URBAN RIVER SURVEY MANUAL 2014

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ACKNOWLEDGMENTS

The Urban River Survey (URS) was originally developed as part of the PhD thesis of Dr Angela Boitsidis (nee Davenport) (University of Birmingham 2001) under the supervision of Professor Angela Gurnell.

In 2003 the URS method and manual were modified by Angela Boitsidis and Angela Gurnell as part of the SMURF project (LIFE02 ENV/UK/000144).

The present (2014) version of the manual is a complete revision undertaken mainly by Angela Gurnell and Lucy Shuker under funding from Queen Mary, University of London and a ESRC-NERC funded research studentship awarded to Lucy Shuker with some additional contributions from Geraldene Wharton.

Any comments on lack of clarity or suggestions for improvements should be directed to a.m.gurnell@qmul.ac.uk

PLEASE NOTE THAT THE SURVEY METHOD IS BASED ON THE ENVIRONMENT AGENCY'S RIVER HABITAT SURVEY AND SO THIS MANUAL IS BEST USED IN CONJUNCTION WITH THE RHS MANUAL.

We thank the Environment Agency for permission to reproduce some diagrams from the River Habitat Survey in Britain and Ireland, Field Survey Guidance Manual, 2003 version.

We also thank Ruth Hanniffy of the Environment Agency for her collaboration in compiling this manual.

Cover photograph: Lucy Shuker

CONTENTS

1. INTRODUCTION TO THE URBAN RIVER SURVEY

This manual provides a modification of the RHS methodology which is specifically designed for urban rivers – the Urban River Survey (URS).

1.1 **Health and Safety** is extremely important when working on rivers. You must conform with all Health and Safety related guidance from your organisation and you must ensure that you undertake a full risk assessment conforming to your organisation's requirements BEFORE you go into the field. The survey is designed to be undertaken by one surveyor and there may be occasions where you are undertaking the survey alone. On these occasions you will need to ensure that you comply with your organisation's lone working regulations. As an indication of the types of health and safety precautions that you should consider, Appendix E reproduces EA documentation from the RHS (2003) Manual).

1.2 **Biosecurity.** You should also ensure that you take appropriate measures to reduce the risk of spreading diseases, parasites and invasive non-native species. Please refer to the biosecurity advice provided by the following campaigns:

NNSS **Be Plantwise** : (http://www.nonnativespecies.org//beplantwise/index.cfm)

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

1.3 The river habitat survey (RHS) was developed by the Environment Agency in 1997 to provide a simple, rapid assessment of physical habitat along 500m stretches of river. The derived data were used to develop a working classification of UK natural rivers. However, the RHS does not give a full description of urban rivers, which typically show high levels of channel and habitat modification as well as other forms of degradation, and as a result a generally lower extent and diversity of physical habitats. The URS provides greater detail on the style and extent of engineering modification as well as physical habitats in order to more strongly differentiate between stretches of urban river. Since many different types of channel engineering are often seen on urban rivers and these have a fundamental influence on river habitats, the URS survey is applied to stretches of a single engineering type of up to 500m in length.

1.4 For the URS, a **stretch** is defined as a length of river normally 500m and a minimum of 300m in length that is subject to any **one engineering type**. An engineering type is a unique combination of channel planform, cross profile and level of reinforcement (section 4 and Appendix C).

1.5 The Urban River Survey involves the completion of a four page form (Appendix A). Some sections of the form are optional (shaded in yellow), whereas others are essential since they underpin the estimation of a variety of indices. There are also

three pages of summary definitions of the measurement codes (Appendix B) needed to complete the four page form. Where similar data to the RHS are being collected, the RHS definitions have been retained.

1.6 To undertake the URS, the surveyor needs:

a copy of the URS 4 page survey form for each stretch to be surveyed,

a waterproof clip board

a digital camera

a hand-held GPS (WSG84 co-ordinates)

a range-finder, expanding metal or surveying tape, or some other means of linear measurement is also helpful for estimating channel dimensions.

a ranging pole

appropriate weatherproof clothing and footwear

1.7 The survey should be undertaken by walking the stretch three times.

The first pass checks (i) the length of the stretch so that the spacing of the 10 spot checks can be estimated, (ii) makes an initial assessment of the engineering type (URS sheet 1), and (iii) identifies a suitable site for estimating channel dimensions.

The second pass is used to complete the spot checks (URS sheet 2) and the engineering type and channel dimensions sections (URS sheet 1).

The third pass is used to complete the cumulative measurements (URS sheets 3 and 4).

The survey may commence from the upstream or downstream end of the stretch and should be marked accordingly on Page 2 of the form. The following sections provide the information required to complete the subsections of the URS form (Appendix A).

2. SURVEY DETAILS

2.1 Enter the **WFD water body ID** (if known), the **river name** given on 1:50,000 scale maps, or more detailed scale if available. Unnamed headwater tributaries should be categorised as such, but refer to the named mainstream watercourse (e.g. tributary of River Quaggy). For the **stretch name/number**, surveyors should enter their own unique reference number/name as appropriate for the site. Also enter the **date** and **time** of the survey, and the **name of the surveyor**.

3. SITE INFORMATION

3.1 **Stretch length***:* For the purpose of URS, stretches of river between 300m (minimum) and 500m in length are located in the field following identification of the limits of a

single engineering type. The stretch length to the nearest 50m is determined by the surveyor (paces) and completed at the end of the survey when the actual length of the stretch has been estimated. The *GPS* readings (or estimates of the *NGR*) at the upstream and downstream end of the stretch also aid estimation of the stretch length. Wherever possible, the stretch length should be 500m.

3.2 **Site surveyed from left or right bank?** For wide and deep rivers, surveys might only be able to be carried out from one bank only, although for best results each bank would need to be walked. This is linked to spot checks by recording whether **spot check 1 is at the upstream or downstream end of the stretch.**

3.3 At least one **photograph** should be taken of the surveyed stretch, preferably at the site where channel dimensions are estimated. Insert photo references that are informative (e.g. stretch name / number plus nearest spot check number).

3.4 The optional sections (**Distance from Source, Slope (m/km), Solid geology code, Drift geology code**) can be completed after the field survey. If you wish to estimate these properties for your surveys, distance from source can best be estimated from the Environment Agency's Detailed River Network (DRN) or the Ordnance Survey's Mastermap but the blue lines on 1:25000 scale Ordnance Survey topographic maps will also give an adequate estimate. Geology codes are obtained from British Geological Survey maps (http://www.bgs.ac.uk/geoindex/)

3.5 The sections of the form concerning **bed visibility** and **adverse conditions** are completed by the surveyor on the day of the assessment. Whenever possible the river survey should be conducted during normal baseflow conditions. However, sometimes this is not possible and so these two fields indicate that some of the later measurements may not be as accurate as they would be under baseflow and in the absence of other specific adverse conditions. Bed visibility is crucial to recording bed materials and features and is recorded as yes or no. If no, then there are adverse conditions because of 'murky, polluted water' or 'high suspended sediment load'. Note that water clarity is also recorded on page 3 of the survey sheets under 'extent of pollution'. Other commonly occurring adverse conditions are high or flood flows, limited access, high levels of riparian vegetation, and windy or poor light conditions.

4. URS STRETCH ENGINEERING

4.1 **The engineering type** is representative of the surveyed stretch and is derived from a combination of the predominant planform, cross profile and level of reinforcement of

the surveyed stretch. Each of the categories of planform, cross profile and level of reinforcement is described in detail with photographic examples in Appendix C.

4.2 **Planform.** There are four planform types: Semi-Natural (SN); Engineered–straight (ST); Engineered–sinuous (ME); Recovering (RC).

4.3 **Cross Profile.** There are six channel cross profile types: Semi-natural (SN); Cleaned (CL); Restored (RE); Resectioned (RS); Enlarged (EN); Two-Stage (TS).

4.4 **Reinforcement.** The characteristic / predominant level of reinforcement along a URS reach is defined as one of six categories (none, bed only, one bank only, bed and one bank only, both banks only, both banks and bed). Predominant bank reinforcement is recorded where reinforcement to any vertical extent up the bank (full, upper bank or lower bank) characterises all or most of the bank length in the surveyed reach.

Table 1: Planform, Cross profile and Reinforcement Types and Codes

Planform	**Cross-Profile**	**Level of Reinforcement**
Engineered Straight, ST (engineered to a straight planform)	Enlarged, EN (cross section made substantially wider and/or deeper than a naturally-adjusted channel would be at the same site)	No reinforcement, NONE
Engineered Sinuous, ME (engineered to a sinuous planform)	Two-stage, TS (cross section includes a flood channel with an inset smaller channel to accommodate non-flood flows)	Bed reinforced, BED
Recovering, RC (engineered straight or sinuous but showing significant planform readjustment induced by fluvial processes)	Resectioned, RS (cross section reshaped to a more efficient trapezoidal form)	One Bank reinforced, ONE
Semi-natural, SN (no obvious sign of engineering of the planform)	Cleaned, CL (flow resistance reduced through removal of roughness elements such as trees and shrubs and minor morphological irregularities)	Bed and one bank reinforced, BEDONE
	Restored, RE (cross profile form designed as part of a restoration scheme)	Both banks reinforced, TWO
	Semi-natural, SN (cross profile form shows no obvious signs of engineered modification / has completely recovered from historical engineering)	Full reinforcement, FULL

5. CHANNEL DIMENSIONS (ONCE ONLY MEASUREMENTS)

Recording of the channel dimensions should be undertaken **once** in the surveyed stretch, and should be located at a riffle if one is present, or at a suitable shallow section of the river. Measurement accuracy is improved by using a ranging pole or

other method of measurement. Channel dimension measurements are taken according to the RHS methodology as shown in Figure 1 below. Sometimes the river bed will be inaccessible or the water will be too deep or dangerous to measure directly. In these cases visually estimate the water depth if possible.

- **Banktop** = first major break in slope above which cultivation or development is possible.
- **Bankfull** = point where river first spills on to floodplain.

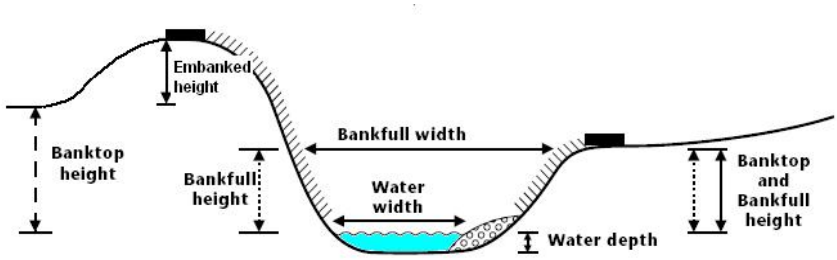


Figure 1: Channel dimensions (source: RHS 2003 manual)

5.1 **Water width** (nearest m) is the distance across the wetted part of the channel. Use a ranging rod to make crossing the watercourse safer and to aid measurement. , and use the rod to help measure the width. If it is impossible to wade safely across the river, and you do not have a range-finder, a reasonably accurate estimate can be made by sticking a ranging pole on the bank, and walking along the bank until the pole appears to be the same distance away as the far bank; pace the distance to the pole to estimate the channel width.

5.2 **Bankfull width** (nearest m) is the horizontal distance across the channel at the level where the river first spills out of the channel on to the floodplain.

5.3 **Left and right bank height** (nearest m) Banktop height is the vertical distance from water level, to the first major break in slope above which cultivation or development is possible

5.4 **Embanked height** (nearest m). Where present, record the extra height created by the embanked material, including setback embankments.

5.5 **Water depth** (nearest 10 cm) is the average depth of the channel. An average of 3 depths measured using the ranging pole is adequate. Estimate the depth if possible, where access is not feasible

6. SPOT-CHECK MEASUREMENTS

6.1 **NOTE: Many of the spot-check measurements coincide with those collected during RHS surveys.** Summary definitions are provided here for convenience, but more detail can be obtained from the RHS handbook. 10 spot-check measurements are taken at equally spaced distances (e.g. every 50m for a 500m stretch). The spot check

measurements are usually taken from the bank. The location of each spot check should be recorded using a GPS. Some of the measurements taken at each spot-check differ somewhat from the RHS manual but the general layout of the spot check measurements corresponds the RHS methodology as shown in the diagram below. **Sweep up (SW) measurements** differ from the RHS methodology. Any other feature seen throughout the reach that has not been recorded previously in the spot-checks is recorded in the sweep up column. (e.g. rarer macrophyte types such as SLL or RFL).

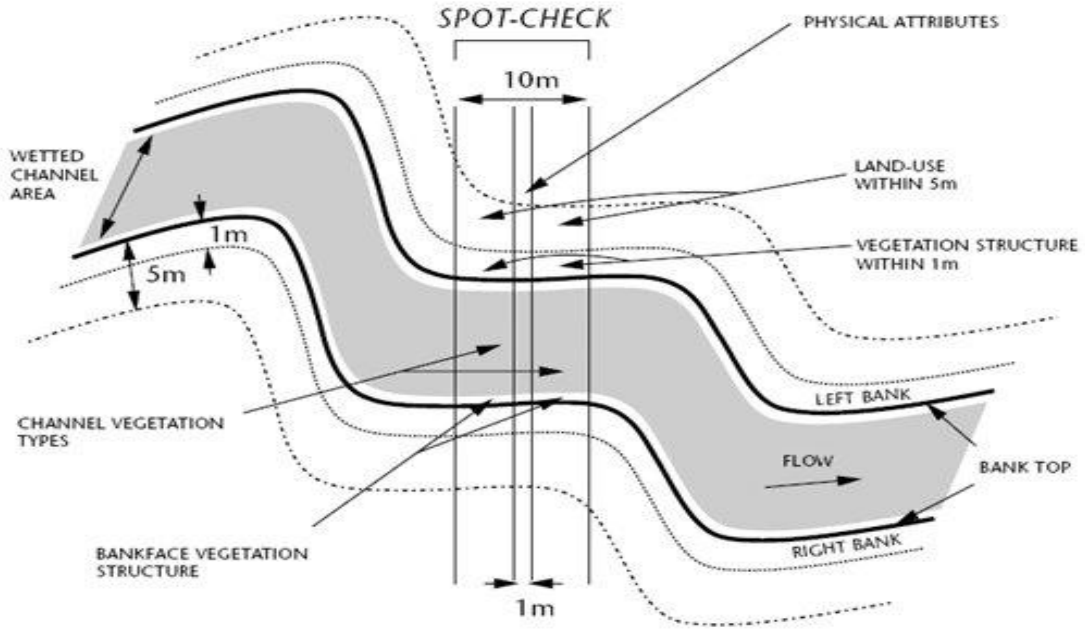


Figure 2: Dimensions for spot checks (source: RHS 2003 manual)

6.2 Physical Attributes (observed within a 1m wide transects across the channel, Figure 2)

6.2.1 **Bank Material** (code check list provided in Appendix B): The bank material should only be recorded as artificial (AR) if it completely conceals the natural bank materials, since bank protection is recorded separately. If any part of the natural bank materials are exposed then the predominant type should be recorded as bedrock (BE), boulders (BO - >256mm diameter), cobbles (CO – 64-256mm), gravel/sand (GS - <64mm to <2mm but where are grains are clearly visible at the lower end and the particles are loose), clay (CL - cohesive fine material, sticky when moist, particles not visible), earth (EA - crumbly material of mixed fine particle size typically < 2mm).

6.2.2 **Bank Protection** (code check list provided in Appendix B): Where two protection types are present on the same bank, record the predominant type. Bank protection types are concrete (CC – cemented reinforcement providing a solid reinforcement with

no gaps), concrete and brick (CB – comprised of blocks of bricks and mortar separated above, below or laterally by concreted areas), brick / laid stone (BR – areas of brick or stone held together by mortar to produce a solid wall or bank facing), builders waste (BW – loose hard core tipped at the bank toe or across much/all of the bank face); sheet piling (SP – interlocking steel sheets, including corrugated iron, protecting the bank face), wood piling (WP – vertical or horizontal wood planks protecting the bank face – often confined to the bank toe), rip-rap (RR – boulders: normally quarried, roughly square stones, often similar size, purposely tipped or laid along the bankface and often confined to the bank toe - includes un-cemented blockstone and boulders compacted into the bank with soil between), gabions (GA – stones in wire baskets), planted reeds (RE – only record when obviously, from regular spacing along bank toe, deliberately planted), willow spiling / faggot bundles (WS – cut stakes of willow driven into the bank toe or face, often linked by woven willow to create a living fence that roots into the bank / bundles of sticks or twigs), biotex / coir (BC – any woven fabric spread across the bank face to protect the underlying bank materials from erosion), washed out (WO - bank protection materials that have been eroded or have collapsed into the channel so that they no longer protect the banks).

6.2.3 **Marginal and Bank Features** (code check list provided in Appendix B): eroding cliff (EC – Bank face profile is *predominantly* vertical, near vertical, or undercut, with a minimum height of 0.5m and largely bare of vegetation (<50% cover of mosses, ferns, other vegetation)), stable cliff (SC – similar to eroding cliff but with higher vegetation cover (>50%), and no obvious signs of erosion), unvegetated point bar (PB – unconsolidated river bed material transported from upstream and deposited at the bank toe in a distinctive bar feature on the inside of river bends. Point bars are exposed at low flow and are unvegetated if <50% of their surface has vegetation cover), vegetated point bar (VP – identical to PB but with >50% of surface covered by vegetation), unvegetated side bar (SB – as PB but found along channel margins at locations other than the inside of bends), vegetated side bar (VS – as SB but with >50% of surface covered by vegetation), natural berm (NB – are the vegetated features which result from stabilisation and extension of PB, VPB, SB, VS features over time. A key difference between a ‘bar’ and a ‘natural berm’ is the former is made up of similar material to the channel substrate and has a gradual slope into the water whereas the latter often has a distinct steep face at the water edge and includes a transition towards terrestrial plant species).

6.2.4 **Channel Substrate** (code check list provided in Appendix B): The dominant substrate type is recorded. Artificial immobile substrates usually consist of concrete, concrete/brick or laid stone and are recorded as AR. It is important that both mobile and immobile substrates are recorded when they occur together, so record whichever dominates at each spot check to gain a representative picture. The definitions of bedrock (BE), boulder (BO), cobble (CO), gravel/pebble (GP) are the same as for bank materials (section 6.2.1). Other mobile substrate types are artificial (AR – non-natural bed material such as concrete, bricks, tipped waste - but if the artificial materials have been ground down by the river so that they are of similar shape and size to any natural particles located near them, then they can be counted as natural and assessed simply by their size), sand (SA – particles <2mm and >0.06mm), silt (SI - very small loose particles (<0.06mm) - only record when >5mm and completely conceals any underlying coarser material), clay (CL – a very fine, sticky, cohesive bed material), peat (PE – very rare in an urban catchment - only record if the river bed is formed of organic matter derived from decayed vegetation under water-logged conditions).

6.2.5 **Flow (Patch) Type** (code check list provided in Appendix B): Flow types are identified from patterns and flow directions on areas / patches of the water surface and sometimes the additional influence of particles on the river bed. The predominant flow type is recorded at each spot check. Free fall (FF - generally associated with water falls and artificial vertical structures - vertically-falling water separates from the 'back-wall' of the vertical structure), chute (CH – mainly associated with cascades - .curving flow with substantial water contact with the substrate), broken-standing wave (BW - mostly associated with rapids but occasionally with riffles – recognised by white-water tumbling waves with an appearance that water is trying to flow upstream), unbroken standing wave (UW – mostly associated with major riffles but can be found on rapids - 'babbling' water with a disturbed 'dragon-back' surface, which has upstream facing wavelets that have not broken. White water may occur as crest waves, but not as breaking waves), chaotic flow (CF - . a chaotic mixture of three or more of the BW, UW, CH, FF flow types with no predominant one obvious), rippled (RP – mostly associated with runs - no waves, flow direction generally downstream with disturbed rippled surface), upwelling (UP – water surface heaving as upwelling water breaks the surface, has the appearance of boiling water), smooth (SM – mostly associated with glides, smooth downstream movement of water), no perceptible flow (NP – usually associated with pools marginal deadwater areas and areas ponded

behind obstructions such as weirs - no obvious downstream movement of water), dry (DR – dry channel).

6.2.6 **Channel Features** (code check list provided in Appendix B): Exposed bedrock (EB – bedrock protruding above the water surface at low flow), exposed boulders (RO – boulders protruding above the water surface at low flow), vegetated rock (VR – exposed bedrock or boulders supporting established vegetation such as herbs, reeds, grasses, shrubs), unvegetated mid-channel bar (MB – accumulation of unconsolidated river bed material exposed above the water surface but surrounded by water at low flow with <50% area covered by vegetation), vegetated mid-channel bar (VB – as for MB but with >50% area covered by vegetation), island (MI – well vegetated mid-channel sedimentary feature, colonised by mature vegetation usually including shrubs or trees, with island surface at same level as bank tops), trash (TR – rubbish such as shopping trolleys, traffic cones, loose bricks, etc.)

6.3 Bank top land use and vegetation structure (observed within a 10 m wide transects across the channel, Figure 2)

6.3.1 **Land use** (code check list provided in Appendix B): Land use within 5m of the bank top is recorded using the following, self-explanatory, codes: Residential (Re): Commercial (Co); Industrial (In); Mixed Industrial/Commercial (Ic); Transport infrastructure (roads, railways) (Tr); Foot Path (Fp); Sewage Treatment Works (Sw); Scrap / waste recycling yards (Sy); Landfill/Refuse (Ld); Derelict/abandoned land (Dr); Cultivated cropland (Cr); Pasture (Pa); Orchard (Or); Allotments (Al); Closed feedin - Intensive (indoor) stock production (Fe); Coniferous woodland (Co); Deciduous and mixed woodland (Dd); Open woodland (with grassland) (Ow); Heathland (He); Scrub (e.g. brambles, gorse, rhododendron and other woody shrubs) (Sc); Open parkland and community grassland (Op); Recreational land (playing fields) (Rc); Cemeteries/crematoria (Ce); Lake/pond (La); Reservoir (Rv); Canal (Ca); Quarry (Qu); Junction with tributary stream/river (Tb); Wetland (Wl).

6.3.2 **Bank Face and Top Vegetation Structure**: This is recorded as defined in the RHS Manual and illustrated in Figure 3.

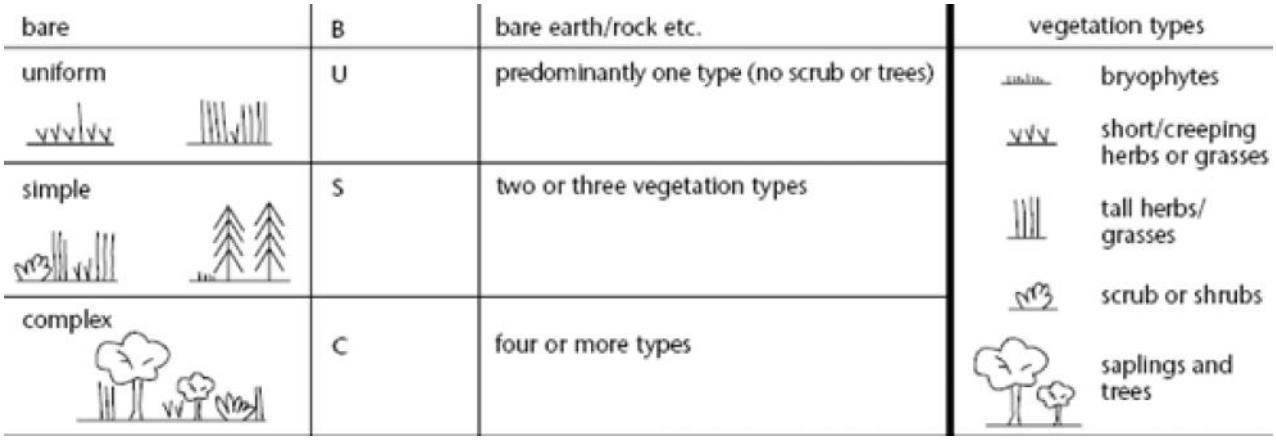


Figure 3: Codes for bank face and bank top vegetation structure (source: RHS 2003 manual)

6.4 Channel vegetation (observed within a 10 m wide transects across the channel, Figure 2)

6.4.1 The channel vegetation types are the same as recorded in the RHS and percentage cover is recorded as either 1% (present) or to the nearest 5%. Brief definitions are: **none** (<1% vegetation cover, or none is visible), **liverworts/mosses/lichens** (includes submerged vegetation or in the splash zone), **emergent broad-leaved herbs** (broad-leaved plants rooted on the river bed or at the water's edge with foliage above the water surface), **emergent reeds/sedges/rushes/grasses/horsetails** (narrow-leaved plants rooted on the river bed or at the water's edge with foliage above the water surface), **floating-leaved** (rooted) (plants rooted on the river bed but with either broad or linear floating leaves), **free-floating** (plants floating on, or just under, the water surface, and not rooted to the river bed), **amphibious** (plants rooted at the edge of the river, or on the bank, but shoots or leaves trail across the water), **submerged broad-leaved** (rooted submerged plants with underwater leaves no more than three times longer than broad - some part of the plant, or some leaves, may reach the surface but the majority are submerged), **submerged linear-leaved** (rooted submerged plants with narrow, unbranched, laminar leaves that are either totally submerged or just have their tips or upper parts floating on the surface), **submerged fine-leaved** (rooted submerged plants with fine, branched, leaves), **filamentous algae**. Channel vegetation types observed in between spot-checks can also be recorded in the 'sweep-up' column to right of spot-checks 1-10

6.4.2 Optional records include **channel choked with macrophytes**, which implies that no moving water is visible. In this case record the predominant macrophyte type (as

described in 6.4.1) or species. **Macrophyte species** present can also be recorded for the entire stretch in the box provided.

7. CUMULATIVE MEASUREMENTS

Cumulative measurements provide an overall assessment of the character of the surveyed stretch and are recorded with a variety of measurement scales to suit their importance in the urban context

7.1 Bank Profile and Protection

7.1.1 Bank Profile. Bank profiles are recorded in three categories: natural / unmodified, artificial (reinforcement), artificial (bank profile). In each case there is a 'none' class to ensure that percentages (nearest 5%) relating to all classes within any of the three categories sum to 100% over the reach. **It is also possible for banks sections to fall into more than one of the three categories. For example a bank might have a natural lower profile (e.g. undercut) but have a resectioned upper profile and also be reinforced in the upper part of the bank.** Figure 4 illustrates the classes within each of the three categories (note – poached refers to heavy trampling by animals or humans).

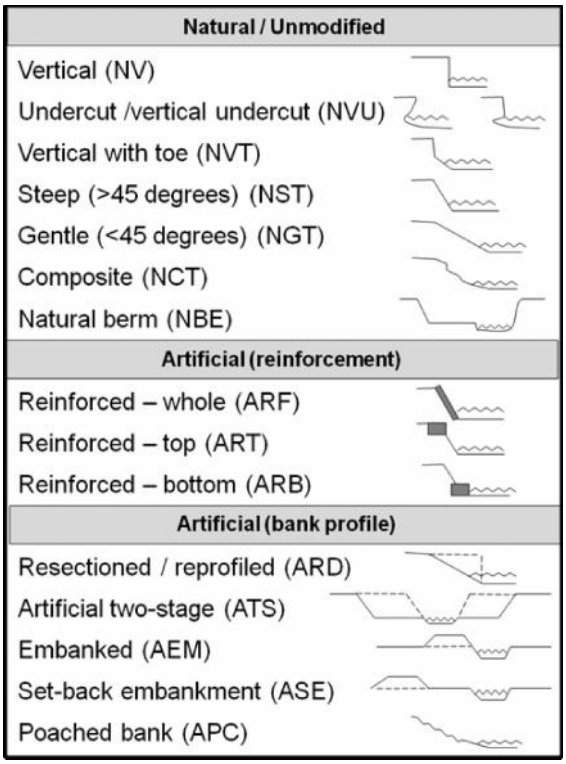


Figure 4: Bank profile classes and codes

7.1.2 **Bank Protection** is recorded in the same categories as for the spot checks (for definitions see section 6.2.2) which should be recorded in terms of the length of bank affected to the nearest 5%. It is feasible for the total protection along a bank to sum to more than 100% if different protection types are applied to different parts of the bank profile (e.g. toe is protected using a different material from the bank face). The none class should provide a percentage of banks with no protection at any level of the bank profile.

7.2 **(Geomorphological) Dynamics** are important because they provide an indication of whether the river channel is (i) undergoing change and the nature of that change; (ii) is in 'dynamic' equilibrium; or (iii) is in a 'moribund' or fossilised /immobile state. Geomorphological dynamics are also important for the ecological condition of the river channel because they drive habitat turnover and thus they reset habitats used by some species (e.g. bare gravel bars, eroding bank faces) and ensure that a full range of young to mature habitats are maintained.

Channel dynamics are assessed as a proportion (%) of the stretch length as none, negligible (<5%), local (5-20%), extensive (20-30%), very extensive (>30%):

One bank eroding (i.e. showing vertical, vertical + toe, or undercut bank profiles on one bank – section 7.1)

Opposite banks eroding (i.e. showing vertical, vertical + toe, or undercut bank profiles on both opposing banks – section 7.1).

Opposite banks depositing (i.e. showing vegetated bars or berms on both opposing banks – section 6.2.3).

Berms on one or both banks totalling more than 25% channel width (one bank or both opposing banks with berm > 25% channel width - berm defined in section 6.2.3).

Channel dynamic features are assessed on an absent, present (<33% stretch affected), extensive (>33% stretch affected) scale relative to the stretch length or the extent of the features (e.g. bridge piers) that are involved.

Buried soil within bank profile (relatively organic-rich layers are present within the bank profiles and are overlain by sediment with a distinctly lower organic content)

Burial of river bed with fine sediment (the river bed sediment is buried by a finer sediment layer – usually the burial of a gravel bed by sand or silt that can be assessed by pushing a probe into the fine sediment to assess whether there is a coarser layer underneath)

Burial of base of structures (structures such as bridge piers, jetties show distinct signs of burial, usually by fine sediment but coarser bed material can also be deposited by floods to raise the river bed)

Burial of base of established vegetation (usually best indicated by the clear burial of the base of tree trunks)

River channel narrow relative to bridge openings (indicated where bridges have several openings and the outer openings are becoming closed or partly-closed by the accumulation of sediment)

Bed sediment exposed within bank profile (sediments of similar size and texture to the bed material (e.g. gravel layers that are coarser than the upper bank profile) are exposed in the river banks above current bed level).

Trees with exposed roots or collapsing / leaning into the channel on both (opposing) banks (bankside trees are heavily undercut to expose their root structures and/or are collapsing and/or are leaning into channel)

Exposure of foundations of structures (e.g. foundations of bridge or jetty piers)

Heavily compacted and armoured bed (the river bed sediments are strongly compacted (individual particles are not easily removed) and armoured (there is a distinctly coarser layer of particles at the bed surface than immediately underneath).

7.3 Artificial Influences

7.3.1 **Artificial Features** are recorded in the same way as for the RHS, and are illustrated in Figure 5 (page 17) according to type and impact. For bridges complete the number of each type (rail, road, foot/cycle, other).

7.3.2 **Nuisance Species.** The abundance along the surveyed stretch of the seven species listed in this category is recorded (i.e. Himalayan balsam, Japanese knotweed, Giant hogweed, Floating pennywort, Australian swamp stonecrop, Parrot's feather, Creeping water primrose). These are the seven non-native species identified by the Environment Agency (2010) in their document entitled 'managing invasive non-native plants'. Here 'Individuals' means isolated plants occupying <1% cover, 'Isolated clumps' indicates distinct clumps of plants but with low cover (<5%), 'Frequent' indicates a cover of

between 5 and 33%, and 'Extensive' indicates a cover of >33%. The percentage cover should be related to available bank area (Himalayan balsam, Japanese knotweed, Giant hogweed) or available channel area (the other 4 species). Record other nuisance species in the space provided. Photographs of each species are included in Appendix D to aid identification.

7.3.3 Recent Management. Recording is optional and relates to obvious, recent activities in the listed classes. Briefly describe other activities as appropriate. Record whether each listed activity is absent (A - none), present (P - <33% cover) or extensive (E - >33% cover) along the length of the stretch.

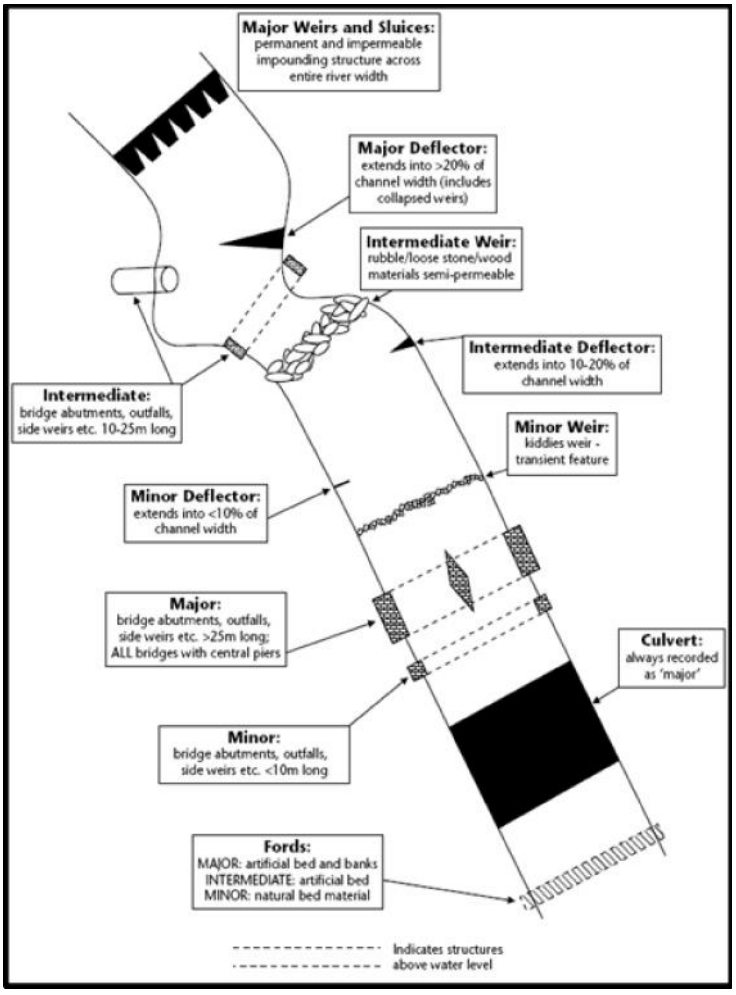


Figure 5: Types of artificial features and their impact level (minor, intermediate, major) (source: RHS 2003 manual)

7.4 Extent of Pollution

7.4.1 **Pollution Indicators** are recorded on the APE (absent – none; present - <33%, extensive > 33%) scoring system according to the length of the stretch affected. **Water odour** typically refers to the sewage effluent odours, but also includes industrial chemical aromas such as ammonia. **Sediment odour** describes the characteristic 'rotten egg' odour due to the presence of hydrogen sulphide emitted by anoxic sediments, and can easily be tested by inserting a ranging pole through the channel sediments. **Oil** can be extensive in urban channels and is characteristically seen floating on the water surface but may also be released from toxic sediments when their surface is disturbed (e.g. during testing for sediment odour). **Surface scum** consists of foams caused by the presence of phosphate detergents during surface mixing. It is usually seen by sewage outfalls but may also refer to floating mats of small particles of debris and thin foams formed in slow flowing waters. **Gross pollution** includes larger items of urban trash including shopping trolleys, mechanical parts, and anthropogenic litter. If you identify a pollution incident while undertaking the survey it should be reported to the Environment Agency's hotline 0800 80 70 60.

7.4.2 **Pollution Sources.** **Input pipes** are counted and include sewage outfalls, industrial effluent pipes and surface runoff pipes. **Leach points** are also counted and include natural leaching and small land drains <10cm with signs of active seepage

7.4.3 **Water Clarity** is assessed for the whole stretch as either Good (i.e. clear), Average (fairly clear or patchy), or Poor (difficult to see the channel bed).

7.5 Habitat Features and Flow Types

7.5.1 **Habitat Features** are discrete features that are recorded as a count for the entire stretch. Definitions of bedrock (BE) and rock/boulder (RO) are given in section 6.2.1. Definitions of island (MI), unvegetated mid-channel bar (MB), vegetated mid-channel bar (VM), unvegetated point bar (PB), vegetated point bar (VP), unvegetated side bar (SB), vegetated side bar (VS) are given in sections 6.2.3 and 6.2.6. Definitions of riffle (RI) and Pool (PO) are given in section 7.5.2. The remaining categories relate to organic matter or areas of still water. A discrete organic matter deposit (OM) is comprised of wood pieces less than 1m length and 10cm diameter, twigs, leaves, and smaller organic material and forms a distinct patch within the river channel. Wood debris (WD) is one or more pieces of wood greater than 1 m length and 10 cm diameter forming a discrete deposit. A wood jam (WJ) is similar to WD but extends across the entire channel. Marginal backwater (MBW), connected backwater (CBW),

and disconnected backwater (DBW) are areas of imperceptible flow located in the positions shown in Figure 6.

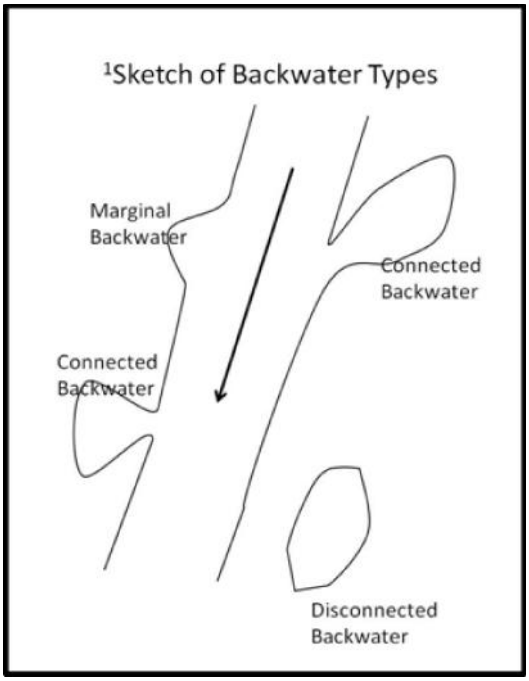


Figure 6: Backwater types

7.5.2 **Flow (habitat) types** are recorded according to the percentage (nearest 5%) of the water area affected by each type. They represent areas of the channel predominantly affected the flow (patch) types described in 6.2.5. Brief definitions of each type are as follows: cascade (CC - Distinct series of 'stepped' flow features occurring over boulder substrate or bedrock outcrops), boil (BL – area of channel where discrete areas of the water surface heave as upwelling water breaks the surface), rapid (RP – area with water surface dominated by broken standing waves), riffle (RI – area of channel dominated by unbroken standing waves), run (RU – area of channel with no waves, flow direction generally downstream with disturbed rippled surface), glide (GL – area of channel dominated by smooth downstream movement of water), pool (PO – discrete area of imperceptible flow over a low area in the channel bed), marginal deadwater (MD – discrete area of imperceptible flow associated with marginal and connected backwaters, see figure 6), ponded (PR – area of slow to imperceptible flow upstream of a channel obstruction such as a weir).

7.6 Special Features

7.6.1 **Tree features** are recorded on the APE (absent – none; present - <33% , extensive > 33%) scoring system according to the length of the stretch affected. Record 'present' even if cover is only 1%. **Channel shading** and **overhanging boughs** are recorded according to their cover of the low flow channel area. **Exposed bankside roots, underwater roots, fallen trees** and **large wood debris** (wood pieces and accumulations containing at least one piece longer than 1m and with a diameter greater than 10 cm) are recorded according to their presence on / along either bank along the length of the stretch.

7.6.2 **Tree distribution** is recorded separately for each bank according to a range of self-explanatory classes (Figure 7)

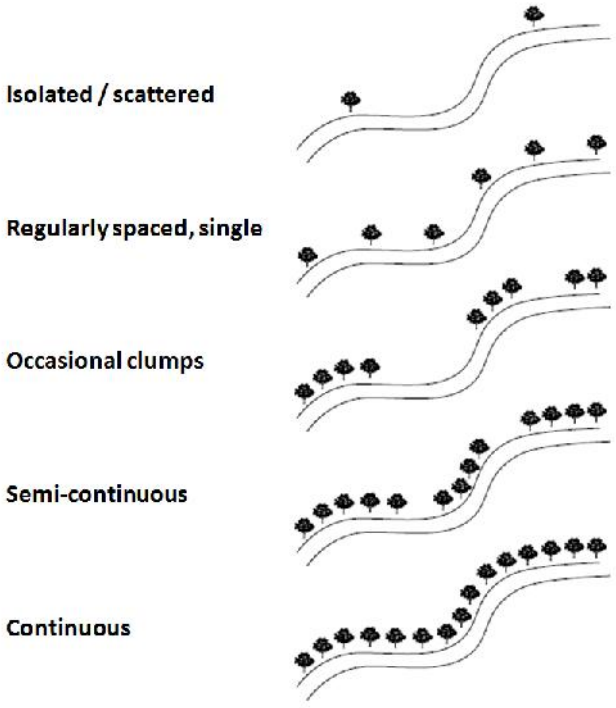


Figure 7: Tree distribution categories (source: RHS 2003 manual)

7.6.3 **Special Features** are extremely rare in urban river corridors. They are fully described in the RHS manual but the following are brief summaries: **Side channels** are discrete additional channels to the main channel, separated from the latter by a vegetated area and they may be dry in periods of low-flow; **fens** are comprised of wetland vegetation, often growing over peat, where the water-table is at, or just below, the surface (water is derived from both rainfall and drainage of surrounding land); **marsh / bogs** are comprised of vegetation growing on wet peat where the water table is at, or just

below, the surface and the water source is primarily direct rainfall; **carr** is wet woodland comprised of riparian tree species such as willows and alders, usually with an understorey of wetland herbs, reeds and mosses; **water meadows** are floodplain meadows, primarily associated with chalk streams, and traditionally flooded via constructed feeder channels; **floating mats / reed beds** form a distinct floating 'ledge' or shelf of vegetation extending into the channel.

7.6.4 **Evidence for Protected Species** This section provides the opportunity to record physical signs or suitable habitat for a list of protected species. These should also be highlighted in the key points of the High Level Assessment of Habitat and biodiversity.

7.6.5 Ecological characteristics. This optional section allows the surveyor to circle any species observed during the survey and to add additional species and observations in the box provided.

APPENDIX A

Urban River Survey Forms

URBAN RIVER SURVEY SHEET 1

The Urban River Survey (sheets 1 to 4) is applicable to *stretches* of a *single* engineering type, 500m (minimum 300m) in length

SURVEY DETAILS

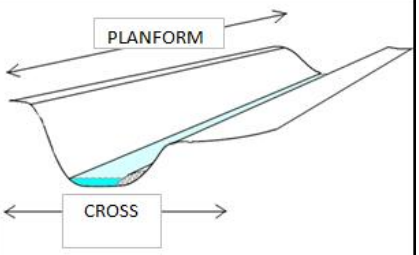
WFD water body ID		**Surveyor name**	
River Name		**Date**	
River Stretch name/number		**Time**	

LOCATION INFORMATION

Stretch length		GPS (lat/long 6dp) upstream	
NB - must be single engineering type only		GPS (lat/long 6dp) downstream	
River surveyed from left, right (facing downstream) or both banks ?		Bed visible? (Y or N)	
Spot check 1 located at upstream or downstream end of stretch?		Adverse Conditions? (Y or N)	
		If yes, describe (e.g. high flow, poor access / light)	
Distance from source		*Optional* Solid geology code	
Gradient (m/km)		*Optional* Drift geology code	
Photograph to characterise the stretch?			
If yes, insert photo reference(s)			

STRETCH ENGINEERING

Predominant character of cross sectional profile and planform of the stretch



Check ONE planform type

Planform type	Semi-natural	Engineered straight	Engineered sinuous	Recovering

Check ONE cross profile type

Cross profile type	Semi-natural	Cleaned	Restored	Resectioned	Enlarged	Two-stage

Check ONE level of reinforcement level

Reinforcement level	None	Bed only	1 bank only	Bed and 1 bank only	Both banks only	Full

See photo guidance for engineering types: in the manual: Appendix C

CHANNEL DIMENSIONS: ONCE ONLY MEASUREMENTS

Choose a location at a riffle, if present or at a suitable shallow run

LOCATION:

Distance from upstream point (m)		Measured at Riffle or Run?	
GPS (lat/long degrees to 6 decimal places)		Measured at spot check? (if yes, state number)	

CHANNEL DIMENSIONS:

Channel water width (m)		Channel water depth (m)	
Channel bankfull width (m)			

LEFT BANK

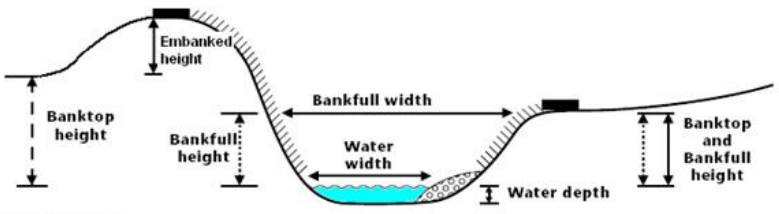
Left bank top height (m)	
Left embanked height (m)	

RIGHT BANK

Right bank top height (m)	
Right embanked height (m)	

Cross profile measurement guide:

- **Banktop** = first major break in slope above which cultivation or development is possible.
- **Bankfull** = point where river first spills on to floodplain.



Source: *River Habitat Survey Manual: 2003 version*

URBAN RIVER SURVEY SHEET 2

SPOT-CHECK MEASUREMENTS

*Spot-check data must be gathered at **ten** spot checks located at equal intervals along the river stretch (irrespective of stretch length)*

Ensure that on sheet 1 you have recorded whether spot check 1 is a the upstream or downstream end of the stretch

Record predominant parameter using codes provided

PARAMETER	1	2	3	4	5	6	7	8	9	10	SW
GPS (lat/long degrees to 6 decimal places)											
Latitude (Northing)											
Longitude (Easting)											
PHYSICAL ATTRIBUTES (1m transect across channel)											
BANK MATERIAL											
Left bank material AR, BE, BO, CO, GS, EA, CL, NV											
Right bank material AR, BE, BO, CO, GS, EA, CL, NV											
BANK PROTECTION											
Left bank protection NO, CC, CB, BR. BW. SP, WP, RR, GA, RE, WS,											
Right bank protection NO, CC, CB, BR. BW. SP, WP, RR, GA, RE, WS,											
MARGINAL AND BANK FEATURES											
Left marginal & bank features NV, NO, EC, SC, PB, VP, SB, VS, NB											
Right marginal & bank features NV, NO, EC, SC, PB, VP, SB, VS, NB											
RIVER CHANNEL											
Channel substrate AR, BE, BO, CO, GP, SA, SI, CL, PE, NV											
Flow (Patch) Type FF, CH, BW, UW, CF, RP, UP, SM, NP, DR											
Channel features NV, EB, RO, VR, MB, VB, MI, TR, NO											
BANKTOP LAND USE & VEGETATION STRUCTURE (10m transect)											
LAND USE (CODES: Re, Cm, In, Ic, Tr, Fp, Sw, Sy, Ld, Dr, Cr, Pa, Or, Al, Fe, Co, Dd, Ow, He, Sc, Op, Rc, Ce, La, Rv, Ca, Qu, Tb, Wl)											
Left bank landuse (within 5m)											
Right bank landuse (within 5m)											
BANK TOP STRUCTURE											
Left bank top structure (within 1m) B, U, S, C											
Right bank top structure (within 1m) B, U, S, C											
BANK FACE STRUCTURE											
Left bank face structure B, U, S, C											
Right bank face structure B, U, S, C											

CHANNEL VEGETATION (10m transect)

Record % of each vegetation type present within 10m cross-channel transect in macrophyte zone i.e. to wetted margin

(present = 1%, otherwise record to nearest 5%

Vegetation type	1	2	3	4	5	6	7	8	9	10	SW*
None											
Liverworts/mosses/lichens											
Emergent broad-leaved herbs											
Emergent reeds/ linear-leaved/ horsetails											
Floating leaved (rooted)											
Free-floating											
Amphibious											
Submerged broad-leaved											
Submerged linear-leaved											
Submerged fine-leaved											
Filamentous algae											

***SW** - Record type and estimate % cover of other macrophyte types present in stretch but not at spot checks*

Channel choked with macrophytes? (if YES, identify species or type)	

Additional notes:

e.g. Macrophyte Species

URBAN RIVER SURVEY SHEET 3

CUMULATIVE MEASUREMENTS (i)

Cumulative measurements record vital information about key indicators of urban river habitat status along the river stretch

BANK PROFILE & PROTECTION

Bank Profile:

Bank Profile Code	Description	Left Bank % length	Right Bank % length
Natural / unmodified (should sum to 100% for each bank)			
NV	Vertical		
NVU	Undercut / vertical+undercut		
NVT	Vertical with toe		
NST	Steep (>45 deg)		
NGT	Gentle (<45 deg)		
NCI	Composite		
NBE	Natural Berm		
None	None		
Artificial (reinforcement) (should sum to 100% for each bank)			
ART	Reinforced - whole		
ARI	Reinforced - top only		
ARB	Reinforced - bottom only		
None	No reinforcment		
Artificial (bank profile) (should sum to 100% for each bank)			
ARD	Resectioned (reprofiled)		
AEM	Embanked		
ATS	Artificial two-stage		
ASE	Set back embankment		
APC	Poached		
None	No modified profile		

Description	Left Bank % length	Right Bank % length
None		
Washed out		
Reede (planted)		
Biotex / Coir		
Willow spiling / faggot bundles		
Wood piling		
Gabione		
Rip rap		
Builder's waste		
Sheet piling		
Brick / laid stone		
Concrete		
Concrete and brick		
Other (specify)		

Note : total for Artificial (reinforcement) needs to match total for Bank Protection

CHANNEL DYNAMICS

Indicators of channel dynamics:

Percentage of stretch length	none	negligible <5%	local 5-20%	extensive 20-30%	very extensive > 30%
one bank eroding (vert/vert+toe/undercut)					
opposite banks eroding					
opposite banks depositing (vegetated bars/berms)					
berms totalling > 25% channel width					

	A	P	E
Buried soil within bank profile			
Burial of river bed with finer sediment			
Burial of base of structures (e.g. bridge piers)			
Burial of base of established vegetation (e.g. trees)			
River channel narrow relative to bridge openings			
Bed sediment exposed within bank profile			
Trees with exposed roots / collapsing / leaning into channel or both banks			
Exposure of foundations of structures (e.g. bridge piers)			
Heavily compacted and armoured bed			

Tick appropriate box. A = absent, P = present, E = extensive (>33%).

Estimate to nearest 5% or 25m for a 500m stretch

Handy reminder - 1% of 500m = 5m

ARTIFICIAL INFLUENCES

Artificial Features (count)	Major	Intermediate	Minor
Bridges (total)			
Weirs / Sluices			
Deflectors/ Groynes			
Culverts		N/A	N/A
Other (state)			

For the bridges record the number of each type

Bridge Type	Number
rail	
road	
foot / cycle	
other	

*Photograph all major artificial features and note location in photo reference

Recent Management	A	P	E
None	N/A	N/A	
Aquatic weed cutting			
Dredging			
Bank mowing			
Tree pollarding			
Other (specify)			

Tick box:
A = absent
P = present
E = extensive (>33%).

Tick box:
Individuals = isolated plants, <1% cover
Isolated clumps = distinct clumps, low cover (<5%)
Frequent = 5 to 33% cover
Extensive = >33% cover.

Nuisance Plant Species	Individual(s)	Isolated clump(s)	Frequent	Extensive
Himalayan balsam				
Japanese knotweed				
Giant hogweed				
Floating pennywort				
Australian swamp stonecrop				
Parrot's feather				
Creeping water primrose				
Other (specify)				

EXTENT OF POLLUTION

Pollution sources	Count
Input pipes (include sewage outfalls, industrial effluent pipes and surface runoff pipes)	
Leach points (include natural leaching and small land drains <10cm with signs of active seepage)	

EA hotline in case of significant pollution: 0800 80 70 60

Pollution indicators	A	P	E
Water odours e.g. sewage effluent odours, industrial chemical aromas			
Sediment odours e.g. odours from anoxic sediments			
Oils floating, released from sediments when disturbed			
Surface scum - Foams or floating mats of small particulates			
Gross pollution (Larger items of litter - e.g. shopping trolleys, traffic cones)			

Water Clarity?	Good (clear)	Average (fairly clear/patchy)	Poor (difficult to see through)	Comment

URBAN RIVER SURVEY SHEET 4

CUMULATIVE MEASUREMENTS (ii)

Cumulative measurements record vital information about key indicators of urban river habitat status along the river stretch

HABITAT FEATURES AND FLOW TYPES

Record as COUNT

Habitat feature code and name		Count
BF	Bedrock	
RO	Rock/boulder	
WF	Waterfall	
RI	Riffle	
PO	Pool	
MBW	Marginal backwater	
CBW	Connected backwater	
DBW	Disconnected backwater	
SL	Discrete sand/silt deposits	
MI	Island	
MB	Unvegetated mid-channel bar	
VM	Vegetated mid-channel bar	
PB	Unvegetated point bar	
VP	Vegetated point bar	
SB	Unvegetated side bar	
VS	Vegetated side bar	
OM	Discrete organic matter deposit	
WD	Wood debris	
WJ	Wood Jam	

Record as % WATER SURFACE AREA along stretch (nearest 5%)

Flow (habitat) type code and name		Percent (%)
CC	Cascade (predominantly free fall and chut	
BL	Boil (predominantly upwelling)	
RP	Rapid (predominantly broken standing waves)	
RI	Riffle (predominantly unbroken standing waves)	
RU	Run (predominantly rippled, clear downstream water movement)	
GL	Glide (predominantly smooth, clear downstream flow)	
PO	Pool (predominantly imperceptible flow over depression in channel bed)	
MD	Marginal deadwater (predominantly imperceptible flow in marginal and connected backwaters)	
PR	Ponded (predominantly smooth-imperceptible flow behind obstructions e.g. weir)	

SPECIAL FEATURES

Tick appropriate box: A = absent / P = present / E = extensive (>33% cover).

Special Features	A	P (even if <5%)	E	Photo Ref (optional)
Side channels (including fish passes)				
Fen (low wet land, grassy veg)				
Marsh / Bog				
Carr (wetland, woody veg)				
Water meadow				
Floating mat / reed bed				
Waterfall >5m				

Tree features	A	P (even if <1%)	E
Channel shading			
Overhanging boughs			
Exposed bankside roots			
Underwater roots			
Fallen trees			
Large wood debris			

Tree distribution	Left bank	Right bank
None		
Isolated/scattered		
Regularly spaced individuals		
Occasional clumps		
Semi-continuous		
Continuous		

Species Observed *(Optional)*

Circle if present, add others if observed

Invertebrates (Aquatic)	Dragonfly - Damselfly - Banded Demoiselle - Midge other (specify)
Invertebrates (Terrestrial)	Stag beetle - Bombus humilis - Other Beetle - other (specify)
Mammals	Water Vole - Bat - Hedgehog - other (specify)
Amphibians /	Greater Crested Newt - Common frog - Toad -
Reptiles	Grass snake - Adder - Slow worm - other (specify)
Birds	Black Redstart - Grey Heron - Grey Wagtail - House Martin - House sparrow - Kingfisher - Robin - Sand Martin - Swift - other (specify)
Fish	Bullhead - Minnow - other (specify)
Trees	Mistletoe - Black poplar - Crack Willow - Alder (healthy or diseased?) - other (specify)
Plants	Water Crowfoots (Ranunculus sp.) - Water Cress - Purple Loosestrife - Common Reed - other (specify)

Additional Species Observed

Evidence for Protected Species

Tick boxes if physical signs or suitable habitat observed

	Physical Signs	Suitable Habitat
European Protected Species		
Bats		
Great Crested Newt		
Otter		
Dormouse		
Sand Lizard		
Natterjack Toad Smooth Snake		
Lesser Whirlpool Ramshorn Snail		
Nationally Protected Species		
Adder		
Badger		
Water Vole		
White Clawed Crayfish		

APPENDIX B

Urban River Survey Codes

URBAN RIVER SURVEY (v7 2014) River Survey Codes & Spot Check Key [1]

Sheet 1 STRETCH ENGINEERING

IMPORTANT:

THE URBAN RIVER SURVEY IS APPLIED TO RIVER STRETCHES (REACHES) OF A SINGLE PREDOMINANT ENGINEERING TYPE, WHERE THE ENGINEERING TYPE IS MADE UP OF THE PREDOMINANT PLANFORM, CROSS PROFILE AND LEVEL OF REINFORCEMENT WITHIN THE SURVEYED REACH. WHEREVER POSSIBLE A STRETCH/REACH SHOULD BE 500m LENGTH, BUT IF THE ENGINEERING TYPE CHANGES THEN SHORTER REACHES MUST BE USED TO ENSURE THAT A REACH WITH A CONSISTENT ENGINEERING TYPE IS SURVEYED TO A MINIMUM REACH LENGTH OF 300m.

THE URBAN RIVER SURVEY IS APPLIED TO STRETCHES (REACHES) OF A SINGLE ENGINEERING TYPE (PLANFORM, CROSS PROFILE AND LEVEL OF REINFORCEMENT) SO THAT THE DETAILED FEATURES OF THE REACH CAN BE SET IN THE CONTEXT OF THE OVERALL ENGINEERING MODIFICATION OF THE REACH.

Planform code	Description	Definition
SN	Semi-natural	River follows an irregular course showing no significant evidence of engineering modification of planform
ST	Engineered - straight	River's course has been modified (engineered) to a straight planform
ME	Engineered - sinuous	River's course has been modified (engineered) to a sinuous planform
RE	Recovering	River's course has been modified by engineering (straight or sinuous) but the channel's plan (bank positions) is recovering to a more natural form through significant erosion or deposition of sediment
Cross profile code	**Description**	**Definition**
SN	Semi-natural/recovered	River cross section shows no significant evidence of engineering modification (either no previous engineering or completely recovered from engineering)
CL	Cleaned (vegetation/ structures removed)	River cross section shows no significant evidence of engineering modification but has a neat clean appearance as a result of cutting/pruning of vegetation and removal / reduction of other rough obstructions
RE	Restored	River cross section has been modified (engineered) to a profile with a more natural appearance
RS	Resectioned	River cross section has been modified to a smooth trapezoidal profile (usually to improve flood conveyance) but not obviously enlarged
EN	Enlarged	River cross section has been enlarged (over widened / over deepened), usually accompanied by resectioning. At normal/low flows, overwidened channels have very shallow water, often only occupying part of the channel.
TS	Two-stage	River cross section has been modified to include an large outer flood channel to accommodate floods with an inset smaller channel to accommodate non-flood flows. Three stage channels should be placed in this category
Level of reinforcement	The characteristic / predominant level of reinforcement along a stretch is defined as one of six categories (none, bed only, one bank only, bed and one bank only, both banks only, both banks and bed). Predominant bank reinforcment is recorded where reinforcement to any vertical extent up the bank (full, upper bank or lower bank) characterises all or most of the bank length in the surveyed stretch.	

URBAN RIVER SURVEY River Survey Codes & Spot Check Key [2]

Sheet 2 SPOT-CHECK MEASUREMENTS

WITHIN 1m TRANSECT

Bank Material Code	Description
AR	Artificial
BE	Bedrock
BO	Boulder
CO	Cobble
GS	Gravel/Sand
CL	Clay
EA	Earth (i.e. mixed)
NV	Not visible

Bank Protection Code	Description
CC	Concrete
CB	Concrete and brick
BR	Brick / laid stone
BW	Builder's waste
SP	Sheet piling
WP	Wood piling
RR	Rip rap
GA	Gabions
RE	Reeds (planted)
WS	Willow spiling
BC	Biotex/coir
WO	Washed out
NO	None

Marginal & Bank Feature Code	Description
NV	Not Visible
NO	None
EC	Eroding Cliff (steep bare earth)
SC	Stable Cliff (steep some vegetation)
PB	Unvegetated Point Bar
VP	Vegetated Point Bar
SB	Unvegetated Side Bar
VS	Vegetated Side Bar
NB	Natural Berm

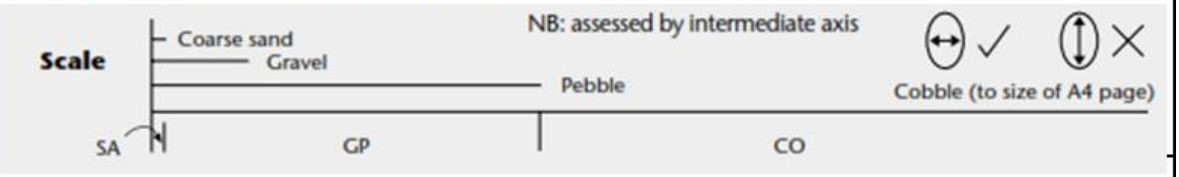
Type Code	Description
FF	Free Fall
CH	Chute
BW	Broken standing wave
UW	Unbroken standing wave
CF	Chaotic Flow
RP	Rippled
UP	Upwelling
SM	Smooth
NP	No perceptable flow
DR	Dry

Channel Substrate Code	Description (*see template for particle size guidance*)
AR	Artificial (concrete)
BE	Bedrock
BO	Boulder
CO	Cobble
GP	Gravel-Pebble
SA	Sand
SI	Silt
PE	Peat
NV	Not visible

Channel Feature Code	Description
NV	Not Visible
NO	None
EB	Exposed Bedrock
RO	Exposed Boulders
VR	Vegetated Rock
MB	Unvegetated Mid-channel Bar
VB	Vegetated Mid-channel Bar
MI	Island (mature veg.)
TR	Trash (significant accumulation)

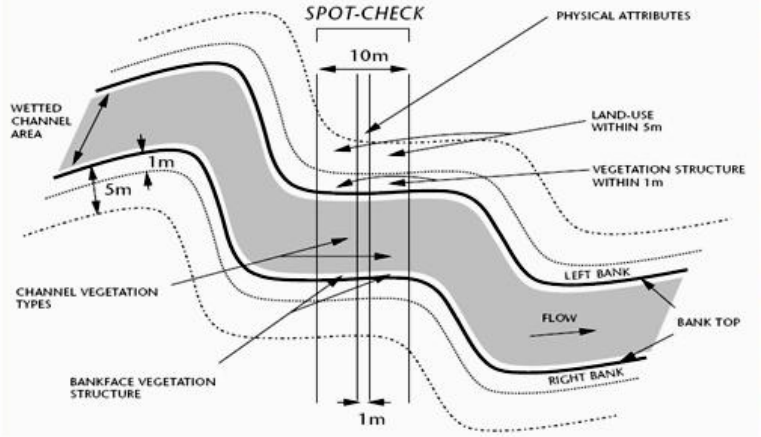
WITHIN 10m TRANSECT

BANK STRUCTURE CODES (Note Bank Top Structure assessed within 1m):



			vegetation types
bare	B	bare earth/rock etc.	bryophytes
uniform	U	predominantly one type (no scrub or trees)	short/creeping herbs or grasses
simple	S	two or three vegetation types	tall herbs/ grasses
complex	C	four or more types	scrub or shrubs
			saplings and trees

Figure 1 Diagram showing dimensions for spot-checks



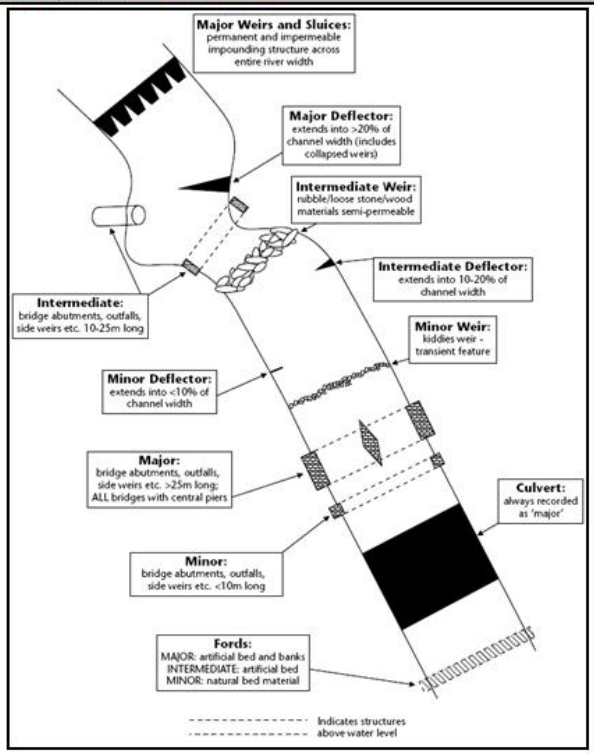
Source: *River Habitat Survey 2003 version*

Land use code	Description *(NB within 5m of bank top)*
Re	Residential
Cm	Commercial
In	Industrial
Ic	Industrial/Commercial
Tr	Transport infrastructure (roads,
Fp	Pedestrianised/Footpath
Sw	Sewage Treatment Works
Sy	Scrap/Waste Recycling Yard
Ld	Landfill/Refuse Deposits
Dr	Derelict Land / Brownfield
Cr	Cropland
Pa	Pasture
Or	Orchard
Al	Allotments
Fe	Intensive animal husbandry
Co	Coniferous
Dd	Deciduous / Mixed woodland
Ow	Open Woodland (with grassland)
He	Heathland
Sc	Scrub
Op	Open Parkland (Community Grass etc.)
Rc	Recreational Land (Playing Fields)
Ce	Cemeteries/Crematoria
La	Lake / pond
Rv	Reservoir
Ca	Canal
Qu	Quarry
Tb	Tributary
Wl	Wetland
Ot	None of the above

URBAN RIVER SURVEY RIVER SURVEY CODES & SPOT CHECK KEY [3]

Sheet 3 CUMULATIVE MEASUREMENTS - BANK PROFILE & PROTECTION; ARTIFICIAL INFLUENCES

Natural / Unmodified
Vertical
Undercut or vertical undercut
Vertical with toe
Steep (>45 degrees)
Gentle (<45 degrees)
Composite
Natural berm
Artificial (reinforcement)
Reinforced – whole
Reinforced – top
Reinforced – bottom
Artificial (bank profile)
Resectioned / reprofiled
Artificial two-stage
Embanked
Set-back embankment
Poached bank

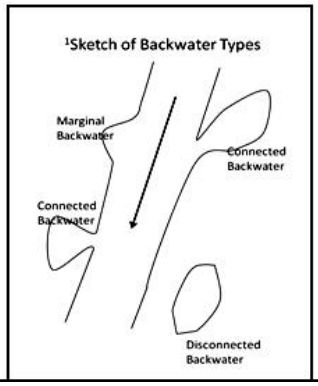


After: *River Habitat Survey Manual: 2003 version*

Sheet 4 CUMULATIVE MEASUREMENTS - HABITAT FEATURES

Habitat Features	Recorded as count:
Code	Description
BE	Bedrock
RO	Rock/boulder
WF	Waterfall
RI	Riffle
PO	Pool
MBW	Marginal Backwater[1]
CBW	Connected Backwater[1]
DBW	Disconnected Backwater[1]
SL	Discrete sand/silt deposit
MI	Island (mature vegetation)
UM	Unvegetated mid-channel bar
VM	Vegetated mid-channel bar
UP	Unvegetated point bar
VP	Vegetated point bar
US	Unvegetated side bar
VS	Vegetated side bar
OM	Discrete organic matter deposit (no large wood pieces
WD	Wood debris (large wood piece: >1m x >10cm dia, accumulation, tree in part of channel width)
WJ	Wood Jam (wood accumulation / fallen tree extending across entire channel)

Flow (habitat) types:	Recorded as % water surface area of entire stretch (nearest 5%)	
Code	Description	Dominating flow (patch) types
CC	Cascade	free fall and chute flow
BL	Boil	upwelling
RP	Rapid	broken standing waves
RI	Riffle	unbroken standing waves
RU	Run	rippled downstream movement of water
GL	Glide	smooth downstream movement of water
MD	Marginal deadwater	imperceptible flow in marginal and connected backwaters
PR	Ponded (e.g. upstream of weir)	smooth / imperceptible flow



APPENDIX C

Engineering Descriptions and Photographs

Not all of the types of engineering will be found on any one urban river. Following are descriptions and pictures of the most common types seen in the built environment:

1. Planform

1.1 Semi-Natural (SN): River follows an irregular course showing no significant evidence or influence of engineering modification of planform (Plate C1).

1.2 Engineered – straight (ST): The river's course has been modified (engineered) to a straight planform (i.e. very low sinuosity to completely straight planform: Plate C2).

1.3 Engineered – sinuous (ME): The river's course has been modified (engineered) to a sinuous (meandering) planform, such as is often employed in major restoration schemes. (Plate C3).

1.4 Recovering (RC): The river's course has been modified by engineering (straight or sinuous) but the channel's plan (bank positions) is recovering to a more natural plan form through significant erosion or deposition of sediment that is causing changes in the bank position (Plate C4).

2. Channel Cross Section

2.1 Semi-natural (SN): River cross section shows no significant evidence of engineering modification (either through lack of engineering or complete recovery from engineering) (Plate C5).

2.2 Cleaned (CL): River cross section shows no significant evidence of engineering modification but has a neat clean appearance as a result of cutting/pruning of vegetation and removal / reduction of other rough obstructions (Plate C6).

2.3 Restored (RE): River cross section has been modified (engineered) to a profile with a more natural appearance, usually as part of a restoration scheme (Plate C7).

2.4 Resectioned (RS): River cross section has been modified to a smooth trapezoidal profile (usually to improve flood conveyance) but is not obviously enlarged (Plate C8)

2.5 Enlarged (EN): River cross section has been enlarged (over widened and/or over deepened), may be accompanied by resectioning or ‘canalisation’. At normal/low flows, overwidened channels have very shallow water, often only occupying part of the channel. Over widened and/or over deepened channels. are especially obvious where concrete channels have been created (Plates C9 & C10).

2.6 Two-Stage (TS): Characteristic step appearance to the bank where the narrower bottom section contains the average to low river flows, and the widened upper section contains the flood flows. Three stage channels are not uncommon in urban channels and should be placed in this category (Plate C11).

3. Reinforcement

The characteristic / predominant level of reinforcement along a URS reach is defined as one of six categories (none, bed only, one bank only, bed and one bank only, both banks only, both banks and bed). Predominant bank reinforcment is recorded where reinforcement to any vertical extent up the bank (full, upper bank or lower bank) characterises all or most of the bank length in the surveyed reach.

The most commonly found levels of reinforcement are ONE BANK (C12), TWO BANKS (C13), FULL (C14)

Plate C1: Semi-Natural Planform

Plate C2: Engineered-Sinuous Planform

Plate C3: Engineered-Straight Planform

Plate C4: Recovering Planform

Plate C5: Semi Natural / Recovered Cross Section

Plate C6: Cleaned Cross Section

Plate C7: Restored Cross Section

Plate C8: Resectioned Cross Section

Plate C9: Enlarged (Overwidened) Cross Section

Plate C10: Enlarged (over-deepened) Cross Section

Plate C11: Two-Stage Cross Section

Plate C12: One Bank Only Reinforced

Plate C13: Both Banks Reinforced

Plate C14: Fully Reinforced

APPENDIX D

SEVEN NON-NATIVE 'NUISANCE' 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

Flower | Seedling | Adult Plant

Japanese knotweed (*Fallopia japonica*)

Giant hogweed (*Heracleum mantegazzianum*)

Flower | Seedling | Adult Plant

Himalayan balsam (*Impatiens glandulifera)*

Flower | Adult Plant | Plant stand

Australian swamp stonecrop (*Crassula helmsii)*

Adult Plant

Plant Stand

Parrot's feather
(*Myriophyllum aquaticum*)

Adult Plant

Plant Stand

Floating pennywort
(*Hydrocotyle ranunculoides*)

Adult Plant

Creeping water primrose
(*Ludwigia grandiflora*)

Plant stand

APPENDIX E

Health and Safety

1. A URS should not be undertaken until an appropriate risk assessment form has been completed by the surveyor, and also, if the surveyor is to be working alone, appropriate 'lone working' procedures and paperwork also need to be completed in accordance with his/her organisation's requirements.
2. The URS should not be carried out during periods of high flow. Surveys should be delayed until the water level and clarity return to background levels.
3. Urban Rivers characteristically display a very rapid response to rainfall. It is important that local weather conditions are monitored to ensure that the survey is carried out safely.
4. Appropriate clothing MUST be worn at all times when surveying urban rivers. Strong waders are ideal, and protection from nettles etc with thick clothing or waterproofs is recommended.
5. Fly-tipping and other hazardous waste are prevalent on urban river banks. Thick rubber gloves and hard soled boots or waders are recommended to be worn at all times through the survey.
6. Where clarity of the water is very poor, extreme care should be used when measuring channel dimensions. A ranging pole is desirable for surveying urban channels, for assessing the channel depth before measuring, and for general safety. A range-finder should also be used if the channel is too wide or too deep to wade or if the banks are too steep or too high to ensure safety when measuring the channel
7. If a riffle is not present along the stretch, the shallowest part of the river should be used for measuring the channel dimensions. Where water clarity is poor, first use a ranging pole to gauge the water depth. N.B due to the engineering of urban rivers, shallow sections can flow at very fast rate and should be entered with caution.
8. The surveyor's organisation's code of practice for Health and Safety should be closely followed. 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) provides some useful advice in relation to Health and safety issues: this information is reproduced below

Appendix 1 – Health & Safety Guidance

General guidelines

Being near rivers, streams or any other body of water, either for work or recreation, is potentially hazardous.

When doing an RHS survey, health and safety must always be taken into account.

Safety is an integral, and important, part of the RHS training course with the main hazards/risks being highlighted. However it is not fully comprehensive and line managers of surveyors are responsible for making all field staff aware of potential dangers, and the procedures to follow, in case of accidents.

RHS surveyors need to be physically fit and must have adequate personal protective equipment (PPE) i.e. appropriate footwear and waterproof jacket and trousers. Footwear should have cleated, felt or studded soles. Waders or wellington boots must be worn when surveying from the channel.

Every effort should be made to minimise risks in the field and the following guidelines should be followed:

- Life jackets should be worn at all times when working **in** rivers, and in any other situations wherever there is a risk of drowning. Do not enter a river in spate flow.
- Do not enter the water if the river bed is not visible.
- When entering the channel, take into account the depth, flow and temperature of water, conditions under foot (e.g. substrate, algae) and entry/exit points. Check for any potential obstructions.
- It is sensible to walk **against** the flow of the river.
- When in the channel, use a ranging pole or wading stick to check depth and substrate.
- Avoid steep, unstable and overhanging banks, and always have an identified exit route close to where you are surveying.
- Work in pairs if river channels need to be crossed.
- Never enter a culvert.
- Look out for hazards, especially in urban rivers, e.g. broken glass, sharp metal, decomposing waste or pollutants.
- Take care to avoid contact with the water, soil or vegetation before eating or drinking during survey work.
- Wear the right clothes for both the job and the weather conditions.
- When driving, shoes or walking boots should be worn and not waders.
- Carry a basic first-aid kit and hand-wipes.
- Wear a whistle, especially in remote, urban or wooded areas. Do not put it in a rucksack or pocket.
- When there is good reception, carry a mobile telephone.
- Always double-man or use a 'lone worker' system i.e. reporting-in and signing-off procedures, linked to a home base. (**NB lone working also includes where two people are working in a remote location.**) Line managers should have systems in place that ensure that the location of surveyors is known, and should establish an agreed system of emergency action in case a surveyor does not report back at the end of the day. For more details on lone-working, see Appendix 2.

A risk assessment should be carried out before doing survey work and an RHS health and safety assessment needs to be completed on-site. If there are problems on site, the surveyor needs to report these to their line manager, or survey coordinator, at their office. If it is considered unsafe, or there is any doubt, the survey should not be carried out.

Risk assessment for a River Habitat Survey (see Appendix 1.1)

Surveyors need to decide if there are any risks and to what level they are. Measures are suggested to reduce the risks and they should be applied. However it is down to the surveyor's, and their line manager/survey supervisor's, personal judgement(s) whether to proceed with the survey. The information in the Appendix 1.1 table should be used as a guide in undertaking risk assessment.

Appendix 1.1 – River Habitat Survey 2003 version: risk assessment

Site Number/Reference: Date:

Task Element	Risk	Risk Level (low, moderate, high)	Potential Risk Control Measures	Proceed With Survey (Yes or No)
Arriving at site and the duration of survey	Aggressive animals/ people, hostile situation.		Cautionary approach, avoid animals where possible, conflict resolution/breakaway training, double-man or lone worker system, mobile phone, personal alarm, whistle	
	Bank stability, high/steep banks.		Cautionary approach, test with ranging pole/wading stick, double-man, wear a lifejacket.	
	Falling in, swept-off feet, losing footing.		Cautionary approach, double-man, wear a lifejacket, walk in upstream direction.	
	Fences (barbed wire, electric).		Try to find a safe crossing point. Do not climb over, or crawl under, unless assessed to be safe to do so. If not safe to cross and no alternative crossing points, abandon the survey.	
	Livestock.		Cautionary approach, avoid animals where possible, walk around the edges of fields.	
	Lone or remote working, lack of visibility, lack of local knowledge, vulnerable position.		Double-man or lone worker system, estimated finish time known to others, assess communications before starting survey, mobile phone, personal alarm, whistle.	
	No communication (out of mobile range/no telephone).		Double-man or lone worker system, estimated finish time known to others, assess communications before starting survey, personal alarm, whistle.	
	Railway, road.		Find a safe crossing point.	
	Rough terrain, marsh/bogs.		Appropriate footwear and clothing, watch footing, walk around outer edges of bogs etc.	
	Ticks (Lyme disease).		Wear long sleeves & trousers, regularly check for ticks, inspect body at end of survey.	
	Valuable equipment, high crime rate location.		Double-man in such locations, estimated finish time known to others, assess communications before starting survey, mobile phone, personal alarm, whistle. If confronted for equipment, always give it over.	
	Weather: dehydration, heatstroke, hypothermia or unpredictable.		Heat: wear suncream, sunglasses, keep head and back of neck covered, have bottled water, go into shade regularly. Cold: have insulating layers, wear hat/hood and gloves. Wet: do not survey in heavy rain, be extra vigilant to conditions underfoot. Be prepared for all likely conditions.	
When surveying from channel	Swept-off feet, losing footing.		Double-man, use ranging pole to test depth and ground before entering channel, wear lifejacket, If water above knee-height or you do not feel comfortable, do not survey from channel	
	Entry & exit points.		Check bank stability with ranging pole, wear lifejacket, double-man.	
	Hidden hazards under the water.		Use ranging pole to check in the channel before entering, and whilst in, the channel. If hazards found, do not enter channel or make a safe exit from it.	
	Infection (in particular *Leptospirosis*).		Keep open skin covered, wear gloves, have hand wipes and first-aid kit, wash hands thoroughly, avoid touching face, carry *Leptospirosis* Card.	
	Pools.		Use ranging pole to test depth and ground, move around outer edges, watch footing.	
	Poor visibility/water clarity.		Use ranging pole to check in channel, watch footing. If not comfortable do not survey from channel.	
	Poor water quality, pollution, sewage outfall/treatment works.		Wear gloves, keep open skin covered, have hand wipes and first-aid kit, wash hands thoroughly before eating/drinking.	
	Substrate soft or uneven.		Use ranging pole to test depth and conditions underfoot before entering the channel and whilst in it. If not comfortable, do not survey from channel.	
	Algae, thick weed growth, woody debris dams.		Use ranging pole to check in channel, watch footing. If not comfortable, do not survey from channel.	

Site health and safety form (see Appendix 1.2)

This is now a required component of an RHS Survey and should be submitted along with the other four pages of the survey form. Surveyors need to assess, and comment on, the general characteristics of the site, and specifically on such aspects as weather and flow conditions. On the form it is necessary to record if the risks are low, medium or high. If a single category is recorded as a 'high' risk, surveys should not be carried out; similarly if more than three 'moderate' risks are recorded, RHS should not be carried out.

Personal safety

Equipment used in an RHS survey can be highly expensive and the surveyor should also have a mobile phone. This may attract unwanted attention, particularly in urban areas, and might lead to a hostile situation.

Surveyors need to be able to recognise these types of situations and know how to deal with them appropriately, minimising risk of personal injury. Some sort of 'conflict resolution' training may be required so that the surveyor is able to evaluate the situation, avoid aggravating it, and know how to breakaway and escape attack if necessary.

If confronted for survey equipment, always give it over. Equipment, or data, are not as valuable as the surveyor!

Life jackets

Where there is a risk of drowning a life jacket must be worn.

Surveyors must be trained in how to use, maintain and inspect their life jacket. They also need to know about the dangers of immersion and hypothermia.

Weil's disease (*Leptospirosis*)

This can be a life threatening disease and surveyors need to **carry a medical/warning card at all times** (for England and Wales available from the RHS team at Warrington) to alert people to the nature of any potential illness. The symptoms start as a fever and headache. Treatment with antibiotics is needed straightaway.

Rivers being surveyed for RHS may contain rat urine, which can cause this illness. Therefore **waterproof clothing** must be worn when in the channel. Dead rodents at the site should not be touched, with or without, hand protection. Infection enters through breaks in the skin (i.e. abrasions, cuts, eyes, nose and mouth). Cuts and/or broken skin must be covered with **waterproof plasters** and surveyors should not rub their eyes, nose and mouth.

Surveyors **must always wash their hands before drinking, eating or smoking**. Clothing and equipment should be cleaned after use.

Lyme disease

Lyme Disease can lead to serious illness if not treated quickly and properly. It is caught through being bitten by infected ticks, particularly in areas with sheep and deer. The first symptom is a ring-shaped rash around the bite followed by the development of flu-like symptoms within 24-48 hours. Treatment with antibiotics is required and is normally successful. If the disease is not treated, serious complications will develop over 1-12 weeks.

Whilst doing survey work in areas where tall grasses, reeds, heather (*Erica, Calluna*), bracken (*Pteridium*) and cranberry/blueberry/bilberry (*Vaccinium*) are abundant, surveyors must **keep their skin covered** (i.e. trousers and long sleeves). They also need to **regularly inspect** their clothing and skin for ticks and thoroughly check their body at the end of the day.

If ticks are found on the body, use tweezers to remove them. This needs to be done slowly and carefully to ensure no mouth-parts are left behind below the skin. Following removal, put a dressing over the bite, and seek medical attention.

Appendix 1.2 – River Habitat Survey 2003 version: site health and safety assessment form

RIVER HABITAT SURVEY 2003 VERSION: SITE HEALTH AND SAFETY ASSESSMENT			
Site Number[1]:	Site Ref:	River Name:	Date:
Grid References/Co-ordinates:	Spot 1[2]:	Mid-site:	End of site[2]:
Surveyor Name:		Accredited Surveyor Code:	
[1] Leave blank if new site.		[2] Optional	

Weather Conditions:
Flow Conditions:

Site details: (enter comments or circle if applicable and give details)	**Risk Level (Low/Mod/High)**
Access and Parking: (entry & exit)	
Conditions: comment on ground stability, footing, exposure/remoteness	
Obstacles/Hazards: fencing, stiles, dense vegetation, steep bank	
Occupied/Unoccupied: people, livestock, animals	
Activities/Land-use: agriculture, woodland, residential, industrial, construction, recreational	
Risk if lone-working	

IF THERE ARE ANY HIGH RISKS OR MORE THAN THREE MODERATE RISKS DO NOT CONTINUE WITH THE SURVEY.

Weil's Disease (*Leptospirosis*)

Instructions to card holders

1. As infection may enter through breaks in the skin, ensure that any cut, scratch or abrasion is thoroughly cleansed and covered with a waterproof plaster.
2. Avoid rubbing your eyes, nose and mouth during work.
3. Clean protective clothing, footwear and equipment etc. after use
4. After work, and particularly before taking food or drink, wash hands thoroughly.
5. Report all accidents and/or injuries, however slight.
6. Keep your card with you at all times.

Lyme Disease

1. Dress appropriately with skin covered up.
2. Regularly inspect for ticks when in the field.
3. Check for, and remove, any ticks as soon as possible after leaving the site.
4. Seek medical attention if bitten by a tick.

Appendix 2 – Lone Working Guidance

This Appendix contains excerpts form the Environment Agency's *Health and Safety Risk Management Manual* and the *Lone Worker Code of Practice.*

'**Lone working**' is where there is either no visual or audible communication with someone who can effectively get assistance in the event of an incident.

'**Remote working**' is when there are two people working in an area which is regarded as being isolated from potential rescuers, either because of the distance from inhabited locations, or because of features which make the site inaccessible.

Lone or **remote working** surveyors need to have the same level of safety as those working with others, or in populated locations, i.e. be in a minimal risk situation.

☠ If it is deemed **high risk** for a lone surveyor to do a survey, those responsible for the safety of surveyors need to make an additional person available. Surveyors should not perform RHS alone when there is a foreseeable chance that doing so might result in an accident, which would require a second person to be available to summon help.

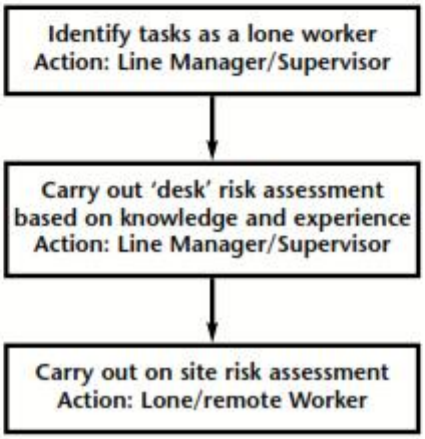
💡 Those who do work alone, or remotely, should have health and safety training which includes first-aid, map reading, using safety equipment and conflict resolution/breakaway skills.

Risk assessment

Personnel responsible for the safety of surveyors must carry out a **risk assessment** for lone and remote surveyors and reduce risks to an acceptable level. However, surveyors must complete a risk assessment on site and use their own judgement. If they feel they are vulnerable, they should have assistance.

☠ **Surveyors should not put themselves or others at risk.**

The risk assessment may be carried out in three phases:



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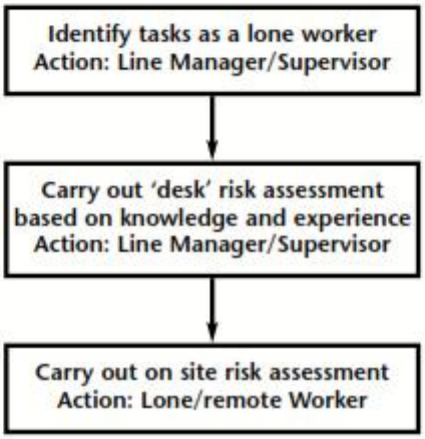

Lone or remote surveyors need to evaluate the following key risk criteria:

- the kind of accidents that may occur;
- the type of injuries that might result;
- the need for those injuries to receive immediate treatment;
- the chances of the injured person being able to summon help using telephone/radio equipment.

These should be looked at in addition to the RHS Risk Assessment (Appendix 1.1).

Lone, or remote, surveyors should not do RHS in:

- reduced visibility when there is a risk of falling into deep or fast flowing water or if there are steep banks;
- sites where banks are unstable or slippery;
- urban areas with high crime rates or known problems of physical attacks and muggings;
- sites where a hostile situation might be anticipated.

Lone surveyors should not undertake survey from within the channel if the water is above knee height, fast flowing, or turbid.

Safe system for lone working

Once risks have been assessed, and hazards identified, then risk control measures can be put in place to minimise the risks.

When designing a safe system of work, the following areas must be examined:

- work location;
- hazards;
- safety equipment;
- personnel;
- communication.

Personnel responsible for the safety of surveyors need to ensure there is a system in place to enable effective communication with, and monitoring of, surveyors working alone or remotely. They should know the **surveyor's location, route, estimated start and finish times and be able to contact them**. Similarly, surveyors should be able to make contact with personnel operating their safety procedures.

Good practice procedures for lone, or remote, surveyors include reporting to their office:

- at the start of a survey;
- periodically during a survey;
- if there are problems or changes to the planned routine;
- at the end of the survey.

There also needs to be a pre-determined course of action in case a surveyor **fails to report in at the end of survey work, or at the agreed times**. In such circumstance, good practice requires attempts to be made to contact the surveyor at 5-10 minute intervals, and record the attempts made. If after an hour there is still no contact, search and emergency procedures should be initiated.