M42 Junction 6 Development Consent Order

Scheme Number TR010027

8.37 Aquatic Macroinvertebrate Survey Report 2018

Planning Act 2008

Rule 8 (1)(e)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

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1 Introduction

1.1 Background

1.1.1 This aquatic macroinvertebrate survey report has been prepared by Highways England (the Applicant) following the completion and review of aquatic macroinvertebrate surveys undertaken in September 2018 on waterbodies associated with the M42 Junction 6 scheme (the Scheme).

1.1.2 The surveys considered sites upstream and downstream of watercourse crossings and other development proposed near watercourses, the purpose of which has been to determine the diversity and biological quality of the communities each waterbody supported and to identify whether any rare or notable species present may be impacted by the Scheme.

1.1.3 Due to seasonal constraints, the findings of these surveys were unable to be incorporated into the biodiversity assessment reported in Chapter 9 Biodiversity of Volume 1 of the Environmental Statement [**APP-054/Volume 6.1**], which was submitted as part of the Development Consent Order (DCO) application for the Scheme.

1.1.4 Accordingly, this report has been submitted to inform the examination of the DCO application, the content of which builds on the aquatic survey data and assessment previously collected and reported in Chapter 9 Biodiversity of Volume 1 of the Environmental Statement [**APP-054/Volume 6.1**] and in Appendix 9.12 of Volume 3 of the Environmental Statement [**APP-140/Volume 6.3**].

2 Survey Methods

2.1 Desk Study

2.1.1 A desk study was undertaken in 2017 and updated in 2018 to inform the identification and assessment of the Scheme's potential effects on aquatic habitats.

2.1.2 The desk study sourced records of notable and protected aquatic macroinvertebrates from the local ecological records centre (Warwickshire Biological Records Centre) within an area extending 1km from the Scheme's Order Limits (the study area).

2.1.3 Records within the study area were collected for the previous 10 years to reflect the current (rather than historic) baseline conditions associated with the study area.

2.1.4 The findings of the desk study in relation to aquatic habitats are reported in Appendix 9.12 of Volume 3 of the Environmental Statement [**APP-140/Volume 6.1**].

2.2 Aquatic Macroinvertebrate Survey

Field Survey

2.2.1 An initial walkover of the sites to assess their potential, was undertaken on the 6 and 7 of August 2018, the findings of which are reported in Appendix 9.12 of Volume 3 of the Environmental Statement [**APP-140**]. This identified suitable macroinvertebrate sampling locations within each of the waterbodies identified in **Table 2-1**, the locations of which are illustrated on **Figure 1**.

Table 2.1 Aquatic Macroinvertebrate Sampling Locations

Waterbody	Location (NGR)
Hollywell Brook, West of M42	SP 19752 83628
Hollywell Brook, East of M42	SP 20157 83750
Hollywell Brook, Pond	SP 20243 83692
Hollywell Brook, Ditch	SP 19913 83779
Shadow Brook East of M42	SP 19625 80955
Tributary of Shadow Brook, West of M42	SP 19449 82126
Tributary of Shadow Brook, East of M42	SP 19629 82098
Kinghurst Brook	SP 18149 82012

2.2.2 Aquatic macroinvertebrate sampling was subsequently carried out on 3 and 4 September 2018 by two appropriately experienced aquatic ecologists.

2.2.3 The survey methods for the running water sites followed the aquatic macroinvertebrate sampling procedures standardised by the Environment Agency [REF 1].

2.2.4 The collection method within the pond at Hollywell Brook was based on the Predictive System for Multimetrics (PSYM) sampling protocols used for ponds [REF 2]. An aggregate aquatic macroinvertebrate sample was collected through sampling the total number of mesohabitats (for example open water and reed beds) present at the site. Sampling this range of habitats was undertaken to obtain representative samples of the taxa present.

2.2.5 All samples were taken using a standard Freshwater Biological Association pattern pond net (mesh size: 1mm) and were sampled by kick sampling for three minutes followed by a one-minute hand search of larger substrates in accordance with the respective methodologies. The samples collected, were subsequently preserved in 70% v/v Industrial Methylated Spirits for laboratory processing.

Analysis of Aquatic Macroinvertebrate Samples

2.2.6 Each collected sample was sorted and analysed by suitably trained and experienced ecologists.

2.2.7 Lists of the aquatic macroinvertebrate taxa present were produced in line with Environment Agency guidance [REF 3]. The aquatic invertebrate samples were identified to 'mixed taxon level' using stereo-microscopes. The majority of groups were identified to species level, where practicable, with the exception of the following:

a. worms (Oligochaeta) which were identified to order;
b. truefly larvae (Chironomidae, Psychodidae, Empididae, Culicidae), which were identified to the to the maximum resolution specified in the guidance;
c. butterfly/moth larvae (Lepidoptera), which were identified to order;
d. springtails (Collembola) which were identified to order; and
e. immature or damaged specimens, which were identified to the maximum resolution possible on a case-by-case basis.

2.2.8 The survey data were then used to calculate various biotic indices, as set out below, to inform an assessment of relative nature conservation importance.

2.2.9 The Community Conservation Index (CCI) [REF 4] was calculated for each waterbody. The CCI classifies many groups of freshwater invertebrates according to their scarcity and nature conservation value in England as understood at the time that the classification was developed. Species scores range from 1 to 10, with 1 being very common and 10 being Endangered, as presented in **Table 2-2**.

2.2.10 In some cases, the references used in the CCI classification to define scarcity and value importance since been superseded by more recent assessments [REF 5; REF 6]. Although the CCI cannot be modified to take account of this more current information, this has been considered when making the wider assessment of nature conservation importance.

Table 2.2 Conservation Scores from the Community Conservation Index

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

2.2.11 The overall CCI provides an indication of the conservation importance of the community sampled, based on a combination of the rarity of the different aquatic macroinvertebrate taxa present (as understood when the CCI was developed) and overall community richness, as presented in **Table 2-3**.

2.2.12 In some cases expert judgment including the use of more up to date ecological information and criteria for ecological evaluation, for example the selection guidelines for local wildlife sites (LWS) [REF 7]

2.2.13 has been applied to moderate the CCI assessments, with reference to current information on status and distribution.

Table 2.3 Conservation Scores from the Community Conservation Index [REF 5]

Community Conservation Index (CCI)	Expected conservation value
< 5	Low conservation value
5 to 10	Moderate conservation value
10 to 15	Fairly high conservation value
15 to 20	High conservation value
> 20	Very high conservation value

2.2.14 The invertebrate data were also analysed to generate Biological Monitoring Working Party (BMWP) scores and Average Score Per Taxon (ASPT) values [REF 8].

2.2.15 The BMWP system assigns a numerical value to about 80 different taxa (known as the BMWP-scoring families) according to their sensitivity to organic pollution. The average of the values for each taxon in a sample (the ASPT) is a stable and reliable index of organic pollution. Therefore, these assessments can indicate to what extent an aquatic macroinvertebrate community is exposed to organic pollution. Further information regarding the BMWP system is provided in **Appendix A**.

2.2.16 It is important to note that these indices can vary between geological regions and habitat types. Slow flowing sites for example are unable to support many of the high-scoring taxa associated with fast flowing habitats. Therefore, the resultant metrics have been reviewed with an awareness of their potential limitations, and the site-specific context.

2.3 Nature Conservation Evaluation Approach

2.3.1 Aquatic macroinvertebrate communities, and the component individual species, can be of nature conservation importance for various reasons, and their relative value has been determined on a case-by-case basis. Importance may relate, for example, to the uniqueness of the assemblage, or to the extent to which species are threatened throughout their range, or to their rate of decline. The importance of these assemblages and species recorded by the survey has been defined with reference to the geographical level at which the feature being assessed is considered to matter.

2.3.2 This approach to the assessment of ecological features is consistent with that detailed in Chapter 9 Biodiversity of Volume 1 of the Environmental Statement [**APP-054/Volume 6.1**].

2.4 Limitations

2.4.1 The macroinvertebrate survey was undertaken during good weather conditions; however, where issues were encountered these are described below.

2.4.2 The optimal sampling season for PSYM pond assessment is June – August, which is based upon the optimal survey window for assessing both macrophytes (aquatic plants) and macro-invertebrates concurrently. The sample within Hollywell Brook Pond was collected outside of this period and therefore a PSYM score could not be calculated, according to requirements of the Freshwater Habitats Trust who calculate PSYM indices. Notwithstanding this, the optimal period for sampling aquatic macroinvertebrates in lotic (flowing water) habitats is autumn (September to November), which is the focus of this assessment. This period is suitable because many groups are absent or undetectable during the summer after hatching/emergence and therefore may be more easily detected in autumn. The sampling of habitats in September is not considered to be a limitation of the assessment of the importance of Hollywell Brook Pond due to the lack of impacts proposed to the pond. As the pond was identified as of fairly high conservation value, if direct impacts to it are proposed, further survey and/or mitigation may be required

2.4.3 Five of the originally scoped sites could not be sampled for macroinvertebrates as they were dry during the survey (Shadow Brook West of M42, Ponds 10, 39 and 45 and the drain within Bickenhill Meadows Site of Special Scientific Interest (SSSI). The locations of these five sites are illustrated on **Figure 1**.

2.4.4 Shadow Brook and the ponds, however, only appeared to temporarily hold water. These areas are therefore unlikely to support the diverse macrophyte communities and lack the habitat structure required to support notable aquatic macroinvertebrate populations, and are more likely to support a range of common early successional species found in temporary wet habitats. As such, this is not considered a major limitation in the assessment.

2.4.5 The ditch within Bickenhill Meadows SSSI has the potential to support a notable aquatic macroinvertebrate community, given its location and the habitat conditions of the drain. However, taking into account standard mitigation measures it is considered that the ditch would not be subject to significant effects, and therefore this is not considered a limitation to this assessment.

2.4.6 Samples of aquatic invertebrates are typically collected in both spring and autumn. This is because in some circumstances not all macroinvertebrate are present at all times of year, and therefore some may be overlooked when surveying in a single season. Sampling for this assessment has only been completed in the autumn period. The autumn survey data is consistent with the aquatic macroinvertebrate fauna comprising common and widespread species, and therefore of low conservation importance. In this context, which is consistent with the poor quality of the habitats present, it is considered that sampling in autumn is sufficient to evaluate the habitats and design appropriate mitigation measures. Therefore, further survey, including within the spring period, is not required for the assessment.

3 Survey Results

3.1 Desk Study Results

3.1.1 The desk study returned a number of aquatic beetle species records within the study area, all of which are associated with either Coleshill and Bannerly Pools SSSI or Shadowbrook Meadows Nature Reserve (which comprises of Bickenhill Meadows SSSI & Greens Ward Piece LWS. None of these species are afforded legal protection, although many of them are regarded as Notable by the CCI. Recent assessments however now regard many of these species as being more common than previously known [REF 5] (see **Appendix B**).

3.1.2 The most notable beetle species recorded was *Helochares obscurus* which is now regarded as Vulnerable (CCI: 9) [REF 5] and is known to occur either within sandy coastal dune areas or peat bogs supporting diverse macrophyte communities [REF 5]. However, given its specific habitat requirements which are not present within the Order Limits, it is unlikely that this species is present. As such, this species is not considered further in this report.

3.2 Field Survey Results

3.2.1 The aquatic macroinvertebrate species recorded and the associated indices for each waterbody are detailed in **Appendix C**. Representative site photographs are provided in **Appendix D**.

3.2.2 No aquatic macroinvertebrate species recorded within any of the waterbodies receive specific legal protection by way of Schedule 5 of the Wildlife and Countryside Act 1981 [REF 9] or are listed on Section 41 of the Natural Environment & Rural Communities Act 2006 [REF 10] as being of principal importance for nature conservation in England.

3.2.3 A summary of the results for each waterbody surveyed is provided below.

Hollywell Brook

3.2.4 The watercourse flows west to east through riparian broadleaf woodland, flowing under the M42 motorway through a culvert. The brook was approximately 2m wide and 20cm deep (on average) and supported a range of riffle, run and pool habitats. The substrate predominantly consisted of sand, gravel and silt, with occasional larger cobbles (see Photographs 1 and 2 in **Appendix D**).

3.2.5 Both of the sampling sites within Hollywell Brook fall within the boundary of the potential Local Wildlife Site (pLWS) ‘Hollywell Brook corridor to A41’. This designation covers the brook and the surrounding riparian corridor.

Hollywell Brook, West of M42

3.2.6 A moderate diversity of invertebrates was sampled, with a total of 15 taxa recorded to species level and a further 21 to genus or higher taxonomic level. These consisted of a range of taxa, notably snails, but also crustaceans, mayflies, damselflies, true bugs, beetles, caddis and truefly larvae typical of waterbodies with variable flow velocities.

3.2.7 The CCI score for the sample was 7.7 indicating that the watercourse is of moderate conservation value. The majority of the species were of Very Common to Frequent nature conservation status within the CCI.

3.2.8 The only exception was a leech (*Erpobdella testacea*). This is classified as of Local nature conservation status within the CCI. This species has been recorded within a range of habitats including lakes, rivers and ditches and ponds [REF 6]. No recent information is available to indicate that the status of this species has changed since the CCI was established.

3.2.9 The biological quality of the watercourse was poor to moderate (BMWP 73, APST 3.8). It supported a single pollution-sensitive macroinvertebrate (the damselfly, *Calopterygidae*), in addition to a range of taxa defined as having moderate tolerance to pollution. This indicates that the watercourse is somewhat affected by poor water (pollution) or habitat quality.

Hollywell Brook East of M42

3.2.10 A low diversity of invertebrates was sampled, with a total of 6 taxa recorded to species level and a further 6 to genus or higher taxonomic level. These included snail, crustacean, and truefly taxa and the assemblage is considered typical of the habitat conditions.

3.2.11 The CCI score of 1.2 indicates that this section of the brook is of Low conservation importance. All of the species are of Common or Very Common nature conservation status in the CCI.

3.2.12 The biological quality of the watercourse was poor (BMWP 39, APST 3.9). No pollution-sensitive macroinvertebrates were present but it did support some taxa defined as having moderate tolerance to pollution (*Gammaridae, Anyclidae* and *Dytiscidae*). This indicates that the community and watercourse are significantly affected by poor water (pollution) or habitat quality.

Hollywell Brook Pond

3.2.13 Along the eastern section, Hollywell Brook discharges into a pond, which is approximately 2,000m^2 (see Photograph 3 in **Appendix D**). This supported margins areas of common rush (*Phragmites australis*), flowering rush (*Butomus umbellatus*), gypsywort (*Lycopus europaeus*), branched bur-reed (*Sparganium erectum*), soft rush (*Juncus effusus*) and water mint (*Mentha aquatica*) with the water open areas supporting water starwort (*Callitriche* sp.) and abundant green filamentous algae.

3.2.14 This pond also occurs within the boundary of the pLWS ‘Hollywell Brook corridor to A41’, covering the brook and the surrounding riparian corridor.

3.2.15 A moderate diversity of invertebrates was sampled, with a total of 11 taxa recorded to species level and a further 12 to genus or higher taxonomic level. These included a range of taxa including snail, mayfly, true bug and truefly which is fairly typical of a waterbody of this type.

3.2.16 The CCI score was 10.5 indicating that the pond is of fairly high conservation value. The majority of the species were of Very Common to Occasional nature conservation status.

3.2.17 The only exception was a lesser water boatman (Micronecta scholtzi). This is classified by the CCI as Regionally Notable, however, it is classified as Least Concern in the most recent Hemiptera (aquatic bugs) Red Data Book (NE, 2015) due to a recent increase in its range [REFxx]. This species can be found in a range of habitats including rivers and lakes [REF 11]. This species has, over the past 30 years, had a 479 % increase in the number of hectads where it has been recorded. Although some of this increase is believed to be associated with greater recording effort, it does appear to be expanding in range [REF 12].

3.2.18 The biological quality of the watercourse was moderate/poor (BMWP 49, APST 3.8). A single pollution-sensitive taxon was present (the mayfly, Caenidae) in addition to a range of taxa defined as having moderate tolerance to pollution. This indicates that the community and watercourse are significantly affected by poor water (pollution) and/or habitat quality.

Hollywell Brook Ditch

3.2.19 A small tributary of Hollywell Brook runs parallel to the M42, along its eastern boundary, flowing from north to south. This minor ditch was approximately 0.5m in width and 5cm deep, supporting run habitats with pebbles, gravel and sand. This ditch was very heavily shaded with marginal vegetation with bankside trees and scrub (see Photograph 4 in **Appendix D**).

3.2.20 A low diversity of invertebrates was sampled, with a total of 3 taxa recorded to species level and a further 5 to genus or higher taxonomic level. These included crustacean, true bug and truefly taxa and the assemblage is considered typical of the habitat conditions.

3.2.21 The CCI score of 1.33 indicates that it is of Low nature conservation value. All of the species were of Common or Very Common nature conservation status according to the CCI.

3.2.22 The biological quality of the watercourse was poor (BMWP 11, APST 3.7). No pollution-sensitive macroinvertebrates were present but it did support *Gammaridae* which is defined as having moderate tolerance to pollution. This indicates that the community and watercourse are significantly affected by poor water (pollution) and/or habitat quality.

Shadow Brook East of M42

3.2.23 The watercourse flows west to east through arable and grazing pasture, flowing under the M42 through a culvert. During the survey the western section was dry while the eastern area only supported a small number of pooled wetted areas (see Photograph 5 in **Appendix D**).

3.2.24 A low diversity of invertebrates was sampled, with a total of 4 taxa recorded to species level and a further 8 to genus or higher taxonomic level. These included a range of taxa notably truefly, with small numbers of molluscs, worms, crustaceans, leechs, truebugs and beetles. The assemblage is considered typical of the habitat conditions.

3.2.25 The CCI score of 4.5 indicates that it is of Low nature conservation value. All of the species were of Very Common to Frequent nature conservation status, according to the CCI.

3.2.26 The biological quality of the watercourse was poor (BMWP 28, APST 3.5). No pollution-sensitive macroinvertebrates were present but it did support some taxa defined as having moderate tolerance to pollution (*Gammaridae, Scirtidae* and *Dytiscidae*). However, overall the data indicate that the community and watercourse are significantly affected by poor water (pollution) and/or habitat quality.

Tributary of Shadow Brook

3.2.27 This small stream was approximately 30cm wide and 10cm deep and flows west to east under the M42 through a culvert. It borders arable fields and was heavily shaded by adjacent hedgerows. The substrate was predominately silt (see Photographs 6 and 7 in **Appendix D**). Samples were collected within the watercourse along each sections, east and west of the M42.

Tributary of Shadow Brook West of M42

3.2.28 A low diversity of invertebrates was sampled, with a total of 4 taxa recorded to species level and a further 7 to genus or higher taxonomic level. These included a range of taxa notably snails, molluscs, crustaceans and truefly larvae and the assemblage is considered typical of the habitat conditions.

3.2.29 The CCI score of 1.0 indicates that it is of Low conservation importance, with all of the species of very common status according to the CCI.

3.2.30 The biological quality of the watercourse was poor/moderate (BMWP 33, APST 4.1). A single pollution-sensitive taxon was present, signal crayfish (*Pacifastacus leniusculus*). This species is also of note, as it is a invasive non-native species. However, overall the data indicate that the community and watercourse are affected by poor water (pollution) and/or habitat quality.

Tributary of Shadow Brook East of M42

3.2.31 A low diversity of invertebrates was sampled, with a total of 4 taxa recorded to species level and a further 10 to genus or higher taxonomic level. These included a range of taxa notably snails, molluscs, crustaceans and truefly larvae with beetle and true bugs, and the assemblage is considered typical of the habitat conditions.

3.2.32 The CCI score of 5.3 indicates that it is of Moderate nature conservation importance, with all of the species of Very Common to Frequent nature conservation status according to the CCI.

3.2.33 The biological quality of the watercourse was moderate (BMWP 43, APST 4.3). A single pollution-sensitive taxon was present (the caddisfly *Psychomyiidae*), in addition to a range of taxa defined as having moderate tolerance to pollution. This indicates that the community and watercourse are somewhat affected by poor water (pollution) and/or habitat quality.

Kinghurst Brook

3.2.34 This small stream was approximately 1m wide with an average depth of 5cm. It supports riffle habitats with a bed dominated by silt, with occasional areas of stony substrate (see Photograph 8 in **Appendix D**). The channel was heavily shaded by dense riparian trees and scrub with the surrounding land-use of grazing pasture. The north western unit of Bickenhill Meadows SSSI, which is designated for its botanical interest, is located approximately 20m north-east of the watercourse.

3.2.35 A low diversity of invertebrates was sampled, with a total of 8 taxa recorded to species level and a further 14 to genus or higher taxonomic level. These included a range of taxa notably snails, molluscs and crustaceans, and the assemblage is considered typical of the habitat conditions.

3.2.36 The CCI score of 3.8 indicates that it is of Low conservation importance. All of the species were of very common to frequent status.

3.2.37 The biological quality of the watercourse was good (BMWP 84, APST 4.9). A number of pollution-sensitive taxa were present, including the caddisflies, *Leptoceridae, Limnephilidae, Polycentropodidae* and *Glossosomatidae*, in addition to a range of taxa defined as having moderate tolerance to pollution. This indicates that the watercourse is somewhat affected by poor water (pollution) or habitat quality.

4 Nature Conservation Evaluation

4.1 Overview

4.1.1 This section evaluates the aquatic macroinvertebrate assemblages present and their relative nature conservation importance. The features present within the Order Limits are not of international nature conservation importance [REF 13] as they lack the following:

a. species considered notable in an international context (for example species for which Great Britain holds a substantial part of the international population, or species which are restricted to Great Britain); or

b. species of European Union concern as listed on Annexes II and IV of the Habitats Directive (Council Directive 92/43/EEC) [REF 14].

4.2 Lesser Water Boatman (*Micronecta scholtz*)

4.2.1 This was the only notable species recorded during the surveys, being recorded from Hollywell Brook Pond.

4.2.2 Although previously classified as Notable, this species is either expanding in range or has been under recorded previously (or a combination of both factors). This species is not threatened and can occur in a range of habitats and therefore the CCI is judged to inflate the significance of this species. There are also no grounds to expect that it is restricted to just this pond in the local area, and instead can reasonably be expected to occur wherever there are comparable pond habitats.

4.2.3 On this basis the population of this species in this pond is now considered to be of Local importance only. This assessment is consistent with that presented in Chapter 9 Biodiversity of Volume 1 of the Environmental Statement [**APP-054/Volume 6.1**] and does not affect the evaluation of impacts or mitigation measures. The existing assessment is therefore considered to remain valid.

4.3 Evaluation

4.3.1 With the exception of the lesser water boatman assessed in Section 4.2, all of the aquatic macroinvertebrate recorded in the sampling were common and typical of the habitats present. As none were rare, threatened or legally protected, none of these individual species are considered to be of any more than Local importance.

4.3.2 None of the sites are considered to meet the criteria established to identify sites of county importance (i.e. LWSs). Although the guidance [REF 7] does not define specific thresholds for each of the qualifying criteria, this assessment has concluded that the aquatic macroinvertebrates communities are not notably diverse, rare or meet any other of the criteria set to be of county importance, as such they are judged to be of Local importance.

4.3.3 The specific nature conservation evaluations are summarised in **Table 4-1**.

Table 4-1 Nature Conservation Evaluations

Water body	Aquatic Macroinvertebrate Species Evaluation	Aquatic Macroinvertebrate Assemblages Evaluation
Hollywell Brook, West of M42	Local	Local
Hollywell Brook, East of M42	Local	Local
Hollywell Brook, Pond	Local	Local
Hollywell Brook, Ditch	Local	Local
Shadow Brook East of M42	Local	Local
Tributary of Shadow Brook, West of M42	Local	Local
Tributary of Shadow Brook, East of M42	Local	Local
Kinghurst Brook	Local	Local

5 Conclusion

5.1.1 The aim of the survey undertaken on the 3 and 4 September 2018 was to assess the diversity and biological quality of the macroinvertebrate communities of eight waterbodies associated with the Scheme. This has involved sampling to establish current conditions and to reaffirm their relative nature conservation importance as reported in Chapter 9 Biodiversity of Volume 1 of the Environmental Statement [**APP-054/Volume 6.1**].

5.1.2 A number of notable species were recorded by the desk study, the most noteworthy was the beetle, *Helochares obscurus*. This species is now regarded as Vulnerable (CCI: 9). However, given its specific habitat requirements, which are not present within the Order Limits, it is considered unlikely that this species is present.

5.1.3 All of the sites appear to be somewhat affected by poor water quality (nutrient enrichment or pollution) or habitat quality.

5.1.4 No rare or protected species were recorded within any of the sites and all are judged to be of Local importance. This includes the lesser water boatman (*Micronecta scholtz*), which has previously been assessed as Notable within the CCI; however, more recent evidence suggests that this species is either expanding in range or has been under recorded previously at the national level.

5.1.5 None of the macroinvertebrate communities present within any of the sites are judged to be either notably diverse or rare enough to meet the criteria set to evaluate sites of county value. As such, they are also judged to be of Local importance.

5.1.6 Paragraph 9.6.79 in Chapter 9 Biodiversity of Volume 1 of the Environmental Statement [**APP-054/Volume 6.1**] concluded the following regarding aquatic invertebrates:

'The ponds within the Order Limits, which are ephemeral and over-shaded features that lack botanical or structural diversity, are considered to be of no more than Local importance for aquatic invertebrates. It is considered that at most the watercourses within the Order Limits are of County importance for aquatic invertebrates.'

5.1.7 The data presented in this report supports an assessment that both the ponds and watercourses within the Order Limits are of Local importance, which respectively is either equal to or of less importance than that previously reported.

5.1.8 Therefore, overall this assessment of the species and assemblages of aquatic macroinvertebrates is consistent with that presented in Chapter 9 Biodiversity of Volume 1 of the Environmental Statement [**APP-054/Volume 6.1**] and does not affect the evaluation of impacts or mitigation measures. The existing assessment is therefore considered to remain valid.

6 References

REF 1	Environment Agency (last issue: 2012) Freshwater macroinvertebrate sampling in rivers. Operational instruction 018_08
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REF 3	Environment Agency (2014) *Freshwater macro-invertebrate analysis of riverine samples, Version 28/01/2014.* Operational instruction 024_08
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REF 14	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora [Online]. [Accessed 21st November 2018]. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31992L0043

Figure 1 – Aquatic Macroinvertebrate Sampling Locations

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NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.

LEGEND

- THE SCHEME
- LIMITS OF LAND TO BE ACQUIRED OR USED PERMANENTLY OR TEMPORARILY (THE ORDER LIMITS)
- LIMITS OF LAND TO BE TEMPORARILY ACQUIRED FOR SIGNAGE INSTALLATION
- LAND NOT INCLUDED WITHIN THE ORDER LIMITS
- G1 - STANDING WATER
- G2 - RUNNING WATER

AQUATIC MICROINVERTEBRATE SAMPLE LOCATIONS

- AQUATIC MACROINVERTEBRATE SAMPLE SITE
- SITES WHERE AQUATIC MACROINVERTEBRATE COULD NOT BE SAMPLED

Sample ID	Sample Location
1	Holywell Brook, West of M42
2	Holywell Brook, East of M42
3	Holywell Brook Pond
4	Holywell Brook Ditch
5	Shadow Brook East of M42
6	Tributary of Shadow Brook West of M42
7	Tributary of Shadow Brook East of M42
8	Kinghurst Brook
9	Pond 10
10	Pond 39
11	Pond 45
12	Bickenhill Meadows SSSI Drain
13	Shadow Brook West of M42

SEE SHEET 2

0 50 100 200 300 400 Metres

FIRST ISSUE	GB / JG	26/04/19	C01
Revision Details	By / Check	Date	Suffix

Purpose of Issue: DCO SUBMISSION

Client: Highways England, Floor 5, Two Colmore Square, 38 Colmore Circus, B4 6BN

Development Consent Order Number: TR010027

Project Title: M42 JUNCTION 6 IMPROVEMENT

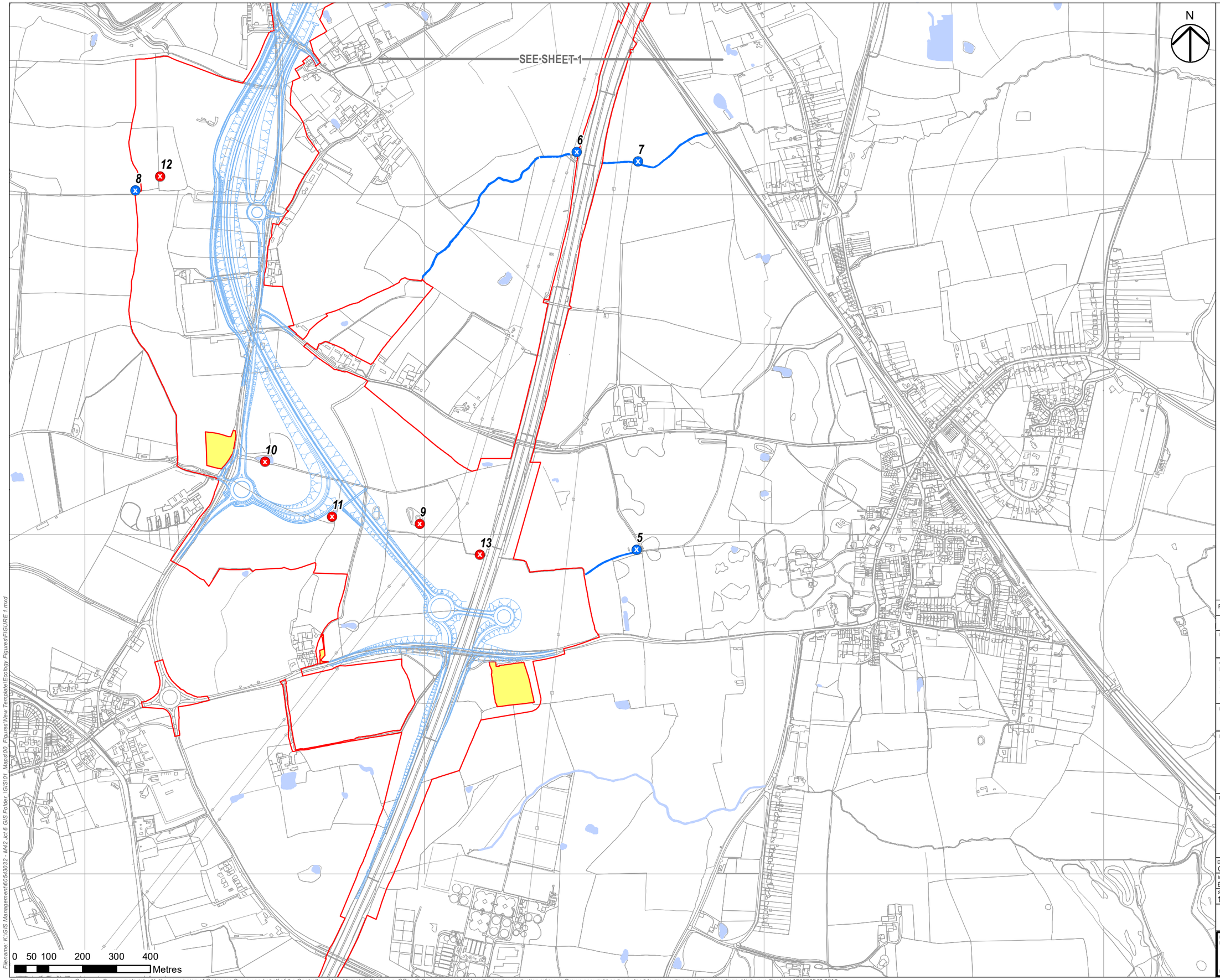
Drawing Title: FIGURE 1 AQUATIC MACROINVERTEBRATE SAMPLE LOCATIONS SHEET 1 OF 2

Designed	Drawn	Checked	Approved	Date
CW	GB	MWH	JG	26/04/19

Internal Project No	Suitability
60543032	D7
Scale @ A3: 1:10,000	Zone: M42

Drawing Number: Highways England Pin HE551485 | Originator -ACM | Volume -EGN- | Location M42_SW_ZZ_ZZ | Type -DR- | Role -DC- | Number -0239 | Rev C01

Filename: K:\GIS Management\60543032 - M42 Jct 6 GIS Folder_\GIS\01_Maps\00_Figures\New Template\Ecology Figures\FIGURE 1.mxd



NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.

LEGEND

- THE SCHEME
- LIMITS OF LAND TO BE ACQUIRED OR USED PERMANENTLY OR TEMPORARILY (THE ORDER LIMITS)
- LIMITS OF LAND TO BE TEMPORARILY ACQUIRED FOR SIGNAGE INSTALLATION
- LAND NOT INCLUDED WITHIN THE ORDER LIMITS
- G1 - STANDING WATER
- G2 - RUNNING WATER

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CW	GB	MWH	JG	26/04/19

Internal Project No	Suitability
60543032	D7
Scale @ A3: 1:10,000	Zone: M42

Drawing Number: Highways England Pin | Originator | Volume | Location | Type | Role | Number

HE551485 -ACM -EGN- M42_SW_ZZ_ZZ -DR-DC-0240

Rev: C01

Filename: K:\GIS Management\60543032 - M42 Jct 6 GIS Folder_\GIS\01_Maps\00_Figures\New Template\Ecology Figures\FIGURE 1.mxd

Appendices

Appendix A: Biological Monitoring Working Party (BMWP) System

The BMWP system assigns a numerical value to about 80 different taxa (known as the BMWP-scoring families) according to their sensitivity to organic pollution. The average of the values for each taxon in a sample, known as ASPT (average score per taxon) is a stable and reliable index of organic pollution. Values lower than expected indicate organic pollution.

The most useful way of summarising the biological data has been found to be one that combined the number of taxa and the ASPT. The best quality is indicated by a diverse variety of taxa, especially those that are sensitive to pollution. Poorer quality is indicated by a smaller than expected number of taxa, particularly those that are sensitive to pollution. Organic pollution sometimes encourages an increased abundance of the few taxa that can tolerate it.

The biotic scores can be interpreted by following the guidelines in the table below (taken from Armitage et al., 1983; Chapman, 1996; Mason, 2002). However, these categories are for guidance only and the maximum achievable values will vary between geological regions.

For example, pristine lowland streams in East Anglia will always score lower than pristine Welsh mountain streams as they are unable to support many of the high-scoring taxa associated with fast flowing habitat. BMWP scores and ASPT for different types watercourse are dependent on the quality and diversity of habitat, natural water chemistry (associated with geology, distance from source etc.), altitude, gradient, the time of year the sample was taken, and other factors.

Table A: A guide to interpreting BMWP Score and ASPT

BMWP score	ASPT	Interpretation
0-10	<3.0	Very poor, heavily polluted
11-40	3.0-4.3	Poor, polluted or impacted
41-70	4.3-4.8	Moderate, moderately impacted
71-100	4.8-5.4	Good, clean but slightly impacted
>100	>5.4	Very good, unpolluted, unimpacted

Appendix B: Desk Study Data

TAXON GROUP	SCIENTIFIC NAME	CCI SCORE	UPDATED CONSERVATION ASSESSMENT (DERIVED FROM FOSTER, 2010)	LOCATION	PROVIDED GRID REFERENCE	DATE
Coleoptera	*Enochrus affinis*	7	Downgraded from Nationally Scarce*, too widespread to qualify	Coleshill and Bannerly Pools SSSI	SP 1985	19/05/2010
Coleoptera	*Hydroporus neglectus*	7	Nationally Scare	Coleshill and Bannerly Pools SSSI	SP 1985	19/05/2010
Coleoptera	*Ilybius fenestratus*	7	Downgraded from Nationally Scarce, too widespread to qualify	Coleshill and Bannerly Pools SSSI	SP 1986	25/05/2010
Coleoptera	*Helochares obscurus*	8	Upgraded to Vulnerable**	Coleshill and Bannerly Pools SSSI	SP 2086	19/05/2010
Coleoptera	*Elodes elongata*	8	Downgraded to Nationally Scarce	Shadowbrook Meadows NR	SP 1881	04/06/2009
Coleoptera	*Hydroglyphus geminus*	7	Downgraded from Nationally Scarce, too widespread to qualify	Shadowbrook Meadows NR	SP 1881	15/03/2010
Coleoptera	*Elodes minuta*	Not assessed	Nationally Scare	Shadowbrook Meadows NR	SP 1881	04/06/2009
Coleoptera	*Rhantus suturalis*	7	Downgraded from Nationally Scarce, too widespread to qualify	Shadowbrook Meadows NR	SP 1881	15/03/2010
Coleoptera	*Cercyon ustulatus*	7	Downgraded from Nationally Scarce, too widespread to qualify	Shadowbrook Meadows NR	SP 1881	04/06/2009

* only found in 16 to 100 hectads nationally

** only present in 5 to 10 hectads nationally

Appendix C - Aquatic Macroinvertebrate Species Data

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	HOLLYWELL BROOK DITCH	HOLLYWELL BROOK, WEST OF M42	HOLLYWELL BROOK POND	TRIBUTARY OF SHADOW BROOK EAST OF M42	KINGHURST BROOK	TRIBUTARY OF SHADOW BROOK WEST OF M42	HOLLYWELL BROOK, EAST OF	SHADOWBROOK EAST OF M42
Flatworms											
Planariidae	Polycelis sp.	5						1			
Snails											
Lymnaeidae	Lymnaeidae (juvenile / damaged)	3							1		
Lymnaeidae	*Radix balthica*	3	1		1						
Valvatidae	*Valvata piscinalis*	3	1		4						
Hydrobiidae	*Potamopyrgus antipodarum*	3	1			5	167	233	217	82	
Bithyniidae	Bithynia sp.	3				1					
Bithyniidae	*Bithynia tentaculata*	3	1		18						
Physidae	Physidae (juvenile / damaged)	3				9					
Planorbidae	Planorbidae (juvenile / damaged)	3			1						
Planorbidae	*Planorbis carinatus*	3	1		1						
Planorbidae	*Gyraulus albus*	3	1		7	13					

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	HOLLYWELL BROOK DITCH	HOLLYWELL BROOK, WEST OF M42	HOLLYWELL BROOK POND	TRIBUTARY OF SHADOW BROOK EAST OF M42	KINGHURST BROOK	TRIBUTARY OF SHADOW BROOK WEST OF M42	HOLLYWELL BROOK, EAST OF	SHADOWBROOK EAST OF M42
Planorbidae	*Armiger crista*	3	2		2					1	
Planorbidae	*Hippeutis complanatus*	3	3			2					
Limpets and mussels											
Anyclidae	*Ancylius fluviatilis*	6	1		1			1		2	
Sphaeriidae	Sphaeriidae (juvenile / damaged)	3			5					24	
Sphaeriidae	Sphaerium sp.	3			70					3	
Sphaeriidae	Pisidium sp.	3				1	47	40	26		3
Worms											
Oligochaeta		1			16	8	4	2			2
Leeches											
Glossiphoniidae	Glossiphoniidae (juvenile / damaged)	3			6						
Glossiphoniidae	*Glossiphonia complanata*	3	1		8			3			2
Glossiphoniidae	*Helobdella stagnalis*	3	1		2						
Erpobdellidae	*Erpobdella* sp.	3			6						
Erpobdellidae	*Erpobdella testacea*	3	5		3						

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	HOLLYWELL BROOK DITCH	HOLLYWELL BROOK, WEST OF M42	HOLLYWELL BROOK POND	TRIBUTARY OF SHADOW BROOK EAST OF M42	KINGHURST BROOK	TRIBUTARY OF SHADOW BROOK WEST OF M42	HOLLYWELL BROOK, EAST OF	SHADOWBROOK EAST OF M42
Crustaceans											
Ostracoda		-				17					
Cladocera		-				80					
Gammaridae	Gammaridae	6		40	50						
Gammaridae	*Gammarus* sp.	6					29	120			
Gammaridae	*Gammarus pulex*	6	1	45	290		7	39	26	51	1
Astacidae	*Pacifastacus leniusculus*	8							1		
Asellidae	*Asellus aquaticus*	3	1	1	133	11			1	5	4
Asellidae	*Asellus meridianus*	3	3								6
Mayflies											
Baetidae	Baetidae (juvenile / damaged)	4			1	14					
Baetidae	*Baetis* sp.	4						1		3	
Baetidae	*Cloeon dipterum*	4	1			1					
Caenidae	*Caenis* sp.	7				1					
Caenidae	*Caenis horaria*	7	1			1					

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	HOLLYWELL BROOK DITCH	HOLLYWELL BROOK, WEST OF M42	HOLLYWELL BROOK POND	TRIBUTARY OF SHADOW BROOK EAST OF M42	KINGHURST BROOK	TRIBUTARY OF SHADOW BROOK WEST OF M42	HOLLYWELL BROOK, EAST OF	SHADOWBROOK EAST OF M42
Damselflies											
Coenagrionidae	Coenagrionidae (juvenile / damaged)	6				2					
Calopterygidae	Calopterygidae (juvenile / damaged)	8			2						
Gerridae	Gerridae (nymph / damaged)	5			1						
Veliidae	Veliidae (nymph / damaged)	-					1	1			1
Nepidae	*Nepa cinerea*	5	3		5						
Pleidae	*Plea minutissima*	5	4			1					
Corixidae	Corixidae (nymph / damaged)	5				75					
Corixidae	*Micronecta scholzi*	5	6			1					
Corixidae	*Callicorixa praeusta*	5	3			1					
Corixidae	*Sigara dorsalis*	5	1			2					
Hydrometridae	Hydrometridae (damaged)	-			1						
Hydrometridae	*Hydrometra stagnorum*	-	2	1	1						

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	HOLLYWELL BROOK DITCH	HOLLYWELL BROOK, WEST OF M42	HOLLYWELL BROOK POND	TRIBUTARY OF SHADOW BROOK EAST OF M42	KINGHURST BROOK	TRIBUTARY OF SHADOW BROOK WEST OF M42	HOLLYWELL BROOK, EAST OF	SHADOWBROOK EAST OF M42
Beetles											
Dytiscidae	Dytiscidae (larvae / damaged)	5			2		5		1	1	1
Dytiscidae	*Platambus maculatus*	5	2				2				
Hydraenidae	*Hydraena riparia*	5	1					3			
Scirtidae	Scirtidae (larvae / damaged)	5					1	3			1
Elmidae	*Elmis aena*	5	1					17			
Alderflies											
Sialidae	Sialidae (juvenile / damaged)	4									
Sialidae	*Sialis lutaria*	4	1			1				1	
Caddisflies											
Glossosomatidae	*Agapetus fuscipes*	7	1					1			
Polycentropodidae	Polycentropodidae (juvenile / damaged)	7						1			
Psychomyiidae	*Lype reducta*	8	3				3				
Hydropsychidae	Hydropsychidae (juvenile / damaged)	5			5						

BMWP GROUP	SPECIES	BMWP SCORE	CONSERVATION SCORE	HOLLYWELL BROOK DITCH	HOLLYWELL BROOK, WEST OF M42	HOLLYWELL BROOK POND	TRIBUTARY OF SHADOW BROOK EAST OF M42	KINGHURST BROOK	TRIBUTARY OF SHADOW BROOK WEST OF M42	HOLLYWELL BROOK, EAST OF	SHADOWBROOK EAST OF M42
Hydropsychidae	*Hydropsyche angustipennis*	5	1		5						
Limnephilidae	Limnephilidae (juvenile / damaged)	7						2			
Limnephilidae	*Chaetopteryx villosa*	7	3					1			
Leptoceridae	*Athripsodes* sp.	10						1			
Trueflies											
Chironomidae	Chironomidae (damaged / pupea)	2			27		50	14	118	30	267
Chironomidae	Tanypodinae	2			7						
Chironomidae	Orthocladiinae	2		9	10	2					
Chironomidae	Chironomini	2			3	23					
Chironomidae	Tanytarsini	2			4						
Pediciidae	*Dicranota* sp.	5					1				
Simuliidae	Simuliidae (damaged / juvenile)	5			3		1	1			
Dixidae	Dixidae (damaged / juvenile)	-						7	1		
Psychodidae		-					1	2			2

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Empididae		-		1							
Culicidae	Culicidae	-							2	1	3
Other Taxa											
Lepidoptera		-		1	1				1		
Collembola		-		1							
Diptera		-			1						
Number of scoring families (BMWP)				3	19	13	10	17	8	10	8
Number of non-scoring families (BMWP)				4	3	3	2	3	3	2	3
Total number of families (BMWP)				7	22	16	12	20	11	12	11
BMWP score				11	73	49	43	84	33	39	28
ASPT (BMWP)				3.7	3.8	3.8	4.3	4.9	4.1	3.9	3.5
CCI Score				1.33	7.7	10.5	5.3	3.8	1.0	1.2	4.5
Total Number of species				3	15	11	4	8	4	6	4
Total Number of genus / above				5	21	12	10	14	7	6	8

Appendix D – Site Photographs

Photograph 1: Hollywell Brook, West of M42

Photograph 2: Hollywell Brook East of M42

Photograph 3: Hollywell Brook Pond

Photograph 4: Hollywell Brook Ditch

Photograph 5: Shadow Brook East of M42

Photograph 6: Tributary of Shadow Brook, West of M42

Photograph 7: Tributary of Shadow Brook, East of M42

Photograph 8: Kinghurst Brook