A38 Derby Junctions

TR010022

Volume 6

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Regulation 5(2)(a)

Planning Act 2008

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

April 2019

Infrastructure Planning

Planning Act 2008

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

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6.3 Environmental Statement Appendices
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Regulation Number	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	6.3
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	April 2019	DCO Application

A38 Derby Junctions

Aquatic Macroinvertebrate Survey Report

Report Number: HE514503-ACM-EBD-A38_SW_PR_ZZ-RP-EG-0024 P02 S4
December 2018

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1 INTRODUCTION

1.1 Background and Scope

1.1.1 AECOM Infrastructure & Environment UK Limited (AECOM) has been commissioned by Highways England to provide design services with regards to the A38 Derby Junctions Scheme (referred to as "the Scheme" herein).

1.1.2 The Scheme concerns the grade separation of three junctions on the A38 in Derby, namely:

- A38/ A5111 Kingsway junction
- A38/ A52 Markeaton junction
- A38/ A61 Little Eaton junction

1.1.3 These three junctions are located along an approximate 5.5km stretch of the A38 to the west and north-west of Derby. Refer to Figure 1, Appendix A for the Scheme location plan.

1.1.4 Since 2015 a range of environmental surveys have been carried out to assess baseline conditions and support the environmental assessment of the Scheme. As the Scheme design has progressed, the Scheme boundary has been redefined, and as a result, additional sites have been scoped in for surveys during 2018 (where applicable).

1.1.5 Aquatic macroinvertebrate surveys were carried out in the spring and autumn of 2018. The sample locations were identified during the 2017 Phase 1 Habitat survey (AECOM, 2016a) on watercourses which were considered the most likely to be affected by the Scheme. The 2018 survey included updated surveys of those sites previously surveyed in 2015, given the data was over two years old (report reference 47071319-URS-05-RP-EN-018(AECOM, 2016). An additional site, Middle Brook, was also scoped in during 2018 due to Scheme boundary changes, which was not previously surveyed in 2015. Middle Brook sits adjacent to a proposed temporary construction compound, which includes a temporary crossing of the watercourse.

1.1.6 This report presents the 2018 survey results, and includes a summary of aquatic macroinvertebrate surveys carried out in 2015..

1.1.7 Refer to the AECOM 2018 White-clawed Crayfish Survey Report for further details on the desk study records, survey results and recommendations specifically for white-clawed crayfish (a macroinvertebrate species) (AECOM 2018(d), Report reference HE514503-ACM-EBD-A38_SW_PR_ZZ-RP-EG-0019).

1.1.8 Fish surveys were commissioned on Dam Brook and Watermeadows Ditch during the summer of 2018Dam Brook would need to be diverted due to Scheme works at Little Eaton junction. The survey objective was to identify species present in Dam Brook and assess the suitability of Watermeadows Ditch as a donor watercourse. Refer to the Fish Survey Report for further details on the results and recommendations specifically for fish (AECOM 2018(e), Report reference HE514503-ACM-EBD-A38_SW_PR_ZZ-RP-EG-0021).

1.2 Study Area – Watercourses

1.2.1 The following watercourses were identified during the 2016 Phase 1 habitat survey (AECOM, 2016a) as having the potential to support a diverse aquatic community, which could potentially be affected by the Scheme. Middle Brook was also scoped in since 2015 due to changes to the Scheme boundary (AECOM, 2018b). The sites are in descending order of size:

- **The River Derwent:** The River Derwent rises near Bleaklow in the north of Derbyshire and flows southwards through the city of Derby to join the River Trent at Derwent-mouth, approximately 12km south-east of the city. It is crossed by the existing A38 to the west of Little Eaton junction. This river crossing is located at the western extent of the Scheme boundary at Little Eaton junction (approximately 500m west of Little Eaton roundabout).
- **Markeaton Brook:** a 17km long tributary of the River Derwent that drains from Hulland Ward north-west of the city and flows through Markeaton Park, north of Markeaton Lake with some flow diverted to maintain water levels in the lake. The Scheme crosses Markeaton Brook approximately 65m north-east of Markeaton junction and crosses the culvert separating Markeaton Lake from Mill Dam Lake and Mill Dam Canal.
- **Bramble Brook:** a small stream that flows from the north of the A38, entering culverts beneath the A38 northbound carriageway into the Kingsway junction southern central reservation Local Wildlife Site (LWS).
- **Dam Brook:** a small tributary of the River Derwent heavily canalised and culverted beneath Little Eaton junction before joining Watermeadows Ditch south of Little Eaton junction and flowing west to join the River Derwent.
- **Middle Brook:** a small tributary of Markeaton Brook, fed by a weir from Markeaton Lake. It flows east for approximately 400m before joining the brook. A section of the watercourse is currently culverted beneath the A38 at the Kedleston Road junction.

1.2.2 Refer to Figures 2 and 3, Appendix A for the location of the watercourse sample areas.

1.2.3 The Study Area focused primarily on those watercourses within or adjacent to the Scheme boundary which may be potentially affected by the Scheme (as identified from the River Corridor Survey (RCS) and River Habitat Survey (RHS) (AECOM 2016b; and AECOM 2018c)). The survey area varied per watercourse dependent on access and suitable habitat present; refer to the methodology section for details on the survey extent.

1.3 Relevant Legislation and Biodiversity Strategy

1.3.1 The aquatic macroinvertebrate survey sought to identify the presence of protected or notable habitats and species related to the quality of the watercourses as detailed in Section 1.2, which in this case are covered under one or more of the following legislation:

- The Natural Environment and Rural Communities (NERC) Act 2006
- The Wildlife and Countryside Act (1981) as amended (WCA)
- The EC Habitats Directive (Directive 92/43/ECC) as translated into UK law by The Habitats and Species Regulations 2017

- Water Resources Act 1991
- The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2015.

1.3.2 Highways England, through the national Road Investment Strategy (RIS), has set an aspiration that the operation, maintenance, and enhancement of the Strategic Road Network (SRN) should move to a position that reduces net loss of biodiversity; and, in the long term, Highways England should deliver a net gain in biodiversity across its broader range of works. Highways England published a Biodiversity Plan in 2015 to show how it will work with service providers to halt overall biodiversity loss and maintain and enhance habitats and ecological networks.

1.3.3 The Government requires Highways England to demonstrate progress against the Biodiversity Plan, to secure an ongoing annual reduction in the loss of net biodiversity due to its activities. The Biodiversity Plan provides a general plan to protect and increase biodiversity. The Highways England Biodiversity Plan supersedes the 2002 Highways Agency (now Highways England) Biodiversity Action Plan (BAP), which still however carries some relevance as it lists specific habitats of conservation concern.

1.3.4 Water features (including rivers and streams) are listed in the 2002 Highways England BAP as priority habitats. The 2002 Highways England BAP also notes a water beetle (*Agabus brunneus*) and white-clawed crayfish (*Austropotamobius pallipes*) to be priority species associated with water features.

2 METHODOLOGY

2.1 Desk-based Study

2.1.1 A desk study was undertaken as part of the scope of works for the Phase 1 Habitat survey and is reported in detail in the Extended Phase 1 Habitat Report (AECOM 2018a). Aquatic invertebrate records were obtained in 2015 from the relevant local ecological records centres (Derbyshire Wildlife Trust (DWT) and Derbyshire and Nottinghamshire Entomological Society (DaNES) for a search radius of 1km from the Scheme boundary, referred to in this report. The desk study was updated in 2018, however, no new records were obtained from DWT or DaNES in 2018.

2.1.2 Details of relevant invertebrate desk study records are presented in the Phase 1 Habitat Survey report (AECOM, 2018a), and are not duplicated here.

2.1.3 The Highways England Environmental Information System (EnvIS) was also searched for any relevant records.

2.2 Site Survey

2.2.1 Field surveys at selected sites were undertaken by AECOM aquatic ecologists in spring (10 May 2018) and autumn (05, September 2018); these seasons are recognised to be optimal for aquatic macroinvertebrate sampling. Photos were taken to support survey findings and are presented in Appendix B.

2.2.2 For each watercourse, samples were taken upstream and downstream of the Scheme crossing, to cover the range of habitats present within potentially affected areas, as follows (refer to Figures 2 and 3, Appendix A):

- River Derwent: between approximately 50m upstream of the A38 crossing point, at NGR SK 35890 39998 and approximately 70m downstream of the A38 crossing point, at NGR SK 35882 39880 (Appendix B, P1 and P2).
- Markeaton Brook: sampled between approximately 110m upstream of the A38 crossing point at SK 33713 37639 and approximately 140m downstream at SK 33988 37441. The channel is heavily shaded throughout and lacks in channel vegetation (Appendix B, P3 and P4).
- Bramble Brook: sampled within Kingsway junction south roundabout at SK 32652 35986 and within Kingsway junction north island at SK 32782 36065 (Appendix B, P5 and P6).
- Dam Brook: sampled upstream of the culvert beneath Little Eaton junction at SK 36488 40010 and downstream of the culvert (Appendix B, P7 and P8).
- Middle Brook: sampled next to Kedleston Road junction approximately 100m downstream of the A38 at SK 33898 37346 and at approximately 220m downstream at SK 33990 37269 (Appendix B, P9 and P10).

2.2.3 Biological (macroinvertebrate) sampling was undertaken by two experienced aquatic ecologists to assess the biological quality of the watercourses. Biological samples were collected with a standard Freshwater Biological Association (FBA) pattern pond net (mesh size: 1mm) in line with standard Environment Agency methodology (Environment Agency, 2014). Instream habitats were ‘kick sampled’ where practicable, or ‘sweep sampled’, for three minutes followed by a one-minute hand search of larger substrates.

2.2.4 The collected samples were then preserved in isopropyl alcohol 70% v/v for laboratory processing.

2.3 Macroinvertebrate Analysis

2.3.1 Detailed sorting of the entire samples was carried-out in the laboratory by a trained and experienced aquatic biologist, to gain comparable lists of macroinvertebrate taxa (in line with Environment Agency, 2014). Macroinvertebrates were identified to species level (where practicable) for most groups, using stereomicroscopes (under low power) and appropriate identification keys. In line with Environment Agency analytical guidance protocols (2014), the following groups were excluded from species level identification, and taxonomic identifications as indicated:

- Diptera (family)
- Coleoptera larvae (family)
- Oligochaeta (order)
- Nematoda (order)
- Sphaeriidae (genus)
- Hydracarina (order)
- Immature or damaged specimens (to a reliable level of identification)

2.3.2 The invertebrate data were analysed using the following indexes:

- Biological Monitoring Working Party (BMWP) score and Average Score per Taxon (ASPT) values (Hawkes, 1997) – an explanation of BMWP scores and ASPT is provided as Appendix C. Scores are derived based on the sensitivity of taxa (families) of invertebrates to organic pollution.
- Community Conservation Index (CCI) method (Chadd and Extence, 2004) – to assess the conservation value of the macroinvertebrate populations present and identify any unusual or rare species (see below).

2.3.3 The conservation value of the different invertebrate species and communities was assessed using the CCI. The CCI classifies many groups of freshwater invertebrates according to their scarcity and nature conservation value in Great Britain. Species conservation scores (CS) range from 1 to 10, with 1 being very common and 10 being endangered (as shown in Table 1). These classifications relate closely to the categories in the Red Data Books (RDB) (Shirt 1987, Hyman & Parsons 1992 and Bratton, 1991), although some RDB have since been updated and some species re-classified; the most recent species status is described herein.

Table 1: Conservation Scores (CS) from the Community Conservation Index (CCI)

CS	Conservation Value/ Equivalent RDB Status
10	RDB1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (but not RDB status)
6	Regionally notable

CS	Conservation Value/ Equivalent RDB Status
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)

2.3.4 The overall index provides an indication of the conservation value of the community sampled based on a combination of the rarity of the different species present and overall community richness, as shown in Table 2.

Table 2: Guidance on Interpretation of CCI Scores (from Chadd & Extence, 2004)

CCI Score	Description	Interpretation
0.0 – 5.0	Sites supporting only common species and/or a community of low taxon richness	Low conservation value
5.0 – 10.0	Sites supporting at least one species of restricted distribution and/ or a community of moderate taxon richness	Moderate conservation value
10.0 – 15.0	Sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness	Fairly high conservation value
15.0 – 20.0	Sites supporting several uncommon species, at least one of which may be nationally rare and/ or a community of high taxon richness	High conservation value
> 20.0	Sites supporting several rarities, including species of national importance, or at least one extreme rarity and/ or a community of high taxon richness	Very high conservation value

2.4 Survey Limitations

2.4.1 Access was impracticable where watercourses ran in culverts, so for health and safety reasons, these areas were not sampled. However, this did not affect the validity of the data, as box-section concrete culverts do not provide high quality habitats for aquatic macroinvertebrates.

2.4.2 Access to the River Derwent was not possible from the western bank, so all samples were collected from the eastern bank. The spring and autumn samples were not collected from the same grid reference locations due to access restrictions. The upstream sample was collected approximately 140m further upstream in autumn, and the downstream sample a further 120m downstream. Due to the largely homogenous nature of the in-stream habitats at this point in the watercourse, this is not expected to have affected the survey results.

2.4.3 Markeaton Brook was heavily engineered where the A38 carriageway crosses the watercourse, so sampling directly upstream and downstream of the crossing was not possible due to a lack of in-channel habitat. Samples were, therefore, taken from sections where in-channel habitat was present. The autumn samples were collected approximately 35m from the spring sample points. This may have contributed to the variation in macroinvertebrate community recorded between the seasons.

2.4.4 Sections of Bramble Brook were heavily engineered with man-made and natural materials which generated a mix of substrates including bedrock, concrete and deep silt. However, a good representation of species was obtained from the spring and summer surveys.

2.4.5 The survey investigated conditions at the time of sampling, but species that may occur at other times of year, sporadically and/ or in low numbers, may not have been recorded. This is an inevitable consequence of seasonal sampling, and its effects are minimised by standardised sampling methodology and sampling during the optimal survey seasons i.e. spring and autumn.

2.4.6 It is acknowledged that summer sampling was conducted for the aquatic invertebrate surveys in 2015. However, it was not considered necessary to repeat summer sampling during the 2018 update surveys, because any discrepancy between spring, summer and autumn sampling would have been established by the 2015 survey. Best practice methodology prescribes spring and autumn sampling as a suitable approach, reinforced by summer sampling where further information on seasonal fluctuations in species presence is considered valuable, as was the case in 2015.

2.4.7 This sampling regime allows the characterisation of invertebrate communities and establishes the biological quality of freshwater habitats. Where juvenile or damaged specimens only were available, species-level identification was not possible. These limitations would not be considered to have affected the results presented herein.

3 RESULTS

3.1 Desk-based Study

3.1.1 Refer to Table 3 for recent desk-study records of freshwater macroinvertebrates i.e. from within the last 10 years, provided by DWT and DaNES for 1km of the Scheme boundary. No macroinvertebrate records were found on EnvIS.

Table 3: Desk-based Study Records for Freshwater Macroinvertebrates

DWT/ DaNES	Species	Scientific name	Habitat Regs	UK Priority spp.	W&C Act	Local BAP species	Other Notable spp.	Likelihood on site	Likelihood within 1 km	Most recent record
DWT	White-clawed crayfish	*Austropotamobius pallipes*	Y	Y	Y	Y	Y	2	2	2014
DaNES	Green drake (a mayfly)	*Ephemera danica*	N	N	N	N	N	2	1	2010
DaNES	Water measurer	*Hydrometra stagnorum*	N	N	N	N	N	2	1	2010
DaNES	Water cricket	*Velia caprai*	N	N	N	N	N	2	1	2010
DaNES	Water scorpion	*Nepa cinerea*	N	N	N	N	N	2	1	2010
DaNES	Water stick insect	*Ranatra linearis*	N	N	N	N	N	2	1	2010
DaNES	Common water boatman	*Notonecta glauca*	N	N	N	N	N	2	1	2004
DaNES	Common pond skater	*Gerris lacustris*	N	N	N	N	N	2	1	2004
DaNES	Banded Demoiselle	*Caleopteryx splendens*	N	N	N	N	N	2	1	2010
DaNES	Brown hawker	*Aeshna grandis*	N	N	N	N	N	2	1	2006
DaNES	Blue-tailed damselfly	*Ischnura elegans*	N	N	N	N	N	2	1	2010
DaNES	Common blue damselfly	*Enallagma cyathigerum*	N	N	N	N	N	2	1	2010
DaNES	Large red damselfly	*Pyrrhosoma nymphula*	N	N	N	N	N	2	1	2007
DaNES	Southern hawker	*Aeshna cyanea*	N	N	N	N	N	2	1	2004
DaNES	Black-tailed skimmer	*Orthetrum cancellatum*	N	N	N	N	N	2	1	2006

DWT/ DaNES	Species	Scientific name	Habitat Regs	UK Priority spp.	W&C Act	Local BAP species	Other Notable spp.	Likelihood on site	Likelihood within 1 km	Most recent record
DaNES	Common Darter	*Sympetrum striolatum*	N	N	N	N	N	2	1	
DaNES	Migrant hawker	*Aeshna mixta*	N	N	N	N	N	2	1	
	Key to Likelihood of species presence: 1 = **confirmed**, 2 = **likely**, 3 = **possible**, 4 = **unlikely**									

*Desk study records also provided 40 records of adult Odonata comprising nine species from the grid square SK3538 that are likely to be breeding in the surrounding watercourses/ waterbodies

3.1.2 Desk-study records indicated that Markeaton Brook is a Local Wildlife Site (LWS) designated for its macroinvertebrate interest (including white-clawed crayfish) and its large population of freshwater sponges.

3.1.3 With the exception of white-clawed crayfish, species recorded in Table 3 are relatively common and of low conservation importance and do not have any statutory or non-statutory designations.

3.2 Aquatic Macroinvertebrate Survey Results – 2015

3.2.1 A summary of the 2015 aquatic macroinvertebrate biological indices scores can be found in Table 4. In the summary below, where species status has changed in the most recent RDB publications, the former and current species status is given.

3.2.2 The 2015 survey highlighted the River Derwent as having “Very Good” biological water quality and a “Moderate” to “Fairly High” conservation value. Two formerly “Regionally Notable” species of caddisfly were recorded *Lepidostoma basale* (Letpoceridae) and *Brachycentrus subnubilus* (Brachycentridae) – both species have been re-classified as “Least Concern” in the 2016 RDB.

3.2.3 Markeaton Brook was classified as having “Very Good” biological water quality in spring and summer, declining to “Good” in autumn. The CCI of the brook was classed as of “Moderate” conservation value. Two formerly “Regionally Notable” species of caddisfly were recorded, *Brachycentrus subnubilus* (Brachycentridae) (now “Least Concern”), and *Potamophylax rotundipennis* (Limnephilidae) (now “Nationally Scarce”, although the IUCN category is “Data Deficient”).

3.2.4 Biological water quality at Bramble Brook was classed as “Moderate”, with a “Low” conservation value. All species recorded at the site were very common and the community was dominated by pollution tolerant taxa.

3.2.5 Dam Brook was classified as having “Moderate” to “Good” biological quality, with a “Low” to “Moderate” conservation value. One “Regionally Notable” caddisfly was recorded, *Potamophylax rotundipennis* (Limnephilidae) (Now “Nationally Scarce”).

Table 4: Aquatic Macroinvertebrate Results Summary (2015)

Site	River Derwent			Markeaton Brook			Bramble Brook			Dam Brook		
Season	**Sp**	**Su**	**Au**	**Sp**	**Su**	**Au**	**Sp**	**Su**	**Au**	**Sp**	**Su**	**Au**
BMWP Score	161	189	175	172	125	98	50	41	60	97	104	76
ASPT	6.4	6.3	6.5	6.1	6.0	5.2	5.0	3.7	4.4	5.4	5.5	4.5
CCI Score	11.9	10.2	9.6	12.4	9.1	7.9	1.1	1.1	3.9	4.4	7.8	4.0

3.3 Field Surveys

Site Observations

River Derwent

3.3.1 The River Derwent rises near Bleaklow in the north of Derbyshire and flows southwards through the city of Derby where it joins the River Trent at Derwent-mouth, located approximately 12km south-east of the city. Near to the A38 crossing, it is gently meandering through mixed-use agricultural land with residential properties on the western bank near to the road bridge.

3.3.2 Details of the environmental conditions on the River Derwent at the time of the surveys are presented in Table 5.

Table 5: River Derwent Survey Conditions

National Grid Reference	SK 35871 39950
Depth	0.10 – 1.5m
Width	20 – 40m
Flow velocities	10 – 25 cm/sec
Substrate	Cobbles, pebbles, gravel and sand with clay
Spring observations	River flow normal and clear, and 3-spined stickleback (*Gasterosteus aculeatus*) present.
Autumn observations	Temperature 14.2°C. Bullhead (*Cottus gobio*), 3-spined stickleback, stone loach (*Barbatula barbatula*) and minnow (*Phoxinus phoxinus*) present. Himalayan balsam (*Impatiens glandulifera*) and Japanese knotweed (*Fallopia japonica*) recorded on site.

Markeaton Brook

3.3.3 Markeaton Brook drains from Hulland Ward north-west of Derby and flows through Markeaton Park north of Markeaton Lake with some flow diverted to maintain water levels in the lake. The drainage from the Markeaton lake complex re-joins Markeaton Brook east of the Scheme. After Markeaton Park, the brook continues through residential areas and amenity parklands before being culverted for approximately 2km beneath the city, emerging to join the River Derwent.

3.3.4 Details of the environmental conditions at Markeaton Brook are presented in Table 6.

Table 6: Markeaton Brook Survey Conditions

National Grid Reference	SK 33850 37583
Depth	0.08 – 0.4m
Width	3.5 – 5m
Flow velocities	25 – 50cm/sec
Substrate	Bedrock, boulders, cobbles, pebbles, gravel and sand.
Spring observations	Brook flow normal and clear. Channel entirely shaded, only filamentous algae recorded. Bullhead present.
Autumn observations	Temperature 12.2^{o}C. Bullhead and minnow present and one dead stone loach.

Bramble Brook

3.3.5 Bramble Brook is a small stream that flows from the north of the A38, entering culverts under the A38 northbound carriageway into Kingsway junction southern central reservation LWS. The brook is then culverted beneath Kingsway roundabout circular road to Kingsway junction north roundabout, a continued section of the Kingsway Junction LWS. After flowing through Kingsway junction, the brook is culverted beneath Kingsway Retail Park and Kingsway Close Industrial Park to arise in Cheviot Street Recreation Ground approximately 1,300m north-east of Kingsway junction. The brook is then further culverted beneath the city of Derby to drain into the River Derwent.

3.3.6 Details of the environmental conditions at Bramble Brook are presented in Table 7.

Table 7: Bramble Brook Survey Conditions

National Grid Reference	SK 32735 36011
Depth	0.05 to 0.15m
Width	1.0m
Flow velocities	30cm/sec
Substrate	Boulders, cobbles, pebbles, gravel and sand with silt.
Spring observations	Some filamentous algae and emergent reeds/sedges/rushes. Extensive shading with large woody debris and overhang.
Autumn observations	Temperature 14^{o}C. Brook flow low and watercourse turbid. Channel with minimal shading and no macrophytes.

Dam Brook

3.3.7 Dam Brook is a small tributary of the River Derwent. It consists of two small streams rising from land east of Little Eaton junction, converging to form Dam Brook. Flow is heavily canalised and culverted beneath Little Eaton junction before joining Watermeadows Ditch, south of the junction and flowing west to join the River Derwent. Above the culvert, Dam Brook flows through a completely shaded channel under dense hawthorn. The substrate is solid clay with some sand/ gravel in places and organic debris. Downstream of the culvert, the brook flows in a straightened channel, riparian vegetation overhangs the channel, but does not shade it completely.

3.3.8 Details of the environmental conditions at Dam Brook are presented in Table 8.

Table 8: Dam Brook Survey Conditions

National Grid Reference	SK 36455 39969
Depth	0.02 – 0.3m
Width	1.5m
Flow velocities	20cm/sec
Substrate	Gravel, clay and sand with silt.
Spring observations	Brook slightly turbid with normal flow. Bullhead and brook lamprey present.
Autumn observations	Temperature 13.6^{o}C. Brook flow normal with moderate turbidity.

Middle Brook

3.3.9 Middle Brook is a heavily modified tributary of the Markeaton Brook, fed via a weir from Markeaton Lake. The brook flows east for approximately 400m before joining Markeaton Brook. A long section of the brook is culverted beneath the A38. Beyond the culvert, Middle Brook flows through a heavily shaded area dominated by broad-leaved mixed woodland, with areas of amenity grassland known as Sturgess Fields. The substrate was dominated by gravel and pebbles, with sand and silt, together with some larger substrate types, also present.

3.3.10 Details of the environmental conditions at Middle Brook are presented in Table 9.

Table 9: Middle Brook Survey Conditions

National Grid Reference	SK 33971 37290
Depth	0.05 – 0.1m
Width	4.5m
Flow velocities	20cm/sec; Low flow noted at time of survey
Substrate	Boulder, cobble, pebble, gravel and sand with silt.
Spring observations	Site heavily shaded with broadleaved mixed woodland. No macrophytes present. Freshwater sponge present.
Autumn observations	Temperature 14.5^{o}C. Site heavily shaded. Himalayan balsam, bullhead and minnow present.

3.4 Macroinvertebrate Analysis Results

3.4.1 Table 10-14 presents the results of the macroinvertebrate surveys undertaken between spring and autumn 2018 on the named watercourses.

Table 10: Macroinvertebrates Recorded in the River Derwent (2018)

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Flatworms							
Planariidae	*Polycelis felina*	✓		**5**	**3**		1
Snails							
Lymnaeidae	*Radix balthica*	✓		**3**	**1**	3	8
Hydrobiidae	*Potamopyrgus antipodarum*	✓		**3**	**1**	36	15
Valvatidae	*Valvata cristata*	✓		**3**	**2**	1	
	Valvata piscinalis	✓			**1**	1	
Planorbidae	*Hippeutis complanatus*	✓		**3**	**3**	1	
Limpets and mussels							
Ancylidae grp.	*Ancylus fluviatilis*	✓		**6**	**1**	2	10
Sphaeridae	*Sphaerium* sp.		✓	**3**	**-**	2	1
	Sphaeriidae (juvenile / damaged)		✓		**-**		2
	Pisidium sp.		✓		**-**	15	13
Worms							
Oligochaeta	Oligochaeta		✓	**1**	**-**		6
Leeches							
Glossiphoniidae	*Glossiphonia complanata*	✓		**3**	**1**	1	1
Erpobdellidae	Erpobdellidae (juvenile / damaged)		✓	**3**	**-**		1
Mites							
Hydracarina	Hydracarina		✓	**-**	**-**	13	2

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Crustaceans							
Gammaridae	*Gammarus pulex*	✓		**6**	**1**	16	17
	Gammaridae		✓		**-**	16	16
	Gammarus sp.		✓		**-**	11	
Asellidae	*Asellus aquaticus*	✓		**3**	**1**	3	1
Crangonyctidae	*Crangonyx pseudogracilis*	✓		**6**	**1**	4	
Mayflies							
Baetidae	*Baetis sp.*		✓	**4**	**-**	1	29
	Baetis buceratus	✓			**6**		19
	Baetis rhodani	✓			**1**		14
	Baetis scambus	✓			**4**		7
	Centroptilum luteolum	✓			**4**	2	
Heptageniidae	*Heptagania sp.*		✓	**10**	**-**	112	106
	Heptagania (juvenile / damaged)		✓		**-**	10	
	Heptagenia sulphurea	✓			**4**	17	
	Rhithrogena semicolorata	✓			**2**	20	
Leptophlebiidae	*Leptophlebiidae sp.*		✓	**10**	**-**		3
	Leptophlebidae (juvenile / damaged)		✓		**-**	1	
	Paraleptophlebia submarginata	✓			**2**	3	
Ephemerellidae	*Serratella ignita*	✓		**10**	**1**		4
Ephemeridae	*Ephemera sp.*		✓	**10**	**-**	32	14
	Ephemera danica	✓			**1**	30	18

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Caenidae	*Caenis sp.*		✓	**7**	**-**	23	7
	Caenis horaria	✓			**1**	553	
	Caenis rivulorum	✓			**3**	30	10
Stoneflies							
Nemouridae	*Nemoura* sp.		✓	**7**	**-**		1
Leuctridae	*Leuctra fusca*	✓		**10**	**1**		37
	Leuctra sp.		✓		**-**	7	
	Leuctra geniculata	✓			**4**	10	
Damselflies							
Calopterygidae	*Calopteryx sp.*		✓	**8**	**-**	20	4
True Bugs							
Corixidae	*Sigara dorsalis*	✓		**5**	**1**	1	
Beetles							
Gyrinidae	*Orectochilus villosus*	✓		**5**	**3**		4
	Gyrinidae (larvae / damaged)		✓		**-**	2	
Dytiscidae	Dytiscidae larvae		✓	**5**	**-**		1
Haliplidae	*Haliplus ruficollis* group		✓	**5**	**-**	1	
Elmidae	*Elmis aena*	✓		**5**	**1**	12	15
	Esolus parallelepipedus	✓			**4**	20	36
	Limnius volckmari	✓			**2**	2	40
	Oulimnius sp.		✓		**-**	4	91
	Oulimnius tuberculatus	✓			**2**	4	8
Curculionidae			✓	**-**	**-**	1	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Caddisflies							
Rhyacophilidae	*Rhyacophila sp.*		✓		**-**		1
	Rhyacophila dorsalis	✓			**1**	1	
Glossosomatidae	*Glossoma sp.*		✓	**7**	**-**		1
	Agapetus sp.		✓		**-**	7	30
	Agapetus fuscipes	✓			**1**	12	31
Hydropsychidae	*Hydropsyche sp.*		✓		**-**	1	31
	Hydropsyche pellucidula	✓		**5**	**2**	8	9
	Hydropsyche siltatai	✓			**1**	7	4
Hydroptilidae	*Hydroptila sp.*		✓	**6**	**-**		2
Limnephilidae	*Chaetopteryx villosa*	✓		**7**	**3**	7	1
	Limnephilus lunatus	✓			**1**	11	
	Anabolia nervosa	✓			**2**	18	
	Halesus radiatus	✓			**2**	15	
Psychomyiidae	*Lype reducta*	✓		**8**	**3**	2	
Leptoceridae	*Ceraclea annulicornis*	✓		**10**	**4**		5
	Athripsodes sp.		✓		**-**	26	45
	Athripsodes albifrons	✓			**4**		4
	Athripsodes cinereus	✓			**1**	72	9
	Mystacides sp.		✓		**-**	32	35
	Mystacides azurea	✓			**2**	52	
Goeridae	*Goera pilosa*	✓		**10**	**3**	1	1

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Lepidostomatidae	*Lepidostomatidae sp.*		✓	**10**	**-**		30
	Lepidostomatidae (juvenile / damaged)		✓		**-**	2	
	Lasiocephala basalis	✓			**6**	1	
	Lepidostoma hirtum	✓			**2**	76	1
Brachycentridae	*Brachycentrus subnubilus*	✓		**10**	**6**	1	5
Sericostomatidae	*Sericostomatidae sp.*		✓	**10**	**-**		13
	Sericostomatidae (juvenile / damaged)		✓		**-**	9	
	Sericostoma personatum	✓			**1**	12	11
Trueflies							
Chironomidae	Chironomidae (damaged/pupae)		✓	**2**	**-**	3	13
	Orthocladiinae / Diamesinae		✓		**-**	36	125
	Tanypodinae		✓		**-**	18	4
	Chironomini		✓		**-**	45	239
	Tanytarsini		✓		**-**	2	17
	Prodiamesinae		✓		**-**		6
Tipulidae group	*Tipula sp.*		✓	**5**	**-**		1
Pediciidae	*Dicranota sp.*		✓	**5**	**-**		2
Simuliidae	*Simulium sp.*		✓	**5**	**-**	2	51
Limoniidae	*Antocha* sp.		✓	**5**	**-**	2	
Psychodidae			✓	**-**	**-**	1	
Empididae	Empididae		✓	**-**	**-**	4	6

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Ceratopogonidae			✓	-	-	14	
Stratiomyidae			✓	-	-	1	
Athericidae			✓	-	-		8
Other Taxa							
Nematoda			✓	-	-	1	2
Total number of Taxa, ID to species level, ID to family/ genus/ tribe/ family level	**98**	**48**	**50**				
				Number of scoring families	-	**33**	**35**
				Number of non-scoring families	-	**7**	**4**
				Total number of families	-	**40**	**39**
				BMWP score	-	**172**	**171**
				ASPT	-	**6.4**	**6.3**
				CCI Score	-	**13.6**	**14.4**

Table 11: Macroinvertebrates Recorded in Markeaton Brook (2018)

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Snails							
Hydrobiidae	*Potamopyrgus antipodarum*	✓		**3**	**1**	2070	200
Physidae	*Physa fontinalis*	✓		**3**	**1**	2	
Planorbidae	*Anisus vortex*	✓		**3**	**1**	1	
	Armiger crista	✓			**2**	1	
	Bathyomphalus contortus	✓			**2**	3	
Limpets and mussels							
Anyclidae	*Ancylius fluviatilis*	✓		**6**	**1**	3	
Sphaeridae	*Sphaerium* sp.		✓	**3**	**-**	30	2
	Sphaerium corneum	✓			**1**	18	5
	Pisidium sp.		✓		**-**	90	21
Worms							
Oligochaeta	Oligochaeta		✓	**1**	**-**	25	15
Leeches							
Glossiphoniidae	*Glossiphonia complanata*	✓		**3**	**1**	16	1
Mites							
Hydracarina			✓	-	-	3	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Crustaceans							
Gammaridae	*Gammarus sp.*		✓	**6**	**-**	60	9
	Gammarus pulex	✓			**1**	80	
Crangonyctidae	*Crangonyx pseudogracilis*	✓		**6**	**1**	16	
Astacidae	*Pacifastacus leniusculus*	✓		**8**	**-**		2
Asellidae	*Asellus aquaticus*	✓		**3**	**1**	25	1
Mayflies							
Baetidae	Baetidae (juvenile / damaged)		✓	**4**	**-**	25	
	Baetis rhodani	✓			**1**	26	
	Baetis scambus	✓			**4**	10	
Heptageniidae	Heptageniidae (juvenile / damaged)		✓	**10**	**-**	1	
	Heptagenia sulphurea	✓			**4**	1	
	Ecdyonorus sp.		✓		**-**	1	
Ephemeridae	*Ephemera sp.*		✓	**10**	**-**	75	41
	Ephemera danica	✓			**1**	100	22
Leptophlebiidae	Leptophlebiidae (juvenile / damaged)		✓	**10**	**-**	13	
	Paraleptophlebia submarginata	✓			**2**	1	
	Habrophlebia fusca	✓			**2**	1	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Ephemerellidae	*Serratella ignita*	✓		**10**	**1**	6	
Caenidae	*Caenis sp.*		✓	**7**	**-**	1	
	Caenis luctuosa	✓			**1**	5	
	Caenis rivulorum	✓			**3**	1	
Stoneflies							
Leuctridae	*Leuctra geniculata*	✓		**10**	**4**	1	
True bugs							
Veliidae	Veliidae (nymph/damaged)	✓		**-**	**2**		2
Beetles							
Gyrinidae	Gyrinidae (larvae)		✓	**5**	**-**	11	2
Elmidae	*Elmis aena*	✓		**5**	**1**	150	20
	Limnius volckmari	✓			**2**	110	12
	Oulimnius tuberculatus	✓			**2**	2	
	Oulimnius sp.		✓		**-**	2	10
Scirtidae	Scirtidae (larvae / damaged)		✓	**5**	**-**	1	
Alderflies							
Sialidae	*Sialis lutaria*	✓		**4**	**1**		1

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Caddisflies							
Glossosomatidae	*Agapetus* sp.		✓	**7**	**-**	40	9
	Glossosomatidae (juvenile / damaged)		✓		**-**	40	
	Agapetus fuscipes	✓			**1**	130	
Polycentropodidae	Polycentropodidae (juvenile / damaged)		✓	**7**	**-**	2	
	Polycentropus flavomaculatus	✓			**2**	1	1
Hydropsychidae	Hydropsychidae (juvenile / damaged)		✓	**5**	**-**	1	
	Hydropsyche sp.		✓		**-**	1	
	Hydropsyche pellucidula	✓			**5**	4	
	Hydropsyche siltatai	✓			**5**	2	
	Hydropsyche angustipennis	✓			**1**		2
Hydroptilidae	*Hydroptila sp.*		✓	**6**	**-**	10	
Limnephilidae	*Limnephilus lunatus*	✓		**7**	**1**	2	
	Potamophylax latipennis	✓			**2**	3	
Leptoceridae	*Athripsodes sp.*		✓	**10**	**-**	40	3
	Athripsodes cinereus	✓			**1**	6	
	Mystacides nigra	✓			**6**	4	
	Mystacides sp.		✓		**-**	1	8

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Lepidostomatidae	Lepidostomatidae (juvenile / damaged)		✓	**10**	**-**	40	
	Lepidostoma hirtum	✓			**2**	65	
Sericostomatidae	Sericostomatidae (juvenile / damaged)		✓	**10**	**-**	20	
	Sericostoma personatum	✓			**1**	25	
Trueflies							
Chironomidae	Chironomidae (damaged / pupea)		✓	**2**	**-**		6
	Orthocladinae / Diamesinae		✓		**-**	85	1
	Tanypodinae		✓		**-**	98	6
	Chironomini		✓		**-**	3	9
	Tanytarsini		✓		**-**	12	1
	Prodiamesinae		✓		**-**	3	2
Pediciidae	*Dicranota* sp.		✓	**5**	**-**	3	10
Simuliidae	Simuliidae (damaged / juvenile)		✓	**5**	**-**	5	
	Simulium ornatum group		✓		**1**	7	
	Simulium sp.		✓		**-**	23	
Psychodidae			✓	**-**	**-**	1	
Empididae			✓	**-**	**-**	4	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Dixidae	*Dixa* sp.		✓	-	-		1
Ceratopogonidae	Ceratopogonidae		✓	-	-	5	4
Total number of Taxa, ID to species level, ID to family/ genus/ tribe/ family level	**76**	**38**	**38**				
				Number of scoring families	**-**	**31**	**17**
				Number of non-scoring families	**-**	**4**	**3**
				Total number of families	**-**	**35**	**20**
				BMWP score	**-**	**150**	**70**
				ASPT	**-**	**5.9**	**5.2**
				CCI Score	**-**	**9.5**	**3.8**

Table 12: Macroinvertebrates Recorded in Bramble Brook (2018)

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Snails							
Hydrobiidae	*Potamopyrgus antipodarum*	✓		**3**	**1**	10	6
Lymnaeidae	*Radix balthica*	✓		**3**	**1**		1
Planorbidae	Planorbidae (juvenile/damaged)		✓	**3**	**1**		1
Zonitoides	*Zonitoides nitidus*	✓		**-**	**4**		1
Succineidae	*Succinea sp.*		✓	**-**	**-**	1	
Limpets and mussels							
Sphaeriidae	*Pisidium* sp.		✓	**3**	**-**	23	7
	Sphaeriidae (juvenile / damaged)		✓		**-**	4	
Worms							
Oligochaeta	Oligochaeta		✓	**1**	**-**	214	15
Leeches							
Glossiphoniidae	Glossiphoniidae (juvenile/damaged)		✓	**3**	**-**		1
	Glossiphonia complanata	✓			**1**	4	6
	Helobdella stagnalis	✓			**1**	6	5

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Erpobdellidae	*Erpobdella* (juvenile / damaged)		✓	**3**	**-**	5	1
	Trocheta pseudodina	✓			**5**	1	
Mites							
Hydracarina			✓	**-**	**-**	2	
Crustaceans							
Gammaridae	Gammaridae		✓	**6**	**-**		10
	Gammarus sp.		✓		**-**	495	28
	Gammarus pulex	✓			**1**	203	9
Crangonyctidae	*Crangonyx pseudogracilis*	✓		**6**	**1**	128	9
Asellidae	*Asellus aquaticus*	✓		**3**	**1**	306	115
Mayflies							
Baetidae	Baetidae (juvenile / damaged)		✓	**4**	**1**	3	1
	Baetis rhodani	✓			**1**	310	
Ephemerellidae	*Serratella ignita*	✓		**10**	**1**	1	
True bugs							
Veliidae	Veliidae (nymph/damaged)	✓		**-**	**2**	6	1
Beetles							
Dytiscidae	*Nebrioporus elegans*	✓		**5**	**1**	1	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Elmidae	*Elmis aena*	✓		**5**	**1**	20	6
	Limnius volckmari	✓			**2**	4	2
	Oulimnius sp.		✓		**-**		1
Hydrophilidae	*Helophorus brevipalpis*	✓		**5**	**1**	1	
	Anacaena globulus	✓			**2**	1	
Scirtidae	Scirtidae (larvae / damaged)		✓	**5**	**-**	30	
Caddisflies							
Glossosomatidae	*Agapetus sp.*		✓	**7**	**-**		2
	Agapetus fuscipes	✓			**1**	21	
Hydroptilidae	Hydroptilidae (juvenile / damaged)		✓	**6**	**-**		1
Limnephilidae	Limnephilidae (juvenile / damaged)		✓	**7**	**-**	1	9
	Limnephilus lunatus	✓			**2**	54	2
	Micropterna sequax	✓			**1**	9	2
Polycentropodidae	Polycentropodidae (juvenile / damaged)		✓	**7**	**-**	2	
	Plectrocnemia conspersa	✓			**2**	2	
Psychomyiidae	*Tinodes unicolor*	✓		**8**	**7**	3	
	Lype reducta	✓			**3**	3	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Lepidostomatidae	*Crunoecia irrorata*	✓		**10**	**3**	2	
Sericostomatidae	*Sericostoma personatum*	✓		**10**	**1**	3	
Trueflies							
Chironomidae	Chironomidae (damaged / pupea)		✓	**2**	**-**	20	5
	Tanypodinae		✓		**-**	101	15
	Orthocladiinae		✓		**-**	83	12
	Tanytarsini		✓		**-**	58	29
	Chironomini		✓		**-**	505	1
	Prodiamesinae		✓		**-**	20	29
Pediciidae	*Dicranota* sp.		✓	**5**	**-**	2	16
Limoniidae	Limoniidae		✓	**5**	**-**	7	2
Tipulidae	*Tipula sp.*		✓	**5**	**-**	1	
Simuliidae	Simuliidae (damaged / juvenile)		✓	**5**	-	1	
Dixidae	*Dixa submaculata*		✓	**-**	**4**	1	
Psychodidae			✓	**-**	**-**	5	2
Empididae			✓	**-**	**-**	5	
Ceratopogonidae			✓	**-**	**-**	10	
Stratiomyidae	Stratiomyidae		✓	**-**	**-**	5	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Ptychopteridae	*Ptychoptera sp.*		✓	-	-	23	1
Total number of Taxa, ID to species level, ID to family/ genus/ tribe/ family level	**58**	**25**	**33**				
				Number of scoring families		**25**	**18**
				Number of non-scoring families		**9**	**4**
				Total number of families		**34**	**22**
				BMWP score		**79**	**45**
				ASPT		**5.1**	**3.9**
				CCI Score		**9.9**	**2.8**

Table 13: Macroinvertebrates Recorded in Dam Brook (2018)

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Snails							
Hydrobiidae	*Potamopyrgus antipodarum*	✓		**3**	**1**	495	179
Planorbiidae	*Gyraulus albus*	✓		**3**	**1**		4
	Anisus vortex	✓			**1**	2	
	Armiger crista	✓			**2**	3	10
Limpets and mussels							
Sphaeridae	*Pisidium sp.*		✓	**3**	**-**	174	34
Worms							
Oligochaeta	Oligochaeta		✓	**1**	**-**	4	12
Leeches							
Glossiphoniidae	*Glossiphoniidae* sp.		✓	**3**	**-**		5
	Glossiphoniidae (juvenile / damaged)		✓			5	
	Glossiphonia complanata	✓			**1**	14	7
	Helobdella stagnalis	✓			**1**		1
Erpobdellidae	Erpobdellidae (juvenile / damaged)		✓	**3**	**-**	2	
Mites							
Hydracarina	Hydracarina		✓	**-**	**-**	6	26

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Crustaceans							
Gammaridae	Gammaridae		✓	**6**	**-**		362
	Gammarus sp.		✓		**-**	81	55
	Gammarus pulex	✓			**1**	732	143
Asellidae	*Asellus aquaticus*	✓		**3**	**1**	113	30
Crangonyctidae	*Crangonyx pseudogracilis*	✓		**6**	**1**	15	
Mayflies							
Baetidae	Baetidae		✓	**4**	**-**	70	24
	Baetis sp.		✓			6	
	Baetis rhodani	✓			**1**	150	8
Caenidae	*Caenis luctuosa*	✓		**7**	**1**	1	
Ephemerellidae	*Serratella ignita*	✓		**10**	**1**		1
Ephemeridae	*Ephemera* sp.		✓	**10**	**-**	13	19
	Ephemera danica	✓			**1**	16	7
Leptophlebiidae	Leptophlebiidae (juvenile / damaged)		✓	**10**	**-**	14	
Stoneflies							
Nemouridae	*Nemoura sp.*		✓	**7**	**1**		3
Damselflies							
Calopterygidae	*Calopteryx sp.*		✓	**8**	**-**	1	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Beetles							
Dytiscidae	Dytiscidae larvae		✓	**5**	**-**		1
	Oerodytes sanmarkii	✓			**2**	2	3
	Platambus maculatus	✓			**2**		7
Haliplidae	*Haliplus ruficollis group*	✓		**5**	**3**		1
Scirtidae	Scirtidae larvae		✓	**5**	**-**	4	10
Elimdae	*Elmis aena*	✓		**5**	**1**	14	52
	Limnius volckmari	✓			**2**	13	33
	Oulimnius sp.		✓		**-**	1	16
Alderflies							
Sialidae	*Sialis lutaria*	✓		**4**	**1**	5	18
	Sialis sp.		✓				1
Caddisflies							
Polycentropodidae	*Polycentropodidae (juvenile / damaged)*		✓	**7**	**-**		1
Hydropsychidae	*Hydropsyche siltatai*	✓		**5**	**5**	1	
	Hydropsyche sp.		✓		**-**	1	
Leptoceridae	*Athripsodes* sp.		✓	**10**	**-**	5	5
	Mystacides sp.		✓		**-**	5	35
	Mystacides azurea	✓			**2**	5	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Limnephilidae	Limnephilidae (juvenile / damaged)		✓	**7**	**-**	35	6
	Chaetopteryx villosa	✓			**3**	50	5
	Halesus sp.		✓		**-**	2	
	Halesus radiatus	✓			**2**	10	
	Halesus digitatus	✓			**3**	5	
Goeridae	*Silo pallipes*	✓		**10**	**2**		1
Sericostomatidae	*Sericostoma personatum*	✓		**10**	**1**	10	4
	Sericostomatidae (juvenile / damaged)		✓		**-**		2
Beraeidae	*Beraea pullata*	✓		**10**	**4**	1	
Trueflies							
Chironomidae	Chironomidae (damaged / pupea)		✓	**2**	**-**	1	4
	Orthocladinae / Diamesinae		✓		**-**	210	61
	Tanypodinae		✓		**-**	20	24
	Chironomini		✓		**-**	8	2
	Tanytarsini		✓		**-**		10
	Prodiamesinae		✓		**-**	25	8
Pediciidae			✓	**5**	**-**	3	19

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Simuliidae	Simuliidae (damaged / juvenile)		✓	**5**	**-**		58
	Similium sp.		✓		**-**		5
Limoniidae	*Eleophila* sp.		✓	**5**	**-**	11	
Pediciidae	*Dicranota* sp.		✓	**5**	**-**	3	
Dixiidae	*Dixa nebulosa*	✓		**-**	**4**		6
	Dixa submaculata	✓		**-**	**4**		2
Psychodidae			✓	**-**	**-**	2	5
Empididae			✓	**-**	**-**		1
Ceratopogonidae			✓	**-**	**-**	10	1
Ptychopteridae	*Ptychoptera sp.*		✓	**-**	**-**	3	1
Other Taxa							
Nematoda			✓	**-**	**-**	1	
Lepidoptera	Crambidae		✓	**-**	**-**		1
Total number of Taxa, ID to species level, ID to family/ genus/ tribe/ family level	**71**	**29**	**42**				
					Number of scoring families	**27**	**24**
					Number of non-scoring families	**5**	**8**
					Total number of families	**32**	**32**
					BMWP score	**106**	**102**
					ASPT	**5.4**	**5.5**
					CCI Score	**6.1**	**6.6**

Table 14: Macroinvertebrates Recorded in Middle Brook (2018)

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Flatworms							
Planariidae	*Polycelis sp.*		✓	**5**	**-**	3	6
	Polycelis felina	✓			**3**	1	
Dugesiidae	Dugesiidae (juvenile / damaged)		✓	**-**	**-**	2	
	Dugesia lugubris/polychroa	✓			**2**		10
Dendrocoelidae	*Dendrocoelum lacteum*	✓		**5**	**2**	2	
Snails							
Lymnaeidae	*Lymnaea stagnalis*	✓		**3**	**1**	2	1
	Radix balthica	✓			**1**	2	2
Valvatidae	*Valvata piscinalis*	✓		**3**	**1**	1	
Hydrobiidae	*Potamopyrgus antipodarum*	✓		**3**	**1**	8	1
Bithyniidae	*Bithynia* sp.		✓	**3**	**-**		18
	Bithynia tentaculata	✓			**1**	132	151
Physidae	*Physella sp.*		✓	**3**	**-**	2	
Planoribidae	*Anisus vortex*	✓		**3**	**1**	4	5
	Planorbarius corneus	✓			**4**	6	
	Gyraulus albus	✓			**1**	6	
	Bathyomphalus contortus	✓			**2**	40	14
	Hippeutis complanatus	✓			**3**	1	2

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Limpets and mussels							
Sphaeridae	*Sphaerium sp.*		✓	**3**	**-**	270	318
	Pisidium sp.		✓		**-**	216	18
Unionidae	*Anodonta anatina*	✓		**6**	**3**	1	
Worms							
Oligochaeta	Oligochaeta		✓	**1**	**-**	200	89
Leeches							
Glossiphoniidae	Glossiphoniidae (juvenile / damaged)		✓	**3**	**-**	17	1
	Glossiphonia complanata	✓			**1**	29	3
	Hemiclepsis marginata	✓			**4**	1	
	Helobdella stagnalis	✓			**1**	13	6
Erpobdellidae	Erpobdellidae (juvenile / damaged)		✓	**3**	**-**	2	2
	Erbodella octoculata	✓			**1**	7	5
Hirudinidae	*Haemopis sanguisuga*	✓		**3**	**5**		1
Crustaceans							
Ostracoda			✓	**-**	**-**	3	1
Crangonyctidae	*Crangonyx pseudogracilis*	✓		**6**	**1**	400	121
Asellidae	*Asellus aquaticus*	✓		**3**	**1**	226	257

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Mayflies							
Baetidae	Baetidae (juvenile / damaged)		✓	**4**	**-**	1	
Ephemeridae	*Ephemera sp.*		✓	**10**	**-**	63	51
	Ephemera danica	✓			**1**	10	10
Damselflies							
Coenagrionidae	Coenagrionidae (juvenile / damaged)		✓	**6**	**-**	2	
	Enallagma cyathigerum	✓			**2**	2	
True bugs							
Veliidae	Veliidae (nymph / damaged)		✓	**-**	**-**	3	
Nepidae	*Nepa cinereal*	✓		**5**	**3**		1
Corixidae	Corixidae (nymph / damaged)		✓	**5**	**-**		1
	Callicorixa praeusta	✓			**3**		1
	Sigara sp.		✓		**-**		1
	Sigara dorsalis	✓			**1**		13
	Sigara distincta	✓			**3**		15
	Sigara falleni	✓			**1**	1	11
Notonectidae	*Notonecta sp.*		✓	**5**	**-**	5	

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Beetles							
Dytiscidae	*Nebrioporus elegans*	✓		**5**	**1**	18	1
Elimdae	*Elmis aena*	✓		**5**	**1**	5	12
	Limnius volckmari	✓			**2**	3	1
	Oulimnius tuberculatus	✓			**2**		1
	Oulimnius sp.		✓		**-**	2	64
Hydrophilidae	Hydrophilidae (larvae / damaged)		✓	**5**	**-**	1	
	Laccobius bipunctatus	✓			**2**	1	
Curculionidae			✓	**-**	**-**	4	
Alderflies							
Sialidae	*Sialis lutaria*	✓		**4**	**1**	3	8
Caddisflies							
Glossosomatidae	*Agapetus fuscipes*	✓		**7**	**1**		1
Molannidae	Molannidae (juvenile / damaged)		✓	**10**	**-**		1
Hydropsychidae	*Hydropsyche* sp.		✓	**5**	**-**		29
	Hydropsyche angustipennis	✓			**1**		104

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Leptoceridae	*Athripsodes sp.*		✓	**10**	**-**		15
	Athripsodes aterrimus	✓			**1**	1	
	Athripsodes cinereus	✓			**1**	1	6
	Mystacides sp.		✓		**-**		21
	Mystacides azurea	✓			**2**	12	6
Lepidostomatidae	*Lepidostoma hirtum*	✓		**10**	**2**	3	
Limnephilidae	Limnephilidae (juvenile / damaged)		✓	**7**	**-**	5	
	Limnephilus sp.		✓		**-**	1	
	Limnephilus lunatus	✓			**1**	35	
	Anabolia nervosa	✓			**2**	6	
	Halesus radiatus	✓			**2**	1	
Sericostomatidae	Sericostomatidae (juvenile / damaged)		✓	**10**	**-**		2
	Sericostoma personatum	✓			**1**	31	8
Trueflies							
Chironomidae	Orthocladinae / Diamesinae		✓	**2**	**-**	484	6
	Tanypodinae		✓		**-**	146	29
	Tanytarsini		✓		**-**	31	1
	Chironomini		✓		**-**	72	6
	Prodiamesinae		✓		**-**		1

BMWP group	Taxa	ID to Species level	ID to family, genus, tribe, family or higher taxonomic levels	BMWP score	CS	Spring	Autumn
Simuliidae	Simuliidae (juvenile / damaged)		✓	**5**	**-**		6
Ceratopogonidae			✓	**-**	**-**	9	1
Syrphidae			✓	**-**	**-**	1	
Ptychopteridae	*Ptychoptera sp.*		✓	**-**	**-**	1	
Total number of Taxa, ID to species level, ID to family/ genus/ tribe/ family level	**49**	**23**	**26**				
				Number of scoring families		**29**	**26**
				Number of non-scoring families		**7**	**3**
				Total number of families		**36**	**30**
				BMWP score		**107**	**90**
				ASPT		**4.6**	**4.7**
				CCI Score		**6.0**	**5.91**

4 DISCUSSION

4.1 River Derwent

4.1.1 Ninety-eight taxa were recorded across the two seasons surveyed, of which 48 were identified to species and a further 50 to genus, tribe, family or higher taxonomic levels. The highest number of species recorded was caddisfly larvae, with 18 species. There was a relatively high diversity of other taxa including mayfly larvae, beetles, truefly larvae and molluscs.

4.1.2 The macroinvertebrate community composition was very similar across spring and summer. A high number of BMWP scoring families were recorded (33 – 35) with spring and summer scores of 172 and 171 respectively. There were several highly pollution sensitive taxa recorded such as mayfly (Heptageniidae, Leptophlebiidae, Ephemeridae, Ephemerellidae), stonefly (Leuctridae) and caddisfly (Leptoceridae, Goeridae, Lepidostomatidae, Brachycentridae, Sericostomatidae). Other taxa were also recorded including flatworms (*Polycelis felina*), snails (Lymnaeidae, Hydrobiidae, Valvatidae, Planorbidae), limpets (*Ancylus fluviatilis*), mussels (*Sphaerium* sp., *Pisidium* sp.), crustaceans (*Gammarus pulex, Asellus aquaticus, Crangonyx pseudogracilis),* damselfly larvae (*Calopteryx* sp.) and aquatic beetles (*Orectochilus villosus*, *Elmis aenea, Esolus parallelepipedus, Limnius volckmari, Oulimnius tuberculatus*). The diversity of the macroinvertebrate community indicates the River Derwent is of “Very Good” biological quality within the surveyed reach and supports communities likely to be highly sensitive to pollution and changes in water quality.

4.1.3 The site achieved CCI scores of 13.6 and 14.4 in spring and autumn respectively, which translates to “Fairly High” conservation value. The majority of species recorded were very common. The mayfly *Baetis buceratus* and caddisflies *Lepidostoma basale* and *Brachycentrus subnubilus* were relatively high scoring, with Conservation Scores of 6. The most recent Red Data Books have re-classified the status of all three species to ‘Least Concern’. None of these species has any statutory or non-statutory designations.

4.1.4 There was some variation in indices scores when comparing the up and downstream sites. In both spring and summer, the upstream community achieved a higher BMWP score (190 vs. 154 and 185 vs. 156) and a marginally higher ASPT. Despite the lower BMWP and ASPT scores, the downstream site is considered to have “Very Good” biological water quality.

4.2 Markeaton Brook

4.2.1 Seventy-six taxa were recorded from the two surveys, of which 38 were identified to species level and 38 to genus, tribe, family or higher taxonomic levels. The most diverse groups were caddisflies (11 species recorded), trueflies (12 taxa) and mayflies (8 species). Several species of mollusc (7 species) and crustaceans (4 species) were also recorded.

4.2.2 The sample collected in spring was the most diverse, with 31 BMWP scoring families recorded. Several pollution sensitive mayfly (Heptageneiidae. Ephemeridae, Leptophlebiidae, Ephemerellidae), stonefly (Leuctridae) and caddisfly (Leptoceridae, Lepidosomatidae, Sericosomatidae) were recorded. The community present indicates “Very Good” biological water quality, with an overall BMWP score of 150 (ASPT 5.9).

4.2.3 The macroinvertebrate community recorded in autumn was less diverse with 17 BMWP scoring families present. Only two top-scoring pollution sensitive taxa were recorded; Ephemeridae (mayfly) and Leptoceridae (caddisfly). The number and diversity of snails, crustaceans, beetles, mayfly, stonefly and caddisfly declined in autumn. As a result, the BMWP score decreased to 70 (ASPT 5.2) which is indicative of “Moderate” biological water quality.

4.2.4 The summer of 2018 was subject to prolonged dry conditions which would have resulted in lower flows in the Markeaton Brook in autumn. Some macroinvertebrate families are sensitive to flow conditions and prefer habitat with more rapid flows. Families including Heptageneiidae, Leptophlebiidae, Leuctridae, Sericosomatidae and Elmidae prefer faster flowing watercourses and were notably absent or reduced in the autumn sample.

4.2.5 The decline in diversity could also be attributed to nutrient enrichment; however, pollution tolerant species did not increase in abundance. A dead perch was recorded during the survey. Seasonal variations could be another contributing factor as the 2015 survey of the Markeaton Brook recorded a similar seasonal trend. For example, some species of caddisfly and mayfly emerge in the summer and will therefore not be found in autumn.

4.2.6 One relatively higher scoring (Conservation Score 6) caddisfly species was recorded, *Mystacides nigra*. The most recent Red Data Book for caddisflies designates *Mystacides nigra* as of “Least Concern”. The other taxa recorded were generally very common and the site achieved a CCI score of 9.5 (moderate conservations value) in spring and 3.8 (low conservation value) in autumn.

4.2.7 The upstream sample point consistently achieved higher BMWP scores than downstream. The upstream spring sample scored 181 compared to 119 downstream, and in autumn 76 upstream compared to 64 downstream.

4.2.8 Overall, these results suggest that Markeaton Brook supports communities that are likely to be sensitive to changes in water quality and quantity.

4.3 Bramble Brook

4.3.1 Fifty-eight taxa were recorded across both seasons, including 25 identified to species and a further 33 identified to genus, tribe, family or higher taxonomic levels. The most diverse groups were trueflies (16 taxa), caddisflies (8 species) and beetles (5 species).

4.3.2 The spring sample had a higher number of taxa recorded, 34 overall compared to 22 in the autumn. The number of individuals recorded in autumn was significantly lower than spring for some taxa. For example, *Gammarus pulex* numbers declined by 95 %, *Crangonyx pseudogracilis* by 92%, *Elmis aena* by 70% and *Limnephilus lunatus* by 96%.

4.3.3 The samples were dominated by pollution tolerant taxa such as crustaceans (*Asellus aquaticus, Gammarus pulex*), worms (Oligochaeta) and truefly larvae (Chironomidae). Three pollution sensitive taxa were recorded in spring only; the mayfly *Serratella ignita* and two caddisfly *Crunoecia irrorate* and *Sericostoma personatum.*

4.3.4 The caddisfly *Tinodes unicolor* was recorded at the site and has a relatively high Conservation Score of 7. The most recent Red Data Book for caddisflies amended the species designation from “Nationally Notable” to “Least Concern”.

4.3.5 The biotic indices suggest “Good” (BMWP 79, ASPT 5.1) biological water quality in spring and “Moderate” (BMWP 45, ASPT 3.9) quality in autumn. The biological indices scores were improved compared to the respective seasons in 2015. The macroinvertebrate community during spring could be sensitive to changes in water quality due to the presence of more pollution intolerant taxa.

4.3.6 The downstream sample point achieved higher BMWP scores across both seasons, with the most dramatic difference observed in spring. BMWP upstream was 49 (ASPT 4.1) and downstream was 108 (ASPT 5.7).

4.3.7 In terms of conservation value, most species recorded were very common. The CCI derived from the spring sample is considered of “Moderate” conservation value (Conservation Score 9.9) whereas the score in autumn (2.8) is indicative of a “Low” conservation value.

4.4 Dam Brook

4.4.1 Seventy-one taxa were recorded across the two seasons. These included 29 identified to species level and a further 42 to genus, tribe, family or higher taxonomic levels. The most diverse group were trueflies (15 taxa recorded) and caddisflies (8 species recorded), although several species of mollusc, mayfly and beetle were also present.

4.4.2 The samples collected in spring and autumn were similar in both abundance and diversity of taxa (27 and 24 BMWP scoring families respectively). Seven pollution sensitive taxa were recorded including mayfly (*Serratella ignita, Ephemera Danica,* Leptophlebiidae) and caddisfly (*Mystacides azurea, Silo pallipes, Sericostoma personatum, Beraea pullata*).

4.4.3 Most species recorded throughout the survey period were very common. This is reflected in the low CCI scores of 6.1 and 6.6 respectively, indicative of a “Moderate” conservation value.

4.4.4 Overall, the results suggest that Dam Brook is of “Very Good” biological water quality. The autumn result is an improvement on the 2015 survey findings which recorded BMWP of 76 (“Good” biological water quality).

4.5 Middle Brook

4.5.1 Forty-nine taxa were recorded across the two seasons. These included 23 identified to species level and a further 26 to genus, tribe, family or higher taxonomic levels. The most diverse group were snails (15 species recorded), caddisflies (10 species recorded) and trueflies (9 taxa recorded), although several species of leech, true bugs, mayfly and beetle were also present.

4.5.2 The spring sample was slightly more diverse with 29 BMWP scoring families compared to 26 in autumn. Five pollution sensitive taxa were recorded; the mayfly *Ephemera danica* and four caddisfly families (Molannidae, Leptoceridae, Lepidostomatidae, Sericostomatidae).

4.5.3 No notable species were recorded in either season. The macroinvertebrate community in Middle Brook can be considered as of “Moderate” conservation value (CCI scores of 6.0 and 5.91), with most species recorded very common.

4.5.4 The survey results indicate that Middle Brook has “Good” to “Very Good” biological water quality, and communities that may be sensitive to changes in water quality.

5 CONCLUSIONS AND SUMMARY

5.1.1 The objective of the macroinvertebrate surveys undertaken on the five watercourses (River Derwent, Markeaton Brook, Dam Brook, Bramble Brook and Middle Brook), within the vicinity of the Scheme, was to gather baseline data to characterise the macroinvertebrate communities and assess the conservation value of the watercourses.

5.1.2 Macroinvertebrate surveys were undertaken in the spring and autumn of 2018. The most diverse macroinvertebrate groups included caddisfly larvae, mayfly larvae and snails.

5.1.3 The results of the macroinvertebrate analyses undertaken demonstrated that:

- The River Derwent was of “Very Good” biological water quality in the stretch sampled and of “Fairly High” conservation value. The river supports communities likely to be very sensitive to changes in water quality.
- Markeaton Brook was of “Moderate” to “Very Good” biological water quality in the stretch sampled, and of “Low” to “Moderate” conservation value. The macroinvertebrate community supported here appears to be sensitive to changes in water quality.
- Bramble Brook was of “Moderate” to “Good” biological water quality in the stretch sampled, and of “Low” to “Moderate” conservation value. The brook supports a community that is likely to be relatively tolerant of changes in water quality.
- Dam Brook was of “Very Good” biological water quality in the area surveyed and of “Moderate” conservation value; it supported communities likely be sensitive to changes in water quality.
- Middle Brook was of “Good” to “Very Good” biological water quality in the stretch sampled, and of “Moderate” conservation value. The community here is likely to be sensitive to changes in water quality.

5.1.4 Most of the species recorded across the survey areas were very common. The following species, formerly “Regionally Notable”, were recorded; however, all have now been re-classified as “Least Concern” in the most recent RDB:

- *Baetis buceratus* (a mayfly): recorded in the River Derwent, widespread in streams and rivers throughout England and Wales (Macadam, 2016).
- *Brachycentrus subnubilus* (a caddisfly): recorded in the River Derwent and Markeaton Brook, a species typical of clean rivers and large streams.
- *Lepidostoma basale* (a caddisfly): recorded in the River Derwent, a species that occurs in a variety of unpolluted flowing waters.

5.1.5 One “Notable (but not RDB)” species of caddisfly was recorded in the Bramble Brook, *Tinodes unicolor*. This species has now been re-classified as of “Least Concern” in the most recent RDB.

5.1.6 The above species are known to be present within proximity of the Scheme and are relatively widespread across Britain and have no statutory or non-statutory designated status.

5.1.7 The survey results presented herein will be considered as part of the ecological impact assessment of the Scheme.

5.1.8 The sites selected for sampling contained a range of habitats, some of which were eroding and are potentially at risk from siltation due to transported suspended load. However, if appropriate safeguards are put in place, this should not be an issue. Mitigation and enhancement measures will be considered and reported in the Scheme Environmental Statement (where applicable).

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Appendix A Figures

N

M1 JUNCTION 28

A38/A61 LITTLE EATON JUNCTION

A38/A6 PALM COURT JUNCTION

A38/A52 MARKEATON JUNCTION

A38/A5111 KINGSWAY JUNCTION

A50/A38 JUNCTION

2 0 2 4 6 8 Kilometres

Project Title/Drawing Title

A38 DERBY JUNCTIONS SCHEME LOCATION PLAN

AECOM Internal Project Number
60533462

Drawn	Checked	Approved
GB	SR	DD
Date	Scale @ A3	Purpose of issue
01/10/2018	1:100,000	FINAL
Drawing Number		Rev
Figure 1		1F

Highways England
A38 Derby Junctions Project
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www.aecom.com

File Name:\\ch-wip-001\CH_Roads\A38 Derby Jcns - PO1339\2 CAD\12.1 WIP\FIGURE 1.1 - LOCATION PLAN F1.mxd

N

Markeaton Brook

Middle Brook

Bramble Brook

Legend

- Scheme Boundary
- Flowing water

Sample points

- Autumn Upstream
- Autumn Downstream
- Spring Upstream
- Spring Downstream

100 0 100 200 300 400 500 Metres

File Name:Y:\Highways Agency\47071390 A38 Derby Jcns - Environment\Technical\Ecology\GIS_A38_2018\project_files\Aquatic Invert\A38 KM Aquatic invert survey 2018.mxd

Project Title/Drawing Title

A38 DERBY JUNCTIONS AQUATIC INVERTEBRATE SAMPLING LOCATIONS KINGSWAY MARKEATON

AECOM Internal Project Number
60533462

Drawn	Checked	Approved
GSB	LL	PC
Date	**Scale @ A3**	**Purpose of issue**
20/11/2018	1:8,000	FINAL
Drawing Number		**Rev**
Figure 2		0

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N

River Derwent

Dam Brook

Watermeadows ditch

Legend

- Scheme Boundary
- Flowing water

Sample points

- Autumn Upstream
- Autumn Downstream
- Spring Upstream
- Spring Downstream

100 0 100 200 300 400 500 Metres

File Name:\\NM-MAN-001\Jobs\Derby-Jobs\Highways Agency\47071390 A38 Derby Jcns - Environment\Technical\Ecology\GIS_A38_2018\project_files\Aquatic Invert\A38 Little Eaton Aquatic invert survey 2018.mxd

Project Title/Drawing Title

A38 DERBY JUNCTIONS AQUATIC INVERTEBRATE SAMPLING LOCATIONS LITTLE EATON

AECOM Internal Project Number
60533462

Drawn	Checked	Approved
GSB	LL	PC
Date	**Scale @ A3**	**Purpose of issue**
15/12/2018	1:8,000	FINAL
Drawing Number		**Rev**
Figure 3		0

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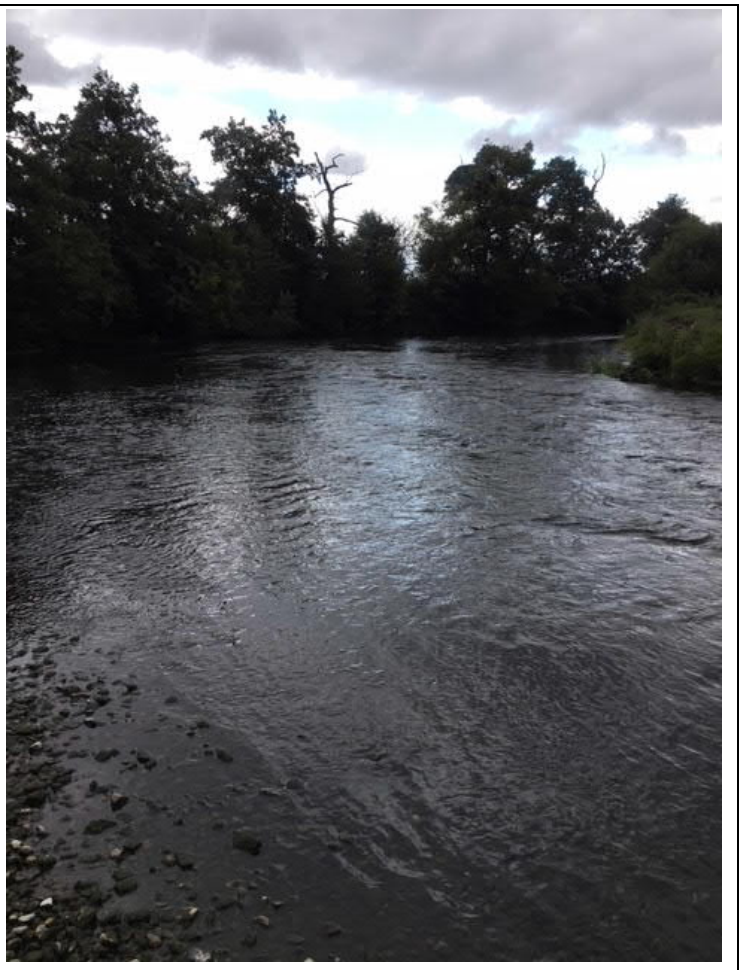
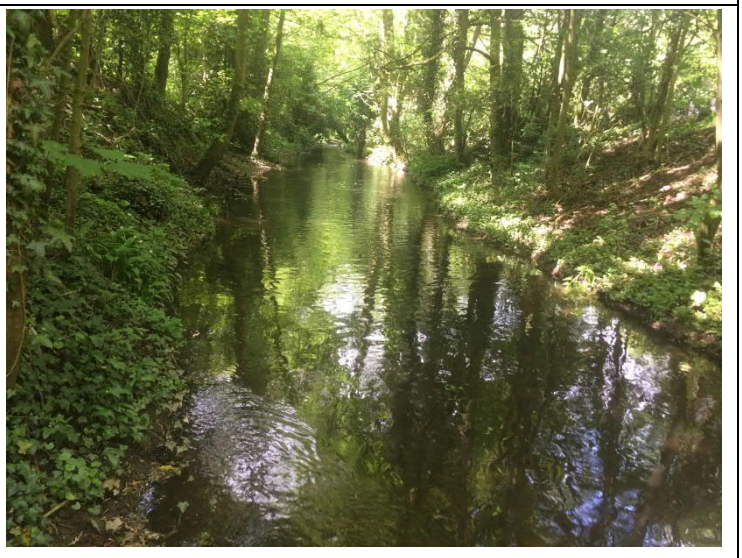
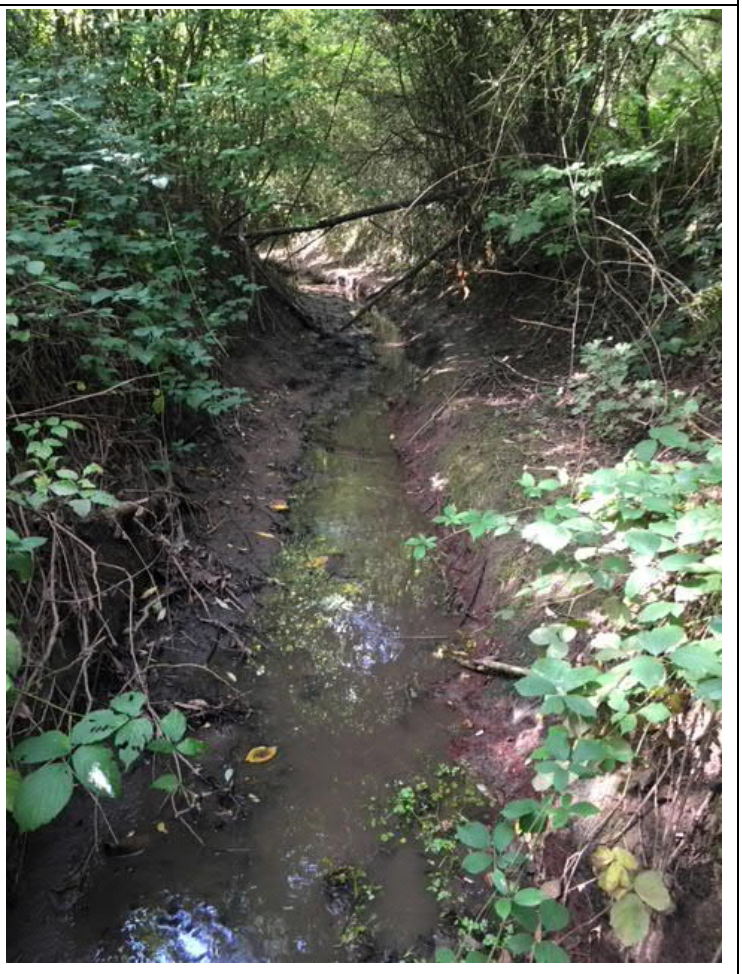
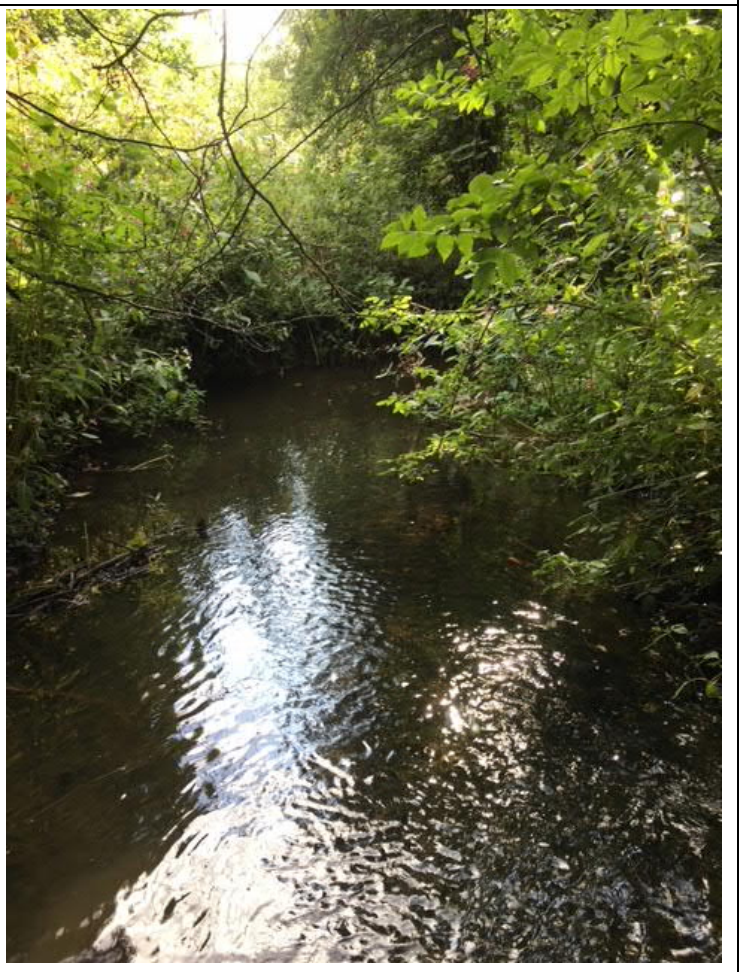
Appendix B Photographs

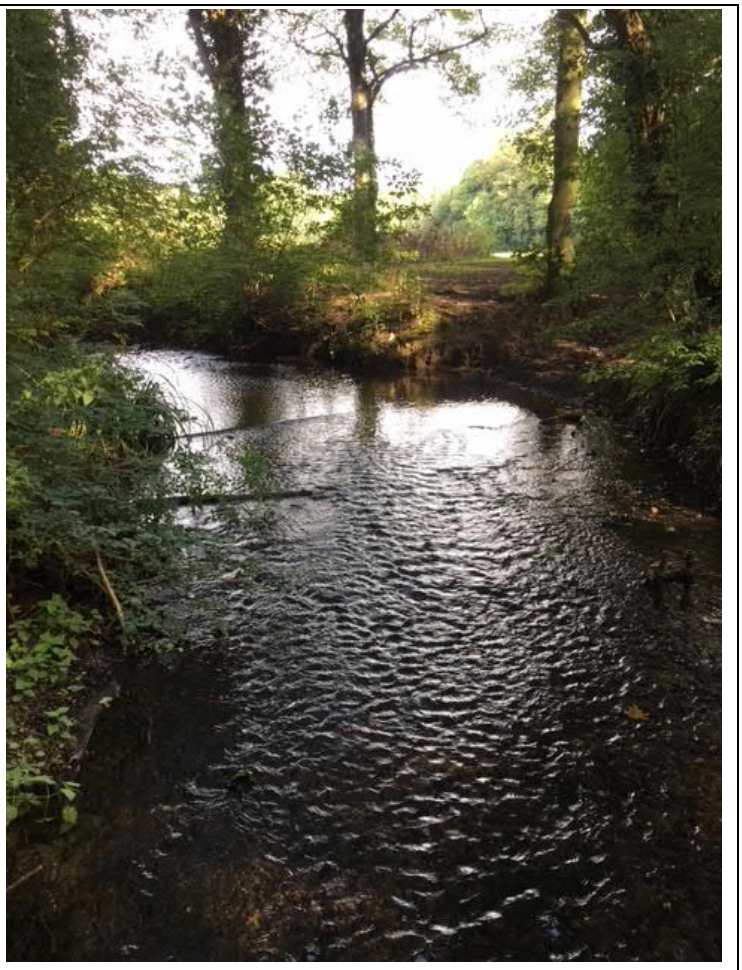
P1	**River Derwent - Upstream**	

P2	**River Derwent - Downstream**	
P3	**Markeaton Brook**	

P4	**Markeaton Brook - Downstream**	
P5	**Bramble Brook – Upstream**	

P6	**Bramble Brook – Downstream**	
P7	**Dam Brook - Upstream**	

P8	**Dam Brook - Downstream**	
P9	**Middle Brook - Upstream**	

P10	**Middle Brook - Downstream**	

Appendix C Biological Monitoring Working Party (BMWP) System

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

For consistency, we only report taxa used in the BMWP (Biological Monitoring Working Party) system (see below). Some animals are more susceptible to organic pollution than others and the presence of sensitive species indicates good water quality. This fact is taken into account by the 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 was found to be one that combined the number of taxa and the ASPT. The best quality is indicated by a diverse variety of taxa, especially those that are sensitive to pollution. Poorer quality is indicated by a smaller than expected number of taxa, particularly those that are sensitive to pollution. Organic pollution sometimes encourages an increased abundance of the few taxa that can tolerate it.

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 it should be remembered that 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, time of year the sample was taken and other factors.

Table C1: 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