A47 Wansford to Sutton Dualling

Scheme Number: TR010039

Volume 6
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APFP Regulation 5(2)(a)

Planning Act 2008

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

July 2021

Infrastructure Planning

Planning Act 2008

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

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ENVIRONMENTAL STATEMENT APPENDICES
Appendix 8.5 - Aquatic Invertebrate Survey Report (River Nene)

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010039
Application Document Reference	TR010039/APP/6.3
BIM Document Reference	HE551494-GTY-EBD-000-RP-LB-30018
Author:	A47 Wansford to Sutton Project Team, Highways England

Version	Date	Status of Version
Rev 0	July 2021	Application Issue

A47 Wansford (River Nene) Aquatic Macroinvertebrate and Bivalve Diversity Report 2020

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Issue/revision	1
Remarks	
Prepared by	AJK
Date	November 2020
Checked by	TRA
Authorised	TRA

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1 Introduction

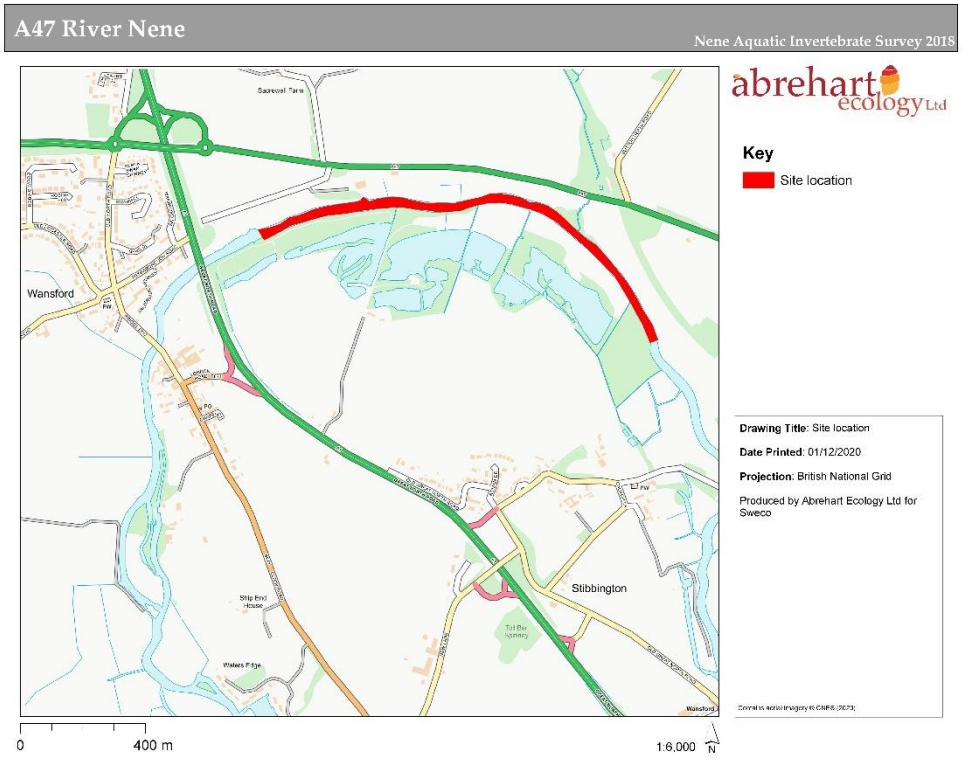
Abrehart Ecology was commissioned by SWECO to carry out a monitoring survey of the diversity of aquatic invertebrate species (including bivalves) following development works undertaken as part of the A47 widening near Wansford. The survey acts to monitor abundance of species of conservation interest (particularly the depressed river mussel *Pseudanodonta complanata* and the fish spined loach *Cobitis taenia*) recorded in previous surveys, in the section of the River Nene adjacent to the A47, that may have been impacted by pollutants and run-off during construction works.

Wansford is located approximately 7.5km west of Peterborough in Cambridgeshire, and is bisected by the River Nene (Figure 1). The sample sites were located along the River Nene (including one tributary stream) to the east of the village, covering sections of the river that are closest to the proposed road widening works.

The aim of the survey detailed in this report was to monitor aquatic invertebrate and mollusc diversity following development works (measured against the 2017 baseline survey and 2018 update surveys). This can then be used to inform mitigation, future monitoring, and assist the effective management of the site. The main survey objectives were to provide information on:

- Species richness (of macro-invertebrates and bivalves);
- Species abundance (of macro-invertebrates and bivalves); and
- The continued presence and extent of any species of conservation interest, such as *Pseudanodonta complanate* and *Cobitis taenia.*

Figure 1. Location of survey area.



2 Methods

Sampling points were distributed approximately 100m apart along the River Nene, as close as possible to sample locations used in the 2017 baseline survey and 2018 update survey (Abrehart Ecology, 2017 and 2018, Figure 2). Sample collection was undertaken by a pair of surveyors, including an experienced on-site surveyor (Toby Abrehart) and a second team member responsible for recording ditch features and assisting with sample collection (Ali Killingsworth). Sampling was undertaken in June and August 2020.

2.1 Aquatic invertebrate sampling

Two samples were collected using ten-second sweeps of a net with 0.5mm mesh. Sweeps were repeated three times in different sections of the ditch profile, i.e. floating vegetation (where present), the benthic layer and the submerged edge of the nearside bank. Once collected each sample was placed into a 5-litre bucket and preserved in 99.9% ethanol for long-term storage.

For identification, all invertebrates were separated from the retained sediment, detritus and vegetation under 40 - 80x stereo, binocular microscopes. All specimens were then separated into major taxonomic groups, preserved in fresh 99.9% ethanol, and referred to an appropriate taxonomist for identification. Where possible, all specimens were identified to species level. Exceptions to this are groups that require specialist, time-consuming preparatory techniques such as head capsule dissection for chironomid larvae and prolonged clearing procedures for oligochaetes species. Such procedures are beyond the remit of this study.

2.2 Bivalve sampling

Nine trawl samples were taken at each survey location. The trawl net was towed slowly behind a boat and was lowered through the water until resting on the river bed. The net was then towed for approximately 25m before the contents were lifted into the boat washed and emptied into a white plastic tray for identification of aquatic species. All readily identifiable species were returned to the river and all others were retained in 2.5litre white lidded buckets for later preservation in 99.9% Isopropyl alcohol and ID in the laboratory at the Abrehart Ecology office.

2.3 SAFIS analysis

Data collected during the surveys were processed using SAFIS analysis (Site Analysis for Freshwater Invertebrate Surveys v.30.0). This was used to give an indication of the current conservation value of the River Nene, to assess water quality, and to highlight any species of conservation interest already present.

2.4 Limitations

Species within the orders Hirundinea (leeches) and Tricladida (flatworms) can be affected by preservation in ethanol (damage to eyes and genital pores – often key features of identification). During future monitoring surveys, samples should be preserved using preservatives such as Bonuin's or Fleming's fixative, as recommended by Elliott & Mann (1998) among others.

Figure 2. Locations of sampling points along the River Nene.

3 Results

Aquatic invertebrate samples were collected at 11 survey points in total along the River Nene and associated stream (Figure 2). Bivalve samples were undertaken at 10 locations along the River Nene, with four trawls carried at each sample location. The water depth was similar across all the sample points at approximately 3-4m deep, the banks were steep sided with a solid substrate across the river channel - with an exception on the east of the site on the inside of the bed in the river, here there was a higher density of *Nuphar lutea* and corresponding increase in soft sediments. The navigable sections of the river channel are regularly weed cut by the Environment Agency, as was noted on the survey day.

2017

During baseline surveys in 2017, one RDB3-listed and one Regionally Notable species were found in total during the survey (Table 1). The occurrence of species of conservation interest coincided with high overall species richness of aquatic invertebrates.

The Annex II species *Cobitus taenia* (spined loach) and *Cottus gobio* (bullhead) were also recorded within samples. *Cobitus taenia* is also listed as a Species of Principle Importance in England under Section 41of the NERC Act 2006.

Three invasive species, the amphipods *Crangonyx pseudogracilis* and *Dikerogammarus haemobaphes*, and the mollusc *Potamopyrgus antipodarum*, were found to be widespread throughout the survey area.

In total, at least 64 taxa of aquatic invertebrates were recorded during baseline surveys; of which, 49 were identified to species. The overall species richness of aquatic invertebrates varied from a minimum of nine taxa to a maximum of 23 taxa in a sample. Areas of high overall species richness were predominantly found at the eastern end of the survey area, corresponding with a generally improved water quality. Sample sites with lower diversity and reduced water quality were observed at the western end of the survey area.

Table 1. Notable, and Red-Listed species found during 2017 surveys.

RDB3	Regionally Notable	Local	Annex II	NERC S41
Musculium transversum	*Ecnomus tenellus*	*Erythroma najas*	*Cobitus taenia*	*Cobitus taenia*
Libellula fulva		*Noterus clavicornis*	*Cottus gobio*	
		Pisidium suprinum		
		Pseudanodonta complanata		
		Sphaerium rivicola		

2018

Surveys in 2018 found two RDB3-listed, one Regionally Notable, and 16 Local species in total (Table 2). The occurrence of species of conservation interest coincided with high overall species richness of aquatic invertebrates.

The Annex II species *Cobitus taenia* and *Cottus gobio* were again recorded within samples.

Four invasive species, *Crangonyx pseudogracilis, Dikerogammarus haemobaphes*, *Potamopyrgus antipodarum*, and *Dreissena polymorpha* (the zebra mussel) were found to be widespread throughout the survey area – at least two invasive species were recorded in ten of the eleven samples.

In total, at least 87 taxa of aquatic invertebrates were recorded during the update survey (2018); of which, 74 were identified to species. The overall species richness of aquatic invertebrates is greatly increased from baseline surveys undertaken in 2017. These 2018 samples varied from a minimum of 23 taxa to a maximum of 50 taxa in a sample. Areas of high overall species richness were predominantly found at the eastern and western extents of the survey area, corresponding with a generally improved water quality. Sample sites with lower diversity and reduced water quality were observed at the central / central-

eastern sections of the survey area. This differed from the baseline surveys, where high species richness was restricted to the eastern end of the survey area.

Table 2. Notable, and Red-Listed species found during 2018 surveys.

RDB3	Regionally Notable	Local	Annex II	NERC S41
Musculium transversum	*Limnephilus decipiens*	*Erythroma najas*	*Cobitis taenia*	*Cobitis taenia*
Libellula fulva		*Pisidium supinum*	*Cottus gobio*	
		Pseudanodonta complanata		
		Unio tumidus		
		Bithynia leachii		
		Ranatra linearis		

2020

Surveys in 2020 found three RDB3-listed, three Regionally Notable, and ten Local species in total (Table 2). The occurrence of species of conservation interest coincided with high overall species richness of aquatic invertebrates.

The Annex II species *Cobitus taenia* and *Cottus gobio* were again recorded within samples.

Six invasive species, *Crangonyx pseudogracilis, Dikerogammarus haemobaphes*, *Potamopyrgus antipodarum, Physella acuta, Ferrissia wautieri, Corbicula fluminea*, and *Dreissena polymorpha* (the zebra mussel) were found to be widespread throughout the survey area – at least two invasive species were recorded in ten of the eleven samples.

In total, at least 99 taxa of aquatic invertebrates were recorded during the June update survey and 95 taxa in August with a total of 124 aquatic invertebrate taxa with three species of vertebrates; of which, 104 were identified to species. The overall species richness of aquatic invertebrates is greatly increased from baseline surveys undertaken in 2017 and 2018. These 2018 samples varied from a minimum of 17 taxa to a maximum of 54 taxa in a sample. Areas of high overall species richness were predominantly found at the eastern and western extents of the survey area, corresponding with a generally improved water quality. Sample sites with lower diversity and reduced water quality were observed at the central / central-eastern sections of the survey area. This conforms to the 2018 surveys.

A total of seven non-native/invasive species were recorded in 2020 samples. As well as the previously recorded species detailed above, *Corbicula fluminea* (the Asian clam) and *Ferrissia wautieri* was recorded within dredge samples.

Table 3. Notable, and Red-Listed species found during 2020 surveys.

RDB 2 / 3	Regionally Notable	Local	Annex II	NERC S41
Libellula fulva	*Ceraclea senilis*	*Bithynia leachii*	*Cobitis taenia*	*Cobitis taenia*
Musculium transversum	*Ecnomus tenellus*	*Ecnomus tenellus*	*Cottus gobio*	
Valvata macrostoma	*Helophorus alternans*	*Erythroma najas*		
		Gyraulus laevis		
		Phryganea grandis		
		Pisidium supinum		
		Platycnemis pennipes		
		Pseudanodonta complanata		
		Sphaerium rivicola		
		Unio tumidus		

Full species lists for each sampling point are provided in the accompanying spreadsheet and appendices.

3.1.1 Sample Site 1

At least 43 taxa June and 45 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 63 taxa with 53 species identified (32 in 2018).

Table 4. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Sphaerium rivicola	1	*Crangonyx pseudogracillis*	54
		Dikerogammarus haemobaphes	26
		Potamopyrgys antipodarum	35

Table 5. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Ecnomus tenellus	1	*Crangonyx pseudogracillis*	23
Erythromma najas	15	*Dikerogammarus haemobaphes*	16
Gyraulus laevis	2	*Ferrissia waulteri*	31
Libellula fulva	6	*Physella acuta*	1
Musculium transversum	2	*Potamopyrgys antipodarum*	36
Phryganea grandis	1		

3.1.2 Sample Site 2

At least 39 taxa June and 38 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 55 taxa with 48 species identified (36 in 2018).

Table 6. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Gyraulus laevis	2	*Crangonyx pseudogracillis*	2
Helophorus alternans	1	*Dikerogammarus haemobaphes*	56
Musculium transversum	2	*Ferrissia waulteri*	3
Sphaerium rivicola	2	*Potamopyrgys antipodarum*	74
Unio tumidus	1		

Table 7. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Erythromma najas	5	*Crangonyx pseudogracillis*	6
Gyraulus laevis	2	*Dikerogammarus haemobaphes*	7
Musculium transversum	1	*Ferrissia waulteri*	5
Pisidium supinum	4	*Potamopyrgys antipodarum*	53
Unio tumidus	2		

3.1.3 Sample Site 3

At least 55 taxa June and 40 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 68 taxa with 48 species identified (20 in 2018).

Table 8. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Bithynia leachii	12	*Crangonyx pseudogracillis*	17
Gyraulus laevis	1	*Dikerogammarus haemobaphes*	51
Pisidium supinum	13	*Physella acuta*	1
Platycnemis pennipes	1	*Potamopyrgus antipodarum*	130
Pseudanodonta complanata	1		

Table 9. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Erythromma najas	18	*Crangonyx pseudogracillis*	14
Gyraulus laevis	7	*Dikerogammarus haemobaphes*	23
Libellula fulva	1	*Ferrissia waulteri*	15
Pisidium supinum	1	*Potamopyrgys antipodarum*	63

3.1.4 Sample Site 4 (tributary/stream)

At least 16 taxa June and 13 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 26 taxa with 19 species identified (24 in 2018).

Table 10. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Cottus gobio	3	*Crangonyx pseudogracillis*	2
Mesovelia furcata	1	*Dikerogammarus haemobaphes*	1
		Potamopyrgys antipodarum	42

Table 11. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
		Crangonyx pseudogracillis	1
		Ferrissia waulteri	1
		Potamopyrgys antipodarum	27

3.1.5 Sample Site 5

At least 44 taxa June and 39 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 59 taxa with 48 species identified (30 in 2018).

Table 12. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Gyraulus laevis	2	*Crangonyx pseudogracillis*	33
Libellula fulva	2	*Dikerogammarus haemobaphes*	18
Phryganea grandis	1	*Potamopyrgys antipodarum*	40
Pisidium supinum	4		
Sphaerium rivicola	2		
Valvata macrostoma	1		

Table 13. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Erythromma najas	19	*Crangonyx pseudogracillis*	3
Gyraulus laevis	1	*Dikerogammarus haemobaphes*	13
Unio tumidus	1	*Ferrissia waulteri*	19
		Potamopyrgys antipodarum	36

3.1.6 Sample Site 6

At least 35 taxa June and 47 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 58 taxa with 49 species identified (31 in 2018).

Table 14. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Gyraulus laevis	2	*Crangonyx pseudogracillis*	22
Musculium transversum	1	*Dikerogammarus haemobaphes*	23
Unio tumidus	3		

Table 15. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Ceraclea senilis	1	*Crangonyx pseudogracillis*	16
Erythromma najas	34	*Dikerogammarus haemobaphes*	64
Gyraulus laevis	4	*Ferrissia waulteri*	57
Pisidium supinum	5	*Physella acuta*	1
Unio tumidus	1	*Potamopyrgys antipodarum*	32

3.1.7 Sample Site 7

At least 33 taxa June and 46 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 49 taxa with 48 species identified (42 in 2018).

Table 16. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Gyraulus laevis	5	*Crangonyx pseudogracillis*	6
Musculium transversum	2	*Dikerogammarus haemobaphes*	16
Pisidium supinum	3	*Potamopyrgys antipodarum*	76
Pseudanodonta complanata	3		
Unio tumidus	3		

Table 17. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Cobitus taenia	2	*Crangonyx pseudogracillis*	19
Bithynia leachii	1	*Dikerogammarus haemobaphes*	13
Erythromma najas	31	*Ferrissia waulteri*	68
Gyraulus laevis	3		
Pisidium supinum	3		

3.1.8 Sample Site 8

At least 33 taxa June and 44 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 56 taxa with 46 species identified (42 in 2018).

Table 18. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Libellula fulva	1	*Crangonyx pseudogracillis*	24
Gyraulus laevis	2	*Dikerogammarus haemobaphes*	23
Pisidium supinum	1	*Potamopyrgys antipodarum*	52

Table 19. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Ecnomus tenellus	2	*Corbicula fluminea*	3
Erythromma najas	13	*Crangonyx pseudogracillis*	470
Gyraulus laevis	2	*Dikerogammarus haemobaphes*	220
Musculium transversum	1	*Ferrissia waulteri*	35
Pisidium supinum	2	*Potamopyrgys antipodarum*	74

3.1.9 Sample Site 9

At least 44 taxa June and 40 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 46 taxa with 51 species identified (46 in 2018).

Table 20. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Gyraulus laevis	3	*Corbicula fluminea*	1
Musculium transversum	3	*Crangonyx pseudogracillis*	15
Pseudanodonta complanata	1	*Dikerogammarus haemobaphes*	30

Valvata macrostoma	1	*Physella acuta*	3

Table 21. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Bithynia leachii	2	*Crangonyx pseudogracillis*	27
Erythromma najas	9	*Dikerogammarus haemobaphes*	5
Musculium transversum	1	*Ferrissia waulteri*	24
		Potamopyrgys antipodarum	76

3.1.10 Sample Site 10

At least 29 taxa June and 35 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 47 taxa with 41 species identified (30 in 2018).

Table 22. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Gyraulus laevis	3	*Crangonyx pseudogracillis*	4
Libellula fulva	1	*Dikerogammarus haemobaphes*	20
Pisidium supinum	5	*Potamopyrgys antipodarum*	35

Table 23. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Erythromma najas	5	*Corbicula fluminea*	2
Pisidium supinum	1	*Crangonyx pseudogracillis*	6
Pseudanodonta complanata	2 (dead)	*Dikerogammarus haemobaphes*	34
		Ferrissia waulteri	15
		Dreissena polymorpha	2
		Potamopyrgys antipodarum	53

3.1.11 Sample Site 11 (tributary stream)

At least 39 taxa June and 38 taxa in August of aquatic invertebrates were present within the sample; which gave a total of 40 taxa with 31 species identified (25 in 2018).

Table 24. Species of interest recorded in June

Species of conservation interest	Number recorded	Invasive species	Number recorded
Cottus gobio	5	*Potamopyrgys antipodarum*	26
Gyraulus laevis	1		

Mesovelia furcata	2

Table 25. Species of interest recorded in August

Species of conservation interest	Number recorded	Invasive species	Number recorded
Cottus gobio	1	*Potamopyrgys antipodarum*	26

3.2 SAFIS analysis

Full results from SAFIS are presented in Appendix A.

Water quality across the site was classed as "Good" or "Very Good" (Figure 3). The sample points considered to have "Good" water quality were located towards the central-eastern end of the survey area and coincide with the lowest taxa richness (of aquatic invertebrates).

All of the eleven sample sites supported at least one species of conservation interest (according to SAFIS criteria this is defined as a species listed as Notable or above), with nine sites supporting two or three supported two species of interest.

According to the CCI value produced by SAFIS, sample sites surveyed are of "Low", "Moderate", "Fairly High", and "Very High" conservation importance (Figure 6), with the "Very High" sites coinciding with the presence of RDB3 species. This assessment considers both the overall taxon richness at a sample site, and the presence of conservation priority species (for example rare species or species with limited distributions).

3.3 Rare and notable species

The eleven samples collected from the River Nene (and associated tributary stream) held five species of national importance and one species considered local. The habitat requirements, and local and national status for each are briefly detailed below:

Spined Loach *Cobitis taenia (Linnaeus, 1758)*

National Status and local status

In the UK the spined loach is restricted to five east-flowing rivers, including the River Nene. This is a species protected under Annex II species of the Habitats Directive and listed as a Species of Principle Importance in England under Section 41 of the NERC Act 2006.

Habitat

This is a bottom-dwelling fish that has a restricted microhabitat associated with its specialist feeding mechanism. It occurs patchily in east-flowing rivers, small streams to large rivers and small drainage ditches. It is a species of limited dispersal ability and populations are generally isolated from each other.

Bullhead *Cottus gobio (Linnaeus, 1758)*

National Status

The bullhead is widespread and often common in rivers across Europe.

This is a species protected under Annex II species of the Habitats Directive.

Local Status

The Bullhead is restricted in distribution across Cambridgeshire, with populations centred on the River Nene, a River Ouse with occasional records elsewhere. The population in the River Nene is considered to be of local importance.

Habitat

The bullhead is a small bottom-dwelling fish that inhabits a variety of rivers, streams and stony lakes. However, in East Anglia, it also occurs in lowland situations, on softer substrates, so long as the water is well-oxygenated and there is sufficient cover (this habitat was found across the sampling area). It is not found in badly polluted rivers.

It is considered that there will be no issues with the continued presence of this species in the River Nene, unless there are pollution incidents.

Oblong Orb Mussel *Musculium transversum (Say, 1829)*

National Status

This species is introduced in to the UK from the USA and was first recorded in 1856. Its main distribution is in the canals and river systems in central England.

Local Status

There is only one record from Cambridgeshire, this was from the River Nene at a location under the A1 road bridge. This record was made by the Environment Agency in 1995. There are no other records on the NBN database.

This surveys record in three locations in the east of the survey area is of local importance and it is recommended that additional surveys are undertaken to determine the extent of the population in this area of the River Nene.

Habitat

This species occupies a range of habitat types including lakes, slow-flowing rivers, canals, and swamps (Burch 1975, Mouthon and Loiseau 2000). It occurs most commonly on muddy substrates, but has also been found on stone and sand sediments. Juveniles can burrow into muddy sediments to depths of up to 16 cm, where they may stay in a diapause for several weeks.

Large-mouthed Valve Snail *Valvata macrostoma (Muller, 1774)*

National Status

Mainly restricted to the southern half of England, where it is a widespread and often common still water species. It has been recorded in 118 hectads from 1980-2014 (Wallace, 2016).

Local status:

There are few records for Cambridgeshire, with the nearest of these from Holme Fen Nature Reserve (approximately 15km south-east of the Site) and ditch systems near Glinton (approximately 8km north-east of the Site).

Habitat

A rare calcicole restricted to drainage ditches in marshland levels and river floodplains. It is predominantly found in stagnant or slowly moving water in well-vegetated habitats with a good diversity of species – it is often found in association with other rare/uncommon species, such as *Anisus vorticulus*, *Segmentina nitida*, and *Pisidium pseudosphaerium*. This species is at risk from eutrophication and destruction of habitats.

Scarce Chaser *Libellula fulva (Muller, 1764)*

National Status

Found across Europe, within the UK the scarce chaser is predominantly found in central, southern, and eastern England, with very few records from Wales and the north of England. There are no records from Scotland.

This species is listed as Rare (RDB3) in the UK.

Local Status

The scarce chaser is found across Cambridgeshire, with good numbers of observations from the River Nene (including records from Wansford and immediate surrounding habitats) and River Great Ouse and associated riparian habitats (such as marshes and floodplains).

Habitat

Found in lowland river floodplains, in particular slow-flowing rivers and large dykes – occasionally in mature gravel pits and nearby ponds. All of the inhabited sites have good water quality and submerged and floating vegetation, as well as prolific stands of emergent vegetation.

Threats to this species include inappropriate river management, inappropriate river management schemes, pollution, eutrophication, over-shading, changing water levels, and excessive boat traffic.

4 Discussion and Mitigation

The surveys detailed in this report assessed the diversity and conservation value of aquatic invertebrate communities at eleven locations along the River Nene (and one tributary stream), to the east of Wansford in Cambridgeshire.

The results indicate that the area is of high conservation value for aquatic invertebrates, reflected in the presence of the RDB3 species *Musculium transversum* and *Libellula fulva,* the presence of Annex II/NERC S41 species (*Cobitis taenia* and *Cottus gobio*), and supported by the results of SAFIS analysis. However, most species found (and certainly the species found in greatest abundance) were common and generalist species and invasive species were recorded throughout the survey area. Results differed from baseline surveys conducted in 2017 and 2018, areas of high overall species richness were predominantly found at the eastern and western extents of the survey area, corresponding with a generally improved water quality. Sample sites with lower diversity and reduced water quality were observed at the central / central-eastern sections of the survey area. This conforms to the 2018 surveys.

The 2020 surveys found three RDB3-listed, three Regionally Notable, and ten Local species in total (Table 2). The occurrence of species of conservation interest coincided with high overall species richness of aquatic invertebrates.

The Annex II species *Cobitus taenia* and *Cottus gobio* were again recorded within samples, the former only in the river with bullhead in the river and stream.

Seven invasive species, *Crangonyx pseudogracilis, Dikerogammarus haemobaphes*, *Potamopyrgus antipodarum, Physella acuta, Ferrissia wautieri*, *Corbicula fluminea* and *Dreissena polymorpha* (the zebra mussel) were found to be widespread throughout the survey area. It is noteworthy that in each of the three surveys a new invasive has been added to the species list, with them becoming more frequent on each of the following years. Of note this year it that the new species of freshwater limpet *Ferrissia wauteri* was found in every sample point and in good numbers, meaning it may have been missed previously or has undergone a very rapid expansion in the past two years. In addition a new species of invasive bivalve was found in two samples *Corbicula fluminea* - Asian clam mussel, this is a highly invasive species that can very quickly dominate the mollusc fauna and will need to be carefully monitoured to assess the changes in distribution along this section of the river.

In total, 99 taxa of aquatic invertebrates were recorded during the June update survey and 95 taxa in August with a total of 124 aquatic invertebrate taxa with three species of vertebrates; of which, 104 were identified to species. The overall species richness of aquatic invertebrates is increased from baseline surveys undertaken in 2017 and follow-up surveys in 2018.

None of these species should be affected by the proposed works on the routing of the A47. Continued threats to all the species mentioned above are water pollution and increased sedimentation through excessive bank works.

Several invertebrates recorded in samples were not identified to species level, due to these groups requiring either specific preservation techniques or identification skills which are beyond the remit of this study. Consequently, disparity exists between the SAFIS species richness results and taxon richness actually recorded. This is caused by the spreadsheet used for the analysis (which requires a certain level of identification) and has been taken into account in this assessment.

Of note was the finding of 51 species of molluscs and bivalve, which represents 25% of the UK mollusc fauna, which is impressive for a small sample area and considering no terrestrial habitat was specifically searched, even though a few terrestrial species were found washed into the samples.

Continued care should be taken to avoid hazardous materials from construction works entering the watercourses, to prevent impact to these important habitats, and spill kits should be kept with each vehicle. Should hazardous materials enter the watercourses, then the area should be re-surveyed to assess the impact to invertebrate fauna.

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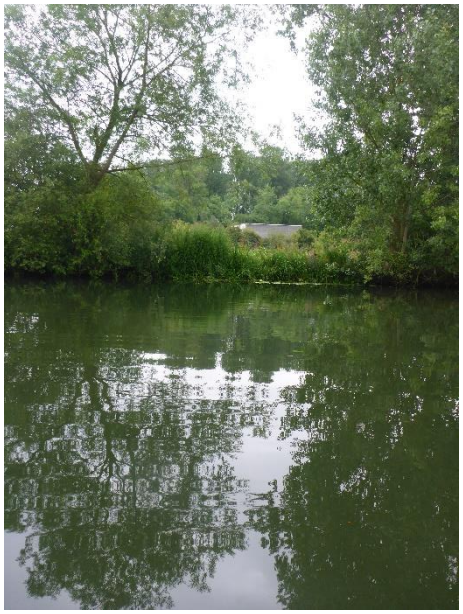
Appendix A – Site photos


Sample Point 1


Sample Point 2


Sample Point 3

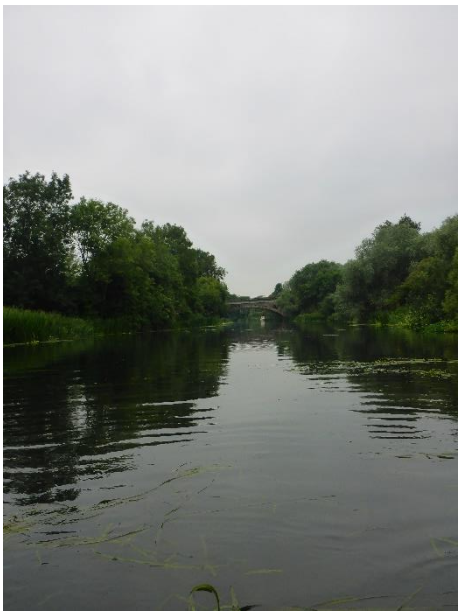

Sample Point 4


Sample Point 5


Sample Point 6


Sample Point 7


Sample Point 8


Sample Point 9


Sample Point 10


Sample Point 11

Appendix B – Full Species Lists – June

BMWP group	Family	Species	1	2	3	4	5	6	7	8	9	10	11
Flatworms													
Tricladida													
	Planariidae												
		Tricladida sp.	2	2	1					1			
Snails													
Gastropoda													
	Acroloxidae												
		Acroloxus lacustris	4	1	10		6	6	9	5	4	3	
	Bithyniidae												
		Bithynia leachii			12								
		Bithynia tentaculata	8	10	17		6	10	7	17	11	9	
	Cochlicopoidae												
		Cochlicopa lubrica			1								
	Lymnaeidae												
		Lymnaea stagnalis		2	2		1	4		3	1		
		Radix auricularia	5	2	8		6			2	3	1	
		Radix balthica	3	9	4		9	5	9	3	7	4	
	Neritidae												
		Theodoxus fluviatilis	3				4	3	7	3	19		12
	Physidae												
		Physa fontinalis	2		1		7	4	6	9	3	2	
		Physella acuta			1						3		
	Planorbidae												
		Ancylus fluviatilis	1	1	1	2	1		1				1
		Anisus vortex	4	6	16		7	2	4	5	4	1	2
		Bathyomphalus contortus			5								1

		Ferrissia wautieri		3									
		Gyraulus albus	3	3	3		2	1					
		Gyraulus crista	1	2	1	2	1		1	3			2
		Gyraulus laevis		2	1		2	2	5	2	3	3	1
		Hippeutis complanatus			3		1						
		Planorbis carinatus			2								
		Planorbis planorbis	2	1	1		1	3			2		
	Succineidae												
		Oxyloma elegans	3		1						1		
		Succinea putris	1		2		3		2	1	1		2
	Tateidae												
		Potamopyrgus antipodarum	35	74	130	42	40		76	52		35	26
	Valloniidae												
		Vallonia excentrica			1								
	Valvatidae												
		Valvata cristata		2	1		1						
		Valvata macrostoma					1				1		
		Valvata piscinalis	6	5	1		6	2	5	4	15	5	
	Viviparidae												
		Viviparus viviparus	13	23	9		66	8	14	51	42	9	
Limpets and mussels													
Bivalvia													
	Cyrenidae												
		Corbicula fluminea									1		
	Sphaeriidae												
		Musculium lacustre						5		3	1	4	
		Musculium transversum		2				1	2		3		
		Pisidium amnicum	3	2	24		23	7	17	18	9	24	
		Pisidium casertanum			5				1			4	

		Pisidium henslowanum	13		16		7		3	2	6	5	
		Pisidium milium	8	13									
		Pisidium nitidum		5	3		2	1	4		5	3	
		Pisidium obtusale			7						1		
		Pisidium personatum											9
		Pisidium sp.		47	28		21	9	22		13	21	
		Pisidium subtruncatum					3	3					
		Pisidium supinum			13		4		3	1		5	
		Sphaerium corneum	4		43		2	5	1		45		
		Sphaerium rivicola	1	2			2						
		Sphaerium sp. (juvenile)	24										
	Unionidae												
		Anadonta anatina	1				3						
		Anadonta cygnea	1										
		Pseudanodonta complanata			1				3		1		
		Unio pictorum	1	1	1						1		
		Unio tumidus		1				3	3				
Worms													
Oligochaetidae													
	Oligochaetidae												
		Oligochaetidae sp.	4		1			6			1		
Leeches													
Hirudinea	Erpobdellidae												
		Erpobdella octoculata	4	1	2		2	3		2	2	1	1
	Glossiphoniidae												
		Alboglossiphonia heterclita	1		1								
		Glossiphonia complanata						2	1		1		2
		Helobdella stagnalis	1								1	1	
		Hemiclepsis marginata						1					

	Piscicolidae												
		Piscicola geometra							1				
Crustaceans													
Amphipoda													
	Asellidae												
		Asellus aquaticus	14	8	40	2	106	36	28	33	11	14	
	Corophiidae												
		Chelicorophium curvispinum	18	9	1			3	8	4	6	1	
	Crangonyctidae												
		Crangonyx pseudogracilis	54	2	17	2	33	22	6	24	15	4	
	Gammaridae												
		Dikerogammarus haemobaphes	26	56	51	1	18	23	16	23	30	20	
		Gammarus pulex		2	1	13							15
	Podonidae												
		Cladocera group	6	176			1	8	1	10	2	1	
Dragonflies and damselflies													
Odonata													
	Calopterygidae												
		Calopteryx splendens	1		2	1							13
	Coenagrionidae												
		Coenagrionidae indet.									1		
		Ischnura elegans			2								
	Libellulidae												
		Libellula fulva					2			1		1	
	Platycnemididae												
		Platycnemis pennipes			1								
True bugs													
Hemiptera													
	Corixidae												

		Corixinae indet.		1			2	1			1		
		Hesperocorixa sahlbergi											1
		Sigara dorsalis		1							1		
	Mesoveliidae												
		Mesovelia furcata				1							2
	Notonectidae												
		Notonecta glauca		1						1			
		Notonecta sp. (early instar)	2		2		1		1	7	1		
	Veliidae												
		Velia sp. (immature)											1
Beetles													
Coleoptera													
	Elmidae												
		Elmidae sp. (larvae)				17							22
		Elmis aenea				1							3
	Haliplidae												
		Haliplus lineatocollis	1										
		Haliplus sp. (larvae)				6							71
	Helophoridae												
		Helophorus alternans		1									
	Hydrophilidae												
		Anacaena limbata											1
Caddisflies													
Trichoptera													
	Goeridae												
		Goerid sp. (parasitised larvae)											
	Leptoceridae												
		Leptoceridae sp.			1								
	Limnephilidae												

		Anabolia nervosa			1								
		Limnephilus lunatus					6		1				
		Limnephilus marmoratus								1			
	Phryganeidae												
		Phryganea grandis					1						
	Molinnidae												
		Molanna angustata	1		4		3			2	1	3	
	Polycentropodidae												
		Polycentropodidae sp. (early instar)	2	1		1							
Mayflies													
Ephemeroptera													
	Baetidae												
		Centroptilum luteolum						1					
		Cloeon dipterum			3		5				4	1	
		Procloeon bifidum						1					
	Caenidae												
		Caenis luctuosa/macrura			1		1	2					
Stoneflies													
Plecoptera													
	Leuctridae												
		Leuctra hippopus											2
Alderfly													
Megaloptera													
	Sialidae												
		Sialis lutaria	1	1				1				3	
True flies													
Diptera	Chironomidae												
		Chironomidae sp. (larvae)	1032	1216	713	190	1033	190	875	311	188	318	72
	Diptera												

		Diptera sp.								2			
	Pediciidae												
		Pedicia sp. (larvae)				1							3
Sawflies													
Hymenoptera													
	Symphyta												
		Symphyta sp. (larvae)			1		5			1	1		
Other taxa													
Gasterosteiformes													
	Gasterosteidae												
		Gasterosteiformes sp.	1										
		Pungitus pungitus			3								
Scorpaeniformes													
	Cottidae												
		Cottus gobio				3							5

Appendix C – Full Species Lists – August

BMWP group	Family	Species	1	2	3	4	5	6	7	8	9	10	11
Snails													
Gastropoda													
	Acroloxidae												
		Acroluxus lacustris	1	7	29		16	3	5	19	36		1
	Bithyniidae												
		Bithynia leachii							1		2		
		Bithynia tentaculata	2	1	9			8	2	14	4	3	
	Lymnaeidae												
		Lymnaea stagnalis			1			1				1	
		Radix auricularia	2	1	5			1			1	2	
		Radix balthica	4	3	4		7	21	2		2	3	1
	Neritidae												
		Theodoxus fluviatilis	3	2	2	1	4	1	2	8		7	1
	Physidae												
		Physa fontinalis					2	4		2	1		
		Physella acuta	1					1					
	Planorbidae												
		Ancylus fluviatilis	11		12		24	23	21	28	36	13	
		Anisus vortex	1	2	3		2	2	1	3	1		2
		Bathyomphalus contortus								1	1		2
		Ferrissia wautieri	31	5	15	1	19	57	68	35	24	15	
		Gyraulus crista	1					6	1	2	3		
		Gyraulus laevis	2	2	7		1	4	3	2			
		Hippeutis complanatus			1					1			
		Planorbis planorbis		1	1					1			
	Succineidae												
		Oxyloma elegans		1									

		Succinea putris	2	2			3				2		
	Tateidae												
		Potamopyrgus antipodarum	36	53	63	27	36	32		74	76	53	26
	Valvatidae												
		Valvata cristata				1		2	4				
		Valvata piscinalis	17		3			1		7	4	3	
	Viviparidae												
		Viviparus viviparus	11	3	32		16	15	17	16	7	9	
Limpets and mussels													
Bivalvia													
	Cyrenidae												
		Corbicula fluminea								3		2	
	Dreissenoidea												
		Dreissena polymorpha										2	
	Sphaeriidae												
		Musculium lacustre		2									
		Musculium transversum	2	1						1	1		
		Pisidium amnicum	3	13	4		15	1	14	21	1	15	
		Pisidium henslowanum	7	2	9		4		4	6	3	4	
		Pisidium nitidum		2	4			6	3	3			
		Pisidium personatum	5	1	9		6	3	3	4			4
		Pisidium sp.		22	23		2	12	14	22			
		Pisidium subtruncatum	2	3	1		1		4				
		Pisidium supinum		4	1			5	3	2		1	
		Sphaerium corneum	3		4		2		3	3	2	2	
	Unionidae												
		Anodonta anatina			1		1					3	
		Pseudanodonta complanata										2 dead	
		Unio pictorum	1		1		5	3	1	1	1	3	

		Unio tumidus		2			1	1					
Worms													
Oligochaetidae													
	Oligochaetidae												
		Oligochaetidae sp.	1	60	7		2	54	47		1	4	38
Leeches													
Hirudinea	Erpobdellidae												
		Erpobdella octoculata									1	2	
	Glossiphoniidae												
		Glossiphonia complanata			1								3
		Helobdella stagnalis						1					
		Theromyzon tessulatum							1				
	Piscicolidae												
		Piscicola geometra							1				
Crustaceans													
Amphipoda													
	Asellidae												
		Asellus aquaticus	36	3			1	7	32	64	2	2	4
	Corophiidae												
		Chelicorophium curvispinum	49	15	45		24	111	46	38	10	47	
	Crangonyctidae												
		Crangonyx pseudogracilis	23	6	14	1	3	16	19	470	27	6	
	Gammaridae												
		Dikerogammarus haemobaphes	16	7	23		13	64	13	220	5	34	
		Gammarus pulex				1							12
	Podonidae												
		Cladocera group	6	1	4		20	11	14	2	2	1	
Dragonflies and damselflies													
Odonata													

	Calopterygidae												
		Calopteryx splendens	2		2		7	3	3	2		5	7
	Coenagrionidae												
		Coenagrionidae indet.	18				9	7	11	7		1	
		Erythromma najas	15	5	18		19	34	31	13	9	5	
		Ischnura elegans	39	5			4	6	8	4	4		
	Libellulidae												
		Libellula fulva	6		1								
		Orthetrum cancellatum									1		
		Sympetrum sp.					1						
True bugs													
Hemiptera													
	Gerridae												
		Gerris sp.	1							1			
	Notonectidae												
		Notonecta glauca								1			
Beetles													
Coleoptera													
	Dytiscidae												
		Nebrioporus elegans				1							
	Elmidae												
		Elmis aenea											1
		Elmis sp. (larvae)											13
	Haliplidae												
		Haliplus lineatocollis											1
	Hydrophilidae												
		Hydrobius fuscipes											1
Caddisflies													
Trichoptera													

	Ecnomidae												
		Ecnomus tenellus	1								2		
	Molinnidae												
		Molanna angustata	1	3	9		1		2	2	4		
	Leptoceridae												
		Ceraclea senilis						1					
		Oecetis sp.			1								
	Limnephilidae												
		Chaetopteryx villosa											11
		Limnephilus lunatus											11
		Limnephilus sp.						1					
	Phryganeidae												
		Phryganea grandis	1										
	Polycentropodidae												
		Cyrnus flavidus	4	1				1	4				
		Cyrnus trimaculatus						1	2		1		
		Polycentropus flavomaculatus	1			1							3
		Polycentropodidae sp. (early instar)					1						
	Psychomyiidae												
		Lype sp.						1	1				
	Sericostomatidae												
		Sericostoma personatum											7
Mayflies													
Ephemeroptera													
	Baetidae												
		Baetis scambus/fuscatus						19			15	34	
		Baetis sp.			4		14	26	12		24		
		Centroptilum luteolum	5				2		2	4			2
		Cloeon dipterum	5	3	2		2	3	5	2		1	

		Cloeon simile	1							1			
		Procloeon bifidum	1		7		26	19	14		12	26	
	Caenidae												
		Caenis luctuosa/macrura	9			5	2	2	4	6	1	1	2
	Ephemeridae												
		Ephemera vulgata		1						1			
	Ephemerellidae												
		Serratella ignita				1							9
Alderfly													
Megaloptera													
	Sialidae												
		Sialis lutaria		2				1	3		1	1	
True flies													
Diptera	Chironomidae												
		Chironomidae sp. (larvae)	178	54	100	3	307	610	558	184	213	264	12
	Diptera												
		Diptera sp.		1				1			1		1
	Tipulidae												
		Tipulidae sp. (larvae)							1	1			
Stoneflies													
Plecoptera													
	Leuctridae												
		Leuctra hippopus				1							5
	Plecoptera												
		Plectoptera sp. (damaged/early instar)				1							
Other taxa													
Cypriniformes													
	Cobitidae												
		Cobitis taenia							2				

Scorpaeniformes														
	Cottidae													
		Cottus gobio												1

Appendix D – Full SAFIS Results

Sample ID		Taxa	Specimen Count	Revised BMWP	ASPT	Families Contributing to BMWP	Water Quality	LQI	LIFE	PSI	CCI	Conservation Value
1	June	43	1321	80.9	4.26	19	Good	B	6.39	3.64	9.52	Moderate
	August	45	567	106.2	4.83	22	Good	A++	6.21	6.90	28.38	Very High
2	June	39	1697	70.4	3.91	18	Good	C	6.27	5.26	24.84	Very High
	August	38	302	95.9	5.05	19	Good	A++	6.25	0.00	27.00	Very High
3	June	55	1223	99.4	4.32	23	Good	A	6.08	3.85	10.95	Fairly High
	August	40	482	88.7	4.67	19	Good	A+	6.29	8.47	25.94	Very High
4	June	15	282	48.6	4.42	11	Moderate	C	7.08	44.44	8.89	Moderate
	August	13	45	60.8	5.53	11	Good	A+	7.44	42.86	9.00	Moderate
5	June	44	1457	96.3	4.59	21	Good	A+	6.20	3.08	29.00	Very High
	August	39	625	77.8	4.58	17	Good	A	6.50	12.00	12.32	Fairly High
6	June	35	384	72.2	4.01	18	Good	C	6.12	0.00	24.81	Very High
	August	47	1212	99.6	4.53	22	Good	A+	6.33	14.06	18.60	High
7	June	33	1143	75.4	4.19	18	Good	B	6.46	6.38	23.70	Very High
	August	45	1010	105.5	4.80	22	Good	A++	6.35	14.52	13.24	Fairly High
8	June	33	607	79	4.39	18	Good	B	6.13	0.00	22.40	Very High
	August	44	1302	104.8	4.76	22	Good	A++	6.14	6.45	24.41	Very High
9	June	44	473	80.3	4.23	19	Good	B	6.00	0.00	29.63	Very High
	August	40	544	87.9	4.40	20	Good	A	6.32	13.46	24.19	Very High
10	June	29	506	77.3	4.07	19	Good	C	6.21	0.00	22.92	Very High
	August	35	577	71.9	4.23	17	Good	B	6.57	7.69	12.00	Fairly High
11	June	23	265	77.7	4.86	16	Good	A	6.80	29.41	9.72	Moderate
	August	26	180	109.4	5.47	20	Good	A++	7.05	38.24	7.86	Moderate