A303 Amesbury to Berwick Down

TR010025

6.3 Environmental Statement Appendices

Appendix 8.7A Aquatic macrophyte survey River Avon

Volume 6

APFP Regulation 5(2)(a)

Planning Act 2008

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

October 2018

Subject:	River Avon Aquatic Macrophyte Surveys		
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1 Introduction

1.1 Overview

1.1.1 Aquatic macrophyte surveys were undertaken at six sites on the River Avon, 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, as well as the baseline for future construction monitoring.

1.1.2 Figure 1-1 shows the sections of river surveyed. A total river length of 3km was surveyed: 1km upstream of the A303 crossing (NGR SU15873 42176) and 2km downstream.

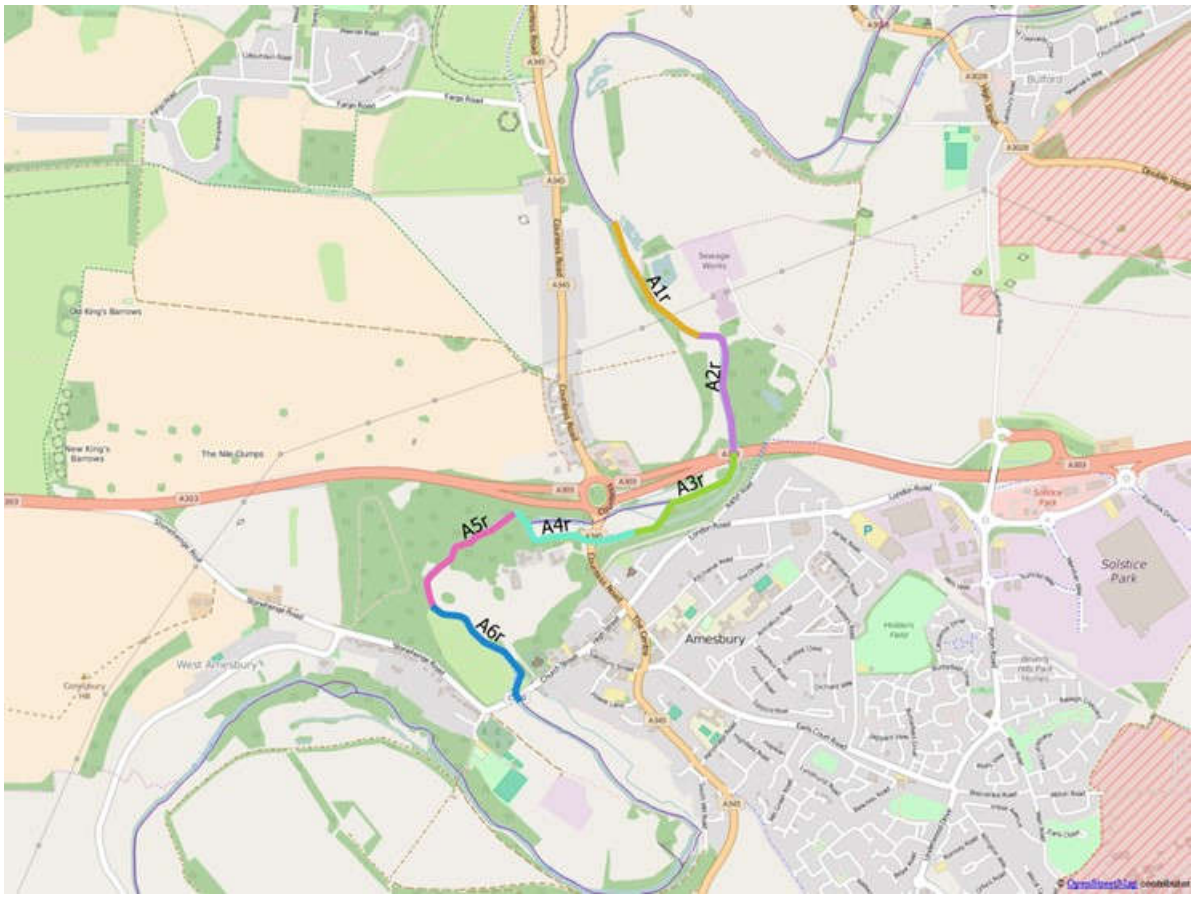

Figure 1-1 River Avon macrophyte survey locations

2 Methods

2.1 Field survey

2.1.1 Surveys were undertaken by APEM on the 23rd and 24th August 2016.

2.1.2 Two survey methods were applied to provide a range of information regarding the macrophyte communities present:

- The Holmes method for surveying macrophytes and determining river community type as described in Life in UK Rivers[1], applied at a 500m reach scale.
- The LEAFPACS method as described in the UK TAG guidance for Water Framework Directive (WFD) monitoring[2], applied at a 100m reach scale.

2.1.3 Full details can be found in the relevant references. The two methods are briefly described below.

2.2 Holmes method

2.2.1 The Holmes method records macrophytes from within the watercourse (plants that are rarely out of water) and on the immediate bankside (plants that are submerged except by the highest of flows) over a 500m reach. The survey records estimated relative abundance and percentage cover of species from a predetermined check-list. Other species of interest (not on the checklist) are also noted.

2.2.2 The aim of this survey method is to obtain a comprehensive list of species presence and abundance in order to characterise the vegetation and heath of the watercourse. Six of these surveys were undertaken on the River Avon as shown in Figure 1-1. The extent of these surveys are the same as those used for the River Habitat Survey (RHS), which provides detailed habitat descriptions for each 500m reach.

2.3 LEAFPACS method

2.3.1 The LEAFPACS method involves a survey of the macrophytes within the watercourse (up to the height of the bank that would typically be submerged for more than 50% of the year) over a 100m reach. The survey records the presence and percentage of the river channel covered by each macrophyte taxa from a predetermined list. One 100m LEAFPACS survey was conducted within a representative section of each of the six 500m Holmes method survey reaches.

2.3.2 Physical attributes of the channel are also recorded for each 100m survey, including: channel width, water depth and clarity, substrate composition, flow type and shading.

[1] Life in UK Rivers (2003). Monitoring Watercourses Characterised by *Ranunculion fluitantis* and *Callitricho-Batrachion* Vegetation Communities. Conserving Natura 2000 Rivers Monitoring Series No. 11, English Nature, Peterborough.

[2] UKTAG (2014) Guide to Macrophytes in Rivers River LEAFPACS2. Available at: http://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/River%20Macrophytes%20UKTAG%20Method%20Statement.pdf

2.3.3 The LEAFPACS method has been designed for the Water Framework Directive (WFD) to reflect the impact of nutrient enrichment on the WFD water body status. It may also be sensitive to other pressures such as alterations to river flow and morphology. A number of metrics are calculated based on the taxa recorded:

- River macrophyte nutrient index (RMNI): The RMNI is designed to categorise a macrophyte community's preference to nutrient levels. Scores range from 1 to 10 with scores of 1 representing plant communities with preference for very low levels of nutrients and 10 representing communities with a preference for (or tolerance of) enriched conditions.
- River macrophyte hydraulic index (RMHI)[3]: The RMHI describes a plant community's preference for flow conditions. Scores range from 1 to 10 with scores of 10 indicating a preference for very slow flow and scores of 1 indicating a preference for very fast flows.
- Number of aquatic taxa (NTAXA): A diversity score indicating the number of truly aquatic macrophyte taxa recorded from the field survey.
- Number of aquatic plant functional groups (NFG): A diversity score indicating the number of functional macrophyte groups within the plant community, from a predefined list of 24 different functional groups. Only truly aquatic taxa are included.
- Cover of green filamentous algae (ALG): The percentage cover of green filamentous algae over the whole of the surveyed section of the river.

3 Summary results

3.1 Macrophyte taxa

3.1.1 Table 1 summaries the results from the 500m Holmes method surveys, showing which taxa were recorded at each site (r = river channel, b = bankside).

Table 1 – Taxa recorded from the Holmes method 500m surveys

Taxa	A1r	A2r	A3r	A4r	A5r	A6r	Comment
Algae							
Cladophora / *Rhizoclonium* agg.					r	r	Only present two sites up to 5% cover.
Filamentous green algae (other)		r	r	r	r	r	Recorded at all sites within the channel, except A1, up to 5% cover.
Hildenbrandia rivularis			r	r		r	Recorded at three sites with abundance increasing downstream.
Vaucheria sp.					r		Recorded at only one site at less than 0.1% cover.
Lichens							
Encrusting Lichen(s)					r	r	Recorded at two sites at less than 0.1% cover.
Liverworts							

3 The RMHI is no longer used in the WFD assessment but is reported here to be used as a relative comparison between the survey sites within the same watercourse.

Taxa	A1r	A2r	A3r	A4r	A5r	A6r	Comment
Conocephalum conicum						b	Recorded only at the most downstream site at less than 0.1% cover.
Pellia epiphylla				b	b	b	Most abundant at A3r up to 5% cover
Mosses							
Fontinalis antipyretica	r	r	r	r	r	r	Present at all sites up to 5% cover.
Leptodictyum riparium			b	b	b	b	Present downstream of A303 at less than 0.1% cover.
Rhynchostegium riparioides						r	Only recorded at site furthest downstream at less than 0.1% cover.
Herbs							
Apium nodiflorum			b			r	Recorded at less than 0.1% cover.
Berula erecta		r	r	r	r	r	Recorded at all sites except A1r; most abundant at A3r.
Callitriche obtusangula	r	r	r	r	r	r	Most abundant at A3r at more than 5% cover.
Callitriche sp. *indeterminate*	r		r	r	r	r	
Eupatorium cannabinum	b	b					Only upstream of A303 at less than 0.1% cover.
Filipendula ulmaria		b	b	b	b		Recorded up to 5% cover.
Galium palustre		r					Only at A2r and at less than 0.1% cover.
Lycopus europaeus				b	b	b	Up to 5% cover where present.
Lythrum salicaria	r	b	b	r/b	r/b	b	Up to 5% cover where present.
Mentha aquatica	r	r	r			r	Most abundant at A3r up to 5% cover.
Myosotis scorpioides	r	r	r	r	r	r	Present at all sites up to 5% cover.
Nuphar lutea			r				Only recorded at A3r, over 5% cover.
Oenanthe crocata	r	r	r	r	r	b	Present within the channel up to 5% cover; less than 0.1% on banks at A6r.
Persicaria amphibia		r					Only at A2r and less than 0.1% cover.
Pulicaria dysenterica		b	b			b	Only on banks at less than 0.1% cover.
Ranunculus penicillatus ssp. pseudofluitans	r	r	r	r	r	r	Most abundant at A1r and A6r at greater than 5% cover.
Rorippa nasturtium-aquaticum	r	r	r	r	r	r	Recorded up to 5% cover at all sites but abundant/dominant at A1r and A3r.
Scrophularia auriculata				r	b	b	Rare where present; up to 5% cover.
Scutellaria galericulata		b	b				More abundant at A2r up to 5% cover.
Solanum dulcamara	b	b	b	b	b		Less than 0.1% cover where present.

Taxa	A1r	A2r	A3r	A4r	A5r	A6r	Comment
Stachys palustris	r						Only at A1r and less than 0.1% cover.
Symphytum officinale	b	b	b				Less than 0.1% cover where present.
Veronica anagallis-aquatica			r			r	More abundant at A3r up to 5% cover.
Veronica beccabunga			r			r	Less than 0.1% cover at both sites.
Trees and shrubs							
Salix sp.	r	r	r			r	Up to 5% cover where present.
Other Deciduous Trees and Shrubs	r	r	r			b	Less than 0.1% cover within the channel.
Monocotyledons							
Butomus umbellatus	r	r					Rare where present; less than 0.1% cover.
Carex acutiformis	r	r					
Elodea canadensis *	r	r	r		r	r	Rare where present up to 5% cover.
Glyceria maxima	r	r	r		r	r	Up to 5% cover where present.
Iris pseudacorus						r	Only at A6r; less than 0.1% cover.
Juncus acutiflorus					b		Only at A5r; less than 0.1% cover.
Lemna minor	r	r	r	r	r	r	Most abundant at A1r and A3r, up to 5% cover.
Lemna trisulca						r	Only at A6r; less than 0.1% cover.
Phalaris arundinacea	r	r		r	r	r	Up to 5% cover where present.
Phragmites australis	r	r/b	r/b		r		
Potamogeton pectinatus				r			Only at A4r; less than 0.1% cover.
Potamogeton perfoliatus			r	r			More than 5% cover at A3r; rare at A4r
Sagittaria sagittifolia		r	r			r	Up to 5% cover; rare at A6r.
Schoenoplectus lacustris			r			r	Present at less than 0.1% cover.
Sparganium emersum	r	r	r	r	r	r	Over 5% cover at all sites except A6r.
Sparganium erectum	r	r	r	r	r	r	Most abundant at A2r and A3r; over 5% cover.
Total taxa recorded	**24**	**30**	**33**	**23**	**27**	**36**	

3.2 LEAFPACS assessment

3.2.1 Table 2 summarises the results of the LEAFPACS assessment and metric outputs for each site.

Table 2 – LEAFPACS results

	A1r	A2r	A3r	A4r	A5r	A6r
RMNI	7.96	8.07	8.15	7.32	7.61	7.73
RMHI	7.91	7.92	8.10	7.25	7.74	7.71
NTAXA	10.00	6.00	11.00	12.00	8.00	15.00
NFG	7.00	5.00	8.00	10.00	7.00	11.00
ALG	3.80	0.50	3.80	1.70	0.50	0.50
Total % cover	80	80	65	50	75	65
Survey WFD status (macrophytes)[4]	Moderate	Moderate	Moderate	Good	Good	Moderate/ Good[5]

3.3 Physical habitat

3.3.1 A summary of physical attributes is provided below in Section 4, based on observations from the 100m LEAFPACS survey. The RHS report provides detailed physical descriptions and assessment of modification for each of the 500m survey reaches.

4 Site summaries

4.1 Survey site A1r

4.1.1 Tree lined banks provide dense marginal shading through much of the reach. However, the channel is largely unshaded throughout the reach allowing a high percentage of macrophyte cover. Water depth was recorded at greater than 1.0m and channel width between 10m and 20m. Substrate comprised silt/clay and pebbles/gravel in equal proportions.

4.1.2 The 500m survey recorded 24 taxa with *Ranunculus penicillatus* ssp. *pseudofluitans*, *Rorippa nasturtium-aquaticum*, *Sparganium emersum* and *Phragmites australis* recorded as being abundant or dominant. The detailed 100m survey recorded 10 truly aquatic taxa (NTAXA) from seven functional groups.

4.1.3 The RMNI of 7.91 indicates the macrophyte community is subject to some degree of nutrient enrichment. Filamentous algae was recorded during the LEAFPACS survey and noted as extensive through the RHS.

[4] The River LEAFPACS2 Classification Calculator was used to calculate expected values for each LEAFPACS2 metric, calculate the Ecological Quality Ratio from observed and reference values and provide a face value classification for each survey.

[5] Classification confidence: 0.1% high; 46% good; 53.3% moderate; 0.6% poor

4.1.4 *Callitriche* spp, *Fontinalis antipyretica*, *Myosotis scorpioides* and *Oenanthe crocata* were all recorded at the site and all have relatively low individual RMNI being less than 7.0.

4.1.5 The RMHI shows that the predominant flow conditions at this site are similar to the next site downstream but slightly slower flows than the sites at the downstream extent of the surveys.

4.2 Survey site A2r

4.2.1 This reach is directly upstream of the A303 and downstream of site A1r. It is less shaded than site A1r with sections of unshaded margins and areas of broken and dense shade. As with reach A1r, the main channel is largely unshaded allowing a high percentage of macrophyte cover to develop. Water depth was recorded as greater than 1.0m and channel width between 10m and 20m. Substrate composition was similar to site A1r, with silt/clay and pebbles/gravel in equal proportions.

4.2.2 The 500m survey recorded 30 taxa with *Ranunculus penicillatus* ssp. *pseudofluitans*, *Rorippa nasturtium-aquaticum*, *Sparganium emersum* and *Sparganium erectum* recorded as being abundant or dominant. The reduced shading through this reach results in a greater number of bankside taxa recorded; however, the detailed 100m surveys recorded only six truly aquatic species from five functional groups.

4.2.3 Although the wider macrophyte community is more diverse than at site A1r, there is a reduction in truly aquatic species. The RMNI shows a slight increase in nutrient enrichment from site A1r; the taxa noted at site A1r with relatively low individual RMNI are absent from this site. The decrease in cover of filamentous algae represented by ALG does not reflect this increase in nutrient enrichment. It is also not consistent with the observed cover recorded in the field (15%) or the extensive algal cover reported in the RHS.

4.2.4 The RMHI shows flow conditions at this site are similar to A1r upstream but indicate slightly slower flows than the sites at the downstream extent of the surveys.

4.3 Survey site A3r

4.3.1 This reach is directly downstream of the A303. Tree lined banks provide dense marginal shading throughout the reach. The increased shading across the channel results in reduced macrophyte cover. Water depth is shallower than more upstream sites, predominantly under 1m and was therefore more accessible to survey from the channel. Substrate was dominated by silt/clay with limited pebbles/gravel.

4.3.2 The RHS notes this site as being subject to greater modification than the previous sites upstream. This site includes the A303 road bridge.

4.3.3 The 500m survey recorded 33 taxa with only *Mentha aquatica* and *Rorippa nasturtium-aquaticum* recorded as being abundant or dominant. However, *Berula erecta, Nuphar lutea, Potamogeton perfoliatus, Sparganium emersum* and *Sparganium erectum* were also all recorded at greater than 5% cover. The detailed 100m survey recorded 11 truly aquatic taxa from eight functional groups.

4.3.4 Although overall macrophyte cover was lower here than the two sites further upstream, the richness of aquatic taxa is greater, despite the greater modification recorded. The site shows greater depth variation with the inclusion of shallow water areas.

4.3.5 The RMNI shows further increase in nutrient enrichment compared to the two sites further upstream.

4.3.6 The RMHI is highest at this site indicating slower flows here compared to the other sites surveyed.

4.4 Survey site A4r

4.4.1 Tree lined banks provide dense marginal shading through much of the reach. The lowest percentage cover recorded in this reach reflects the greater extent of channel shading compared to other reaches. Water depth was predominantly between 0.25m and 0.5m with some areas of deeper water. Channel width was between 10m and 20m. The RHS reports this section as supporting a greater variety of habitats compared with upstream sites. However, the total macrophyte cover is the lowest recorded of all six sites on the River Avon.

4.4.2 The 500m survey recorded 23 taxa with only *Sparganium emersum* recorded at greater than 5% cover, this is reflected in the lower total percentage cover. The detailed 100m survey recorded 12 truly aquatic taxa from ten functional groups, greater than the previous upstream sites.

4.4.3 The RMNI is the lowest of all six sites from the River Avon. A number of taxa were recorded with relatively low individual RMNI such as *Fontinalis antipyretica*, *Hildenbrandia rivularis* and *Callitriche* spp. This site is one of only two noted as achieving good WFD status through this LEAFPACS survey.

4.4.4 RMHI is also the lowest at this site compared to others on the River Avon. This suggests this site is subject to faster flows.

4.5 Survey site A5r

4.5.1 Marginal shading through this reach is a combination of dense and broken shade on both banks. However, the channel returns to a more open habitat as recorded in the upstream reaches A1r and A2r. The reach is dominated by deep water (greater than 1.0m) with limited areas of shallow water. Channel width was between 10m and 20m. As at sites A3r and A4r, substrate was dominated by silt/clay with limited pebbles/gravel. The RHS reports this site as subject to the greatest level of modification of the six River Avon sites surveyed.

4.5.2 The 500m survey recorded 27 taxa with only *Sparganium emersum* recorded as abundant or dominant. The *Callitriche* species recorded, although not abundant or dominant were recorded at greater than 5% cover. The detailed 100m survey recorded eight truly aquatic taxa from seven functional groups. Despite being one of the lowest scoring sites in terms of the number of truly aquatic taxa, this site is one of only two noted as achieving good WFD status through this LEAFPACS assessment.

4.5.3 The RMNI (7.61) indicates a slight response to increase in nutrient enrichment compared to the site immediately upstream but remains lower than sites A1r to A3r, as reflected by the good provisional WFD status.

4.5.4 The RMHI is higher than at the previous site indicating slower flow conditions compared to A4r; however, flows are greater than at sites A1r to A3r.

4.6 Survey site A6r

4.6.1 Marginal shading comprises a mixture of dense and broken shade on both banks with some unshaded areas. This site shows the greatest range in water depth, the majority being within 25cm to 50cm but with areas of both shallower and deeper water, increasing the range of available habitat.

4.6.2 The 500m survey recorded 36 taxa, greater than all other sites on the River Avon. *Ranunculus penicillatus* ssp. *pseudofluitans, Rorippa nasturtium-aquaticum, Hildenbrandia rivularis, Phalaris arundinacea* and *Salix* sp were all recorded as abundant or dominant. The detailed 100m survey recorded 15 truly aquatic taxa from 11 functional groups, also greater than all other sites on the River Avon.

4.6.3 Despite this, the reach has a provisional WFD status of moderate/good based on this LEAFPACS assessment. This is due to the slight increase in RMNI (7.73) recorded at the site.

4.6.4 The RMHI indicates similar flow conditions to site A5r.

Arup Atkins Joint Venture Approvals

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P01	Author	Esther Wade	[redacted]	26 September 2016
	Checker	Ian Morrissey	[redacted]	30 September 2016
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