ANNEX B2

Ecological Monitoring

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Grand Union Canal Transfer SRO

Affinity Water, Severn Trent Water, Canal & River Trust

Grand Union Canal Strategic Transfer – Ecological Monitoring: Phase 2 Report

Official Sensitive

Grand Union Canal Strategic Transfer – Ecological Monitoring: Phase 2 Report

Prepared for:

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Report reference: P00006490R1D1, June 2022

OFFICIAL SENSITIVE

Report status: Final

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Grand Union Canal Strategic Transfer – Ecological Monitoring: Phase 2 Report

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Revision record:

Reference	Date	Status	Comment	Author	Checker	Reviewer	Issued to
P00006490R1	14/12/2021	Draft		[redacted]			STWL
P00006490R1	17/01/2022	Draft	Addressing PMB comments	[redacted]			STWL
P00006490R1	04/02/2022	Final		[redacted]			STWL
P00006490R1	30/05/2022	Final	Addressing 3rd Line Comments	[redacted]			STWL

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1 Introduction

1.1 Background to report

The Grand Union Canal (GUC) transfer scheme is one of the Strategic Regional Option (SRO) programmes in which Affinity Water (AfW) and Severn Trent Water Ltd (STWL) are jointly funded and are working together to deliver along with the Canal & River Trust (The Trust) (the GUC Transfer project team). Using treated wastewater from Minworth Wastewater Treatment Works in Birmingham, the scheme looks to transfer water from the Midlands to the South East using the existing canal network. This report relates to the transfer of water through the canal network only. At the start of Gate 2 the scheme was considering various transfer volumes between 50Ml/d to 100Ml/d and various sub-option routes in the upper sections of the canal. The main route has now been identified as transferring from Minworth to Atherstone via a pipeline (Route 3), and being abstracted at Leighton Buzzard, an option that was identified following consultation with the Environment Agency (EA) with the aim of preventing/minimising interaction with the chalk streams which begin interacting with the GUC South of the Tring; the main route is outlined in Illustration 1.1. It is noted that this monitoring programme was scoped and implemented when three discharge routes and four abstraction routes were still under consideration, in June 2021.

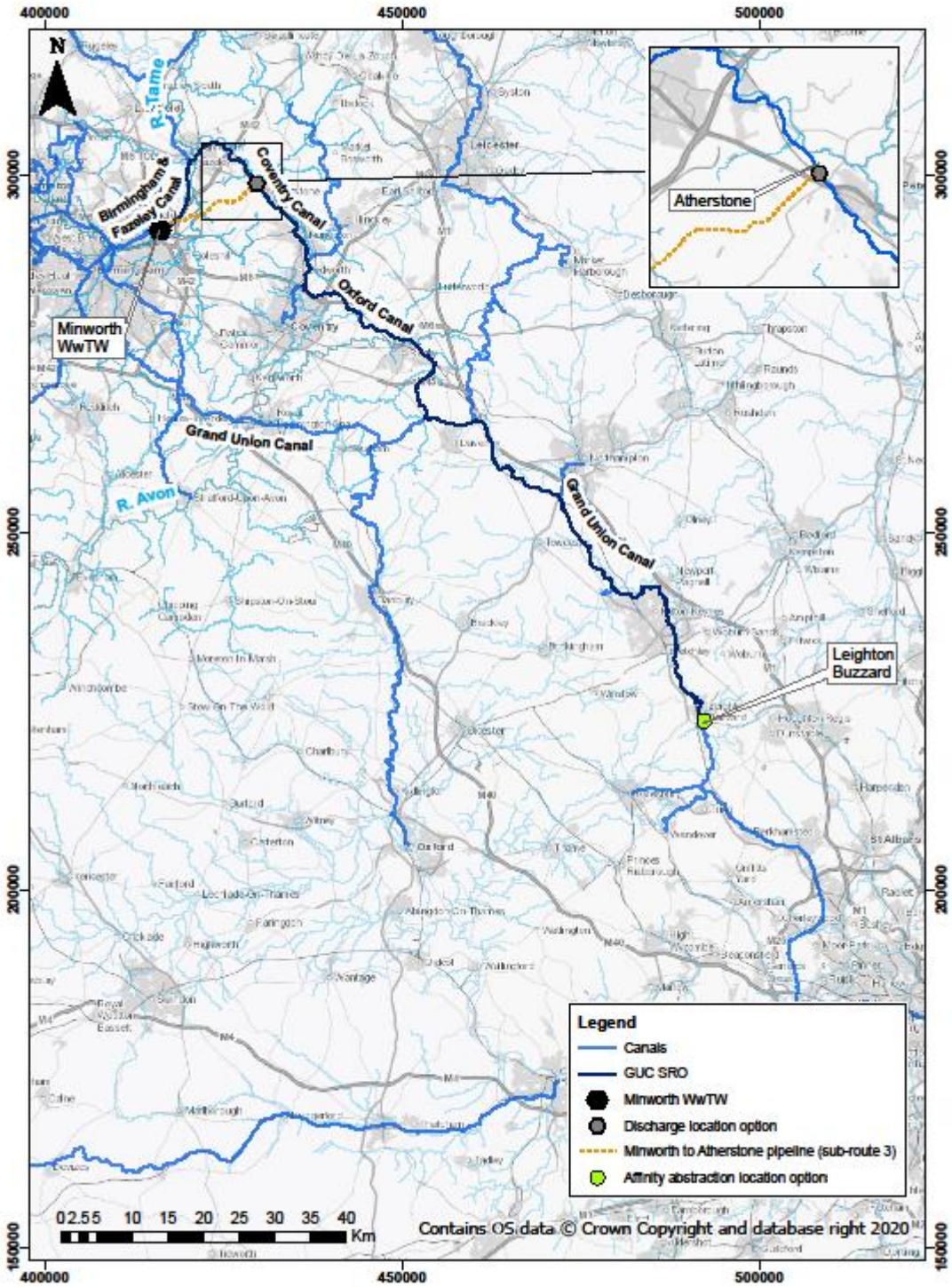

Illustration 1.1 Proposed water transfer routes relating to the GUC Strategic Transfer Scheme

The purpose of this document is to present the data collected as part of the 2021 Phase 2 ecological monitoring programme, required as part of the GUC Transfer Scheme. The GUC Strategic Transfer Project Management Board (PMB) identified the need to continue the monitoring work implemented under Gate 1 into Gate 2, in order to better establish baseline ecological conditions and, in turn, to understand the potential impacts associated with the GUC transfer scheme.

The aim of the Phase 2 monitoring programme is to build upon the data collected during Phase 1 and provide a robust and reliable assessment of ecological quality in the GUC and associated water bodies.

It is noted that:

- Where possible, data collected in 2021 will be used to complement existing datasets, and the data presented in this report should be considered alongside other workstreams – notably, the Environmental Assessments workstream, to be completed by May 2022.
- The monitoring programme undertaken in 2021 will not be the only and final set of ecological data collected as more data will be collected as repeat surveys and/or within additional reaches as this scheme progresses through the gated process.

This report presents data collected on canal and river water bodies associated with the GUC Transfer Route in 2021. The objectives of this report are:

- To present the 2021 Gate 2 survey results and, where possible compare these to the Gate 1 survey results; and
- Present recommendations for future monitoring, where necessary.

For the purposes of this report, the GUC is described in three sections:

- Upper: Birmingham & Fazeley Canal (Upper), Coventry and Ashby Canals, Oxford Canal, and GUC from Birmingham to Leamington Spa;
- Middle: GUC from Leamington Spa to Tring; and
- Lower: GUC from Tring to Hanwell.

1.2 Timeline

A timeline for the Phase 2 Ecological Monitoring project, part of the wider GUC Strategic Transfer Scheme, is detailed in Table 1.1 and further represented in Illustration 1.2.

Table 1.1 Timeline of ecological monitoring

Item	Date
Severn Trent Water, Affinity Water, Environment Agency, The Trust, Natural England: GUC Ecology Workshop	March 2020
Plan Phase 1 ecological monitoring	July – August 2020
Phase 1 ecological monitoring fieldwork	August 2020 – October 2020
Phase 1 ecological monitoring report	November 2020 – March 2021
Ecology literature review and gap analysis*	November 2020 – April 2021
Plan Phase 2 ecological monitoring	May – June 2021
Phase 2 ecological monitoring fieldwork	July 2021 – October 2021
Phase 2 ecological monitoring report	November 2021 – February 2022

Item	Date
Gate 2 Environmental Assessments workstream	October 2021 – May 2022

*The GUC ecology literature review and gap analysis is a separate piece of work, outside of the scope of the monitoring projects. However, recommendations from both workstreams were used to inform Phase 2 monitoring and Environmental Assessments works.

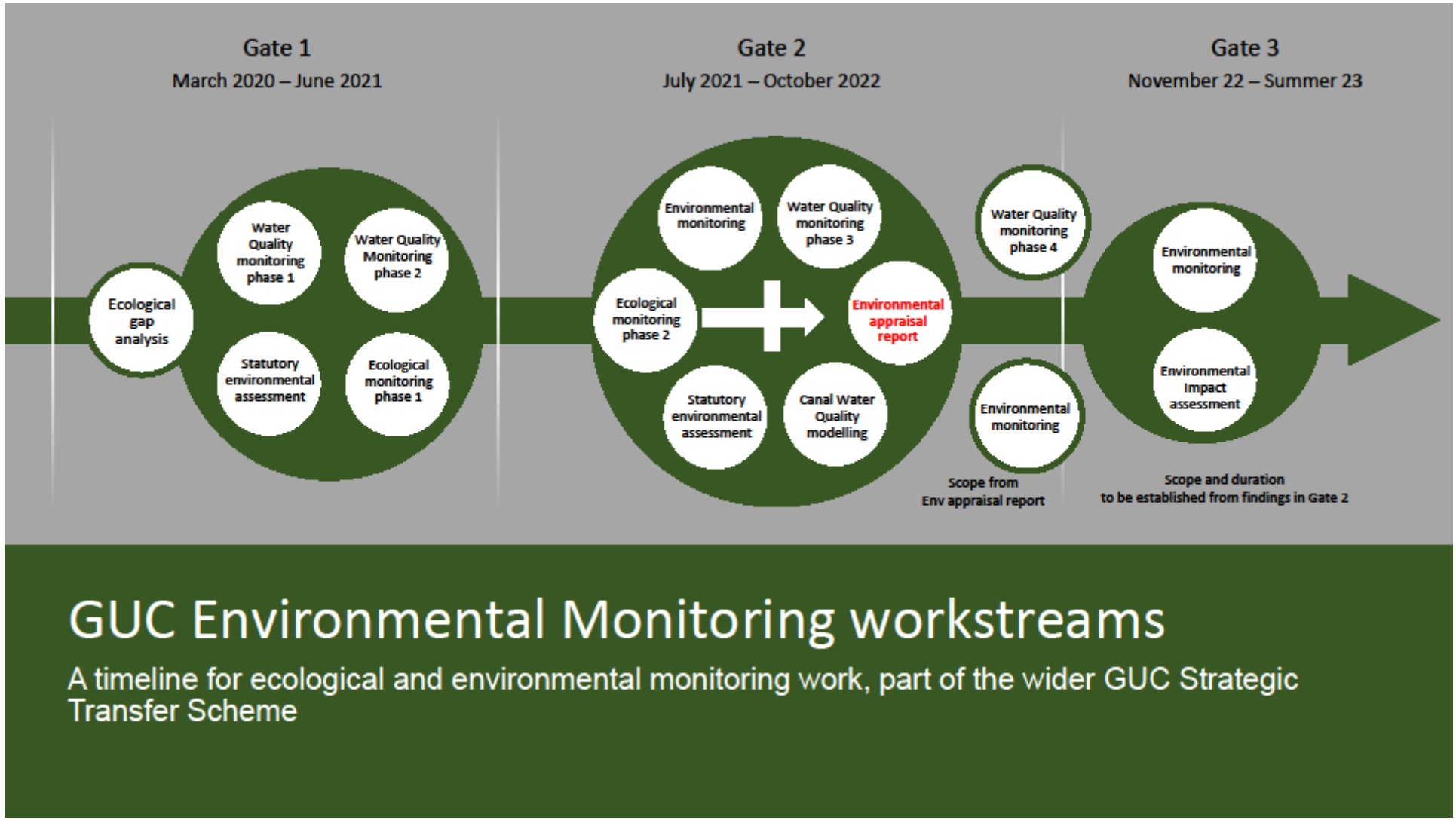

Illustration 1.2 A timeline for ecological and environmental monitoring works, as part of the wider GUC Strategic Transfer Scheme

2 Approach

2.1 Review of Gate 1 Recommendations

Recommendations for future monitoring, as presented within Phase 1 Ecological Monitoring Report (APEM, 2021) and the Gate 1 GUC Strategic Transfer – Ecological Literature Review and Gap Analysis Report (APEM, 2021), were reviewed alongside Gate 1 feedback from the relevant regulatory bodies. The recommended monitoring methods, monitoring locations, and seasonal requirements were taken into account when planning the 2021 monitoring programme.

Key recommendations from Gate 1 included:

- Continuation of Canal Chironomid Pupal Exuviae Technique (CPET) monitoring;
- Invasive non-native species (INNS) monitoring;
- Macrophyte monitoring of the chalk streams associated with the GUC (rivers Bulbourne, Gade, and Colne) – upstream and downstream of river/ canal confluences;
- Canal Predictive System of Multimetrics (PSYM); and
- Canal drawdown for fish assessment.

Recommendations for canal CPET monitoring, INNS monitoring, and macrophyte monitoring were taken forward for implementation in summer/ autumn 2021. Following consultation with the Environment Agency (EA) in June 2021, it was highlighted that for reaches of the Hertfordshire chalk streams that are subject to inputs from the GUC, there was a requirement to better characterise in-stream habitat under baseline conditions. As such, flow habitat transect surveys were undertaken in the connected chalk streams.

Engagement with the EA found that full characterisation of canal macroinvertebrate and macrophyte communities via Canal PSYM was not required as part of the 2021 monitoring programme, providing that INNS (both macroinvertebrate and plant species) were otherwise suitably surveyed; therefore, Canal PSYM was not taken forward for completion in 2021. It is understood fish assessment through eDNA analysis, and three run catch depletion electro fishing will be undertaken as part of the GUC Environmental Assessments workstream, and therefore further assessment of fish populations sits outside the scope of this report and will be reported separately.

2.2 Monitoring locations 2021

Monitoring locations for the Phase 2 Ecological Monitoring programme were finalised in June 2021, following consultation with the EA.

2.2.1 Canal CPET

Survey locations were selected in the Upper, Middle and Lower sections of the GUC to provide representative coverage across the study area and pick up sensitive habitat locations, whilst aligning with existing GUC Transfer Scheme monitoring programmes from Gate 1.

Monitoring locations were mainly in-line with those sampled in 2020, under the Phase 1 monitoring programme, with only a few variations. As the Birmingham and River Tame options for conveying water into the canal network are no longer under consideration, monitoring locations relating to the River Tame and the western arm of the GUC network as it passes through Birmingham were dropped from the 2021

programme[1]. Monitoring effort was instead re-allocated to reaches of the canal that were less well characterised under Gate 1 assessment (Daventry to Leighton Buzzard); new sites in 2021 are highlighted in Table 2.1.

Table 2.1 Canal CPET monitoring locations 2021

Location ID	Location Name	Grid Reference	Notes
GUC, Birmingham, Coventry, and Oxford canals – Upper Section			
CP-01	Birmingham & Fazeley Canal Minworth	[redacted]	Located at Minworth.
CP-02	Coventry Canal, Fazeley		Located on Coventry canal south of Birmingham and Fazeley canal junction
CP-04	Coventry Canal, Atherstone		Located before junction with Ashby canal
CP-04a	Oxford Canal, Willoughby		Located north of junction with GUC
CP-07	GUC, Leamington Trough Pound		Located north of Oxford and Erewash canal Junction
GUC – Middle Section			
CP-08	GUC, Welton Lane, Daventry	[redacted]	Located east of GUC Leicester Arm junction
CP-09	GUC, Long Buckby Wharf		Located west of GUC Leicester Arm junction
CP-13*	GUC, Stoke Bruerne		Upstream of River Tove
CP-14*	GUC, Three Locks		Upstream of River Ouzel
GUC – Lower Section			
CP-10	GUC, Tring	[redacted]	Upstream of River Bulbourne
CP-11	GUC, Hemel Hempstead		Upstream of River Gade (Hemel)
CP-12	GUC, above Batchworth Lock		Upstream of River Chess and River Colne

*New monitoring location 2021.

Grid references for continued monitoring locations redacted

[1] Although River Tame dropped from monitoring in the context of the canal, the Minworth SRO is still monitoring ecology in the River Tame and Trent system with a view to understanding the need for mitigation at various flow changes.

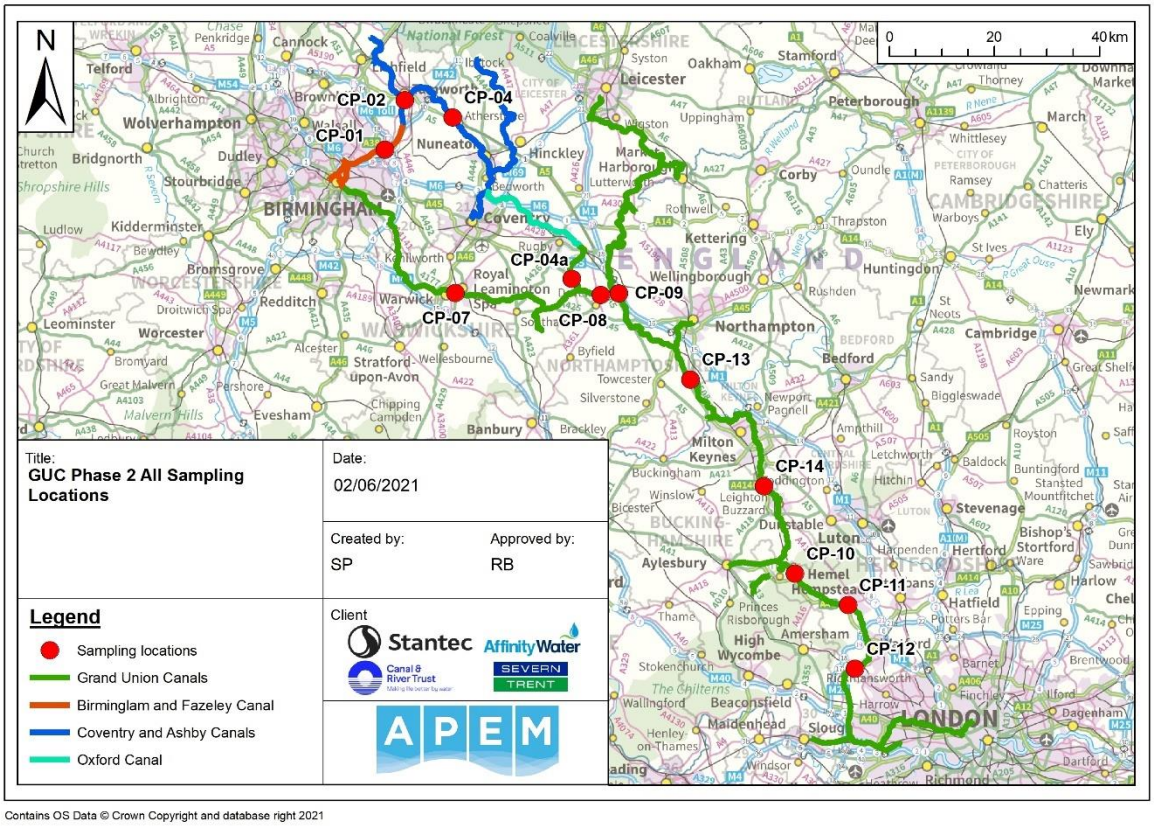

Illustration 2.1 Canal CPET monitoring locations on the Coventry Canal, Oxford Canal, Birmingham & Fazeley Canal, and Grand Union Canal

2.2.2 Invasive Non-native Species

Survey locations were selected in the Upper, Middle and Lower sections of the GUC to provide representative coverage across the reaches of interest and pick-up sensitive habitat locations, whilst aligning with existing GUC Transfer Scheme monitoring programmes.

Engagement with the EA emphasised that canal reaches in close, or direct, connectivity with neighbouring river water bodies were of greatest concern. INNS surveys were therefore targeted at canal reaches in close connectivity with the rivers Bulbourne, Gade, Colne, Ouzel, and Tove. Whilst the canal and rivers are already wholly interconnected, the aim of this work is to determine any INNS which are already present in the system. This will inform future mitigation when developing the transfer option further. Additionally, surveys were undertaken at the three water-discharge locations which were under consideration at the time of survey planning; at the Birmingham & Fazeley Canal at Minworth, the Coventry Canal at Atherstone, and the GUC at Leamington Trough Pound.

Table 2.2 INNS monitoring locations 2021

Location ID	Location Name	Grid Reference	Notes
GUC, Birmingham, Coventry, and Oxford canals – Upper Section			
IN-01	Birmingham & Fazeley Canal Minworth	[redacted]	Possible discharge location
IN-02	GUC, Atherstone		Possible discharge location
IN-03	GUC, Leamington Trough Pound		Possible discharge location
GUC – Middle Section			
IN-04	GUC, River Tove	[redacted]	At River Tove
IN-05	GUC, River Ouzel		At River Ouzel
GUC – Lower Section			
IN-06	GUC, Tring	[redacted]	U/S all chalk stream interaction
IN-07	GUC, River Bulbourne		At River Bulbourne
IN-08	GUC, Hemel Hempstead		At River Gade
IN-09	GUC, Batchworth Lock		At three rivers: Gade, Chess, Colne

Grid references for continued monitoring locations redacted

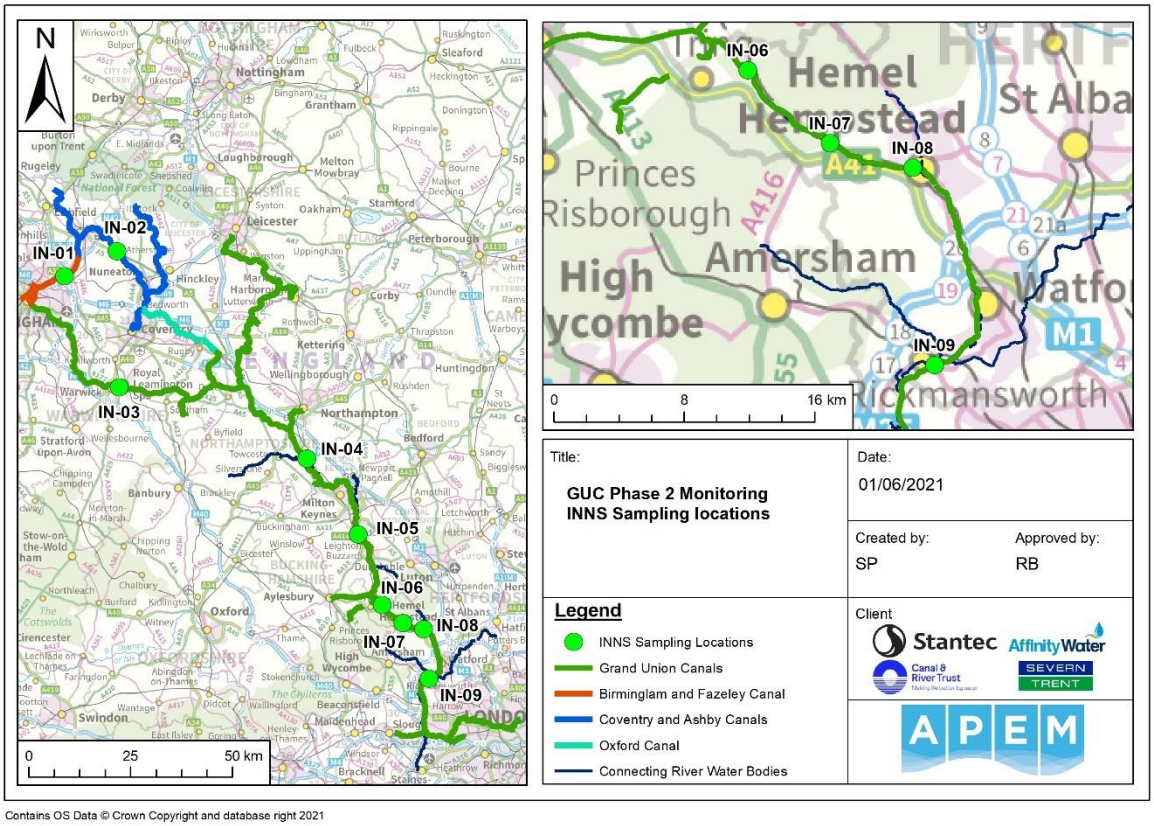

Illustration 2.2 INNS monitoring locations on the Coventry Canal, Birmingham & Fazeley Canal, and Grand Union Canal

2.2.3 Macrophytes (Chalk Streams)

The GUC Literature Review and Gap Analysis (APEM, 2020), commissioned under Gate 1, identified a knowledge gap regarding the characterisation of plant communities within the chalk streams associated with the lower GUC, at locations downstream of canal confluences. Three rivers were surveyed, the River Bulbourne, River Gade, and River Colne.

Macrophyte monitoring was undertaken at river monitoring locations downstream of major interactions with the GUC, to gain an understanding of current, baseline conditions at these locations. Additionally, macrophyte monitoring was also undertaken at control locations on each river, sited upstream of major interactions with the GUC. Appropriate survey locations were identified via river walkovers, and review of EA monitoring locations. 2021 macrophyte monitoring locations are detailed in Table 2.3 and displayed in Illustration 2.3.

It should be noted that, since implementation of the Phase 2 Monitoring Programme in July 2021, the proposed water-transfer route has been further revised, and the most southerly abstraction point now under consideration is at Leighton Buzzard; previously, abstraction was proposed at one of three locations, at Tring, Hemel Hempstead, or The Grove, close to Watford. The proposed abstraction location has been moved north to Leighton Buzzard to reduce any possible risk to the connecting chalk stream water bodies which interact with the GUC south of Tring.

Table 2.3 Macrophyte monitoring locations 2021

Location ID	Location Name	Grid Reference	Notes
Bulbourne			
M-01	DS Northchurch	[redacted]	Bulbourne US GUC
M-02	Bulbourne at Winkwell		Bulbourne DS GUC
M-03	Chaulden		Bulbourne DS GUC
Gade			
M-04	Water Gardens	[redacted]	Gade US GUC
M-05	DS Grove Mill		Gade DS GUC
M-06	Gade at Croxley Common		Gade DS GUC
Colne			
M-07	At Tolpits Lane	[redacted]	Colne US GUC
M-08	DS Batchworth Lock		Colne DS GUC

Grid references for continued monitoring locations redacted

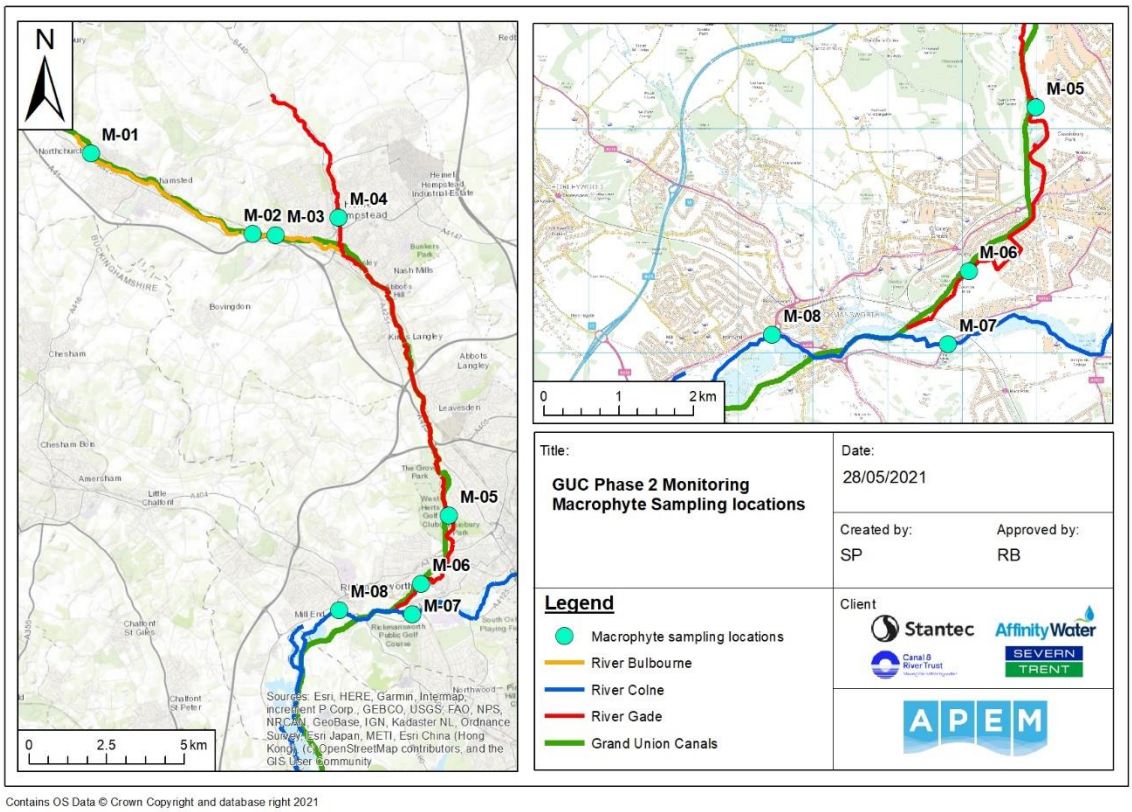

Illustration 2.3 Macrophyte monitoring locations on the River Bulbourne, River Gade, and River Colne.

2.2.4 Habitat Transects (Chalk Streams)

Following consultation with the EA in June 2021, the requirement to better characterise in-channel habitat at flow-sensitive locations on the chalk streams associated with the GUC was identified. Habitat transects were therefore undertaken at flow-sensitive locations on the River Bulbourne, River Gade and River Colne. Appropriate survey locations were identified via river walkovers, and via consultation with EA technical specialists. The majority of sampling effort was focussed on the River Bulbourne and the River Gade; the survey programme focussed on these two rivers due to their proximity to the previously proposed abstraction locations at Tring, Hemel Hempstead, and The Grove (Watford). The River Colne is in connection with the GUC further south within the Colne Valley, where the risk of impact associated with the GUC Transfer Scheme was considered lower; as such, monitoring effort on the River Colne was reduced, relative to the River Bulbourne and River Gade.

Habitat transects were undertaken at river monitoring locations sited downstream of, or in close proximity to, interactions with the GUC, to gain an understanding of current, baseline conditions at these locations. Habitat transect locations are detailed in Table 2.4 and displayed in Illustration 2.4 and Illustration 2.5.

Due to health and safety concerns, it was not possible to survey at location T-09 on the River Colne in 2021 (see Section 3.4 for details).

It should be noted that, since implementation of the Phase 2 Monitoring Programme in July 2021, the proposed water-transfer route has been further revised, and the most southerly abstraction point now under consideration is at Leighton Buzzard; previously, abstraction was proposed at one of three locations, at Tring, Hemel Hempstead, or The Grove, close to Watford. The proposed abstraction

location has been moved north to Leighton Buzzard to reduce any possible risk to the connecting chalk stream water bodies which interact with the GUC south of Tring.

Table 2.4 Habitat transect monitoring locations 2021

Location ID	Location Name	Grid Reference	Notes
Bulbourne			
T-01	Bulbeggars Lane	[redacted]	Bulbourne DS GUC
T-02	Winkwell		Bulbourne DS GUC
T-03	Chaulden		Bulbourne DS GUC
T-04	Boxmoor		Bulbourne DS GUC
Gade			
T-05	At Kings Langley	[redacted]	Gade DS GUC
T-06	D/S Grove Mill Lane		Gade DS GUC
T-07	Cassiobury Park		Gade DS GUC
T-08	Croxley Common		Gade DS GUC
Colne			
T-09	D/S Batchworth	[redacted]	Colne DS GUC

Grid references for continued monitoring locations redacted

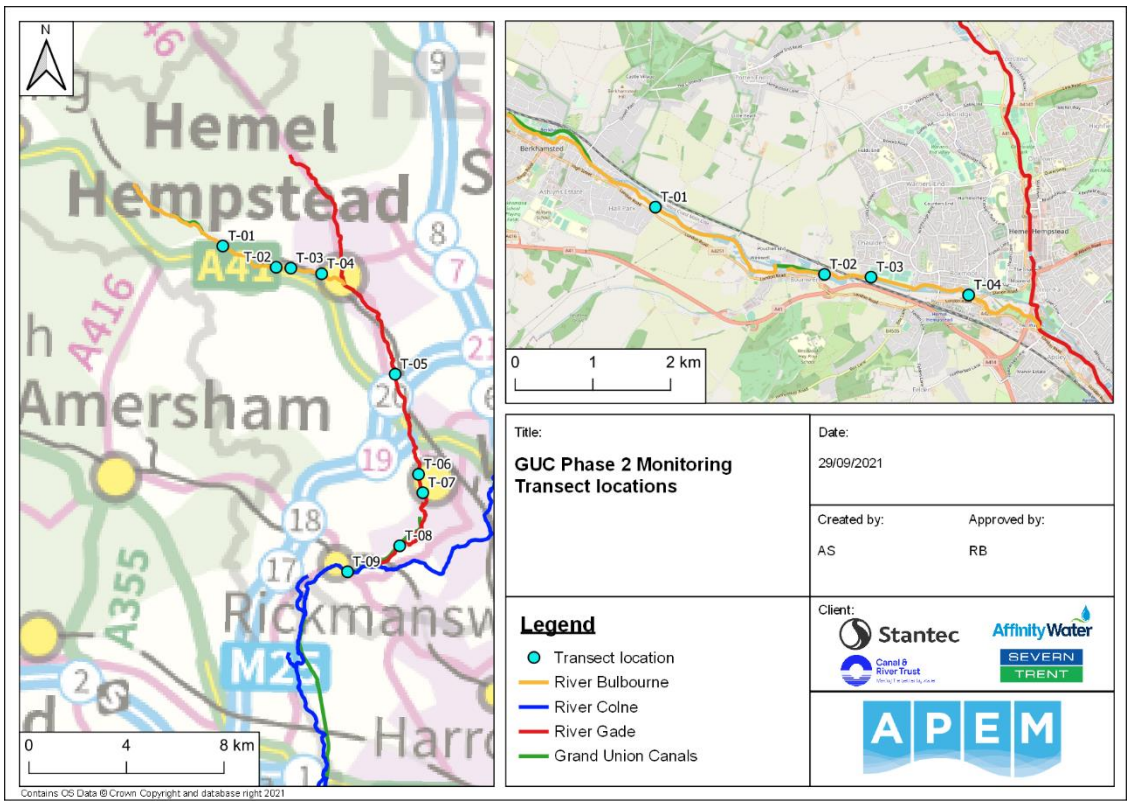

Illustration 2.4 Habitat transect locations on the River Bulbourne, River Gade, and River Colne.

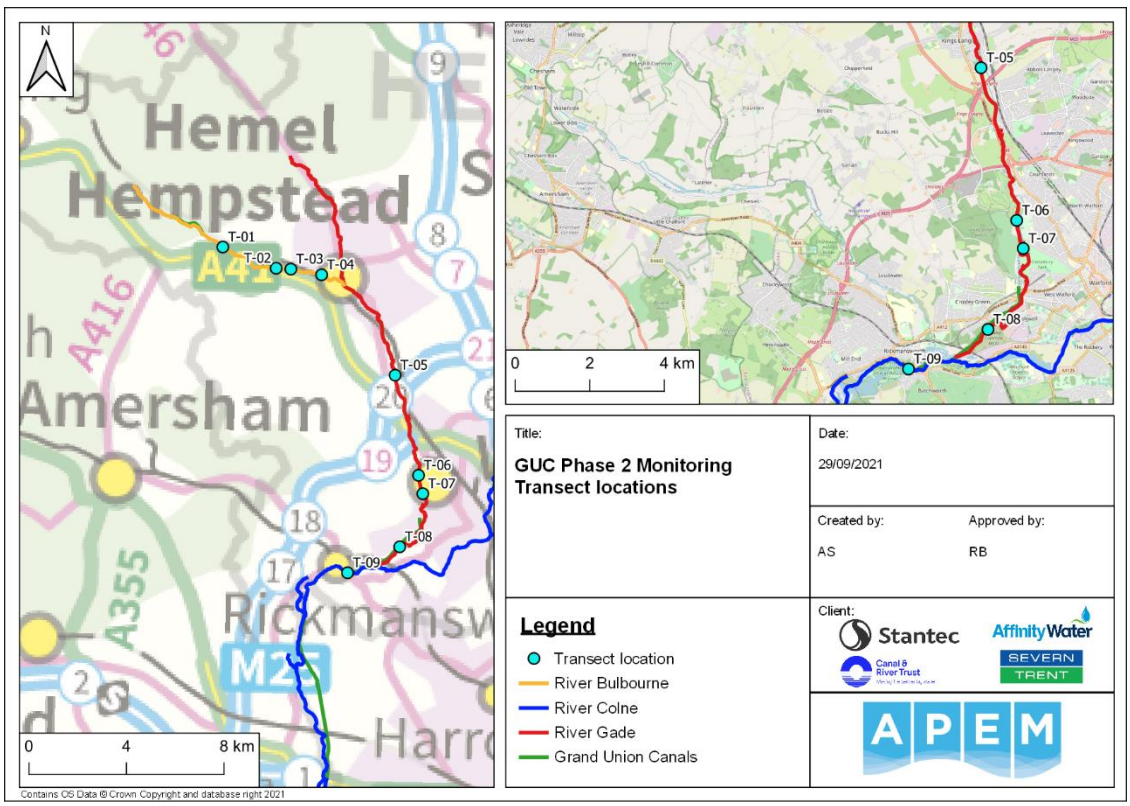

Illustration 2.5 Habitat transect locations on the River Bulbourne, River Gade, and River Colne.

3 Methodology

Monitoring methods were workshopped and agreed in collaboration with Environment Agency area staff prior to commencement of the Gate 2 monitoring programme.

3.1 Canal CPET

The macroinvertebrate family Chironomidae (midge larvae) colonises a wide variety of water quality habitats and the CPET method assesses nutrient enrichment based on chironomid species composition. The CPET methodology can be used to provide a robust, representative assessment of canal ecological quality and may be particularly useful in cases where there is a requirement to assess changes in nutrients.

The method involves skimming the water surface of the canal with a hand net (extendable handle with mesh size of 250 um) to collect floating chironomid pupal exuviae. Collection of three samples from different months was required to capture at least 80% of the species present across the whole year. Using the Canal CPET method[2], samples may be collected throughout the spring, summer and autumn, from May to October; in 2021, samples were collected in July, August and September.

Using sub-samples, two hundred chironomid pupal exuviae were identified from each sample to genus level, and a single list of taxa for the year was produced (for species lists, see Appendix A). Nutrient sensitivity scores are assigned to each chironomid taxon, and an overall canal quality assessment category (Good, Moderate, Poor or Bad)[3] is derived for each monitoring location.

3.2 Invasive Non-native Species

Data reviews completed as part of the Gate 1 Monitoring Report and Gate 1 Literature Review and Gap Analysis Report identified several INNS – both plants and macroinvertebrates – that are currently known to be present throughout the GUC. Key species highlighted included demon shrimp (*Dikerogammarus haemobaphes*), zebra mussel (*Dreissena polymorpha*), Canadian/ nuttall's waterweed (*Elodea canadensis/ nutalii*), and Floating pennywort (*Hydrocotyle ranunculoides*).

The Gate 2 field surveys were undertaken in August 2021. Field surveys for INNS included a presence/absence survey for invasive non-native bivalve species, using bank scrapes of the canal wall and associated structures, and a multi-habitat survey, following the canal PSYM survey methodology[4], to detect invasive shrimp species.

Additionally, communications with technical specialists at the EA identified the requirement for further, more generalised INNS sampling, in order to capture species that might not be picked up through taxon-specific targeted surveys. Net hauls were therefore utilised to sample the deeper bottom sediments within the canal (method dependent on depth: hand net (<80cm); naturalist's dredge (>80cm) [5]); this aimed to sample bottom sediment habitats, which may not be covered by targeted survey methods such

[2] Ruse, L. P. (1998) A biological key to canal water quality. The Journal of the Chartered Institution of Water and Environmental Management (12), Vol. 3
[3] Ruse, L. P. (1998) A biological key to canal water quality. The Journal of the Chartered Institution of Water and Environmental Management (12), Vol. 3
[4] Environment Agency and Pond Action (2002) A guide to monitoring the ecological quality of ponds and canals using PSYM
[5] Environment Agency and Pond Action (2002) A guide to monitoring the ecological quality of ponds and canals using PSYM

as bank-scrapes. Net-hauls were undertaken at each monitoring location; where possible, INNS were identified in the field, and any unknown species were preserved for laboratory analysis.

Surveyors also recorded marginal and in-channel invasive non-native macrophyte species. This was done via a bankside walk-over of a 100-meter survey length, using a grappling hook to sample open water canal habitats. INNS identified on the canal bank (for instance, Himalayan balsam) during the course of the walk-over were also noted. Surveys were undertaken in August 2021; this is well within the advised macrophyte survey season (June to September), so allowed for suitable identification of macrophyte species.

3.3 Macrophytes (Chalk Streams)

Macrophyte surveys were conducted in accordance with EA Operational Instruction 131_07 surveying freshwater macrophytes in rivers (EA, 2016[6]), to be compliant with the Water Framework Directive (2000/60/EC).

A standard survey was carried out within a defined 100-metre-long stretch of river. Each scoring macrophyte taxa present was identified to species (or the level required by the LEAFPACS standard methodology). Then each taxon's abundance (recorded as a cover value estimate) was recorded on a scale of 1 to 9. Additionally, where possible, non-scoring marginal taxa and INNS within each survey reach were identified and recorded.

LEAFPACS2 was run using the data collected to assess the indicative WFD status of the macrophyte communities surveyed. Survey-level WFD classifications are presented in Section 4.3 alongside key macrophyte indices, including RMNI, NTAXA, and %ALG.

- River Macrophyte Nutrient Index (**RMNI**) is a measure of which plants grow in the river and their association with high nutrients and is measured on a scale from 1-10; high scores are associated with species that dominate under enriched conditions.
- **NTAXA** is a measure of the number of different aquatic macrophytes present.
- **%ALG** is a measure of the extent of green filamentous algae in the channel.

3.4 Habitat Transects (Chalk Streams)

In October 2021, flow habitat transects were undertaken on the River Bulbourne and River Gade at possible flow-sensitive locations, where flow may habitat be influenced by the GUC. The aim was to capture existing habitat conditions within these inter-connected chalk rivers. At this stage of the assessment, one set of transects at each location was considered suitable to initially capture the types and diversity of habitat present at each location; however, it should be acknowledged that river flows do vary across a year, and this has an impact on in-channel habitat.

Flow monitoring was undertaken in accordance with British Standard EN ISO 748:2007 – 'Hydrometry – Measurement of liquid flow and velocity in open channels using current-meters or floats'.

A transect was set up across the channel, using a tape measure, and depth stakes and flow measurements were recorded at regular intervals across the channel; the number of intervals at each monitoring location was relative to stream size. Flow measurements were taken using a rotating element current meter or a handheld acoustic doppler velocimeter, depending on channel conditions, to gauge flows. This allowed for characterisation of habitat availability (i.e. depth and velocity) variability at each transect location.

[6] EA, 2016. Surveying freshwater macrophytes in rivers: Operational Instruction 131_07 Issued 31/05/2015 EA, Bristol.

It was not possible to survey monitoring location T-09 D/S Batchworth due to health and safety concerns; a transect was attempted, however, soft silts and a lack of stable sediment meant that the river channel was not safely accessible.

Froude (Fr) numbers, computed using averaged depth and velocity readings, were used to assign a habitat type based on biotope for each of the habitat transect locations surveyed. Fr, the ratio of inertial forces acting upon flow, is often utilised to characterise hydraulic habitat. Froude is computed using the following equation:

$$Fr = V/(g\ d)^{0.5}.$$

Where: *V* is the measured velocity, here taken to be transect average velocity; *g* is acceleration due to gravity, taken to be a constant value of 9.807m/s; and *d* is measured depth, taken to be transect averaged depth. Biotope classification bounds taken from Bentley *et al.* 2016 and supported by Heritage *et al.* 2009 have been utilised to classify the hydraulic habitat at each transect, biotope classification bounds are detailed in Table 3.1.

Table 3.1 Habitat classification by biotope based on Froude number, classification bounds taken from Bentley et al. 2016.

Habitat	Fr lower	Fr upper
Pool	0.00	0.04
Glide	0.04	0.15
Run	0.15	0.24
Riffle	0.24	0.49
Chute	0.49	1.50

4 Results

4.1 Canal CPET

4.1.1 Interpretation of Results

The Phase 1 Ecological Monitoring Report, completed under Gate 1, identified that the stretch of the canal network running from Minworth, then south through Birmingham towards Leamington Spa, demonstrated the greatest degree of ecological pressure via poor water quality, as indicated by the canal quality classifications[7] calculated for monitoring locations within this reach. The Birmingham arm of the canal network is no longer being considered as part of the possible transfer route (note, an optioneering process to determine route selection was undertaken in parallel to this workstream; the Gate 2 Submission document contains further information on the optioneering process); therefore, locations previously monitored in 2020 at the Birmingham & Warwick Canal Junction, Bordesley Junction, and Copt Heath were dropped in 2021. However, monitoring was retained at possible water-discharge locations CP-01 Birmingham & Fazeley Canal, Minworth and CP-07 Leamington Trough Pound Canal (Illustration 4.1). Here, canal quality classifications in 2021 were similar to those calculated based on 2020 data only. At CP-01 Birmingham & Fazeley Canal, Minworth and CP-07 Leamington Trough Pound, the canal quality assessment classification was Poor in 2021, and the data indicated that the chironomid community was dominated by taxa tolerant of poor water quality and pollution; for both monitoring locations, this was consistent with 2020 data.

In 2021, as part of the Gate 2 assessment, the canal quality assessment classification for CP-04, located on the Coventry Canal at Atherstone Canal (Illustration 4.1), was Poor; this is a reduction relative to the 2020 (Gate 1) assessment, when canal quality assessment for this location was Moderate. The change in canal quality assessment classification at CP-04 Coventry Canal, Atherstone from 2020 to 2021 appears to result from an increase in the abundance of pollution-tolerant *Dicrotendipes* and *Glyptotendipes* species that were identified in 2021.

In 2021, the canal quality assessment classification CP-04a, located on the Oxford Canal at Willoughby Canal (Illustration 4.1), was Moderate; this is consistent with 2020 data. In both 2020 and 2021, the chironomid community at CP-04a Oxford Canal, Willoughby comprised species that, generally, have a lesser tolerance of poor water quality and pollution. Similar results were identified at CP-09 Long Bucky Warf, located on the GUC, east of the confluence with the Oxford Canal (Illustration 2.1); the canal quality assessment classification for CP-09 Long Bucky Warf was Moderate in both 2020 and 2021. These results indicate that poor water quality pressures maybe lesser within the Oxford Canal, and the GUC east of the confluence with the Oxford Canal, when compared to the Birmingham & Fazeley Canal and upper reaches of the GUC.

CP-13 Stoke Bruerne and CP-14 Three Locks were new additions to the CPET monitoring programme in 2021. Both monitoring locations are sited on the GUC, between Daventry and Leighton Buzzard Canal (Illustration 4.1); CP-13 is sited south-east of Daventry and north of Milton Keynes, close to the River Tove, whilst CP-14 is sited further south, just north of Leighton Buzzard, and close to the River Ouzel. The canal quality assessment classification for CP-13 Stoke Bruerne was Moderate, and the canal quality assessment classification for CP-14 Three Locks was Poor. At CP-14 Three Locks, *Polypedilum sordens*, a miner of soft plant tissues that is relatively tolerant of high nutrient concentrations, was identified in moderate abundance. This taxon was identified in similar abundance

[7] Ruse, L. P. (1998) A biological key to canal water quality. The Journal of the Chartered Institution of Water and Environmental Management (12), Vol. 3

at CP-01 Birmingham & Fazeley Canal, Minworth and CP-10 Tring in 2021; both of these monitoring locations also had a canal quality classification of Poor in 2021.

The 2020 and 2021 data are indicative of comparatively better canal ecological quality in the southern reaches of the GUC, as the canal passes through Hertfordshire, when compared to much of the upper reaches of the canal network. In 2021, the canal quality assessment classification at CP-11 Hemel Hempstead and CP-12 Above Batchworth Lock was Moderate and Good, respectively. Consistent with 2020 data, the greatest degree of community diversity was again observed at the most southerly monitoring location, Batchworth Lock in 2021. At Batchworth, the GUC is influenced by inputs from the River Gade and River Colne, and the positive effects of this on canal ecology are evident in the chironomid community. Batchworth Lock was the only canal location at which fast-water taxa *Cardiocladius* was found, and the greatest abundance of pollution-sensitive taxa were observed at this location; for instance, *Apsectrotanypus trifascipennis*, which is intolerant of low dissolved oxygen and high nutrient concentrations, was identified at this Batchworth Lock only.

Overall, chironomid communities were indicative of relatively poor water quality throughout the canal network, with improvements seen on the Oxford Canal and lower reaches of the GUC. The poor water quality indicated here by canal CPET results is further supported by a parallel water quality sampling programme being undertaken for the GUC SRO at Gate 2. More information on this sampling programme is available within the Gate 2 Submission document.

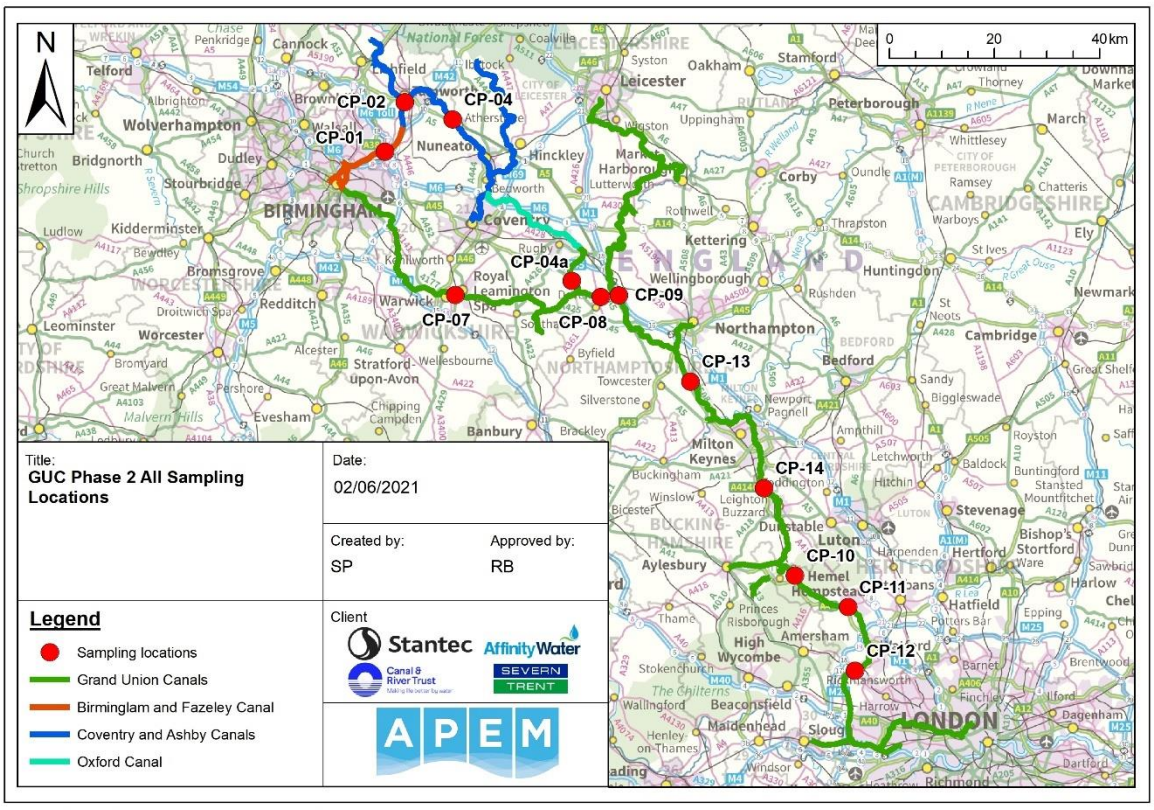

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Illustration 4.1 Canal CPET monitoring locations on the Coventry Canal, Oxford Canal, Birmingham & Fazeley Canal, and Grand Union Canal

4.1.2 Monitoring location evaluations

A summary evaluation of each canal CPET monitoring location is given in Table 4.1.

Table 4.1 Canal CPET monitoring location evaluations

Location No.	Location name	Location Evaluation*
CP-01	Birmingham & Fazeley Canal, Minworth	2020 Classification: **Poor** 2021 Classification: **Poor** Consistently characteristic of poor water quality. The chironomid community at this location was found to be tolerant of poor water quality and pollution. *Polypedilum sordens*, a miner of soft plant tissues that is relatively tolerant of high nutrient concentrations, was identified in moderate abundance.
CP-02	Coventry Canal, Fazeley	2020 Classification: **Moderate** 2021 Classification: **Poor** The chironomid community at this location was found to be less tolerant of poor water quality and pollution, compared to locations on the south-west arm. Some pollution-sensitive taxa were identified; however, in 2021, *Tanypus punctipennis*, which is tolerant of dissolved salts and anoxia for short periods, was identified. Given that only two years of data are available, it is not possible to comment on whether the reduction from Moderate to Poor status reflects degradation in the environment at this location.
CP-03	At River Tame, Fazeley	2020 Classification: **Good** 2021 Classification: **Not assessed** CP-03 was considered as a discharge location for Gate 1; however, this is no longer being considered for Gate 2.
CP-04	Coventry Canal, Atherstone	2020 Classification: **Moderate** 2021 Classification: **Poor** The chironomid community at this location was found to be less tolerant of poor water quality and pollution, compared to locations on the south-west arm in 2020; however, in 2021, a greater proportion of pollution tolerant species were identified, including *Tanypus punctipennis*, which is tolerant of dissolved salts and anoxia for short periods. Given that only two years of data are available, it is not possible to comment on whether the reduction from Moderate to Poor status reflects degradation in the environment at this location.

Location No.	Location name	Location Evaluation*
CP-04a	Oxford Canal, Willoughby	2020 Classification: **Moderate** 2021 Classification: **Moderate** The chironomid community at this location was found to be less tolerant of poor water quality and pollution, compared to locations on the upper GUC and Coventry Canal. Some pollution-sensitive taxa were identified. *Chironomus sp.,* bottom-dwelling mud-eaters that are tolerant of low oxygen conditions, were absent at this location but present at all others (with the exception of Location 13, Stoke Bruene).
CP-05	Birmingham & Warwick Canal Junction, Birmingham	2020 Classification: **Poor** 2021 Classification: **Not assessed** The Birmingham option for conveying water through the canal network is no longer under consideration in Gate 2.
CP-05a	DS Bordesley Junction	2020 Classification: **Poor** 2021 Classification: **Not assessed** The Birmingham option for conveying water through the canal network is no longer under consideration in Gate 2.
CP-06	Grand Union Canal, Copt Heath	2020 Classification: **Bad** 2021 Classification: **Not assessed** The Birmingham option for conveying water through the canal network is no longer under consideration in Gate 2.
CP-07	Grand Union Canal, Leamington Trough Pound	2020 Classification: **Poor** 2021 Classification: **Poor** Characteristic of poor water quality. The chironomid community at this location was found to be tolerant of poor water quality and pollution in 2020 and 2021.
CP-08	Grand Union Canal. Welton Lane, Daventry	2020 Classification: **Poor** 2021 Classification: **Poor** Characteristic of poor water quality. The chironomid community at this location was found to be tolerant of poor water quality and pollution in 2020 and 2021.

Location No.	Location name	Location Evaluation*
CP-09	Grand Union Canal. Long Buckby Wharf	2020 Classification: **Moderate** 2021 Classification: **Moderate** In 2020 and 2021, the chironomid community at this location was found to be less tolerant of poor water quality and pollution, compared to locations upstream on the GUC. This location is downstream of the confluence of the GUC with the Coventry/Oxford Canal (Leister Line). Some pollution-sensitive taxa were identified.
CP-13	Grand Union Canal. Stoke Bruerne	2020 Classification: **Not assessed** 2021 Classification: **Moderate** In 2021, the chironomid community at this location was found to be less tolerant of poor water quality and pollution, compared to locations upstream on the GUC. Some pollution-sensitive taxa were identified. *Chironomus sp.,* bottom-dwelling mud-eaters that are tolerant of low oxygen conditions, were absent at this location but present at all others (with the exception of Location 4a, Oxford Canal).
CP-14	Grand Union Canal. Three Locks	2020 Classification: **Not assessed** 2021 Classification: **Poor** Characteristic of poor water quality. The chironomid community at this location was found to be tolerant of poor water quality and pollution in 2020 and 2021. *Polypedilum sordens*, a miner of soft plant tissues that is relatively tolerant of high nutrient concentrations, was identified in moderate abundance.
CP-10	Grand Union Canal, Tring	2020 Classification: **Poor** 2021 Classification: **Poor** The Poor classification in 2020 may reflect low number of pupal skins collected. In 2021, the chironomid community at this location was found to be tolerant of poor water quality and pollution. *Polypedilum sordens*, a miner of soft plant tissues that is relatively tolerant of high nutrient concentrations, was identified in moderate abundance. Additionally, *Ablabesmyia monilis*, a bottom-dweller of mud which is relatively intolerant of low oxygen conditions and is an indicator of below average nutrient levels for canal sites, was identified.

Location No.	Location name	Location Evaluation*
CP-11	Grand Union Canal, Hemel Hempstead	2020 Classification: **Moderate** 2021 Classification: **Moderate** The chironomid community at this location was found to be less tolerant of poor water quality and pollution, compared to locations upstream on the GUC in 2020 and 2021. Some pollution-sensitive taxa were identified. Additionally, *Ablabesmyia monilis*, a bottom-dweller of mud which is relatively intolerant of low oxygen conditions and is an indicator of below average nutrient levels for canal sites, was identified.
CP-12	Grand Union Canal, Above Batchworth Lock	2020 Classification: **Moderate** 2021 Classification: **Good** This is the only canal location at which fast-water taxa *Cardiocladius* was found. At Batchworth, the GUC is influenced by faster-flowing inputs from the Colne and Gade rivers. The greatest number of taxa were identified at this location, with the greatest abundance of pollution-sensitive taxa. In 2021, *Apsectrotanypus trifascipennis*, which is intolerant of low dissolved oxygen and high nutrient concentrations, was identified at this location only. Additionally, *Ablabesmyia monilis*, a bottom-dweller of mud which is relatively intolerant of low oxygen conditions and is an indicator of below average nutrient levels for canal sites, was identified.

* An overall canal quality assessment category (Good, Moderate, Poor or Bad)[8] was derived for each monitoring location, based on the chironomid community assemblage.

[8] Ruse, L. P. (1998) A biological key to canal water quality. The Journal of the Chartered Institution of Water and Environmental Management (12), Vol. 3

4.2 Invasive Non-native Species

4.2.1 Interpretation of Results

The Phase 1 Monitoring Report and Literature Review and Gap Analysis Report, both completed as part of the Gate 1 programme of works, identified a number of INNS – both plants and macroinvertebrates – that are currently known to be present throughout the GUC, and the wider associated canal network; however, on the whole, there was a paucity of data available, and records were temporally and spatially sporadic. Key macroinvertebrate species identified during Gate 1 data reviews included: demon shrimp (*Dikerogammarus haemobaphes*), zebra mussel (*Dreissena polymorpha*), and signal crayfish (*Pacifastacus leniusculus*). Although not previously identified within the study area, quagga mussel (*Dreissena bugensis*) was also highlighted as a species of concern, given its current distribution in south-west London, close to the southern reaches of the GUC. Key macrophyte species identified included: Canadian/ nuttall's waterweed (*Elodea canadensis/ nutalii*), Floating pennywort (*Hydrocotyle ranunculoides*), Curly waterweed (*Lagarosiphon* major) and Himalayan balsam (*Impatiens glandulifera*).

The surveys undertaken as part of the Phase 2 monitoring programme aimed to provide a better understanding of the current distribution of the key species highlighted during the Phase 1 works, and to identify any other INNS which were not previously highlighted.

Engagement with the EA emphasised that canal reaches in close, or direct, connectivity with neighbouring river water bodies were of greatest concern. Monitoring was therefore targeted at canal reaches in close connectivity with the rivers Bulbourne, Gade, Colne, Ouzel, and Tove. Additionally, the three water discharge locations under consideration at the time of survey planning were included within the monitoring programme, these are: Birmingham & Fazeley Canal at Minworth, Coventry Canal at Atherstone, and GUC at Leamington Trough Pound.

Macroinvertebrates

The most frequently identified species was demon shrimp (*Dikerogammarus haemobaphes*), identified at six of the nine locations surveyed. This indicates that demon shrimp are likely widely distributed throughout the study area, and can be found in the upper, middle and lower reaches of the GUC network. Demon shrimp were not identified at locations IN-05 GUC at River Ouzel, IN-06 GUC at Tring, and IN-07 GUC at River Bulbourne; however, given that this species has been identified at neighbouring canal locations, to both the north and south, it is highly likely that demon shrimp populations do persist in these reaches. Moreover, demon shrimp have previously been identified in the River Bulbourne at Winkwell (TL0265406341), in the River Gade at Watford (TQ0907296255), in the River Colne at Rickmansworth (TQ0530094200). Each of these locations is downstream of inputs from the GUC; this indicates that transfer of non-native species between the GUC and the rivers Colne, Gade, and Bulbourne is likely an existing issue under current environmental conditions. Killer shrimp (*Dikerogammarus villosus*), also highlighted as a species of concern in the Literature Review and Gap Analysis, was not identified at any of the monitoring locations surveyed in 2021.

Zebra mussel (*Dreissena polymorpha*) were found to be widely distributed throughout the GUC network, identified at five of the nine locations surveyed: IN-02 Coventry Canal at Atherstone, IN-03 GUC at Leamington Trough Pound, IN-04 GUC at River Tove, IN-05 GUC at River Ouzel, and IN-06 GUC at Tring. Zebra mussel were not identified at the three survey locations south of Tring; however, previous data records have identified zebra mussel in the GUC south of Tring, at locations close to interactions with the River Bulbourne (TL0270006300) and River Gade (TQ0664080070) – records are from 2002 and 2004, respectively.

Quagga mussel (*Dreissena bugensis*), also highlighted as a species of concern in the Literature Review and Gap Analysis, was not identified at any of the monitoring locations surveyed in 2021.

Signal crayfish (*Pacifastacus leniusculus*) were identified only at IN-01 Birmingham & Fazeley Canal at Minworth. However, as detailed in the Phase 1 monitoring report, it is likely that signal crayfish are widespread throughout the GUC network and wider study area, and records obtained from the Environment Agency demonstrate that this species is already well established in the chalk rivers of the south east region, which interact with the GUC. As such, it is assumed that the lack of signal crayfish identified during phase 2 monitoring reflected the limitations of the sampling method applied, rather than a true absence of signal crayfish within the GUC network. It is likely that individuals were able to evade the hand-nets used during phase 2 sampling; however, it was not considered necessary to deploy specific crayfish traps, given that the wide-spread nature of signal crayfish had previously been described within the Gate 1 reports.

Bloody-red mysid (*Hemimysis anomala*) was recorded at IN-04 GUC at River Tove. The bloody-red mysid is a Ponto-Caspian species, first recorded in Britain in 2004, and now rapidly expanding in the English Midlands. Review of EA and NBN Atlas records did not identify any previous records of bloody-red myside at, or in direct proximity to, this monitoring location on the GUC; however, numerous records of this species have been made throughout the central and southern midlands, and the east of England, including on the GUC at Tring (SP933136), and the River Ouzel at Newport Pagnell (SP878438). While the full distribution of bloody-red mysid within the study area remains relatively uncertain, this information confirms that this species is present within the GUC network under current environmental conditions.

Macrophytes

The only in-channel INNS identified was Canadian/ nuttall's waterweed (*Elodea canadensis/ nutalii*). Canadian/ nuttall's waterweed was identified at two monitoring locations, IN-07 GUC at River Bulbourne and IN-08 GUC at Hemel Hempstead. Canadian/ nuttall's waterweed grows fully submerged and grows well within the sluggish flows of the canal network; however, where introduced, it can also thrive within river channels, primarily those with slow, sluggish flows, and channels which are subject to high sediment loads. Canadian/ nuttall's waterweed has previously been identified in the River Bulbourne at Boxmoor (TL0522005957) in 2012. This reach of the River Bulbourne is in close connection with the canal network and, in recent years, has undergone substantial river restoration works. Canadian/ nuttall's waterweed has not been recorded within this reach of the River Bulbourne since restoration works were undertaken.

INNS surveys did not find floating pennywort (*Hydrocotyle ranunculoides*) at any of the monitoring locations detailed in Table 4.2. However, floating pennywort was identified in the GUC, just upstream of Chaulden playing fields (TL0328206300) during site scoping activities in early August 2021. Moreover, during the river macrophyte surveys undertaken in September 2021, floating pennywort was also identified further upstream within the River Bulbourne system, within the River Bulbourne itself, at Winkwell (M-02, see Illustration 2.3). The Winkwell monitoring location is sited downstream of a significant interaction with the GUC.

The most commonly recorded bank-side non-native plant species was Orange Balsam (*Impatiens capensis*), identified at IN-02 Coventry Canal at Atherstone, IN-03 GUC at Leamington Trough Pound, IN-04 GUC at River Tove, IN-08 GUC at Hemel Hempstead. Anecdotal evidence, provided by a local canal-user, suggested that both Orange Balsam and Himalayan Balsam (*Impatiens glandulifera*) are also present at IN-09. Orange balsam had not previously been highlighted in the Literature Review and

Gap Analysis, and no previous records had been made on NBN (National Biodiversity Network) Atlas[9], within a 2km radius of the INNS survey network. Additionally, orange balsam was recorded at a number of macrophyte monitoring locations on the neighbouring chalk rivers in September 2021; this included the River Bulbourne at Winkwell, the River Bulbourne at Chaulden, and the River Colne downstream of Batchworth Lock. Orange balsam is a non-native species, introduced to Europe and the UK from North America; however, much of the available literature regards this species as 'naturalised' and it is not listed within Schedule 9 of Section 14 of the Wildlife and Countryside Act 1981[10], which lists non-native species that are already established in the wild within the UK, but which continue to pose a conservation threat to native biodiversity and habitats.

4.2.2 Monitoring location evaluations

A summary evaluation of each INNS monitoring location is given in Table 4.2.

Table 4.2 INNS survey location evaluations

Location ID	Location name	Location Evaluation
IN-01	Birmingham & Fazeley Canal – At Minworth	Uniform reach of canal; minimal in-channel and bankside vegetation. Substrate primarily silt, with some sand. **In-channel species:** Demon shrimp (*Dikerogammarus haemobaphes*), signal crayfish (*Pacifastacus leniusculus*) **Bankside species:** Snowberry (*Symphoricarpos albus*)
IN-02	Coventry Canal – At Atherstone	Coventry Canal – At Atherstone Uniform reach of canal; opposite bank (without towpath) reasonably well vegetated. Substrate primarily silt, with some sand. **In-channel species:** Demon shrimp (*Dikerogammarus haemobaphes*), zebra mussel (*Dreissena polymorpha*) **Bankside species:** Orange balsam (*Impatiens capensis*) (5% of 100m).
IN-03	GUC – At Leamington Trough Pound	Uniform reach of canal; opposite bank (without towpath) reasonably well vegetated. Substrate primarily silt, with some sand. **In-channel species:** Demon shrimp (*Dikerogammarus haemobaphes*), zebra mussel (*Dreissena polymorpha*) **Bankside species:** Orange balsam (*Impatiens capensis*)

[9] https://nbnatlas.org/
[10] http://www.nonnativespecies.org/index.cfm?pageid=67

Location ID	Location name	Location Evaluation
IN-04	GUC – At River Tove	Uniform reach of canal; opposite bank (without towpath) reasonably well vegetated with tall herbs and broadleaf trees. Substrate primarily silt, with some sand. **In-channel species:** Demon shrimp (*Dikerogammarus haemobaphes*), zebra mussel (*Dreissena polymorpha*), bloody-red mysid (*Hemimysis anomala*) **Bankside species:** Orange balsam (*Impatiens capensis*) (40% of 100m, bank opposite towpath).
IN-05	GUC – At River Ouzel	Both banks were reasonably well vegetated with grasses and tall herbs, with broadleaf tree cover on the opposite bank (without towpath). Substrate primarily silt, with some sand. **In-channel species:** Zebra mussel (*Dreissena polymorpha*)
IN-06	GUC – At Tring	Moderately shaded reach of canal; cover from broadleaf woodland on both banks. Substrate primarily silt, with some sand. **In-channel species:** Zebra mussel (*Dreissena polymorpha*) – recorded in comparatively high abundance.
IN-07	GUC – At River Bulbourne	Uniform reach of canal; minimal in-channel and bankside vegetation. Substrate primarily silt, with some sand. **In-channel species:** Canadian/ nuttall's waterweed (*Elodea canadensis/ nutalii*) **Bankside species:** Montbretia (*Montbretia Crocosmia x crocosmiiflora)*
IN-08	GUC – At Hemel Hempstead	Both banks were reasonably well vegetated with grasses and tall herbs, with broadleaf tree cover on the opposite bank (without towpath). Substrate primarily silt, with some sand. **In-channel species:** Demon shrimp (*Dikerogammarus haemobaphes*), Canadian/ nuttall's waterweed (*Elodea canadensis/ nutalii*) **Bankside species:** *Impatiens capensis* (<5% of 100m survey reach).

Location ID	Location name	Location Evaluation
IN-09	GUC – At Batchworth Lock	Uniform reach of canal; highly urbanised area; sampling location at the three rivers confluence. Substrate primarily silt, with some sand. **In-channel species:** Demon shrimp (*Dikerogammarus haemobaphes*). **Bankside species:** No bankside INNS were observed at the time of survey; however, orange balsam (*Impatiens capensis*), Himalayan balsam (*Impatiens glandulifera*) and Japanese knotweed (*Reynoutria japonica*) were reported to be present locally by a canal boat tour operator.

4.3 Macrophyte Survey (Chalk Streams)

4.3.1 Interpretation of Results

In September 2021, macrophyte surveys were undertaken on the River Bulbourne, River Gade, and River Colne at monitoring locations sited both upstream and downstream of interactions with the GUC.

River Bulbourne

Data collected at monitoring locations on the River Bulbourne were indicative of greater community diversity at locations sited downstream of major interactions with the GUC, relative to those sited upstream. At M-01 Northchurch, the river channel was narrow and exhibited limited and uniform flow habitat (Image 4.1). Macrophyte community diversity here was relatively limited, with only three scoring taxa identified (Table 4.3), and the community was dominated by only marginal and terrestrial species which had encroached throughout the river channel. However, downstream of a major interaction with the GUC at M-02 Winkwell, the River Bulbourne exhibited a range of flow and habitat types which had been colonised by a reasonably diverse macrophyte community – with seven scoring taxa identified at the Winkwell monitoring location (Table 4.3). Water crowfoot (*Ranunculus penicillatus ssp. pseudofluitans var pseudofluitans*), which requires well-oxygenated waters and, typically, moderate flow velocities, *was* recorded at both the M-02 Winkwell and M-03 Chaulden monitoring locations (Image 4.3), located on the River Bulbourne downstream of interactions with the GUC.

High nutrient conditions were indicated by the macrophyte data recorded at all three monitoring locations on the River Bulbourne; this is reflected in the relatively high RMNI metrics calculated for each survey location (Table 4.3). At M-02 Winkwell and M-03 Chaulden, located downstream of a major interaction with the GUC, site-level WFD classification was at Moderate status; this was primarily driven by the high RMNI values already highlighted. At M-01 Northchurch, located upstream, site-level WFD classification was at Poor status; this was driven by a combination of the notably low community diversity observed, and the high RMNI score calculated for this monitoring location. On the whole, survey data and site-level classifications were in-line with the River Bulbourne water body WFD classification for macrophytes, which is currently classified at Poor status (Cycle 2, 2019) (Table 4.3).


Image 4.1 and Image 4.2 River Bulbourne macrophyte monitoring location Northchurch, sited upstream of major interactions with the GUC.


Image 4.3 and Image 4.4 River Bulbourne macrophyte monitoring locations Winkwell and Chaulden, respectively. Both locations are sited downstream of interactions with the GUC.

Floating Pennywort (*Hydrocotyle ranunculoides*) was recorded in relatively limited abundance at survey location M-02 Winkwell. Review of EA monitoring data indicates that floating pennywort was not identified at, or in close proximity to, this location until June 2021, despite regular monitoring over the last several years. This indicates that floating pennywort has only recently become established within this reach of the River Bulbourne.

Table 4.3 Survey-level classifications and indices for macrophyte surveys undertaken on the River Bulbourne in September 2021

River	Location	RMNI	NTAXA	NFG	Final EQR	Survey-level Status	CoC PMB	WFD WB ID	Cycle 2 2019 Status
Bulbourne	Northchurch – U/S GUC	8.17	3	3	0.336	Poor	99.7	Bulbourne (GB106039029890)	Poor
Bulbourne	Winkwell – D/S GUC	7.93	7	6	0.491	Moderate	90.8		
Bulbourne	Chaulden – D/S GUC	8.22	8	6	0.402	Moderate	98.6		

River Gade

Data collected at monitoring locations on the River Gade were indicative of greater community diversity at locations sited downstream of interactions with the GUC, relative to those sited upstream. Slow, near-stagnant flow was observed at M-04 Boxmoor, sited on the River Gade upstream of all interactions with the GUC. Here, the river channel was uniform and highly-modified in structure, and emergent / marginal species, primarily grasses such as reed sweet-grass (*Glyceria maxima*), dominated the macrophyte community (Image 4.5). A total of four hydrophyte taxa were identified at this monitoring location. Downstream of the GUC, at both M-05 Cassiobury Park and M-06 Croxley Common, the River Gade exhibits a much greater range of flow and habitat types, which have been colonised by a reasonably diverse macrophyte community; five scoring taxa were identified at M-05 Cassiobury Park, and eleven scoring taxa were identified at M-06 Croxley Common (Table 4.4).

High nutrient conditions were indicated by the macrophyte data recorded at all three monitoring locations on the River Gade; this is reflected in the relatively high RMNI metrics calculated for each survey location (Table 4.4). For all three monitoring locations assessed, site-level WFD classification was at Moderate status; this was primarily driven by the high RMNI values already highlighted, however, low taxonomic diversity was also found to be a limiting factor in achieving Good status for the macrophyte communities surveyed at M-04 Boxmoor and M-05 Cassiobury Park. On the whole, survey data and site-level classifications were in-line with water body WFD classifications for macrophytes, for both of the River Gade water bodies (Table 4.3); the Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC) water body (GB106039029900) was classified at Poor status for macrophytes (Cycle 2, 2019), and the Gade (from confluence with Bulbourne to Chess) water body (GB106039029860) was classified at Moderate status for macrophytes (Cycle 2, 2019).

Image 4.5 River Gade macrophyte monitoring location At Boxmoor, sited upstream of any interaction with the GUC.

Image 4.6 and Image 4.7 River Gade macrophyte monitoring locations Cassiobury Park and Croxley Common, respectively. Both locations are sited downstream of interactions with the GUC.

Table 4.4 Survey-level classifications and indices for macrophyte surveys undertaken on the River Gade in September 2021

River	Location	RMNI	NTAXA	NFG	Final EQR	Survey-level Status	CoC PMB	WFD WB ID	Cycle 2 2019 Status
Gade	Boxmoor – U/S GUC	8.09	4	4	0.447	Moderate	96.3	Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC) (GB106039029900)	Poor
Gade	Cassiobury – D/S GUC	8.06	5	3	0.519	Moderate	84.5	Gade (from confluence with Bulbourne to Chess) GB106039029860	Moderate
Gade	Croxley Common – D/S GUC	8.02	11	10	0.538	Moderate	78.6		

River Colne

Data collected at monitoring locations on the River Colne were indicative of similar community diversity (i.e. the number of different taxa recorded) both upstream and downstream of the GUC. However, greater overall abundance of in-channel macrophyte growth was recorded upstream of the GUC, at M-07 Tollpits Lane. At both monitoring locations, the River Colne was wide, and deep; however, at M-08 D/S Batchworth, located downstream of the GUC, the river margins and bank are modified and re-enforced to defend against high-flow conditions, as the river here passes through a highly populated and urbanised area of Hertfordshire. Moreover, it should be noted that, as well as the GUC, the River Colne at M-08 D/S Batchworth is connected to several small lakes at Rickmansworth Aquadrome, which are primarily used for recreation.

High nutrient conditions were indicated by the macrophyte data recorded at both monitoring locations on the River Colne; this is reflected in the relatively high RMNI metrics calculated for each survey location (Table 4.5). A higher RMNI score, indicative of greater nutrient pressure, was calculated for M-07 Tollpits Lane; this likely reflects the notable abundance of bulrush (*Typha latifolia*) and reed sweet-grass (*Glyceria maxima*) that was recorded at this monitoring location, given that both species are associated with high nutrient conditions.

For both monitoring locations assessed, site-level WFD classification was at Moderate status; this was primarily driven by the high RMNI values already highlighted, however, low taxonomic diversity was also found to be a limiting factor in achieving Good status. On the whole, survey data and site-level classifications were in-line with water body WFD classifications for macrophytes, for both of the River Colne water bodies (Table 4.5); the Colne (from Confluence with Ver to Gade) water body (GB106039029840) was classified at Poor status for macrophytes (Cycle 2, 2019), and the Colne (Confluence with Chess to River Thames) water body (GB106039023090) was classified at Moderate status for macrophytes (Cycle 2, 2019).

Image 4.8 and Image 4.9 River Colne macrophyte monitoring locations Tollpits Lane and D/S Batchworth, respectively. Locations are sited upstream and downstream of interactions with the GUC, respectively.

Table 4.5 Survey-level classifications and indices for macrophyte surveys undertaken on the Colne in September 2021

River	Location	RMNI	NTAXA	NFG	Final EQR	Survey-level Status	CoC PMB	WFD WB ID	Cycle 2 2019 Status
Colne	Tollpits Lane – U/S GUC	8.43	6	5	0.433	Moderate	97.3	Colne (from Confluence with Ver to Gade) GB106039029840	Poor
Colne	DS Batchworth – D/S GUC	8.15	6	5	0.552	Moderate	73.3	Colne (Confluence with Chess to River Thames) GB106039023090	Moderate

4.3.2 Monitoring location evaluations

A summary evaluation of each macrophyte monitoring location is given in Table 4.6.

Table 4.6 Macrophyte survey location evaluations

Location ID	River/ Location name	Location Evaluation
M-01	Bulbourne - DS Northchurch	Upstream of the GUC; Small stream, with limited/ shallow flow. Community dominated by marginal species, which encroach into the central channel. **Key species:** Dominant species were watercress, reed canary grass, and fool's watercress. **INNS:** None recorded.
M-02	Bulbourne - Winkwell	Downstream of the GUC; Relatively diverse channel; riffle habitat; backwater at the right hand bank (RHB), associated with historic watercress beds. **Key species:** Dominant species were water crowfoot and watercress. Duckweed and blunt-fruited water starwort were recorded in moderate abundance also. **INNS:** Floating pennywort – several small patches identified; orange balsam.
M-03	Bulbourne - Chaulden	Downstream of the GUC; Relatively wide channel – RHB is not visible due to abundant macrophyte growth, primarily *Typha latifolia*; abundant macrophyte growth at RHB and left hand bank (LHB) margins concentrates flow down a central – moderately deep – channel. **Key species:** Dominant species were watercress, and bulrush. Reed sweetgrass recorded in moderate abundance also. **INNS:** Orange balsam. Floating pennywort **was not identified**; however, this species was recorded earlier in the year by EA surveyors.
M-04	Gade - Water Gardens	Upstream of the GUC; Silty, sluggish channel, with abundant growth of marginal macrophyte species occupying c.50% of the channel. **Key species:** Dominant species were reed sweetgrass and reed canary grass. **INNS:** None recorded.

Location ID	River/ Location name	Location Evaluation
M-05	Gade - DS Grove Mill (Cassiobury Park)	Downstream of the GUC; Wide, varied channel, with macrophyte growth primarily restricted to the margins; minor algae and *Verrucaria* growth downstream of the footbridge; . **Key species:** Dominant species were branched bur-reed, greater pond sedge and reed canary grass. Watercress and floating sweetgrass were also recorded in moderate abundance. **INNS:** None recorded.
M-06	Gade - Croxley Common	Downstream of the GUC; Varied channel; deep, slow flow upstream of the GUC inflow; transition to greater velocities and some riffle habitat downstream of the GUC inflow; notable algae growth downstream of the GUC inflow. Highest taxonomic diversity of any site assessed. **Key species:** Dominant species were water crowfoot, branched bur-reed, and watercress. Filamentous algae, water starwort, and reed sweetgrass were also recorded in moderate abundance. **INNS:** None recorded.
M-07	Colne - At Tolpits Lane	Upstream of the GUC; Deep, wide, slow-flowing section of river; moderately vegetated with a mix of marginal, submerged and emergent species. **Key species:** Dominant species were bulrush, yellow waterlily and reed sweetgrass. **INNS:** None recorded.
M-08	Colne - DS Batchworth Lock	Downstream of the GUC; Deep, wide section of river, with moderate flow; deep silt substrate throughout; relatively limited macrophyte abundance, with the majority of plant growth at the right-hand bank. **Key species:** Dominant species were yellow waterlily and water mint. **INNS:** Orange balsam

4.4 Habitat Transects (Chalk Streams)

4.4.1 Interpretation of Results

In October 2021, flow habitat transects were undertaken on the River Bulbourne and River Gade at possible flow-sensitive locations, where flow habitat may be influenced by the GUC.

The flow gauging data collected for the River Bulbourne and River Gade were analysed to inspect the depth and velocity distributions for each of the surveyed transect locations; plots used to visualise this data are provided for each transect in Illustration 4.2 to Illustration 4.9 below. A summary of the transect mean hydraulic parameters is provided in Table 4.7; this table provides information on the current physical habitat conditions at reaches of the River Bulbourne and River Gade which are (under existing conditions) influenced by inputs from the GUC. This provides a basis for future comparison, if the scheme progresses and possible change is predicted within these reaches.This information could be used to indicate habitat availability for targeted fish species, and life-stages, if required as part of further works.

Table 4.7 Mean hydraulic parameters for habitat flow gauging transects on the River Gade and River Bulbourne

River	Location ID	Location Name	Wetted width (m)	Mean depth (m)	Mean velocity (m/s)	Flow (Ml/d)	Wetted area (m^2)
Bulbourne	T-01	Bulbeggars Lane	2.3	0.1	0.4	10.1	0.03
Bulbourne	T-02	Winkwell	6.4	0.1	0.4	18.5	0.11
Bulbourne	T-03	Chaulden	5.5	0.2	0.1	14.3	0.13
Bulbourne	T-04	Boxmoor	5.7	0.2	0.2	16.3	0.06
Gade	T-05	At Kings Langley	6.3	0.7	0.1	41.2	0.27
Gade	T-06	D/S Grove Mill Lane	10.0	0.3	0.2	40.4	0.30
Gade	T-07	Cassiobury Park	22.0	0.4	0.2	203.8	0.51
Gade	T-08	Croxley Common	12.8	0.6	0.2	167.6	0.56

The hydraulic habitat, which is depth and velocity dependent, varies throughout a transect; for instance, slower velocities, which may be used for refuge habitat, are typically associated with marginal channel areas or around aquatic flora, which increases roughness and energy losses within the cross-section. Fr numbers, computed using averaged depth and velocity readings, have been utilised to assign a habitat type based on biotope for each of the habitat transect locations – see Table 4.8. It should be acknowledged that, whilst Fr is a useful indicator, differences in predicted Fr number are possible across the range of depth and velocity combinations and therefore uncertainty does exist. As such, Fr should not be relied upon as a single indicator of habitat type or suitability, and a site-specific walkover should also support any analysis based on Fr to validate predictions. Here, site-specific observations made at the time of survey are detailed alongside plots used to present the velocity and depth distribution for each monitoring location (Illustration 4.2 to Illustration 4.9). The site-specific observations are used to validate biotope classification of habitat types.

Table 4.8 Predicted hydraulic habitat type based on Fr number for the River Bulbourne and the River Gade.

River	Location ID	Location Name	Fr number	Biotope
Bulbourne	T-01	Bulbeggars Lane	0.35	Riffle
Bulbourne	T-02	Winkwell	0.32	Riffle
Bulbourne	T-03	Chaulden	0.09	Glide
Bulbourne	T-04	Boxmoor	0.18	Run
Gade	T-05	At Kings Langley	0.03	Pool
Gade	T-06	D/S Grove Mill Lane	0.09	Glide
Gade	T-07	Cassiobury Park	0.12	Glide
Gade	T-08	Croxley Common	0.07	Glide

For the majority of locations surveyed, the thalweg (the line of lowest elevation within a watercourse) was generally found towards the centre of each transect; this is intuitive, as the surveyed reaches have been straightened historically to allow for construction of the GUC. There were, however, two exceptions, where velocity was increased towards channel margins: at T-06 D/S Grove Mill Lane, and at T-07 Cassiobury park, where two branches of the River Gade confluence just downstream of inputs from the GUC, resulting in two focused fields of flow around a central gravel bar.

The transect velocity and depth profiles recorded at T-01 were characteristic of other locations on the River Bulbourne and River Gade, with faster velocity and deeper flow recorded within the central section, and shallower more sluggish flow recorded within the channel margins. The biotope classification of riffle appears sensible for T-01 (see Table 4.8), as some turbulent flow was observed; there was a visible crest at the site where flow transitioned from sluggish to energetic.

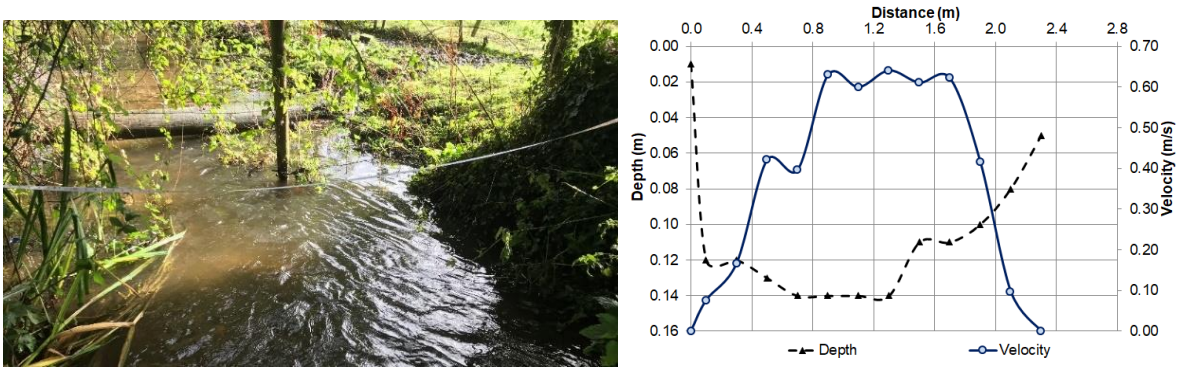

Illustration 4.2 Velocity and depth distribution at T-01 Bulbeggars Lane on the River Bulbourne.

At T-02, habitat-type was generally riffle, with a backwater occurring on the right bank; this is reflected on the gauging profile, which shows shallow flow with no velocity on the right bank (Illustration 4.3). The riffle biotope classification is considered to be sensible for transect location T-02 (see Table 4.8).

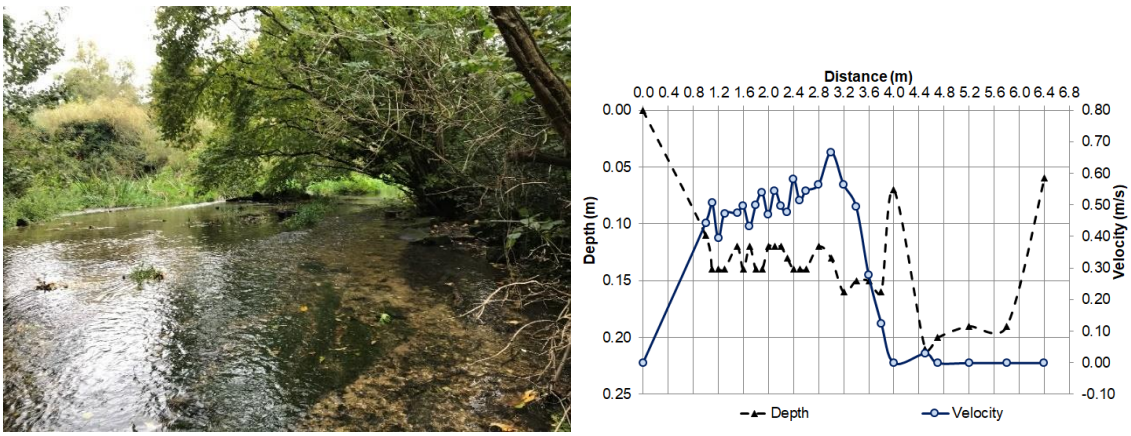

Illustration 4.3 Velocity and depth distribution at T-02 Winkwell on the River Bulbourne.

At T-03, the transect was characterised by a defined thalweg, visible within the gauge profile as a high velocity flow stream. Habitat creation and / or bank-stabilisation works has been undertaken and could be seen on the left bank; this created a varied velocity profile throughout the transect, with sluggish velocities observed in the channel margins (Illustration 4.4). Flow was generally slow, and the glide biotope is considered to be sensible for transect location T-03 (see Table 4.8).

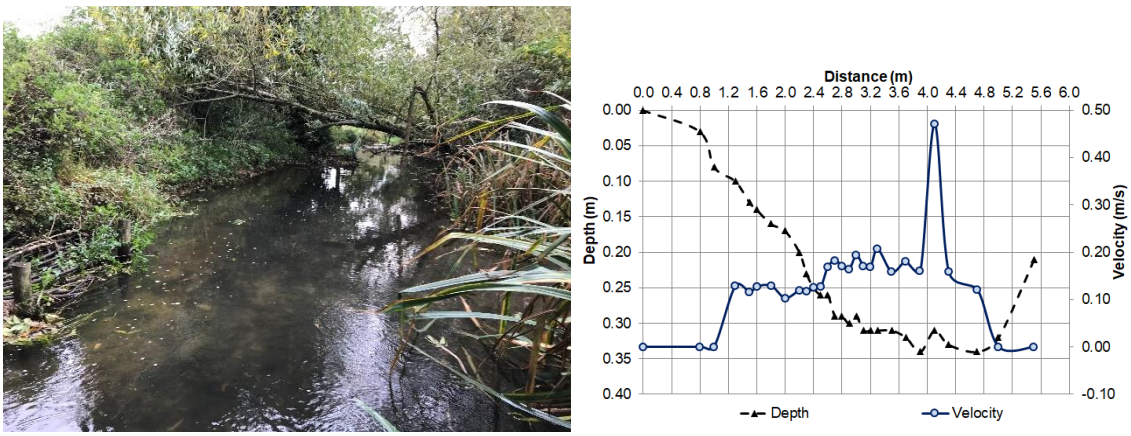

Illustration 4.4 Velocity and depth distribution at T-03 Chaulden on the River Bulbourne.

The T-04 transect was located in an area of wetland habitat which has recently been restored by the Boxmoor trust; the river here was clear and shallow flowing. The marginal velocities recorded were again more sluggish, with faster flow focused around the centre of the transect (Illustration 4.5). Generally, mixed coarse gravel substrate was observed. Channel flow was slightly energetic but not turbulent, so the run biotope is considered to be sensible for transect location T-04 (see Table 4.8).

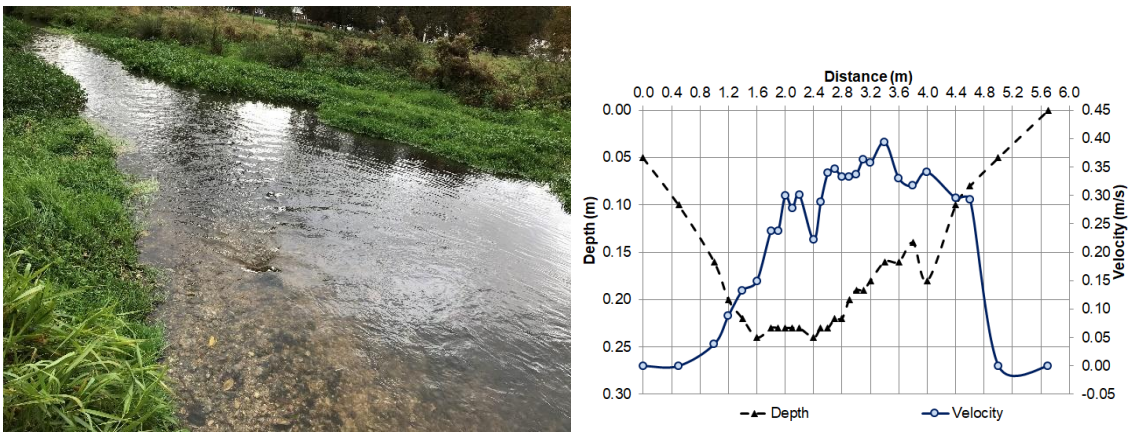

Illustration 4.5 Velocity and depth distribution at T-04 Boxmoor on the River Bulbourne.

The T-05 transect was deep and slow flowing (Illustration 4.6). The River Gade appears to be culverted slightly downstream of the transect location, before discharging into a section of the GUC. The culvert structure is likely a key hydraulic control preventing more energetic flow from occurring within the River Gade at T-05. The pool type biotope is considered to be sensible for this sluggish reach of river at T-05 (see Table 4.8).

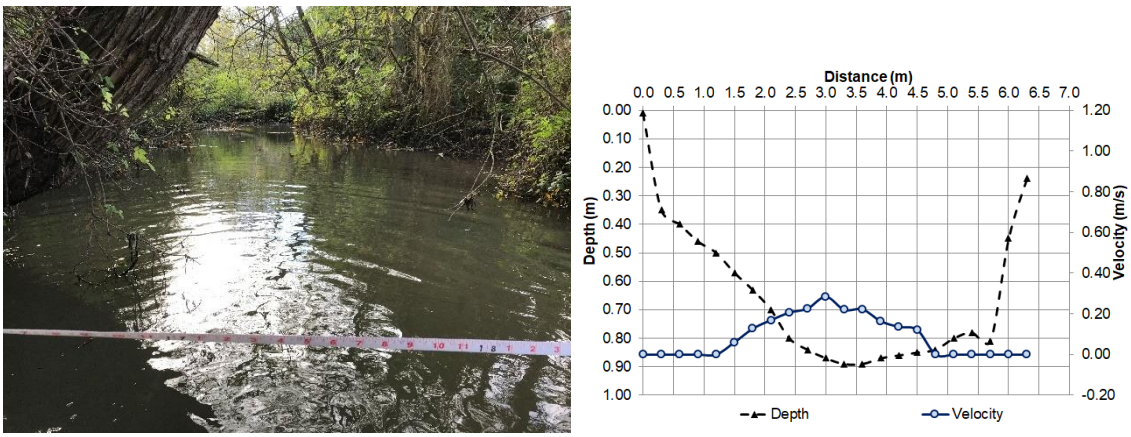

Illustration 4.6 Velocity and depth distribution at T-05 At Kings Langley on the River Gade.

Transect T-06 is a relatively sluggish reach, located slightly upstream of a confluence with the GUC. The GUC water level likely provides a key hydraulic control on reach energy. There was also a backwater on the right bank caused by a deflector; this is visible within the depth and velocity profile, where velocity drops to zero

(Illustration 4.7). The reach biotope classification of glide is sensible for the transect location T-06 (see Table 4.8).

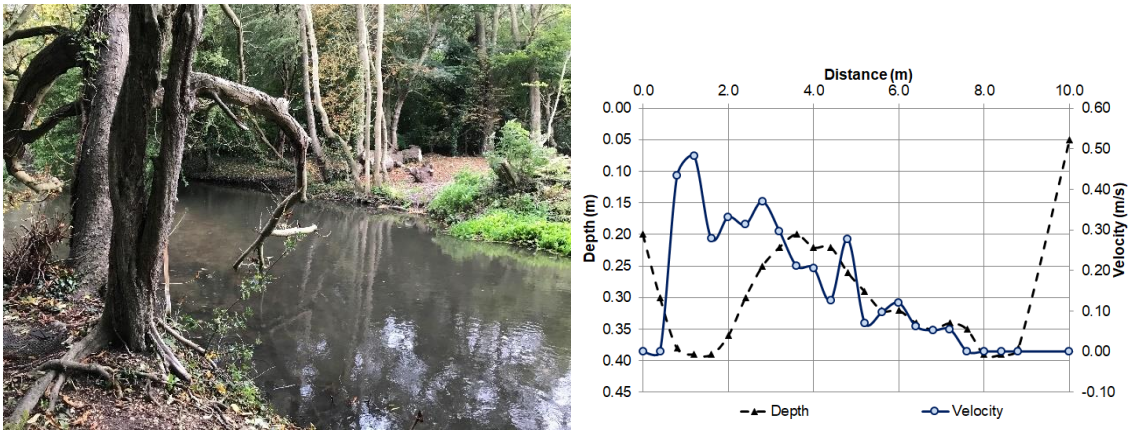

Illustration 4.7 Velocity and depth distribution at T-06 D/S Grove Mill Lane on the River Gade.

Transect T-07 was wide and generally quite shallow. The transect comprised two main flow fields and was at the confluence of two branches of the river Gade, around a large island feature. Towards the centre of the transect, flow velocity diminished, as is visible within the depth and velocity profile (Illustration 4.8); this coincided with the presence of a mixed coarse sediment gravel bar feature, just upstream of the footbridge in Cassiobury Park. The glide biotope typology is sensible for the transect location T-07 (see Table 4.8).

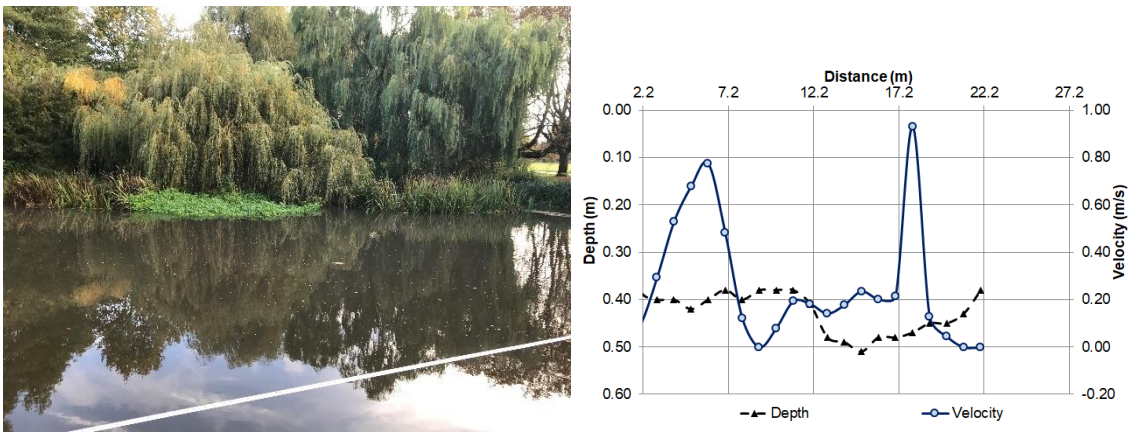

Illustration 4.8 Velocity and depth distribution at T-07 Cassiobury Park on the River Gade.

Transect T-08 was located within a straight and relatively uniform reach of the river Gade. Marginal vegetation was visible, with some localised sediment input from bank erosion, and there are fine to coarse sized gravels exposed on the left bank of the transect, with some emergent reeds. Riparian willow trees were within the marginal extents of the channel, upstream from the gauging location, and appeared to be a significant influence on river hydraulics, with zero velocity recorded within both left and right bank margins (Illustration 4.9). The glide biotope typology is considered sensible for transect T-08 (see Table 4.8), although the central higher

velocity stream could be considered run habitat as some energetic flow was observed towards the centre of the channel.

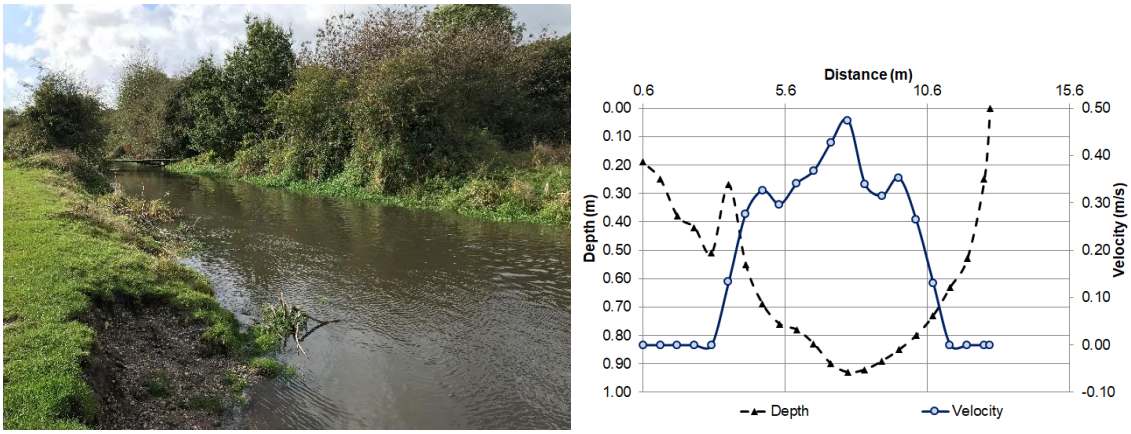

Illustration 4.9 Velocity and depth distribution at T-08 Croxley Common on the River Gade.

4.4.2 Monitoring location evaluations

A summary evaluation of each habitat transect monitoring location is given in Table 4.6.

Table 4.9 Habitat transect gauging survey location evaluations

Location ID	River/ Location name	Location Evaluation
T-01	Bulbourne – Bulbeggars Lane	Small stream, with shallow flow; mixed coarse gravel sized bed sediment. High velocity through centre of channel with lower marginal velocity which may provide refuge habitat amongst reeds.
T-02	Bulbourne – Winkwell	Relatively diverse channel; riffle habitat with mixed coarse gravel substrate; backwater at RHB, associated with historic watercress beds which creates an area of very low velocity, higher velocity towards left bank.
T-03	Bulbourne – Chaulden	Relatively wide channel, with variability in depth and velocity classified as glide type habitat. Local bank improvement or strengthening works have created flow diversity through deflection.
T-04	Bulbourne – Boxmoor	Shallow and slightly energetic flow types; recently restored reach of river within Boxmoor Trust Estate, with mixed coarse gravel sizes and wetland habitat within the riparian zone and channel margins; run type habitat.
T-05	Gade – At Kings Langley	Deep and sluggish reach of the river Gade, pool type habitat; the downstream confluence/culvert leading to GUC appears to be acting as a hydraulic control preventing more energetic flow from occurring in the reach. Plenty of marginal reeds and grasses.

Location ID	River/ Location name	Location Evaluation
T-06	Gade – D/S Grove Mill Lane	Deep, wide, slow-flowing section of river; backwater caused by large deflector on right hand bank of the river.
T-07	Gade – Cassiobury park	Wide and varied channel, with a gravel bar towards the centre of the transect which reduces flow velocity to zero; flow is generally sluggish and combines two sizable branches of the River Gade just upstream from the Cassiobury Park footbridge.
T-08	Gade – Croxley Common	Deep, wide, generally slow flowing river, with an energetic section towards the thalweg; classified as glide typology but could be considered run given the faster flow through the centre of the channel downstream from the confluence of a chute channel from the GUC and the River Gade.

5 Summary

5.1 Canal CPET

Results from Canal CPET monitoring are indicative of ecological pressure via poor water quality at the majority of monitoring locations on the proposed transfer routes. This indication is further supported by a parallel water quality sampling programme being undertaken for the GUC SRO at Gate 2; more information on this sampling programme is available within the Gate 2 Submission document. Ecological pressure via poor water quality appears to be most acute in the upper reaches of the canal network, including the Birmingham & Fazeley Canal at Minworth, and the GUC as it passes east through Leamington Spa and towards Daventry.

The data are indicative of a lesser degree of ecological pressure via poor water quality at monitoring locations sited on the Oxford Canal, and the GUC at Long Bucky; the Long Bucky monitoring location is sited just east of the confluence of the Oxford Canal and GUC. At monitoring locations on the Oxford Canal and GUC at Long Buckby, the chironomid communities demonstrated a greater degree of sensitivity to poor water quality and pollutants and so were indicative of improved ecological condition, relative to the upper reaches of the proposed transfer route.

In 2021, the greatest community diversity and abundance of pollution-sensitive taxa was observed at the most southerly monitoring location, at Batchworth Lock; this was consistent with 2020 data. Despite likely water quality pressure (given the proximity to Greater London), the monitoring locations in the south east, as the GUC passes through Hertfordshire, demonstrated an ecological condition which was improved, relative to that seen in urbanised reaches of the midlands (primarily around greater Birmingham); again, this is consistent with the findings of the 2020 report.

The improved ecological condition identified at monitoring locations on the GUC south of Tring likely reflects the high degree of connectivity between the GUC and neighbouring river water bodies that is observed throughout this reach of the canal; this indicates that river confluences may have a positive effect via contribution of species to the canal network and improvement in water quality.

5.2 Invasive Non-native Species

INNS were identified at monitoring locations sited throughout the GUC network; the most frequently identified macroinvertebrate species were demon shrimp (*Dikerogammarus haemobaphes*) and zebra mussel (*Dreissena polymorpha*). Demon shrimp were recorded at each of the three water-discharge locations that were under consideration at the time of survey, this includes: Birmingham & Fazeley Canal at Minworth, Coventry Canal at Atherstone, and GUC at Leamington Trough Pound. Zebra mussel were not identified at the Birmingham & Fazeley Canal at Minworth, but were recorded at the Coventry Canal at Atherstone, and the GUC at Leamington Trough Pound. Demon shrimp were also recorded at the majority of the remaining monitoring locations, this includes reaches of the GUC that are closely connected to the River Tove, River Gade, and River Colne. Zebra mussel were not identified at the three survey locations south of Tring; however, EA data records have previously identified zebra mussel in the GUC south of Tring, at locations close to interactions with the River Bulbourne and River Gade. EA data records have previously identified demon shrimp and / or zebra mussel at river monitoring locations on the Colne, Gade and Bulbourne, downstream of interactions with the GUC; this indicates transfer of INNS may occur under the current environmental conditions.

Bloody-red mysid (*Hemimysis anomala*) was recorded at only one monitoring location, on the GUC at the River Tove. Review of EA and NBN Atlas records did not identify any previous records of bloody-red myside at, or in direct proximity to, this monitoring location on the GUC; however, numerous records of this species have been made throughout the central and southern midlands, and the east of England.

Records of macrophyte species were sparser than for macroinvertebrates; the only in-channel INNS identified was Canadian/ nuttall's waterweed (*Elodea canadensis/ nutalii*). Canadian/ nuttall's waterweed was identified at two monitoring locations in the southern reaches of the canal, the monitoring locations were sited in close proximity to interactions with the River Bulbourne and River Gade. INNS surveys did not find floating pennywort (*Hydrocotyle ranunculoides*) at any of the monitoring locations surveyed. However, floating pennywort was identified in the GUC, just upstream of Chaulden playing fields at Hemel Hempstead, during site scoping activities in early August 2021. Moreover, during river macrophyte surveys undertaken in September 2021, floating pennywort was also identified within the River Bulbourne system at Winkwell.

The most commonly recorded bank-side non-native plant species was Orange Balsam (*Impatiens capensis*). Additionally, orange balsam was recorded at a number of macrophyte monitoring locations on the neighbouring chalk rivers in September 2021; this included the River Bulbourne at Winkwell, the River Bulbourne at Chaulden, and the River Colne downstream of Batchworth Lock. Orange balsam is a non-native species, introduced to Europe and the UK from North America; however, much of the available literature regards this species as 'naturalised' and it is not listed within Schedule 9 of Section 14 of the Wildlife and Countryside Act 1981[11].

5.3 Macrophytes (Chalk Streams)

Data collected at monitoring locations on the River Bulbourne and River Gade were indicative of greater community diversity at locations sited downstream of interactions with the GUC, relative to those sited upstream. On the River Colne, data were indicative of similar community diversity both upstream and downstream of the GUC.

For all monitoring locations assessed, site-level WFD classification was consistently at less-than-good status; this was primarily driven by high RMNI values, which were indicative of high nutrient conditions at all monitoring locations assessed. However, low taxonomic diversity was also found to be a limiting factor in achieving Good status for several survey locations. On the whole, survey data and site-level classifications were in-line with water body WFD classifications for macrophytes (Cycle 2, 2019) for the River Bulbourne, River Gade, and River Colne.

5.4 Habitat Transects (Chalk Streams)

Data collected during flow transect surveys have allowed for characterisation of habitat availability, i.e. depth and velocity variability, and biotope classification, at a number of locations on the River Bulbourne and the River Gade. Each of the locations surveyed is subject to influence from the GUC.

For the River Bulbourne, biotope classification was primarily run / riffle type, and for the River Gade, biotope classification was primarily of glide type. Biotope classification was validated using site-specific observations, made at the time of survey. This information, along with the raw depth and velocity distributions, and mean hydraulic parameters, detailed for each survey location in Section 4.4, can be used to indicate habitat availability for targeted fish species and life-stages.

Due to health and safety concerns (Section 3.4), it was not possible to survey at location T-09 on the River Colne in 2021. However, as the risk of impact associated with the GUC Transfer Scheme was considered to be low, it was not considered necessary to establish an alternative survey location on the River Colne. Further to this, as highlighted in Section 1.1, the proposed abstraction location has been moved north to Leighton Buzzard to reduce any possible risk to the connecting chalk stream water; thus, any possible risk of the River Colne has been further reduced.

[11] http://www.nonnativespecies.org/index.cfm?pageid=67

6 Recommendations

Recommendations for future monitoring are outlined below. These recommendations should be considered in conjunction with the outcomes of the Gate 2 Environmental Assessments workstream; this will aid in further identifying canal reaches of significance, or of notable ecological concern, where future monitoring should be targeted.

6.1 Canal CPET

It is recommended that a third year of canal CPET monitoring is undertaken in 2022; three years of CPET monitoring data would provide a robust, reliable baseline assessment of canal ecological quality. Canal CPET samples can be collected from April to October; collection of three samples from different months is required to capture at least 80% of the species present across the whole year. Samples collected in 2020 and 2021 were collected from July to October. If monitoring were to commence in spring 2022 (April or May), this would likely allow for identification of a greater wealth of species, improving the accuracy of assessment at each monitoring location. A third year of canal CPET monitoring data would increase overall reliability and robustness of the data and allow for continued assessment of ecological pressure via poor water quality and nutrient enrichment.

For continuity and comparability, it is recommended that canal CPET monitoring is continued at the same locations unless the route is no longer required as a result of the SRO optioneering activities. However, it is acknowledged that this may require further consideration, as the GUC Strategic Transfer Scheme progresses in determining the proposed route of water transfer.

Furthermore, it is recommended that the data presented in this report (Section 4.1) is considered alongside data collected as part of the Environmental Assessments and Water Quality work streams.

6.2 Invasive Non-native Species

eDNA monitoring is to commence at monitoring locations throughout the proposed transfer route in 2022, as part of the Gate 2 Environmental Assessments work stream (Table 1.1). It is recommended that the data presented in this report (Section 4.2) is considered alongside data collected as part of the eDNA monitoring programme. The two datasets should supplement each other; the eDNA data may pick-up species which were not suitably detected using active sampling techniques – for instance, invasive crayfish species which can evade survey nets – and the active sampling data should provide a more complete in-situ assessment of monitoring locations and canal reaches.

Combined, these datasets, along with EA, CRT, and NBN data records, should provide a suitable overview of current INNS distribution within the GUC network. However, INNS data should also be considered in conjunction with Gate 2 water quality and flow modelling work streams, to better understand where changes in water quality or flow conditions may encourage expansion, or further transfer, of INNS throughout the canal network or to connecting river water bodies.

If the GUC Strategic Transfer Scheme is taken through to implementation, further monitoring may be required to understand any possible effects on INNS distribution and abundance within the GUC network and associated water bodies.

6.3 Macrophytes (Chalk Streams)

Since implementation of the Phase 2 Monitoring Programme in July 2021, the proposed water-transfer route has been further revised, and the most southerly abstraction point now under consideration is at Leighton Buzzard; previously, abstraction was proposed at one of three locations, at Tring, Hemel Hempstead, or The Grove, close to Watford. The proposed abstraction location has been moved north to Leighton Buzzard to

reduce any possible risk to the connecting chalk stream water bodies which interact with the GUC south of Tring. In light of this change, no further baseline macrophyte monitoring on the River Bulbourne, River Gade, or River Colne is recommended.

The data collected as part of the Phase 2 Ecological Monitoring programme will provide a basis for comparison, if the need for post-implementation assessment of the chalk streams is identified.

6.4 Habitat Transects (Chalk Streams)

Since implementation of the Phase 2 Monitoring Programme in July 2021, the proposed water-transfer route has been further revised, and the most southerly abstraction point now under consideration is at Leighton Buzzard; previously, abstraction was proposed at Grove Mill, close to Watford. The proposed abstraction location has been moved north to Leighton Buzzard to reduce any possible risk to the connecting chalk stream water bodies which interact with the GUC south of Tring. In light of this change, no further baseline flow habitat assessment of the River Bulbourne or River Gade is recommended.

The data collected as part of the Phase 2 Ecological Monitoring programme will provide a basis for comparison, if the need for post-implementation assessment of the chalk streams is identified.

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Appendix A Canal CPET Species List

Table A.1 Canal CPET species list for CP-01, CP-02, and CP-04

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Apsectrotanypus trifascipennis (Zett)																		
Clinotanypus nervosus (Mg)																		
Macropelopia adaucta Kieffer																		
Macropelopia nebulosa (Mg)															1			
Procladius (Holo) "Type A" Fittkau &																		
Procladius (Holo) crassinervis (Zett)																		
Procladius (Holotanypus) group	55	11	22	15	8	9		7		8	2	2	17	42	13	5	3	12
Procladius (Psilotanypus) group																		
Psectrotanypus varius (Fab)																		
Ablabesmyia longistyla Fitt		8																
Ablabesmyia monilis (L)																		
Ablabesmyia phatta (Egger)																		
Arctopelopia																		
Conchapelopia melanops (Mg)																		
Conchapelopia other																		
Guttipelopia guttipennis (Wulp)																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Krenopelopia nigropunctata																		
Labrundinia longipalpis (Goet)																		
Larsia																		
Monopelopia tenuicalcar (K)																		
Nilotanypus dubius (Mg)																		
Paramerina pygmaea (Van der																		
Rheopelopia maculipennis (Zett)																		
Rheopelopia ornata																		
Schineriella schineri (Strobl)																		
Thienemannimyia																		
Trissopelopia longimana (Staeg)																		
Xenopelopia																		
Zavrelimyia hirtimana (K)																		
Tanypus punctipennis Mg	3			1		3		12	7	7							4	
Tanypus other																		
Protanypus morio (Zett)																		
Diamesa																		
Potthastia gaedii group																		
Potthastia longimana group																		
Monodiamesa bathyphila (K)																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Odontomesa fulva (K)																		
Prodiamesa olivacea (Mg)		18	31					4	52					26	11			
Acricotopus lucens (Zett)																		
Brillia bifida Kieffer																		
Brillia flavifrons (Johannsen)											1							
Cardiocladius																		
Cricotopus (C) bicinctus (Mg)																		
Cricotopus (C) trifascia gp.																		
Cricotopus (Cricotopus) other		3					16	6	7		23	14	9	9	35	3		5
Cricotopus (I) intersectus group	17	8	23	12			30	48	13	13	8	4	8	4	3	1	1	3
Cricotopus (I) sylvestris	6	9	18		4		1	5	9		3	7			27	4	2	1
Cricotopus (?Isocladius) Pe																		
Cricotopus (Isocladius) other																		
Eukiefferiella claripennis (Lund)																		
Eukiefferiella other																		
Georthocladius luteicornis																		
Hydrobaenus distylus (Kieffer)																		
Heterotanytarsus apicalis (K)																		
Heterotrissocladius																		
Nanocladius balticus Palmen																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Nanocladius other	31	7	8	5		7	17	10		6	63	37	56	8	18	1		18
Orthocladius (Eudactylocladius)																		
Orthocladius (Pogo) consobrinus																		
Orthocladius (Euorthocladius)																		
Orthocladius (ss) frigidus (Zett)																		
Orthocladius (Symp) holsatus																		
Orthocladius (ss) rubicundus (Mg)																		
Orthocladius (sensu stricto) other															1			
Paracladius conversus (Walk)																		
Paratrichocladius rufiventris (Mg)							42	4	23	5	17	11		6	3	13		
Paratrichocladius other																		
Psectrocladius (Mono) calcaratus																		
Psectrocladius (Allo) obvius (Walk)																		
Psectrocladius (Allo) platypus (Edw)																		
Psectrocladius (Meso) barbatipes K																		
Psectrocladius (ss) barbimanus (Edw)																		
Psectrocladius (ss) octomaculatus Wulk																		
Psectrocladius (sensu stricto) other																		
Rheocricotopus (Psilocricotopus)																		
Rheocricotopus (sensu stricto)																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Synorthocladius semivirens (K)																1		
Tvetenia discoloripes Goet																		
Tvetenia other									6									
Zalutschia humphresiae																		
Acamptocladius																		
Bryophaenocladius												1	1	4				
Chaetocladius																		
Corynoneura arctica group																		
Corynoneura celtica Edw																		
Corynoneura fittkaui Schlee																		
Corynoneura scutellata group																		
Krenosmittia camptophleps																		
Limnophyes .							73		8	4	4	8	68	25	15	50	2	6
Heleniella ornaticollis (Edw)																		
Metriocnemus				1														
Parametriocnemus																		
Parakiefferiella coronata (Edw)																		
Parakiefferiella fennica Tuiskunen																		
Parakiefferiella Pe1																		
Parakiefferiella other																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Paratrissocladius excerptus (Walker)																		
Paraphaenocladius																		
Pseudorthocladius																		
Pseudosmittia	1												3	1	1	3	1	1
Smittia																		
Thienemannia gracilis K																		
Corynoneurella paludosa Brundin																		
Thienemanniella																		
Chironomus anthracinus Zett																		
Chironomus holomelas Keyl																		
Chironomus plumosus group	18	17	13	1		2				3		1	5	2	3			1
Chironomus piger Strenzke			3															
Chironomus other	2	6		8		7	1				1			5	5	1	1	2
Cladopelma	9	7		21		29				6	4	8		28		8		16
Cryptochironomus obreptans group	3									9	2	3		1		2	1	3
Cryptochironomus redekei group																		
Cryptotendipes						16												
Demeijerea rufipes (L)	3							1		22	5		3			12	3	
Demicryptochironomus																		
Dicrotendipes (Dic) pallidicornis Goet																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Dicrotendipes (Lim) nervosus (Staeg)	2			2	7	5	4			55	60	87	2	19		54	93	78
Dicrotendipes (Lim) notatus (Mg)																		
Dicrotendipes (Lim) tritomus (K)																		
Dicrotendipes other																		
Chironomus (Lobochironomus)																		
Chironomus (Lobo) carbonarius Meigen																		
Einfeldia pagana (Mg)																		
Endochironomus																		
Synendotendipes																		
Glyptotendipes (sensu stricto)	17	8		8	17	13					2	3	3				86	26
Glyptotendipes (caulochironomus)	35	2		12		5				7							1	
Harnischia curtilamellata (Mall)								4				3						
Kiefferulus tendipediformis											3	2	1			28	15	15
Lauterborniella agrayloides (K)																		
Microchironomus tener (K)						2										1		1
Microtendipes	2			4	3	4					2	1						
Nilothauma brayi (Goet)																		
Pagastiella orophila (Edw)																		
Parachironomus arcuatus (Goet)	1	3												3				
Parachironomus biannulatus (Staeg)																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Parachironomus frequens	2										2	5				1		2
Parachironomus tenuicaudatus (Mall)																		
Parachironomus other																		
Paracladopelma camptolabis group																		
Paracladopelma nigritulum																		
Paratendipes											1			3			2	
Phaenopsectra				5		5	5	11		8	2	10	1	16				
Polypedilum (Pent) nubens (Edw)																		
Polypedilum (Pent) sordens group	29	6		32		14		6						4				4
Polypedilum (ss) arundineti																		
Polypedilum (ss) nubeculosum group	13	5			7	5			6	3		5		21	7		6	2
Polypedilum (Trip) pullum group																		
Polypedilum other	1							1										
Sergentia																		
Stenochironomus																		
Stictochironomus																		
Tribelos intextus (Walker)																		
Pseudochironomus prasinatus (Staeg)																		
Xenochironomus xenolabis (K)			3							16	4					8	3	11
Cladotanytarsus atridorsum K																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Cladotanytarsus difficilis Br																		
Cladotanytarsus lepidocalcar Krug																		
Cladotanytarsus vanderwulpi (Edw)																		
Cladotanytarsus nov. Pe																		
Cladotanytarsus other	1			1														
Micropsectra atrofasciata K																		
Micropsectra other																		
Neozavrelia longappendiculata																		
Neozavrelia other																		
Parapsectra nana (Mg) (Nent)																		
Paratanytarsus laccophilus																		
Paratanytarsus tenellulus (Goet)																		
Paratanytarsus other	1			5		2		12		25		4				5		
Rheotanytarsus other																		
Stempellina almi Brundin .																		
Stempellina bausei (K)																		
Stempellinella																		
Tanytarsus anderseni																		
Tanytarsus brundini Lind																		
Tanytarsus buchonius Reiss &																		

Taxon	CP-01 Birmingham & Fazeley Canal Minworth						CP-02 Coventry Canal Fazeley						CP-04 Coventry Canal Atherstone					
	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	26-08-20	29-09-20	12-10-20	09-07-21	10-08-21	08-09-21	26-08-20	30-09-20	12-10-20	09-07-21	10-08-21	08-09-21
Tanytarsus chinyensis Goet																		
Tanytarsus medius group								3						4				
Tanytarsus mendax K			1															
Tanytarsus pallidicornis (Walk)																		
Tanytarsus sylvaticus (Wulp)																		
Tanytarsus Part 1 group																		
Tanytarsus Part 2 group	1									10								
Tanytarsus Part 3 group																		
Virgatanytarsus																		
Zavrelia																		

Table A.2 Canal CPET species list for CP-04a, CP-07, and CP-08

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Apsectrotanypus trifascipennis (Zett)																		
Clinotanypus nervosus (Mg)																		
Macropelopia adaucta Kieffer																		
Macropelopia nebulosa (Mg)																		
Procladius (Holo) "Type A" Fittkau &																		
Procladius (Holo) crassinervis (Zett)																		
Procladius (Holotanypus) group	4	4	14	3	2		41	11	14	37	5	17	2	9		8		9
Procladius (Psilotanypus) group																		
Psectrotanypus varius (Fab)																		
Ablabesmyia longistyla Fitt																		
Ablabesmyia monilis (L)																		
Ablabesmyia phatta (Egger)																		
Arctopelopia																		
Conchapelopia melanops (Mg)																		
Conchapelopia other																		
Guttipelopia guttipennis (Wulp)																		
Krenopelopia nigropunctata																		
Labrundinia longipalpis (Goet)																		
Larsia																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Monopelopia tenuicalcar (K)																		
Nilotanypus dubius (Mg)																		
Paramerina pygmaea (Van der																		
Rheopelopia maculipennis (Zett)																		
Rheopelopia ornata																		
Schineriella schineri (Strobl)																		
Thienemannimyia																		
Trissopelopia longimana (Staeg)																		
Xenopelopia																		
Zavrelimyia hirtimana (K)																		
Tanypus punctipennis Mg																		
Tanypus other																		
Protanypus morio (Zett)																		
Diamesa																		
Potthastia gaedii group																		
Potthastia longimana group																		
Monodiamesa bathyphila (K)																		
Odontomesa fulva (K)																		
Prodiamesa olivacea (Mg)		31	24					10	11					7	11			
Acricotopus lucens (Zett)																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Brillia bifida Kieffer																		
Brillia flavifrons (Johannsen)																		
Cardiocladius																		
Cricotopus (C) bicinctus (Mg)																		
Cricotopus (C) trifascia gp.																		
Cricotopus (Cricotopus) other	20	21			6	12	1	11	23	8	5		1			7	4	6
Cricotopus (I) intersectus group	10	3		10	27	7	19	92	54	21	12	24		23	20	11	10	29
Cricotopus (I) sylvestris	1		6	3	4			28	6		4	3				9	1	5
Cricotopus (?Isocladius) Pe																		
Cricotopus (Isocladius) other																		
Eukiefferiella claripennis (Lund)																		
Eukiefferiella other	1		2															
Georthocladius luteicornis																		
Hydrobaenus distylus (Kieffer)																		
Heterotanytarsus apicalis (K)																		
Heterotrissocladius																		
Nanocladius balticus Palmen																		
Nanocladius other							1											
Orthocladius (Eudactylocladius)				1														
Orthocladius (Pogo) consobrinus																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Orthocladius (Euorthocladius)																		
Orthocladius (ss) frigidus (Zett)																		
Orthocladius (Symp) holsatus																		
Orthocladius (ss) rubicundus (Mg)																		
Orthocladius (sensu stricto) other			3													1		
Paracladius conversus (Walk)																		
Paratrichocladius rufiventris (Mg)	32	51	45	30	32	80	1	17	19	2	7		1	9		17	5	17
Paratrichocladius other																		
Psectrocladius (Mono) calcaratus																		
Psectrocladius (Allo) obvius (Walk)																		
Psectrocladius (Allo) platypus (Edw)																		
Psectrocladius (Meso) barbatipes K																		
Psectrocladius (ss) barbimanus (Edw)																		
Psectrocladius (ss) octomaculatus Wulk																		
Psectrocladius (sensu stricto) other																		
Rheocricotopus (Psilocricotopus)																		
Rheocricotopus (sensu stricto)																		
Synorthocladius semivirens (K)		1																
Tvetenia discoloripes Goet																		
Tvetenia other		1																

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Zalutschia humphresiae																		
Acamptocladius																		
Bryophaenocladius	1	4	2			2												
Chaetocladius																		
Corynoneura arctica group																		
Corynoneura celtica Edw																		
Corynoneura fittkaui Schlee																		
Corynoneura scutellata group																		
Krenosmittia camptophleps																		
Limnophyes .	10	36	18	8	18	34				1								
Heleniella ornaticollis (Edw)																		
Metriocnemus																		
Parametriocnemus		1				2												
Parakiefferiella coronata (Edw)																		
Parakiefferiella fennica Tuiskunen																		
Parakiefferiella Pe1																		
Parakiefferiella other																		
Paratrissocladius excerptus (Walker)																		
Paraphaenocladius																		
Pseudorthocladius																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Pseudosmittia	3	4	8	3	6	5												
Smittia																		
Thienemannia gracilis K																		
Corynoneurella paludosa Brundin																		
Thienemanniella																		
Chironomus anthracinus Zett																		
Chironomus holomelas Keyl																		
Chironomus plumosus group	3	1					3			15	19	2						
Chironomus piger Strenzke																		
Chironomus other							2		9	3			120	7		5	9	
Cladopelma				6				3	3			16	6			16	3	21
Cryptochironomus obreptans group	2	2					7	3				13				2	1	6
Cryptochironomus redekei group																		
Cryptotendipes													7					
Demeijerea rufipes (L)							1				6					1	1	
Demicryptochironomus																		
Dicrotendipes (Dic) pallidicornis Goet																		
Dicrotendipes (Lim) nervosus (Staeg)	90	9		11	13	17	56			42	48	26	22			32	8	39
Dicrotendipes (Lim) notatus (Mg)	4									1						1		
Dicrotendipes (Lim) tritomus (K)																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Dicrotendipes other																		
Chironomus (Lobochironomus)																		
Chironomus (Lobo) carbonarius Meigen																		
Einfeldia pagana (Mg)																		
Endochironomus																		
Synendotendipes																		
Glyptotendipes (sensu stricto)				2			1	1		3	33	2	19	8		2	4	11
Glyptotendipes (caulochironomus)				2	2							2				1	3	
Harnischia curtilamellata (Mall)	11	11				4	17	10										
Kiefferulus tendipediformis					1								1					1
Lauterborniella agrayloides (K)																		
Microchironomus tener (K)	6				3	1	6	1		2							1	
Microtendipes	6	4	5				14		5	5	2	2	1			1		2
Nilothauma brayi (Goet)																		
Pagastiella orophila (Edw)																		
Parachironomus arcuatus (Goet)													1			1		
Parachironomus biannulatus (Staeg)																		
Parachironomus frequens					1		2			1			7				2	
Parachironomus tenuicaudatus (Mall)																		
Parachironomus other																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Paracladopelma camptolabis group																		
Paracladopelma nigritulum																		
Paratendipes	1			5			3	1		4	3		2			8		2
Phaenopsectra			9															3
Polypedilum (Pent) nubens (Edw)																		
Polypedilum (Pent) sordens group												8						
Polypedilum (ss) arundineti																		
Polypedilum (ss) nubeculosum group	6	3					14	3		12	3	3	4	15		7		37
Polypedilum (Trip) pullum group																		
Polypedilum other																		
Sergentia																		
Stenochironomus																		
Stictochironomus		1	17					1										
Tribelos intextus (Walker)																		
Pseudochironomus prasinatus (Staeg)																		
Xenochironomus xenolabis (K)	13			4			4	1								4	2	
Cladotanytarsus atridorsum K																		
Cladotanytarsus difficilis Br																		
Cladotanytarsus lepidocalcar Krug																		
Cladotanytarsus vanderwulpi (Edw)																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Cladotanytarsus nov. Pe																		
Cladotanytarsus other	3																	
Micropsectra atrofasciata K																		
Micropsectra other								1										
Neozavrelia longappendiculata																		
Neozavrelia other																		
Parapsectra nana (Mg) (Nent)																		
Paratanytarsus laccophilus																		
Paratanytarsus tenellulus (Goet)																		
Paratanytarsus other	37	13		9		8	10	7	12	5	13		8	5	17			12
Rheotanytarsus other								1										
Stempellina almi Brundin .																		
Stempellina bausei (K)																		
Stempellinella	1																	
Tanytarsus anderseni																		
Tanytarsus brundini Lind																		
Tanytarsus buchonius Reiss &																		
Tanytarsus chinyensis Goet																		
Tanytarsus medius group																		
Tanytarsus mendax K																		

Taxon	CP-04a Oxford canal						CP-07 Grand Union Canal Leamington Trough Pound						CP-08 Grand Union Canal Welton Lane, Daventry					
	27-08-20	30-09-20	12-10-20	08-07-21	09-08-21	07-09-21	26-08-20	29-09-20	12-10-20	08-07-21	10-08-21	08-09-21	27-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21
Tanytarsus pallidicornis (Walk)																		
Tanytarsus sylvaticus (Wulp)																		
Tanytarsus Part 1 group																		
Tanytarsus Part 2 group	5								1									
Tanytarsus Part 3 group							1											
Virgatanytarsus																		
Zavrelia																		

Table A.3 Canal CPET species list for CP-09, CP-13, and CP-14

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Apsectrotanypus trifascipennis (Zett)												
Clinotanypus nervosus (Mg)												
Macropelopia adaucta Kieffer												
Macropelopia nebulosa (Mg)												
Procladius (Holo) "Type A" Fittkau & Mur.												
Procladius (Holo) crassinervis (Zett)												
Procladius (Holotanypus) group	3	8	8	17	5		10	1	5	8	2	7
Procladius (Psilotanypus) group												
Psectrotanypus varius (Fab)												
Ablabesmyia longistyla Fitt												
Ablabesmyia monilis (L)												
Ablabesmyia phatta (Egger)												
Arctopelopia												
Conchapelopia melanops (Mg)												
Conchapelopia other												
Guttipelopia guttipennis (Wulp)												
Krenopelopia nigropunctata (Staeg)												
Labrundinia longipalpis (Goet)												
Larsia												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Monopelopia tenuicalcar (K)												
Nilotanypus dubius (Mg)												
Paramerina pygmaea (Van der Wulp)												
Rheopelopia maculipennis (Zett)												
Rheopelopia ornata												
Schineriella schineri (Strobl)												
Thienemannimyia												
Trissopelopia longimana (Staeg)												
Xenopelopia												
Zavrelimyia hirtimana (K)												
Tanypus punctipennis Mg							3				25	6
Tanypus other												
Protanypus morio (Zett)												
Diamesa												
Potthastia gaedii group												
Potthastia longimana group												
Monodiamesa bathyphila (K)												
Odontomesa fulva (K)												
Prodiamesa olivacea (Mg)		11	9									
Acricotopus lucens (Zett)												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Brillia bifida Kieffer												
Brillia flavifrons (Johannsen)												
Cardiocladius												
Cricotopus (C) bicinctus (Mg)										13		
Cricotopus (C) trifascia gp.												
Cricotopus (Cricotopus) other	5	10	8	3	23	11	15	31	11	7	7	
Cricotopus (I) intersectus group	16	15		19	6	13		5	26	10	2	12
Cricotopus (I) sylvestris	1		7	8	4		5					6
Cricotopus (?Isocladius) Pe .												
Cricotopus (Isocladius) other		1										
Eukiefferiella claripennis (Lund)												
Eukiefferiella other												
Georthocladius luteicornis (Goetghebuer)												
Hydrobaenus distylus (Kieffer)												
Heterotanytarsus apicalis (K)												
Heterotrissocladius												
Nanocladius balticus Palmen												
Nanocladius other	35				3						46	7
Orthocladius (Eudactylocladius)		10	6		1			1				
Orthocladius (Pogo) consobrinus Holmgren												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Orthocladius (Euorthocladius)												
Orthocladius (ss) frigidus (Zett)												
Orthocladius (Symp) holsatus Goetghebuer												
Orthocladius (ss) rubicundus (Mg)												
Orthocladius (sensu stricto) other												
Paracladius conversus (Walk)												
Paratrichocladius rufiventris (Mg)	20	19	28	47	24	28	84	37	40		7	
Paratrichocladius other												
Psectrocladius (Mono) calcaratus Edw												
Psectrocladius (Allo) obvius (Walk)												
Psectrocladius (Allo) platypus (Edw)												
Psectrocladius (Meso) barbatipes K												
Psectrocladius (ss) barbimanus (Edw)												
Psectrocladius (ss) octomaculatus Wulk												
Psectrocladius (sensu stricto) other												
Rheocricotopus (Psilocricotopus)												
Rheocricotopus (sensu stricto)												
Synorthocladius semivirens (K)												
Tvetenia discoloripes Goet												
Tvetenia other												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Zalutschia humphresiae Dowling & Murray												
Acamptocladius												
Bryophaenocladius							1				1	
Chaetocladius												
Corynoneura arctica group												
Corynoneura celtica Edw												
Corynoneura fittkaui Schlee												
Corynoneura scutellata group												
Krenosmittia camptophleps (Edwards)												
Limnophyes .	7	3	47	10	3	15	3	16	47	7	47	1
Heleniella ornaticollis (Edw)												
Metriocnemus												
Parametriocnemus												
Parakiefferiella coronata (Edw)												
Parakiefferiella fennica Tuiskunen												
Parakiefferiella Pe1												
Parakiefferiella other												
Paratrissocladius excerptus (Walker)												
Paraphaenocladius												
Pseudorthocladius												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Pseudosmittia									3		12	1
Smittia												
Thienemannia gracilis K												
Corynoneurella paludosa Brundin												
Thienemanniella												
Chironomus anthracinus Zett												
Chironomus holomelas Keyl												
Chironomus plumosus group	5				1					6	1	2
Chironomus piger Strenzke									2		1	
Chironomus other	2	3			1							2
Cladopelma	11			4			5	2			3	9
Cryptochironomus obreptans group	2			6			6	4				
Cryptochironomus redekei group												
Cryptotendipes							1					
Demeijerea rufipes (L)	1											
Demicryptochironomus												
Dicrotendipes (Dic) pallidicornis Goet												
Dicrotendipes (Lim) nervosus (Staeg)	29	1		41	17	27	52	76	24	17	52	19
Dicrotendipes (Lim) notatus (Mg)				3								
Dicrotendipes (Lim) tritomus (K)												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Dicrotendipes other												
Chironomus (Lobochironomus) dissidens												
Chironomus (Lobo) carbonarius Meigen												
Einfeldia pagana (Mg)												
Endochironomus												7
Synendotendipes												
Glyptotendipes (sensu stricto)	7			3	1		1	1	3	23	87	68
Glyptotendipes (caulochironomus)				9			2				3	
Harnischia curtilamellata (Mall)							1					
Kiefferulus tendipediformis (Goet)		2										
Lauterborniella agrayloides (K)												
Microchironomus tener (K)	4							2				
Microtendipes	1						1		8			
Nilothauma brayi (Goet)												
Pagastiella orophila (Edw)												
Parachironomus arcuatus (Goet)	2										3	
Parachironomus biannulatus (Staeg)												
Parachironomus frequens (Johannsen)							6				5	
Parachironomus tenuicaudatus (Mall)												
Parachironomus other												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Paracladopelma camptolabis group												
Paracladopelma nigritulum (Goetghebuer)												
Paratendipes	5			11	2	9						
Phaenopsectra	4	5	6		3			2				3
Polypedilum (Pent) nubens (Edw)												
Polypedilum (Pent) sordens group											3	21
Polypedilum (ss) arundineti (Goetghebuer)												
Polypedilum (ss) nubeculosum group	17	9		6			5	6			4	17
Polypedilum (Trip) pullum group												
Polypedilum other												
Sergentia												
Stenochironomus												
Stictochironomus												
Tribelos intextus (Walker)												
Pseudochironomus prasinatus (Staeg)												
Xenochironomus xenolabis (K)				2	1		3					
Cladotanytarsus atridorsum K												
Cladotanytarsus difficilis Br												
Cladotanytarsus lepidocalcar Krug							3					
Cladotanytarsus vanderwulpi (Edw)												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Cladotanytarsus nov. Pe												
Cladotanytarsus other				5	2		4	4				6
Micropsectra atrofasciata K												
Micropsectra other				2			1					
Neozavrelia longappendiculata Albu												
Neozavrelia other												
Parapsectra nana (Mg) (Nent)												
Paratanytarsus laccophilus (Edwards)												
Paratanytarsus tenellulus (Goet)												7
Paratanytarsus other	23	4		8	5		6	11	7		1	6
Rheotanytarsus other											1	
Stempellina almi Brundin .												
Stempellina bausei (K)												
Stempellinella					1	7						
Tanytarsus anderseni Reiss&Fittkaui												
Tanytarsus brundini Lind												
Tanytarsus buchonius Reiss & Fitt												
Tanytarsus chinyensis Goet												
Tanytarsus medius group							1					
Tanytarsus mendax K												

Taxon	CP-09 Grand Union canal, Long Buckby Wharf						CP-13 GUC at Stoke Bruerne			CP-14 GUC at Three Locks		
	2-08-20	30-09-20	13-10-20	08-07-21	09-08-21	07-09-21	08-07-21	09-08-21	07-09-21	07-07-21	09-08-21	07-09-21
Tanytarsus pallidicornis (Walk)							3	7				
Tanytarsus sylvaticus (Wulp)												
Tanytarsus Part 1 group												
Tanytarsus Part 2 group							6	5				
Tanytarsus Part 3 group					1							
Virgatanytarsus												
Zavrelia												

Table A.4 Canal CPET species list for CP-10, CP-11, and CP-12

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Apsectrotanypus trifascipennis (Zett)													1	4	1			
Clinotanypus nervosus (Mg)																		
Macropelopia adaucta Kieffer																		
Macropelopia nebulosa (Mg)				3									1	1	12			
Procladius (Holo) "Type A" Fittkau &																		
Procladius (Holo) crassinervis (Zett)																		
Procladius (Holotanypus) group		8		8	2			8	4	7	4	3		7	10	5	10	6
Procladius (Psilotanypus) group		5																
Psectrotanypus varius (Fab)				2														
Ablabesmyia longistyla Fitt																		
Ablabesmyia monilis (L)		6								1							1	
Ablabesmyia phatta (Egger)																		
Arctopelopia				2														
Conchapelopia melanops (Mg)													2				3	
Conchapelopia other																		
Guttipelopia guttipennis (Wulp)																		
Krenopelopia nigropunctata																		
Labrundinia longipalpis (Goet)																		
Larsia																		

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Monopelopia tenuicalcar (K)																		
Nilotanypus dubius (Mg)																		
Paramerina pygmaea (Van der																		
Rheopelopia maculipennis (Zett)																		
Rheopelopia ornata																		
Schineriella schineri (Strobl)																		
Thienemannimyia																		
Trissopelopia longimana (Staeg)																		
Xenopelopia																		
Zavrelimyia hirtimana (K)																		
Tanypus punctipennis Mg							26				18	1		1			3	
Tanypus other																		
Protanypus morio (Zett)																		
Diamesa																		
Potthastia gaedii group														7	3		5	
Potthastia longimana group																		
Monodiamesa bathyphila (K)																		
Odontomesa fulva (K)																		
Prodiamesa olivacea (Mg)									4			1		13	7		5	3
Acricotopus lucens (Zett)																		

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Brillia bifida Kieffer															1			
Brillia flavifrons (Johannsen)													1		3			
Cardiocladius														1	8		1	
Cricotopus (C) bicinctus (Mg)				2							4		5	14	9			7
Cricotopus (C) trifascia gp.														1				
Cricotopus (Cricotopus) other	9		7	17	23	9	7	7	33	18	89	36	23	45	27	16	76	31
Cricotopus (I) intersectus group	30	17	21	7	7	30	31	7	28	9	17	5	23	16	41			
Cricotopus (I) sylvestris	14			9		14	19	9	31	17	14		3	7	15	5	3	7
Cricotopus (?Isocladius) Pe																		
Cricotopus (Isocladius) other													2					
Eukiefferiella claripennis (Lund)													18	4	2			
Eukiefferiella other															5			
Georthocladius luteicornis																		
Hydrobaenus distylus (Kieffer)																		
Heterotanytarsus apicalis (K)																		
Heterotrissocladius																		
Nanocladius balticus Palmen																		
Nanocladius other							15		3			2	28	12	2		3	
Orthocladius (Eudactylocladius)													1					
Orthocladius (Pogo) consobrinus																		

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Orthocladius (Euorthocladius)																		
Orthocladius (ss) frigidus (Zett)																		
Orthocladius (Symp) holsatus																		
Orthocladius (ss) rubicundus (Mg)			5										3	1	6		1	
Orthocladius (sensu stricto) other			6										1			6		
Paracladius conversus (Walk)				2										1	1			3
Paratrichocladius rufiventris (Mg)	15		10	5		15	17		16		17	9	22	14	10		28	9
Paratrichocladius other																		
Psectrocladius (Mono) calcaratus																		
Psectrocladius (Allo) obvius (Walk)																		
Psectrocladius (Allo) platypus (Edw)																		
Psectrocladius (Meso) barbatipes K																		
Psectrocladius (ss) barbimanus (Edw)																		
Psectrocladius (ss) octomaculatus Wulk																		
Psectrocladius (sensu stricto) other																		
Rheocricotopus (Psilocricotopus)													2					
Rheocricotopus (sensu stricto)																		
Synorthocladius semivirens (K)													3	4	8	3	3	
Tvetenia discoloripes Goet																		
Tvetenia other													6	5	16		4	

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Zalutschia humphresiae																		
Acamptocladius																		
Bryophaenocladius																		
Chaetocladius															1			
Corynoneura arctica group																		
Corynoneura celtica Edw																		
Corynoneura fittkaui Schlee																		
Corynoneura scutellata group	19					19					6		3		9			6
Krenosmittia camptophleps																		
Limnophyes .								3	1				74	3	6		4	2
Heleniella ornaticollis (Edw)																		
Metriocnemus																		
Parametriocnemus													1	9				
Parakiefferiella coronata (Edw)																		
Parakiefferiella fennica Tuiskunen																		
Parakiefferiella Pe1																		
Parakiefferiella other														3				
Paratrissocladius excerptus (Walker)																		
Paraphaenocladius								1										
Pseudorthocladius																		

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Pseudosmittia													10	1	5			
Smittia																		
Thienemannia gracilis K																		
Corynoneurella paludosa Brundin																		
Thienemanniella													6	13	24		1	5
Chironomus anthracinus Zett																		
Chironomus holomelas Keyl																		
Chironomus plumosus group										1		2		1				
Chironomus piger Strenzke									1			1						
Chironomus other	6	4			8	6	5	2						4				
Cladopelma	11				25	11	4					1	2	3	1		3	6
Cryptochironomus obreptans group											4	3	2	2	1		1	2
Cryptochironomus redekei group																		
Cryptotendipes													2				1	
Demeijerea rufipes (L)							1					17						3
Demicryptochironomus																		
Dicrotendipes (Dic) pallidicornis Goet																		
Dicrotendipes (Lim) nervosus (Staeg)					3							14					1	9
Dicrotendipes (Lim) notatus (Mg)					5			3		4		11	1				1	
Dicrotendipes (Lim) tritomus (K)																		

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Dicrotendipes other																		
Chironomus (Lobochironomus)																		
Chironomus (Lobo) carbonarius Meigen																		
Einfeldia pagana (Mg)																		
Endochironomus								6										
Synendotendipes																		
Glyptotendipes (sensu stricto)	34			13	52	34	7	4				16					1	
Glyptotendipes (caulochironomus)																	1	
Harnischia curtilamellata (Mall)													3	2				
Kiefferulus tendipediformis					1													
Lauterborniella agrayloides (K)																		
Microchironomus tener (K)																		
Microtendipes	28			17	1	28	21		1	4		15	3	9	6	4	9	10
Nilothauma brayi (Goet)																		
Pagastiella orophila (Edw)																		
Parachironomus arcuatus (Goet)	14			2	3	14	16	5	3		3				1			
Parachironomus biannulatus (Staeg)																		
Parachironomus frequens												1	2				2	2
Parachironomus tenuicaudatus (Mall)																		
Parachironomus other																		

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Paracladopelma camptolabis group																	2	
Paracladopelma nigritulum																		
Paratendipes	10			6	22	10			1	2		12	4	6	8		13	7
Phaenopsectra	9			3		9		1	7			6	4	4	2			5
Polypedilum (Pent) nubens (Edw)																		
Polypedilum (Pent) sordens group	7			1	11	7						5		2	2			3
Polypedilum (ss) arundineti																		
Polypedilum (ss) nubeculosum group	5		6		3	5	9	6			6	3			6		5	3
Polypedilum (Trip) pullum group																		
Polypedilum other												2	2	4			7	
Sergentia																		
Stenochironomus																	1	
Stictochironomus																		
Tribelos intextus (Walker)																		
Pseudochironomus prasinatus (Staeg)																		
Xenochironomus xenolabis (K)										2	2	2	1	3				3
Cladotanytarsus atridorsum K														1				
Cladotanytarsus difficilis Br																		
Cladotanytarsus lepidocalcar Krug																		
Cladotanytarsus vanderwulpi (Edw)																		

Taxon	CP-10 GUC at Tring						CP-11 GUC at Hemel Hempstead						CP-12 GUC above Batchworth Lock					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Cladotanytarsus nov. Pe																		
Cladotanytarsus other																		5
Micropsectra atrofasciata K									1	2								
Micropsectra other				5	21				18	5			2		7	4		1
Neozavrelia longappendiculata																		
Neozavrelia other																		
Parapsectra nana (Mg) (Nent)																		
Paratanytarsus laccophilus																		
Paratanytarsus tenellulus (Goet)																		
Paratanytarsus other	15			3	7	15	23	14	36	36	18	33	3	7		3	3	9
Rheotanytarsus other									12	1		3	5	34	11		1	1
Stempellina almi Brundin .																		
Stempellina bausei (K)																		
Stempellinella													8	29	30	2		2
Tanytarsus anderseni																		
Tanytarsus brundini Lind														3	2	2		32
Tanytarsus buchonius Reiss &																		
Tanytarsus chinyensis Goet																		
Tanytarsus medius group				7	1													2
Tanytarsus mendax K		5							9	15								

Taxon	**CP-10 GUC at Tring**						**CP-11 GUC at Hemel Hempstead**						**CP-12 GUC above Batchworth Lock**					
	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	20-08-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21	20-08-20	23-09-20	13-10-20	07-07-21	09-08-21	07-09-21
Tanytarsus pallidicornis (Walk)												2				5		5
Tanytarsus sylvaticus (Wulp)																		
Tanytarsus Part 1 group																		
Tanytarsus Part 2 group									7					11	3		5	20
Tanytarsus Part 3 group														5	7			
Virgatanytarsus																		
Zavrelia																		