A303 Amesbury to Berwick Down

TR010025

6.3 Environmental Statement Appendices

Appendix 8.7B Aquatic macrophyte survey River Till

Volume 6

APFP Regulation 5(2)(a)

Planning Act 2008

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

October 2018

Subject:	River Till Aquatic Macroinvertebrate Surveys		
Date:	03 August 2017	**Date amended:**	16 August 2017
Copies:	HE551506-AA-EWE-SWI-SU-YE-000006 P04		
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1 Introduction

1.1 Overview

1.1.1 Aquatic macroinvertebrate surveys were undertaken at six sites on the River Till, to provide a baseline of the existing health and structure of the communities present. These surveys will inform the environmental assessment and any design mitigation/compensation that may be required. The data will also provide a baseline for future construction monitoring.

1.1.2 Figure 1 shows the sections of the River Till surveyed and locations from which macroinvertebrate samples were collected. For each of the Winterbourne Stoke A303 bypass options (northern and southern) the survey reaches were contiguous, extending 500m upstream of the proposed crossing location, and for 1km downstream, with a sample collected from a representative location within each 500m reach (

1.1.3 Table 1).

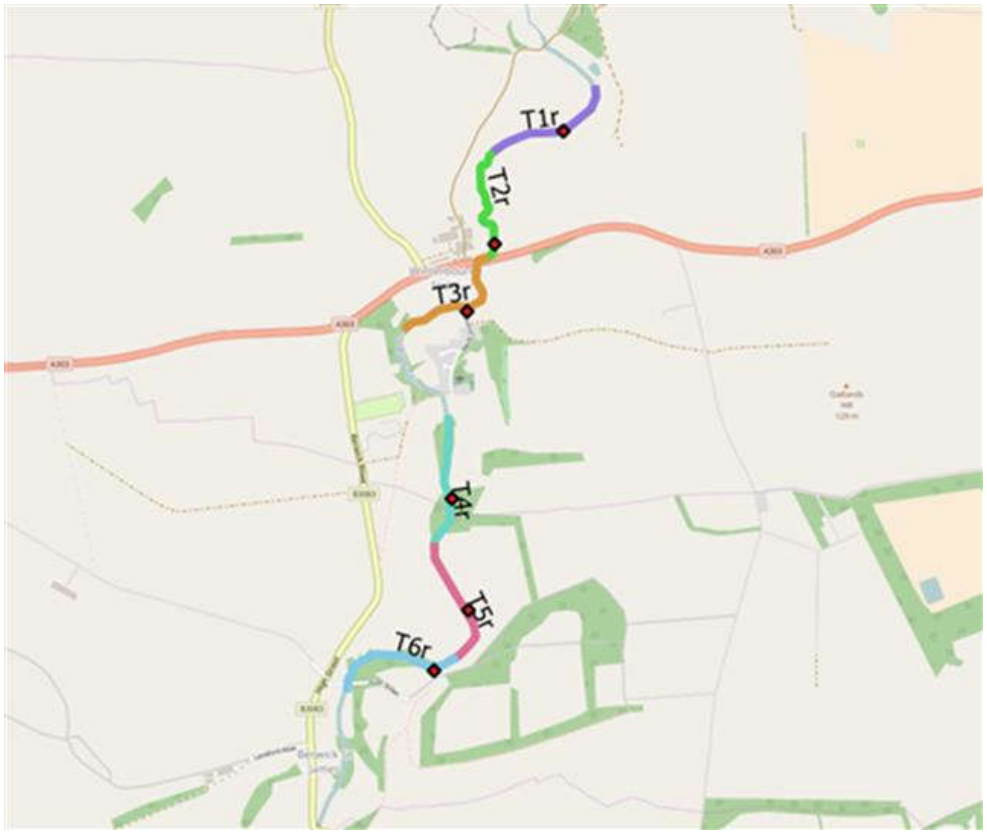

Figure 1: River Till macroinvertebrate reach and sampling locations (red markers)

Table 1: River reach NGR and macroinvertebrate sampling site location

Survey reach	Upstream NGR	Downstream NGR	Macroinvertebrate sampling point NGR	Description
T1r	SU 08202 41752	SU 07827 41506	SU 08085 41591	Northern bypass – 500m upstream and 1km downstream
T2r	SU 07827 41506	SU 07807 41109	SU 07824 41162	
T3r	SU 07807 41109	SU 07518 40865	SU 07717 40910	
T4r	SU 07649 40501	SU 07642 40031	SU 07661 40203	Southern bypass – 500m upstream and 1km downstream
T5r	SU 07642 40031	SU 07726 39588	SU 07726 39782	
T6r	SU 07726 39588	SU 07272 39518	SU 07598 39554	

2 Methods

2.1 Field survey and laboratory identification

2.1.1 Aquatic macroinvertebrate surveys were undertaken on the 24th May 2017.

2.1.2 A representative macroinvertebrate sampling site was identified within each of the six survey reaches. At each site a standardised sample was collected in accordance with RIVPACS[1] sampling protocols. This method involved the use of a standard pond net (1mm mesh size) to collect macroinvertebrates by employing kicking and sweeping motions over a three-minute period.

2.1.3 In addition, the full suite of environmental variables required to generate RIVPACS2 community predictions were also recorded for each sampling site. Thus ensuring that, should a full site classification be required in future, the data collected was fit for this purpose.

2.1.4 The samples were preserved in alcohol in the field and returned to the laboratory for species/mixed level identification (RIVPACS IV Taxonomic Level 4[2]).

2.2 Post survey analysis

2.2.1 A number of biotic indices were calculated from the macroinvertebrate data collected. The aim of calculating these indices is to provide information on the macroinvertebrate communities' sensitivity to organic pollution, changes in river flow, habitat

[1] EU Star UK (2006) RIVPACS Macroinvertebrate Sampling Protocol. Available at: http://www.eu-star.at/pdf/RivpacsMacroinvertebrateSamplingProtocol.pdf

[2] Available at: http://eprints.bournemouth.ac.uk/16550/2/SNIFFER_WFD72C_RICT_Final_Report_-_Davy-Bowker,_Clarke_et_al_2008.pdf

modification and siltation. The following section outlines the methods used to calculate each score and the outputs from each biotic index.

2.3 Biological Monitoring Working Party (BMWP), Average Score per Taxon (ASPT) and Number of Scoring Macroinvertebrate Taxa (NTAXA)

2.3.1 These indices were developed primarily as a means of assessing water quality and do not necessarily correlate intimately with conservation importance. They are underpinned by Pressure Sensitivity (PS) scores, based on tolerance to organic pollutants. These are assigned at a family level ranging from 1 (extremely tolerant) to 10 (extremely sensitive). The scores have been refined since their initial development; however the method of their calculation has not changed.

2.3.2 BMWP is the sum of PS scores for all scoring* macroinvertebrate families recorded in a given sample. Theoretically, a site with good water quality should result in a higher BMWP than a site with poor water quality. Commonly used BMWP interpretation bands are presented in Table 2. NTAXA is simply the number of scoring taxa (families) recorded in the sample. ASPT is the BMWP divided by NTAXA, and is less influenced by seasonal community changes. ASPT is the most appropriate index of the three by which to monitor a site over time.

**Not all macroinvertebrate families have an assigned PS score.*

Table 2: Interpretation of BMWP score

BMWP score	Water quality interpretation
151+	Very High
101-150	High
51-100	Good
17-50	Moderate
0-16	Poor

2.4 Whalley, Hawkes, Paisley and Trigg (WHPT)

2.4.1 The WHPT metric improves on the BMWP method by including a larger data set of reference sites and the addition of an abundance measure to provide a more robust assessment technique. However, the principle of using macroinvertebrate families as biological indicators still remains.

2.4.2 WHPT enables the assessment of macroinvertebrates according to WFD requirements in relation to organic pollution, but also responds to toxic pollution and other degradation sources.

2.4.3 Similar to BMWP, PS scores are allocated at a family level. However, each PS score also contains an abundance measure (Table 3). This takes into account the density at which a taxon is present in a sample resulting in an increase in metric sensitivity to changes in macroinvertebrate assemblage structure. The sum of the PS scores for all scoring taxa gives the WHPT.

2.4.4 WHPT ASPT is calculated in the same way as for BMWP, by dividing the WHPT score by the number of scoring taxa (WPHT NTAXA).

2.4.5 As with BMWP scoring, a higher WHPT is indicative of higher water quality and lower levels of environmental degradation. As a general rule WHPT scores can be broadly interpreted using Table 2. Although the WHPT values are reported in the results section, the assessment of community response to organic pollution has been described with reference to BMWP scores only.

2.5 Community Conservation Index (CCI)

2.5.1 The CCI accounts for both community richness and the relative rarity of macroinvertebrate species present. It utilises BMWP and the conservation status of individual species. Species are assigned a Conservation Score (CS) in accordance with Table 3 as defined by the Joint Nature Conservation Committee (JNCC) accepted designations.

Table 3: Conservation Scores for freshwater macroinvertebrate species in Great Britain

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

2.5.2 The sum of CSs is calculated and divided by the number of contributing species. This is then multiplied by a Community Score (CoS) determined either by the rarest taxon present or the BMWP (whichever results in the higher CoS) with reference to Table 4. The resulting CCI score can then be interpreted with respect to the Table 5.

Table 4: Community Score (CoS) categories

BMWP	Community Score (CoS)	Highest CS (CSmax)
>301	15	10
251-300	12	9

201-250	10	8
151-200	7	7
101-150	5	5 or 6
51-100	3	3 or 4
1-50	1	1 or 2
0	0	Scoring taxa absent

Table 5: CCI interpretation

CCI	Description	Conservation Value
0.0 to 5.0	Sites supporting only common species and/or a community of low taxon richness.	Low
>5.0 to 10.0	Sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness.	Moderate
>10.0 to 15.0	Sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness.	Fairly High
>15.0 to 20.0	Sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness.	High
>20.0	Sites supporting several rarities, including species of national importance, or at least one extreme rarity (e.g. taxa included in the British RDBs) and/or a community of very high taxon richness.	Very High (potentially of national significance and may merit statutory protection)

2.6 Lotic Invertebrate Flow Evaluation (LIFE)

2.6.1 Lotic Invertebrate Flow Evaluation (LIFE) scores were calculated to give an indication of each macroinvertebrate community's sensitivity to changes in flow.

2.6.2 Species are assigned to a flow group depending on their documented flow preferences (current velocity) ranging from I (Rapid) to VI (Drought Resistant). This has also been undertaken at a family level; however the use of family level data may result in the loss of precision as a number of families contain species with wide-ranging flow requirements. Family level LIFE scores are reported in the result section, but assessment of community response to flow has been described with reference to the species level LIFE score.

2.6.3 Additionally, ubiquitous taxa such as Chironomidae and Oligochaeta are not used in the method as their abundance appears to have no definitive relationship with flow. The calculation of a community LIFE score is underpinned by Flow Scores (fs). These are derived with reference to the abundance/flow group matrix (Table 6), such that both the

abundance and flow preference of recorded taxa is taken into account. Abundance categories are defined by standard EA categories (Table 7).

Table 6: Flow Scores (fs) abundance-flow group matrix

Flow Groups	Abundance categories			
	A	B	C	D/E
I Rapid	9	10	11	12
II Moderate/Fast	8	9	10	11
III Slow/Sluggish	7	7	7	7
IV Flowing/Standing	6	5	4	3
V Standing	5	4	3	2
VI Drought Resistant	4	3	2	1

Table 7: Abundance categories

Category	Estimated abundance
A	1-9
B	10-99
C	100-999
D	1000-9999
E	10 000+

2.6.4 LIFE Scores are calculated by taking the sum of all flow scores and dividing by the number of contributing taxa:

$$\text{LIFE} = \frac{\Sigma\, fs}{n}$$

2.6.5 LIFE scores can be broadly interpreted as shown in Table 8.

Table 8: LIFE score interpretation

LIFE score	Interpretation
7.26 and above	High sensitivity to reduced flows
6.51 – 7.25	Moderately sensitive to reduced flows
6.5 and below	Low sensitivity to reduce flows

2.7 Proportion of Sediment-sensitive Invertebrates (PSI)

2.7.1 Proportion of Sediment-sensitive Invertebrates (PSI) was calculated for macroinvertebrate samples collected from each river reach.

2.7.2 PSI is a biotic index designed to describe a macroinvertebrate community's sensitivity to sedimentation. It is based on the known ecological responses of different macroinvertebrate species or family groups to the accumulation of sediment on riverine substrata. The index declines as the pressure of fine sediments cover the river bed.

2.7.3 Those taxa that are known to benefit from, or that are largely unaffected by, sedimentation, are given a high score, known as a 'Sediment Sensitivity Rating (SSR)'. Those taxa that are known to suffer from the accumulation of sediment are given a low SSR. The metric also depends on the relative abundance of different taxa and so is not just dependent on "presence-absence", but also on the numbers of different taxa recorded.

2.7.4 The PSI score describes the percentage of sediment-sensitive taxa present in a sample with high values indicating a greater proportion (percentage) of silt intolerant invertebrate species present within the macroinvertebrate community sampled i.e. the less a site is affected by silt the greater the PSI score. How to interpret the score is shown in Table 9.

Table 9 - Interpretation of PSI scores

PSI score	Riverbed condition
81- 100	Minimally sedimented/unsedimented
61-80	Slightly sedimented
41-60	Moderately sedimented
21-40	Sedimented

2.8 Percentage Ephemeroptera and Trichoptera (%ET)*

2.8.1 %ET is the percentage of macroinvertebrates in the sample (as an abundance of the overall assemblage) that belong to the mayfly and caddisfly orders. These are generally the more pollution sensitive orders of macroinvertebrates and as such, a higher %ET is indicative of higher water quality. It is important to note that in a species rich system, the %ET may low, but water quality may still be high. This is due to the number of other species present reducing the %ET. Additionally, substrate and physical habitat conditions will also impact the species composition within a river and therefore you may find high water quality, but low %ET.

** %ET is usually called %EPT and includes the order Plectoptera (stonefly). However, since no stonefly species were present in the samples, the measure only includes Ephemeroptera and Trichoptera.*

3 Results and site summaries

3.1.1 This section outlines the main results from macroinvertebrate samples on the River Till. The raw macroinvertebrate survey data (i.e. fully enumerated taxon lists) are not presented, but are available on request. Biotic metrics described in Section 2.2 are provided

in Table 10 and Table 11 and are used to describe the macroinvertebrate community characteristics at each site.

3.1.2 The full suite of RIVPACS2 environmental data is not presented although selected habitat variables have been included in the environmental data table (

3.1.3 Table 12).

3.1.4 Macroinvertebrate sampling at the six sites on the River Till yielded a total of 108 macroinvertebrate taxa. In general, the macroinvertebrate communities were characterised by the presence of a moderately species rich assemblage (when compared to the River Avon). At all sites, the proportionally high representation from macroinvertebrate families sensitive to poor water quality and/or habitat degradation, such as those belonging to the Emphemeroptera and Trichoptera orders, indicates the absence of significant environmental stresses on the assemblages present.

3.1.5 Flow metrics indicate that the macroinvertebrate communities present are likely to be sensitive to change as a result of reduced flow and it is considered that any increase in riverbed sedimentation may be a key factor that would act to constrain the assemblages at a survey site and potentially reach scale. Drought tolerant taxa were confined to the upper survey sites e.g. the molluscs *Anisus leucostoma* and *A. spirorbis*[3], indicting the ephemeral nature of watercourse. The general increase in species richness, in the downstream direction, is also likely to be a function of the change in watercourse character from an ephemeral to perennial system.

3.1.6 One Red Data Book macroinvertebrate species was recorded from site T1r, namely the mayfly *Paraleptophlebia werneri*, as well as a number of other uncommon species which are identified in the following sections for each sampling site.

Table 10: BMWP, WHPT and LIFE scores for the River Till macroinvertebrate sampling sites by reach location.

Reach	BMWP score	ASPT	NTaxa	WHPT score	WHPT ASPT	WHPT NTaxa	LIFE score (Species)
T1r	102	5.67	18	111	5.54	20	8
T2r	107	5.35	20	117	5.3	22	6.81
T3r	86	5.38	16	95	5.6	17	8.36
T4r	103	5.42	19	110	5.24	21	7.55
T5r	188	5.7	33	205	5.86	35	7.44
T6r	176	6.29	28	194	6.47	30	8.19

[3] The mollusc *Anisus spirorbis* was recorded in two samples collected from the River Till (T1r and T3r). There is some debate regarding the status of this species which, although not recognised within the CCI scoring system, is of conservation interest due to its potential rarity. Due to its occurrence in samples collected form reaches associated with the northern bypass option further information on its status are provided in Section 3.8.

Table 11: CCI, %oligo&chiro, %EPT and PSI scores for the River Till macroinvertebrate sampling sites by reach location.

Reach	CCI Score	CCI interpretation	% Oligo & Chiro	% EPT	PSI Species Score	Species PSI Interpretation
T1r	20	High	5.54	69.78	45.61	Moderately Sedimented
T2r	7.67	Moderate	6.79	47.43	42.31	Moderately Sedimented
T3r	3.38	Low	3.63	32.16	61.54	Slightly Sedimented
T4r	10.79	Fairly High	15.74	32.01	49.02	Moderately Sedimented
T5r	11.52	Fairly High	6.6	67.69	48.91	Moderately Sedimented
T6r	12.09	Fairly High	3.23	44.29	71.13	Slightly Sedimented

Table 12: Environmental data recorded at each sampling site within each reach.

Environmental data	T1r	T2r	T3r	T4r	T5r	T6r
pH	8.16	7.31	7.3	7.21	7.4	7.47
O_2 (mg/l)	7.86	9.29	9.02	9.34	10.21	9.7
Estimated flow velocity at sample site ($cm.s^{-1}$)	<10	<10	<10	<10	<10	<10
Land use - left hand bank	Grassland	Grassland	Grassland and housing	Arable	Grassland	Grassland
Land use – right hand bank	Grassland	Grassland	Housing	Grassland and woodland	Grassland	Woodland
Flow type	80% riffle, 20% run	50% riffle, 50% run	50% run, 50% glide	100% glide	80% run, 20% glide	100% run
Dominant substrate	Pebbles	Pebbles	Pebbles	Pebbles	Pebbles	Pebbles
Substrate composition *	Cobbles 30%, Pebbles/ gravel 65%, sand 5%	Cobbles 5%, Pebbles/ gravel 90%, sand 5%	Cobbles 10%, pebbles/ gravel 80%, sand 10%	Cobbles 20%, pebbles/ gravel 50%, silt/clay 30%	Cobbles 7%, pebbles/ gravel 83%, sand 10%	Cobbles 20%, pebbles/ gravel 70%, sand 10%

**Substrate sizes: Boulders (>256mm), cobbles (64-256mm), pebbles/gravel (2-64mm), sand (0.06-2mm), silt/clay (<0.06mm).*

3.2 Site T1r

3.2.1 This site is located upstream of the perennial head of the River Till. At the macroinvertebrate sampling site, water depth was 0.15m and channel width 3.6m (wetted width 2.6m). The flow type was identified as a combination of riffle and run and bankside habitats characterised by grassland land use.

3.2.2 The BMWP score of 102, indicates high water quality at the sampling location. Additionally, the ASPT of 5.67 confirms the site contained a high proportion of pollution sensitive taxa. Therefore, the community at the time of survey was not experiencing significant environmental stress.

3.2.3 The CCI score of 20 identifies the site as having high conservation value. Review of the full species assemblage indicates that this classification is driven, in part, due to the presence of the mayfly *Paraleptophlebia werneri*, which is classified as a Red Data Book (RDB) (Rare) species.

3.2.4 The species LIFE score of 8.0 indicatives that the community is highly sensitive to flow reduction. Flow types at the sample site were recorded as 80% riffle and 20% run, with an estimated velocity of less than 10 $cm.s^{-1}$.

3.2.5 The sample returned a PSI species score of 45.61 indicating a moderately sedimented riverbed.

3.3 Site T2r

3.3.1 This site is located upstream of the perennial head of the River Till. At the sample site the river channel was 4.5m wide and 0.1m deep and characterised by both riffle and run flow types. The stream character was generally comparable to the T1r.

3.3.2 The BMWP score of 107, indicates high water quality at the sampling location. Similar to upstream, the ASPT score of 5.35, indicates a macroinvertebrate community with a high proportion of pollution sensitive taxa.

3.3.3 The CCI score of 7.67 identifies the community as being of moderate conservation value due to the assemblage having a moderate taxon richness and supporting a species of restricted distribution, namely the mollusc, *Anisus leucostoma*.

3.3.4 The species LIFE score of 6.81 identifies the macroinvertebrate community as being moderately sensitive to reduced flows and the PSI species score of 42.31, is indicative of a moderately sedimented riverbed.

3.4 Site T3r

3.4.1 This site is located downstream of the perennial head of the River Till i.e. the watercourse flows all year round. At the sample site the river channel was 6m wide and 0.1m deep and characterised by both run and glide flow types. The substrate at the sampling location was dominated by pebbles and broadly comparable to the two upstream survey locations.

3.4.2 The BMWP and NTAXA scores was the lowest recorded at 86 and 16, respectively, but still indicative of good water quality.

3.4.3 The site was classified as having a low conservation value (CCI = 3.38), due to the low taxon richness and the presence of only commonly occurring species.

3.4.4 The species LIFE score of 8.36 was the highest recorded for the River Till sites and indicates that the macroinvertebrate community is highly sensitive to reduced flows. The PSI species score of 61.54 indicates a slightly sedimented riverbed.

3.5 Site T4r

3.5.1 This site is located downstream of the perennial head of the River Till and is notably wider (9.9m) and deeper (0.33m) than the upstream sites.

3.5.2 The BMWP score of 103 and ASPT of 5.42 again indicate high water quality at the site. The CCI of 10.79 classifies the assemblage as having fairly high conservation value. The conservation value was driven by the presence of an uncommon specie and species of restricted distribution, namely the Regionally Notable *Niphargus* aquilex (Crustacea) and Locally occurring *Silo nigricornis* (Caddisfly) and *Procloeon pennulatum* (Mayfly).

3.5.3 The species LIFE score of 7.55 is indicative of a community highly sensitive to reduced flows. The PSI species score of 49.02 indicates that the channel bed was moderately sedimented at the sample location.

3.6 Site T5r

3.6.1 This site is located downstream of the perennial head of the River Till. At the sample site the river was 7m wide and 0.16m deep and characterised by both run and glide flow types.

3.6.2 The BMWP, ASPT and NTAXA scores were the highest recorded across the River Till sampling sites at 188, 5.7 and 33, respectively, indicating very high water quality and a relatively species rich assemblage, that contains a high proportion of pollution sensitive taxa.

3.6.3 The CCI of 11.52 classifies the site as being of fairly high conservation value. This score was driven by the high taxon richness observed and the presence of the Notable flatworm species, *Bdellocephala punctata*.

3.6.4 The species LIFE score of 7.44 indicates that the macroinvertebrate community is highly sensitive to reduced flows and the PSI species score of 48.91 indicates the riverbed was moderately sedimented.

3.7 Site T6r

3.7.1 This site is located downstream of the perennial head of the River Till. At the sample location the channel width was relatively narrow (4.7m) and shallow (0.17m) when compared to T4r and T5r.

3.7.2 In common with T5r both BMWP (176) and NTAXA (28) were high and indicative of very high water quality. The ASPT of 6.29, was the highest recorded at survey, indicating that this site contained the highest proportion of pollution sensitive taxa within the taxon rich assemblage.

3.7.3 The CCI of 12.09 classifies the site as being of fairly high conservation value. This score was driven by the presence of species of restricted distribution including the Locally occurring caddisflies *Athripsodes bilineatus* and *Silo nigricornis*.

3.7.4 The species LIFE score of 8.19 indicates that the macroinvertebrate community is highly sensitive to reduced flows. The PSI species score of 71.13 indicates a slightly sedimented riverbed.

3.8 Other notable species

3.8.1 The mollusc *Anisus spirorbis* was recorded in two samples collected from the River Till (T1r and T3r). It was abundant at T1r with 375 individuals recorded. There is some debate regarding the status of this species which, although not recognised within the CCI scoring system, is potentially of conservation interest due to its potential rarity. Due to its occurrence in samples collected form reaches associated with the northern bypass option further information on its status are merited.

3.8.2 ***Is it a good species?*** *Anisus leucostoma* and *A. spirorbis* are closely related. They were considered for many years to be a single species, under the name *A. leucostoma* (e.g. Macan 1977), and even now there is debate as to whether they are simply morphotypes of the same species, with *A. leucostoma* being the narrow-whorled variety and *A. spirorbis* the broad-whorled variety. Standard practice is currently to follow Anderson (2008), who recognised the two species in the British fauna while acknowledging that they may simply be varieties of the same species. Elsewhere in Europe, recent publications treat them as separate species (e.g. Welter-Schultes 2012, Glöer 2015).

3.8.3 **Habitat.** Both species live in temporary water bodies and periodic water bodies, including ditches and ponds. They prefer presence of aquatic vegetation. It is not known if *A. spirorbis* can colonise new habitat easily or is restricted to long-established seasonally flooded areas.

3.8.4 **Is it rare or just under-recorded?** Macan (1977) is, despite its age, still widely used as the most recent British key in print, and use of this key would not enable *Anisus spirorbis* to be distinguished. The morphological difference is subtle, and many would hesitate to separate them, particularly in the absence of both species to enable a comparison. The Environment Agency training manual (Killeen 2009) suggests recording these species as an aggregate if not sure about separating them. Therefore, it is very likely to have been under-recorded. However, it may also be rare. Welter-Schultes (2012) records it as endangered in Germany and in parts of Austria. Gloër (2015) considers it to be endangered in Germany. It is classed as Vulnerable in the Czech Republic (Slovak Academy of Sciences, 2010). The European Environment Agency undated) considers it to be of Least Concern, although acknowledges that information is limited. In Ireland it is considered to be very uncommon and restricted in distribution (Anderson 2016).

3.8.5 *Anisus spirorbis* has no formal conservation designations.

3.8.6 **Summary and recommendation.** *Anisus spirorbis* is almost certainly under-recorded, due to its taxonomic history and similarity to *A. leucostoma*. However, its preference for seasonally wet areas and its acknowledged rare status elsewhere in Europe suggest that it may be vulnerable and that attempts should be made to minimise habitat damage where it occurs.

3.8.7 It is therefore recommended that, where recorded, this is flagged to the client. It should be emphasised that it is not a species with a statutory conservation status but that that concerns elsewhere in its range across Europe may cause this to change in due course. Therefore, wherever possible damage to its habitat should be avoided or minimised.

4 References

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