

Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP)

ERAMMP Document-50: Field-Survey Handbook (Procedures) Freshwater 2021

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Abbreviations Used in this Report

COSHH	Control of Substances Hazardous to Health
CS	Countryside Survey
DARES	Diatoms for Assessing River Ecological Status
ERAMMP	Environment and Rural Affairs Monitoring & Modelling Programme
GMEP	Glastir Monitoring & Evaluation Programme
IRIS	Integrated Riparian Survey
LPS	Lowland Pond Survey
RDB	Red Data Book
RHS	River Habitat Survey
RIVPACS	River Invertebrate Prediction and Classification System
UKCEH	UK Centre for Ecology & Hydrology

Abbreviations and some of the technical terms used in this document are expanded on in the programme glossaries: <https://erammp.wales/en/glossary> (English) and <https://erammp.cymru/geirfa> (Welsh)

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1 INTRODUCTION

The ERAMMP project follows on from the GMEP project and the UK Countryside Surveys (CS) of 1990 (CS1990), 1998 (CS2000) and 2007 (CS2007), all of which included surveys of running watercourses. In 1996 the Lowland Pond Survey (LPS) was added.

For the ERAMMP project, the biological condition of headwater streams and ponds will be surveyed using methods that are compatible with the original GMEP project and Countryside Surveys. To that end this manual follows the CS2007 manual closely (Murphy & Weatherby 2008). In light of scientific research some minor adjustments to the original methods have been made. For those who have carried out Countryside Surveys before the methods are nearly identical.

All changes to methods are made clear in the detailed methods sections and can be found listed in Appendix 1.

For headwater streams, the following elements will be re-surveyed:

- Diatom community
- Macroinvertebrate community
- Hydromorphological and physical characteristics of watercourse (amended River Habitat Survey)

The following elements will be surveyed in a randomly selected pond in each of the squares found to contain ponds:

- Macroinvertebrate community
- Aquatic plant community

Physical characteristics (pond environmental attributes)

2 EQUIPMENT

Table 2-1: Items issued from general supplies or as personal equipment to surveyors used by the freshwater team.

General Items	Central supply	Surveyor	Number per team
Safety & identification			
Bivvy bags	√		1
Dayglo waistcoats	√		1
First aid kit	√		1
Handouts (explaining project)	√		
Identity card	√		1
Mobile phones	√		2
Phone cards	√		
Torches (in vehicles)	√		1
Whistle	√		1
Personal waterproof clothing	√	√	1
Navigation & location			
Aerial photographs of the site	√		1
Compass	√		1
Hand held GPS	√		1
Maps of the site (1:10,000)	√		1
Road atlas	√		1
Maps to locate sites (1:50,000)	√		1
Recording & measuring			
Survey poles (x plot)	√		1
Field assessment booklets (FAB's)	√		1
Weatherproof clipboards (A3 and A4)	√		2
Measuring tape (30 metre)	√		2
Digital camera	√		1
Rangefinder	√		1
Plot marker boards	√		1
DBH tape	√		1
Poly bags	√		
Folding 2 m ruler			1
Metal detectors	√		1
Spring balance			1
Rucksack (if available)	√	√	1
Pencils and rubber	√		
Reference books (if needed)		√	√
Hand lens		√	√

Table 2-2: Items specific to freshwater surveying

Freshwater equipment	Number needed per team
Health and Safety	
Life jacket (including spare)	2
Spare CO2 cylinders	3
Bactericidal soap	2
Tap water container	1
Protek anti-septic cream	1
Antiseptic wipes	1
Hand gloves	1
Shoulder length gloves	1
Penknife	1
General	
Thigh waders	2
Chest waders	1
Permanent broad marker pens	2
Scissors	1
Waterproof labels	1
Waterproof notepad	1
A4 aquascribe laser paper (box of 250 sheets)	1
Box file	1
Pencils (soft e.g. 3b)	4
Pencil sharpener	2
Rubber	2
Stapler	1
Headwater Streams & Ponds Water Chemistry	
1l bottle for water sample	2
pH & conductivity meter	1
pH calibration standards	1
Conductivity calibration standards	1
Distilled water wash bottle	1
Pre-paid, pre-addressed padded envelopes	40
75 ml syringe	10
Disposable, non-sterile 0.45 µm filter cartridges (33mm diameter)	1-2 (per site)
60ml acid-washed water sample bottles	2 (per site)
250ml water sample bottles	1 (per site)
Headwater Streams Diatom Sampling	
Toothbrush	1 (per site)
Wide-mouthed plastic sample bottles with water-tight lids (approximately 100 ml or greater)	1 (per site)
Lugol's solution	100ml
Tinted (light-proof) glass bottle for storage of Lugol's solution	1
Headwater Streams & Ponds Macroinvertebrate Sampling	
Standard FBA pond-nets with graduated handles	2
18" x 12" plastic bags (pack of 100)	2
1.3 litre polythene pots with tight fitting lids	130
Toxic warning tape for small formalin transport bottles and sample pots	1
PVC tape for sealing pot lids	2
40% formaldehyde	1

Freshwater equipment	Number needed per team
Small plastic bottles for transporting formalin	10
Stop watch	1
River Habitat Survey	
Range poles	1
Ponds Aquatic Plant and Environmental Attributes	
Grapnel	1
Pile of A4 white paper	1
Old newspaper (for drying and pressing plant specimens)	1
Shallow plastic tray, e.g. 35cm x 25 cm x 5 cm for pressing	1
Thin white card for lifting floating plants for pressing	2
Weight for pressing ,e.g. plant crib	1
A4 plastic punched wallets for dry pressed specimens	20
Box file for keeping dry pressed specimens	1
25ml sterilin tubes	30

3 HEADWATER STREAMS

3.1 Tasks Involved

At each square with a headwater stream the following elements will be surveyed:

1. pH and conductivity will be measured in the field
2. Alkalinity, Calcium, and Dissolved Organic Carbon, analysed in the lab
3. The diatom community will be sampled (DARES method)
4. The stream macroinvertebrate community will be sampled (RIVPACS method)
5. The habitat of the site will be recorded (2003 River Habitat Survey method with minor modifications).

The location of the headwater stream sampling site within a square was generally chosen to maximise the length of RHS that could be conducted within the square, while also being as close as possible to the exit-point from the square. This approach also tended to maximise the proportion of the site's catchment which lies within the bounds of the square.

The length of the headwater stream sampling site is 500 m of watercourse. This 500 m defines the limits of the RHS survey area. The 100 m aquatic plant survey stretch is located within this stretch, centred on the macroinvertebrate and water chemistry sampling point, which in turn are, where possible, located at RHS spot-check 6, Figure 3.1. However it is not always possible to ensure that the sampling locations adhere to the ideal arrangement. A number of reasons for this are envisaged and rules for dealing with each circumstance have been devised, Figure 3.2.

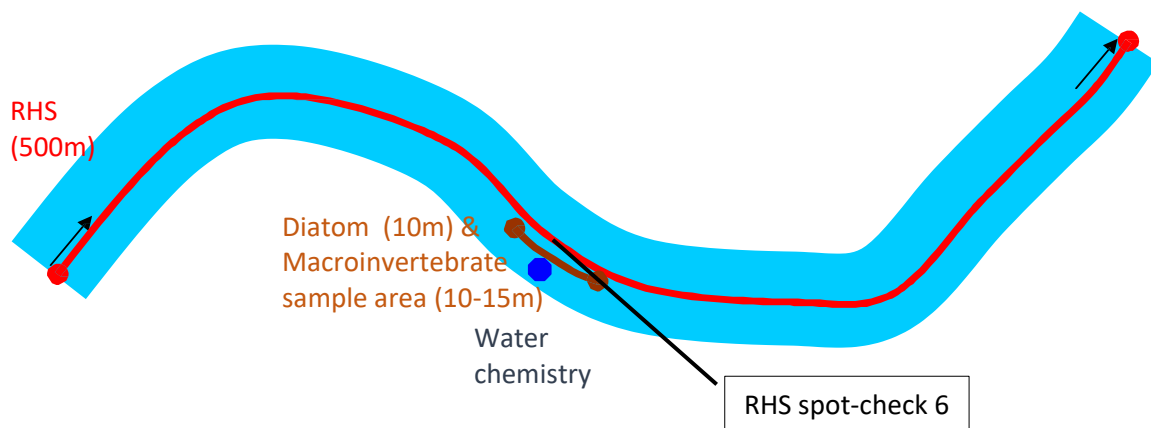


Figure 3.1: The nested spatial arrangement of sampling stretches for the different tasks at each headwater sampling site.

Diatom / Macroinvertebrate sample

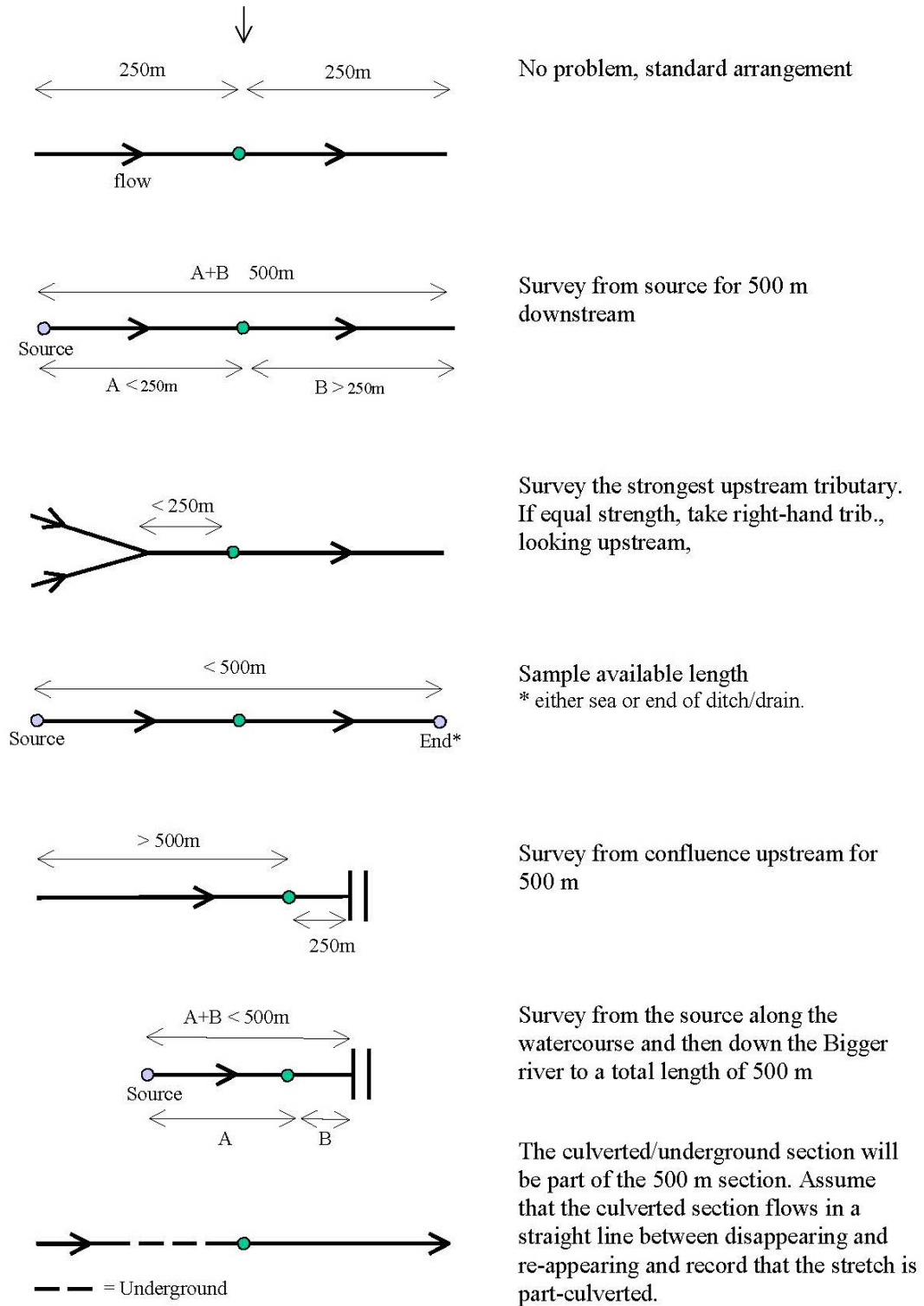


Figure 3.2, Rules for surveying 500 m stretches of standard and non-standard watercourses

3.1.1 Distribution of Duties

Having established permission to sample, the surveyor should first find the diatom / macroinvertebrate sampling point, using the maps and grid references provided. All other survey procedures relate to this position.

3.1.2 Health & Safety

Upon locating the macroinvertebrate sample point along the watercourse the surveyor should assess whether the watercourse is safe to sample. Issues to consider include:

- Vehicle parking, access from road
- Current weather/flow conditions/water colour (does the watercourse appear to be in spate?), river bed substrate, ease of access/bank stability and general condition
- Obstacles to the watercourse, e.g. fencing
- Livestock in adjacent fields

These factors need to be considered and if any are deemed to be HIGH RISK or more than two are deemed MODERATE RISK, then do not proceed with the sampling. It is also advisable to note the nearest location where there is an adequate mobile phone signal.

3.1.3 Photographs

Photographs are required of both the macroinvertebrate sampling area and any other features of interest along the RHS reach. The macroinvertebrate photograph will be used to relocate the site for future surveys and should be sufficiently wide angled and composed to show any prominent natural or man-made features that will identify the location accurately.

The marker board should be in the photograph and should be marked with the letter M (for macroinvertebrate sample) and the square number and should be of the form:

The RHS photographs should show the typical character of the river along the 500 m survey section. The marker board should again be included marked with the letters RHS and the square number and hence be of the form:

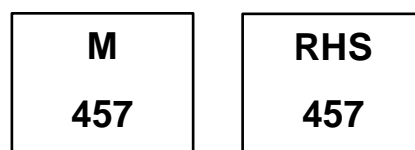


Figure 3.3, Marker boards for photographs

Record the photographs taken on the RIVPACS electronic form, in RAPID and IRIS.

3.2 Water Chemistry

3.2.1 General principle

A single indicative chemical sample will be taken at each watercourse. The sample will be collected at the downstream end of the macroinvertebrate sampling area prior to any biological sampling.

The following elements will be measured at each headwater stream site.

- Conductivity and pH: field measurement
- Alkalinity, Calcium, and Dissolved Organic Carbon

3.2.2 Method

Enter the watercourse and facing upstream rinse a 1 litre wide-neck bottle three times with river water taken from a flowing area upstream of your position. Then move a few more steps upstream and fill the bottle with undisturbed stream water from the water column without disturbing the stream bed or any soft bed-sediments.

3.2.2.1 Conductivity and pH measurement

Please familiarise yourselves with the pH and conductivity meter prior to use. Read the manufacturer's instructions and understand the operational protocols. Ensure that the meter is well-rinsed since use at the previous site and is properly calibrated (two-point calibration for the pH meter). A small piece of sponge soaked in storage solution should be used to keep the conductivity meter moist. The manufacturer's instructions for calibrating the meter are provided in the meter box. Ideally the meter should be checked against the standards before every square and re-calibrated if necessary.

You toggle between pH/conductivity and total dissolved solids display on the meter by pressing the SET/HOLD button.

Conductivity: Submerge the probe-end of the meter in the collected 1 l sample bottle, immediately after the sample has been taken. Select 'µS' mode with the SET/HOLD button. The measurements should be taken when the stability symbol (a stopwatch icon) on the top left of the display screen disappears. Please note the units.

pH: Submerge the meter in the collected 1 l sample bottle, immediately after the sample has been taken, stirring gently. Select 'pH' mode with the SET/HOLD button. The measurement should be taken when the stability symbol (a stopwatch icon) on the top left of the display screen disappears. Record the readings on the electronic RIVPACS Sample Area Form.

3.2.2.2 Water samples for laboratory analysis (Alkalinity, Calcium, and Dissolved Organic Carbon). Stream only

Fill one 250ml bottle to the top with unfiltered water. Fill two 60ml bottles to the top with water filtered using the syringe and disposable filter cartridges. Label all sample bottles with sample number and date and store cool until dispatch to UKCEH Lancaster and Bangor. Include sample information sheet with samples.

3.3 Diatom sampling

This section explains how to take diatom samples from headwater streams. The sampling location is the same as for the macroinvertebrates and is centred on the middle of the RHS survey at spot-check 6, see Figure 3.1. This sampling follows the standard DARES method closely.

3.3.1 General principle

Diatom communities in headwater streams are neither simple nor homogeneous. There is a widespread assumption that water quality overrides physical factors in determining the benthic diatoms found at a site, however, physical variability between sampling sites should be avoided wherever possible by sticking to the method below.

3.3.2 Method

3.3.2.1 Timing of surveys

Record the date on the electronic record form and the sample bottle.

3.3.2.2 Sample location and depth

The sampling location is the same as for macroinvertebrates and is centred on the middle of the RHS survey at spot-check 6, see Figure 3.1. All depths that can be easily sampled wearing thigh waders are suitable. The aim is to sample substrata that have been submerged for at least four weeks before sampling.

3.3.2.3 Choice of substratum

Benthic diatom samples are collected from submerged surfaces in headwater streams to collect taxa representative of the site. Cobbles are the recommended substratum wherever these are available. If they are not available, Figure 3.4 will help you choose the most appropriate substratum.

Different sampling methods are used for different substrata. In order of preference use:

Cobbles /small boulders, free of algae – **Method A**

Algae covered cobbles - **Method B**

Emergent macrophytes – **Method C**

Submerged macrophytes (rivers only) – **Method D**

If no sample is possible, record the reason in the comments box of the electronic form. NB: Record the sampling method you use on the field record form under 'sample substratum'.

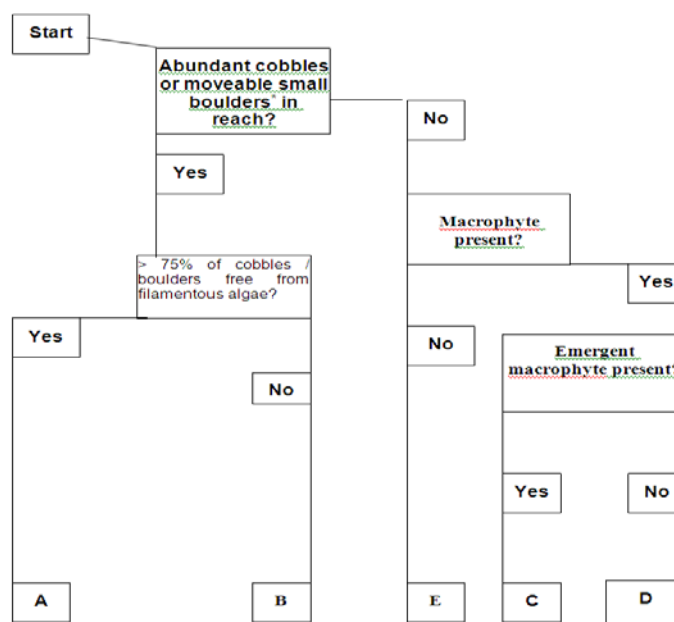


Figure 3.4, Flow chart for selecting appropriate sampling strategies for collecting benthic diatoms for monitoring studies in rivers. Under some circumstances (e.g. chalk streams), large

pebbles may be substituted for cobbles. Increase the number of pebbles sampled accordingly. See text for further details. Note method E is not used in ERAMMP.

Cobbles are the recommended substratum because they are stable (allowing diatom communities to develop) and manoeuvrable. They are available in most river types. Large pebbles and small boulders can be used if there are no cobbles (**Method A**).

In many lowland reaches, most hard surfaces are smothered with growths of *Cladophora* or other filamentous algae. In this case, modify the sampling method to ensure samples are representative of the site (**Method B**).

If there are no cobbles or other hard surfaces, collect samples from macrophytes. The films found on submerged portions of the stems of emergent macrophytes such as *Phragmites* and *Sparganium* and are preferred (as long as they are not contaminated by bottom sediments) (**Method C**). If these are not present use submerged macrophytes such as *Ranunculus* (**Method D**).

There may be some watercourses, often dominated by silty substratum, that do not have cobbles or macrophytes present to sample. If Methods A, B, C or D cannot be used, record on the form that no method could be used.

3.3.2.4 Method for each type of substratum

Method A - Sampling cobbles and boulders from rivers and lakes (without significant filamentous green alga cover)

1. Collect at least five cobbles (> 64 and <256 mm) or small boulders (> 256 mm) from the sampling area and which have an obvious diatom film (detected by either its brown colour or slimy texture). Where suitable substrata are very abundant, each cobble should be selected from a separate location within the reach / sampling area.
2. Remove any loosely attached surface contamination of the biofilm by gently agitating the cobbles in stream water (this will not dislodge the biofilm). This surface contamination might include small particles of organic matter or sediment.
3. Place the stones in a tray with approximately 50 ml of stream water.
4. Wash a stiff toothbrush in clean stream water and rub it on waders or a similar surface to remove any diatoms from previous samples. Brush the upper surface of the stone vigorously to remove the diatom film, rinsing the toothbrush periodically in the water to transfer the diatoms. If there are filamentous algae or silt deposits on the stone try to remove diatoms from parts of the stone where these are absent.
5. Replace the stone in the stream, and repeat the process for replicate stones. Transfer the water (which should be brown and turbid from the diatoms) from the tray to the sample bottle.
6. If samples will be stored for some time, the suspension can be concentrated by allowing it to settle overnight, decanting the supernatant and transferring the sediment to a smaller (e.g. 60 - 100 ml) bottle.

Table 3.1, Number of algae-smothered cobbles to be collected for method B

% cover of filamentous green algae	Number of cobbles
< 15%	0
> 15 < 29	1
> 30 < 44	2
> 45 < 59	3
>60 < 75	4
> 75	5

Method B - Modified method for sites where filamentous green algae are abundant

1. If filamentous green algae such as *Cladophora* are abundant at a sampling site, the sampling of the cobbles / small boulders needs to be modified.
2. Assess the percent cover of filamentous algae at the site to the nearest five %. Use the result to determine the number of cobbles with filamentous algae cover to sample according to Table 3.1
3. Remove cobbles or small boulders from the water, as in method A. After rinsing the cobble, brush the upper surface (including the filamentous algae) with a toothbrush to remove both the diatoms from the cobble and those attached to the algae. Any filaments not dislodged in the cleaning process can be removed and placed in the sample pot.
4. Continue with steps 3 and 4 of Method A.

Method C - Sampling emergent macrophytes

1. Take samples from an emergent macrophyte species such as *Glyceria maxima*, *Phragmites australis*, *Sparganium erectum*. or *Typha* spp. When you select the plants to sample, ensure that portions of the stem remain permanently submerged and are not contaminated by bottom sediments. Record the species of macrophyte you use on the electronic form.
2. Select five healthy, established stems from different individuals of the same species, with the lower end at approximately wrist depth (~20 cm). Avoid dead material and new shoots. Select plants from the edge of the reed bed rather than in the middle of the stand to reduce the effects of light scattering.
3. Avoid touching the piece of stem to be sampled because the film is often very fragile and easily lost. In each case, cut away unwanted portions of the stem then place a plastic sampling bottle or glass jar upside down over the underwater stem. The stem should be cut below the mouth of the bottle, then the bottle plus stem turned upright. Diatoms should be brushed from the stem into the tray using a toothbrush, as described above.

Method D - Sampling submerged macrophytes

1. Collect samples wherever possible from a single macrophyte species or genus that is sufficiently abundant at the reach that it will be there in the future. Genera such as *Ceratophyllum*, *Elodea*, *Myriophyllum*, *Potamogeton* and *Ranunculus* and are all suitable. Record the species of macrophytes you sample on the electronic record form.
2. Take replicate samples from five different plants of the same species. The plant should be the dominant submerged species at the site. Place samples of plants growing in the main flow of the river (avoiding edges and side-arms) into a plastic bag with about 50 ml of stream water. Each replicate should consist of a single stem plus associated branches of the plant from the lowest healthy leaves to the tip. Submerged leafless stems should not be included. Diatom epiphytes should be present as a brown floc or film associated with the macrophytes.

3. Shake the plants vigorously in the plastic bag to dislodge attached diatoms. Pour the brown suspension into a bottle.

3.3.3 Sample fixing & Storage

All sample containers must be labelled. Apply labels before the container gets wet and do not label the lid (these can become separated from the rest of the container when the sample is being prepared in the laboratory). On the label record: square number, stream name, site name, date of sampling, sampler's initials and the name of preservative.

Sample transport: Transfer the sample to the laboratory in a cool, dark place. Preservative should be added within 24 hours.

Preserving samples: Preserve the diatom samples in the field or back at the laboratory with Lugol's iodine. Add sufficient to achieve a straw colour. Refer to the COSHH Assessment for Lugol's iodine, the Work Instruction for Ecology Laboratory Safety and any local safety requirements.

Sample storage: Following preservation, samples should be stored in air-tight containers in a cool, dark place (such as a refrigerator) until they are processed. Note that iodine sublimates from most types of container, so should not be used for long-term storage.

3.3.4 Environmental data

A simple suite of environmental variables is recorded on the form for the diatom sample. Details of how to distinguish between substrate types can be found under the instructions for benthic invertebrates. Definitions for some of the other environmental variables can be found in the plant survey section, the rest are self-explanatory. Note the area one reports environmental variables for is the area of stream sampled for the diatoms.

3.3.5 Recording data electronically

The field record form must be completed. The field record form is electronic Figure 3.5.

Figure 3.5, DARES electronic form

3.4 Macroinvertebrate sampling

3.4.1 General principle

This section explains how to take macroinvertebrate samples from streams using the standard RIVPACS method. The sampling location is the same as for diatoms, although it is larger, and is centred on the middle of the RHS survey at spot-check 6, see Figure 3.1. The method follows the standard kick sampling method used by UK environment agencies. Site environmental data, specific to the invertebrate sample are recorded at the same time on the electronic RIVPACS form.

3.4.2 Equipment

- A 25 cm² pond-net with a 900 µm mesh net. Wash the net thoroughly before and after taking samples. Damaged pond nets must not be used.
- Sample bags/pots
- Waders, life jacket

3.4.3 Method

The sampling technique is designed to sample a wide range of Macroinvertebrates habitats in a 10 - 15m long stream reach. The technique is standardised by time, four minutes in total with, a one minute search and a three minute pond-net sample when habitats within the reach are sampled in proportion to their area. The one minute search is split in two to allow different animals to be targeted. Collect the sample in the following sequence:

- **Manual search part 1:** Seek and collect individual animals from the water surface
- **Main kick or sweep sample:** take with pond net (three minutes duration)
- **Manual search part 2:** Search and collect individual animals from submerged rocks, logs or vegetation.

Choose one of these three approaches for the main kick/sweep sample, depending on site character:

- **A - shallow/wadeable :** collect a pond-net sample by a combination of kicking and sweeping, depending on the nature of the substratum, current and habitats, for benthos and free-swimming animals. All habitats sampled in proportion to their cover.
- **B - too deep to kick sample whole site, but possible to sample in part** Active pond-net sample collected by a combination of kicking and sweeping for benthos and free-swimming animals. Attempt to sample all habitats in proportion to their cover, although this may not be possible for habitats in the main channel
- **C - impossible to sample material from the main channel using a pond-net.** Sweep with the pond-net to collect free-swimming animals and those from vegetation, but not the benthos

If a site appears to be homogeneous in character, use continuous diagonal transects to cover a wide area.

3.4.3.1 Sample area

The sample area **must be** a single continuous area of stream-bed whose major habitat types can be sampled within four minutes. It **must not be** a collection of separate sampling points within an extended length of river, for instance to include both riffles and pools in an attempt to increase the variety of animals captured.

Each habitat in the sampling area must be sampled with an effort (time) proportional to its cover. Within the limitations imposed by this procedure, as many different taxa in the sampling area as possible should be collected.

3.4.3.2 General sampling instructions

There is no limit to the amount of material collected: only the sampling time controls the volume of the sample. Material collected in the net must be removed periodically, to prevent the mesh becoming blocked. As a minimum, this must be done after every minute of sampling with a pond-net, and more frequently if the net is filling rapidly or becoming blocked. Wash fine sediment through the net more frequently than this, to minimise the amount retained in the sample.

Large stones and pieces of vegetation (that may damage the net) can be discarded, but before doing so, agitate them vigorously in the collecting net whilst it is half-submerged, to wash any animals back into it. Check that no animals are still attached before discarding this material. Retain only enough water to keep the sample damp. This reduces the amount of fixative or preservative that has to be added to it, and reduces damage.

Do not retain fish, amphibians, and readily identified rare species in the samples, such as large specimens of the freshwater pearl mussel (*Margaritifera margaritifera*) and native crayfish (*Austropotamobius pallipes*), but return them to the water with care and unharmed. Record their presence in the sample on the electronic RIVPACS Sample Area Form. It is important to identify crayfish correctly e.g. differentiating native from introduced species, so if there is any doubt then retain the specimen in the sample.

Avoid sampling during and immediately after spates. Samples collected in these conditions will not accurately reflect the underlying environmental quality of the site.

3.4.3.3 Main kick/sweep sampling

Always move upstream and diagonally across the stream a number of times whilst sampling, rather than straight upstream. This will ensure that a greater number of habitats are sampled, even if they are not apparent, and therefore a higher proportion of the taxa present at the site are collected. The three minutes covers only the time spent actively sampling, and excludes the time spent emptying the net, or moving around the site. It is recommended that sampling is done in **short bursts of 15-20 seconds**. There will be nine to twelve bursts in a three minute sample, which is worth remembering when apportioning the sampling effort to the different habitats. A stopwatch must be used to ensure that the cumulative time spent actively sampling is precisely three minutes.

Kick sampling from gravel or cobbles: When kick sampling, hold the net vertically with the frame at right-angles to the current, downstream from your feet, and resting firmly on the river bed; disturb the stream bed vigorously by kicking or rotating the heel of your boot to dislodge the substratum and the fauna within it to a depth of about 10 cm. Hold the net close enough for the macroinvertebrates to flow into the net with the current, but far enough away for most of the sand and gravel to drop before entering the net. Hold the net further away where the substratum is finer or the current swifter, to prevent it clogging. Move large stones by hand if they cannot be shifted by foot, and sample the finer sediment that collects beneath them.

Sampling from soft sediments: Where the stream bed is soft silt or clay, kick sampling is ineffective because the net will become blocked rapidly. Instead, skim the bottom edge of the net gently through the top few centimetres of the substratum, which is where most of the animals will be found. Alternatively, stir-up the surface of the sediment by foot or with the back of the net, and pass the open net through the clouded water. Rinse the silt away through the net frequently, by agitating the net in the current or at the water surface.

Sampling from boulders: It is not easy, and sometimes impossible, to take a kick sample amongst boulders. Most of the macroinvertebrates will be in the finer deposits that accumulate under the boulders. To reach them, boulders may have to be moved by hand, though small ones may be prised away by foot. Move boulders away at right-angles to the current, or upstream and away from feet, so that the net can be held downstream from the area disturbed. Sample the exposed river bed by kicking in the normal way. It is impossible to sample effectively where the stream-bed is dominated by large boulders, particularly near waterfalls or where the gradient is steep. Replace these sites by ones that can be sampled effectively.

Sampling from vegetation: Sample from submerged and emergent vegetation and tree roots by pushing the net into them with a variety of forward, upward, and lateral movements. Dislodge animals from dense tangles of tree roots by kicking. Sample the sediment that accumulates beneath plants by kicking or skimming the surface of the sediment. Do not overlook water under overhanging banks, because macroinvertebrates may be hiding there.

Sampling from still or slow-flowing water over gravel or cobbles: When sampling from still or slow-flowing water, a different procedure is necessary because there is no current to carry dislodged animals into the net. Disturb the substratum with your feet and catch the dislodged animals by sweeping the net through the water immediately above the disturbed area. Use this technique wherever the current is weak, to supplement the methods described above.

Sampling from deep waters: In watercourses too deep for conventional kick-sampling, it is possible to take a sweep sample from the marginal vegetation and wadeable shoreline with the pond-net. All habitats must be sampled, where safe to do so. If possible, use a combination of sweeping and kicking. Wherever practicable, collect the sample from both banks. In these circumstances you should sample each habitat in proportion to its linear dominance along the river channel.

3.4.3.4 Manual searching

The search is in two parts which together last one minute. The first part is to seek and collect animals living on the water surface, such as whirligig beetles, water crickets and pond skaters. This must be done before any other sampling, because these animals are easily disturbed and will either leave the sampling area or be much more difficult to find later. They are best caught with a pond-net. Most surface dwellers are very active and they should be secured in a tied bag or vial immediately after capture. Whilst searching for these animals, note the area occupied by different habitats within the sampling area, so that you can apportion the sampling effort amongst them in the main sample.

The second part of the search is for animals from habitats that are not sampled effectively by the methods used to collect the main sample. Pick-off animals attached or clinging to the submerged stems of emergent plants, rocks, logs, or other solid objects, with forceps or a stiff paint brush. Examine rocks at several places across the stream to cover the different biotopes and areas covered by different sized substrata. Always search for animals attached to floating-leaved plants. Inspect the under- surfaces of floating leaves as well as the upper surface and stems.

The whole search must last one minute. It is standardised by time alone. This period only covers the time spent actually searching, and excludes the time spent moving around the site. A stopwatch or watch with second hand must be used to ensure that the cumulative time spent actively searching is one minute. At some sites, the search will be fruitless however even where the sampler suspects that nothing will be found, the search must be undertaken honestly, to maintain consistency.

3.4.4 Sample fixing and storage

On completion of sampling, the sample should be emptied into a medium gauge, 18" x 12" polythene bag as provided. Intermediate emptying of the net after each minute's active sampling is strongly recommended and is essential if the net becomes so full as to preclude efficient sampling.

Rinse the sample, where possible by shaking the pond-net vigorously in the stream without risking losing any animals, to remove silt and clay. Discard stones, wood, and large fragments of vegetation before removing the sample from the net but take care to remove any clinging animals and drop them back in the pond-net.

The easiest way to remove a sample from the pond-net is to wash the catch into one corner of the net first, by dipping the net into the water and gently shaking it from the opposite corner as it is lifted out of the water. Then, by gradually inverting the corner of the net, the bulk of the sample can be dropped into a labelled sample container, or polythene bag. Material clinging to the net can be shaken, or flicked-off from the other side of the net, into the container. Repeat this process until the net is clear of material. Recalcitrant specimens may be picked-off the net by hand. **Always wash the collecting net thoroughly to prevent contaminating subsequent samples.**

It is very easy to cross-contaminate samples from residual specimens retained on nets from previous site visits. **Always wash pond nets as thoroughly as possible after sampling at each site and also before sampling the next site. Also disinfect nets after each sampling in accordance with our project biosecurity policy.**

Fill the sample containers to no more than about two thirds full with collected material. This will leave sufficient room for fixative or preservative, and an air space. Never cram material into a sample container, and never fill it completely: use an additional container instead. Then add 40% formalin solution to the sample bag until the liquor in the bag is equivalent to 4% aqueous formaldehyde. The precise amount of formalin needed varies from sample to sample but is in the region of 50 – 100 ml per plastic bag. It is better to err on the side of excess.

A clear pencil-written label should be placed in the sample bag. The label should contain the following information:

Type of sample : "macroinvert"

Square number : Square number (e.g. 38)

Date : day-month-year (e.g. 07-08-07).

The plastic bag should be firmly tied and placed inside a 1.3 l storage pot and the lid of the pot tightly closed. An extra sharp twist of the lid is then recommended. Apply PVC tape around the lid to form a seal and to prevent the lid becoming loose during transport. The pot should be clearly labelled on the outside, using a permanent marker, with the same information as given on the internal label.

The sample may be split into two or more bags/pots if too large to fit within a single container. All parts of the sample should be labelled as above, together with the additional information "Part one of two" or "Part two of two" or "Part one of three" etc. Samples should very rarely require more than one container. Single containers should be adequate for the large majority of sites. **Thorough labelling of samples is essential.**

RIVPACS SAMPLE AREA FORM

Site Number

Sample date NGR

Collected by Identified by

Sample Method

Is sampling proportional to occurrence of habitats?

Give details if not

Photograph of sample are taken?

Water width in sample area (m)

Water depth in the sample area (cm) at stream width;

1/4 1/2 3/4

Estimated surface velocity in main channel

Substratum in sample area

Please give details for the full width of river at the sampling area

Substrate type (%)

Boulders and Cobbles >64 mm Pebbles and Gravel >2 - 64 mm

Sand >0.0625 - 2 mm Silt and Clay =0.004 - 0.0625mm

Other habitats (%)

Figure 3.6, Part of the electronic form for recording environmental data in the macroinvertebrate sample area

3.4.5 Environmental Data

Site environmental data should be recorded on the electronic RIVPACS form for each macroinvertebrate sample, Figure 3.6. For the purposes of environmental data collection, **the sample area is defined as the full width of the watercourse for the full length sampled** for macroinvertebrates. The significance of the different definitions of sample area given for macroinvertebrate sampling and environmental data collection is that sections of the watercourse too deep for macroinvertebrate sampling are, nevertheless, included in width, depth and substratum evaluations.

The following measurements must be made at a point along the sample area which is typical of that area (i.e. representing the modal condition). The graduated pond-net handle can be used for width, depth and surface velocity measurements.

Water width: Measure the stream width at right-angles to the channel. Measure the width of the water surface, and include water under overhanging banks. If temporary islands form in the channel because of low flow, include them in the measurement. Use the accurately marked kick-net handle to measure width. On deep watercourses, estimate the stream width, making use of nearby bridges.

Water depth: The depth should reflect the predominant conditions in the sampling area. Depth should be based on the average of measurements from approximately a quarter, half, and three-quarter distance along a transect across the stream in the sampling area. Do not measure depth where it is atypical of the site, for instance over or close to boulders. When a temporary island appears in mid-channel, the depth there will be zero, and should be recorded as such. Where the stream is wadeable, record the depth to the nearest centimetre. Where the depth has to be estimated, record depths of 1m or more to the nearest 10 cm, and greater depths to the nearest 50 cm.

Surface velocity: The time that it takes for a floating object (e.g. a leaf of a twig) to travel a known distance can be used to measure the velocity. If the object is thrown into the current, measurements should not be started until initial inertia of the object is overcome. Results should be measured as cm s^{-1} , ideally over 10m, as the mean of three measurements and recorded in the categories in table 3.2.

Substratum: Visual estimates of four categories of particle size are required (Table 4.2, Figure 3.7). Estimates must be based on a bird's-eye view of the superficial stream-bed layer and should include both particles which are visible and those which would be visible in the absence of plant-growth. The percentage cover of the stream-bed occupied by each of the four size categories should be recorded. **THE FOUR VALUES SHOULD ALWAYS TOTAL 100%**. Estimates should exclude bedrock which is recorded on a separate part of the recording form. A peat stream-bed should be recorded as silt. Clay can either be areas of soft fine particles or a continuous sheet. A fine layer of silt or clay through which the shape of the underlying stones can be seen should be typed according to the underlying substratum, but if the shapes of the underlying stones are not distinct, the silt or clay should be recorded instead. Compacted clay should be recorded as clay, even when broken-up into gravel-sized fragments. It is difficult to judge the composition of the river bed in deep or turbid water. The substratum visible at the water's edge, the feel of the stream-bed under foot, the contents of the sampling net, previously recorded data, and local knowledge may all be used as guides.

Other Habitats: **Bedrock:** Enter the % of the total stream-bed in the sample area covered with bedrock. Include areas under plant growth.

Filamentous algae: Enter the % of the total stream-bed in the sample area obscured by filamentous algae. This category excludes diatom growth on stones.

Moss: Enter the % of the total stream-bed in the sample area covered by mosses of all kinds.

Higher plants: Enter the % of the stream-bed in the sample area covered with, or obscured by all kinds of plants other than algae and mosses.

Street lighting: Please note the presence or absence of street lighting within 20 m of the site.

Table 3.2, Velocity categories for RIVPACS

Velocity category	Current velocity (cms-1):
1	<10
2	>10 - 25
3	>25 - 50
4	>50 - 100

Table 3.3, Substratum particle size categories recorded for RIVPACS

Category	Longest axis (mm)	Description
silt/clay	<0.06	soft in texture and not abrasive to the hands when rubbed
Sand	0.06 – 2	smaller than coffee granules, and unlike silt/clay, abrasive to the hands when rubbed
pebbles/gravel	2 - 64	coffee granule to half fist size
boulders/cobbles	>64	half-fist size or larger

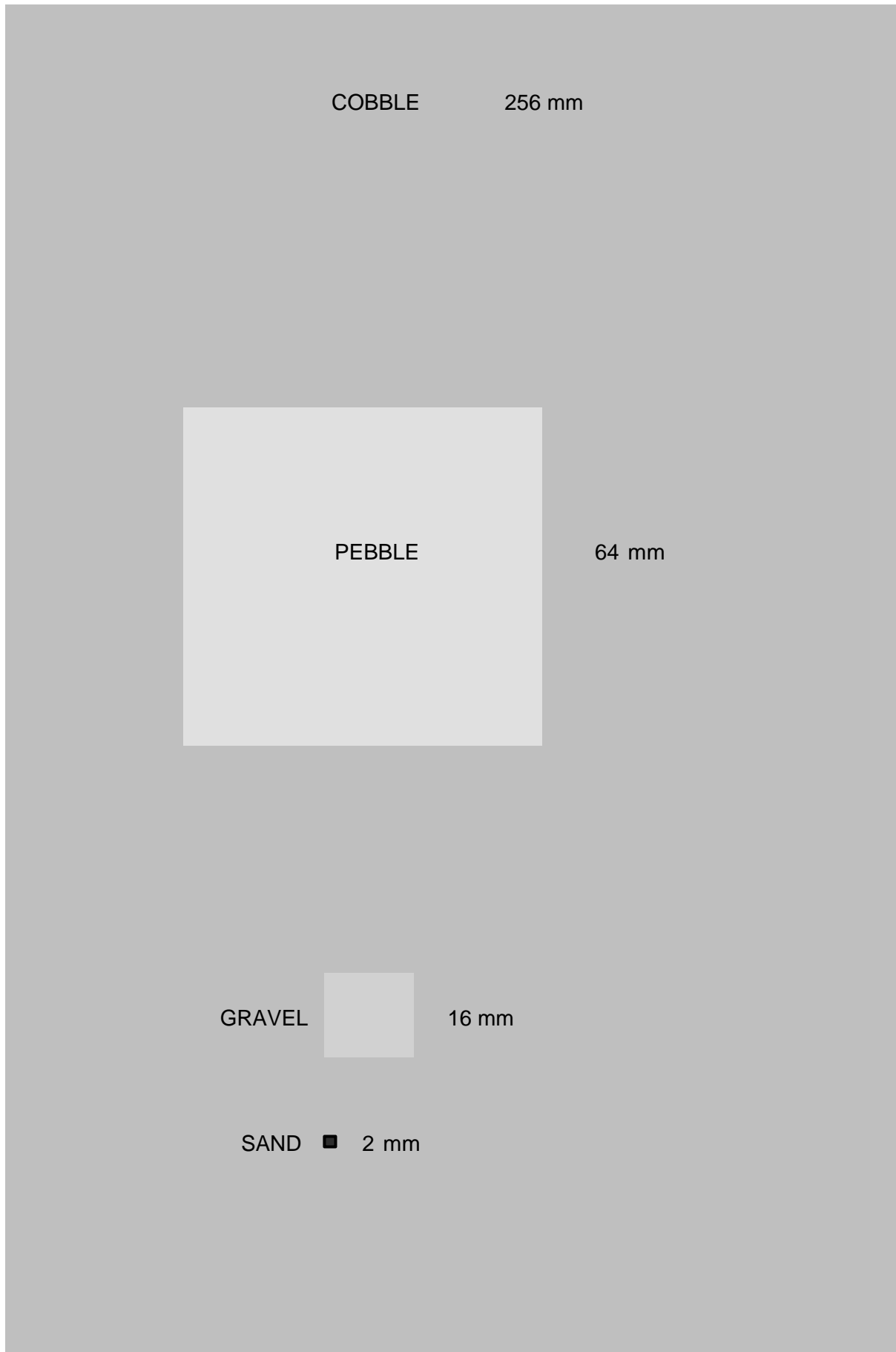


Figure 3.7, Guide to substratum particle sizes

3.4.6 Sketch map

A sketch map of the macroinvertebrate site should be drawn on waterproof paper and marked with the Square number. The purpose of the sketch map is to enable future relocation of the site. Keep this fact in mind when drawing the map.

Draw a sketch of approximately 50 m of river channel indicating the general physical character of the site and incorporating the macroinvertebrate sampling area. This should include permanent reference features (such as a distance from a bridge or footpath sign) which would enable anyone else to find the site with adequate precision in the future.

Main features to mark on sketch map:

- General form of river channel, including islands, flow direction and prominent bank features
- Relocation features - for both ends of the survey length if possible. These should be near permanent landmarks such as hedgerows, fence lines, walls, electricity pylons, roads, bridges, buildings etc.
- Record distances from/ between features
- Grid north (found from OS map) and estimated scale e.g. indicate on map what length is 10 m. Adjacent land use - for example woodland, arable, pasture, factory, waste, set aside
- Extent of macroinvertebrate sampling area Location from where photos were taken. Any potential hazards.

Photograph: A photograph is required of each sampling site. The photograph should include a numbered site board. If possible it should also include a fixed natural or man-made feature of the site which can be helpful in re-location.

3.4.7 Recording data electronically

The screenshot shows the 'RIVPACS SAMPLE AREA FORM' with the following fields and values:

- Site Number: 5030
- Sample date: 12:26:49
- Sample date: 11/04/2013
- NGR: 566
- Collected by: Emily Meilleur
- Identified by: [empty]
- Sample Method: K/S + Search
- Is sampling proportional to occurrence of habitats?
- Give details if not: [empty text box]
- Photograph of sample are taken?
- Water width in sample area (m): 3
- Water depth in the sample area (cm) at stream width:
 - 1/4: 4
 - 1/2: 4
 - 3/4: 5
- Estimated surface velocity in main channel: >10 to 25 m/s
- Substratum in sample area**
- Please give details for the full width of river at the sampling area
- Substrate type (%)

Boulders and Cobbles >64 mm	23	Pebbles and Gravel >2 - 64 mm	45
Sand >0.0625 - 2 mm	1	Silt and Clay =0.004 - 0.0625mm	21

Figure 3.8, RIVPACS electronic form.

Enter environmental on the electronic RIVPACS Sample Area form Figure 3.8. The form is mostly self-explanatory but the following instructions do apply:

- NGR:** Use GPS to record position of macroinvertebrate sampling site to *at least 8- digit numeric national grid reference e.g. SY12345678*
- Sample method:** Use the drop down menu to enter either:
- Kick/sweep - disturbing the substratum with feet plus sweeping amongst plants
 - Kick - substratum disturbance but no sweeping
 - Sweep - sweeping amongst plants but no substratum disturbance
- Sample time:** If the time of active sampling is not the standard 3 minutes enter the actual period of active pond-netting in the notes box.
- Proportionality:** Answer 'No' if the full width of the river for the full length of the sample area is not sampled. Only a simple explanation is required (e.g. "Not left-hand- bank - too deep"). NOTE: left/right banks are determined looking downstream.

3.5 River Habitat Survey

3.5.1 General principle

The 2003 RHS protocol is described in detail in the guidance manual provided along with the training course and is not covered in detail here. UK CEH have made amendments to the survey protocol for ERAMMP. These are relatively minor but described in detail below. We will be using a field digital data entry system, called RAPID, to record the RHS data on site. The RHS section will be 500 m long and will be centred (wherever possible) on the selected macroinvertebrate sampling site. In some circumstances it may not be possible to centre the survey on the macroinvertebrate sampling site, rules for dealing with such circumstance have been devised, Figure 3.2.

3.5.2 Recording data electronically - RAPID

Double-click the RAPID icon on the desktop to open the application. Then select from the opening form whether you wish to input survey data for a new site, export data from an existing site or exit the database, Figure . Pages 1, 3 and 4 gather general survey information and data for the sweep-up part of the RHS. Page 2 is where the spot-check data is entered. You can switch between the four pages using page buttons at the top of the window, Figure . Most data fields are drop-down lists. By default all data fields are set at '-9' or 'missing value' until you interact with them.

3.5.2.1 Main Buttons

The purpose of the buttons at the top of the window is as follows:

About database: provides basic contact details and ownership information.

Main Menu: returns you to the opening menu screen of RAPID.

Survey Notes: opens a text box linked to a particular survey, for entering necessary field notes.

RHS manual: opens an electronic version of the 2003 RHS guidance manual, complete with example pictures of all hydromorphological features recorded in a survey.

Input Survey data when selected from the main menu, first asks you to select the square for which you wish to enter data. Use the 'Select Square' drop down list in the top right-hand corner of the window.

Check Data: on completion of an RHS survey you must press this button to validate the data entered. RAPID will only display one error at a time (so that you have the opportunity to correct the problem). Once you have corrected the problem you must press the Check Data button again to find the next error (if there is one). Once the validation is successful, RAPID produces a message 'This RHS survey appears to be complete'.

If, for whatever reason, you cannot carry out the RHS at a square, then you should still select that square in rapid, enter the date, surveyor name and in the survey notes provide a reason for not completing the survey.



Figure 3.9, Desktop icon and screen shot of the opening menu of the River Habitat Survey field digital data entry system (RAPID).

Figure 3.10, Screen shot of part of Page 1 of RAPID.

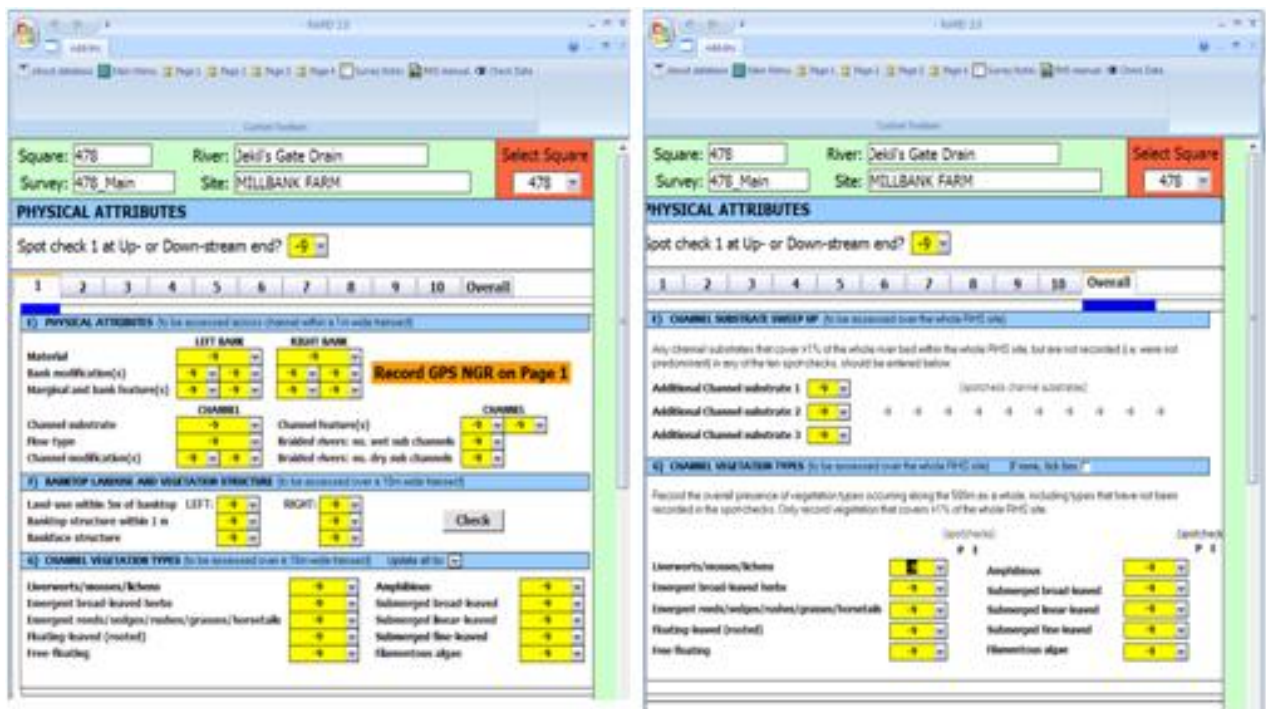


Figure 3.11, Screen shot of the Page 2, spot-check form and Overall tab.

3.5.2.2 Page Buttons

The use of RAPID is self-explanatory, where significant changes have been made or if care is required your attention is drawn to those sections below.

Page 1

Section D Artificial Features: A new addition for ERAMMP is the question ‘Location of most significant weir/dam is between spot-checks numbered:’. Provide answers in boxes marked Spot-check u/s of weir or dam; Spot-check d/s of weir or dam. In the box Weir height provide a measure of the most significant weir’s height above the river bed on the downstream side of the weir. The ranging pole or 2 m rule can be used.

Page 2: Spot-checks

Each of the 10 spot-checks, the summary channel vegetation and extra substrate section are on separate tabbed pages nested within Page 2. A blue bar underneath the tab numbers indicates which tab is currently selected, Figure 3.11. This design aids data-entry. You are reminded on the tabs for spot-checks 1, 6 and 10 to record the GPS readings.

Each spot-check tab also features a ‘Check’ button (located at the right-hand side of Section F) which, when clicked, will confirm that there are no missing data or omissions for that spot-check. Use this button before you move to the next spot-check.

Section E Physical Attributes: You are allowed to enter a maximum of two codes for bank modifications and marginal and bank features on each bank. If you need to enter more than two codes then use the survey notes. The same applies for channel modifications and features. If you wish to record only one bank modification sat this spot-check, you still need to change the optional second drop-down to NO (none).

Section G Channel Vegetation Types: If there is less than 1% channel vegetation at the spot-check, then select 'No plants' from the 'Update all to:' drop-down to the right in the blue section header bar, Figure . This will enter NO in all the boxes. If the water is too turbid to estimate the cover of submerged vegetation forms then you should select 'Submerged plants not visible' from the 'Update all to:' drop-down. If it is not possible to see the channel from your position at the spot-check and you therefore cannot make any judgement on the presence of vegetation in the channel the same applies. For vegetation in Section G a modified DAFOR scale is now applied, the DAFLOR, Dominant = >75%, Abundant = 75 – 51%, Frequent = 50 – 33%, Less Frequent = 33 – 26%, Occasional = 25 – 11%, Rare 10 – 1 %.

Section K Extent of Channel and Bank Features: You should first tick the box near the top-left of the section which will turn all the -9s in the section to zeros. Then you can enter data for those features that are present. A new question for ERAMMP is 'Are side and point bars found opposite one another or are they found to alternate between banks?' Possible answers are: opposite / alternate / both, Figure . This measure gives an indication of how the fluvial geomorphology of the channel is responding to flow or channel alterations.

Page 4: Dimensions and Influences

Section L Channel Dimensions: Use the numerical drop-down lists to record the measured dimensions, Figure 3.14. Additional measures have been added for ERAMMP. For each bank record 'Length of bank which is fenced' in meters. These distances are best paced out when the length of the RHS reach is initially paced.

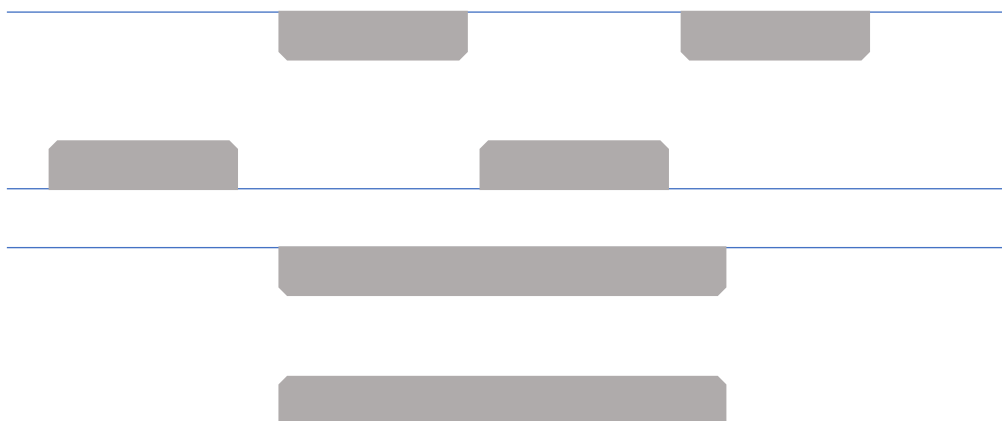


Figure 3.12, Diagrams illustrating an alternate (top) and opposite (bottom) arrangement of bars.

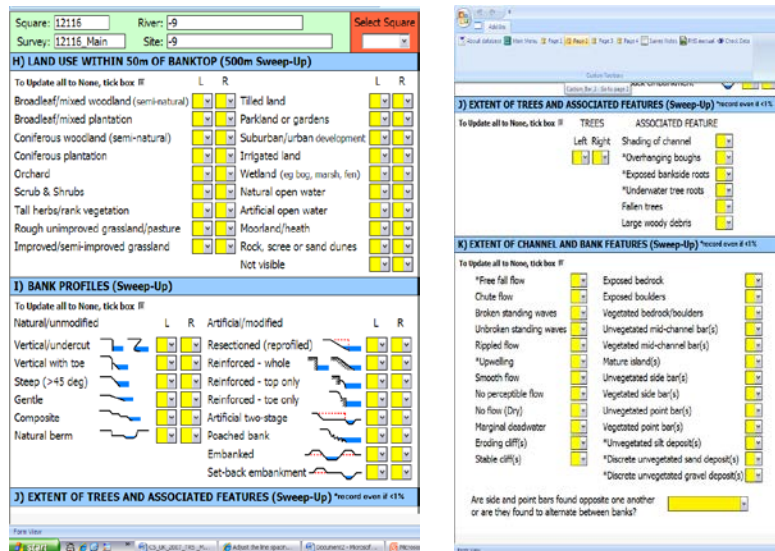


Figure 3.13, Screen shot of upper and lower halves of Page 3.

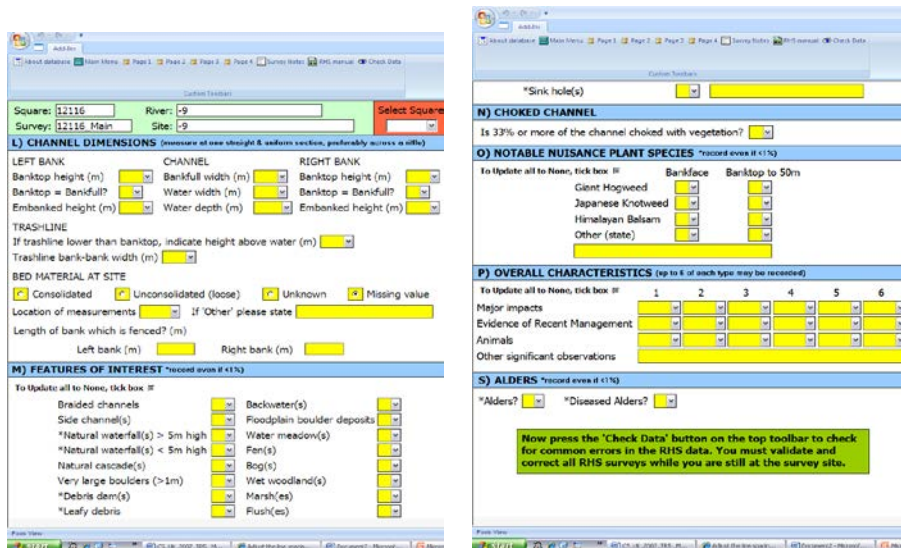


Figure 3.14, Screen shot of upper and lower halves of Page 4.

3.5.2.3 Validating data

Once you have completed the survey you must validate the form, while still at the site in order that any omissions can be accurately corrected. RAPID has an in-built validation routine that can be activated by pressing the 'Check data' button at the top left hand corner of the window. RAPID will check, sequentially from the start of the form to the finish, for data fields that have been left empty by mistake and where possible, for inconsistencies in the data entered. RAPID will only display one error at a time (so that you have the opportunity to correct the problem). Once you have corrected the problem you must press the Check Data button again to find the next error (if there is one). Once the validation is successfully finished, RAPID produces a message 'This RHS survey appears to be complete, Figure 3.15.

You can now close down RAPID by returning to the main menu and clicking EXIT.

The screenshot shows the RAPID 2.0 software interface with a completed survey form. The form is divided into several sections:

- Debris dam(s)**: P - Marsh(es) E -
- Leafy debris**: P - Flush(es) E -
- Fringing reed-bank(s)**: P - Natural open water E -
- Quaking bank(s)**: P - Others (state)
- Sink hole(s)**: P - Boulders covered in moss

N) CHOKED CHANNEL
Is 33% or more of the channel choked with vegetation? N -

O) NOTABLE NUISANCE PLANT SPECIES *record even if <1%
To Update all to None, tick box Bankface Banktop to 50m

- Giant Hogweed E -
- Japanese Knotweed P - E -
- Himalayan Balsam P - E -
- Other (state) E - E -
- Martian Oak

P) OVERALL CHARACTERISTICS (up to 6 of each type may be recorded)
To Update all to None, tick box

Major impacts	1 LAN	2 MIL	3 POL	4 ROA	5 OVE	6 F.M
Evidence of Recent Management	RREH	RREH	WEEDC	WEEDC	BRHOW	WEEDC
Animals				MIRK	MIRK	MIRK

Other significant observations

S) ALDERS *record even if <1%
*Alders? P - *Diseased Alders? E -

A green box at the bottom contains the following text: "Now press the 'Check Data' button on the top toolbar to check for common errors in the RHS data. You must validate and correct all RHS surveys while you are still at the survey site."

Figure 3.15, Screen shot of the completed form in RAPID

3.6 Field survey check-list

Upon completing all the tasks at the headwater stream site and before leaving the site, it is very important that the field survey check-list is completed, Figure 3.16, to ensure that all tasks have in fact been completed. It is quite easy to over-look a task, especially if field and/or weather conditions are difficult.

The screenshot shows the 'Headwaters field survey checklist' form. The form includes the following fields and items:

- SQUARE ID**: 3030
- Date**: 22/04/2011
- Number of sample pots**:
- Macroinvertebrate sample taken**:
- Site map drawn**:
- DARES diatom sample taken**:
- Which RHS spot-check transect contains the invert sampling site?**:
- Conductivity and pH recorded**:
- SRP, TON, Alkalinity 50 ml filtered water sample taken**:
- Aquatic plant survey completed and validated**:
- Plant specimens for ID confirmation bagged and correctly labelled**:

A **Save Record** button is located at the bottom of the form.

Figure 3.16, Check-list of tasks to be completed at each headwater stream site.

3.7 Transit and storage of diatom, macroinvertebrate and aquatic plant specimens

Clearly labelled macroinvertebrate sample pots should be stored, while in transit, in the back of the van in the grey storage boxes provided. The storage box itself should also be labelled with a Transport Emergency (TREM) card Figure . The TREM card provides important relevant information on the nature of the liquids contained within the box and any hazards that may be associated with them. It also provides information on what action to take in case of spillage, and emergency contact details. All macroinvertebrate sample pots should be carefully catalogued and stored until they are couriered for processing.

Diatom samples should be kept until there are enough to courier.

TREM CARDUK CENTRE FOR ECOLOGY & HYDROLOGY
TRANSPORT EMERGENCY CARD (Road)

CARGO	FORMALDEHYDE SOLUTION 4% (IN PLASTIC CONTAINERS)
	Colourless solution, odour of formaldehyde.
NATURE OF HAZARD	Harmful if ingested in quantity or of exposure is prolonged.by inhalation, Irritating to skin and eyes.
PROTECTIVE DEVICES	Goggles or face shield. Rubber or plastic gloves.
EMERGENCY ACTION	Move people away from vapours as soon as possible.
FIRST AID	Eyes: Irrigate thoroughly with water for at least 10 minutes. Lungs: Remove from exposure, rest and keep warm. Skin: Wash off thoroughly with water. Remove contaminated clothing. Mouth: Wash out mouth thoroughly with water and then give plenty of water to drink. Do not induce vomiting, unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities are swallowed call a physician immediately.
In severe cases	OBTAIN MEDICAL ATTENTION.

APPLIES ONLY DURING ROAD TRANSPORT

Figure 3.17 Transport emergency card (TREM card) for samples in fixative carried by road.

4 PONDS

4.1 Introduction

Before the pond condition assessment is carried out, field habitat mappers should have identified all the ponds in the square (including any new ponds) and have recorded their basic attributes. This information will have been recorded on the electronic form “Pond survey – for habitat mappers”.

Once details of all the pond have been recorded on the “Pond survey – for habitat mappers”, they will use the PC tablet to select one pond (in every square that contains ponds) for condition assessment. This pond is named the “**SURVEY POND**”. Details of the location of the survey pond will be given to the freshwater habitat surveyor. The pond surveyor will then fill in the electronic form “Pond survey – for pond surveyors”.

4.1.1 Pond definition

The field mapping handbook contains information to help identify ponds; under the section “Further information on identification and mapping of ponds”. In summary, the definition of a pond used for ERAMMP is “*a body of standing water 25 m² to 2 ha in area which usually holds water for at least four months of the year*”. The area is based on the **OUTER** pond area defined by the **MAXIMUM WINTER WATER LEVEL** which may be different from the current area of water. The definition includes all types of water body, including temporary ponds; ponds which are dry at the time of survey will be recorded as part of the square inventory and will be included as potential survey ponds.

4.1.1.1 Ponds on the boundary of a square

Where a pond falls on the boundary of a square, so that only part of the total area is inside the square, it will have been included in mapping the square for the number of ponds, but only the area inside the square will have been included in the area measured. **For the condition survey you should survey the entire pond including the area outside the square.**

4.1.2 Inputting survey data

Use the PC tablet to record all survey information using the following forms:

- Pond checklist - which includes water chemistry and macroinvertebrate survey details.
- Pond attributes - pond characteristics and environmental information.
- Pond plant survey - wetland plant abundance and vegetation cover.

Table 4.1 Pond Condition Assessment – Quick Look Summary

Pond Condition Assessment – Quick Look Summary		
Aim	Steps	Notes
Pond plants: Record all species of wetland plant present within the outer boundary of the pond, and estimate their abundance.	Record all plant information on 'Pond Plants form – sheets 1 and 2' (PC tablet).	
	1. Walk or wade all safely accessible areas within the outer boundary of the pond. Deeper water areas should be surveyed by regularly throwing a grapnel to collect submerged plants.	Terrestrial plants and wetland plants growing outside the pond boundary should not be recorded. Wetland plants not found on the form – e.g. hybrids, should be recorded in the space provided and their abundance given.
	2. Estimate the abundance of each species.	Use the DAFOR scale.
	3. Record on the survey form any areas that it was not possible to survey.	
	4. Collect plant material of species which are difficult to identify or rare species.	Rare species marked with an asterisk on the recording form, must be sent for verification.
	5. Press or pickle plant material being sent for verification.	Make a note on the survey form of the number and provisional identification of the material being sent.
Estimate the total plant cover (%)	6. Send plant material for verification to POND CONSERVATION once a month.	Label all plant samples with pond location details.
	7. % submerged plants - cover of species listed as submerged on survey form.	Species in other categories do not count towards the total.
	8. % floating-leaved plants - cover of species listed as floating on survey form.	Species in other categories do not count towards the total.
	9. % emergent plants - cover of those species listed as emergent on survey form.	Species in other categories and terrestrial species do not count towards the total.
Record the amount of overhanging trees and shrubs	10. % of pond surface area occupied by all macrophytes.	Includes any emergent, floating or submerged plants reaching the pond surface.
	11. 'Shade' - % overhang of total pond area.	Record as if taking a bird's eye view of the pond, with the sun directly overhead.
	12. 'Shade' - % overhang of pond perimeter shaded to at least 1m from the shore.	Record as if taking a bird's eye view of the pond, with the sun directly overhead.
CONFIRM THAT YOU HAVE COMPLETED POND PLANT SURVEY ON POND CHECKLIST FORM		
Macro-invertebrate Survey: 3 minute survey divided equally between the main habitats, plus 1 minute visual search.	Record details of macroinvertebrate survey on the 'Pond Checklist' form (PC tablet).	
	1. Identify the pond's main habitat types.	Can be helpful to include habitats on sketch map during initial walkover.
	2. Divide 3 minute netting time equally between the habitats.	May need to further sub-divide time if one habitat type is located in two or more different areas of the pond.
	3. Spend 1 minute visual search time looking for creatures on the pond surface, under logs and stones, etc.	Before disturbing the water as 'flighty' species are easily lost.
	4. Vigorously net habitats using stopwatch to regulate time spent in each area.	Empty net regularly to increase sampling efficiency.
	5. Put sample into 18" x 12" polythene bag and preserve.	Place label with sample info. inside bag.
	6. Put sample bag into 1.3 l storage pot.	Label sample info. on outside of the pot.
7. Record on the survey form any areas that it was not possible to survey.		
CONFIRM THAT YOU HAVE COMPLETED INVERTEBRATE SURVEY ON POND CHECKLIST FORM		
n.b. MAKE SURE THAT ALL SURVEY FORMS INCLUDE POND LOCATION DETAILS – SQUARE NUMBER, POND NUMBER AND SURVEY DATE to ensure that records are attributed to the correct site in the database.		

4.2 Preparation

Having established permission to sample, the surveyor should find the survey pond, using the maps and grid references provided. All other survey procedures relate to this position.

4.2.1 Health and safety

At the survey pond, the surveyor should assess whether the waterbody is safe to sample. Issues to consider include:

- Vehicle parking, access from road.
- Current weather.
- Pond substrate, ease of access/bank stability and general condition.
- Floating mats of emergent plants and floating fen or bog should always be avoided.
- False bases of surface-dried mud or submerged plant mats.
- Uneven bases – ponds often have holes, rapid changes in slope and underwater objects which are not visible in turbid water.
- Deep water, deep silt.
- Obstacles to the pond, e.g. fencing.
- Livestock in adjacent fields.

These factors need to be considered and if any are deemed to be HIGH RISK or more than two are deemed MODERATE RISK, then do not proceed with the sampling. It is also advisable to note the nearest location where there is an adequate mobile phone signal. A strong pole (e.g. a pond net) should always be available as a safety aid for testing the pond base when wading in the water.

4.2.2 Sequence of tasks

- The reference number and location details of the survey pond will have been provided.
- Collect the water sample and record pH, conductivity and turbidity before the water is disturbed.
- Take photograph and begin recording pond attribute data.
- Collect macroinvertebrate sample.
- Complete the recording of pond attributes and the aquatic plant survey.
- Confirm all sections of the survey are complete.
- Dispatch water samples.
- Gather and prepare any plant specimens along with sketch maps of the pond and dispatch at least monthly to Pond Conservation.

Pond checklist

SURVEY DETAILS

Square reference Survey Date

Pond reference Name of surveyor

GPS reading

WATER CHEMISTRY

Is there enough water to take a sample? Tick to confirm water sample has been taken for SRP/TON/Aik (50ml filtered)

pH Conductivity $\mu\text{S cm}^{-1}$ Turbidity

Estimate turbidity by looking into c.30cm depth of water in the pond.

MACRONVERTEBRATE SURVEY

Invertebrate survey complete?

Were you able to adequately survey the pond for macroinvertebrates?

If not, describe (e.g. couldn't access all habitat types e.g. reedbed)

POND WETLAND PLANT SURVEY

Pond plant survey complete?

POND ATTRIBUTES SURVEY

Pond attributes survey complete?

Figure 4.1, Screen shot of the Pond checklist form.

4.3 Water chemistry

4.3.1 General Principle

Open the 'Pond Checklist' page to record water chemistry - making sure that you include the square number, pond reference and survey date at the top of the form, Figure 4.1

If there is sufficient water in the pond, and before the water is disturbed, estimate the water turbidity and take water chemistry sample and meter readings. If there is not sufficient water to do this, record this in the box on the survey form.

A single chemical sample should be taken from a typical area of the pond using the same methods as used for headwaters. If the pond has an outflow, take the sample there. Avoid taking samples near to inflows.

The following elements will be measured at each pond site:

- Conductivity, pH and turbidity: field measurements.

4.3.2 Equipment

- pH and conductivity meter

4.3.3 Method

Enter the water where safe to do so and rinse the two 1 l wide-neck bottles three times. Then move a few steps away from the disturbed area and fill the bottles with undisturbed water without disturbing the sediment. Avoid collecting plant material.

Estimating turbidity: Estimate the turbidity of the water by looking down into the pond to a depth of c.30 cm. Classify the turbidity of the water into one of the following four categories: clear, moderately clear, moderately turbid or turbid.

Conductivity and pH measurement: Please familiarise yourselves with the pH and conductivity meter prior to use.

You toggle between pH/conductivity and total dissolved solids display on the meter by pressing the SET/HOLD button.

Conductivity: Submerge the probe-end of the meter in the collected 1 l sample bottle, immediately after the sample has been taken. Select 'µS' mode with the SET/HOLD button. The measurements should be taken when the stability symbol (a stopwatch icon) on the top left of the display screen disappears. Please note the units. **RECORD µS not PPM.** Note: PPM is usually half the value of µS — double-check the units if your value looks unusually low!

pH: Submerge the meter in the collected 1 l sample bottle, immediately after the sample has been taken, stirring gently. Select 'pH' mode with the SET/HOLD button. The measurement should be taken when the stability symbol (a stopwatch icon) on the top left of the display screen disappears. Record the readings on the Pond Checklist Survey Form.

4.3.4 Recording data

- Tick the boxes on the Pond Checklist survey form to confirm the samples have been taken.
- Record the Turbidity, pH and conductivity readings on the Pond Checklist Survey Form.
- Include the sample information sheet with the samples.

4.4 Survey of pond environmental attributes

4.4.1 General principle

In summary the procedure is as follows:

- Open the Pond attribute survey form Figure 4.2 making sure that you include the square number, pond reference and survey date at the top of the form.
- Take a photo of the pond.
- Identify the outer boundary of the pond.
- Walk the pond perimeter, noting relevant features on the survey form as you go (e.g. presence of inflows, surrounding landuse and waterbodies etc.)
- Draw a sketch of the pond outline as you walk the pond perimeter and estimate pond size.
- Fill in the rest of the survey form. Filling in some sections will require you to enter the pond and so disturb the sediment: make sure the water quality survey has been carried out before you do this.

Pond attributes

SURVEY DETAILS You will survey 1 pond in each grid square for environmental variables, water chemistry, plants and invertebrates. The location of this pond has been chosen randomly by the habitat surveyor for each square.

Square reference Survey date Name of surveyor

Pond reference Pond location notes:

GPS reading

POND DETAILS

Photo

Is this a new pond?

If new, give approx. age of the pond? months


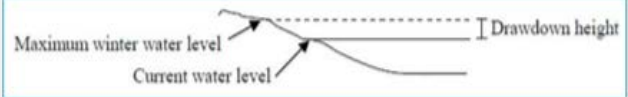
Pond area and hydroperiod

Pond area m²

Proportion of water present in the pond? %

Drawdown height cm

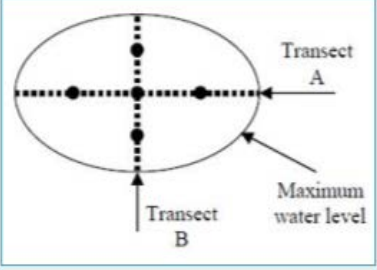
Pond permanence

Sediment and water depths

Not possible to measure depths

	Transect A			Transect B	
	1/4	1/2	3/4	1/4	3/4
Water depth (cm)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Total depth (silt + water) (cm)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>



Inflows/Outflows

	Wet	Dry
Number of inflows	<input type="text"/>	<input type="text"/>
Number of outflows	<input type="text"/>	<input type="text"/>

Pond base

Clay / Silt

Sand / Gravel / Cobbles

Bed rock

Peat

Other (specify)

Pollution

Is there road runoff? Other physical evidence of pollution? (list or give details)

Is there a field drain?

Is there rubbish?

Is there rubble?

Waterfowl

Is there any evidence the pond is ever used by waterbirds?

Impact

Major = severe impact of waterfowl i.e. little or no evidence of submerged plants, water turbid, pond banks showing patches where vegetation removed, evidence of provisioning waterfowl; Minor = waterfowl present, but little indication of impact on pond vegetation, pond still supports submerged plants and banks are not denuded of vegetation; None = no evidence of waterfowl impact (moorhens may be present).

Fish

Is there any evidence for fish/or fishing at the pond?

Impact

Major = dense populations of fish known to be present; Minor = small numbers of crucian carp, goldfish or stickleback known to be present; Possible = no evidence of fish, but local conditions suggest that they may be present; Absent = no records of fish stocking and no fish revealed during survey(s).

Figure 4.2, Screen shot of the first sheet of Pond attribute form.

Pond management (tick where relevant):

Fully dredged Partly dredged >5% vegetation removed <5% vegetation removed

Trees planted Trees felled Trees partly cut back Pond changed in shape or size

Plants introduced Bank plants mown Structural work e.g. to dam Straw added

Other management (list or add detail):

Is there evidence the pond is grazed by livestock? Grazing intensity

% of the pond perimeter grazed %

Amphibians

	Adult	Evidence of breeding (larvae/eggs/spawn/mating pairs)
Common Frog	<input type="checkbox"/>	<input type="checkbox"/>
Common Toad	<input type="checkbox"/>	<input type="checkbox"/>
Smooth Newt	<input type="checkbox"/>	<input type="checkbox"/>
Palmate Newt	<input type="checkbox"/>	<input type="checkbox"/>
Great Crested Newt	<input type="checkbox"/>	<input type="checkbox"/>
Frog/Toad unspecified	<input type="checkbox"/>	<input type="checkbox"/>
Newt unspecified	<input type="checkbox"/>	<input type="checkbox"/>

Other amphibian - Please state

Amphibian habitat None = clearly no suitable habitat within immediate pond locale; Poor = habitat with poor structure that offers limited opportunities for foraging and shelter (e.g. amenity grassland); Moderate = offers opportunities for foraging and shelter, but may not be extensive; Good = extensive habitat that offers good opportunities for foraging and shelter completely surrounds pond e.g. rough grassland, scrub or woodland.

Water quality for amphibians Bad = clearly polluted, only pollution-tolerant invertebrates, no submerged plants; Poor = low invertebrate diversity, few submerged plants; Moderate = moderate invertebrate diversity; Good = abundant and diverse invertebrate community.

Surrounding land use Estimate the percentage of surrounding land-use within the following zones from the pond perimeter

Habitat	%	0-5m	0-100m	Examples
Trees + woodland	<input type="text"/>	<input type="text"/>	<input type="text"/>	Deciduous and coniferous woodland, individual trees, scrub, hegerdow
Heathland + moorland	<input type="text"/>	<input type="text"/>	<input type="text"/>	Dwarf shrub, heath, sub-arctic montain
Unimproved grassland	<input type="text"/>	<input type="text"/>	<input type="text"/>	Herb-rich, calcareous, acid and moorland grassland (plant quality indicators usually present)
Rank vegetation	<input type="text"/>	<input type="text"/>	<input type="text"/>	Unmanaged grass, neglected + abandoned land, set-aside, verges, golf course roughs, buffer strips
Improved grassland	<input type="text"/>	<input type="text"/>	<input type="text"/>	Fertile agricultural grass, mown grass, golf course greens (plant quality indicators absent)
Arable	<input type="text"/>	<input type="text"/>	<input type="text"/>	All crops - includes flower and fruit crops (e.g. strawberries) and ploughed land
Urban buildings + Gardens	<input type="text"/>	<input type="text"/>	<input type="text"/>	Area in curtilage - includes glass-houses, farm years
Roads tracks + paths	<input type="text"/>	<input type="text"/>	<input type="text"/>	Including car-parks and footpaths
Rock stone + gravel	<input type="text"/>	<input type="text"/>	<input type="text"/>	Cliffs, rock-outcrops, gravel-pits, quarries, areas of sand, gravel or stone
Bog fen marsh + flush	<input type="text"/>	<input type="text"/>	<input type="text"/>	Wetland vegetation, blanket bog
Ponds + lakes	<input type="text"/>	<input type="text"/>	<input type="text"/>	Permanent and seasonal waterbodies
Streams + ditches	<input type="text"/>	<input type="text"/>	<input type="text"/>	River, stream, ditch, spring
Other - Please state	<input type="text"/>	<input type="text"/>	<input type="text"/>	E.g. maritime vegetation, saltmarsh, sand-dune, orchard, bracken, canal, railway

General Comments

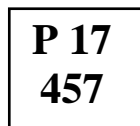
Figure 4.3, Screen shot of the second sheet of Pond attribute form.

4.4.2 Method

4.4.2.1 Photographs

Take one or two photographs of the pond. This will, in part, be used to relocate the site for future surveys and to provide information on the nature and extent of any alteration or impacts to the pond. One photograph should be sufficiently wide angled and composed to show any prominent natural or man-made features that will identify the location accurately for future surveys.

A marker board should be included in the photograph and should be marked with the P (for pond survey) along with the pond reference number and the square number and should be of the form:



Tick the box on the survey form to confirm a photo has been taken.

4.4.2.2 Determining pond age

Record the age of new ponds (up to c.10 years of age). Determine age on the basis of the best available information - e.g. information from land owners/land managers, bare banks, lack of bottom sediment, presence of bare spoil heaps following pond excavation, etc.

4.4.2.3 Identifying the outer pond boundary

The outer edge of the pond is defined as the '*upper level at which water stands in winter*'. The pond will usually be drier than this at the time of the survey. The outer boundary can be identified from one or more characteristics.

- A change in the distribution of wetland plants, particularly by a rapid transition to terrestrial species, often marked by a fringe of soft rush.
- Where solid features such as trees, walls or pipes occur within the water area, a “water mark” will usually be evident.
- In some cases where willow trees are present a thick bundles of fine roots out of the water can indicate the depth to which the roots have been submerged.
- In some cases a break of slope will be present at the winter waterline.
- In ponds with outflows, the level of the outflow will usually determine the upper winter water level.

4.4.2.4 Sketching pond outline

Sketch the outline of the outer pond boundary on a piece of A4 waterproof paper. This will help you estimate the pond area and help to confirm the identity of the pond in future surveys. Note on the sketch any obvious nearby features which will help identify the pond again e.g. wall / hedge / inflow.

Draw an appropriate scale bar (e.g. 10 m long) and indicate north.

Label the map with the following:

Project:	ERAMMP
Type of waterbody:	Pond
Square number:	Square number
Pond number:	Pond reference number
Date:	day-month-year (e.g.06-07-21).

4.4.2.5 Estimating pond area

In order to estimate the area of the pond you need to know the length of your standard pace and have practiced and checked your accuracy in pacing distances. Pace the length and width of the outer area of the pond (maximum winter water level). Calculate the area by treating the pond as a simple shape such as a circle or rectangle (or a number of joined shapes) and adjusting the result to account for the difference between the actual pond shape and the shape used for calculation. For example, if the pond is an oval approximately 10 m long and 5 m wide, you could treat it as a rectangle of 50 m², then decide to record an area of 45 m² to account for its oval shape.

Remember that the definition of a pond is “a body of standing water from 25m² (e.g. 5 m x 5 m) to 2 ha (e.g. 200 m x 100 m) in area which usually holds water for four months of the year or more”.

4.4.2.6 Estimating proportion of water present in the pond

Estimate the proportion of water area present in the pond at the time of survey relative to the area covered when the pond is full to the maximum water level. It may help to draw the actual water level on your sketch Figure 4.4.

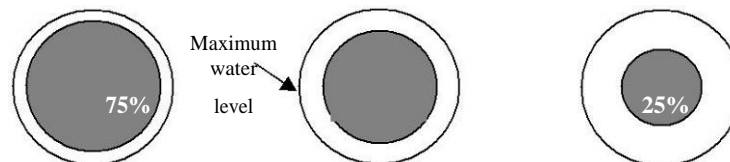


Figure 4.4, The figures show 75%, 50% and 25% of the area of the pond covered with water

4.4.2.7 Measuring drawdown height

The drawdown height is the vertical distance between the height of the maximum winter water level and the actual water level at the time of survey. It is not the horizontal distance or the distance along the ground, Figure . Measure this height using the distance markings on the handle of your pond net. This is easiest at a steep edge of the pond.

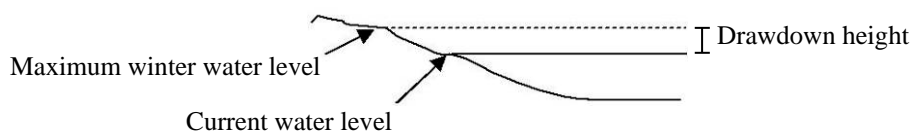


Figure 4.5, figure illustrates that drawdown height is the vertical distance between the height of the maximum winter water level and the actual water level at the time of survey

4.4.2.8 Pond permanence

Deduce pond permanence from local knowledge and personal judgement. The landowner may know how often a pond dries. However, if not, then try and make a judgement based on water level at the time of the survey. Ponds that dry out annually usually have a hard base. Classify pond permanence into one of the following four categories: never, rarely (once in every 10 years), sometimes (once in every three-five years) or annually.

4.4.2.9 Measuring sediment and water depths

Check that the water quality survey has been carried out before you enter the pond and disturb the sediment.

Water depth and sediment depth are measured using the length markings on the handle of your pond net at the locations specified in figure 4.6. To measure water depth, put the pole into the water (net end upwards) and note the depth at which the pole touches the top of the sediment. In most ponds you will feel resistance from the sediment at this point, but where the sediment is very fine you will need to do this by eye. You may see bubbles of gas released as the sediment is disturbed. To measure the total depth of sediment plus water push the pole down further until you reach the solid base of the pond. If it is not possible to take some of the readings then tick the box to this effect on the form. If it is possible to walk safely to the middle of the pond then measure sediment and water depth at the five positions.

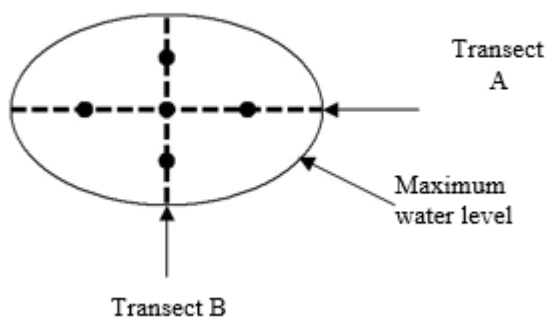


Figure 4.6 (Transect A is the longest dimension of the pond. Take readings at $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ along it. Transect B is perpendicular to this. Take readings at $\frac{1}{4}$ and $\frac{3}{4}$ of the distance across transect B.

4.4.2.10 Recording the number of inflows and outflows

Determine the number of inflows and outflows to and from the pond and whether they are wet or dry at the time of the survey. Record the number of each in the relevant boxes.

4.4.2.11 Estimating composition of the pond base

The pond base is usually a natural material (e.g. gravel, clay, rock or peat) but occasionally may be man-made (e.g. puddled clay or artificial liner). It lies UNDER any layers of sediment consisting of muddy silts, organic debris, or sometimes stream-borne sands. Note that puddled clay pond bases are quite rare: most ponds with clay bases are located on naturally occurring clay geology.

Examine the pond base to work out its composition. Wearing long sleeved gloves feel the base material at various positions around the pond, both in and out of the water. Use the net pole to feel in deeper water to feel the extent of soft and hard material.

Estimate the proportion of the total area of the pond base that is made up of each of the following: (i) clay or silt, (ii) gravel, sand or cobbles, (iii) rock, (iv) peat or (v) others (specify). For each of these categories determine whether that element makes up: 0 (0% of the total), 1 (1% to 32% of the total), 2 (33% to 66% of the total) or 3 (67% to 100% of the total).

4.4.2.12 Recording pollution in the pond

Assess visually and tick the relevant box, if the pond is suffering from any of the following pollution issues: road runoff (either directly through drains or where the pond takes road runoff by virtue of its proximity to the road or because water drains downhill from the road into the pond), field drains entering the pond, dumped rubbish in the pond (including litter) and dumped rubble in the pond.

List any other physical evidence of pollution (e.g. oil) or give details in addition to the ticked boxes if there are specific pollution issues at the pond (e.g. rubbish affects less than 1% of the pond, pond filled with more than 50% rubble).

4.4.2.13 Evidence of use by water birds

This section refers to use, and over-use, by water birds, for example, ducks, geese, coots, moorhens and swans. If there is evidence that the pond is used by these birds (either the birds themselves or signs such as trampling, feathers, faeces, food left by humans) then tick the box on the survey form. Then estimate the intensity of their impact from: Major = severe impact of waterfowl i.e. little or no evidence of submerged plants, water turbid, pond banks showing patches where vegetation removed, evidence of provisioning waterfowl; Minor = waterfowl present, but little indication of impact on pond vegetation, pond still supports submerged plants and banks are not denuded of vegetation; None = no evidence of waterfowl impact (moorhens may be present).

4.4.2.14 Evidence of fish

If fish are known to be present i.e. if you or your colleagues have seen fish in the pond during the survey or if someone who knows the pond has seen fish in it this year then tick the box on the survey form. Then estimate the intensity of their impact from: Major = dense populations of fish known to be present; Minor = small numbers of Crucian Carp, goldfish or stickleback known to be present; Possible = no evidence of fish, but local conditions suggest that they may be present; Absent = no records of fish stocking and no fish revealed during survey(s).

4.4.2.15 Recording pond management

Tick the appropriate boxes if there is any evidence of the following pond management having been carried out. Ignore any management which has obviously been carried out over 10 years ago or is at such a distance that it is unlikely to impact the pond. The options to record are as follows:

- the pond has been fully dredged
- the pond has been partly dredged
- more than 5% of the pond vegetation has been removed
- some, but less than 5%, of the pond vegetation has been removed
- trees have been planted
- trees have been felled
- trees have been partly cut back
- the pond has been changed in its shape or size
- plants have been introduced (e.g. obvious species that should not be in this geographic locations, baskets etc)
- plants on the pond bank have been mown
- straw has been added to the pond
- structural work has been carried out (e.g. to dam the pond).

4.4.2.16 Evidence of livestock grazing

This section refers to evidence of grazing by livestock defined as cows, sheep and horses, not grazing by wild animals (e.g. rabbits or deer). If there is evidence that the pond is grazed by livestock (e.g. ground is poached) tick the box on the survey form and record the percentage of the pond perimeter that is grazed. This will usually be the entire pond perimeter, unless access is restricted in some parts e.g. by fencing, trees or if an area is too steep. If there is evidence of grazing, then estimate grazing intensity from: 1 (infrequent or low intensity) to 5 (pond margins heavily poached and almost bare).

4.4.2.17 Evidence of amphibians

Tick the relevant boxes if you see any amphibians and the life stages seen. Record non-native amphibian species if present.

Make an assessment of the surrounding habitat in terms of its suitability for amphibians. Terrestrial habitat should be considered only on the near side of any major barriers to dispersal (e.g. main roads or large expanses of bare habitat). Score the habitat as follows: None = clearly no suitable habitat within immediate pond locale; Poor = habitat with poor structure that offers limited opportunities for foraging and shelter (e.g. amenity grassland); Moderate = offers opportunities for foraging and shelter, but may not be extensive; Good = extensive habitat that offers good opportunities for foraging and shelter completely surrounds pond e.g. rough grassland, scrub or woodland. Good quality terrestrial habitat also has structure. The presence of rabbit borrows, small mammal holes, proximity to old farm buildings, stone walls, piles of loose stone/rock all contribute towards 'good' terrestrial habitat. Note that it is rare to encounter a pond with a terrestrial habitat category of 'none'.

The assessment of water quality is subjective and should be based primarily on invertebrate diversity. Water quality should not be confused with water clarity. Sometimes clear water can be devoid of invertebrates, and turbid ponds can support a wealth of invertebrates. There is no quick and simple invertebrate index of water quality. Place the pond into one of the following 4 categories:

Bad = clearly polluted, only pollution-tolerant invertebrates, no submerged plants;

Poor = low invertebrate diversity, few submerged plants;

Moderate = moderate invertebrate diversity;

Good = abundant and diverse invertebrate community.

4.4.2.18 Recording surrounding land use

Estimate the percentage of surrounding land use or land cover in each of the following categories (Table 8) in two distance zones from the perimeter of the pond: (i) 0 to 5 m and (ii) 0 to 100 m, Figure 23. This can include land outside the kilometre square.

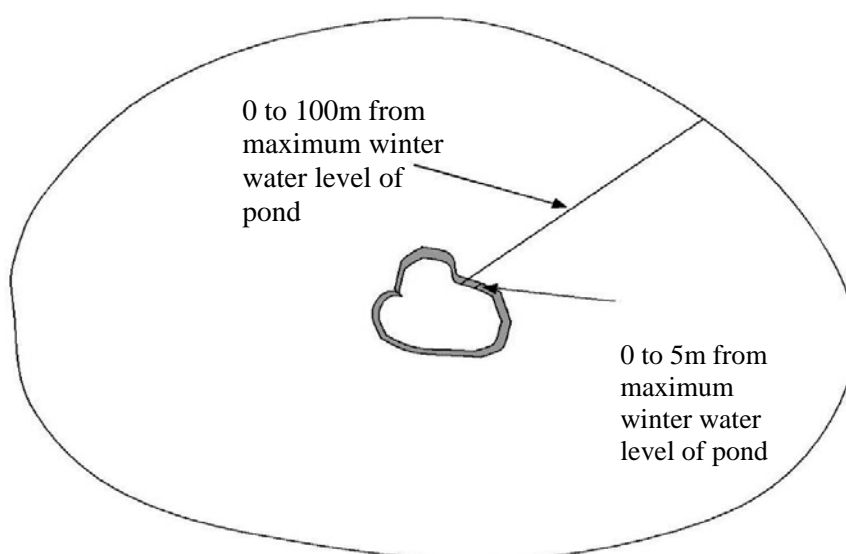


Figure 4.7, The two distance zones surrounding a pond which are used for surveying land use.

Table 4.2, Landuse categories.

Category	Examples
Trees & woodland	Deciduous and coniferous woodland, individual trees, scrub, hedgerow
Heathland & moorland	Dwarf shrub heath, sub-arctic mountain
Unimproved grassland	Herb-rich, calcareous, acid and moorland grassland (plant quality indicators usually present)
Rank vegetation	Unmanaged grass, neglected & abandoned land, set-aside, verges, golf course roughs, buffer strips
Improved grassland	Fertile agricultural grass, mown grass, golf course greens (plant quality indicators absent)
Arable	All crops, includes flower and fruit crops (e.g. strawberries) and ploughed land
Urban buildings & gardens	Areas in curtilage, includes glass-houses, farm yards
Roads, tracks & paths	Including car-parks and footpaths
Rock, stone & gravel	Cliffs, rock-outcrops, gravel-pits, quarries, areas of sand, gravel or stone
Bog, fen, marsh & flush	Wetland vegetation, blanket bog
Ponds & lakes	Permanent and seasonal waterbodies
Streams & ditches	River, stream, ditch, spring
Other (state)	Where the land use does not fit into any of the above categories e.g. maritime vegetation, saltmarsh, sand-dune, orchard, bracken, canal, railway

4.5 Aquatic Plant Survey

4.5.1 General principle

The aims of the macrophyte survey are to:

- Record all species of wetland plant present within the outer boundary of the pond, and estimate their abundance.
- Estimate the total plant cover in terms of submerged, floating-leaved and emergent species, and the percentage of pond surface occupied by macrophytes.
- Record the amount of shade from overhanging trees and woody plants.

4.5.2 Method

Make sure you are aware of the position of the outer boundary of the pond. The aim is to record all species of wetland macrophyte within this area.

Open the Pond Plants recording forms (Sheet 1 and 2) to input the data Figure 4.8. The recording forms give a list of all plant species to be considered as wetland plants for this survey. Nomenclature follows The New Atlas of the British and Irish Flora (2002). Taxa such as hybrids, sub-species, exotics and cultivars have been omitted to save space. If they are identified, they should be noted in the space provided. Terrestrial plants and wetland plants growing outside the pond boundary should not be recorded.

Rare species (IUCN Red List status or recorded in less than 100 10 x 10 km squares in Britain) have been marked with an asterisk. If any of these are found confirmation is needed. Guidance for this is given in the section "Rare species confirmation" below.

Plants should be surveyed by walking and wading all safely accessible areas within the outer boundary of the pond. Deeper water areas should be surveyed by regularly throwing a grapnel to collect submerged plants. In larger waterbodies, look for plants blown from deeper

water and deposited on the strand-line. In ponds with inorganic substrates (e.g. new ponds, ponds with a sand or gravel base), check the very shallow areas for stoneworts and fine-leaved pondweeds. Stoneworts, in particular, are often under recorded. Better quality ponds often support more than one species of stonewort, so if stonewort plants are found, look around for other plants with a different morphology or colour.

Note on the survey form any areas of the pond you are unable to access to survey.

4.5.3 Species identification

Most wetland plants can be identified in the field using a hand lens. All plants should be identified to species level wherever possible, except for *Populus* and *Salix*, which can be recorded as 'sp'.

If you are not sure of an identification, collect a sample in a sealed, labelled plastic bag to examine later using your identification keys. A list of identification keys for wetland plants is given in the box below.

If you are unable to identify a species you can send a specimen for identification. This will be likely for many *Callitriche*, *Potamogeton*, *Ranunculus* and charophyte species. See table below for guidance.

4.5.3.1 Rare species confirmation

Species that are (or suspected to be) rare need to be confirmed. Note that rare and legally protected plants are indicated on the plant survey form with an asterisk.

The process of confirming rare plants needs to be undertaken with care because (i) there should be a general presumption against damaging plants, particularly of uncommon species, and (ii) a licence is needed to remove Wildlife and Countryside Act Schedule 8 species.

In practice, however, pieces of plants will need to be "picked" in order to examine them out of the water for identification. These bits can then be re-used to provide voucher specimens for confirmation. *However*, care should always be taken to minimise damage to potentially rare species, particularly where populations are small.

Where there are concerns about damage, then a digital photograph can be used for confirmation if this is likely to be sufficient for identification (e.g. flowering or fruiting *Baldellia* growing on muddy shores). For very rare species (i.e. RDB or Scheduled species), where there are no other appropriate means of confirmation, a message should be left, as soon as possible, for the Pond Conservation project team (see contact details at the end of the pond section) who will visit the site.

4.5.4 Sample fixing and storage – reference specimens

To send a specimen for identification take a small amount of the plant (e.g. 15 cm minimum), if possible including any features likely to help identification e.g. flowers / fruit / branched stems / underwater and surface leaves.

Write a label in pencil on waterproof paper. Include the square number and pond identification number, your name and the date and make sure the information on the label is transferred with the specimen as it is pressed or preserved.

Place the wet plant in a sealable plastic bag and press or preserve within a few hours.

To press most plants (e.g. *Callitriche* species): place on a piece of A4 clean white paper and put this between two more sheets. Put this between c.10 sheets of newspaper and store with

a weight on top e.g. under a heavy book. Change the surrounding paper as necessary to ensure the plant is completely dry and so does not rot.

To press plants with finely divided floating leaves (e.g. *Ranunculus*, *Potamogeton* species): float the plant in clean water in a small shallow tray. Place a piece of thin white card under the plant and lift out of the water gently so the structure of the plant can be seen – then treat as described above.

When the pressed plants are dry store in the plastic wallets in the box file provided.

To preserve in alcohol ('pickle'), (e.g. Charophytes): put a specimen of the plant into a 25 ml Sterilin tube and fill with 80% alcohol (provided for preservation of the invertebrate sample).

Make a note of the number of species sent for verification on the survey form and any provisional identification. Return pressed and preserved plant specimens to Pond Conservation at the address at the end of this section.

Table 4.3, Recommendations for plants to routinely send off for identification

Group	Recommended routine collection	Method	Comments
Callitriche	All species but only if fruits present.	Pressed	This group has always caused significant confusion and even the translucent-leaved species have sometimes been mis-recorded due to the spread of <i>C. truncata</i> . Vegetative material can only rarely be identified reliably and usually needs to be recorded as <i>Callitriche</i> sp.
Potamogeton	All species except <i>P. natans</i> , <i>P. polygonifolius</i> , <i>P. crispus</i> .	Pressed	Fine-leaved species are critical and are frequently confused. Broad-leaved species are easier but are complicated by some frequent hybrids.
Ranunculus (Sect. Batrachium)	All species if aquatic and with flowers and fruits except <i>R. hederaceus</i> , <i>R. omiophyllus</i> and <i>R. circinatus</i> .	Pressed	A difficult group and complicated by hybridisation. Most species with capillary leaves cannot be identified without flowers and fruits or when growing terrestrially. These should be recorded as <i>R. aquatilis</i> agg.
Utricularia	Routine collection of <i>U. minor</i> is not necessary, while the segregates of <i>U. vulgaris</i> agg. cannot be separated vegetatively.	Pickled	Separating into the three main groups is not difficult. In the <i>U. vulgaris</i> agg., <i>U. australis</i> and <i>U. vulgaris</i> cannot satisfactorily be separated vegetatively. Flowering material is fairly easy to separate but the flowers are best preserved pickled. The segregates of <i>U. intermedia</i> agg. (which very rarely flower in the UK) can be separated vegetatively from the internal hairs on the bladders. These must be pickled, not pressed.
Stoneworts (Charophytes)	All species	Pressed or pickled	An important group, because a high proportion of species are uncommon. Some species require microscopic confirmation.
Hybrids	All hybrids of aquatic species and uncommon hybrids of emergent taxa.	Pressed	
Other problem areas			
Myriophyllum	Consider keeping samples if the site is in an area where the	Pressed	Some confusion has arisen between <i>M. spicatum</i> , <i>M. verticillatum</i> and <i>M.</i>

	species is uncommon (e.g. the Highlands and upland areas for <i>M. spicatum</i> , most of England for <i>M. alterniflorum</i> , most areas outside the Fens and Norfolk Broads for <i>M. verticillatum</i>).		<i>alterniflorum</i> due to lack of clarity of characters in some identification texts, particularly in the past.
Sparganium	Consider keeping samples of <i>S. natans</i> from upland or acidic lake situations.	Pressed	Again there have been confusions, particularly in the past, between <i>S. angustifolium</i> and <i>S. natans</i> . This has resulted in some over-recording of the latter.

Modified from: Stewart (2004). Recommendations for the collection and preservation of specimens during macrophyte surveys.

List of identification keys for wetland plants (non-exhaustive)
<p>General</p> <p>Blamey, M., Fitter, R. and Fitter, A. (2003). The Wild Flowers of Britain and Ireland, The Complete Guide to the British and Irish Flora. Collins.</p> <p>Clapham, A.R., Tutin, T.G. and Moore, D.M. (1988). Flora of the British Isles (3rd ed.). Cambridge University Press, Cambridge.</p> <p>Garrard, I. and Streeter, D. (1983) The wild flowers of the British Isles. Midsummer Books, London.</p> <p>Haslam, S., Sinker, C. and Wolseley, P. (1975). British Water Plants. Field Studies 4, 243-351.</p> <p>Rich, T.C.G. and Jermy, A.C. (1998). Plant Crib 1998. Botanical Society of the British Isles, London. (particularly useful for Potamogeton, Ranunculus and Glyceria spp.).</p> <p>Stace, C. (1997). New flora of the British Isles. Second Edition. Cambridge University Press, Cambridge. (useful new data and key for Callitriche spp.). There is also a field version of this book.</p> <p>See also other BSBI guides on specific families.</p>
<p>Grasses and Sedges</p> <p>Hubbard, C.E. (1968). Grasses. Penguin Books. Middlesex.</p> <p>Jermy, A.C., Chater, A.O. and David, R.W. (1982). Sedges of the British Isles. Botanical Society of the British Isles, London.</p> <p>Rose, F. (1989). Colour identification guide to the grasses, sedges, rushes and ferns of the British Isles and north-western Europe. Viking, London.</p>
<p>Ferns and Horsetails</p> <p>Merryweather, J. and Hill, M. (1992) The fern guide. Field Studies, 8, 101-188.</p>
<p>Charophytes</p> <p>Moore, J.A. (1986). Charophytes of Great Britain and Ireland. Botanical Society of the British Isles, London.</p> <p>Stewart, N.F. and Church, J.M. (1992) Red Data Books of Britain and Ireland: Stoneworts. JNCC, Peterborough.</p>

4.5.5 Recording data electronically

Data are input directly into the database using the tablet PCs.

Estimate abundance for each species in terms of the area of the pond it covers using the following scale:

D	Dominant	91	–	100% cover
A	Abundant	51	–	90% cover
F	Frequent	21	–	50% cover
O	Occasional	6	–	20% cover
R	Rare	0	–	5% cover

Plant names are arranged alphabetically within the following classifications – submerged plants, floating-leaved plants and emergent plants in drop down menus. This is to help in the assessment of percentage cover of each group at the end of the section.

The plant survey form is split between two sheets (you can switch between sheets at any time during the survey). Make sure that you include the pond reference number on both sheets to ensure that the records are attributed to the correct site.

4.5.5.1 Total plant cover

Once all the plants have been recorded, use the boxes provided to give the total percentage of pond area covered by:

- Submerged plant species (species in the submerged plant list)
- Floating-leaved plant species (species in the floating-leaved plant list)
- Emergent plant species (species in the emergent plant list)

Then, as a measure of the quality of the habitat for amphibians:

- Estimate the percentage of the pond surface area occupied by macrophytes. This includes emergents, floating-leaved plants (excluding duckweeds) and submerged plants reaching the surface.

4.5.5.2 Shade

The degree to which the pond is shaded needs to be measured in two ways:

- Firstly, record the percentage of tree cover over the pond (imagine looking down on the pond from above and assess the proportion of the area of the pond that is directly overhung by woody vegetation).
- Secondly, record the percentage of the total pond margin shaded to at least 1m from the shore. Shading is usually from trees, but can include buildings. However, it should not include emergent pond vegetation.

Figure 4.8, A screen shot of the macrophyte recording form.

4.6 Macroinvertebrate sampling

4.6.1 General principle

The aim of the pond macroinvertebrate survey is to obtain, within the available sampling time (3 minutes net in the water; + 1 minute visual searching) as complete a species list as possible for the pond and to obtain information on the abundance of each species recorded.

4.6.2 Method

4.6.2.1 Selecting habitats for macroinvertebrate sampling

All the main habitats in the pond are sampled so that as many species are collected from the site as possible. Examples of typical habitats are: stands of *Carex* (sedge); gravel- or muddy-bottomed shallows; areas overhung by willows, including water-bound tree-roots; stands of *Elodea*, or other submerged aquatics; flooded marginal grasses; and inflow areas. As a rough guide, the average pond might contain 5-10 habitats, depending on its size and variety.

It is important that vegetation structure, as well as plant species composition, is considered when selecting habitats: it is better to identify habitats consisting of e.g. soft floating leaves, stiff emergent stems, etc. than to make each different plant species a separate habitat.

Habitats are identified during the initial walk around the pond examining vegetation stands and other relevant features (this can be combined with the initial plant survey stage).

4.6.2.2 Sample collection

The sample should be collected using a standard 25 cm² pond-net with a 900 µm mesh net. Wash the net thoroughly before and after taking samples. Check that it is neither damaged

nor contaminated with animals from previous samples. Damaged pond nets must not be used.

- (i) The three-minute sampling time is divided **EQUALLY** between the number of habitats recorded: e.g. for six habitats, each will be sampled for 30 seconds. Where a habitat is extensive or covers several widely separated areas of the pond, the sampling time allotted to that habitat is further divided in order to represent it adequately (e.g. into 6 x 5 second sub-samples). The three-minute sampling time refers solely to 'net-in-the-water' time, and does not include time moving between adjacent netting areas.
- (ii) Each habitat is netted vigorously to collect macroinvertebrates. Stony or sandy substrates are lightly 'kick-sampled' to disturb and capture macroinvertebrate inhabitants. N.B. deep accumulations of soft sediment are avoided, since this makes later sorting extremely difficult: the netted sample should be as clean and silt-free as possible. Similarly, large accumulations of plant material, root masses, and the like should not be taken away in the sample: the idea is to dislodge and capture the animals without collecting an unmanageable sample.
- (iii) Amphibians or fish caught whilst sampling are noted on the field recording sheet and returned to the pond. It is worth making a quick search through the net and removing these: dead fish, tadpoles etc. in the sample make for a very unpleasant sorting session in the laboratory later!

4.6.2.3 Additional macroinvertebrate sampling

A further 1 minute (total time, not net-in-the-water time) is spent searching for animals which may otherwise be missed in the 3-minute sample. Areas which might be searched include the water surface (for whirligig beetles, pond skaters etc.), and under stones and logs (for limpets, snails, leeches, flatworms etc.). Additional species found are added to the main 3-minute sample. Note: the 1 minute search should ideally be undertaken before the hand-net sample (i.e. before you disturb the water) to improve the chance of catching species.

4.6.3 Sample fixing and storage

Samples are preserved in the field for later sorting in the laboratory. On completion of sampling, the sample should be emptied into a medium gauge, 18" x 12" polythene bag as provided. Intermediate emptying of the net is essential to prevent the net becoming so full as to preclude efficient sampling. Retain only enough water to keep the sample damp. This reduces the amount of preservative that has to be added to it and reduces damage.

It is very easy to cross-contaminate samples from residual specimens retained on nets from previous site visits. **Always wash pond nets as thoroughly as possible after sampling at each site and also before sampling the next site.**

Fill the sample containers to no more than about two thirds full with collected material. This will leave sufficient room for preservative and an air space. Never cram material into a sample container and never fill it completely: use an additional container instead.

Then, 40% formalin solution should be added to the sample bag until the liquor in the bag is equivalent to 4% aqueous formaldehyde. The precise amount of formalin needed varies from sample to sample but is in the region of 50 – 100 ml per plastic bag. It is better to err on the side of excess.

A clear pencil-written label should be placed in the sample bag. The label should contain the following information:

Type of sample : POND macroinvert

Square number : Square number

Pond number: Pond reference number

Date: Day-month-year (e.g. 07-08-13).

The plastic bag should be firmly tied and placed inside a 1.3 l storage pot and the lid of the pot tightly closed. An extra sharp twist of the lid is then recommended. Apply PVC tape around the lid to form a seal and to prevent the lid becoming loose during transport.

The pot should be clearly labelled on the outside, using a permanent marker, with the same information as given on the internal label.

The sample may be split into two or more bags/pots if too large to fit within a single container. All parts of the sample should be labelled as above, together with the additional information "Part one of two" or "Part two of two" or "Part one of three" etc. However, samples should very rarely require more than one container. Single containers should be adequate for the large majority of sites. **Thorough labelling of samples is essential**

4.6.4 Transit and storage of macroinvertebrate samples

Clearly labelled macroinvertebrate sample pots should be stored, while in transit, in the back of the van in the grey storage boxes provided. The storage box itself should also be labelled with a Transport Emergency (TREM) card as for stream macroinvertebrate samples (Figure 3.17). The TREM card provides important relevant information on the nature of the liquids contained within the box and any hazards that may be associated with them. It also provides information on what action to take in case of spillage and emergency contact details.

4.7 Field survey check-list

Check all relevant boxes on the survey forms have been filled in and that the Pond checklist form has been completed, confirming that water samples, pond attributes, aquatic plant and macroinvertebrate surveys have been undertaken at the pond.

Tick the boxes on the Pond checklist to confirm that this has been done.

4.8 Transit and storage of pond samples and specimens

The surveyors is responsible for overseeing storage of pond water samples, plant specimens, macroinvertebrate samples and sketch maps. The biological and chemical samples are treated in the same manner as those taken from streams.

4.8.1 Aquatic plant samples and sketch maps

Sketch maps should be photocopied and posted with plant specimens. Photos can be copied onto a CD and posted or emailed with square and pond numbers.

5 APPENDIX 1 MODIFICATIONS TO STANDARD METHODS FOR HEADWATER STREAMS AND PONDS

5.1 Benthic Invertebrate sampling

There is now a question about the proximity of street lighting.

5.2 River Habitat RAPID (RHS)

In Section G a modified DAFOR scale is applied, the DAFLOR, Dominant = >75%, Abundant = 75 – 51%, Frequent = 50 – 33%, Less Frequent = 33 – 26%, Occasional = 25 – 11%, Rare 10 – 1 %.

The following series of questions have been added 'Location of most significant weir/dam is between spot checks number:' provide answer boxes marked Spotcheck u/s of weir or dam; Spotcheck d/s of weir or dam – Add second box marked Weir height (metre units)

In Section K the following question has been added, 'Are side and point bars found opposite one another or are they found to alternate between banks? Answer opposite / alternate / both'

In Section L) Additional question - 'Length of bank which is fenced?' (recorded in metres)

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