

The MoRPh Survey

Technical Reference Manual

2022 version



This manual was revised in March 2022 by Angela Gurnell and Lucy Shuker.

It is based on earlier versions to which Judy England and Geraldene Wharton made contributions.

The supporting software was developed by David Gurnell.

The Modular River Physical or MoRPh survey was developed for Citizen Scientists to support the Catchment Based Approach and river stewardship for Catchment Partnerships. It is now being used more widely by both volunteers and professional river scientists for river assessment and monitoring

The MoRPh survey is one part of the Modular River Survey suite of scaled assessment techniques that have been designed to promote understanding of the way rivers function across a hierarchy of spatial scales within river catchments.

MoRPh represents an adaptation of standard industry methodologies that is accessible to non-professional surveyors who may already be involved in other biological or physico-chemical monitoring activities but can also be used by professional surveyors where appropriate.

IMPORTANT NOTES before conducting a MoRPh Survey!

Health and Safety is extremely important: When carrying out a MoRPh assessment, all surveyors must carry out a full risk assessment specific to working beside water BEFORE starting a new survey; and ensure that you follow Health and Safety guidelines appropriate to yourself and in line with your host organisation's requirements.

Biosecurity: You must ensure that you take appropriate measures to reduce the risk of spreading diseases, parasites and invasive non-native species. The protection of water courses is a priority consideration and should ensure no lasting adverse effects to the biological, physical or chemical condition of the river or stream being surveyed. In particular, the spread of aquatic disease or non-native invasive species (NNIS) must be avoided by following 'Check, Clean, Dry' practices when arriving and leaving all survey sites and you must apply the biosecurity advice provided by the following campaigns:

NNSS Be Plantwise - <http://www.nonnativespecies.org/beplantwise/index.cfm>

Check, Clean, Dry - <http://www.nonnativespecies.org/checkcleandry/index.cfm>

Open access data: By adding photos and data to the Modular River Survey / MoRPh web database, all surveyors will thereby give their permission and agreement for their uploaded data to be shared.

Data QA: All survey data will be quality assured before their publication on the modular river survey website. However, host organisations (e.g. catchment groups) are encouraged to form 'hubs' in which a small number of trained personnel quality assure surveys collected within their hub/area. A workspace can be assigned to the hub for this purpose (contact help@cartographer.io).

Data applications & appropriate use of outputs: the MoRPh survey is designed for use by citizen scientists and should not be used commercially or to replace recognised technical methods. For information on the use of outputs, please go to the MoRPh website which will be regularly updated with guidance on how to interpret results: www.modularriversurvey.org/

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I. INTRODUCTION

I.1 A Modular Approach to River Reach Survey and Assessment

The Modular River Physical or MoRPh survey is a foundation level survey within a scaled hydromorphological assessment approach known as the Modular River Survey that combines information gathered from three river units of different size (*module*, *sub-reach*, *reach*) based upon both primary field survey and secondary sources (e.g. remotely-sensed and map data).

Module (MoRPh) and *sub-reach* (MultiMoRPh) surveys are conducted in the field using the MoRPh survey method, focusing on a single river channel and its immediate margins (banks and land area within 10 m of the bank edges).

The *reach* (River Type) survey encompasses the entire length of a river reach (typically >500 m to 10 km) including the locations of several *module* and *sub-reach* surveys. The *reach* survey attempts to assess the geomorphological type of river under consideration and thus the expected types-abundances of physical features within the river if it were functioning in a near-natural way.

This manual describes the MoRPh survey.

I.2 How MoRPh extends existing river habitat surveys.

The MoRPh survey includes many of the components of the Environment Agency's River Habitat Survey (RHS, 2003) and so provides compatible information. However, it provides a number of modifications and additions that allow it to deliver **a more detailed local picture** of a river and its margins than the RHS (which provides **a broader overview**) and makes the survey more accessible for citizen scientists:

1. MoRPh is a rapid, flexible and simple survey that provides greater detail of physical habitats on much shorter lengths of river (i.e. modules). This scale is similar to that of much biological monitoring (e.g. riverfly (macroinvertebrate) sampling),
2. Several contiguous MoRPh surveys build into a MultiMoRPh survey of longer sub-reaches,
3. A MultiMoRPh survey provides more precise information than other standard reach-scale surveys for interpreting the hydrogeomorphology of rivers including their current dynamics,
4. As a quick and precise survey MoRPh is easily repeated at the same site for monitoring changes over time, with accurate survey site relocation supported by photographs and GPS records.

I.3 Applications of MoRPh

MoRPh can be applied in different and complementary ways to support either spatial or temporal analyses according to the number of contiguous modules surveyed, their distribution within the river catchment or sub-catchment and the frequency with which surveys are repeated at the same site.

I.3.1 MoRPh – single and multiple surveys

- (i) *1 x MoRPh: For recording habitat at a river biological sampling site:* a single module survey centred on the biological (or other) sampling site is sufficient and can be completed on each sampling occasion.
- (ii) *3 x MoRPh: For recording habitat available locally to an in-channel biological sampling site:* surveys of three contiguous modules centred on the module containing the sampling location will provide more comprehensive information on local habitat types and their diversity than a single MoRPh survey.
- (iii) *5 x MoRPh / MultiMoRPh5: For professional recording of vegetation, sediment and morphological characteristics and human pressures-interventions of short sub-reaches.*

Multiple MoRPh5 surveys allow a balance between detailed recording of local features and broader coverage of the river by significant numbers of MultiMoRPh surveys. MultiMoRPh5 surveys underpin the River Condition Assessment component of DEFRA's Biodiversity Metric (Panks et al., 2021).

- (iv) *10 x MoRPh / MultiMoRPh10: For investigating general habitat availability to highly mobile organisms and also typical geomorphic units and contemporary hydrogeomorphological processes:* 10 contiguous (i.e. joining up in a sequence along a sub-reach) MoRPh surveys are needed. Together these form a full Multi-MoRPh10 survey for which the MoRPh CitSci software computes 14 high-level summary indicators that can be used to compare sub-reaches.

NOTE: for the Modular River Survey information system to recognise the relevant modules of a MultiMoRPh survey and compute the indicators, the modules must have identical river name, reach name, and sub-reach name, must be surveyed within the same week, and the modules need to be numbered from 1 in an upstream to downstream sequence.

I.3.2 Spatial assessments

The distribution of MoRPh, surveys within reaches and across river catchments allows characterisation and comparison of physical habitat (MoRPh and 3 x MoRPh surveys) or morphological characteristics or processes (MultiMoRPh). Carefully spaced MultiMoRPh surveys provide a compromise between local detail and overall coverage of reach characteristics (e.g. Figure 1). MultiMorph sites can be equally spaced (a systematic sample of subreaches) or the river length can be split into lengths displaying similar channel characteristics (e.g. sections that have been engineered to a similar degree, or appear not to have been engineered and thus represent semi-natural conditions) with at least one MultiMoRPh site located within each section. NOTE: river flows and sediment transport change at major tributary junctions, so these need to mark reach start/end points when targeting changing river channel characteristics in response to changing flows, sediment transport and human interventions.

I.3.3 Temporal assessments

For habitat and hydrogeomorphology monitoring purposes, any of (i) to (iv) (section I.3.1) can be repeated on different occasions to track river module to sub-reach to reach dynamics. Carrying out repeat MoRPh surveys at the same time as other repeat sampling will facilitate investigations of relationships between physical channel characteristics and biological or physico-chemical variables.

I.3.4 BACI monitoring designs

A robust monitoring scheme to assess, for example, the success of a particularly intervention on a river, should incorporate MoRPh5 or MoRPh10 surveys into a BACI (Before-After-Impact-Control) design (Figure 1). Such a design monitors sites upstream, within, and preferably also downstream of where an intervention is planned, preferably along a reach that is not affected by major tributaries.

In terms of the spatial distribution of MultiMoRPh surveys, the number of surveys needs to reflect the size and complexity of the interventions that are being monitored. For monitoring the impact of the smallest interventions, it is essential to have at least one upstream control survey site and one survey site directly affected by the intervention. For larger-scale interventions, several MultiMoRPh surveys are required within the impacted area and, ideally, more than one upstream and at least one downstream. Surveys at the upstream sites will capture changes occurring that are not attributable to the intervention. Surveys within the impacted river length will monitor changes that occur as a direct consequence of the intervention but also that are attributable to wider (e.g. catchment-scale) changes. Comparisons of surveys from upstream control and impact survey sites helps to separate changes directly caused by the interventions. Surveys at downstream control sites can provide important

information on whether local downstream changes are caused by wider factors (monitored at upstream survey sites) or whether there may be downstream impacts of the interventions.

Once the survey sites are established, MultiMoRPh surveys should be conducted at all sites on a minimum of three occasions: before the intervention; immediately after the intervention; and after a period (e.g. 5 years) during which there can be some recovery from the intervention. More frequent resurveys following the intervention will capture the rate of recovery and the way in which the river recovers from the interventions. Such information will not only provide adequate cause-effect monitoring of the intervention but it will provide useful guidance on the likely impact of similar interventions that may be planned elsewhere.

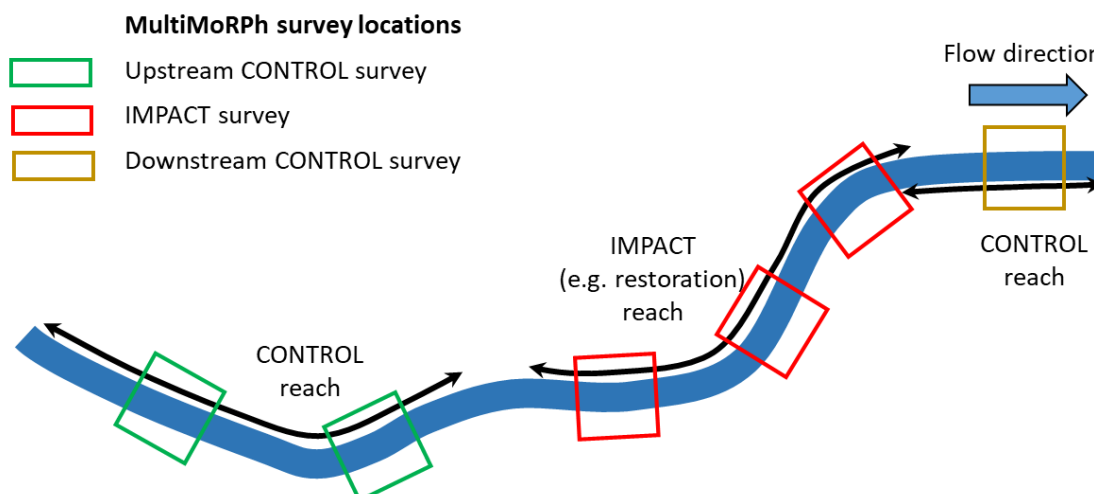


Figure 1: Possible locations for MultiMoRPh surveys to monitor the impact of an intervention on a river. You need a minimum of one CONTROL survey site located a short distance upstream of the intervention and one IMPACT survey within the length of river where an intervention (e.g. restoration of a length of river) is implemented. Surveys at all MultiMoRPh monitoring sites should be carried out at least once before the intervention, once immediately after the intervention, and once after a period (e.g. 5 years) during which the river can recover from the intervention.

I.3.4 Multi thread rivers and single thread rivers with occasional large islands.

MoRPh is designed to be applied to single-thread channels with good visibility of the opposite bank from the survey point. The following rules apply elsewhere.

- (i) In small multi-thread systems, the survey can capture mid-channel bars and islands and so can be applied as a single module survey when it is possible to see and survey the opposite bank.
- (ii) Where the opposite bank is not visible, the surveys needs to be conducted on individual channel threads, to provide an overview of their joint characteristics. Clarify this in the notes
- (iii) An special case of (ii) arises when a mature island blocks the view of the opposite bank on a predominantly single-thread river. In this case, survey the river width up to the island, which becomes the opposite bank and clarify this in the notes.

Reference

Panks, S., White, N., Newsome, A., Potter, J., Heydon, M. Mayhew, E. Alvarez, M., Russell, T. Scott, S.J., Heaver, M., Scott, S.H., Treweek, J., Butcher, B., Stone, D. 2021. Biodiversity metric 3.0: Auditing and accounting for biodiversity – User Guide. Natural England (download from [The Biodiversity Metric 3.0 - JP039 \(naturalengland.org.uk\)](https://naturalengland.org.uk/Biodiversity%20Metric%203.0-JP039)).

II. MoRPh SURVEYS: A CONTEXT

II.1 Website

MoRPh survey data is entered, stored, analysed, visualised and downloaded through the Modular River Survey website (www.modularriversurvey.org).

The site allows surveyors to enter their own survey data via a series of web pages that are designed to match the field survey forms, with drop down entry boxes and optional visual guidance to reduce errors; to receive summary indices for each survey; to download survey data, and view data outputs on a base map, to observe how physical habitat and human pressures vary across reaches or the wider catchment and have changed at a location over time where repeat surveys are conducted.

MoRPh survey data can be entered onto paper forms comprising four sheets (General information, Bank top, Bank face and channel margin, Channel bed) or on a tablet using an 'App'. This manual refers throughout to the paper sheets but the sections, subsections and fields on the sheets are mirrored in the App.

II.2 Equipment

To undertake a MoRPh survey you will need the following equipment:

- A copy of the MoRPh field survey sheets and code sheet (see Appendix A) whether in paper format or on a tablet
- A waterproof clip board
- A hand held GPS (WSG84 co-ordinates) and digital camera OR a mobile phone / tablet with a GPS App and camera
- A length measuring device to help in estimating channel dimensions. *An expandable metal 10 m tape is ideal, particularly if it is wide and stiff enough to maintain some rigidity when you are taking measurements. A range-finder is useful for wider rivers but not essential.*
- A ranging pole can aid your stability as well as serving as a measuring device
- Waterproof footwear, clothing and safety equipment appropriate to working on river banks.

II.3 Timing

Although MoRPh surveys can be undertaken at any time of year, they are best completed between May and September inclusive when aquatic vegetation is clearly apparent. **Ideal months for survey are May, June and October** when all vegetation is visible but not so well developed that it makes access or observation of some physical features difficult. **Surveys should be undertaken under low flow conditions for safety and to ensure bed visibility and consistent hydraulic conditions.**

II.4 Health and Safety

Your Health and Safety is extremely important when working on rivers!

You must conform with all relevant Health and Safety guidance from your host organisation and you must ensure that you undertake a full risk assessment conforming to your host organisation's requirements BEFORE you go into the field.

Although the MoRPh survey is designed to be undertaken by one surveyor from the bank top undertaking lone survey activities may not be recommended by your host organisation. However, if there are occasions where you are undertaking the survey alone, you will need to ensure that you comply with your host organisation's Lone Working Regulations.

To ensure safety when working near rivers, please consider these foundation principles:

1. Always carry out an appropriate risk assessment BEFORE undertaking a MoRPh survey
2. If working alone, always follow appropriate 'lone working' procedures including the completion of any required paperwork or notifications in accordance with the host organisation's requirements.
3. Although it is not necessary to enter the river to complete a MoRPh survey, surveyors should use appropriate safety equipment, in accordance with the host organisation's requirements.
4. MoRPh surveys should NEVER be carried out during periods of high flow. Surveys should be delayed until the water level and clarity return to low flow conditions.
5. Rivers often respond rapidly to rainfall. It is important to check the local weather conditions BEFORE commencing and to monitor changes to ensure that the survey is carried out safely.
6. Appropriate clothing MUST be worn at all times when surveying rivers. Strong boots or waders are ideal, and provide protection from nettles, brambles etc also thick clothing or waterproofs are recommended.
7. The entire MoRPh survey can be completed from the bank top so it should not be necessary to enter the river to collect any data. Nevertheless, extreme care should be taken, particularly when water clarity is poor and channel entry may be considered necessary for example, to estimate channel dimensions.*
8. The shallowest part of the river should be used for measuring the channel dimensions.

*A ranging pole is desirable for surveying channels, for assessing the channel depth before measuring, and for general safety. A range-finder should also be used if the channel is wide.

In conclusion:

Always closely follow your organisation's code of practice for Health and Safety. The Environment Agency's Health and Safety Guidance and also their Lone Worker Code of Practice (Appendices 1 and 2 in the RHS 2003 manual) provide some useful advice in relation to Health and safety issues.

This can be downloaded from <http://www.riverhabitatsurvey.org/manual/rhs-manuals/>

In addition to taking account of your own Health and Safety, you should also ensure that you take appropriate measures to reduce the risk of spreading diseases, parasites and invasive non-native species (NNS). Please refer to the biosecurity advice provided by the following campaigns:

NSS Be Plantwise : (<http://www.nonnativespecies.org/beplantwise/index.cfm>)

Check, Clean, Dry (<http://www.nonnativespecies.org/checkcleandry/index.cfm>)

III. CONDUCTING A MoRPh SURVEY

III.1 Defining the river module length for a MoRPh survey

MoRPh (and MultiMoRPh) surveys are undertaken within a river reach (typically >100m to 10 km long) that is subject to similar boundary conditions. These will include similar bedrock, a similar land cover mosaic and a similar hydrological regime (i.e the reach will be located between major tributaries or flow obstructions such as large weirs or dams).

MoRPh and MultiMoRPh surveys provide a sample of the physical character of the reach within which they are located. While an individual MoRPh survey simply characterises the local physical structure of a river, MultiMoRPh surveys aim to capture as much of the full suite of physical habitats that are supported by the river. River physical features or units tend to repeat along rivers at a frequency that is related to the size of the river channel. In other words, the larger (i.e. wider) the river channel, the larger the features and the wider their downstream spacing tends to be. For this reason, it is not appropriate to define an absolute river length for individual MoRPh or MultiMoRPh surveys, but rather to scale the length according to the width of the river channel. In this way, an individual MoRPh survey should capture the main local physical habitats and a MultiMoRPh survey should capture the range and diversity of physical habitats within the river.

Most repeating geomorphic features or units are expected to appear at least once and probably more frequently within a river length equal to 20 river widths.

To capture the locations, spacing, and geographical arrangement of these physical (geomorphic) features in sufficient detail to make hydrogeomorphologically robust interpretations, 10 contiguous MoRPh physical habitat surveys are needed (MultiMoRPh10). However, shorter sub-reach surveys (MultiMoRPh5) spaced equally to capture 20% of a reach length offer a compromise between local detail and reach coverage.

Based on these principles, Table 1 recommends an appropriate river module length for MoRPh surveys of rivers of different size, where 'MoRPh river width' is measured at a typical cross section and is the width of the water and any bare sediments, bars and areas of emergent aquatic plants at the water's edge (Figures 2 and 3). For rivers ≥ 30 m wide the channel is usually too wide for a detailed MoRPh survey. However, if you need to collect data for professional applications (e.g. if you are conducting a River Condition Assessment): (i) use a module length of 50 m, (ii) thoroughly survey the bank tops/faces and (iii) as many features as possible (visible) across the bed. For citizen science surveys on large and navigable rivers or canals, a reduced MoRPh survey of a 50 m long module is possible, focusing on the bank tops and faces and those bed features that are visible.

In the case of MultiMoRPh surveys, select a single, typical 'MoRPh river width' to apply across all MoRPh surveys to ensure that all MoRPh modules capture the same river length. **Note** that the local 'MoRPh river width' is also recorded for every MoRPh module mid-point (unless specified otherwise).

Table 1. River module lengths for MoRPh surveys for a typical river width.

MoRPh river width (m)*	River length for each module survey (m)
< 5 m	10 m
5 to < 10 m	20 m
10 to < 20 m	30 m
20 to < 30 m	40 m
<u>Large / navigable rivers and canals</u>	50 m

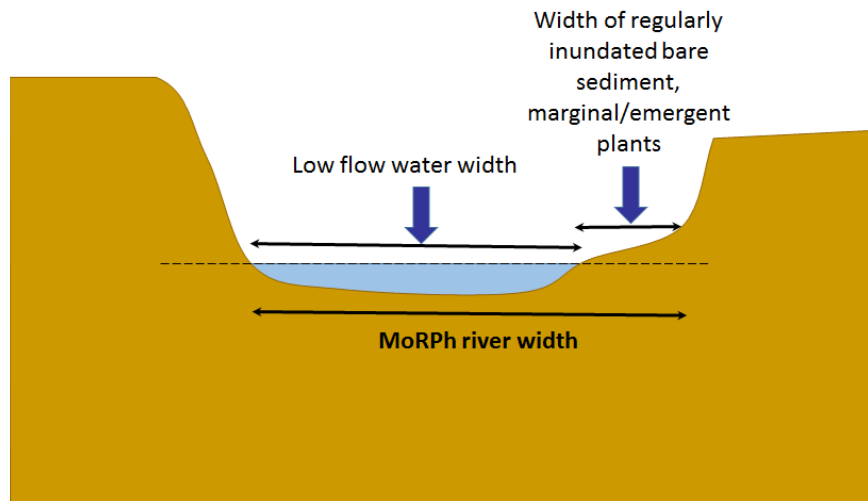


Figure 2 The 'MoRPh river width' is measured at a typical sized cross section and is the width of the water and any bare sediments and areas of emergent aquatic plants at the water's edge

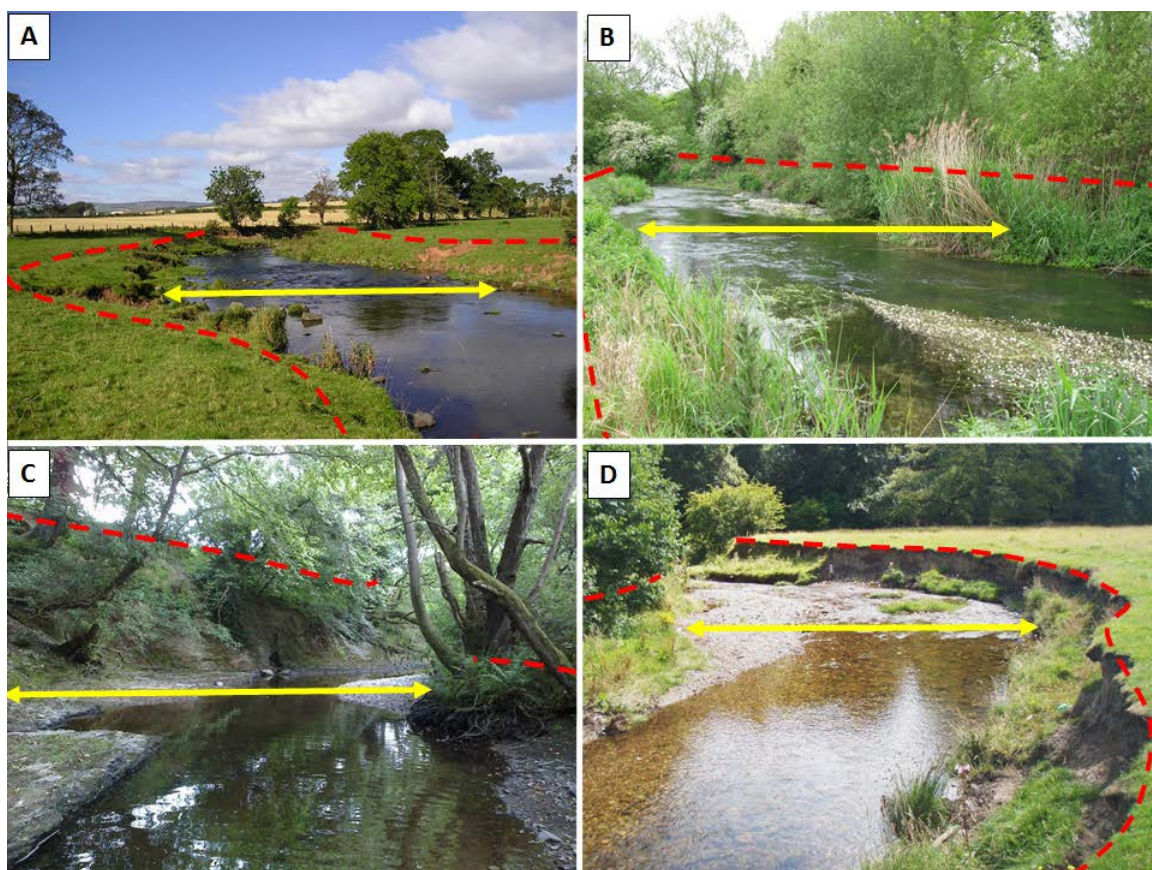


Figure 3: Four different rivers with a yellow arrow indicating the 'MoRPh river width' (used to determine the length of the module, see Table 1) and a red dashed line indicating the boundary between the bank face (area that is generally sloping towards the wetted channel) and the bank top (the outer flatter area across which water would spread onto the valley bottom / floodplain during floods).

NOTE: the clumps of emergent linear-leaved plants at the edge of the wetted channel in photograph B and the areas of bare gravel (unvegetated side bars) in photographs C and D, both of which are included when measuring the MoRPh river width.

(All photographs provided by the Environment Agency).

III.2 Completing the Survey Sheets

MoRPh surveys only record WHAT YOU SEE not what you know is there but is now buried or has been modified by the river or by humans!

The MoRPh module survey is designed to record physical features, vegetation structure, and human interventions and pressures on the bank tops (adjacent flatter areas) within 10 m from the river channel edge; the bank faces and bed margins (or generally steeper areas next to the active channel) and the river channel bed (Figure 4). A 10 m distance from the bank top edge is chosen for the bank top survey to enclose features (particularly vegetation) that may provide nearby habitat for river organisms or may act as pressures on the river ecosystem.

Before commencing a MoRPh survey, use the geometry of the river to decide, where the relatively flat river bed changes into the distinctly steeper bank faces and then the distinctly flatter bank tops (Figures 3 and 4B) and then keep these in mind as you decide what to record on each survey sheet.

The four survey sheets and the MoRPh code sheet can be found in Appendix A. Completion of each survey sheet and related codes are described in detail in the following sections, which are numbered in the same way as the field survey sheets and their subsections.

Following the more general information recorded on sheet 1, the remaining 3 sheets record information on the bank tops / floodplain within 10 m of the bank top edge (sheet 2), the bank faces and channel edges (sheet 3), and the channel bed (sheet 4). Each of these survey sheets is organised so that physical features are mainly recorded in the upper part of the sheet, with vegetation properties in the lower part of the sheet. Within these categories, natural features are mainly recorded before human-modified ones. The survey sheets provide space for notes so that you can record anything that may help you or others interpret your survey information. The website also provides plenty of space for uploading any notes that you wish to store.

The MoRPh survey sheets are colour coded.

Grey boxes indicate the type of feature to be recorded.

Orange boxes provide notes on what is to be recorded.

For most features an abundance is recorded in **White boxes with a bold black border**.

Green boxes indicate that a code is needed and these codes are recorded in **Green boxes with a black bold border**.

Sheet 1: General Information

Project details

The 'Project name', Project code', 'WFD Water Body ID', 'Survey type' fields are optional for most surveys, but if used with care they may help in sorting surveys linked to specific projects and sites.

For survey types, most surveys will be for general 'monitoring'. However, if repeat surveys are being undertaken at the same locations in relation to a particular river project, options are provided to record whether the survey is 'pre-project', immediately 'post-project', or some time after the project has been completed – 'post-recovery'. In addition, surveys may be associated with a 'training' course or they may be deliberately manipulated surveys to simulate the impact of specific management actions – 'simulation'.

NOTE: The Correlation Code is compulsory for MoRPh surveys leading to a River Condition Assessment for DEFRA's Biodiversity Metric. The code ensures that MoRPh5 surveys are correctly grouped and linked to the relevant River Type survey.

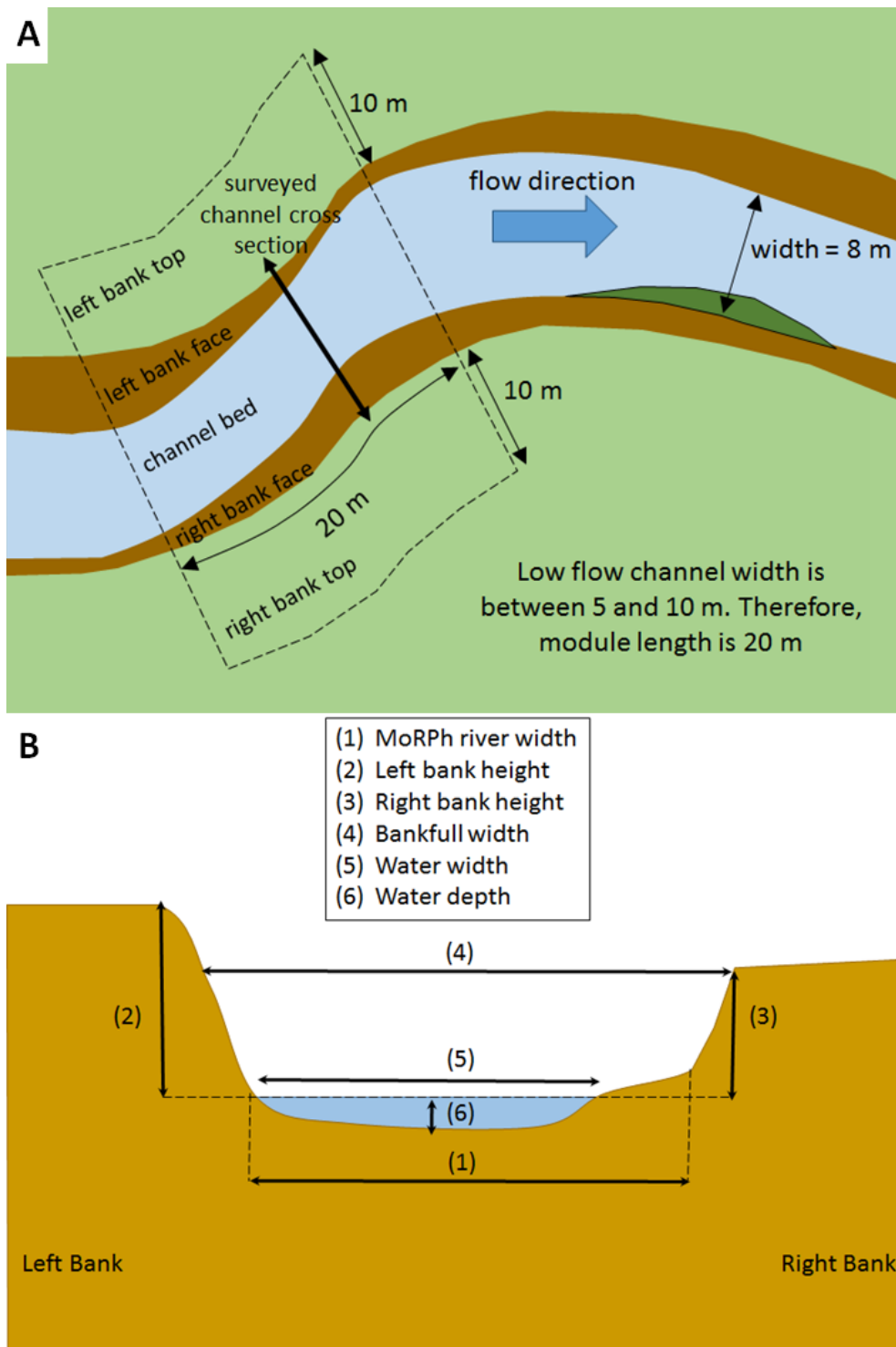


Figure 4: A. Layout of a MoRPh survey and indication of how the typical MoRPh river width (labelled width = 8 m) is determined; B. Measured channel dimensions, including the local MoRPh river width, at a representative cross section within each surveyed MoRPh module (left and right banks are defined when facing in a downstream direction).

1.1 Surveyor and Survey conditions

1.1 SURVEYOR AND SURVEY CONDITIONS	
Surveyor	
Survey date and time	
Module surveyed from?	left / right / both banks
Bed visible?	Yes / No
Adverse conditions?	Yes / No
If yes, describe e.g. elevated flow, turbid water, etc	

Figure 5: Survey Sheet 1 – Surveyor and Survey Conditions

Complete the boxes for the surveyor, survey date and time and the bank(s) from which the survey is conducted. Record whether the bed is visible and also any specific adverse conditions (e.g. high flows, turbid water). Remember that **MoRPh surveys should be conducted under fairly low flow conditions when the bed features are clearly visible and the banks are exposed.**

1.2 Module name and location

1.2 MODULE NAME AND LOCATION	
River name	
Location/Reach name	
SubReach name (used to reference a sub-reach of contiguous modules)	
Module number (1, 2, 3... number from upstream to downstream within SubReach)	
Riverfly site reference (optional)	
Module length (m) (i)	
NGR / GPS - Midpoint	

Figure 6: Survey Sheet 1 – Module name and location

Section 1.2 provides space to record the names of the river and the reach in which the survey is undertaken. The river name should be that recorded on reasonably large scale maps e.g. 1:50000 or 1:25000 scale Ordnance Survey (OS) maps. Reaches can be named to suit the surveyor – use an appropriate local name. Use of consistent names aids retrieval of river catchment data sets from the Modular River Survey website. The Sub-reach name (or letter, e.g. A) is a local name identifying your MoRPh or MultiMoRPh survey. The module number must also be entered. Use 1 for a first or single MoRPh module and thereafter modules should be 2, 3, etc. as adjacent or contiguous modules are surveyed. The modules within a sub-reach should be numbered from upstream to downstream and they must be contiguous (i.e. each module has a common boundary with the adjacent module(s)).

NOTE: For a MultiMoRPh survey to be recognised by the Modular River Survey Information System, river, reach and sub-reach names must be identical. You can ensure this by entering these fields on a blank survey, saving the survey as draft, and then using the 'copy a survey' function to create enough draft surveys for your MultiMoRPh. These draft surveys can then be edited and completed for each of your MultiMoRPh modules. Also remember that all MoRPh

modules need to be completed within a week and numbered from upstream (module 1) to downstream.

In addition to recording the river length that is to be used for one MoRPh, it is essential to locate the mid-point of each surveyed MoRPh module. Each module length can be approximated by pacing along the bank top and then the location of the mid-points can be recorded using a hand-held GPS or an appropriate 'App' on a mobile phone or tablet.

NOTE: Location data can be recorded either as latitude and longitude or using an Ordnance Survey / National Grid Reference. Location data can also be checked for rogue values by entering all module locations into Google Earth across a clear aerial image.

1.3 River channel dimensions

The main dimensions of the channel within the river length encompassed by the survey module should be measured to record the local MoRPh river width (at the surveyed cross section), bankfull width, left bank height, right bank height, water width, and water depth at the time of survey (Figure 3B). These measurements should be conducted at a representative cross section within the module that is being surveyed preferably at a riffle or run (where the water is relatively shallow). The location of the cross section should also be recorded if it is not at the same location as the mid-point of the module.

Each measurement should be as precise as possible, but where visual estimation is necessary record horizontal measurements to the nearest metre and vertical measurements to the nearest 10 cm.

NOTE: It is not essential to enter the channel to measure channel dimensions. Measurements of the adjacent bank height can support visual estimates of the opposite bank height. Extending a measuring tape for a fixed length (e.g. 5 or 10 m) along the bank top will help you to judge widths. Furthermore, river widths can be sanity checked in the field at bridge crossings and can be further checked following field survey using Google Earth images.

1.4 Photographs

Up to four photographs can be uploaded through the Modular River Survey website (www.modularriversurvey.org). without size restriction.

It is essential to take photographs of each module surveyed, which can be used subsequently both as 'fixed point' photographic data, to assess the likely accuracy of the MoRPh survey, and to see how the river module has changed when repeat surveys are conducted at a particular site. **Wherever possible take 3 photos from your fixed survey point or close by – one looking upstream, one across the river and one looking downstream.**

By noting the location-direction of the photograph(s) together with any outstanding landscape features in the notes section, your representative 'fixed point' photographic data will form an important component of repeat survey assessments, that will complement the MoRPh survey data. Your fourth photograph can highlight a particular important / problematic feature (include a comment to explain) or a more general photograph of the broad setting of the module.

Sheet 2: Bank top measurements (within 10 m of the bank edge)

This survey sheet records the abundance of features within the area between the bank top edge and 10 m back from the bank top separately for each side of the river channel (Figure 4A).

The ABUNDANCE of many of the features on sheet 2 are recorded using an A / T / P / E scale, referring to the area occupied by the feature on the bank top along the length of the module and within 10 m of the bank edge: absent (A, 0% cover), trace (T, < 5% cover), present (P, 5-33% cover) or as extensive (E, > 33% cover).

2.1 Bank top - Artificial / managed ground cover

2.1 BANK TOP - ARTIFICIAL / MANAGED GROUND COVER			LB	RB	LB	RB
Artificial ground cover	Artificial ground cover (Fp, Tr, Ic, Re, Sy, Ld, Ar, Pv, Pr, Pw, Ow)	DOMINANT TYPE			A / T / P / E	A / T / P / E
		SUB-DOMINANT TYPE (see (i))			A / P / E	A / P / E

Figure 7: Survey Sheet 2 – Bank top artificial / managed ground cover

Artificial / managed ground cover is recorded using a cover type code (Table 2). Separate assessments of cover type code (Table 2) and abundance (A, T, P, E) are made for the left and right bank within 10 m of the bank edge and are recorded in the code and abundance columns provided for each bank in the field sheet (Figure 7). The artificial land cover categories are very broad and are indicative of different levels of human pressure, so choose the closest to what you observe and if you are unsure, explain this in your notes.

If no artificial / managed ground cover is present record absent (A) for the dominant artificial cover type. Otherwise record the relevant code and the land cover's abundance as trace (T, cover less than 5% of the area within 10 m of bank top along the length of the module), present (P, cover between 5% and 33% bank top area) or as extensive (E, cover exceeds 33% of the bank top area). If two or more artificial cover types are present, the one with the second largest coverage can be recorded as the sub-dominant type ONLY if it exceeds 20% of the area within 10 m of the bank top. Because of this restriction, the sub-dominant type can only be recorded as A, P or E, since its cover will automatically exceed 5% of the bank top area.

Table 2: Artificial / Managed land cover types and codes

Section 2.1 Artificial / Managed ground cover types	
Fp	Pedestrianised, footpath
Tr	Transport infrastructure (road, railway, car park)
Ic	Buildings (commercial / industrial)
Re	Buildings (residential)
Sy	Storage area
Ld	Landfill area
Ar	Arable agriculture / allotments
Pv	Permanently vegetated agriculture (e.g. pasture, orchard)
Pr	Permanently vegetated recreation (e.g. playing fields, parks, gardens)
Pw	Plantation woodland
Ow	Open water (e.g. canal, reservoir)

2.2 Bank top – Natural / lightly managed ground cover

2.2 BANK TOP - NATURAL / LIGHTLY MANAGED GROUND COVER		LB	RB
Terrestrial vegetation	Unvegetated (bare soil / rock)	A / T / P / E	A / T / P / E
	Mosses / lichens	A / T / P / E	A / T / P / E
	Short/creeping herbs/grasses	A / T / P / E	A / T / P / E
	Tall herbs/grasses	A / T / P / E	A / T / P / E
	Scrub or shrubs	A / T / P / E	A / T / P / E
	Saplings or trees	A / T / P / E	A / T / P / E
	Fallen trees (ONLY those with a significant proportion on bank top)	A / T / P / E	A / T / P / E
	Leaning trees	A / T / P / E	A / T / P / E
	J-shaped trees	A / T / P / E	A / T / P / E
	Tree/shrub branches trailing into channel	A / T / P / E	A / T / P / E
	Large wood (wood pieces > 1m long, > 10 cm diameter)	A / T / P / E	A / T / P / E
	Predominant tree type (Absent, Deciduous, Coniferous, Mixed)	A / D / C / M	A / D / C / M
Non-native invasive plant species	Himalayan balsam	A / T / P / E	A / T / P / E
	Japanese knotweed	A / T / P / E	A / T / P / E
	Giant hogweed	A / T / P / E	A / T / P / E
	Floating pennywort	A / T / P / E	A / T / P / E
	Other: NAME SPECIES	A / T / P / E	A / T / P / E
	Other: NAME SPECIES	A / T / P / E	A / T / P / E

Figure 8: Survey Sheet 2 – Natural / lightly managed ground cover

Section 2.2 records measurements of the area of unvegetated bare earth or bare rock and components of the natural / lightly managed vegetation structure.

NOTE that this includes areas overlapping the ‘artificial / managed land cover’ where vegetation or bare earth/rock (NOT artificial surfaces) are present (e.g. in gardens) and it also includes areas under non-native invasive plant species within 10 m of the bank top edge.

Use the A, T, P, E abundance scale and assess abundance against a realistic maximum, particularly for trees. Vegetation is multi-layered so, for saplings and trees, use their canopies rather than the area covered by their trunks to assess a realistic maximum abundance (the maximum number of trees of the local size that could be accommodated in the survey area) to assess actual abundance!

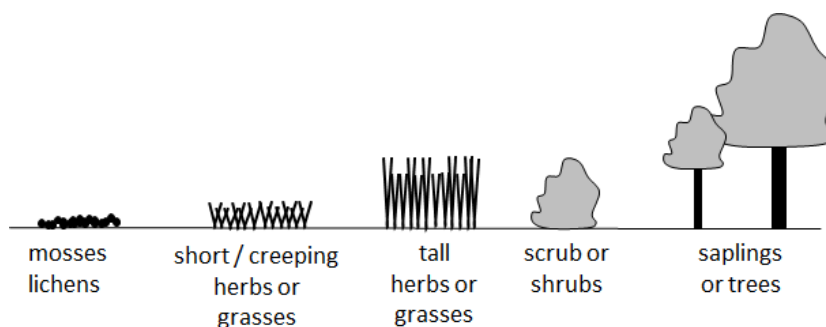


Figure 9: Terrestrial vegetation types

Terrestrial vegetation is recorded according to 5 broad types which show a progressive increase in height and woodiness: mosses/lichens, short or creeping grasses and herbs (includes ground ivy), tall herbs and grasses, scrub (including briars) or shrubs, saplings or trees (Figure 9).

The other features recorded for terrestrial vegetation are habitat features and geomorphological process indicators associated with trees within 10 m of the bank top edge. These are illustrated in Figure 10 and defined in the Figure caption. NOTE that some of these features are also recorded on the bank face and channel bed according to where they are located, as specified in the caption for Figure 10, so make sure that you define your bank top, bank face and channel bed areas carefully and stick rigidly to these boundaries when recording features. The predominant type of tree on the bank top (codes: A=absent, D=deciduous, C=coniferous, M = mixed) is also recorded.

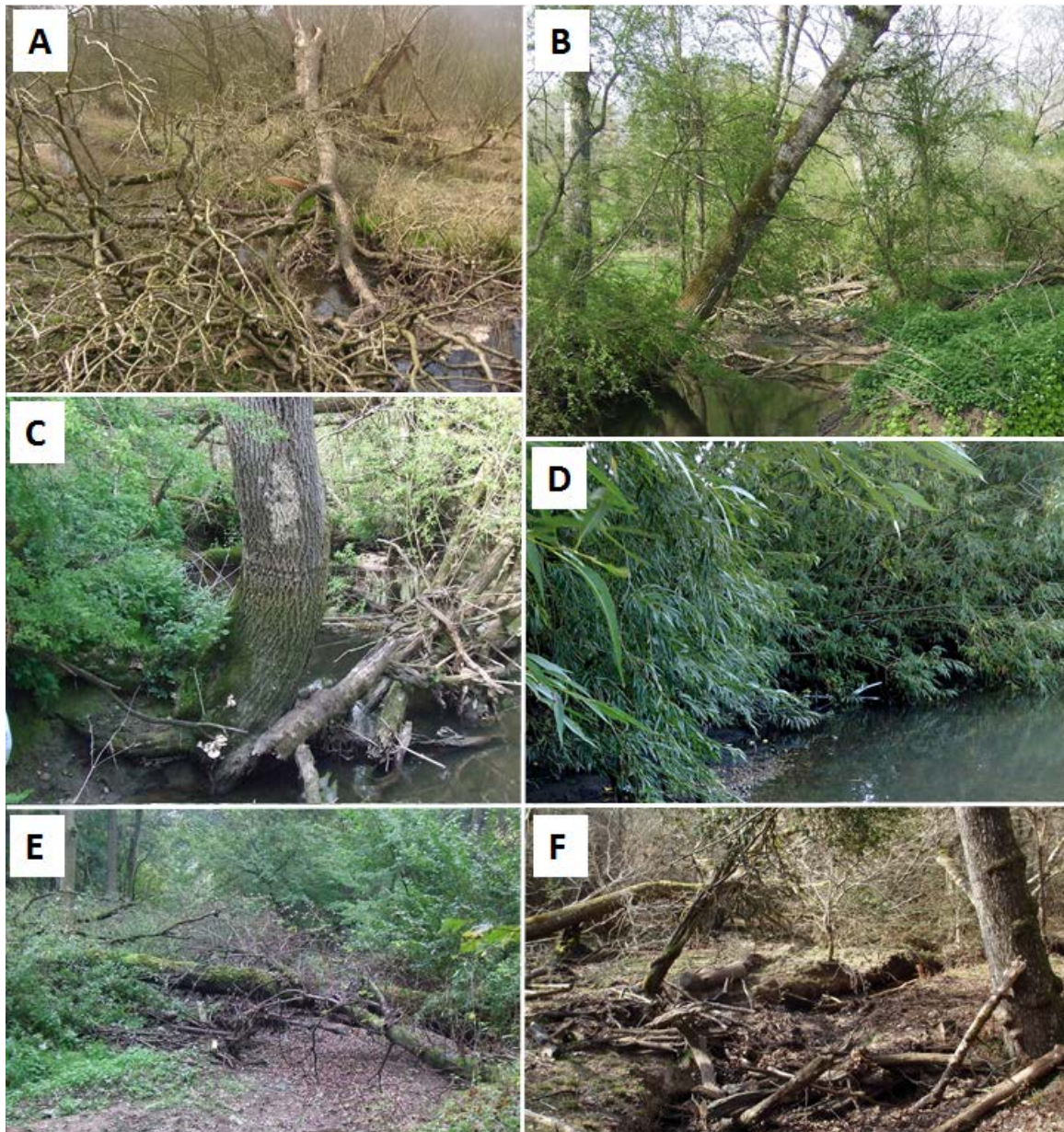


Figure10: Tree habitat features and geomorphological process indicators

- A. Fallen tree (ONLY record on sheet 2 if a significant part of the tree is on the bank top, sheet 3 if a significant part is on the bank face, and on sheet 4 if a significant part is in the channel)
- B. Leaning tree (ONLY record on sheet 2 if on bank top or sheet 3 if on bank face),
- C. J-shaped tree (note curvature near base of trunk) (ONLY record if located on the bank top or bank face for bank top (sheet 2) and bank face (sheet 3) measurements, respectively),
- D. Branches from trees trailing into channel (ONLY record if from trees growing on the bank top or bank face for bank top (sheet 2) and bank face (sheet 3) measurements, respectively),
- E. and F. Large wood (i.e. wood piece(s) > 1 m long, > 10 cm diameter) (ONLY record if predominantly on the bank top, bank face, or in the channel for bank top (sheet 2), bank face (sheet 3), and channel bed (sheet 4) measurements, respectively). **NOTE: In all records for large wood include the wood that is present within fallen trees and other accumulations (e.g. wood dams on sheet 4) as well as more widely distributed pieces to give a total assessment of large wood abundance**

Up to six non-native invasive plant species can be recorded as absent (A, 0% cover), trace (T, < 5% cover), present (P, 5-33% cover) or as extensive (E, > 33% cover). Himalayan balsam, Japanese knotweed and Giant hogweed are the most likely to be encountered on bank top surfaces. Floating pennywort and another three less common species identified by the Environment Agency (i.e. Australian swamp stonecrop, Parrot's feather, Creeping water primrose) are most likely to be found in association with water-related features such as side channels and ponds (see section 2.3 below).

Pictures of all seven species can be found in Appendix B.

2.3 Bank top - Water related features

2.3 BANK TOP - WATER RELATED FEATURES			LB	RB
Water-related features	Pond	Disconnected from river at time of survey	A / T / P / E	A / T / P / E
		Connected to river by water-filled channel at time of survey	A / T / P / E	A / T / P / E
	Side channel - free flowing separate channel including tributaries and fish passes		A / T / P / E	A / T / P / E
	Wetland (recorded by dominant vegetation type)	Short non-woody vegetation (e.g. mosses, sedges)	A / T / P / E	A / T / P / E
		Tall, non-woody vegetation (e.g. reeds, rushes)	A / T / P / E	A / T / P / E
		Shrubs and trees (e.g. alder / willow carr)	A / T / P / E	A / T / P / E

Figure 11: Survey Sheet 2 – Bank top water – related features

Water-related features are recorded as absent (A, 0% cover), trace (T, < 5% cover), present (P, 5-33% cover) or as extensive (E, > 33% cover) in terms of the area they occupy. These may be natural features, or they may have been artificially created in some cases. However, they all contain, either permanently or periodically, features or species that depend on water (Figure 11).

Connected and disconnected ponds and side channels are recorded as part of the bank top survey and are differentiated according to whether they are connected by a water-filled channel at the time of survey. Side channels are defined as a free-flowing separate channel (although flow may be impounded or very low at the time of recording) which may or may not join the main channel within the survey area. Figure 12 illustrates the difference between disconnected, connected and marginal backwaters and side channels.

NOTE: Fish passes and tributaries can be recorded as side channels.

Wetlands are waterlogged areas, often with patches of standing water. These are discriminated into one of three types according to the height and type of their dominant vegetation (short non-woody vegetation (e.g. mosses, sedges, short grasses and herbs); tall non-woody vegetation (e.g. reeds, rushes); trees and shrubs (e.g. alder or willow carr)).

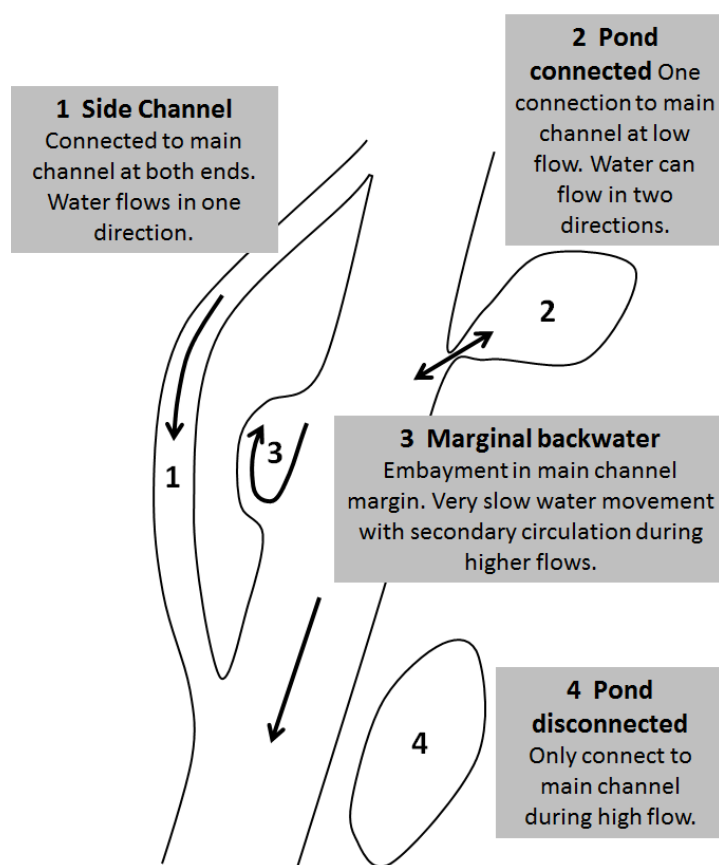


Figure 12: Sketch illustrating the characteristic form of side channels, connected and disconnected ponds and marginal backwater features. **NOTE: Marginal backwaters are recorded on Sheet 3 as a bank face - channel margin measurement (section 3.3).**

Sheet 3: Bank face and channel margin measurements

The bank face and channel margin is the area between the bank top edge and the water surface (or river bed if the channel is dry) along the length of the module.

The ABUNDANCE of most of the features on sheet 3 are recorded using an A / T / P / E scale, referring to the proportion of the BANK LENGTH occupied by the feature within the module: absent (A, 0% bank length), trace (T, < 5% bank length), present (P, 5-33% bank length) or as extensive (E, > 33% bank length).

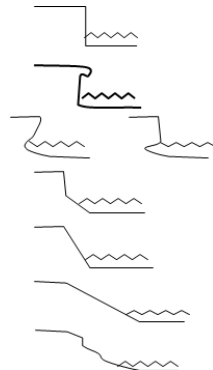
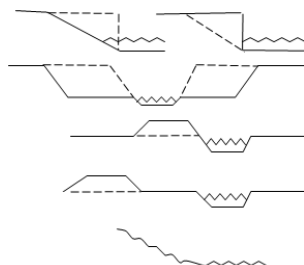
However, the ABUNDANCE of 'Terrestrial vegetation on bank face' and 'Non-native invasive plant species' (section 3.4) are recorded as a proportion of the AREA OF THE BANK FACE along the length of the module.

3.1 Bank face – Profile

3.1 BANK FACE - PROFILE				LB	RB	LB	RB
Bank face - Profile	Natural / artificial bank profile	DOMINANT TYPE (V, Vo, Vu, Vt, St, Gt, Cm, Rs, Ts, Em, Sm, Pc)	Bank profile type			A / T / P / E	A / T / P / E
		SUB-DOMINANT TYPE (see (i))	Bank profile type			A / P / E	A / P / E

Figure 13: Survey Sheet 3 – Bank face - profile

Table 3: Bank profile types and codes

Code	Description	Profile
Natural / Unmodified bank profile		
V	Vertical	
Vo	Vertical with top overhang	
Vu	Undercut or vertical with undercut	
Vt	Vertical with toe	
St	Steep (> 45 degrees)	
Gt	Gentle (< 45 degrees)	
Cm	Composite	
Artificial / Obviously modified bank profile		
Rs	Reshaped	
Ts	Artificial two-stage	
Em	Embanked	
Sm	Set-back embankment	
Pc	Poached bank	

The vertical shapes or profiles of the left and right bank are each recorded separately using the profile type codes listed in Table 3.

The dominant profile type (most extensive along the length of the module bank) is recorded and a second (sub-dominant) type can be recorded if it extends for more than 20% of the bank length. Because of this restriction, the sub-dominant type can only be recorded as A, P or E, since its cover will automatically exceed 5% of the bank length.

If the bank has a clearly artificial profile as a result of engineering or poaching (i.e. heavy trampling by animals or people) then one of the artificial types (Rs, Ts, Em, Sm, Pc) should be recorded. Otherwise select one of the natural types (V, Vo, Vu, Vt, St, Gt, Cm).

Note that vertical with top overhang (Vo) refers to banks where only a shallow vegetated section (e.g. turf) protrudes at the bank top. Undercut (Vu) refers to profiles where the river has excavated the base of the bank, leaving a deeper overhanging section than Vo. Vt refers to vertical banks where eroded bank material (sediment or vegetated clods) has accumulated at the bank toe (e.g. Figure 18 G).

3.2 Bank face – Materials

The MoRPh survey uses a standard set of codes to record the sizes of sediment particles found in the river banks, channel bed, and in several channel and bank features (Table 4). Section 3.2 records both natural sediment and reinforcement materials found on the left and right banks of the river.

3.2 BANK FACE - MATERIALS				LB	RB		
Bank face - Natural materials	Bank face sediment (AR, BE, BO, CO, GP, SA, SI, CL, OR, PE, EA, NV)		Sediment size (top 2/3)			LB	RB
			Sediment size (bottom 1/3)				
Bank face - Reinforcement	Which part of the bank is reinforced? (NOTE SPECIFIC CODES IN BOX (ii))					A / T / B / W	A / T / B / W
	How extensive is the reinforcement horizontally along the module?					A / T / P / E	A / T / P / E
	Bank reinforce- ment	DOMINANT TYPE (CC, CB, BR, SP, WP, BW, RR, GA, WS, RE, BC, WO)		Reinforcement type			
		SUB-DOMINANT TYPE (see (iii))		Reinforcement type			

Figure 14: Survey Sheet 3 – Bank face - materials

'Bank face - natural materials' refer to the sediments that make up the river bank. The dominant sediment size is recorded separately for the upper (approximately top 2/3) and lower (approximately bottom 1/3) parts of the bank, as bank sediments often vary between the upper and lower bank. If NO natural materials are exposed then record AR (artificial) as the sediment code.

'Bank face – reinforcement' records three different aspects of any bank reinforcement on each bank:

- (i) 'Which part of the bank is reinforced?' This records whether reinforcement is absent (A), predominantly confined to the top or upper (T), bottom or lower (B) part of the bank profile or covers the whole (W) bank profile. **NOTE that these codes are different from the A, T, P, E scale used for most features in the MoRPh survey.**
- (ii) 'How extensive is the reinforcement horizontally along the module?' The horizontal extent of the reinforcement along each river bank is recorded using the A, T, P, E scale (A, 0% bank length), trace (T, < 5% bank length), present (P, 5-33% bank length) or as extensive (E, > 33% bank length).
- (iii) Reinforcement type. This is recorded using a code to describe the dominant type of reinforcement. The codes (CC, CB, BR, SP, WP, BW, RR, GA, WS, RE, BC, WO) are illustrated in Figure 15. A second, subdominant type of reinforcement can only be recorded if this occupies > 20% of the reinforced area. The same reinforcement type codes are also used to record bed reinforcement (section 4.1).

Table 4: Sediment size codes used for describing the sediments that comprise river banks, the river bed, and some physical features (note EA (earth) is ONLY used when describing river bank face materials)

Code	Name	Technical Description	Simple Field Description
AR	Artificial	Only record if artificial materials (e.g. concrete) completely obscure the natural sediments	
BE	Bedrock	Bare bedrock exposed at the surface	
BO	Boulder	Mineral particles, diameter > 256 mm	head size
CO	Cobble	Mineral particles, diameter 64-256 mm	fist size
GP	Gravel-Pebble	Mineral particles, diameter 2-64 mm	particles clearly visible to naked eye from several meters
SA	Sand	Mineral particles, diameter 0.0625-2 mm	very loose crumbly material, particles clearly visible to naked eye from within 1 m.
SI	Silt (and finer non-sticky particles)	Mineral particles, diameter 0.00195-0.0625 mm	loose crumbly material but individual particles difficult to see with the naked eye
CL	Clay	Mineral particles, diameter < 0.00195 mm	sticky material made up of very small particles invisible to the naked eye)
OR	Organic	Dead plant material (leaves, twigs etc.) that is intact or only lightly decomposed	
PE	Peat	More or less decomposed plant material that has accumulated in a water-saturated environment and in the absence of oxygen	
EA	Earth	A mixture of mineral and organic particle sizes (mainly sand and finer with occasional gravel) (only used for bank face material)	
NV	Not visible	Only record if all natural sediments are present but obscured from view (e.g. by vegetation, when observed from the opposite river bank)	

NOTE: The coloured lines down the right side of this page indicate lengths of approximately 256 mm (**blue line** – lower limit of boulder and upper limit of cobble particles), 64 mm (**green line** – lower limit of cobble, upper limit of gravel-pebble), and 2 mm (**red line** – lower limit of gravel-pebble, upper limit of sand).



Figure 15: Reinforcement types.

- CC - concrete (cemented reinforcement with no gaps),
- CB - concrete and brick, blocks or stone (areas of bricks/stone/concrete blocks and mortar with separate areas of more extensive concrete),
- BR - brick / laid stone / blocks (brick, stone or other blocks) held together by mortar,
- SP - sheet piling (interlocking metal sheets, including corrugated iron),
- WP - wood piling (vertical or horizontal wood planks protecting the bank face) often confined to the bank toe,
- BW - builders waste (loose hard core tipped at the bank toe or across the bank face),
- RR - rip-rap (normally roughly square stones, often of very similar size, purposely tipped/laid along the bank face but not cemented together), often confined to the bank toe - includes blockstone and boulders compacted into the bank with soil between,
- GA - gabions (stones in wire baskets),
- WS - willow spiling / faggot bundles (cut willow stakes driven into bank toe / face, often linked by woven willow to create a living fence that roots into the bank, or bundles of sticks or twigs),
- RE - planted reeds (only record when regularly spaced and so obviously deliberately planted),
- BC - biotex / coir (woven fabric spread across the bank face to protect the underlying bank materials from erosion),
- WO - washed out (bank protection materials that have collapsed into the channel so that they no longer protect the banks).

3.3 Bank face / channel margin – Features

3.3 BANK FACE / CHANNEL MARGIN - FEATURES			LB	RB	LB	RB
Natural physical features	Bare / unvegetated side bar (< 50% vegetation cover)	Sediment size			A / T / P / E	A / T / P / E
	Vegetated side bar (>50% vegetation cover)	Sediment size			A / T / P / E	A / T / P / E
	Berm (if unsure whether berm/bench record as berm)				A / T / P / E	A / T / P / E
	Bench (if unsure whether berm/bench record as berm)				A / T / P / E	A / T / P / E
	Stable cliff (> 0.5 m)				A / T / P / E	A / T / P / E
	Eroding cliff (> 0.5m)				A / T / P / E	A / T / P / E
	Toe				A / T / P / E	A / T / P / E
	Nest holes or animal burrows				A / T / P / E	A / T / P / E
	Marginal backwater				A / T / P / E	A / T / P / E
	Tributary junction / confluence: RECORD AS COUNT					
Artificial physical features	Pipes / outfalls (if appear potentially functional): RECORD AS COUNT					
	Jetty				Maj / Int / Min	Maj / Int / Min
	Deflector				Maj / Int / Min	Maj / Int / Min
	Other: INSERT FEATURE NAME				Maj / Int / Min	Maj / Int / Min

Figure 16: Survey Sheet 3 – Bank face / channel margin - Features

Natural physical features

This section records the natural physical features that may be observed on river bank faces and at the channel margins as illustrated in Figure 18 and defined in the figure caption (see also Figure 12 for marginal backwater). If you are unsure whether a feature is a berm or a bench (which depends on the elevation of their vegetated surface relative to low-flow water levels), then record the feature as a berm.

Artificial physical features

This section records the following artificial features:

Pipes and outfalls are recorded as a count - only include those that appear to be potentially functional (capable of draining something into the river).

Jetties, deflectors and any other artificial feature that projects out into the water from the bank face are recorded as major (Maj), intermediate (Int) and minor (Min) according to their projection across the channel width (Figure 17). Jetties allow some flow underneath them whereas deflectors do not. If 'other' is recorded, insert the name of the feature in the green box. **NOTE that bridge piers protruding into the channel from the edge are recorded as deflectors.**

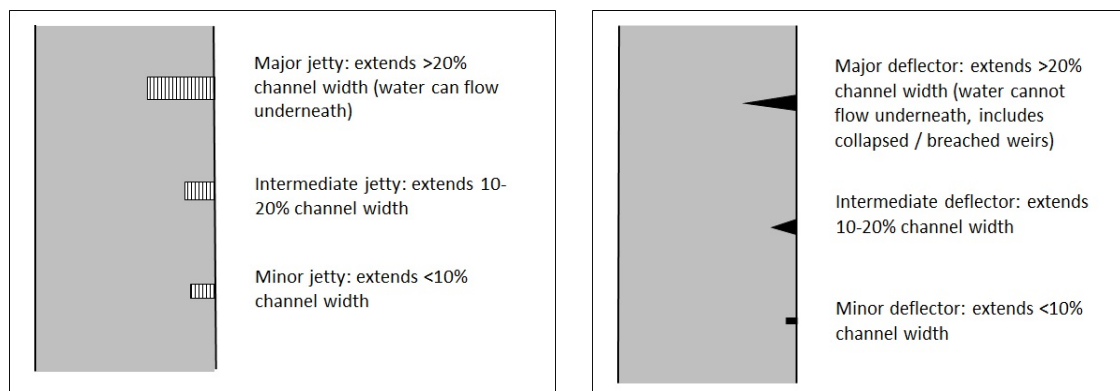


Figure 17: Major, intermediate and minor jetties (left) and deflectors (right).

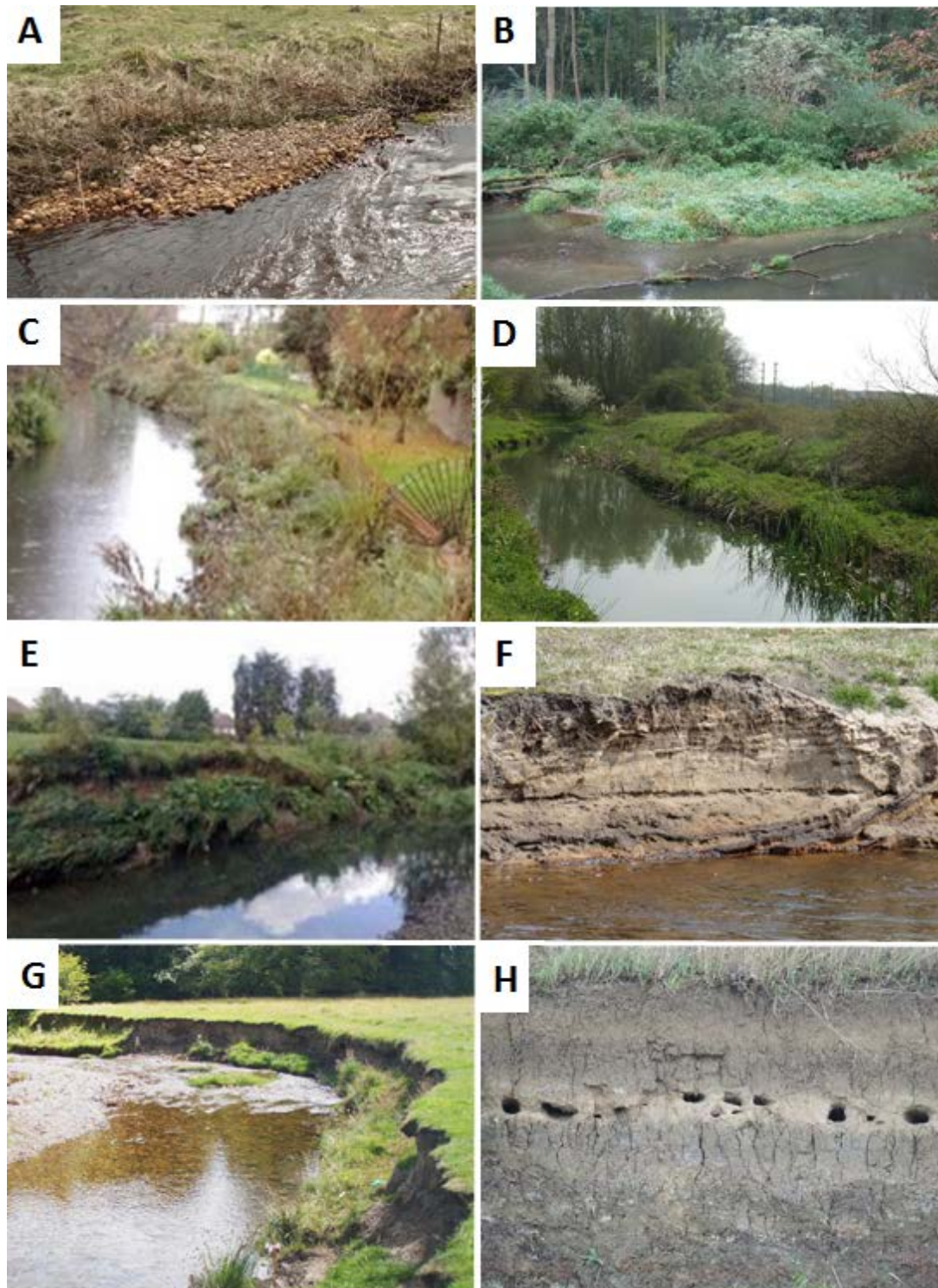


Figure 18: Bank natural physical features

- A – Bare / unvegetated side bar (curved surface dips gently towards the water, <50% vegetation cover)
- B – Vegetated side bar (curved surface dips gently towards the water, >50% vegetation cover)
- C – Berm (near flat vegetated surface close to the low flow water level with a distinct edge towards the water),
- D – Bench (near flat vegetated surface elevated above the low flow water level with a distinct edge towards the water)
- E – Stable cliff (near vertical, > 0.5 m high, > 50% vegetated),
- F – Eroding cliff (near vertical, > 0.5 m high, < 50% vegetated),
- G – Bank toe (sloping area of deposited sediment, bare or vegetated, at the base of the bank)
- H – Animal nesting holes or burrows

Not shown – Marginal backwater (a local embayment or widened area along the water's edge margin, see Figure 12 for illustration); junction / confluence of tributary stream.

3.4 Bank face / channel margin - Vegetation

3.4 BANK FACE / CHANNEL MARGIN - VEGETATION		LB	RB		LB	RB
Terrestrial vegetation on bank face	Unvegetated (bare earth or rock)	A / T / P / E	A / T / P / E	Fallen trees (ONLY those with a significant proportion on bank face)	A / T / P / E	A / T / P / E
	Mosses / lichens	A / T / P / E	A / T / P / E			
	Short/creeping herbs/grasses	A / T / P / E	A / T / P / E	Leaning trees	A / T / P / E	A / T / P / E
	Tall herbs/grasses	A / T / P / E	A / T / P / E	J-shaped trees	A / T / P / E	A / T / P / E
	Scrub or shrubs	A / T / P / E	A / T / P / E	Tree/shrub branches trailing into channel	A / T / P / E	A / T / P / E
	Saplings or trees	A / T / P / E	A / T / P / E	Exposed tree roots	A / T / P / E	A / T / P / E
	Large wood (pieces > 1m long, > 10 cm diameter)	A / T / P / E	A / T / P / E	Discrete organic accumulation (e.g. leaves, twigs)	A / T / P / E	A / T / P / E
Aquatic vegetation at bank-water margin	Liverworts, mosses, lichens	A / T / P / E	A / T / P / E	Amphibious	A / T / P / E	A / T / P / E
	Emergent broad-leaved	A / T / P / E	A / T / P / E	Filamentous algae	A / T / P / E	A / T / P / E
	Emergent linear-leaved (incl horsetails)	A / T / P / E	A / T / P / E			
Non-native invasive plant species	Himalayan balsam	A / T / P / E	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E	A / T / P / E
	Japanese knotweed	A / T / P / E	A / T / P / E			
	Giant hogweed	A / T / P / E	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E	A / T / P / E
	Floating pennywort	A / T / P / E	A / T / P / E			

Figure 19: Survey Sheet 3 – Bank face / channel margin - vegetation

Section 3.4 of the recording sheet includes terrestrial vegetation on the bank face, aquatic vegetation at the bank-water margin and non-native invasive plant species on the bank face or at the bank-water margin. Many of these features recorded on sheet 3 are the same as features already discussed in relation to survey sheet 2 (section 2.2) but they are now found on the bank face rather than the bank top. Sometimes it may be difficult to specify the location when a feature is close to the boundary between the bank top and face (especially for tree features). In such cases it is important not to 'double count' features but to record them at the location where their influence appears to be greatest. All are recorded using the A, T, P, E scale ((A, 0% bank length), trace (T, < 5% bank length), present (P, 5-33% bank length) or as extensive (E, > 33% bank length)).

Terrestrial vegetation on bank face

The features recorded under the heading 'terrestrial vegetation on bank face' are mainly the same as those recorded on the bank top (section 2.2) but here we only record these features if they are (predominantly) on the bank face rather than the bank top according to their area abundance across the bank face. Measurements are recorded for unvegetated areas of bare soil or rock and components of the vegetation structure. The latter is split into 5 broad types which show a progressive increase in height and woodiness: mosses, short or creeping herbs and grasses (includes ground ivy), tall herbs and grasses, scrub (including briars) or shrubs, and saplings or trees (Figure 9). Tree-related features that were recorded when they were predominantly on the bank top are also recorded in this section when they are predominantly on the bank face (Figure 10), but there are some additional tree-related features recorded for the bank face – channel margin area including leaning trees, exposed tree roots (not underwater) and discrete accumulations of organic material consisting of pieces smaller than large wood pieces (e.g. leaves and twigs).

Aquatic vegetation at the bank face - channel margin

Five broad morphological types of aquatic vegetation (mosses/lichens, emergent broad-leaved, emergent linear-leaved (incl. horsetails), amphibious, filamentous algae) may be present at the channel margin between the bank and the water. These are illustrated and described fully in section 4.4 and so are not described here. They are recorded according to their linear abundance along the bank length using the A, T, P, E scale.

Non-native invasive plant species

These species have already been discussed in section 2.2 and are illustrated in Appendix B and are recorded according to their area abundance across the bank face using the A, T, P, E scale.

Survey sheet 4: Channel bed measurements

The channel bed is the relatively flat area between the bank faces. In most rivers and streams the bed is largely covered by water at low flow. However, many rivers contain features that emerge from the water, such as mid-channel bars and islands. Depending upon the flow, the extent of these emergent features will vary and also parts of the bed may be dry at the time of survey. For streams that only flow for part of the year, the bed may be completely dry on some survey occasions.

The ABUNDANCE of many of the features on sheet 4 are recorded using an A / T / P / E scale, referring to the area of the channel bed occupied by each feature within the length of the module: absent (A, 0% cover), trace (T, < 5% cover), present (P, 5-33% cover) or extensive (E, > 33% cover)..

4.1 Channel bed – materials

4.1 CHANNEL BED - MATERIALS					
Channel bed - Natural materials	Bed sediment size	Bedrock (BE)	A / T / P / E	Silt (and finer non-sticky particles, SI)	A / T / P / E
		Boulder (BO)	A / T / P / E	Clay (CL)	A / T / P / E
		Cobble (CO)	A / T / P / E	Organic (leaves, twigs etc. not fully decomposed) (OR)	A / T / P / E
		Gravel-Pebble (GP)	A / T / P / E		A / T / P / E
	Silt overlying coarser sediments	Sand (SA)	A / T / P / E	Peat (PE)	A / T / P / E
		Continuous silt layer (the form of underlying coarser sediments is visible)	A / T / P / E	Patchy thin layer (some coarser particles protrude through the silt layer)	A / T / P / E
Channel bed - Reinforcement	Bed reinforcement extent		A / T / P / E	(i) SUB-DOMINANT REINFORCEMENT TYPE: ONLY RECORD if it occupies > 20% reinforced area	
			CODE / DESCRIPTION		
	Bed reinforcement materials	DOMINANT TYPE (CC, CB, BR, SP, WP, BW, RR, GA, WS, RE, BC, WO)	reinforcement type		
		SUB-DOMINANT TYPE (see (i))	reinforcement type		

Figure 20: Survey Sheet 4 – Channel bed - materials

Channel bed natural materials are recorded using the sediment size codes (Table 4) with the exclusion of earth (EA) which can only be used for river bank materials.

Looking at the entire channel bed area, the abundance of each sediment size class is recorded (or for non-mineral river beds the codes for 'organic' or 'peat' are used), using the A, T, P, E scale. Virtually all river beds will show sediment of more than one size (e.g. gravel between boulders or sand/silt overlying gravel). In addition to when silt and finer sediments form the bed material (i.e. a thick layer through which no coarser sediments can be observed), silty sediments often spread over coarser sediments either as a continuous, thin layer through which the form of the underlying coarser particles can be seen, or as a patchy, discontinuous, thin layer, through which some coarser particles protrude. The extent of these two types of silty overlying layer are also recorded.

Channel bed reinforcement is also recorded. The extent of the reinforcement is recorded using the A, T, P, E scale and the dominant type of reinforcement is recorded using the same codes as those for bank reinforcement (Figure 15). If there is a second type of reinforcement occupying more than 20% of the reinforced area of the bed, the code for this subdominant reinforcement type is also recorded.

4.2 Water surface

4.2 WATER SURFACE					
Water surface flow patterns	Flow types	Free fall (FF)	A / T / P / E	Rippled (RP)	A / T / P / E
		Chute (CH)	A / T / P / E	Smooth (SM)	A / T / P / E
		Broken standing waves (BW)	A / T / P / E	No perceptible flow (NP)	A / T / P / E
		Unbroken standing waves (UW)	A / T / P / E		A / T / P / E
		Upwelling (UW)	A / T / P / E	Dry (DR)	A / T / P / E

Figure 21: Survey Sheet 4 – Water surface

Water surface flow types are typical disturbance patterns on the water surface, which are important indicators of the hydraulic and bed habitats that underlie the water surface. Flow types are illustrated in Figure 22, with codes and definitions for each flow type provided in the Figure caption. The water surface flow types are organised from fast flow velocity types (Figure 22, top, left to right) through intermediate velocity types (Figure 22, middle, left to right) to low or zero velocity types and areas of the bed that have no water and so are recorded as dry (Figure 22, bottom, left to right). The extent of each type is recorded using the A, T, P, E scale.

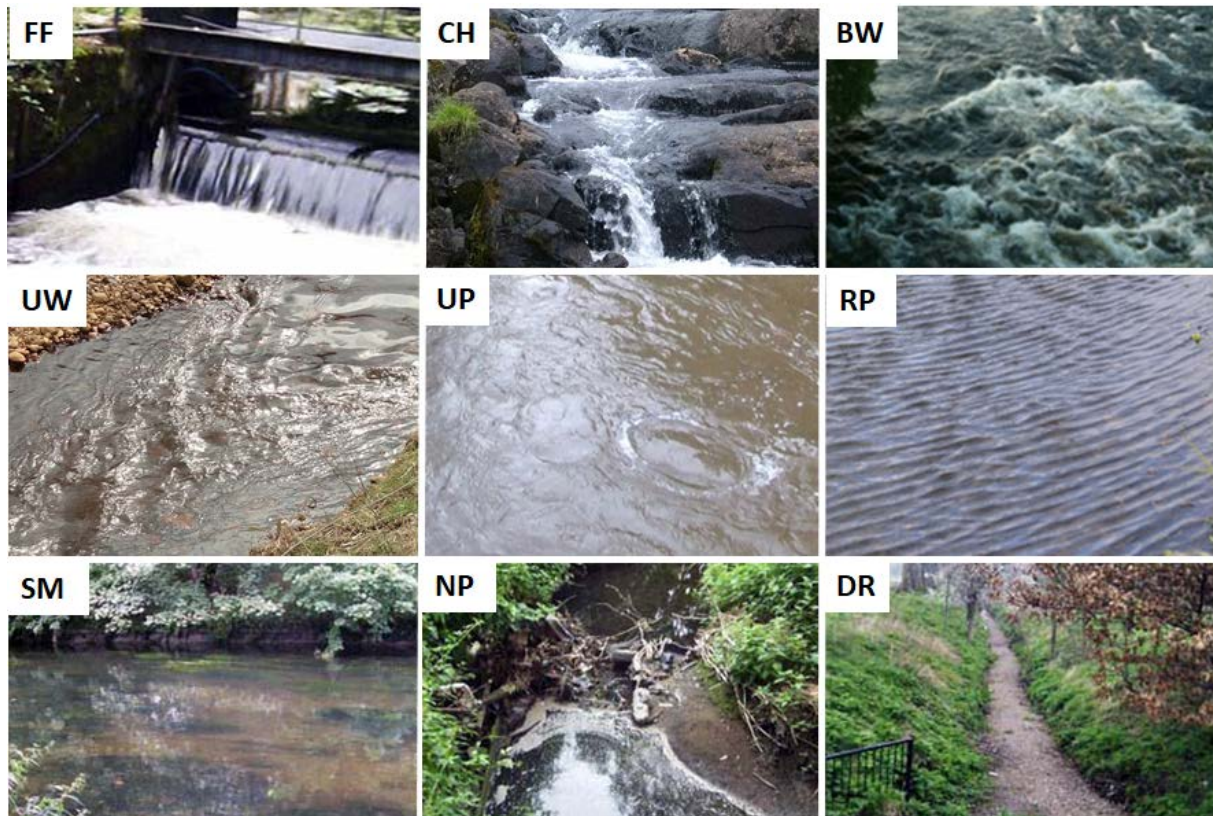


Figure 22: Water surface flow types

- FF – Free fall (near vertical falling water with open air behind the falling water and so no direct contact with river bed,
 CH – Chute flow (steep water surface with some air gaps behind the water but mainly water is contact with river bed – there are three chutes in the downstream sequence in the picture) (Source: www.freeimageslive.co.uk free_stock_image watercascade3897jpg).
 BW – Broken standing waves (waves on the water surface that occupy a fixed position in the river channel and have a foaming / breaking crest),
 UW – Unbroken standing waves (waves on the water surface that occupy a fixed position in the river channel and do not have a foaming / breaking crest),
 UP – Upwelling (formed by water rising up to the water surface and then spreading sideways in all directions like the surface of slowly boiling water),
 RP – Ripples (small waves on the water surface that are not in fixed locations but move gradually – usually in a downstream direction),
 SM – Smooth (near featureless water surface but water clearly moving downstream as witnessed by movements of leaves on the water surface)
 NP – no perceptible flow (water not clearly moving – often occurs when water is ponded back by a weir, wood jam, etc.)
 DR – a completely dry channel (no water in the channel and so ‘dry’ is recorded as extensive (E)).

4.3 Channel bed features

4.3 CHANNEL BED - FEATURES			
Channel bed - Natural physical features	Exposed bedrock		A / T / P / E
	Exposed unvegetated boulders / rocks (< 50% vegetation cover)		A / T / P / E
	Exposed vegetated boulders / rocks (> 50% vegetation cover)		A / T / P / E
	Bare / unvegetated mid channel bar (< 50% vegetation cover)	sediment size	A / T / P / E
	Vegetated mid channel bar (>50% vegetation cover)	sediment size	A / T / P / E
	Island		A / T / P / E
	Cascade		A / T / P / E
	Pool: RECORD AS COUNT		
	Riffle: RECORD AS COUNT		
	Step (steep boulder/bedrock feature <2m high, mainly chute and free fall): RECORD AS COUNT		
	Waterfall (steep boulder/bedrock feature >2m high, mainly free fall): RECORD AS COUNT		
Channel bed - Artificial features	Large trash (car parts, trolleys, traffic cones etc)		A / T / P / E
	Major weir (see (ii)): RECORD AS COUNT		
	Intermediate weir (see (ii)): RECORD AS COUNT		
	Minor weir (see (ii)): RECORD AS COUNT		
	Bridge piers in river bed: RECORD AS COUNT		
	Bridge shadow (see (iii))		Wide / Int / Narr
	Culvert: RECORD AS COUNT		

Figure 23: Survey Sheet 4 – Channel bed - features

Channel bed natural physical features are illustrated in Figure 24 and defined in the Figure caption. They are mainly recorded using the A, T, P, E scale, although pools, riffles, steps and waterfalls are counted. For bare/unvegetated or vegetated mid-channel bars, the predominant sediment size is also recorded using the same codes as for bed and bank sediments (Table 4, but excluding EA).

Channel bed artificial features include large trash such as shopping trolleys, traffic cones, metal drums, car parts etc. (Figure 25A). Trash is recorded using the A, T, P, E scale. Weirs (Figure 25B) are counted according to three size groups (major, intermediate, minor). The number of culverts (Figure 25C) and bridge piers located in the river bed (Figure 25D) are recorded as a count, whereas shading below bridges (Figure 25E) is recorded as Wide (wide), Int (intermediate) or Narr (narrow) according to the length of channel affected (Wide = > 25 m channel length, Int = 10-25 m channel length, Narr = < 10 m channel length).

NOTES for recording NFM (Natural Flood Management) features.

- (i) If these features are clearly artificial features made of artificial materials (hewn planks, wood boards, etc.) or are clearly secured by posts, wires or other features not naturally found in a river, they need to be recorded as artificial features. Thus, most 'leaky barriers', which are obviously artificial and constructed by humans should be recorded as intermediate weirs (semi-permanent, rubble/loose stone/wood structures, Figure 25 A).
- (ii) Following the 'record what you see not what you know' mantra, if these artificial structures have become so broken or buried in natural large wood pieces that their artificial origin is no longer apparent, they can be recorded as wood jams (in section 4.4).
- (iii) In either case, if the structure contains large wood pieces, these wood pieces should be included within the estimate of large wood abundance (section 4.4).

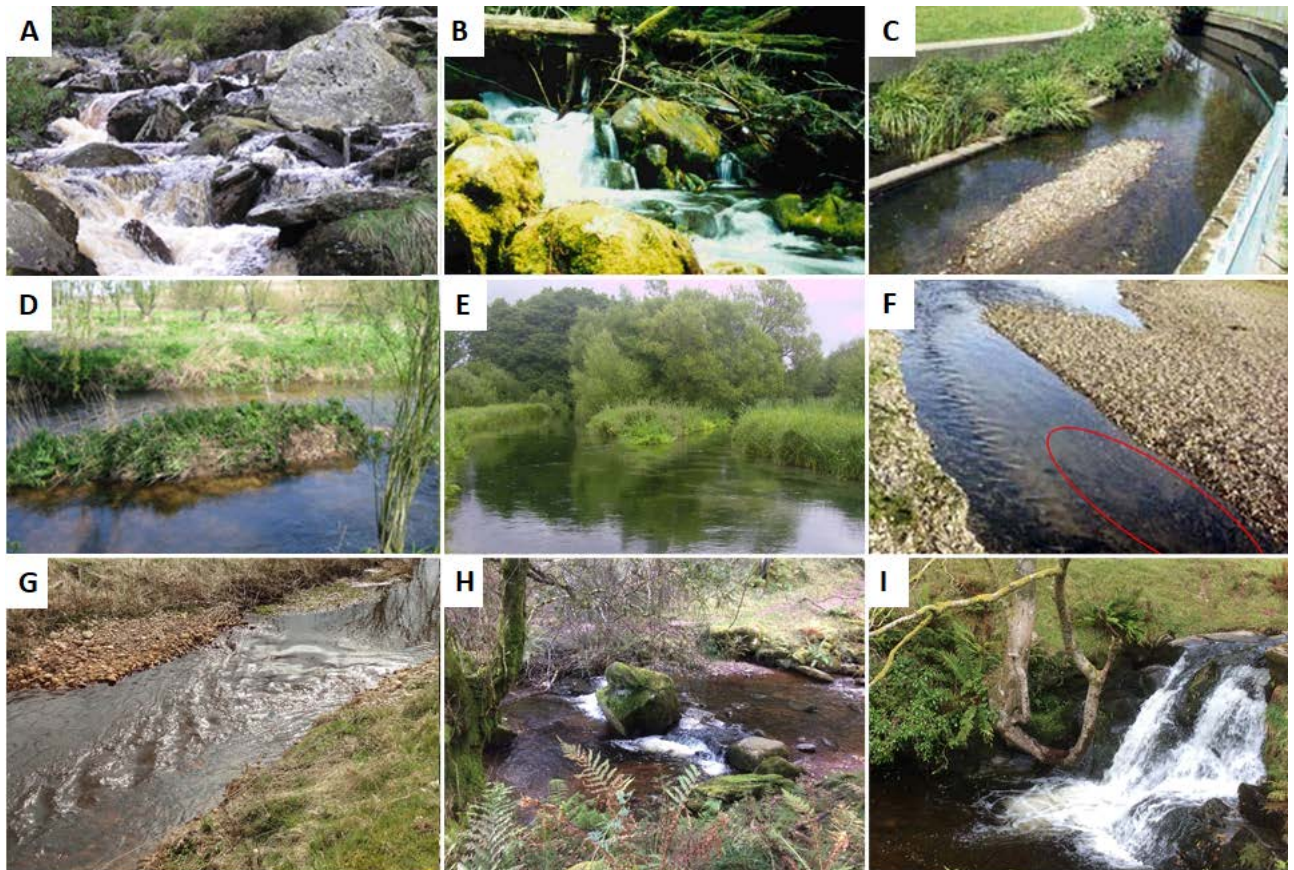


Figure 24: Bed natural physical features

- A – (i) exposed unvegetated boulders / rocks (i.e. < 50% vegetation cover)
(ii) a cascade (sequence of chutes and broken standing waves),
- B – (i) exposed vegetated (i.e. > 50% vegetation/moss cover) boulders / rocks
(ii) a cascade (sequence of chutes and broken standing waves),
- C – Unvegetated mid channel bar (i.e. < 50% vegetation cover),
- D – Vegetated mid channel bar bank (> 50% vegetation cover). Note rounded shape with an upper surface that is much lower than the level of the channel bank tops),
- E – Island (similar to vegetated mid channel bar but note the more tabular shape with a flatter upper surface and steeper sides than a vegetated mid channel bar and an upper surface that is close to the level of the surrounding bank tops),
- F – Pool (locally deep area with smooth / rippled water surface),
- G – Riffle (area of locally shallow water over a coarse cobble / gravel river bed with (un)broken standing waves),
- I – Step (near-vertical mix of chute flow and some free fall less than 2 m high, usually in bedrock/boulder rivers)
- H – Waterfall (near-vertical mix of mainly free fall with some chute flow over 2 m high, usually in bedrock/boulder rivers).

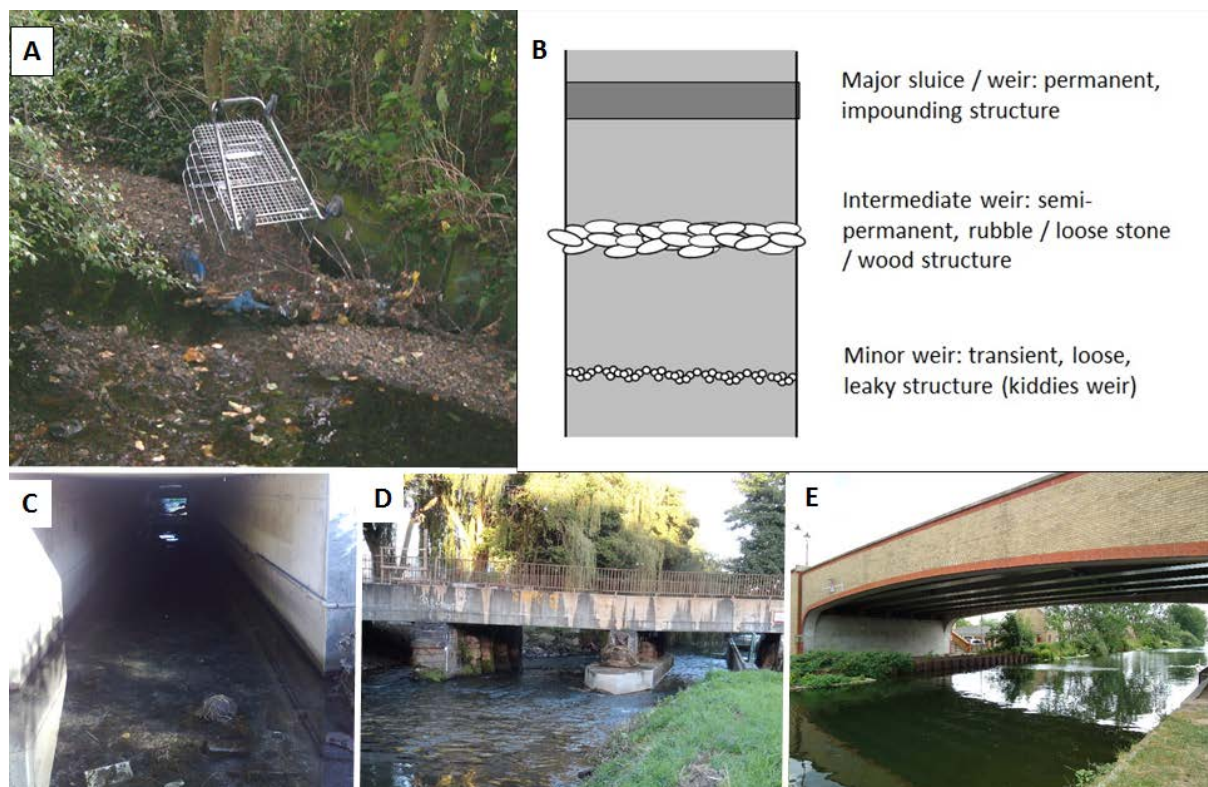


Figure 25: Bed natural physical features
A – large trash, B – weir sizes and definitions, C – culvert; D – bridge piers built into the river bed, E – bridge shadow.

4.4 Channel bed - Vegetation

MEASUREMENT CATEGORY	MEASUREMENT TYPE	ABUNDANCE	MEASUREMENT TYPE	ABUNDANCE
4.4 CHANNEL BED - VEGETATION				
Unvegetated	Unvegetated (bare river bed)	A / T / P / E	Amphibious	A / T / P / E
Aquatic vegetation	Liverworts, mosses, lichens (terrestrial & aquatic)	A / T / P / E	Submerged broad-leaved	A / T / P / E
	Emergent broad-leaved	A / T / P / E	Submerged linear-leaved	A / T / P / E
	Emergent linear-leaved (incl horsetails)	A / T / P / E	Submerged fine-leaved	A / T / P / E
	Floating leaved (rooted)	A / T / P / E	Filamentous algae	A / T / P / E
	Free floating	A / T / P / E	Channel choked with aquatic plants?	YES / NO
Terrestrial vegetation	Short/creeping herbs/grasses	A / T / P / E	Large wood (pieces > 1m long, 10cm diameter)	A / T / P / E
	Tall herbs/grasses	A / T / P / E	Discrete accumulations of organic material (e.g. twigs, leaves)	A / T / P / E
	Scrub or shrubs	A / T / P / E	Large wood dam (crosses entire width of channel bed): RECORD AS COUNT	A / T / P / E
	Saplings or trees	A / T / P / E	Fallen trees (ONLY those with a significant proportion in channel): RECORD AS COUNT	A / T / P / E
	Vegetation shading channel	A / T / P / E		
	Submerged tree roots	A / T / P / E		
	Trees/shrubs/saplings growing from submerged river bed	A / T / P / E		
Non-native invasive plant species	Himalayan balsam	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E
	Japanese knotweed	A / T / P / E		
	Giant hogweed	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E
	Floating pennywort	A / T / P / E		

Figure 26: Survey Sheet 4 – Channel bed - Vegetation

Four aspects of the vegetation cover of the channel bed are recorded (Figure 26), remembering that the channel bed includes the inundated area and any exposed area of the river bed, including emergent features such as mid-channel bars and islands

First, the extent of bare (unvegetated) river bed is assessed.

Second, the abundance of each of 10 aquatic vegetation morphological types or 'morpho-types' (not species) are recorded using the A, T, P, E scale. These morpho-types are illustrated in Figure 27.

NOTE that when recording liverworts, mosses and lichens, they may occur widely across both exposed and inundated areas of the bed – record an integrated abundance for the entire bed.

The vegetation morpho-types differ according to:

- (i) Plant structure and position: whether their leaves are emergent, i.e. emerge above the water surface; float on the water surface; or remain submerged,
- (ii) Leaf shape: broad (leaf length < 4 times leaf width); linear (leaf length > 4 times width, usually blade-shaped); or fine (leaves very long and narrow, string like / often cylindrical in cross section),
- (iii) Plant attachment: whether the plants are free-floating in the water column or attached by roots to the channel bed.

From these three criteria (leaf position, leaf shape, rooting characteristics), 10 morphological types are distinguished, which are described in Table 5 and illustrated in Figure 27. In addition, record whether or not (YES/NO) the channel is choked with plants.

Table 5: Key with descriptions of aquatic vegetation morphotypes illustrated in Figure 26

Figure 22 reference	Morpho type
A	Lichens, mosses and liverworts (Figure 22A shows mosses on rocks within a river channel)
B	Emergent broad-leaved (and rooted into river bed)
C	Emergent linear-leaved (and rooted into river bed)
D	Floating leaved (leaves on water surface and plant rooted into river bed)
E	Free floating (leaves on or below water surface and plant not rooted into the river bed but floating freely in the water column),
F	Amphibious (plant rooted in river margins rather river bed but leaves trailing and floating on the water surface,
G	Submerged broad-leaved (and rooted into river bed),
H	Submerged linear-leaved (and rooted into river bed),
I	Submerged fine-leaved (and rooted into river bed),
J	Filamentous algae (web of fine filaments covering and often smothering the surface of the river bed and submerged parts of plants),

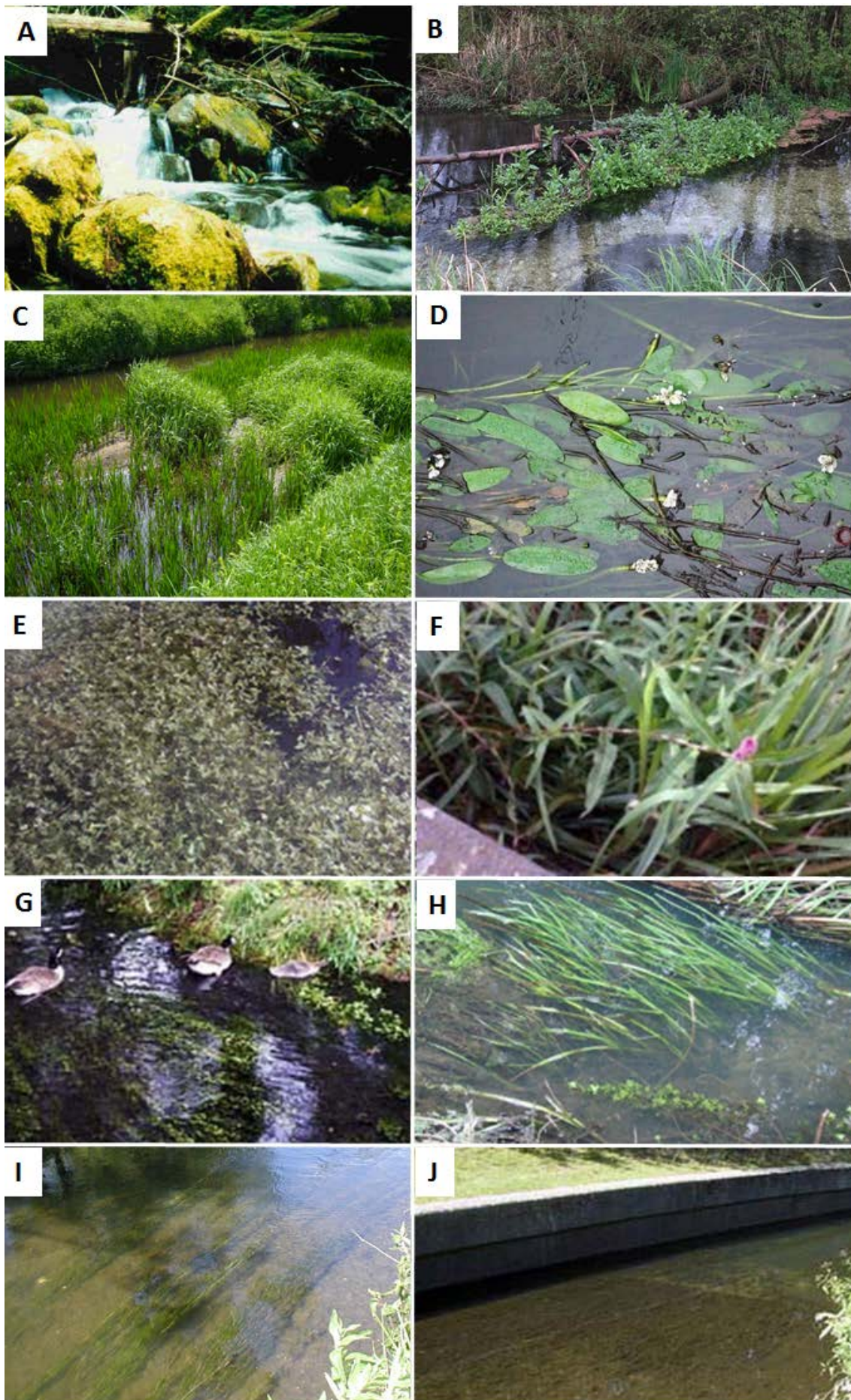


Figure 27: Vegetation within the wetted channel (for descriptions see Table 5)

Third, terrestrial vegetation abundance is recorded using four of the terrestrial morphotypes (Figure 9: short/creeping herbs/grasses, tall herbs/grasses, scrub or shrubs, saplings or trees) since mosses/lichens have already been recorded in the aquatic vegetation section). Records of morphotype abundance are followed by a set of mainly tree-related features that interact with the channel bed. Most of these are recorded using the A, T, P, E scale, although large wood dams and fallen trees are recorded as a count. These tree-related features include many previously recorded on the bank top and face (Figure 10), but here we focus on their presence in or effect on the channel bed area. Features include:

- Vegetation shading the channel - shade cast by terrestrial vegetation (whether on the banks or in the channel) across the channel bed area.
- Submerged tree roots - tree roots exposed below the water surface in channels containing flowing water.
- Trees / shrubs / saplings growing from the submerged river bed.
- Large wood pieces (**NOTE: the estimated abundance for the entire bed area should include the wood within fallen trees and large wood dams as well as wood in smaller wood accumulations and any dispersed wood pieces**).
- Discrete accumulations of organic material – accumulations of smaller wood/organic pieces (< 1m long and < 10 cm diameter, typically twigs and leaves) across the entire bed area.
- Large wood dam – discrete accumulation of large wood and smaller pieces that extends completely across the width of the channel bed to form a flow obstruction.
- Fallen tree located entirely or with a significant cover across the channel bed.

Fourth, the abundance of non-native invasive plant species is recorded using the A, T, P, E scale, referring to the same seven species already discussed in sections 2.2 and 3.4 and illustrated in Appendix B. All seven species may be found on the channel bed. The four aquatic species are most likely to be identified in submerged areas. The three more terrestrial species (Himalayan balsam, Japanese knotweed, Giant Hogweed) are most likely to occur on mid-channel bars and islands.

APPENDIX A

MoRPh Codes and Survey Sheets

Note: section numbers on the survey and code sheets correspond with section numbers in part III.2 of this manual

MoRPh River Survey (ver 13)

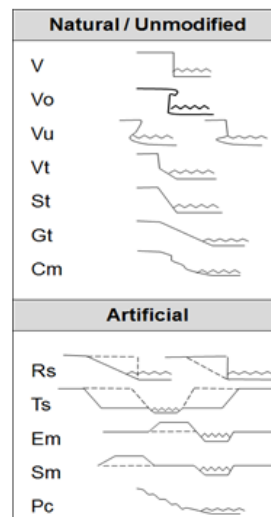
Sheet 5 - CODES

Section 2.1 Artificial / Managed ground cover types	
Fp	Pedestrianised, footpath
Tr	Transport infrastructure (road, railway, car park)
Ic	Buildings (commercial / industrial)
Re	Buildings (residential)
Sy	Storage area
Ld	Landfill area
Ar	Arable agriculture / allotments
Pv	Permanently vegetated agriculture (e.g. pasture, orchard)
Pr	Permanently vegetated recreation (e.g. playing fields, parks, gardens)
Pw	Plantation woodland
Ow	Open water (e.g. canal, reservoir)

Section 3.1 Bank profile types	
Natural / Unmodified	
V	Vertical
Vo	Vertical with top overhang
Vu	Undercut or Vertical with undercut
Vt	Vertical with toe
St	Steep (> 45 degrees)
Gt	Gentle (< 45 degrees)
Cm	Composite
Artificial (OBVIOUSLY MODIFIED)	
Rs	Reshaped
Ts	Artificial two-stage
Em	Embanked
Sm	Set-back embankment
Pc	Poached bank

Section 4.2 Flow types	
FF	Free fall
CH	Chute
BW	Broken standing waves
UW	Unbroken standing waves
UP	Upwelling
RP	Rippled
SM	Smooth
NP	No perceptible flow
DR	Dry

Sections 3.2 / 3.3 / 4.1 / 4.3 Sediment sizes	
AR	Entirely artificial
BE	Bedrock
BO	Boulder
CO	Cobble
GP	Gravel-Pebble
SA	Sand
SI	Silt / Fine non-sticky sediments
CL	Clay
OR	Organic (leaves, twigs etc. not fully decomposed)
PE	Peat
EA	Earth (i.e. mixed, mainly sand and finer) (for bank face material only)
NV	Not visible



Sections 3.2 / 4.1 Reinforcement types	
CC	Concrete
CB	Concrete & brick / laid stone (cemented)
BR	Brick / laid stone (cemented)
SP	Sheet piling
WP	Wood piling / panels
BW	Builders waste / hard core (tipped)
RR	Rip-rap (large laid stone, uncemented)
GA	Gabions / rock rolls
WS	Willow spiling
RE	Planted reeds
BC	Biotextiles / coir
WO	Washed out reinforcement

MoRPh River Survey (ver 13)

Sheet 1 - GENERAL INFORMATION

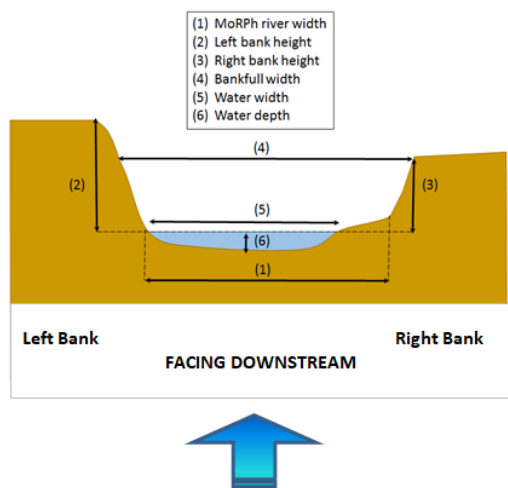
RECORD WHAT YOU SEE NOT WHAT YOU KNOW

PROJECT DETAILS	
Project name	
Correlation code	

1.1 SURVEYOR AND SURVEY CONDITIONS	
Surveyor	
Survey date and time	
Module surveyed from?	left / right / both banks
Bed visible?	Yes / No
Adverse conditions?	Yes / No
If yes, describe e.g. elevated flow, turbid water, etc	

1.3 CHANNEL DIMENSIONS (m)	
Cross section GPS	
1. MoRPh river width	
2. Left bank height	
3. Right bank height	
4. Bankfull width	
5. Water width	
6. Water depth	

Multi-MoRPh Channel Dimensions
If surveying multiple adjoining modules: a minimum of ONE (REPRESENTATIVE) SET OF CHANNEL DIMENSIONS should be measured for each group - up to 10 modules.
TIP!:- Bridges provide a good location for estimating dimensions of larger rivers.



PROJECT DETAILS	
WFD Water Body ID	
Survey type (monitoring, pre-project post-project, post-recovery, scenario, training)	

1.2 MODULE NAME AND LOCATION	
River name	
Location/Reach name	
SubReach name (used to reference a sub-reach of contiguous modules)	
Module number (1, 2, 3... number from upstream to downstream within SubReach)	
Riverfly site reference (optional)	
Module length (m) (i)	
NGR / GPS - Midpoint	

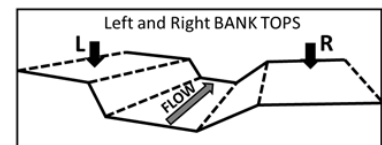
(i) Determining your Module Length	
River width (m) (ii)	Module length (m)
< 5 m	10 m
5 to < 10 m	20 m
10 to < 20 m	30 m
20 to < 30 m	40 m
Large & navigable rivers and canals	50 m
(ii) Predominant MoRPh river width is used to determine module length. It is estimated as the typical water width plus any area of bare sediment or emergent aquatic plants at the water edge. <i>If river ≥ 30 m wide it is usually too large for a full MoRPh Survey. For Large & navigable rivers and canals a reduced MoRPh survey is possible, focusing on the banktops and faces and those bed features that are visible</i>	

Identifying the LEFT AND RIGHT BANK
The LEFT and RIGHT BANK of a river are on the left and right sides of the channel when facing in a downstream direction with the water flowing away from you

1.4 PHOTOGRAPHS (max 4)	
Fixed point photograph taken with NGR / GPS? (Y/N)	
Photo ref 1 (iv)	
Photo ref 2	
Photo ref 3	
Photo ref 4	
We recommend 3 photos from the midpoint, one across, one looking upstream and one downstream to cover entire module. Photo 4 could be of special features or to support notes/queries.	

NOTES
Use this box to enter details where you are unsure of any measurements / records you have made.

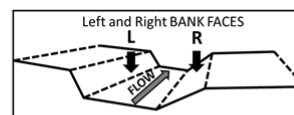
Sheet 2 - BANK TOP MEASUREMENTS



RECORD WHAT YOU SEE NOT WHAT YOU KNOW (within 10 m of bank edge)

MEASUREMENT CATEGORY	MEASUREMENT TYPE	CODE	ABUNDANCE	NOTES	
2.1 BANK TOP - ARTIFICIAL / MANAGED GROUND COVE					
Artificial ground cover	Artificial ground cover (Fp, Tr, Ic, Re, Sy, Ld, Ar, Pv, Pr, Pw, Ow)	DOMINANT TYPE	LB	RB	SUB-DOMINANT TYPE ONLY RECORD if it occupies > 20% of area within 10m of bank edge
		SUB-DOMINANT TYPE	LB	RB	
2.2 BANK TOP - NATURAL / LIGHTLY MANAGED GROUND COVER					
Terrestrial vegetation	Unvegetated (bare soil / rock)		LB	RB	ABUNDANCE CODES A/T/P/E abundance codes on <u>sheet 2</u> refer to proportion of <u>area</u> within 10 m of bank edge along the module length. Circle one of: A = absent, T = trace (< 5%), P = present (5% - <33%), E = extensive (> 33%)
	Mosses / lichens		A / T / P / E	A / T / P / E	
	Short/creeping herbs/grasses		A / T / P / E	A / T / P / E	
	Tall herbs/grasses		A / T / P / E	A / T / P / E	
	Scrub or shrubs		A / T / P / E	A / T / P / E	
	Saplings or trees		A / T / P / E	A / T / P / E	
	Fallen trees (ONLY those with a significant proportion on bank top)		A / T / P / E	A / T / P / E	
	Leaning trees		A / T / P / E	A / T / P / E	
	J-shaped trees		A / T / P / E	A / T / P / E	
	Tree/shrub branches trailing into channel		A / T / P / E	A / T / P / E	
	Large wood (wood pieces > 1m long, > 10 cm diameter)		A / T / P / E	A / T / P / E	
	Predominant tree type (Absent, Deciduous, Coniferous, Mixed)		A / D / C / M	A / D / C / M	
Non-native invasive plant species	Himalayan balsam		A / T / P / E	A / T / P / E	PLANT IDENTIFICATION See MoRPh field guide
	Japanese knotweed		A / T / P / E	A / T / P / E	
	Giant hogweed		A / T / P / E	A / T / P / E	
	Floating pennywort		A / T / P / E	A / T / P / E	
	Other: NAME SPECIES		A / T / P / E	A / T / P / E	
	Other: NAME SPECIES		A / T / P / E	A / T / P / E	
2.3 BANK TOP - WATER RELATED FEATURES					
Water-related features	Pond	Disconnected from river at time of survey	LB	RB	
		Connected to river by water-filled channel at time of survey	A / T / P / E	A / T / P / E	
	Side channel - free flowing separate channel including tributaries and fish passes		A / T / P / E	A / T / P / E	
	Wetland (recorded by dominant vegetation type)	Short non-woody vegetation (e.g. mosses, sedges)	A / T / P / E	A / T / P / E	
		Tall, non-woody vegetation (e.g. reeds, rushes)	A / T / P / E	A / T / P / E	
		Shrubs and trees (e.g. alder / willow carr)	A / T / P / E	A / T / P / E	

NOTES (ctd.)

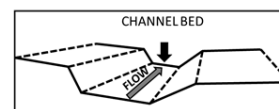


RECORD WHAT YOU SEE NOT WHAT YOU KNOW

MEASUREMENT CATEGORY	MEASUREMENT TYPE	CODE	ABUNDANCE	NOTES		
3.1 BANK FACE - PROFILE						
Bank face - Profile	Natural / artificial bank profile	DOMINANT TYPE (V, Vo, Vu, Vt, St, Gt, Cm, Rs, Ts, Em, Sm, Pc)	LB RB LB RB	SUB-DOMINANT TYPE ONLY RECORD if it occupies > 20% of the bank length		
		SUB-DOMINANT TYPE (see (ii))	LB RB LB RB			
3.2 BANK FACE - MATERIALS						
Bank face - Natural materials	Bank face sediment (AR, BE, BO, CO, GP, SA, SI, CL, OR, PE, EA, NV)	Sediment size (top 2/3)	LB RB	WHICH PART OF THE BANK IS REINFORCED? A = absent T = mainly the top B = mainly the bottom W = Whole bank face		
		Sediment size (bottom 1/3)	LB RB			
Bank face - Reinforcement	Which part of the bank is reinforced? (NOTE SPECIFIC CODES IN BOX (iii))		A / T / B / W	A / T / B / W		
	How extensive is the reinforcement horizontally along the module?		A / T / P / E	A / T / P / E		
Bank reinforcement	Bank reinforcement	DOMINANT TYPE (CC, CB, BR, SP, WP, BW, RR, GA, WS, RE, BC, WO)	Reinforcement type	SUB-DOMINANT TYPE ONLY ONLY RECORD if it occupies > 20% reinforced area		
		SUB-DOMINANT TYPE (see (iii))	Reinforcement type			
3.3 BANK FACE / CHANNEL MARGIN - FEATURES						
Natural physical features	Bare / unvegetated side bar (< 50% vegetation cover)	Sediment size	LB RB	A / T / P / E		
	Vegetated side bar (> 50% vegetation cover)	Sediment size	LB RB	A / T / P / E		
	Berm (if unsure whether berm/bench record as berm)			A / T / P / E		
	Bench (if unsure whether berm/bench record as berm)			A / T / P / E		
	Stable cliff (> 0.5 m)			A / T / P / E		
	Eroding cliff (> 0.5m)			A / T / P / E		
	Toe			A / T / P / E		
	Nest holes or animal burrows			A / T / P / E		
	Marginal backwater			A / T / P / E		
	Tributary junction / confluence: RECORD AS COUNT					
Artificial physical features	Pipes / outfalls (if appear potentially functional): RECORD AS COUNT					
	Jetty			Maj / Int / Min		
	Deflector			Maj / Int / Min		
	Other: INSERT FEATURE NAME			Maj / Int / Min		
ABUNDANCE CODES A/T/P/E abundance codes on sheet 3 refer to proportion of bank length occupied by feature, APART FROM 'Terrestrial vegetation on bank face' and 'Non-native invasive plant species' in section 3.4, which refer to proportion of bank face area : A = 0%, T = < 5%, Maj (Major) = > 20% channel width; Int (Intermediate) = 10-20% width; Min (Minor) = < 10% width						
MEASUREMENT CATEGORY	MEASUREMENT TYPE	ABUNDANCE	MEASUREMENT TYPE	ABUNDANCE		
3.4 BANK FACE / CHANNEL MARGIN - VEGETATION						
Terrestrial vegetation on bank face	Unvegetated (bare earth or rock)	A / T / P / E	A / T / P / E	Fallen trees (ONLY those with a significant proportion on bank face)	A / T / P / E	A / T / P / E
	Mosses / lichens	A / T / P / E	A / T / P / E	Leaning trees	A / T / P / E	A / T / P / E
	Short/creeping herbs/grasses	A / T / P / E	A / T / P / E	J-shaped trees	A / T / P / E	A / T / P / E
	Tall herbs/grasses	A / T / P / E	A / T / P / E	Tree/shrub branches trailing into channel	A / T / P / E	A / T / P / E
	Scrub or shrubs	A / T / P / E	A / T / P / E	Exposed tree roots	A / T / P / E	A / T / P / E
	Saplings or trees	A / T / P / E	A / T / P / E	Discrete organic accumulation (e.g. leaves, twigs)	A / T / P / E	A / T / P / E
	Large wood (pieces > 1m long, > 10 cm diameter)	A / T / P / E	A / T / P / E			
Aquatic vegetation at bank-water margin	Liverworts, mosses, lichens	A / T / P / E	A / T / P / E	Amphibious	A / T / P / E	A / T / P / E
	Emergent broad-leaved	A / T / P / E	A / T / P / E	Filamentous algae	A / T / P / E	A / T / P / E
	Emergent linear-leaved (incl horsetails)	A / T / P / E	A / T / P / E			
Non-native invasive plant species	Himalayan balsam	A / T / P / E	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E	A / T / P / E
	Japanese knotweed	A / T / P / E	A / T / P / E			
	Giant hogweed	A / T / P / E	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E	A / T / P / E
	Floating pennywort	A / T / P / E	A / T / P / E			

Sheet 4 - CHANNEL BED MEASUREMENTS

RECORD WHAT YOU SEE NOT WHAT YOU KNOW



MEASUREMENT CATEGORY	MEASUREMENT TYPE	ABUNDANCE	MEASUREMENT TYPE	ABUNDANCE	
4.1 CHANNEL BED - MATERIALS					
Channel bed - Natural materials	Bed sediment size	Bedrock (BE)	A / T / P / E	Silt (and finer non-sticky particles, SI)	A / T / P / E
		Boulder (BO)	A / T / P / E	Clay (CL)	A / T / P / E
		Cobble (CO)	A / T / P / E	Organic (leaves, twigs etc. not fully decomposed) (OR)	A / T / P / E
		Gravel-Pebble (GP)	A / T / P / E	Peat (PE)	A / T / P / E
		Sand (SA)	A / T / P / E		
	Silt overlying coarser sediments	Continuous silt layer (the form of underlying coarser sediments is visible)	A / T / P / E	Patchy thin layer (some coarser particles protrude through the silt layer)	A / T / P / E
Channel bed - Reinforcement	Bed reinforcement extent		A / T / P / E	(i) SUB-DOMINANT REINFORCEMENT TYPE: ONLY RECORD if it occupies > 20% reinforced area	
	CODE / DESCRIPTION				
	Bed reinforcement materials	DOMINANT TYPE (CC, CB, BR, SP, WP, BW, RR, GA, WS, RE, BC, WO)	reinforcement typ		
		SUB-DOMINANT TYPE (see (ii))	reinforcement typ		
4.2 WATER SURFACE					
Water surface flow patterns	Flow types	Free fall (FF)	A / T / P / E	Rippled (RP)	A / T / P / E
		Chute (CH)	A / T / P / E	Smooth (SM)	A / T / P / E
		Broken standing waves (BW)	A / T / P / E	No perceptible flow (NP)	A / T / P / E
		Unbroken standing waves (UW)	A / T / P / E		
		Upwelling (UP)	A / T / P / E	Dry (DR)	A / T / P / E
MEASUREMENT CATEGORY	MEASUREMENT TYPE	CODE / DESCRIPTION	ABUNDANCE	NOTES	
4.3 CHANNEL BED - FEATURES					
Channel bed - Natural physical features	Exposed bedrock		A / T / P / E	ABUNDANCE CODES A/T/P/E abundance codes on sheet 4 refer to proportion of the area of the river bed within the module length. Circle one of: A = absent, T = trace (< 5%), P = present (5% - <33%), E = extensive (> 33%)	
	Exposed unvegetated boulders / rocks (< 50% vegetation cover)		A / T / P / E		
	Exposed vegetated boulders / rocks (> 50% vegetation cover)		A / T / P / E		
	Bare / unvegetated mid channel bar (< 50% vegetation cover)	sediment size	A / T / P / E		
	Vegetated mid channel bar (>50% vegetation cover)	sediment size	A / T / P / E		
	Island	A / T / P / E			
	Cascade	A / T / P / E			
	Pool: RECORD AS COUNT				
	Riffle: RECORD AS COUNT				
	Step (steep boulder/bedrock feature <2m high, mainly chute and free fall): RECORD AS COUNT				
Waterfall (steep boulder/bedrock feature >2m high, mainly free fall): RECORD AS COUNT					
Channel bed - Artificial features	Large trash (car parts, trolleys, traffic cones etc)		A / T / P / E	WEIR TYPES / SIZES Major: permanent, impermeable, impounding structure across entire channel width Intermediate: semi-permeable, loose stone / wood structure across entire channel width Minor: highly permeable, transient feature across entire channel width	
	Major weir (see (ii)): RECORD AS COUNT				
	Intermediate weir (see (ii)): RECORD AS COUNT				
	Minor weir (see (ii)): RECORD AS COUNT				
	Bridge piers in river bed: RECORD AS COUNT				
	Bridge shadow (see (iii))		Wide / Int / Narr		
Culvert: RECORD AS COUNT					
BRIDGE SHADOW Wide = > 25 m channel length, Int (Intermediate) = 10-25 m, Narr (Narrow) = < 10m					
MEASUREMENT CATEGORY	MEASUREMENT TYPE	ABUNDANCE	MEASUREMENT TYPE	ABUNDANCE	
4.4 CHANNEL BED - VEGETATION					
Unvegetated	Unvegetated (bare river bed)	A / T / P / E	Amphibious	A / T / P / E	
Aquatic vegetation	Liverworts, mosses, lichens (terrestrial & aquatic)	A / T / P / E	Submerged broad-leaved	A / T / P / E	
	Emergent broad-leaved	A / T / P / E	Submerged linear-leaved	A / T / P / E	
	Emergent linear-leaved (incl horsetails)	A / T / P / E	Submerged fine-leaved	A / T / P / E	
	Floating leaved (rooted)	A / T / P / E	Filamentous algae	A / T / P / E	
	Free floating	A / T / P / E	Channel choked with aquatic plants?	YES / NO	
Terrestrial vegetation	Short/creeping herbs/grasses	A / T / P / E	Large wood (pieces > 1m long, 10cm diameter)	A / T / P / E	
	Tall herbs/grasses	A / T / P / E	Discrete accumulations of organic material (e.g. twigs, leaves)	A / T / P / E	
	Scrub or shrubs	A / T / P / E	Large wood dam (crosses entire width of channel bed): RECORD AS COUNT	A / T / P / E	
	Saplings or trees	A / T / P / E			
	Vegetation shading channel	A / T / P / E	Fallen trees (ONLY those with a significant proportion in channel): RECORD AS COUNT	A / T / P / E	
	Submerged tree roots	A / T / P / E			
Trees/shrubs/saplings growing from submerged river bed	A / T / P / E				
Non-native invasive plant species	Himalayan balsam	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E	
	Japanese knotweed	A / T / P / E			
	Giant hogweed	A / T / P / E	Other: RECORD SPECIES NAME	A / T / P / E	
	Floating pennywort	A / T / P / E			

APPENDIX B

Seven Non-Native Invasive Plant Species

Photographs on the following pages were either provided by Christopher Cockel or
the Environment Agency

For more information on these seven species, see Environment Agency (2010)
Managing Invasive Non-native Plants, downloadable from www.environment-agency.gov.uk

Japanese knotweed (*Fallopia japonica*)

Flower



Seedling



Adult plant



Giant hogweed (*Heracleum mantegazzianum*)

Flower



Seedling



Adult plant



Himalayan balsam
(*Impatiens glandulifera*)

Flower



Seedling



Plant stand



Australian swamp stonecrop
(*Crassula helmsii*)

Flower



Adult plant



Plant stand



Photograph: The Environment Agency

Parrot's feather
(*Myriophyllum aquaticum*)

Leaves



Plant stand



Photograph: The Environment Agency

Creeping water primrose
(*Ludwigia grandiflora*)

Flower



Photograph Copyright 2009 Andrey Zharkikh.
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Floating pennywort
(*Hydrocotyle ranunculoides*)

Leaves



Plant stand



Photograph: The Environment Agency

Plant



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