Habitat Action Plan
RIVERS AND STREAMS

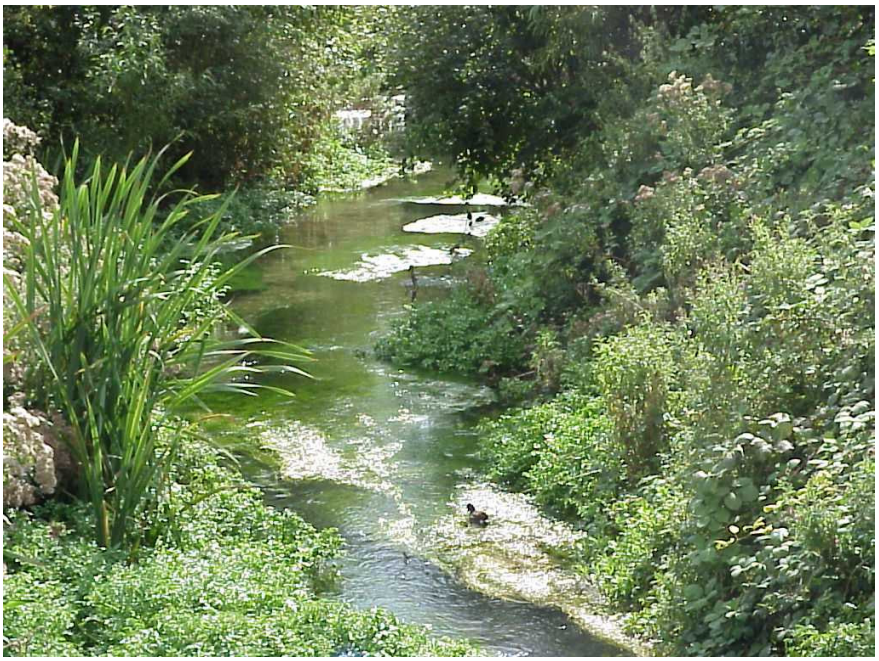


Figure 1: River Wandle at Mill Lane

"When Caesar was encamped here, his troops were in great need of water, and none could be found in the vicinity. Observing, however, that a raven frequently alighted near the camp, and conjecturing that it was for the purpose of quenching its thirst, he ordered the coming of the bird to be watched for, and the spot to be particularly noted. This was done, and the result was as he anticipated. The object of the Raven's resort was this little spring; from thence Caesar derived a supply of water for the Roman legions, and from the circumstance of its discovery, the spring was called the Raven's bourne or brook."

Notes and Queries, Vol. 3 2nd S. (74) p438 May 30 1857

1. Aims

- To maintain and enhance the ecological value of London's Rivers and their associated habitats.
- To maintain and restore the natural processes and continuity of London's Rivers.
- To increase and promote the contribution of rivers towards quality of life in London.

2. Introduction

Rivers in their natural state are dynamic systems continually modifying their form. If present, features such as riffles, pools and exposed sediments enable them to support a diverse range of aquatic plants and animals. Marginal and bankside habitats provide an important wildlife corridor for further associated fauna. The river corridor creates a link between a variety of London's green spaces.

The rivers and streams of Greater London comprise all free-flowing watercourses that are above the tidal limit. Together, these total over 600km in length, with many smaller watercourses, such as drainage ditches, further increasing this network. This Habitat Action Plan also includes the associated banks and the river corridor up to fifty metres wide as defined by River Corridor Survey Guidance. This range of habitat supports a large variety of plant and animal species as well as being of recreational, cultural, heritage and landscape importance.

London rivers are broadly classified as chalk or clay depending upon the principle geology of the catchment. However, the alteration of channels to make way for the growing city has impacted on many of their natural features. In summer chalk rivers typically dry out in their upper reaches and rely on winter rainfall to

replenish aquifers. Their clean water and gravel beds can support a rich variety of flora and fauna, including water-crowfoot, mayflies and brown trout. Clay rivers typically have deep pools and shallow riffles and the water level commonly fluctuates in response to heavy rainfall. Historic river processes have deposited sand and gravel onto the floodplain. These natural deposits have long been quarried for use in road making and construction.

Since the Industrial Revolution, many London rivers have been progressively straightened and culverted for land take and flood defence, leaving sterile channels of low ecological and social value. Rivers such as the Fleet, Tyburn and Effra were lost altogether below ground forming part of the city's sewerage system. Habitat continuity has been lost as these natural corridors for wildlife became severed. Today's thinking is to encourage biodiversity through regeneration and sustainable flood risk management.

3. Current Status

The current state of London's rivers is greatly affected by both historic and present land uses within the Thames basin. While issues such as waste water treatment management, and urban surface water run off, influence the quality of the habitat, historic practises used for maximum land take and flood alleviation, have arguably had a greater effect. The methods, have resulted in the loss or alteration of natural banks and channels, causing a significant detrimental impact on the overall quality of the habitat. However, despite this pressures still existing for maximum land use and flood protection. Today's methods need to address these demands and risks in a sustainable and more natural manner.

Natural and semi-natural river habitats also offer economic and social benefits, to the local community. The recognition of these benefits has led to an increase in river restoration projects across Greater London. Where urban development has led to rivers being removed from their natural course, current practises are seeking to redress the balance, by restoring rivers to their more natural form, whilst not increasing flood risk. A more attractive river environment helps local regeneration, by attracting commercial and residential developments. An attractive river view promotes a popular and safer environment for all members of the community in which to interact with nature. It also promotes a variety of both active and passive recreational activities, including walking and angling, which has implications for a healthy life-style. The restoration of river corridors also offers the opportunity to provide footpaths and cycle routes away from the pollution and hazards of roads. An accessible river habitat also presents a valuable opportunity for formal and informal learning, helping people to develop an appreciation and sense of ownership of their local environment.

Rivers and streams have considerable historical and cultural significance, and play a key part in determining local identity and distinctiveness. Rivers and water bodies have had a close association with human activity and settlement for millennia and provide a rich source of evidence for the lifestyles, belief systems, and social organisation of our forebears. The associated alluvial deposits in rivers provide a particularly good medium for preservation of archaeological remains and, therefore, a disproportionate record of our cultural heritage derives from these sources. Human interaction with rivers and their ecological resources is evident in the survival of prehistoric and medieval structures, such as fish-traps and causeways, and industrial era buildings such as mills and their associated water features (e.g. ponds and races). The legacy of this activity is widespread on many of London's rivers and streams, notably the Lee and the Wandle, and may have implications for the management of these habitats.

Urbanisation, of London's rivers has played a strong role in the deterioration of its riparian biodiversity. There have been localised losses of species such as the otter and the white-clawed crayfish. Fish populations are affected by poor habitat quality and where the river's water quality is affected by pollution from urban run off, particularly after heavy rain or misconnections of wastewater to the surface drains. Enhancement schemes, fish restocking, and water quality improvements are seeking to establish natural recruitment within London's fisheries.

Urbanisation, not only has a large impact on the landscape, but also the natural river processes of deposition, erosion, flow variation and tidal influences. Rivers are frequently constrained and in many cases

have either been completely isolated from their floodplain or this has been lost entirely beneath development. Without a floodplain, geomorphological features formed by a natural river processes are lost, e.g. oxbows and river terraces. The hard surfaces of development result in rapid and increased run-off following rainfall events. These rivers can then act unpredictably, as they attempt to adjust to flow velocities, erosion and depositional processes. The resulting changes in water depth and velocity can have disastrous impacts on biota and intensify erosional processes. Invertebrates and fish are impacted either through direct 'wash out' or by persistent removal of habitat. The preferred solution to bank instability is often to increase bed and bank protection, which also removes natural habitat.

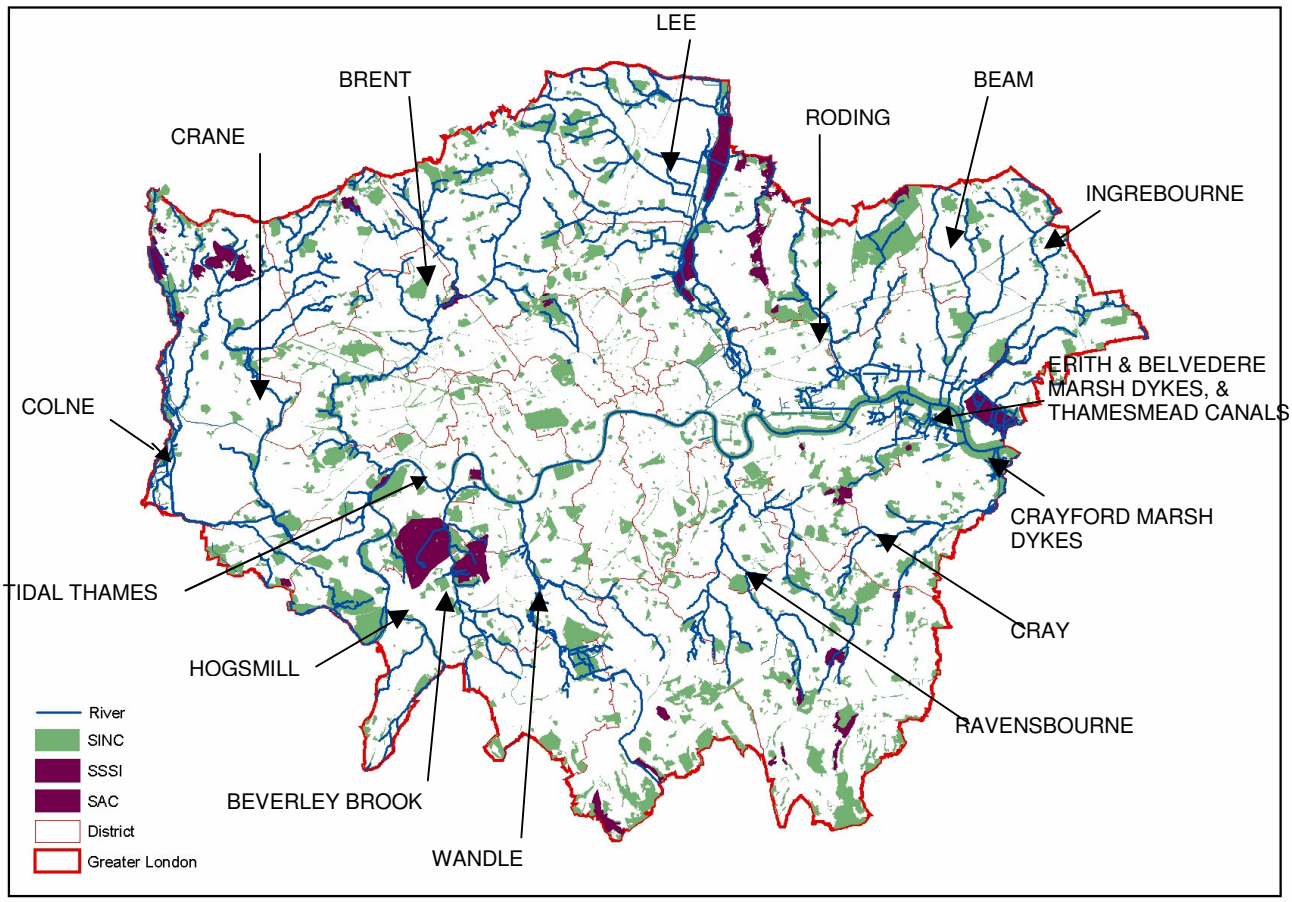
Where rivers are no longer able to disperse silts on to a floodplain, there is an increase of fine silt in the system. This is often deposited upstream of engineering structures encouraging the growth of lush vegetation. Increasing flood risk and thus increasing the requirement for regular maintenance. Silts also smother gravels, riffles and other types of valuable in-channel features. Gravel riffles provide important spawning grounds for fish. Invertebrates and aquatic plants are dependent upon gravel areas being re-charged on a frequent basis. Removal of natural erosion processes further up the catchment retards natural gravel recharge. Existing gravel areas become compacted and armoured, devaluing the habitat. These processes are vital to the health and biodiversity value of the whole river system.

Sites of Special Scientific Interest (SSSI) are nationally important conservation sites, and of the 34 that exist in Greater London, 17 have a river or stream flow though, or form the boundary. Watercourses play an important role in linking these valuable habitats.

Figure 2: Sites of Special Scientific Interest (SSSI) in Greater London through which a River or Stream Flows.

SITE NAME	WATERCOURSE	CATCHMENT
Bentley Priory	Edgeware Brook	Brent & Crane
Brent Reservoir	River Brent	Brent & Crane
Chingford Reservoirs	Lee Navigation	Lower Lee
Walthamstow Marshes	Lee Navigation	Lower Lee
Walthamstow Reservoirs	Lee Navigation, Lee New Cut & Dagenham Brook	Lower Lee
Denham Lock Wood	Fray S River	Colne
Fray's Farm Meadows	Fray S River	Colne
Mid Colne Valley	Broadwater	Colne
Ruislip Woods	Northwood Hills Stream, Cannon Brook, Mad Bess Brook & Newyears Green Bourne	Colne
Epping Forest	River Ching, Honey Lane Brook & Brook House Brook	Roding, Beam & Ingrebourne
Hainault Forest	Lambs Brook	Roding, Beam & Ingrebourne
Ingrebourne Marshes	River Ingrebourne & Berwick Pond Stream	Roding, Beam & Ingrebourne
Inner Thames Marshes	Drainage Ditch System & Thames Tideway	Ingrebourne & Thames Tideway
Crofton Woods	Kyd Brook	Ravensbourne
Keston & Hayes Common	River Ravensbourne	Ravensbourne
Richmond Park	Beverley Brook, Kingsmere Stream & Queensmere Stream	Beverley Brook
Wimbledon Common	Beverley Brook, Kingsmere Stream & Queensmere Stream	Beverley Brook

Figure 3: Map illustrating the location of river catchments along with the SSSIs, SACs and SINCs within Greater London.



4. Management of watercourses:

Responsibility for the management of a watercourse lie with a variety of different bodies including riverbank owners, the EA, LA, navigation authorities and internal drainage boards. There are also a growing number of local user groups and charities which are having an increasingly important role in the management of London's rivers and streams.

The riverbank owner is responsible for the maintenance of the riverbank, and to the centre of the riverbed. Maintenance includes management of trees or shrubs growing on the banks, clearing debris, and the upkeep of structures such as river walls, culverts, trash screens, weirs and mill gates.

The EA has responsibilities for the management of designated main rivers in England and Wales, along with a wide range of regulatory powers. The principal duty of the EA is to contribute to the achievement of sustainable development through pollution prevention, waste regulation, flood defence, water resources, fisheries, recreation and conservation. To this aim the EA annually carry out work such as debris clearance for flood defence within the channels, tree works, invasive species clearance, especially of plants such as floating pennywort, management of instream vegetation, pollution prevention and control, and regulation of consents.

Local authorities generally manage the watercourses when these are on or adjoining their land. Management priorities normally fall into a few main areas. One of these is the control of invasive species such as Japanese knotweed, Himalayan balsam or giant hogweed. Management of bankside trees on wooded rivers, which can cause major blockages and bankside damage if they fall, is also very important. Other aspects of management may include litter clearance from banks and, occasionally, from within the channel. Where the associated habitat is dependent on the watercourse (e.g. wet woodland) effective management may encompass both the associated habitat and the watercourse itself. However, where the adjacent land is of a

different character (e.g. a footpath) this may well be managed separately from the watercourse. A number of charities and local interest groups also conduct work such as clearance of litter and invasive plant control.

Management of a whole river catchment is impeded by land ownership boundaries and in most cases the management of adjacent owners is not "joined up". Only recently have river catchment forums with other landowning bodies started to change this view point to that of whole watercourse management e.g. Crane valley forum.

5. Specific Factors Affecting the Habitat

5.1 Climate change

The projected rise in temperatures, sea level and weather extremes through climate change could affect the magnitude and frequency of extreme flows along water courses, causing unpredictable losses or gains of certain habitats and species. There would be inevitable changes to the composition of vegetation, with certain communities becoming vulnerable to extreme hydrological conditions. The improvement of river corridor floodplain profiles through habitat restoration would not only help offset the loss of habitats likely to be vulnerable to such change, but also provide opportunities for vegetation communities that would otherwise be lost.

5.2 Modified channels

London's rivers have had their channels severely modified in some sections of their river corridors e.g. through the inclusion of concrete channels and culverts. For example, this has led to the disruption of natural replenishment of gravels in some sections of river leading to the loss of gravel along the riverbed, reducing the opportunity for river fauna to find refuge from high flows of water during storm events. Those habitats which have managed to establish themselves within the restricted river profile are often more susceptible to disruption of their natural processes as a consequence of pollution or flooding events. Other habitats might be unable to establish themselves within the modified channel. Species that depend wholly on such habitats are thereby excluded from ever colonising that section of the river.

5.3 Fragmentation of the river corridor

River corridor fragmentation is often caused either due to obstructions located within the channel including weirs, through inappropriate development immediately adjacent to the river or else from extreme modification of channels. Therefore, the ability of certain terrestrial species to move through the urban environment can become restricted. Furthermore, essential natural processes such as fish migration can become disrupted. In addition, the isolation of less mobile and/or sensitive populations is also enhanced. The consequences of the above include: isolated animal/plant populations becoming more vulnerable to extreme events; species becoming extinct or unable to colonise suitable habitat; and habitats being unable to fulfil their maximum potential for wildlife. The impacts above can be countered through various measures e.g. buffer zones being incorporated into development designs; the removal or bypassing of in-channel obstructions; channel restoration schemes; installation of mammal or fish passes; etc.

5.4 Loss of floodplain

The loss of floodplain can lead to the constraint of flows within the channel leading to greater extremes in water levels. There is also the inevitable loss of floodplain habitats. Furthermore, the ability of the constricted channel to lock up harmful contaminants from run-off is greatly reduced. These artificially constrained channels with their lack of wetland habitat diversity can suffer not only from the loss of biodiversity due to any reduction in water quality, but also from extreme low flows as well as biological wash out as a consequence of floods**.** To some degree, the loss of floodplain can be countered through the floodplain restoration schemes, the incorporation of Sustainable Urban Drainage systems within

developments, the incorporation of habitat features within channels to mitigate for impacts and through the protection of floodplains.

5.5 Problem species

Colonisation of river courses by certain exotic plant and animal species can cause problems for native species. These include American mink, non-native crayfish species, Chinese mitten crab, zander, Japanese knotweed, floating pennywort, giant hogweed and Indian balsam. These species have the ability to reduce native species diversity, cause localised extinction of certain vulnerable native species, destabilise riverbanks and/or alter riverside habitat communities. The response to the above has been to increase the public awareness of risks of these exotic species, to develop monitoring and surveillance systems for invasive species, and also to improve access to guidance on identification, risk and control of these species.

6. Legislation, Policy and Plans

The principal biodiversity legislation, policy and statutory planning documents that relate to the rivers and streams of London can be found listed in the table below. Further information can be found on the LBP website www.lbp.org.uk

EUROPEAN	EU Birds Directive EU Habitats and Species Directive Water Framework Directive
NATIONAL	Environment Act 1995 Wildlife & Countryside Act 1981 Countryside & Rights of Way Land Drainage Act 1991 Water Resources Act 1991 Salmon & Freshwater Fisheries Act 1975 Planning Policy Statements Working with the Grain of Nature: A Biodiversity Strategy for England Tree Preservation Orders UKBAP
REGIONAL	Regional Spatial Strategies The London Plan- blue ribbon network, biodiversity strategy EA Wetland Policy EA Culverting Policy EA Floodplain Policy lBAP
LOCAL	Unitary Development Plans EA River Restoration Strategy lBAP

Figure 4: The principal biodiversity legislation, policy and statutory planning documents that relate to the rivers and streams of London

An example where planning policy applies to rivers and streams is the Mayor's London Plan. The Thames tributaries (including culverted sections) are recognised as part of the Blue Ribbon Network in the London Plan and the Mayor's Biodiversity Strategy. The Network is seen as a key element in London's identity as a sustainable world city. Development is expected to protect and enhance the Network, through taking account of a number of principles that relate to public use, access, economic activity, biodiversity, landscape and heritage. There is also a number of policies within each local borough which support the protection of our rivers and streams

Policy 4C.3 in the London Plan deals with Biodiversity across the Network as a whole. '*The Mayor will, and boroughs should, protect and enhance the biodiversity of the Blue Ribbon Network... resisting development that results in a net loss of biodiversity, designing new developments in ways that enhance biodiversity value, and allowing development into the waterspace only where it serves a water dependent purpose or is a truly exceptional case which adds to London's world city status.*' Policy 4C.5 opposes proposals for impounding of rivers unless they are clearly in the wider interest of London. Policy 4C.31 relates more specifically to tributary rivers and streams to ensure they are protected,

improved and respected as part of the Blue Ribbon Network, and that measures should be taken to improve the habitat and amenity value of such waterways.

The Mayor's Biodiversity Strategy goes further in its Proposal 21, which makes a commitment to work with others, and particularly the EA, to establish a restoration strategy for the tributary rivers of the Blue Ribbon Network.

The EA also has a Wetland Policy, which has been adopted and requires the Agency to conserve, enhance and re-create the wetland capacity of catchments as part of their contribution to rebuilding the biodiversity of England and Wales on a landscape scale. Similarly many local authorities have specific policies within local plans to support similar ideals.

7. Current Actions

Due to the degree of urbanisation in London, the flood defence operatives have to maintain a great degree of vigilance regarding maintenance of the rivers and streams. One way of tackling flood risk is at a strategic scale. This is currently being undertaken by the EA's Flood Defence function through the production of Catchment Flood Management Plans (CFMP). Within each CFMP there will also be flood strategies covering smaller geographical units i.e. the Lower Lee Flood Risk Management Strategy. These strategies outline possible solutions for dealing with key flood risk areas based on the CFMP. These options develop into a series of capital schemes, designed to deliver a holistic and sustainable approach to existing and future flood risk.

These strategies have resulted in several capital schemes seeking to alleviate flood risk on the Salmon's Brook, Quaggy and Cobbins Brook, all of which involve the creation of new flood storage areas.

These schemes involve multidisciplinary teams (including engineers, ecologists, landscape architects, geomorphologists to name a few) with a general aim to address the 'wrongs' of the past, and to promote river restoration. These works may include de-culverting rivers through open space, removal of toe-boarding, re-creation of natural channel form, creation of backwaters, bank re-profiling, re-creation of in-channel features such as riffles, channel narrowing and in-channel planting. This is often achieved through partnership working with amongst others the EA, local authorities, individual land owners, local wildlife trusts, Groundwork, individual interest groups, anglers, canal authorities and water companies among many others. Some of the larger schemes have included Tokyngton Park on the Brent, Brookmill Park and Norman Park on the Ravensbourne and Shaftsbury Park on Spring Brook. At Tokyngton Park the EA in collaboration with the London Borough of Brent restored a large section of the river, by removing it from a concrete channel, and thereby providing sustainable flood defences and delivering biodiversity.

River corridors and floodplains are also protected and enhanced through consenting and planning consultations. The EA and local authorities for example, seek to protect natural banks & channels and their associated flora and fauna from inappropriate bank or channel works under the land drainage consents procedure. Similarly in planning, PPG25 seeks to prevent development in floodplains, ensuring that applicants produce a flood risk assessment to ensure that any development does not create an additional flood risk. The Environment Act 1995, also gives the EA extra powers to ensure that staff seek protection and enhancement of any flora and fauna associated with the aquatic environment. This also includes impacts on landscape character, heritage, archaeology and geomorphological features.

The principal of protecting river corridors and floodplains is supported by wider legislation on the environment (see Figure 4). Such legislation includes; the Wildlife & Countryside Act (as amended); the Habitats Directive; Planning Policy Statement 9 (Biodiversity and geological conservation, replacing Planning Policy Guidance 9); CRoW Act 2000 and the Government's commitment to Biodiversity. This includes protecting habitats and protected species, along with those of Biodiversity importance such as water voles, kingfishers, otters, Desmoulin's whorled snail and bitterns.

Planning issues should also ensure provision of wildlife buffer strips between development and the river, ensuring native planting, seeking enhancement opportunities, minimising negative impacts and seeking mitigation/compensation. It is important to look at development sites, both in relation to their immediate surroundings and on a wider catchment or sub-catchment scale. In addition to measures seeking to address water quality issues, diffuse pollution, discharges, abstraction and re-cycling, such as promotion of sustainable urban drainage systems (SuDS), re-use of grey water recycling facilities, use of brown/green roofs should also be promoted.

One way of tackling these sorts of issues proactively is through the promotion of river restoration, by providing constructive information and examples. This has already been achieved by the EA's South East Area office through the production of 'River Restoration – A Stepping Stone to Urban Regeneration Highlighting the Opportunities in South London', produced in 2002, in collaboration with English Nature, the Mayor of London and the GLA. This document highlights how and where river restoration can play an integral part in realising the Mayor's vision of a London as an exemplary sustainable world city. Promoting river restoration as a way of actively achieving an environmentally sustainable approach to design and planning which will help to create a more attractive, safe and accessible urban environment.

A similar document is currently in preparation for North London. Together it is hoped these two documents will influence not only development at a local scale and individual site scale, but also for major initiatives such as the Thames Gateway, Single Re-generation Bids and the Olympic Bid proposals. In addition, more and more areas are being earmarked for framework/ master plan development strategies. These are led by London Development Agency and currently include sites at Bow Creek and Ferry Lane, Rainham.

A significant proportion of accessible urban space is associated with the rivers, their tributaries and canal corridors, which have been recognised by the local authorities. London Wildlife Trust are currently working in partnership with several local authorities and the EA to progress habitat enhancement work and access to four of their reserves along the Yeading Brook and Wandle. Similarly, a new partnership forum for the River Crane has recently been established to provide a holistic approach to the management of the River and to deliver BAP actions on the ground.

8. Flagship Species

These special plants and animals are characteristic of rivers and streams in London:

Daubenton's Bat	*Myotis daubentonii*	A relatively common and widespread bat, which is strongly associated with London's waterways. The "water bat" forms maternity roosts in bridges, old stone buildings or hollow trees close to water. The bats fly close to the surface of the water in search of insects, providing a wonderful finale for the public attendants on a riverside bat walk.
Water Vole	*Arvicola terrestris*	The "water rat" of the literary classic "The Wind in the Willows" is often mistaken for the brown rat. However, the water vole has a blunt nose, a shorter hairy tail and a pair of small ears tucked away within its fur. It is Britain's fastest declining mammal, yet some of its UK strongholds are associated with London's watercourses.
Kingfisher	*Alcedo atthis*	The flash of brilliant blue as a kingfisher flies low over the water adds a special thrill to any riverside ramble. The species' expansion into the city owes much to improvement in water quality and associated availability of small fish in recent decades. It has also proved capable of nesting in man-made structures within the urban "concrete jungle".
Grey Wagtail	*Motacilla cinerea*	Grey wagtail is a confusing name for a bird most conspicuous for its yellow breast and under-parts, rather than the grey found on its back. Historically, the bird was a rare breeder along London's rivers, and locally was known as the "winter wagtail" due to the influx of birds that migrated into southern England during the winter. However, the breeding population has increased in recent decades, expanding into the heart of the city.
Common Eel	*Anguilla anguilla*	Eels must be among the most familiar of all freshwater fishes characterised by their slimy bodies and serpentine form. Eels are an important food source for wintering bitterns and grey herons, as well as larger fish including pike, trout and other eels. They are also the favoured prey of the otter, which has begun to venture into the outskirts of the capital in recent years. Eels used to be important commercially in London for human consumption as jellied eels, elver cakes, and eel pie and mash.
Banded Demoiselle	*Calopteryx splendens*	This large damselfly has a graceful, dancing flight over the emergent vegetation located on banks of slow-flowing rivers and streams. Males are particularly striking, with a metallic blue-green body and a central wing band of dark blue-black. It appears to tolerate the higher nutrient levels typical of the lower stretches of many London rivers.
Water-crowfoots (Stream / Pond / Common Water-crowfoots)	*Ranunculus penicillatus* ssp. *pseudofluitans*; *R. peltatus*; *R. aquatilis*	Highly variable submerged aquatic plants, but with strikingly white buttercup flowers, seen floating on the surface of the water, often in glorious masses in May and June. The stream water-crowfoot is often associated with faster flowing water, whereas the other two species are found in slower flowing stretches, backwaters and ditches. In essence, water-crowfoots can colonise both pool and riffle sections of rivers, providing habitat for fish and aquatic invertebrates.

Water-cress	*Rorippa nasturtium-aquaticum*	A low semi-aquatic herb with creeping or ascending stems. The alternate leaves ascend the stems towards small white flowers arranged in tight terminal flower clusters. The plant prefers to grow in the shallower margins, backwaters and marshy ground of non-shaded sections of rivers or streams with clear, moderate to good water quality. The herb is rich in vitamin C and historically would have found use as a remedy for scurvy in the port of London. Today, water-cress is seen more frequently in the salad section of London's supermarkets.
Crack willow	*Salix fragilis*	A broad-crowned, often pollarded, tree with twigs that are very brittle and can be snapped off easily; from this characteristic are derived both its common and botanical names. Historically, mature willows on farmland would have been pollarded to produce products including hedge stakes, hurdles and fencing, as well as the framework for baskets to take market produce into central London. Mature willows can support over 450 species of insects and mites, a variety of nesting birds (including heronries) and roost sites for bats.

9. Objectives, Targets and Actions

Objective 1 To increase our understanding of London's rivers & streams.

Target: Collate quantifiable data and information on London's rivers by 2007.

Action	Target Date	Lead	Other Partners
Audit and collate existing data (biological, chemical and physical aspects)	2007	EA	Working Group, GLA, GIGL
Identify and map areas of opportunity & need	2006	EA	GLA
Review data collection in response to the Water Framework Directive implementation	Annual	Working Group	GIGL

Objective 2 To increase amount and improve quality of riparian habitats.

Target: i) To prevent further loss or degradation of existing riparian habitat.
ii) Improvement of 100 km of riparian habitats by 2020.

Action	Target Date	Lead	Other Partners
Promote and advise on sympathetic river design through planning and other consenting processes	annual	EA	LAs, GLA
Produce best practise guidance for developments adjacent to rivers & streams	2007	Working Group	
Distribute guidance document to targeted audiences	2008	Working Group	
Advise and support London Boroughs in taking into account the needs of rivers & streams in the development or implementation of London BAPs	annual	Working group	

Objective 3 Demonstrate the contribution of rivers & streams to enhancing quality of life.

Target: Establish dedicated self-sustained river catchment flagship projects on five rivers by 2010.

Action	Target Date	Lead	Other Partners
Define the self-sustained river catchment flagship projects	2006	LBP	Working Group
Prioritise which 5 rivers are to become initial flagship projects	2006	Working Group	
Secure funds for Project Officers to deliver proposals	2008	LBP	GLA, Working Group

Abbreviations

CFMP	Catchment Flood Management Plan
EA	Environment Agency
GUC	Grand Union Canal
LA	Local Authority
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
SuDS	Sustainable Drainage System

Key References & Further Reading

Environment Agency (2004) *The State of England's Chalk Rivers*
Environment Agency (2001 updated 2004) *Living on the Edge – Rights and responsibilities of a riverside owner*
Environment Agency, English Nature & Mayor of London (2002) *River Restoration – A Stepping Stone to Urban Regeneration Highlighting the Opportunities in South London*
Environment Agency (2006) *bringing your rivers back to life – A strategy for restoring rivers in North London*
Environment Agency (2000) *State of the Environment Report*
Greater London Authority (2002) *Connecting with London's Nature: The Mayor's Biodiversity Strategy*
Greater London Authority (2003) *Green Capital: The Mayor's State of the Environment Report for London*
London Ecology Unit (From 1984) *Ecology Handbooks*, *various*
National Rivers Authority (1992) *NRA River Corridor Surveys Methods and Procedures, Conservation Technical Handbook No.1.*

Relevant Action Plans

Reedbed Habitat Action Plan see http://www.lbp.org.uk/03action_pages/ac31_reedbeds.html
Water vole Species Action Plan see http://www.lbp.org.uk/03action_pages/ac14_vole.html
Grey Heron Species Action Plan see http://www.lbp.org.uk/03action_pages/ac15_greyheron.html
Tidal Thames Habitat Action Plan see http://www.lbp.org.uk/03action_pages/ac08_thames.html
Swift Statement see http://www.lbp.org.uk/03action_pages/ac32_swifts.htm
Black Poplar Species Action Plan see http://www.lbp.org.uk/03action_pages/ac24_poplar.html
Canals Habitat Action Plan see http://www.lbp.org.uk/03action_pages/ac09_canals.html
Bat Species Action Plan see http://www.lbp.org.uk/03action_pages/ac13_bats.html

Glossary

Aquifer	Layer of rock able to hold or transmit water.
Catchment	Area of ground which collects and feeds water to a given waterway or wetland.
Culvert	Piped watercourse, drain or covered channel carrying water across or under a road, canal, embankment etc.
Ephemeral Stream	Temporary stream that dries out for part of the year.
Main River	Designated under the Water Resources Act 1991 they include all watercourses which contribute significantly to a catchment's drainage.
Non-Main River	Every natural river or stream which is not Main river (see above). Also known as Ordinary Watercourse.
River Corridor	That part of the floodplain or land either side of the river extending from bankfull banktop to 50 metres width.
Urban runoff	Rain water that flows across urban areas, often collecting urban pollutants in it's path before draining into the watercourse.
Watercourse	A stream, river or channel along which water flows.
Weir	A device to control flows whereby flow occurs when flow depth is above a pre-set level.

APPENDIX

Catchment summaries

1 Ravensbourne/Quaggy/Pool/Beck

Today, only about 30% of the River Ravensbourne and its tributaries remain in semi-natural condition, with the remainder in a highly modified state flowing through culverts and artificial channels. Semi-natural sections of this clay river and its tributaries have retained suitable conditions for aquatic vegetation such as watercress, sedges and curled pondweed. Grey wagtails and kingfishers are now being seen more frequently. Improvements to the river channels have locally increased the suitable habitat for fish via the creation of pools and riffles to maintain oxygen levels and sufficient depth of water during low flow. The Environment Agency (EA) has restocked the river with fish such as chub and dace, and trout have been reported towards the tidal limit. However, these populations remain isolated in specific reaches due to the fragmented sections of the river, and there are limited areas of suitable spawning gravels. Fish shelters provide protection to fish, which would otherwise be washed away in high flows, and weir bypasses assist the passage of migratory fish. Further improvements are limited until more habitat enhancement opportunities arise.

Recent re-developments of derelict areas have enhanced biodiversity by restoring sections of rivers. This has been done through the opening up of culverts, the removal of concrete banks, and reforming meanders to recreate a natural course e.g. Sutcliffe Park. Artificial habitats for species such as the water vole have also been incorporated into re-developments, along with cycle routes, footpaths and fishing platforms.

2 Marsh Dykes

The Marsh Dykes include Crayford, Erith, and Belvedere ditch systems, along with the Thamesmead Canals.

The Marsh Dykes display some of the finest floodplain grazing marsh in South London, rich in bird life, aquatic invertebrates and water voles. The Marsh Dykes act as important wildlife corridors connecting to other wildlife habitat such as the River Thames and inland up both the Darent and Cray Valleys, which comprise other floodplain habitats. Grazing marsh needs to be maintained by human intervention, as do the associated ditches, drains and dykes.

The Marshes are a significant historic landscape that is evidenced by extensive prehistoric ring ditches and the discovery of a Neolithic (Bronze Age) hearth at Littlebrook. Research suggests that sea walls and drainage ditches were in place by the 12th century to enable arable and pastoral land use, and this allowed for the development of vast areas of grazing marsh either side of the Thames Estuary. However, between 1930 and 1980, 64% of grazing marsh in the Greater Thames Estuary was lost to development and agricultural improvement. Such threats still exist. Today, 44% of Greater London's remaining grazing marsh can be found at Crayford and Erith Marshes. Although the marshes have suffered huge loss and fragmentation, the remaining network of ditches provide a valuable habitat for a rich diversity of flora and fauna.

This area is particularly important for breeding waders and once common farmland birds. A variety of reeds, sedges and rushes can be seen, along with dragonflies and a nationally important population of water voles. Crayford and Dartford Marshes have been proposed to English Nature for consideration as a Site of Special Scientific Interest (SSSI). Opportunities to experience the wildlife and history of Crayford Marsh have been opened up through the Crayford Marsh Wildlife and Heritage Trail developed by the Slade Green Community Forum and the "Managing the Marshes Project". This project has also helped to coordinate management of these areas.

The Thamesmead drainage system consists of a number of interlinked artificial channels and lakes. These form an integral part of the flood defences for the immediate area and were originally constructed by artificially modifying and formalising the existing dyke system. A more sympathetic management regime adopted in recent years has meant an increase in ecological value and local amenity. The Thamesmead system supports a very fine fishery, dominated by roach and bream with many large carp and pike also present in the lakes. A characteristic of the system is the regular seasonal movement of the fish from the lakes to the canals in the winter. They return to the lakes in the summer months. These high fish densities have led to significant angling pressure, but a local angling club sensitively controls this.

3 River Cray

The River Cray chalk stream resides within a highly urban catchment and its character has been modified with many upper reaches flowing through artificial channels and culverted sections. In the middle and lower reaches where the river flows through the grounds of semi-natural parkland and small holdings, as in Footscray Meadows and Hall Place, the channel is more natural in character exhibiting a more sinuous course between low profile banks supporting lush bankside vegetation and riparian woodland. Although the river has been modified it still retains a defined river corridor

along much of its length and in places exhibits good geo-fluvial diversity with many important in-channel features present.

The Cray arises from a large spring fed pond in Orpington and although the catchment is predominantly urban, biological quality is high. However the biological quality of the Cray has been shown to decline sharply below the confluence of the Shuttle. This is attributable to poor water quality within the Shuttle. The Cray supports characteristic macrophyte communities and, in the middle and upper reaches, beds of water crowfoot are frequent, contributing to diverse flow regimes and in-channel structure. The river also supports healthy water vole populations in its lower reaches above the tidal limit.

The River Cray's fishery is predominantly coarse with the most significant species being chub, roach, eels, pike, perch, gudgeon and dace. There are also a number of on-line coarse fishing lakes in the catchment which support mixed coarse fisheries specialising in carp. The fishery is subject to a number of natural and anthropogenic stresses. Historically low flows have lead to deposition of silt and concretion of gravels. It has also resulted in areas becoming over wide and shallow, leading to loss of cover for fish. The catchment is mainly urban, and the fishery is susceptible to pollution, particularly during storm events. Evidence of the poor health status of fish has been found on the River Shuttle during fisheries surveys and may be linked to pollution events. There are a number of significant artificial barriers to fish migration throughout the catchment.

4 River Wandle

The River Wandle, once a thriving chalk stream, had its habitat physically altered during the industrial revolution, particularly by the introduction of water mills. Poor sewage treatment, and increased pollution from heavy industry operating along the route, also had an impact on biodiversity. However, in recent years major improvements in sewage treatment, which contributes to 80% of the river's flow downstream of Beddington, has led to an improvement in water quality and biodiversity. Today, this mainly urban chalkstream provides a valuable green corridor, containing several local nature reserves, that links otherwise isolated plant and animal communities, including the kingfisher, grey wagtail and water crowfoot. The Wandle now holds a good fishery, however this is a result of annual stocking by the EA of large numbers of chub, roach, barbel and dace. Reports of river lamprey breeding in the Wandle have been received, but are yet to be verified. Further recovery of biodiversity is limited where the river flows through unnatural channels. Both weirs and lack of refugia restrict fish movement. A recent report published by the EA 'The State of England's Chalk Rivers' highlights the threats facing chalk streams, and sets out an agenda to identify means of restoring damaged reaches.

The history and heritage of the area has shaped the river, and today provides a variety of habitats via the flow splits and deep channels. However, levels can rise rapidly over a few minutes, a characteristic that illustrates it is not a typical chalk stream.

It is hoped that by regenerating the river and creating a more natural environment, specifically the bank-side habitat, that a sustainable water vole population can be re-introduced to the some stretches of the river. See http://www.lbp.org.uk/03action_pages/ac14_vole.html

The benefits of the regeneration of the River Wandle extend beyond the water vole. Not only will regeneration provide London residents with the opportunity to see this rare species in the wild, but also, if a sustainable water vole community is established, this will signify a marked improvement in habitat and water quality. This in turn will benefit many other species and therefore biodiversity along the river will be improved.

Figure 5: River Wandle at Mill Lane before and after restoration.

5 River Hogsmill

The River Hogsmill provides a significant corridor for wildlife, and sections of this chalk and clay river and its tributaries support extensive aquatic vegetation. This includes some of London's rarities such as small pondweed, *Potamogeton berchtoldii*, however, in places the banks have also been colonised by excessive populations of the invasive Himalayan Balsam that can out-compete our own native bank-side species. Very small sections of the Hogsmill are culverted, and the remainder flows through straightened, toe-boarded or semi-natural channel. The Hogsmill provides a good habitat for fish and kingfishers feed along the channel. The limiting factor to fish populations here is water quality, but minnow and stone loach that both require clear flowing water have been found. The EA has recently restocked dace, chub and barbel populations. Many areas of public open space are located alongside the river, and these offer opportunities for future restoration schemes.

The Hogsmill, like all the London tributaries, also holds a wealth of history regarding our heritage and culture. As the name suggests, mills have been sited along the river since the time of the Domesday Book, and famous artists such as William Holman Hunt and John Millais have used it as a back drop for some of their best known paintings.

6 Beverley Brook

This is a clay river and is also very flashy due to rapid run-off during rainfall, and hence has steep sided banks. Up to 90% of flow in the upper section of the Beverley Brook is final effluent from Hogsmill Sewage Treatment Works, and consequently this affects the water quality. However, the water quality in the brook also suffers from pollution associated with urban run-off. The Brook has been widened for flood defence in some areas, and banks have been replaced with wooden toe boards in others e.g. Wimbledon Common. Where the brook flows through open spaces the banks are lined with elm, crack willow, elder and hawthorn, and grey wagtails and kingfishers are attracted to the water's edge. The Brook acts as an important wildlife corridor as it provides a link between the valuable natural areas of Richmond Park, Wimbledon Common and the River Thames. The first two of these are European SACS, and highlight the important role rivers can have in linking our important wildlife areas.

Until recent years the Brook has supported very little in term of a fishery due to poor water quality and restrictions to fish movements by a large culvert at the confluence with the River Thames. Recent restocking programmes by the EA have added chub and dace to the populations of eels and three-spined sticklebacks. Further improvements will occur through future fish stocking and habitat improvement, via river enhancement schemes.

7 Lower Colne

South of Uxbridge, the river comprises a complex of broadly parallel watercourses, based on a predominantly clay catchment, including the Colne, Wraysbury, Colne Brook, Frays River and the Grand Union Canal (GUC). This southern part of the Colne has been subject to intense development in the last 50 to 60 years. Urbanisation in the Lower Colne has consisted of housing and industrial developments, resulting in huge raised storage reservoirs, gravel pits, and road and rail networks. This has resulted in fragmentation of habitats, loss of floodplain and, on a more positive note, created a bevy of large open water bodies. These networks of large open water bodies are of huge wildlife importance on a European scale. A diverse landscape and a high biological resource is provided by The Colne Valley Regional Park, the 200 year old GUC, and fragments of past landscapes in the form of wet grasslands and ditches. Frays Farm Meadows, for example, is currently home to water voles and the Desmoulin's whorled snail.

Large sections of the Lower Colne are species rich in invertebrates, and regularly achieve exceptionally high biological potential. Exceptions tend to be in those areas immediately downstream from sewage treatment works, that have communities which reflect the slight organic enrichment. However, water quality is generally good, away from major sewage treatment works. Other significant issues revolve around localised flood flows, and development pressures along the river corridor.

Fish populations are generally good in terms of species diversity, abundance and growth. The Frays is particularly good and the Colne Brook has been identified as an important spawning habitat for Barbel. Conversely the Wraysbury has poorer communities which could be due to the habitat degradation and increased surface run-off following re-alignment for the M25.

8 Brent and Crane

The Brent and Crane catchments, home to over a million people, are predominantly urban and crossed by major road, rail and air traffic corridors. The ecology of these catchments has been altered by a range of human activities, associated with progressive urbanisation of the area in the last 100 years. This has resulted in loss of floodplain, increased rates of surface water run off and increased flashiness of flows. These hydrological changes have lead to flood prevention methods, including a lowering of water levels through channel deepening, alterations to channel dimensions, use of flow regulation structures, reinforcement of channel banks and bed to prevent erosion and increase use of culverts. This has culminated in several degraded instream, river margin and bank side habitats, greatly reducing ecological value and

potential, as well as promoting a discontinuous connectivity between the river and its floodplain. Flashy flows disrupt natural river processes and result in the washout of fish. Large sections of degraded river sections can also isolate populations of fish and invertebrates and act as barriers to migration.

The Brent has a relatively steep gradient in its upper section, where river cliffs and associated gravel bars and riffles typical of a clay river can be found. Further downstream, the river is less steep and is navigable at its confluence with the Grand Union Canal (GUC), where it has been canalised with the relic river loops running parallel to the navigation.

The Crane catchment, conversely, is largely flat and as a result once supported a large number of London's market gardens. The legacy of this period is the labyrinth of artificial watercourses and backwaters, which flow into and out of the Crane. Some of these channels were constructed to feed flour and gunpowder mills.

The Duke of Northumberland River, although a highly 'un-natural' feature, is very rich in invertebrate fauna and forms an important corridor between the Colne and Crane catchments.

Fish populations on the Brent are thought to be suppressed by poor water quality, an unstable flow regime and an impoverished instream habitat. The Brent Reservoir is an important nursery ground and source of migration for fish in the Brent.

The Crane is in a similar situation and is physically isolated from the Yeading Brook by an extensive section of engineered channel, hampering natural colonisation and migration within the catchment.

9 Roding, Beam & Ingrebourne

A large part of these catchments have been similarly affected by urban sprawl. There are major industrial sites such as at Fords of Dagenham, with major roads and rail networks such as the A13 and the Docklands Light Railway. A large part of the urbanisation was as a result of the historical importance of Barking Creek and Ilford for ship-building and fishing, which led to the area being seen as the 'Thames Gateway' to the world. This naturally led to large-scale industry requiring the need for transport networks and housing to accommodate workers. As industrial restructuring lead to a decline in the ports in the mid 20th century, the commercial strength of the area changed and then declined, leaving a legacy of derelict often contaminated land.

All three rivers are based on a clay catchment, and as such are naturally fairly flashy, however in combination with the high degree of modification and surface water run-off, this means that the rivers are heavily managed to reduce flood risk.

All three channels have been heavily modified, straightened, embanked, culverted and deepened by industrialisation and flood defence works. However, modification, which has led to low channel gradients and high sediment loads, has resulted in much of the lower section supporting luxuriant and some instances, diverse growth of emergent, submerged and aquatic vegetation, providing many benefits for wildlife. In addition, Green Belt and the need for maintaining floodplains have helped to check urban sprawl. Good examples of this are the Beam Washlands, Ingrebourne Marshes and the Inner Thames Marshes.

The Beam Washlands harbour great crested newts and water voles. Ingrebourne Marshes SSSI supports the largest area of freshwater marshland in Greater London and the Inner Thames Marshes, comprising London's largest wetland SSSI, supporting low-lying grazing marsh dissected by a network of fresh to brackish watercourses, culminating in a corridor of huge biological significance. Overall the Roding has a good coarse fisheries with naturally sustainable populations

The area is also within the Thames Gateway Planning Framework, which means there are huge opportunities for improved master planning to restore degraded and contaminated land and restore the river channels and processes.

10 River Lee (see http://www.ukbap.org.uk/lbap.aspx?id=375)

The progressive urbanisation of the catchment over the last 100 years has resulted in a high proportion of modified channels, flood prevention methods, including channel deepening, changes to channel dimensions, flow regulation structures and bank protection. This is due to loss of floodplain for development, increased flashiness due to urban run-off and poor water quality issues. An area of the Lower Lee has been designated as Metropolitan Green Belt to prevent the further spread of London.

The majority of the river runs through clay with the chalk underneath forming an important aquifer for water supply. Occasional outcrops of clay type material with sand occur in the Stratford area, which is in hydrological continuity with the chalk. The catchment, therefore, demonstrates a typical 'flashy' nature, common to the character of a clay system.

The lower part of the Lee catchment is a relatively complex systems of large and small watercourses, flood channels, mill leats, back channels, water supply channels and navigations. These are all interspersed with large open water bodies,

relics of old gravel workings and reservoirs for water supply. The largest of the flood channels is the River Lee Flood Relief Channel, constructed in the 1970's as a result of a major flood in 1947, spanning some 3,500 ha.

All the river systems are highly managed with regard to flow control, particularly in the downstream part of the catchment, primarily due to the high degree of urbanisation,. There is, therefore, a low abundance of taxa such as caddisflies, mayflies and stoneflies in the system. This is compounded by the water quality issues from urban run-off, sewage works and mis-connections. However, good invertebrate communities have been found on some sections of the Lee Navigation and the Lee Flood Relief channel, primarily due to the proliferation of channel and emergent vegetation.

The continuous complex of rivers, reservoirs and associated wetlands within the Lower Lee valley provides a critical green corridor. A large part of the area has been designated as an Special Protection Area (Lee Valley SPA) and a Special Area of Conservation (Epping Forest SAC). There are also several other SSSI's and other non-statutory sites which form important wildlife corridors and green chains across the valley.

Many of these key wildlife sites are available to the public as they fall within the Lee Valley Regional Park, an area of some 4,000ha, extending from London into Hertfordshire, providing an important wildlife and recreational resource. The River Lee Navigation is also a significant feature and is managed by British Waterways. In addition, the large complex of open water, rivers, wetlands and reservoirs creates major opportunities for angling. The Lower Lee supports a mixed coarse fish community of variable composition and abundance.