M54 to M6 Link Road

TR010054

Volume 6

6.3 Environmental Statement Appendices

Appendix 8.14 Aquatic Invertebrates, Fish and Aquatic Macrophytes

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

January 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

M54 to M6 Link Road

Development Consent Order 202[ ]

6.3 Environmental Statement Appendices

8.14 Aquatic Invertebrates, Fish and Aquatic Macrophytes

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1 Introduction

1.1.1 Highways England are developing a link road between the M54 and M6 to provide a link between Junction 1 of the M54, M6 North and the A460 to Cannock. The M54 to M6 Link Road (herein referred to as 'the Scheme') aims to reduce congestion on local / regional routes, particularly the A449 and A460 and deliver improved transport links to encourage the development of the surrounding area. This appendix has been prepared in respect of aquatic invertebrates and fish relating to the Scheme.

1.1.2 This appendix includes the following information:

- relevant legislation and policy;
- methodologies for desk and field-based assessments undertaken in 2018 and 2019;
- technical competencies of ecologists undertaking the surveys;
- limitations to the surveys undertaken and any assumptions made;
- survey results; and
- the approach for determining the nature conservation importance of aquatic invertebrates and fish populations recorded.

1.1.3 This appendix should be read in conjunction with Chapter 8: Biodiversity of the Environmental Statement (ES) [TR010054/APP/6.1].

2 Relevant Legislation and Policy

2.1.1 Appendix 8.1 Legislation and Policy Framework [TR010054/APP/6.3] provides detail on the legislation that is of direct relevance to the assessment of biodiversity.

2.1.2 Freshwater habitats including standing and running water are listed on Annex I of the 'Habitats Directive (HD 1992)', while several fish and aquatic invertebrates are listed under Annex II,IV and V of the HD. In the UK and wetlands and their resources including lakes and rivers are protected under the Ramsar Convention on Wetlands of International Importance 1971..

2.1.3 The white-clawed crayfish, *Austropotamobius pallipes,* is protected under Schedule 5 of the Wildlife and Countryside Act 1981, along with other aquatic invertebrate species, including leeches (the medicinal leech *Hirudo medicinalis*), bivalves (the freshwater pearl mussel *Margaritifera margaritfera*), coleoptera (the lesser silver beetle *Hydrochara caraboides*, the spangled diving beetle *Graphoderus zonatus* and the Bembridge beetle *Paracymus aeneus*) and odonata (the southern damselfly *Coenagrion mercuriale* and the Norfolk aeshna *Aeshna isosceles*).

2.1.4 Proposed developments or activities that have the potential to affect the water environment require a Water Framework Directive Assessment.

2.1.5 All migratory and freshwater fish stocks are protected in line with the Salmon and Freshwater Fisheries Act (1975).

2.2 Planning policy

2.2.1 Full details of national and local planning policy relevant to nature conservation is provided in Appendix 8.1 Legislation and Policy Framework [TR010054/APP/6.3] and a summary is provided in Chapter 8: Biodiversity of the ES [TR010054/APP/6.1].

2.3 Priority species

2.3.1 Some fish, invertebrates and white-clawed crayfish are listed on the Natural Environment and Rural Communities Act (NERC) 2006 (refer to Appendix 8.1 [TR010054/APP/6.3]) whose conservation is therefore a material planning concern.

2.3.2 The Staffordshire Biodiversity Action Plan (SBAP) 3rd edition (Ref 1) works at a landscape scale and replaces previous habitat and species action plans with Ecosystem Action Plans (EAP) and a River Action Plan for the county. The Scheme falls within the ‘Central Farmland’ EAP, which targets floodplain grazing marsh, eutrophic standing water, fens, ponds, and reedbeds. The waterbodies listed have the potential to provide important habitat for fish, macroinvertebrates and white-clawed crayfish.

3 Methodology

3.1 Desk study

3.1.1 Records for aquatic macrophytes, invertebrates and fish from Staffordshire Ecological Record Centre (SERC), and the ecological database for Birmingham and the Black Country (EcoRecord) were obtained in 2018 for 2 km from the Scheme boundary. This distance is considered appropriate to obtain an indication of aquatic invertebrates and fish within the wider landscape.

3.1.2 For fish, records from the last 10 years have been detailed in the assessment, where these were returned. Where only a historic (i.e. over 10 years old) record was returned this has been used for context where more recent records do not exist.

3.1.3 Aquatic invertebrate populations may fluctuate in response to natural and human-caused events. Therefore, only records from the last three years were considered in the baseline study; older records were considered to offer limited value in determining current presence and distribution of aquatic invertebrates.

3.1.4 In addition to the above, the Multi-Agency Geographic Information for the Countryside (MAGIC) Interactive Maps was consulted in September 2019 to identify designated habitats and species.

3.1.5 Furthermore, to inform the presence and conservation value of fish and macroinvertebrates, data were requested from the Environment Agency and angling club.

3.1.6 This desk study data has been used to inform assumptions in relation to aquatic invertebrates and fish where field data is incomplete, or access was not possible.

3.2 Field survey

Surveyor competency

3.2.1 The aquatic assessment has three key areas, fish, macroinvertebrates and white-clawed crayfish. A specialist in each of these areas led the surveys, data analysis and reporting. The fisheries lead has over 11 years' experience specialising in fish stock assessment, passage, habitat degradation and improvement. The macroinvertebrate lead has over 15 years' experience in overseeing the processing of freshwater macroinvertebrates and specialises in mixed-taxon analysis. The white-clawed crayfish specialist has over 13 years' experience as an aquatic biologist specialising in freshwater ecological monitoring, macroinvertebrate surveys, data analysis and reporting, including white-clawed crayfish (licence number 2017-31214-CLS-CLS or 2016-23822-CLS-CLS) registered to use the Class Licence CL11 (White-clawed crayfish survey).

Scoping

3.2.2 Fisheries, aquatic macroinvertebrate and white-clawed crayfish walk over surveys were conducted on the 21st and 22nd May 2019 by experienced aquatic ecologists to identify sensitive aquatic habitats potentially threatened by the Scheme. This involved assessing waterbodies within the 2 km Scheme boundary that could potentially be impacted by the Scheme as identified by the WFD (WFD)assessment. Those water bodies expected to be impacted by the Scheme, from south to north are shown in Table 3.1. This included scoping out some water bodies outside of the Scheme boundary in addition to those scoped out of the WFD as they were not expected to be impacted.

3.2.3 Three ponds (Chubb Angling Ponds (x2) and the Pond near Watercourse 5, Brookfields Fishery) (refer to Figure 8.34 for locations [TR010054/APP/6.2]) were scoped out from further fisheries and white-clawed crayfish assessment because they are standing water bodies located outside of the Scheme boundary with no connection to the Scheme. Furthermore, the fishing ponds are expected to hold those species typically stocked for angling such as carp, perch and roach, while the pond habitats are unlikely to support white-clawed crayfish.

3.2.4 The habitat at Watercourses 2 and 5 has the potential to support white-clawed crayfish and therefore they were scoped in for more detailed surveys, while Watercourse 3, 4 and 6 did not have suitable habitat for white-clawed crayfish and were therefore scoped out (refer to Figure 8.34 for locations [TR010054/APP/6.2]).

3.2.5 Watercourse 3 (outside the Scheme boundary), 4 (outside the Scheme boundary) and 6 (refer to Figure 8.34 for locations [TR010054/APP/6.2]) were also scoped out for macroinvertebrate surveys as the Scheme is not expected to impact these Watercourses at these locations.

3.2.6 Watercourse 3 at its furthest upstream section within the Scheme boundary is connected to Lower Pool and it is this area of the watercourse that will be directly impacted by the Scheme. This section on Watercourse 3 is epithermal and was dry during the summer walkover and surveys and was therefore scoped out as the Scheme is not expected to impact this watercourse at this location

3.2.7 Fish are a mobile species and can migrate long distances and are likely to move between areas for breeding, feeding and spawning, for this reason they were scoped in for Watercourse 2, 3, 4, 5 and 6, even though some of these watercourses are outside of the Scheme boundary.

Table 3.1: Survey sites, location and proposed aquatic survey methods (refer to Figure 8.34 for locations [TR010054/APP/6.2])

Surface waterbody (site)	Grid reference	Aquatic survey method or sites scope out		
		Fish	Invertebrate	White-clawed crayfish
Fishing ponds				
Tower House Pool	SJ94512 04762	eDNA*	PSYMS +	eDNA

Surface waterbody (site)	Grid reference	Aquatic survey method or sites scope out		
		Fish	**Invertebrate**	**White-clawed crayfish**
Lower pool	SJ94727 05336	eDNA*	PSYMS +	eDNA
Brookfield Fishery	SJ95109 06327	Scoped out	PSYMS +	Scoped out
Brookfield Farm Pond 1	SJ95249 06080	eDNA*	PSYMS +	eDNA
Brookfield Farm Pond 2	SJ95290 06025	eDNA*	PSYMS +	eDNA
Brookfield Farm Pond 3	SJ95372 05980	Scoped out	PSYMS +	Scoped out
Chubb Pond 1 & 2	SJ94944 05306	Scoped out	PSYMS +	Scoped out
Pond near Watercourse 5a	SJ95417 06523	Scoped out, outside the Scheme boundary		
Watercourses				
Watercourse 1	SJ93386 04862	No land access		
Watercourse 2	SJ94339 04793	Electric fish	Invertebrate	Kick-sampling / netting (unsuitable for trapping and hand search)
Watercourse 3	SJ94032 05876	Electric fish	Scoped out for invert and crayfish	
Watercourse 4	SJ95043 06677	Electric fish	Scoped out for invert and crayfish	
Watercourse 5a	SJ95511 06509	Electric fish	Invertebrate	Trapping + hand search
Watercourse 5b	SJ94159 07254	Electric fish	Scoped out for invert and crayfish	
Watercourse 6	SJ95740 07644	Electric fish	Scoped out for invert and crayfish	
Watercourse 7	SJ 92138 04571	Scoped out because the Signage works proposed within the area are not expected to have any physical impact on the Watercourse or aquatic biota		
Brookfield ditch (Watercourse 4)	SJ95280 06015	Scoped out	Invertebrate	Scoped out

Fisheries Data Collection

Ponds

3.2.8 Environmental DNA (eDNA) surveys were completed for fish and white-clawed crayfish on the 21st and 22nd of May 2019 at the four ponds Tower House Pool, Lower Pool and Brookfield Farm Ponds 1 and 2 identified within the Scheme boundary (refer to Figure 8.34 for locations [TR010054/APP/6.2]), using commercial eDNA extraction kits. For each pond, 20 water samples were taken from around the margins with a clean bottle and the pond water was mixed well before being filtered. The pond water was pushed through a filter until the syringe pressure increased so no more water could be pushed through. The total volume of pond water that passed through the filter was recorded. The eDNA kits were then sent to NatureMetrics for processing and data analysis.

3.2.9 Species presence/absence data was collected from angling clubs for Tower House and Lower Pool fishing ponds, angler catch data was not available. No contact could be made with the Brookfield Farm fishing club for Ponds 1 and 2 and therefore no presence/absence data was collected.

Watercourses

3.2.10 Six watercourses were identified for fisheries assessment of which Watercourse 2 and 5a are the only watercourses within the Scheme boundary. Watercourses 3, 4, 5b and 6 were also identified as important sites for fisheries surveys because potential impacts from the Scheme could have indirect impacts on downstream reaches outside the Scheme boundary (refer to Table 3.2:). Fisheries surveys were completed by a specialist fisheries team in August 2019 to identify species and available habitat present.

3.2.11 Single run electric fishing surveys were carried out for each site using an Electracatch WFC4 in line with the standard Environment Agency methodology (Ref 2). Surveys were conducted by two operatives (one anode operator and one netsman) wading in an upstream direction covering a minimum length of 10 times the river width (e.g. a 3 m wide river would have a minimum survey length of 30 m). The length of river surveyed for each site varied due to difficulties accessing the river because of dense vegetation and overgrown banks covering the river, therefore it is not advised that catches between sites are compared as the survey areas are not comparable.

3.2.12 Immobilised fish were captured using hand-nets and transferred to holding tanks prior to data collection. Fish were identified to species level, measured to fork length (mm) and held in oxygenated tanks before being released at the site unharmed, close to where they were captured following completion of data collection.

3.2.13 Instream habitat surveys were conducted for each survey site to collect information on a variety of habitat characteristics important for fish. Average water depth (to the nearest 0.1 m) and wetted river width (to the nearest 0.1 m) were recorded. Substratum [bedrock, boulders (> 25.6 cm longest axis length), cobbles (6.4–25.6 cm), pebbles (1.6-6.4 cm), gravel (0.2–1.6 cm), fine sand (< 0.2 cm)] and flow (riffle, run, pool, glide or no perceptible flow) categories were recorded as a percentage according to their contribution by surface area.

Table 3.2: Fisheries survey site details August 2019

Site	NGR	Survey date	Length (m)/	Mean width (m)	Area (m^2)
Watercourse 2	SJ94339 04793	19/08/19	20	0.5	10
Watercourse 3	SJ94032 05876	20/08/19	40	1.2	48
Watercourse 4	SJ95043 06677	20/08/19	20	1.0	20
Watercourse 5a	SJ95511 06509	20/08/19	100	2.5	250
Watercourse 5b	SJ94159 07254	20/08/19	40	1.0	40
Watercourse 6	SJ95740 07644	20/08/19	20	0.8	16

Macroinvertebrate survey

Ponds

3.2.14 The pond survey followed the Predictive SYstem for Multimetrics (PSYM) (Ref 3) method and were completed 5th and 6th August 2019 for ponds listed in Table 3.1. This is a standard method which provides an assessment of the biological quality of a pond which includes collection of physical data, invertebrate sampling and macrophyte recording. Surveys were carried out within the optimal PSYM survey season (summer).

3.2.15 Macroinvertebrates were 'kick/sweep sampled' for three minutes follows by a one-minute hand search of larger substrates using a standard Freshwater Biological Association (FBA) pattern pond net (mesh size: 1 mm) in line with the PSYM methodology.

3.2.16 Pond macrophytes were surveyed by walking or wading the entire perimeter of the dry and shallow water areas of the water body. Deeper water areas were sampled by grapnel thrown from shallow water or the bank. The aim of plant recording was to make a complete list of wetland plants present within the outer edge of the pond.

3.2.17 The data was used to undertake an analysis to compare the pond against a national database held by the Freshwater Habitats Trust (FHT). The data was submitted to FHT for analysis.

Watercourses

3.2.18 The sampling was conducted within the optimal spring (21st May 2019) and autumn (2nd September 2019) survey season for macroinvertebrate sampling for Watercourses 2 and 5a. Brookfield ditch was only sampled in spring, as it was too shallow and overgrown in September. Weather conditions at the time of the survey were dry and the watercourses were not in spate.

3.2.19 At each sample site a macroinvertebrate sample was taken by an experienced aquatic ecologist, using a standard Freshwater Biological Association (FBA) pattern pond net (mesh size: 1 mm), in line with the standard Environment Agency methodology (Ref 4).

3.2.20 At each sample site, the instream habitats were 'kick sampled' for three minutes followed by a one-minute hand search of larger substrates. Specimens found during the hand-search were added to the sample for subsequent laboratory analysis.

Data analysis

3.2.21 For both the watercourses and the ponds, the macroinvertebrate samples were preserved in industrial methylated spirits (70%) for laboratory processing.

3.2.22 Detailed sorting of the entire samples was carried-out by a trained and experienced taxonomist in the laboratory using stereo-microscopes (under low power) and appropriate identification keys in line with Environment Agency guidance (Ref 4). Macroinvertebrates were identified to 'mixed taxon level' (Ref 4) which is to species level (where practicable) for most groups.

3.2.23 Macroinvertebrates removed from the samples were preserved and are stored until it is confirmed they are longer be required.

3.2.24 The results were used to calculate pressure-specific biotic indices for each site:

- Whalley, Hawkes, Paisley and Trigg (WHPT) metric (Ref 5)– used as an indicator of organic pollution/ general degradation in rivers;
- WHPT Average Score Per taxon (ASPT) – used as an indicator of organic pollution and more reliable than WHPT in cases of low taxon richness for flowing and still waters;
- Proportion of Sediment-sensitive Invertebrates (PSI) – used to indicate the level of sedimentation at a site (flowing water only) (Ref 5);
- Lotic-Invertebrate index for Flow Evaluation (LIFE) – used to evaluate the flow regime at a site (flowing water only) (Ref 6); and
- Community Conservation Index (CCI) – used to indicate the conservation value of macroinvertebrates at a site (flowing and still water) (Ref 7). In addition, to assess the overall biological quality of a ponds, data was submitted to the FHT where PSYM was used to provide General Quality Assessment (GQA) and GQA % Scores.

3.2.25 The macroinvertebrate data (historic records, survey records) were checked against relevant legislation WFD, Habitats Directive and published Joint Nature Conservation Committee (JNCC) reviews for specific macroinvertebrate groups.

Whalley, Hawkes, Paisley * Trigg (WHPT) Metric

3.2.26 There are approximately 4,000 species of aquatic macroinvertebrates in the British Isles. To simplify the analysis of the samples and the data, identification to individual species is not required for the WHPT metric but only the major types (taxa), mostly at the family taxonomic level. A key piece of information is the number of different taxa at a site. A fall in the number of taxa indicates ecological damage, including pollution (organic, toxic and physical pollution such as siltation, and damage to habitats or the river channel).

3.2.27 The WHPT scoring system (Ref 8) is based upon the sensitivity of macroinvertebrate families to organic pollution. It replaces the Biological Monitoring Working Party (BMWP) system (Ref 9) previously used in the UK.

3.2.28 The WHPT system assigns a numerical value to about 100 different taxa (known as the WHPT-scoring taxa) according to their sensitivity to organic pollution. In addition to the presence of macroinvertebrate taxa at a sampling site, as in the BMWP scoring system, the WHPT system also uses another type of information, this being the abundances of different scoring taxa.

3.2.29 Taxa abundances are classified in four categories (Class 1: 1 to 10 individuals, Class 2: 11 to 100 individuals, Class 3: 101 to 1,000 individuals, and Class 4: > 1,000 individuals). A score (Pressure Sensitivity Scores (PSS) is then assigned to each taxa, depending of the taxa sensitivity and abundances recorded.

3.2.30 The total WHPT score for a sample corresponds to the sum of PSs of scoring taxa recorded. The Average Score Per Taxon (ASPT) values are calculated as the Sum PSs divided by the number of scoring taxa (NTAXA). As such, WHPT score, NTAXA and ASPT are calculated.

3.2.31 Some animals are more susceptible to organic pollution than others, and the presence of sensitive species indicates good water quality. This fact is considered by the WHPT metrics.

3.2.32 The most useful way of summarising the biological data was found to be one that integrates the number of taxa and the ASPT. The best quality is indicated by a diverse variety of taxa, especially those that are sensitive to pollution. Poorer quality is indicated by a smaller than expected number of taxa, particularly those that are sensitive to pollution. Organic pollution sometimes encourages an increased abundance of the few taxa that are tolerant. Additionally, maximum achievable values will vary between geological regions. For example, pristine lowland streams in East Anglia will always score lower than pristine Welsh mountain streams because they are unable to support many of the high-scoring taxa associated with fast flowing habitat. WHPT scores and ASPT for different types watercourse are dependent on the quality and diversity of habitat, natural water chemistry (associated with geology, distance from source etc.), altitude, gradient, time of year the sample was taken and other factors.

Proportion of sediment-sensitive invertebrates (PSI)

3.2.33 The Proportion of Sediment-sensitive Invertebrates (PSI) index (Ref 5) provides an assessment of the extent to which the river bed is composed of, or covered by, fine sediments (Table 3.3).

3.2.34 Under the assessment, individual species of aquatic macroinvertebrates are assigned a Fine Sediment Sensitivity Rating (FSSR) raging from A to B, as detailed in the Table B1 below. The PSI score for a macroinvertebrate sample is then derived from individual species scores and abundances, as detailed on the Table 3.3 below. The PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample. PSI score for a sample ranges from 0 to 100 where lowest scores correspond to watercourses with high fine sediment cover (Table 3.4 and 3.5).

Table 3.3: Fine Sediment Sensitivity rating (FSSR) groups used to derive PSI scores (Ref 5)

FSSR group	Description
A	Highly sensitive
B	Moderately insensitive
C	Moderately insensitive
D	Highly insensitive

Table 3.4: Abundance categories used to derive PSI scores (Ref 5)

FSSR group	Abundance			
	1-9	10-99	100-999	>999
A	2	3	4	5
B	1	2	3	4
C	1	2	3	4
D	2	3	4	5

Table 3.5: Interpretation of PSI scores (Ref 5)

PSI	Description
81-100	Minimally sedimented / Un sedimented
61-80	Slightly sedimented
41-60	Moderately sedimented
21-40	Sedimented
0-20	Heavily sedimented

Lotic-invertebrate Index for Flow Evaluation

3.2.35 The Lotic-Invertebrate Index for Flow Evaluation (LIFE) provides an assessment of the impact of variable flows on benthic macroinvertebrate communities. Under the assessment, individual species of aquatic macroinvertebrates are assigned to a flow group varying from I to VI, as detailed on the Table 3.6 below. The LIFE score for a macroinvertebrate sample is then derived (mean of individual scores) from individual species scores and abundances, as detailed on the Table 3.7 and 3.8 below. LIFE scores for a macroinvertebrate sample ranges from 1 to 12, where highest scores describe communities adapted to rapid flows (Table 3.8).

Table 3.6: Flow groups used to derive LIFE scores (Ref 6)

LIFE score Group	Description	Mean current velocity
I	Taxa primarily associated with rapid flows	Typically > 100 $cm.s^{-1}$
II	Taxa primarily associated with moderate to fast flows	Typically 20 to 100 $cm.s^{-1}$
III	Taxa primarily associated with slow or sluggish flows	Typically < 20 $cm.s^{-1}$
IV	Taxa primarily associated with (usually slow) and standing waters	
V	Taxa primarily associated with standing waters	
VI	Taxa frequently associated with drying or drought impacted sites	

Table 3.7: Abundance categories used to derive LIFE scores (Ref 9)

Abundance category	Description
A	1 to 9
B	10 to 99
C	100 to 999
D	1000 to 9999
E	> 10000

Table 3.8: A guide to interpreting LIFE scores (Ref 9)

Flow groups	Abundance categories			
	A	B	C	D/E
I	9	10	11	12
II	8	9	10	11
III	7	7	7	7
IV	6	5	4	3
V	5	4	3	2
VI	4	3	2	1

Community Conservation Index (CCI)

3.2.36 The Community Conservation Index (Ref 7) allows a classification of the nature conservation value associated with a macroinvertebrate community. The CCI score for one sample is derived from individual Conservation Scores (CS), assigned to some species of aquatic macroinvertebrates and relating closely to the available published Red Data Books (Ref 10 and 11). Conservation Scores assigned to individual species vary from 1 to 10, as detailed on the Table 3.9 below. The derived CCI scores generally vary from 0 to > 20, as detailed in the Table 3.10 below. The Table B3 below provides a guide to interpreting CCI scores.

Table 3.9: Conservation Scores from the Community Conservation Index (Ref 7)

Conservation Score	Relation to Red Data Books
10	RDB1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (but not RDB status)
6	Regionally notable
5	Local
4	Occasional (species not in categories 10-5, which occur in up to 10% of all samples from similar habitats)
3	Frequent (species not in categories 10-5, which occur in up to >10-25% of all samples from similar habitats)
2	Common (species not in categories 10-5, which occur in up to >25-50% of all samples from similar habitats)
1	Very common (species not in categories 10-5, which occur in up to >50-100 % of all samples from similar habitats)

Table 3.10: General guide to CCI scores (Ref 7)

CCI Score	Description	Interpretation
0 to 5.0	Sites supporting only common species and/or community of low taxon richness	Low conservation value
> 5.0 to 10.0	Sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness	Moderate conservation value
> 10.0 to 15.0	Sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness	Fairly high conservation value
> 15.0 to 20.0	Sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness	High conservation value
> 20.0	Sites supporting several rarities, including species of national importance and/or a community of very high taxon richness	Very high conservation value

White-clawed crayfish survey

Ponds

3.2.37 eDNA surveys were completed 21st and 22nd of May 2019 at the four ponds identified within the Scheme boundary in line with the method outlined above.

Watercourses

3.2.38 White-clawed crayfish surveys were completed on Watercourse 2 and 5 (Latherford Brook) on the 5th and 6th August 2019. Watercourse 2 was deemed to have low habitat potential for white-clawed crayfish and unsuitable for manual search and trapping surveys. Ttherefore additional surveys were only carried out on Latherford Brook on the 2nd and 3rd of September only, as repeating the sampling within a season improves the chance of detecting the presence of white-clawed crayfish. Surveys were undertaken during the optimal survey season for white-clawed crayfish by a specialist team of two, led by an experienced white-clawed crayfish license holder (2016-23822-CLS-CLS) using a Class Licence CL11.

3.2.39 On Watercourse 2, a 200 m stretch was surveyed between SJ 94242 04899 and SJ 94408 04762. Habitat suitable for white-clawed crayfish was limited, with a low number of potential suitable habitat refuges and therefore it was not possible to conduct a manual search survey. In addition, the watercourse was too shallow for trapping. Therefore, the watercourse was surveyed by kick – sweep sampling at discreet locations using a standard FBA pattern pond net.

3.2.40 On Watercourse 5a, a 500 m stretch was surveyed between SJ 95499 06514 and SJ 95788 06261 involving a range of survey techniques following standard survey protocols (Ref 12), including manual searching and kick – sweep sampling (using a standard FBA pattern pond net) and trapping. Given the limited amount of refuges to manually search, it was not possible to select discreet survey sites as per standard survey protocols. Therefore, a total of three patches of 10 refuges were manually searched throughout the survey area on the 5th August 2019.

3.2.41 In addition, white-clawed crayfish trapping surveys were undertaken at Watercourse 5a on the 5th and 6th August and again on the 2nd and 3rd September. During the first trapping survey, 10 baited crayfish traps were set and during the second trapping survey, 15 baited crayfish traps were set. The traps were set in deep areas of the watercourse that could not be manually searched but had potential refuges for white-clawed crayfish, such as tree roots or undercut banks. During each trapping survey, the traps were set in the afternoon, left overnight and retrieved the following morning.

Nature conservation evaluation

3.2.42 The evaluation of ecological importance for aquatic invertebrates, fish and macrophytes was defined in terms of the following geographical context:

- international and European – population of aquatic invertebrates or fish which results in the designation of, or would meet the criteria of a qualifying feature for designation of an internationally designated site, such as Special Areas of Conservation (SAC);
- national (England) – population of aquatic invertebrates or fish which results in the designation of nationally designated sites such as SSSI or aquatic invertebrates or fish populations that would meet SSSI criteria but are not currently designated;
- regional (West Midlands) - populations that occur within regionally important sites or localities, and whose loss would significantly affect the regional distribution of aquatic invertebrates or fish;
- county (Staffordshire) - populations of aquatic invertebrates or fish which qualify for designation as a local wildlife site (LWS) known in Staffordshire as sites of biological importance (SBI); and
- local (South Staffordshire); populations of aquatic invertebrates or fish which qualify for designation as a biodiversity alert sites (BAS); or undesignated populations that contribute to the maintenance of aquatic invertebrates or fish at a local level.

3.2.43 Characteristics used to determine the geographical importance of aquatic invertebrates, fish and aquatic macrophytes include, but were not limited to, the following taken from the Ratcliffe criteria (Ref 13):

- fragility: of supporting habitats, such as ponds/watercourses prone to drying out;
- rarity: distribution of aquatic invertebrates and fish with the area under consideration;

- size: dependent on population sizes within a given area;
- habitat diversity: affecting provision of breeding, foraging and hibernation opportunities;
- typicalness: white-clawed crayfish are present in rivers, streams, lakes and canals and prefer mineral rich waters. Fish are present within online watercourses or off line ponds/lakes which have been stocked or where larvae/eggs have been transferred by humans or animals. Aquatic invertebrates are present in a wide range of watercourse or waterbodies where sufficient oxygen is present;
- position with the ecological/geological unit: connectivity of suitable habitat to other populations within the wider landscape;
- recorded history: stable, well connected populations with flexibility to move between suitable habitats in differing conditions; and
- naturalness: availability of suitable habitats not subject to significant human interference.

3.2.44 Use has been made of the following when assessing Importance:

- for SSSIs, the guidelines for selection in relation to freshwater fish (Ref 14) and freshwater invertebrates (Ref 15) have been used;
- there are no guidelines for assessing fish population in the context of Staffordshire; however, guidelines for the selection of SBIs in Staffordshire (Ref 9) have been used to assess the importance of aquatic invertebrates in a county context. This includes any sites that support a substantial (1000 or more) breeding population of white-clawed crayfish.
- BAS are sites of local rather than county importance in Staffordshire and are stated as being “of lower intrinsic quality, smaller size or damage or disturbance. Nevertheless, they collectively form a significant part of the County’s nature conservation resource, and in some cases a valuable ‘reserve series’ for some of the Sites of Biological Importance. The degree of protection merited by each site needs to be assessed on an individual basis and in the light of prevailing circumstances. Both SBIs and BASs contribute significantly to the maintenance of biodiversity in the wider countryside, now recognised as a major local and national objective” There are no guidelines for the selection of BAS in relation to fish or aquatic invertebrates, therefore this has been considered on a site by site basis.

Assumptions and limitations

Desk study

3.2.45 The information collected from the desk study represents only those records submitted to records centres and is therefore not considered to be a definitive list of aquatic invertebrates and fish identified within the 2 km of the Scheme boundary. If records have not been provided, this does not confirm absence from the study area.

3.2.46 The following are inherent limitations of a desk study which includes obtaining data from a Biological Records Centre (BRC):

- recorder bias - biological records are not a representation of the distribution of species within the study area, only records of those species, so the dataset provided by a BRC may be biased towards the favoured locations / 'patches' of taxonomic preference of local recorders (and the locations / favoured 'patches' of those recorders) and the presence (or absence) of specialist recording groups within that county or vice county;
- incomplete data – the current dataset held by a BRC is considered to be the most accurate and most up-to-date representation of species within each BRC boundary although records are largely random. Where atlases which have systematically surveyed for taxonomic groups within a given area are available these records therein are a more accurate picture of species assemblage and distribution;
- data availability lag - resources at BRCs can be limited, which can lead to a lag between the time that records are submitted by recorders and the time that they are verified and entered into the database for that county. Additionally, special interest recording groups (which often hold their own datasets) may only submit their records annually (if at all) which causes further lag in dataset accuracy; and
- changes in data due to the verification process – where new information or specialist knowledge sheds light on the validity of recent or historical submitted records, the verification process may add or remove records which may alter the results of a desk study over time.

Field survey

3.2.47 Watercourse 2 was too shallow to be manually searched or trapped and potential white-clawed crayfish refuges were limited throughout the survey stretch. Therefore, the results are not expected to be affected as white-clawed crayfish are not expected to be present in this watercourse.

3.2.48 Water turbidity in Watercourse 5a was moderate during the manual white-clawed crayfish search undertaken on the 5th August and the bed was covered by a high abundance of overlain sand. The combination of these two factors could have impacted the efficiency of the manual search; however, combined with the trapping technique, this is not anticipated to have significantly affected the outcome of the assessment.

3.2.49 Watercourse 1 was not surveyed as land access was not possible.

3.2.50 The area of each fish survey site differed due to overgrown vegetation restricting access at some sites, therefore fish numbers could underrepresent the population present.

3.2.51 The sampling methods for macroinvertebrates used allow characterisation of the invertebrate communities and establish the biological quality of freshwater habitats; however, it is not intended to be the case that they generate a comprehensive list of every taxon present. This is generally accepted as a limitation within surveys of this nature for aquatic macroinvertebrates. It is not considered that this would significantly influence the quality assessment of the water bodies being assessed.

3.2.52 There were no limitations to the macroinvertebrate surveys except Brookfield Ditch (Watercourse 4) (See 3.2.57 below), all of which were undertaken within optimal seasonal windows and therefore provided a good indication of the macroinvertebrate species groups likely to be present.

3.2.53 The surveys recorded species/Taxa and conditions that could be identified at the specific time of the survey and other species/Taxa that may be present at other times of year, sporadically and/or in low numbers may not have been recorded.

3.2.54 During autumn sampling, Brookfield Ditch was overgrown with very low flows therefore the site was not sampled for macroinvertebrates. It is possible that the absence of the autumn sample has led to an underestimation of the diversity of the macroinvertebrate community and hence of the value of the community present in the ditch. However, the sample collected in spring would still give a good estimation of the diversity of invertebrate families present in the ditch and this is unlikely to have significantly affected metrics such as WHPT or ASPT.

4 Results

4.1 Desk Study

4.1.1 No historical data was returned for fish, macroinvertebrate and white-clawed crayfish data within a 2 km boundary of the proposed Scheme, except for historical angling data reporting the stocking of carp, perch and roach in Tower House Pool and Lower Pool.

4.1.2 Water fern *Azolla filiculoides*, Canadian waterweed *Elodea canadensis* and Himalayan Balsam *Impatiends glandulifera* were recorded at Northycote, 1.5 km from the Scheme in 2000, 2004 and 2009, respectively. All these plant species are have moderate designation by Schedule 9 of the Wildlife and Countryside Act as plant species that not naturally occur in Great Britain but have become established in the wild and represent a threat to the natural flora.

4.2 Scoping

4.2.1 Eight ponds all apparently used for fishing are located within 100 m of the Scheme boundary and were visited during the site walk over to assess if further aquatic surveys were needed. Four ponds all within the Scheme boundary were scoped in for fish and white-clawed crayfish assessment as they are expected to experience direct or indirect impacts from the Scheme; these were Tower House Pool, Lower Pool, Brookfield Farm Ponds 1 and 2. Brookfield Fishery and Chubb Ponds are outside the Scheme boundary and are not expected to be impacted by the Scheme. Brookfield Farm Pond 3 is on the boundary of the Scheme and connected to Brookfield Farm Pond 2 via a pipe and therefore eDNA results from Brookfield Farm Pond 2 are expected to be representative of Brookfield Farm Pond 3.

4.2.2 Seven ponds were scoped in for macroinvertebrate surveys, this included the four ponds that were surveyed for fish and white-clawed crayfish, in addition to three pond outside of the Scheme boundary, these were Brookfield Fishery, Brookfield Farm Pond 3 and Chubb Pond 1

4.2.3 Eight watercourses are located within the Scheme boundary (Watercourses 1 – 5) or immediately downstream of the Scheme (Watercourse 6 – 9) and were visited during the site walk over to assess if further aquatic surveys were needed. Six watercourses were scoped in for fisheries surveys; these were Watercourses 2 to 6, including Watercourse 5b an additional site downstream of Watercourse 5a and to the west of the Scheme boundary. Three waterbodies were scoped in for macroinvertebrate surveys; these were Watercourses 2, 5a and Brookfield Ditch (Watercourse 4 within the scheme boundary); and only two water bodies scoped in for white-clawed crayfish surveys, these were Watercourses 2 and 5a. Watercourse 1 was scoped in for further assessment, but access was not permitted. Watercourse 7, although within the Scheme boundary, was scoped out of further aquatic survey because it is not connected to any of the other watercourses within the Scheme boundary and the signage works proposed within the area are not expected to have any physical impact on the Watercourse or aquatic biota.

4.3 Field survey

Fisheries survey data

eDNA

4.3.1 Carp, perch and roach were detected in the Tower House Pool and Lower Pool (Plates 1 and 2, respectively) from the eDNA samples, and are listed in order of confidence of detection; in addition there was low detection of gudgeon at Tower House Pool and tench at Lower Pool (Table 4.1). Roach, carp and perch were detected in Brookfield Farm Fishing Ponds 1 and 2 (Plates 3 and 4, respectively), listed in order of confidence of detection, in addition to low detection of tench in Brookfield Farm Fishing Pond 1 (Table 4.1).

Plate 1: Tower House Pool

Plate 2: Lower Pool

Plate 3: Brookfield Farm Pond 1

Plate 4: Brookfield Farm Pond 2

Table 4.1: Fisheries eDNA results showing the proportion of sequencing output allocated to the different species at four Ponds*.

Site	Carp	Perch	Roach	Tench	Gudgeon
Tower House Pool	37.09	32.57	24.31	0.00	6.04
Lower Pool	48.55	41.65	8.04	1.75	0.00
Brookfield Farm Pond 1	31.57	28.73	38.12	1.59	0.00
Brookfield Farm Pond 2	29.68	28.14	42.18	0.00	0.00

* Care should be taken when interpreting the numbers in terms of relative abundance, these numbers represent the proportion of the total DNA detected from each species and do not represent the number or percentage abundance of each species present and should not be used to compare between sites. The higher the proportion detected can be interpreted as lending a greater confidence that the species is currently present.

4.3.2 The fishery owner of Tower House Pool has confirmed the fishery is stocked with carp, perch, roach and gudgeon which are consistent with the eDNA results.

Electric fishing and habitat survey results

Watercourse 2

4.3.3 Watercourse 2 (Plates 5 and 6) is a small watercourse in a suburban setting surrounded by roads, rough pasture and Tower House fishing pond is nearby. It's width is on average 0.5 m and was extremely shallow in some sections with an average depth of 0.40 m. Flow characteristics were dominated by shallow run (80 %) and riffle (20 %) and the bed substrate was dominated by gravel (40 %) and sand (40 %), with small areas covered by cobbles (10 %) and pebbles (10%). Shading of Watercourse 2 was high (90 %), mainly resulting from bankside trees and shrubs, while instream shading was dominated by rocky substrate (20 %) and macrophytes (20 %).

4.3.4 Two fish species were captured at Watercourse 2, three bullhead (Plate 7) and one perch all of which were adult fish (Tables 4.2 and 4.3).

Plate 5: Watercourse 2 bottom of site

Plate 6: Watercourse 2 top of site

Plate 7: Bullhead 114 mm in length

Watercourse 3

4.3.5 Watercourse 3 (Plate 8) is also a small watercourse and the surrounding land use is mainly agricultural and rough pasture. The head waters of Watercourse 3 located to the west of Lower Pool and within the Scheme boundary were dry when visited on 21st May and so the electric fishing survey was relocated outside of the Scheme boundary, to the west of Kings Pools Fishery. Its width is on average 1.2 m and average depth of 0.20 m. Flow characteristics were dominated by shallow glide (80 %), riffle (10 %) and small pool areas (10 %), while bed substrate was dominated by silt (80 %) and pebbles (20 %). Shading of Watercourse 3 was high (80 %), mainly resulting from bankside trees and shrubs, while instream shading was dominated by underwater roots and (10 %) and macrophytes (10 %). Himalayan Balsam *Impatiens glandulifera* was present in abundance at this Watercourse 3 (Plate 9).

4.3.6 Three fish species were captured at Watercourse 3; eight three-spined sticklebacks, one bullhead and one minnow (Plate 10) all of which were adult fish except for two of the three-spined sticklebacks, which were juvenile (Tables 4.2 and 4.3).

Plate 8: Watercourse 3

Plate 9: Watercourse 3 Himalayan Balsam

Plate 10: Minnow 66 mm in length

Watercourse 4

4.3.7 Watercourse 4 (Plate 11) is tree lined and the surrounding land use is mainly agricultural and rough pasture. Its width is on average 1.5 m and average depth of 0.50 m. Flow characteristics were dominated by standing water with no flow (40 %), run-glide (40 %) with small areas of pool (10 %) and riffle (10%), while bed substrate was dominated by silt (100 %). Shading of Watercourse 4 was high (80 %), mainly resulting from bankside trees and shrubs, while instream shading was dominated by underwater roots and (10 %) and macrophytes (20 %). It is expected that the watercourse could have water quality problems, there were signs of fly tipping and stagnant water (Plate 12) in addition to Japanese Knotweed *Reynoutria japonica*.

4.3.8 No fish were captured at Watercourse 4.

Plate 11: Watercourse 4

Plate 12: Watercourse 4 debris and litter

Watercourse 5a (Latherford Brook within the Scheme boundary)

4.3.9 Watercourse 5a (Plates 13 and 14) is tree lined and the surrounding land use is mainly agricultural and rough pasture. Its width is on average 2.0 m and average depth of 0.30 m Flow characteristics were dominated by riffle (40 %), run (30 %) and glide (30 %), while bed substrate was dominated by pebbles (80 %), cobbles (10 %) and silt (10 %). Shading of Watercourse 5a was high (90 %), mainly resulting from bankside trees and shrubs, while instream shading was dominated by underwater roots and (10 %).

4.3.10 Four fish species were captured at Watercourse 5a, Latherford Brook. The catch was dominated by perch (n = 17) and roach (n = 13), with low numbers of stone loach (n = 4) and three-spined stickleback (n = 3) (Tables 4.2 and 4.3, Plates 15, 16 and 17). Bullhead were not captured during the survey but two were seen.

Plate 13: Watercourse 5a bottom of site

Plate 14: Watercourse 5a top of site

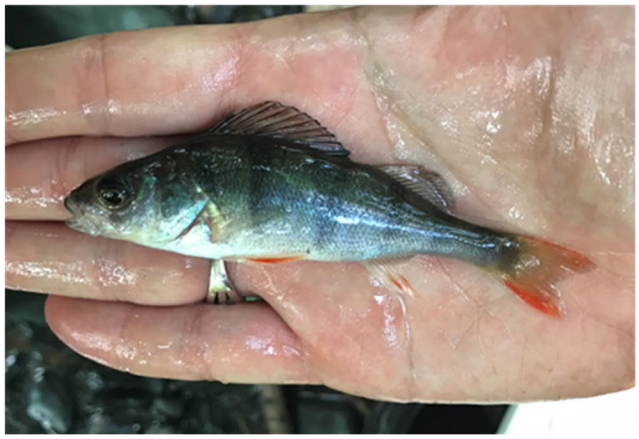

Plate 15: Perch 105 mm in length

Plate 16: Roach 148 mm in length

Plate 17: Three-spined stickleback 50 mm in length

Watercourse 5b (Latherford Brook outside the Scheme boundary)

4.3.11 Watercourse 5b (Plate 18) is a small watercourse that is tree lined and the surrounding land use is also mainly agricultural and rough pasture. Its width is on average 1.2 m and average depth of 0.30 m. Flow characteristics were dominated by riffle (80 %) and pool (20 %), while bed substrate was dominated by silt (50 %), pebbles (40 %) and cobbles (10 %). Shading of Watercourse 5b was medium (50 %), mainly resulting from bankside shrubs with a few infrequent trees, while instream shading was dominated by underwater roots and (10 %). The dimensions of Watercourse 5b are smaller than Watercourse 5a (upstream) which was not expected especially as rivers should get larger as they flow downstream; there is the possibility that water is abstracted from Latherford Brook for the local fishing ponds present between Watercourses 5a and 5b.

4.3.12 Four fish species were captured at Watercourse 5b, Latherford Brook. The catch was dominated by bullhead (n = 19), with low numbers of brown trout (n = 1), three-spined stickleback (n = 3) and stone loach (n = 3) (Table 4.2 and 4.3, Plates 19 and 20).

Plate 18: Watercourse 5b bottom of site

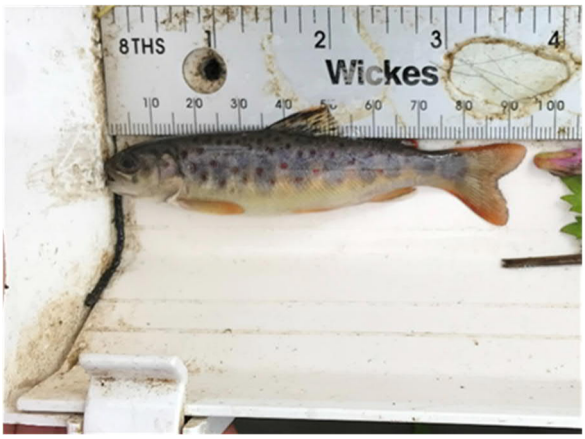

Plate 19: Brown trout 89 mm in length

Plate 20: Stone loach 127 mm in length

Watercourse 6

4.3.13 Watercourse 6 (Plate 21) is a small watercourse lined with a dense hedgerow, restricting access to the watercourse in several places. The surrounding land use is mainly agricultural and rough pasture, there are also areas of cattle poaching increasing sedimentation within the watercourse. The width of Watercourse 6 is on average 0.8 m and average depth of 0.20 m. Flow characteristics were dominated by pool (50 %), riffle (40 %) and glide (10 %), while bed substrate was dominated by pebbles (60 %) and silt (30 %). Shading of Watercourse 6 was high (90 %), mainly resulting from bankside shrubs and the dense hedgerow, with a few infrequent trees but there was no instream shading at the accessible section of the watercourse.

4.3.14 Three-spined stickleback was the only species captured in low numbers (n = 3) at watercourse 6 (Table 4.2 and 4.3).

Plate 21: Watercourse 6

Table 4.2: Numbers of fish captured at each Watercourse

Species	Watercourse					
	2	3	4	5a	5b	6
Bullhead (Bh)	3	1	0	0	19	0
Three-spined stickleback (3-Sp)	0	8	0	3	3	3
Perch (Pe)	1	0	0	17	0	0
Stone loach (StL)	0	0	0	4	2	0
Roach (Ro)	0	0	0	13	0	0
Brown trout (Bt)	0	0	0	0	1	0
Minnow (Mi)	0	1	0	0	0	0

Table 4.3: Fish length data

Watercourse	Fish species and lengths (mm)						
	Pe	Ro	3-Sp	Bh	StL	Mi	Bt
Watercourse 2	98			70, 70, 114			
Watercourse 3			23, 32, 44, 46, 49,56, 57, 59	94		66	
Watercourse 5	60, 62, 95, 96, 96, 99, 100, 101, 102, 105, 108, 131, 146, 147, 150, 165, 168	134, 138, 142, 143, 144, 144, 145, 146, 147, 148, 149, 151, 180	34, 50, 50		91, 96, 102, 140		
Watercourse 5b			17, 26, 47	25, 28, 33, 34, 34, 35, 38, 40, 40, 43, 46, 46, 47, 56, 56, 62, 63, 65, 78	109, 127		89
Watercourse 6			34, 46, 82				

4.4 Macroinvertebrate data

Watercourses

4.4.1 Summary descriptions of the habitats and other relevant features associated with each of the sample sites at Watercourses 2, 5a and Brookfield Ditch (Watercourse 4 within the Scheme boundary) are provided in Table 4.4. The species/Taxa recorded from each watercourse, their WHPT score (presence only), Conservation Score* and Flow group is presented in Table 4.5, along with the summary WHPT score, ASPT (WHPT), PSI Score (species), LIFE Score (species) and CCI Score for each watercourse.

Table 4.4: Description of sample sites in relation to macroinvertebrate samples on Watercourses 2, 5 and Brookfield Ditch (Watercourse 4 within the Scheme boundary)

Site	Description	Substrate	Siltation
Watercourse 2	Riffle and run habitat, with the bed dominated by cobbles and pebbles. Woody debris (10%) and tree roots (10%) present in the channel. Bed stability was loose. Heavily shaded channel, 1 m wide, 10 cm deep and flowing at approximately 10 to 25 cm/sec. Water clear. Gradually sloping and vegetated earth banks. Vegetation on both bank sides was complex comprising mainly of trees and nettles. Surrounding land use of broadleaf wood, scrub and buildings. The site is close to a road and a footpath. In channel culverts present (Annex F, Plate 1).	Cobbles (30%), Pebbles (30%), Gravel (20%), Sand (20%)	None
Watercourse 5a	Riffle and pool habitat, with the bed dominated by cobbles and pebbles. Stable channel bed. Woody debris present. Moderately shaded channel, 1.5/2 m wide, 10 to 30 cm deep and flowing at approximately 10 to 25 cm/sec. Water slightly turbid. Gradual slope on left bank and steeper on the right side. Earth banks dominated by simple vegetation. Surrounding land use of broadleaf wood, industrial, scrub, tall herb and road (Annex F, Plate 2).	Cobbles (20%), Pebbles (30%), Gravel (20%), Sand (20 %), Silt (5%), Boulders (5%)	None
Brookfield Ditch (spring survey only)	Ponded reach of a ditch habitat. The sampling site has ponded areas of water but is mainly dry with flow less than 10cm/s. The channel is heavily shaded. Bed stable with 50% woody debris, tree roots 5% and macrophytes 5%. No turbidity was observed. Surrounded land use primarily rough pasture, broadleaf wood, scrub, and road (Annex F, Plates 3).	Clay (60%), Cobbles (10%), Pebbles (10%), Gravel (10%), Silt (10%)	Low to Moderate

Table 4.5: Macroinvertebrate data for Watercourse 2, 5a and Brookfield Ditch (Watercourse 4 within the Scheme boundary).

Family	Species	WHPT score (presence only)	CS*	Flow group	Watercourse 2 abundance		Watercourse 5a abundance		Brookfield Ditch abundance
					Spring	Autumn	Spring	Autumn	Spring
Flatworms									
Planariidae	Planariidae (juvenile / damaged)	**4.9**		**IV**		1			
	Polycelis felina		**3**	**II**	3	5			1
Lymnaeidae	Lymnaeidae (juvenile / damaged)	**3.3**		**IV**					1
Hydrobiidae	*Potamopyrgus antipodarum*	**4.2**	**1**	**III**	466	255	1	1	10
Planorbidae	*Gyraulus albus*	**3.1**	**1**	**IV**		1			1
Limpets and mussels									
Sphaeriidae	Sphaeriidae (juvenile / damaged)	**3.9**		**IV**		7			
	Pisidium sp.				20	6	25	4	13
Worms									
Oligochaeta		**2.7**			2	2	9	7	12
Leeches									
Glossiphoniidae	*Glossiphonia heteroclita*	**3.2**	**4**	**IV**		7			
	Glossiphonia complanata		**1**	**IV**	5	1			
	Helobdella stagnalis		**1**	**IV**				1	1
Mites									
Hydracarina		**-**				2		1	

Family	Species	WHPT score (presence only)	CS*	Flow group	Watercourse 2 abundance		Watercourse 5a abundance		Brookfield Ditch abundance
					Spring	Autumn	Spring	Autumn	Spring
Crustaceans									
Gammaridae	Gammaridae	**4.4**		**II**	189	14			
	Gammarus sp.				146		402	60	74
	Gammarus pulex/fossarum agg.		**1**			15			
	Gammarus pulex		**1**	**II**		39	96	940	170
Crangonyctidae	*Crangonyx sp.*					1			57
Asellidae	Asellidae	**2.8**		**IV**					
	Asellus aquaticus		**1**	**IV**	1		5	5	29
Mayflies									
Baetidae	Baetidae (juvenile / damaged)	**5.5**		**II**		3			
	Baetis sp.			**II**				1	
	Baetis rhodani		**1**	**II**	4		1		
	Baetis rhodani / atlanticus					17	9	51	
	Cloeon dipterum		**1**	**IV**					9
Stoneflies									
Nemouridae	*Nemoura avicularis*	**9.3**	**3**	**IV**					1
Damselflies									
Coenagrionidae	Coenagrionidae (juvenile / damaged)	**3.5**		**IV**					1
	Ischnura elegans		**1**	**IV**					1

Family	Species	WHPT score (presence only)	CS*	Flow group	Watercourse 2 abundance		Watercourse 5a abundance		Brookfield Ditch abundance
					Spring	Autumn	Spring	Autumn	Spring
Dragonflies									
Libellulidae	Libellulidae (juvenile / damaged)	**4.1**		**IV**					2
True bugs									
Veliidae	Veliidae (nymph / damaged)	**4.5**		**IV**	1				1
	Velia caprai		**2**	**III**					1
Corixidae	*Hesperocorixa sahlbergi*	**3.8**	**2**	**IV**					4
Beetles									
Dytiscidae	Dytiscidae (larvae / damaged)	**4.5**		**IV**					1
	Hydroporus sp.								1
	Platambus maculatus		**1**	**II**	1				
	Agabus paludosus		**1**	**II**	1				
Hydrophilidae	*Helophorus brevipalpis*	**6.2**	**1**	**IV**					2
	Helophorus grandis		**2**	**IV**	1				
	Anacaena globulus		**1**	**IV**					1
Scirtidae	Scirtidae (larvae / damaged)	**6.9**		**IV**	4				22
Elmidae	*Elmis aena*	**6.6**	**1**	**II**	2		19	108	3
	Limnius volckmari		**1**	**II**			15	58	
Caddisflies									
Glossosomatidae	Glossosomatidae (juvenile / damaged)	**7.7**		**II**		1	2		

Family	Species	WHPT score (presence only)	CS*	Flow group	Watercourse 2 abundance		Watercourse 5a abundance		Brookfield Ditch abundance
					Spring	Autumn	Spring	Autumn	Spring
	Agapetus sp.			**II**	2				
	Agapetus fuscipes		**1**	**II**	3	1	4	3	
Polycentropodidae	Polycentropodidae (juvenile / damaged)	**8.1**		**IV**		15			
	Plectrocnemia conspersa		**2**	**II**	5	8			7
Psychomyiidae	*Tinodes waeneri*	**5.8**	**1**	**III**	5				
Hydropsychidae	*Hydropsyche sp.*	**6.6**						89	
	Hydropsyche pellucidula		**1**	**II**				1	
	Hydropsyche siltatai		**1**	**II**			3		
Limnephilidae	Limnephilidae (juvenile / damaged)	**6.2**		**IV**	2				1
	Drusus annulatus		**1**	**II**	2				
	Limnephilus lunatus		**1**	**IV**	6		1		3
	Micropterna sequax		**1**	**II**	5	1			
Leptoceridae	*Athripsodes sp.*	**6.7**					1	1	
	Athripsodes bilineatus	**6.7**	**5**	**II**			3		
Lepidostomatidae	Lepidostomatidae (juvenile / damaged)	**10.1**		**II**		3			
Trueflies									
Chironomidae	Chironomidae (damaged / pupea)	**1.1**				3	37	25	232
	Tanypodinae				10	10			

Family	Species	WHPT score (presence only)	CS*	Flow group	Watercourse 2 abundance		Watercourse 5a abundance		Brookfield Ditch abundance
					Spring	Autumn	Spring	Autumn	Spring
	Orthocladiinae					145			
	Tanytarsini				22	26			
	Diamesinae				37				
Tipulidae	*Tipula sp.*	**5.9**		**IV**	1				
Pediciidae	*Dicranota* sp.	**5.9**		**II**		8	12	14	2
Limoniidae	Limoniidae	**5.9**			7				1
	Helius sp.						1		
Simuliidae	Simuliidae (damaged / juvenile)	**5.8**		**II**	1	45		8	
	Simulium sp.					6			
	Simulium ornatum		**1**					2	
	Simulium reptans		**5**			16			
	Simulium noelleri		**3**			4			
Psychodidae		**4.4**							1
Empididae		**7.1**			17	4			
Ceratopogonidae		**5.5**					4		11
Dolichopodidae		**4.9**							1
Other Taxa									
Lepidoptera		**-**				1			
Terrestrial gastropods		**-**						1	

Family	Species	WHPT score (presence only)	CS*	Flow group	Watercourse 2 abundance		Watercourse 5a abundance		Brookfield Ditch abundance
					Spring	Autumn	Spring	Autumn	Spring
Curculionidae		-						1	
Terrestrial coleoptera		-					1		3
NTAXA (WHPT)					**21**	**17**	**14**	**14**	**27**
Total number of families					**21**	**19**	**15**	**17**	**28**
WHPT score					**107.5**	**86.5**	**72.9**	**73.6**	**119.7**
ASPT (WHPT)					**5.1**	**5.1**	**5.2**	**5.3**	**4.4**
PSI Score (species)					**54.8**	**52.4**	**74.1**	**76.9**	**26.7**
LIFE Score (species)					**7.3**	**7.4**	**7.9**	**8.1**	**6.8**
CCI Score					**3.8**	**10.0**	**7.0**	**3.0**	**4.3**

Watercourse 2

4.4.2 Watercourse 2 is a small, linear and shallow watercourse flowing through a wooded area. It is very overgrown with a substrate dominated by sand, gravel and small cobbles throughout the stretch surveyed (Table 4.4, Plates 5 & 6).

4.4.3 A total of 50 taxa were recorded from the two samples collected, 25 identified to species level (Table 4.5). These included a range of snails, leeches, crustaceans, true bugs, beetles, mayfly larvae and taxa considered to be clean water indicators such as the caddisfly larvae belonging to the Family Lepidostomatidae, *Drusus annulatus*, *Plectrocnemia conspersa*, *Agapetus fuscipes*. This is reflected in the relatively high WHPT scores (86.5 and 107.5) and ASPT values (5.1 & 5.1) (Table 4.5).

4.4.4 The CCI scores are indicative of a 'Low' (3.8) conservation value for the spring sample and 'Moderate' (10.0) conservation value for the autumn sample. This is because most species recorded were relatively common, except for the blackfly *Simulium reptans* present in the autumn sample. The species is considered as 'Local' (Conservation Score 5) under the CCI index, it does not however have any statutory designations (Table 4.5).

4.4.5 In terms of flow sensitivity, the LIFE scores are indicative of communities adapted to moderately fast-flowing waters, with a majority (53%) of taxa 'primarily associated with moderate to fast flows' (Flow Group II), such as *Gammarus pulex, Baetis rhodani, Elmis aenea and Platambus maculatus* (Table 4.5).

4.4.6 The PSI scores are indicative of 'moderately sedimented' conditions (Table 4.5).

Watercourse 5a

4.4.7 Watercourse 5a is a moderate-size and sinuous stream with successions of pools and riffles flowing through a woodland throughout the survey stretch. It has a substrate dominated by cobbles, gravel and sand. Significant amount of the channel bed (60%) is covered by thick overlay sand (Table 4.4, Plate 13 and 14).

4.4.8 In total, there were 30 taxa recorded from the two samples collected, of which 16 were identified to species level and a further 14 to genus or higher taxonomic levels. These included snails, mussels, crustaceans, beetles, mayfly and truefly larvae along with several species of caddisfly larvae, considered to be clean water indicator species, such as *Athripsodes bilineatus, Agapetus fuscipes and Limnephilus lunatus*. This is shown in the moderate WHPT scores (72.9 & 73.6) and relatively high ASPT values (5.2 & 5.3) (Table 4.5).

4.4.9 Although most of the species recorded are very common, the caddisfly *Athripsodes bilineatus* ('Local', Conservation Score 5) was recorded in the spring sample. The species does not however have any statutory designations. The CCI scores are indicative of 'Low' (3.0) conservation value in spring and 'Moderate' (7.0) conservation value in autumn. The variation within CCI score between both sampling seasons is due to the presence of the uncommon caddisfly in the spring sample (Table 4.5).

4.4.10 In terms of flow sensitivity, the LIFE scores are indicative of communities adapted to moderately fast flowing water with a vast majority of the taxa recorded (81%)

'primarily associated with moderate to fast flows' (Flow Group II). These include representatives of beetles (*Elmis aenea, Limnius volckmari*), mayfly (*Baetis rhodani*) and caddislfy larvae (*Agapetus fuscipes, Hydropsyche pelluciluda, Hydropsyche siltalai*) (Table 4.5).

4.4.11 The PSI scores are indicative of 'slightly sedimented' conditions (Table 4.5).

Brookfield Ditch

4.4.12 The Brookfield Ditch is a small, heavily shaded ditch (1 m across) and is the most upper reach of Watercourse 4, within the scheme boundary. It has ponded and dry areas and is connected to Brookfield Farm Pond 1, 2 and 3. The fishing ponds are connected to the ditch with overflow culverts (no photograph available). During autumn sampling the site was overgrown with very low flows deeming it unfeasible to sample (Table 4.4, no photo was taken).

4.4.13 A total of 32 taxa were recorded in the sample collected in spring 2019, of which 16 were identified to species level and a further 16 to genus or higher taxonomic level (Table 4.5).

4.4.14 This included a range of flatworms, snails, leeches, crustaceans, damselfly and dragonfly larvae, true bugs and a few taxa considered to be indicators of good water quality, such as stonefly larvae (*Nemoura avicularis*) and caddisfly larvae (*Plectrocrnemia conspersa, Limnephilus lunatus*). This is reflected in the relatively high WHPT score (119.7) and moderate ASPT value (4.4) (Table 4.5).

4.4.15 The LIFE score is indicative of communities adapted to slow flowing conditions, with the vast majority (79%) of taxa recorded typical of 'slow, sluggish flows' and 'standing waters' (Flow Groups III and IV).

4.4.16 The CCI score of 4.2 is indicative of a 'Low' conservation value, with most of the species recorded being very common and no species of conservation interest (Table 4.5).

4.4.17 The PSI scores are indicative of 'sedimented' conditions (Table 4.5).

Ponds

4.4.18 Summary descriptions of the habitats and other relevant features associated with each of the sample sites at Brookfield Nursery, Brookfield Farm Ponds 1, 2 & 3, Chubb Pond 1, Lower Pool and Tower House Pool are provided below along with a table of macrophyte species recorded and a table of the species/Taxa recorded from each waterbody, the WHPT score (presence only) and Conservation Score, along with the summary WHPT score, ASPT (WHPT) and CCI Score for each pond.

Brookfield Fishery

4.4.19 Brookfield Fishery (Plate 22) is a large (4700 m^2) rectangular fishing pond with a fringe of emergent macrophytes along the banks (10% cover) and two central vegetated islands (Plate 22). No submerged macrophytes were recorded. It has relatively steep earth banks with fishing platforms. Water was highly turbid at the time of the survey. The substrate was dominated by small stony substrate (33%-66%) and clay / silt (0% - 32% cover).

4.4.20 Nine species of macrophyte were recorded, as summarised in Table 4.6. No nationally or county rare or notable species were recorded, and the assemblage present is considered typical of this type.

Plate 22: Brookfield Fishery

Table 4.6: Macrophyte species recorded from Brookfield Fishery in August 2019

Common name	***Scientific name***
Great willowherb	*Epilobium hirsutum*
Common marsh-bedstraw	*Galium palustre*
Yellow iris	*Iris pseudacorus*
Soft rush	*Juncus effuses*
Hard rush	*Juncus inflexus*
Gypsywort	*Lycopus europaeus*
Reed Canary-grass	*Phalaris arundinacea*
Brooklime	*Veronica beccabunga*
Docks	*Rumex* sp.

4.4.21 A total of 34 taxa were recorded within the sample collected, 16 of which have been identified to species and a further 18 to genus or higher taxonomic level.

4.4.22 The community was typical of slowing water and included a range of flatworms, snails, leeches, crustaceans, mayfly, damselfly, alderfly and caddisfly larvae, along with several species of true bugs and beetles. This notably included good water quality indicators such as *Mystacides longicornis* and *Oecetis* sp. (Leptoceridae).

4.4.23 The macroinvertebrate CCI score (10.3) associated with the sample is indicative of a 'Fairly high conservation value'. This is likely to reflect the moderate taxa diversity recorded and the presence of the lesser water boatmen species *Micronecta scholtzi* ('Local', Conservation Score 5 under the CCI index) and *Sigara iactans* ('Regionally notable', Conservation Score 6 under the CCI index). Both species are not considered uncommon and have no statutory designations, they are both considered as 'Least Concern' based on IUCN criteria (Ref 16). Other species recorded were relatively common.

4.4.24 However, the Freshwater Habitat Trust analysis only classifies the pond as being of 'Poor' quality (PSYM quality category GQA of 44%). This is likely to reflect the low diversity of Coleoptera, Odonata and Megaloptera and the lack of uncommon macrophyte species.

Table 4.7: Macroinvertebrates data for Brookfield Fishery from August 2019

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Flatworms				
Planariidae	Polycelis sp.	**4.9**		8
Snails				
Lymnaeidae	Lymnaeidae (juvenile / damaged)	**3.3**		1
Hydrobiidae	*Potamopyrgus antipodarum*	**4.2**	**1**	6
Physidae	Physidae (juvenile / damaged)	**2.4**		13
	Physella sp.			7
Planorbidae	*Ferrissia wautieri*	**3.1**		5
	Gyraulus albus		**1**	2
Worms				
Oligochaeta	Oligochaeta	**2.7**		63
Leeches				
Glossiphoniidae	Glossiphoniidae (juvenile / damaged)	**3.2**		1
	Glossiphonia heteroclita		**4**	1
	Helobdella stagnalis		**1**	43

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Erpobdellidae	Erpobdellidae (juvenile / damaged)	**3.1**		1
Piscicolidae	*Piscicola geometra*	**5.2**	**2**	1
Mites				
Hydracarina		**-**		9
Crustaceans				
Cladocera		**-**		77
Crangonyctidae	*Crangonyx sp.*	**3.9**		15
Asellidae	Asellidae	**2.8**		1
	Asellus aquaticus		**1**	10
Mayflies				
Baetidae	*Cloeon dipterum*	**5.5**	**1**	3
Damselflies				
Coenagrionidae	Coenagrionidae (juvenile / damaged)	**3.5**		3
True bugs				
Corixidae	Corixidae (nymph / damaged)	**3.8**		15
	Micronecta scholtzi		**5**	39
	Sigara sp.			1
	Sigara falleni		**1**	1
	Sigara iactans		**6**	1
Beetles				
Noteridae	*Noterus clavicornis*	**3.2**	**2**	1
Hydrophilidae	Hydrophilidae (larvae / damaged)	**6.2**		4
	Laccobius bipunctatus		**2**	1
	Laccobius minutus		**2**	1
Alderflies				
Sialidae	*Sialis lutaria*	**4.3**	**1**	2
Caddisflies				
Leptoceridae	*Mystacides sp.*	**6.7**		2
	Mystacides longicornis		**1**	2
	Oecetis sp.			1
Trueflies				

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Chironomidae	Chironomidae (damaged / pupae)	**1.1**		192
NTAXA (WHPT)				**19**
Total number of families				**21**
WHPT score				**67.4**
ASPT (WHPT)				**3.5**
CCI Score				**10.3**

Brookfield Farm Pond 1

4.4.25 Brookfield Farm Pond 1 is a large (1600 m^2) fishing pond with relatively steep earth banks (Plate 3). It is deep in central areas (>1 m deep), with shallower marginal areas. Water was highly turbid at the time of the survey. There was overhanging vegetation shading 15% of the pond, with a low cover (2%) of emergent macrophytes. The pond's substrate was predominantly clay / silt (33%-66%), but also sand, gravel and cobbles (0% - 32% cover). Leaf litter was also present.

4.4.26 Eight species of macrophyte were recorded, as summarised in Table 4.8. No nationally or county rare or notable species were recorded, and the assemblage present consisted of common taxa considered typical of habitats of this type.

Table 4.8: Macrophyte species recorded from Brookfield Farm Pond 1 in August 2019

Common name	Scientific name
Wild angelica	*Angelica sylvestris*
Great willowherb	*Epilobium hirsutum*
Soft rush	*Juncus effusus*
Hard rush	*Juncus inflexus*
Water mint	*Mentha aquatica*
Brooklime	*Veronica beccabunga*
Docks	*Rumex* sp.
Bitter-cresses	*Cardamine* sp.

4.4.27 The results of the macroinvertebrate analyses are presented in, Table 4.9.

4.4.28 The sample was characterised by a low diversity, with only 10 taxa recorded, of which four were identified to species level. It included a range of flatworms, worms, crustaceans, mayfly larvae, true bugs and caddisfly and truefly larvae. This included the good water quality indicator *Cyrnus trimaculatus*, belonging to the caddis Family Polycentropodidae (Table 4.9).

4.4.29 The macroinvertebrate CCI score (17.5) associated with the sample taken is indicative of a 'High' conservation value. However, the score is considered to be artificially inflated, because of the presence of only a very low number of scoring species (four) under the CCI index but all scored 2 or higher. In fact, most of the species present are common. A specimen of the lesser water boatmen species *Micronecta scholtzi* ('Local', Conservation Score 5) was recorded (Table 4.9), the species is however not uncommon and has no statutory designations. In reality, the low diversity and the lack of species of conservation interest are more likely to indicate that the macroinvertebrate communities of the pond are of relatively low conservation value.

4.4.30 This is consistent with the fact that the Freshwater Habitat Trust analysis classified the pond as being of 'Poor' quality (PSYM quality category GQA of 33%). This is notably because of a low diversity of macrophytes, a lack of uncommon macrophyte species and a low diversity of macroinvertebrates (Table 4.9).

Table 4.9: Macroinvertebrate data for Brookfield Farm Pond 1 from August 2019

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Flatworms				
Planariidae	*Polycelis sp.*	**4.9**		1
Worms				
Oligochaeta	Oligochaeta	**2.7**		73
Leeches				
Glossiphonidae	*Theromyzon tessulatum*	**3.2**	**2**	2
Crustaceans				
Crangonyctidae	*Crangonyx sp.*	**3.9**		1
Mayflies				
Baetidae	Baetidae (juvenile / damaged)	**5.5**		1
True bugs				
Gerridae	Gerridae (nymph / damaged)	**5.2**		1
Corixidae	*Micronecta scholtzi*	**3.8**	**5**	1
Caddisflies				
Polycentropodidae	*Cyrnus trimaculatus*	**8.1**	**3**	2
Trueflies				
Chironomidae	Chironomidae (damaged / pupae)	**1.1**		34
Dixidae	*Dixa nebulosa*	**7.0**	**4**	2
NTAXA (WHPT)				**10**

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Total number of families				**10**
WHPT score				**43.2**
ASPT (WHPT)				**4.3**
CCI Score				**17.5**

Brookfield Farm Pond 2

4.4.31 Brookfield Farm Pond 2 is a rectangular fishing pond, approximately 2200 m^2 (Plate 4). It has a low emergent macrophyte cover (2%). Approximately a third of the pond area is overhung by marginal vegetation. The substrate consisted mainly of clay / silt (33%-66%) with sand, gravel and cobbles (0% - 32% cover), with leaf litter also present (Plate 4).

4.4.32 Seven species of macrophyte were recorded, as summarised in Table 4.10. No nationally or county rare or notable species were recorded, and the assemblage present consisted of common taxa considered typical of habitats of this type.

Table 4.10: Macrophyte species recorded from Brookfield Fishery Pond 2 in August 2019

Common name	Scientific name
Wild angelica	*Angelica sylvestris*
Great willowherb	*Epilobium hirsutum*
American willowherb	*Epilobium ciliatum*
Yellow iris	*Iris pseudacorus*
Soft rush	*Juncus effusus*
Bulrush	*Typha latifolia*
Docks	*Rumex* sp.

4.4.33 The results of the macroinvertebrate analyses are presented in Table 4.11.

4.4.34 The macroinvertebrate sample was characterised by a moderate diversity, with 28 taxa recorded, of which 15 were identified to species level and a further 13 to genus or higher taxonomic level (Table 4.11).

4.4.35 The taxa recorded included larvae of dragonfly (Aeshnidae) and damselfly (Coenagrionidae), leeches (Glossiphoniidae, Erpobdellidae, Piscicolidae), snails (Lymnaeidae, Planorbidae) and mayfly larvae (Baetidae). The low ASPT of 4.0 reflects the lack of good water quality indicators (Table 4.11).

4.4.36 The CCI score of 6.4 is indicative of a 'Moderate' conservation value, which is likely to reflect the moderate diversity and the absence of uncommon or designated species of macroinvertebrates (Table 4.11).

4.4.37 This is consistent with the Freshwater Habitat Trust analysis, which classified the pond as being of 'Moderate' quality (PSYM quality category GQA of 56 %) (Table 4.11).

Table 4.11: Macroinvertebrate data for Brookfield Farm Pond 2 from August 2019

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Snails				
Lymnaeidae	Lymnaeidae (juvenile / damaged)	**3.3**		4
Planorbidae	*Gyraulus albus*	**3.1**	**1**	1
	Armiger crista		**2**	1
	Hippeutis complanatus		**3**	1
Limpets and mussels				
Acroloxidae	*Acroloxus lacustris*	**3.6**	**2**	1
Leeches				
Glossiphoniidae	*Glossiphonia heteroclita*	**3.2**	**4**	1
	Glossiphonia complanata		**1**	
	Helobdella stagnalis		**1**	2
Erpobdellidae	Erpobdellidae (juvenile / damaged)	**3.1**		4
Piscicolidae	*Piscicola geometra*	**5.2**	**2**	1
Mites				
Hydracarina	Hydracarina	**-**		1
Oribatei	Oribatei	**-**		1
Crustaceans				
Cladocera		**-**		1
Crangonyctidae	*Crangonyx sp.*	**3.9**		2
Asellidae	*Asellus aquaticus*	**2.8**	**1**	2
Mayflies				
Baetidae	*Cloeon dipterum*	**5.5**	**1**	3
Damselflies				
Coenagrionidae	Coenagrionidae (juvenile / damaged)	**3.5**		2
	Ischnura elegans		**1**	1
Dragonflies				
Aeshnidae	Aeshnidae (juvenile / damaged)	**4.7**		1

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
True bugs				
Gerridae	Gerridae (nymph / damaged)	**5.2**		3
Nepidae	*Ranatra linearis*	**2.9**	**4**	1
Naucoridae	Naucoridae (damaged)	**3.7**	**3**	4
Beetles				
Haliplidae	*Haliplus ruficollis* group	**3.6**		1
Noteridae	*Noterus clavicornis*	**3.2**	**2**	1
Caddisflies				
Leptoceridae	*Mystacides longicornis*	**6.7**	**1**	1
Trueflies				
Chironomidae	Chironomidae (damaged / pupae)	**1.1**		14
Dixidae	Dixidae (damaged / juvenile)	**7.0**		1
	Dixa nebulosa		**4**	1
Other Taxa				
Argulidae	*Argulus foliaceus*	**-**		3
NTAXA (WHPT)				**19**
Total number of families				**23**
WHPT score				**75.7**
ASPT (WHPT)				**4.0**
CCI Score				**6.4**

Brookfield farm Pond 3

4.4.38 Brookfield Farm Pond 3 is a moderate size (1800 m^2) rectangular fishing pond, deep in central areas with shallower marginal areas (Plate 23). It has a low emergent macrophyte cover (5% cover), with some floating macrophytes along the margins. There was evidence of pond vegetation being cleared around the margins. The water was of high turbidity. The substrate was predominantly of clay / silt (33%-66%), with sand, gravel and cobbles (0% - 32% cover).

4.4.39 Fourteen species of macrophyte were recorded, as summarised in Table 4.12. The Nationally Scarce fringed water-lily (*Nymphoides peltata*) was recorded. This species is native to the fens of East Anglian and the Thames basin hence its Nationally Scare designation, however it is widely naturalised and planted outside its native range.

Plate 23: Brookfield Farm Pond 3

Table 4.12: Macrophyte species recorded from Brookfield Fishery Pond 3 in August 2019

Common name	Scientific name
Creeping bentgrass	*Agrostis stolonifera*
Water-plantain	*Alisma plantago-aquatica*
Wild angelica	*Angelica sylvestris*
Pendulous sedge	*Carex pendula*
Great willowherb	*Epilobium hirsutum*
Reed sweet-grass	*Glyceria maxima*
Yellow iris	*Iris pseudacorus*
Soft rush	*Juncus effusus*
Hard rush	*Juncus inflexus*
Water forget-me-not	*Myosotis scorpioides*
Water figwort	*Scrophularia auriculata*
Bulrush	*Typha latifolia*
White water-lily	*Nymphaea alba*
Fringed water-lily	*Nymphoides peltata*

4.4.40 The results of the macroinvertebrate analyses are presented in (Table 4.13).

4.4.41 The macroinvertebrate sample was moderately diverse, with 24 taxa recorded, of which 14 were identified to species level. These included a few good water quality indicators, such as the caddisfly species *Limnephilus lunatus* and *Mystacides longicornis*. Other taxa consisted of flatworms (Dugesiidae), damselfy larvae (Coenagrionidae), snails (Hydrobiidae, Planorbidae), worms (Oligochaeta), true bugs (Naucoridae, Corixidae, Notonectidae), beetles (Hydrophilidae), caddisfly (Phryganeidae) and truefly larvae (Table 4.13).

4.4.42 The CCI score of 5.1 is indicative of a 'Moderate' conservation value, which is likely to reflect the moderate taxa diversity and the lack of species of conservation interest or designated species (Table 4.13).

4.4.43 This is consistent with the Freshwater Habitat Trust analysis, which classified the pond as being of 'Moderate' quality (PSYM quality category GQA of 61%) (Table 4.13).

Table 4.13: Macroinvertebrate data for Brookfield Farm Pond 3 from August 2019

Family	Species	WHPT score (presence only)	Conservation score	Abundance
Flatworms				
Dugesiidae	*Dugesia tigrina*	**2.9**	**3**	1
Snails				
Hydrobiidae	*Potamopyrgus antipodarum*	**4.2**	**1**	18
Planorbidae	*Gyraulus albus*	**3.1**	**1**	3
Limpets and mussels				
Sphaeriidae	*Musculium lacustre*	**3.9**	**3**	1
Worms				
Oligochaeta	Oligochaeta	**2.7**		21
Leeches				
Glossiphoniidae	*Helobdella stagnalis*	**3.2**	**1**	3
Crustaceans				
Cladocera		**-**		100
Crangonyctidae	*Crangonyx pseudogracilis*	**3.9**		1
Asellidae	*Asellus aquaticus*	**2.8**	**1**	38
Mayflies				
Baetidae	*Cloeon dipterum*	**5.5**	**1**	15
Damselflies				
Coenagrionidae	Coenagrionidae (juvenile / damaged)	**3.5**		16
True bugs				
Naucoridae	Naucoridae (damaged)	**3.7**	**3**	4
Corixidae	Corixidae (nymph / damaged)	**3.8**		7
	Sigara sp.			1
	Sigara dorsalis		**1**	1
Notonectidae	*Notonecta glauca*	**3.4**	**1**	1
Beetles				

Family	Species	WHPT score (presence only)	Conservation score	Abundance
Hydrophilidae	Hydrophilidae (larvae / damaged)	**6.2**		1
Caddisflies				
Phryganeidae	Phryganeidae (juvenile / damaged)	**5.5**		1
Limnephilidae	*Limnephilus lunatus*	**6.9**	**1**	1
Leptoceridae	*Mystacides sp.*	**6.7**		4
	Mystacides longicornis		**1**	10
Trueflies				
Chironomidae	Chironomidae (damaged / pupea)	**1.1**		60
Dixidae	*Dixa nebulosa*	**7.0**	**4**	1
Other Taxa				
Argulidae	*Argulus foliaceus*	**-**		2
NTAXA (WHPT)				**19**
Total number of families				**21**
WHPT score				**79.3**
ASPT (WHPT)				**4.2**
CCI Score				**5.1**

Chubb Pond 1

4.4.44 Chubb Pond 1 is a large (5400 m^2) fishing pond with steep earth banks, circular in shape, with a low emergent plant cover (5%) (Plate 24 and 25). The substrate of the pond consisted mainly of sand, gravel, cobbles (33%-66%), and clay / silt (0% - 32% cover).

4.4.45 Seventeen species of macrophyte were recorded, as summarised in Table 4.14. The Great Fen-sedge *Cladium mariscus*, which is rare as a native species in Staffordshire, was recorded. However, it is considered that the species was not naturally present on the pond but had been planted. Therefore, it was not considered as contributing to the natural value of the pond. No other nationally or county rare species were recorded, however, the invasive non-native species Montbretia (*Crocosmia x. crocosmiiflora*) was recorded. This species is listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

Plate 24: Chubb Pond 1

Plate 25: Chubb Pond 1

Table 4.14: Macrophyte species recorded from Chubb Pond 1 in August 2019

Common name	Scientific name
Creeping bentgrass	*Agrostis stolonifera*
Great Fen-sedge*	*Cladium mariscus*
Montbretia	*Crocosmia x crocosmiiflora*
Great willowherb	*Epilobium hirsutum*
Common marsh-bedstraw	*Galium palustre*
Yellow iris	*Iris pseudacorus*
Soft rush	*Juncus effusus*
Hard rush	*Juncus inflexus*
Gypsywort	*Lycopus europaeus*
Yellow Loosestrife	*Lysimachia vulgaris*
Creeping buttercup	*Ranunculus repens*
Skullcap	*Scutellaria galericulata*
Branched Bur-reed	*Sparganium erectum*
White water-lily	*Nymphaea alba*
Yellow water-lily	*Nuphar lutea*
Amphibious Bistort	*Persicaria amphibia*
Yellow cresses	*Rorippa* sp.
* This species is rare as a native species in Staffordshire, however, it is likely that the species was not naturally present on the pond but had been planted.	

4.4.46 The results of the macroinvertebrate analyses are presented in (Table 4.15).

4.4.47 There was a moderate diversity of macroinvertebrates, with 18 taxa recorded, including nine to species level and a further nine to genus or higher taxonomic level. These included snails (Physidae, Succineidae, Planorbidae), true bugs (*Micronecta scholtzi*), trueflies (Chironomidae, *Dixa nebulosa*), leeches (*Helobdella stagnalis*, *Piscicola geometra*), beetles (Dytiscidae) and damselfly larvae (*Erythromma najas*). A lack of good water quality indicators is reflected by the relatively low ASPT (4.2) (Table 4.15).

4.4.48 The CCI score of 13.6 is indicative of a 'Fairly High' conservation value, and is likely to reflect the moderate taxa diversity and the combined presence of the lesser water boatman *Micronecta scholtzi* (Conservation Score 5, 'Local' under the CCI index). The species is however widespread throughout England and does not have any statutory designations. Other species recorded were very common (Table 4.15).

4.4.49 This is consistent with the Freshwater Habitat Trust analysis, which classified the pond as being of 'Moderate' quality (PSYM quality category GQA of 61%) (Table 4.15).

Table 4.15: Macroinvertebrate data for Chubb Pond 1 from August 2019

Family	Species	WHPT score (presence only)	Conservation score	Abundance
Snails				
Physidae	*Physella sp.*	**2.4**		3
Succineidae	*Succinea sp.*	**-**		5
Planorbidae	*Hippeutis complanatus*	**3.1**	**3**	1
Leeches				
Glossiphoniidae	Glossiphoniidae (juvenile / damaged)	**3.2**		1
	Helobdella stagnalis		**1**	7
Piscicolidae	*Piscicola geometra*	**5.2**	**2**	1
Mites				
Hydracarina	Hydracarina	-		10
Crustaceans				
Cladocera	Cladocera	-		3
Mayflies				
Baetidae	*Cloeon dipterum*	5.5	1	19
Damselflies				
Coenagrionidae	Coenagrionidae (juvenile / damaged)	3.5		2
	Erythromma najas		3	3
True bugs				

Family	Species	WHPT score (presence only)	Conservation score	Abundance
Gerridae	Gerridae (nymph / damaged)	5.2		3
Corixidae	*Micronecta scholtzi*	3.8	5	1
Beetles				
Dytiscidae	Dytiscidae (larvae / damaged)	4.5		11
Trueflies				
Chironomidae	Chironomidae (damaged / pupae)	1.1		40
Dixidae	*Dixa nebulosa*	7.0	4	1
Other Taxa				
Argulidae	*Argulus foliaceus*	-		12
Lepidoptera	*Elophila nymphaeta*	-		1
NTAXA (WHPT)				11
Total number of families				16
WHPT score				45.8
ASPT (WHPT)				4.2
CCI Score				13.6

Lower Pool

4.4.50 Lower Pool is a very large (14000 m^2) linear pond, with a vegetated island and a bridge (Plate 2). The pond's floating vegetation covers 40% of the pond area while emergent plants cover 30% of the total area. The substrate of the pond is mainly clay / silt (33%-66%) and sand, gravel, cobbles (0% - 32% cover), with leaf litter also present. The pond is slightly shaded (10% of area).

4.4.51 Twenty-two species of macrophyte were recorded, as summarised in Table 4.16. No nationally or county rare species were recorded however the invasive non-native species Canadian waterweed *Elodea canadensis* was the dominant submerged macrophyte. This species is a controlled weed species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

Table 4.16: Macrophyte species recorded from Lower Pool

Common name	Scientific name
Creeping bentgrass	*Agrostis stolonifera*
Water-plantain	*Alisma plantago-aquatica*
Wild angelica	*Angelica sylvestris*
Pendulous sedge	*Carex pendula*
Tufted hair-grass	*Deschampsia cespitosa*
Great willowherb	*Epilobium hirsutum*
Common marsh-bedstraw	*Galium palustre*

Common name	Scientific name
Reed sweet-grass	*Glyceria maxima*
Yellow iris	*Iris pseudacorus*
Sharp-flowered rush	*Juncus acutiflorus*
Compact rush	*Juncus conglomeratus*
Soft rush	*Juncus effusus*
Yellow Loosestrife	*Lysimachia vulgaris*
Purple Loosestrife	*Lythrum salicaria*
Water cress	*Rorippa nasturtium-aquaticum*
Skullcap	*Scutellaria galericulata*
Branched Bur-reed	*Sparganium erectum*
Bulrush	*Typha latifolia*
Brooklime	*Veronica beccabunga*
Common duckweed	*Lemna minor*
Ivy-leaved Duckweed	*Lemna trisulca*
Yellow water-lily	*Nuphar lutea*

4.4.52 The results of the macroinvertebrate analyses are presented in (Table 4.17).

4.4.53 The sample collected was characterised by a high diversity, with a total of 41 taxa recorded, of which 23 were identified to species level and a further 18 to genus or higher taxonomic level (Table 4.17).

4.4.54 The taxa recorded included several species of snails (Bythinia tentaculata, Gyraulus albus, Planorbis carinatus), leeches (Theromyzon tessulatum, Helobdella stagnalis Glossiphonia heteroclita, Erpobdella testacea), beetles (Laccophilus hyalinus, Hyphydrus ovatus, Hydroporus palustris, Noterus clavicornis, Laccobius bipunctatus), true bugs (Gerris lacustris, Nepa cinerea, Corixa punctata, Sigara dorsalis, Notonecta glauca, Notonecta maculata) and caddisfly (Holocentropus picicornis, Limnephilus lunatus, Athripsodes sp., Mystacides sp.). In addition, a representative of mussels Unionidae (Anodonta cygnaea) was observed during the survey (Table 4.17).

4.4.55 This is reflected in the CCI score (9.8) which is indicative of a ‘Moderate’ conservation value. Most of the species recorded were however relatively common, except for the backswimmer *Notonecta maculata* (Conservation Score 5. ‘Local’). The species is however relatively widespread throughout England and has no statutory designation (Table 4.17).

4.4.56 This is consistent with the Freshwater Habitat Trust analysis, which classified the pond as being of ‘Moderate’ quality (PSYM quality category GQA of 67%) (Table 4.17).

Table 4.17: Macroinvertebrate data for Lower Pool from August 2019

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Snails				
Lymnaeidae	*Stagnicola sp.*	**3.3**		1
Bithyniidae	*Bithynia tentaculata*	**3.7**	**1**	21
Planorbidae	*Planorbis carinatus*	**3.1**	**1**	30
	Gyraulus albus		**1**	3
Limpets and mussels				
Sphaeriidae	Sphaeriidae (juvenile / damaged)	**3.9**		1
	Pisidium sp.	**3.9**		3
Unionidae	*Anodonta cygnaea*	**5.3**	**2**	1
Worms				
Oligochaeta		**2.7**		8
Leeches				
Glossiphoniidae	*Theromyzon tessulatum*	**3.2**	**2**	2
	Glossiphonia heteroclita		**4**	1
	Helobdella stagnalis		**1**	53
Erpobdellidae	*Erpobdella sp.*	**3.1**		10
	Erpobdella testacea		**4**	1
Crustaceans				
Crangonyctidae	*Crangonyx sp.*	**3.9**		35
Asellidae	*Asellus aquaticus*	**2.8**	**1**	140
Mayflies				
Baetidae	Baetidae (juvenile / damaged)	**5.5**		26
Damselflies				
Coenagrionidae	Coenagrionidae (juvenile / damaged)	**3.5**		1
True bugs				
Gerridae	Gerridae (nymph / damaged)	**5.2**		9
Gerridae	*Gerris lacustris*		**1**	6
Nepidae	*Nepa cinerea*	**2.9**	**3**	2

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Corixidae	Corixidae (nymph / damaged)	**3.8**		40
	Corixa punctata		**1**	10
	Sigara dorsalis		**1**	1
Hydrometridae	Hydrometridae (damaged)	**4.3**		1
Notonectidae	Notonectidae (nymph / damaged)	**3.4**		2
	Notonecta glauca		**1**	15
	Notonecta maculata		**5**	1
Beetles				
Haliplidae	Haliplidae (larvae / damaged)	**3.6**		1
Dytiscidae	Dytiscidae (larvae / damaged)	**4.5**		11
	Laccophilus hyalinus	**4.5**	**3**	1
	Hyphydrus ovatus		**2**	4
	Hydroporus palustris		**1**	2
Noteridae	*Noterus clavicornis*	**3.2**	**2**	3
Hydrophilidae	*Laccobius bipunctatus*	**6.2**	**2**	1
Polycentropodidae	*Holocentropus picicornis*	**8.1**	**3**	7
Limnephilidae	*Limnephilus lunatus*	**6.9**	**1**	1
Leptoceridae	*Athripsodes sp.*	**6.7**		1
	Mystacides sp.	**6.7**		1
Trueflies				
Chironomidae	Chironomidae (damaged / pupea)	**1.1**		60
Psychodidae		**4.4**		1
Ptychopteridae	*Ptychoptera sp.*	**6.4**		16
NTAXA (WHPT)				**27**
Number of non-scoring families (WHPT)				**0**
Total number of families				**27**
WHPT score				**113.1**
ASPT (WHPT)				**4.2**
CCI Score				**9.8**

Tower House Pool

4.4.57 Tower House Pool is a relatively large (5000 m^2) and shallow fishing pond (Plate 1). The water was highly turbid at the time of the survey. In terms of vegetation, the emergent plant cover was of 30% of the pond area. There was no submerged vegetation however, under the water surface filamentous algae was observed. The substrate of the pond consisted mainly of sand, gravel, cobbles (33%-66%), and clay / silt (0% - 32% cover).

4.4.58 Eleven species of macrophyte were recorded, as summarised in Table 4.18. No nationally or county rare or notable species were recorded, and the assemblage present is considered typical of the habitat conditions.

Table 4.18: Macrophyte species from Tower House Pool in August 2019

Common name	Scientific name
Creeping bentgrass	*Agrostis stolonifera*
Cuckooflower	*Cardamine pratensis*
Great willowherb	*Epilobium hirsutum*
Common marsh-bedstraw	*Galium palustre*
Square-stalked St John's-wort	*Hypericum tetrapterum*
Yellow iris	*Iris pseudacorus*
Jointed rush	*Juncus articulatus*
Compact rush	*Juncus conglomeratus*
Soft rush	*Juncus effusus*
Hard rush	*Juncus inflexus*
Bulrush	*Typha latifolia*

4.4.59 The results of the macroinvertebrate analyses are presented in (Table 4.19).

4.4.60 The sample collected was characterised by a relatively high diversity, with a total of 31 taxa recorded, of which 23 were identified to species level and a further 8 to genus or higher taxonomic level. The taxa recorded consisted of a range of snails (*Radix auricularia, Potamopyrgus antipodarum, Ferrissia wautieri, Gyraulus albus, Hippeutis complanatus*), leeches (*Helobdella stagnalis)*, worms, damselfly (*Ischnura elegans*) crustaceans (*Gammarus pulex, Crangonyx pseudogracilis, Asellus aquaticus*), true bugs (*Ranatra linearis, Gerris lacustris)*, beetles (*Noterus clavicornis, Anacaena limbata*), including the good water quality indicators *Mystacides longicornis, Molanna angustata* (caddiflsy larvae) and *Caenis horaria* (mayfly larvae) (Table 4.19).

4.4.61 The CCI score (9.0) is indicative of a 'Moderate' conservation value. Most of the species recorded were however very common, except for the lesser water boatman *Micronecta scholtzi* (Conservation Score 5. 'Local'). The species is however not uncommon and has no statutory designations (Table 4.19).

4.4.62 This is consistent with the Freshwater Habitat Trust analysis, which classified the pond as being of 'Moderate' quality (PSYM quality category GQA of 61%) (Table 4.19).

Table 4.19: Macroinvertebrate data for Tower House Pool from August 2019

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Snails				
Lymnaeidae	*Radix auricularia*	**3.3**	**2**	1
Hydrobiidae	*Potamopyrgus antipodarum*	**4.2**	**1**	10
Planorbidae	*Ferrissia wautieri*	**3.1**		2
	Gyraulus albus		**1**	15
	Hippeutis complanatus		**3**	5
Limpets and mussels				
Sphaeriidae	*Pisidium sp.*	**3.9**		15
Worms				
Oligochaeta	Oligochaeta	**2.7**		
Leeches				
Glossiphoniidae	*Helobdella stagnalis*	**3.2**	**1**	1
Crustaceans				
Gammaridae	*Gammarus pulex*	**4.4**	**1**	12
Crangonyctidae	*Crangonyx pseudogracilis*	**3.9**		8
Asellidae	*Asellus aquaticus*	**2.8**	**1**	45
Mayflies				
Baetidae	*Cloeon dipterum*	**5.5**	**1**	25
Caenidae	*Caenis horaria*	**6.5**	**1**	4
Damselflies				
Coenagrionidae	Coenagrionidae (juvenile / damaged)	**3.5**		17
	Ischnura elegans		**1**	3
True bugs				
Gerridae	*Gerris lacustris*		**1**	1
Nepidae	*Ranatra linearis*	**2.9**	**4**	2
Naucoridae	Naucoridae (damaged)	**3.7**	**3**	8
Corixidae	*Micronecta scholtzi*	**3.8**	**5**	2
Beetles				
Dytiscidae	Dytiscidae (larvae / damaged)	**4.5**		1

Family	Species	WHPT score (presence only)	Conservation Score	Abundance
Noteridae	*Noterus clavicornis*	**3.2**	**2**	4
Hydrophilidae	*Anacaena limbata*	**6.2**	**1**	2
Alderflies				
Sialidae	*Sialis lutaria*	**4.3**	**1**	1
Caddisflies				
Psychomyiidae	*Tinodes waeneri*	**5.8**	**1**	1
Molannidae	*Molanna angustata*	**6.6**	**2**	1
Leptoceridae	*Mystacides longicornis*	**6.7**	**1**	30
Trueflies				
Chironomidae	Chironomidae (damaged / pupae)	**1.1**		60
Limoniidae	*Helius sp.*	**5.9**		4
Dixidae	*Dixa nebulosa*	**7.0**	**4**	2
Stratiomyidae	Stratiomyidae	**3.6**		2
Other Taxa				
Argulidae	Argulus foliaceus	**-**		6
NTAXA (WHPT)				**26**
Total number of families				**27**
WHPT score				**114.2**
ASPT (WHPT)				**4.4**
CCI Score				**9.0**

White-clawed crayfish

eDNA from ponds

4.4.63 No white-clawed crayfish DNA was detected in any of the four samples taken from Tower House Pool, Lower Pool, and Brookfield Ponds 1 & 2. All controls performed as expected and so conclusive negative results are returned for all samples.

Watercourse 2

4.4.64 Watercourse 2 is a small, linear and shallow watercourse, with a substrate dominated by sand, gravel and small cobbles throughout the stretch surveyed (Plate 5 and 6). It is considered to have a low habitat potential for white-clawed crayfish, with a lack of potential refuges in the channel and on the banks, although tree roots and macrophytes are present in places. No white-clawed crayfish were recorded during the kick-sweep sampling undertaken on the 5th September.

Watercourse 5a

4.4.65 Watercourse 5a (Latherford Brook) is a moderate-size and sinuous stream with successions of pools and riffles flowing through a woodland throughout the survey stretch (Plate 13 and 14). River substrate is dominated by cobbles, gravel and sand. The bed is covered by significant amounts of overlay sand. Water was highly turbid (brown) on the 9th August and 3rd September 2019 (Plate 26 and 27), which could explain the high amounts of overlay sand observed on the top of the cobbles and gravel.

Plate 26: Watercourse 5a high turbidity

Plate 27: Watercourse 5a undercut bank

4.4.66 Watercourse 5a has moderate habitat potential for white-clawed crayfish, with limited refuges in the channel and marginal areas, including large cobbles and occasional boulders (Plate 13 and 14). Banks are however undercut in places with tree roots, which could provide potential refuges for crayfish (Plate 27).

4.4.67 The results of the manual search undertaken on Latherford Brook on the 5th August are presented in Table 4.20. No white-clawed crayfish were recorded in any of the habitat patches searched. No white-clawed crayfish were found within the kick-sweep samples taken or in any of the traps set on the 9th August or the 3rd September. In addition, upon inspection of the banks, there was no obvious evidence of crayfish burrows.

Table 4.20: White-clawed manual search survey on Watercourse 5a (Latherford Brook)

Site	Patch 1	Patch 2	Patch 3
Easting Northing	SJ 95627 06491	SJ 95565 06482	SJ 95590 06475
Habitat appraisal within stretch searched	**Flow Characteristics**: Riffle / run, 2 m wide, 20 cm deep, 25 - 50 cm/sec, moderate turbidity, high overlay sand **Substrate:** dominated by large cobbles and sand, providing limited potential refuges for crayfish essentially in both mid channel and margins **Banks**: undercut and with tree roots in places, providing additional potential refuges	**Flow Characteristics:** Riffle / run, 80 m long, 10 m wide, 20 cm to 50 cm deep, 25 - 50 cm/sec, moderate turbidity, high overlay sand **Substrate:** dominated by large cobbles and sand, providing limited potential refuges for crayfish essentially in mid channel **Banks**: undercut and with tree roots in places, providing additional potential refuges	**Flow Characteristics:** Riffle, 2 m wide, 10 cm deep, 25 - 50 cm/sec, moderate turbidity, high overlay sand **Substrate**: dominated by small and large cobbles, providing limited potential refuges for crayfish essentially in mid channel
Method	Standard manual search of refuges, both mid channel and marginal areas Kick - sweep netting in tree roots and deeper areas not suitable for manual searching	Standard manual search of refuges, both mid channel (abundant) and marginal areas (frequent) Kick - sweep netting in tree roots and deeper areas not suitable for manual searching	Standard manual search of refuges, both mid channel (abundant) and marginal areas (abundant) Kick - sweep netting in tree roots and deeper areas not suitable for manual searching
Number of refuges searched	10 refuges (mainly large cobbles)	10 refuges (mainly large cobbles)	10 refuges (mainly small and large cobbles)
Number of white-clawed crayfish	0	0	0

4.5 Nature conservation evaluation

Fish

4.5.1 Fish surveys undertaken during 2019 found that Watercourses 4 and 6 provide poor habitat for fish, and no notable fish species were recorded.

4.5.2 Bullhead were present in Watercourses 2, 3, 5a and 5b, while brown trout were present in Watercourse 5b. These watercourses provide suitable habitat for these notable species. Bullhead is listed on Annex II of the EC Habitats Directive, and both bullhead and brown trout are UK BAP priority species. Brown trout is also a species of Principal Importance in England under Section 41 of the NERC Act 2006.

4.5.3 The habitat at Watercourse 5a supports a diverse range of common fish, none of which are notable within in this area. Given its widely distributed status, bullhead in this area are not classed as notable

4.5.4 Tower House Pool, Lower Pool and Brookfield Farm Ponds 1 and 2 all contain an assemblage of coarse fish (carp, perch and roach) as expected for a fishing pond. This has been established by eDNA survey in 2019. While these fish contribute to the overall biodiversity and value of the water bodies, they are not protected or notable species.

4.5.5 Watercourses 2, 3, 5a and 5b are assessed to be of local importance in relation to fish due to the confirmed presence of bullhead and brown trout. The remaining watercourses; 4 and 6 and the ponds are of negligible importance in relation to fish due to the presence of common and widespread species, which, in the case of the fishing ponds, have likely been stocked.

Aquatic macroinvertebrates

4.5.6 Macroinvertebrate survey results are summarised as follows.

- Watercourse 2 – a high diversity of macroinvertebrates comprising mostly common species, except for the blackfly *Simulium reptans*, considered ‘Local’ (Conservation Score 5) under the CCI index; however, this species does not have any statutory designation. Watercourse 2 is categorised as moderate overall conservation value.
- Watercourse 5a – a moderate diversity of macroinverterbrates, comprising mostly common species, except for the Caddisfly *Athripsodes bilineatus* considered ‘Local’ under the CCI index, however it does not have any statutory designation. Watercourse 5a categorised as moderate overall conservation value.
- Brookfield Farm Ditch – a low diversity comprising mostly of common species, with no rare or notable species. This ditch was assessed as being of low conservation value.
- Tower House Pool, a relatively high diversity of macroinvertebrates comprising common species, with no rare or notable species. This pond was categorised as moderate conservation value.

- Lower Pool - a high diversity of macroinvertebrates comprising common species, with no rare or notable species. This pond was categorised as good conservation value.
- Chubb Pond 1 – a moderate diversity comprising mostly common species, expect for the lesser water boatman *Micronecta scholtzi* ('Local' under the CCI index), however the species is widespread throughout England and does not have any statutory designation. This pond was assessed as good conservation value.
- Brookfield Fishery – a moderate diversity comprising mostly common species, with the presence of the lesser water boatman *Sigara iactans* ('Regionally notable' under the CCI index). This species has only been recorded in 19 hectads (1990 – 2013) but is considered under-recorded and an establishing native species, and therefore has no statutory designation (Ref 16). This pond was assessed as good conservation value.
- Brookfield Farm Pond 1 – low macroinvertebrate diversity comprising mostly of common species. This pond was assessed as of low conservation value.
- Brookfield Farm Ponds 2 and 3 - moderate diversity comprising mostly of common species with no rare or notable species. These ponds were assessed as moderate conservation value.

4.5.7 The ponds and watercourses within the Scheme boundary have been shown to support common and widespread species of no more than local value and are therefore considered to be of no more than local importance for aquatic invertebrates.

Aquatic macrophytes

4.5.8 The macrophyte assemblage in Tower House Pool, Chubb Pond 1, Brookfields Fishery and Brookfield Farm Ponds 1 and 2, is considered typical for fishing ponds with no rare or notable species.

4.5.9 Brookfield Farm Pond 3 – The fringed water-lily was recorded in this water body. This species is native to the fens of East Anglia and the Thames basin, hence its Nationally Scarce Designation. However, it is widely naturalised outside its native range and is therefore likely to be introduced in this area, and of least concern.

4.5.10 Aquatic macrophyte surveys have identified common and widespread species only. Although the macrophyte assemblage recorded in the ponds and watercourses contributes to their overall biodiversity value, the species recorded are not in themselves considered to be of any more than local ecological importance.

White-clawed crayfish

4.5.11 White-clawed crayfish are likely absent from watercourses 2 and 5a, Tower House Pool, Lower Pool and Brookfield Farm Ponds 1 and 2 and are not therefore considered further in the assessment.

5 Summary

5.1.1 Eight fishing ponds are located within the vicinity of the Scheme and were visited during the site walkover to assess if further aquatic surveys were needed. Four ponds all within the Scheme boundary were surveyed for fish, white-clawed crayfish and macroinvertebrates, these were Tower House Pool, Lower Pool, Brookfield Farm Ponds 1 and 2.

5.1.2 Six water courses were scoped in for fisheries surveys, these were Watercourses 2 to 6 (including Watercourse 5b an additional site downstream of watercourse 5 and to the west of the Scheme boundary), while three were scoped in for macroinvertebrate and white-clawed crayfish surveys, these were Watercourses 2, 5a and Brookfield Ditch (Watercourse 4 within the Scheme boundary). Watercourse 1, outside of the Scheme boundary was not surveyed as land access was not approved.

5.1.3 White-clawed crayfish were not captured during the surveys while the habitat present at Watercourse 5a was deemed suitable to support a population. Historical data did not record their presence within the Scheme boundary.

5.1.4 The majority of fish captured at the watercourses were common freshwater fish in the UK with no protected status. Bullhead, identified in watercourse 2, 3 and 5b, were of interest as a notable species. This species is listed on Annex II of the EC Habitats Directive and is a species of principal importance; however, it is widespread in watercourses of suitable habitat throughout the UK. It is recommended in line with best practise that future mitigation should continue to provide suitable habitat for this species and protected bullhead from disturbance during construction.

5.1.5 Brown trout were present at Watercourse 5b only, this is outside of the Scheme boundary however, fish are mobile species and could enter the section of Watercourse 5 that lies inside the proposed Scheme and expected to be impacted by the Scheme.

5.1.6 Carp, perch and roach were detected from analysis of water samples taken for eDNA in the Tower House Pool and Lower Pool Brookfield Farm Fishing Ponds 1 and 2. In addition, the eDNA analysis produced a low detection of tench in Brookfield Farm Fishing Pond 1 and Lower Pool and gudgeon in the Tower House Pool .

5.1.7 Across the three watercourses and seven ponds surveyed, a total of 145 macroinvertebrate taxa were recorded throughout three survey seasons (spring – autumn for the watercourses, summer for the ponds).

5.1.8 Most of the species recorded were common, except the lesser water boatman *Sigara iactans* (‘Regionally notable’, Conservation Score 6) in Brookfield Fishery. It was first recorded on the Norfolk coast in 2005, as a presumed recent colonist, and its fairly rapid spread in England represents a natural extension of its range. It is now considered an established native and has no statutory designations (Ref 16).

5.1.9 A total of 41 macrophyte species were recorded across the seven ponds surveyed. None of the seven ponds sampled support communities of macrophytes of interest, however, one of the species recorded is of conversation interest. The ‘Nationally Scarce’ fringed water-lily (*Nymphoides peltata*) was recorded. This species is native

to the fens of East Anglian and the Thames basin hence its Nationally Scarce designation, however it is widely naturalised and planted outside its native range.

5.1.10 Two species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) were recorded: Montbretia in Chub Pond and Canadian waterweed in Lower Pool. In addition, the non-native terrestrial plant Rhododendron sp. was recorded on the banks of Brookfield Fishery.

5.1.11 Using the PSYM classification, none of the seven ponds were assessed to be of good or excellent quality, nor identified as priority ponds. Overall, this is likely to reflect a lack of diversity of Coleoptera, Odonata and Megaloptera species, a relatively low diversity of macrophyte species and the lack of uncommon macrophyte species. Two ponds (Brookfield Fishery and Brookfield Farm Pond 1) were of poor quality with a Biotic Integrity score of 44% and 33 % for respectively. Five other ponds were determined as being of moderate quality ranging from 56% to 67% of PSYM Biotic Integrity score (see Table 5.1). The Lower Pool fishing pond scored the highest overall quality out of the seven ponds. However, based on macroinvertebrates and the CCI index, three ponds (Brookfield Fishery, Lower Pool and Chubb Pond 1) appear to be of good ecological value, because of either a relatively high taxa diversity and / or the presence of species of 'Local' or 'Regional' interest, such as *Micronecta scholtzi* or *Sigara iactans*.

5.1.12 Although no species of conservation interest were recorded within the three watercourses surveyed, Watercourse 2 and the Brookfield Ditch (Watercourse 4 within the Scheme boundary) appear to support diverse macroinvertebrate communities, while Watercourse 5 had a lower taxonomic diversity. In addition, Watercourse 2 and Watercourse 5 support macroinvertebrate communities adapted to relatively fast flowing conditions and likely to be sensitive to pollution and sedimentation, as indicated by the high ASPT (5.1 to 5.3) and the PSI scores (indicative of 'Slightly sedimented' to 'Moderately sedimented' conditions). The analyses demonstrated that the Brookfield Ditch supports communities more adapted to slow flowing conditions and likely to be more tolerant to pollution and sedimentation, as indicated by the lower ASPT (4.4) and the PSI score indicative of 'Sedimented' conditions.

Table 5.1: A summary of the survey findings undertaken on ponds and watercourses..

Site name	PSYM quality category (Index of Biotic Integrity	Macroinvertebrates	Macrophytes	Non-native species and Schedule 9 species
Brookfield Fishery Outside the Scheme boundary	Poor (44%)	'Fairly high conservation value' (CCI score 10.3). Presence of the 'Regionally notable (Conservation Score 6) *Sigara iactans*, which is outside of its current known range, The species has however no statutory designations. Relatively high taxa diversity (34 taxa recorded), including flatworms, snails, leeches, crustaceans, mayfly, damselfly, alderfly and caddisfly larvae, along with several species of true bugs and beetles	Low number of species (9), with no species of conservation interest recorded	*Rhododendron* sp.
Lower Pool Inside the Scheme Boundary	Moderate (67%)	'Moderate' conservation value (CCI score 9.8). No species of conservation interest recorded. High taxa diversity (41 taxa recorded). Presence of clean water indicator (caddisfly larvae, mayfly larvae).	High number of species (22), with no species of conservation interest recorded	Canadian waterweed (*Elodea canadensis*)
Chub Angling Pond 1 Outside the Scheme boundary	Moderate (61%)	'Fairly High' conservation value. However, no species of conservation interest recorded. Moderate diversity (18 taxa recorded), including snails, true bug, trueflies, leeches, beetles and damselfly larvae.	Moderate number of species (17), with no species of conservation interest recorded	Montbretia (*Crocosmia x. crocosmiiflora)*
Brookfield Farm Pond 3 Outside the Scheme Boundary	Moderate (61%)	'Moderate' conservation value (CCI score 5.1). No species of conservation interest recorded. Moderate taxa diversity (24 taxa recorded), including flatworms, damselfly larvae, snails, true bugs, beetles, caddisfly and truefly larvae.	Moderate number of species (13), with one species (*Nymphoides petlata*) of conservation interest recorded	None recorded

Site name	PSYM quality category (Index of Biotic Integrity	Macroinvertebrates	Macrophytes	Non-native species and Schedule 9 species
Tower House Pool (Pond 1) Within the Scheme boundary	Moderate (61%)	'Moderate' conservation value (CCI score 9.0) Relatively high taxa diversity (31 taxa recorded). Presence of clean water indicator (caddisfly larvae, mayfly larvae).	Moderate number of species (11), with no species of conservation interest recorded	None recorded
Brookfield Farm Pond 2 Within the Scheme boundary	Moderate (56%)	Moderate' conservation value (CCI score 6.4). No species of conservation interest recorded. Moderate taxa diversity (28 taxa recorded), including dragonfly, damselfly and mayfly larvae, leeches and snails.	Low number of species (7), with no species of conservation interest recorded	None recorded
Brookfield Farm Pond 1 Within the Scheme boundary	Poor (33%)	No species of conservation interest recorded. Low taxa diversity (10 taxa recorded), including flatworms, leeches, crustaceans, mayfly, true bugs, caddisfly and true fly larvae.	Low number of species (8), with no species of conservation interest recorded	None recorded
Watercourse 2 Within the Scheme boundary	n/a	Low' to 'Moderate' conservation value, with no species of conservation interest recorded. Relatively high taxa diversity (50 taxa recorded across spring and autumn), including snails, leeches, crustaceans, true bugs, beetles and mayfly larvae. Presence of some clean water indicators (caddisfly larvae). Communities adapted to moderately fast flows and indicative of 'moderately sedimented' conditions.	n/a	n/a
Watercourse 5 Inside the Scheme boundary	n/a	Low' to 'Moderate' conservation value, with no species of conservation interest recorded. Moderate taxa diversity (30 taxa recorded across spring and autumn), including snails, mussels, crustaceans, beetles, mayfly and truefly larvae. Presence of some clean water indicators (caddisfly larvae).	n/a	n/a

Site name	PSYM quality category (Index of Biotic Integrity	Macroinvertebrates	Macrophytes	Non-native species and Schedule 9 species
		Communities adapted to moderately fast flows and indicative of 'moderately sedimented' conditions.		
Brookfield Ditch (Watercourse 4inside the Scheme boundary)	n/a	Low' conservation value, with no species of conservation interest recorded. Moderate taxa diversity (32 taxa recorded in spring), including flatworms, snails, leeches, crustaceans, damselfly and dragonfly larvae, true bugs and true fly larvae. Presence of some clean water indicator (stonefly and caddislfy larvae). Communities adapted to slow flows and indicative of 'sedimented' conditions.	n/a	n/a

6 References

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