ANNEX B1

Aquatic Ecology Monitoring: Tame and Trent

Minworth SRO
Severn Trent Water & Affinity Water

AECOM

Rivers Tame and Trent Strategic Resource Options Aquatic Ecology Monitoring

Final Report

Affinity Water, Anglian Water Services Ltd and Severn Trent Water Ltd

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1. Introduction

1.1 Aquatic Ecological Assessment

1.1.1 AECOM was commissioned to undertake a suite of aquatic ecological surveys to support the environmental assessment of Strategic Resource Options (SRO) in support of three related SRO schemes – Minworth, South Lincolnshire Reservoir (SLR), and the Anglian to Affinity Transfer (A2AT), which involve the Rivers Tame or Trent directly or indirectly. The Services to be delivered are for Affinity Water, Anglian Water Services Limited and Severn Trent Water Limited.

1.1.2 The purpose of the Gate 2 assessment is to assess the impact of the reduction of discharge to the River Tame and Trent system, where Minworth currently discharges a Dry Weather Flow (DWF) of 417 Ml/d (as per Concept Design Report CDR, Jacobs 2022), separately and in-combination with the potential abstraction of up to 300 Ml/d (as an absolute maximum) for the SLR SRO. The maximum reduction in DWF from Minworth under consideration is 230 Ml/d. This assessment is critical to supporting concept design and scheme environmental assessment for key SROs at Gate 2.

1.1.3 A key element of the related SROs, Minworth and SLR, is to investigate the environmental risks and opportunities associated with delivery of the schemes. The scope of the aquatic ecological assessment has been widened to include six major rivers: the Trent (classed into the Upper and Lower Trent), the Tame, the Nene, the Great Ouse, the Welland and the Witham, in order to inform wider assessment of the SRO schemes.

1.2 Background

1.2.1 AECOM previously completed the Hydrology, Environment and Ecological (HEE) gap analysis of the River Tame, River Trent and Humber (TTH) system for Gate 1, carried out jointly for Minworth and the SLR. Subsequent investigations completed for Gate 2 include baseline water quality monitoring in the River Tame (June 2022), Hydrological, Aquator and Hydraulic Modelling of the rivers Tame and Trent (June 2022), and overall environmental assessments for the Tame and Trent (AECOM, May 2022).

1.2.2 The Humber Estuary and tidal River Trent have been scoped out of the aquatic ecological assessment and are being assessed in other work streams.

1.2.3 The HEE baseline study for the TTH system in support of the Minworth and SLR for Gate 1 encompassed 19 in-depth topic reports and an overall summary report to inform further environmental assessment for the SROs.

1.2.4 The baseline assessment for Gate 1 collated information relating to Water Framework Directive (WFD) related impacts and benefits, baseline ecological data, and in particular the potential impacts of changes in flow to ecological receptors such as designated sites and their qualifying features, protected and notable species, and particular constraints from the presence or future spread of Invasive Non-Native Species (INNS). The outcome of the Gate 1 assessment included recommendations for further monitoring to inform the baseline scenario, which, with the feedback of stakeholders including the Environment Agency (EA) and Natural England (NE) at Gate 1, has informed the scope of aquatic ecological surveys; monthly stakeholder workshops with the EA and NE have been held throughout the Gate 2 assessments, and this has both informed and refined the scope of aquatic ecology surveys.

1.2.5 Also underway are water quality monitoring in the River Tame, and Hydrological, Aquator and Hydraulic Modelling of the rivers Tame and Trent, due to be completed in July 2022. The monitoring and modelling work streams are running parallel with the overall Gate 2 Environmental Assessment (60669746_REP_002_Env-Ass_Trent_SRO_V5 Annex B3.1[1]) to inform the assessment of potential environmental impacts.

[1] AECOM, April 2022. Environmental Assessment for the Trent Strategic Resource Options (SRO): Minworth SRO and South Lincolnshire Reservoir (SLR) SRO: Results and Recommendations. Report to Affinity Water, Anglian Water Services Ltd and Severn Trent Water Ltd

1.3 Scope of Report

1.3.1 The purpose of aquatic ecological surveys, reported in this document, is to determine the assemblages of aquatic macroinvertebrate, macrophyte, INNS and fish within the pre-determined survey locations, and thereby characterise the aquatic habitats present. The overall rationale and objectives for the study are as follows:

- Support the Water Companies with the delivery of aquatic ecology monitoring in support of three SRO schemes:
- the SLR,
- the Trent intake of the A2AT; and
- Minworth.

1.3.2 A key element of the related SROs, Minworth and SLR, is to investigate the environmental risks and opportunities associated with delivery of the schemes. The monitoring is designed to fill ecological data gaps, feed into hydro-ecological assessment work and inform INNS risk assessments for each SRO scheme.

1.3.3 The rationale for the assessment is as follows:

- alignment with standard EA WFD monitoring for macroinvertebrates and macrophytes;
- alignment of survey locations with existing EA monitoring sites to aid temporal analysis;
- alignment with CIEEM guidelines on the lifespan of ecological data – macroinvertebrate and macrophyte data surveyed from 2019 onward are regarded as 'up to date' and are not required for re-survey; and
- supplementary surveys for highly mobile and rapidly spreading INNS through targeted surveys and eDNA sampling.

1.3.4 Aquatic ecological monitoring data will enable hydro-ecological assessment for the SRO schemes. A bespoke scope of monitoring has been agreed for each SRO, and this report details the results of this monitoring.

1.3.5 The report includes the following information:

- relevant legislation and policy;
- methods for desk and field-based assessments (undertaken in 2021);
- limitations to the surveys undertaken and any assumptions made as a result of incomplete data;
- survey results and evaluation, and conclusions and recommendations.

1.4 Relevant wildlife legislation

1.4.1 This assessment has been undertaken within the context of the following relevant legislative instruments, planning policies and guidance documents:

- The Conservation of Habitats and Species Regulations 2017 ("the Conservation Regulations");
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- Wildlife and Countryside Act 1981 (as amended) (the 'WCA');
- Natural Environment and Rural Communities Act (2006), Section 41 of which provides a list of habitats and species of principal importance for nature conservation in England;
- The Conservation of Habitats and Species Regulations 2010 (as amended);
- The Salmon and Freshwater Fisheries Act (1975);
- The Eels (England and Wales) Regulations 2009;
- Regulation 1143/2014 on invasive alien species; and
- UK Post-2010 Biodiversity Framework.

2. Methodology

2.1 Desk Study

2.1.1 A comprehensive desk study was undertaken as part of the TTH Gate 1 baseline assessment, and this informed the gap analysis to identify the targeted scope of aquatic ecological monitoring. Refer to the Gate 1 assessment reports for further details of the Gate 1 assessment (AECOM, March 2021).

2.1.2 Further data has since been obtained to support the wider environmental assessment, including:

- data from EA fish population survey reports (River Trent hydro-acoustic reports 2016, 2017, 2018 and 2019) were also used to aid in understanding of fish populations along the River Trent.
- INNS survey date for the SLR assessment (Mott MacDonald, 2020) covering physical and eDNA survey records for the River Nene, River Welland, South Forty Foot Drain, Fossdyke and River Witham.

2.1.3 Only records up to ten years old were generally considered within the assessment, as any records older than ten years are unlikely to be representative of aquatic species in the local area, with the exception of older records where these are considered relevant to inform the assessment.

2.1.4 Critical to the assessment has been the age and completeness of available data, and surveys have been completed to fill spatial and temporal gaps in data, as flagged at Gate 1.

2.2 River Habitat Survey

Surveyor names and accreditation codes redacted

2.2.1 River Habitat Surveys (RHS) were carried out between August and December 2021 by accredited RHS surveyors ([redacted]).

2.2.2 A 500m stretch of watercourse was surveyed at each survey location (Figure A1, Appendix A) as detailed in the EA RHS Manual (EA, 2003).

2.2.3 For lowland rivers, May and June are considered optimal periods for RHS as the presence of key diagnostic features such as flowers and fruiting bodies facilitate the identification of macrophytes, while vegetation cover remains insufficient to obscure bank and channel features. RHS, however, can be conducted at any time of year. Weather conditions were good during the surveys and flow conditions were generally low-normal.

RHS Methodology

2.2.4 RHS is a method designed to characterise and assess the physical structure of freshwater streams and rivers, including recognition of vegetation types and basic geomorphological principles and processes. RHS is carried out along a standard 500m stretch of river channel, with observations made at ten equally spaced 'spot-checks' and additional context provided by observations of land-use and valley form in the river corridor. Surveyor training and accreditation facilitates accurate and consistent recording of features to allow standardised conclusions to be drawn.

2.2.5 The RHS methodology (Appendix B) includes a mandatory health and safety risk assessment component, stringent requirements for the recording of grid references and photographic evidence and recording of any unusual features with special notes and photographs as supporting evidence. RHS is not designed to provide the level of detail needed for specialist surveys for specific flora or fauna; however, RHS can support recommendations for and findings of surveys for aquatic macroinvertebrates, macrophytes, fish and hydro-geomorphology.

2.2.6 RHS was undertaken at 35 sites as summarised in Table 1 and illustrated in Figure A1 (Appendix A) by an EA accredited surveyor between August and December 2021, and in accordance with the EA RHS Manual (EA, 2003).

2.2.7 It is noted that 13 of the proposed RHS sites on the Rivers Tame, Trent, Great Ouse, Nene, Welland and Witham have not previously been surveyed using RHS methodology. Consequently, these sites were assessed at the start of the survey for appropriate access and survey-ability – RHS relies on clear

access to, and good visibility of in-channel features, if not access to the channel itself, for the entire 500m survey reach.

Table 1: RHS site locations

Grid references for continued monitoring locations redacted

Watercourse	ID	Site Name	Survey reach central NGR	Date completed
Great Ouse	GO1	Olney	[redacted]	07/12/2021
Great Ouse	GO2	Harrold		14/12/2021
Great Ouse	GO3	Milton Ernest		14/12/2021
Great Ouse	GO4	Kempston		15/12/2021
Great Ouse	GO5	Willington		15/12/2021
Great Ouse	GO6	Church End		07/12/2021
Nene	NE3	Ringstead		04/10/2021
Nene	NE4	Lilford Road		04/10/2021
Nene	NE5	Oundle		04/10/2021
Nene	NE6	Elton		16/09/2021
Nene	NE7	Wansford		26/08/2021
Tame	TA1	Castle Bromwich		01/10/2021
Tame	TA2	Water Orton		01/10/2021
Tame	TA3	Lea Marston		24/09/2021
Tame	TA4	Tamworth		24/09/2021
Tame	TA5	Elford		29/09/2021
Tame	TA6	Alrewas Arboretum		29/09/2021
Upper Trent	UT1	Burton		17/09/2021
Lower Trent	LT1	Willington		13/09/2021
Lower Trent	LT2	Long Eaton		13/09/2021
Lower Trent	LT3	Trentside		13/09/2021
Lower Trent	LT4	Gunthorpe		08/09/2021
Lower Trent	LT5	Winthorpe		07/09/2021
Lower Trent	LT6	Dunham		07/09/2021
Welland	WE1	Collyweston Bridge		27/08/2021
Welland	WE2	Tinwell Mill		27/08/2021
Welland	WE3	Stamford		16/09/2021
Welland	WE4	Uffington Road Bridge		26/08/2021
Welland	WE5	Tallington		16/09/2021
Witham	WI1	Aubourn		24/08/2021
Witham	WI2	North Hykeham		23/09/2021
Witham	WI3	Lincoln upstream Brayford Pool		25/08/2021
Witham	WI4	Five Mile House		24/08/2021
Witham	WI5	Bardney		24/08/2021
Witham	WI6	Tattershall Bridge		25/08/2021

Habitat and Hydro-morphological Indices

2.2.8 RHS data can be used to provide an assessment of habitat quality and the extent of channel modification, and this can then inform physical quality objectives for river works and restoration. Hydro-

morphological indices were calculated using the RHS Toolbox software (Naura 2021), including the Habitat Modification Score (HMS), Habitat Quality Assessment (HQA) and River Habitat Quality (RHQ).

2.2.9 HMS indicates the degree of modification of the river habitat, with a higher score indicating a higher degree of modification. HMS results in a Habitat Modification Class (HMC) which allocates each survey an HMC Description ranging from Pristine/Semi-Natural to Severely Modified. HQA provides a broad indication of river quality and habitat diversity by collating natural features assessed through the field survey. A more diverse site in terms of natural river habitats will result in a higher HQA score. RHQ is calculated by calibrating HMS and HQA scores against Benchmark sites and assessing potential management impact, resulting in a RHQ score which gives an indication of the overall diversity and naturalness of physical structure, and the degree of artificial modification of a surveyed reach.

2.2.10 The HMS and HQA scoring criteria and the RHQ method are further described in Appendix B.

2.3 Aquatic Macroinvertebrate Survey

2.3.1 Aquatic macroinvertebrate surveys were completed at 20 pre-determined sites identified from the gap analysis assessment described in Section 1.3.3. The locations of the 20 sites are presented in Table 2. For sites on the rivers Tame and Trent it was considered pertinent to include summer survey (June to August) to provide further data for the development of the Minworth scheme – this is because summer data is more indicative of low flow impacts, the time when the Minworth scheme is proposed to operate.

Table 2: Aquatic macroinvertebrate sampling locations

Grid references for continued monitoring locations redacted

Waterbody	Site Reference	Airlift Survey	NGR	Survey date within sample season		
				Summer 2021	Autumn 2021	Spring 2022
Great Ouse	GO1	-	[redacted]	N/A	23/11/2021	01/03/2022
Great Ouse	GO3	-		N/A	24/11/2021	01/03/2022
Great Ouse	GO5	-		N/A	24/11/2021	01/03/2022
Nene	NE1	-		N/A	11/11/2021	01/03/2022
Nene	NE2	-		N/A	11/11/2021	04/03/2022
Nene	NE3	-		N/A	04/10/2021	04/03/2022
Nene	NE4	-		N/A	04/10/2021	04/03/2022
Nene	NE6	-		N/A	16/09/2021	04/03/2022
Tame	TA1	-		19/08/2021	20/10/2021	03/03/2022
Tame	TA2	-		19/08/2021	20/10/2021	03/03/2022
Tame	TA3	-		11/08/2021	20/10/2021	03/03/2022
Tame	TA4	-		19/08/2021	20/10/2021	03/03/2022
Tame	TA5	-		19/08/2021	11/11/2021	02/03/2022
Tame	TA6	-		18/08/2021	11/11/2021	02/03/2022
Upper Trent	UT1	-		18/08/2021	17/09/2021	02/03/2022
Lower Trent	LT4	-		18/08/2021	08/09/2021	03/03/2022
Lower Trent	LT6	Y		31/08/2021	23/11/2021	22/03/2022
Welland	WE3	-		N/A	16/09/2021	09/03/2022
Welland	WE5	-		N/A	16/09/2021	09/03/2022
Welland	WE6	-		N/A	23/09/2021	09/03/2022

2.3.2 The macroinvertebrate survey method followed the aquatic macroinvertebrate sampling procedures standardised by the EA (Environment Agency, 2017), which conforms to BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters. The method allowed characterisation of aquatic macroinvertebrate communities and

were used to determine whether rare or notable species or communities were present. The samples were taken using a standard Freshwater Biological Association (FBA) pattern pond net (mesh size: 1mm). The habitats present were sampled through a combination of kick sampling and sweep sampling for three minutes followed by a one-minute hand search of larger substrates in accordance with the standard methods. The samples collected were subsequently preserved in Industrial Methylated Spirit (IMS) for laboratory processing.

2.3.3 All sites were surveyed in autumn 2021 (September to November) and again in spring 2022 (March). River Tame and River Trent sites were also surveyed in summer 2021 (August). The Great Ouse, Nene and Welland systems would not be impacted by a change in Minworth discharges, whereas the Rivers Tame and Trent have a direct link, and this justifies the additional Summer 2021 survey, a period of the year indicative of low flow impacts, the time when Minworth is proposed to operate. All seasonal surveys were completed within the seasons as defined by industry best practice.

2.3.4 In-situ measurements of temperature, dissolved oxygen, electrical conductivity, and pH were determined using a calibrated YSI probe. Water samples were collected in spring 2022 for subsequent laboratory analysis for ammonia (Ammonia un-ionised as N, and Ammoniacal Nitrogen as N), nitrate (Nitrate as N), nitrite (Nitrite as N), phosphorous (Orthophosphate, reactive as P) and Biochemical Oxygen Demand (BOD: 5 Day ATU). Where existing EA data is lacking, water samples were also be analysed for alkalinity to inform River Invertebrate Classification Tool (RICT) analysis – see below.

2.3.5 The use of airlift methodology was deemed necessary at several survey sites (for both aquatic macroinvertebrate and INNS surveys) following consultation with the EA, specifically LT6 for macroinvertebrate survey, and LT3 and LT5 for INNS survey. The use of airlift sampling was chosen due to local water properties, including depth, velocity, and currents. The use of this methodology complies with industry best practice and was safer and more effective under those specific site conditions than kick and sweep sampling, which could have put the surveyor at risk as well as provide non-representative samples. As such, samples could still be collected from the river benthos and accurately inform the analysis of water quality through macroinvertebrate sensitivity indices.

2.3.6 Each of the samples collected was sorted and analysed in a laboratory by suitably trained and experienced aquatic ecologists. Lists of the aquatic macroinvertebrate taxa present were produced in line with EA guidance (Environment Agency, 2014). The aquatic macroinvertebrate samples were identified to 'mixed taxon level' using stereomicroscopes. Most groups were identified to species level (where practicable), with the exception of the following:

- Mites (Hydracarina) which were identified to order;
- Worms (Oligochaeta) which were identified to sub-class;
- Marsh beetles (Scirtidae) which were identified to family;
- Butterfly / moth larvae (Lepidoptera), which were identified to order;
- Springtails (Collembola) which were identified to order;
- Truefly larvae, which were identified to the maximum resolution possible; and
- Immature or damaged specimens, which were identified to the maximum resolution possible on a case-by-case basis.

2.3.7 The survey data was then used to calculate the following metrics (see Section 3.3) that can be used to inform an assessment of relative nature conservation value, sensitivity to sedimentation, flow regime and organic enrichment.

Community Conservation Index (CCI)

2.3.8 A Community Conservation Index (CCI) (Chadd & Extence, 2004) was calculated for each site as detailed in Appendix D. The CCI classifies many groups of aquatic macroinvertebrates according to their scarcity and nature conservation value in England as understood at the time that the classification was developed.

2.3.9 Species scores range from 1 to 10, with 1 being very common and 10 being Endangered (see Appendix D). Since its initial publication, in some cases the references used in the CCI classification to define scarcity and value have been superseded by more recent assessments. Due to this, the author has

provided AECOM with updated species scores to take account of this new information (Chadd, *pers. comm*., 2018). These updated scores have been used within this assessment.

2.3.10 The overall CCI derived provides an indication of the conservation value of the community sampled, based on a combination of the rarity of the different aquatic macroinvertebrate taxa present and overall community richness, as shown in Appendix D. As indicated above, in some cases expert judgment may be needed to moderate these assessments with reference to current information on status and distribution.

Whalley, Hawkes, Paisley & Trigg (WHPT) Index

2.3.11 The aquatic macroinvertebrate data were analysed to generate Whalley, Hawkes, Paisley & Trigg (WHPT) Average Score Per Taxon (ASPT), and Number of scoring taxa (NTAXA) values which provides an indication of the ecological quality in the watercourse (WFD-UKTAG, 2021). This assigns numerical value to taxa according to their sensitivity to organic pollution. The average of the values for each taxon in a sample, known as ASPT, is a stable and reliable index of organic pollution. Therefore, these assessments can indicate to what extent an aquatic macroinvertebrate community is exposed to organic pollution (further information is provided in Appendix E).

2.3.12 It is important to note that these indices can vary between geological regions and habitat types. Ditches, for example are unable to support many of the high-scoring taxa associated with fast flowing habitats. Therefore, the resultant metrics should be reviewed with an awareness of their potential limitations, and the site-specific context, as described in this report.

Proportion of Sediment-sensitive Invertebrates (PSI) Index

2.3.13 Calculations were also made to determine the proportion of sediment sensitive aquatic macroinvertebrates present using the Proportion of Sediment-sensitive Invertebrates (PSI) index (Extence *et al*., 2011). Using this approach, individual taxa of aquatic macroinvertebrate are assigned a Fine Sediment Sensitivity Rating (FSSR) ranging from A to D, as detailed in Appendix F.

2.3.14 The PSI score for each aquatic macroinvertebrate sample was derived from individual species scores and abundances. The derived PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, where low scores correspond to watercourses with high fine sediment cover. The PSI score therefore provides an indication of the extent to which watercourses are influenced by fine sediments, and therefore by inference the potential sensitivity of the associated aquatic macroinvertebrate community to changes in silt load and deposition.

Lotic-invertebrate Index for Flow Evaluation (LIFE)

2.3.15 Lotic-invertebrate Index for Flow Evaluation (LIFE) indices were also calculated (Extence *et al*., 1999). This is an index that links benthic macroinvertebrate data to flow regimes prevailing in UK waters. Flow scores have been allocated to various aquatic macroinvertebrates based on species/family abundance and ecological association with different flows.

2.3.16 The overall LIFE score for a site is calculated as the sum of the individual scores divided by the number of scoring species/families, as detailed in Appendix G. LIFE scores increase with current velocity, with scores <6.00 generally indicating sluggish or still water conditions and scores >7.5 indicating fast flows. LIFE allows the mean flow preference of macroinvertebrates colonising a site to be determined so that effect of habitat changes such as sediment accumulation can be monitored.

River Invertebrate Classification Tool (RICT)

2.3.17 The resultant WHPT-ASPT and NTAXA values and environmental data collected were processed through the River Invertebrate Classification Tool version 2 (RICT) web application, available on the Freshwater Biological Association website[2].

2.3.18 RICT predicts the WHPT-ASPT and NTAXA scores for the surveyed locations based on the Reach location, altitude, alkalinity, slope, discharge category, distance from source, channel dimensions and substrate composition. The predicted scores are then compared to actual scores and the output is an Ecological Quality Ratio (EQR). The EQR can be translated into a WFD classification (High, Good, Moderate, Poor, or Bad).

[2] https://fba.org.uk/FBA/Public/Discover-and-Learn/Projects/RIVPACS_Landing.aspx

1.1.1 Where available from existing EA monitoring or by spot sampling undertaken alongside macroinvertebrate sampling, alkalinity data was used to inform RICT analysis. Alkalinity data is essential to determine watercourse typology to compare to reference sites.

2.4 Macrophyte Survey

2.4.1 Aquatic macrophyte surveys were undertaken at nine sites identified from the gap analysis assessment described in Section 1.3.3. Survey details are presented in Table 3. The recommended survey season for aquatic macrophytes is 1st June to 30th September and should not be undertaken during, or immediately after periods of high flow. The survey methodology undertaken varied depending on the waterbody type.

Table 3: Macrophyte survey locations on the River Tame and River Trent

Grid references for continued monitoring locations redacted

Site Reference	Site Name	Waterbody	Date	NGR Start	NGR Finish
TA1	Castle Bromwich	Tame	01/10/21	[redacted]	
TA2	Water Orton	Tame	01/10/21		
TA4	Tamworth	Tame	01/10/21		
TA6	Alrewas Arboretum	Tame	29/09/21		
LT7	Twyford	Trent	29/09/21		
LT8	Long Eaton	Trent	29/09/21		
LT9	Gunthorpe	Trent	28/09/21		
LT10	Newark on Trent	Trent	28/09/21		
LT11	North Clifton	Trent	28/09/21		

2.4.2 Surveys flowing watercourses followed guidance presented in the UKTAG River Assessment Method (Macrophytes and Phytobenthos) for use with LEAFPACS2 (WFD-UKTAG, 2014), which conforms to BS EN 14184:2014 Water quality - Guidance for the surveying of aquatic macrophytes in running waters. Macrophytes were identified to the lowest taxonomic level along a 100m transect. This was carried out by walking within the channel where possible, or along the banks using a grapnel to survey deeper water.

2.4.3 A list of all macrophytes encountered was collated and their relative abundance was recorded using Taxon Cover Values (TCV), detailed below (Table 4).

Table 4: Taxon Cover Values (TCV) and their associated percentage cover

TCV	Percentage cover for the macrophyte species
C1	<0.1%
C2	0.1 to 1%
C3	1 to 2.5%
C4	2.5 to 5%
C5	5 to 10%
C6	10 to 25%
C7	25 to 50%
C8	50 to 75%
C9	>75%

2.4.4 River macrophyte data was processed through the River LEAFPACS2 programme, available from the WFD UKTAG website[3]. Four metrics were calculated using macrophyte species and groups data:

- River Macrophyte Nutrient Index (RMNI) – Macrophyte taxa are allocated a score based on their relative tolerance of nutrients.
- Number of macrophyte taxa (NTAXA) – The number of scoring taxa recorded in the field survey. Only true hydrophytes are included.
- Number of Functional Groups (NFG) – Hydrophytes are allocated to one of 24 "functional groups". These are groups of organisms which exploit a resource in a similar way.
- Cover of filamentous green algae (ALG) – The percentage cover of filamentous green algae over the whole of the surveyed section.

2.4.5 LEAFPACS2 predicts the RMNI, NTAXA and NFG scores for the surveyed reach based on the site altitude, alkalinity and slope. The predicted scores are then compared to actual scores and the output is an EQR which can be translated into a Water Framework Directive (WFD) classification (High, Good, Moderate, Poor or Bad).

2.4.6 River LEAFPACS2 analysis was designed to reflect the impact of nutrient enrichment on macrophyte communities, with High status indicating no impact and Bad status indicating a severe impact. The method can also be sensitive to alterations in river flow and/or modifications to morphological conditions which may impact macrophyte communities (WFD-UKTAG, 2014).

2.4.7 Aquatic macrophyte species were cross referenced against the JNCC Taxon Designations list to identify if any protected and/or notable species were recorded during the survey.

2.5 Fish surveys

2.5.1 Electric fishing surveys were undertaken during August 2021 up and downstream of six weirs (where accessible) by boat, as shown in Table 5, to identify species present. Environmental DNA (eDNA) surveys for fish DNA were also completed upstream and downstream of all six weirs.

2.5.2 These surveys were all carried out in the optimum season for fish surveys; after the close season (March 15th – June 15th) and before autumn when heavy rainfall can make rivers unsuitable for surveying.

Table 5: Fish survey locations.

Grid references for continued monitoring locations redacted

Waterbody	Site Reference	Date	NGR Start	NGR Finish	eDNA sample NGR
Trent	Cromwell Weir US	06/08/2021	[redacted]		
	Cromwell Weir DS	06/08/2021			
	Hazelford Weir US	05/08/2021			
	Hazelford Weir DS	05/08/2021			
	Gunthorpe Weir US	09/08/2021			
	Gunthorpe Weir DS	09/08/2021			
Tame	Broad Meadow Weir US*	24/09/2021			
	Broad Meadow Weir DS*	24/09/2021			
	Lea Marston Weir US	11/08/2021			
	Lea Marston Weir DS	11/08/2021			
	Water Orton Weir US	13/08/2021			
	Water Orton Weir DS	13/08/2021			

** No electric fishing was performed at the Broad Meadow sites due to unsafe access near the weir, all other sites were deemed safe and allowed surveys*

[3] https://www.wfduk.org/resources/rivers-macrophytes

2.5.3 Fish survey methodology followed EA Operational Instruction 993_08; Electric fishing operations: equipment and working practices (Environment Agency, 2019). The electric fishing method requires a small electrical current to be placed into the water temporarily stunning any fish to be captured, measured to fork length and released unharmed.

2.5.4 Due to the large size of the rivers at these sites, quantitative electric fishing methods were unsuitable, therefore qualitative presence/absence data was collected. The run lengths were determined by the extents of suitable habitat and accessibility by boat.

2.5.5 Sites on the River Trent had marginal areas of both banks surveyed due to the river being very wide (>50m) and deep (>2m) in the middle channel at each survey site. River Tame sites were fished in the middle of the channel either from the boat or wading where conditions were determined safe to do so.

2.6 Invasive Non-Native Species (INNS)

2.6.1 Targeted surveys for INNS were undertaken at 12 sites, as detailed in Table 6.

Table 6: INNS survey locations

Grid references for continued monitoring locations redacted

ID	Airlift Survey	Waterbody	NGR	Date completed
TA2	-	Tame	[redacted]	19/08/2021
TA6	-	Tame		18/08/2021
LT4	-	Lower Trent		18/08/2021
LT5	Y	Lower Trent		07/09/2021
LT6	Y	Lower Trent		31/08/2021
FC1	-	Fossdyke Canal		08/09/2021
FC2	-	Fossdyke Canal (Brayford Pool)		23/09/2021
RW	-	River Witham		24/09/2021
SFFD1	-	South Forty Foot Drain		10/09/2021
SFFD2	-	South Forty Foot Drain		10/09/2021
SFFD3	-	South Forty Foot Drain		24/09/2021
SC	-	Sawley Cut		17/09/2021

2.6.2 INNS surveys consisted of:

- eDNA sampling (subsequent analysis by eDNA provider NatureMetrics) for single-species analysis, to give a higher chance of detection, especially if species are in low abundance. Single-species tests for signal crayfish, crayfish plague and Chinese mitten crab and metabarcoding for Quagga and Zebra mussel were undertaken. Additional data for Veneridae (bivalve mussels) were also obtained to identify if other species such as Asian clam were present.
- visual search for non-native plants, aided by use of a grapnel to retrieve specimens for identification, where possible concurrently with macrophyte or other surveys.
- manual search for non-native aquatic invertebrates using a pond net, including sampling of hard standing areas which are generally favourable for INNS but are not routinely sampled.

2.6.3 The length of watercourse surveyed was documented, with species locations mapped using GIS coordinates and/or polygons as appropriate. Survey extents were as broad as possible within the confines of land access, bank and channel accessibility, health and safety, and time constraints.

2.6.4 Surveys were completed between August and September 2021 inclusively, when water levels were generally low, and plants in full growth

2.6.5 Where it was not possible to survey a reach in its entirety, surveys for aquatic INNS focused on areas with inflows, outfalls, drawdown, and strandlines, as well as selective strategic sampling in open water

areas. INNS are most likely to be encountered in sheltered bays or areas where material gathered by wave action accumulates. In addition to the banks walked, relevant hard infrastructure including screens, locks, and bank reinforcement, were searched as far as was practicable. This approach ensured reasonable effort suitable to maximise INNS detection.

2.6.6 Two locations, LT5 and LT6 on the River Trent, were surveyed for macroinvertebrate INNS using an airlift following consultation with the EA and based on the sampling methodology used by the EA during surveys of these locations.

2.6.7 INNS surveys were completed primarily to inform the risks associated with potential abstractions from the River Trent, including to the River Witham. Due to the potential risk of the spread of INNS due to potential flow reductions at Minworth, INNS surveys were also completed on the River Tame. This will be assessed in detail in the Gate 2 Environmental Assessment report (AECOM 2022).

Biosecurity

2.6.8 Best-practice biosecurity measures were implemented throughout all aquatic and riparian surveys to prevent the spread of INNS, propagules, and water-borne diseases, including:

- Planning sequences of site visits taking into account biosecurity risks, e.g., upstream to downstream to prevent the spread of INNS upstream;
- Checking all clothing, footwear, vehicle, and equipment for visible debris before leaving site;
- Using a stiff brush and water to remove mud and debris;
- Using a brush and water to clean equipment, and a water spray to rinse;
- Use of an appropriate disinfectant such as Virkon S to spray equipment and PPE;
- Complying with specific site restrictions in the event of any pathogen outbreak;
- Leaving mud, plant, and animal debris on site;
- Emptying buckets on site; cleaning equipment rinsed with clean water;
- Allow equipment to dry thoroughly between sites.

2.7 Water Quality Sampling and Analysis

2.7.1 Dissolved oxygen (DO; % saturation and mg/L), temperature (°C), pH (pH units) and conductivity (µS/cm) were measured using a YSI Pro Plus multimeter at each of the macroinvertebrate and macrophyte survey sites.

2.7.2 Additionally, water samples were collected at all macroinvertebrate and macrophyte sites using clean plastic containers during March 2022. Sample water was decanted into sterilised sample bottles (containing any required preservative) provided by the appointed laboratory. The water quality samples were retained in a portable cooler with ice packs to maintain the required temperature of 2-8°C and sent via courier to ALS laboratory on the day of sampling for next day delivery. Samples were analysed by ALS for the following parameters: ammonia (Ammonia un-ionised as N, and Ammoniacal Nitrogen as N) in mg/L, nitrate (Nitrate as N) in mg/L, nitrite (Nitrite as N) in mg/L, phosphorous (Orthophosphate, reactive as P) in mg/L and Biochemical Oxygen Demand (BOD: 5 Day ATU) in mg/L.

2.7.3 None of the received samples were reported as deviating by the laboratory.

2.7.4 All water samples were collected, stored and transported in accordance with British Standards (BS) Institution ISO 5667, particularly the following parts:

- BS EN ISO 5667-3:2018 Water quality. Sampling. Preservation and handling of water samples;
- BS EN ISO 5667-14:2016 Water quality. Sampling. Guidance on quality assurance and quality control of environmental water sampling and handling.

2.7.5 The water quality data were analysed in relation to WFD standards for rivers given in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015. Of the

different standards for various river typologies, the following was applied, which were deemed as the most appropriate:

- river type 5 and 7 (alkalinity ≥100 to <200 CaCO3/L or alkalinity < 200 mg/L, and altitude < 80 m) for dissolved oxygen, BOD and ammoniacal nitrogen.

2.7.6 This was based on a data from the nearest location from a database (spreadsheet) on river typologies provided by the Environment Agency.

2.7.7 The list of standards used in this report is presented as Appendix M.

2.8 Assumptions and Limitations

2.8.1 Land access was agreed where possible with landowners prior to survey start dates. Small stretches of watercourse undergoing RHS were inaccessible due to health and safety (primarily steep banks, dense vegetation and deep water); however, it is believed this has not comprised the survey results.

River Habitat Survey limitations

2.8.2 Most RHS were surveyed and viewed from one bank, due to inaccessibility, primarily from only being able to access one side of the river. For several surveys, local geography or dense bankside vegetation resulted in small sections of the RHS reach not being visible. High turbidity resulting from heavy rainfall the night or nights prior the survey date did obscure some substrate and submerged vegetation of within reaches of all the surveyed rivers. The depth of some of the survey rivers meant that where substrate or submerged macrophytes were not visible, it was unsafe to enter to check. It is not believed these limitations, however, will have impacted on the recorded general characteristics and details of the surveys or the overall outcomes of the analysis.

2.8.3 A total of 11 RHS were completed outside of the optimum recording period (April to September). These were all sites on the River Great Ouse, two sites on the River Tame and a further three sites on the River Nene. It is not believed that the completion in October, November and December will have impacted drastically on the overall outcomes of the analysis or the recorded general characteristics and details of the surveys, as RHS can be performed during any time of the year and supporting information on macrophyte assemblage has been obtained through parallel surveys at those locations. Likewise, details of macrophyte, riparian vegetation and INNS presence, for example, can be ascertained outside of the optimal survey season under mild conditions such as those in late 2021.

Macrophyte survey limitations

2.8.4 High flows and turbid waters at some of the River Tame survey sites (TA1, TA2 and TA4) impeded submerged vegetation detection and identification, however, grapnel sampling was effective under such scenarios.

2.8.5 The use of the grapnel was occasionally hindered along the banksides due to overhanging vegetation and steep banks, sometimes dislodging collected material. Increased underflow current from moderate to high flows were also noted as being a limitation on the macrophyte surveys. In this instance, additional grapnel throws were completed every 10-15m of the survey reach.

2.8.6 Access issues were also reported at TA2, with access near the weir. In this instance the survey reach was moved downstream, and a full survey length completed.

INNS survey limitations

2.8.7 The sites at Fossdyke canal and the Lower Trent were hindered by large sections of private and sometimes gated boat moorings on the banksides. Surveys were moved up or downstream to ensure the survey extent was maximised to all accessible and priority areas, such as lock gates and moorings. On some survey lengths, similar to the macrophyte surveys, the use of the grapnel was hindered along the banksides due to overhanging vegetation and steep banks. Boat moorings also prevented the use of the grapnel in some locations, as it was not safe to throw near moving and moored boats. The long-handled net was used instead to ensure INNS surveys were carried out satisfactorily under these limiting locations. The limitations are not considered to have affected the survey outcomes.

2.8.8 Other methods of sample collection were used where sufficient sample could not be collected from standard kick, sweep or grapnel samples. Airlift samples were collected at two macroinvertebrate and INNS sites on the River Trent. The use of eDNA sampling was also used to help identify any INNS not

found in the manual search of the watercourses, where species may have been missed due to inaccessibility, and to maximise INNS detection.

Fish survey limitations

2.8.9 At sites on the River Trent where the river was very wide (>50m) both banks were set to be surveyed; however, a lack of suitable habitat due to the presence long stretches of concrete or sheet piling and of anglers (particularly downstream of weirs) only one bank was surveyed at some sites.

2.8.10 The efficiency of the electric fishing equipment is limited by depth and width of the water surveyed. On the River Trent some deep areas may have meant the electrical field in the water would have been limited in its effectiveness to stun fish, therefore some fish may have been missed that were present in these areas.

2.8.11 The electric fishing data obtained for these surveys indicate the fish assemblages present at these sites; however, it is not a fully comprehensive assessment due to limitations in fishing efficiency on such large rivers. It is considered however that the use of eDNA survey, together with desk study information, has provided a comprehensive indication of fish assemblages at the surveyed locations.

2.8.12 It is also important to note that no electric fishing was undertaken at the Broad Meadow sites on the River Tame due to unsafe access near the weir, as advised by the EA.

Water quality survey limitations

2.8.13 Temperature, dissolved oxygen and conductivity water quality parameters could not be obtained at eight sites during the surveys due to faulty sensors on the YSI probe. Consequently, these parameters at the affected sites are not included within the results (Table 14).

2.8.14 The presented WFD classifications for sites, where water quality has been assessed, are based on average values of the measurements collected during survey periods and are therefore indicative of point-in-time classification only.

3. Results

3.1 Invasive Non-Native Species

Desk Study

3.1.1 Table 7 summarises previous records of INNS in the surveyed catchments to inform SLR SRO scheme from 2020, provided by Mott MacDonald Ltd on behalf of Anglian Water Services. Records have been obtained by both physical (conventional) and eDNA surveys, in October 2020.

Table 7: SLR INNS records 2020[4]

Grid references for continued monitoring locations redacted

		Nene		Welland		SFFD		Fossdyke	Witham
		Wansford	Near tidal limit and North Side	Near Tinwell	Near tidal limit, Spalding	Swineshead Bridge	Near tidal limit, Boston	Lincoln, at Fossdyke-Witham confluence	Towards tidal limit, Anton's Gowt
Species	Method[5]	[redacted]							
Demon shrimp *Dikerogammarus haemobaphes*	C		✓					✓	✓
Himalayan balsam *Impatiens glandulifera*	C	✓		✓					
Nuttall's waterweed *Elodea nuttallii*	C		✓			✓			✓
Water fern *Azolla filiculoides*	C							✓	✓
Least duckweed *Lemna minuta*	C		✓			✓	✓	✓	✓
Red duckweed *Lemna turionifera*	C					✓	✓		
Zebra mussel *Dreissena polymorpha*	C					✓	✓		✓
	E	✓	✓	✓	✓				✓
Bloody red mysid *Hemimysis anomala*	C						✓		
Asian clam *Corbicula fluminea*	E							✓	
Caspian mud shrimp *Chelicorophium curvispinum*	C						✓		✓
False dark mussel	E					✓	✓	✓	✓

[4] Provided by Mott MacDonald Limited (Received December 2021)
[5] C = Conventional survey; E = eDNA survey

Species	Method[5]	Nene		Welland		SFFD		Fossdyke	Witham
		Wansford	Near tidal limit and North Side	Near Tinwell	Near tidal limit, Spalding	Swineshead Bridge	Near tidal limit, Boston	Lincoln, at Fossdyke-Witham confluence	Towards tidal limit, Anton's Gowt
Mytilopsis leucophaeata									
A freshwater shrimp *Gammarus tigrinus*	C					✓	✓		
Gulf wedge clam *Rangia cuneata*	E						✓		✓
New Zealand mud snail *Potamopyrgus antipodarum*	C	✓	✓	✓			✓		
A freshwater shrimp *Crangonyx pseudogracilis / floridanus*	C	✓	✓		✓				
Crayfish plague *Aphanomyces astaci*	E	✓		✓					

3.1.2 A comprehensive desk study for records of INNS was completed for the Gate 1 baseline assessment (AECOM 2021).

3.1.3 In order to update desk study records of invasive species, a refreshed desk study was undertaken to inform this report. Table 8 summarises additional records of specific fish and invertebrate INNS records identified during the refreshed desk study.

Table 8: INNS records for the River Tame and River Trent

Grid references for continued monitoring locations redacted

Species	Waterbody	Location of most upstream record	Location of most downstream record	Year or most recent record	Number of records
Zander *Sander lucioperca*	Tame			2008	2
	Trent			2016	7
Wels Catfish *Silurus glanis*	Tame				
	Trent				
Sunbleak *Leucaspius delineatus*	Tame				
	Trent				
Asian Clam *Corbicula fluminea*	Tame				
	Trent			2021	37
	Tame			2011	2

Species	Waterbody	Location of most upstream record	Location of most downstream record	Year or most recent record	Number of records
Zebra mussel *Dreissena polymorpha*	Trent	[redacted]		2019	30

Conventional INNS Surveys

3.1.4 INNS records for the surveyed reaches are summarised in Table 9 and reported in full in Appendix K, with relevant density or abundance of specimens and species level identification. INNS were also identified through eDNA sampling, to identify species at sites where standard survey-ability was limited by local hydromorphology and accessibility (refer to Section 2.8).

3.1.5 Within the Tame INNS survey reaches, Himalayan balsam *Impatiens glandulifera* was dominant at both sites TA4 and TA6 whilst also being the only INNS record at the latter site. At TA4, the demon shrimp *Dikerogammarus haemobaphes* was also found along with INNS macrophytes Japanese knotweed *Reynoutria japonica* and giant hogweed *Heracleum mantegazzianum*.

3.1.6 The Lower Trent INNS survey site LT4 had a density of 10% for Canadian waterweed *Elodea canadensis* and less than half this for Himalayan balsam found on the banks. The New Zealand mud snail *Potamopyrgus antipodarum*, Nuttall's waterweed *Elodea nuttallii* and Asian clam *Corbicula fluminea* were also identified. Floating pennywort *Hydrocotyle ranunculoides* was recorded just upstream of the surveyed reach. At LT5 only INNS macroinvertebrates were identified: large numbers of Caspian mud shrimp *Chelicorophium curvispinum* (approximately 160 individuals) were recorded alongside the freshwater shrimp *Crangonyx pseudogracilis/floridanus*, the bladder snail *Physella acuta/gyrina*, New Zealand mud snail and zebra mussel *Dreissena polymorpha*.

3.1.7 Within the INNS survey sites for South Forty Foot Drain, Nuttall's waterweed was recorded as frequent and occasional at SFFD1 and SFFD2 respectively, increasing to abundant for SFFD3. Numbers of the shrimp *C. pseudogracilis/floridanus* were much greater at SFFD2 than at SFFD1, with over 270 individuals at the former and only 25 specimens at the latter. SFFD 3 had the highest number of INNS, gulf wedge clam *Rangia cuneata*, the false dark mussel *Mytilopsis leucophaeata*, zebra mussel, an abundance of water fern *Azolla filiculiodes* and butterfly bush *Buddleia* found along the bank tops. SFFD2 had a further two INNS records with water fern, classed as having occasional abundance, and zebra mussel both also present.

3.1.8 At the Fossdyke Canal, water fern was more frequent at FC2 than at FC1. Both sites also had records of Asian clam and *C. pseudogracilis/floridanus*, with site FC1 having additional records of zebra mussel and Caspian mud shrimp. Site FC2 had Nuttall's waterweed, demon shrimp and New Zealand mud snail also recorded.

3.1.9 Two invasive macrophyte species were recorded the River Witham site RW1, with abundant levels of Nuttall's waterweed and a dominant presence of water fern. Three macroinvertebrate INNS were also recorded; *C. pseudogracilis/floridanus*, demon shrimp, and zebra mussel.

INNS eDNA Results

3.1.10 The eDNA INNS survey results are summarised in Table 9 and reported in full in Appendix L.

3.1.11 Zebra mussel *Dreissena polymorpha* eDNA records at sites LT5, SFFD2, SFFD3, FC1 and RW1 were confirmed by conventional surveys at the same locations. Zebra mussel presence were also recorded at LT6, TA6, FC2 and RC1 through eDNA surveys, although live specimens were not discovered during the conventional surveys.

3.1.12 Quagga mussel *Dreissena rostriformis* was detected at SC1 by eDNA, although no specimens were found during conventional surveys. This was the only site where Quagga mussel was detected.

3.1.13 At both SFFD2 and SFFD3 eDNA detected the presence of the false dark mussel *Mytilopsis leucophaeata*, with confirmation of presence by conventional survey at SFFD3. The South Forty Foot Drain was the only watercourse where this species was detected.

3.1.14 The Asian clam *Corbicula fluminea* was present at nine sites in total, based on results from both conventional and eDNA surveys. Presence was recorded by eDNA and confirmed through conventional surveys at both Fossdyke sites (FC1 and FC2). At LT4 no eDNA was detected although Asian clam specimens were found during the conventional surveys. The eDNA surveys also detected this species at LT5, LT6, TA6, SFFD2 and SFFD3, although no specimens of Asian clam were recorded during conventional surveys.

3.1.15 Gulf wedge clam *Rangia cuneata* was detected by eDNA and confirmed by conventional surveys at SFFD3, the only surveyed site with presence of this INNS.

3.1.16 American signal crayfish *Pacifastacus leniusculus* was detected through eDNA surveys at four of the sample sites. The sites with American signal crayfish were LT5 and LT6 on the Lower Trent, TA6 on the River Tame, and SC1 on the Sawley Cut. No specimens of American signal crayfish were recorded during conventional surveys.

3.1.17 Crayfish plague *Aphanomyces astaci* was detected by eDNA survey at Sawley Cut SC1 and River Tame TA6.

3.1.18 Chinese mitten crab *Eriocheir sinensis* was not detected by eDNA survey at any locations.

Table 9: INNS suveys results for both conventional and eDNA across the Lower Trent, Tame, South Forty Foot Drain, Fossdyke Canal, River Witham and Sawley Cut

Species	Common name	Species type	Survey type	LT4	LT5	LT6	TA2	TA6	SFFD 1	SFFD 2	SFFD 3	FC1	FC2	RW1	SC1
Dreissena polymorpha	Zebra mussel	Mollusc	Conventional	-	Y	-	-	-	-	Y	Y	Y	-	Y	-
			eDNA	-	Y	Y	-	Y	-	Y	Y	Y	Y	Y	Y
Dreissena rostriformis	Quagga mussel	Mollusc	eDNA	-	-	-	-	-	-	-	-	-	-	-	Y
Mytilopsis leucophaeata	False dark mussel	Mollusc	Conventional	-	-	-	-	-	-	-	Y	-	-	-	-
			eDNA	-	-	-	-	-	-	Y	Y	-	-	-	-
Corbicula fluminea	Asian clam	Mollusc	Conventional	Y	-	-	-	-	-	-	-	Y	Y	-	-
			eDNA	-	Y	Y	-	Y	-	Y	Y	Y	Y	-	Y
Rangia cuneata	Gulf wedge clam	Mollusc	Conventional	-	-	-	-	-	-	-	Y	-	-	-	-
			eDNA	-	-	-	-	-	-	-	Y	-	-	-	-
Dikerogammarus haemobaphes	Demon shrimp	Invertebrate	Conventional	-	-	-	Y	-	-	-	-	-	Y	Y	-
Chelicorophium curvispinum	Caspian mud shrimp	Invertebrate	Conventional	-	Y	-	-	-	-	-	-	Y	-	-	-
Crangonyx pseudogracilis/floridanus	A freshwater shrimp	Invertebrate	Conventional	-	Y	-	-	-	Y	Y	-	Y	Y	Y	-
Physella acuta/gyrina	Bladder snail	Invertebrate	Conventional	-	Y	-	-	-	-	-	-	-	-	-	-
Potamopyrgus antipodarum	New Zealand mud snail	Invertebrate	Conventional	-	Y	-	-	-	-	-	-	-	Y	-	-
Pacifastacus leniusculus	American signal crayfish	Invertebrate	Conventional	-	-	-	-	-	-	-	-	-	-	-	-
			eDNA	-	Y	Y	-	Y	-	-	-	-	-	-	Y
Heracleum mantegazzianum	Giant hogweed	Macrophyte	Conventional	-	-	-	R	-	-	-	-	-	-	-	-
Impatiens glandulifera	Himalayan balsam	Macrophyte	Conventional	O	-	-	R	O	-	-	-	-	-	-	-
Reynoutria japonica	Japanese knotweed	Macrophyte	Conventional	O	-	-	R	-	-	-	-	-	-	-	-
Elodea nuttallii	Nuttall's waterweed	Macrophyte	Conventional	R	-	-	-	-	F	F	A	-	O	A	-
Elodea canadensis	Canadian waterweed	Macrophyte	Conventional	O	-	-	-	-	-	-	-	-	-	-	-
Azolla filiculoides	Water fern	Macrophyte	Conventional	-	-	-	-	-	-	O	A	O	A	D	
Hydrocotyle ranunculoides	Floating pennywort	Macrophyte	Conventional	R	-	-	-	-	-	-	-	-	-	-	-
Buddleia sp.	Butterfly bush	Macrophyte	Conventional	-	-	-	-	-	-	-	O	-	-	-	-
Aphanomyces astaci	Crayfish plague	Water mould	eDNA	-	-	-	-	Y	-	-	-	-	-	-	Y
Eriocheir sinensis	Chinese mitten crab	Invertebrate	Conventional	-	-	-	-	-	-	-	-	-	-	-	-
			eDNA	-	-	-	-	-	-	-	-	-	-	-	-

Note: Where a species is present a ‘Y’ has been used; for macrophyte species, presence is denoted through the use of DAFOR, where ‘D’ = Dense, ‘A’ = Abundant, ‘F’ = Frequent, ‘O’ = Occasional and ‘R’ = Rare.

3.2 River Habitat Survey

3.2.1 RHS forms will be provided separately for each survey reach; they are not included in this report due to the bulk of documentation. General characteristics are highlighted in the sections below and hydromorphological indices are provided in Appendix C.

3.2.2 Site photographs are available for all RHSs and can be provided separately. Some photographs have been included in this report to provide context where necessary.

River Trent (General River Characteristics)

3.2.3 The River Trent is the third longest river in the UK, rising in Staffordshire and running for approximately 270 km before draining into the Humber Estuary 40 miles west of the North Sea. The catchment covers more than 4,000 square miles. At the location of its confluence with the River Tame at Alrewas, the river broadens into a typical large lowland river with extensive floodplain. Main tributaries of the Trent include the rivers Tame, Churnet, Dove and Derwent.

3.2.4 The River Trent is tidal for 80 km up to Cromwell Lock downstream of Newark and is navigable as far upstream as Shardlow Lock in Derbyshire. For this report, the River Trent upstream of the confluence with the River Dove is known as the Upper Trent; downstream of the same confluence is the Lower Trent.

3.2.5 Despite generally being heavily modified, the River Trent displays a meandering course and features associated with less modified watercourses, including depositional features associated with weirs and areas of wetland habitats associated with designated sites and restoration initiatives. There are several weirs and other barriers along the River Trent, some of which have had fish passes installed to facilitate the migration of migratory fish species such as Atlantic salmon *Salmo salar*, European eel *Anguilla anguilla* and lamprey species.

3.2.6 The modification of the River Trent has been as a result of historic navigation requirements, and these remain in existence today for largely recreational boating. Several marinas have been constructed on man-made side channels or ‘Cuts’, and lock gates allow navigation around the major weirs. Active and former gravel workings are common in the floodplain, and many of these have been restored to provide wetland habitats.

UT1 Upper Trent at Burton

3.2.7 The surveyed reach was located within Burton Upon Trent where the River Trent flows over Burton weir and under the A511 Burton Bridge. The River Trent at this point constituted a natural watercourse flowing through a predominantly urban landscape. The site was surveyed from the left bank and the channel. No adverse conditions affected the survey, and the bed was more or less entirely visible throughout.

3.2.8 In-channel features comprised two mature islands; no pools or riffles were noted. Artificial features comprised the A511 Burton Bridge and Burton weir located immediately upstream of the bridge. Flow was generally rippled throughout the surveyed reach with occasional sections of smooth flow. The substrate consisted of a mixture of silt, sand, gravel and pebbles, cobbles, and boulders.

3.2.9 The dominant bank material was laid brick with a small section of earth on the left bank, and earth with one section of laid brick on the right bank. Sections of the right bank, however, were not visible during the survey. The left bank was reinforced for much of the survey length, with a small section of unreinforced bank that was notably resectioned. In contrast, the right bank was only reinforced at one location, but was considered to be resectioned throughout.

3.2.10 An eroding cliff and a stable cliff were present at one spot check each on the right bank, whilst a vegetated side bar was recorded on the left bank below the reinforced brick wall. Bank face and bank top vegetation was bare for much of the left bank but developed a largely uniform bank top vegetation community composed of short grasses with a simple bank face vegetation community characterised by grasses and tall herbs in the upper extent. The right bank comprised a largely simple bank face vegetation structure of tall herbs and grasses, whilst the bank top vegetation structure varied between uniform (short grasses only) and simple (grasses and tall herbs).

3.2.11 Bankside trees were present in occasional clumps on the left bank and were semi-continuous on the right bank, providing habitat in the form of exposed bankside and underwater tree roots, fallen trees,

and overhanging boughs contributing large woody material and leafy material into the river channel and shading of the channel.

3.2.12 Channel dimensions were recorded at spot check 10. Bank full width was 230 m as the river channel was split around a mature island, and water width was 72 m for both channels combined. The right bank was elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was 0.2 m, and the bed material was unconsolidated.

3.2.13 In-channel vegetation consisted of a mixture of floating-leaved rooted plants, emergent broad-leaved herbs, submerged broad-leaved and linear-leaved plants, free-floating plants, filamentous algae, and bryophytes.

3.2.14 Land use adjacent to the river comprised suburban and urban developments and parklands and gardens on the left bank, with suburban and urban developments, parklands and gardens and tall rank herbs present on the right bank. The wider landscape consisted of the same land use types. The riparian INNS Himalayan balsam *Impatiens glandulifera* was present on both bank top and bank face within the survey reach. Mallard ducks, Canada geese and gulls were also noted.

3.2.15 The channel was obviously over-deepened, realigned and impounded, with impacts due to the historic modification obvious in the local area. The river at this location was assessed as severely modified; habitat quality was excellent, with a management objective to protect. Sediment load was considered low, with agricultural sediment risk very low.

LT1 Lower Trent at Willington

3.2.16 The surveyed reach was located between the Derbyshire villages of Willington and Repton, where the River Trent meanders in a generally easterly direction towards Castle Donington. The River Trent at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the right bank and the channel. No adverse conditions affected the survey, and the bed was more or less entirely visible throughout.

3.2.17 In-channel features were limited; no riffles or pools were present. A mature island was noted, as was a vegetated point bar and discrete unvegetated silt deposits. Artificial features comprised the B5008 Willington Road bridge. Flow was generally rippled throughout the surveyed reach with one section of smooth flow. The substrate consisted predominantly of gravel and pebbles, although silt and sand were also recorded.

3.2.18 The dominant bank material was earth for both banks, although rip-rap (rock armour) and laid brick were present at one section each on the left bank. The left bank was substantially resectioned throughout much of the survey extent and also found to be reinforced at three distinct locations. By comparison, the right bank was largely unmodified, with resectioning and associated reinforcement noted at one spot check, and poaching recorded at another spot check.

3.2.19 Natural features on the left bank were largely absent; only one vegetated side bar was noted. The right bank, in contrast, recorded stable cliffs at three spot checks, a large natural berm, and a vegetated side bar. Bank top vegetation structure was uniformly comprised of short grasses throughout the entire survey extent on the right bank, and the right bank face vegetation structure was simple comprising grasses and tall rank herbs. The left bank comprised a largely uniform bank top vegetation structure of grasses which occasionally became simple where tall herbs grew amongst the grass, whilst the bank face vegetation structure was predominantly simple (grasses and tall herbs) with one section of uniform (short grasses only).

3.2.20 Bankside trees were isolated and scattered on both banks, providing habitat in the form of overhanging boughs. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, and submerged fine-leaved plants, free-floating plants.

3.2.21 Channel dimensions were recorded at spot check 2. Bank full width was 64 m and water width 52 m. The right bank was elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was 0.5 m, and the bed material was unconsolidated.

3.2.22 Land use adjacent to the river was dominated by improved grassland on the right bank, but comprised parklands and gardens, broadleaf woodland, and tall rank herbs on the left bank. The wider landscape included suburban and urban developments in addition to those land use types noted adjacent to the

river. The riparian INNS Himalayan balsam was present on both bank top and bank face within the survey reach. Duck mussels, fish, gulls, swans, and a toad were also noted during the survey.

3.2.23 The channel was not obviously over-deepened, realigned, or impounded, although impacts due to historic modification were noted. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered very low, with agricultural sediment risk very low.

LT2 Lower Trent at Long Eaton

3.2.24 The River Trent at Long Eaton was surveyed from the left bank and channel. No adverse conditions affected the survey, and the bed was partially visible. The river was approximately 90 m in width at the location of the single riffle, this likely formed by deposition downstream of Sawley Weir and the meander immediately downstream. The left bank was vertical and higher than the right bank, 2 m compared to 1.5 m, meaning the river would overtop the right bank first.

3.2.25 Unusually for a river of this size and character, a single riffle was present in association with two unvegetated point bars and a vegetated mid-channel bar, as described above caused by deposition downstream of Sawley Weir. Such depositional features, often associated with weirs, provide valuable habitat diversity and spawning habitat for fish. To the south off the right bank was Sawley Cut and Sawley Marina forming a side-channel with lock gates. A single major bridge crossed the river carrying the B6540 Tamworth Road.

3.2.26 Banks were generally earth with brick and laid stone reinforcement associated with the bridge. Stable cliffs were extensive on the steep left bank, with eroding cliff at one spot check on the right bank. Substrate, where visible, was gravel and pebble, with sand and silt in the margins and occasional cobbles. Flow was smooth and rippled throughout with standing waves and marginal dead water.

3.2.27 Emergent reeds and rushes were present along both banks, with submerged linear and fine-leaved macrophytes and filamentous algae also present. Trees were isolated on the left bank and occasional clumps on the right, with shading of the channel and woody debris present. Riparian land use consisted of tall ruderal vegetation and improved grassland, with suburban development, and also broad-leaved woodland on the right bank. Himalayan balsam was present on the bank face and bank top.

3.2.28 The channel was not obviously over-deepened, realigned, or impounded, although impacts due to navigation and historic modification were obvious in the local area. The river at this location was assessed as obviously modified; habitat quality was moderate, with a management objective to enhance. Sediment load was considered low, with agricultural sediment risk very low.

LT3 Lower Trent at Trentside

3.2.29 The surveyed reach was located in West Bridgford, Nottingham where the River Trent flows past the Trent Bridge cricket stadium and the City Ground football stadium in a generally easterly direction towards Holme Pierrepoint and Radcliffe on Trent. The River Trent at this point constituted a natural watercourse flowing through a predominantly urban landscape. No adverse conditions affected the survey, although the bed across the entire river width was barely visible due to water depth. The site was surveyed from the right bank.

3.2.30 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The A6011 Lady Bay Bridge was the only artificial feature recorded. The substrate was largely not visible during much of the survey but was noted to be composed predominantly of pebble and gravel where it could be assessed. Cobbles, silt and sand were also noted as components of the channel substrate. Flow was consistently smooth throughout the surveyed reach.

3.2.31 The left bank was noted to be reinforced throughout, and composed of variously sheet piling, brick, concrete and earth in the one section where the reinforcement was on the bank toe only, and resectioned bank face was also present. The right bank was composed mostly of earth, although reinforcing materials (concrete and brick) were noted where reinforcement modifications had been made to the bank face. Where the right bank was not reinforced, it was considered to be resectioned.

3.2.32 Natural features were absent from both banks. Bank top vegetation structure was largely bare on the right bank, although one section of simple vegetation bank top structure characterised by trees, tall herbs and grasses. The left bank face vegetation structure was a mixture of bare due to the reinforcements

and simple vegetation structure comprising grasses and tall rank herbs. The right bank comprised a mixture of bare bank top in the vicinity of the sporting arenas but developed into a simple bank top vegetation structure characterised by trees, tall herbs, and grasses downstream of Lady Bay Bridge. A similar pattern was noted in the bank face vegetation structure, which was uniformly composed of short grasses near the sport stadia but increased in complexity to simple downstream of Lady Bay Bridge where bank face vegetation structure comprised trees, grasses, and tall rank herbs.

3.2.33 Bankside trees were present in occasional clumps on both banks, providing habitat in the form of overhanging boughs and shading the channel. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, floating-leaved rooted plants, and, where visible, filamentous algae and submerged broad-leaved, linear-leaved, and fine-leaved plants.

3.2.34 Channel dimensions were recorded at spot check 1. Bank full width was 82 m and water width 72 m. The left bank was elevated above the right bank; i.e., the river would overtop the right bank before the left bank at this location. Water depth was 2 m, and the bed material was unconsolidated.

3.2.35 Land use adjacent to the river was dominated by suburban and urban developments with one section of broadleaf woodland on the left bank, but comprised a mixture of tall rank herbs, broadleaf woodland, and suburban and urban developments on the right bank. The wider landscape included parkland and gardens in addition to those land use types noted adjacent to the river. The riparian INNS Himalayan balsam, Orange balsam *Impatiens capensis* and butterfly bush *Buddleia* sp. were present on both bank top and bank face within the survey reach. Fish, Canada geese, Greylag geese, pond skaters, and swans were also noted during the survey.

3.2.36 The channel was not obviously over-deepened, realigned, or impounded, although impacts due to navigation and historic modification were obvious in the local area. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered very low, with agricultural sediment risk very low.

LT4 Lower Trent at Gunthorpe

3.2.37 The surveyed reach was located in Gunthorpe upstream of where the River Trent flows over Gunthorpe weir before turning and meandering in a north-east direction towards Newark-on-Trent. The River Trent at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the left bank. No adverse conditions affected the survey, and the bed was partially visible.

3.2.38 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded, nor were there any riffles or pools. Gunthorpe Bridge was the only artificial feature recorded. The substrate consisted predominantly of gravel and pebbles throughout. Boulders, silt, and sand were also recorded as present albeit not dominant components of the channel substrate. Flow was consistently smooth throughout the surveyed reach.

3.2.39 Both banks were composed entirely of earth and considered to be resectioned throughout the survey reach. Natural features were absent from both banks. Bank top vegetation structure was largely bare on the left bank due to the presence of a footpath, but was otherwise simple (comprising trees, tall herbs and grasses) or uniform and composed of grasses. The left bank face vegetation structure was a mixture of bare, simple vegetation structure comprising grasses and tall rank herbs, and complex vegetation structure additionally including trees and bryophytes. The right bank comprised a largely uniform bank top vegetation structure comprising short grasses, with occasional section of simple vegetation structure additionally including trees and tall herbs.

3.2.40 Bankside trees were isolated and scattered on the left bank and regularly spaced on the right bank, providing habitat in the form of overhanging boughs shading the channel and contributing large woody material and leafy debris into the aquatic habitat. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, broad-leaved emergent herbs, and submerged fine-leaved plants.

3.2.41 Channel dimensions were recorded at spot check 10. Bank full width was 80 m and water width 71 m. Both banks were the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 3 m, and the bed material was unconsolidated.

3.2.42 Land use adjacent to the river was dominated by improved grassland on the right bank but comprised a mixture of both improved grassland and broadleaf wood on the left bank. The wider landscape included parkland and gardens and suburban and urban developments in addition to those land use types noted

adjacent to the river. The riparian INNS Himalayan balsam was present on both bank top and bank face within the survey reach, whilst Asian clam was recorded from the river channel. Black-headed gulls, butterflies, damselflies, mallard duck and fish were also noted during the survey.

3.2.43 The channel was not obviously over-deepened, realigned, or impounded, although impacts due to navigation and historic modification were obvious in the local area. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered very low, with agricultural sediment risk low.

LT5 Lower Trent at Winthorpe

3.2.44 The surveyed reach was located to the west of Winthorpe where the River Trent flows under the A1 Great North road and meanders in a northerly direction towards Dunham on Trent. The River Trent at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the right bank. No adverse conditions affected the survey, and the bed was partially visible.

3.2.45 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The A1 road bridge was the only artificial feature recorded. The substrate consisted predominantly of boulders throughout the survey extent. Gravel and pebbles, silt and sand were also recorded as present, albeit not dominant, components of the channel substrate. Flow was consistently smooth throughout the surveyed reach.

3.2.46 Both banks were composed entirely of earth except under the A1 bridge where both banks were reinforced with sheet piling. Both banks were considered to be resectioned throughout the survey reach, with the right bank additionally reinforced with boulder rip-rip (rock armour). Poaching was evident at one location on the left bank. Natural features were absent from both banks. Vegetation structure was largely uniform and composed of grasses on both bank tops, except under the A1 road bridge where bank top vegetation structure was bare and one section on the right bank where tall rank herbs contributed towards a simple vegetation structure. The vegetation structure of both bank faces was simple, comprising grasses and tall rank herbs throughout the survey reach, again except under the A1 road bridge where bank face vegetation structure was bare.

3.2.47 Bankside trees were present in occasional clumps on the left bank and isolated and scattered on the right bank, providing habitat in the form of overhanging boughs shading the channel. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, broad-leaved emergent herbs, and bryophytes. Much of the submerged vegetation community could not be observed or assessed accurately.

3.2.48 Channel dimensions were recorded at spot check 2. Bank full width was 105 m and water width 85 m. Both banks were the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 3 m, and the bed material was unconsolidated.

3.2.49 Land use adjacent to the river was dominated by improved grassland on both banks. The wider landscape included suburban and urban developments in addition to improved grassland. No riparian macrophyte INNS were noted within the survey reach. Bullhead, butterflies, damselflies, fish, heron, and kingfishers were all observed and recorded during the survey.

3.2.50 The channel was not obviously over-deepened, realigned, or impounded, although impacts due to navigation and historic modification were obvious in the local area. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered very low, with agricultural sediment risk very low.

LT6 Lower Trent at Dunham

3.2.51 The surveyed reach was located between Dunham on Trent and Newton on Trent where the River Trent flows under the A57 Dunham Road toll bridge and meanders northwards towards Gainsborough, eventually discharging into the Humber estuary at Alkborough. The River Trent at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the left bank. No adverse conditions affected the survey, and the bed was partially visible.

3.2.52 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The A57 Dunham Road toll bridge was the only artificial feature recorded. The channel substrate was largely not visible enough to

accurately assess, though silt and cobbles were recorded as present. Flow was consistently smooth throughout the surveyed reach.

3.2.53 Both banks were composed entirely of earth except under the A57 Dunham Road toll bridge where both banks were reinforced with brickwork. Both banks were considered to be resectioned throughout the survey reach, and both were also sporadically reinforced with boulder rip-rip (rock armour). Poaching was evident at one location on the left bank, whilst the right bank was noted to be embanked at one section. Natural features were absent from both banks. Vegetation structure was a mixture of uniformly consisting of short grasses and simple structure comprising grasses and tall ruderal vegetation on both bank tops. Vegetation structure on both bank faces was simple and comprising grasses and tall rank herbs throughout the survey reach, except at two sections on the right bank where the addition of trees and bryophytes increased vegetation structure to complex.

3.2.54 Bankside trees were isolated and scattered on both banks, providing habitat in the form of overhanging boughs. The in-channel vegetation consisted predominantly of broad-leaved emergent herbs and emergent reeds, sedges and rushes. Much of the submerged vegetation community could not be observed or assessed accurately.

3.2.55 Channel dimensions were recorded at spot check 2. Bank full width was 105 m and water width 85 m, with the right bank elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. The left bank was noted to have extensive set-back embankments through the survey extent. Water depth was 3 m.

3.2.56 Land use adjacent to the river was dominated by improved grassland on the right bank but comprised a mixture of predominantly improved grassland alongside rough pasture and tall herbs on the left bank. The wider landscape included tilled land in addition to those land use types noted adjacent to the river. No riparian macrophyte INNS were noted within the survey reach. Fish including pike, butterflies and mallard duck were all observed and recorded during the survey.

3.2.57 The channel was not obviously over-deepened, realigned, or impounded, although impacts due to navigation and historic modification were obvious in the local area. The river at this location was assessed as severely modified; habitat quality was moderate, with a management objective to enhance. Sediment load was considered very low, with agricultural sediment risk very low.

River Nene (General River Characteristics)

3.2.58 The River Nene is the tenth longest river in the UK, rising in Arbury Hill, Northamptonshire, and flowing in a generally north-easterly direction for approximately 160 km. It has a catchment area of approximately 631 square miles.

3.2.59 The River Nene is navigable from Northampton to Sutton Bridge in Lincolnshire where it discharges into The Wash, England's largest bay. Major tributaries of the River Nene include the River Ise, Willow Brook, Wootton Brook, Harpers Brook, and the Brampton Branch.

3.2.60 The River Nene is tidal from the river mouth to the Dog in a Doublet lock at Whittlesey, and is navigable as far inland as Northampton, a total of 140 km. Much of the leisure boating occurs between Northampton and Peterborough, served by a number of marinas throughout the course. Whilst modified for navigation, the River Nene retains a meandering course.

NE3 Nene at Ringstead

3.2.61 The surveyed reach was located to the north of Ringstead downstream of where the River Nene flows below Ringstead Road. The River Nene at this point constituted a natural watercourse flowing through a predominantly arable landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the right bank. High turbidity impeded visibility of the riverbed and submerged features such as submerged vegetation.

3.2.62 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools, nor were any artificial features recorded. The channel substrate could not be discerned due to high turbidity.

3.2.63 The dominant bank material throughout the entirety of the surveyed length was earth. The majority of the survey reach was considered to be resectioned on the left bank but largely natural on the right bank.

No bank features were recorded during the survey. Bank face and bank top vegetation was largely simple throughout the surveyed reach, composed of predominantly of grasses and tall rank herbs.

3.2.64 Channel dimensions were recorded at spot check 7. Bank full width was 25 m and water width 22 m, with right bank elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was estimated at 1.5 m.

3.2.65 Bankside trees were isolated and scattered on the left bank and present in occasional clumps on the right bank, providing habitat in the form of exposed bankside and submerged roots, and overhanging boughs contributing large woody debris and leafy material into the river channel and shading of the channel. Visible in-channel vegetation consisted of emergent reeds, sedges and rushes, and emergent broad-leaved herbs. The submerged in-channel vegetation was not visible due to water conditions.

3.2.66 Land use adjacent to the river was predominantly tall rank herbs with occasional patches of improved grassland on the left bank and semi-natural broadleaf woodland with occasional patches of tall rank herbs on the right bank. The wider landscape also included artificial open water in the form of fishing lakes developed from former gravel pits post-1960. An extensive presence of the riparian INNS Himalayan balsam was recorded on both bank top and bank face, whilst fish and adult damselflies were also noted.

3.2.67 The channel was obviously over-deepened but not obviously realigned or impounded. Impacts due to navigation and historic modification were evident in the local area. The river at this location was assessed as obviously modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered low, with agricultural sediment risk very low.

NE4 Nene at Lilford Road

3.2.68 The surveyed reach was located where the River Nene flows below Lilford Road in a north-easterly direction towards Oundle. The River Nene at this point constituted a natural watercourse flowing through an arable and pastoral landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the left bank. High turbidity impeded visibility of the riverbed and submerged features such as submerged vegetation.

3.2.69 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools, nor were any artificial features recorded. The channel substrate could not be discerned due to high turbidity.

3.2.70 The dominant bank material throughout the entirety of the surveyed length was earth, although laid brick was noted at one section of bank reinforcement on the right bank. The majority of the survey reach was considered to be resectioned on both banks. No natural bank features were recorded during the survey. Bank top vegetation structure was uniform throughout on the left bank comprising short grasses, whilst bank face vegetation was predominantly simple and composed of grasses and tall rank herbs. Bank face and bank top vegetation structure on the right bank was largely simple throughout the surveyed reach, composed of predominantly of grasses and tall rank herbs.

3.2.71 Channel dimensions were recorded at spot check 4. Bank full width was 28 m and water width 25 m, with left bank elevated above the right bank; i.e., the river would overtop the right bank before the left bank at this location. Water depth was estimated at 2 m.

3.2.72 Bankside trees were absent from the left bank and were semi-continuous on the right bank, providing habitat in the form of exposed bankside and submerged roots, and overhanging boughs contributing large woody debris and leafy material into the river channel and shading of the channel. Visible in-channel vegetation consisted of emergent reeds, sedges and rushes, and emergent broad-leaved herbs. The submerged in-channel vegetation was not visible due to water conditions.

3.2.73 Land use adjacent to the river was dominated by improved grassland on the left bank and was largely semi-natural broadleaf woodland with one patch of improved grassland on the right bank. The wider landscape also included an extensive presence of parkland on the right bank and an extensive presence of improved grassland on the left bank. The presence of the riparian INNS Himalayan balsam was noted on both bank tops, whilst adult damselflies were also recorded during the survey.

3.2.74 The channel was obviously over-deepened and realigned but was not impounded. Impacts due to navigation and historic modification were obvious in the local area. The river at this location was

assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered low, with agricultural sediment risk very low.

NE5 Nene at Oundle

3.2.75 The surveyed reach was located to the north of Oundle downstream of where the River Nene flows under the A605 and A427 road bridges. The River Nene at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the left bank. High turbidity impeded visibility of the riverbed and submerged features such as submerged vegetation.

3.2.76 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools, nor were any artificial features recorded. The channel substrate could not be discerned due to high turbidity.

3.2.77 Dominant bank material throughout was earth, although wood piling was recorded at one spot check on the right bank. The majority of the survey reach was considered to be resectioned on both banks, whilst extensive livestock poaching was also noted on the left bank. No natural bank features were recorded during the survey. Bank face and bank top vegetation structure was largely uniform comprising grasses throughout the surveyed reach, with occasional patches of simple vegetation structure where tall rank herbs grew among the grasses.

3.2.78 Channel dimensions were recorded at spot check 9. Bank full width was 34 m and water width 32 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was estimated at 2 m.

3.2.79 Bankside trees absent from the left bank and isolated and scattered on the right bank, providing habitat in the form of overhanging boughs shading of the channel. Visible in-channel vegetation consisted of emergent reeds, sedges and rushes, floating-leaved rooted plants, and emergent broad-leaved herbs. The submerged in-channel vegetation was not visible due to water conditions.

3.2.80 Land use adjacent to the river was predominantly improved grassland on both banks, with one patch of parkland noted on the right bank and one patch of tall rank herbs recorded on the left bank. The wider landscape also included suburban and urban developments. No INNS were recorded during the survey, whilst adult damselflies were noted.

3.2.81 The channel was not obviously realigned or impounded but was over-deepened. Impacts due to navigation and historic modification were evident in the local area. The river at this location was assessed as significantly modified; habitat quality was extremely poor, with a management objective to restore.

NE6 Nene at Elton

3.2.82 The surveyed reach was located downstream of Elton where the River Nene flows below the Elton Road bridge, meandering northwards towards Wansford. The River Nene at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the left bank. High turbidity impeded visibility of the riverbed and submerged features such as submerged vegetation.

3.2.83 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools, though stable cliffs were present on the right bank. Elton Road bridge and a minor outfall were any artificial features noted. The channel substrate could not be discerned due to high turbidity.

3.2.84 The dominant bank material throughout the entirety of the surveyed length was earth except for concrete associated with Elton Road bridge. The majority of the survey reach was considered to be resectioned on both banks, in addition to the reinforcements associated with Elton Road bridge. Bank face and bank top vegetation was largely simple throughout, composed of predominantly of grasses and tall rank herbs. Occasional patches of uniform vegetation structure, comprising grasses only, and bare bank tops were also recorded.

3.2.85 Channel dimensions were recorded at spot check 7. Bank full width was 25 m and water width 15 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was estimated at 2.5 m.

3.2.86 Bankside trees were absent from the left bank and present in occasional clumps on the right bank, providing habitat in the form of overhanging boughs contributing large woody debris and leafy material into the river channel and shading of the channel. Visible in-channel vegetation consisted of emergent reeds, sedges and rushes, floating-leaved rooted plants, and free-floating plants. The submerged in-channel vegetation was not visible due to water conditions.

3.2.87 Land use adjacent to the river constituted a mixture of rough pasture, broadleaf plantation and garden on the left bank, and a combination of semi-natural broadleaf woodland, garden and improved grassland on the right bank. The same land uses were also present in the wider landscape. The riparian INNS Himalayan balsam was recorded on the river bank faces, whilst fish and adult damselflies were also noted.

3.2.88 The channel was not obviously realigned or impounded but was over-deepened. Impacts due to navigation and historic modification were obvious in the local area. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered low, with agricultural sediment risk very low.

NE7 Nene at Wansford

3.2.89 The surveyed reach was located at Wansford immediately upstream of where the River Nene flows under the Wansford Road bridge before meandering in a generally easterly direction towards Peterborough. The River Nene at this point constituted a natural watercourse flowing through a predominantly pastoral and suburban landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the left bank and the channel. No adverse conditions affected the survey, and the river bed was partially visible.

3.2.90 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools, although a mature island was present in the upstream extent of the survey reach. No artificial features were recorded, though Wansford Road Bridge was just beyond the downstream extent of the survey reach and would constitute a major bridge. The channel substrate comprised a mixture of sand, cobbles, gravel and pebble, clay, and artificial materials.

3.2.91 The dominant bank material throughout the entirety of the surveyed length was earth, though laid brick was also present on the right bank where the riverbank had been reinforced in addition to the resectioning of both banks evident throughout the survey extent. No bank features were recorded during the survey except for a stable cliff at one point on the left bank. Bank face vegetation structure was largely simple throughout the surveyed reach and comprised predominantly of grasses and tall rank herbs, whilst bank top vegetation was uniformly composed of grasses.

3.2.92 Channel dimensions were recorded at spot check 6. Bank full width was 25 m and water width 20 m, with right bank elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was estimated at 3 m.

3.2.93 Bankside trees were isolated and scattered on the left bank and present in occasional clumps on the right bank, providing habitat in the form of overhanging boughs contributing large woody debris and leafy material into the river channel and shading of the channel. In-channel vegetation consisted of emergent reeds, sedges and rushes, emergent broad-leaved herbs, floating-leaved rooted plants, submerged linear leaved plants, filamentous algae, and an extensive presence of submerged broad-leaved plants.

3.2.94 Land use adjacent to the river consisted entirely of improved grassland on the left bank and comprised a mixture of parkland and gardens, suburban and urban development, and improved grassland on the right bank. The same land uses were also present in the wider landscape. The riparian INNS Himalayan balsam was recorded on the river bank face, whilst cormorant, fish, moorhen, and swan were also noted.

3.2.95 The channel was not obviously over-deepened, realigned or impounded, though impacts due to navigation and historic modifications were evident in the local area. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered low, with agricultural sediment risk moderate.

River Tame (General River Characteristics)

3.2.96 The River Tame flows for approximately 95 km from its source in Oldbury, West Midlands, to its confluence with the River Trent at Alrewas. It is one of the major rivers of the West Midlands and the largest tributary of the River Trent. Heavily modified for much of its catchment through Greater Birmingham, it drains heavily urbanised and industrialised areas, and has historically been one of the most heavily polluted rivers in the United Kingdom. The Tame catchment covers an area of approximately 1,500 km^2 with a population in excess of 1.7 million people.

3.2.97 The River Tame is heavily engineered or canalised in its urban upper reaches but has remained non-navigable throughout its course. As it leaves the suburbs of Birmingham east of Minworth and Water Orton it becomes more naturalised and regains some of its original meandering course.

3.2.98 South of Kingsbury the Tame flows through three settlement lakes at Lea Marston, which are constructed from former gravel workings with the aim of helping to remove heavy metals and other pollutants from the watercourse. The river flows past Minworth Wastewater Treatment Works (WwTW), Europe's largest sewage treatment works, treating waste from across the Birmingham area.

3.2.99 Over recent years since the 1980s, water quality has vastly improved in the river, to such an extent that fish populations began to recover, and otter returned to the river in 2000. However, the river remains subject to urban and industrial discharges that influence the hydrology of the river.

3.2.100 Main tributaries of the River Tame include the River Blythe at Whitacre, the River Anker at Tamworth, and numerous smaller watercourses along its length.

TA1 Tame at Castle Bromwich

3.2.101 The surveyed reach was located near the Castle Bromwich Junction of the M6 and upstream of where the River Tame flows through Water Orton. The River Tame at this point constituted a natural watercourse flowing through an urban landscape. Flow was rippled throughout the surveyed reach. The site was surveyed from the right bank. Heavy overnight rainfall preceding the survey resulted in increased flows and high turbidity impeding visibility of the riverbed and submerged features such as non-emergent or floating vegetation.

3.2.102 There were few in-channel features; for example, no point bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools, nor were any artificial features recorded in the surveyed reach. An unvegetated side bar was noted in the channel margin. The channel substrate could not be discerned due to high turbidity.

3.2.103 The dominant bank material throughout the entirety of the surveyed length was earth, although laid brick was recorded on the left bank at one spot check. The entire survey reach was considered to be resectioned and both banks had set-back embankments. The left bank was also reinforced where a side channel flowed under the adjacent railway line and into the River Tame. No natural bank features were recorded during the survey. Bank face and bank top vegetation was largely simple throughout the surveyed reach, composed of predominantly of grasses and tall rank herbs.

3.2.104 Bankside trees were absent from the right bank but present in occasional clumps on the left bank, providing habitat in the form of exposed bankside and submerged tree roots, and overhanging boughs contributing large woody material and leafy material into the river channel and shading of the channel. The submerged in-channel vegetation was not visible due to high turbidity. Visible in-channel vegetation consisted of emergent reeds, sedges and rushes, and emergent broad-leaved herbs.

3.2.105 Channel dimensions were recorded at spot check 7. Bank full width was 18 m and water width 15 m, with the left bank elevated above the right bank; i.e., the river would overtop the right bank before the left bank at this location. Water depth was estimated to be 1.5 m.

3.2.106 Land use adjacent to the river was dominated by tall herbs on both banks, with a presence of semi-natural broadleaf woodland noted on the left bank. The wider landscape of suburban and urban developments, semi-natural broadleaf woodland, natural open water, and an extensive presence of tall herbs and rank vegetation. An extensive presence of the riparian INNS Himalayan balsam was noted on both bank top and bank face, whilst the INNS Nuttall's waterweed was detected from within the channel. Bees and a kingfisher were also noted during the survey.

3.2.107 The channel was obviously over-deepened and realigned but was not impounded. Impacts due to the historic modification were obvious in the local area. The river at this location was assessed as severely modified; habitat quality was extremely poor, with a management objective to restore. Sediment load was considered very low, with agricultural sediment risk very low.

TA2 Tame at Water Orton

3.2.108 The surveyed reach was located at Water Orton. The River Tame at this point constituted a natural watercourse flowing through an urban landscape. Flow was rippled throughout the surveyed reach. The site was surveyed from the left bank. Heavy overnight rainfall preceding the survey resulted in increased flows and high turbidity impeding visibility of the riverbed and submerged features such as non-emergent or floating vegetation.

3.2.109 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The Water Orton Lane road bridge was the only artificial feature recorded in the surveyed reach. The channel substrate could not be discerned due to high turbidity.

3.2.110 The dominant bank material throughout the entirety of the surveyed length was earth, although concrete was present on the right bank at one spot-check at the downstream extent of the survey reach and associated with the Water Orton Lane road bridge. The entire survey reach was considered to be resectioned and with extensive set-back embankments. No natural bank features were recorded during the survey. Bank face and bank top vegetation was largely simple throughout the surveyed reach, composed of predominantly of grasses and tall rank herbs.

3.2.111 Channel dimensions were recorded at spot check 5. Bank full width was 11 m and water width 10 m, with right bank elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was estimated at 1.5 m.

3.2.112 Bankside trees were absent from the left bank and isolated and scattered on the right bank, providing habitat in the form of overhanging boughs contributing leafy material into the river channel and shading of the channel. Visible in-channel vegetation consisted of emergent reeds, sedges and rushes, and emergent broad-leaved herbs. The submerged in-channel vegetation was not visible due to water conditions.

3.2.113 Land use adjacent to the river was dominated by tall rank herbs on both banks, although semi-natural broadleaf woodland was noted at one spot-check for each bank. The wider landscape additionally included suburban and urban developments. An extensive presence of the riparian INNS Himalayan balsam was noted on both bank top and bank face, whilst the INNS Nuttall's waterweed was detected from within the channel. Furthermore, the INNS Japanese knotweed was also recorded on left bank top. Mallard ducks were also noted during the survey.

3.2.114 The channel was not obviously over-deepened, realigned, or impounded, although impacts due to historic modification were obvious in the local area. The river at this location was assessed as significantly modified; habitat quality was extremely poor, with a management objective to restore. Sediment load was considered very low, with agricultural sediment risk very low.

TA3 Tame at Lea Marston

3.2.115 The surveyed section of the River Tame was immediately upstream of the lakes at Lea Marston, with the weirs and flow control structure at the upstream end of the lakes beyond the downstream extent of the RHS. The lower half of the reach was crossed by two major bridges, the Network Rail line, and Lea Bridge on Birmingham Road. No adverse conditions were considered to have affected the survey, with normal flow conditions and the bed partially visible. The river was surveyed from the right bank.

3.2.116 The river was considered to be obviously realigned and over-deepened for the majority of the reach, but beyond the extent of impoundment by the Lea Marston weirs. Bank top height was 1.5 m on the left bank and 2.0 m on the right bank, with no flood embankments present. Water width was 25 m and bank full width 26 m due to the steep low banks. Two riffles were present throughout the surveyed reach.

3.2.117 Re-sectioned banks were earth throughout, with both stable and eroding cliffs present, and single vegetated side bar on the left bank and unvegetated side bar on the right bank. Channel substrate, where visible, was gravel and pebble, with overlaying silt and exposed clay in places. Flow type was

smooth with unbroken standing waves at riffles and marginal dead water. The channel was reinforced at the downstream end in association with the bridge crossing. Urban trash was present in the channel.

Figure 1: River Tame general structure with urban trash in channel

3.2.118 Land use was generally tall ruderal vegetation on the right bank with scrub and broadleaved woodland at the upstream end on the left bank, and areas of suburban development in the form of road and rail. Bank vegetation structure was generally simple with up to three vegetation types, and single trees or occasional clumps. Channel vegetation was dominated by submerged macrophytes and filamentous algae. Wider land use was generally tall ruderal vegetation and broadleaved semi-natural woodland, with water meadows present as part of Whitacre Heath SSSI on the right bank.

3.2.119 The River Tame in this location was assessed as Severely Modified (HMC = 5) with major impacts identified as rail, road and realignment. River habitat quality was assessed as Poor (River Habitat Quality class = 4) with a management objective to Rehabilitate. The site was considered to be at very low risk of impacts from agricultural sediment load. INNS were extensive on both banks in the form of Himalayan balsam with greater than 33% cover on both the bank top and bank face (Figure 2). Giant hogweed *Heracleum mantegazzianum* was also present on the right bank top.

Figure 2: River Tame downstream of rail crossing with extensive Himalayan balsam on bank top

TA4 Tame at Fazeley, Tamworth

3.2.120 The River Tame at Fazeley was surveyed immediately upstream of Tameside Local Nature Reserve (LNR). Flow was normal and the bed was partially visible due to normal turbidity of the river. The river

was constrained within its flat valley bottom between Fazeley and Tamworth, with the tributaries Bourne Brook and Mill Brook entering at the upstream extent, and numerous areas of standing water in the river corridor including Middleton Lakes RSPB Reserve upstream.

3.2.121 The river was historically realigned and over-deepened, with only one riffle present in the reach and two major bridges, for Watling Street and the Birmingham and Fazeley Canal aqueduct. Left bank top height was 1.5 m, with the right bank top much higher at 10 m; water width was approximately 22 m and bank full width 25 m at the point of measurement.

3.2.122 Riverbanks were of earth throughout, both banks resectioned but with no reinforcement. Both stable and eroding cliffs were present but not extensive. Channel substrate, where visible, consisted of gravel with overlay silt, with some sand also visible. Flow type was smooth or rippled throughout, with unbroken standing waves present at the riffle.

3.2.123 Land use was generally improved grassland and plantation broadleaved woodland extensive on the left bank, with tall ruderal vegetation and suburban development dominant on the right bank in the form of the Tamworth suburbs. Bank vegetation structure was generally simple with riparian trees on the right bank leading to complex structure, with channel shading, overhanging boughs and woody debris increasing channel diversity (Figure 3). Emergent broad and linear-leaved macrophytes were present, together with submerged macrophytes and filamentous algae.

Figure 3: River Tame looking downstream from Watling Street

3.2.124 The River Tame at this location was considered subject to major impacts including housing, industry, realignment, roads and silting, the latter runoff from urban and rural land use. The river was assessed as severely modified (HMC = 5), with the river habitat quality class of 4 indicating poor habitat quality with a recommended management objective to rehabilitate.

TA5 Tame at Elford

3.2.125 The River Tame was surveyed at Elford downstream of Elford Bridge (Figure 4). Adverse conditions somewhat constrained the survey due to the presence of dense, steep overgrown banks and access constraints; however, the survey was completed satisfactorily. The bed of the river was only partially visible due to turbidity of the water. The river sat in an asymmetrical floodplain with low-lying arable land on the left bank and a steep-sided wooded bank on the right up to Burton Road, The Shrubbery, and the village of Elford. The left bank was approximately 1.5 m in height, the right bank much higher at about 6 m, water width 35 m and bank full width 40 m.

Figure 4: Elford Bridge at upstream end of TA5

3.2.126 The channel was uniformly deep and steep sided with no riffles present, a single major bridge at the upstream end (Elford Bridge), and three minor outfalls for road and surface water drainage. The channel was not obviously realigned with historic maps showing its course has remained unchanged for the recorded period, but the right bank was heavily reinforced to stabilise the bank below the roads and village.

3.2.127 Bank material was dominated by earth, with gravel and sand and laid stone also prevalent. The left bank was semi-natural and unmodified with eroding and stable cliffs throughout; the right bank was heavily modified and reinforced with laid stone at the upstream end. Flow type was rippled throughout, with channel substrate where visible consisting of gravel and pebbles with overlying silt, cobbles, and some clay in the margins. Vegetated side bars were present on both banks.

3.2.128 Land use was tilled land and improved grassland for livestock grazing right up to the left bank top leading to uniform vegetation structure. The right bank top was dominated by landscaped improved grassland and suburban development, with the bank face dominated by scattered trees, scrub, and broadleaved woodland.

3.2.129 Channel vegetation consisted of common water moss *Fontinalis antipyretica*, emergent broad and linear-leaved macrophytes, submerged macrophytes including fennel pondweed *Stuckenia pectinata,* the INNS Nuttall's waterweed, and filamentous algae.

3.2.130 The River Tame in this location (Figure 5) was assessed as obviously modified (HMC = 3), with the river habitat quality class of 3 indicating moderate habitat quality with a management objective of enhance. Fine sediment accumulation was considered low; however, some agricultural impacts were considered likely from land use on the left bank and impacts from suburban drainage and runoff on the right bank.

Figure 5: River Tame TA5, general character

TA6 Tame at Alrewas

3.2.131 This surveyed reach of the River Tame adjacent to the National Memorial Arboretum at Alrewas was immediately upstream of the confluence of the River Trent, with its downstream extent being the Network Rail Wichnor Viaduct (Figure 6). Flow was normal at the time of the survey; however, turbidity was high as a result of recent rainfall, so the bed was only partially visible. The river lay in a distinct flat valley bottom with widespread floodplain, shared with the River Trent and nearby River Mease. The river appeared not to have been historically realigned or resectioned, with its course having remained largely unchanged on historic maps.

Figure 6: Wichnor rail viaduct at downstream extent of TA6

3.2.132 A single minor outfall was recorded in the form of a drainage channel from the arboretum. No riffles or point bars were present. The channel was divided by a large mature island for the downstream half of the survey extent. Vegetated mid-channel bars were also present. No bridges were present in the survey reach; however, the Wichnor viaduct constituted a major bridge immediately downstream.

3.2.133 Both banks were formed of earth with some concrete reinforcement at the outfall location. Both eroding and stable cliffs were present, with vegetated sidebars also present on the right bank, much of which was not visible. Flow type was rippled and consistent throughout.

3.2.134 Land use was entirely the landscaped improved grassland and suburban parkland development of the arboretum on the left bank, with rough pasture and tall ruderal vegetation around Croxall Lakes Nature

Reserve (Staffordshire Wildlife Trust) forming an area identified as coastal and floodplain grazing marsh priority habitat for the entire extent on the right bank top. Bank vegetation structure was generally uniform or simple throughout, with occasional clumps or isolated trees providing shading, overhanging boughs, and woody debris.

3.2.135 The river at this location was approximately 40 m in width, with a bank full width of 45 m. Bank top heights were consistently 1.5 m, with water depth estimated at 2 m.

3.2.136 The INNS Himalayan balsam and floating pennywort *Hydrocotyle ranunculoides* (Figure 7) were present along the left bank. Kingfisher was observed, and there was suitable nesting habitat for this species, especially on the right bank.

Figure 7: River Tame TA6 general character; floating pennywort in foreground

3.2.137 The River Tame at this location was assessed as predominantly unmodified, with some natural features and habitat diversity. River habitat quality class was 3, indicating moderate habitat quality with a management recommendation to enhance. Fine sediment accumulation and agricultural sediment risk were assessed as very low.

River Welland (General River Characteristics)

3.2.138 The River Welland rises in the Hothorpe Hills in North Northamptonshire and flows in a north-easterly direction through Market Harborough, Stamford, and Spalding for approximately 105 km before discharging into the Wash at Fosdyke. Much of the upper reaches of the River Welland flows through the gently rolling hills, whilst downstream of Stamford the landscape becomes increasingly flat and typical of the fens. Following its confluence with the Folly River, which drains northern Peterborough, the River Welland takes on an entirely different character as a deep, wide, and straight drainage channel above the level of the surrounding Fenland. The River Welland becomes tidal at Fulney Lock in Spalding.

3.2.139 Analysis of historic maps shows that the River Welland follows a planform which is similar to the current planform, indicating the water body has remained largely unchanged since at least 1890. Substantial alterations since 1890 include straightening of the river channel and subsequent loss of meanders near Tallington, and realignment of the river channel west of Stamford to accommodate the construction of the A1 Great North Road. The planform has likely been further altered for agriculture and riverine navigation prior to 1890.

WE1 Welland at Collyweston Bridge

3.2.140 The surveyed reach was located between Ketton and Collyweston where the River Welland passes under the Collyweston Bridge flowing generally northwards towards Stamford. The River Welland at this point constituted a natural watercourse flowing through a predominantly arable landscape. Flow was generally smooth throughout the surveyed reach. The site was surveyed from both banks and the channel.

3.2.141 In-channel features comprised a vegetated mid-channel bar, one riffle and two pools. Artificial features comprised the Collyweston Bridge and one minor weir downstream of the bridge. The substrate consisted predominantly of clay, although silt, sand, gravel and pebbles were also present.

3.2.142 The dominant bank material throughout the entirety of the surveyed length was earth. Both banks were considered unmodified except for the reinforcements associated with Collyweston Bridge. A stable cliff and a natural berm were present at one spot check each on the left bank. A stable cliff was noted at one spot check and natural berm was present at two spot checks on the right bank. Bank face and bank top vegetation was largely simple throughout the surveyed reach, composed of predominantly of grasses and tall rank herbs. Bankside trees were isolated and scattered on both banks throughout the surveyed reach, providing habitat in the form of exposed bankside and underwater tree roots, and overhanging boughs contributing large woody material and leafy material into the river channel and shading of the channel.

3.2.143 Channel dimensions were recorded at spot check 10. Bank full width was 36 m and water width 25 m, with the left bank elevated above the right bank; i.e., the river would overtop the right bank before the left bank at this location. Water depth was 0.2 m, and the bed material was unconsolidated.

3.2.144 The in-channel vegetation consisted of a mixture of floating-leaved rooted plants, emergent broad-leaved herbs, submerged broad-leaved, linear-leaved, and fine-leaved plants, free-floating plants, filamentous algae, and an extensive presence of emergent reeds, sedges and rushes.

3.2.145 Land use adjacent to the river was dominated by tall herbs and rank vegetation with a minor presence of improved grassland on the left bank, whilst the right bank adjacent land use was composed entirely of tall rank herbs. The wider landscape land use was dominated by tilled land but also included improved grassland, semi-natural broadleaf/mixed woodland, and tall herbs and rank vegetation. No invasive non-native plants were recorded during the survey, whilst fish, butterflies, damselflies, and moorhen were noted.

3.2.146 The channel was not obviously over-deepened, realigned or impounded, though historic modifications to the river channel were noted in the area. The river at this location was assessed as obviously modified; habitat quality was moderate, with a management objective to enhance. Sediment load was considered moderate, with agricultural sediment risk low.

WE2 Welland at Tinwell Mill

3.2.147 The surveyed reach was located to the south of Tinwell and upstream of where the River Welland passes under the A1 Great North Road. The River Welland at this point constituted a natural watercourse meandering through a predominantly arable landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the right bank and the channel.

3.2.148 In-channel features comprised three pools. One intermediate bridge was the sole artificial feature noted during the survey. The substrate consisted of a complex mixture of clay, gravel, pebbles, silt, cobbles, and earth.

3.2.149 The dominant bank material throughout the entirety of the surveyed length was earth. The left bank was considered to be largely unmodified, although sections of that bank were not visible for assessment. The right bank was considered to be unmodified except for resectioning between spot checks 5-9. Stable (two spot checks) and eroding (one spot check) cliffs were recorded on the right bank, whilst stable cliffs were present at two spot checks on the left bank. Where visible, bank top and bank face vegetation on the left bank was entirely simple and comprised grasses and tall rank herbs.

3.2.150 Bank face vegetation on the right bank was largely simple and composed of grasses and tall rank herbs, with discrete patches of uniform vegetation (comprising grasses) and bare bank face. Bank top vegetation on the right bank was largely uniform composed of grasses, with occasional patches of simple vegetation structure where tall rank herbs grew alongside the grasses. Bankside trees were semi-continuous on the left bank and present in occasional clumps on the right bank, providing habitat in the form of overhanging boughs contributing large woody material and leafy material into the river channel and shading of the channel.

3.2.151 Channel dimensions were recorded at spot check 10. Bank full width was 13 m and water width 10 m, with the right bank elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was 1.6 m, and the bed material was unconsolidated.

3.2.152 The in-channel vegetation consisted of a mixture of floating-leaved rooted plants, emergent broad-leaved herbs, submerged broad-leaved, linear-leaved, and fine-leaved plants, free-floating plants, filamentous algae, and emergent reeds, sedges, and rushes.

3.2.153 Land use adjacent to the river was dominated by improved grassland with a minor presence of tall herbs and rank vegetation on the right bank. Adjacent land use to the river on the left bank comprised a mixture of semi-natural broadleaf woodland and tall herbs and rank vegetation. The wider landscape land use was dominated by tilled land but also included parkland/garden, improved grassland, and semi-natural broadleaf/mixed woodland. The riparian INNS macrophyte Himalayan balsam was present on bank top and extensive on bank face throughout the survey reach. Moorhen was additionally noted during the survey.

3.2.154 The channel was not obviously over-deepened, realigned or impounded, though historic modifications to the river channel were noted in the area. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered low, with agricultural sediment risk low.

WE3 Welland at Stamford

3.2.155 The surveyed reach was located in Stamford before the River Welland flows under the A1175 road bridge. The River Welland at this point constituted a natural watercourse flowing through a predominantly urban landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the left bank and the channel.

3.2.156 In-channel features comprised discrete sand deposits, discrete silt deposits, and leafy debris. The sole artificial feature was a minor footbridge crossing the River Welland. The substrate consisted predominantly of gravel, although cobble, sand, boulder, silt, and pebbles were also present.

3.2.157 The dominant bank material throughout the surveyed length was earth, although laid brick was present in the lower extent on the right bank (spot checks 8-10) where the bank was also reinforced. Furthermore, sheet piling was present on the left bank at spot check 8. In addition to the reinforced sections noted, the right bank was also considered to be resectioned at spot checks 3-10. The left bank was considered to be resectioned at spot checks 5-10, whilst bankside poaching of the left bank was also recorded at spot check 3. Except for a stable cliff at spot check 1 on the left bank, no natural bank habitat features were noted.

3.2.158 Bank top vegetation structure of the left bank was generally uniform comprising grasses, except for a section of simple vegetation structure at spot checks 1-3 where tall rank herbs were present alongside grasses. Left bank face vegetation structure was generally simple (comprising grasses and tall rank herbs) except for bare patches of poached bank face, and one discrete patch of uniform vegetation structure composed entirely of grasses. Right bank face vegetation structure was also generally simple and comprised of grasses and tall rank herbs. Bank top vegetation structure on the right bank was generally uniform (composed of grasses) or bare.

3.2.159 Bankside trees were generally regularly spaced on the left bank and semi-continuous on the right bank throughout the surveyed reach, providing habitat in the form of exposed bankside and underwater tree roots, and overhanging boughs contributing large woody material and leafy material into the river channel and shading of the channel.

3.2.160 Channel dimensions were recorded at spot check 3. Bank full width was 25 m and water width 15 m, with the right bank elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was 1.4 m, and the bed material was unconsolidated.

3.2.161 The in-channel vegetation consisted of a mixture of floating-leaved rooted plants, emergent broad-leaved herbs, submerged broad-leaved and fine-leaved plants, free-floating plants, filamentous algae, emergent reeds, sedges and rushes, and an extensive presence of submerged linear-leaved plants.

3.2.162 Land use adjacent to the river was entirely suburban and urban developments on the right bank, whilst the left bank adjacent land use comprised improved grassland and parkland. The wider landscape land use also comprised suburban and urban developments, improved grassland, parkland, and gardens. The riparian INNS Himalayan balsam was recorded on both bank top and bank face during the survey, whilst damselflies, mallard duck, fish, grey squirrel, and kingfisher were also noted.

3.2.163 The channel was not obviously over-deepened, realigned or impounded, though impacts due to historic modification including flood defences were apparent in the local area. The river at this location was assessed as significantly modified; habitat quality was moderate, with a management objective to enhance. Sediment load was considered low, with agricultural sediment risk very low.

WE4 Welland at Uffington Road Bridge

3.2.164 The surveyed reach was located south of Uffington where the River Welland passes under the Uffington Road Bridge flowing in an easterly direction towards Tallington. The River Welland at this point constituted a natural watercourse flowing through a predominantly arable landscape. Flow was generally smooth throughout the surveyed reach. The site was surveyed from the right bank and the channel.

3.2.165 In-channel features comprised one pool. Artificial features comprised the Uffington Road Bridge. The substrate consisted predominantly of gravel clay, although silt, sand, pebbles, and cobbles were also present.

3.2.166 The dominant bank material throughout the entirety of the surveyed length was earth. The left bank was considered unmodified, whilst the right bank was considered to be extensively resectioned. Bank reinforcements were also present around Uffington Road Bridge, whilst poaching of the right bank was also recorded. Natural berms were recorded at spot checks 3-8 on the left bank, whilst a stable cliff was noted at spot check 3 on the right bank.

3.2.167 Right bank top vegetation structure was largely uniform throughout and comprised short grass, whilst the right bank face vegetation structure was mostly simple and composed of grasses and tall rank herbs. Left bank face vegetation structure was similar to that of the right bank face, whilst the left bank top vegetation structure varied between uniform, simple and complex, composed of a mixture of trees, scrub/shrubs, grasses, and tall rank herbs. Bankside trees were present in occasional clumps on both banks throughout the surveyed reach, providing habitat in the form overhanging boughs contributing leafy material into the river channel and shading of the channel.

3.2.168 Channel dimensions were recorded at spot check 6. Bank full width was 41 m and water width 26 m, with the left bank elevated above the right bank; i.e., the river would overtop the right bank before the left bank at this location. Water depth was 0.5 m, and the bed material was unconsolidated.

3.2.169 The in-channel vegetation consisted of a mixture of floating-leaved rooted plants, emergent broad-leaved herbs, submerged broad-leaved and linear-leaved plants, free-floating plants, and an extensive presence of emergent reeds, sedges, and rushes, submerged fine-leaved plants and filamentous algae.

3.2.170 Land use adjacent to the river was dominated by improved grassland on the right bank. Adjacent land use to the river on the left bank comprised a mixture of semi-natural broadleaf woodland scrub and shrubs, and improved grassland. The wider landscape land use was dominated by improved grassland but also included semi-natural broadleaf/mixed woodland, suburban and urban developments, tilled land, and parkland and gardens. The INNS macrophyte Himalayan balsam was present on bank face, whilst cormorant, mallard duck, moorhen, and swan were also noted.

3.2.171 The channel was obviously realigned but not obviously over-deepened or impounded. Impacts due to historic modification were obvious in the local area. The river at this location was assessed as significantly modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered low, with agricultural sediment risk very low.

WE5 Welland at Tallington

3.2.172 The surveyed reach was located immediately to the south of Tallington where the River Welland passes under the Bainton Road bridge flowing east towards Crowland. The River Welland at this point constituted a natural watercourse flowing through a predominantly arable landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the left bank and the channel.

3.2.173 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The Bainton Road bridge was the only artificial feature recorded. The substrate consisted predominantly of gravel and pebbles, although sand, silt, and cobbles were also present.

3.2.174 The dominant bank material throughout the entirety of the surveyed length was earth. Both banks were considered resectioned and embanked throughout the entire survey reach. No natural habitat bank features were recorded. Bank face and bank top vegetation on both banks was uniform and composed

of short grass throughout the surveyed reach. Bankside trees were absent from the right bank but were isolated and scattered on the left bank, providing habitat in the form of overhanging boughs and shading of the channel.

3.2.175 Channel dimensions were recorded at spot check 6. Bank full width was 34 m and water width 20 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 0.7 m, and the bed material was unconsolidated.

3.2.176 The in-channel vegetation consisted of a mixture of emergent broad-leaved herbs, submerged linear-leaved plants, free-floating plants, emergent reeds, sedges and rushes, and an extensive presence of filamentous algae.

3.2.177 Land use adjacent to the river was dominated by improved grassland on both banks. The wider landscape land use included rough pasture, improved grassland, suburban and urban developments, and tilled land. No invasive non-native plants were recorded during the survey, whilst fish, butterflies, damselflies, and moorhen were noted. The riparian INNS Himalayan balsam was extensively present on bank face, whilst bees, butterflies, damselflies, mallard duck, fish, and moorhen were also noted.

3.2.178 The channel was obviously realigned but not obviously over-deepened or impounded. Impacts due to historic modification were evident in the local area. The river at this location was assessed as severely modified; habitat quality was extremely poor, with a management objective to restore. Sediment load was considered low, with agricultural sediment risk very low.

River Witham (General River Characteristics)

3.2.179 The River Witham is a river almost entirely in the county of Lincolnshire in the east of England. It rises south of Grantham close to South Witham. The River Witham passes through the centre of Grantham flowing in a generally northwards direction until it reaches Brayford Pool in Lincoln city centre, at which point the river turns east until Shortferry and then south-east to Boston where it joins The Haven, a tidal arm of The Wash. Except for where it passes through conurbations, the River Witham flows through a largely agricultural landscape. The river is navigable from Brayford Pool in Lincoln to Boston and has locks at Lincoln, Bardney and the Grand/Great Sluice tidal lock at Boston. From Brayford Pool the Fossdyke Navigation links the River Witham to the River Trent.

3.2.180 Analysis of historic maps shows that the River Witham follows a planform which is similar to the current planform, indicating the water body has remained unchanged since at least 1890. The planform has likely been altered for agriculture and riverine navigation prior to this date.

WI1 Witham at Aubourn

3.2.181 The surveyed reach was located just to the north of Aubourn before the River Witham joins with the River Brant and flows north towards Lincoln. The River Witham at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from both banks and the channel.

3.2.182 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The Bridge Road bridge was the only artificial feature recorded. The substrate consisted predominantly of sand, although silt, cobbles, gravel, and pebbles were also present.

3.2.183 The dominant bank material throughout the entirety of the surveyed length was earth. The entire survey reach was considered to be resectioned and both banks had set-back embankments. An eroding cliff on the right bank was the only bank feature recorded during the survey. Bank face and bank top vegetation was largely simple throughout the surveyed reach, composed of predominantly of grasses and tall rank herbs. Bankside trees were isolated and scattered on both banks throughout the surveyed reach, providing habitat in the form of overhanging boughs contributing large woody material and leafy material into the river channel and shading of the channel.

3.2.184 Channel dimensions were recorded at between spot checks 1 and 2. Bank full width was 8 m and water width 8 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. However, the left embankment was higher than the right embankment. Water depth was 1 m, and the bed material was unconsolidated.

3.2.185 The in-channel vegetation consisted primarily of emergent reeds, sedges, and rushes, submerged linear-leaved and broad-leaved plants, and filamentous algae. Patches of emergent broad-leaved herbs, free-floating plants, submerged fine-leaved plants were also present.

3.2.186 Land use adjacent to the river was dominated by improved grassland on both banks. The wider landscape consisted of extensive improved grassland with a presence of tilled land. No invasive non-native plants were recorded during the survey, whilst fish, adult damselflies and swans were noted.

3.2.187 The channel was obviously over-deepened and realigned but not impounded. Impacts due historic modifications including flood defence were evident in the local area. The river at this location was assessed as severely modified; habitat quality was poor, with a management objective to rehabilitate. Sediment load was considered low, with agricultural sediment risk moderate.

WI2 Witham at North Hykeham

3.2.188 The surveyed reach was located downstream of where the River Witham joins with the River Brant and flows north towards Lincoln. The River Witham at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from both banks.

3.2.189 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The Meadow Lane road bridge was the only artificial feature recorded. The majority of the channel substrate across the channel width was not visible and as such dominant substrate at spot checks could not be determined. However, the presence of silt substrate was recorded from the channel margins.

3.2.190 The dominant bank material throughout the entirety of the surveyed length was earth. The entire survey reach was considered to be resectioned, with embankments also recorded on the left bank between spot checks 6 and 9. The right bank had embankments at spot checks 6 and 7, whilst bankside poaching on the right bank was also recorded at spot checks 8-10. Set-back embankments were present at all other spot checks on both banks where embankments were not recorded. An eroding cliff on the right bank was the only bank feature recorded during the survey. Bank top vegetation was uniformly composed of grass throughout the surveyed reach, whilst bank face vegetation was simple and comprised predominantly of grasses and tall rank herbs.

3.2.191 Channel dimensions were recorded at the upstream survey extent. Bank full width was 13 m and water width 9 m, with left bank elevated above the right bank; i.e., the river would overtop the right bank before the left bank at this location. Furthermore, the left embankment was higher than the right embankment. Water depth was 1.5 m, and the bed material was unconsolidated.

3.2.192 Bankside trees were isolated and scattered on both banks throughout the surveyed reach, providing habitat in the form of overhanging boughs contributing leafy material into the river channel and shading of the channel. The in-channel vegetation consisted primarily of free-floating plants and emergent reeds, sedges, and rushes. Patches of emergent broad-leaved herbs and filamentous algae were also present. Submerged vegetation was not visible due to water conditions.

3.2.193 Land use adjacent to the river was dominated by improved grassland on both banks. The wider landscape consisted of extensive improved grassland with a presence of tilled land. No invasive non-native plants were recorded during the survey, whilst mallard duck, adult damselflies and swans were noted.

3.2.194 The channel was obviously over-deepened and realigned but not impounded. Impacts due historic modifications including flood defence were evident in the local area. The river at this location was assessed as severely modified; habitat quality was very poor, with a management objective to restore.

WI3 Witham at Lincoln, upstream of Brayford Pool

3.2.195 The surveyed reach was located within the city of Lincoln before the River Witham meets Brayford Pool. The River Witham at this point constituted a natural watercourse flowing through an urban landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the left bank and the channel.

3.2.196 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools, nor were any artificial features within the survey reach. The A1434 road bridge, which would constitute a major bridge, was

present just upstream of the survey extent. The majority of the channel substrate across the channel width was not visible and as such dominant substrate at spot checks could not be determined. However, silt, clay, and artificial substrates were recorded from the channel margins.

3.2.197 The dominant bank material throughout the entirety of the surveyed length was earth. The entire survey reach was considered to be resectioned, with extensive set-back embankments present. No bank features were recorded during the survey. Bank top vegetation was uniformly composed of grass throughout the surveyed reach, whilst bank face vegetation was simple and comprised predominantly of grasses and tall rank herbs.

3.2.198 Channel dimensions were recorded at spot check 6. Bank full width was 15 m and water width 15 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. Furthermore, the setback embankments from the left and right banks were also the same height. Water depth was 2 m.

3.2.199 Bankside trees were isolated and scattered on both banks throughout the surveyed reach, providing habitat in the form of overhanging boughs contributing leafy material into the river channel and shading of the channel. The in-channel vegetation consisted of a mixture of free-floating plants, emergent reeds, sedges, and rushes, submerged broad-leaved plants, submerged fine-leaved plants and filamentous algae.

3.2.200 Land use adjacent to the river was dominated by improved grassland on both banks. The wider landscape consisted of a complex mixture of suburban and urban developments, semi-natural broadleaf/mixed woodland, rough pasture, tall herbs and rank vegetation, parkland/garden and improved grassland. The INNS Nuttall's waterweed was recorded with an extensive presence in the channel, though no riparian invasive non-native macrophyte species were noted. Fish, magpies, Mallard duck, moorhen, pond skaters, and swans were also recorded during the survey.

3.2.201 The channel was obviously over-deepened and realigned but not impounded. Impacts due historic modifications including flood defence were evident in the local area. The river at this location was assessed as severely modified; habitat quality was very poor, with a management objective to restore. Sediment load was considered low, with agricultural sediment risk very low.

WI4 Witham at Five Mile House

3.2.202 The surveyed reach was located east of Lincoln and to the south of the village of Fiskerton. The River Witham at this point constituted a natural watercourse flowing through a rural landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the right bank.

3.2.203 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The only artificial feature was File Mile Lane footbridge. Silt was the dominant substrate throughout the survey extent, although sand, clay and cobbles were also present.

3.2.204 The dominant bank material throughout the entirety of the surveyed length was earth, although sheet piling was present at spot check 6 close to Five Mile Lane footbridge. The entire survey reach was considered to be resectioned, with extensive set-back embankments present. No bank features were recorded during the survey. Bank top and bank face vegetation was largely simple throughout and comprised predominantly of grasses and tall rank herbs. Bank top and bank face was bare at spot check 6, which comprised an area of hardstanding on bank top and sheet piling on bank face.

3.2.205 Channel dimensions were recorded at spot check 6. Bank full width was 28 m and water width 23 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 1 m.

3.2.206 Bankside trees were not present in the surveyed reach. The in-channel vegetation consisted of a mixture of floating-leaved rooted plants, emergent reeds, sedges and rushes, emergent broad-leaved herbs, submerged broad-leaved, linear-leaved, and fine-leaved plants, and an extensive presence of free-floating plants and filamentous algae.

3.2.207 Land use adjacent to the river was dominated by improved grassland on the left bank and comprised a mixture of tall herbs and rank vegetation, semi-natural broadleaf/mixed woodland wood, suburban and urban development (in the form of a car park), and improved grassland on the right bank. The wider landscape consisted of a complex mixture of suburban and urban developments, semi-natural

broadleaf/mixed woodland, artificial open water, improved grassland, tall herbs and rank vegetation, and tilled land. The INNS water fern was recorded with an extensive presence in the channel on the water surface, whilst the INNS Himalayan balsam was also present on both bank top and bank face. Fish, damselflies, heron, and swallows were also recorded during the survey.

3.2.208 The channel was obviously over-deepened and realigned but not impounded. Impacts due historic modifications were evident in the local area. The river at this location was assessed as severely modified; habitat quality was very poor, with a management objective to restore. Sediment load was considered very low, with agricultural sediment risk low.

WI5 Witham at Bardney

3.2.209 The surveyed reach was located upstream of Bardney Bridge and downstream of Branston Island, where the River Witham joins with the South Delph. The River Witham at the survey reach constituted a natural watercourse flowing in a south-easterly direction through a largely rural landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the right bank.

3.2.210 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The only artificial features were two boat moorings. Silt was the dominant substrate throughout the survey extent, although sand, gravel, pebbles, and cobbles were also present.

3.2.211 The dominant bank material throughout the entirety of the surveyed length was earth. The entire survey reach was considered to be resectioned, with set-back embankments also present throughout. No bank features were recorded during the survey. Bank top and bank face vegetation was largely simple throughout and comprised predominantly of grasses and tall rank herbs.

3.2.212 Channel dimensions were recorded at spot check 7. Bank full width was 25 m and water width 25 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 2 m.

3.2.213 Bankside trees were isolated and scattered on both banks throughout the surveyed reach, providing habitat in the form of shading of the channel. The in-channel vegetation consisted of a mixture of floating-leaved rooted and free-floating plants, emergent reeds, sedges and rushes, emergent broad-leaved herbs, submerged broad-leaved, linear-leaved, and fine-leaved plants, and filamentous algae.

3.2.214 Land use adjacent to the river was dominated by tilled land on the left bank and comprised a mixture of suburban and urban development, improved grassland, and tilled land on the right bank. The wider landscape consisted of a mixture of rough pasture, improved grassland, suburban and urban developments, tilled land, and gardens. The INNS water fern was recorded with an extensive presence in the channel on the water surface, though no riparian invasive non-native macrophyte species were noted. Fish, damselflies, butterflies, kingfisher, and swan were also recorded during the survey.

3.2.215 The channel was obviously over-deepened and realigned but not impounded. Impacts due to navigation and historic modification including flood defence were evident in the local area. The river at this location was assessed as severely modified; habitat quality was very poor, with a management objective to restore.

WI6 Witham at Tattershall Bridge

3.2.216 The surveyed reach was located at Tattershall Bridge immediately downstream of where the A153 road crosses the River Witham. The River Witham at the survey reach constituted a natural watercourse flowing in a south-easterly direction towards Boston through a largely rural landscape. Flow was smooth throughout the surveyed reach. The site was surveyed from the right bank.

3.2.217 There were few in-channel features; for example, no point bars, side bars or discrete unvegetated deposits of silt, sand or gravel were recorded. There were no riffles or pools. The only artificial features were the now defunct Tattershall Old Bridge and two boat moorings on the right bank. The majority of the channel substrate across the channel width was not visible and as such dominant substrate at spot checks could not be determined. However, silt, sand, gravel, pebbles, and cobbles were recorded from the channel margins.

3.2.218 The dominant bank material throughout the entirety of the surveyed length was earth. The entire survey reach was considered to be resectioned, with both banks also embanked throughout and reinforced bank face present at spot checks 1 and 3-6 on the left bank. No bank habitat features were recorded

during the survey. Bank face vegetation was largely simple throughout and comprised predominantly of grasses and tall rank herbs. Bank top was largely bare on the right bank due to the presence of a tarmac road but was predominantly simple on the left bank and also comprised grasses and tall rank herbs.

3.2.219 Channel dimensions were recorded at spot check 10. Bank full width was 60 m and water width 35 m, with both banks the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 3 m.

3.2.220 Bankside trees were absent from the left bank and were isolated and scattered on the right bank, providing habitat in the form of shading of the channel. The in-channel vegetation consisted of a mixture of floating-leaved rooted plants, emergent reeds, sedges and rushes, emergent broad-leaved herbs, submerged broad-leaved, linear-leaved, and fine-leaved plants, and an extensive presence of free-floating plants and filamentous algae.

3.2.221 Land use adjacent to the river was dominated by suburban and urban development in the form of a tarmac road alongside improved grassland at one spot check on the right bank and comprised a mixture of rough pasture, garden, and improved grassland on the left bank. The wider landscape consisted of a mixture of rough pasture, suburban and urban developments, tilled land, and gardens. The INNS water fern was recorded with an extensive presence in the channel on the water surface and the INNS Nuttall's waterweed was also extensively present in the channel. Furthermore, the INNS zebra mussel was also noted within the channel and the riparian INNS butterfly bush *Buddleia* was recorded on Tattershall Old Bridge, though no riparian invasive non-native macrophyte species were noted. Fish, damselflies, buzzard, goldfinch, swan, and mallard duck were also recorded during the survey.

3.2.222 The channel was obviously over-deepened and realigned but not impounded. Impacts due to navigation and historic modification including flood defence were evident in the local area. The river at this location was assessed as severely modified; habitat quality was very poor, with a management objective to restore.

Great Ouse (General River Characteristics)

3.2.223 The Great Ouse river is the fifth longest river in the United Kingdom, rising in Northampton shire and flowing in a generally north-easterly direction for approximately 230 km through Buckinghamshire, Bedfordshire, Cambridgeshire and Norfolk to discharge into the Wash at Kings Lynn. It has a catchment area of approximately 3,240 square miles.

3.2.224 The Great Ouse river currently operates 18 locks within the 75 miles of navigable watercourse from Bedford to the Wash at King's Lynn. Major tributaries of the Great Ouse include the rivers Cam, Lark, Little Ouse and Nar.

GO1 Great Ouse at Olney

3.2.225 The surveyed reach was located downstream of Olney on a relatively straight section of the Great Ouse. The Great Ouse at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the left bank. High flow conditions impeded visibility of the riverbed.

3.2.226 In-channel features constituted vegetated side bars and two vegetated point bars; no riffles, pools, or discrete unvegetated deposits of silt, sand or gravel were recorded. Four fishing platforms were the only artificial features noted. The substrate could not be assessed as visibility of the riverbed was impeded. Flow was generally smooth throughout the surveyed reach, with a presence of marginal dead water.

3.2.227 Both banks were composed entirely of earth and considered to be unmodified throughout the survey reach with the exception of some poaching on the right bank. Natural features were absent from both banks. Bank top vegetation structure was entirely uniform and composed of grasses on the left bank. Both left and right bank face vegetation structures were a mixture of uniform and simple vegetation structure comprising grasses and tall rank herbs. The right bank comprised a largely uniform bank top vegetation structure comprising short grasses, with one section of simple vegetation structure one further section of complex vegetation structure.

3.2.228 Bankside trees were isolated and scattered on both banks, providing habitat in the form of exposed bankside and submerged tree roots, and overhanging boughs shading the channel and contributing large woody material into the aquatic habitat. The in-channel vegetation consisted predominantly of

emergent reeds, sedges and rushes, broad-leaved emergent herbs, and amphibious plants. Submerged vegetation could not be assessed due to high flow conditions

3.2.229 Channel dimensions were recorded at a run/glide. Bank full width was 18 m and water width 14 m. Both banks were the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 1.2 m.

3.2.230 Land use adjacent to the river was dominated by improved grassland on both banks, with an additional presence of broadleaf woodland on the right bank and tall herbs and rank vegetation on the left bank. The wider landscape included scrub in addition to those land use types noted adjacent to the river. No riparian INNS were recorded during the survey, whilst kingfishers and swans were noted.

3.2.231 The channel was considered to be not obviously over-deepened, realigned, or impounded. The river at this location was assessed as Pristine/semi-natural; habitat quality was moderate with a management objective to enhance. Sediment load was considered very low, with agricultural sediment risk also very low.

GO2 Great Ouse at Harrold

3.2.232 The surveyed reach was located immediately downstream of Harrold where the Great Ouse gently meanders around Grebe Lake. The Great Ouse at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the left bank. High flow conditions resulting in increased turbidity impeded visibility of the riverbed.

3.2.233 In-channel features constituted a mature island and one pool; no side bars, point bars, riffles, or discrete unvegetated deposits of silt, sand or gravel were recorded. One major road bridge was the only artificial feature noted. The substrate could not be assessed as visibility of the riverbed was impeded. Flow was generally smooth throughout the surveyed reach, with an extensive presence of marginal dead water.

3.2.234 Both banks were composed entirely of earth except at the upstream extent where both banks comprised reinforcing brickwork associated with a road bridge. Both banks were considered to be resectioned at various locations. Natural features were largely absent from both banks with the exception of a presence of stable cliffs. Bank top vegetation structure was largely uniform and composed of grasses on the left bank, with occasional sections of simple vegetation and one section of bare ground. Both left and right bank face vegetation structures were a mixture of uniform and simple vegetation structure with one section of complex vegetation structure on the left bank face. The right bank comprised a largely uniform bank top vegetation structure with one section of complex vegetation structure.

3.2.235 Bankside trees were continuous on the left bank and isolated and scattered on the right bank, providing habitat in the form of extensive exposed bankside and submerged tree roots, and extensive overhanging boughs shading the channel and contributing large woody material into the aquatic habitat. Fallen trees within the channel were also noted. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, broad-leaved emergent herbs, free-floating and amphibious plants. Submerged vegetation could not be assessed due to high flow conditions

3.2.236 Channel dimensions were recorded at a run/glide. Bank full width was 22 m and water width 16 m. Both banks were the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 1.5 m.

3.2.237 Land use adjacent to the river on both banks was a mixture of tall herbs and rank vegetation, parkland and gardens, improved grassland and broadleaf woodland. The wider landscape included scrub on both banks and suburban developments on the left bank in addition to those land use types noted adjacent to the river. No riparian INNS were recorded during the survey, whilst Canada geese were noted.

3.2.238 The channel was not obviously over-deepened, or impounded, but was considered to be extensively realigned. The river at this location was assessed as severely modified; habitat quality was extremely poor with a management objective to restore. Sediment load was considered very low, with agricultural sediment risk low.

GO3 Great Ouse at Milton Ernest

3.2.239 The surveyed reach was located on the outskirts of Milton Ernest between two large meanders. The Great Ouse at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape with a suburban influence. The site was surveyed from the right bank. High flow conditions resulting in increased turbidity impeded visibility of the riverbed.

3.2.240 The river at this point was devoid of in-channel features; no side bars, point bars, riffles, pools, or discrete unvegetated deposits of silt, sand or gravel were recorded. No artificial features were noted. The substrate could not be assessed as visibility of the riverbed was impeded. Flow was generally smooth throughout the surveyed reach, with an extensive presence of marginal dead water.

3.2.241 Both banks were composed entirely of earth with the left bank also considered to be unmodified. The right bank was considered to be extensively resectioned and embanked. Natural features were largely absent from both banks with the exception of a presence of eroding cliffs on the right bank. Bank top vegetation structure was uniform and composed of grasses on both banks throughout the survey extent. Both left and right bank face vegetation structures were a mixture of uniform and simple vegetation structure.

3.2.242 Bankside trees were semi-continuous on the left bank and present in isolated clumps on the right bank, providing habitat in the form of extensive exposed bankside and submerged tree roots, and extensive overhanging boughs shading the channel and contributing large woody material into the aquatic habitat. Fallen trees within the channel were also noted. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, broad-leaved emergent herbs, and free-floating plants. Submerged vegetation could not be assessed due to high flow conditions

3.2.243 Channel dimensions were recorded at a run/glide. Bank full width was 22 m and water width 16 m. The right bank was elevated above the left bank; i.e., the river would overtop the left bank before the right bank at this location. Water depth was 1.5 m.

3.2.244 Land use adjacent to the river on both banks consisted of tall herbs and rank vegetation on the left bank, and improved grassland on the right bank. The wider landscape included tilled land, parkland and gardens, scrub, and broadleaf woodland in addition to those land use types noted adjacent to the river. No riparian INNS were recorded during the survey, whilst Canada geese, ducks, and wrens were noted.

3.2.245 The river at this location was assessed as significantly modified; habitat quality was poor with a management objective to rehabilitate. Sediment load and agricultural sediment risk were both considered very low.

GO4 Great Ouse at Kempston

3.2.246 The surveyed reach was located on a meander of the Great Ouse in the outskirts of Bedford upstream of the town centre. The Great Ouse at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the right bank. High flow conditions resulting in increased turbidity impeded visibility of the riverbed.

3.2.247 In-channel features constituted a mature island; no side bars, point bars, pools, riffles, or discrete unvegetated deposits of silt, sand or gravel were recorded. Artificial comprised one minor bridge, two minor outfalls/intakes and two landing stages approximately 10 m long. The substrate could not be assessed as visibility of the riverbed was impeded. Flow was generally smooth throughout the surveyed reach, with a presence of marginal dead water.

3.2.248 Both banks were composed entirely of earth except at the upstream extent where both banks comprised reinforcing concrete associated with the minor bridge. The left bank was considered to be largely resectioned throughout, embanked at three spot checks and poached bare at one section. The right bank variously resectioned in places with one section of poaching and one additional section of reinforcement present. Natural features were absent from both banks.

3.2.249 Bank top vegetation structure was a mixture of uniform and simple vegetation structure on both banks, with one section of bare ground present on the right bank. Both left and right bank face vegetation structures were a mixture of uniform and simple vegetation structure with occasional sections of bare ground.

3.2.250 Bankside trees were isolated and scattered on the left bank and continuous on the right bank, providing habitat in the form of exposed bankside and submerged tree roots, and overhanging boughs shading the channel and contributing large woody material into the aquatic habitat. Fallen trees within the channel were also noted. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, and broad-leaved emergent herbs. Submerged vegetation could not be assessed due to high flow conditions

3.2.251 Channel dimensions were recorded at a run/glide. Bank full width was 20 m and water width 14 m. Both banks were the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 1.2 m.

3.2.252 Land use adjacent to the river on the left bank constituted a mixture of tall herbs and rank vegetation, tilled land, and improved grassland, whilst the right bank land use comprised suburban and urban developments, parkland and gardens, and broadleaf woodland. The wider landscape included scrub on both banks in addition to those land use types noted adjacent to the river. No riparian INNS were recorded during the survey, whilst mallard ducks and swans were noted.

3.2.253 The channel was not obviously over-deepened, or impounded, but was considered to be extensively realigned. The river at this location was assessed as significantly modified; habitat quality was poor with a management objective to rehabilitate. Sediment load and agricultural sediment were both considered very low.

GO5 Great Ouse at Willington

3.2.254 The surveyed reach was located on downstream outskirts of Bedford before the Great Ouse gently passes under the A421 dual carriageway. The Great Ouse at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape with a substantial urban influence. The site was surveyed from the right bank. High flow conditions resulting in increased turbidity impeded visibility of the riverbed.

3.2.255 In-channel features constituted vegetated side bars and one pool; point bars, riffles, or discrete unvegetated deposits of silt, sand or gravel were recorded. Artificial features comprised one major road bridge, one major lock and two pontoons (upstream and downstream of the lock). The substrate could not be assessed as visibility of the riverbed was impeded. Flow was generally smooth throughout the surveyed reach, with an extensive presence of marginal dead water.

3.2.256 Both banks were composed entirely of earth except at the lock where both banks were reinforced with concrete. Both banks were considered to be largely resectioned except for the upstream and downstream survey extents, which were considered unmodified. The right bank was also considered to be embanked at various locations. Natural features were absent from both banks. Bank top vegetation structure was a combination of simple and uniform on the left bank, with occasional sections of simple vegetation and one section of bare ground. Both left and right bank face vegetation structures were largely simple vegetation structure, both with one section of uniform vegetation structure and one section of bare ground. The right bank dominated with uniform bank top vegetation structure, although occasional sections of simple vegetation structure and one section of bare ground was recorded.

3.2.257 Bankside trees were continuous on the left bank and semi-continuous on the right bank, providing habitat in the form of extensive exposed bankside and submerged tree roots, and extensive overhanging boughs shading the channel and contributing large woody material into the aquatic habitat. Fallen trees within the channel were also noted. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, and broad-leaved emergent herbs. Submerged vegetation could not be assessed due to high flow conditions

3.2.258 Channel dimensions were recorded at a run/glide. Bank full width was 26 m and water width 16 m. The left bank was elevated above the right bank; i.e., the river would overtop the right bank before the left bank at this location. Water depth was 1.5 m.

3.2.259 Land use adjacent to the river on both banks was a mixture of parkland and gardens, and improved grassland, with broadleaf woodland also present on the left bank. The wider landscape included scrub, and tall herbs and rank vegetation on both banks and suburban developments on the left bank in addition to those land use types noted adjacent to the river. No riparian INNS were recorded during the survey, whilst ducks, herons and wrens were noted.

3.2.260 The channel was not obviously over-deepened but was considered to be extensively realigned and extensively impounded. The river at this location was assessed as severely modified; habitat quality was poor with a management objective to rehabilitate. Sediment load was considered very low, with agricultural sediment risk low.

GO6 Great Ouse at Church End

3.2.261 The surveyed reach was located in the vicinity of Church End. The Great Ouse at this point constituted a natural watercourse flowing through a predominantly arable and pastoral landscape. The site was surveyed from the left bank. High flow conditions resulting in increased turbidity impeded visibility of the riverbed.

3.2.262 In-channel features constituted a mature island and one pool; no side bars, point bars riffles, or discrete unvegetated deposits of silt, sand or gravel were recorded. Artificial features comprised one minor bridge, one major lock and two pontoons (upstream and downstream of the lock). The substrate could not be assessed as visibility of the riverbed was impeded. Flow was generally smooth throughout the surveyed reach, with an extensive presence of marginal dead water.

3.2.263 Both banks were composed entirely of earth except at the lock where both banks were reinforced with concrete. Both banks were considered to be largely resectioned except for the upstream and downstream survey extents, which were considered unmodified. Natural features were absent from both banks. Bank top vegetation structure was a combination of simple, complex, and uniform on the left bank, and bare, uniform and simple on the right bank. Both left and right bank face vegetation structures were largely simple vegetation structure and bare in the location of the lock.

3.2.264 Bankside trees were semi-continuous on the left bank and present in occasional clumps on the right bank, providing habitat in the form of extensive exposed bankside and submerged tree roots, and extensive overhanging boughs shading the channel and contributing large woody material into the aquatic habitat. Fallen trees within the channel were also noted. The in-channel vegetation consisted predominantly of emergent reeds, sedges and rushes, and broad-leaved emergent herbs. Submerged vegetation could not be assessed due to high flow conditions

3.2.265 Channel dimensions were recorded at a run/glide. Bank full width was 25 m and water width 20 m. . Both banks were the same height; i.e., the river would overtop both banks at the same time at this location. Water depth was 1.5 m.

3.2.266 Land use adjacent to the river on both banks was a mixture of parkland and gardens, tall herbs and rank vegetation, and improved grassland, with broadleaf woodland and scrubs and shrubs also present on the left bank. The wider landscape included artificial open water and suburban developments on the left bank in addition to those land use types noted adjacent to the river. No riparian INNS were recorded during the survey, whilst wrens were noted.

3.2.267 The channel was not obviously over-deepened but was considered to be realigned and extensively impounded. The river at this location was assessed as severely modified; habitat quality was poor with a management objective to rehabilitate. Sediment load was considered very low, with agricultural sediment risk low.

Hydromorphological Indices

3.2.268 Based on the criteria outlined in Section 2.2, Habitat Modification Scores (HMS), Habitat Quality Assessment (HQA) and River Habitat Quality (RHQ) scores for each survey stretch are detailed in Table C1 in Appendix C.

3.3 Aquatic Macroinvertebrate Survey

3.3.1 The full list of aquatic macroinvertebrate taxa can be found in Appendix H and the biological metrics calculated for each survey undertaken at each site are presented in Table I1 in Appendix I.

Summer, Autumn and Spring Invertebrate Surveys

GO1 Great Ouse at Olney

3.3.2 Autumn macroinvertebrate assemblage for GO1 was dominated by snails (*Potamopyrgus antipodarum*, *Bithynia tentaculata*, *Physella acuta/gyrina*, *Menetus dilatatus*, *Gyraulus albus* and *Armiger crista*) and the Ponto-Caspian invader Demon shrimp *Dikerogammarus haemobaphes* which totalled 38.2% and 19.2% respectively of the number of specimens collected. The other taxa recorded included: the river limpet *Ancylius fluviatilis*, the pea mussel *Pisidium* sp., freshwater Oligochaeta worms, the fish leech *Piscicola* sp., the water slater *Asellus aquaticus*, Mayflies (Baetidae, *Ephemera danica*, *Ephemera vulgata* and *Caenis* sp.), damselflies nymphs (Coenagrionidae and *Calopteryx splendens*), the dragonfly nymph *Anax* sp., the greater water boatman *Notonecta glauca*, caddisflies (*Tinodes waeneri*, *Limnephilus* sp. and *Mystacides azurea*) and non-biting midges (Tanypodinae, Orthocladiinae, Chironomini and Tanytarsini).

3.3.3 The spring sample for the site differed to the previous season and was primarily comprised of non-biting midge larvae (Orthocladiinae, Chironomini and Tanytarsini) and freshwater Oligochaeta worms, totalling 27.9% and 18.3% respectively of identified specimens. Additional taxa to those found in the autumn surveys included the greater pond snail *Lymnaea stagnalis*, the lake limpet *Acroloxus lacustris*, the freshwater leech *Erpobdella*, the freshwater shrimp *Crangonyx floridanus/pseudogracilis*), mayflies (*Ephemera vulgata* and *Caenis luctuosa/macura*), damselfly nymphs (*Ischnura elegans* and *Coenagrion* sp.), the case-building caddisfly *Limnephilus decipiens*, Limoniidae cranefly and Simuliidae blackfly larvae.

3.3.4 The PSI scores for this site indicate that the site was Heavily sedimented and the LIFE scores of the site indicates the macroinvertebrate community had Low to Moderate sensitivity to reduced flows (Table I1, Appendix I).

3.3.5 CCI scores of 9.5 in spring from 12.9 in autumn indicate that the site has Moderate to Fairly high conservation values. All taxa found at the site had conservation values of 4 (Occasional) or below, except for the Locally Notable caddisfly *L. decipiens* (conservation value 5) and the trumpet ramshorn snail *Menetus dilatatus*, which (conservation value 7; Notable but not RDB status). The non-native but non-invasive species New Zealand mud snail *P. antipodarum*, freshwater shrimp *C. floridanus/pseudogracillis* and bladder snail *P. acuta/gyrina* were all recorded from the site alongside the legislated INNS demon shrimp.

GO3 Great Ouse at Milton Ernest

3.3.6 The autumn macroinvertebrate assemblage for GO3 was dominated by a single species of snail, the New Zealand mud snail, which totalled 48% of the number of specimens collected. The other species collected from the sample were identified as: snails (*Bithynia tentaculata, P. acuta/gyrina, Planorbis planorbis, Gyraulus albus* and *Armiger crista)*, mussels and limpets (*Ancylus fluviatilis, Acroloxus lacustris, Pisidium amnicum, Pisidium henslowanum, Pisidium nitidum* and *Corbicula fluminea*), freshwater Oligochaeta worms, crustaceans (*Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus)*, mayfly larvae (*Ephemera vulgata,* and *Caenis luctuosa/macrura*), the damselfly larva *Calopteryx splendens*, caddisfly larvae (*Tinodes waeneri, Lype phaeopa/reducta, Hydropsyche pellucidula, Limnephilus marmoratus, Limnephilus lunatus, Athripsodes cinereus, Mystacides azurea* and *Mystacides longicornis*) and true fly larvae (Tanypodinae, Orthocladiinae, Chironomini, *Simulium* sp.).

3.3.7 The spring macroinvertebrate assemblage for GO3 was mainly composed of the New Zealand mud snail and freshwater Oligochaeta worms, which totalled 24.7% and 21.6% respectively of the number of specimens collected. Additional taxa recorded in spring included the freshwater shrimp *Gammarus pulex*, the cased caddisfly *Anabolia nervosa* and non-biting midges (Tanytarsini and Prodiamesinae).

3.3.8 The PSI scores indicate that the site was Moderate to Heavily sedimented and the LIFE scores of the site indicate the macroinvertebrate community had a Moderate sensitivity to reduced flows (Table I1, Appendix I).

3.3.9 CCI scores of 4.4 in autumn to 5.5 in spring indicates that the site has Low to Moderate conservation values. All taxa found at the site had a conservation value of 4 (Occasional) or below. The non-native but non-invasive species New Zealand mud snail, bladder snail *P. acuta/gyrina*, and freshwater shrimp *C. floridanus/pseudogracillis* were all present within the sample, with no legislated INNS present.

GO5 Great Ouse at Willington

3.3.10 The autumn macroinvertebrate assemblage for GO5 was dominated by the non-biting midge Chironomini and the Caspian mud shrimp *Chelicorophium curvispinum* which totalled 32.8% and 15.8% respectively of the number of specimens collected. The other species collected from the sample were identified as: snails (*Viviparus viviparus, Galba truncatula, Lymnaea stagnalis, Radix auricularia, Radix balthica, Valvata piscinalis, P. antipodarum, Bithynia tentaculata, P. acuta/gyrina, Planorbarius corneus, Planorbis planorbis, Anisus vortex, Gyraulus albus, Armiger crista* and *Hippeutis complanatus*), limpets (*Ancylius fluviatilis* and *Acroloxus lacustris*), mussels (*Pisidium amnicum* and *Anodonta anatina*), the freshwater leech *Erpobdella octoculata*, crustaceans (*Gammarus* sp., *Dikerogammarus haemobaphes*, *Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus*), Baetidae mayfly, damselflies (Coenagrionidae, *Ischnura elegans*, *Coenagrion* sp. and *Calopteryx splendens*), caddisflies (*Polycentropus flavomaculatus, Cyrnus trimaculatus, Tinodes waeneri, Lype* sp., *Phryganea grandis, Limnephilus flavicornis, Limnephilus marmoratus* and *Leptocerus lusitanicus*), other non- biting midges (Orthocladiinae and Tanytarsini) and Limoniidae cranefly larvae.

3.3.11 The spring macroinvertebrate assemblage for GO5 was mainly comprised of non-biting midge larvae (Tanypodinae, Orthocladiinae, Chironomini and Tanytarsini) totalling 51.7% of identified specimens. The remaining additional taxa to the autumn surveys identified included: flatworms (*Polycelis* sp. and *Dugesia lugubris/polychroa*), the native bladder snail *Physa fontinalis,* the pea mussel *Sphaerium corneum,* freshwater Oligochaeta worms, the Caspian mud shrimp *Chelicorophium curvispinum*, the damselfly *Erythromma najas*, the riffle beetle *Oulimnius* sp., the alderfly *Sialis lutaria*, caddisflies (*Cyrnus flavidus, Limnephilus lunatus* and *Anabolia nervosa*), biting midge larvae Ceratopogonidae and Stratiomyidae soldier fly larvae.

3.3.12 The PSI scores for this site indicate that the site was Heavily sedimented and the LIFE scores of the site indicate the macroinvertebrate community had a Low sensitivity to reduced flows across both seasons (Table I1, Appendix I).

3.3.13 CCI scores of 8.9 in spring from 20.7 in autumn indicate that the site has Moderate to Very high conservation values. All taxa found at the site had a conservation value of 4 (Occasional) or below, with the exceptions of the caddisflies *T. waerneri* and *P. grandis*, which both have a conservation value 5 (Locally notable), and *L. lusitanicus* (conservation value 8, Rare RDB3). The non-native but non-invasive taxa identified included the Caspian mud shrimp, the New Zealand mud snail, the bladder snail *P. acuta/gyrina* and the freshwater shrimp *C. floridanus/pseudogracillis* along with the INNS demon shrimp.

NE1 Nene at Oundle

3.3.14 The autumn surveys for highlighted a high proportion of snails (*Lymnaea stagnalis, Radix balthica, Potamopyrgus antipodarum, P. acuta/gyrina, Gyraulus albus* and *Gyraulus crista*) within the population, totalling 45.4% of recorded specimens. The remaining taxa were identified as: the river limpet *Ancylus fluviatilis*, freshwater Oligochaeta, the fish leeches *Piscicola geometra* and *Piscicola siddalli*, crustaceans (*Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis, Corophium curvispinum* and *Asellus aquaticus*), the mayfly *Cloeon dipterum*, damselfly larvae (*Ischnura elegans* and *Coenagrion* sp.), beetle *Hydraena rufipes*, caddisfly larvae (*Cyrnus flavidus* and *Limnephilus marmoratus*) and true fly larvae (Chironomidae pupae, Orthocladiinae, Chironomini and Tanytarsini).

3.3.15 The spring surveys for NE1 had the highest high proportion of the freshwater shrimp *C. pseudogracillis/floridanus* within the population, totalling 40.8% between the seasons. Taxa recorded in spring additional to those determined in the autumn surveys included: the freshwater snail *Bithynia tentaculata*, limpets *Acroloxus lacustris*, the damselfly *Calopteryx splendens*, cased caddisflies (*Limnephilus lunatus* and *Anabolia nervosa*), the non-biting midges Tanypodinae and *Simulium* blackfly larvae.

3.3.16 The PSI scores indicate that the site was Sedimented to Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low sensitivity to reduced flows (Table I1, Appendix I).

3.3.17 CCI scores of 4.3 in spring from 16.6 in autumn indicate that the site has Low to High conservation values. All taxa found at the site had a conservation value of 4 or below apart from three species; the

beetle *Hydraena rufipes* has a conservation value of 7 (Nationally notable but not Red Data Book species), the leech *Piscicola siddalli;* conservation value of 6 (Regionally notable) and the caddisfly larvae *Cyrnus flavidus;* conservation value of 5 (Locally notable). The non-native but non-invasive species Caspian mud shrimp, New Zealand mud snail, the bladder snail *P. acuta/gyrina*, and the freshwater shrimp *C. floridanus/pseudogracillis* were all present within the sample in addition to the INNS demon shrimp.

NE2 Nene at Peterborough

3.3.18 The autumn sample at Peterborough was heavily dominated by crustaceans (*Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis, Chelicorophium curvispinum and Asellus aquaticus*) comprising 70.5% of the total specimens. Remaining taxa included: snails (*Lymnaea stagnalis, Radix balthica, P. antipodarum,* juvenile Physidae*, P. acuta/gyrina, Succinea* sp. and *Gyraulus albus),* limpets *(Ancylus fluviatilis* and *Acroloxus lacustris),* mayflies *(*Damaged Baetidae and *Cloeon dipterum),* damselfly larvae *(Pyrrhosoma nymphula, Ischnura elegans and Erythromma najas),* caddisfly larvae *(Lype phaeopa/reducta, Limnephilus lunatus)* and true fly larvae *(*Tanypodinae, Orthocladiinae, Chironomini and Tanytarsini*).*

3.3.19 Taxa compositions changed during the spring sample and was primarily comprised by caddisflies (*Limnephilus lunatus, Anabolia nervosa, Halesus radiatus* and *Mystacides* sp.) totalling 41.4% of recorded specimens. Taxa records additional to those from the autumn sample included snails (*Anisus vortex* and *Armiger crista),* the pea mussel *Pisdium*, damselfly larvae *Calopteryx* and water boatmen *(Callicorixa praeusta* and *Notonecta glauca).*

3.3.20 The PSI scores for this site indicate it was Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low sensitivity to reduced flows (Table I1, Appendix I).

3.3.21 CCI scores of 4.4 to 4.7 indicate the site has Low conservation value. All taxa found at the site had a conservation value of 3 (frequent) or lower. The non-native but non-invasive species Caspian mud shrimp, New Zealand mud snail*, P. acuta/gyrina,* and *C. floridanus/pseudogracillis* were all present within the sample, in addition to the INNS demon shrimp. Additionally, one specimen of the non-native freshwater polychaete worm *Hypania invalida* was found within the spring sample.

NE3 Nene at Ringstead

3.3.22 The autumn sample at Ringstead was primarily composed of the New Zealand mud snail *Potamopyrgus antipodarum*, totalling 47.6% of the identified specimens. Other species identified within the autumn sample included snails (*Viviparus viviparus, Bithynia tentaculata* and *Gyraulus albus*), pea mussels (*Pisidium henslowanum* and *Pisidium nitidum*), mussels (*Unio pictorum and Corbicula fluminea*), water fleas Cladocera, crustaceans (*Dikerogammarus haemobaphes*, *Chelicorophium curvispinum*, *Asellus aquaticus* and *Proasellus meridianus*), damselflies (Coenagrionidae and *Ischnura elegans*), true bugs (*Gerris lacustris* and *Notonecta glauca*), the alderfly *Sialis lutaria*, caddisflies (*Molanna angustata* and *Mystacides longicornis*) and the non-biting chironomids (Tanypodinae, Orthocladiinae and Chironomini).

3.3.23 From the spring sample primary species composition shifted to non-biting midges (Tanypodinae, Orthocladiinae, Chironomini, Prodiamesinae and Tanytarsini.) totalling 36.3% of the total specimens. Further taxa identified from the autumn sample include snails (*Lymnaea stagnalis, P. acuta/gyrina* and *Armiger crista),* the pea mussel *Pisdium* sp., freshwater Oligochaeta worms, water mites (Hydracarina and Oribatei)*,* Mayflies (Baetidae*, Cloeon dipterum, Ephemera sp.* and *Caenis luctuosa/macura),* demisoelle larvae *Calopteryx sp.,* water boatmen *(Corixa dentipes, Sigara sp.,* and *Notonecta viridis),* riffle beetle larvae *Oulimnius sp.,* and true fly larvae (Prodiamesinae and Tanytarsini).

3.3.24 The PSI scores for this site indicate it was Heavily sedimented and the LIFE scores indicate the macroinvertebrate community has a Low sensitivity to reduced flows (Table I1, Appendix I).

3.3.25 CCI scores of 5.1 in autumn to 10.6 in spring indicating the site has Moderate to Fairly high conservation value. All taxa found at the site had a conservation value of 3 (frequent) or lower with the exception of Locally Notable water boatman *C. dentipes* with a conservation value of 5. The non-native but non-invasive New Zealand mud snail*,* bladder snail *P. acuta/gyrina* and Caspian mud shrimp were present within the sample in addition to the non-native Asian clam *C. flumninea* and the INNS demon shrimp.

NE4 Nene at Lilford Road

3.3.26 The autumn sample at Lilford Road has a relatively even distribution of species diversity across taxa, although snails comprised a majority of 37% of sample specimens. The remaining taxa included: limpets

(*Ancylus fluviatilis* and *Acroloxus lacustris*), pea mussels *Pisidium* sp., the leech *Erpobdella octoculata*, freshwater Oligochaeta, crustaceans (*Dikerogammarus haemobaphes*, *Crangonyx floridanus/pseudogracilis, Chelicorophium curvispinum* and *Asellus aquaticus*), mayflies of Baetidae, damselflies of Coenagrionidae, caddisfly larvae (Limnephilidae and *Mystacides* sp.) and true fly larvae (Tanypodinae and Chironomini).

3.3.27 Taxa composition of the spring sample differed and was mainly comprised of non-biting midges (Tanypodinae, Orthocladiinae, Chironomini, Tanytarsini and Prodiamesinae) and freshwater Oligochaeta worms, totalling 36.6% and 16.9% respectively of specimens. Additional taxa found during the spring survey included: snails (*Potamopyrgus antipodarum*, *Bithynia tentaculata* and *Succinea* sp.), mayflies *Caenis luctuosa/macura*, damselfly and dragonflies (*Ischnura elegans* and *Sympetrum* sp.), lesser water boatmen Corixidae, aquatic beetles (Dryopidae and *Oulimnius* sp.), cased caddisflies (*Limnephilus lunatus* and *Anabolia nervosa*), Limoniidae cranefly larvae, *Simulium* sp. blackfly larvae and Psychodidae moth fly larvae.

3.3.28 The PSI scores indicate this site was Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low sensitivity to reduced flows (Table I, Appendix I1).

3.3.29 CCI scores of 5.0 in autumn down to 3.4 in spring indicate the site has Low to Moderate conservation values. All taxa found at the site had a conservation value of 3 (Frequent) or below. The non-native but non-invasive New Zealand mud snail, Caspian mud shrimp and the freshwater shrimp *C. floridanus/pseudogracillis* were present at the sample site, alongside the INNS demon shrimp.

NE6 Nene at Elton

3.3.30 The autumn sample at Elton was dominated by molluscs including the snails *Lymnaea stagnalis*, *Radix auricularia*, *Radix balthica*, *Potamopyrgus antipodarum*, *Bithynia tentaculata*, *P. acuta/gyrina*, and *Succinea* sp., the limpet *Ancylus fluviatilis*, and the zebra mussel *Dreissena polymorpha*. Molluscs accounted for 36.6% of the total specimens, with the next most abundant group, trueflies (Chironomidae pupae, Orthocladiinae, Tanytarsini, Limoniidae, and *Dixa nebulosa*), comprising 23.1% of all identified specimens. Remaining taxa included: crustaceans (*Crangonyx floridanus/pseudogracilis,* Corophidae and *Chelicorophium curvispinum*), Baetidae mayfly larvae, damselfly larvae *(*Coenagrionidae, *Ischnura elegans*, *Erythromma najas,* and *Calopteryx splendens*), the pondskater *Gerris lacustris*, beetles (Dytiscidae and Gyrinidae larvae, and *Anacaena limbata*), and caddisfly larvae *(Tinodes waeneri,* Limnephilidae).

3.3.31 The spring sample was similarly dominated by non-biting midges (Tanypodinae, Orthocladiinae, Chironomini and Tanytarsini) although the cased caddisfly *Anabolia nervosa* also had a high composition of the sample. Additional taxa identified from the sample, compared to those of autumn included the limpets *Acroloxus lacustris*, mussels (*Sphaerium sp.* and *Pisidium sp.),* crustaceans (*Dikerogammarus haemobaphes* and *Asellus aquaticus*), the mayfly *Caenis luctuosa/macura*, the damselfly *Pyrrhosoma nymphula,* beetles (*Gyrinus substriatus Orectochilus villosus and Helophorus sp.*), the riffle beetle *Elmis aenea,* caddisfly larvae (*Hydropsyche pellucidula, Limnephilus marmoratus, Limnephilus lunatus and Halesus radiatus)*, craneflies *Limoniidae*, blackflies *Simulium sp., and* drainflies Psychodidae.

3.3.32 The PSI scores for this site indicate it was Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low sensitivity to reduced flows (Table I1, Appendix I).

3.3.33 CCI scores of 4.6 to 4.8 indicates the site has Low conservation value. All taxa found at the site had a conservation value of 3 (frequent) or lower except for the meniscus midge larva *Dixa nebulosa* which possesses a conservation value of 4. The non-native but non-invasive species Caspian mud shrimp, zebra mussel, New Zealand mud snail, bladder snail *P. acuta/gyrina*, and freshwater shrimp *C. floridanus/pseudogracillis* were all present within the sample, in addition to INNS demon shrimp.

TA1 Tame at Castle Bromich

3.3.34 The summer macroinvertebrate community at TA1 mainly comprised true fly larvae (Orthocladiinae, Chironomini and Prodiamesinae) at 37% of the sample, 21.8% snails (*Radix balthica, Potamopyrgus antipodarum, Bithynia tentaculata, Anisus vortex* and *P. acuta/gyrina*) and a further 19.6% mayflies (*Baetis rhodani / atlanticus* and *Baetis scambus*). The American flatworm *Girardia tigrina*, the mussels *Sphaerium corneum* and *Pisidium* sp., the leeches *Alboglossiphonia heteroclita, Glossiphonia complanata* and *Erpobdella octoculata*, the demon shrimp *Dikerogammarus haemobaphes*, the water slater *Asellus aquaticus*, the riffle beetle *Elmis aenea*, and net-spiinning caddisfly larvae (*Hydropsyche pellucidula* and *Hydropsyche contubernalis*) were also recorded.

3.3.35 The autumn sample from TA1 was less diverse than the previous season. Taxa composition was relatively evenly distributed between New Zealand mud snail *Potamopyrgus antipodarum*, freshwater Oligochaeta worms, the damselfly *Calopteryx splendens,* and true fly larvae (damaged Chironomidae, Tanypodinae, Orthocladiinae, Chironomini, *Tipula* sp., Psychodidae, and Ceratopogonidae).

3.3.36 In the spring sample further specimens of mayflies (*Baetis rhodani/atlanticus* and *Caenis luctuosa/macura*), the cased caddisfly *Mystacides azurea,* and biting midges Ceratopogonidae were also all recorded.

3.3.37 The PSI scores indicate that the site was Sedimented to Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Moderate sensitivity to reduced flows throughout the survey period (Table I1, Appendix I).

3.3.38 CCI scores ranged from 1.0 to 5.4 indicating the site has Low to Moderate conservation values. All taxa found at the site had a conservation value of 4 (Occasional – occur in up to 10% of samples from similar habitat) or lower. No protected species were identified during the survey however, the INNS 'demon shrimp' *Dikerogammarus haemobaphes* was found at the site. The American flatworm *G. tigrina,* New Zealand mud snail and the bladder snail *P. acuta/gyrina* were also identified from the macroinvertebrate surveys, however these are all non-native but non-invasive species.

TA2 Tame at Water Orton

3.3.39 The summer macroinvertebrate community present at TA2 was dominated by snails (*Radix balthica, Valvata piscinalis, Potamopyrgus antipodarum, Bithynia tentaculata, P. acuta/gyrina* and *Gyraulus albus*) comprising 57.2% of the specimens within the sample. The remaining specimens were identified as the river limpet *Ancylus fluviatilis*, mussels (*Sphaerium corneum* and *Pisidium* sp.), leeches (*Glossiphonia complanata* and *Erpobdella octoculata*), the demon shrimp *D. haemobaphes*, the mayfly *Baetis scambus*, the damselfly *Calopteryx splendens*, the riffle beetle *Elmis a*enea, caddisfly larvae (*Hydropsyche pellucidula, Hydropsyche contubernali*s and *Hydroptila s*p.), and true fly larvae (Tanypodinae, Orthocladiinae, Chironomini, *Simulium* sp.).

3.3.40 The autumn taxa assemblage mainly consisted of specimens of Oligochaeta freshwater worms and snails (*Radix balthica, Potamopyrgus antipodarum, Bithynia tentaculata, P. acuta/gyrina* and *Succinea* sp.) totalling 34.5% and 29.1% of the total specimens of the sample, respectively. Additional taxa were identified during summer survey included the lake limpet *Acroloxus lacustris*, the freshwater leech *Helobdella stagnalis*, crustaceans (*Gammarus pulex/fossarum* agg. and *Asellus aquaticus*), aquatic beetles *Haliplus* sp., the caddisfly larvae *Tinodes waeneri* and *Tipula* cranefly larvae.

3.3.41 Similarly, the spring sample at Water Orton mainly consisted of specimens of Oligochaeta freshwater worms and non-biting midges (Tanypodinae, Orthocladiinae, Chironomini and Tanytarsini) totalling 55.0% and 26.5% of the total specimens of the sample, respectively. Further taxa identified from previous seasons included the lesser water boatman *Sigara concinna* and the caddisfly *Athripsodes bilineatus*.

3.3.42 The PSI score indicates the site was Sedimented to Heavily sedimented and the LIFE score indicates the macroinvertebrate community had a Moderate sensitivity to reduced flows (Table I1, Appendix I).

3.3.43 CCI scores, of 3.3 in autumn to 14.2 in spring, indicate Low to Fairly high conservation value. All taxa found at the site had a conservation value of 4 (Occasional) or less, except for the lesser water boatman *S. concinna* and caddisfly *A. bilineatus*, which both have conservation value of 5 (Locally Notable). No protected species were identified during the survey however, the INNS demon shrimp was recorded. The non-native but non-invasive species of the New Zealand mud snail and bladder snail *P. acuta/gyrina* were also identified from the macroinvertebrate surveys.

TA3 Tame at Lea Marston

3.3.44 The summer macroinvertebrate community present at TA3 was mainly comprised of crustaceans (*Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus*) at 35.2% of the sample, and an additional 30.4% as true fly larvae (Tanypodinae, Orthocladiinae, Chironomini, Tanytarsini, Prodiamesinae and *Simulium* sp.). The American flatworm *G tigrina*, snails (*Potamopyrgus antipodarum* and *P. acuta/gyrina*), mussels (*Sphaerium corneum* and *Pisidium* sp.), worms of Oligochaeta and the leech *Erpobdella* sp. were also all recorded.

3.3.45 During autumn surveys crustaceans (*Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus*) continued to be the highest proportion of taxa at the site, comprising over 55%. Further taxa were identified as: snails from the genus *Succinea*, the freshwater leech *Alboglossiphonia heteroclita*, the mayfly *Caenis luctuosa/macrura*, the caddisfly larva *Hydropsyche pellucidula*, and Psychodidae moth fly larvae.

3.3.46 The spring macroinvertebrate community shifted to a primary composition of non-biting midges larvae (Orthocladiinae, Chironomini, Tanytarsini and Prodiamesinae) at 59.2% of the sample, and an additional 29.5% as the freshwater Oligochaeta worms. Additional taxa identified, compared to the previous seasons, included flatworms (*Dendrocoelum lacteum* and *Polycelis* sp.), the freshwater leech *Erpobdella testacea*, the river shrimp *Gammarus pulex,* caddisflies (*Cyrnus trimaculatus, Hydropsyche pellucidula*, *Hydropsyche contubernalis* and *Mystacides azurea*) and Phantom midges Chaoboridae.

3.3.47 The PSI scores indicate the site was Sedimented to Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low to Moderate sensitivity to reduced flows (Table I1, Appendix I).

3.3.48 CCI scores of 4.2 in summer, 5.3 in autumn and 6.0 in spring, indicate the site has Low to Moderate conservation value. All taxa found at the site had a conservation value of 3 (frequent) or less, with most species unclassified. No protected species were identified during the survey however, the INNS demon shrimp was identified. The non-native but non-invasive freshwater amphipod *C. floridanus/pseudogracillis*, New Zealand mud snail and American flatworm *G tigrina* were all recorded from the site.

TA4 Tame at Tamworth

3.3.49 The summer macroinvertebrate community present at TA4 was comprised of 31.1% true fly larvae (Orthocladiinae, Chironomini and *Simulium* sp.), 27.6% snails (*Potamopyrgus antipodarum*, *Bithynia tentaculata, P. acuta/gyrina* and *Gyraulus albus*) and 19.1% mayflies (*Baetis fuscatus, Baetis scambus, Baetis vernus* and *Caenis luctuosa/macrura*). Other identified species included: river limpet *Ancylus fluviatilis*, pea mussels *Pisidium* sp., freshwater Oligochaeta worms, the demon shrimp *Dikerogammarus haemobaphes*, damselfly larvae (*Pyrrhosoma nymphula* and *Calopteryx splendens*), and caddisfly larvae (*Hydropsyche pellucidula*, *Hydroptila* sp., *Athripsodes cinereus* and *Brachycentrus subnubilus*).

3.3.50 Snails continued to dominate the autumn sample with *P. antipodarum* and *G. albus* totalling 25.6% and 19.8% of total identified specimens. Additional species records included the freshwater flatworm *Dugesia* sp., snails (*Bithynia leachii, Menetus dilatatus, Planorbis planorbis* and *Armiger crista*), the pea mussel *Pisidium henslowanum*, freshwater leeches (*Helobdella stagnalis* and *Erpobdella octoculata* and *Piscicola geometra*), freshwater shrimp (*Gammarus pulex* and *Crangonyx floridanus/pseudogracilis*), the water slater *Asellus aquaticus*, the mayflies *Caenis horaria* and *Caenis robusta*, the damselfly larvae *Ischnura elegans*, the beetle *Haliplus* sp., the caddisfly larvae *Mystacides azurea*, non-biting midges Tanypodinae, in addition to Muscidae flies, with more diversity in the sample than summer.

3.3.51 The spring macroinvertebrate community present at TA4 was comprised of 36.7% of the New Zealand mud snail and a further 27.6% of non-biting midges (Tanypodinae, Orthocladiinae, Chironomini and Tanytarsini). Further species records, compared to previous seasons, included the river limpet *Ancylus fluviatilis*, the water mite Oribatei, the lesser water boatman *Sigara concinna*, aquatic beetle larvae Gyrinidae and the moth flies Psychodidae.

3.3.52 The PSI score indicated the site was Moderately to Heavily sedimented and the LIFE score indicates the macroinvertebrate community had a Low to High sensitivity to reduced flows (Table I1, Appendix I).

3.3.53 CCI scores of 9.0 to 10.4 indicate the site has Moderate to Fairly high conservation values. All taxa found at the site had a conservation value of 3 (frequent) or less, with the mayfly *B. scambus* possessing a conservation value of 4 (Occasional), whilst the caddisfly *B. subnubilus* and the lesser water boatman *S. concinna* have conservation values of 5 (Locally Notable). No protected species were identified during the survey however, the INNS demon shrimp and the non-native but not invasive taxa New Zealand mud snail and *P. acuta/gyrina* bladder snail were identified.

TA5 Tame at Elford

3.3.54 The summer macroinvertebrate community present at TA5 consisted of 31.4% snails (*Radix balthica*, *Valvata cristata*, *Valvata piscinalis*, *Potamopyrgus antipodarum*, *Bithynia tentaculata*, *P. acuta/gyrina*, *Succinea* sp., *Anisus vortex* and *Gyraulus albus*) and a further 22.4% true fly larvae (Tanypodinae,

Orthocladiinae, Chironomini, Tanytarsini, *Tipula* sp., *Simulium* sp. and Ceratopogonidae). The remaining species included: the river limpet *Ancylus fluviatilis*, mussels (*Sphaerium corneum* and *Pisidium henslowanum*), freshwater Oligochaeta worms, the leech *Glossiphonia complanata*, crustaceans (Ostracoda, Cladocera, *Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis and Asellus aquaticus*), mayflies (*Baetis scambus, Caenis horaria* and *Caenis luctuosa/macrura*), the damselfly *Ischnura elegans*, true bugs (Gerridae and *Sigara dorsalis*), beetles (*Haliplus fluviatilis, Haliplus ruficollis* group) and caddisfly larvae (Leptoceridae and *Athripsodes bilineatus*).

3.3.55 The autumn sample was also mainly comprised of snails *(R. balthica, P. antipodarum, B. tentaculata* and *G. albus*) totaling 36.9% of the sample, with a further 29% as true fly larvae (Chironomini, *Tipula* sp. and Simuliidae). Additional taxa records included the lake limpet *Acroloxus lacustris*, and caddisfly larvae (*Psychomyia pusilla, Hydropsyche pellucidula, Hydropsyche angustipennis, Micropterna sequax, Athripsodes cinereus* and *Brachycentrus subnubilus*).

3.3.56 The spring macroinvertebrate community present consisted of primarily of the New Zealand mud snail at 30.9% of the identified specimens. Further specimens of the damselfly Calopterygidae, the non-biting midge Prodiamesinae and moth fly larvae Psychodidae were also identified within the spring sample.

3.3.57 The PSI scores indicate the site was Moderate to Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low to Moderate sensitivity to reduced flows (Table I1, Appendix I).

3.3.58 CCI scores, of 3.4 in spring from 8.0 in autumn, indicate the site has Low to Moderate conservation values. All taxa found at the site had a conservation value of 4 (Occasional) or below, apart from the Locally Notable caddisfly larvae *B. subnubilus* and *A. bilineatus*, which both possess conservation values of 5. No notable species were identified during the survey however, the INNS demon shrimp and the non-native New Zealand mud snail, bladder snail *P. acuta/gyrina* and freshwater amphipod *C. floridanus/pseudogracilis* were identified.

TA6 Tame at Alrewas

3.3.59 The summer macroinvertebrate community present at TA6 was dominated by true fly larvae (Orthocladiinae, Tanytarsini and *Simulium* sp.) comprising 67.9% of the sample, with a further 20.3% of the demon shrimp *Dikerogammarus haemobaphes*. The remaining 11.8% was identified as snails (*Viviparus viviparus* and *Potamopyrgus antipodarum*), the river limpet *Ancylus fluviatilis*, mussels (*Sphaerium corneum, Pisidium sp.* and Asian clam *Corbicula fluminea*), freshwater Oligochaeta worms, the mayfly *Baetis scambus* and caddisfly larvae (*Hydropsyche pellucidula, Hydropsyche angustipennis, Hydroptila* sp., and *Brachycentrus subnubilus*).

3.3.60 From the autumn survey at TA6, a similar assemblage of taxa was recorded to that of the previous season, however there was a more equal composition of specimens within the sample. Most abundant was crustaceans (*D. haemobaphes* and *Crangonyx floridanus/pseudogracilis*) with 32.1%. Additional taxa records to those of the summer smaple included the flatworm *Dugesia lugubris/polychroa*, the lake limpet *Acroloxus lacustris*, the mayfly *Caenis luctuosa/macrura*, the damselfly *Calopteryx splendens*, caddisfly larvae (*Tinodes waeneri, Psychomyia pusilla,* and *Mystacides* sp.) and the non-biting midges Chironomini.

3.3.61 The spring macroinvertebrate community present at TA6 was dominated by non-biting midge larvae (Orthocladiinae and Chironomini) comprising 34.1 % of the sample. Further taxa records, in addition to those of the previous survey seasons, included snails (*Radix balthica, Bithynia tentaculata* and *P. acuta/gyrina*), the mayfly *Caenis luctuosa/macura*, the caddisfly larvae *Athripsodes* sp., crane flies *Tipula* sp., moth fly larvae Psychodidae, biting midges Ceratopogonidae and horsefly larvae Tabanidae. Additionally, two specimens of the non-native freshwater polychaete worm *Hypania invalida* were found within the sample.

3.3.62 The PSI score indicated that the site was Slightly sedimented and the LIFE score indicates the macroinvertebrate community had a High sensitivity to reduced flows (Table I1, Appendix I).

3.3.63 CCI scores, of 9.5 in autumn from 10.6 in summer, indicate the site has Moderate to Fairly high conservation values. All taxa found at the site had a conservation value of 4 (Occasional) or below, apart from the caddisfly larvae *B. subnubilus*, which is a locally notable species, with a conservation value of 5. No protected species were identified within the sample. The INNS demon shrimp, and the non-native Asian clam and freshwater polychaete worm *H. invalida* were all identified during surveys. The non-

native, non-invasive New Zealand mud snail, bladder snail *P. acuta/gyrina* and *C. floridanus/pseudogracillis* were also recorded at TA6.

UT1 Upper Trent at Burton

3.3.64 The summer macroinvertebrate community present at UT1 comprised true fly larvae (Chironomidae pupae and damaged, Orthocladiinae, Tanytarsini and *Simulium* sp.) and crustaceans (*Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis* and *Chelicorophium curvispinum*), at 46% and 12.8% of specimens respectively. Also present were snails (*Viviparus viviparus, Potamopyrgus antipodarum, Bithynia leachii, Physella acuta/gyrina* and *Succinea* sp.), the river limpet *Ancylus fluviatilis*, mussels (*Sphaerium corneum, Pisidium amnicum* , *Pisidium henslowanum, Anodonta cygnaea* and *Corbicula fluminea*), mayflies (*Baetis fuscatus, Baetis scambus* and *Caenis luctuosa/macrura*), the damselfly *Calopteryx splendens*, Caddisfly larvae (*Psychomyia pusilla*, Hydropsychidae juveniles and damaged, *Hydropsyche pellucidula, Hydropsyche angustipennis, Hydropsyche contubernalis, Hydroptila* sp., and *Brachycentrus subnubilus*).

3.3.65 From the autumn sample at Burton, 39.8% of the specimens at the site were identified as snails from three species (*Lymnaea stagnalis, Radix balthica* and *Valvata piscinalis*). Additional species records to the summer assemblage included: Oligochaeta freshwater worms, the leech *Helobdella stagnalis*, Corixidae lesser water boatmen, and caddisfly larvae (*Lype* sp.*, Mystacide*s sp., and *Goera pilosa*).

3.3.66 During the spring survey, the macroinvertebrate community present at UT1 primarily comprised of mussels (Sphaeriidae and *Pisidium* sp.) with 51.5% of identified specimens. Additional taxa records compared to other seasons included the snail *Stagnicola* sp., the lake limpet *Acroloxus lacustris*, freshwater Leeches (*Helobdella stagnalis* and *Erbodella octoculata*), the mayfly *Caenis horaria*, the lesser water boatman *Sigara* sp., caddisfly larvae (*Limnephilus marmoratus* and *Limnephilus lunatus*), the non-biting midge Prodiamesinae, the cranefly *Antocha vitripennis* and the biting midges Ceratopogonidae.

3.3.67 The PSI scores indicated the site was Sedimented to Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low to High sensitivity to reduced flows (Table I1, Appendix I).

3.3.68 CCI score of 12.5 in summer to 4.1 in spring indicate the site has a Low to Fairly high conservation value. Most taxa had a conservation value of 4 (Occasional) or less, although two species with conservation value of 5 (locally notable), the snail *B. leachii* and the caddisfly *B. subnubilus*, were recorded. No protected species were identified during the survey however, the INNS demon shrimp, along with the non-native but non-invasive New Zealand mud snail, freshwater shrimp *C. floridanus/pseudogracillis* and the Caspian mud shrimp were identified.

LT4 Lower Trent at Gunthorpe

3.3.69 Summer macroinvertebrate community present at LT4 was primarily snails (*Viviparus viviparus*, *Radix Auricularia*, *Radix balthica*, *Valvata piscinalis*, *Potamopyrgus antipodarum*, *Bithynia tentaculata*, *P. acuta/gyrina*) with 47.6% of the total specimen count, followed by true fly larvae at 25.8% (Tanypodinae, Orthocladiinae, Chironomini, Tanytarsini and Prodiamesinae). The remaining species within the sample from the lower Trent site were identified as: the river limpet *Ancylus fluviatilis*, mussels (*Sphaerium corneum*, *Pisidium amnicum*, *Pisidium henslowanum* and Asian clam *Corbicula fluminea*), freshwater Oligochaeta worms, the duck leech *Theromyzon tessulatum*, crustaceans (Ostracoda, Cladocera, *Dikerogammarus haemobaphes*, *Crangonyx floridanus/pseudogracilis* and *Corophium multisetosum*), mayflies (damaged Baetidae and *Cloeon dipterum*), damselflies (Coenagrionidae and *Pyrrhosoma nymphula*), the lesser water boatman *Sigara dorsalis*, beetles (Haliplidae larvae and *Haliplus ruficollis* group) and the caddisfly larvae *Mystacides longicornis*.

3.3.70 The autumn sample from Gunthorpe was similarly highly comprised of snails (*Lymnaea stagnalis, Radix balthica, Potamopyrgus antipodarum, P. acuta/gyrina* and *Gyraulus albus*) and true fly larvae (Tanypodinae, Orthocladiinae, Chironomini and Prodiamesinae) with 28% and 24% of identified specimens respectively. Further identified taxa included the non-native freshwater polychaete worm *Hypania invalida.*

3.3.71 The spring macroinvertebrate community present at LT4 shifted to primarily non-biting midges (Tanypodinae, Orthocladiinae, Chironomini, Tanytarsini and Prodiamesinae) with 34.9% of the total specimens identified. Additional taxa records than previous seasons included the flatworm *Polycelis* sp., the lake limpet *Acroloxus lacustris*), water mites Hydracarina, water slaters Asellidae, the damselfly *Calopteryx* sp., the aquatic beetle *Anacaena limbata*, riffle beetles (*Esolus parallelepipedus* and *Limnius*

volckmari), caddisflies (*Tinodes waeneri, Lype phaeopa/reducta* and *Limnephilus lunatus*), craneflies *Tipula* sp., moth flies Psychodidae and Shore flies Ephydridae.

3.3.72 The PSI score indicates the site was Sedimented to Heavily sedimented and the LIFE score indicates the macroinvertebrate community had a Low to Moderate sensitivity to reduced flows (Table I1, Appendix I).

3.3.73 CCI scores did not differ greatly among seasons, with 4.3 to 4.8, indicating the site has Low conservation value. All taxa found at the site had a conservation value of 3 (Frequent) or less. The INNS demon shrimp were identified within the sample, further to records of the non-native and non-invasive New Zealand mud snail, Caspian Mud shrimp, bladder snail *P. acuta/gyrina* and the freshwater polychaete worm *H. invalida*.

LT6 Lower Trent at Dunham

3.3.74 Summer macroinvertebrate community present at LT6 was dominated by crustacean taxa (*Dikerogammarus haemobaphes* and *Chelicorophium curvispinum*), comprising over 60% of the sample. Other taxa included: the flatworm *Girardia tigrina*, snails (*Radix balthica, Potamopyrgus antipodarum, Bithynia tentaculata* and Planorbidae), the river limpet *Ancylus fluviatilis*, mussels (*Sphaerium corneum, Pisidium henslowanum* and *Corbicula fluminea*), true fly larvae (Tanypodinae, Orthocladiinae, Chironomini, Tanytarsini, Prodiamesinae and *Simulium* sp.), in addition to four specimens of the non-native freshwater polychaete worm *H. invalida*.

3.3.75 The autumn sample for LT6 had a lower diversity than during summer with the sample mainly comprised of 38.8% mussels (*Sphaerium corneum* and *Pisidium henslowanum*) in addition to 43.6% crustaceans (*Dikerogammarus haemobaphes* and *Chelicorophium curvispinum*). Additional taxa identified were the flatworm *Dendrocoelum lacteum*, the greater water boatman *Notonecta glauca* and caddisfly larvae (*Tinodes waeneri* and damaged Limnephilidae).

3.3.76 The spring macroinvertebrate community to be dominated by pea mussels (Pisidium sp.) in addition to non-biting midges, together comprising over 60% of the sample. Additional species identified compared to previous seasons included the shrimp *Gammarus zaddachi,* mayflies Baetidae, aquatic beetles of Hydrophilidae, the riffle beetles *Limnius volckmari*, the caddisfly *Athripsodes cinereus*. Further specimens of the non-native freshwater polychaete worm *H. invalida* were also found in the spring sample.

3.3.77 The PSI scores indicate the site was Sedimented to Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had Low to High sensitivities to reduced flows (Table I1, Appendix I).

3.3.78 CCI scores, of 3.9 in spring from 4.9 in summer, indicate the site has Low conservation value. All taxa found at the site had a conservation value of 3 (Frequent) or less. The INNS demon shrimp, the non-native freshwater polychaete *H. invalida*, and the non-native but not invasive Caspian mud shrimp, New Zealand mud snail and American flatworm *G. tigrina* were all recorded at the site.

WE3 Welland at Stamford

3.3.79 Mayflies (Baetidae, *Ephemera* sp., *Ephemera vulgata* and *Caenis* sp.) and the non-biting Chironomids (Tanypodinae, Orthocladiinae, Chironomini and Prodiamesinae) were identified as the dominant taxa groups, with a total of 36.8% and 24.6% respectively of the specimens sampled. The remaining taxa included snails (*Lymnaea stagnalis, Valvata piscinalis, Potamopyrgus antipodarum, Bithynia tentaculata*, *P. acuta/gyrina*, *Anisus vortex, Gyraulus albus* and *Bathyomphalus contortus*), pea mussels *Pisidium* sp., freshwater leeches (*Helobdella stagnalis* and Erpobdellidae), Hydracarina water mites, crustaceans (*Dikerogammarus haemobaphes, Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus*), the banded deimoselle *Calopteryx splendens*, pondskater Gerridae nymphs, lesser water boatmen (*Sigara* nymph, *Sigara dorsalis* and *Sigara falleni*), aquatic beetles (*Haliplus ruficollis*-group, *Gyrinus substriatus* and Dytiscidae larva), riffle beetles (*Elmis aenea* and *Oulimnius* sp.), the alderfly *Sialis lutaria*, caddisflies (*Lype* sp., *Hydroptila* sp., *Limnephilus lunatus*, *Molanna angustata*, *Mystacides* sp. and *Sericostoma personatum*) and the meniscus midge *Dixa nebulosa*.

3.3.80 The spring sample were dominated by the mayfly *Caenis luctuosa/macura*, which totalled 42.2% of the identified specimens within the sample. Additional taxa found from spring survey included: snails (*Bithynia leachii, Succinea* sp. and *Armiger crista*), the river limpet *Ancylius fluviatilis*, mussels *Sphaerium* sp., freshwater Oligochaeta worms, the freshwater fish leech *Piscicola geometra*, mayflies (Baetidae, *Ephemera danica* and *Ephemera vulgata*), the riffle beetle *Oulimnius tuberculatus*, caddisflies

(*Anabolia nervosa*, *Mystacides azurea* and *Lepidostoma hirtum*), non-biting midges Prodiamesinae, moth flies Psychodidae and biting midges Ceratopogonidae.

3.3.81 The PSI scores indicate the site was Heavily sedimented and the LIFE scores indicate the macroinvertebrate community had a Low to Moderate sensitivity to reduced flows (Table I1, Appendix I).

3.3.82 CCI scores of 6.3 from autumn to 7.9 in spring indicate that the site has a Moderate conservation value. All taxa found at the site had a conservation value of 4 (Occasional) or below, with the exception of the freshwater snail *B. leachii*, which is Locally Notable with a conservation value of 5. The INNS demon shrimp was identified within the sample. Some non-native but non-invasive species were also identified, including the freshwater amphipod *C. floridanus/pseudogracillis* and the New Zealand mud snail and *Physella acuta/gyrina* bladder snail.

WE5 Welland at Tallington

3.3.83 Snails (*Lymnaea stagnalis, Radix balthica, Valvata piscinalis, Bithynia tentaculata, Physa fontinalis, Anisus vortex* and *Bathyomphalus contortus*) were identified as the dominant group in autumn at this location, with a total of 47.1% of the specimens sampled. The remaining taxa was diverse and included: Pisidium sp., leeches (*Glossiphonia complanata, Helobdella stagnalis* and *Erpobdella octoculata*), crustaceans (*Gammarus pulex, Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus*), mayflies (*Caenis luctuosa/macrura* and *Ephemera danica*), the damselfly *Calopteryx splendens*, true bugs (*Gerris lacustris* and *Sigara dorsalis*), beetles (Haliplidae larvae, *Haliplus fluviatilis,* and *Haliplus ruficollis*-group), the riffle beetle *Elmis aenea*, caddisfly larvae (*Hydropsyche pellucidula, Phryganea bipunctata, Athripsodes aterrimus, Athripsodes cinereus* and *Brachycentrus subnubilus*) and true fly larvae (Tanypodinae, Tanytarsini and Prodiamesinae).

3.3.84 At WE5 in spring, taxa composition of the sample shifted to a dominant cover of non-biting midges (Tanypodinae, Orthocladiinae, Chironomini, Tanytarsini and Prodiamesinae) totalling 30% of identified specimens. Addition taxa records to autumn included snails (*Bithynia leachii*, *P. acuta/gyrina*, *Succinea* sp., *Planorbis planorbis, Anisus vortex* and *Gyraulus albus*), the lake limpet *Acroloxus lacustris*, mussels (*Sphaerium* sp. and *Pisidium* sp.), freshwater Oligochaeta worms, Hydracarina water mites, Baetidae mayflies, the damselfly *Calopteryx splendens*, the lesser water boatman *Sigara dorsalis/striata*, aquatic beetles (*Nebrioporus elegans* and Hydrophilidae), riffle beetles (*Oulimnius tuberculatus*), the alderfly *Sialis lutaria*, cased caddisflies (*Limnephilus marmoratus*, *Limnephilus lunatus*, *Anabolia nervosa*, and *Sericostoma personatum*) and *Simulium* blackfly larvae.

3.3.85 The PSI score indicates the site was Heavily sedimented and the LIFE score indicates the macroinvertebrate community had a Low sensitivity to reduced flows (Table I1, Appendix I).

3.3.86 The CCI scores of 6.3 to 7.4 between seasons indicates the site has Moderate conservation value. All taxa found at the site had a conservation value of 2 (Common) or below, with the exception of the caddisfly *B. subnubilus* and the freshwater snail *B. leachii*, which are Locally Notable with a conservation score of 5. No protected or invasive species were identified form the sample in autumn sample, apart from the non-invasive, non-native freshwater amphipod *C. floridanus/pseudogracillis* and the bladder snail *P. acuta/gyrina*.

WE6 Welland at Deeping St James

3.3.87 The summer macroinvertebrate community at WE6 was dominated by 44.6% crustaceans (*Gammarus pulex, Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus*) and 36.6% true bugs (*Ilyocoris cimicoides, Sigara dorsalis, Notonecta glauca* and *Notonecta maculata*). The remaining taxa were identified as: snails (*Lymnaea stagnalis, Radix balthica, Bithynia tentaculata, Physa fontinalis, Planorbarius corneus, Planorbis planorbis* and *Gyraulus albus*), mussels (S*phaerium corneum* and *Pisidium* sp.), worms of Oligochaeta, leeches (*Theromyzon tessulatum, Erpobdella testacea* and *Erpobdella octoculata*), damselfly larvae (*Ischnura elegans* and *Calopteryx splendens*), beetles (Haliplidae larvae, *Haliplus fluviatilis, Haliplus immaculatus, Hygrotus versicolor* and *Nebrioporus elegans*), alderfly larvae *Sialis lutaria*, the caddisfly larvae *Phryganea grandis*, and true fly larvae of Tanypodinae.

3.3.88 Similarly in autumn, the water slater *A. aquaticus* comprised the highest proportion of specimens, totalling 42.9% of the sample, although followed closely by the lesser water boatman *Sigara dorsalis* with 35.6%. Additional species records to summer included: Coenagrionidae damselfly larvae, *Anax* dragonfly larvae, and true bugs (Ilyo*coris cimicoides, Sigara dorsalis, Notonecta glauca* and *Notonecta maculata*).

3.3.89 Spring macroinvertebrate community at WE6 was continued to be dominated by crustaceans (*Crangonyx floridanus/pseudogracilis* and *Asellus aquaticus*) with 44.6% of specimens. Additional taxa records compared to previous seasons included: the snail *Hippeutis complanatus*, the lake limpet *Acroloxus lacustris*, the mayfly *Cloeon dipterum*, the aquatic beetle *Hyphydrus ovatus*, the riffle beetle *Elmis aenea*, caddisflies (*Phryganea bipunctata, Limnephilus marmoratus, Limnephilus lunatus, Halesus radiatus* and *Athripsodes aterrimus*), the meniscus midge *Dixella* sp., and non-biting midges (Orthocladiinae, Chironomini and Tanytarsini).

3.3.90 The PSI score indicated that the site was Heavily sedimented and the LIFE score indicated the macroinvertebrate community had a Low sensitivity to reduced flows (Table I1, Appendix I).

3.3.91 CCI scores of 9.8 for summer and autumn to 11.2 in spring, indicates the site has Moderate to Fairly high conservation value. All taxa found at the site had a conservation value of 4 (Occasional) or below, with four exceptions. The greater water boatman *N. maculata*, the aquatic beetle *H. versicolor*, in addition to the caddisfly larvae *P. grandis* are all Locally Notable species with a conservation value of 5. The aquatic beetle *H. laminatus* was also recorded at WE6 and has a conservation value of 7 (Nationally Notable). No INNS were identified, apart from the non-native but non-invasive freshwater amphipod *C. floridanus/pseudogracillis*.

Macroinvertebrate WFD classification

3.3.92 Overall macroinvertebrate WFD classifications are presented in Table I1 in Appendix I following the completion of spring surveys and RICT analysis. The overall WFD class is based on the results of spring and autumn data only as stipulated by industry best practice (UKTAG, 2021).

3.3.93 From the macroinvertebrate surveys only two sites received a High overall classification (WE5 and NE6), with a further four sites attaining a Good classification (GO5, NE3, NE4 and WE3). The River Nene was the only river within the project to improve classification with each subsequent site downstream, indicating a reduction in water quality and/or habitat pressure along its course. Similarly, this is evident within the Tame, although the Tame survey sites starts with a Bad WFD classification upstream of Minworth STW and finishes with a Moderate WFD classification at the final survey point, improving consistently along the way.

3.3.94 The Welland attained WFD classifications of Good to High at sites WE3 and WE5 respectively, decreasing to Moderate at WE6 resulting from decreased WHPT-ASPT in comparison to the upstream locations and indicating an increase in water quality pressure. The Tame macroinvertebrate sites had the lowest quality WFD classifications and was the only watercourse within the project to receive a Bad WFD classification at site TA1. Water quality pressures were evident across the upstream sites TA1 and TA2 in summer and autumn in addition to all sites during spring surveys. INNS species may be of influence within the Tame, with multiple species identified within the macroinvertebrate surveys (Table H3) and desk study. Comparably low NTAXA scores for TA1 and TA3 suggest habitat or INNS pressures are prevalent at these locations. The Trent site LT6 also seemed to be experiencing habitat quality pressures across all three survey periods, again indicated by low NTAXA sores, although not water quality pressures were evident.

3.3.95 The RICT analysis follows the official WFD classification as it has been based on combined spring and autumn macroinvertebrate samples. However, alkalinity data should be obtained from monthly analysis of samples from each over a period of at least one year, whereas here, only one sample was taken during each survey period. Long term alkalinity assessments were available for all sites except NE6 and TA1, which were not available through the EA data explorer, and subsequent RICT analysis used the alkalinity data collected during macroinvertebrate surveys. Therefore, classifications presented here based on only an average of two (NE6) or three (TA1) alkalinity measurements, dependent on location but are likely representative of annual averages for these sites.

3.4 Macrophyte Survey

3.4.1 The full list of macrophyte taxa and marginal species recorded during surveys can be found in Appendix J. Macrophyte index scores and resultant WFD status derived from macrophyte survey data are presented in Table 10.

Table 10: Macrophyte LEAFPACS2 scores

Water Body	Site reference	Date	WFD Status (2021 data)	RMNI	NTaxa	NFG	ALG
Tame	TA1	01/10/21	**Bad**	8.98	4	3	0.05
Tame	TA2	01/10/21	**Bad**	8.89	4	3	0.05
Tame	TA4	01/10/21	**Poor**	8.25	8	6	0.05
Tame	TA6	29/09/21	**Good**	8.15	6	5	1.7
Lower Trent	LT7	29/09/21	**Poor**	8.26	5	5	3.8
Lower Trent	LT8	29/09/21	**Poor**	8.17	8	7	3.8
Lower Trent	LT9	28/09/21	**Moderate**	7.84	3	3	7.5
Lower Trent	LT10	28/09/21	**Poor**	8.57	4	4	0.5
Lower Trent	LT11	28/09/21	**Moderate**	7.67	2	2	3.8

3.4.2

TA1 Tame at Castle Bromwich

3.4.3 The width of the TA1 reach ranged between 10-20 m, with 90% of the water depth as 0.5-1 m. The dominant habitat type was run over an unknown substrate, due to high turbidity. There was primarily no shading along both banks, with only 5% of the left bank receiving broken shading. The survey stretch was adjusted 20 m downstream due to access issues near the weir in the water channel. It is considered that high turbidity led to approximately 50% of the data obtained being compromised, with steep banks and dense bank vegetation growth impeding grapnel use for in channel macrophyte survey. However, results obtained were consistent with expectations and therefore are considered valid.

3.4.4 Ten macrophyte species were recorded with a total macrophyte cover of 4%, each covering similar areas of the channel. Filamentous algae cover was approximately 1% of the channel.

3.4.5 No notable species were recorded, however the two INNS Himalayan balsam *Impatiens glandulifera* and Nuttall's waterweed *Elodea nuttallii* were identified covering 1% and less than 0.1% of the channel respectively.

3.4.6 The macrophyte assemblage was analysed using LEAFPACS2 and attained Bad WFD status (EQR 0.154). This result indicates the macrophyte community was intensively impacted by nutrient enrichment and/or alterations in river flow and/or modifications to morphological conditions.

TA2 Tame at Water Orton

3.4.7 The Tame at TA2 was relatively wide, spanning 10-20 m, with 90% of its water depth 0.5-1 m; the central part of the channel measured greater than 1 m in depth. The dominant habitat type was run over an unknown substrate, due to high turbidity. Water clarity was low, but there was primarily no shading along both banks, with 5% of the right bank received broken shading. The survey was moved 20m downstream due to access issues near the weir in the water channel. It is likely that some data was compromised due to survey limitations, however results were consistent with expectations as described above.

3.4.8 Nine macrophyte species were recorded with a total macrophyte cover of 18%. The Horned pondweed *Zanichellia palustris* and Fennel pondweed *Stukenia pectinata* were the most abundant species, covering around 25% and 2.5%, respectively, of the surveyed stretch. Filamentous algae cover was approximately 1% of the channel.

3.4.9 No protected species were recorded, however the two INNS Himalayan Balsam *Impatiens glandulifera* and Nuttall's waterweed *Elodea nuttallii* were identified covering bank faces and less than 0.1% of the channel respectively.

3.4.10 The macrophyte assemblage was analysed using LEAFPACS2 and attained Bad WFD status (EQR 0.176). This result indicates the macrophyte community was intensively impacted by one or a combination of nutrient enrichment, alterations in river flow, and/or modifications to morphological conditions.

TA4 Tame at Tamworth

3.4.11 Water width at TA4 was between 10-20 m with a depth of greater than 1 m for its entire survey reach. The dominant habitat type was run over an unknown substrate, due to high turbidity. Water clarity was low, but there was primarily no shading along both banks, with only 5% of the left bank receiving broken shading. It is likely that more than 50% of the data obtained was compromised with low confidence in identification of submerged species as this was estimated from grapnel throws, with strong undercurrents limiting effectiveness of the survey. However, results obtained were consistent with expectations, as described above.

3.4.12 Thirteen macrophyte species were recorded with a total macrophyte cover of 9%. The Horned pondweed *Zanichellia palustris* and Unbranched bur-reed *Sparganium emersum* were the most abundant species, covering about 10% and 2.5% respectively of the surveyed reach. Filamentous algae cover was less than 0.1% of the channel.

3.4.13 No protected species were recorded at the survey site, however the two INNS Himalayan balsam *Impatiens glandulifera* and Nuttall's waterweed *Elodea nuttallii* were identified covering less than 0.1% of the channel each.

3.4.14 The macrophyte assemblage was analysed using LEAFPACS2 and attained Poor WFD status (EQR 0.311). This result indicates the macrophyte community was greatly impacted by one or a combination of nutrient enrichment, alterations in river flow, and/or modifications to morphological conditions.

TA6 Tame at Alrewas

3.4.15 TA6 was split into two channels, with respective widths of 10-20 m and greater than 20 m for their entirety. Water depth was greater than 1 m for 90% of the reach, although margins were shallower at 0.25-0.5 m. The dominant habitat type was run over mainly pebbles/gravel, and additional substrates of boulders/cobbles, sand, and silt/clay. Water clarity was low, but there was primarily no shading along both banks, with the left and right banks receiving 10% and 5% broken shading, respectively, from bankside vegetation and trees. It is considered that representative survey data was obtained, with survey by grapnel effectively completed from the left bank.

3.4.16 Thirteen macrophyte species were recorded with a total macrophyte cover of 10%. Reed canary-grass *Phalaris arundinacea* and Common club-rush *Schoenoplectus lacustris* were the most abundant species, covering about 5% and 10%, respectively, of the surveyed reach. Filamentous algae cover was 2% of the channel.

3.4.17 No protected species were recorded at the survey site, however the INNS Himalayan balsam *Impatiens glandulifera* was identified on the banks of the surveyed reach, and floating pennywort *Hydrocotyle ranunculoides* was present further upstream.

3.4.18 The macrophyte assemblage was analysed using LEAFPACS2 and attained Good WFD status (EQR 0.617). This result indicates the macrophyte community was not overly impacted by environmental pressures.

LT7 Lower Trent at Twyford

3.4.19 At LT7 the water width was greater than 20 m for the entire length, with a depth greater than 1 m for 95% of the reach. The dominant habitat type was run, with 10% of the reach classed as slack over a substrate of 50% pebbles/gravel. Water clarity was mostly clear with turbidity obscuring views in deeper water. There was largely no shading, with 90% for the left bank and 80% for the right bank, with the remainders for both as broken.

3.4.20 Nine macrophyte species were recorded with a total macrophyte cover of 8%. The Common club-rush *Schoenoplectus lacustris* was the most abundant species, but only covered about 5% of the surveyed stretch. Filamentous algae covered a further 5% of the channel.

3.4.21 No protected species were recorded at the survey site, however the INNS Himalayan balsam *Impatiens glandulifera* was identified on the banks of the surveyed reach.

3.4.22 The macrophyte assemblage was analysed using LEAFPACS2 and attained Poor WFD status (EQR 0.336). This result indicates the macrophyte community was greatly impacted by one or a combination of nutrient enrichment, alterations in river flow, and/or modifications to morphological conditions.

LT8 Lower Trent at Long Eaton

3.4.23 Water width of this reach was far greater than 20 m for the entire reach (refer to RHS results for further detail), with a water depth ranging from 0.5 m or more for 90% of the reach. The dominant habitat type was run, with a section of 5% as slack, over a substrate of pebbles/gravel, with additional substrates of boulders/cobbles, sand, and silt/clay. Water clarity was high, and there was largely no shading along both banks, with 2% of each bank receiving broken shading.

3.4.24 Ten macrophyte species were recorded with a total macrophyte cover of 5%. Reed canary-grass *Phalaris arundinacea* was the most abundant species, but only covered about 2% of the surveyed stretch. Filamentous algae cover was 5%.

3.4.25 No protected species were recorded at the survey site, however the two INNS Himalayan balsam *Impatiens glandulifera* and Nuttall's waterweed *Elodea nuttallii* were identified covering bank faces and 1% of the channel, respectively.

3.4.26 The macrophyte assemblage was analysed using LEAFPACS2 and attained Poor WFD status (EQR 0.372). This result indicates the macrophyte community was greatly impacted by one or a combination of nutrient enrichment, alterations in river flow, and/or modifications to morphological conditions.

LT9 Lower Trent at Gunthorpe

3.4.27 Water width was far greater than 20 m and deeper than 1 m for 98% of the channel. The dominant habitat type was run, with a 10% area of slack, over substrate primarily comprised of silt/clay and sand, with additional substrates of boulders/cobbles and pebbles/gravel. Water clarity was high, with considerable shading on the banks. The left bank had dense shading over 30% of the reach and a further 40% with broken shading. The right bank had 10% shading recorded as dense and another 20% as broken, with the remainder unshaded.

3.4.28 Twelve macrophyte species were recorded with a total macrophyte cover of 5%. Blanketweed *Cladophora glomerata/Rhizoclonium hieroglyphicum* aggregate was the most abundant taxa, which covered about 5% of the surveyed reach. Filamentous algae covered 10% of the channel in total.

3.4.29 No protected species were recorded at the survey site, however the INNS Himalayan balsam *Impatiens glandulifera* was identified on the banks of the surveyed reach.

3.4.30 The macrophyte assemblage was analysed using LEAFPACS2 and attained Moderate WFD status (EQR 0.422). This result indicates the macrophyte community was impacted by one or a combination of nutrient enrichment, alterations in river flow, and/or modifications to morphological conditions.

LT10 Lower Trent at Newark on Trent

3.4.31 Water width was far greater than 20 m and deeper than 1 m for 98% of the channel. The dominant habitat type was run, with a 5% area of slack, over a substrate primarily comprised of pebbles/gravel and sand, with additional substrates of boulders/cobbles and silt/clay. Water clarity was good, with primarily no shading along both banks, with 95% of the right bank receiving no shading and the left bank receiving 40% dense and 20% broken shading with the remainder being clear. It is likely that 25%-50% of the data obtained was compromised due to the deep-water conditions at the site.

3.4.32 Twelve macrophyte species were recorded with a total macrophyte cover of 5%. Reed sweet-grass *Glyceria maxima* was the most abundant species, but only covered about 3% of the surveyed stretch. Filamentous algae covered 1% of the survey reach.

3.4.33 No protected species were recorded at the survey site, however the INNS Himalayan balsam *Impatiens glandulifera* was identified on the banks of the surveyed reach.

3.4.34 The macrophyte assemblage was analysed using LEAFPACS2 and attained Poor WFD status (EQR 0.306). This result indicates the macrophyte community was greatly impacted by one or a combination of nutrient enrichment, alterations in river flow, and/or modifications to morphological conditions.

LT11 Lower Trent at North Clifton

3.4.35 Water width was far in excess of 20 m and deeper than 1 m for 98% of the channel. The dominant habitat type was run over a primarily sand substrate, with silt/clay, pebbles/gravel, and boulders/cobbles. Water clarity was low, with only 20% of the water clear, and there was largely no shading along both banks, with 2% of both banks receiving broken shading from trees. It is likely that 25%- 50% of the data obtained was compromised due to the high turbidity, depth and width of the river at this location.

3.4.36 Eight macrophyte species were recorded with a total macrophyte cover of 2%. Blanketweed *Cladophora glomerata/Rhizoclonium hieroglyphicum* aggregate was the most abundant taxon which covered about 4% of the surveyed reach. Filamentous algae cover was 5% of the channel.

3.4.37 No INNS, protected or notable species were recorded.

3.4.38 The macrophyte assemblage was analysed using LEAFPACS2 and attained Moderate WFD status (EQR 0.482). This result indicates the macrophyte community was impacted by one or a combination of nutrient enrichment, alterations in river flow, and/or modifications to morphological conditions.

3.5 Fish

Desk Study

3.5.1 EA fish monitoring data was provided for the Lower Trent, including the tributaries River Greet, and The Fleet, for years 2016 – 2018; this included hydroacoustic data, fry netting and electric fishing data over several sites between Nottingham and Dunham Bridge. The most recent report from 2019 only included hydroacoustic data from Nottingham to Cromwell lock.

3.5.2 The highest recorded fish densities were below the weirs at Nether Lock and Gunthorpe Lock, with some records of over 100 fish per 1000 m^3. The surveyed reach between Gunthorpe Lock and Hazelford Lock had some of the highest abundances, likely due to proximity of weirs and boat moorings providing refuge for fish. This again followed the previous year, 2018, trend, with Stoke Lock and Gunthorpe Lock followed by Gunthorpe Lock to Hazelford Lock with the highest recorded number of fish of the survey reaches.

3.5.3 The Trent catchment report 2018 reported 11 species of fish caught in fry netting surveys between all the nine survey sites, which was down from 16 species in 2017. Roach *Rutilus rutilus*, dace *Leuciscus leuciscus* and chub *Squalius cephalus* accounted for 30%, 25% and 12% respectively of catches within the Trent and were found across all sites. The remaining species of barbel *Barbus barbus*, 10 spined stickleback *Pungitius pungitius*, bleak *Alburnus alburnus*, common bream *Abramis brama*, flounder *Platichthys flesus*, gudgeon *Gobio gobio*, minnow *Phoxinus phoxinus* and perch *Perca fluviatilis* accounted for 10% or less each and were not found at all surveyed sites. Fish populations within the River Trent are therefore suggested to be moderate, although underestimation may be likely due to limitations when dealing with surveys in large rivers and of the survey methods themselves. Therefore, it is considered important to look at all available data in combination, utilising multiple sources.

3.5.4 Notable species from the EA data include barbel (Habs Dir Annex V), spined loach *Cobitis taenia* (Habs Dir Annex II, UKBAP), zander *Sander lucioperca* (INNS), European eel *Anguilla anguilla* (Eel Regulations 2009, IUCN Critically endangered, UKBAP) and bullhead *Cottus gobio* (Annex II). An Atlantic salmon *Salmo salar* (Habs Dir Annex II,V, UKBAP) was captured by VAKI equipment jumping at Cromwell weir on 18th November 2016. There is also a record of UK BAP species brown/sea tout *Salmo trutta* in 2016 in the River Greet downstream of Hazelford weir near its confluence with the Trent.

3.5.5 Salmon were observed jumping the weirs at Gunthorpe and Stoke Bardolph on 11 November 2021 by AECOM hydroecologists (Figure 8 and Figure 9), providing evidence of salmonids using the fish passes and running the river to access spawning habitat in the Trent catchment.

Figure 8: Salmonid attempting to pass Gunthorpe weir (11/11/21)

Figure 9: Salmonid attempting to pass Stoke Bardolph weir (11/11/21)

Fish surveys

River Trent

Cromwell Weir

3.5.6 Cromwell Weir was surveyed on the 6 August 2021.The average river width was 80 m and the depth was estimated to be >2 m. The weather was wet and overcast.

3.5.7 A 200 m section of the right bank and 340 m of the left bank were surveyed for fish upstream of the weir. Eight fish species were caught and a total of 86 individuals. Roach, dace and perch were the most numerous species caught. European eels were also seen by the surveyors but not captured. Spined loach was the only notable species caught (Figure 10; Table 11).

3.5.8 Downstream of the weir a 215 m run was undertaken on the left bank. No surveying was completed on the right bank due to a large number of anglers throughout this stretch. Eight fish species were captured totalling 74 individuals. Gudgeon, roach and dace were the dominant species. Spined loach was the only notable species caught (Figure 10; Table 11).

3.5.9 The upstream and downstream catches varied in species abundance with gudgeon becoming more dominant downstream. Gudgeon are a benthic species and shallower water depths sampled downstream in the marginal areas would have meant more suitable habitat was present for these species. Perch were far more abundant upstream and again this could be due to more preferable submerged macrophyte coverage and lower flows upstream compared to downstream. A single flounder was caught downstream of Cromwell indicating the tidal limit of the Trent.

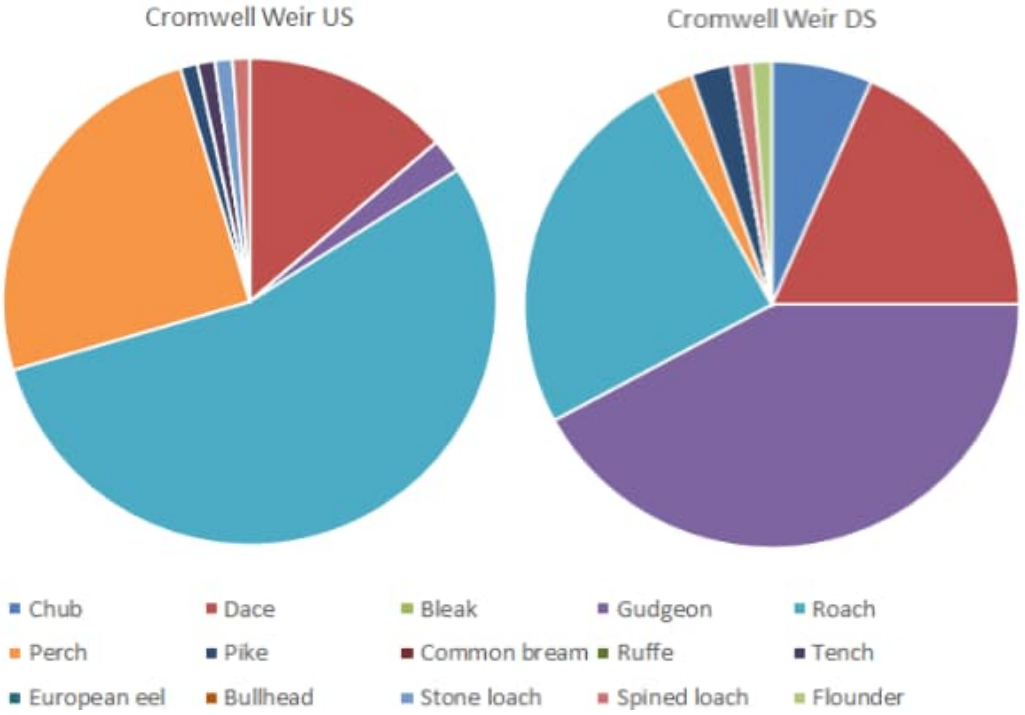

Figure 10: Catch compositions upstream and downstream of Cromwell Weir

Hazelford Weir

3.5.10 Hazelford weir was surveyed on 5 August 2021. The average river width was 50 m and the water depth was estimated to be >2m deep. The weather was warm and sunny with light clouds.

3.5.11 Upstream of Hazelford weir a 300 m section of the right bank was surveyed along with a 330 m section of the left bank upstream of the weir. Eight species were caught and a total of 130 individuals. Notable species caught included four European eel and one bullhead (Figure 11; Table 11).

3.5.12 Downstream of Hazelford weir, a 340 m run of the left bank was surveyed; none of the right bank was surveyed due to a large section of concrete piling and lack of habitat. A total of 11 species were caught totalling 157 individuals. Notable species included five eel and one spined loach (Figure 11; Table 11).

3.5.13 Roach and dace dominated the catch both up and downstream. Eel were equally caught both above and below the weir indicating passage is available for these migratory species. Pike were much more abundant upstream of the weir indicating that the suitability of habitat was greater upstream with submerged macrophytes and lower flows.

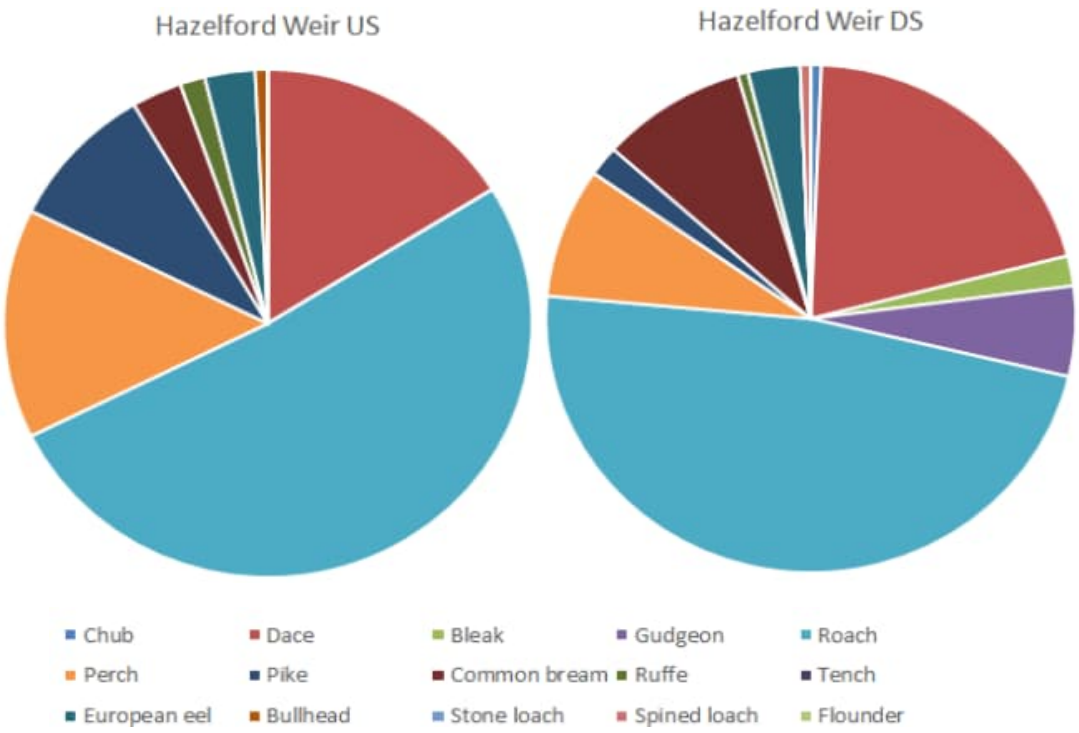

Figure 11: Catch compositions upstream and downstream of Hazelford Weir

Gunthorpe Weir

3.5.14 Gunthorpe weir was surveyed on 9 of August 2021. The average river width was 70 m and the depth was estimated to be >2 m. The weather was sunny and mild.

3.5.15 Upstream of Gunthorpe weir a 600 m section of the right bank was surveyed along with a 100 m section of the left bank. Nine species were caught and 146 individuals. Dace and roach were the dominant species caught. Notable species caught included European eel and bullhead (Figure 12; Table 11).

3.5.16 Downstream of Gunthorpe weir a 350 m section of the right bank was surveyed. The left bank was not surveyed due to a lack of suitable habitat and the presence of anglers. 64 individuals were caught from seven different species. Roach dominated the catch downstream. Notable species caught included spined loach (Figure 12; Table 11).

3.5.17 The section surveyed upstream was of a far greater area than downstream due to habitat and access suitability. This is shown in the lower numbers of fish caught downstream of the weir.

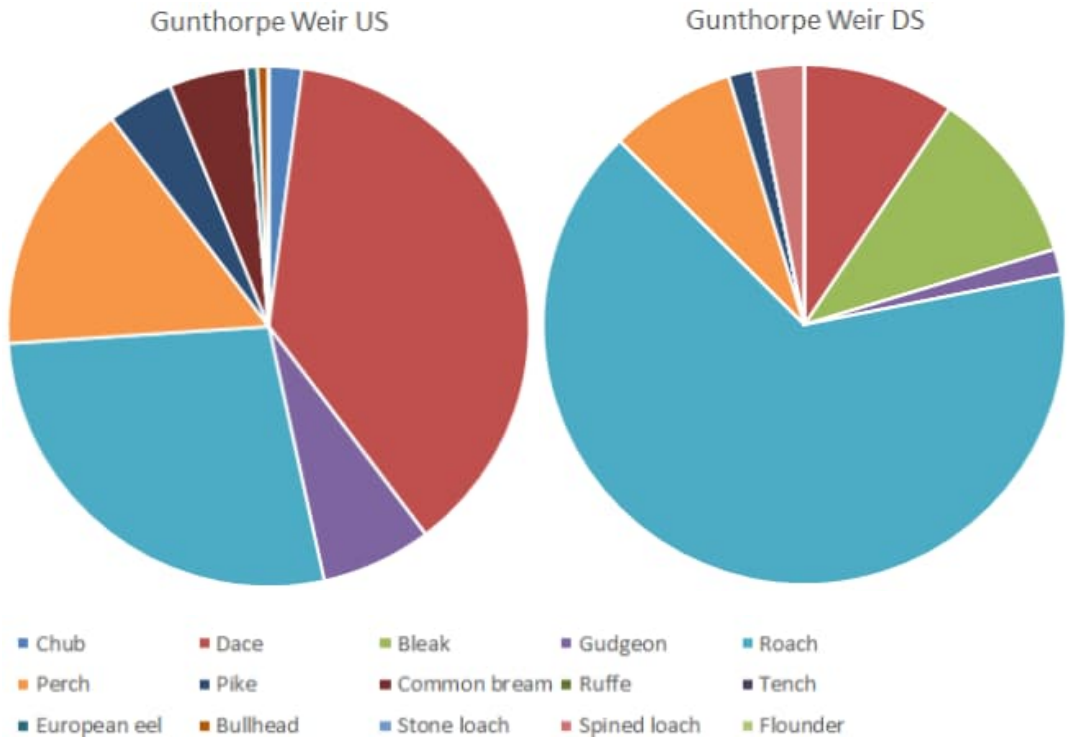

Figure 12: Catch compositions upstream and downstream of Gunthorpe Weir

Table 11: Fish caught upstream and downstream of three weirs on the River Trent

Species	Cromwell Weir US	Cromwell Weir DS	Hazelford Weir US	Hazelford Weir DS	Gunthorpe Weir US	Gunthorpe Weir DS	Total
Chub	0	5	0	1	3	0	**9**
Dace	12	14	21	32	55	6	**140**
Bleak	0	0	0	3	0	7	**10**
Gudgeon	2	32	0	9	10	1	**54**
Roach	48	19	67	75	40	42	**291**
Perch	22	2	19	13	23	5	**84**
Pike	1	2	12	3	6	1	**25**
Common bream	0	0	4	14	7	0	**25**
Ruffe	0	0	2	1	0	0	**3**
Tench	1	0	0	0	0	0	**1**
European eel	0	0	4	5	1	0	**10**
Bullhead	0	0	1	0	1	0	**2**
Stone loach	1	0	0	0	0	0	**4**
Spined loach	1	1	0	1	0	2	**2**
Flounder	0	1	0	0	0	0	**1**
Total	**88**	**76**	**130**	**157**	**146**	**64**	**661**

River Tame

Broad Meadow Weirs, Tamworth

3.5.18 Due to safety concerns of launching and using the boat close to the weir raised by the EA and a resulting lack of land access, no electric fishing was carried out at Broad Meadow and only eDNA samples were taken on the 24 September 2021.

Lea Marston Weir

3.5.19 Lea Marston weir was surveyed on 11 August 2021. The weather was sunny and dry.

3.5.20 The upstream section was on average 25 m wide and 1 m deep. The substrate was a mixture of silt, sand, gravel, cobbles, pebbles, and some boulders. The flow habitats present were glide and run.

3.5.21 A 560 m section of the river was fished. 31 individuals were caught from 8 different species with gudgeon dominating the catch. Notable species caught were bullhead (Figure 13; Table 12).

3.5.22 The downstream lake section was 100% silty substrate and a uniform depth of 0.5 m. A 330 m section of the banks were fished, and no fish were caught. Water quality at this site was deemed poor due to the function of the lakes acting as settlement storage for pollutants.

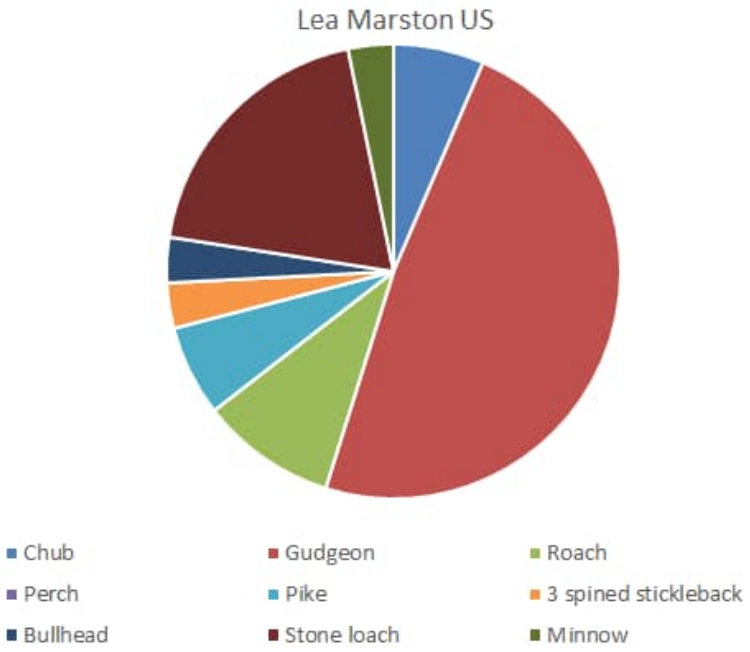

Figure 13: Catch compositions upstream of Lea Marston Weir

Water Orton

3.5.23 Water Orton Weir was surveyed on 13 August 2021. The conditions were sunny and dry.

3.5.24 The average river width at this location was 15 m and 0.5 m depth. The substrate was a mixture of boulders, cobbles, gravel, and sand with some silt also present.

3.5.25 A 400 m run was carried out upstream with 157 individual fish specimens comprising seven species were caught. Stone loach and minnow dominated the catches at both sides of the weir. Bullhead was the only notable species caught (Figure 14; Table 12).

3.5.26 A 400 m run was carried out downstream across the river width 212 specimens comprising five species were caught. Bullhead was the only notable species caught (Figure 14; Table 12).

3.5.27 Catch compositions were similar up and downstream of the weir but with stone loach being much more dominant downstream. Habitat suitability was greater here with a higher abundance of submerged macrophytes and small cobbles/pebbles present.

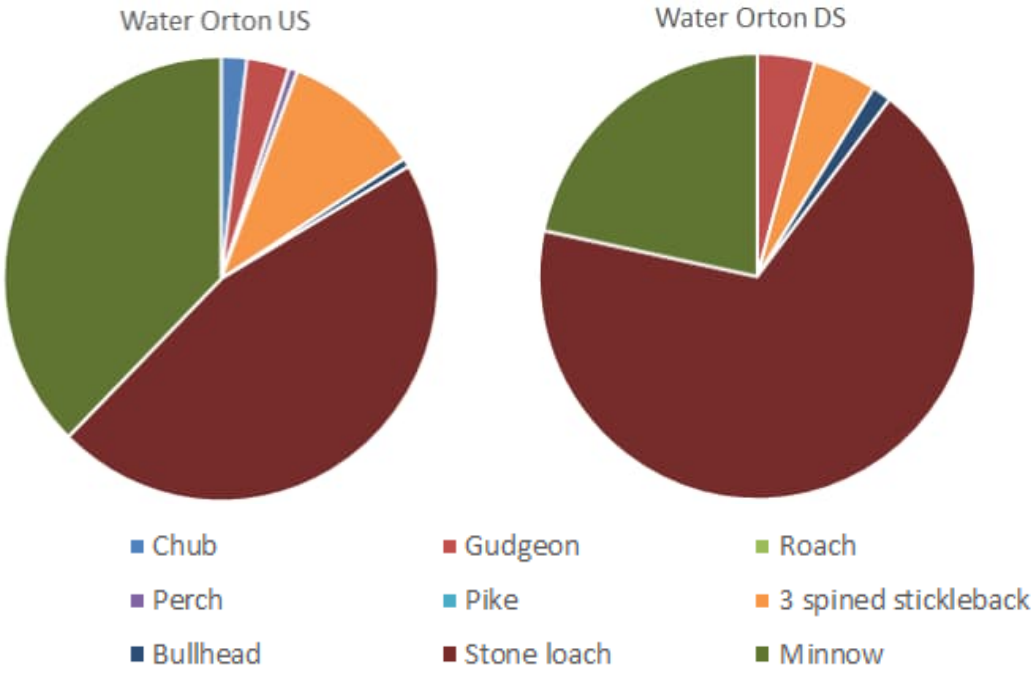

Figure 14: Catch compositions upstream and downstream of Water Orton Weir

Table 12: Fish caught upstream and downstream of weirs on the River Tame

Species	Lea Marston US	Lea Marston DS	Water Orton US	Water Orton DS	Total
Chub	2	0	3	0	**5**
Gudgeon	15	0	5	9	**29**
Roach	3	0	0	0	**3**
Perch	0	0	1	0	**1**
Pike	2	0	0	0	**2**
3 spined stickleback	1	0	16	10	**27**
Bullhead	1	0	1	3	**5**
Stone loach	6	0	72	144	**222**
Minnow	1	0	59	46	**106**
Total	**31**	**0**	**157**	**212**	**400**

Fish eDNA

3.5.28 Water samples for eDNA analysis for fish species were collected from upstream and downstream of three weirs on both the River Tame and the River Trent and are presented in Table 13. A total of 29 taxa were identified within the water bodies.

3.5.29 Average taxon richness was 14 species and ranged from three species at Lea Marston upstream to 22 species at Cromwell weir downstream. The most abundant DNA sequences found were of roach (20.3%) over all 12 sites. The most frequently detected species were chub, roach, and stone loach.

3.5.30 Protected species highlighted from the eDNA analysis include European eel, which were detected at all sites with the exception of Broad Meadow downstream and both up and downstream of Lea Marston and Water Orton. Bullhead were detected at all sites with the exception of Lea Marston. Spined loach was detected at both sites at Cromwell and Broad Meadow and downstream of Hazelford and

Gunthorpe. Brown trout were detected downstream of Hazelford and Gunthorpe and upstream of Broad Meadow, and Atlantic salmon were detected downstream of Cromwell only.

3.5.31 No lamprey species were detected in any samples.

3.5.32 Other notable species found in the eDNA samples include the INNS species sunbleak *Leucaspius delineatus*, which was detected downstream of Hazelford and Gunthorpe weirs, and zander which was detected downstream of Cromwell weir.

3.5.33 Three marine species were also recorded in the eDNA samples which are questionable in their reliability in terms of being present in the fish community at these sites. These include a herring species (*Clupea* sp.) found at downstream of Cromwell, Gilt-head bream *Sparus aurata* upstream of Water Orton and Black sea bream *Spondyliosoma cantharus* downstream of Broad Meadow. These results are most likely linked to angling activities.

3.5.34 Please note that the abundance of taxa cannot be directly inferred from the proportion of total sequence reads. While the proportion of sequence reads is a consequence of abundance, it is also impacted by biomass, activity, surface area, condition, distance from the physical sample, primer bias, and species-specific variation in the genome.

Table 13: Fish eDNA results (% proportion of total sequence reads) from up and downstream of three weirs on the river Trent and three weirs on the river Tame

Species	Common Name	Cromwell Weir US	Cromwell Weir DS	Hazzelford Weir US	Hazzelford Weir DS	Gunthorpe Weir US	Gunthorpe Weir DS	Broad Meadow US	Broad Meadow DS	Lea Marston US	Lea Marston DS	Water Orton US	Water Orton DS
Anguilla anguilla	European eel	0.26	1.16	1.9	16.43	0.96	0.63	0.09	0	0	0	0	0
Clupea sp.	Herring species	0	0.28	0	0	0	0	0	0	0	0	0	0
Cobitis taenia	Spined loach	0.03	0.75	0	0.16	0	0.08	1.31	0.72	0	0	0	0
Abramis brama	Common bream	0.23	1.04	10.08	4.98	1.08	0.71	0.47	0.21	0	0	0	0
Alburnus alburnus	Bleak	0.03	0.1	0.18	0.22	0.21	3.42	0.23	0.2	0	0	0	0.07
Barbus barbus	Barbel	0.11	0.54	0.12	0.3	0	0	0	0.04	0	0	0	0
Cyprinus carpio	Carp	0	0.08	0.17	0.12	0	0	0.05	0	0	0	0	0
Gobio gobio	Gudgeon	0.27	14.43	1.26	0.88	0.81	0.88	2.56	2.84	0	11.01	1.27	1.72
Leucaspius delineatus	Sunbleak	0	0	0	0.04	0	0.04	0	0	0	0	0	0
Leuciscus leuciscus	Dace	90.3	7.18	3.65	4.44	10.26	6.43	1.06	3.53	0	0.29	0	0.28
Phoxinus phoxinus	Minnow	0.13	0.1	0.11	0.08	0	0.05	19.6	18.04	0	2.55	32.33	29.73
Rutilus rutilus	Roach	2.91	27.38	24.41	23.49	45.91	63.92	18.9	22.16	0	25.19	0.04	0.67
Squalius cephalus	Chub	1.93	15.87	6.42	4.81	1.09	3.1	5.71	6.71	60.65	1.43	0.48	0.45
Tinca tinca	Tench	0	0.08	0	0	0	0	0.68	0.63	0	0	0	0
Blicca bjoerkna	Silver bream	0	0	0	0.05	0	0	0	0	0	0	0	0
Barbatula barbatula	Stone loach	0.03	0.09	0.37	0.2	0	0.11	10.62	11.4	13.12	1.84	21.71	19.2
Esox lucius	Northern pike	0.92	23.67	42.59	37.77	28.16	13.86	2.27	1.65	0	41.07	0.03	0
Gasterosteus aculeatus	Three-spined stickleback	0	0.23	0	0	0	0.89	4.27	4.49	26.22	12.75	41.15	40.99
Pungitius pungitius	Nine-spined stickleback	0	0	0	0	0	0	0.49	1.06	0	0	0	0
Dicentrarchus labrax	Bass	0	0	0	0	0	0.08	0	0	0	0	0	0

Species	Common Name	Cromwell Weir US	Cromwell Weir DS	Hazzelford Weir US	Hazzelford Weir DS	Gunthorpe Weir US	Gunthorpe Weir DS	Broad Meadow US	Broad Meadow DS	Lea Marston US	Lea Marston DS	Water Orton US	Water Orton DS
Gymnocephalus cernua	Ruffe	0.03	0.1	0.07	0.58	0	0.12	0.19	0.23	0	0	0	0
Perca fluviatilis	Perch	2.25	5.21	6.81	4.15	11.48	4.75	18.88	19.27	0	3.88	0.18	0.15
Sander lucioperca	Zander	0	0.11	0	0	0	0	0	0	0	0	0	0
Sparus aurata	Gilt-head bream	0	0	0	0	0	0	0	0	0	0	0.03	0
Spondyliosoma cantharus	Black sea bream	0	0	0	0	0	0	0	0.16	0	0	0	0
Platichthys flesus	Flounder	0.09	0.86	0	0	0	0	0	0	0	0	0	0
Salmo salar	Atlantic salmon	0	0.08	0	0	0	0	0	0	0	0	0	0
Salmo trutta	Trout	0	0	0	0.06	0	0.06	0.12	0	0	0	0	0
Cottus gobio	European bullhead	0.49	0.67	1.85	1.24	0.04	0.86	12.5	6.67	0	0	2.77	6.74
Species Richness		**16**	**22**	**15**	**19**	**10**	**18**	**19**	**18**	**3**	**9**	**10**	**10**

3.6 Water Quality

3.6.1 The results of the measurements/water quality analyses undertaken are presented in Table 14 below.

Table 14: Water Quality analysis output and WFD classification[6] (where standard was available)

Site ID	WFD Waterbody Name (ID)	Site altitude (above or under 80 m amsl)	Alkalinity (mg/L)	" Part " of river typology (based on site altitude and alkalinity	Temperature (°C)	Dissolved oxygen (%)[a]	Conductivity (µS/cm)	pH	BOD, unfiltered (mg/L)[a]	Ammoniacal Nitrogen as N (mg/L)[a]	Free Ammonia as N (mg/L)	Phosphorus (µg/L)	Nitrite as N (mg/L)	Phosphate (Ortho as P) (mg/L)	Nitrate as N (mg/L)
GO1	Ouse (Newport Pagnell to Roxton) - GB105033047923	Under 80 metres	243	Type 7	7.0	94.3	570.0	8.20	<1	<0.2	<0.2	278	0.079	0.207	8.53
GO3	Ouse (Newport Pagnell to Roxton) - GB105033047923	Under 80 metres	228	Type 7	6.8	95.6	547.0	8.30	<1	<0.2	<0.2	255	0.051	1.760	8.59
GO5	Renhold Brook - GB105033043210	Under 80 metres	225	Type 7	6.9	92.3	567.0	8.10	<1	<0.2	<0.2	288	0.063	0.172	8.29
NE1	Nene - Islip to tidal - GB105032050381	Under 80 metres	202.5	Type 7	7.0	95.0	515.0	8.20	1.89	<0.2	<0.2	166	0.079	0.094	8.76
NE2	Nene - Islip to tidal - GB105032050381	Under 80 metres	181.5	Type 5	7.8	95.4	558.0	8.10	2.24	<0.2	<0.2	191	0.074	0.104	9.73
NE3	Nene - conf Ise to Islip - GB105032050383	Under 80 metres	214.5	Type 7	8.2	92.3	536.0	7.90	<1	<0.2	<0.2	*320*	0.104	0.114	8.96
NE4	Nene - Islip to tidal - GB105032050381	Under 80 metres	166.5	Type 5	8.1	90.3	544.0	8.00	<1	<0.2	<0.2	186	0.092	0.100	9.66
NE6	Nene - Islip to tidal - GB105032050381	Under 80 metres	197[7]	Type 5	8.0	97.0	555.0	8.00	<1	<0.2	<0.2	187	0.092	0.092	9.61
TA1	Tame - R Rea to R Blythe - GB104028046841	Under 80 metres	138	Type 5	8.2	91.6	546.0	7.90	2.29	0.273	<0.2	219	0.075	<0.02	5.07
TA2	Tame - R Rea to R Blythe - GB104028046841	Under 80 metres	142.5	Type 5	8.3	87.6	533.0	8.00	2.00	0.212	<0.2	123	0.070	<0.02	4.86
TA3	Tame from R Blythe to River Anker - GB104028046440	Under 80 metres	139.5	Type 5	*9.9*	83.0	499.4	7.60	3.65	<0.2	<0.2	229	0.121	0.064	7.52
TA4	Tame from R Blythe to River Anker - GB104028046440	Under 80 metres	138	Type 5	9.2	73.4	512.0	7.80	2.96	0.349	<0.2	347	*0.310*	0.211	8.67
TA5	Tame from River Anker to River Trent - GB104028047050	Under 80 metres	121.5	Type 5	8.3	82.2	485.6	7.80	2.89	0.287	<0.2	*542*	0.114	0.223	7.92
TA6	Tame from River Anker to River Trent - GB104028047050	Under 80 metres	120	Type 5	*	*	*	8.00	2.80	0.299	<0.2	411	0.130	0.231	8.05
UT1	Trent - R Tame to R Dove - GB104028047180	Under 80 metres	136.5	Type 5	8.0	82.0	520.0	7.90	2.98	0.206	<0.2	*385*	0.095	0.191	7.09

[6] WFD water quality classification based on "The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015". Accessed at https://www.legislation.gov.uk/uksi/2015/1623/pdfs/uksiod_20151623_en_auto.pdf in April 2022

[7] Alkalinity value assumed to be equivalent to average alkalinity (~197mg/L) as measured at EA WQ sampling point: R.NENE ELTON LOCK / AN-NENE500E. Accessed at https://environment.data.gov.uk/water-quality/view/sampling-point/AN-NENE500E in April 2022

Site ID	WFD Waterbody Name (ID)	Site altitude (above or under 80 m amsl)	Alkalinity (mg/L)	" Part " of river typology (based on site altitude and alkalinity	Temperature (°C)	Dissolved oxygen (%)[a]	Conductivity (µS/cm)	pH	BOD, unfiltered (mg/L)[a]	Ammoniacal Nitrogen as N (mg/L)[a]	Free Ammonia as N (mg/L)	Phosphorus (µg/L)	Nitrite as N (mg/L)	Phosphate (Ortho as P) (mg/L)	Nitrate as N (mg/L)
LT4	Trent from Soar to The Beck - GB104028053110	Under 80 metres	156	Type 5	7.9	59.9	470.7	7.90	2.07	0.324	<0.2	247	0.065	0.094	5.80
LT6	Trent from Carlton-on-Trent to Laughton Drain - GB104028058480	Under 80 metres	207	Type 7	9.4	107.9	572.0	8.20	2.72	<0.2	<0.2	210	0.052	0.138	6.90
LT7	Trent from Dove to Derwent - GB104028047420	Under 80 metres	170	Type 5	*	*	*	8.06	2.18	<0.2	<0.2	222	0.058	0.107	7.28
LT8	Trent from Derwent to Soar - GB104028053120	Under 80 metres	130	Type 5	*	*	*	8.10	<1	<0.2	<0.2	200	0.058	0.084	6.32
LT10	Trent from Soar to The Beck - GB104028053110	Under 80 metres	150	Type 5	*	*	*	8.24	<1	<0.2	<0.2	222	0.066	0.120	7.56
LT11	Trent from Carlton-on-Trent to Laughton Drain - GB104028058480	Under 80 metres	170	Type 5	*	*	*	8.06	2.18	<0.2	<0.2	222	0.058	0.107	7.28
WE3	Welland - conf Langton Bk to conf Gwash - GB105031050580	Under 80 metres	207	Type 7	*	*	*	8.30	<1	<0.2	<0.2	155	0.026	0.083	7.97
WE5	Welland - conf Gwash to conf Greatford Cut - GB105031050600	Under 80 metres	225	Type 7	*	*	*	8.30	<2	<0.2	<0.2	231	0.06	0.092	8.78
WE6		-	222	Type 7	*	*	*	8.30	<1	<0.2	<0.2	134	0.035	0.072	8.44

[a] Indicative WFD quality class : Blue = 'High', green = 'Good', yellow = 'Moderate', orange = 'Poor', red = 'Bad', blank = no existing standard
[*] Data unavailable

3.6.2 All assessed waterbody locations for water quality were designated as Type 5 and Type 7, due to the lower altitude and high alkalinities. Temperatures were consistent within the waterbodies, with exception to TA3 and TA4 which were measured at 9.9°C and 9.2°C, in addition to LT6 measuring 9.4°C, all over a degree higher than the rest of their respective waterbodies.

3.6.3 Dissolved oxygen (82.0 – 95.6%) were recorded between the waterbodies were classified as having a High WFD. Sites downstream of Minworth STW exhibited a continual decrease to 73.4% dissolved oxygen at TA4, before increasing again at TA5. LT4 had the only Moderate classification with 59.9% dissolved oxygen, while downstream LT6 had the highest DO of all sites with 107.9%, most likely due to aeration from a nearby weir.

3.6.4 The Conductivity values (471 – 572 µS/cm) were within the range typical of freshwaters (50 to 1500 µS/cm) and consistent between the different sample sites. Across all sites pH remained between 7.60 and 8.30, suggesting alkaline conditions with little variation between sites.

3.6.5 Biological oxygen demand had a High WFD classification across all sites. Similar to the reduced dissolved oxygen on the Tame, downstream of Minworth STW, TA3 and TA4 had highest BOD values with 3.65 mg/L and 2.96 mg/L respectively, most likely due to treated sewage input. The remaining sites were below the aforementioned values or below the detection threshold.

3.6.6 Ammoniacal Nitrogen as N was generally below the detection threshold at most assessed sites, with a High WFD classification across all sites, except for TA4 and LT4, with 0.349 mg/L and 0.324 mg/L respectively resulting in a Good WFD classification.

3.6.7 Free ammonia as N was below the detection threshold for all sites.

3.6.8 Phosphorus (134 - 288 µg/L) varied across the project with little consistency throughout a waterbody. NE3 had the highest value of the waterbody with 320 µg/L, almost double that of the sites up and downstream of the sampling point. Downstream sites on the Tame had the highest Phosphorus levels of the assessed waterbodies, at TA4, TA5 and TA6 with 485.6 – 512.0 µg/L, downstream of Minworth and Coleshill STW.

3.6.9 Phosphates within the waterbodies were consistently between 0.72 and 0.231 mg/L. One site on the Great Ouse, GO3, received the highest value with 1.760 mg/L,

3.6.10 Nitrates were consistently between 6.90 – 9.66 mg/L, with only three sites deviating with lower values. TA1 before the Minworth discharge point and TA2 after the discharge point, both had lower values of 5.07 mg/L and 4.86 mg/L respectively, while the remaining Tame sites increased above 6.00mg/L with each consecutive downstream site. LT4 Also had a lower Nitrate value of 5.80 mg/L compared to the higher values of the remaining Trent sites.

4. Discussion and Recommendations

4.1 Protected and notable species

4.1.1 No protected macroinvertebrate species have been found in surveys to date.

4.1.2 The conservation value of macroinvertebrates is classified using the CCI index, and the highest scoring species identified as follows:

- The red-legged moss beetle *Hydraena rufipes* has a conservation score of 7 (Nationally notable but not Red Data Book). This species mainly inhabits river and stream margins;
- The Haliplidae beetle *Haliplus laminatus* has a conservation score of 7 (Nationally notable but not Red Data Book). This species mainly inhabits slower flowing waterbodies with sparse vegetation
- The fish leech *Piscicola siddalli* with a conservation score of 6 (Regionally notable), is an external parasite of freshwater fish;
- The caddisfly larvae *Cyrnus flavidus* and *Brachycentrus subnubilus* have a conservation score of 5 (Locally notable) and are typical of large well-vegetated rivers.
- The lesser water boatmen *Corixa dentipes* and *Sigara concinna,* and the caddisflies *Limnephilus decipiens* and *Atripsodes bilineatus* all have a conservation score of 5 (Locally notable)

4.1.3 No wetland plant or aquatic macrophyte species were recorded during macrophyte surveys that are afforded statutory protection or are regionally or nationally notable.

4.2 Invasive Non-Native Species

4.2.1 Nuttall's waterweed, Canadian waterweed, Himalayan balsam, giant hogweed, Japanese knotweed, floating pennywort and water fern were all identified during INNS, macrophyte and RHS surveys; American signal crayfish *Pacifastacus leniusculus*, and crayfish plague *Aphanomyces astaci* were identified at INNS survey sites, eDNA sampling sites and macroinvertebrate sampling sites. These species are listed in both Schedule 9 of the Wildlife and Countryside Act 1981 (as amended)[8] and the Invasive Alien Species (Enforcement and Permitting) Order 2019[9]. Taken together, the legislation referenced makes it an offence to plant, or otherwise cause to grow (including allowing to spread), listed plant species in the wild. If transported off site, there is a duty of care with regards to the disposal of any part of the plant that may facilitate establishment in the wild and cause environmental harm (as per the Environmental Protection Act 1990[10]). The legislation also makes it an offense to release, or allow to escape, listed species (or species not ordinarily resident in and is not a regular visitor to Great Britain in a wild state) into the wild.

4.2.2 INNS macrophytes included: water fern *Azolla filiculoides* found at five INNS survey sites, butterfly bush *Buddleia* sp. found at one INNS survey site, Nuttall's waterweed *Elodea nuttallii* found at seven INNS sites and three macrophyte sites, Canadian waterweed *Elodea canadensis* found at one INNS site, giant hogweed *Heracleum mantegazzianum* found at one INNS site and one RHS site, floating pennywort *Hydrocotyle ranunculoides* found at one INNS survey site and one RHS site, Himalayan balsam *Impatiens glandulifera* found at two INNS survey sites and seven macrophyte sites and Japanese knotweed *Reynoutria japonica* found at one INNS survey site.

4.2.3 The Caspian mud shrimp *Chelicorophium curvispinum*, demon shrimp *Dikerogammarus haemobaphes*, Zebra mussel *Dreissena polymorpha*, Asian clam *Corbicula fluminea*, gulf wedge clam *Rangia cuneata*, false dark mussel *Mytilopsis leucophaeata*, freshwater polychaete worm *Hypania invalida* and quagga mussel *Dreissena rostriformis bugensis* (SC1) were all recorded at various locations. However, none of these are listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

[8] Wildlife and Countryside Act 1981 (England and Wales) (as amended) c.69. Available at: https://www.legislation.gov.uk/ukpga/1981/69/introduction (accessed 17 June 2021)
[9] Invasive Alien Species (Enforcement and Permitting) Order 2019 (SI 2019/527). Available at: https://www.legislation.gov.uk/uksi/2019/527/introduction/made (accessed 17 June 2021)
[10] Environmental Protection Act 1990, c. 43. Available at: https://www.legislation.gov.uk/ukpga/1990/43/contents (accessed 17 June 2021)

4.2.4 The non-native, but non-invasive species *Crangonyx floridanus/pseudogracillis* (a freshwater shrimp), New Zealand mud snail *Potamopyrgus antipodarum*, bladder snail *Physella acuta/gyrina*, and the American flatworm *Girardia tigrina*, were widely identified, and similar to the macroinvertebrate species listed above, none of these are listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) and are therefore there are no statutory implications regarding their spread; however, best practice biosecurity guidance should be implanted to prevent their spread.

4.2.5 There was evidence of American signal crayfish presence at four sites, through the use of eDNA surveys, although no sightings or specimens were found during conventional surveys at these sites.

4.2.6 The non-native fish species sunbleak *Leucaspius delineatus*, which was detected downstream of Hazelford and Gunthorpe weirs, and zander *Sander lucioperca* which was detected downstream of Cromwell weir, were identified in eDNA fish surveys.

4.3 RHS

4.3.1 The RHS results highlighted that all rivers surveyed were all primarily in Significant or Severe Modification classes. The River Welland was classed as Severely modified across all six RHS sites, with a RHQ score indicating Poor or Extremely Poor habitat quality. The River Nene was the least modified river surveyed, with HMS classes of Obviously Modified to Significantly Modified, with four of the five sites with Poor RHQ score. The River Trent (both Upper and Lower), Tame, and Welland, were equally impacted by modification ranging from Obviously Modified to Severely Modified, with over 60% of RHS sites classing river habitat quality as Poor to Extremely Poor, with suggested management objectives of rehabilitation and restoration. Two notable RHS sites GO1 on the Great Ouse and TA6 on the Tame were deemed to be the least modified with a HMS score class of semi-natural and Predominantly modified respectively.

4.3.2 Removal of artificial features, such as culverts, and rehabilitation, re-naturalisation, or enhancement of the watercourses would increase habitat quality and consequently the ecological value of all the surveyed water bodies. In particular, remediation of the historic re-sectioning of the surveyed reaches would greatly benefit the water bodies. Further objectives may include improvements to longitudinal connectivity, including for passage of migratory fish species.

4.4 Macroinvertebrates

4.4.1 Many of the waterbodies suffered from sedimentation (low to high), modification of habitat and/or high nutrients affecting the quality of habitat and water quality for macroinvertebrates.

4.4.2 Only three sites scored Fairly High conservation value for species assemblage, which included the summer samples for TA4, TA6 and UT1 Burton. The autumn samples for the latter two sites did however decrease to Moderate. No notable or rare macroinvertebrate species were found in these surveys apart from several species with a conservation score of 5 or greater as detailed earlier (see Section 4.1).

4.4.3 No sites were free from non-native species although the Ponto-Caspian invaders the demon shrimp *Dikerogammarus haemobaphes* and the Caspian mud shrimp *Chelicorophium curvispinum* were present at 11 and six sites respectively, including LT4, LT6, TA1-6 NE4 and NE6, and UT1. The remaining non-native species are non-invasive and are not listed in statutory legislation, including the New Zealand mud snail, American flatworm, bladder snail *Physella acuta/gyrina* and the freshwater shrimp *Crangonyx psuedogracilis/floridanus*.

4.5 Macrophytes

4.5.1 Only one site on the River Tame (TA6) achieved Good WFD status for macrophytes, with a variety of taxa (six scoring species) and moderate RMNI, indicating moderate nutrient enrichment.

4.5.2 The other sites surveyed achieved Moderate, Poor, or Bad WFD status for macrophytes, considered likely due to the highly modified nature of the habitat and nutrient input to the watercourses. Some of the rivers surveyed appeared highly eutrophic, suffering from high levels of pollution and modification. Reasons for not achieving good (RNAG) as reported by the EA through the Catchment Data Explorer website[11] for those WFD waterbodies within which the macrophyte survey sites are located include urbanisation of the water course resulting in diffuse pollution and point source intermittent and

[11] https://environment.data.gov.uk/catchment-planning, accessed 21 April 2022

continuous sewage discharge resulting from waste water treatment, diffuse pollution from transport drainage, and specifically for the Trent sites diffuse pollution from poor livestock management.

4.5.3 Water clarity was affected due to turbid water conditions which may have reduced the number of submerged species identified, however all sites had relatively low diversity with eight or less scoring taxa per sample site, indicating consistency of results.

4.5.4 Additional records of the INNS Nuttall's waterweed *Elodea nuttallii*, Canadian waterweed *Elodea canadensis*, Floating Pennywort *Hydrocotyle ranunculoides*, and Himalayan Balsam *Impatiens glandulifera* resulted from the macrophyte surveys.

4.5.5 Based on river conditions reported during the macrophytes surveys and the time of year surveys were undertaken, it is recommended to repeat macrophyte surveys on all Tame survey sites during summer 2022.

4.6 Fish

4.6.1 Notable fish species from the EA River Trent annual monitoring programme data (2019) include barbel, spined loach, European eel and bullhead.

4.6.2 An Atlantic salmon was captured by a VAKI equipment jumping at Cromwell weir on 18th November 2016. There is also a record of UK BAP species brown/sea tout in 2016 in the River Greet downstream of Hazelford weir near its confluence with the Trent. Salmon were also seen jumping the weirs at Gunthorpe and Stoke Bardolph on 11th November 2021 by AECOM ecologists.

4.6.3 Protected species caught in the 2021 fish surveys on the river Trent included spined loach at Cromwell weir, bullhead, spined loach and eel at Hazelford weir and eel, bullhead and spined loach at Gunthorpe weir. Bullhead were also caught on the River Tame at Lea Marston and Water Orton in 2021 fish surveys.

4.6.4 Protected species highlighted from the eDNA samples includes European eel which were detected at all sites bar Broad Meadow downstream and both up and downstream of Lea Marston and Water Orton. Bullhead were detected at all sites bar Lea Marston. Spined loach was detected at both sites at Cromwell and Broad Meadow and downstream of Hazelford and Gunthorpe. Brown trout were detected downstream of Hazelford and Gunthorpe and upstream of Broad Meadow and Atlantic salmon were detected downstream of Cromwell only.

4.6.5 European eel is listed as a species of principal importance under Section 41 of the Natural Environment and Rural Communities (NERC) Act, as a UK Biodiversity Action Plan (BAP) species and a Local Biodiversity Action Plan (LBAP) priority species in most areas. It is also critically endangered under the IUCN Red List of Threatened Species. The Eels (England and Wales) Regulations 2009 (The Regulations) came into force on 15 January 2010 to support the UK in implementing EC Council Regulation (1100/2007) (the EC Eel Regulation). Under this European Regulation, action must be taken to halt and reverse the decline in the European eel stock, aiming to meet mature adult eel biomass escapement targets to sea of 40% relative to that expected in the absence of anthropogenic impacts. This includes safe and unobstructed passage for eel, and consideration regarding channel alterations, river crossings and culverting.

4.6.6 The Salmon and Freshwater Fisheries Act (1975, as amended under the Environment Act 1995) aims to protect all migratory and freshwater fish stocks, with a specific focus on salmon and trout, from activities that could result in direct mortality, barriers to migration and degradation of habitats. Brown trout and salmon are also listed under Section 41 of the NERC Act as species of principal importance and as LBAP priority species in most areas.

4.6.7 Bullhead and spined loach are Annex II species under the Habitats Directive, which means they are a species of Community interest (i.e., endangered, vulnerable, rare, or endemic in the European Union area) whose conservation requires the designation of special areas of conservation. They are also UK BAP priority species, although bullhead is common and widespread in the UK; spined loach are rarer and are only found in certain watercourses of Eastern England.

4.6.8 Barbel is an Annex V species under the Habitats Directive which means exploitation and taking in the wild is compatible with maintaining them in a favourable conservation status. This is due to barbel being a prized recreational fish for anglers.

4.6.9 INNS species found in the EA River Trent monitoring included zander which is a piscivorous invasive species introduced in the late 1800's. They are becoming more widely distributed throughout England but mainly are present in midlands canals and the River Severn. They are actively managed in some waterways by removing them due to their potential threat to native species. Zander were detected in the eDNA samples downstream of Cromwell weir.

4.6.10 Other INNS species found in the eDNA samples include INNS species sunbleak, which was detected downstream of Hazelford and Gunthorpe weirs. This species was introduced in southern England through the aquarium trade in the late 20th century. Its distribution is not currently thought to extend to the River Trent; therefore, this could be a rare occurrence and a new record in the catchment.

4.7 Recommendations and Next Steps

4.7.1 The results of this aquatic ecology baseline assessment have informed the overall environmental assessments for the River Tame and River Trent in relation to the related SRO schemes – Minworth and South Lincolnshire Reservoir (SLR). Therefore, further interpretation, and recommendations for next steps, are made in the following reports:

- AECOM (May 2022). *Environmental Assessment for the Trent Strategic Resource Options (SRO): Minworth SRO and South Lincolnshire Reservoir (SLR) SRO*. Results and Recommendations.
- AECOM (May 2022). Environmental Assessment for the Trent Strategic Resource Options (SRO): Minworth SRO and South Lincolnshire Reservoir (SLR) SRO. Appendix B(ii): Aquatic Ecology.

4.7.2 A summary of recommendations for further assessments is provided in Table 15 below.

Table 15: Recommendations for further aquatic ecology surveys

Recommendation	Details / Location	Justification
INNS monitoring surveys	Minworth WwTW site	To inform INNS risk assessment (as detailed in Appendix D INNS, AECOM, May 2022) and existing Biosecurity Management Plan (BMP)
INNS monitoring surveys	Minworth WwTW outfall channels and outfall locations (+ buffer upstream and downstream TBC) – terrestrial and riparian INNS	To inform INNS risk assessment (as detailed in Appendix D INNS, AECOM, May 2022) for the risk of spread or transfer of INNS as a result of the SRO schemes
INNS monitoring surveys	Trent SLR abstraction location (+ buffer upstream and downstream TBC) – aquatic, terrestrial and riparian INNS	
INNS monitoring surveys	River Witham transfer location (+ buffer upstream and downstream TBC) – aquatic, terrestrial and riparian INNS	
Aquatic ecological surveys	River shingle invertebrate surveys at targeted locations with existing exposed gravel/sediment on Rivers Tame and Trent	Impact assessment and demonstration of potential benefits in relation to habitats for notable invertebrate communities
Aquatic ecological surveys	Repeat of sub-optimal RHS and macrophyte surveys	Out-of-season RHS and macrophyte surveys completed in high flow/turbidity completed in optimal season/conditions to inform the assessment

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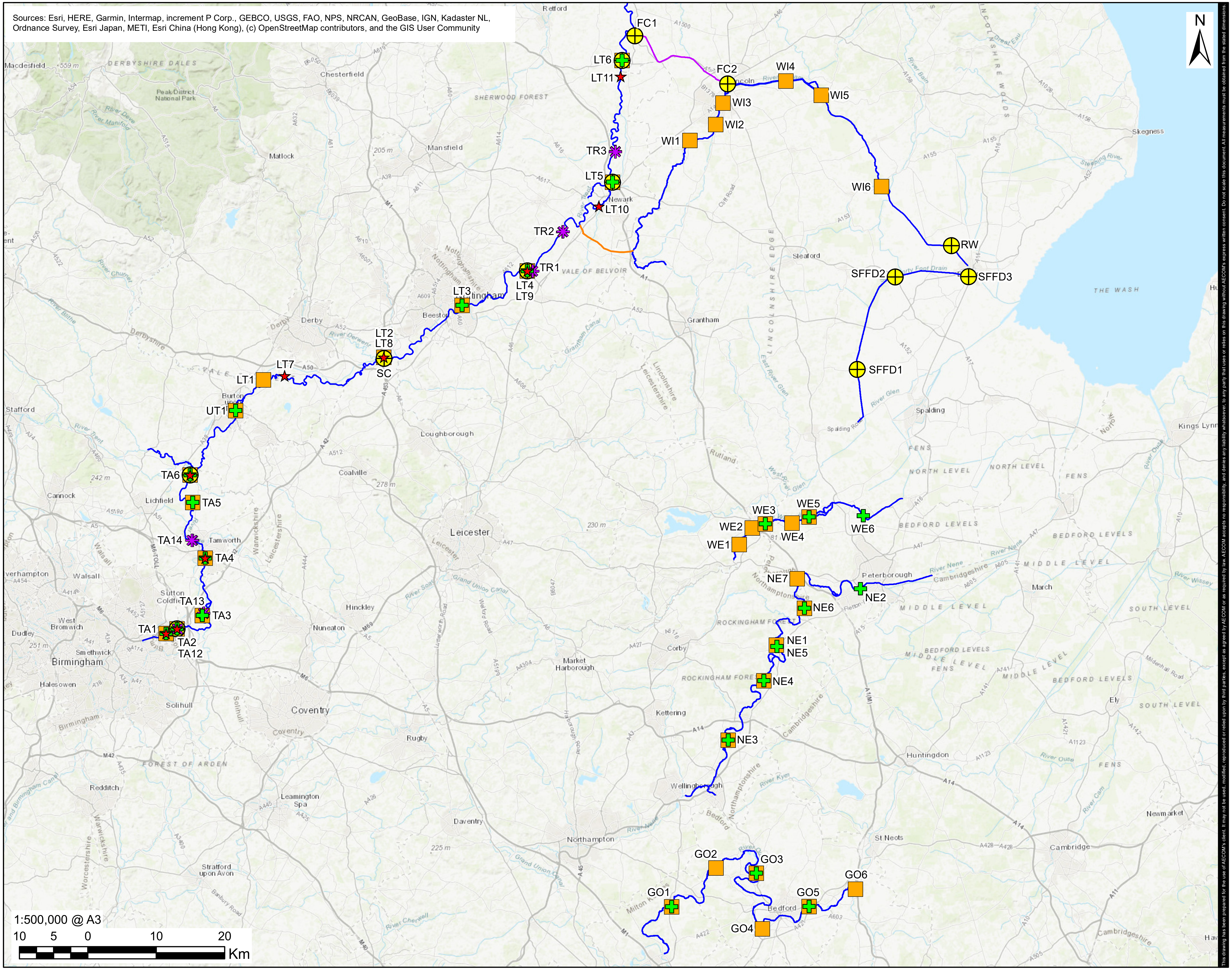
Appendix A Survey locations

Figure A1: Survey locations



AECOM

PROJECT

Aquatic Ecology Monitoring for the Strategic Resource Options (SRO) C-03798

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LEGEND

- Rivers Surveyed
- Fossdyke Canal
- Indicative Trent to Witham Pipeline
- Macrophyte Survey Location
- Macroinvertebrate Survey Location
- Fish Survey Location
- Invasive Species Survey Location
- River Habitat Survey Location

FC - Fossdyke Canal
GO - Great Ouse
LT - Lower Trent
NE - Nene
SC - Sawley Cut
SFFD - South Forty Foot Drain
TA - Tame
UT - Upper Trent
WE - Welland
WI and RW - Witham

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60662976

SHEET TITLE

Aquatic Survey Locations

SHEET NUMBER

Figure 1

Filename: I:\5004 - Information Systems\~GDS_TempUo\Affinity_Water_Env_AssessmentAquatic_Survey_Results\Figure1_Aquatic_Survey_Locations.mxd

Revision: 2

Drawn: JW Checked: CA Approved: KS Date: 07/07/2022

Table A1: Surveys undertaken per site

Waterbody	Site ID	Macroinvertebrates			Water quality	River Habitat Survey	Macrophytes	Fish	INNS
		Summer	Autumn	Spring					
Great Ouse	GO1	-	✓	✓	✓	✓	-	-	-
Great Ouse	GO2	-	-	-	-	✓	-	-	-
Great Ouse	GO3	-	✓	✓	✓	✓	-	-	-
Great Ouse	GO4	-	-	-	-	✓	-	-	-
Great Ouse	GO5	-	✓	✓	✓	✓	-	-	-
Great Ouse	GO6	-	-	-	-	✓	-	-	-
Nene	NE1	-	✓	✓	✓	-	-	-	-
Nene	NE2	-	✓	✓	✓	-	-	-	-
Nene	NE3	-	✓	✓	✓	✓	-	-	-
Nene	NE4	-	✓	✓	✓	✓	-	-	-
Nene	NE5	-	-	-	-	✓	-	-	-
Nene	NE6	-	✓	✓	✓	✓	-	-	-
Nene	NE7	-	-	-	-	✓	-	-	-
Tame	TA1	✓	✓	✓	✓	✓	✓	-	-
Tame	TA2	✓	✓	✓	✓	✓	✓	-	✓
Tame	TA3	✓	✓	✓	✓	✓	-	-	-
Tame	TA4	✓	✓	✓	✓	✓	✓	-	-
Tame	TA5	✓	✓	✓	✓	✓	-	-	-
Tame	TA6	✓	✓	✓	✓	✓	✓	-	✓
Tame	TA12	-	-	-	-	-	-	✓	-
Tame	TA13	-	-	-	-	-	-	✓	-
Tame	TA14	-	-	-	-	-	-	✓	-
Upper Trent	UT1	✓	✓	✓	✓	✓	-	-	-
Lower Trent	LT1	-	-	-	-	✓	-	-	-
Lower Trent	LT2	-	-	-	-	✓	-	-	-
Lower Trent	LT3	-	-	-	-	✓	-	-	-
Lower Trent	LT4	✓	✓	✓	✓	✓	-	-	✓
Lower Trent	LT5	-	-	-	-	✓	-	-	✓
Lower Trent	LT6	✓	✓	✓	✓	✓	-	-	✓
Lower Trent	LT7	-	-	-	✓	-	✓	-	-
Lower Trent	LT8	-	-	-	✓	-	✓	-	-
Lower Trent	LT9	-	-	-	✓	-	✓	-	-
Lower Trent	LT10	-	-	-	✓	-	✓	-	-
Lower Trent	LT11	-	-	-	✓	-	✓	-	-
Lower Trent	TR1	-	-	-	-	-	-	✓	-
Lower Trent	TR2	-	-	-	-	-	-	✓	-
Lower Trent	TR3	-	-	-	-	-	-	✓	-
Welland	WE1	-	-	-	-	✓	-	-	-
Welland	WE2	-	-	-	-	✓	-	-	-
Welland	WE3	-	✓	✓	✓	✓	-	-	-
Welland	WE4	-	-	-	-	✓	-	-	-
Welland	WE5	-	✓	✓	✓	✓	-	-	-

Waterbody	Site ID	Macroinvertebrates			Water quality	River Habitat Survey	Macrophytes	Fish	INNS
		Summer	Autumn	Spring					
Welland	WE6	-	✓	✓	✓	-	-	-	-
Witham	WI1	-	-	-	-	✓	-	-	-
Witham	WI2	-	-	-	-	✓	-	-	-
Witham	WI3	-	-	-	-	✓	-	-	-
Witham	WI4	-	-	-	-	✓	-	-	-
Witham	WI5	-	-	-	-	✓	-	-	-
Witham	WI6	-	-	-	-	✓	-	-	-
Fossdyke Canal	FC1	-	-	-	-	-	-	-	✓
Fossdyke Canal (Brayford Pool)	FC2	-	-	-	-	-	-	-	✓
River Witham	RW	-	-	-	-	-	-	-	✓
South Forty Foot Drain	SFFD1	-	-	-	-	-	-	-	✓
South Forty Foot Drain	SFFD2	-	-	-	-	-	-	-	✓
South Forty Foot Drain	SFFD3	-	-	-	-	-	-	-	✓
Sawley Cut	SC	-	-	-	-	-	-	-	✓

Appendix B RHS methodology

River Habitat Survey (RHS) is a method designed to characterise and assess the physical structure of freshwater streams and rivers, including recognition of vegetation types and basic geomorphological principles and processes. RHS is carried out along a standard 500m stretch of river channel, with observations made at ten equally-spaced 'spot-checks', with additional context provided by observations of land-use and valley form in the river corridor. Surveyor training and accreditation facilitates accurate and consistent recording of features to allow standardised conclusions to be drawn.

The RHS methodology includes a mandatory health and safety risk assessment component, stringent requirements for the recording of grid references and photographic evidence and recording of any unusual features with special notes and photographs as supporting evidence. RHS is not designed to provide the level of detail needed for specialist surveys for specific flora or fauna; however, RHS can support recommendations for and findings of surveys for aquatic macro-invertebrates, macrophytes, fish and hydro-geomorphology.

RHS surveys may be utilised to 'benchmark' top quality sites based on their catchment characteristics, investigate species-habitat relationships (with fish passage as an example), contribute to environmental impact assessment, or as in this case to inform proposed works to the river alongside hydro-geomorphological and other assessments, including the requirement for watercourses to meet the requirements of Water Framework Directive (WFD) monitoring.

RHS methodology includes the following:

- Desk study preparatory work – maps and analysis of online data, including historic maps, provides context on landscape characteristics and river planform over time to assist in identifying historic channel management; however, this does not override field observations.
- Field survey and RHS survey form completion – the presence / absence of features, and in some cases the number and extent thereof, is recorded at ten spot checks and the whole 500m site, including natural and artificial features, and channel measurements.
- General site information is collected on page 1 of the survey form.
- Spot check information is collected on page 2 of the survey form, including predominant channel, bank and river corridor features at 10 locations evenly spaced along the 500m RHS site. This includes: predominant channel substrate types (where visible), flow type, habitat features, channel and bank modifications, channel vegetation types, bank and bank top vegetation structure, and adjacent land use. Physical features are assessed using a 1m-wide transect across the channel; all other elements are assessed using a 10m-wide transect across the river.
- Sweep-up information – general information is recorded on page 3 of the survey form by means of a 'sweep-up' checklist. This allows information not occurring in the spot checks to be recorded over the whole 500m length, thus allowing a broad picture of river character to be established.
- Channel dimensions are recorded on page 4 of the survey form – these are measured at one representative location in the 500m survey stretch, normally across a riffle, if present, otherwise in a straight, uniform location with clearly defined banks. On page 4 is also recorded the presence of features of interest including nuisance plant species and alders.

Hydromorphological indices

River Habitat Survey data can be used to provide an assessment of habitat quality and the extent of channel modification, and this can then inform physical quality objectives for river works and restoration. Hydromorphological indices were calculated using the RHS Input and Analysis Software (Naura, 2021). These include the Habitat Modification Score (HMS) and Habitat Quality Assessment (HQA) as follows.

Habitat Modification Score

HMS scoring criteria are derived from an earlier scoring system developed by the Environment Agency in 1998 and were developed by Riverdene Consultancy (2016a). The scoring criteria indicate the degree of modification of the river habitat, with a higher score indicating a higher degree of modification. HMS results in a Habitat Modification Class (HMC) with each river stretch allocated a HMC Description ranging from Pristine / Semi-natural to Severely Modified. The HMS scoring criteria are summarised in the table below.

HMS scoring criteria

HMS Scoring Criteria	Recorded in RHS Survey Form	HMS Score
Culverts sub-score	Spot check Channel Modification – Culverts (CV)	+ 400, + 50 for additional criteria
	Sweep-up Artificial Features – Culvert	+ 400 for each remaining feature
Bank and Bed Reinforcement sub-score	Spot check Bank Material	Specific scores for bank materials
	Spot check Bank Modification – Reinforced (RI)	+ 20 for additional bank reinforcement
	Sweep-up Bank Profiles – Reinforced	Additional score for extensive reinforcement
	Spot check Channel Substrate	+ 200 for artificial substrate
	Spot check Channel Modification – Reinforcement (RI)	+ 200 for channel modification
Bank and Bed Re-sectioning sub-score	Spot check Bank Modification – Re-sectioned (RS)	+ 40 for re-sectioned spot check
	Sweep-up Bank Profiles – Re-sectioned	+ 40-160 if not recorded in spot check
	Spot check Channel Modification – Re-sectioned (RS)	+ 200 for spot check RS (channel mod.)
	Sweep-up Channel Modification – Over-deepened	+ 200-800 for over-deepened if RS not recorded in spot check
	Sweep-up Channel Modification – Realignment	+ 100-400 for realignment
Berms & Embankments sub-score	Spot check Bank Modification – Berms (BM)	+ 20 each spot check BM
	Spot check Bank Modification – Embankments (EM)	+ 20 each spot check EM
	Sweep-up Bank Profiles – Artificial two-stage	+ 20-80 for artificial two-stage channel
	Sweep-up Bank Profiles – Embanked	+ 20-80 for embankment in sweep-up
	Sweep-up Bank Profiles – Set-back Embankment	+ 4-16 for set-back embankment
Weirs/Dams/Sluices sub-score	Sweep-up Artificial Features – Weirs/dams/sluices	Specific scores for impoundment by weir/dam and each weir/sluice feature
Bridges sub-score	Sweep-up Artificial Features – Bridges	+ 100-250 for each sweep-up bridge
Poaching sub-score	Spot check Bank Modification – Poaching (PC or PC(B))	+ 10 for each spot check PC or PC(B)
	Sweep-up Bank Profiles – Poached	+ 10-40 for sweep-up poaching
Fords sub-score	Sweep-up Artificial Features – Fords	+ 40-200 for each sweep-up ford
Outfalls/Deflectors sub-score	Sweep-up Artificial Features – Outfalls	+ 25-100 for each sweep-up outfall
	Sweep-up Artificial Features – Deflectors	+ 50-150 for each sweep-up deflector
HMS final site score (HMC) Habitat Modification Class	**HMC Description**	**HMS Score**
1	**Pristine/semi-natural**	**0-16**
2	**Predominantly unmodified**	**17-199**
3	**Obviously modified**	**200-499**
4	**Significantly modified**	**500-1399**
5	**Severely modified**	**1400+**

Habitat Quality Assessment

Habitat Quality Assessment (HQA) provides a broad indication of river quality and habitat diversity by collating natural features assessed through the field survey. The HQA score is allocated based on features including point, side and mid-channel bars, eroding cliffs, large woody debris, waterfalls, backwaters and floodplain wetlands. Additional points are scored for variety of channel substrata, flow-types, in-channel vegetation, and also the

distribution of bank-side trees and the extent of near-natural land-use adjacent to the river, resulting in a total HQA score. HQA scores can only be used to compare sites of similar river type or character. For example, river stretches in lowland floodplains should not be compared to those in upland wooded valleys.

A more diverse site in terms of natural river habitats will result in a higher HQA score, converse to the HMS score where a higher score indicates a less natural state. Therefore, HMS and HQA in combination provide an assessment of the influences of natural variation and the extent of human intervention in the river corridor and adjacent land covered by the RHS survey. HQA scoring criteria are summarised in the table below.

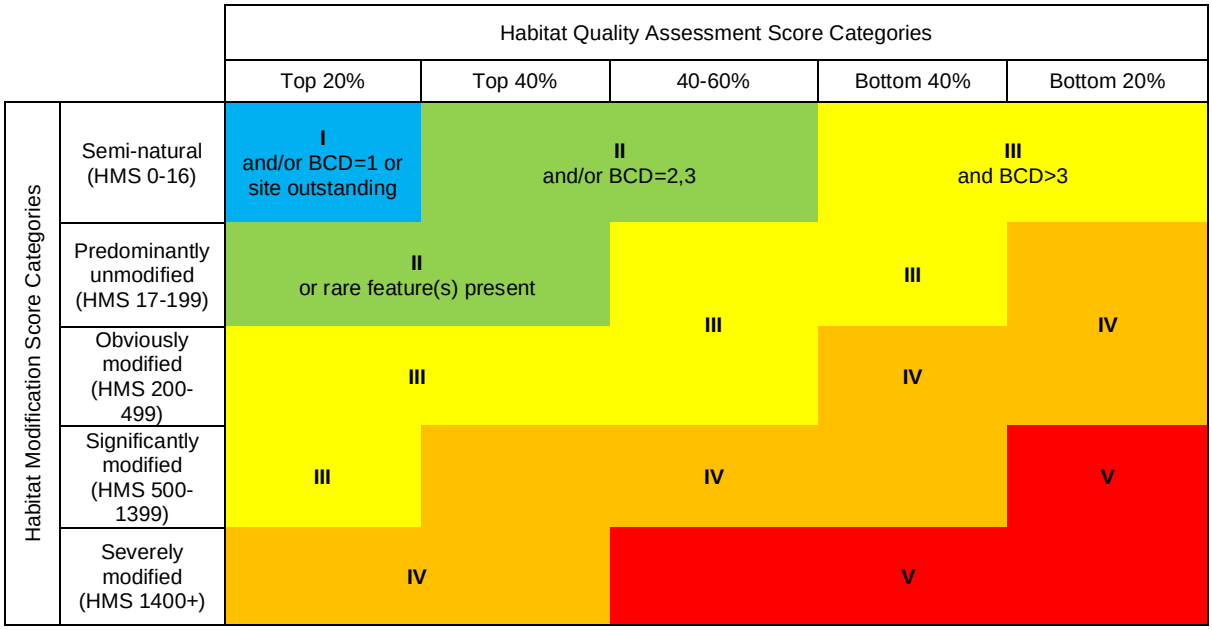
HQA scoring criteria

HQA Scoring Criteria	Description	HQA Scoring Criteria	Description
Flow Types	Score for variety of flow types; additional sweep-up types score extra	Point Bars	Total number of un-vegetated and vegetated point bars
Channel Substrates	Score for variety of natural substrate types: bedrock, boulder, cobble, gravel/pebble, sand, silt, clay, peat	In-Stream Channel Vegetation	Score for channel vegetation grouped into six categories for scoring purposes
Channel Features	Natural channel features: exposed bedrock/boulders, un-vegetated mid-channel bar, vegetated mid-channel bar, mature island	Land-Use Within 50m	Score allocated on sweep-up only: broadleaf woodland (or native pinewood), moorland/heath, and wetland score
Bank Features	Score for each natural feature: eroding earth cliff, stable earth cliff, un-vegetated point bar, vegetated point bar, un-vegetated side-bar, vegetated side-bar	Trees and Associated Features	Score allocated for bankside trees, overhanging boughs, exposed bankside roots, underwater tree roots, coarse woody debris and fallen trees
Bank Vegetation Structure	Score for bank top and bank face simple and complex vegetation structure	Special Features	Score if recorded: waterfall more than 5m high, braided or side channel, debris dams, natural open water, fen, carr, flush, bog

River Habitat Quality

River Habitat Quality (RHQ) – RHQ class was developed by Riverdene Consultancy (2016b) as part of the RHS Toolbox software. The RHQ score gives an indication of the overall diversity and naturalness of physical structure, and the degree of artificial modification (Walker *et al.*, 2002). RHQ is calculated by calibrating HMS and HQA scores against Benchmark sites and assessing potential management impact. Benchmark sites are those of outstanding quality and are derived from an Environment Agency dataset of 150 sites. For semi-natural sites, the HMS, HQA score and the Benchmark Distance score (BCD) are analysed to provide the RHQ class. The BCD score is derived from measuring the distance from the site HQA to the HQA score of the nearest Benchmark site. For modified sites, only the HMS and HQA score are used to define the RHQ category.

Method used to derive River Habitat Quality categories



River Habitat Quality scoring system

River Habitat Quality Categories	Description	Management
I	Excellent	Protect
II	Good	Maintain and Improve
III	Moderate	Enhance
IV	Poor	Rehabilitate
V	Extremely Poor	Restore

Appendix C River Habitat Surveys Hydromorphological Indices

Table C1: RHS Hydromorphological indices and site descriptions

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
Trent	LT1 Willington	630 / 4	Significantly modified	32 / 19.30%	V - Extremely poor, restore	Lowland river, in an improved/semi-improved grassland and parkland/garden setting, with a major bridge and natural in channel features (vegetated side and point bars and a mature island). The watercourse was sitting in an area with no obvious valley sides. Unconsolidated channel substate was made up of gravel pebble and additions of silt and cobble, with continuous rippled flow down its length. The bank material was entirely earth with dominant simple vegetation structure on left and right bank tops and uniform on the bank faces, with stable cliffs present. Emergent reeds/sedges/rushes present along entire channel, with sporadic patches of submerged linear and fine leaved macrophytes and floating leaved (rooted). Trees isolated and scattered across both bank tops. Bank full width of 64m (with the left bank as bank full height) and a water width of 52m were also recorded, and an average water depth of 0.5m. The INNS Himalayan balsam was present on bank top and faces, with additional visual records of Asian clam in watercourse.
Trent	LT2 Long Eaton	354 / 3	Obviously modified	46 / 87.30%	III - Moderate, enhance	Lowland river, in a tall herbs/rank vegetation setting, and a major road traffic bridge. The watercourse was sitting in an area with no obvious valley sides. Unconsolidated channel substate was made up of gravel pebble and additions of silt, sand and cobble, with continuous smoot flow down its length. The bank material was comprised of many materials including sheet piling, concrete, earth and brick/laid stone, with dominant simple vegetation structure on left and right bank tops and faces, with extensive stable cliffs present. Emergent reeds/sedges/rushes present along entire channel and sporadic isolated patches of other macrophyte species submerged. Vegetated mid-channel bar, unvegetated side bar and mature island are also present within the water course. Bank full width of 104m (with the right bank as bank full height at 1.5m) and a water width of 92m were also recorded, and an average water depth of 0.5m. The INNS Himalayan balsam present on bank top and faces.
Trent	LT3 Trentside	1124 / 4	Significantly modified	30 / 36.70%	IV - Poor, rehabilitate	Lowland river, in a suburban/urban development setting, with a major bridge and extensive reinforcement of whole and toe of banks. The watercourse was sitting in an area with no obvious valley sides. Unconsolidated channel substate was comprised of gravel pebble and additions of silt, sand and concrete, with continuous smoot flow down its length. No channel features present due to resectioning and reinforcement. Bank material was comprised of varying substrates of earth, concrete, sheet piling and laid brick/stone with bare banks and patches of simple vegetation on the latter half of the reach. Some emergent reeds/sedges/rushes present with submerged linear and fine leaved macrophytes, floating leaved (rooted) and filamentous green algae. Occasional clumps of trees were also recorded. A side channel was recorded draining into river from suburban/urban development on right bank. The INNS Himalayan balsam and orange balsam were present on bank tops and faces and a further record of Buddleia present on bank tops. Major impacts to the water course were logged as an occurrence from boating, reinforcement for flood defences and high levels of littering also present.

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
Trent	LT4 Gunthorpe	930 / 4	Significantly modified	30 / 39.30%	IV - Poor, rehabilitate	This section of the Trent was tidal, in an improved/semi-improved grassland and parkland/garden setting, with one major outfall/intake and extensive resections of the channel. Channel substate was comprised of silt and additions of gravel pebble, sand and boulders, with continuous smoot flow down its length. The bank material was predominantly earth with dominant simple vegetation structure on left and right bank tops and faces, with occasional bare and complex vegetation patches. Emergent reeds/sedges/rushes present along most of the channel and with occasional patches of emergent broadleaf herbs, submerged linear and fine leaved plants and filamentous algae. No channel features were identified along the course of the survey. The bank full width of 80m (with the right bank as bank full height at 1m) and a water width of 71m was recorded. The INNS Himalayan Balsam was recorded extensively along bank top and faces of the water channel.
Trent	LT5 Lower Trent	1200 / 4	Significantly modified	24 / 26.00%	IV - Poor, rehabilitate	Lowland river, in an improved/semi-improved grassland setting and a major bridge with extensive resections of the channel and an extensive reinforced toe along the right bank. Sitting in valley with no obvious sides. Unconsolidated channel substate comprised of boulders in addition to silt, sand and gravel pebble, with continuous smooth flow down its length. The bank material was predominantly earth with mixed dominant simple and uniform vegetation structure on left and right bank tops and faces. No channel features were recorded along the survey reach. The bank full width of 105m (right bank as bank full height at 2.2m) and a water width of 85m were recorded with an average water depth of 3m. No INNS were identified during survey of this reach of the Trent. Major impacts to river channel at the survey location were recorded as bank poaching from livestock, navigation and the nearby road.
Trent	LT6 Dunham	1416 / 5	Severely modified	26 / 53.30%	V - Extremely poor, restore	This was also considered to be a tidal section of the river Trent, in an improved/semi-improved grassland and tilled land setting, with a major bridge with extensive resections of the channel and reinforcement of the toe. Unconsolidated channel substate was comprised of silt and cobbles, where substrate was visible through turbid waters. A continuous smoot flow down its length was also of note. The bank material was entirely earth, with mixed dominant simple and uniform vegetation structure covering the left and right bank tops and faces. Emergent reeds/sedges/rushes were present along the entire channel with occasional patches of emergent broadleaf herbs. Identification of submerged macrophytes was not possible from poor visibility due to turbid waters. No channel features were identified along the survey length. Bank full width of 105m (left bank as bank full height at 2.5m) and respective water width and depth of 85m and 3m were recorded. No INNS were identified during survey. Major impacts to river channel at the survey location were recorded as embankments, navigation, over deepening and extensive over widening.
Trent	UT1 Burton	4140 / 5	Severely modified	46 / 80.70%	IV - Poor, rehabilitate	Considered as a lowland river, this reach was present in a tall herbs/rank vegetation and parkland/garden setting, with a major weir and road traffic bridge and some reinforcement of the left bank near suburban/urban development. The water course was sitting in valley with no obvious sides. Unconsolidated channel substate comprised of gravel cobble and pebble with additional substrates of boulders, sand and silt. Recorded rippled flow down most of its length, with some smooth 2 check points of smooth flow. Bank material was predominantly brick/laid stone with a majority bare face and top on left bank, contrasting with simple and uniform vegetation on the right banks. Submerged linear leaved macrophytes were present along most of watercourse length with occasional patches of emerged broad leaf herbs, emergent reeds/sedges /rushes and floating leaved (rooted). Extensive bankside roots with present underwater tree roots, fallen trees and woody debris were also recorded in channel. Additionally, occasional clumps of trees on the left

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
						bank and semi-continuous on the right bank were also recorded. No channel features were documented. The bank full width of 40m (with the left bank as bank full height at 0.7m), a water width of 36m and water depth of 0.6m were recorded. A side channel was also documented. The INNS Himalayan balsam was identified during survey on bank tops and faces. Major impacts to river channel at the survey location were logged as extensive over widening, realignment, road and weir.
Nene	NE3 Ringstead	280 / 3	Obviously modified	31 / 31.30%	IV - Poor, rehabilitate	The lowland river, in a broadleaf/mixed woodland (semi-natural) and tall herbs/rank vegetation setting, had some extensive resections of the channel. The watercourse was present in a valley with shallow vee sides. Channel substate was not visible down the entire survey reach but had a smooth flow along the survey length. The bank material was comprised of earth, with simple vegetation covering the bank faces and tops. Emergent broad leaf herbs and emergent reeds/sedges /rushes present along entire watercourse length with submerged macrophytes not visible. Present bankside roots, underwater tree roots, and woody debris were also recorded in channel. Additionally, occasional clumps of trees on the right bank and isolated scattered trees on the left bank were also recorded. No notable channel features were documented. The bank full width was recorded at 25m (with the left bank as bank full height at 1m), a water width of 22m and water depth of 1.5m. A side channel was also documented draining into the watercourse. The INNS Himalayan balsam was identified extensively during survey, along both bank tops and faces. The major impact to river channel at the survey location was logged as over deepening of the water course.
Nene	NE4 Lilford Road	1060 / 4	Significantly modified	27 / 24.00%	IV - Poor, rehabilitate	Another lowland river section of the Nene, in an improved/semi-improved grassland and parkland/garden setting, with extensive resections of the channel and a mature island. Watercourse is sitting in valley with shallow vee sides. The channel substate was not visible down the entire survey reach but had a smooth flow down its entire length. The bank material was comprised of earth with simple and uniform vegetation on bank faces and tops. Emergent broad leaf herbs and emergent reeds/sedges /rushes present along most of the watercourse length with submerged macrophytes not visible. Present bankside roots, underwater tree roots, and woody debris also recorded in channel. Additionally, semi continuous trees on the right bank and no trees on the left bank were also recorded, creating partial shading of the water course. The bank full width was recorded at 28m (with the left bank as bank full height at 1.2m), a water width of 25m and water depth of 2m were recorded. The INNS Himalayan balsam was identified during survey, as present on the bank faces. The major impact to river channel at the survey location was logged as the adjacent agriculture to the watercourse.
Nene	NE5 Oundle	840 / 4	Significantly modified	16 / 5.30%	V - Extremely poor, restore	This section of lowland river was similarly in an improved/semi-improved grassland setting, with extensive resections of the channel and some extensive poaching on banks. The watercourse is present in area with no obvious valley sides. The channel substate was not visible down the entire survey reach but had a smooth flow down its entire length. Bank material was entirely earth with uniform vegetation bank faces and tops. Emergent broad leaf herbs and emergent reeds/sedges /rushes present along entire watercourse length and one area of present free floating macrophytes, with submerged macrophytes not visible. Isolated scattered trees on the right bank and no trees on the left bank were additionally, recorded. No channel features were documented along the survey reach. A bank full width of 34m (left bank as bank full height at 0.5m), a water width of 32m and water depth of 2m were recorded. Side channel/s was also documented. No INNS was identified during survey, on bank tops or faces. Major impacts to river channel at the survey location were logged as over deepening and boating.

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
Nene	NE6 Elton	955 / 4	Significantly modified	27 / 26.70%	IV - Poor, rehabilitate	Lowland river present in a broadleaf/mixed plantation and improved/semi-improved grassland setting, with extensive resections of the channel, some reinforcement of the (whole) bank and a major road bridge. The watercourse was recorded as sitting in valley with shallow vee sides. The channel substate was not visible along most of the survey reach but clay and cobbles were identified. The Nene at Elton also had a smooth flow down its entire length. Bank material was predominantly earth with one reinforced section of concrete with simple vegetation bank faces and tops. Emergent t reeds/sedges /rushes present along entire watercourse length with singular areas of free floating and floating-leaved (rooted) macrophytes present. Submerged macrophytes were not visible due to turbid conditions. Additionally, occasional clumps of trees on the right bank and no trees on the left bank, with woody debris also recorded in channel. No channel features were documented. Bank full width of 25m (left bank as bank full height at 2m), a water width of 15m and water depth of 2.5m were recorded. INNS Himalayan balsam was identified during survey, on bank faces. Major impacts to river channel at the survey location were logged as boating, navigation and siltation of the channel.
Nene	NE7 Wansford	1084 / 4	Significantly modified	30 / 46.00%	IV - Poor, rehabilitate	The final RHS site on the Nene was classed as being tidal, present in an improved/semi-improved grassland and parkland/garden setting, with extensive resections of the channel and a mature island. The watercourse was present in an area with no obvious valley sides. Channel substate was primarily comprised of sand, with additional substrates of cobbles, clay, gravel pebble and artificial bed. The Nene at Wansford had a smooth flow down its entire length. Bank material was earth with simple vegetation bank faces and uniform vegetation on the bank tops. Emergent broad leaf herbs and emergent reeds/sedges /rushes were present along the water course with the latter being classed as extensive in some areas. Submerged broadleaved plants were extensive, with submerged linear and fine leaved classed as present, along the entire reach length. Occasional clumps of trees on the right bank and isolated scattered trees on the left bank, with additional woody debris in channel were also recorded. No channel features were documented. Bank full width of 25m (left bank as bank full height at 1.8m), a water width of 20m and water depth of 3m were recorded. A side channel was also documented. INNS Himalayan balsam was identified during survey, on the bank faces. Major impacts to river channel at the survey location were logged as navigation of the channel.
Tame	TA1 Tame	3142 / 5	Severely modified	31 / 15.30%	V - Extremely poor, restore	Lowland river, in a tall herbs/rank vegetation setting, with extensive resections of the channel. The watercourse is present in an area with no obvious valley sides. The channel substate was not visible down the entire survey reach of TA1 but had a rippled flow down its entire length. Bank material was predominantly earth (producing stable cliffs), with simple vegetation on the bank faces and tops. Emergent broad leaf herbs and emergent reeds/sedges /rushes are present along some of watercourse with submerged macrophytes not visible. Present bankside roots, underwater tree roots, and woody debris also recorded in channel. Additional records of no trees on the right bank and occasional clumps of trees on the left bank were also made, resulting in partial shading of the channel. One channel feature of an unvegetated side bar was documented. A bank full width of 18m (right bank as bank full height at 1.5m), a water width of 15m and water depth of 1.5m were recorded. Side channel/s was also documented. INNS Himalayan balsam was identified extensively during survey, on bank tops and faces. Major impacts to river channel at the survey location were logged as realignment of the channel and nearby railways.
Tame	TA2 Tame	1022 / 4	Significantly modified	25 / 4.70%	V - Extremely poor, restore	Lowland river, in a tall herbs/rank vegetation setting, with extensive resections of the channel, reinforcement of the (whole) bank and setback embankment. A major road

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
						bridge was also recorded. Watercourse was present in an area with no obvious valley sides. The channel substate was not visible down the entire survey reach but had a rippled flow along its entire length. Bank material was earth with simple vegetation bank faces and tops. Emergent broad leaf herbs and emergent reeds/sedges /rushes present along some of the reach with no submerged macrophytes visible due to turbid water. Additionally, isolated scattered trees on the right bank partially shaded the channel. Channel features documented included the presence of unbroken standing waves and side channel/s. Bank full width of 11m (left bank as bank full height at 0.25m), a water width of 10m and water depth of 1.5m were recorded. INNS Himalayan balsam was identified extensively during survey, on bank tops and faces. Major impact to river channel was identified as the flood defences in the survey reach.
Tame	TA3 Tame	3990 / 5	Severely modified	53 / 90.70%	IV - Poor, rehabilitate	Lowland river, in a broadleaf/mixed woodland (semi-natural), tall herbs/rank vegetation and scrub setting, with extensive resections of the channel, some reinforcement of the (whole) bank. Two major bridges were also recorded, one for rail and another for road traffic. The watercourse was present in an area with no obvious valley sides. The channel substate was comprised of clay, pebble gravel, silt, sand and some artificial substrate with a smooth flow down its entire length. Bank material was earth, producing extensive stable and eroding cliffs, with majority simple vegetation bank faces and tops. Emergent broad leaf herbs are present along parts of the watercourse, with submerged broad, linear and fine leaved macrophytes present in parts. Filamentous algae was also recorded ay over half of the reach check points. Present bankside roots, underwater tree roots, fallen trees and woody debris also recorded in channel. Additionally, occasional clumps of trees on the left bank and regularly spaced, single trees on the right bank were also recorded. Upwellings and water meadows were notable channel features documented. A bank full width of 25m (left bank as bank full height at 1m), a water width of 22m and water depth of 1.5m were recorded. The INNS Himalayan balsam was identified extensively during survey, on bank tops and faces. Major impacts to river channel at the survey location were logged as rail, realignment of the channel and road.
Tame	TA4 Tame	3700 / 5	Severely modified	47 / 93.30%	IV - Poor, rehabilitate	Lowland river, in a broadleaf/mixed woodland (semi-natural), suburban/urban development and scrub setting, with extensive resections of the channel and two major bridges, a road traffic bridge and a canal/aqueduct bridge. The watercourse was present in an area with no obvious valley sides. Unconsolidated channel substate was primarily slit and gravel with some sand, and a smooth flow down its entire length was noted. Bank material earth, resulting in both stable and eroding cliffs with simple vegetation bank faces and tops. Emergent broad leaf herbs and emergent reeds/sedges /rushes present along parts of the watercourse with submerged linear and fine leaved macrophytes also present occasionally. Filamentous algae was recorded at 2 spot checks on the survey. Present bankside roots, underwater tree roots, and woody debris also recorded in channel. Additionally, occasional clumps of trees on the right bank and semi continuous trees on the left bank were also recorded. Unbroken standing waves and some areas of rippled flow were notable documented channel features. A bank full width of 25m (left bank as bank full height at 1.5m), a water width of 22m and water depth of 1.5m were recorded. INNS Himalayan balsam and orange balsam was identified as present during the survey, on bank tops and faces. Major impacts to river channel at the survey location were logged as realignment, silting and other impacts from nearby housing and industry.
Tame	TA5 Tame	375 / 3	Obviously modified	46 / 76.70%	III - Moderate, enhance	Lowland river, in a broadleaf/mixed woodland (semi-natural), improved/semi-improved grassland), suburban/urban development and tilled land setting, with extensive steep and vertical/undercut banks. One major road traffic bridge was also recorded. The watercourse was present in an area with no obvious valley sides. Channel substate was comprised of boulders, sand, silt and gravel pebble, with a smooth flow down its entire

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
						length. Bank material was earth with simple vegetation bank faces and uniform vegetation on the bank tops. Emergent reeds/sedges /rushes and bryophytes/lichens were present along entire watercourse length with some Emergent broad leaf herbs present in several spot checks. Submerged macrophytes were not visible due to turbid conditions on the Tame. Additional records of occasional clumps of trees on the left bank and isolated scattered trees on the right bank were made. No channel features were documented. A bank full width of 105m (with the left and right banks as bank full height at 2.2 m each), a water width of 85m and water depth of 3m were recorded. No INNS were identified during survey. Major impacts to river channel at the survey location were logged as bank poaching from livestock, as well as navigation and adjacent road activities.
Tame	TA6 Tame	65 / 2	Predominantly unmodified	37 / 52.00%	III - Moderate, enhance	The final RHS section of the Tame was categorised as being a tidal river, in an improved/semi-improved grassland and tilled setting, with extensive resections of the channel, extensive reinforced toe, embankment and set back embankments. A major and minor bridge was also recorded along with various side channels. The watercourse was present in an area with no obvious valley sides. Channel substate was comprised of silt and cobbles, with a smooth flow down its entire length. Bank material was earth with simple vegetation dominating the bank faces and tops. Emergent reeds/sedges /rushes were present along entire watercourse length with some Emergent broad leaf herbs present in majority of spot checks. Submerged macrophytes were not visible due to turbid conditions on the Tame. Additional records of isolated scattered trees on both banks were made, although no shading impacted the channel. No channel features were documented. A bank full width of 105m (with the left bank as bank full height at 2.5 m), a water width of 85m and water depth of 3m were recorded. No INNS were identified during survey. Major impacts to river channel at the survey location were logged as embankments, navigation activity, over deepening and extensive over widening of the channel.
Welland	WE1 Collyweston Bridge	380 / 3	Obviously modified	47 / 86.70%	III - Moderate, enhance	Lowland river, in a tilled land setting, with extensive steep banks and a vegetated mid-channel bar. One minor weir/sluice and one major road traffic bridge were also recorded and photographed. Watercourse was present in a shallow vee valley. The channel substate was comprised of clay and pebbles, with additional substrates silt, sand and gravel pebble, with a smooth flow down its length. Bank material was comprised of earth, creating stable cliffs, with dominant simple vegetation on the bank faces and tops. Emergent reeds/sedges /rushes and free floating macrophytes were classed as present and extensive at differing spot checks along the entire watercourse. Emergent broad leaf herbs, floating leaved (rooted), submerged broad, linear and fine leaved plants were also all present in approximately half of the spot checks. Present bankside roots, underwater tree roots, and woody debris also recorded in channel. Additional records of isolated scattered trees on both banks were made. Notable channel features documented included unbroken standing waves and rippled flow on some parts of the watercourse in addition to a vegetated mid-channel bar. A ank full width of 36m (with the right bank as bank full height at 2 m), a water width of 25m and water depth of 0.2m were recorded. No INNS were identified during survey. Major impacts to river channel at the survey location were logged as road activities nearby to channel
Welland	WE2 Tinwell Mill	520 / 4	Significantly modified	44 / 76.70%	IV - Poor, rehabilitate	Lowland river, in an improved/semi-improved grassland) and tilled setting, with an intermediate bridge. Watercourse was present in a shallow vee valley. The channel substate was comprised of clay and gravel pebbles, with additional substrates silt, cobbles and earth, with a smooth flow down its length. Bank material was comprised of earth, creating stable cliffs, with dominant simple vegetation on the bank faces and tops and uniform vegetation on right bank top. Emergent reeds/sedges /rushes and

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
						submerged broad and linear leaved plants were classed as present or extensive at different points along the watercourse. and broad leaf herbs, submerged fine leaf, floating leaved (rooted) and free floating macrophytes were classed as present at differing spot checks along the entire watercourse. Filamentous algae was present at over half of the spot check locations, with large woody debris also present. Additional records of semi continuous trees on the left bank and occasional clumps on the right bank, with resultant shading of the channel, were made. The notable channel feature documented was an unvegetated side. A bank full width of 13m (with the left bank as bank full height at 1.8 m), a water width of 10m and water depth of 1.6m were recorded. The INNS Himalayan balsam was identified as present on bank tops and extensive on bank faces during the survey. No major impacts to river channel at the survey location were logged.
Welland	WE3 Stamford	830 / 4	Significantly modified	44 / 82.70%	III - Moderate, enhance	Lowland river, in an improved/semi-improved grassland, suburban/urban and parkland/garden setting, with extensive resections of the channel and an intermediate (foot) bridge. The watercourse was present in an area with no obvious valley sides. Channel substate was comprised of predominantly gravel with additional substrates of silt, boulder, pebble, cobble and sand, and a smooth flow down its length. Bank material was comprised of entirely earth, creating stable cliffs, with dominant simple and uniform vegetation on the bank faces and tops and several bare areas. Emergent reeds/sedges /rushes and submerged linear leaved plants were classed as present or extensive at different points along the watercourse. Broad leaf herbs and submerged fine leaf were classed as present at differing spot checks along the entire watercourse. Filamentous algae was present at 40% of the spot check locations. Extensive exposed bankside roots and large woody debris were recorded alongside also present. Additional records of semi continuous trees on the right bank and continuously, single spaced trees on the left bank, with resultant extensive shading of the channel, were made. The notable channel feature documented were discrete unvegetated silt deposit(s), discrete unvegetated sand deposit(s) and side channel(s). A bank full width of 25m (with the left bank as bank full height at 1m), a water width of 15m and water depth of 1.4m were recorded. The INNS Himalayan balsam was identified as present on bank tops and faces during the survey. The major impacts to river channel at the survey location were logged as housing development and the flood defences in place.
Welland	WE4 Uffington Road Bridge	1116 / 4	Significantly modified	36 / 60.00%	IV - Poor, rehabilitate	Lowland river, in an improved/semi-improved grassland setting, with extensive resections of the channel and set back embankments and a major road traffic bridge. Watercourse was present in an area with no obvious valley sides. The channel substate was comprised of predominantly gravel pebble with additional substrates of silt, cobbles and sand, and a smooth flow down its length. Bank material was formed of earth, creating stable cliffs, with dominant simple vegetation on the bank faces and tops and several areas of uniform and complex vegetation. Emergent reeds/sedges /rushes and submerged linear and fine leaved plants were classed as present or extensive at different points along the watercourse. Broad leaf herbs, free floating and submerged broad leaf macrophytes were classed as present at differing spot checks along the entire watercourse. Filamentous algae was present or extensive at 80% of the spot check locations. Additional records of occasional clumps of trees on both banks with resultant shading of the channel, were made. No notable channel features were documented. A bank full width of 41m (with the right bank as bank full height at 1.5m), a water width of 26m and water depth of 0.5m were recorded. The INNS Himalayan balsam was identified as present on bank faces during the survey. The major impacts to river channel at the survey location were logged as extensive over widening and realignment of the river channel.

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
Welland	WE5 Tallington	3850 / 5	Severely modified	16 / 5.30%	V - Extremely poor, restore	Lowland river, in a suburban/urban development and rough pasture setting, with extensive resections and embankments of the channel and a major road traffic bridge. Watercourse was present in an area with no obvious valley sides. The channel substate was comprised of predominantly gravel pebble with additional substrates of silt, cobble and sand, and a smooth flow down its length. Bank material was comprised of earth, with uniform vegetation across all bank faces and tops. Emergent reeds/sedges /rushes, free floating and submerged linear leaved plants were classed as present or extensive at different points along the watercourse. Filamentous algae was extensive at all the spot check locations. An additional record of isolated scattered trees on the left bank was made. No notable channel features were documented. A bank full width of 34m (with the left bank as bank full height at 3.2m), a water width of 20m and water depth of 0.7m were recorded. The INNS Himalayan balsam was identified as extensive on bank faces during the survey. The major impacts to river channel at the survey location were logged as extensive over widening and realignment of the channel, with flood defences in place.
Witham	WI1 Aubourn	3512 / 5	Severely modified	38 / 74.70%	IV - Poor, rehabilitate	Tidal river, in an improved/semi-improved grassland setting with extensive resections and set back embankments of the channel with one intermediate bridge recorded. Watercourse was present in an area with no obvious valley sides. The channel substate was comprised of predominantly sand with additional substrates of silt, gravel pebble and cobbles, and a smooth flow down its length. Bank material was formed of earth, with dominant simple vegetation across almost all the bank faces and tops and one spot check of a uniform vegetation bank top. Emergent reeds/sedges /rushes and submerged broad, fine and linear leaved plants were classed as present or extensive at different points along the watercourse. Broad leaf herbs and free floating macrophytes were classed as present at differing spot checks along the watercourse. Filamentous algae was present along all of the spot check locations, with extensive coverage at 60% of sites. Additional records of isolated and scattered trees along both banks, with resultant extensive shading of the channel, and in channel large woody debris, were made. No notable channel features were documented. A bank full width of 8m (with the left bank as bank full height at 0.9m), a water width of 8m and water depth of 1m were recorded. No INNS were identified as present on bank tops and faces during the survey. The major impacts to river channel at the survey location were logged as embankments, with modifications to the channel which included over deepening, extensive over widening and realignment.
Witham	WI2 North Hykeham	1582 / 5	Severely modified	23 / 25.30%	V - Extremely poor, restore	Tidal river, in an improved/semi-improved grassland setting with extensive resections and set back embankments of the channel. One intermediate bridge was also recorded. Watercourse was present in an area with no obvious valley sides. Channel substate was comprised of predominantly silt, with no other substrates visible, and a smooth flow down its length. Bank material was earth, with simple vegetation on the bank faces and uniform vegetation on bank tops. Emergent reeds/sedges /rushes were classed as present along the watercourse. Free floating macrophytes were classed as present at differing spot checks along the entire watercourse. Filamentous algae was present at one of the spot check locations and not visible at the others. Turbid water conditions also prevented the visual identification of other submerged plant species. Additional records of isolated and scattered trees on the right bank, with resultant extensive shading of the channel, were made. No notable channel features were documented. Bank full width of 13m (with the right bank as bank full height at 1m), a water width of 9m and water depth of 1.5m were recorded. No INNS were identified as present on bank tops and faces during the survey. The major impacts to river channel at the survey location were logged as embankments and nutrient runoff into the river channel.

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
Witham	WI3 Lincoln	3252 / 5	Severely modified	24 / 47.30%	V - Extremely poor, restore	Lowland river, in a broadleaf/mixed woodland (semi-natural) and improved/semi-improved grassland setting, with extensive resections and set back embankments of the channel. Watercourse was present in an area with no obvious valley sides. Channel substate was not visible due to turbid and deep-water conditions, although a smooth flow down its length was recorded. Bank material was earth, with dominant simple vegetation on the bank faces and uniform vegetation on the bank tops. Emergent reeds/sedges /rushes submerged fine leaf plants and free floating macrophytes were classed as present along the entire watercourse, with extensive cover from submerged broad-leaved plants. Filamentous algae was classed as present or extensive at all of the spot check locations. Additional records of isolated and scattered trees on the right bank, with resultant extensive shading of the channel, were made. No notable channel feature were documented. Bank full width of 55m (with the left bank as bank full height at 1m), a water width of 15m and water depth of 2m were recorded. No INNS was identified as present on bank tops and faces during the survey, however Nuttall's waterweed *Elodea Nuttalli* was considered as extensive in channel. The major impacts to river channel at the survey location were logged as embankments and over deepening, extensive over widening and realignment of the channel.
Witham	WI4 Five Mile House	3352 / 5	Severely modified	29 / 66.70%	IV - Poor, rehabilitate	Tidal river, in an improved/semi-improved grassland and tilled land setting, with extensive resections and set back embankments of the channel and an intermediate bridge. Watercourse was present in an area with no obvious valley sides. The channel substate was predominantly comprised of silt, over sand, clay and cobbles; with water flow being smooth along the entire water channel. Bank material was earth, with dominant simple vegetation on the bank faces and tops, with one spot check location where vegetation cover was considered to be bare on both banks. Emergent reeds/sedges /rushes and free floating macrophytes were classed as present or extensive along the entire watercourse, with varying degrees of present cover from submerged linear and fine leaved macrophytes. Filamentous algae was classed as extensive at all of the spot check locations where it was visible. No records of tree cove or notable channel feature were documented. A bank full width of 28m (with the left bank as bank full height at 1m), a water width of 23m and water depth of 1m were recorded. The INNS Himalayan balsam was identified as present on bank tops and faces during the survey, with an additional record of Waterfern *Azolla filiculoides* was considered as extensive on the water surface. The major impacts to river channel at the survey location were logged as over deepening, extensive over widening and realignment of the channel.
Witham	WI5 Bardney	3252 / 5	Severely modified	29 / 56.00%	V - Extremely poor, restore	Tidal river, in an improved/semi-improved grassland and tilled land setting, with extensive resections and set back embankments of the channel. Watercourse was present in an area with no obvious valley sides. Channel substate was predominantly silt over additional substrates of sand, gravel pebble and cobbles, with a smooth flow down its length was recorded. The bank material was entirely comprised of earth, with dominant simple vegetation present all the bank faces and tops. Emergent reeds/sedges /rushes, free floating and floating leaved (rooted) macrophytes were classed as present along the entire watercourse, and no visible submerged plants along 90% of the watercourse spot checks. Filamentous algae was classed as extensive at one spot check location. Additional records of isolated and scattered trees on both banks and the resultant shading of the channel, were documented. No notable channel feature were identified during the survey. Bank full width of 25m (with the left bank as bank full height at 1.2m), a water width of 25m and water depth of 2m were recorded. No INNS was identified as present on bank tops and faces during the survey, however Waterfern *Azolla filicuidoes* was considered as extensive on the water surface along the course. The major impacts

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
						to river channel at the survey location were logged as embankments and over deepening, extensive over widening and realignment of the channel.
Witham	WI6 Tattershall	3778 / 5	Severely modified	26 / 45.30%	V - Extremely poor, restore	Tidal river, in a rough pasture and tilled land setting, with extensive resections and embankments of the channel and additional reinforcement to the toe of the left bank. A major road traffic bridge was also recorded. Watercourse was present in an area with no obvious valley sides. The channel substate was no visible due to turbid and deep waters, although substrates of cobbles, sand and gravel pebble, were identified from the margins. A smooth water flow occurred along the entire water channel. Bank material was comprised of earth, with dominant simple vegetation on the bank faces and tops, with less than 20% being classed as uniform vegetation. Emergent reeds/sedges/rushes submerged fine and broad leaf plants and free floating macrophytes were classed as present or extensive. Filamentous algae was classed as extensive across all spot check locations. Isolated and scattered trees on the right bank, and their resultant shading of the channel, were present and no additional records notable channel features were documented. A bank full width was 60m (with the left bank as bank full height at 3.4m), a water width of 35m and water depth of 3m were recorded. No INNS was identified as present on bank tops and faces during the survey, however Nuttall's waterweed *Elodea Nuttalli* and Water fern *Azolla filiculoides* were considered as extensive in channel, and the Zebra mussel *Dreissena polymorpha* were identified in the water course. On the abdandoned bridge, Buddleia *Buddeja sp*. was also identified as being present. The major impacts to river channel at the survey location were logged as embankments and over deepening, extensive over widening and realignment of the channel.
Great Ouse	GO1	10 / 1	Semi-natural	28 / 22.00%	III – Moderate, enhance	Lowland river, in an improved/semi-improved grassland and scrub setting, with natural in channel features (vegetated side and point bars) and fishing platforms. The watercourse was sitting in an area with no obvious valley sides. The channel substate was not visible during the survey although a continuous smooth flow down its length was recorded. The bank material was entirely earth with dominant uniform vegetation structure on the left and right bank tops and bank faces. Poaching was present along the banks although no artificial modifications were recorded. Some in-channel macrophytes were visible, including emergent broad-leaved herbs and reeds/sedges/rushes in addition to free-floating species. Trees were recorded as isolated and scattered across both bank tops. Bank full width of 18m (with the right bank as bank full height) and a water width of 14m were also recorded, and an average water depth of 1.2m. No INNS were identified during the survey. No major impacts to river channel at the survey location were logged.
Great Ouse	GO2	1580 / 5	Severely Modified	36 / 51.30%	V - Extremely poor, restore	Lowland river, in an improved/semi-improved grassland and broadleaf/mixed woodland (semi-natural) setting, with a major bridge and natural in channel features (marginal dead water and a mature island). The watercourse was sitting in an area with no obvious valley sides. The channel substate was not visible during the survey although a continuous smooth flow down its length was recorded. Some channel resectioning of the watercourse was present on the left bank and extensive on the right bank, with reinforced toe of both banks present. Additional embankment was also present on the left bank. The bank material was predominantly earth and sections of laid brick/stone, dominated primarily by uniform and simple vegetation bank tops and bank faces. In-channel macrophytes were visible, with emergent broad-leaved herbs and reeds/sedges/rushes, in addition to some amphibious and free-floating species. Trees were continuous along the left bank and isolated along the right, with extensive shading and overhanging boughs. Bank full width of 22m (with the right bank as bank full height) and a water width of 16m were also recorded, and an average water depth of 1.5m. No INNS were

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
						identified during the survey. The major impacts to river channel at the survey location was logged as extensive realignment of the channel.
Great Ouse	GO3	560 / 4	Significantly Modified	33 / 42.70%	IV – Poor, rehabilitate	Lowland river, in a tilled land and broadleaf/mixed woodland (semi-natural) setting, with no obvious artificial or natural features. The watercourse was sitting in an area with no obvious valley sides. The channel substate was not visible during the survey although a continuous smooth flow down its length was recorded. Some extensive channel resectioning and embankment was recorded on the right bank and poaching present on both banks. The bank material was earth and dominated primarily by uniform and simple vegetation bank tops and bank faces. In-channel macrophytes were visible, with emergent broad-leaved herbs and reeds/sedges/rushes, in addition to free-floating species. Trees were semi-continuous along the left bank and in occasional clumps along the right bank, with extensive shading and overhanging boughs. Bank full width of 22m (with the left bank as bank full height) and a water width of 16m were also recorded, and an average water depth of 1.5m. No INNS were identified during the survey.
Great Ouse	GO4	970 / 4	Significantly Modified	34 / 52.00%	IV – Poor, rehabilitate	Lowland river, in a tilled land and broadleaf/mixed woodland (semi-natural) setting, with scrub and tall rank/herb vegetation. Artificial features were present with a minor bridge, two minor outfalls/intakes and 2 landing stages for watercraft. Natural in channel features of interested were also recorded (vegetated boulders/bedrock and a mature island). The channel substate was not visible during the survey although a continuous smooth flow down its length was recorded. Extensive channel resectioning and whole bank reinforcements were recorded on both banks in addition to poaching. Embankment was also extensive on the left bank. The bank material was predominantly earth, with portions of concrete, and was dominated primarily by uniform and simple vegetation. In-channel macrophytes that were visible included emergent broad-leaved herbs and reeds/sedges/rushes. Trees were continuous along the right bank and isolated along the left bank, with shading and overhanging boughs present. Bank full width of 20m (with the right bank as bank full height) and a water width of 14m were also recorded, and an average water depth of 1.2m. No INNS were identified during the survey. The major impact to river channel at the survey location was logged as extensive realignment of the channel.
Great Ouse	GO5	1990 / 5	Severely Modified	38 / 62.00%	IV – Poor, rehabilitate	Lowland river, in a broadleaf/mixed woodland (semi-natural) and parkland/garden setting. Multiple artificial features were recorded, including a major weir, a major bridge and two pontoons. In-channel natural features present included extensive marginal dead water and a vegetated side bar. The watercourse was sitting in an area with no obvious valley sides. The channel substate was not visible during the survey although a continuous smooth flow down its length was recorded. Extensive channel resectioning and embankment was recorded on both banks, with some additional whole bank reinforcement present on both banks. The bank material was predominantly earth, with some areas of concrete, and dominated primarily by uniform and simple vegetation bank tops and bank faces. In-channel macrophytes were visible, with emergent broad-leaved herbs and reeds/sedges/rushes, with no additional macrophyte groups visible. Trees were semi-continuous along the right bank and continuous along the left bank, with extensive shading and overhanging boughs. Bank full width of 26m (with the right bank as bank full height) and a water width of 16m were also recorded, and an average water depth of 1.5m. No INNS were identified during the survey. The major impacts to river channel at the survey location were logged as extensive realignment of the channel, and water impoundment.
Great Ouse	GO6	2010 / 5	Severely Modified	37 / 64.70%	IV – Poor, rehabilitate	Coastal river, in an improved/semi-improved grassland and parkland/garden setting. Artificial features in the watercourse included a minor bridge, deflectors/groynes/croys

Waterbody	Site reference	HMS Score / Class	HMS Interpretation	HQA Score / HQA Class Position	RHQ Category and interpretation	Site Description
						and two pontoons near the lock on the watercourse. One natural in-channel features of interest was recorded, a mature island. The watercourse was sitting in an area with no obvious valley sides. The channel substate was not visible during the survey although a continuous smooth flow down its length was recorded. Extensive channel resectioning was present on both banks, with reinforcement of the whole bank and toe was also present. The bank material was earth and dominated primarily by uniform and simple vegetation bank tops and bank faces. Some in-channel macrophytes were visible and included emergent broad-leaved herbs and reeds/sedges/rushes, with no additional macrophyte groups visible. Trees were semi-continuous along the left bank and in occasional clumps along the right bank, with extensive shading and overhanging boughs. Bank full width of 25m (with the right bank as bank full height) and a water width of 20m were also recorded, and an average water depth of 1.5m. The INNS Himalayan Balsam *Impatiens glandifera* was present on bank faces. The major impacts to river channel at the survey location were logged as extensive realignment of the channel, and water impoundment.

Appendix D Community Conservation Index (CCI)

The Community Conservation Index (Chadd & Extence, 2004) 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 (Bratton, 1990, 1991; Shirt, 1987). Conservation Scores assigned to individual species vary from 1 to 10, as detailed on the Table D1 below. The derived CCI scores generally vary from 0 to > 20, as detailed in the Table D2 below. Table D2 below provides a guide to interpreting CCI scores.

Table D1: Conservation Scores from the Community Conservation Index (from Chadd & Extence, 2004)

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 D2: General guide to CCI scores (from Chadd & Extence, 2004)

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

Appendix E Whalley, Hawkes, Paisley & Trigg (WHPT) Metric

There are approximately 4,000 species of aquatic macroinvertebrates in the British Isles. To simplify the analysis of the samples and the data we do not identify individual species 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).

The WHPT scoring system (WFD-UKTAG, 2021) is based upon the sensitivity of macroinvertebrate families to organic pollution. It replaces the Biological Monitoring Working Party (BMWP) system (Hawkes, 1997) previously used in the UK.

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.

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.

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, three metrics are calculated:

- WHPT score
- NTAXA
- ASPT

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

The most useful way of summarising the biological data was found to be one that combined 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 can tolerate it. However, 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.

Appendix F Proportion of Sediment-sensitive Invertebrates (PSI)

The Proportion of Sediment-sensitive Invertebrates (PSI) index allows an assessment of the extent to which a waterbody is composed of, or covered by, fine sediments. This follows the method stated in Extence *et al*., 2013. Under this system, individual species of aquatic macroinvertebrates are assigned a Fine Sediment Sensitivity Rating (FSSR) as detailed in Table F1, and abundance rating as detailed in Table F2. The PSI score for the aquatic macroinvertebrate sample is then derived from the individual species scores and abundances, as detailed in Table F3. The PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, with low scores corresponding to waterbodies with high fine sediment cover.

Table F1: Fine Sediment Sensitivity Rating (FSSR) groups used to derive PSI scores

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

Table F2: Abundance categories used to derive PSI scores

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

Table F3: Interpretation of PSI scores

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

Appendix G Lotic-Invertebrate Index of Flow Evaluation (LIFE)

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 G1 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 G3 below. LIFE scores for a macroinvertebrate sample ranges from 1 to 12, where highest scores describe communities adapted to rapid flows.

Table G1: Flow groups used to derive LIFE scores (from Extence *et al*., 1999)

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 G2: Abundance categories used to derive LIFE scores (from Extence *et al*., 1999)

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

Table G3: A guide to interpreting LIFE scores (from Extence *et al*., 1999)

Flow groups	Abundance categories			
	A	B	C	D
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

Appendix H Macroinvertebrate taxa list

Table H1: Macroinvertebrate Taxa list For the River Nene

Family	Species	Conservation Score	NE1		NE2		NE3		NE4		NE6	
			Aut	Spr	Aut	Spr	Aut	Spr	Aut	Spr	Aut	Spr
Flatworms												
Dugesiidae	*Girardia tigrina*	**3**	1									
Snails												
Viviparidae	*Viviparus viviparus*	**3**					1		1			
Lymnaeidae	*Lymnaea stagnalis*	**1**	2	2	7			1	1		41	1
Lymnaeidae	*Radix auricularia*	**2**									2	
Lymnaeidae	*Radix balthica*	**1**	4		1	1			8		1	
Hydrobiidae	*Potamopyrgus antipodarum*	**1**	63	1	1	8	100	1	37	14	9	2
Bithyniidae	*Bithyniidae (juvenile / damaged)*							1				
Bithyniidae	*Bithynia tentaculata*	**1**		1			1			1	2	2
Physidae	*Physidae (juvenile / damaged)*				7							
Physidae	*Physella acuta/gyrina*		21	2	12	2		1	3		50	4
Succineidae	*Succinea sp.*				3	1				3	19	
Planorbidae	*Anisus vortex*	**1**				2			2			1
Planorbidae	*Gyraulus albus*	**1**	21		6	2	2					
Planorbidae	*Armiger crista*	**2**	1			1		1				
Limpets and mussels												
Anyclidae	*Ancylius fluviatilis*	**1**	10	3	3	1			8	4	3	3
Acroloxidae	*Acroloxus lacustris*	**2**		1	5				1			2
Sphaeriidae	*Sphaerium sp.*											1
Sphaeriidae	*Pisidium sp.*					7		4	8	2		2
Sphaeriidae	*Pisidium henslowanum*	**2**					1					
Sphaeriidae	*Pisidium nitidum*	**2**					1					
Unionidae	*Unio pictorum*	**3**					1					
Dreissenidae	*Dreissena polymorpha*	**2**									1	
Cyrenidae	*Corbicula fluminea*						1					
Worms												
Oligochaeta			1	1		10		15		69		8
Leeches												
Erpobdellidae	*Erpobdella octoculata*	**1**							1			
Piscicolidae	*Piscicola geometra*	**2**	1									
Piscicolidae	*Piscicola siddalli*	**6**	1									
Mites												
Hydracarina								1				

Family	Species	Conservation Score	NE1		NE2		NE3		NE4		NE6	
			Aut	Spr	Aut	Spr	Aut	Spr	Aut	Spr	Aut	Spr
Oribatei	*Oribatei*							1				
Crustaceans												
Cladocera					1		1					
Gammaridae	*Dikerogammarus haemobaphes*		20		7	1	71	6	8	1		6
Crangonyctidae	*Crangonyx floridanus/pseudogracilis*		2	96	96	1			23	47	24	20
Corophidae	*Corophidae (juvenile / damaged)*										1	
Corophidae	*Chelicorophium curvispinum*	**3**	34	9	139	3	14	1	12		31	39
Asellidae	*Asellidae*			9								
Asellidae	*Asellus aquaticus*	**1**	1	1	2		1	1	4	3		11
Asellidae	*Proasellus meridianus*	**3**					1					
Mayflies												
Baetidae	*Baetidae (juvenile / damaged)*				8			1	1	1	3	2
Baetidae	*Cloeon dipterum*	**1**	1		4			1				
Ephemeridae	*Ephemera sp.*							2				
Caenidae	*Caenis sp.*							3		7		5
Damselflies												
Coenagrionidae	*Coenagrionidae (juvenile / damaged)*					1	1	2	1		9	5
Coenagrionidae	*Pyrrhosoma nymphula*	**3**			1							5
Coenagrionidae	*Ischnura elegans*	**1**	1	2	1	1	4			1	19	
Coenagrionidae	*Coenagrion sp.*		1									
Coenagrionidae	*Erythromma najas*	**3**			2						3	3
Calopterygidae	*Calopteryx sp.*					1		1				
Calopterygidae	*Calopteryx splendens*	**1**		2							28	11
Dragonflies												
Libellulidae	*Sympetrum sp.*									1		
True bugs												
Gerridae	*Gerris lacustris*	**1**					1				7	
Corixidae	*Corixidae (nymph / damaged)*									40		
Corixidae	*Callicorixa praeusta*	**3**				2						
Corixidae	*Corixa dentipes*	**5**						1				
Corixidae	*Sigara sp.*							1				
Notonectidae	*Notonecta glauca*	**1**				1	1					
Notonectidae	*Notonecta viridis*	**3**						2				
Beetles												
Gyrinidae	*Gyrinidae (larvae / damaged)*										1	
Gyrinidae	*Gyrinus substriatus*	**1**										1
Gyrinidae	*Orectochilus villosus*	**2**										1
Dytiscidae	*Dytiscidae (larvae / damaged)*										4	
Hydrophilidae	*Helophorus sp.*											1

Family	Species	Conservation Score	NE1		NE2		NE3		NE4		NE6	
			Aut	Spr	Aut	Spr	Aut	Spr	Aut	Spr	Aut	Spr
Hydrophilidae	*Anacaena limbata*	**1**									6	
Hydraenidae	*Hydraena sp.*		1									
Hydraenidae	*Hydraena rufipes*	**7**	1									
Dryopidae	*Dryopidae (larvae / damaged)*									1		
Elmidae	*Elmis aenea*	**1**										1
Elmidae	*Oulimnius sp.*							1		1		
Alderflies												
Sialidae	*Sialidae (juvenile / damaged)*											
Sialidae	*Sialis lutaria*	**1**					2					
Caddisflies												
Polycentropodidae	*Cyrnus flavidus*	**5**	1									
Psychomyiidae	*Tinodes waeneri*	**1**									1	
Psychomyiidae	*Lype phaeopa/reducta*				1							
Hydropsychidae	*Hydropsyche pellucidula*	**1**										1
Limnephilidae	*Limnephilidae (juvenile / damaged)*		9	7		30		6	2	35	1	12
Limnephilidae	*Limnephilus marmoratus*	**2**	1	1								5
Limnephilidae	*Limnephilus lunatus*	**1**		11	2	2				6		13
Limnephilidae	*Anabolia nervosa*	**2**		30		2				2		150
Limnephilidae	*Halesus radiatus*	**1**				1						6
Molannidae	*Molanna angustata*	**2**					1	1				
Leptoceridae	*Mystacides sp.*					1			1			
Leptoceridae	*Mystacides longicornis*	**1**					1					
Trueflies												
Chironomidae	*Chironomidae* (damaged / pupea)		1			1				2	1	30
Chironomidae	*Tanypodinae*			2	1		1	3	1	7		10
Chironomidae	*Orthocladiinae*		5	18	6	1	1	3		127	14	170
Chironomidae	*Chironomini*		6	4	8		1	12	11	5		10
Chironomidae	*Tanytarsini*		5	9	4	1		7		10	41	50
Chironomidae	*Prodiamesinae*					2		7		1		
Limoniidae	*Limoniidae*									1	1	1
Simuliidae	*Simulium sp.*			2						2		7
Dixidae	*Dixa nebulosa*	**4**									24	
Psychodidae										1		5
Ceratopogonidae										4		

Table H2: Macroinvertebrate list for the Great Ouse

Family	Species	Conservation Score	GO1		GO3		GO5	
			Aut	Spr	Aut	Spr	Aut	Spr
Flatworms								
Planariidae	*Polycelis sp.*							1
Dugesiidae	*Dugesia lugubris/polychroa*	**2**						1
Snails								
Viviparidae	*Viviparus viviparus*	**3**					4	5
Lymnaeidae	*Lymnaeidae (juvenile / damaged)*							2
Lymnaeidae	*Galba truncatula*	**3**					1	
Lymnaeidae	*Lymnaea stagnalis*	**1**		1			2	2
Lymnaeidae	*Radix auricularia*	**2**					1	
Lymnaeidae	*Radix balthica*	**1**					14	
Valvatidae	*Valvata piscinalis*	**1**					2	
Hydrobiidae	*Potamopyrgus antipodarum*	**1**	154	45	155	24	71	48
Bithyniidae	*Bithynia tentaculata*	**1**	3	1	5		1	5
Physidae	*Physa fontinalis*	**1**						1
Physidae	*Physella sp.*		90	30	1		3	1
Planorbidae	*Planorbarius corneus*	**4**					2	
Planorbidae	*Menetus dilatatus*	**7**	1					
Planorbidae	*Planorbis planorbis*	**1**			5		1	
Planorbidae	*Anisus vortex*	**1**					1	1
Planorbidae	*Gyraulus albus*	**1**	27	10	1		33	5
Planorbidae	*Armiger crista*	**2**	1	8	1		1	1
Planorbidae	*Hippeutis complanatus*	**3**					2	2
Limpets and mussels								
Anyclidae	*Ancylius fluviatilis*	**1**	12		10	1	1	
Acroloxidae	*Acroloxus lacustris*	**2**		16	1		7	1
Sphaeriidae	*Sphaerium corneum*	**1**						2
Sphaeriidae	*Pisidium sp.*		9	25			5	12
Sphaeriidae	*Pisidium amnicum*	**2**			1		4	
Sphaeriidae	*Pisidium henslowanum*	**2**			3			
Sphaeriidae	*Pisidium nitidum*	**2**			4			
Unionidae	*Anodonta sp.*							1
Unionidae	*Anodonta anatina*	**2**					1	2
Cyrenidae	*Corbicula fluminea*				2			
Worms								
Oligochaeta			15	80	2	21		126
Leeches								
Erpobdellidae	*Erpobdella sp.*			2				1
Erpobdellidae	*Erpobdella octoculata*	**1**					4	
Piscicolidae	*Piscicola sp.*		4	1				
Crustaceans								
Gammaridae	*Gammarus sp.*						2	
Gammaridae	*Gammarus pulex*	**1**				1		
Gammaridae	*Dikerogammarus haemobaphes*		124	10	25		42	

Family	Species	Conservation Score	GO1		GO3		GO5	
			Aut	Spr	Aut	Spr	Aut	Spr
Crangonyctidae	*Crangonyx floridanus/pseudogracilis*			50	17	4	11	52
Corophidae	*Chelicorophium curvispinum*	**3**					106	13
Asellidae	*Asellus sp.*		7					
Asellidae	*Asellus aquaticus*	**1**	17	15	9		81	31
Mayflies								
Baetidae	*Baetidae (juvenile / damaged)*		12				4	20
Ephemeridae	*Ephemera sp.*		14	2	9			
Ephemeridae	*Ephemera danica*	**1**	3					
Ephemeridae	*Ephemera vulgata*	**4**	6	1	7	3		
Caenidae	*Caenis sp.*		24	3	6	2		
Damselflies								
Coenagrionidae	*Coenagrionidae (juvenile / damaged)*		36				4	6
Coenagrionidae	*Ischnura elegans*	**1**		1			1	3
Coenagrionidae	*Coenagrion sp.*			1			1	
Coenagrionidae	*Erythromma najas*	**3**						1
Calopterygidae	*Calopteryx splendens*	**1**	4		5		1	
Dragonflies								
Aeshnidae	*Anax imperator*	**5**	1					
True bugs								
Notonectidae	*Notonecta glauca*	**1**	7					
Beetles								
Elmidae	*Oulimnius sp.*							1
Alderflies								
Sialidae	*Sialidae (juvenile / damaged)*							
Sialidae	*Sialis lutaria*	**1**						1
Caddisflies								
Polycentropodidae	*Polycentropodidae (juvenile / damaged)*						1	
Polycentropodidae	*Polycentropus flavomaculatus*	**2**					1	
Polycentropodidae	*Cyrnus trimaculatus*	**3**					1	
Polycentropodidae	*Cyrnus flavidus*	**5**						1
Psychomyiidae	*Tinodes waeneri*	**1**	2		1		1	1
Psychomyiidae	*Lype sp.*				1		2	1
Hydropsychidae	*Hydropsyche pellucidula*	**1**			2			
Phryganeidae	*Phryganeidae (juvenile / damaged)*						3	
Phryganeidae	*Phryganea grandis*	**5**					1	
Limnephilidae	*Limnephilidae (juvenile / damaged)*		10	4			2	7
Limnephilidae	*Limnephilus sp.*		3		8			
Limnephilidae	*Limnephilus flavicornis*	**2**					1	
Limnephilidae	*Limnephilus marmoratus*	**2**			10		10	5
Limnephilidae	*Limnephilus decipiens*	**5**		1				
Limnephilidae	*Limnephilus lunatus*	**1**			1			1
Limnephilidae	*Anabolia nervosa*	**2**				14		7
Leptoceridae	*Athripsodes cinereus*	**1**			1			
Leptoceridae	*Mystacides sp.*		2	2				

Family	Species	Conservation Score	GO1		GO3		GO5	
			Aut	Spr	Aut	Spr	Aut	Spr
Leptoceridae	*Mystacides azurea*	**2**	8	1		1		
Leptoceridae	*Mystacides longicornis*	**1**		9				
Leptoceridae	*Leptocerus lusitanicus*	**8**					1	
Trueflies								
Chironomidae	*Tanypodinae*		3	3	6			33
Chironomidae	*Orthocladiinae*		14	65	5	5	1	8
Chironomidae	*Chironomini*		24	25	10		220	302
Chironomidae	*Tanytarsini*		8	32		2	10	64
Chironomidae	*Prodiamesinae*					12		
Limoniidae	*Limoniidae*			3			2	7
Simuliidae	*Simuliidae (damaged / juvenile)*			3				
Simuliidae	*Simulium sp.*				1	1		
Ceratopogonidae			1					1
Stratiomyidae	*Stratiomyidae*							1

Rivers Tame and Trent Strategic Resource Options: Aquatic Ecology Monitoring. Final Report

Affinity Water, Anglian Water Services Ltd and Severn Trent Water Ltd

Annex B1 AEM

Table H3. Macroinvertebrate Taxa list for the River Tame

Family	Species	Conservation Score	TA1			TA2			TA3			TA4			TA5			TA6		
			Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Flatworms																				
Dendrocoelidae	*Dendrocoelum lacteum*	2									1									
Planariidae	*Polycelis* sp.										1									
Dugesiidae	*Dugesia* sp.												1							
Dugesiidae	*Dugesia lugubris/polychroa*	2																	3	
Dugesiidae	*Girardia tigrina*	3	1		1				8											
Snails																				
Viviparidae	*Viviparus viviparus*	3																1		
Lymnaeidae	*Lymnaea stagnalis*	1													1					
Lymnaeidae	*Radix balthica*	1	54		1	289	5									5				3
Valvatidae	*Valvata piscinalis*	1				4														
Hydrobiidae	*Potamopyrgus antipodarum*	1	17	1		31	6		4		1	67	79	52	30	191		33	8	60
Bithyniidae	*Bithynia tentaculata*	1	5		1	7	3					2	4			2				1
Bithyniidae	*Bithynia leachii*	5											1							
Physidae	*Physella acuta/gyrina*		3			6	1		1			1			1					1
Succineidae	*Succinea* sp.						1			1										
Planorbidae	Planorbidae (juvenile / damaged)												2							

Family	Species	Conservation Score	TA1			TA2			TA3			TA4			TA5			TA6		
			Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Planorbidae	*Menetus dilatatus*	7											1							
Planorbidae	*Planorbis planorbis*	1											1							
Planorbidae	*Anisus* sp.														1					
Planorbidae	*Anisus vortex*	1	1																	
Planorbidae	*Gyraulus albus*	1				4						1	61			2				
Planorbidae	*Armiger crista*	2											3							
Limpets and mussels																				
Anyclidae	*Ancylius fluviatilis*	1				8						3			1	16		27	3	15
Acroloxidae	*Acroloxus lacustris*	2					1								2	1			1	1
Sphaeriidae	Sphaeriidae (juvenile / damaged)														2					
Sphaeriidae	*Sphaerium* sp.							3												
Sphaeriidae	*Sphaerium corneum*	1	15			1			4		1				2	9		1		20
Sphaeriidae	*Pisidium* sp.		27		7	14	2	20	22		6	6	3	4	16	55		6		30
Sphaeriidae	*Pisidium henslowanum*	2											2			2				
Cyrenidae	*Corbicula fluminea*																	1		
Worms																				
Oligochaeta				6	441	2	19	170	2	1	141	2	8	19	12	12		1	15	45
Leeches																				
Glossiphoniidae	*Alboglossiphonia heteroclita*	4	1							1										
Glossiphoniidae	*Glossiphonia complanata*	1	5			2	1													
Glossiphoniidae	*Helobdella stagnalis*	1					1						1							
Erpobdellidae	Erpobdellidae (juvenile / damaged)		1			1				1					1					
Erpobdellidae	*Erpobdella* sp.								1											
Erpobdellidae	*Erpobdella testacea*	4									1									
Erpobdellidae	*Erpobdella octoculata*	1	9		1	1	1		1				1							
Piscicolidae	*Piscicola geometra*	2											1							
Mites																				

Family	Species	Conservation Score	TA1			TA2			TA3			TA4			TA5			TA6		
			Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Hydracarina						1				1										
Oribatei	Oribatei													1						
Crustaceans																				
Gammaridae	*Gammarus* sp.										2		19							
Gammaridae	*Gammarus pulex/fossarum* agg.	1					2													
Gammaridae	*Gammarus pulex*	1									2		4	1						
Gammaridae	*Dikerogammarus haemobaphes*		14		7	38		1	3	5	5	32	1			64		241	43	30
Crangonyctidae	*Crangonyx floridanus/ pseudogracilis*								28	1	3		16	7	2				1	1
Asellidae	*Asellus aquaticus*	1	1		8		1	1	12	29	8		34	2	1					
Mayflies																				
Baetidae	Baetidae (juvenile / damaged)		58			113												18		
Baetidae	*Baetis* sp.				8			1												
Baetidae	*Baetis fuscatus*	4										34								
Baetidae	*Baetis rhodani / atlanticus*		2		1															
Baetidae	*Baetis scambus*	4	11			52						2						3		
Baetidae	*Baetis vernus*	3										10								
Caenidae	*Caenis* sp.				1						1		23	10		2			13	6
Caenidae	*Caenis horaria*	1											6		1					
Caenidae	*Caenis luctuosa*	1								2		3								
Caenidae	*Caenis robusta*	5											2							
Damselflies																				
Coenagrionidae	Coenagrionidae (juvenile / damaged)												4							
Coenagrionidae	*Pyrrhosoma nymphula*	3										1								
Coenagrionidae	*Ischnura elegans*	1											2							

Family	Species	Conservation Score	TA1			TA2			TA3			TA4			TA5			TA6		
			Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Calopterygidae	Calopterygidae (juvenile / damaged)														1					
Calopterygidae	*Calopteryx splendens*	1		1		1						2	4	4					4	
True bugs																				
Corixidae	*Sigara concinna*	5						1						1						
Beetles																				
Haliplidae	*Haliplus* sp.						1						1							
Gyrinidae	Gyrinidae (larvae / damaged)													1						
Elmidae	*Elmis aenea*	1	1			1														
Caddisflies																				
Polycentropodidae	*Cyrnus trimaculatus*	3									1									
Psychomyiidae	*Tinodes waeneri*	1					1	1											1	
Psychomyiidae	*Psychomyia pusilla*	4														2			3	1
Hydropsychidae	Hydropsychidae (juvenile / damaged)									1		2								
Hydropsychidae	*Hydropsyche* sp.										1									1
Hydropsychidae	*Hydropsyche pellucidula*	1	1		1	13	4	3		2	2	1	2			1		28	4	
Hydropsychidae	*Hydropsyche angustipennis*	1														1		3		
Hydropsychidae	*Hydropsyche contubernalis*	4	1			1		2			1									
Hydroptilidae	*Hydroptila* sp.					4						3						2		
Limnephilidae	Limnephilidae (juvenile / damaged)																			1
Limnephilidae	*Micropterna sequax*	1														1				
Leptoceridae	*Athripsodes* sp.												3			1				3
Leptoceridae	*Athripsodes cinereus*	1										1				2				
Leptoceridae	*Athripsodes bilineatus*	5						1												
Leptoceridae	*Mystacides* sp.												1						1	
Leptoceridae	*Mystacides azurea*	2			1						1		2							

Family	Species	Conservation Score	TA1			TA2			TA3			TA4			TA5			TA6		
			Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Brachycentridae	*Brachycentrus subnubilus*	5										4				16		15	13	4
Trueflies																				
Chironomidae	Chironomidae (damaged / pupae)			3	15					1	20									
Chironomidae	Tanypodinae			1	100	24		2	2				7	5						
Chironomidae	Orthocladiinae		10	8	17	36	1	60	3	1	84	45		9	8			149	9	20
Chironomidae	Chironomini		89	1	226	18	1	15	14	5	21	32	7	18	4	43			13	100
Chironomidae	Tanytarsini				23			5	9	3	110			5				38	1	
Chironomidae	Prodiamesinae		35		7				2		48				8					
Tipulidae	*Tipula* sp.			1			3	1								9				2
Simuliidae	Simuliidae (damaged / juvenile)									5	21			1	2	105				2
Simuliidae	*Simulium* sp.					11		17	8		2	3						620		
Psychodidae				8				1		2				1	1					1
Ceratopogonidae				1	4			4	1											2
Tabanidae																				2
Chaoboridae											1									
Muscidae													1							

Table H4: Macroinvertebrate Taxa for the River Trent

Family	Species	Conservation Score	UT1			LT4			LT6		
			Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Flatworms											
Dendrocoelidae	*Dendrocoelum lacteum*	**2**			1				2		
Planariidae	*Polycelis sp.*						1				
Dugesiidae	*Dugesia sp.*									1	
Dugesiidae	*Girardia tigrina*	**3**						1	12		
Snails											
Viviparidae	*Viviparus viviparus*	**3**	1		15						
Lymnaeidae	Lymnaeidae (juvenile /			1						2	
Lymnaeidae	*Stagnicola sp.*			1							
Lymnaeidae	*Lymnaea stagnalis*	**1**	20			1					
Lymnaeidae	*Radix auricularia*	**2**			3						
Lymnaeidae	*Radix balthica*	**1**	31		13	1		26	3	2	
Valvatidae	*Valvata piscinalis*	**1**	22	6	3						
Hydrobiidae	*Potamopyrgus antipodarum*	**1**	140	444	140	149	66	10	9	8	5
Bithyniidae	*Bithynia tentaculata*	**1**	2	4	6		1	10			
Bithyniidae	*Bithynia leachii*	**5**	1								
Physidae	*Physella acuta/gyrina*		1	87	2	27	1				
Succineidae	*Succinea sp.*		2								
Planorbidae	*Gyraulus albus*	**1**				1					
Limpets and mussels											
Anyclidae	*Ancylius fluviatilis*	**1**	94	30	3	3	4	1	9	1	2
Acroloxidae	*Acroloxus lacustris*	**2**			6			1			
Sphaeriidae	Sphaeriidae (juvenile /				1						
Sphaeriidae	*Sphaerium sp.*							1			
Sphaeriidae	*Sphaerium corneum*	**1**	1	3		3	2		66	47	
Sphaeriidae	*Pisidium sp.*		23	38	49	17	27	20	83	24	150
Sphaeriidae	*Pisidium amnicum*	**2**	2			5	12				
Sphaeriidae	*Pisidium henslowanum*	**2**				4	2		5	9	
Unionidae	*Anodonta cygnaea*	**2**	3								
Cyrenidae	*Corbicula fluminea*		68			3			5	3	
Worms											
Oligochaeta			1	3	348	19	22	20	5		
Leeches											
Glossiphoniidae	*Theromyzon tessulatum*	**2**				1					
Glossiphoniidae	*Helobdella stagnalis*	**1**		1	1						
Erpobdellidae	*Erpobdella octoculata*	**1**			1						
Mites											
Hydracarina								2			
Crustaceans											
Ostracoda						5					
Cladocera				1		2					
Gammaridae	Gammaridae										17

Family	Species	Conservation Score	UT1			LT4			LT6		
			Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Gammaridae	*Gammarus zaddachi*	**1**								7	
Gammaridae	*Dikerogammarus sp.*		43							3	
Gammaridae	*Dikerogammarus*		98	304		44	42	1	402	87	2
Crangonyctidae	*Crangonyx sp.*		1		15	3		15			
Corophidae	*Chelicorophium curvispinum*	**3**	3	92	3		8	6	14	2	2
Corophidae	*Corophium multisetosum*	**2**				1					
Asellidae	Asellidae							1			
Mayflies											
Baetidae	Baetidae (juvenile / damaged)			3		3		1		1	
Baetidae	*Baetis sp.*		6								
Baetidae	*Baetis scambus*	**4**	9								
Baetidae	*Cloeon dipterum*	**1**				1					
Caenidae	*Caenis sp.*		1								
Caenidae	*Caenis horaria*	**1**			1						
Caenidae	*Caenis luctuosa*	**1**		5							
Damselflies											
Coenagrionidae	Coenagrionidae (juvenile /					2		1			
Coenagrionidae	*Pyrrhosoma nymphula*	**3**				1					
Calopterygidae	*Calopteryx sp.*							1			
Calopterygidae	*Calopteryx splendens*	**1**	1	2							
True bugs											
Corixidae	Corixidae (nymph / damaged)			1							
Corixidae	*Sigara sp.*				1						
Corixidae	*Sigara dorsalis*	**1**				2					
Notonectidae	*Notonecta glauca*	**1**							1		
Beetles											
Haliplidae	*Haliplus sp.*					1					
Haliplidae	*Haliplus ruficollis* group					1					
Hydrophilidae	Hydrophilidae (larvae /									1	
Hydrophilidae	*Anacaena limbata*	**1**						1			
Elmidae	*Esolus parallelepipedus*	**4**						1			
Elmidae	*Limnius volckmari*	**1**						1		1	
Caddisflies											
Psychomyiidae	*Tinodes waeneri*	**1**		1				1	1		
Psychomyiidae	*Lype phaeopa/reducta*			1				1			
Psychomyiidae	*Psychomyia pusilla*	**4**	11	2							
Hydropsychidae	Hydropsychidae (juvenile /		4								
Hydropsychidae	*Hydropsyche pellucidula*	**1**	21	5							
Hydropsychidae	*Hydropsyche angustipennis*	**1**	24								
Hydropsychidae	*Hydropsyche contubernalis*	**4**	4								
Hydroptilidae	*Hydroptila sp.*		4								
Limnephilidae	Limnephilidae (juvenile /				6			25	1	2	
Limnephilidae	*Limnephilus marmoratus*	**2**			1						
Limnephilidae	*Limnephilus lunatus*	**1**			3			35			

Family	Species	Conservation Score		UT1			LT4				LT6	
				Sum	Aut	Spr	Sum	Aut	Spr	Sum	Aut	Spr
Leptoceridae	*Athripsodes sp.*										2	
Leptoceridae	*Athripsodes cinereus*	**1**									2	
Leptoceridae	*Mystacides sp.*			18								
Leptoceridae	*Mystacides longicornis*	**1**				1						
Goeridae	*Goera pilosa*	**2**		1								
Brachycentridae	*Brachycentrus subnubilus*	**5**	34	18								
Trueflies												
Chironomidae	Chironomidae (damaged /		1	2								
Chironomidae	Tanypodinae			2	19	8	15	6	3			
Chironomidae	Orthocladiinae		223	23	27	25	13	14	2			
Chironomidae	Chironomini			84	70	68	7	15	40	3	70	
Chironomidae	Tanytarsini		98	10	19	14		2	2	2	8	
Chironomidae	Prodiamesinae			3	39	2	25	45	2		2	
Tipulidae	*Tipula sp.*							1				
Limoniidae	*Antocha vitripennis*				1							
Simuliidae	Simuliidae (damaged /			1								
Simuliidae	*Simulium* sp.		202						4			
Psychodidae								2				
Ceratopogonidae					2							
Ephydridae								2				
Muscidae					1							

Table H5: Macroinvertebrate Taxa list for the River Welland

Family	Species	Conservation Score	WE3		WE5		WE6	
			Aut	Spr	Aut	Spr	Aut	Spr
Snails								
Lymnaeidae	*Lymnaea stagnalis*	**1**	4		3	1	2	1
Lymnaeidae	*Radix balthica*	**1**			34	29	24	3
Valvatidae	*Valvata piscinalis*	**1**	4		13	8		
Hydrobiidae	*Potamopyrgus antipodarum*	**1**	11	4				
Bithyniidae	*Bithynia tentaculata*	**1**	6	1	26	13	4	3
Bithyniidae	*Bithynia leachii*	**5**		1		1		
Physidae	*Physa fontinalis*	**1**			4		37	6
Physidae	*Physella acuta/gyrina*		20			9		
Succineidae	*Succinea sp.*			1		1		
Planorbidae	*Planorbarius corneus*	**4**					2	
Planorbidae	*Planorbis planorbis*	**1**				3	8	
Planorbidae	*Anisus vortex*	**1**	22	2	7	11		3
Planorbidae	*Gyraulus albus*	**1**	2	3		1	2	
Planorbidae	*Armiger crista*	**2**		4				
Planorbidae	*Bathyomphalus contortus*	**2**	8	1	1	4		
Planorbidae	*Hippeutis complanatus*	**3**						1
Limpets and mussels								
Anyclidae	*Ancylius fluviatilis*	**1**		2				
Acroloxidae	*Acroloxus lacustris*	**2**				4		1
Sphaeriidae	*Sphaerium sp.*			2		1	2	
Sphaeriidae	*Sphaerium corneum*	**1**					2	2
Sphaeriidae	*Pisidium sp.*		4	1	1	3	2	6
Worms								
Oligochaeta				9	2	72	2	
Leeches								
Glossiphoniidae	*Theromyzon tessulatum*	**2**					1	2
Glossiphoniidae	*Glossiphonia complanata*	**1**			3	7		
Glossiphoniidae	*Helobdella stagnalis*	**1**	1	2	5	1		
Erpobdellidae	*Erpobdellidae (juvenile / damaged)*		1	1				1
Erpobdellidae	*Erpobdella sp.*					2		
Erpobdellidae	*Erpobdella testacea*	**4**					7	
Erpobdellidae	*Erpobdella octoculata*	**1**			7		2	5
Piscicolidae	*Piscicola geometra*	**2**		1				
Mites								
Hydracarina			10			3		
Crustaceans								
Gammaridae	*Gammaridae*						3	
Gammaridae	*Gammarus sp.*						2	
Gammaridae	*Gammarus pulex*	**1**			1	1	7	
Gammaridae	*Dikerogammarus haemobaphes*		2	3				
Crangonyctidae	*Crangonyx sp.*		23	88	18	20	4	41
Asellidae	*Asellus aquaticus*	**1**	9	3	2	12	336	80

Family	Species	Conservation Score	WE3		WE5		WE6	
			Aut	Spr	Aut	Spr	Aut	Spr
Mayflies								
Baetidae	*Baetidae (juvenile / damaged)*		54	65		5		1
Baetidae	*Cloeon dipterum*	**1**						7
Ephemeridae	*Ephemera sp.*		65	37		2		
Ephemeridae	*Ephemera danica*	**1**		29	1			
Ephemeridae	*Ephemera vulgata*	**4**	1	28				
Caenidae	*Caenis sp.*		93	387		80		
Caenidae	*Caenis luctuosa*	**1**			24			
Damselflies								
Coenagrionidae	*Coenagrionidae (juvenile /*						3	
Coenagrionidae	*Ischnura elegans*	**1**					1	3
Calopterygidae	*Calopteryx splendens*	**1**	2		4	11	1	1
Dragonflies								
Aeshnidae	*Anax imperator*	**5**					1	
True bugs								
Gerridae	*Gerridae (nymph / damaged)*		1					
Gerridae	*Gerris lacustris*	**1**			1			
Naucoridae	*Ilyocoris cimicoides*	**3**					1	
Corixidae	*Sigara sp.*		1			1		
Corixidae	*Sigara dorsalis*	**1**	2		1		279	
Corixidae	*Sigara falleni*	**1**	1					
Notonectidae	*Notonecta glauca*	**1**					6	
Notonectidae	*Notonecta viridis*	**3**						1
Notonectidae	*Notonecta maculata*	**5**					1	
Beetles								
Haliplidae	*Haliplidae (larvae / damaged)*				9		1	
Haliplidae	*Haliplus sp.*					1	26	
Haliplidae	*Haliplus fluviatilis*	**1**			1		1	8
Haliplidae	*Haliplus immaculatus*	**1**					2	19
Haliplidae	*Haliplus laminatus*	**7**						1
Haliplidae	*Haliplus ruficollis group*		6		4			
Gyrinidae	*Gyrinus substriatus*	**1**	1					
Dytiscidae	*Dytiscidae (larvae / damaged)*		1					
Dytiscidae	*Hyphydrus ovatus*	**2**						1
Dytiscidae	*Hygrotus versicolor*	**5**					1	
Dytiscidae	*Nebrioporus elegans*	**1**				4	1	
Hydrophilidae	*Hydrophilidae (larvae / damaged)*					1		
Elmidae	*Elmis aenea*	**1**	1	2	2	6		1
Elmidae	*Oulimnius sp.*		44	7				
Elmidae	*Oulimnius tuberculatus*	**1**		3		3		
Alderflies								
Sialidae	*Sialis lutaria*	**1**	2	1		2	2	
Caddisflies								
Psychomyiidae	*Lype phaeopa/reducta*		1					

Family	Species	Conservation Score	WE3		WE5		WE6	
			Aut	Spr	Aut	Spr	Aut	Spr
Hydropsychidae	*Hydropsyche pellucidula*	**1**			1			
Hydroptilidae	*Hydroptila sp.*		1					
Phryganeidae	*Phryganea grandis*	**5**					2	
Phryganeidae	*Phryganea bipunctata*	**2**			2			1
Limnephilidae	*Limnephilidae (juvenile / damaged)*			15		4		2
Limnephilidae	*Limnephilus sp.*			1		1		
Limnephilidae	*Limnephilus marmoratus*	**2**				4		5
Limnephilidae	*Limnephilus lunatus*	**1**	6	1		2		1
Limnephilidae	*Anabolia nervosa*	**2**		2		3		
Limnephilidae	*Halesus radiatus*	**1**						1
Molannidae	*Molanna angustata*	**2**	1					
Leptoceridae	*Athripsodes aterrimus*	**1**			1	3		1
Leptoceridae	*Athripsodes cinereus*	**1**			1			
Leptoceridae	*Mystacides sp.*		10	4				
Leptoceridae	*Mystacides azurea*	**2**		2				
Lepidostomatidae	*Lepidostoma hirtum*	**1**		1				
Brachycentridae	*Brachycentrus subnubilus*	**5**			1	1		
Sericostomatidae	*Sericostoma personatum*	**1**	1	2		5		
Trueflies								
Chironomidae	*Chironomidae (damaged / pupea)*			1				
Chironomidae	*Tanypodinae*		25	68	1	60	2	2
Chironomidae	*Orthocladiinae*		30	33		22		8
Chironomidae	*Chironomini*		69	63		12		1
Chironomidae	*Tanytarsini*			2	6	50		4
Chironomidae	*Prodiamesinae*		18	11	1	5		
Simuliidae	*Simulium sp.*					1		
Dixidae	*Dixa nebulosa*	**4**	14					
Dixidae	*Dixella sp.*							1
Psychodidae				1				
Ceratopogonidae				22				

Appendix I Macroinvertebrate indices

Table I1 Macroinvertebrate taxa indices and WFD classification

Site Reference	Season	CCI	PSI (species)	LIFE (species)	WHPT-ASPT	WHPT-NTAXA	WFD class (spring & autumn combined)
GO1	Autumn	12.9	13.16	6.53	4.67	22	Moderate
	Spring	9.5	3.57	6.08	4.11	21	
GO3	Autumn	4.5	15.79	6.62	4.92	19	Moderate
	Spring	5.5††	41.18†	6.67†	5.05	11	
GO5	Autumn	20.7	11.11	6.13	4.39	26	Good
	Spring	8.9	2.27	6.16	4.19	27	
NE1	Autumn	16.6	21.43	6.53	4.44	18	Moderate
	Spring	4.3	15.00	6.17	4.13	15	
NE2	Autumn	4.6	10.00	6.46	4.17	15	Moderate
	Spring	4.4	8.70	6.29	4.18	17	
NE3	Autumn	5.1	0.00	6.20	4.44	16	Good
	Spring	10.6††	0.00	6.20	4.36	21	
NE4	Autumn	4.8	8.33	6.25	4.18	18	Good
	Spring	3.4††	17.65	6.38†	4.39	21	
NE6	Autumn	4.8	13.04	6.29	4.71	20	High
	Spring	4.6	15.79	6.44	4.52	26	
TA1	Summer	5.4	17.24	6.64	3.50	15	-
	Autumn	1.0††	14.29†	6.00†	4.31	7	Bad
	Spring	4.3††	22.73†	6.55†	3.91	14	
TA2	Summer	4.3	31.03	6.86	4.30	19	-
	Autumn	3.3	11.11	6.36	3.83	16	Poor
	Spring	14.2††	50.00	7.00†	4.39	14	
TA3	Summer	4.2	6.25	6.17	3.58	12	-
	Autumn	5.3††	27.78†	6.63†	4.05	11	Poor
	Spring	6.0	33.33	6.70	4.29	16	

Site Reference	Season	CCI	PSI (species)	LIFE (species)	WHPT-ASPT	WHPT-NTAXA	WFD class (spring & autumn combined)
TA4	Summer	10.4	52.00	7.50	4.93	18	-
	Autumn	13.6	9.76	6.30	4.09	20	Moderate
	Spring	9.0	7.69	6.80	4.49	13	
TA5	Summer	7.2	14.29	6.30	4.05	25	-
	Autumn	8.2	42.86	7.20	4.84	18	Moderate
	Spring	3.4††	14.29†	6.17†	4.00	16	
TA6	Summer	10.6	60.00	8.00	5.09	12	-
	Autumn	10.0	47.06	7.20	4.89	14	Moderate
	Spring	10.0††	38.46	6.71†	4.75	22	
UT1	Summer	12.7	45.24	7.67	4.99	20	-
	Autumn	8.1	24.39	6.83	4.70	22	Moderate
	Spring	4.1	11.54	6.08	3.99	20	
LT4	Summer	4.8	5.13	6.29	3.74	20	-
	Autumn	4.3††	9.09	6.50†	3.68	10	Moderate
	Spring	4.8	20.83	6.83	4.45	22	
LT6	Summer	4.9	13.64	6.38	3.93	11	-
	Autumn	4.8	33.33†	6.60	4.13	12	Poor
	Spring	3.9††	38.10†	6.67†	4.50	13	
WE3	Autumn	7.0	4.44	6.27	4.95	31	Good
	Spring	7.9	13.04	6.65	5.13	13	
WE5	Autumn	6.3	12.20	6.42	4.57	24	High
	Spring	7.4	10.53	6.19	4.53	29	
WE6	Summer	9.8	3.92	5.92	3.58	22	-
	Autumn	9.2	4.00	5.96	3.58	22	Moderate
	Spring	11.2	2.38	6.04	4.10	22	

Appendix J Macrophyte indices and taxa list

Table J1: Macrophyte taxa coverage of survey sites on the River Tame

Scientific name	Common name	Taxon Cover Value										
		TA1	TA2	TA3	TA4	TA5	TA6	LT7	LT8	LT9	LT10	LT11
Leptodyctium riparium (amblystegium riparium)	Kneiff's feather moss	1	1		1							
Ceratophyllum demersum	Common hornwort				1							
Cladophora glomerata/Rhizoclonium hieroglyphicum	Blanketweed	2	1		1		3	4		5	2	4
Fontinalis antipyrectica	Common water moss				1					1		1
Glyceria maxima	Reed sweet-grass	2								1	4	
Helosciadium nodiflorum	Fool's watercress							1	1			
Iris pseudacourus	Yellow iris									2		
Juncus inflexus	Hard rush		1									
Lemna sp.	Duckweed				1							
Lemna minor	Common duckweed						3	2	1		2	
Mentha aquatica	Water mint						2					
Myriophyllum spicatum	Spiked water-milfoil	1			2		2	3	2			
Nuphar lutea	Yellow waterlily									2		
Persicaria amphibia	Amphibious bistort						3				1	
Persicaria hydropiper	Water pepper							1		2	2	2
Phalaris arundinacea	Reed canary-grass	1	2		1		4	4	3	3	1	2
Potamogeton natans	Broad-leaved pondweed								2			
Stuckenia pectinata	Fennel pondweed	2	3									
Nasturtium officinale agg.	Watercress		1									
Schoenoplectus lacustris	Common club-rush						5	5	2			
Solanum dulcamara	Woody nightshade				1					R		
Sparganium emersum	Unbranched bur-reed				3		2		2		2	
Sparganium erectum	Branched bur-reed	2			2		3	3	2		2	
Typha latifolia	Common bulrush										2	
Zannichellia palustris	Horned pondweed	1	6		5							
INNS												
Impatiens glandulifera	Himalayan balsam	2	B		1		B	B	B	B	B	
Elodea nuttallii	Nuttall's waterweed	1	1		1				2			
Other noted species												
Persicaria sp.	Bistorts/water pepper										R	R
Lythrum salicaria	Purple loosestrife						R					B
Salix sp.	Willow											B
Crataegus sp.	Hawthorn											B
Epilobium sp.	Willowherb						R				R	
Convolvulaceae sp.	Bindweed									R		
Carex sp.	Sedges									R		
Ranunculus repens	Creeping buttercup									A		
Scrophularia sp.	Figwort						R					

Where plant taxa lack a taxa coverage value and instead are described by their location in channel, R = Riparian, B = found on Banks and A = Amphibious

Appendix K INNS taxa list

Grid references for continued monitoring locations redacted

Table K1: INNS taxa list for the River Trent (Lower)

Scientific name	Common name	NGR	Quantity (inverts)	Density (%) or Abundance (DAFOR)	Group (Macrophyte, Invert)
LT4					
Impatiens glandulifera	Himalayan balsam	[redacted]	-	5	Macrophyte
Elodea canadensis	Canadian waterweed		-	10	Macrophyte
Impatiens glandulifera	Himalayan balsam		-	2	Macrophyte
Impatiens glandulifera	Himalayan balsam		-	1	Macrophyte
Potamopyrgus antipodarum	New Zealand mud snail		-	0.5	Invert
Elodea canadensis	Canadian waterweed		-	10	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	0.5	Macrophyte
Corbicula fluminea	Asian clam		1		Invert
Hydrocotyle ranunculoides	Floating pennywort		-	0.1	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	0.01	Macrophyte
-	No INNS observed		-	-	-
LT5					
Chelicorophium curvispinum	Caspian mud shrimp		100	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		10	-	Invert
Physella acuta/gyrina	A bladder snail		1	-	Invert
Potamopyrgus antipodarum	New Zealand mud snail		20	-	Invert
Chelicorophium curvispinum	Caspian mud shrimp		60	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		60	-	Invert
Potamopyrgus antipodarum	New Zealand mud snail		10	-	Invert
Chelicorophium curvispinum	Caspian mud shrimp		10	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		20	-	Invert
Potamopyrgus antipodarum	New Zealand mud snail		1	-	Invert
Physella acuta/gyrina	A bladder snail		1	-	Invert
Chelicorophium curvispinum	Caspian mud shrimp		30	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		15	-	Invert

Scientific name	Common name	NGR	Quantity (inverts)	Density (%) or Abundance (DAFOR)	Group (Macrophyte, Invert)
Potamopyrgus antipodarum	New Zealand mud snail	[redacted]	6	-	Invert
Chelicorophium curvispinum	Caspian mud shrimp		20	-	Invert
Potamopyrgus antipodarum	New Zealand mud snail		10	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		4	-	Invert
Dreissena polymorpha	Zebra mussel		1	-	Invert
Chelicorophium curvispinum	Caspian mud shrimp		4	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		1	-	Invert
Physella acuta/gyrina	A bladder snail		2	-	Invert

Table K2: INNS taxa list for the River Tame

Scientific name	Common name	NGR	Quantity (inverts)	Density (%) or Abundance (DAFOR)	Group (Macrophyte, Invert)
TA2					
Impatiens glandulifera	Himalayan balsam	[redacted]	-	1	Macrophyte
Dikerogammarus	Demon/killer shrimp		-	-	Invert
Impatiens glandulifera	Himalayan balsam		-	1	Macrophyte
Dikerogammarus	Demon/killer shrimp		-	-	Invert
Impatiens glandulifera	Himalayan balsam		-	-	Macrophyte
Reynoutria japonica	Japanese knotweed		-	1	Macrophyte
Impatiens glandulifera	Himalayan balsam		-	1	Macrophyte
Heracleum mantegazzianum	Giant hogweed		-	0.01	Macrophyte
TA6					
Impatiens glandulifera	Himalayan balsam		-	10	Macrophyte
Impatiens glandulifera	Himalayan balsam		-	1	Macrophyte
Impatiens glandulifera	Himalayan balsam		-	-	Macrophyte
-	NO INNS OBSERVED		-	-	Macrophyte
Impatiens glandulifera	Himalayan balsam		-	-	Macrophyte
Impatiens glandulifera	Himalayan balsam		-	4	Macrophyte

Table K3: INNS taxa list for the South Forty Foot Drain

Scientific name	Common name	NGR	Quantity (inverts)	Density (%) or Abundance (DAFOR)	Group (Macrophyte, Invert)
SFFD1					
-	NO INNS OBSERVED	[redacted]			
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		5	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		1	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		4	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		10	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	F	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		5	-	Invert
SFFD2					
Elodea nuttallii	Nuttall's waterweed		-	F	Macrophyte
Azolla filiculoides	Water fern		-	O	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		200	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	F	Macrophyte
Azolla filiculoides	Water fern		-	O	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		50	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	A	Macrophyte
Azolla filiculoides	Water fern		-	R	Macrophyte
Azolla filiculoides	Water fern		-	O	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		20	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Azolla filiculoides	Water fern		-	O	Macrophyte
Azolla filiculoides	Water fern		-	F	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	F	Macrophyte

Grid references for continued monitoring locations redacted

Scientific name	Common name	NGR	Quantity (inverts)	Density (%) or Abundance (DAFOR)	Group (Macrophyte, Invert)
Crangonyx pseudogracilis/floridanus	A freshwater shrimp	[redacted]	4	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Azolla filiculoides	Water fern		-	O	Macrophyte
Dreissena polymorpha	Zebra mussel		40	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
SFFD3					
Elodea nuttallii	Nuttall's waterweed		-	A	Macrophyte
Azolla filiculiodes	Water fern		-	A	Macrophyte
Rangia cuneata	Gulf wedge clam		2	-	Invert
Mytlopsis leucophaeta	False dark mussel		10	-	Invert
Dreissena polymorpha	Zebra mussel		4	-	Invert
Azolla filiculiodes	Water fern		-	O	Macrophyte
Azolla filiculiodes	Water fern		-	O	Macrophyte
Azolla filiculiodes	Water fern		-	O	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	A	Macrophyte
Azolla filiculiodes	Water fern		-	O	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	A	Macrophyte
Azolla filiculiodes	Water fern		-	O	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Buddeja sp.	Butterfly bush		-	ON BANK TOP (O)	Macrophyte

Table K4: INNS taxa list for the Fossdyke canal

Scientific name	Common name	NGR	Quantity (inverts)	Density (%) or Abundance (DAFOR)	Group (Macrophyte, Invert)
FC1					
Azolla filiculoides	Water fern		-	O	Macrophyte
Corbicula fluminea	Asian clam		2		Invert
Dreissena polymorpha	Zebra mussel		10		Invert
Cragonyx pseudogracilis/floridanus	A freshwater shrimp		16		Invert
Azolla filiculoides	Water fern		-	O	Macrophyte
Corbicula fluminea	Asian clam		7		Invert
Dreissena polymorpha	Zebra mussel		10		Invert
Corbicula fluminea	Asian clam		9		Invert
Dreissena polymorpha	Zebra mussel		20		Invert
Azolla filiculoides	Water fern		-	O	Macrophyte
Dreissena polymorpha	Zebra mussel		20		Invert
Cragonyx pseudogracilis/floridanus	A freshwater shrimp		10		Invert
Chelicorophium curvispinum	Caspian mud shrimp		20		Invert
FC2					
Azolla filiculiodes	Water fern		-	F	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Corbicula fluminea	Asian clam		28	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		5	-	Invert
Dikerogammarus haemobaphes	Demon shrimp		5	-	Invert
Azolla filiculiodes	Water fern		-	F	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	O	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	F	Macrophyte
Dikerogammarus haemobaphes	Demon shrimp		20	-	Invert
Poatmopyrgus antipodarum	New Zealand mud snail		1	-	Invert
Azolla filiculiodes	Water fern		-	A	Macrophyte

Table K5: INNS taxa list for the River Witham

	Species	NGR	Quantity (inverts)	Density (%) or Abundance (DAFOR)	Group (Macrophyte, Invert)
RW1					
Elodea nuttallii	Nuttall's waterweed		-	A	Macrophyte
Azolla filiculoides	Water fern		-	D	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		5	-	Invert
Elodea nuttallii	Nuttall's waterweed		-	A	Macrophyte
Azolla filiculoides	Water fern		-	A	Macrophyte
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		5	-	Invert
Dikerogammarus haemobaphes	Demon shrimp		5	-	Invert
Azolla filiculoides	Water fern		-	D	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	A	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	F	Macrophyte
Azolla filiculoides	Water fern		-	F	Macrophyte
Dreissena polymorpha	Zebra mussel		100	-	Invert
Dikerogammarus haemobaphes	Demon shrimp		5	-	Invert
Crangonyx pseudogracilis/floridanus	A freshwater shrimp		10	-	Invert
Azolla filiculoides	Water fern		-	D	Macrophyte
Elodea nuttallii	Nuttall's waterweed		-	D	Macrophyte

Appendix L eDNA

Fish eDNA

Table L1: Fish identification from eDNA survey for sites on River Tame and associated watercourses

Species	Common Name	eDNA Similarity (%)	Proportion of sequencing output					
			Broad Meadow D/S	Broad Meadow U/S	Lea Marston D/S	Lea Marston U/S	Water Orton D/S	Water Orton U/S
Anguilla Anguilla	European eel	100	0	0.09	0	0	0	0
Clupea sp.	Herring species	100	0	0	0	0	0	0
Cobitis taenia	Spined loach	100	0.72	1.31	0	0	0	0
Abramis brama	Common bream	100	0.21	0.47	0	0	0	0
Alburnus alburnus	Bleak	100	0.2	0.23	0	0	0.07	0
Barbus barbus	Barbel	99.43	0.04	0	0	0	0	0
Cyprinus carpio	Carp	100	0	0.05	0	0	0	0
Gobio gobio	Gudgeon	100	2.84	2.56	11.01	0	1.72	1.27
Leucaspius delineatus	Sunbleak	100	0	0	0	0	0	0
Leuciscus leuciscus	Dace	100	3.53	1.06	0.29	0	0.28	0
Phoxinus phoxinus	Minnow	98.86	18.04	19.6	2.55	0	29.73	32.33
Rutilus rutilus	Roach	100	22.16	18.9	25.19	0	0.67	0.04
Squalius cephalus	Chub	100	6.71	5.71	1.43	60.65	0.45	0.48
Tinca tinca	Tench	100	0.63	0.68	0	0	0	0
Blicca bjoerkna	Silver bream	100	0	0	0	0	0	0
Barbatula barbatula	Stone loach	100	11.4	10.62	1.84	13.12	19.2	21.71

Species	Common Name	eDNA Similarity (%)	Proportion of sequencing output					
			Broad Meadow D/S	Broad Meadow U/S	Lea Marston D/S	Lea Marston U/S	Water Orton D/S	Water Orton U/S
Esox Lucius	Northern pike	100	1.65	2.27	41.07	0	0	0.03
Gasterosteus aculeatus	Three-spined stickleback	100	4.49	4.27	12.75	26.22	40.99	41.15
Pungitius pungitius	Nine-spined stickleback	100	1.06	0.49	0	0	0	0
Dicentrarchus labrax	Bass	100	0	0	0	0	0	0
Gymnocephalus cernua	Ruffe	100	0.23	0.19	0	0	0	0
Perca fluviatilis	Perch	100	19.27	18.88	3.88	0	0.15	0.18
Sander lucioperca	Zander	100	0	0	0	0	0	0
Sparus aurata	Gilt-head bream	100	0	0	0	0	0	0.03
Spondyliosoma cantharus	Black sea bream	100	0.16	0	0	0	0	0
Platichthys flesus	Flounder	100	0	0	0	0	0	0
Salmo salar	Atlantic salmon	100	0	0	0	0	0	0
Salmo trutta	Trout	100	0	0.12	0	0	0	0
Cottus gobio	European bullhead	100	6.67	12.5	0	0	6.74	2.77

Table L2: Fish identification from eDNA survey for sites on River Trent and associated watercourses

Species	Common Name	Similarity	Proportion of sequencing output (%)					
			Cromwell Weir D/S	Cromwell Weir U/S	Hazelford Weir D/S	Hazelford Weir U/S	Gunthorpe Weir D/S	Gunthorpe Weir U/S
Anguilla anguilla	European eel	100	1.16	0.26	16.43	1.9	0.63	0.96
Clupea sp.	Herring species	100	0.28	0	0	0	0	0
Cobitis taenia	Spined loach	100	0.75	0.03	0.16	0	0.08	0

Species	Common Name	Similarity	Proportion of sequencing output (%)					
			Cromwell Weir D/S	Cromwell Weir U/S	Hazelford Weir D/S	Hazelford Weir U/S	Gunthorpe Weir D/S	Gunthorpe Weir U/S
Abramis brama	Common bream	100	1.04	0.23	4.98	10.08	0.71	1.08
Alburnus alburnus	Bleak	100	0.1	0.03	0.22	0.18	3.42	0.21
Barbus barbus	Barbel	99.43	0.54	0.11	0.3	0.12	0	0
Cyprinus carpio	Carp	100	0.08	0	0.12	0.17	0	0
Gobio gobio	Gudgeon	100	14.43	0.27	0.88	1.26	0.88	0.81
Leucaspius delineatus	Sunbleak	100	0	0	0.04	0	0.04	0
Leuciscus leuciscus	Dace	100	7.18	90.3	4.44	3.65	6.43	10.26
Phoxinus phoxinus	Minnow	98.86	0.1	0.13	0.08	0.11	0.05	0
Rutilus rutilus	Roach	100	27.38	2.91	23.49	24.41	63.92	45.91
Squalius cephalus	Chub	100	15.87	1.93	4.81	6.42	3.1	1.09
Tinca tinca	Tench	100	0.08	0	0	0	0	0
Blicca bjoerkna	Silver bream	100	0	0	0.05	0	0	0
Barbatula barbatula	Stone loach	100	0.09	0.03	0.2	0.37	0.11	0
Esox lucius	Northern pike	100	23.67	0.92	37.77	42.59	13.86	28.16
Gasterosteus aculeatus	Three-spined stickleback	100	0.23	0	0	0	0.89	0
Pungitius pungitius	Nine-spined stickleback	100	0	0	0	0	0	0
Dicentrarchus labrax	Bass	100	0	0	0	0	0.08	0
Gymnocephalus cernua	Ruffe	100	0.1	0.03	0.58	0.07	0.12	0
Perca fluviatilis	Perch	100	5.21	2.25	4.15	6.81	4.75	11.48
Sander lucioperca	Zander	100	0.11	0	0	0	0	0
Sparus aurata	Gilt-head bream	100	0	0	0	0	0	0

Species	Common Name	Similarity	Proportion of sequencing output (%)					
			Cromwell Weir D/S	Cromwell Weir U/S	Hazelford Weir D/S	Hazelford Weir U/S	Gunthorpe Weir D/S	Gunthorpe Weir U/S
Spondyliosoma cantharus	Black sea bream	100	0	0	0	0	0	0
Platichthys flesus	Flounder	100	0.86	0.09	0	0	0	0
Salmo salar	Atlantic salmon	100	0.08	0	0	0	0	0
Salmo trutta	Trout	100	0	0	0.06	0	0.06	0
Cottus gobio	European bullhead	100	0.67	0.49	1.24	1.85	0.86	0.04

INNS eDNA

The use of eDNA allowed for the identification of waterbodies with INNS presence

Table L3: Mussel and clam taxa identification from eDNA survey

Species	Common Name	eDNA Similarity (%)	Proportion of sequencing output (%)											
			FC1	FC2	LT4 -	LT5	LT6	RW1	SC1	SFFD	SFFD2	SSFD3	TA2	TA6
Cerastoderma edule	Common cockle	100	0	0	0	0	0	0	0	0	0	0.324	0	0
*Dreissena polymorpha**	Zebra mussel*	100	63.589	70.118	0	52.167	1.988	99.875	2.875	0	21.307	0.082	0	0.471
*Dreissena rostriformis**	Quagga mussel*	100	0	0	0	0	0	0	0.125	0	0	0	0	0
*Mytilopsis leucophaeata**	False dark mussel*	100	0	0	0	0	0	0	0	0	74.063	1.139	0	0
Euglesa casertanum	Pea clam	100	0	0.054	0	0	0	0	0.189	0	0	0	0	0.061
Euglesa subtruncata/henslowana	Short-ended pea mussel	100	0	2.618	0	0	0	0	2.369	0	0	0	0	0.751
Euglesa subtruncata	Short-ended pea mussel	100	0	0	0	0	0	0	0.35	0	0	0	0	0
Euglesa subtruncata	Short-ended pea mussel	99.187	0	0.419	0	0	0.066	0	1.47	0	0	0	22.896	0.382
Euglesa henslowana/Pisidium supinum	Henslow's pea mussel/Humpbacked pea clam	100	0	0	0	0	0	0	0.277	0	0	0	0	0
Musculium lacustre	Capped orb mussel	100	0	0.079	0	0	0	0	0	0	0.283	0	0	0
Odhneripisidium moitessierianum	Moitessier's pea clam	100	0	0.375	0	0	0	0	0.477	0	0	0	0	0
Pisidium amnicum	Greater European pea clam	99.18	0	0.074	0	0	0.08	0	13.518	0	0	0	0	0
Pisidium dorbignyi	Iridescent pea mussel	99.187	0	0.087	0	0	0	0	0.215	0	0	0	0	0.47
Pisidium hibernicum	Globular pea mussel	100	0	0.184	0	0	0	0	1.621	0	0	0	0	0.324
Pisidium milium	Quadrangular pea mussel	100	0	0.054	0	0	0	0	0	0	0	0	0	0.185

Species	Common Name	eDNA Similarity (%)	Proportion of sequencing output (%)											
			FC1	FC2	LT4 -	LT5	LT6	RW1	SC1	SFFD	SFFD2	SSFD3	TA2	TA6
Pisidium nitidum	Shining pea clam	100	0	1.113	0	0	0.667	0	0.928	7.345	0	0	0	1
Pisidium personatum	Red-crusted pea mussel	100	0	0	0	0	0	0	0.657	0	0	0	21.192	0
Pisidium supinum	Humpbacked pea clam	100	0	0	0	0	0.13	0	0.16	0	0	0	0	0.227
Sphaerium corneum	European fingernailclam	100	0	6.99	100	1.506	5.765	0.125	59.268	92.655	0	0.082	55.912	93.726
Sphaerium rivicola	River orb mussel	100	0	0	0	0.056	0	0	9.369	0	0	0	0	0.071
*Corbicula fluminea**	Asian clam*	100	36.411	17.835	0	46.271	91.304	0	6.132	0	4.347	0.144	0	2.332
*Rangia cuneata**	Gulf wedge clam*	100	0	0	0	0	0	0	0	0	0	98.23	0	0

The use of '' by a species name denotes it as a notable INNS – non-native and highly invasive.*

Table L4: American signal crayfish (ASC) presence

Site ID	Waterbody	ASC qPCR assay	Presence confirmed
FC1	Fossdyke Canal	0/12	-
FC2	Fossdyke Canal	0/12	-
LT4	Lower Trent	0/12	-
LT6	Lower Trent	1/12	Y
LT5	Lower Trent	12/12	Y
SC1	Sawley Cut	3/12	Y
RW	River Witham	0/12	-
SFFD1	South Forty Foot Drain	0/12	-
SFFD2	South Forty Foot Drain	0/12	-
SFFD3	South Forty Foot Drain	0/12	-
TA2	Tame	0/12	-
TA6	Tame	12/12	Y

Where ASC qPCR assay is the number of assays, out of 12 replicates per sample, in which American signal crayfish was positively detected within from the collected sample. Presence confirmed with a 'Y' = Yes.

Appendix M Water Quality standards

Table M1: Criteria for identifying the types of river to which the dissolved oxygen, biochemical oxygen demand and ammonia standards for rivers apply

Site Altitude	Alkalinity (as mg/1 CaCO3)				
	Less than 10	≥10 to <50	≥50 to <100	≥100 to <200	Over 200
Under 80 metres	Type 1	Type 2	Type 3	Type 5	Type 7
Over 80 metres			Type 4	Type 6	

Table M2: Biochemical oxygen demand (BOD) standards for rivers

Biochemical oxygen demand (mg/L)				
	(90 percentile)			
Type	High	Good	Poor	Moderate
1, 2, 4, 6 and salmonid	3	4	6	7.5
3, 5 and 7	4	5	6.5	9

Table M3: Ammonia standards for rivers

Total Amonia as nitrogen (mg/L)				
	(90 percentile)			
Type	High	Good	Poor	Moderate
1, 2, 4, 6 and salmonid	0.2	0.3	0.75	1.1
3, 5 and 7	0.3	0.6	1.1	2.5

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