,000	£1,300
	Materials	£300	
TOTAL			£11,300

Grazing Project

Activity	Items	Cost	Total
Enabling Work	Reach agreement with Affinity Water (5 days)	£1,250	£3,000
	Identify tenant farmer and produce grazing agreement (5 days)	£1,250	
	Produce tender and procure contractor for works (2 days)	£500	
Install livestock infrastructure	Fencing (200m)	£4,000	£6,600
	Field Gates (x4)	£800	
	Corrals (x2)	£1,800	
Enhance grassland	Labour	£500	£1,000
	Materials	£500	
Facilitate Grazing	Staff time (5 days)	£1,250	£1,550
	Materials	£300	
TOTAL			£12,150

Total Project Costs

Activity	Cost
Low Flow Channel, Bank Regrading, Tree Work, Creation of Wetland Scrapes	£78,000
Wooded debris installation, Bat Box Installation, Minor Tree Works	£11,300
Grazing Project	£12,150
TOTAL	£101,450

Ongoing Annual Maintenance Costs

Contractor maintenance	Tree works	£5,000	£6,000
	Invasive species removal	£1,000	
Volunteer maintenance	Staff time for volunteer day facilitation (12 days per year)	£6,000	£3,500
	Tools and equipment	£500	
TOTAL			£9,500



*All estimated costs are based on recent quotes from local contactors for similar activities

Site Access Plan



Utilities Search



Sewers - Foul

Sewers - Surface

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 and Hillfield Brook restoration 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.

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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) Knutsford Playing Fields modular river survey 2019.
4. Community Connections Projects CIC (2019) Riverfly Monitoring Report.



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