Appendices

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Appendix 1:

The River Environment of Buckinghamshire and Milton Keynes (ref: Chapter 2)

The Great Ouse in the north

In the north, the county contains some of the headwaters of the Great Ouse, including tributaries such as the Padbury Brook, Claydon Brook and part of the River Ouzel. The upper Great Ouse has headwaters just in Northamptonshire but soon flows into Buckinghamshire, passing through a clay-based catchment with much of the river corridor running through a rural landscape which is largely agricultural. Much of the riparian land use consists of improved grassland that is used for grazing livestock. The main urban area found on the upper river is Buckingham.

In common with many lowland rivers the Great Ouse has historically been extensively re-profiled resulting in a uniform, widened and deepened channel. This has also resulted in the river having limited connectivity with its floodplain. There are a number of weirs and obstructions present in the upper catchment that affect river flow patterns as well as being barriers to migration for fish and wildlife.

Upstream of Buckingham, the river supports important populations of wild brown trout. Some habitat improvements have taken place in this area with further habitat enhancement works under consideration for the future. A population of water vole are also believed to be present in this area of the river, whilst otter are present throughout the upper Great Ouse catchment. Below Buckingham, fish populations consist of mixed coarse species typical of those found in lowland rivers, including perch, chub, dace and roach. Mature riparian willows are relatively common along the Great Ouse and its tributaries in the upper catchment. These trees provide important habitat features along the river corridor, particularly in areas along the Padbury Brook where some are still actively managed as pollards, retaining their ecological value. A notable constraint is the presence of invasive non-native signal crayfish that are widespread and in places abundant throughout the upper Great Ouse and all its tributaries.

From Buckinghamshire, the Great Ouse enters Milton Keynes Authority area, where it forms an important wildlife corridor and green space. This is recognised by the Great Ouse through MK Authority area being designated a Local Wildlife Site (LWS).

To the north of Milton Keynes, Manor Farm LWS overlaps the Great Ouse LWS, where diverse habitats provide floodplain connectivity, areas of permanent open water and floodplain forest. A short distance downstream, the Great Ouse LWS incorporates additional mature floodplain gravel pits that provide additional open water habitats along the river corridor. There is public access to areas of the river corridor around Milton Keynes and Newport Pagnell, providing recreational opportunities and access to green spaces close to the town.

To the north of Milton Keynes, the river Tove joins the Great Ouse at the village of Cosgrove. With its headwaters in Northamptonshire, the Tove flows in a generally south westerly direction before joining the Great Ouse and providing additional connected river habitat.

Beyond Newport Pagnell, the river corridor landscape returns to a generally rural character where riparian land use is mainly under agricultural management. The only other large urban area the river flows through in the Authority area is the market town of Olney.

In common with further upstream in Buckinghamshire, the river through Milton Keynes Authority area has historically been realigned and re-sectioned. This has resulted in a generally over-

widened, deepened and straightened channel, limiting floodplain connectivity and habitat diversity. There are also a number of large weirs along the river, interrupting river flows and limiting longitudinal connectivity and migration opportunities for fish and wildlife.

Mature riparian willow pollards remain along the upstream areas of river near Milton Keynes, whilst further downstream beyond the town limits, riparian habitats are of a more open aspect, with occasional tree-lined reaches.

The main river Ouse and its tributaries throughout Milton Keynes support populations of mixed coarse fish species. Otters are also present throughout the river and tributary watercourses. Since signal crayfish were introduced further upstream, they have spread downstream and are now present throughout the Milton Keynes river network.

Padbury Brook

A short distance below Buckingham is the confluence where the **Padbury Brook** joins the Great Ouse. In common with the Great Ouse, the Padbury Brook and its main tributary, the Claydon Brook, are clay catchments that flow through a predominantly rural agricultural landscape. The riparian land use along the river corridor consists predominantly of improved grassland used for grazing livestock. The Padbury Brook catchment has also historically been engineered, resulting in the channel often being over widened, deepened and with reduced floodplain connectivity.

River Ouzel

The River **Ouzel** is another tributary of the Great Ouse that flows through the eastern part of Buckinghamshire. The Ouzel flows in a generally northerly direction through a clay catchment, flowing into Milton Keynes Unitary Authority area near Bletchley before joining the Great Ouse at Newport Pagnell. The character of the Ouzel is similar to the Great Ouse and other tributaries, being a typical lowland river that has historically been modified. Mature riparian willows are present along the river, some of which are still actively managed as pollards, retaining their ecological value. In this section of the Ouzel the river supports populations of coarse fish species typical of lowland rivers, whilst otters are present along the river.

Rivers Ray and Thame

The river environment in the central swathe of the county is dominated by the broad clay vales at the upper reaches of the River Ray (which joins the Cherwell in Oxfordshire), rising in an extensively low-lying landscape, as well as the headwaters and the upper half of the Thame catchment, a major tributary of the Thames which it joins in Dorchester, also in Oxfordshire. The **Thame** south of Aylesbury flows through a more defined valley landscape to the county boundary near the market town of Thame, in Oxfordshire. These two predominantly clay catchments have been subject to substantial land drainage improvement works in the past, not least in part due their innate flashiness, with the River Ray having been subject to some of the most extensive interventions. However, both rivers still flood their predominantly rural floodplains guite readily after heavy rain, although only the upper Ray has retained a reasonable extent of high guality floodplain and alluvial grassland. The Buckinghamshire Ray provides one of the last refuges for the True Fox Sedge in the Thames catchment. The Ray has one of the lowest gradients of any tributary of the Thames, with the area around Marsh Gibbon prone to frequent flooding and containing valuable remnant floodplain habitat for breeding waders; a small number of curlew also breed in the Thame catchment. The Thame river corridor and floodplain is still predominantly dominated by pasture, other than the considerable urban development at Aylesbury.

The main stems of these two rivers have been subject to considerable re-sectioning (widening and/or deepening) works in the past, and the need to restore physical habitat quality through restoration work and removing barriers to fish passage are important requirements for improving the ecological quality of these watercourses, and properly re-connecting them with their floodplains, particularly on the Thame. The degree of historic engineering adds a substantial challenge to restoring natural functioning and diversity to these watercourses, along with addressing challenges from diffuse and point source pollution and intensive land-use. The urban development at Aylesbury adds another pressure for the Thame. River channel and floodplain habitat enhancement works have been undertaken at a few locations on the Thame in Buckinghamshire, between Aylesbury and the county boundary near Thame, as well as the provision of fish bypass channels, but there is still much more that can be done to improve the quality of habitat here and on the Ray, and to promote floodplain wetland creation.

Some of the smaller tributaries to the Ray and Thame have been equally subject to land drainage improvements. The Hardwick Brook, a tributary of the Thame which it joins at Quarrendon near Aylesbury, is however notable for the amount of reasonably good quality semi-natural gravel-bedded habitat which has been retained. Another tributary of the Thame, the Bear Brook, fed by chalk-influenced streams in its very upper reaches, also has some remnant good quality habitat. There are several other short lengths of chalk stream tributaries flowing from the base of the Chiltern scarp with some semi-natural morphology, feeding into the larger tributary of the Scotsgrove Brook, which runs across the floor of the Aylesbury Vale to join the Thames just north of Thame town, just inside the county. Few of the Ray tributaries in Buckinghamshire have survived with much if any of their post-glacial hard gravel beds intact.

The Chilterns Chalk Streams

A number of chalks streams rise on the south-east facing dip slope of the Chilterns, running either directly to the Thames or to one of its larger tributaries at the eastern edge of the county, the River Colne. Chalk streams are priority habitats, with the UK having by far the greatest proportion of the global resource (see section 2.9). The whole 17km of the River **Wye** lies within the county from its source near West Wycombe to its confluence with the Thames at Bourne End. Although much of the Wye's course is highly urbanised through High Wycombe and Wooburn Green, with many impoundments including at one time over 30 mills, it retains some very good quality gravel bed habitat, in part due to its relatively steep gradient, ideal for brown trout. Improvements to channel habitat and fish passage secured through development and collaborative projects are helping the river to recover from the worst of its industrial past, along with reductions in abstraction pressure by the closure or reductions of groundwater abstractions. As with most chalk streams, the upper reaches of the Wye and its tributary the Hughenden Stream are subject to seasonal downstream migration of the source as groundwater levels drop in the summer.

To the west of the Wye, a much smaller chalk stream flows out of the Chiltern slopes to the Thames, the **Hamble Brook**, which flows for its roughly 6km southward through an iconic Chiltern landscape to the Thames at Mill End. The flows in the Hamble Brook are highly ephemeral, and the often dry channel is in places under pressure from intensive grazing.

Several chalk stream or chalk-influenced tributaries of the Colne rise from the Chilterns in the county, including the Chess, Misbourne and Alderbourne. The **Chess** is a classic winterbourne rising near Chesham, with about half of its 20km length in the county before flowing into Hertfordshire to join the Colne at Rickmansworth. An upper tributary of the Chess, the Vale Brook, is entirely culverted under Chesham. Historic channel dredging and milling, eutrophication pressures and livestock poaching all compromise ecological quality, exacerbated by abstraction pressures which can substantially increase the risk and longevity of drying in the upper reaches. Floodplain grazing marsh has been largely replaced with improved pasture and arable cropping. The Chess still maintains a valuable population of water voles.

The River **Misbourne** is a groundwater fed chalk stream that rises at the northern edge of the village of Great Missenden. It flows in a south-easterly direction within a shallow, rural valley in its upper sections and becomes more influenced by suburban settlements in its lower reaches, including Old Amersham, Chalfont St Giles, Chalfont St Peter, Gerrard's Cross, Higher Denham and Denham. The catchment has been influenced by a history of milling, fisheries, watercress production, groundwater abstraction and urban development. There are also a series of large, on-line, artificial landscaped lakes along the river, for example at Denham Place. The Old Rectory Meadows SSSI sits next to the Misbourne and meadow flowers grow on its floodplain. Groundwater abstraction in the chalk catchment has significantly affected water flows in the River Misbourne, sometimes limiting natural geomorphological processes. The River Misbourne is stable and channel narrowing is the dominant process along the lower reaches of the stream. Much of it is wider and deeper than would be expected for a natural chalk stream.

Alderbourne

Although the **Alderbourne** rises from the Chiltern chalk just above Fulmar village, it then flows over alluvium and clay from below the village for approximately 8km across a gentle gradient to join the Colne Brook at Elk Meadows. Much of the catchment lies within London's Green Belt with agriculture and deciduous woodland the dominant land use. Notably, as the river flows beneath the M25, it passes through Kingscup Meadow and Oldhouse Wood SSSI, designated for its mosaic of wet and dry habitats adjacent to the river. Historic dredging and other agricultural management practices are key pressures to the river, with physical modifications likely to be limiting habitat quality here. Finally, these chalk tributaries flow into the Colne, part of which runs along the eastern edge of the county.

River Colne

The River **Colne** follows the Buckinghamshire-Greater London border from Harefield flowing south to Thorney. Many of the Colne tributaries rise in the Chiltern chalk, and the River Colne remains in connection with the chalk until it reaches Denham. Here the geology changes from the clay, silt and sand of the Lambeth group to the London Clay that takes it to join the Thames at Staines. Historic gravel and mineral workings characterise much of the land adjacent to the river on the Bucks border. These have been redeveloped to form lakes and wetlands used for both angling, watersports and as local nature reserves, most notably the Mid Colne Valley local wildlife site includes 3 SSSIs, a stronghold for both watervole and otter in the catchment. The Colne Brook forms one of the distributaries of the River Colne, flowing from Uxbridge Moor to the River Thames at Hythe End, Wraysbury for 15km. The river corridor is well shaded by deciduous woodland at its upstream end, flowing through agricultural land and becoming less covered through old mineral workings and several golf courses before leaving Buckinghamshire at Thorney. The Colne Brook is under pressure from several invasive species with significant amounts of Floating Pennywort present as well as Himalayan Balsam and Japanese Knotweed stands. Historical physical modifications and weir structures present within the channel impact on fish populations here and work to improve floodplain connectivity is needed. The Colne Brook also faces increased pressure from phosphate pollution, apportioned to sewage discharge and runoff from the roads and surrounding urban areas.

The Thames

The River **Thames** forms the southern boundary of the county from just downstream of Henley. The Thames has been highly modified for navigation, an impounded river flowing on a gentle gradient between a series of lock and weir complexes, eight of which are found on the county boundary from Hambledon Lock to Boveney Lock. This is a much larger river than all the other watercourses in the county, a highly modified channel with the more important flow-dependent habitats being restricted to weir streams and some side-channels, but with the main Thames providing a degree of contemporary stability and depth quite unlike the shallower, multi-thread channel that would have existed before human influence. The Thames is the main focus for informal waterside recreation in the county, as well as for pleasure boating, but also provides habitat for a range of species which benefit from stable water levels and generally benign flow rates, although the river carries huge volumes of water during flood events. The **Jubilee River** leaves the Thames at Taplow and flows out of the county at Dorney just upstream of the main wetland complex there; designed to take flood flows under high flow events, under normal conditions the Jubilee provides a quieter refuge from the powered navigation on the main Thames.

Appendix 2:

The NEP's mapping - priority areas for biodiversity creation and improvement in Buckinghamshire and Milton Keynes (ref: Chapter 5)

Summary

The NEP has recently completed several mapping projects to identify priority opportunities for nature, connectivity, green infrastructure, natural capital and environmental benefits.

The most relevant initiatives are highlighted below.

While we wait for Local Nature Recovery Strategies to be finalised, the various mapping work already completed to identify priority areas for biodiversity, both existing and areas of priority for action to restore it, across Buckinghamshire and Milton Keynes, is provided here.

Biodiversity Opportunity Areas (BOAs) remain the most important areas for biodiversity in the area, and in terms of restoring nature, action taken within BOAs to restore, improve and connect biodiversity is the highest priority.

The NEP has concluded that the following could act as a framework / guide to prioritising action (restoring, improving, reconnecting, creating, etc) for biodiversity, and in terms of what constitutes strategic areas for biodiversity net gains purposes, until such time as LNRSs are in place:

1) Highest priority:	Priority Habitat (new or improved) within BOAs
2) Next highest priority:	Other habitats within BOAs
3) Medium priority:	Creation of other habitats outside BOAs, but informed by other available NEP work (see Chapter 5 and below)
	.

4) Lower priority but still helpful: Action outside these areas, anywhere else.

In determining where the specific practical measures and projects to improve biodiversity should be prioritised, the NEP's Nature Recovery Working Group will work collaboratively to determine and action a prioritised programme of work for habitat creation and improvement i) in the BOAs and ii) buffering, linking between them and, iii) according to the detailed analysis in the mapping work, in other strategic areas and in urban areas , and take into account other work in progress or being completed recently, which together are building the picture of where the other priorities may be. **This appendix provides details of the work and mapping to date to be factored into this thinking**.

The upcoming Local Nature Recovery Strategies will knit this work together with stakeholder input to produce mapping to show the priorities across the area and the NEP's Nature Recovery Working Group intends to factor the BAP thinking into that process and assist with its delivery.

Project work and mapping to be factored into a prioritised programme of work by the NEP's Nature Recovery Working Group (in advance of Local Nature Recovery Strategies)

1) The NEP's spatial priorities for locating biodiversity "offsets" (biodiversity gains external to the development site that caused the need for them)

This mapping resulted from local preparation for biodiversity net gain requirements to identify where offsets should be prioritised. It is based on prioritising Biodiversity Opportunity Areas, buffers around them and identifies areas of linkage between them, based on coverage of woodland and grassland, important freshwater areas and other high value sites (see Map 11, below).

To produce the map, the NEP worked with its partners and with current practitioner, Warwickshire County Council, to create a map of the priority areas to which biodiversity offsets should be directed. The resulting map, below, prioritises two zones, with a third covering all other parts of the area. In so-doing, this adheres to the prioritisation framework of the BAP as outlined above and at Chapter 5:

- i. Strategic areas: Biodiversity Opportunity Areas (BOAs)
- ii. Semi-strategic areas: based on grassland and woodland coverage, creating buffers around the BOAs, linkages between BOAs and incorporating other high-value sites not already included (including SSSIs not within the strategic areas, wetland and heathland habitats from Natural England's Priority Habitat mapping (lowland fens and heaths) and important freshwater areas for the Thame catchment (the only catchment data then available), plus additional linkages based on expert input, including for the Ray, Thame and Ouse valleys.
- iii. Non-strategic areas: all other areas in the county

In the NEP-designed biodiversity net gain scheme, the NEP's working group favoured maximum incentivisation for offsets to be targeted towards the areas where there is significant coverage of woodland or grassland habitats, but not enough to be considered functional, i.e. targeting where it can make the most difference. BOAs remained the key targeted areas, however.

It is intended that the strategic, semi-strategic and non-strategic areas identified here for helping to guide offset locations, alongside a host of other criteria, are taken into account by NEP-Chaired Expert Panel, in relation to the selection of suitable offset locations.

Full details of the methodology and production of this map can be found on the NEP website: **bucksmknep.co.uk/biodiversityaccounting/**

Map 11: Priority target areas for biodiversity net gains according to the NEP's latest mapping work (2020). Produced for the NEP by Warwickshire County Council, based on NEP expert input.



2) Natural Capital Mapping-combined biodiversity opportunity areas

As the biodiversity net gains mapping work came to completion, Buckinghamshire Council's natural capital mapping work was completed. The NEP ensured that Milton Keynes was also covered.

The work enables the mapping to:

- 1. Identify the natural assets (baseline habitats) across Buckinghamshire and Milton Keynes [See Maps X and X, Chapter X].
- 2. Model the ecosystem services that are provided by those habitats (see Chapter 3 for summary descriptions; mapping available in the full report⁵⁸).
- 3. Create opportunity maps to show where the opportunity for creating new habitats (woodland, grassland and wetlands) are best place in order to:
 - iv) maximise biodiversity gains, but at the same time, to
 - v) provide a range of other ecosystem services, or multiple benefits.

The resulting opportunity maps for the creation of new woodland, wetland and grassland, where benefits for wildlife/biodiversity is prioritised, and where other services can also be provided (number 3 ii), are shown below. NB: the opportunity maps are also available at field level.

The full Natural Capital Solutions reports, including all the baseline, ecosystem services and opportunity mapping and explanations, are available on the NEP website: <u>bucksmknep.</u> <u>co.uk/projects/natural-capital-mapping/</u>

⁵⁸ Natural Capital Solutions: [add full text for Bucks and MK] full reports available on the NEP website: <u>bucksmknep.co.uk/projects/natural-capital-mapping/</u>

Map 12a: Combined opportunities for new woodland across Buckinghamshire, restricted to areas that are ecologically connected to existing woodlands.



Map 12b: Combined opportunities for new woodland across Milton Keynes, restricted to areas that are ecologically connected to existing woodlands.



Map 13a: Combined opportunities for new semi-natural grasslands across Buckinghamshire, restricted to areas that are ecologically connected to existing grasslands.



Map 13b: Combined opportunities for new semi-natural grasslands across Milton Keynes, restricted to areas that are ecologically connected to existing grasslands.



Map 14a: Combined opportunities for new new wet grasslands and wetlands across Buckinghamshire, restricted to areas that are ecologically connected to existing wetlands.



Map 14b: Combined opportunities for new new wet grasslands and wetlands across Milton Keynes, restricted to areas that are ecologically connected to existing wetlands.



3) The NEP's Green Infrastructure Opportunity zones

In 2018, the NEP produced a map of GI opportunity zones for Buckinghamshire and Milton Keynes, to accompany its earlier *Vision and Principles for the Improvement of Green Infrastructure in Buckinghamshire and Milton Keynes*.⁵⁹ The mapping was based on expert-led exploration of the following:

- Mapped networks of water assets, biodiversity assets and access–"heat maps" of several layers of data (with double-counting removed)–to show where the greatest concentrations are and where the gaps are;
- Understanding of other considerations, including existing settlement and potential areas of development, such as known or likely area of housing and infrastructure development, existing major roads and motorways, Biodiversity Opportunity Areas, the Chilterns AONB;
- Data on flood risk and impacts, index of multiple deprivation and water quality data;
- Known characteristics or GI across Bucks and MK, including issues, needs and threats, so that broad "zones" could be identified;
- Expert views on specific GI opportunities posed for each zone; and,
- Cross-boundary GI strategies and known links.

The resulting Bucks & MK GI opportunity zone maps were guided by the expertise of the NEPs Green Infrastructure and Health Group. The map shows that GI opportunities exist across the whole area, although there are several landscape-scale "opportunity zones" which have specific, large-scale, broad areas of demand for GI and/or provide specific large-scale opportunities for GI in the future, to provide benefits to landscape, wildlife, water and people.

The map is intended as a high-level, discussion starting point and should be read alongside its supporting document⁶⁰ and the NEP's Vision and Principles for the Improvement of Green Infrastructure in Buckinghamshire and Milton Keynes.

Together, this suit of documents provides an area-based, high-level strategic approach to protecting and enhancing GI. To maximising opportunities from it through early and strategic planning for GI assets and their benefits, and to reducing the risk of ad-hoc and unplanned negative consequences to the environment as a result of rapid growth and development.

⁵⁹ Available: bucksmknep.co.uk/projects/vision-and-principles-for-the-improvement-of-green-infrastructure/

⁶⁰ Available: bucksmknep.co.uk/projects/gi-opportunities-mapping

Map 15: The NEP's Green Infrastructure Opportunity Zones



NB: An interactive GI Opportunity Zones map and further details are available on the NEP website: **bucksmknep.co.uk/projects/gi-opportunities-mapping**

4) The NEP's identified key strategic environmental opportunity areas that were fed into the joint Local Nature Partnerships' Oxford-to-Cambridge Growth Arc environmental opportunity mapping

In February 2020, as part of its input into the Oxford to Cambridge Growth Arc environmental opportunities mapping work alongside other Local Nature Partnerships, the NEP took the GI Opportunity Zones to a higher landscape-scale to suggest the following key opportunity areas. This fed into work identified across the Arc with an ambition to double nature.⁶¹

Map 16: Landscape Scale Green Infrastructure and Environmental Opportunity Areas in Buckinghamshire & Milton Keynes



Source: Buckinghamshire & Milton Keynes NEP

⁶¹ More information is available on the NEP website: <u>bucksmknep.co.uk/projects/doubling-nature/</u>

Map 17: Landscape Scale Green Infrastructure and Environmental Opportunity Areas across the Growth Arc (Local Nature Partnerships, 2018)



- 1. Rockingham Forest into John Clare Country
- 2. Nene Washes
- 3. Nene Valley
- 4. Great Fen
- 5. Wildlife corridor linking Great Fen and Ouse Washes
- 6. Ouse Washes
- 7. East Cambridgeshire and Suffolk Fens
- 8. Arc Parkland Forest
- 9. Ouse Valley Corridor
- 10. Wildlife corridor linking Ouse Washes and Wicken Fen Vision
- 11. Wicken Fen Vision
- 12. Cambridge Green Spaces
- 13. Sywell Wood Area
- 14. South East Cambridgeshire Ancient Woodland Cluster
- 15. South of Daventry
- 16. Greensand Ridge into West Cambridge Hundreds
- 17. Gog Magog Hills
- 18. Bedford Green Arcs
- 19. Forest of Marston Vale
- 20. Bedford-Milton Keynes Waterway Park
- 21. Ivel Valley
- 22. Ouzel Valley and Grand Union Canal Corridor
- 23. Milton Keynes Green Spaces
- 24. Whaddon Chase Freedom to Roam Parkland
- 25. Western Valleys and Cotswolds
- 26. Cherwell Valley and Oxford Canal
- 27. Bernwood Forest, Otmoor and River Ray Complex
- 28. The Chilterns
- 29. River Lea
- 30. Aylesbury Woodland Ring featuring Black Poplar Landscape
- 31. Upper Thames, Wytham and Cothill
- 32. River Thame and Cycleway Corridor
- 33. Vale of White Horse and North Wessex Downs
- 34. Burnham Beeches and Black Park
- 35. Colne Valley