SLR CONSULTING

Aquatic Ecology Surveys of the River Yealm, 2011

FINAL REPORT

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CLIENT:	**SLR Consulting**
ADDRESS:	**8 Stow Court** **Stow-cm-Quy** **Cambridge** **Cambridgeshire** **CB25 9AS** **UK**
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PROJECT DIRECTOR:	**Adrian C. Pinder**
PROJECT MANAGER:	**Tommy McDermott**
REPORT AUTHOR:	**Tommy McDermott** **Adrian C. Pinder**
FIELD TEAM:	**Thomas Coyne** **Steve Duncombe-Smith** **Nick Kneebone** **Tommy McDermott** **Luke Teague** **Kirsty Tennant**
GIS:	**Elisa Anderson**

APEM Ltd.
Aquatic Ecology laboratories
FBA East Stoke
East Stoke
Wareham
Dorset, BH20 6BB
Tel: 01929 405430
Website: www.apemltd.co.uk
Registered in England No. 2530851

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1 INTRODUCTION

In advance of the development and operation of a new landfill and a resource recovery centre, APEM was commissioned to conduct a suite of aquatic ecology surveys of the River Yealm. The purpose of this initial survey was to establish an ecological baseline to assess risks and potential impacts of the development on aquatic communities.

The River Yealm rises in the Dartmoor Special Area of Conservation (SAC) and flows broadly Northeast to Southwest prior to discharging into Wembury Bay on the South Devon coast. The proposed development site is located at the disused New England Quarry near Lee Mill and the A38 (NGR: SX 5952954570). The river at this point is known to support a number of aquatic UK Biodiversity Action Plan (BAP) species including all three UK lamprey species, Atlantic salmon, brown trout and otter. Atlantic salmon, which are a qualifying feature of the Dartmoor SAC, must successfully navigate the Yealm adjacent to the proposed development location in order to reach spawning grounds in the SAC and descend though the reach during smolt migrations.

The initial survey design was based on six sampling sites but due to unresolved land access restrictions in 2010 only three sites were surveyed (all within the development site). Following consultation with local land and fishery owners in early 2011, site access was granted and the survey design was extended to the original six sites. Following further consultation with the Environment Agency (EA) in August 2011 (see Section 1.2), some minor variations to the spatial survey design were agreed which resulted in a formalised optimal sampling programme which has been endorsed by the EA.

1.1 2010 Survey Summary

Two surveys were conducted in 2010 to provide seasonal coverage of macroinvertebrates and diatoms. A macroinvertebrate and diatom survey was conducted on July 27th while a repeat survey, incorporating fisheries, macrophytes and physical habitat, was completed between September 30th and October 1st. River Habitat Survey (RHS) was conducted on October 11th.

July.

Macroinvertebrate communities at the three sites surveyed were typical of fast flowing, well oxygenated rivers with stony substrate. While metric results did not indicate serious anthropogenic pressure was impacting the sites, BMWP metrics indicated that Site 4 was possibly of a higher quality than Sites 2 and 3. Macroinvertebrate communities were considered to be of *moderate* conservation value and variation in diatom communities was not great and generally indicated good ecological status.

September.

During September, macroinvertebrate communities remained typical of the river typology; however temporal changes in community structure were apparent. Site 2 was possibly indicative of high ecological status (based on BMWP metrics) and had high conservation value, while site 3 demonstrated reduced macroinvertebrate diversity (low NTAXA) and conservation value. Nonetheless, the taxa present at Site 3 were indicative of good water quality. Results from Site 4 were similar to results from the July survey.

A potential impact at Site 3 was also evident from the poor diatom results. The presence of high scoring macroinvertebrate taxa combined with low diversity and poor diatom communities may have reflected an impact from elevated flows which took place in the week preceding survey work. This pattern of high scores but low diversity may also highlight potential hydromorphological degradation at Site 3.

Migratory fish were present at all sites indicating good longitudinal connectivity on the Yealm. The fish community was typical of the river typology and consisted predominantly of salmonids with lesser abundances of other species. Site 2 was the most diverse and had the highest fish densities. This is possibly due to the nutrient discharge present at this site in what is predominantly an oligotrophic river. Site 3 had the lowest catch abundances and the presence of a lamprey ammocoete, which prefer silty/fine deposits, may highlight persistent differences in substrate composition at this site when compared with general substrate composition on the Yealm.

Macrophyte cover at Site 3 was low (< 0.1%) which may correspond to the extensive canopy cover and oligotrophic nature of the Yealm catchment. Percentage cover at Site 2 was higher, potentially reflecting the impact from enrichment due to a STW outflow. Site 4, which is slightly more open than Site 3, had approximately 15% cover.

Surveys of the physical habitat/hydromorphology indicated high to good quality at the instream, riparian and land use (50m) scales. Flow diversity was high, with sections of glides, runs, riffle and pool present. Problematic and invasive riparian plant species, such as Himalayan Balsam which reduce terrestrial invertebrate abundances (an important food source for fish, especially in shaded channels) and act as sediment input pathways by leaving bare earth during the winter die-back period, were recorded.

1.2 Site Visit.

Following the 2011 spring survey there was some discussion regarding the appropriateness of the spatial distribution of the survey sites. This was mainly due to two factors. Firstly, to account for an alternative access road scheme which would cross the river north of the current proposed crossing point. Secondly, it was felt that features at site 6 were not consistent with the characteristics found at the other sites, primarily due to heavy poaching and a lack of canopy coverage (a major feature of the other sites).

In order to optimise site selection, a site visit was conducted by Adrian Pinder (APEM) and Robert Hurrell (EA) on the 9th of August 2011. The outcome of the site visit and subsequent discussions between APEM, EA and SLR is presented in table 1.

Table 1. Revised monitoring programme following site visit.

Site	Monitoring Schedule
Site 1	Full suite of monitoring (invert, diatoms, macrophytes, fish, habitat)
Site 2	Invertebrate and diatom sampling only
Site 2a	Full suite of monitoring (invert, diatoms, macrophytes, fish, habitat)
Site 3	Full suite of monitoring (invert, diatoms, macrophytes, fish, habitat)
Site 4	Full suite of monitoring (invert, diatoms, macrophytes, fish, habitat)
Site 5	Full suite of monitoring (invert, diatoms, macrophytes, fish, habitat)
Site 6	Unsuitable. No further monitoring.
Site 6a	Full suite of monitoring (invert, diatoms, macrophytes, fish, habitat)
Site 7	Invertebrate and diatom sampling only

Although a decision was made to replace Site 2 with 2a, the former site was retained to control for any potential impact from the STW outflow. However, samples from this site will be archived and not analysed unless there is a measurable decline in the ecological quality of the survey reach.

Survey work at Site 6 ceased and a new site (6a) was selected which was considered to be more consistent with the characteristics of other sites.

In order to elucidate any impacts delivered to the Yealm via the Lee Mill Stream, a new site (Site 7) was established on the stream just above its confluence with the main channel of the Yealm. As with Site 2, only macroinvertebrate and diatom samples were collected at this site and archived for future analysis, should this be required at any stage during the course of the study.

A map depicting the study area and the relative location of all sampling sites is provided in Figure 1.

1.3 Project objectives

Project objectives remain those identified previously (APEM 2010). These are:

- To provide an ecological baseline to establish the current ecological status of the river and inform the design of future monitoring programmes; and
- To propose future monitoring recommendations to detect potential impacts of the proposed development scheme.

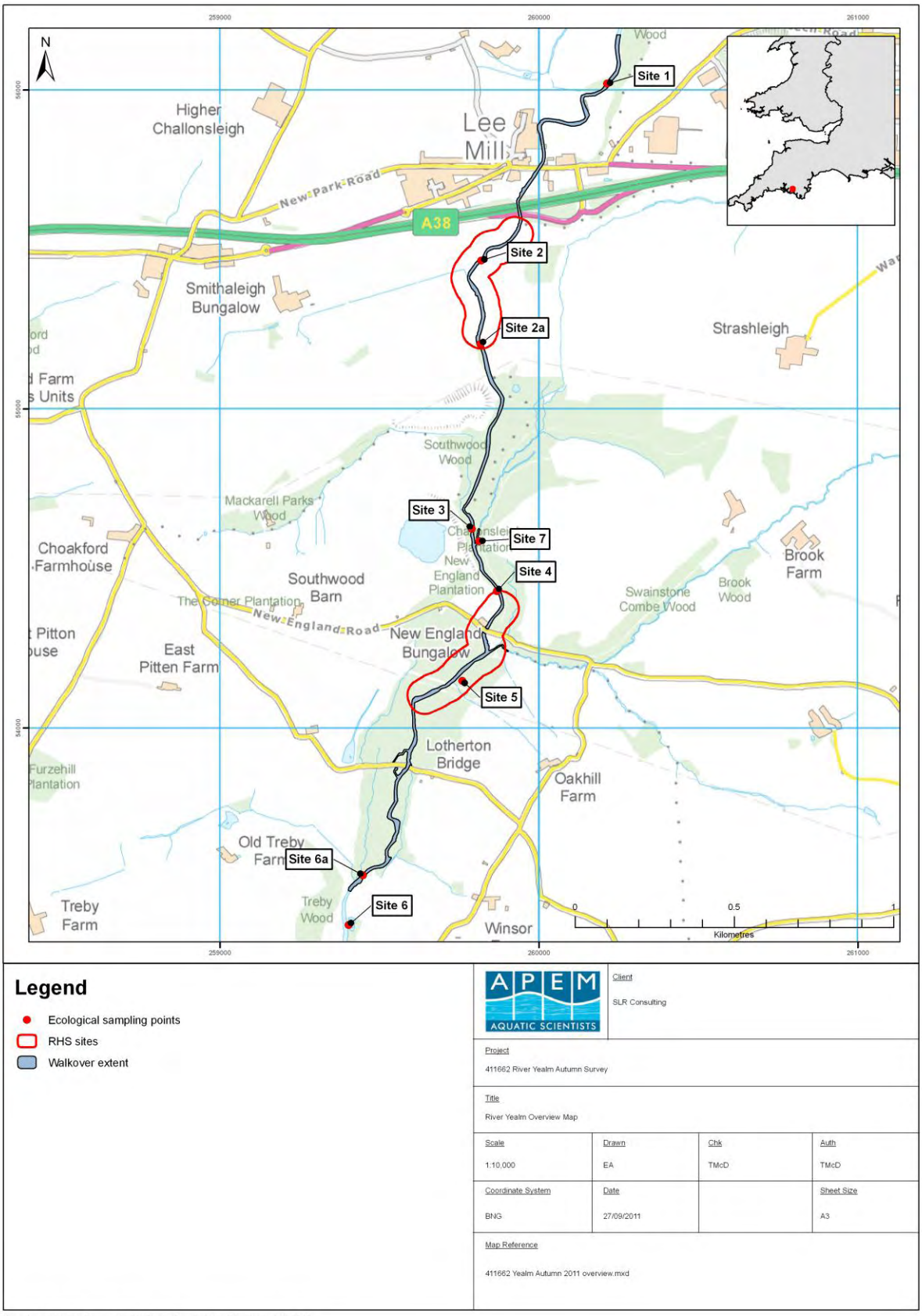

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Figure 1. Map of the survey reach and relative location of survey sites.

2 SURVEY METHODS

2.1 Fisheries

Survey sites were isolated using stop nets (9 mm bar mesh size). Each site was fished using a single anode, energised with pulsed direct current from a 2.5 KVA generator through a WFC7 control box. All electric fishing equipment was compliant with EA Annex A and B: Issue II regulations.

To enable subsequent quantitative population estimates based upon the removal method, three consecutive catches were taken within stop nets set approximately 50m apart. This level of fishing effort is usually sufficient to produce an accurate depletion analysis (Carle & Strub 1978). A period of twenty minutes was left between each run to allow for water turbidity levels to return to normal.

Fishery surveys took place from the 19th to the 23rd the September 2011

2.2 Macroinvertebrates.

Macroinvertebrates were collected using the standard EA three-minute kick sampling procedure using a standard pond net (set out in '*Procedures For Collecting and Analysing Macroinvertebrate Samples"*. BT001 3.0, Third Issue; 1999). This was accompanied by a 1-minute manual search, split into 30 second components before and after the kick-sample. This method is standardised to sample all of the habitats at a site in proportion to their occurrence and to maximise the comparability of data across sites.

Macroinvertebrates were collected on 25/26th May, 2011 (Spring Survey), 19th August 2011 (Summer Survey), and during the week of the 19-23rd September 2011(Autumn Survey).

Samples were returned to APEM's Dorset laboratory where they are sorted and identified to species level (for all groups where possible, except Oligochaetea, Sphaeriidae, Hydracarina Chironomidae and Simuliidae, which were not identified further. Other Diptera were identified to genus or species, where possible) following quality-assured procedures, consistent with standardised EA protocols. A suite of standard biotic indices were calculated to measure the biological quality of the sites and the effect of environmental stressors, such as water pollution, hydrologic alteration and habitat modification: Biological Monitoring Working Party (BMWP) (Wright *et al*., 1984) scores, Number of Taxa (NTAXA), Average Score Per Taxon (ASPT), Lotic invertebrate Index For Flow Evaluation (LIFE) (Extence *et al.*, 1991) and Community Conservation Index (CCI) (Chadd & Extence, 2004) metrics. ASPT and NTAXA can be used for the ecological classification of sites based on the River InVertebrate Prediction and Classification Systems (RIVPACS).

Metric results are presented in relevant sections in the main text. Complete lists of the species (or families depending on the taxa) found at each sites are presented in the Appendices.

2.3 Diatoms

Diatom sampling followed standard procedures (Kelly *et al.* 2001) by collecting diatoms from the upper surface of 5 cobbles that were randomly extracted from riffle habitats at each sampling location. Every effort was made to ensure stones were collected from unshaded patches; however the arboreal nature of the Yealm's riparian corridor meant that the identification of unshaded patches was impractical and stones were collected randomly from the site. In the laboratory slides were prepared for enumeration using the hot hydrogen peroxide method. Coverslips were mounted in Naphrax (refractive index 1.98) and at least 300 valves were enumerated per slide. Identification was conducted to species level using the flora of Krammer & Lange-Bertalot (1999 – 2004). Species were then converted into the checklist of Trophic Diatom Index (TDI taxa as presented in the user's manual (Kelly *et al*., 2001) for calculation of the index.

This approach provided information on less common members of the assemblage and thereby increases the sensitivity of the TDI. In such cases enumeration continued until 300 valves other than the dominant taxa were encountered. TDI results are presented in the main text while taxonomic data and abundances are provided in the Appendices.

2.4 Macrophytes

Macrophyte surveys were carried out at the six sites during the week of the 19-23rd September. A standard 100m survey was carried out with percentage cover of each species recorded. Percentage cover was transformed into Total Cover Value (TCV) for presentation of results. This ranges from 0 -10 with 10 = 100% site coverage. This survey approach was in accordance with the river macrophyte prediction and classification system (LEAFPACS) used for WFD macrophyte classifications.

2.5 Habitat assessment

2.5.1 HABSCORE

HABSCORE was developed by the EA as a tool to measure and evaluate stream salmonid habitat features. Based on the input of physical habitat and geographical data, the outputs generated by the models include an estimate of the expected fish populations density (the Habitat Quality Score, HQS) and where survey data are available, a measure of the degree of habitat utilisation (the Habitat Utilisation Index, HUI). Both of these scores are produced for each of five salmonid species/age combinations (0+ salmon; >0+ salmon; 0+ trout; >0+ trout <20cm; and >0+ trout >20cm) (*note 0+ represents fish less than one year old*). HABSCORE surveys were conducted at each of the six electric fishing sites during the week of the 19-23rd September, 2011. The software required to derive HQS and HUI scores is subject to EA license, and consistent with the 2010 report, completed field forms have been provided in Appendix IV for future analysis.

2.5.2 Fisheries walkover survey.

The methodology for the walkover survey follows that outlined in the EA's Fisheries Technical Manual 4 "Restoration of Riverine Salmon Habitats" (Hendry & Cragg-Hine 1997). The field mapping technique is based upon hand drawing onto a high-resolution map (OS 1 km tiles) at a scale of 1:10,000. The river outline and salient geographic location points are selected from a digital map and printed onto water resistant paper (roughly 300-500m of river length per A3 sheet). These maps offer a high level of detail, enabling very accurate mapping of in-river habitat characteristics.

The habitat features noted along the stretch of the river are drawn directly onto the map, with the boundaries of the different habitat classifications being drawn to represent their actual position within the river using a series of labelled symbols or lettered 'lollipops' (Figure 2.1).

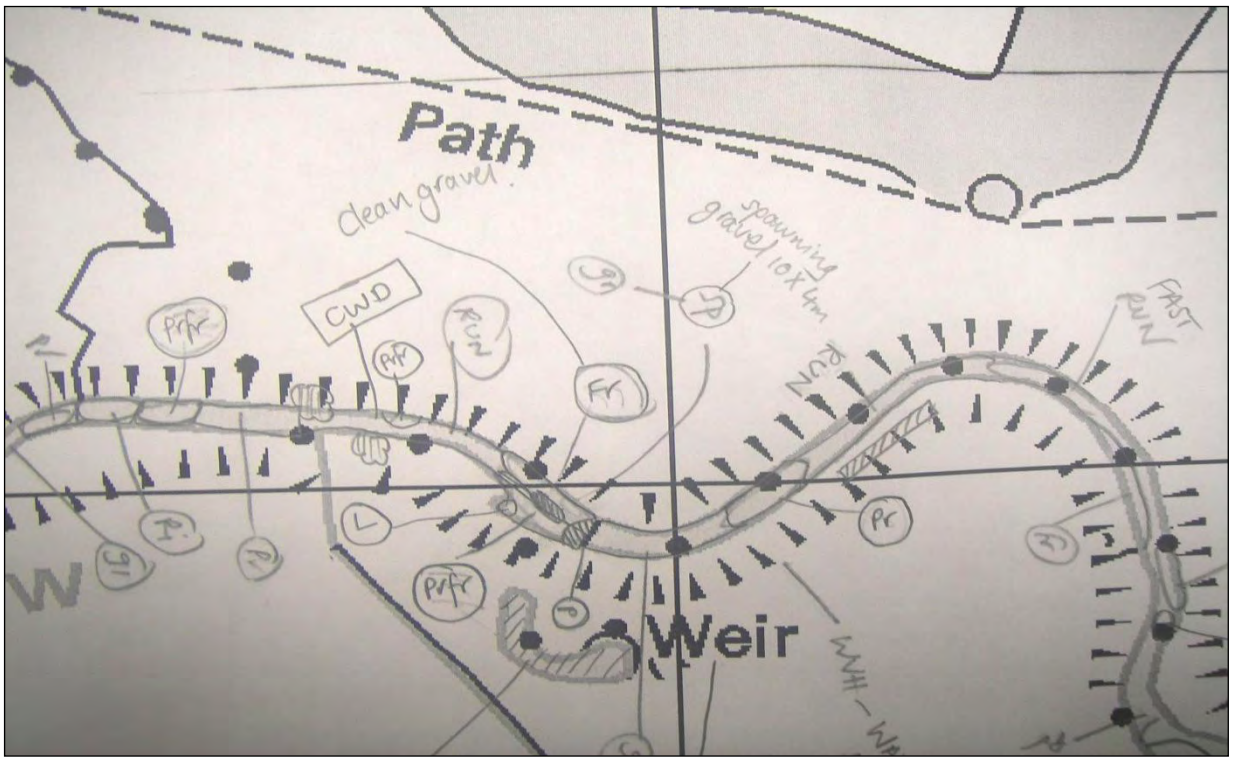

Figure 2.1 Example of salmonid habitat notation from the field.

The symbol is linked by a single pencil stroke to a line parallel with the riverbank delineating the linear extent of that particular habitat feature. Other prominent features (e.g. coarse woody debris, structures etc.) are noted together with trees, electricity pylons and bridges which may aid accurate location, the latter being confirmed via hand held GPS. This allows exact representation of the areas of individual habitat types encountered. In this manner, a mosaic of the different habitat types can be drawn along the whole section of the river. The core methodology was also adapted for the purposes of this study to include optimal habitat for lamprey. Sediment inputs were also noted and graded on a scale of 1 to 3, with 1 being the most severe sediment input.

On return to the laboratory these data were transcribed into ARCview GIS for visual representation as well as facilitating detailed spatial analysis and quantification of habitat

types. These digital data were manipulated to calculate the total area of different habitat types along the entire survey reach.

Habitat types recorded during the walkover survey were as follows:

- Spawning gravel
- Salmonid Fry (0+) habitat
- Salmonid Mixed Juvenile (0+ & >1+) habitat
- Salmonid Parr (>1+) habitat
- Riffles
- Glides
- Pools
- Lamprey
- Bedrock
- Cascade
- Run
- Torrent

The principal instream physical habitat variables that determine suitability for juvenile salmonids are: water depth, water velocity, streambed substratum and cover (Heggenes 1990). The preferred spawning site is the transitional area between pool and riffle where the flow is accelerating and the depth decreasing. Gravels of suitable coarseness are also required with interstices, the voids between gravel particles, cleaned by current or upwelling (Petersen 1978, Bjorn and Reiser 1991 in Hendry and Cragg-Hine 1997).

Salmon fry and parr occupy shallow, fast-flowing water, with a moderately coarse substrate with cover (Symons and Heland 1978, Bagliniere and Champigneulle 1986). Deep or slow moving water, particularly when associated with a sand or silt substrate does not support resident juvenile salmonids (Wankowski and Thorpe 1979, Bagliniere and Champigneulle 1986). Suitable cover for juveniles includes areas of deep water, surface turbulence, loose substrate, large rocks and other submerged obstructions, undercut banks, overhanging vegetation, woody debris lodged in the channel and aquatic vegetation (Heggenes 1990, Bjorn and Reiser 1991, Haury *et al*., 1995).

The relative position of habitat types is also of importance. For instance, the proximity of juvenile habitat to spawning gravels may be significant to their utilisation. In addition, adults will require holding pools immediately downstream of spawning gravels in which they can congregate prior to spawning.

Table provides a definition of each of the key functional salmonid habitat categories used in the survey. In addition, other water flow classification types recorded included cascade and run (see further breakdown for ‘glide’ and ‘run’ in Table 2.2). Although this methodology is primarily intended for identifying and mapping salmonid habitat types, it can also be useful in describing habitats used by other in stream biota such as macrophytes and macroinvertebrates.

Table 2.1 Habitat classification system

Habitat type	Description
Spawning gravel	Ideally stable but not compacted, with a mean grain size 25 mm or less for trout, but up to 80 mm for salmon. 'Fines' (< 2 mm grain size) to be less than 20% by weight. Water 17-76cm deep and 25-90 cm/s.
Fry (0+) habitat	Shallow, < 20 cm deep, fast flowing (> 30 cm/s), with surface turbulence and a gravel and cobble substrate.
Parr (>1+) habitat	20 - 30 cm deep, fast flowing (>30 cm/s), surface turbulent, with gravel / cobble / boulder substrate.
Riffles	Shallow (< 30 Cm Deep), fast flowing (> 50 Cm/S), surface turbulent, gravel / cobble / boulder substrate.
Glides	= or > 30 Cm deep, moderate velocity in range 10-30 cm/sec, surface smooth and unbroken, relatively even substrate of cobbles with finer material (see Table)
Pools	= or > 40 cm deep, slow flowing (< 10 cm/s), surface unbroken, substrate with a high proportion of sand and silt.

A further breakdown of flow categories 'glide' and 'run' provide additional information on depth and flow speed (Table 2.2). In the GIS these depth and speed codes are attributes of the feature and can be viewed within ArcReader using the identify tool (see Appendices).

Table 2.2 Breakdown of flow categories

Habitat type	Codes	Definition
Glide	A	Depth - shallow
	B	Depth - medium
	C	Depth - deep
	1	Flow speed - slow
	2	Flow speed - moderate
	3	Flow speed - fast
Run	A	Depth - shallow
	B	Depth - medium
	C	Depth - deep
	1	Flow speed - slow
	2	Flow speed - moderate
	3	Flow speed - fast

2.5.3 River Habitat Survey

The River Habitat Survey (RHS, Raven *et al.,* 1998) is a standardised protocol for surveying river habitats in the UK. This method involves an EA accredited RHS assessor selecting and walking along a 500m reach of river and noting various habitats, modifications and broad scale landscape features at 50m intervals. This is combined with a finishing "sweep-up" to integrate any other important features or information relevant to the survey.

Data are recorded on the RHS field sheets, which are broken down into a number of categories including, physical, hydrological and land-use groupings. RHS is not targeted to any specific biota or grouping and provides a holistic score relating to the beneficial habitat and hydromorphological alteration at the 500m scale. Two RHS surveys were carried out between the 19th and the 23rd of September 2011. Completed field sheets have been provided in the Appendices.

3 SITE DESCRIPTIONS

The following site descriptions are based on the autumn 2011 macroinvertebrate survey. For site conditions during the spring and summer surveys see the relevant data reports supplied by APEM to SLR.

3.1 Site 1.

Site 1 (Fig 3.1, SX 60214 56020) was surveyed during all seasons. Average depth was 11cm and average width was 10 metres. The main flow types were run and riffle, with sand and pebbles/gravels dominating the substrate. Conductivity was 60.3µS/cm, pH was 8.19 and water temperature was 13.7 °C.

Figure 3.1. Site 1 looking downstream.

3.2 Site 2.

Site 2 (SX59819 55466) will only become active in the event of major reduction in ecological quality on the Yealm during construction and operational phases of the proposed facility. This site has been retained to control for the potential delivery of any pollutants via the STW outflow pipe.

Average depth was 10cm and average width was 8 metres. The main flow type was run and substrate was quite variable including sections of sand, pebble/gravel, cobble and bedrock. Conductivity was 84.4 µS/cm pH was 8.01 and water temperature was 13.3 °C.

3.3 Site 2a.

Site 2a (Fig 3.2 SX 59817 55204) was surveyed during summer and autumn as part of the revised monitoring plan. Average depth was 38cm and average width was 10 metres. The main flow types were run and pool and a sidebar was present, pebbles/gravels and cobble dominated the substrate. Conductivity was 72.6 µS/cm , pH was 8.12 and water temperature was 13.2 °C.

Figure 3.2. Site 2a.

3.4 Site 3.

Site 3 (Fig 3.3, SX 59794 54589) was surveyed during all seasons. Average depth was 38cm and average width was eight metres. The main flow types were riffle and run and pebbles/gravels and cobble dominated the substrate. Conductivity was 63.3µS/cm, pH was 7.86 and water temperature was 13.2°C.

Figure 3.3. Site 3.

3.5 Site 4

Site 4 (Fig 3.4, SX 5986854429) was surveyed during all seasons. Average depth was 20cm and average width was 5.5 metres. The main flow types were riffle and run and substrate was included boulders, cobbles, pebbles, gravels and sand. Conductivity was 74.5µS/cm, pH was 7.97 and water temperature was 13.8 °C.

Figure 3.4. Site 4.

3.6 Site 5.

Site 5 (Fig 3.5, SX 59760 54148) was surveyed during all seasons. Average depth was 38cm and average width was nine metres. The main flow types were run, riffle and pool, while substrate composition was variable. Conductivity was 69.5µS/cm, pH was 8.06 and water temperature was 13.4 °C.

3.7 Site 6.

Sampling at site 6 was discontinued following re-assessment of the survey locations.

3.8 Site 6a.

Site 6a (Fig 3.6 SX 59432 53553) was surveyed during summer and autumn following the re-assessment of the sample locations. The values below represent the site characteristics from the Autumn survey. Average depth was 20cm deep and average width was 4.5 metres. The flow type was dominated by run and substrate was variable but included a mix of gravel/pebbles, cobbles and sand. Conductivity was 89.9µS/cm, pH was 8.15 and water temperature was 13.4 °C.

Figure 3.6. Site 6a

3.9 Site 7.

Invertebrate and diatom samples were collected from Site 7 (SX 59813 54586) during summer and autumn. This site was selected as a useful control to qualify any impacts delivered to the main river from the Lee Mill stream. Samples have been archived and as with site 2 will only be analysed following a measurable temporal or spatial change in the ecological quality of the survey reach.

Average depth was 7cm and average width was 1 metres. The main flow types were riffle and pool, with sand and pebbles/gravels dominating the substrate. Conductivity was 343.1 µS/cm pH was 8.19 and water temperature was 13.7 °C.

Table 3.1. Physical and chemical site parameters recorded during autumn 2011
(Rif = riffle, Po = pool, Sb = sidebar, Sa = sand, Pe = pebble, Gr = gravel, Co = cobble, Bo = boulder, Be = Bedrock)

Site.	Mean depth (cm)	Mean width (m)	Main Habitat	Main Substrate	Cond. (µS/cm)	pH	Temp. (°C)
1	11	10	Run/Rif	Sa/Pe-Gr/Co	60.3	8.19	13.7
2	20	8	Run	Sa/Pe-Gr/Co/Be	84.4	8.01	13.3
2a	38	10	Run/Po/Sb	Pe-Gr/Co	72.6	8.12	13.2
3	38	8	Rif/Run	Pe-Gr/Co	63.3	7.86	13.2
4	20	5.5	Rif/Run	Bo/Co/Sa/Pe-Gr	74.5	7.97	13.8
5	38	9	Rif/Run/Po	Gr-Pe/Co/Sa	69.5	8.06	13.4
6a	20	4.5	Run	Gr-Pe/Co/Sa	89.9	8.15	13.4
7	7	1	Rif/Po	Gr-Pe/Sa	343.1	8.12	13.9

4 RESULTS

4.1 SPRING 2011

Spring surveys were conducted on the 25th and 26th of May 2011 and focused on the collection of macroinvertebrate and diatom samples only.

4.1.1 Macroinvertebrates

Table 4.1 presents the results from macroinvertebrate surveys on the Yealm during spring 2011. A full species list is presented in the Appendix I.

As observed in previous surveys, macroinvertebrate communities were relatively diverse and typical of clean, fast flowing, stony rivers. For example, the high water quality indicating and fast flowing inhabiting *Siphonoperla torrentium* and *Rithrogena semicolorata* were present at all sites and recorded at quite high abundances in certain locations (however, reduced abundances of these species may indicate an impact from the STW discharge at Site 2). Further indication of high water quality was provided by the ubiquitous presence of stoneflies from the genus Luectridae, *L. Fusca* and *L. geniculate*, while the mayfly *Seratella ignitus* was also recorded at high abundances at all sites.

BMWP scores and ASPT were above the thresholds that indicate any effects of water pollution (100 and 5.00, respectively; Hellawell, 1986). Considering the high ASPT and NTAXA values, it is possible that all sites represent High Ecological Status. LIFE scores indicate that water velocity at all sites was typical of stony streams with adequate velocities to support a diverse community, comprising species which are sensitive to the effects of low flows (Extence *et al*. 1999). Site 4 had the lowest BMWP scores of the six sites, while the lowest LIFE scores were found at Site 2. Diversity at Site 3 was observed to have recovered following low NTAXA values recorded during the previous (autumn 2010) survey.

Table 4.1. Summary of benthic macroinvertebrate scores and metrics during spring 2011 (May)

Site.	Biotic Score	ASPT	NTAXA	LIFE	CCI
1	192	6.62	29	8.47	15.87
2	184	6.57	28	8.25	13.79
3	165	6.6	25	8.32	14.72
4	124	6.2	20	8.91	8.5
5	165	6.6	25	8.57	14
6	169	6.5	26	8.66	13.53

4.1.2 Diatoms

Trophic Diatom index (TDI) values ranged between 32.91 (Site 4) and 51.81 (Site 6). Percentage of motile valves demonstrated much greater variability ranging between 10.53% (Site 5) and 91.12% (Site 6), with the higher values potentially indicating higher levels of siltation which the more motile species typically favour. This may be due to the high cattle poaching pressure at site 6. Indeed, this was one of the reasons for the revised location of sampling to Site 6a.. Scores for all sites are presented in Table 4.2 and full taxonomic lists are provided in Appendix II.

Table 4.2. Summary of diatom metric (incl. TDI) during spring 2011 (May)

Site.	TDI	% Motile Valves	Taxa > 50%
1	46.47	51.68	-
2	47.74	49.5	-
3	43.02	34.52	-
4	32.91	21.21	-
5	33.5	10.53	-
6	51.81	91.12	-

4.2 SUMMER 2011

4.2.1 Macroinvertebrates

The macroinvertebrate scores from the River Yealm summer surveys are summarised below in Table 4.3. Full taxonomic lists are provided in Appendix I.

Table 4.3. Summary of benthic macroinvertebrate scores and metrics during summer 2011 (August)

Site	Biotic Score	ASPT	NTAXA	LIFE	CCI
Site 1.	126	5.73	22	8.5	9.5
Site 2a.	136	6.18	22	8.21	8.52
Site 3.	111	5.84	19	8	10
Site 4.	114	5.7	20	8.33	8.13
Site 5.	109	5.74	19	8.06	8.3
Site 6a.	121	5.74	21	8.5	10.22

While the communities recorded during the summer surveys were still broadly indicative of clean and fast flowing rivers; when compared with spring there was a general decline in scores for all metrics. There were reductions in the diversity and abundance of high scoring BMWP taxa, and a 30% reduction in the number of high velocity indicating taxa. Many of the species noted in the spring survey were either much reduced in abundance (e.g., *R. semicolorata, L. geniculata and S. ignitus*) or were absent (*S. torrentium*).

Only Site 2a had an ASPT above 6. With 22 scoring taxa, there was a good proportion of species which are intolerant to poor water quality. In the remaining sites the likelihood of *High* ecological status is considered low. LIFE scores were also lower for the August surveys, perhaps indicating the pressure from the relatively lower summer flows.

With the exception of Site 4, there had also been a major decline in CCI scores from all repeat sites. Furthermore, low CCI scores from the new sites indicated that the declines were system wide. Only one species of a high conservation value was found during summer (*Protonemoura meyeri*) while three species were found during spring.

4.2.2 Diatoms.

Results from the diatom surveys are presented below in Table 4.4.

Table 4.4. Summary of diatom metric (incl. TDI) during Summer 2011 (August)

Site	Sample date	TDI	% Motile Valves
Site 1	15/08/2011	29.34	3.54
Site 2a	15/08/2011	28.74	6.96
Site 3	15/08/2011	32.32	13.50
Site 4	15/08/2011	Insufficient valves.	
Site 5	15/08/2011	30.41	7.91
Site 6a	15/08/2011	37.88	25.38

Results from the analysis of the diatom samples from the River Yealm in August 2011 show TDI values between 28.74 at Site 2a and 37.88 at Site 6a. Such scores would be considered typical at sites where there are low to relatively low nutrients. The percentage of motile valves present was low and similar at all sites, except Site 6a, where the highest percentage of 25.4% was recorded. While higher than the other sites, this is still not a very high value and may reflect changes in the proportion of substrate present at Site 6a.

4.3 AUTUMN 2011

All survey work was carried out between the 19th and the 23rd of September. Although conditions were generally favourable, a pulse of rain on the Tuesday night (20th) resulted in a period of elevated flows. However, effects on flow were minimal and not considered likely to influence monitoring results

With respect to brown and sea trout being the same species (*Salmo trutta*), their distinct life histories allow us to consider them as separate groupings for assessment, monitoring and conservation purposes.

4.3.1 Fish communities.

A total of 388 individual fish represented by six species were captured throughout the study area. Average site density in fish per m^2 were: 1.78 for lamprey, 1.48 for bullhead, 7.36 for brown trout, 7.42 for Atlantic salmon, 0.53 for eel, and 2.93 for minnow. A summary of the catch by site, including total abundance and densities (no./100m^2) is presented in Table 4.5, with a more detailed breakdown of relative species composition and population age structure presented in Sections 4.3.2 and 4.3.3 respectively.

Site 1.
Four species were recorded at Site 1 including a single lamprey from the genus *Lampetra*. Bullhead, brown trout and Atlantic salmon were also present, with Atlantic salmon numerically dominating the community. Along with Site 6a, Site 1 was the least diverse in terms of fish species. Density of brown trout was below the study average, while Atlantic salmon densities were higher than average. (see Table 4.5).

Site 2a

Five species were recorded at Site 2a; lamprey, bullhead, brown trout, Atlantic salmon and European eel. This site had the highest density of sea trout (although they should be considered transients). Site 5a had the lowest density of Atlantic salmon while densities of brown trout and eel were higher than the study average. Bullhead densities were low at this site and considerably lower than the study average. (See Table 4.5.)

Site 3

Site 3 had the same species presence as site 2a. However, this site had the lowest densities of lamprey, bullhead and eel from sites where these species were recorded. The density of brown trout was below the study average, while Atlantic salmon density was just above the study average. (See table 4.5).

Site 4

Site 4 consisted of five species; bullhead, brown trout, Atlantic salmon, eel and minnow. This was one of only two sites that included minnow and an absence of lamprey. Brown trout density was relatively high, although Atlantic salmon density was below the study average. (See table 4.5).

Site 5

Site 5 was the most diverse site with lamprey, bullhead, brown trout, Atlantic salmon, eel and minnow recorded. It was also the most productive site with densities of brown trout, Atlantic salmon, eel and minnow representing the highest of the autumn fish survey. Densities of bullhead were also above the study average.

Site 6

The fish community at Site 6 was composed of four species, bullhead, brown trout, Atlantic salmon and eel. Although the density of Atlantic salmon was just below the study average, the density of brown trout was the lowest recorded spatially and the density of the remaining species were also below the average for all sites (see Table 4.5).

Table 4.5. Catch totals and minimum density estimates of each species at Sites 1-6a

Common name	Site 1		Site 2a		Site 3		Site 4		Site 5		Site 6a	
	n.	Density 100m^2	n.	Density 100m^2	n.	Density 100m^2	n.	Density 100m^2	n.	Density 100m^2	n.	Density 100m^2
Brook/River Lamprey	1	1.78	4	1.00	2	0.67	0	0.00	3	0.71	0	0.00
Bullhead	7	5.33	3	0.60	1	0.33	3	0.33	7	1.88	2	0.46
Brown trout	24	5.33	47	9.60	18	6.33	24	8.67	43	10.59	14	3.68
Sea trout	0	0.00	2	0.40	0	0.00	1	0.33	1	0.24	0	0.00
Atlantic salmon	37	9.56	21	4.40	20	7.67	17	5.67	31	10.12	23	7.13
European eel	0	0.00	3	0.60	1	0.33	1	0.33	4	0.94	2	0.46
Minnow	0	0.00	0	0.00	0	0.00	2	0.67	19	5.18	0	0.00

4.3.2 Relative species composition by site.

Figure 4.1 demonstrates the relative species composition and abundance by site. Brown trout were dominant at Sites, 2a, 4, and 5 while Atlantic salmon were the dominant species at Sites 1 and 6a. Both species occurred in approximate equal numbers at Site 3. Although the relative abundance of salmon was low at Site 5, due to the exceptionally high numbers of fish recorded, salmon density was highest here (see table 4.3)

Only two other species were present at greater than 10% of the total abundance at a site, bullhead at Site 1 and minnow at Site 5.

The dominance of salmonids in the River Yealm is further illustrated by Figure 4.2.

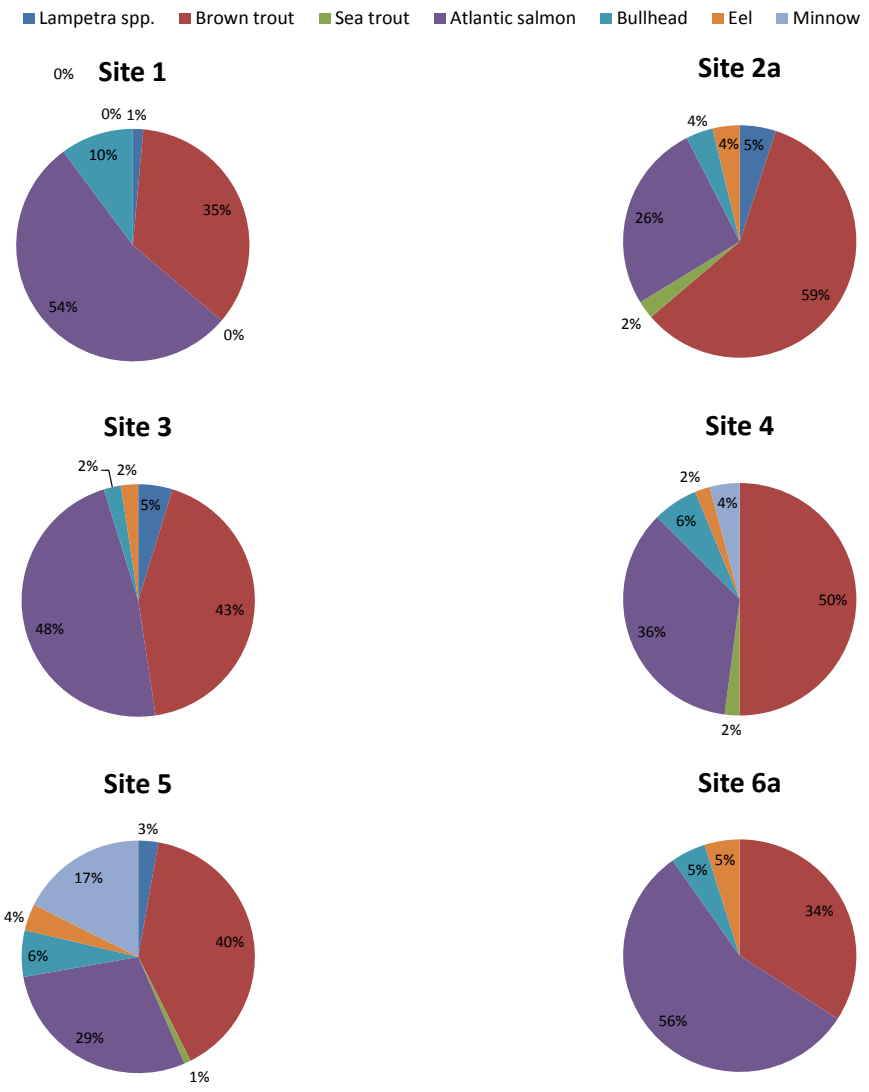

Figure 4.1. Relative species composition by site.

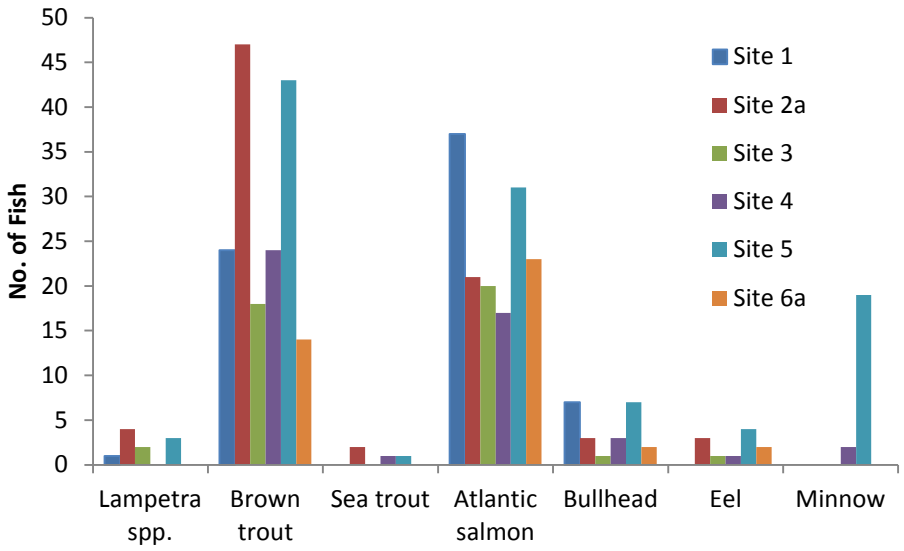

Figure 4.2. Abundance of fish species recorded during autumn 2011 survey.

4.3.3 Fish size and population demographics.

Brown Trout

Figure 4.3 illustrates the age structure of the brown trout populations at the six sites. Distinct age cohorts, including the 2011 year class (0+), were present at all survey sites. Site 1 was dominated by the 0+ cohort, indicating that a major proportion of the available habitat was nursery habitat. However, the 2011 year class was not particularly strong when compared with other sites. 0+ trout also dominated population structure at Site 5, although total fish abundance here was much higher. Site 2 demonstrated the strongest cohorts of fish older than 0+ while also retaining a strong 0+ group.

Atlantic salmon

Figure 4.4 illustrates the age structure of the juvenile Atlantic salmon populations at the six sites. Unlike the 2010 survey, multiple age classes were recorded at all sites. There was a strong 0+ cohort at Site 1, and to a lesser extent site 5. Site 1 did not appear to be particularly suitable for fish older than 0+, indicating either poor survival of previous year's cohorts or migration to more suitable habitat. This pattern is also evident at site 5. Larger fish were more prevalent at sites 3, 4, and 6a.

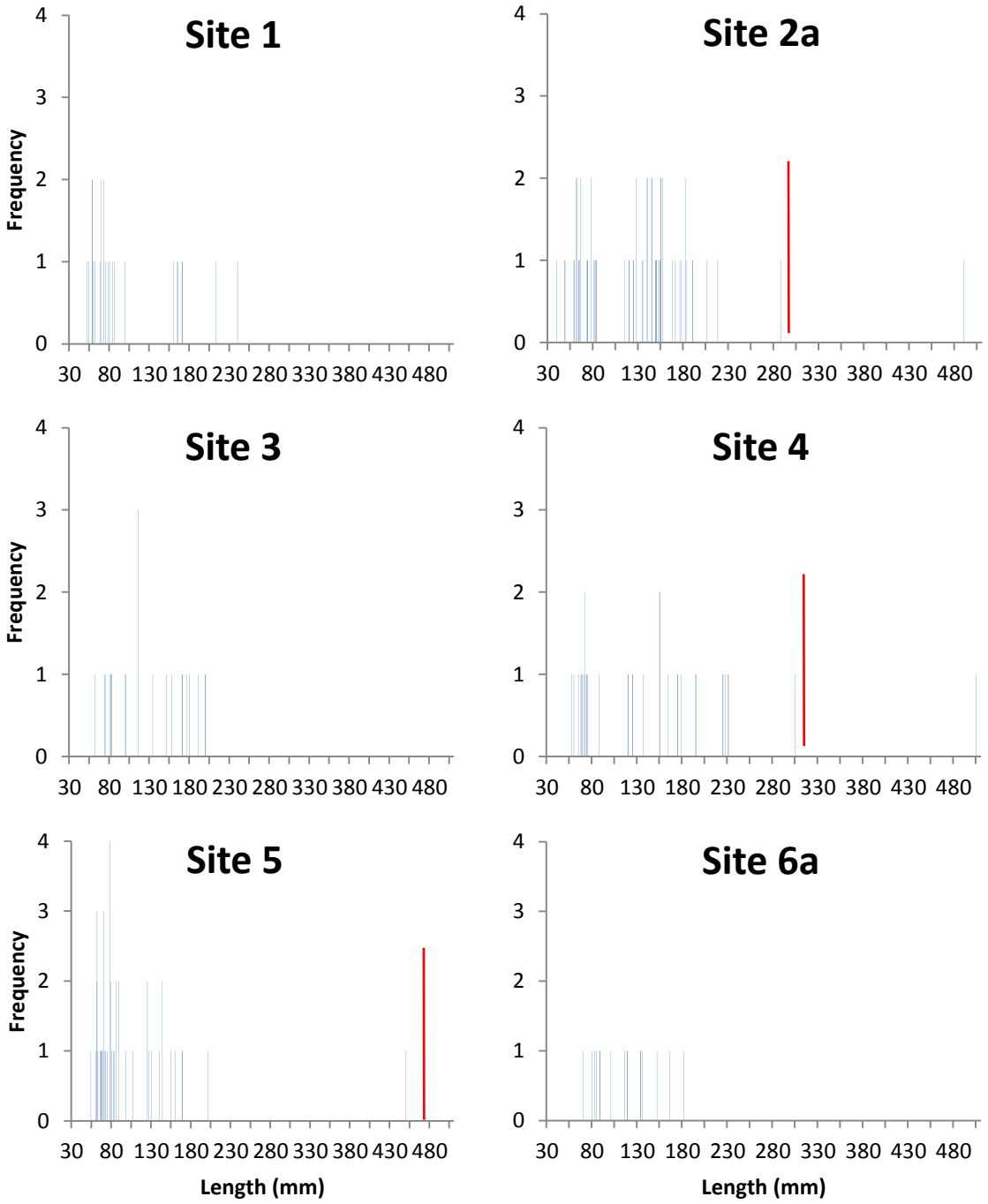

Figure 4.3 Brown trout length frequency plots. The red line indicates minimum sea tout length at each site.

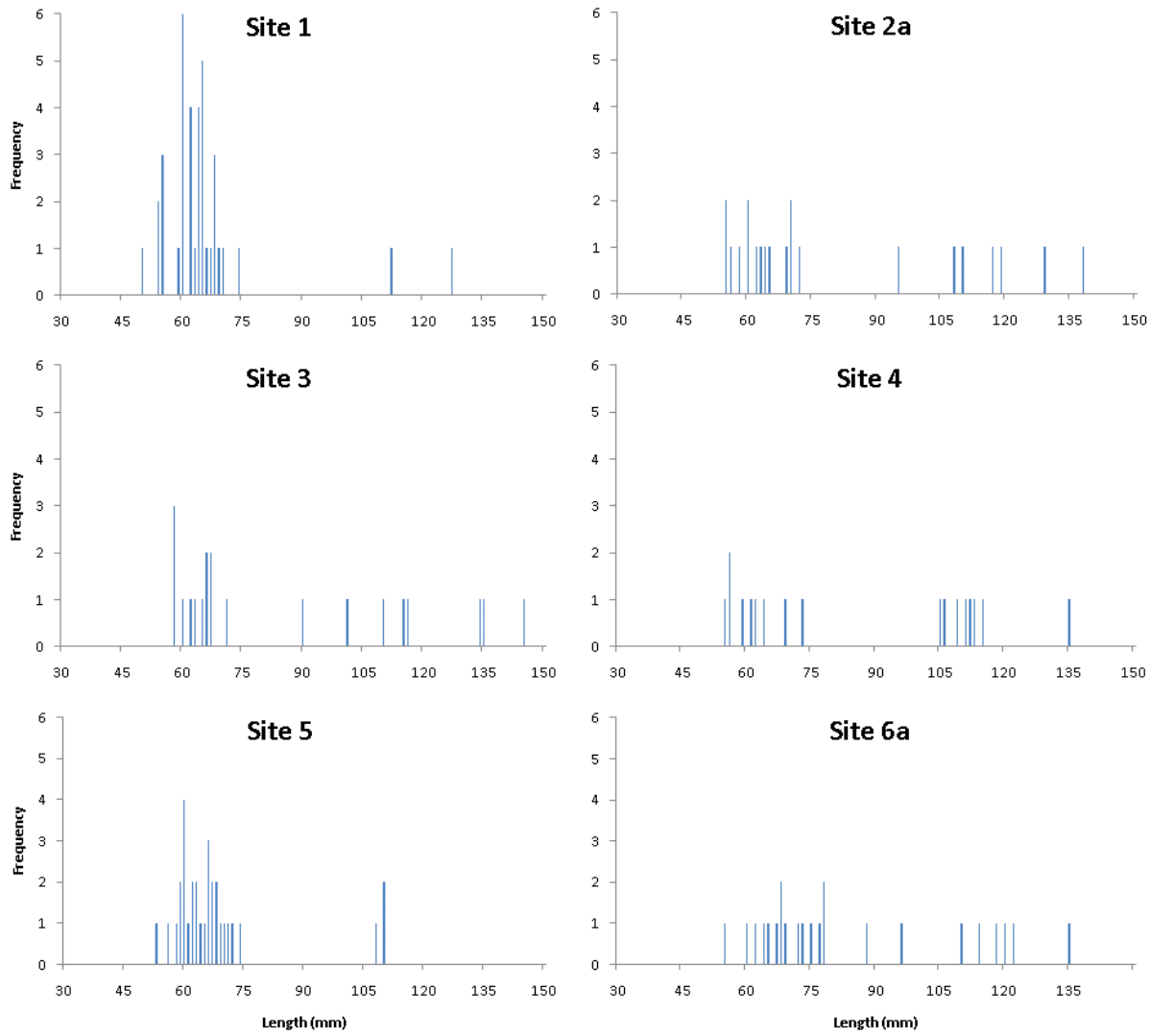

Fig. 4.4 Juvenile Atlantic salmon length frequency plots from the Yealm.

4.3.4 Benthic Macroinvertebrates

Physical site characteristics for the benthic macroinvertebrates surveys are presented in Table 3.1 (September summary table). Metric results for the benthic macroinvertebrates are presented below in Table 4.6.

Table 4.6. Metric results from autumn macroinvertebrate surveys.

Site	Biotic Score	ASPT	NTAXA	LIFE (family)	CCI
Site 1	134	6.09	22	7.810	7.500
Site 3	164	6.07	27	7.222	12.654
Site 2a	144	6.26	23	7.318	9.444
Site 4	107	5.94	18	8.000	7.857
Site 5	141	6.71	21	7.850	10.750
Site 6a	132	6.00	22	7.714	8.810

ASPT and biotic scores were relatively high at all sites and represent scores that would be typically found on upland rivers characterised by energetic flows, coarse mobile substrate and medium to good quality riparian zones. As with the previous surveys conducted by APEM on the Yealm, the community composition was typified by those species which prefer heterogenic flow regimes. This is further supported by the LIFE scores which range from low 7 to 8; scores which are indicative of communities which favour well oxygenated and energetic flows.

There were high abundances of the stonefly *Leuctra fusca*, the mayfly *Habrophlebia fusca*, and apart from the ubiquitous Oligochatea, Chironimadae and *Baetis rhodani*, no other taxa were especially abundant. Abundances of "high" LIFE scoring taxa were lacking, perhaps reflecting the seasonal reduction in discharge which occurs naturally in the period preceding the autumn survey.

4.3.5 Diatoms

The results from the autumn diatom surveys are presented below in Table 4.7.

Table 4.7. Results of September diatomaceous algae surveys

Site name	Sample date	TDI	% Motile Valves
1	20/09/2011	24.92	7.96
2a	22/09/2011	Insufficient valves	
3	21/09/2011	37.46	12.62
4	20/09/2011	29.68	10.79
5	21/09/2011	30.63	9.97
6a	22/09/2011	42.33	37.42

Results from the analysis of the diatom samples from the River Yealm in September 2011 show TDI values between 24.92 at Site 1 and 42.33 at Site 6a. It would be expected to

observe such TDI values at sites where there are relatively low nutrients. The percentage of motile valves present was low and similar at all sites except Site 6 where the highest percentage of 37.4% was recorded. While higher than the other sites, this is still not an exceptionally high value, and may reflect changes in the type of substrate present at Site 6a.

4.3.6 Macrophytes

The results of the September macrophyte survey are presented in Table 4.8. In common with the macroinvertebrate communities, the observed macrophyte communities were indicative of a stony-bottomed, relatively clean river. Sites generally lacked major vascular plant coverage, possibly due to the high degree of canopy cover along the survey reach allied with mobile, coarse substrate.

Average macrophyte cover was 4.93% (± 2.33) at the six study sites and all three major groupings were present (algae, mosses/liverworts, and vascular plants). Mosses dominated the communities at all sites. However, at Site 6a, taxonomic diversity of vascular plants was higher than mosses/liverworts.

Hildenbrandia was quite common, especially at sites 4, 5, and 6a, and constitutes a major component of the total vegetative cover at these sites. The only other taxa which accounted for > 1% total cover at any site was *Vaucheria*, (also at site 6a). Another species worthy of note was Himalayan balsam, *Impatiens glandulifera.* Although only recorded at Site 6a during the macrophyte survey, stands of *L. glandulifera* were common along the river banks on the study reach (pers. obs.).

Table 4.8. Summary of macrophyte survey results

Site	**1**	**2a**	**3**	**4**	**5**	**6a**
Total vegetative cover (%)	**2.45**	**4.39**	**3.61**	**3.97**	**6.24**	**8.97**
Taxa	**SCV**	**SCV**	**SCV**	**SCV**	**SCV**	**SCV**
Algae						
Hildenbrandia	2		2	3	4	4
Vaucheria					2	3
Cladophora						1
n.	1	0	1	1	2	3
Mosses and Liverworts						
Fontinalis antipyretica	1	2	2	2	3	2
Thamnobryum alopecurum	2	2		2	2	2
Chiloscyphus polyanthos	2	2		2	1	2
Fontinalis squamosa	2	2	1	2	1	
Homalia trichomanoides			1			
Pelia endivifolia	2		1	2	1	
Amblystegium fluviatile			2		2	2
Rhynchostegium riparoides		3	2	2		1
Fissidens spp.					2	
Concephalum conicum	2	2	2	2	3	2
Lunularia cruciata			1			
n.	6	6	8	7	8	6
Higher Plants						
Callitriche hamulata	1				1	2
Oenanthe crocata	2		1	1	1	1
Carex spp.						1
Equisetum spp.						1
Mentha aquatica						2
Veronica beccabunga						2
Apium nodiflorum						2
Himalayan balsam						1
Juncus spp.						2
n.	2	0	1	1	2	9
Total n.	9	6	10	9	12	18

4.3.7 Habitat assessment

HABSCORE

With the exception of the Environment Agency's flow discharge category, all data needed for the derivation of HQS and HUI scores from the HABSCORE model have been provided in Appendix IV.

Walkover Survey.

With the relevant land owner consent the survey team were able to walk the full survey reach from Site 1 to Site 6a. All georeferenced habitat data are provided on the DVD which accompanies this report, with instructions for GIS interrogation and summary maps provided in Appendix V. Table 4.6 presents a summary of the habitat types, including surface area and percentage composition of the total instream habitats, throughout the entire survey reach.

These data (Table 4.9) show a dominance of run and glide, with glide category B2 and run category B2 especially dominant. The total area of optimal salmonid spawning habitat was quite low, accounting for only 0.07% of the total (or just below 24 m^2) while optimal fry habitat was also low at 2.7%. Suitable habitat for older juvenile salmonid was much higher, accounting for 32% of the entire survey reach. With respect to fulfilling the seasonal life history demands of fishes, it is important to note that the ecological functionality of habitats is determined by a combination of substrate, depth and velocity. Therefore, the survey undertaken during low flows in September by APEM, does not necessarily represent the likely abundance of spawning habitat during the spawning season (November – January) when discharge would typically elevated by winter flows. The distribution and juxtaposition of all habitat features recorded during the September survey are provided within the GIS DVD which accompanies this report.

Table 4.9 Summary of habitat contributions in the River Yealm survey reach. Green shading relates to features over 10%, while orange shading relates to features between 1 and 10 percent

Attribute	Category	Area (m^2)	% Area
Instream Features	Artificial substrate	102.7	0.31
	Debris dam	60.3	0.18
	Exposed substrate	10.8	0.03
	Ford	119.5	0.36
	Island	26.2	0.08
	Attribute Total	**319.4**	**0.96**
Flow Types	Eddy	342.6	1.03
	Dry sub-channel	275.0	0.83
	Cascade	528.5	1.59
	Glide A1	947.9	2.85
	Glide A2	1016.1	3.05
	Glide B1	1094.6	3.29
	Glide B2	2725.5	8.19
	Glide B3	0.0	0.00
	Glide C1	1520.5	4.57
	Glide C2	633.9	1.90
	No flow	168.6	0.51
	Pool	101.2	0.30
	Riffle	1744.7	5.24
	Run A1	292.7	0.88
	Run A2	397.0	1.19
	Run A3	853.2	2.56
	Run B1	0.0	0.00
	Run B2	6428.4	19.31
	Run B3	54.0	0.16
	Run C2	1754.7	5.27
	Attribute Total	**20879.04**	**62.72**
Specific Habitat	Lamprey habitat	208.5	0.63
	Salmonid Fry	902.2	2.71
	Salmonid Parr	10816.8	32.49
	Mixed juvenile salmonid	138.8	0.42
	Salmonid Spawning	23.9	0.07
	Attribute Total	**12090.2**	**36.3**
	Total	**54487.1**	**164**

River Habitat Survey.

RHS results indicate a river rich in habitat features (habitat quality score was 56 for both surveys and structures) but with a habitat modification class (HMC) of 4, which corresponds to *Significantly Modified*. This was driven by the presence of reinforcement (RI), bridges, and weirs. These scores and their constituent sub-scores are presented in Tables 4.10 and 4.11. RHS field sheets are presented in Appendix VI.

Table 4.10. RHS hydromorphological modification score (HMS) and sub-scores

Survey	Culverts	Bank and bed RI	Bank and bed RS	Berms and EMB	Weirs, dams and sluices	Bridges	Poaching	Fords	Outfalls/ deflectors	HMS	HMC
RHS-1	0	60	80	0	0	500	10	0	0	**650**	**4**
RHS-2	0	240	0	20	255	100	0	0	0	**615**	**4**

Table 4.11. RHS habitat quality results (HQA) and sub-scores

Survey	Flow	Channel substrate	Channel features	Bank features	Bank veg structure	Instream channel veg	Land use	Trees, Assoc. features	Special features	HQA
RHS-1	10	6	5	2	12	3	4	11	3	**56**
RHS-2	9	6	7	1	10	4	4	11	4	**56**

5 DISCUSSION

5.1 Macroinvertebrates

Macroinvertebrate communities were relatively diverse and typical of clean, fast flowing, stony rivers in the UK. Macroinvertebrate metric scores between sites were remarkably similar and probably reflective of the spatial similarity of habitat characteristics across sites.

Biological quality indices (BMWP/LIFE) during Spring indicated that overall community diversity and the diversity of pollution sensitive families was sufficient to indicate that there were no severe effects of water pollution, ecologically detrimental habitat alterations or major alternations in the flow regime. However BMWP metric scores were reduced during summer. Some potential causes in the decline of scores between the species present in the spring survey and the summer survey are noted below:

- Abundances of *Baetidae*, especially *B. rhodani* were much reduced in summer, perhaps reflecting the less energetic flow environment present during the summer months. However, given their tolerance of reduced water quality when compared with other members of the Ephemera, a substantial proportion of the decline was accounted for by the removal of Site 2.
- Changes in the mayfly species *Ecdyorus* spp, *Rithrogena semicolorata* and the stoneflies *Leuctridae fusca* and *L. geniculata* may be attributable to life history preferences and time of emergence.
- *Chloroperla tripunctata*, although much reduced from summer was only common at Site 1, and as with *Leuctridae* its absence was probably due to life history factors
- *Elmidae* abundance was increased in summer.
- *Gammurus pulex* abundances were much reduced in summer. This is considered to be mainly due to the exclusion of Site 2.

Following a reduction in ASPT between spring to summer, scores increased again in autumn. This appears to have been predominantly due to an increase in the presence of members of the Trichoptera taxonomic grouping (caddis flies), including both lower scoring and higher scoring taxa. At no point during summer or autumn were the high levels of macroinvertebrate diversity recorded during spring (as represented by NTAXA) replicated.

LIFE scores declined into the autumn survey. While still within the range of scores which are expected at energetic well-oxygenated streams, the lower LIFE scores may reflect the impact of natural low-flow summer periods. Indeed, lags between cause and effect in LIFE scores are not unexpected (APEM data, unpublished). The combination of reduced BMWP metric scores in summer and lowered LIFE scores in autumn indicate that spring may be the optimum period for assessing future impacts from construction and operational phases of the proposed facility.

A total of three species of the highest conservation value were recorded, one during spring (*Brachycentrus subnubilus*) and two during summer (*Protonemouri meyeri* and *Lasiocephala basalis*). Of these three, only *P. meyeri* could be considered common on the Yealm. The differences in the CCI scores appear to be due to the combined effect of a low diversity in rare species and high diversity of low scoring species. However, it is important to note that CCI scores do not provide information on specific pressures.

The above paragraphs highlight the possibility the variation in seasonal metric scores on the Yealm is due to the complex life histories of the species sampled. This is often exacerbated by high scoring species often having temporally distinct life histories (McDermott, 2008). While it is possible that excluding these taxa may introduce stability to scoring metrics such as BMWP and LIFE (Cao et al., 1998), the risk of losing early warning indicators of ecological stress is high, (Clarke & Murphy, 2006) especially in good quality reaches such as reach surveyed here.

5.2 Fish

Surveys to date have confirmed that the River Yealm supports a healthy population of resident and migratory salmonids. The presence of mature sea trout suggests that the anadromous form of *Salmo trutta* plays an important role in the overall population dynamics of the trout population. Despite the small number of adult sea trout captured, it is expected that numbers are likely to increase as autumn progresses towards the spawning season in November/December.

The presence of Atlantic salmon juveniles also emphasises the longitudinal connectivity of the Yealm and the presence of a suitable proportion of habitats to support breeding and nursery functions. The presence of multiple cohorts at each site indicates adequate habitat availability at each site. Furthermore, the combined presence of both salmon and trout indicates that interspecific exclusion of salmon by the more dominant brown trout is not a major limiting factor on the production of juvenile Atlantic salmon within the study reach. This would further confirm that physical habitat is not limiting fish populations.

Although bullhead, minnow, eel and lamprey species were also captured, it is considered that the salmonids represent the species most vulnerable to anthropogenic perturbations. Potential impacts include the mechanical clogging of spawning gravels through elevated sediment deposition, reduced water quality, changes in hydrology, and construction noise which has the potential to impact upon the disruption of migration and general disturbance of all life stages. Due to the conservation status of both salmon and trout (BAP priority species) and the fact that Atlantic salmon is a qualifying feature of the Dartmoor SAC, future monitoring of spawning performance, achieved through the monitoring of parr density and growth, should be regarded as a priority.

In addition to salmonids, lamprey species are also afforded BAP status and while spawning adults may be impacted in the same way as returning salmonids, ammocoetes may also be impacted either positively or negatively due to changes in sediment transport dynamics and the spatial distribution of suitable habitats. Accordingly, lamprey should also be afforded appropriate consideration. The continued mapping of the abundance and distribution of functional habitat for ammocoetes during the annual fisheries walkover surveys (see Appendix V) will therefore be important in assessing potential impacts (either positive or negative) on ammocoete carrying capacity.

5.3 Diatoms

With the exception of two high results from the spring samples at Sites 1 and 6, TDI values reflect those expected from an oligotrophic river system with transient substrate and woody riparian buffer. Common individual species such as *Achnanthidium minutissimim*, *Achnanthes oblongella* and *Cocconeis placentula* are fast growing pioneer species which are common in good quality, circumnuetral waters. *A. Minutissumim* especially is considered an indicator of clean healthy systems, while *A. Oblongella* is an indicator of ecologically sound rivers systems which is specific to the southwest UK.

As mentioned above, TDI values at Sites 1 and 6 during spring indicated a measure of ecological degradation. However, the assumption should not be made that this is due to organic enrichment as high TDI may also reflect an elevated sediment level. Both these sites are at risk from increased sediment input during winter; at site 1 due to the bare banks left by the seasonal die back of the invasive Himalayan balsam and site 6 by the presence of extensive cattle poaching (this being one of the prime reasons Site 6 was replaced with Site 6a).

The diatom community at site 6a also contained species which could be considered indicative of ecological degradation (*e.g.*, *Navicula* and *Gomphonema* spp). However, as at Sites 1 and 6, these may indicate a changing sediment regime or change of river physical typology. The observed contrast between Site 6a and the remaining sites is also mirrored by the macrophyte survey.

5.4 Macrophytes

Vegetative communities on the Yealm highlighted subtle differences between each of the six sites. Site 1 had the lowest coverage, indicating the overall habitat suitability for macrophytes was low. However species diversity was not low, indicating that patch diversity was substantial. The site with the lowest diversity was Site 2a which was composed entirely of mosses and liverworts. The lack of higher plants could potentially be due to the absence of sufficient light, unsuitable substrate, or a combination of both. Sites 3 and 4 were quite similar and could be considered a typical baseline of the vegetative community on the Yealm in both community structure and abundance.

Percentage of cover by *Hildenbrandia* increased with distance from river source and was the main driver of increasing vegetative cover at the lower sites. This red freshwater alga is indicative of good water quality and favours slower moving or lentic environments (Eloranta & Kwadrans, 2004). *Vaucheria* was also present at sites 5 and 6a, and further confirms the relatively unpolluted status (Schagerl & Kerschbuamer, 2009) of the Yealm.

Although either *Callitriche* and *Oenanthe* (or both) were present at most sites, only Site 6a had a notable community of higher plants. This does not necessarily indicate increased nutrient supply at this site (the presence of higher aquatic plants is mostly controlled by hydromorphology, not nutrient supply, Willby *et al* 2000), and the low SCV values and the presence of *Hildenbrandia* and *Vaucheria* confirm that organic enrichment is not a major issue. Therefore either the hydromorphological conditions were more conducive to plant growth at this Site 6a, canopy coverage was less dense or a combination of both. Table 4.1 demonstrates that substrate at this site was composed mostly of gravel and sand which are

readily colonised by plant communities. Indeed, the composition of the substrate at this site may be responsible for the promotion of the growth of vascular plants. Site 6a is also located in an area just before the transition from forest to open field landscapes, and as such may have less dense tree cover and a higher light budget.

5.5 Habitat

Considering that riffle dominated habitat was selected for survey sites, riffle accounts for a sparse 5% of total channel area. Other features of note are the 60m^2 of debris dam, a feature which often increases the ecological quality of rivers, and over 200m^2 of non-natural river substrate (ford and artificial substrate) which has a negative relationship with healthy river communities.

Habitat throughout the survey reach was varied. 0+ fish were found at all sites indicating the presence of the full range of functional habitats required by a range of life stages at each site.

It is important to note that the fisheries walkover survey records habitat availability at the point in time the survey is conducted. Due to the ecological functionality of habitats being governed by water depth and velocity, river discharge plays a fundamental role in governing the seasonal availability of habitats. On this basis, the limited areas recorded as suitable for salmonid spawning during September, represent an underestimation of total habitat likely to be available during the spawning season (November – December) when discharge would typically be expected to be elevated. Indeed, the presence of multiple age cohorts (including 0+) of both salmon and trout at all sites, confirms that spawning and nursery habitats are currently functioning throughout the study reach.

The results presented by RHS are somewhat paradoxical. The river has good habitat features, of many different types, yet it is significantly modified. This is due to the age of the majority of the modifications which are quite "naturalised" and have been successionally vegetated over time. This allows for the creation of beneficial features like mature riparian buffers and a heterogeneous flow environment within the confines of a restricted channel. Notwithstanding, these older altered features will re-activate during extreme periods of disturbance (such as flooding) and continue to restrict lateral connections and speed up flow rates.

The presence of large stands of Himalayan balsam (noted in RHS & Habitat Walkover) remains a potential problem, especially once construction has begun. Any disturbance removing or damaging the native riparian vegetation will allow rapid and aggressive colonisation by this alien plant. This has the potential to result in increased sediment runoff when this species dies back, leaving the banks exposed during the winter.

5.6 Conclusions

The ecological surveys from 2011 indicate that the ecological community of the River Yealm is relatively typical of a natural upland stream. While the river may not be at "reference condition", primarily due to the presence of negative landscape and hydromorphological pressures, the biological communities are of a suitably good quality and stable state to act as primary indicators for the duration of the construction and operation of the proposed development. The exceptions to this statement are the lamprey species, and more specific surveys may be required for these cryptic species.

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APPENDIX I MACROINVERTEBRATE TAXA AND ABUNDANCE

SPRING

Taxa ID	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Adicella reducta	3					
Agapetus delicatulus			2			
Agapetus fuscipes		2				
Agapetus ochripes						2
Agapetus sp.		1	3			3
Alainites muticus	3	9	1	9	10	
Amphinemura sulcicollis	1					
Ancylus fluviatilis	8	6			4	3
Ancylus group (incl. *Ancylus, Ferissia* & *Acroloxus)*		1				
Baetis rhodani	169	47	46	226	159	288
Baetis scambus/fuscatus	103	58	37		19	176
Brachycentrus subnubilus		1				
Caenis rivulorum	157	98	66	43	26	108
Calopteryx splendens		2	1			
Calopteryx virgo	1					
Ceratopogonidae		1	1	3	4	5
Chaetopteryx villosa	3	10	1			
Chelifera sp.			1			
Chironomidae	28	166	9	83	32	80
Chloroperla tripunctata	49		6			
Clinocerinae			1			
Dicranota sp.	5	2	10	16	21	22
Diptera			1		2	
Dixa puberula					1	
Drusus annulatus			1		1	1
Ecdyonurus sp.		2	4	4	1	14
Ecdyonurus torrentis						2
Electrogena lateralis		1				
Elmis aenea	13	10	1	9	3	22
Ephemera danica						1
Erpobdella octoculata		1	1			
Esolus parallelepipedus	2		5	2	1	22
Gammarus pulex		36	2	2	2	4

Gammarus sp.	1					
Glossosoma boltoni	5		1		3	8
Glossosoma sp.		2	6	124	4	34
Glossosomatidae			11	1		
Goeridae	1					
Gyrinus sp.						1
Helophorus brevipalpis		3				1
Helophorus grandis		1				
Hemerodromia sp.	2	3				1
Hydracarina	1	4	3			
Hydraena gracilis	16	1	3	10	6	21
Hydropsyche siltalai	50	12	10	10	17	4
Hydropsyche sp.					1	
Ibrisia marginata	1	1				1
Isoperla grammatica	1				2	1
Lepidostoma hirtum	43	76	8		1	2
Leuctra fusca	6	19	4	17	7	20
Leuctra geniculata	59	109	28	18	3	109
Leuctra inermis				3		
Leuctra sp.	72	5	26	46	39	104
Limnephilidae					2	
Limnius volckmari	27	19	34	35	36	44
Mystacides azurea		1				
Nematoda			1			
Oecetis testacea	3	1	1			
Oligochaeta	101	398	273	106	372	136
Oreodytes sanmarkii					1	
Oulimnius sp.		5				
Oulimnius tuberculatus	1	1				
Phagocata vitta						1
Piscicola geometra	1					1
Pisidium sp.	2	1				
Polycelis felina	13	31	7	10	7	25
Polycentropus flavomaculatus		5				1
Polycentropus kingi	20	2	8		1	6
Polycentropus sp.			2	1		
Potamophylax cingulatus		1				
Potamophylax latipennis				1		
Potamopyrgus antipodarum	21	147	58	4	33	60
Rhithrogena semicolorata	95	13	64	101	84	68
Rhithrogena sp.					1	
Rhyacophila dorsalis	5	1	10	30	22	15

Rhyacophila sp.		1	1	1		
Sericostoma personatum	8	9	3	1	1	
Serratella ignita	483	644	194	214	170	294
Silo pallipes		14	2		2	6
Silo sp.						1
Simuliidae	2	22	2	13	3	4
Siphonoperla torrentium	3	19	54	20	71	36
Velia sp.	4		3		3	

SUMMER

Taxa ID	Site 1	Site 2a	Site 3	Site 4	Site 5	Site 6a
Alainites muticus	5	2				5
Anabolia nervosa			1			
Ancylus fluviatilis	11	3	1	9	9	8
Baetis rhodani	51	32	5	35	7	120
Baetis scambus/fuscatus	4		2		1	
Baetis sp.	5			7	1	12
Ceratopogonidae		1				
Chelifera sp.						1
Chironomidae	285	11	8	91	24	171
Chloroperla tripunctata			1			
Chrysops sp.						1
Clinocerinae	1					1
Collembola						1
Crangonyx pseudogracilis					1	
Dendrocoelum lacteum	3		2			3
Dicranota sp.	10	14	12	14	1	23
Dixa puberula						4
Drusus annulatus				1		1
Ecdyonurus sp.	36	6	2	1		17
Elmis aenea	12	1		56		8
Elodes sp.	1					
Erpobdellidae		1				
Esolus parallelepipedus	2		8		1	1
Gammarus pulex	1	1	1	1	9	16
Glossosoma boltoni	1			1		1
Glossosoma sp.	1					2
Glossosomatidae					1	1
Hydracarina			1		1	
Hydraena gracilis	18	6	3	10	1	35
Hydropsyche pellucidula			1			5
Hydropsyche siltalai	6			1		13
Hydropsyche sp.		1				
Hydropsychidae	37			1	1	27
Ibrisia marginata	2		1			
Lasiocephala basalis		1				
Leuctra fusca	360	67	11	78	62	151
Leuctra geniculata			2	1	13	4

Leuctra sp.						4
Limnephilidae		1				
Limnius volckmari	23	19	28	56	25	39
Mystacides sp.					1	
Nematoda	1					
Oligochaeta	429	199	311	155	236	151
Orectochilus villosus				1		
Oribatei						1
Oulimnius sp.		1				
Oulimnius tuberculatus		1				
Pisidium sp.	1			1	1	1
Plectrocnemia conspersa	1					
Polycelis felina	24	1	5	8	2	13
Polycentropus flavomaculatus	2	1			3	3
Polycentropus kingi	16	14	48	28	18	29
Polycentropus sp.	2					
Potamophylax cingulatus	1					
Potamophylax latipennis		1				
Potamopyrgus antipodarum				1		2
Protonemura meyeri	20	8	3	8	2	20
Psychodidae	11	2	2	6	2	12
Rhithrogena semicolorata		2			2	
Rhithrogena sp.	9	1		2	1	4
Rhyacophila dorsalis						5
Rhyacophila sp.	2					2
Sericostoma personatum	4	3	7	3		8
Serratella ignita	51	21	1	8	8	16

AUTUMN

Taxa ID	Site 1	Site 2a	Site 3	Site 4	Site 5	Site 6a
Alainites muticus		1			1	
Ancylus fluviatilis	12	7	6	1	1	13
Athericidae			1			
Baetis rhodani	12	36	22	52	18	75
Baetis sp.				4		
Ceratopogonidae	1	1	2			
Chironomidae	79	76	91	38	18	5
Clinocerinae				1		
Cordulegaster boltonii					2	
Crangonyx pseudogracilis		3				
Dendrocoelum lacteum		1				
Dicranota sp.	12	6	18	9	3	5
Diptera		1				
Ecdyonurus sp.	43	17	7	13	13	20
Elmis aenea	7	2	2	3	2	8
Erpobdella octoculata						1
Erpobdella sp.			2	1		
Esolus parallelepipedus		1		1	1	3
Gammarus pulex		2	8	3	3	4
Gammarus sp.	1					
Glossiphonia complanata		2	1			1
Glossosoma boltoni	2	2	1	2		3
Glossosoma sp.	2	4	1	16	5	14
Glossosomatidae				1		
Habrophlebia fusca			1			
Hydracarina	1	1	1			
Hydraena gracilis	6			4		3
Hydropsyche pellucidula						1
Hydropsyche siltalai	17	5	3	7	1	5
Hydropsychidae			1			
Ibrisia marginata		1				
Lasiocephala/Lepidostoma group	1	2	2	1	1	2
Lepidostoma hirtum		1				
Leuctra fusca	114	74	57	45	17	36
Leuctra geniculata					2	
Leuctra sp.						2

Limnephilidae	1	19	15		5	
Limnius volckmari	14	21	38	28	25	10
Mystacides azurea		3			2	1
Nemoura avicularis		7	3			
Odontocerum albicorne				1	1	
Oecetis testacea		4	4		2	
Oligochaeta	368	82	145	104	56	178
Orectochilus villosus	4		2			
Oreodytes sanmarkii		2				
Oribatei		3				
Oulimnius sp.			1			
Oulimnius tuberculatus			1			
Physidae		1				
Pisidium sp.	1					
Polycelis felina	1	3	2			7
Polycelis nigra/tenuis		6	3			
Polycentropus flavomaculatus		2			2	
Potamophylax latipennis						1
Potamophylax latipennis/cingulatus		1	4		2	
Potamopyrgus antipodarum	13	23	20	17	51	62
Radix balthica		2				
Rhithrogena sp.		2		3		5
Rhyacophila dorsalis	8	4		3	5	9
Rhyacophila sp.			1		1	6
Sericostoma personatum	7	2	4		1	3
Serratella ignita		1				
Silo nigricornis					1	7
Silo pallipes		4	2		1	7
Silo sp.	6	3	4			17
Simuliidae	23	3		4	1	4
Siphonoperla torrentium	2			1		

APPENDIX II TAXONOMIC PRESENCE AND ABUNDANCE OF DIATOMS

SPRING

Taxon Name	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Achnanthes conspicua		2				
Achnanthes hungarica		1				
Achnanthes oblongella	24	30	16	23	2	
Achnanthes daui			1		1	
Achnanthes helvetica			2			
Amphora pediculus		1	4			
Cocconeis placentula	24	34	72	86	196	5
Cocconeis placentula var. euglypta		1		7	17	
Cocconeis pediculus	2					
Cyclotella sp.	1	2	1			
Diatoma tenue				1		
Diatoma mesodon		1	2			
Eunotia bilunaris	1			1		
Encyonema silesiacum				1	2	
Fragilaria vaucheriae	3	2	1	1		3
Fragilaria capucina	6	5	5	17	1	5
Fragilaria capucina var. gracilis	25	4	5	15	6	
Gomphonema olivaceum	1	1	1	2		
Gomphonema parvulum	14	7	2	1	3	1
Gomphonema tergestinum		3	2		1	1
Gomphonema angustum	1					
Melosira varians						1
Meridion circulare	2	4	1	2		
Navicula rhynchocephala	3	3	1		1	
Navicula lanceolata	14	9	9	6	4	6
Navicula gregaria	93	91	65	36	18	20
Navicula menisculus					1	
Navicula minima	6	15	20	6		1
Navicula veneta		1				
Navicula slesvicensis				1		
Navicula atomus	3	2	1	1		9
Navicula cryptotenella			1	1		
Nitzschia fonticola						1
Nitzschia frustulum	10	4				3
Nitzschia palea	6		1			16
Nitzschia dissipata	1	1	1			1
Nitzschia capitellata	9	1	2	6	3	

Nitzschia linearis		1				
Nitzschia paleacea	7	15	2	3	1	201
Nitzschia inconspicua	1				1	
Nitzschia draveillensis		1	1			5
Nitzschia pusilla	1					
Nitzschia sociabilis			1			
Rhoicosphenia abbreviata				1		
Reimeria sinuata	5	0	16	9	7	2
Staurosirella pinnata	1					
Surirella angusta	3		1		2	1
Surirella brebissonii	12	5	1	3	1	13
Synedra ulna	9	1	3		1	3
Tabellaria flocculosa	1					
Thalassiosira pseudonana			1			
Achnanthidium minutissimum type	30	36	53	63	31	6
Planothidium lanceolatum	8	17	15	4	3	

SUMMER

Taxa Name	Site 1	Site 2a	Site 3	Site 4	Site 5	Site 6a
Achnanthes oblongella	18	19	15		10	10
Achnanthidium minutissimum type	151	188	139		50	91
Amphora pediculus			3		4	
Aulacoseira ambigua		2				
Cocconeis placentula	44	21	56		194	66
Cocconeis placentula var. euglypta			3		1	6
Cocconeis placentula var. pseudolineata	5		1		2	10
Cyclotella meneghiniana					1	
Cyclotella sp.					1	
Denticula tenuis	2				1	
Diadesmis perpusilla					1	
Diatoma mesodon			2			
Diatoma vulgare					2	
Encyonema minutum	4	3	2			
Encyonema silesiacum	2	1	2			
Eunotia bilunaris			4		5	2
Eunotia exigua		3				
Eunotia incisa			1			
Eunotia soleirolii					1	
Eunotia sp.		2	2			
Fragilaria bicapitata		1			1	
Fragilaria capucina var. gracilis	11		4		1	24
Fragilaria capucina var. rumpens		2	1		2	
Fragilaria perminuta			3			9
Fragilariforma virescens	2					
Frustulia vulgaris	1					
Gomphonema angustatum		2				
Gomphonema angustum/pumilum type	2					
Gomphonema olivaceoides		3				
Gomphonema olivaceum	4					1
Gomphonema parvulum var. exilissimum	2	2			2	
Gomphonema sp.						2
Gomphonema tergestinum		1				
Meridion circulare		1				
Navicula atomus			1			
Navicula cryptocephala			4			
Navicula cryptotenella			1			
Navicula gregaria	5	4	14		6	63
Navicula lanceolata			2		1	4
Navicula minima	2	14	8		2	2

Navicula molestiformis		1				
Navicula radiosa					1	
Navicula saprophila		1				3
Navicula small species			4			7
Navicula submuralis					1	
Nitzschia frustulum	1		2		2	
Nitzschia inconspicua			2			
Nitzschia levidensis var. salinarum					2	
Nitzschia palea var. debilis					1	3
Nitzschia paleacea			1			1
Nitzschia perminuta	2				2	
Nitzschia pusilla					3	
Nitzschia sociabilis					1	
Nitzschia sp.			2			
Nitzschia sublinearis					1	
Nitzschia tubicola			1			
Pennate undif.		2				2
Pinnularia appendiculata					2	
Planothidium frequentissimum	6	3	2			
Planothidium lanceolatum	10		4		8	3
Psammothidium marginulatum		3				
Psammothidium sp.			1			
Psammothidium subatomoides			7		2	2
Pseudostaurosira brevistriata			6			
Reimeria sinuata	34	34	11		1	14
Rhoicosphenia abbreviata						4
Rossithidium linearis	2					
Sellaphora seminulum		2				
Staurosirella pinnata					1	
Stephanodiscus hantzschii						1
Surirella angusta						1
Tabellaria flocculosa	1	1				

AUTUMN

Taxa name	Site 1	Site 2a	Site 3	Site 4	Site 5	Site 6a
Achnanthes oblongella	36	N/A	12	1	37	3
Achnanthidium minutissimum type	139		119	256	140	62
Amphora pediculus			3	4	13	5
Aulacoseira distans			1			
Aulacoseira granulata						2
Caloneis silicula			2			
Cocconeis placentula	49		16	5	33	31
Cocconeis placentula var. euglypta					1	4
Cocconeis placentula var. lineata	3		1			
Cocconeis placentula var. pseudolineata	3		3		2	5
Ctenophora pulchella			4		1	
Cyclotella sp.			1			
Diadesmis contenta			2			
Diatoma mesodon				1	1	
Diatoma problematica			1		1	
Encyonema silesiacum					2	
Eunotia bilunaris			6	1	4	2
Eunotia exigua			1			
Eunotia implicata	4		2		1	
Eunotia minor					3	
Eunotia sp.			1		2	
Fragilaria bicapitata	1					3
Fragilaria bidens						1
Fragilaria capucina	1		2		5	8
Fragilaria capucina var. gracilis	25		9	2	1	37
Fragilaria perminuta					1	
Fragilaria vaucheriae	2				3	1
Fragilariforma exigua			6		1	
Frustulia vulgaris					1	
Gomphonema affine			2		2	
Gomphonema olivaceoides	2		9		1	
Gomphonema parvulum	1		2	1	2	19
Gomphonema parvulum var. exilissimum	6		2	2	2	
Meridion circulare						1
Meridion circulare var. constrictum			1			
Navicula atomus	2					
Navicula cryptocephala			1			
Navicula gregaria	8		11	6	6	77

Navicula ignota var. acceptata					1	
Navicula lanceolata	2		2			7
Navicula minima	2		2	19	7	24
Navicula rhynchocephala					1	1
Navicula saprophila				2	1	2
Navicula slesvicensis			1			
Navicula small species	4		7		3	1
Navicula suchlandtii	2			2		
Navicula tripunctata	1					
Navicula trivialis					1	
Nitzschia amphibia			1			
Nitzschia capitellata					1	
Nitzschia dissipata			1	1	1	
Nitzschia dissipata subsp. media	1					
Nitzschia fonticola			2			
Nitzschia frustulum	1		1		1	
Nitzschia inconspicua					1	
Nitzschia liebetruthii				1		
Nitzschia palea			1			
Nitzschia palea var. debilis			3			1
Nitzschia perminuta					1	
Nitzschia pusilla						1
Nitzschia recta			1			
Nitzschia sp.	2			1	2	
Pennate undif.	2				2	1
Pinnularia appendiculata			2			
Planothidium ellipticum					2	
Planothidium frequentissimum	3		9	1	4	
Planothidium lanceolatum	1		1	1	4	1
Psammothidium subatomoides			5		3	
Pseudostaurosira brevistriata			1			
Reimeria sinuata	9		35	5	3	10
Rhoicosphenia abbreviata			2			
Sellaphora pupula						2
Sellaphora seminulum				1	2	3
Staurosira construens					1	
Staurosira elliptica			17			
Staurosirella pinnata				1		
Surirella minuta				1		
Surirella ovalis			1		1	
Surirella roba			1			
Synedra ulna	1				1	
Tabellaria flocculosa	1		1		1	3

APPENDIX III ELECTRIC FISHING SURVEY DATA

Table A3.1 Codes used to identify catch

Code	Species/Stage
BT	Brown trout
BH	Bullhead
SAL	Atlantic salmon
EEL	Adult eel
ELVER	Elver
B/RL AMMO	Brook/River lamprey ammocoete
MN	Minnow
RL TRANS	River lamprey transformer

Table A3.2 Site 1

Site 1			
Run	**Fish**	**Species**	**Length (cm)**
1	1	BH	68
1	2	SAL	60
1	3	SAL	60
1	4	BH	62
1	5	SAL	62
1	6	SAL	60
1	7	BH	62
1	8	SAL	127
1	9	BH	63
1	10	BT	52
1	11	SAL	59
1	12	SAL	65
1	13	SAL	68
1	14	SAL	55
1	15	BT	60
1	16	SAL	62
1	17	BT	58
1	18	SAL	63
1	19	SAL	64
1	20	SAL	67
1	21	BT	165
1	22	SAL	65
1	23	BT	68
1	24	SAL	54
1	25	BT	69
1	26	BT	62
1	27	BT	160

1	28	BT	75
1	29	BT	171
1	30	BT	73
1	31	SAL	74
1	32	SAL	60
1	33	SAL	64
1	34	BT	86
1	35	BT	59
1	36	BH	42
1	37	BT	69
1	38	BT	58
2	39	BH	78
2	40	SAL	66
2	41	SAL	112
2	42	SAL	65
2	43	SAL	68
2	44	SAL	62
2	45	SAL	50
2	46	SAL	64
2	47	SAL	54
2	48	SAL	60
2	49	BT	99
2	50	BT	73
2	51	SAL	64
2	52	SAL	65
2	53	BT	78
2	54	BT	80
2	55	BH	43
2	56	SAL	68
2	57	BT	59
2	58	BT	54
2	59	BT	213
2	60	SAL	55
2	61	BT	240
3	62	SAL	60
3	63	SAL	55
3	64	SAL	69
3	65	SAL	62
3	66	SAL	70
3	67	BT	84
3	68	SAL	65
3	69	B/Rl AMMO	120

Table A3.3 Site 2a

Site 2a			
Run	**Fish**	**Species**	**Length (cm)**
1	1	BT	73
1	2	BT	84
1	3	BT	61
1	4	BT	190
1	5	SAL	129
1	6	BT	288
1	7	BT	218
1	8	BT	182
1	9	BT	115
1	10	B/RL AMM	115
1	11	B/RL AMM	90
1	12	BT	183
1	13	BT	150
1	14	BT	149
1	15	SAL	138
1	16	SAL	69
1	17	BH	42
1	18	BT	83
1	19	BT	157
1	20	BT	155
1	21	BT	145
1	22	SAL	117
1	23	SAL	95
1	24	BT	128
1	25	BT	74
1	26	BT	82
1	27	BT	40
1	28	BH	76
1	29	EEL	180
1	30	BT	62
1	31	BT	65
1	32	BT	62
1	33	BT	66
1	34	BT	81
1	35	SAL	55
1	36	BT	120
1	37	SAL	119
1	38	BT	66
1	39	BT	78
1	40	BT	59
1	41	BT	178

1	42	EEL	260
1	43	SAL	72
1	44	BT	154
1	45	SAL	58
1	46	BH	57
1	47	SAL	63
1	48	SAL	64
1	49	EEL	310
1	50	BT	490
1	51	BT	64
1	52	SAL	70
1	53	BT	78
1	54	SAL	62
1	55	BT	49
2	56	BT	182
2	57	BT	176
2	58	BT	145
2	59	BT	171
2	60	SAL	110
2	61	BT	168
2	62	BT	157
2	63	BT	155
2	64	BT	140
2	65	BT	125
2	66	BT	128
2	67	BT	61
2	68	B/RL AMM	93
2	69	SAL	60
2	70	BT	135
2	71	SAL	60
2	72	B/RL AMM	110
2	73	SAL	65
2	74	SAL	55
2	75	SAL	56
3	76	BT	206
3	77	BT	140
3	78	BT	152
3	79	SAL	108
3	80	SAL	70

Table A3.4 Site 3

Site 3			
Run	**Fish**	**Species**	**Length (cm)**
1	1	BT	180
1	2	BT	171
1	3	BT	116
1	4	BT	200
1	5	BT	116
1	6	BT	82
1	7	SAL	134
1	8	BT	134
1	9	SAL	65
1	10	BT	116
1	11	BT	100
1	12	SAL	66
1	13	BH	70
1	14	SAL	63
1	15	BT	74
1	16	SAL	90
1	17	BT	191
1	18	BT	80
1	19	BT	75
1	20	SAL	67
1	21	SAL	60
1	22	SAL	58
1	23	SAL	116
2	24	SAL	145
2	25	SAL	110
2	26	BT	176
2	27	BT	158
2	28	BT	151
2	29	SAL	115
2	30	SAL	66
2	31	BT	83
2	32	R/BL AMM	96
2	33	R/BL AMM	97
2	34	SAL	67
2	35	SAL	58
2	36	SAL	58
3	37	SAL	135
3	38	SAL	71
3	39	BT	62
3	40	SAL	62
3	41	SAL	101

3	42	EEL	330

Table A3.5 Site 5

Site 4			
Run	**Fish**	**Species**	**Length (cm)**
1	1	BT	225
1	2	BT	195
1	3	BT	74
1	4	MN	50
1	5	SAL	64
1	6	BT	72
1	7	BT	88
1	8	SAL	62
1	9	EEL	330
1	10	BT	72
1	11	BH	63
1	12	BT	60
1	13	SAL	56
1	14	SAL	113
1	15	BT	69
1	16	BT	120
1	17	SAL	106
1	18	BT	71
1	19	MN	27
1	20	SAL	56
1	21	BT	505
2	22	BT	305
2	23	SAL	109
2	24	BT	231
2	25	SAL	105
2	26	SAL	112
2	27	SAL	135
2	28	BT	179
2	29	SAL	115
2	30	BH	73
2	31	BH	63
2	32	SAL	55
2	33	SAL	111
2	34	BT	68
2	35	SAL	73
2	36	BT	137
2	37	BT	155
3	38	BT	175

3	39	BT	164
3	40	BT	58
3	41	BT	228
3	42	BT	75
3	43	BT	155
3	44	SAL	69
3	45	SAL	59
4	46	BT	125
4	47	BT	65
4	48	SAL	61

Table A3.6 Site 5

Site 5			
Run	**Fish**	**Species**	**Length (cm)**
1	1	MN	63
1	2	MN	62
1	3	BT	62
1	4	BT	69
1	5	BT	61
1	6	BT	155
1	7	BH	85
1	8	BT	144
1	9	BT	78
1	10	SAL	67
1	11	BT	79
1	12	BT	84
1	13	BT	125
1	14	BT	86
1	15	BT	144
1	16	BT	70
1	17	BH	63
1	18	BT	169
1	19	SAL	108
1	20	BT	68
1	21	BT	70
1	22	SAL	66
1	23	MN	67
1	24	BT	89
1	25	BT	78
1	26	SAL	67
1	27	MN	60
1	28	BH	66
1	29	BT	60

1	30	BT	86
1	31	MN	58
1	32	SAL	59
1	33	MN	48
1	34	SAL	64
1	35	BT	82
1	36	MN	59
1	37	BT	54
1	38	BT	72
1	39	SAL	66
1	40	MN	60
1	41	BT	61
1	42	BT	98
1	43	MN	67
1	44	SAL	60
1	45	BT	66
1	46	SAL	58
1	47	SAL	53
1	48	EEL	124
1	49	BT	89
1	50	SAL	71
1	51	BH	60
1	52	SAL	63
1	53	EEL	310
1	54	EEL	280
1	55	BT	450
2	56	BT	70
2	57	BT	125
2	58	SAL	66
2	59		
2	60		
2	61	BT	75
2	62	SAL	74
2	63	BT	67
2	64	SAL	62
2	65	SAL	72
2	66	SAL	69
2	67	SAL	110
2	68	SAL	60
2	69	SAL	68
2	70	BT	127
2	71	SAL	110
2	72	BT	78
2	73	BT	62

2	74	MN	69
2	75	BT	130
2	76	BT	201
2	77	BT	160
2	78	MN	75
2	79	MN	76
2	80	BT	78
2	81	MN	70
2	82	MN	63
2	83	BH	76
2	84	BT	63
2	85	MN	62
2	86	SAL	60
2	87	SAL	60
2	88	SAL	59
3	89	BH	42
3	90	MN	80
3	91	SAL	56
3	92	BT	140
3	93	R/BL AMM	88
3	94	BT	80
3	95	BT	107
3	96	BT	79
3	97	R/BL AMM	90
3	98	SAL	70
3	99	RL TRANS	120
3	100	SAL	68
3	101	SAL	65
3	102	SAL	63
3	103	SAL	62
3	104	SAL	61
3	105	EEL	310
3	106	BH	72
3	107	BT	62
3	108	MN	65
3	109	MN	57
3	109	MN	56

Table A3.7 Site 6a

Site 6a			
Run	**Fish**	**Species**	**Length (cm)**
1	1	BT	80
1	2	BT	83
1	3	SAL	78
1	4	SAL	135
1	5	SAL	69
1	6	SAL	118
1	7	BT	152
1	8	BT	166
1	9	BT	134
1	10	BT	136
1	11	BT	116
1	12	SAL	55
1	13	BT	89
1	14	BT	101
1	15	SAL	68
2	16	BT	119
2	17	SAL	110
2	18	BH	80
2	19	SAL	88
2	20	SAL	114
2	21	SAL	73
2	22	BT	70
2	23	SAL	65
2	24	SAL	64
2	25	SAL	77
2	26	BT	182
3	27	BH	75
3	28	SAL	75
3	29	SAL	60
3	30	SAL	72
3	31	SAL	67
3	32	SAL	68
3	33	SAL	96
3	34	BT	85
3	35	EEL	330
3	36	SAL	62
4	37	SAL	122
4	38	SAL	120
4	39	SAL	78
4	40	ELVER	97

APPENDIX IV HABSCORE FIELD FORMS

HABSCORE for Windows v1.1 : HAB*form*
Site habitat record
NB - this form is double sided

Site identification

Site code		Catchment	
Site name	**Site 1**	NGR	**SX 60207 56005**
River name	**Yealm**	Survey date	**20/9/11**

Riparian shading of the site

What percentage of the water surface of the site is overhung by riparian vegetation? Estimate this percentage, for the three vegetation classes indicated, to the nearest 5%.

Deciduous trees & shrubs [90] Coniferous trees [ ] Herbaceous vegetation [ ]

Migratory access

What is the accessibility of the site ?

	Salmon	Sea trout
Always accessible	NK	NK
Sometimes accessible	NK	NK
Never accessible	NK	NK

Substrate embededness

What is the degree of substrate embededness throughout the site? Tick one box.

High [ ] Medium [ ] Low [x]

Flow conditions

Briefly describe the prevailing flow conditions (as observed at the time of the HABSCORE survey) in the space provided below.

Normal Autumn Flows

Upstream land-use considerations

What is the principal land-use immediately upstream of the site? Tick appropriate box(es).

Moor / heathland	[ ]	Coniferous woodland	[ ]	Deciduous woodland	[x]
Rough pasture	[ ]	Urban development	[ ]	Other	[ ]
Improved pasture	[x]	Industrial land	[ ]	.....	
Arable land	[ ]	Tips / waste	[ ]	.....	

Potential impacts

Are there likely to be any impacts at the site from the following sources? Tick appropriate box(es).

pH effects	[ ]	Stocking	[ ]	Other	[ ]
Migration barriers	[ ]	Habitat modification	[ ]	**Not Known**	
River engineering	[ ]	Low flows	[ ]		
Pollution	[ ]	Flow regulation	[ ]		

Width and depth profile at bottom stop net

Record widths to the nearest 0.1m and depths to the nearest 1.0cm.

Channel width	7.8
Depth at ¼ channel width	15
Depth at ½ channel width	13
Depth at ¾ channel width	15

Section dimensions

Record section lengths and widths to the nearest 0.1m and depths to the nearest 1.0cm.

Section length	10	10	10	10	10					
Section width	11.4	11.4	10	8.8	9.5					
Depth at ¼ channel width	18	25	50	52	45					
Depth at ½ channel width	23	22	25	45	25					
Depth at ¾ channel width	13	16	22	15	2					

Substrate

Absent	Scarce	Common	Frequent	Dominant
0%	>0% & <5%	≥5% & <20%	≥20% & <50%	≥50%
A	***S***	***C***	***F***	***D***

What percentage of the stream bed area in each section is composed of the following substrate types? Enter *A*, *S*, *C*, *F* or *D* as appropriate (see above table).

Substrate category

Bedrock / artificial	A	A	A	C	C					
Boulders ***>25.6 cm***	S	S	S	S	S					
Cobbles ***6.4-25.6 cm***	D	D	F	F	F					
Gravel / coarse sand ***0.2-6.4 cm***	C	F	F	F	F					
Fine sand / silt ***<0.2 cm***	A	S	S	S	S					
Compacted clay	A	A	A	A	A					

Flow

What percentage of the water surface area in each section is composed of the following flow types? Enter *A*, *S*, *C*, *F* or *D* as appropriate.

Flow category

Cascade / torrential	A	A	A	A	A					
Turbulent / broken ***deep***	S	S	C	D	F					
Turbulent / broken ***shallow***	D	D	D	F	D					
Glide / run ***deep***	A	A	A	S	A					
Glide / run ***shallow***	A	A	A	S	A					
Slack ***deep***	A	A	A	S	S					
Slack ***shallow***	A	S	S	S	S					

Sources of cover for >10cm trout

What percentage of the stream bed area in each section could provide cover (for a >10cm trout) in the form of *submerged overhang*, or *overhang within 0.5m of the water surface*?
Indicate the abundance of cover within the various categories which are listed below. For 'submerged vegetation' include all macrophytes, mosses and algae which are providing cover. Estimate as 0, 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%.

Source of cover

Submerged vegetation	0	0	0	0	0					
Boulders, cobbles, etc.	0	0	0	0	1					
Tree root systems	3	3	1	2	1					
Branches and logs	0	0	2	0	0					
Undercut banks	1	2	2	2	1					
Other submerged cover	1	1	0	0	0					
Overhang ***within 0.5m***	0	1	0	1	0					
Area of deep water	0	0	0	0	0					

HABSCORE for Windows v1.1 : MAP*form*
Catchment data

Site identification

Site code		Catchment	
Site name	**Site 2a**	NGR	**SX5984855500**
River name	**Yealm**	Date	**21/09/11**

Riparian shading of the site

What percentage of the water surface of the site is overhung by riparian vegetation? Estimate this percentage, for the three vegetation classes indicated, to the nearest 5%.

Deciduous trees & shrubs [85] Coniferous trees [X] Herbaceous vegetation [X]

Migratory access

What is the accessibility of the site ?

	Salmon	Sea trout
Always accessible	x	x
Sometimes accessible		
Never accessible		

Substrate embededness

What is the degree of substrate embededness throughout the site? Tick one box.

High [ ] Medium [ ] Low [x]

Flow conditions

Briefly describe the prevailing flow conditions (as observed at the time of the HABSCORE survey) in the space provided below.

Normal Autumn Flow

Upstream land-use considerations

What is the principal land-use immediately upstream of the site? Tick appropriate box(es).

Moor / heathland	[ ]	Coniferous woodland	[ ]	Deciduous woodland	[x]
Rough pasture	[ ]	Urban development	[ ]	Other	[ ]
Improved pasture	[x]	Industrial land	[ ]	.....	
Arable land	[ ]	Tips / waste	[ ]	.....	

Potential impacts

Are there likely to be any impacts at the site from the following sources? Tick appropriate box(es).

pH effects	[ ]	Stocking	[ ]	Other	[ ]
Migration barriers	[ ]	Habitat modification	[ ]	**Not Known**	
River engineering	[ ]	Low flows	[ ]		
Pollution	[ ]	Flow regulation	[ ]		

Width and depth profile at bottom stop net

Record widths to the nearest 0.1m and depths to the nearest 1.0cm.

Channel width	10.1
Depth at ¼ channel width	29
Depth at ½ channel width	33
Depth at ¾ channel width	25

Section dimensions

Record section lengths and widths to the nearest 0.1m and depths to the nearest 1.0cm.

Section length	10	10	10	10	10					
Section width	8.3	10.6	10.5	9.9	8.4					
Depth at ¼ channel width	16	27	24	62	81					
Depth at ½ channel width	49	33	58	73	74					
Depth at ¾ channel width	12	64	32	70	49					

Substrate

Absent	Scarce	Common	Frequent	Dominant
0%	>0% & <5%	≥5% & <20%	≥20% & <50%	≥50%
A	***S***	***C***	***F***	***D***

What percentage of the stream bed area in each section is composed of the following substrate types? Enter *A*, *S*, *C*, *F* or *D* as appropriate (see above table).

Substrate category

Bedrock / artificial	C	F	D	C	C					
Boulders ***>25.6 cm***	S	s	S	S	S					
Cobbles ***6.4-25.6 cm***	D	F	F	F	C					
Gravel / coarse sand ***0.2-6.4 cm***	S	S	S	S	S					
Fine sand / silt ***<0.2 cm***	A	A	A	A	A					
Compacted clay										

Flow

What percentage of the water surface area in each section is composed of the following flow types? Enter *A*, *S*, *C*, *F* or *D* as appropriate.

Flow category

Cascade / torrential	A	A	A	A	A					
Turbulent / broken ***deep***	F	F	D	C	C					
Turbulent / broken ***shallow***	F	F	F	C	C					
Glide / run ***deep***	A	A	A	F	D					
Glide / run ***shallow***	A	A	A	C	C					
Slack ***deep***	S	S	S	S	S					
Slack ***shallow***	S	S	S	S	S					

Sources of cover for >10cm trout

What percentage of the stream bed area in each section could provide cover (for a >10cm trout) in the form of *submerged overhang*, or *overhang within 0.5m of the water surface*?
Indicate the abundance of cover within the various categories which are listed below. For 'submerged vegetation' include all macrophytes, mosses and algae which are providing cover. Estimate as 0, 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%.

Source of cover

Submerged vegetation	1	0	0	0	0					
Boulders, cobbles, etc.	1	1	1	1	0					
Tree root systems	2	3	0	1	3					
Branches and logs	0	2	1	3	0					
Undercut banks	1	0	0	0	0					
Other submerged cover	0	0	0	0	0					
Overhang ***within 0.5m***	1	2	1	1	1					
Area of deep water	0	0	0	0	1					

HABSCORE for Windows v1.1 : HAB*form*
Site habitat record

NB - this form is double sided

Site identification

Site code		Catchment	
Site name	**Site 3**	NGR	**SX 59800 54573**
River name	**Yealm**	Survey date	**21/9/11**

Riparian shading of the site

What percentage of the water surface of the site is overhung by riparian vegetation? Estimate this percentage, for the three vegetation classes indicated, to the nearest 5%.

Deciduous trees & shrubs	95	Coniferous trees	x	Herbaceous vegetation	x

Migratory access

What is the accessibility of the site ?

	Salmon	Sea trout
Always accessible	x	x
Sometimes accessible		
Never accessible		

Substrate embededness

What is the degree of substrate embededness throughout the site? Tick one box.

High		Medium		Low	x

Flow conditions

Briefly describe the prevailing flow conditions (as observed at the time of the HABSCORE survey) in the space provided below.

Slightly elevated Autumn flow – Water clear

Upstream land-use considerations

What is the principal land-use immediately upstream of the site? Tick appropriate box(es).

Moor / heathland		Coniferous woodland		Deciduous woodland	x
Rough pasture		Urban development		Other	
Improved pasture		Industrial land		.....	
Arable land		Tips / waste		.....	

Potential impacts

Are there likely to be any impacts at the site from the following sources? Tick appropriate box(es).

pH effects		Stocking		Other	
Migration barriers		Habitat modification		**Not known**	
River engineering		Low flows			
Pollution		Flow regulation			

Width and depth profile at bottom stop net

Record widths to the nearest 0.1m and depths to the nearest 1.0cm.

Channel width	8.7
Depth at ¼ channel width	70
Depth at ½ channel width	42
Depth at ¾ channel width	55

Section dimensions

Record section lengths and widths to the nearest 0.1m and depths to the nearest 1.0cm.

Section length	10	10	10	10	10					
Section width	8.2	4.5	9	7.9	7.6					
Depth at ¼ channel width	45	33	45	43	63					
Depth at ½ channel width	51	41	35	43	59					
Depth at ¾ channel width	29	37	30	24	22					

Substrate

Absent	Scarce	Common	Frequent	Dominant
0%	>0% & <5%	≥5% & <20%	≥20% & <50%	≥50%
A	***S***	***C***	***F***	***D***

What percentage of the stream bed area in each section is composed of the following substrate types? Enter *A*, *S*, *C*, *F* or *D* as appropriate (see above table).

Substrate category

Bedrock / artificial	A	A	A	A	A					
S	S	S	C	S	S					
Cobbles ***6.4-25.6 cm***	D	F	F	D	D					
Gravel / coarse sand ***0.2-6.4 cm***	F	F	F	F	F					
Fine sand / silt ***<0.2 cm***	S	S	S	S	S					
Compacted clay	A	A	A	A	A					

Flow

What percentage of the water surface area in each section is composed of the following flow types? Enter *A*, *S*, *C*, *F* or *D* as appropriate.

Flow category

Cascade / torrential	A	A	A	A	A					
Turbulent / broken ***deep***	D	D	D	D	D					
Turbulent / broken ***shallow***	F	F	C	F	F					
Glide / run ***deep***	A	A	A	A	A					
Glide / run ***shallow***	A	A	A	A	A					
Slack ***deep***	S	A	A	A	A					
Slack ***shallow***	S	S	S	S	S					

Sources of cover for >10cm trout

What percentage of the stream bed area in each section could provide cover (for a >10cm trout) in the form of *submerged overhang*, or *overhang within 0.5m of the water surface*?
Indicate the abundance of cover within the various categories which are listed below. For 'submerged vegetation' include all macrophytes, mosses and algae which are providing cover. Estimate as 0, 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%.

Source of cover

Submerged vegetation	1	0	0	0	0					
Boulders, cobbles, etc.	2	1	2	2	1					
Tree root systems	1	1	1	1	2					
Branches and logs	0	0	1	1	0					
Undercut banks	1	1	1	1	1					
Other submerged cover	0	0	0	0	0					
Overhang ***within 0.5m***	1	1	1	1	1					
Area of deep water	0	0	0	0	0					

HABSCORE for Windows v1.1 : HAB*form*
Site habitat record
NB - this form is double sided

Site identification

Site code		Catchment	
Site name	**Site 4**	NGR	**SX 59889 54417**
River name	**Yealm**	Survey date	**21/09/2011**

Riparian shading of the site

What percentage of the water surface of the site is overhung by riparian vegetation? Estimate this percentage, for the three vegetation classes indicated, to the nearest 5%.

Deciduous trees & shrubs	95	Coniferous trees	X	Herbaceous vegetation	X

Migratory access

What is the accessibility of the site ?

	Salmon	Sea trout
Always accessible	x	x
Sometimes accessible		
Never accessible		

Substrate embededness

What is the degree of substrate embededness throughout the site? Tick one box.

High		Medium		Low	x

Flow conditions

Briefly describe the prevailing flow conditions (as observed at the time of the HABSCORE survey) in the space provided below.

Slightly elevated Autumn flow. Water Clear

Upstream land-use considerations

What is the principal land-use immediately upstream of the site? Tick appropriate box(es).

Moor / heathland		Coniferous woodland		Deciduous woodland	x
Rough pasture		Urban development		Other	
Improved pasture		Industrial land		.....	
Arable land		Tips / waste		.....	

Potential impacts

Are there likely to be any impacts at the site from the following sources? Tick appropriate box(es).

pH effects		Stocking		Other	
Migration barriers		Habitat modification		**Not known**	
River engineering		Low flows			
Pollution		Flow regulation			

Width and depth profile at bottom stop net

Record widths to the nearest 0.1m and depths to the nearest 1.0cm.

Channel width	8.1
Depth at ¼ channel width	71
Depth at ½ channel width	69
Depth at ¾ channel width	51

Section dimensions

Record section lengths and widths to the nearest 0.1m and depths to the nearest 1.0cm.

Section length	10	10	10	10	10					
Section width	8	8.1	10.1	10.3	8.7					
Depth at ¼ channel width	50	35	20	10	16					
Depth at ½ channel width	35	25	20	25	40					
Depth at ¾ channel width	21	20	27	50	55					

Substrate

Absent	Scarce	Common	Frequent	Dominant
0%	>0% & <5%	≥5% & <20%	≥20% & <50%	≥50%
A	***S***	***C***	***F***	***D***

What percentage of the stream bed area in each section is composed of the following substrate types? Enter *A*, *S*, *C*, *F* or *D* as appropriate (see above table).

Substrate category

Bedrock / artificial	S	A	A	A	A					
Boulders ***>25.6 cm***	S	S	C	S	S					
Cobbles ***6.4-25.6 cm***	F	F	D	D	D					
Gravel / coarse sand ***0.2-6.4 cm***	D	F	D	D	D					
Fine sand / silt ***<0.2 cm***	S	S	S	S	S					
Compacted clay	A	A	A	A	A					

Flow

What percentage of the water surface area in each section is composed of the following flow types? Enter *A*, *S*, *C*, *F* or *D* as appropriate.

Flow category

Cascade / torrential	A	A	A	A	A					
Turbulent / broken ***deep***	D	F	C	C	F					
Turbulent / broken ***shallow***	F	F	D	D	F					
Glide / run ***deep***	A	A	A	A	A					
Glide / run ***shallow***	A	A	A	A	A					
Slack ***deep***	S	A	A	S	A					
Slack ***shallow***	S	S	S	S	S					

Sources of cover for >10cm trout

What percentage of the stream bed area in each section could provide cover (for a >10cm trout) in the form of *submerged overhang*, or *overhang within 0.5m of the water surface*?
Indicate the abundance of cover within the various categories which are listed below. For 'submerged vegetation' include all macrophytes, mosses and algae which are providing cover. Estimate as 0, 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%.

Source of cover

Submerged vegetation	0	0	0	0	0					
Boulders, cobbles, etc.	2	1	1	1	1					
Tree root systems	1	1	0	3	2					
Branches and logs	1	0	0	0	0					
Undercut banks	1	2	1	2	3					
Other submerged cover	0	0	0	0	0					
Overhang ***within 0.5m***	1	1	1	1	1					
Area of deep water	2	0	0	0	0					

HABSCORE for Windows v1.1 : HAB*form*
Site habitat record

NB - this form is double sided

Site identification

Site code		Catchment	
Site name	**Site 5**		**SX 59740 54169**
River name	**Yealm**	Survey date	**21/09/11**

Riparian shading of the site

What percentage of the water surface of the site is overhung by riparian vegetation? Estimate this percentage, for the three vegetation classes indicated, to the nearest 5%.

Deciduous trees & shrubs	95	Coniferous trees	x	Herbaceous vegetation	x

Migratory access

What is the accessibility of the site ?

	Salmon	Sea trout
Always accessible	x	x
Sometimes accessible		
Never accessible		

Substrate embededness

What is the degree of substrate embededness throughout the site? Tick one box.

High		Medium		Low	x

Flow conditions

Briefly describe the prevailing flow conditions (as observed at the time of the HABSCORE survey) in the space provided below.

Slightly elevated Autumn flow. Water Clear

Upstream land-use considerations

What is the principal land-use immediately upstream of the site? Tick appropriate box(es).

Moor / heathland		Coniferous woodland		Deciduous woodland	x
Rough pasture		Urban development		Other	
Improved pasture		Industrial land		.....	
Arable land		Tips / waste		.....	

Potential impacts

Are there likely to be any impacts at the site from the following sources? Tick appropriate box(es).

pH effects		Stocking		Other	
Migration barriers		Habitat modification		**Not known.**	
River engineering		Low flows			
Pollution		Flow regulation			

Width and depth profile at bottom stop net

Record widths to the nearest 0.1m and depths to the nearest 1.0cm.

Channel width	11.
Depth at ¼ channel width	19
Depth at ½ channel width	23
Depth at ¾ channel width	24

Section dimensions

Record section lengths and widths to the nearest 0.1m and depths to the nearest 1.0cm.

Section length	10	10	10	10	10					
Section width	11.2	9.3	9.1	9.6	10.2					
Depth at ¼ channel width	19	59	51	39	31					
Depth at ½ channel width	29	38	43	41	34					
Depth at ¾ channel width	53	21	27	62	31					

Substrate

Absent	Scarce	Common	Frequent	Dominant
0%	>0% & <5%	≥5% & <20%	≥20% & <50%	≥50%
A	***S***	***C***	***F***	***D***

What percentage of the stream bed area in each section is composed of the following substrate types? Enter *A*, *S*, *C*, *F* or *D* as appropriate (see above table).

Substrate category

Bedrock / artificial	A	A	A	A	A					
Boulders ***>25.6 cm***	S	S	S	S	S					
Cobbles ***6.4-25.6 cm***	D	D	D	F	F					
Gravel / coarse sand ***0.2-6.4 cm***	F	F	F	F	F					
Fine sand / silt ***<0.2 cm***	S	S	S	S	S					
Compacted clay	A	A	A	A	A					

Flow

What percentage of the water surface area in each section is composed of the following flow types? Enter *A*, *S*, *C*, *F* or *D* as appropriate.

Flow category

Cascade / torrential	A	A	S	A	A					
Turbulent / broken ***deep***	C	F	D	D	F					
Turbulent / broken ***shallow***	D	F	C	C	F					
Glide / run ***deep***	A	A	A	A	A					
Glide / run ***shallow***	A	A	A	S	a					
Slack ***deep***	S	S	S	S	S					
Slack ***shallow***	S	S	S	S	S					

Sources of cover for >10cm trout

What percentage of the stream bed area in each section could provide cover (for a >10cm trout) in the form of *submerged overhang*, or *overhang within 0.5m of the water surface*?
Indicate the abundance of cover within the various categories which are listed below. For 'submerged vegetation' include all macrophytes, mosses and algae which are providing cover. Estimate as 0, 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%.

Source of cover

Submerged vegetation	0	1	0	0	0					
Boulders, cobbles, etc.	0	1	2	1	1					
Tree root systems	2	2	1	1	3					
Branches and logs	1	0	3	2	0					
Undercut banks	2	2	1	2	1					
Other submerged cover	0	0	0	0	0					
Overhang ***within 0.5m***	2	1	1	2	1					
Area of deep water	0	0	0	0	0					

HABSCORE for Windows v1.1 : HAB*form*
Site habitat record

NB - this form is double sided

Site identification

Site code		Catchment	
Site name	**Site 6A**	NGR	**SX 59427 53511**
River name	**Yealm**	Survey date	**22-09-11**

Riparian shading of the site

What percentage of the water surface of the site is overhung by riparian vegetation? Estimate this percentage, for the three vegetation classes indicated, to the nearest 5%.

Deciduous trees & shrubs	70	Coniferous trees	X	Herbaceous vegetation	X

Migratory access

What is the accessibility of the site ?

	Salmon	Sea trout
Always accessible	x	x
Sometimes accessible		
Never accessible		

Substrate embededness

What is the degree of substrate embededness throughout the site? Tick one box.

High		Medium		Low	x

Flow conditions

Briefly describe the prevailing flow conditions (as observed at the time of the HABSCORE survey) in the space provided below.

Normal Autumn flow.

Upstream land-use considerations

What is the principal land-use immediately upstream of the site? Tick appropriate box(es).

Moor / heathland		Coniferous woodland		Deciduous woodland	x
Rough pasture		Urban development		Other	
Improved pasture	x	Industrial land		.....	
Arable land		Tips / waste		.....	

Potential impacts

Are there likely to be any impacts at the site from the following sources? Tick appropriate box(es).

pH effects		Stocking		Other	
Migration barriers		Habitat modification		Not Known.	
River engineering		Low flows			
Pollution		Flow regulation			

Width and depth profile at bottom stop net

Record widths to the nearest 0.1m and depths to the nearest 1.0cm.

Channel width	5.9
Depth at ¼ channel width	70
Depth at ½ channel width	50
Depth at ¾ channel width	35

Section dimensions

Record section lengths and widths to the nearest 0.1m and depths to the nearest 1.0cm.

Section length	10	10	10	10	10					
Section width	5.3	9	8	5.6	5.5					
Depth at ¼ channel width	12	20	15	12	20					
Depth at ½ channel width	22	19	21	23	42					
Depth at ¾ channel width	35	22	40	42	42					

Substrate

Absent	Scarce	Common	Frequent	Dominant
0%	>0% & <5%	≥5% & <20%	≥20% & <50%	≥50%
A	***S***	***C***	***F***	***D***

What percentage of the stream bed area in each section is composed of the following substrate types? Enter *A*, *S*, *C*, *F* or *D* as appropriate (see above table).

Substrate category

Bedrock / artificial	A	A	A	A	A					
Boulders ***>25.6 cm***	S	S	S	S	C					
Cobbles ***6.4-25.6 cm***	D	D	D	D	D					
Gravel / coarse sand ***0.2-6.4 cm***	F	F	C	F	F					
Fine sand / silt ***<0.2 cm***	A	S	S	S	S					
Compacted clay	A	A	A	A	A					

Flow

What percentage of the water surface area in each section is composed of the following flow types? Enter *A*, *S*, *C*, *F* or *D* as appropriate.

Flow category

Cascade / torrential	A	A	A	A	A					
Turbulent / broken ***deep***	D	F	C	F	D					
Turbulent / broken ***shallow***	F	F	D	F	F					
Glide / run ***deep***	A	A	A	A	A					
Glide / run ***shallow***	A	A	A	A	A					
Slack ***deep***	A	A	A	S	A					
Slack ***shallow***	S	S	S	S	S					

Sources of cover for >10cm trout

What percentage of the stream bed area in each section could provide cover (for a >10cm trout) in the form of *submerged overhang*, or *overhang within 0.5m of the water surface*?
Indicate the abundance of cover within the various categories which are listed below. For 'submerged vegetation' include all macrophytes, mosses and algae which are providing cover. Estimate as 0, 1, 2, 3, 4, 5, 10, 15, 20, 25, ... 100%.

Source of cover

Submerged vegetation	0	1	0	0	0					
Boulders, cobbles, etc.	1	1	1	0	1					
Tree root systems	0	0	1	0	2					
Branches and logs	0	1	1	0	2					
Undercut banks	2	0	1	2	3					
Other submerged cover	0	0	0	0	0					
Overhang ***within 0.5m***	1	1	1	1	2					
Area of deep water	1	0	0	1	1					

APPENDIX V FISHERY WALKOVER MAPS

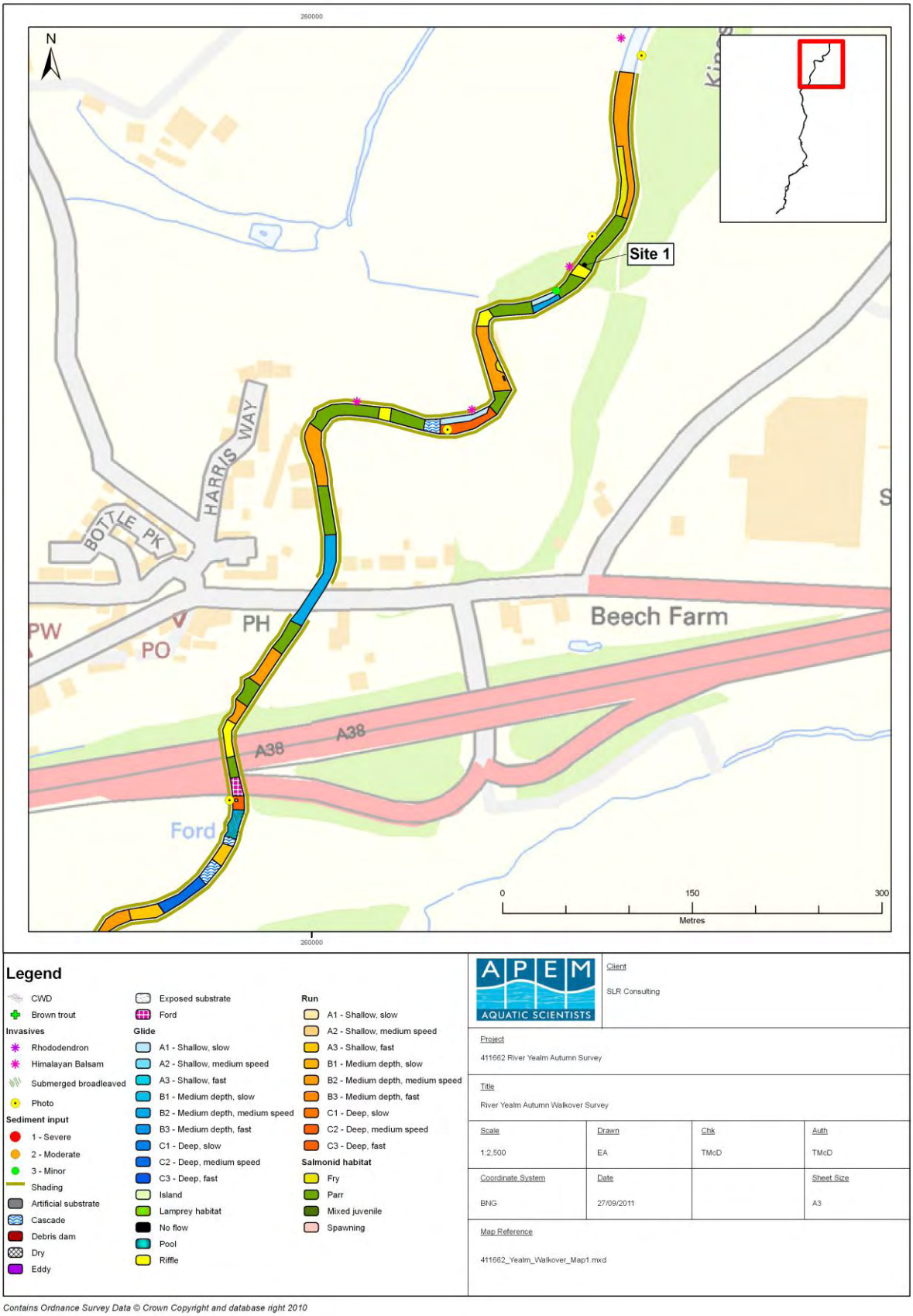

Figure A.5.1 Habitat walkover map 1

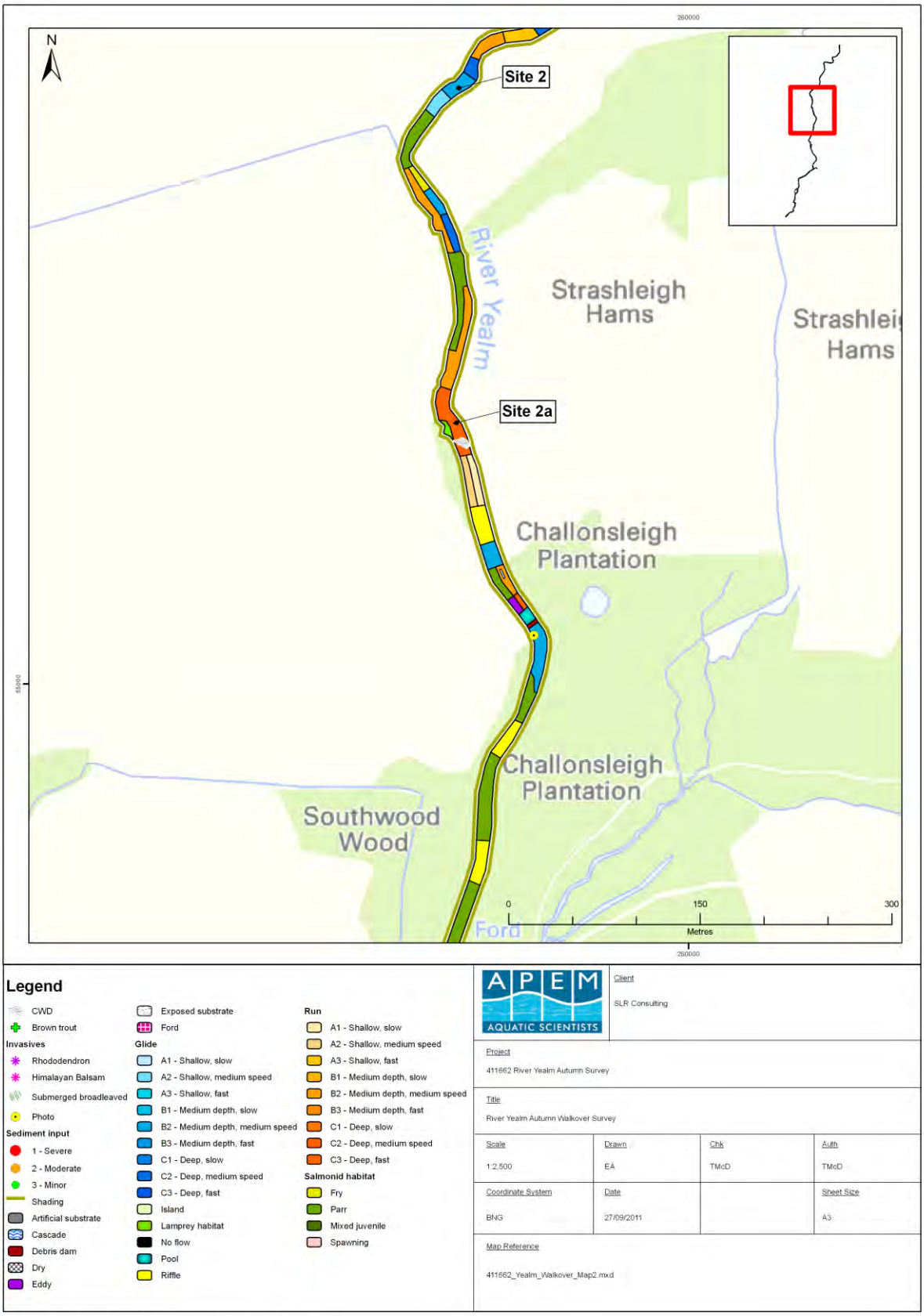

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Figure A.5.2 Habitat walkover map 2

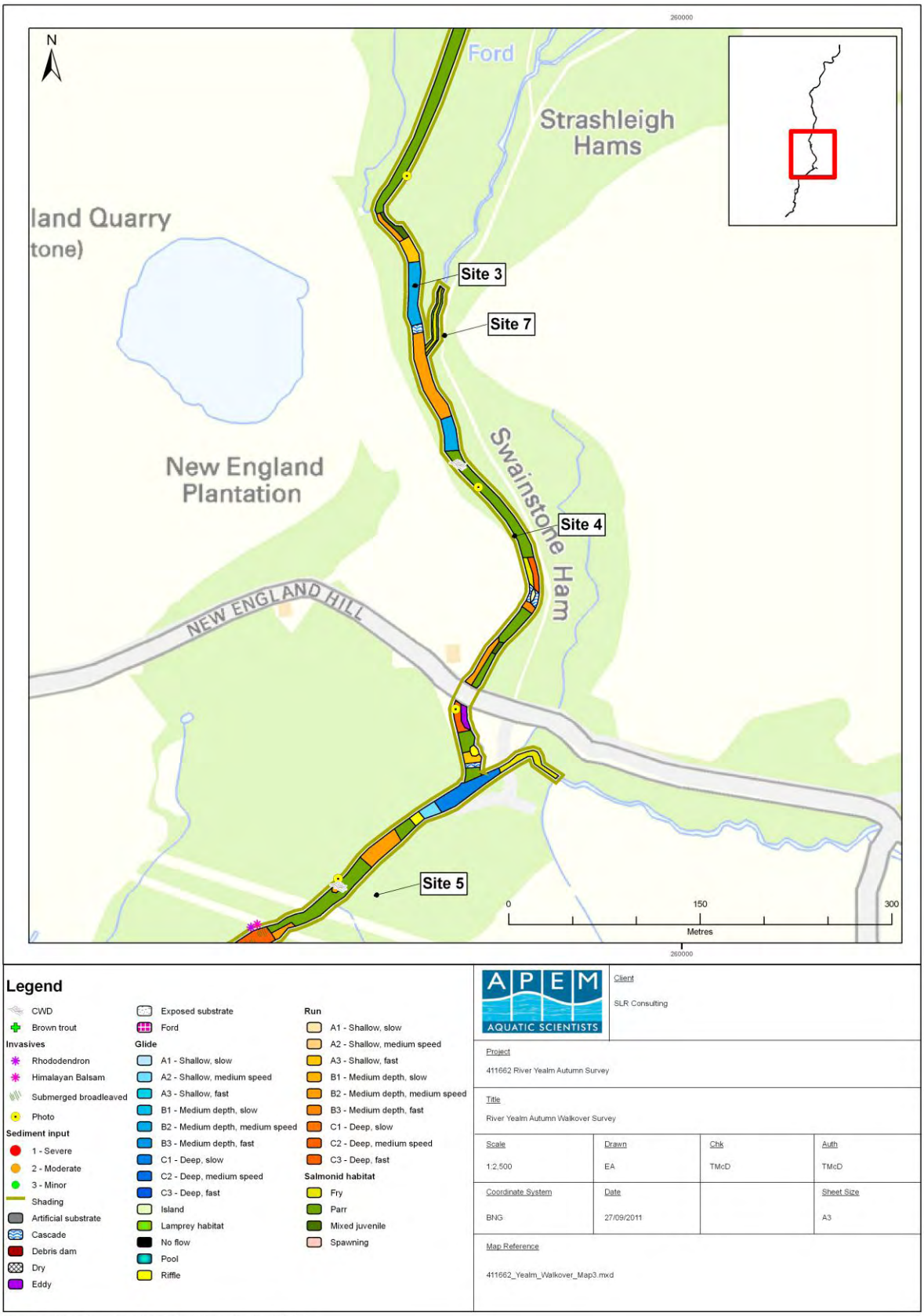


Figure A.5.3 Habitat walkover map 3

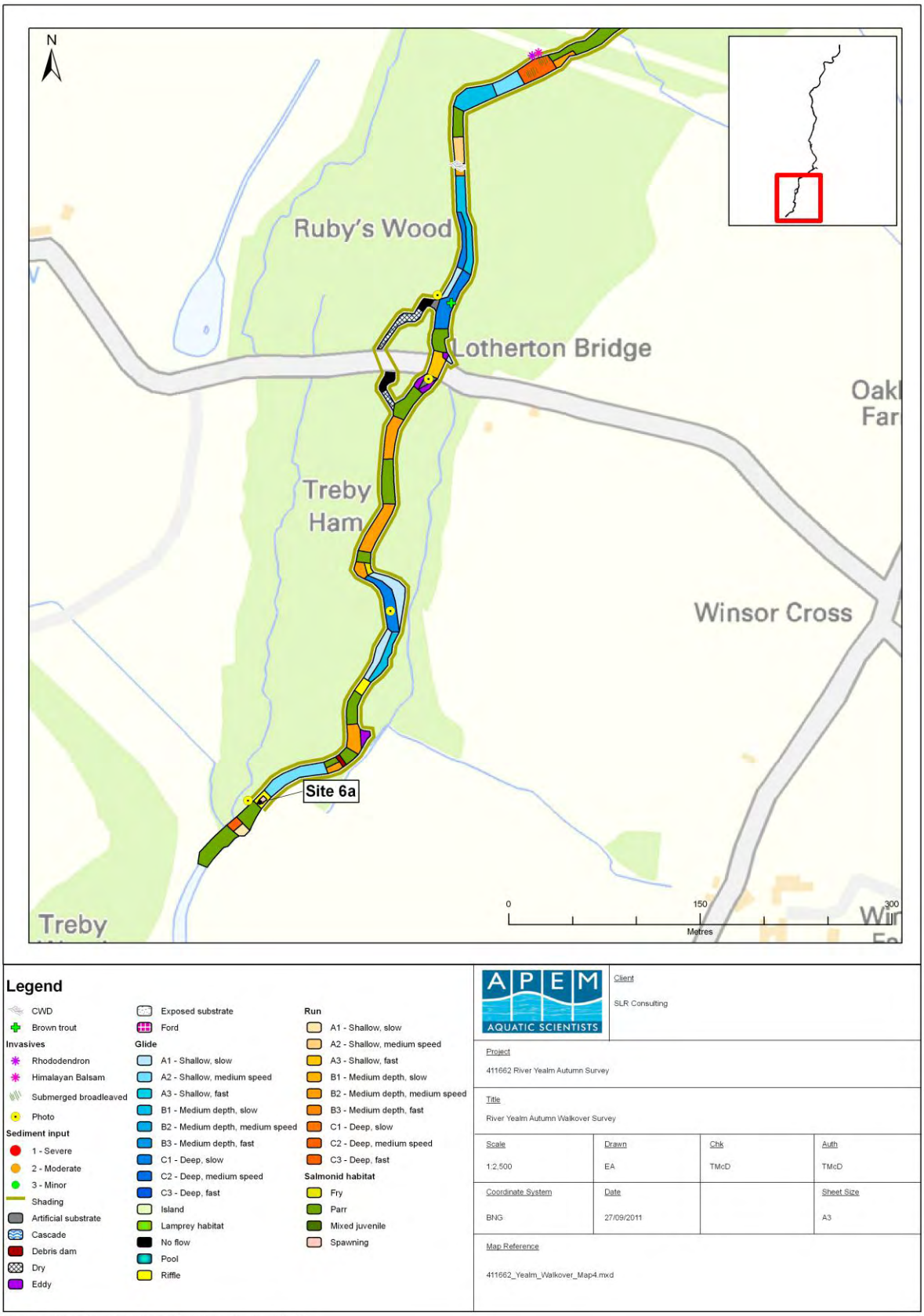
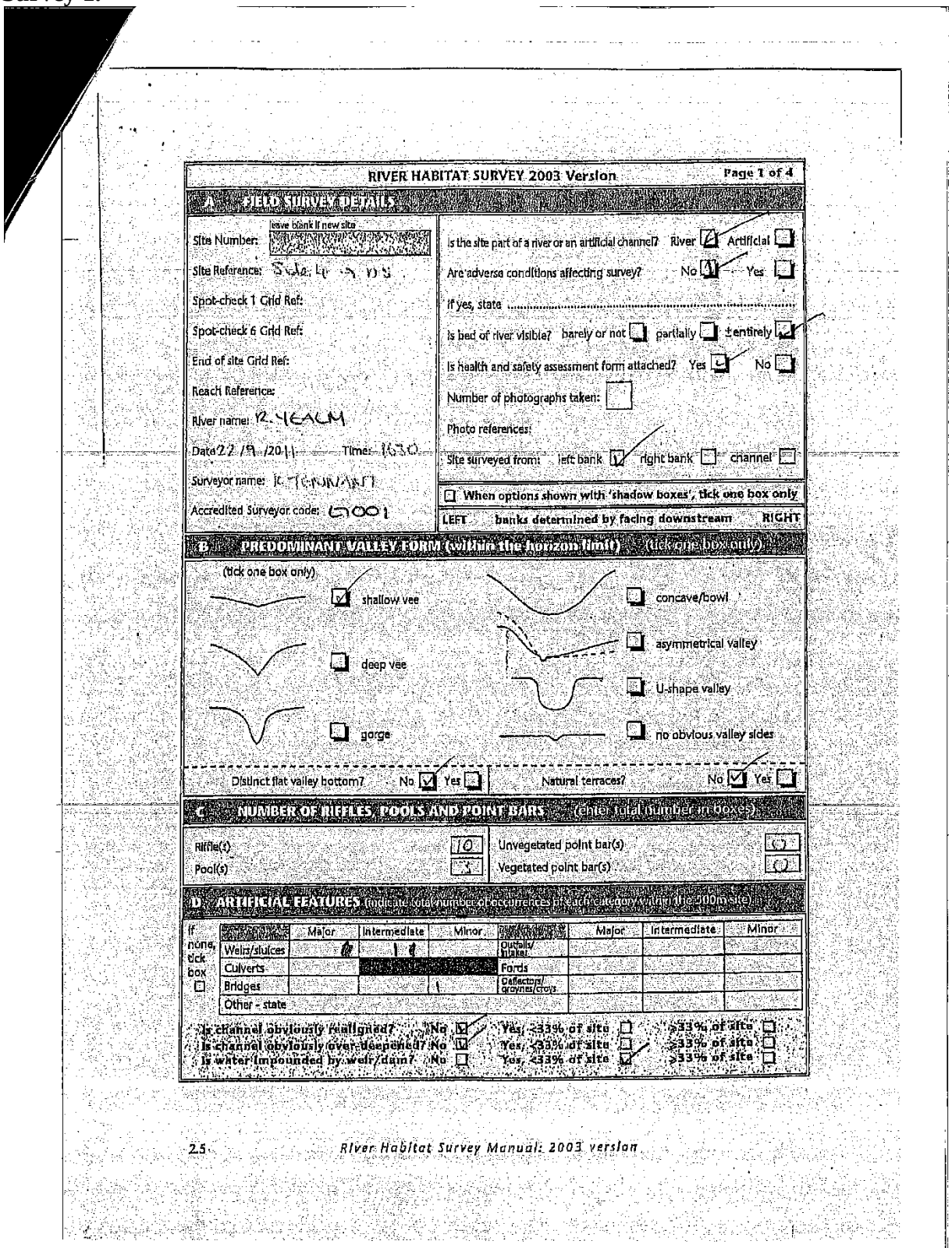


Figure A.5.4 Habitat walkover map 4

APPENDIX VI RIVER HABITAT SURVEY (RHS) SHEETS

Survey 1.



RIVER HABITAT SURVEY 2003 Version — Page 1 of 4

A FIELD SURVEY DETAILS

Site Number: (leave blank if new site)
Site Reference:
Spot-check 1 Grid Ref:
Spot-check 6 Grid Ref:
End of site Grid Ref:
Reach Reference:
River name: R. YEALM
Date 22 /9 /2011 Time: 1030
Surveyor name: K. TURNBULL
Accredited Surveyor code: 0001

Is the site part of a river or an artificial channel? River ☑ Artificial ☐
Are adverse conditions affecting survey? No ☑ Yes ☐
If yes, state .....
Is bed of river visible? barely or not ☐ partially ☐ entirely ☑
Is health and safety assessment form attached? Yes ☑ No ☐
Number of photographs taken: 1
Photo references:
Site surveyed from: left bank ☑ right bank ☐ channel ☐

☐ When options shown with 'shadow boxes', tick one box only
LEFT banks determined by facing downstream RIGHT

B PREDOMINANT VALLEY FORM (within the horizontal limit) (tick one box only)

(tick one box only)
☑ shallow vee
☐ deep vee
☐ gorge
☐ concave/bowl
☐ asymmetrical valley
☐ U-shape valley
☐ no obvious valley sides

Distinct flat valley bottom? No ☑ Yes ☐
Natural terraces? No ☑ Yes ☐

C NUMBER OF RIFFLES, POOLS AND POINT BARS (enter total number in boxes)

Riffle(s) 10
Pool(s) 3
Unvegetated point bar(s) 2
Vegetated point bar(s) 0

D ARTIFICIAL FEATURES (indicate total number of occurrences of each category within the 500m site)

If none, tick box ☐

	Major	Intermediate	Minor		Major	Intermediate	Minor
Weirs/sluices		1	1	Outfalls/ Intakes			
Culverts				Fords			
Bridges			1	Deflectors/ groynes/croys			
Other - state							

Is channel obviously realigned? No ☑ Yes, ≤33% of site ☐ >33% of site ☐
Is channel obviously over-deepened? No ☑ Yes, ≤33% of site ☐ >33% of site ☐
Is water impounded by weir/dam? No ☐ Yes, ≤33% of site ☑ >33% of site ☐

2.5 *River Habitat Survey Manual: 2003 version*

SITE REF.

RIVER HABITAT SURVEY: TEN SPOT-CHECKS Page 2 of 4

Spot-check 1 is at: upstream end ☑ downstream end ☐ of site (tick one box)

4 PHYSICAL ATTRIBUTES (Left Bank, Channel, Right Bank)

When boxes 'bordered', only one entry allowed	1 GPS	2	3	4	5	6 GPS	7	8	9	10	GPS
LEFT BANK											
Material NV, BE, BO, CO, CS, EA, PE, CL, CC, SP, WP, CA, ST, BR, TD, EA, SI	BP	EA	BR	EA	EA	EA	EA	EA	EA	EA	
Bank modification(s) NK, NO, RS, RI, PC(B), BM, EM	RI	NO	RI	NO	NO	NO	NO	NO	NO	NO	
Marginal & bank feature(s) NV, NO, BC, SC, PB, VP, SB, VS, NB	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
CHANNEL											
Channel substrate NV, BE, BO, CO, GP, SA, SI, CL, PE, EA, AR	CO	CO	GP	GP	GY	SP	GP	CO	GP	GP	
Flow-type NV, FF, CH, BW, UW, CP, RF, UP, SM, NP, DR	BW	RP	BW	RP	RP	UW	UW	BW	RP	RP	
Channel modification(s) NK, NO, CY, RS, RI, DA, FO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Channel feature(s) NV, NO, EB, RO, VR, MB, VB, MI, TR	RO	MB	RO	NO	NO	NO	NO	NO	MB	NO	
For braided rivers only: number of sub-channels											
RIGHT BANK											
Material NV, BE, BO, CO, CS, EA, PE, CL, CC, SP, WP, CA, BR, BM, TD, EA, SI	GP	RO	BO	NO	RO	BO	EA	EA	EA	EA	
Bank modification(s) NK, NO, RS, RI, PC(B), BM, EM	NO	RI	RI	RI	RI	RI	NO	NO	NO	NO	
Marginal & bank feature(s) NV, NO, BC, SC, PB, VP, SB, VS, NB	SB	NO	NO	NO	NO	NO	NO	NO	NO	NO	

Enter channel substrate(s) not occurring as predominant in spot-checks but present in >1% of whole site.

5 BANKTOP LAND-USE AND VEGETATION STRUCTURE (Left Bank, Right Bank)

Land-use: choose one from BL, BP, CW, CP, SH, OR, WL, MH, AW, OW, RP, IG, TH, RD, SU, TL, IL, PG, NV

LAND-USE WITHIN 5m OF LEFT BANKTOP	BL	BL	BL	BL	BL	BL	BL	BL	BL	BL
LEFT BANKTOP (structure within 1m) B/U/S/C/NV	C	C	U	C	U	U	C	C	C	C
LEFT BANK-FACE (structure) B/U/S/C/NV	U	U	U	S	U	U	U	U	U	S
RIGHT BANK-FACE (structure) B/U/S/C/NV	U	U	S	U	U	U	U	S	U	S
RIGHT BANKTOP (structure within 1m) B/U/S/C/NV	C	C	C	C	C	U	C	C	C	C
LAND-USE WITHIN 5m OF RIGHT BANKTOP	BL	BL	BL	BL	BL	BL	BL	BL	BL	BL

6 CHANNEL VEGETATION TYPES (Left Bank, Channel, Right Bank)

None (✓) or Not Visible (NV)										
Liverworts/mosses/lichens	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Emergent broad-leaved herbs										
Emergent reeds/sedges/rushes/grasses/horsetails										
Floating-leaved (rooted)										
Free-floating										
Amphibious									✓	
Submerged broad-leaved									✓	
Submerged linear-leaved										
Submerged fine-leaved										
Filamentous algae									✓	

Use end column for overall assessment over 500m, including types not occurring in spot-checks (use ✓, E or NV)

SITE REF.	RIVER HABITAT SURVEY : 500m SWEEP-UP	Page 3 of 4

4 LAND USE WITHIN 50m OF BANKTOP (tick one box per column)

	L	R		L	R
Broadleaf/mixed woodland (semi-natural) (BL)	E	E	Natural open water (OW)		
Broadleaf/mixed plantation (BP)			Rough/unimproved grassland/pasture (RP)		
Coniferous woodland (semi-natural) (CW)			Improved/semi-improved grassland (IG)		
Coniferous plantation (CP)			Tall herb/rank vegetation (TH)	E	E
Scrub & shrubs (SH)	✓	✓	Rock, scree or sand dunes (RD)		
Orchard (OR)			Suburban/urban development (SU)		
Wetland (e.g. bog, marsh, fen) (WL)			Tilled land (TL)		
Moorland/heath (MH)			Irrigated land (IL)		
Artificial open water (AW)			Parkland or gardens (PG)		
			Not visible (NV)		

5 BANK PROFILE (tick one box per column)

Natural/unmodified	L	R	Artificial/modified	L	R
Vertical/undercut	E	E	Resectioned (reprofiled)		
Vertical with toe			Reinforced - whole	✓	E
Steep (>45°)	✓	✓	Reinforced - top only		
Gentle	✓		Reinforced - toe only		
Composite			Artificial two-stage		
Natural berm			Poached bank		
			Embanked	✓	
			Set-back embankment		

6 EXTENT OF TREES AND ASSOCIATED FEATURES

TREES (tick one box per bank)	Left	Right
None		
Isolated/scattered		
Regularly spaced, single		
Occasional clumps		
Semi-continuous		
Continuous	☑	✓

ASSOCIATED FEATURES (tick one box per feature)	None	Present	E (>33%)
Shading of channel			☑
*Overhanging boughs		☑	
*Exposed bankside roots		☑	
*Underwater tree roots		☑	
Fallen trees		☑	
Large woody debris		☑	

7 EXTENT OF CHANNEL AND BANK FEATURES

	None	Present	E (>33%)
*Free fall flow	☑		
Chute flow		☑	
Broken standing waves		☑	
Unbroken standing waves		☑	
Rippled flow		☑	
*Upwelling		☑	
Smooth flow		☑	
No perceptible flow	☑		
No flow (dry)	☑		
Marginal deadwater	☑		
Eroding cliff(s)	☑		
Stable cliff(s)	☑		

	None	Present	E (>33%)
Exposed bedrock	☑		
Exposed boulders		☑	
Vegetated bedrock/boulders		☑	
Unvegetated mid-channel bar(s)		☑	
Vegetated mid-channel bar(s)		☑	
Mature island(s)		☑	
Unvegetated side bar(s)		☑	
Vegetated side bar(s)		☑	
Unvegetated point bar(s)		☑	
Vegetated point bar(s)		☑	
*Unvegetated silt deposit(s)	☑		
*Discrete unvegetated sand deposit(s)	☑		
*Discrete unvegetated gravel deposit(s)	☑		

SITE REF.	RIVER HABITAT SURVEY : DIMENSIONS AND INFLUENCES	Page 4 of 4

L CHANNEL DIMENSIONS

LEFT BANK		CHANNEL		RIGHT BANK	
Banktop height (m)	1.2	Bankfull width (m)	12	Banktop height (m)	1.2
Is banktop height also bankfull height? (Y or N)	Y	Water width (m)	10	Is banktop height also bankfull height? (Y or N)	Y
Embanked height (m)	–	Water depth (m)	0.3	Embanked height (m)	–

If trashline lower than banktop, indicate: height above water (m) = width from bank to bank (m) =

Bed material at site is: consolidated ☐ unconsolidated (loose) ☑ unknown ☐

Location of measurements is: riffle ☑ other ☐ (state)

M FEATURES OF SPECIAL INTEREST

None	☐	Very large boulders (>1m)	☑	Backwater(s)	☐	Marsh(es)	☐
Braided channels	☐	*Debris dam(s)	☑	Floodplain boulder deposits	☐	Flush(es)	☐
Side channel(s)	☐	*Leafy debris	☑	Water meadow(s)	☐	Natural open water	☐
*Natural waterfall(s) > 5m high	☐	Fringing reed-bank(s)	☐	Fen(s)	☐	Others (state)	☐
*Natural waterfall(s) < 5m high	☐	Quaking bank(s)	☐	Bog(s)	☐		
Natural cascade(s)	☐	*Sink hole(s)	☐	Wet woodland(s)	☐		

N CHOKED CHANNEL

Is 33% or more of the channel choked with vegetation? No ☑ Yes ☐

O NOTABLE NUISANCE PLANT SPECIES

		bankface	banktop to 50m		bankface	banktop to 50m
None ☐	*Giant hogweed	☐	☐	*Himalayan balsam	☑	☑
	*Japanese knotweed	☐	☐	*Other (state)........................	☐	☐

P OVERALL CHARACTERISTICS (Circle appropriate words, add others as necessary)

Major impacts: landfill - tipping - litter - sewage - pollution - drought - abstraction - mill - dam - road - rail - industry - housing mining - quarrying - overdeepening - afforestation - fisheries management - silting - waterlogging - hydroelectric power

Evidence of recent management: dredging - bank mowing - weed cutting - enhancement - river rehabilitation - gravel extraction - other (please specify)

Animals: otter - mink - water vole - kingfisher - dipper - grey wagtail - sand martin - heron - dragonflies/damselflies

Other significant observations: If necessary use separate sheet to describe overall characteristics and relevant observations

Q ALDERS (tick one box in each of the two categories)

*Alders? None ☑ Present ☐ Extensive ☐ | *Diseased Alders? None ☐ Present ☐ Extensive ☐

R FIELD SURVEY QUALITY CONTROL (√ boxes to confirm checks)

- Have you taken at least two photos that illustrate the general character of the site and additional photos of any weirs/ sluices and major/intermediate structures across the channel? ☐
- Have you completed all ten spot-checks and made entries in all boxes in E & F on page 2? ☐
- Have you completed column 11 of section G (and E if appropriate) on page 2? ☐
- Have you recorded in section C the number of riffles, pools and point bars (even if 0) on page 1? ☐
- Have you given an accurate (alphanumeric) grid reference for spot-checks 1, 6 and end of site (page 1)? ☐
- Have you stated whether spot-check 1 is at the upstream or downstream end of the site (top of page 2)? ☐
- Have you cross-checked your spot-check and sweep-up responses with the channel modification indicators given on page 2 of the spot-check key? ☐

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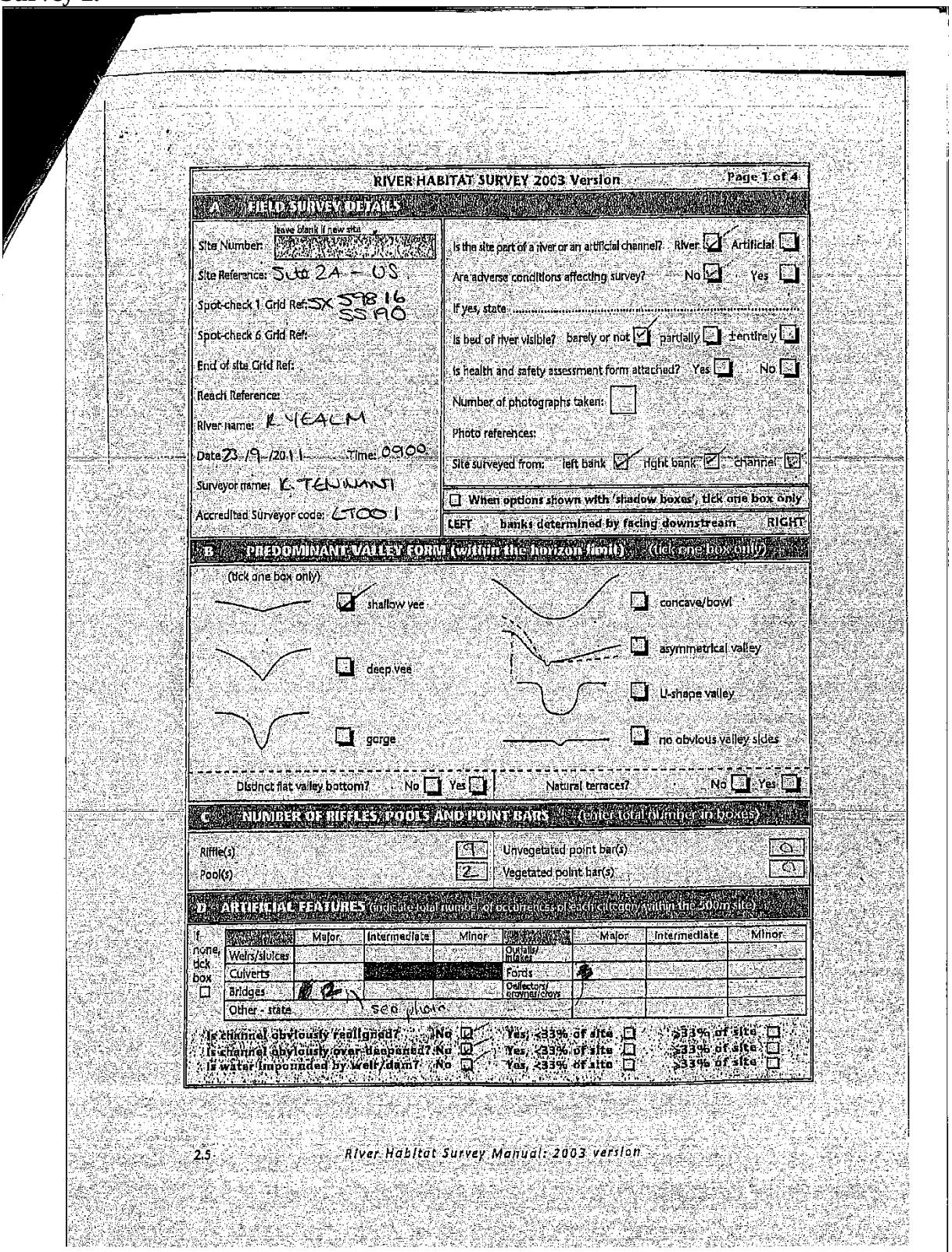
Survey 2.



RIVER HABITAT SURVEY 2003 Version — Page 1 of 4

A FIELD SURVEY DETAILS

Site Number: (leave blank if new site)
Site Reference: SWB 2A – US
Spot-check 1 Grid Ref: SX 5781 6 / SS 90
Spot-check 6 Grid Ref:
End of site Grid Ref:
Reach Reference:
River name: LYEACM
Date: 23/9/2011 Time: 0900
Surveyor name: K. TENNANT
Accredited Surveyor code: LTOO1

Is the site part of a river or an artificial channel? River ☑ Artificial ☐
Are adverse conditions affecting survey? No ☑ Yes ☐
If yes, state .....
Is bed of river visible? barely or not ☑ partially ☐ entirely ☐
Is health and safety assessment form attached? Yes ☐ No ☒
Number of photographs taken:
Photo references:
Site surveyed from: left bank ☑ right bank ☑ channel ☑

☐ When options shown with 'shadow boxes', tick one box only
LEFT banks determined by facing downstream RIGHT

B PREDOMINANT VALLEY FORM (within the horizon limit) (tick one box only)

(tick one box only)

☐ shallow vee
☐ deep vee
☐ gorge
☐ concave/bowl
☐ asymmetrical valley
☐ U-shape valley
☐ no obvious valley sides

Distinct flat valley bottom? No ☐ Yes ☐ Natural terraces? No ☐ Yes ☐

C NUMBER OF RIFFLES, POOLS AND POINT BARS (enter total number in boxes)

Riffle(s): 9
Pool(s): 2
Unvegetated point bar(s): 0
Vegetated point bar(s): 0

D ARTIFICIAL FEATURES (indicate total number of occurrences of each category within the 500m site)

If none, tick box ☐

	Major	Intermediate	Minor		Major	Intermediate	Minor
Weirs/sluices				Outfalls/ Inlets			
Culverts				Fords			
Bridges	2			Outfalls/ drowned/ dows			
Other - state	see photo						

Is channel obviously realigned? No ☐ Yes, <33% of site ☐ >33% of site ☐
Is channel obviously over-deepened? No ☐ Yes, <33% of site ☐ >33% of site ☐
Is water impounded by weir/dam? No ☐ Yes, <33% of site ☐ >33% of site ☐

2.5 River Habitat Survey Manual: 2003 version

SITE REF.	RIVER HABITAT SURVEY : 500m SWEEP-UP	Page 3 of 4

LAND-USE WITHIN 50m OF BANKTOP [illegible]

	L	R		L	R
Broadleaf/mixed woodland (semi-natural) (BL)	E	E	Natural open water (OW)		
Broadleaf/mixed plantation (BP)			Rough/unimproved grassland/pasture (RP)		
Coniferous woodland (semi-natural) (CW)			Improved/semi-improved grassland (IG)	E	[illegible]
Coniferous plantation (CP)			Tall herb/rank vegetation (TH)	✓	[illegible]
Scrub & shrubs (SH)	E	E	Rock, scree or sand dunes (RD)		
Orchard (OR)			Suburban/urban development (SU)		
Wetland (e.g. bog, marsh, fen) (WL)			Tilled land (TL)		
Moorland/heath (MH)			Irrigated land (IL)		
Artificial open water (AW)			Parkland or gardens (PG)		
			Not visible (NV)		

BANK PROFILES ✓ (present) or E (≥33% bank length)

Natural/unmodified	L	R	Artificial/modified	L	R
Vertical/undercut	E	E	Resectioned (reprofiled)	✓	✓
Vertical with toe			Reinforced - whole	✓	✓
Steep (>45°)	✓	✓	Reinforced - top only		
Gentle	✓	✓	Reinforced - toe only	✓	
Composite			Artificial two-stage		
Natural berm			Poached bank	✓	
			Embanked		
			Set-back embankment		

EXTENT OF TREES AND ASSOCIATED FEATURES (record even if [illegible])

TREES (tick one box per bank)

	Left	Right
None	☐	☐
Isolated/scattered	☐	☐
Regularly spaced, single	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☐	☐
Continuous	☑	☑

ASSOCIATED FEATURES (tick one box per feature)

	None	Present	E (≥33%)
Shading of channel	☐	☐	☑
*Overhanging boughs	☐	☑	☐
*Exposed bankside roots	☐	☑	☐
*Underwater tree roots	☐	☑	☐
Fallen trees	☐	☑	☐
Large woody debris	☐	☑	☐

EXTENT OF CHANNEL AND BANK FEATURES (tick one box for each feature) (record even if [illegible])

	None	Present	E(≥33%)
*Free fall flow	☑	☐	☐
Chute flow	☐	☑	☐
Broken standing waves	☐	☑	☐
Unbroken standing waves	☐	☐	☑
Rippled flow	☑	☐	☐
*Upwelling	☐	☑	☐
Smooth flow	☐	☑	☐
No perceptible flow	☑	☐	☐
No flow (dry)	☑	☐	☐
Marginal deadwater	☐	☑	☐
Eroding cliff(s)	☐	☑	☐
Stable cliff(s)	☑	☐	☐

	None	Present	E (≥33%)
Exposed bedrock	☐	☑	☐
Exposed boulders	☐	☑	☐
Vegetated bedrock/boulders	☑	☐	☐
Unvegetated mid-channel bar(s)	☑	☐	☐
Vegetated mid-channel bar(s)	☑	☐	☐
Mature island(s)	☑	☐	☐
Unvegetated side bar(s)	☐	☑	☐
Vegetated side bar(s)	☑	☐	☐
Unvegetated point bar(s)	☑	☐	☐
Vegetated point bar(s)	☑	☐	☐
*Unvegetated silt deposit(s)	☑	☐	☐
*Discrete unvegetated sand deposit(s)	☑	☐	
*Discrete unvegetated gravel deposit(s)	☑	☐	

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SITE REF.	RIVER HABITAT SURVEY : DIMENSIONS AND INFLUENCES	Page 4 of 4

L CHANNEL DIMENSIONS (to be measured at one location on a straight uniform section, preferably across a riffle)

LEFT BANK		CHANNEL		RIGHT BANK	
Banktop height (m)	1.5	Bankfull width (m)	14	Banktop height (m)	1.5
Is banktop height also bankfull height? (Y or N)	Y	Water width (m)	12	Is banktop height also bankfull height? (Y or N)	Y
Embanked height (m)	—	Water depth (m)	0.4	Embanked height (m)	—

If trashline lower than banktop, indicate: height above water (m) = width from bank to bank (m) =

Bed material at site is: consolidated ☐ unconsolidated (loose) ☐ unknown ☐

Location of measurements is: riffle ☐ other ☐ (state)

M FEATURES OF SPECIAL INTEREST (Use ✓ or E (≥33% length); record even if 0)

None	☐	Very large boulders (>1m)	☐	Backwater(s)	☐	Marsh(es)	☐
Braided channels	☐	*Debris dam(s)	☑	Floodplain boulder deposits	☐	Flush(es)	☐
Side channel(s)	☐	*Leafy debris	☑	Water meadow(s)	☐	Natural open water	☐
*Natural waterfall(s) > 5m high	☐	Fringing reed-bank(s)	☐	Fen(s)	☐	Others (state)	☐
*Natural waterfall(s) < 5m high	☐	Quaking bank(s)	☐	Bog(s)	☐		
Natural cascade(s)	☐	*Sink hole(s)	☐	Wet woodland(s)	☐		

N CHOKED CHANNEL (tick one box)

Is 33% or more of the channel choked with vegetation? No ☑ Yes ☐

O NOTABLE NUISANCE PLANT SPECIES (Use ✓ or E (≥33% length); record even if 0)

		bankface	banktop to 50m		bankface	banktop to 50m
None ☐	*Giant hogweed	☐	☐	*Himalayan balsam	☑	☐
	*Japanese knotweed	☐	☐	*Other (state)......................	☐	☐

P OVERALL CHARACTERISTICS (Circle appropriate words, add others as necessary)

Major impacts: landfill - tipping - litter - sewage - pollution - drought - abstraction - mill - dam - road - rail - industry - housing mining - quarrying - overdeepening - afforestation - fisheries management - silting - waterlogging - hydroelectric power

Evidence of recent management: dredging - bank mowing - weed cutting - enhancement - river rehabilitation - gravel extraction - other (please specify)

Animals: otter - mink - water vole - kingfisher - dipper - grey wagtail - sand martin - heron - dragonflies/damselflies

Other significant observations: If necessary use separate sheet to describe overall characteristics and relevant observations

Q ALDERS (tick one box in each of the two categories)

*Alders? None ☑ Present ☐ Extensive ☐ | *Diseased Alders? None ☑ Present ☐ Extensive ☐

R FIELD SURVEY QUALITY CONTROL (✓ boxes to confirm checks)

- Have you taken at least two photos that illustrate the general character of the site and additional photos of any weirs/ sluices and major/intermediate structures across the channel? ☐
- Have you completed all ten spot-checks and made entries in all boxes in E & F on page 2? ☐
- Have you completed column 11 of section G (and E if appropriate) on page 2? ☐
- Have you recorded in section C the number of riffles, pools and point bars (even if 0) on page 1? ☐
- Have you given an accurate (alphanumeric) grid reference for spot-checks 1, 6 and end of site (page 1)? ☐
- Have you stated whether spot-check 1 is at the upstream or downstream end of the site (top of page 2)? ☐
- Have you cross-checked your spot-check and sweep-up responses with the channel modification indicators given on page 2 of the spot-check key? ☐

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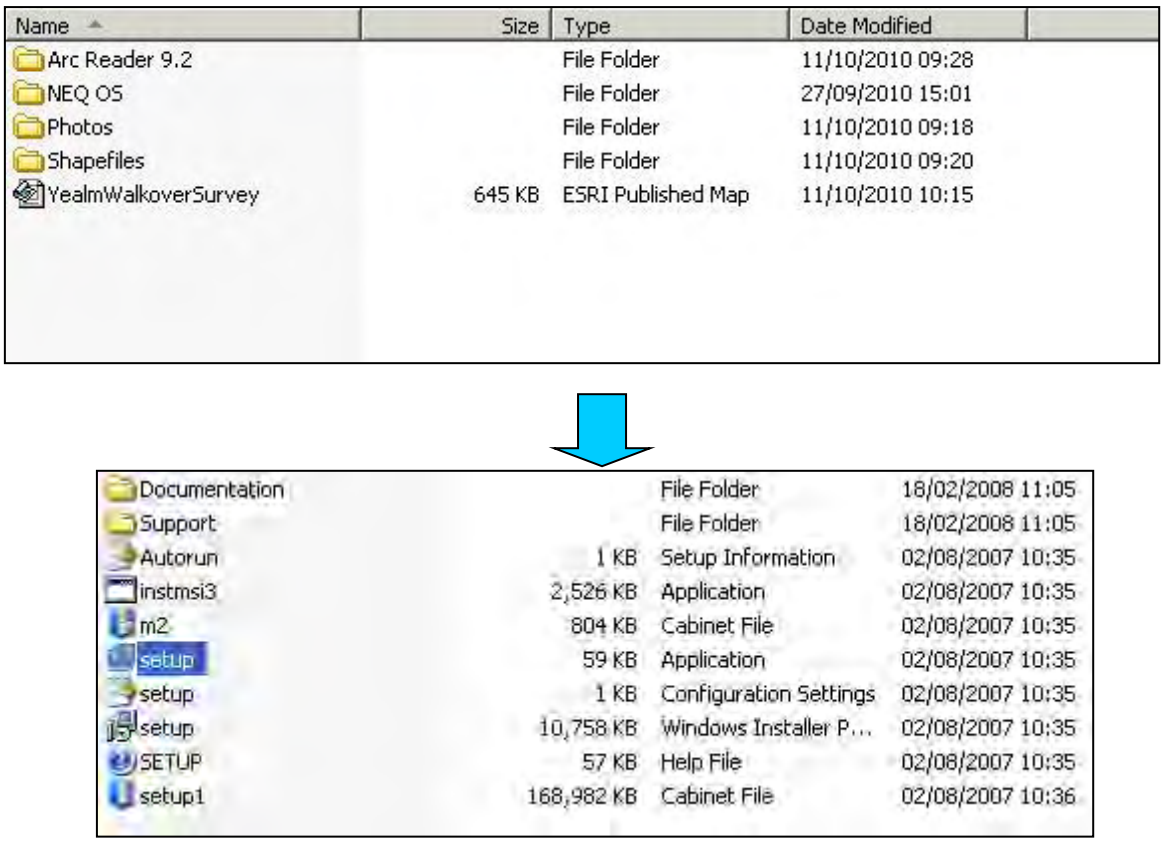
APEM AQUATIC SCIENTISTS

APPENDIX VII ARC READER INSTALLATION AND USE

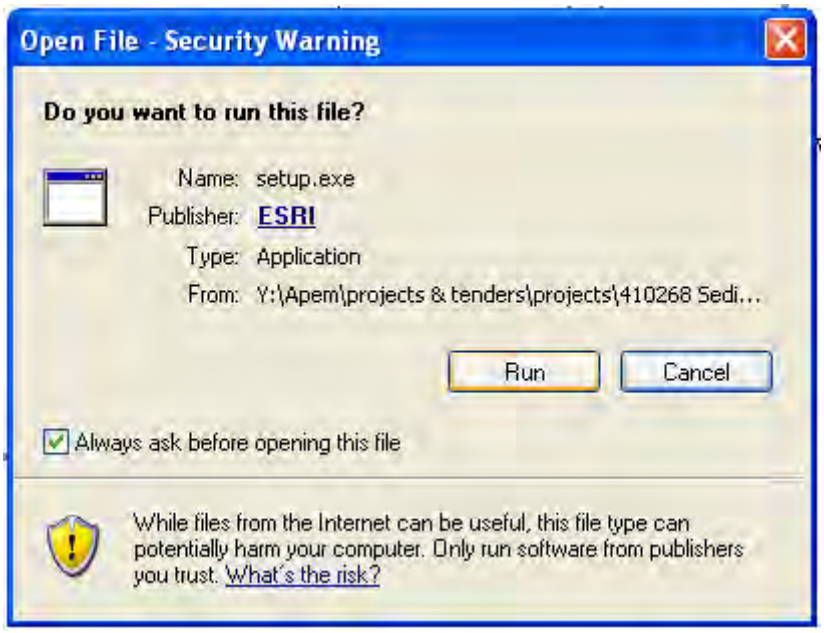
Electronic copies of maps for the River Yealm have been provided on the DVD accompanying this report. All the images, habitat observations and sediment sources observed during the walkover survey conducted are linked to the map. ArcReader (the GIS viewing software) must first be installed by running the ArcReader executable file which can be downloaded free from the ESRI website (http://www.esriuk.com/) and which has been included on the DVD provided. The following documentation will guide the reader through the installation and use of ArcReader, software which will enable the reader to view and interact with the map provided.

Installation of ArcReader

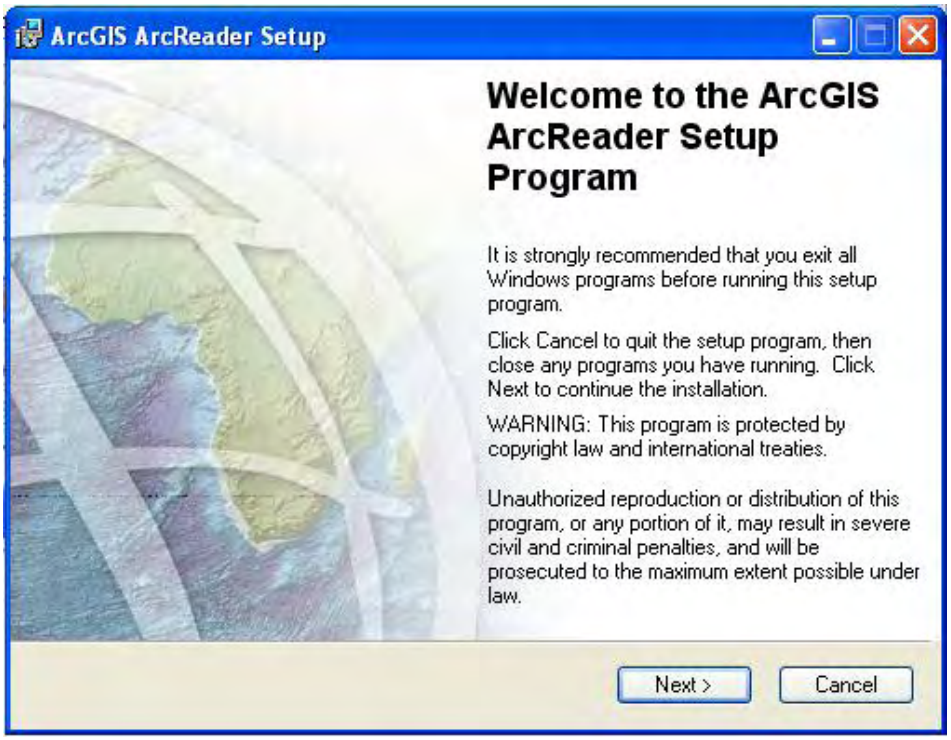
To install ArcReader, click on the folder titled "ArcReader 9.2" and then the file titled "setup":



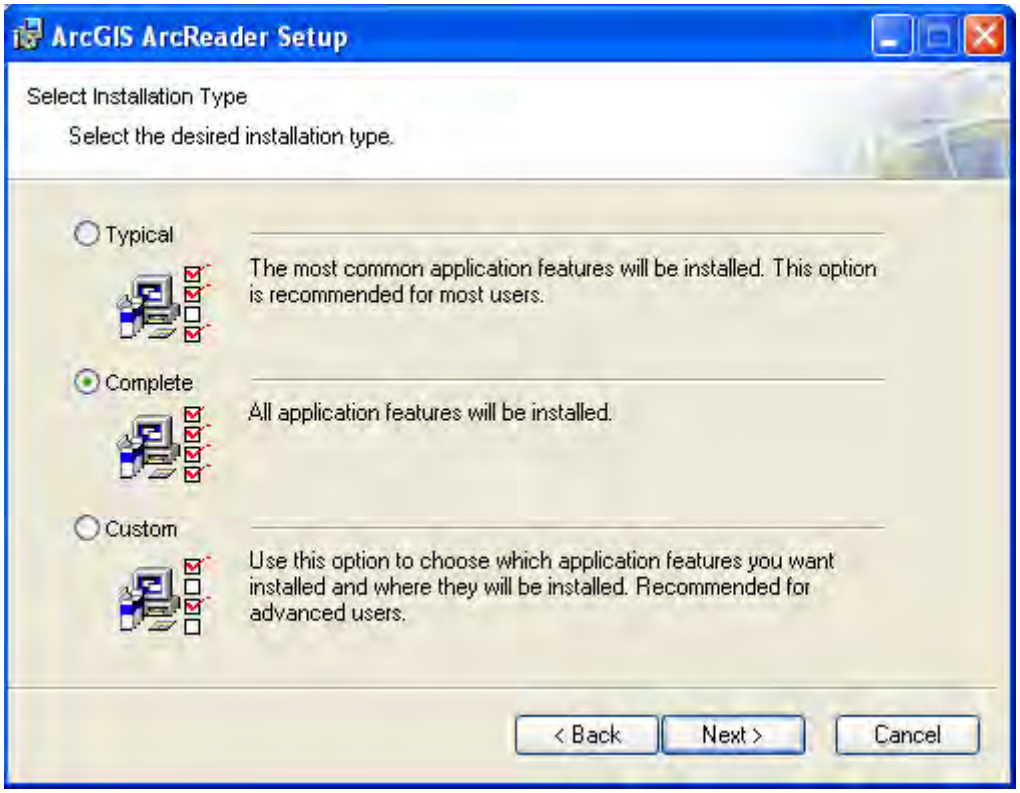
The following dialogue box may appear (depending on the specific configuration of your computer). If it does, click “Run”:



The installation wizard for ArcReader 9.2 will then be launched, which will appear as this window:



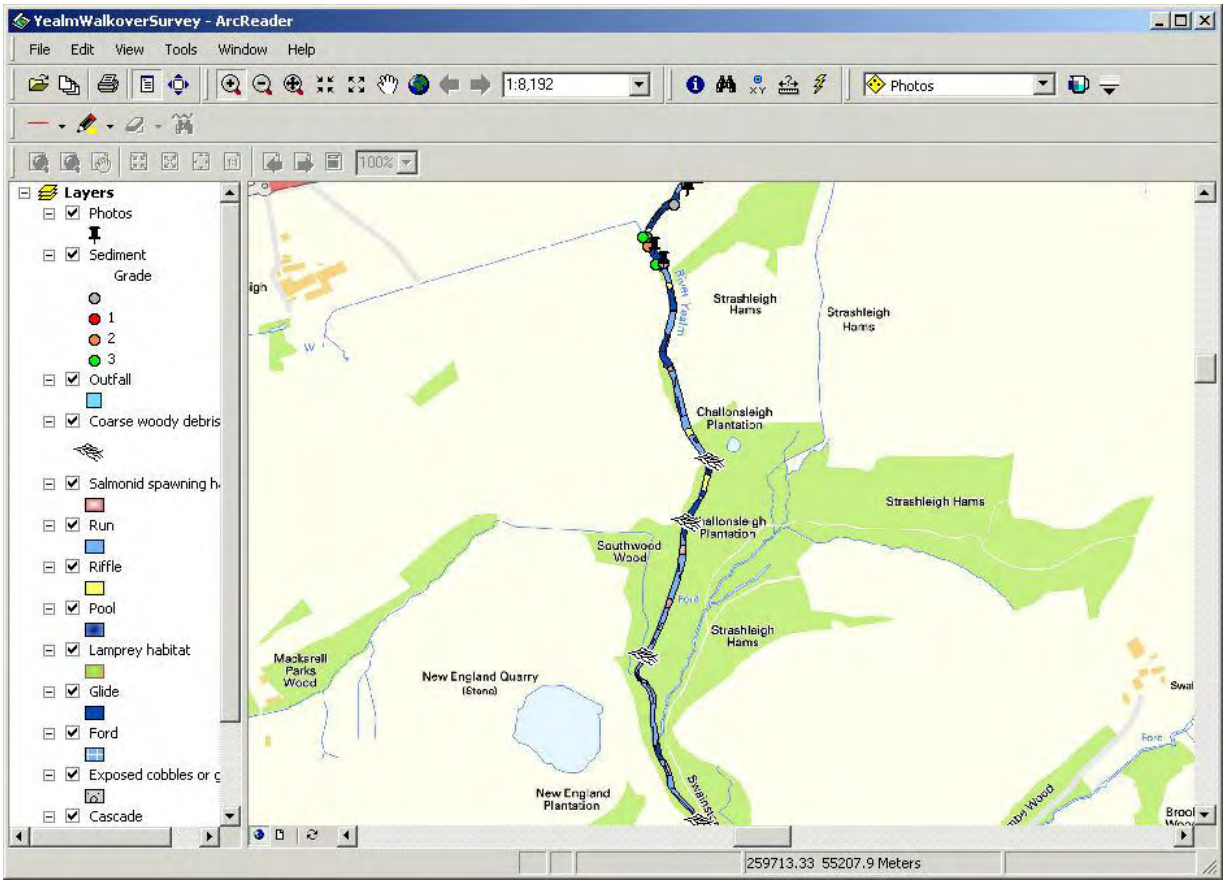
Click “Next” and follow the installation instructions. It is recommended that you install the complete version of ArcReader when this dialogue box appears:



Using ArcReader

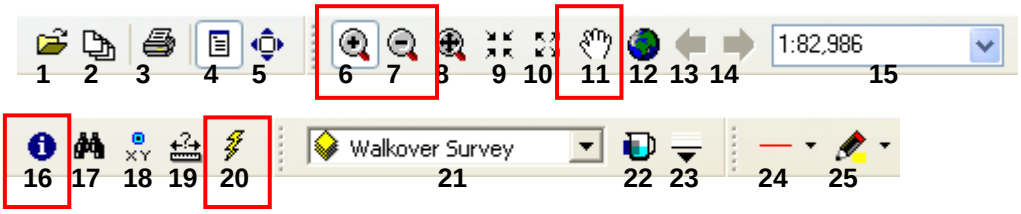
Once ArcReader is installed you may open and view the maps provided on the DVDs accompanying this report, along with all the data linked to them. Open the published map, which will appear on the DVD with the following icon:

This will launch ArcReader, and the map produced will appear similar to the image shown on the following page.


YealmWalkoverSurvey - ArcReader
File Edit View Tools Window Help
1:8,192
Photos
100%
Layers
Photos
Sediment
Grade
1
2
3
Outfall
Coarse woody debris
Salmonid spawning h
Run
Riffle
Pool
Lamprey habitat
Glide
Ford
Exposed cobbles or g
Cascade
Strashleigh Hams
Strashleigh Hams
Challonsleigh Plantation
Strashleigh Hams
Southwood Wood
Strashleigh Hams
Mackerell Parks Wood
New England Quarry (Stone)
New England Plantation
259713.33 55207.9 Meters

The left hand frame of the ArcReader window contains a table of contents of all the available data. Clicking in the box beside each parameter either activates or deactivates that particular dataset. Activated datasets will appear on the map in the main frame of the ArcReader window, and a tick mark will appear in the box beside the parameter name in the left frame. The map will initially open with all the data collected during the walkover survey activated. Data can only be accessed if the dataset is activated in the left frame and its symbols are displayed on the map.

Various tools are available as buttons along the top of the ArcReader window. Resting your mouse pointer over the top of these buttons will bring up a brief explanation of each tool, however, a description of each tool is provided here as an aid. The most important tools in terms of viewing the data provided with the map are indicated with a red box below:



1. Opens files, as in any other windows based program.

2. Produces a dropdown clickable list of recently opened files.

3. Prints the current view of the map.

4. Toggles the left frame table of contents open and closed

5. Toggles the application to and from full screen mode.

6. Zoom in tool. To use this tool click on the button and then click on the particular area of the map you wish to zoom in to.

7. Zoom out tool. Used in the same way as the zoom in tool.

8. Continuous zoom/pan tool. Clicking this tool allows you to zoom in and out by holding down the left button on your mouse and moving your mouse forward or backward, and to pan in all directions by holding down the right button on your mouse and moving it in the direction you wish to pan to.

9. Fixed zoom in button. Clicking on this button will zoom the map in at a fixed interval.

10. Fixed zoom out button. Used in the same way as the fixed zoom in button.

11. Pan tool which allows you to drag the map to the desired view. Use it by clicking on the button, then holding the left mouse button down while moving your mouse.

12. This button zooms the view out to show everything that is plotted on the map

13. Go back to previous extent – clicking this button takes you back to the last view shown (useful if you have zoomed in or out too far).

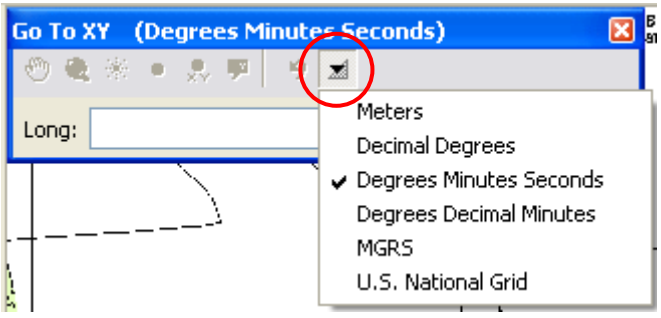
14. Go to next extent – works in the same way as "go back to previous extent" except that it takes you to the view which followed the current view (if there is one).

15. Drop down list with various map scales you can zoom to.

16. Identify: this is a very important tool. This tool is used to access the images that are linked to the symbols on the map. This tool allows you to click on symbols on the map to open an informational dialogue box. The dialogue box may contain further attribute information about the feature or comments.

17. This is a find tool which will locate search parameters on the map. This tool is not particularly useful for the current application.

18. Allows you to zoom to a specific coordinate on the map. Clicking on the encircled arrow in the illustration below will display a drop down menu of various coordinate system options.



19. Measuring tool. Allows you to measure the distance between points on the map. You can measure curved distances in segments by clicking on the start point, moving your mouse to the end of the first segment and clicking once, then continuing on to the end of the next segment. Double-clicking ends the measuring session.

20. Hyperlink tool – this is also a very important tool. With this tool you can click on any of the hyperlinked symbols. If there is more than one image available, a list will appear from which you may select an image to open and view.

21. The next three tools are used in conjunction with one another. This item is a layer list control which allows you to select a layer with which to work.

22. Transparency tool – this tool allows you to make the symbols associated with the layer selected in 21 above entirely transparent or transparent to some degree.

23. Swipe tool – allows you to temporarily remove the layer/layers selected in 21. To use, click on this button, then click and hold the left mouse button on the map and move in the mouse in the direction of the points/items you wish to clear. Once you let go of the mouse button the items will reappear. This tool may be useful if many points are on

top of one another, or in order to quickly view features of the OS tiles which may be obscured by map symbols.

24. A pen tool with a drop down menu enabling you to choose different thicknesses of line.

25. Highlight tool. When you use either the pen tool or the highlight tool, the eraser tool becomes usable:

 It is equipped with a drop down menu with options for eraser types.

Description of the Layers

All of the data obtained during the walkover survey are contained in individual layers. The layers are;

Layer	Format
Photos	Point
Sediment	Point
Outfall	Point
Coarse woody debris	Point
Run	Polygon
Pool	Polygon
Riffle	Polygon
Glide	Polygon
Cascade	Polygon
Salmonid spawning habitat	Polygon
Lamprey habitat	Polygon
Ford	Polygon
Exposed cobbles or gravel	Polygon
Bedrock	Polygon
*OS tiles	Raster tile

* Ordnance Survey Data © Crown Copyright and database right 2010