Common Standards Monitoring Guidance

for

Ditches

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1. Introduction

1.1 These guidelines describe a monitoring methodology for judging the condition of freshwater and brackish ditches within designated sites in the UK, where the ditch system is a notified habitat feature. If ditches are present but are only of incidental interest, there is no requirement for them to be monitored in their own right. Guidance on setting attributes and targets for assessing ditch features is given, and summarised in Table 1. Recommended survey techniques are also described in detail. Checklists of non-native and native aquatic and marginal plants associated with ditch systems are given (Appendices 1, 2, 3) and recording forms for use in the field are included (Appendices 4 and 5). The guidelines are intended primarily to provide a general assessment of the condition of the vegetation. Where other biological groups or individual species are also notified interest features, the guidance on conservation objectives and monitoring pertaining to these should also be followed.

1.2 Ditch systems in different parts of the UK vary in terms of their vegetation and general species composition, so local targets should take into account natural and regional variability for each attribute. The methodology described here has been tested at Woodwalton Fen National Nature Reserve, Cambridgeshire, and Baston and Thurlby Fens SSSI, Lincolnshire. However, further testing is desirable, in order to validate the targets and to make sure that the field survey techniques are satisfactory for general use within the statutory nature conservation agencies, both in sites with ditch networks and in those with few or single channels with botanical interest.

1.3 The most extensive ditch systems are situated in the remnants of ancient coastal wetlands in the south and east of England (e.g. Norfolk/Suffolk Broadland, Lincolnshire and Cambridgeshire Fens, North Kent Marshes, Romney Marsh, Pevensey Levels) and around the Bristol Channel (e.g. Somerset Levels, Gwent Levels). Many of these ditch networks are now integral parts of grazing marshes, where wet grassland, birds, amphibia and terrestrial invertebrate communities may also be interest features. Ditches are especially important for their aquatic plants and invertebrates, often representing valuable relict fen and marsh communities.

1.4 The main threats to ditch communities are gross fluctuations in water level or permanent lowering of water level; water pollution, notably nutrient enrichment from agricultural runoff; the spread of invasive alien species; and inappropriate management. The last can take a number of forms:

- insufficient clearing of vegetation and silt from the channel, leading to shallowing and loss of open water through encroachment of reedswamp
- over-management of ditches, causing a severe reduction in the quantity and quality of aquatic vegetation
- unsuitable profiling, resulting in steep-sided, uniform channels and consequent loss of shallow water species
- insufficient management of bankside vegetation, allowing tall herbaceous and woody vegetation to dominate and shade out aquatic vegetation.

These threats have influenced the choice of attributes for monitoring the condition of ditches.

2. Definition

2.1 Ditches are artificial channels, many of which are centuries old and were excavated to drain ancient wetlands such as marshes or fens. Some were used to transport materials such as peat or reed; others were dug as ‘wet fences’, as channels in water meadows or to canalise small streams. Some ditches in arable areas are now used as reservoirs for irrigation. Most ditches are virtually stagnant for much of the year; others, such as arterial drainage channels, have a slow flow rate. In order to retain their land drainage function, ditches need to be kept open by frequent (often annual) cutting of aquatic and bankside vegetation and occasional removal of silt.

2.2 Ditches are typically straight, uniform channels, but they vary in dimension from less than a metre wide and deep, to large main drains several metres deep and perhaps ten metres wide. This variation is reflected in the different plant and animal communities present and is perpetuated by management regimes. Two other important aspects of variation in ditch systems are trophic status and salinity. Some freshwater ditches, generally in acid peat areas, are moderately nutrient-poor, but most are naturally nutrient-rich. In coastal grazing marshes some ditches may contain brackish water. A few channels may be saline enough to support seaweeds (*Fucus* spp.). Sites that contain a broad spectrum of conditions also harbour a wide range of plant and invertebrate communities, so it is important that such variation is maintained.

2.3 The in-channel vegetation of ditches can include a wide range of the National Vegetation Classification aquatic and swamp communities (Rodwell, 1995). The most common aquatic communities are those characterised by duckweeds (*Lemna gibba*, *L. minor*, *L. trisulca*, *Spirodela polyrhiza*). The most frequent emergent NVC communities in freshwater ditches are S4 *Phragmites australis*, S5 *Glyceria maxima*, S6 *Carex riparia*, S8 *Scirpus lacustris* ssp. *lacustris*, S12 *Typha latifolia*, S14 *Sparganium erectum*, S22 *Glyceria fluitans* and S23 Other water margin vegetation. S20 *Scirpus lacustris* ssp. *tabernaemontani* and S21 *Scirpus maritimus* often occur in brackish ditches.

Some aquatic ditch communities, especially those that have *Hydrocharis morsus-ranae* or *Stratiotes aloides* as a component (A3 and A4), are now rare in the UK in habitats other than ditch systems. Other uncommon communities that occur in ditches are A6 *Ceratophyllum submersum*, A21 *Ranunculus baudotii*, S1 *Carex elata* and S2 *Cladium mariscus*. Several aquatic plants (e.g. *Potamogeton acutifolius* and *P. compressus*) are confined or almost confined to ditches. In addition to aquatic vascular plants, ditch systems can be very important for charophytes. These are largely early colonisers, flourishing best in the period following ditch clearance.

3. Attributes and targets

3.1 A series of broad habitat attributes has been defined, which should be monitored in order to assess whether the ditch feature is in favourable condition. At least one target is specified for each attribute. The targets set out here are for guidance only and may need to be modified in the light of the local characteristics and history of the site. Assessment of most of the attributes is mandatory, but one (salinity gradient) is not relevant to all sites and another (water chemistry) need only be assessed if data are available from the statutory environmental protection agencies or where condition assessment indicates that there may be a pollution problem. Then it may be necessary to undertake further investigative water quality monitoring if such data are not available. Indicators of local distinctiveness should be monitored wherever they are significant elements of the feature.

3.2 The seven attributes used for monitoring ditch systems are listed below. Some have two or more constituent elements. Those marked * are discretionary or site-specific.

- Extent of the ditch feature
- Habitat functioning: water availability
- Habitat functioning: water quality
  - water clarity
  - algal dominance
  - * water chemistry
- Habitat structure
  - channel form
  - extent and composition of in-channel vegetation
  - extent and composition of bankside vegetation
- Aquatic vegetation composition: native species richness

- Indicators of negative change: introduced/non-native plants
- * Indicators of local distinctiveness
  - salinity gradient: - conductivity
    - botanical indicators
  - presence of rare species and quality indicators

3.3 Targets for each of these attributes and the relevant assessment methods are summarised in Table 1. The failure of any one attribute to meet its target condition generally dictates that the condition of the whole ditch feature should be classed as unfavourable.

4. Monitoring

4.1. Recommended visiting period and frequency of visits

4.1.1 Monitoring should be carried out between mid June and late August, if possible during the same month each time the procedure is repeated. The cutting regime for ditches should be taken into account when timing the visit, as ditch vegetation may be cut annually in the summer. Monitoring should precede this or take place a few weeks afterwards, to give the vegetation time to recover.

4.1.2 A monitoring visit should be made at least once in each six-yearly reporting cycle. If possible, additional visits should be made on two or three other occasions within each reporting cycle, to check on problems or potential problems noted during the main monitoring visit. This could be done when the site is being visited for other purposes, such as liaison with site managers. These extra visits would provide an early warning of deterioration, so that timely remedial action can be taken. The full monitoring procedure should take between one and five days, depending on the size of the site.

4.1.3 A preliminary visit is an essential precursor to the first full monitoring session. This visit is required in order to locate precise monitoring sites (see Procedures).

4.2. Skills required

A limited amount of taxonomic expertise is required for monitoring ditch vegetation. Plants should be identified to species level wherever possible, but if this is difficult (e.g. for some *Callitriche* and *Utricularia* spp., *Potamogeton* hybrids, some lower plants) identification to genus is generally sufficient. Where determination to species is not possible, a voucher specimen should be collected for future reference and/or subsequent identification. A useful identification guide to aquatic plants is Haslam, Sinker & Wolseley (1975) and a simple key to charophytes is given in Stewart & Church (1992).

4.3. Equipment

Very little equipment is needed for the fieldwork. The following is suggested:

- site maps, species checklists (Appendices 1, 2, 3), recording forms (Appendices 4, 5)
- graduated pole for measuring water depth and for safety purposes
- small grapnel for sampling aquatic vegetation
- hand lens
- polaroid sunglasses to enhance the ability to see submerged plants
- camera for photographing sampling sites and features of interest
- conductivity meter (for sites with a brackish element)
- GPS equipment for pinpointing sampling sites (optional).

4.4. Overview of monitoring methodology

The plant survey methodology recommended for monitoring ditch systems draws on *A standard method for the survey of ditch vegetation* (Alcock & Palmer, 1985), used widely by the Nature Conservancy Council in the 1980s. The species-richness standards suggested here are a modification of those in *Guidelines for selection of biological SSSIs* (NCC, 1989). The ditch assessment method, unlike the general quality assessment method for standing waters described by Biggs *et al.* (2000a and 2000b), does not use invertebrates, fish or periphyton. However, ditch invertebrate communities, both aquatic and marginal, are considered indirectly through the recommendations made here on habitat features. It is assumed that if the targets for water quantity and quality and for habitat structure are reached, conditions on the site will be generally favourable for ditch invertebrates.

4.5. The dual approach: structured site walk and fixed point sampling

4.5.1 Site condition is assessed within a standard framework (see Generic attributes table) that specifies the attribute being assessed, the target to be reached and the method of assessment. Habitat attributes can only be monitored effectively by a general approach, covering a large area of the site. This is achieved by walking a fixed route through the site and recording a number of general ditch characteristics. In contrast, some plant community attributes are best measured using quantitative botanical survey methods applied to small sample areas. Such detailed vegetation sampling is obviously more time-consuming and demands more taxonomic expertise than recording general features during a structured walk. This rapid overview of a site is a cost-effective monitoring method, but the information gathered can be somewhat subjective. Quantitative botanical recording at fixed sampling points produces more objective data. A combination of the two methods should enable a good overall impression of site condition to be obtained, together with hard evidence to illustrate the state of aquatic plant communities. Both elements are needed in order to determine whether targets for favourable condition have been met.

4.5.2 Recording during the structured walk is used for

- checking on the **extent** of the feature
- estimating **water availability**
- monitoring water clarity (an aspect of **water quality**)
- assessing **water quality** using algae as indicators
- assessing general **habitat structure** (channel form, in-channel vegetation, bankside cover)
- recognising biological disturbance by introduced plants (an **indicator of a negative trend**)
- determining the presence of rare plants and other species indicative of high quality ditches (an aspect of **local distinctiveness**)
- checking on salinity gradient (an aspect of **local distinctiveness**)

4.5.3 Detailed vegetation sampling at fixed points is used for

- quantifying species-richness (an aspect of the **aquatic vegetation composition**)
- recording the presence of plant communities indicative of a **salinity gradient** (an aspect of **local distinctiveness**).

Water depth, water clarity, algal cover, conductivity, habitat structure and the abundance of non-native plants are recorded as background information at these sampling points.

4.6. Recording information along the structured walk

4.6.1. The route of the structured walk should be fixed and marked on a site map. GPS should be used in the field, if available. The route should closely follow the ditches and should cover at least 10% of the total channel length on the site. The walk should include a fair representation of all the major variation present within the interest feature, for instance

- salinity gradients, if relevant
- major and subsidiary channels
- different soil types
- areas with different ditch management regimes
- grazed and ungrazed areas
- a range of successional stages in the ditch system (see Habitat Structure).

4.6.2. At some sites where ditches are present, not all of them necessarily form part of the notified interest feature. Where this is the case, the structured walk should avoid these ditches which are exempt from the assessment.

4.6.3. The route should take in specific features, including

- depth gauges
- inflow and outflow points
- populations of plants characteristic of the site (threatened, Nationally Scarce and 'quality indicators' (listed in Appendix 2)), chosen because they are relatively widespread on the SSSI
- uncommon plant communities (see Indicators of local distinctiveness)
- all the vegetation sampling sites.

4.6.4 A standard recording form for the walk is given as Appendix 5. The attributes to be assessed are given on the form, in 4.5.2. and in the generic condition table (Table 1). Additional information that could prove useful should also be gathered, including evidence of recent ditch management, maintenance of pollarding regimes, signs of obvious change since the previous visit and potential pollution sources. Points where specific observations are made should be marked on the site map, as well as being noted on the recording form.

4.6.5 The structured walk should be divided into sub-sections of approximate equal length, with a review point at the end of each. The recording form is filled in at each review point. The overall result is obtained by producing a combined assessment of the results from all the sub-sections, in the ways explained later.

4.7. Procedure for sampling in 20 m ditch lengths - see Appendix 1

Vegetation sampling units are representative 20 m lengths of ditch in mid or late succession (see Habitat structure). A length of 20 m is chosen because this can be viewed in detail from one spot and is easily estimated (10 paces in each direction).

Please see Appendix 1 for the procedure

5. Condition assessment

The following paragraphs should be read in conjunction with Table 1.

5.1. Extent of the ditch feature

This attribute considers any reductions in channel length. This includes loss caused by active management, such as infilling or channel diversion. Drying out and successional change are covered under other attributes (see Habitat structure).

5.2. Water availability: water levels

The levels characteristic of the site, in relation to both freeboard and water depth, should be maintained. The assessment should, if possible, be guided by knowledge of historical water regimes. High water levels are particularly important in spring and early summer for semi-aquatic riparian invertebrates. Water levels should be recorded using depth gauges, if they are present. Ditches that are being deliberately left to revert to reedswamp are excluded from the assessment. Although the overall target is set at a mean depth of at least 50 cm, the water level in main drains may be expected to be considerably more than this, usually at least 1 m. However, the level can be subject to large variation as a result of seasonal demand for water supply in the catchment. During critically dry periods a subsequent visit may be needed to re-assess water levels over the whole or part of the site.

5.3. Water quality: water clarity

Water quality underpins the status of many of the interest features in ditches. Brown coloration of the water is natural in acid peat areas, but other types of discoloration or turbidity may be due to phytoplankton blooms, ochre deposits or polluting effluent. The water should be clear enough to enable the ditch bottom to be visible, where the density of aquatic vegetation allows observation.

5.4. Water quality: algal dominance

The effect of excessive nutrient enrichment is often signified by increased prevalence of algae, either filamentous or planktonic. The combined cover of filamentous algae and *Enteromorpha* species is estimated as one indicator of eutrophication (phytoplankton blooms are covered in 7.3). Macro-algal dominance is assessed in freshwater ditches only: it should not be estimated in brackish ditches because *Enteromorpha* and other macro-algae are associated with salinity. Late in the summer, or during exceptional spells of hot or dry weather, there may be a temporary build-up of algae that pushes cover well above the target of maximum 10% mean cover. A further visit will then be needed to check whether algal cover has reduced and the target can be regarded as having been reached.

Charophytes are not included in this assessment because, unlike most other macro-algae, they are pollution-sensitive and need clear water.

5.5. Water quality: water chemistry (discretionary attribute)

Where data are available it will be possible to assess water quality against the targets for total phosphorus and chemical class, as given in Table 1. Targets should be assessed against mean annual concentrations. Unless routine water analysis is the norm for the site, chemical analysis need be carried out only if there is an incident such as a fish kill, or when changes in water clarity or the aquatic vegetation indicate possible pollution. Specialist advice should then be sought to investigate the problem and to give guidance on a water sampling regime. Sources of water entering the ditch system should be taken into account when considering actual or potential problems. Field drains and roads, for instance, may be sources of pollution. (See also Section 5.12.)

5.6. Habitat structure: channel form

The presence of shallow wet margins to ditches increases habitat diversity for aquatic plants and aquatic and semi-terrestrial invertebrates. Trapezoidal channels lack these shallow water areas.

Non-trapezoidal profiles include those where the banks have been trampled by stock, where the ditch has been allowed to silt up but still contains water, or where berms have been constructed. Berm creation is especially desirable in sites where there is little opportunity for extensive stands of emergent vegetation to develop. An important feature for the conservation of semi-terrestrial invertebrates is the continuity of stands of emergent vegetation. Ditch profiling and vegetation management should allow for this continuity.

The percentage of ditch length with trapezoidal and non-trapezoidal cross sections is estimated. A range of variation in ditch profiles appropriate to the site should be present and the target may be modified according to the characteristics of the site. Trapezoidal profiles are acceptable in some types of site or ditch system. Examples are wetland sites (e.g. those with large amounts of fen or with areas of shallow standing water) and sites consisting of a single main drain with a few feeders containing abundant emergent vegetation. Traditional management techniques should be considered when deciding on the appropriateness of ditch profiles.

5.7. Habitat structure: extent/composition of in-channel vegetation

A species-rich ditch system will have a balance of early, mid and late successional stages, allowing full expression for submerged, floating and emergent elements of the vegetation. The successional stage of ditches is determined by desilting or reprofiling, not by vegetation cutting. The latter has little effect on succession because regrowth is rapid. Early succession ditches are those that have been desilted or reprofiled in the same year as the monitoring visit and so contain little aquatic plant growth. Mid-succession ditches are those with small amounts of open water and a mixture of submerged, floating and emergent vegetation, the last not occupying more than 70% of the ditch width. Late succession ditches contain over 70% cover of emergents. This may not be apparent if ditch vegetation has been cut in the season of the site visit. The large amount of organic debris or cut stems under the water will indicate this.

5.8. Habitat structure: extent/composition of bankside vegetation

Although some bankside shading can provide habitat for some invertebrate species, heavy shading is detrimental to characteristic ditch flora and fauna. Heavy shading reduces the growth of aquatic macrophytes and causes a build-up of leaf litter in the ditches. During the structured walk an assessment is made of the percentage of channel length that is heavily shaded (i.e. over 50% of the channel surface overhung) by coarse ruderal vegetation, scrub or hedges. Ditch sections in which the principal management objective is to maintain woodland or scrub are excluded from this assessment.

5.9. Aquatic vegetation composition: native species richness

High quality ditch systems are rich in plant species, often providing refugia for formally widespread aquatic vegetation. The mean number of aquatic plant species per 20 m length of ditch is used as a measure of diversity. A checklist of submerged, floating and emergent plants is given as Appendix 2. As brackish systems are naturally species-poor, different targets are given for fresh and brackish ditches. The targets of 7 species on average for freshwater ditches and 5 for brackish ditches were derived by reference to extensive surveys of ditch systems in England and Wales.

In sites of exceptionally high quality, ditches may contain considerably more species per 20 m length than the target numbers. If this is the case, the mean number of taxa per sample should be used as the target in subsequent monitoring visits. If there is then a decrease of two or more species on average, compared with the initial visit, the condition of the ditch should be graded as unfavourable, even if the generalised target (freshwater: 7, brackish: 5) is met.

Although the relative abundance of species is not used in the targets, it is advisable to record plants on the DAFOR scale. If this is done over several reporting cycles, trends in relative species abundance may be distinguishable. These could be useful pointers to potential change of condition (see procedure for sampling in Appendix).

5.10. Indicators of negative trends: non-native/introduced plants

Non-native plant invasions may result in gross distortions to aquatic plant communities. However, long-established, widespread non-native species such as *Elodea canadensis* (first recorded in the British Isles in 1836 - Croft & Preston, 1997) are now frequently a prominent component of ditch vegetation and can coexist with a diverse aquatic community. However, it is desirable to limit the spread of such species to new sites and regions of the British Isles. It is also important that monitoring for condition assessment does not contribute to their spread around the site. Care should be taken to ensure that plant fragments are not transferred on either equipment or on the boots of surveyors. (The same precautions are necessary in sites where non-native crayfish occur.)

Aquatic plants non-native to the UK and recorded in ditches are listed in Appendix 3. Most of these species are potentially invasive, but the four indicated ** are especially aggressive and their presence may have serious management implications. *Azolla* spp., *Crassula helmsii* and *Hydrocotyle ranunculoides* can blanket sections of ditch and out-compete native species (Croft & Preston, 1997) resulting in a significant loss of diversity. *Myriophyllum aquaticum* may also have this potential. If any of these four species is found on the site, remedial measures should quickly be put in place to eliminate them or at least to prevent their spread. Because some non-native species are more damaging than others, separate targets are given for each of the four most aggressive species (maximum 1% cover) and for combined cover of all non-natives (maximum 30%).

Lemna minuta is not included in the assessment unless there is an obvious over-abundance of *Lemna minor*/*minuta.* These two species are difficult to separate (*L. minuta* fronds have a single vein, *L. minor* fronds have 3 to 5 veins) and estimating their relative abundance is very difficult in the field. In sites where thick blankets of *Lemna* are widespread, samples should be taken to check for the presence of *L. minuta* (a microscope may be needed). Only if the majority of the sample is found to consist of *L. minuta* should it be included in the assessment.

Where invasive native plants with a restricted natural distribution in the UK (e.g. *Stratiotes aloides* and *Nymphoides peltata*) are introduced to an area well away from their natural range, they should be treated as non-native. Appendix 2 gives the distribution of native aquatic plants and indicates where the less common ones have been introduced.

5.11. Indicators of local distinctiveness: presence of rare species and quality indicators

Indicators of local distinctiveness are features that form part of the reason for notification but which are not covered by the attributes already described or by separate guidance e.g. for notified species features. They should be apparent from the SSSI citations or past surveys. This is a discretionary attribute in that it may not be applicable to every site; but where local distinctiveness has contributed to the selection of a site it should be mandatory. A detailed species monitoring target is not required, rather to provide a rapid indication of presence/absence and or approximate extent, allowing for natural fluctuations in population size.

This attribute therefore covers only those species that are not features to be monitored in their own right. For example, plant species that are notified features (such as *Luronium natans*, which is listed in Annexes II and IV of the EC Habitats Directive) should not be included in this assessment as they will be monitored separately.

Each site will have its own characteristic aquatic plant flora, determined by geographical location, history and management regime. The flora may include Schedule 8, Red List, Nationally Rare or Nationally Scarce species and other species indicative of good water quality or rich ditch systems (e.g. *Hottonia palustris, Hydrocharis morsus-ranae, Groenlandia densa,* charophytes). All these species are indicated in Appendix 2. Other plants mentioned on the SSSI citation may also be included. A suite of species should be selected and the structured walk should be routed so that populations can be checked and recorded as present where appropriate. If a species cannot be found in its usual location on the route of the walk it should be searched for elsewhere, to confirm its loss from the site as a whole.

The feature may also support uncommon characteristic plant communities, the most notable of which are A3 *Spirodela polyrhiza-Hydrocharis morsus-ranae,* A4 *Hydrocharis morsus-ranae - Stratiotes aloides*, A6 *Ceratophyllum submersum*, A21 *Ranunculus baudotii*, S1 *Carex elata* and S2 *Cladium mariscus.* The continued presence of these vegetation types should be recorded during the structured walk. Invertebrate species may also have been noted on the SSI citation or from previous surveys, and their continued presence would need to be noted.

5.12. Indicators of local distinctiveness: salinity gradient

This attribute is site-specific. A natural saline transition adds to diversity, as brackish and freshwater ditches contain distinct assemblages of plants and invertebrates. Artificial salinity gradients, for instance those caused by road run-off, are not desirable features. A freshwater/ brackish transition, as indicated by conductivity measurements below and above 2000 µmhos cm^{-3}, should be maintained. Conductivity of 2000 µmhos cm^{-3} indicates a salinity of approximately 500 mgL^{-1} NaCl. (However, it could also indicate highly polluted water, so caution should be used before assuming that a salinity gradient exists simply on the evidence of high conductivity.) Conductivity for brackish ditch water ranges from about 2000 to over 15000 µmhos cm^{-3}.

If a salinity gradient is a feature of the site, 20 m sampling sites should be chosen to represent brackish as well as freshwater ditches. Using the records of aquatic plants gathered under 'Aquatic vegetation composition', brackish and freshwater assemblages can be distinguished, the aim being to maintain these as distinct elements.

The flora of saline ditches is generally poorer than that of freshwater ones because few species can tolerate salinity. The most saline channels may contain seaweeds such as *Fucus* spp. and abundant *Enteromorpha.* Other aquatic species tolerant of brackish water are listed in Appendix 4. All the saline-tolerant species except *Bolboschoenus maritimus*, *Ranunculus baudotii* and *Ruppia* spp. may also occur in eutrophic fresh water, but in the latter a wide range of other species would also be found. Brackish water communities are defined as much by the absence of salinity sensitive species as by the presence of tolerant ones. Widespread ditch margin species that can be used as additional indicators of brackish areas are listed in Appendix 4.

5.13. Aspects of environmental disturbance noted as an accompaniment to condition assessment

Other characteristics not covered by this guidance may be of significance for maintaining site quality, despite not being used in condition assessment. Incidental points of interest should be noted during the monitoring visit. They include evidence of undesirable management activity, sightings of non-native fish or other non-native animals, or signs of disturbance that might suggest the presence of such species. Disturbance by introduced animal species may manifest itself in deterioration in water quality (e.g. churning of the bottom by carp), in changes in the quantity or structure of vegetation or in damage to banks from burrowing. It is unlikely that disturbance by introduced animals, apart perhaps from carp, would result in the site not reaching

the targets under water quality or plant community attributes, thereby causing general site condition to become unfavourable. However, priority species can be affected by introductions of non-native aquatic animals (e.g. water voles by mink; native crayfish by American signal crayfish). If introduced animal species are suspected of causing damage or impairing the capacity of the ditch system to support characteristic flora and fauna, specialists should be called in to investigate and quantify the problem and to suggest remedial measures.

5.14. Overall assesment

Biological and non-biological attributes must be examined for condition assessment of both vascular plant and habitat features. A site should be classed as being in unfavourable condition if any individual attribute fails to meet its targets. However, careful consideration must be given to the confidence in the data collected. The absence of a species when habitat conditions are favourable could be a false negative due to the ecology of the species, or the timing of the survey. Failure of a particular attribute from low confidence data should trigger further investigation and monitoring.

6. Generic attributes table

The following table lists the generic attributes that should be used to define the condition of ditch systems and gives guidance on target setting and appropriate methods for assessment.

Table 1. UK GUIDANCE ON CONSERVATION OBJECTIVES FOR MONITORING DESIGNATED SITES

Interest feature: Ditch systems

May include the following aquatic and swamp NVC communities (Rodwell, 1995):

A3 *Spirodela polyrhiza-Hydrocharis morsus-ranae*; A4 *Hydrocharis morsus-ranae - Stratiotes aloides*; A6 *Ceratophyllum submersum,* A21 *Ranunculus baudotii* and other aquatic communities.

S1 *Carex elata*; S2 *Cladium mariscus*; S3 *Carex paniculata*; S4 *Phragmites australis*; S5 *Glyceria maxima*; S6 *Carex riparia*; S7 *Carex acutiformis*; S8 *Scirpus lacustris* ssp *lacustris*; S9 *Carex rostrata*; S10 *Equisetum fluviatile*; S11 *Carex vesicaria*; S12 *Typha latifolia*; S13 *Typha angustifolia*; S14 *Sparganium erectum*; S15 *Acorus calamus*; S16 *Sagittaria sagittifolia*; S17 *Carex pseudocyperus*; S18 *Carex otrubae*; S19 *Eleocharis palustris*; S20 *Scirpus lacustris* ssp *tabernaemontani*; S21 *Scirpus maritimus*; S22 *Glyceria fluitans*; S23 Other water-margin vegetation.

Equivalent Phase 1 category: G1 Standing water (part)

Reporting category: Standing open water and canals

NB All attributes listed are mandatory unless indicated as discretionary or site specific by *.

Attribute	Targets	Method of assessment	Comments
Extent of the ditch feature	No reduction in channel length	During the structured walk note any changes caused by active management, such as infilling or channel diversion.	These observations do not include drying out or successional change, which are covered under other attributes.
Habitat functioning: water availability	Characteristic water levels to be maintained. Generally, in wet ditches summer water depth at least 0.5 m in minor ditches and 1 m in major drains. 90% of channel length should reach this target.	Ideally, depth gauges should be inserted in ditches at strategic points, including the main feeder. During the structured walk, water levels should be recorded using these gauges and/or by probing ditches with a pole marked in quarter metre intervals.	The levels characteristic of the site, in relation to both freeboard and water depth, should be maintained. High water levels are particularly important in spring and early summer for semi-aquatic riparian invertebrates. Except for parts of the ditch system that dry up naturally in the summer or are being allowed to succeed to swamp in a long management rotation or are influenced by tidal flow, a good depth of water should be maintained. If the site is used as a wash, or if ditches within it are used as reservoirs by the drainage authorities or the land manager, periodic flooding or high water levels will be encountered.
Habitat functioning: water quality			Water quality underpins the status of many of the interest features in ditches.

Attribute	Targets	Method of assessment	Comments
a) water clarity	Water clear or only slightly turbid/discoloured in at least 90% of channel length	Along the structured walk note unnatural turbidity or discoloration of water. For each sub-section, record % of the length (to nearest 5%) with clear water, % with slight turbidity/coloration and % with marked turbidity/coloration. The overall result is the mean of each set of figures from the sub-sections.	Both turbidity and coloration are recorded under this attribute. Blooms of planktonic algae cause reduced water clarity. Ochre deposits in peaty areas can also cause discoloration. Brown coloration of the water in acid peat areas is natural, so should not be regarded as discoloration.
b) extent of algal dominance	Mean cover of filamentous macro-algae and *Enteromorpha* not more than 10% (mid June to end August)	For each structured walk sub-section, in freshwater ditches only, estimate % cover of the channel (to nearest 5%) by filamentous algae and *Enteromorpha* species taken together. Occasional sampling of the vegetation by grapnel may be necessary. The overall result is the mean of cover values for the sub-sections.	The effect of excessive nutrient enrichment is often signified by increased prevalence of algae, either filamentous or planktonic. Algae such as *Enteromorpha* are not good indicators in saline conditions. Charophytes are not included in the group of macro-algae indicative of nutrient enrichment because they need clear water.
c) *water chemistry	Total phosphorus <0.1 mg L^{-1}; water quality equivalent to at least Chemical Class 2 of the River Quality Classification.	Water sampling should be undertaken using specialist advice about location and frequency. The analyses should be done in a specialist laboratory (e.g. by the Environment Agency).	If water sampling and analysis are carried out routinely on the site these results should be assessed. Additional sampling or new baseline chemical analysis are needed only if water clarity or aquatic vegetation composition indicate poor water quality. Total phosphorus levels for groundwater-fed systems should be considerably less than 0.1 mg L^{-1}. Toxic substances are of concern, but there is currently no relevant standard biological monitoring technique or surveillance programme for ditches. For basic parameters (dissolved oxygen, biochemical oxygen demand and total ammonia) a minimum equivalent to Chemical Class 2 of the River Quality Classification should be maintained, with no drop in class.

Attribute	Targets	Method of assessment	Comments
Habitat structure: channel form	A range of variation in ditch profiles. If ditches are the only wetland feature, no more than 75% of ditch length with a trapezoidal cross-section. (This target may be adjusted according to the characteristics of the site.)	During the structured walk, note variation in ditch profiles and make an estimate of the percentage (to the nearest 5%) of ditch length with trapezoidal and non-trapezoidal cross sections in each sub-section of the route. The overall result is calculated by taking the mean of the figures for the sub-sections.	Shallow, as well as deep water, is important for the maintenance of diverse plant and invertebrate assemblages. The context and traditional management practices of the site should be taken into consideration when deciding on the target for non-trapezoidal ditch length. In a fenland site with ample areas of shallow standing water, trapezoidal ditch profiles may be acceptable. Non-trapezoidal profiles include those where the banks have been trampled by stock, where the ditch has been allowed to silt up but still contains water, or where berms have been constructed. Berm creation is especially desirable in sites where there is little opportunity for extensive stands of emergent vegetation to develop by leaving some ditches unmanaged, where trampling of the banks by stock is limited, or where ditches are the only permanent wetland feature present.
Habitat structure: extent/ composition of in-channel vegetation	Mix of early, mid and late succession ditches: 10-25% early 35-75% mid 10-25% late	Make an assessment for each of the structured walk sub-sections of the percentage (to nearest 5%) of channel length in early, mid and late successional stages. The overall results are the means of the three sets of values.	Characteristic faunal assemblages require a range of successional stages, from open water, through domination by submerged higher plants, to swamp communities. Some open water plant species require early and mid-successional stages, but late succession ditches are important for emergents. Early succession ditches are defined here as those that have been desilted or reprofiled in the same year as the monitoring visit. Late succession ditches have >70% cover of emergents. This may not be apparent if ditch vegetation has been cut in the season of the site visit. The large amount of organic debris and stems under the water will indicate this.
Habitat structure: extent/ composition of bankside vegetation	Where aquatic vegetation is a key feature of the site, no more than 10% of the channel length should be heavily shaded.	For each of the structured walk sub-sections, assess the percentage (to nearest 5%) of channel length that is heavily shaded (i.e. over 50% of the channel surface overhung) by coarse ruderal vegetation, scrub or hedges. The overall result is the mean of the values recorded for the sub-sections.	Although some bankside shading can provide habitat for some invertebrate species, heavy shading is detrimental to characteristic ditch flora and fauna. It shades out aquatic plants, leading to the loss of plant diversity and vegetated habitat for aquatic invertebrates and vertebrates. Where ditch vegetation is the chief interest (i.e. excluding areas where woodland is the key interest) shading should be limited. Ditches may be shaded by vegetation for only half their width, completely shaded for part of the day only, or densely and continuously shaded. Heavy shading (the feature assessed here) is defined as >50% of the ditch surface being overhung by bankside vegetation.

Attribute	Targets	Method of assessment	Comments
Aquatic vegetation composition: native species richness	Native aquatic flora of ditches species-rich: freshwater ditches - mean at least 7 species per 20m; brackish ditches - mean at least 5.	5 to 10 fixed sampling points are established in each ditch. Between mid June and mid August, record (on DAFOR scale) all native aquatic plant taxa in each 20 m sampling site. Calculate the mean number of species to give the overall result. For fresh and brackish ditches calculate separate means.	If the site is designated for the botanical interest of the ditches, in-channel vegetation should be rich in native plant species. Appendix 2 should be used as a checklist of native aquatic plants (submerged, floating and emergent) when counting the number of species present. Some difficult vascular plant groups (e.g. *Utricularia* spp., *Callitriche* spp.), charophytes and mosses need only be identified to genus. Plants are recorded using the DAFOR scale of abundance. This enables trends in relative species abundance to be detected over a series of monitoring cycles, if required. In sites of exceptionally high quality, ditches may contain considerably more species per 20 m length than the target numbers. If this is the case, the mean number of taxa per sample should be used as the target in subsequent monitoring visits. If there is then a decrease of two or more species on average, compared with the initial visit, the condition of the ditch should be graded as unfavourable, even if the generalised target (freshwater: 7, brackish: 5) is met.
Indicators of negative change: introduction of or natural colonisation by non-native plants	Mean cover of each very aggressive non-native plant not exceeding 1%. Mean total combined cover of all non-native species and introduced species less than 30%.	For each structured walk sub-section estimate abundance of non-native or introduced aquatic plant species: (a) for each of the four most invasive non-native species (see Appendix 3): separate percentage cover values (b) for all non-native and introduced species: a combined percentage cover value (to the nearest 5%). Occasionally sampling vegetation with a grapnel will be necessary. The overall results (for a and b) are the mean of the cover values for the sub-sections.	Non-native plant invasions may result in gross distortions to aquatic plant communities. The very aggressive *Azolla* spp., *Crassula helmsii* and *Hydrocotyle ranunculoides* can blanket sections of ditch and out-compete native species, resulting in a significant loss in diversity. *Myriophyllum aquaticum* may also have this potential in ditches. A more stringent target may be necessary on large ditch systems. Native plants are able to co-exist somewhat more easily with other non-native species, such as *Acorus calamus*, *Elodea* spp. and *Lagarosiphon major*. The non-native *Lemna minuta* is not included in this assessment unless it is found to be dominant, because it is very difficult to distinguish from *Lemna minor*. Where invasive native plants with a restricted natural distribution in the UK (e.g. *Stratiotes aloides* and *Nymphoides peltata*) are introduced to a site outside their natural range, these species should be treated as ‘non-native’.

Attribute	Targets	Method of assessment	Comments
*** Indicators of local distinctiveness: rare species and quality indicators**	Populations of rare species and other species/ communities characteristic of high quality ditch systems should persist.	Record for each sub-section of the structured walk the presence of rare aquatic plant species and other species/ communities chosen as 'quality indicators'. Where possible, take note of the size and condition of the population and the extent of flowering.	Each statutory site will have its own characteristic aquatic plant flora, varying according to geographical location, history and management regime. The aquatic flora may include internationally or nationally protected, nationally threatened or scarce species and should include other species indicative of high quality ditch systems. All these are listed in Appendix 2. A suite of these species should be selected. Other notable plants mentioned on the SSSI citation may also be included in the observations, if desired. The monitoring system should be designed to pick up those that are relatively widespread on the site, to check that populations persist. Ditches may also support uncommon characteristic plant communities, the most notable of which are A3 *Spirodela polyrhiza-Hydrocharis morsus-ranae*, A4 *Hydrocharis morsus-ranae - Stratiotes aloides*, A6 *Ceratophyllum submersum*, A21 *Ranunculus baudotii*, S1 *Carex elata* and S2 *Cladium mariscus* or invertebrate features of interest. The persistence of these should be confirmed.
*** Indicators of local distinctiveness: salinity gradient**			Salinity gradients support specialist species that would not otherwise be present. This attribute should only be considered in sites with a natural fresh/brackish water transition. Artificial salinity gradients, for instance those caused by road run-off, are not desirable features.
a) conductivity	Where saline influences are characteristic, the existing salinity gradient across the site to be maintained.	While walking the structured route, record water conductivity at the inflow of the system and at 50 to 100 m intervals along any suspected transition.	A conductivity of >2000 µmhos cm^{-3} indicates either brackish water (salinity >500 mg L^{-1} NaCl) or highly polluted water. Conductivity for brackish ditch water ranges from c. 2000 to over 15000 µmhos cm^{-3}.
b) botanical indicators	Plant communities to reflect the fresh/brackish transition.	In the 20 m sampling sites in representative high and low conductivity areas record the presence of saline-tolerant aquatic plants species (see list under Comments). These species should be most numerous and/or most abundant in areas of high conductivity.	Saline-tolerant aquatic plant species include *Bolboschoenus maritimus, Ceratophyllum submersum, Myriophyllum spicatum, Potamogeton pectinatus, Potamogeton pusillus, Phragmites australis, Ranunculus baudotii, Ruppia* spp., *Schoenoplectus tabernaemontani, Typha angustifolia, Zannichellia palustris* and some *Chara* spp. All these species except *Ruppia* spp. and *B. maritimus* may also occur in eutrophic fresh water.

7. References

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8. Appendix 1. Procedure for sampling in 20 m ditch lengths

Vegetation sampling units are representative 20 m lengths of ditch in mid or late succession (see main text). A length of 20 m is chosen because this can be viewed in detail from one spot and is easily estimated (10 paces in each direction).

The locations of all the vegetation sampling points are marked on a map of the site, so that they can be revisited. GPS may be used to do this. After reprofiling or desilting it may be necessary to relocate some sampling points to areas nearby in mid or late succession. Sampling sites are chosen to cover a range of mid and late succession vegetation types, for instance ditches dominated by submerged stands of *Potamogeton* species; lengths in which floating-leaved species such as water lilies dominate; areas with a mixture of submerged and floating-leaved species; channels with a dense cover of emergents. All the sampling sites should be wet ditches, not those left unmanaged and reverting to reedswamp. Other variation, where it exists, should be covered within the selection of sampling sites (see main text methods).

All sampling sites should be photographed on each monitoring visit. Photographs are useful for relocating sampling sites and provide an invaluable record of changes in the vegetation.

The number of sampling points required varies with the size and diversity of the statutory site, but there should not be fewer than 5 or more than 10 for each ditch. It should be possible for one person to sample ten 20 m lengths in a day, as well as carry out the required recording along the structured route.

Vegetation is sampled by throwing a grapnel into the ditch and identifying the plants retrieved. (Note: where Schedule 8 species (see Appendix 2) are present at a site, any licensing issues with using a grapnel should be checked prior to the site visit.) Repeat the throws until no additional species are found. A checklist of native aquatic species is given in Appendix 2 and Appendix 3 is a checklist of non-native aquatic species. Vascular plants should be identified to species level wherever possible, but where this is very difficult (e.g. for *Callitriche* spp., *Utricularia* spp. or *Potamogeton* hybrids) the genus may be used, as indicated in Appendix 2. If determination to species is not possible, a voucher specimen should be collected for future reference and/or subsequent identification. A very limited checklist of bryophytes is included in Appendix 2 and genus, rather than species, is the unit used for charophytes when assessing taxon-richness. However, for other purposes (e.g. checking on the presence of rare species) it may be necessary to identify charophytes to species. The SSSI citation and previous survey records will provide an indication of the species to look out for.

Plants are recorded using the DAFOR scale of abundance (and not just 'species presence' alone). Although the DAFOR ratings will not contribute to condition assessment in the short term, it is important to collect this additional information for longer term assessments. Changes in the DAFOR rating over a series of monitoring cycles will enable trends in relative species abundance to be detected over time. A trend that is established over several sampling cycles and is related to changes in site management or other impacts could be indicative of declining condition. DAFOR ratings are assessed on the basis of percentage cover of the 20 m of channel length by the taxon under consideration. Because of the layering typical of aquatic vegetation, with emergent and/or floating plants forming canopies over submerged species, total cover may exceed 100%.

D (Dominant)	70% to 100% cover (roughly more than two-thirds cover)
A (Abundant)	30% to under 70 % cover (roughly one- to two-thirds cover)
F (Frequent)	10% to under 30% cover
O (Occasional)	3% to under 10% cover
R (Rare)	< 3% cover

A standard field recording form for 20 m sampling sites is given as Appendix 6. Part of the information to be gathered comprises a set of background measurements and assessments. Targets for species-richness are provided, for use in assessing whether the plant community is in a favourable condition.

The following habitat information should be recorded as additional background information to give context to the native plant recording. Although there are no overall targets for these data, they gives context to the native plant data and may help to explain any changes in condition over time.

- Measure the water depth. (Water depth is recorded by probing ditches with a pole marked in quarter metre intervals. The pole should be allowed to gently penetrate soft sediment so that the end of it rests on fairly firm substrate. If the water is too deep to measure with a pole, a weighted length of string on the end of the pole can be used.)
- Assess water clarity on a three-point scale:-
  - the whole 20 m clear
  - slight or limited turbidity or coloration (green, brown)
  - marked or extensive turbidity or coloration.
- Take a conductivity reading if there is a salinity gradient on the site.
- Record whether the channel is trapezoidal or non-trapezoidal.
- Note whether the ditch is in the mid or late successional stage
- Assess the extent of heavy shade on a three-point scale:-
  - none
  - up to 50% of the 20 m length shaded
  - over 50% of the 20 m length shaded.
- Assess on the DAFOR scale the total macro-algal cover (filamentous species and *Enteromorpha*).
- Assess on the DAFOR scale the cover of each non-native aquatic plant species (Appendix 3). *Lemna minuta* is not included in the assessment unless there is an obvious over-abundance of *Lemna minor*/*minuta* (see Indicators of negative trends).

9. Appendix 2. Checklist of aquatic native plants found in ditches in the UK

Vascular plants	Code		UK distribution	British status	NI status	Quality indicator
Alisma gramineum	Al.g	Ribbon-leaved water-plantain	E	Sch.8 CR		
Alisma lanceolatum	Al.l	Narrow-leaved water-plantain	E S W NI			
Alisma plantago-aquatica	Al.p	Water-plantain	E S W NI			
Apium inundatum	Ap.i	Lesser marshwort	E S W NI			
Apium nodiflorum	Ap.n	Fool's water-cress	E S W NI			
Baldellia ranunculoides	Ba.r	Lesser water-plantain	E S W NI			Q
Berula erecta	Be.e	Narrow-leaved water-parsnip	E S W NI			
Bolboschoenus maritimus	Bo.m	Sea club-rush	E S W NI			
Butomus umbellatus	Bu.u	Flowering rush	E W (intro S NI)			
Callitriche brutia	Ca.b	Pedunculate water-starwort	E S W NI			
Callitriche hamulata	Ca.h	Intermediate water-starwort	E S W NI			
Callitriche hamulata agg. (*C. hamulata*/*brutia*)	Ca.hb		E S W NI			
Callitriche hermaphroditica	Ca.he	Autumnal water-starwort	E S W NI			Q
Callitriche obtusangula	Ca.o	Blunt-fruited water-starwort	E S W NI			
Callitriche platycarpa	Ca.p	Various-leaved water-starwort	E S W NI			
Callitriche stagnalis	Ca.s	Common water-starwort	E S W NI			
Callitriche stagnalis agg. (*C. obtusangula/platycarpa/stagnalis*)	Ca.sp		E S W NI			
Callitriche truncata	Ca.t	Short-leaved water-starwort	E W	NS		
Carex acuta	Cx.at	Slender-tufted sedge	E S W NI			
Carex acutiformis	Cx.af	Lesser pond-sedge	E S W NI			
Carex aquatilis	Cx.aq	Water sedge	E S W NI			Q
Carex elata	Cx.el	Tufted sedge	E S W NI			Q
Carex lasiocarpa	Cx.la	Slender sedge	E S W NI			
Carex limosa	Cx.li	Mud sedge	E S W NI			
Carex paniculata	Cx.pa	Greater tussock-sedge	E S W NI			
Carex pseudocyperus	Cx.ps	Cyperus sedge	E W NI (intro S)			

	Code		UK distribution	British status	NI status	Quality indicator
Carex riparia	Cx.ri	Great pond-sedge	E S W NI			
Carex rostrata	Cx.ro	Bottle sedge	E S W NI			
Carex vesicaria	Cx.ve	Bladder sedge	E S W NI			
Carex sp.	Cx.sp					
Catabrosa aquatica	Ct.a	Whorl-grass	E S W NI			
Ceratophyllum demersum	Ce.d	Hornwort	E S W NI			
Ceratophyllum submersum	Ce.s	Soft hornwort	E W NI			Q
Cicuta virosa	Ci.v	Cowbane	E S W NI	NS		
Cladium mariscus	Cl.m	Great fen-sedge / saw sedge	E S W NI			Q
Crassula aquatica	Cr.a	Pygmyweed	S	Sch8 VU		
Eleocharis acicularis	El.a	Needle spike-rush	E S W NI			Q
Eleocharis palustris	El.p	Common spike-rush	E S W NI			
Eleogiton fluitans	Eg.f	Floating club-rush	E S W NI			
Equisetum fluviatile	Eq.f	Water horsetail	E S W NI			
Glyceria declinata	Gl.d	Small sweet-grass	E S W NI			
Glyceria fluitans	Gl f	Flote-grass	E S W NI			
Glyceria maxima	Gl.m	Reed sweet-grass	E S W NI			
Glyceria notata	Gl.n	Plicate sweet-grass	E S W NI			
Glyceria fluitans agg. (*G. declinata/fluitans/notata)*	Gl.sp					
Groenlandia densa	Gr.d	Opposite-leaved pond-weed	E W NI (intro S)		IRL	Q
Hippuris vulgaris	Hi.v	Mare's tail	E S W NI			
Hottonia palustris	Ho.p	Water violet	E W NI (intro S)		Sch8 IRL	Q
Hydrocharis morsus-ranae	Hy.m	Frogbit	E W NI (intro S)			Q
Iris pseudacorus	Ir.p	Yellow flag	E S W NI			
Juncus bulbosus (aquatic form)	Ju.b	Bulbous rush	E S W NI			
Leersia oryzoides	Lee.o	Cut-grass	E	Sch.8 EN		
Lemna gibba	Le.g	Fat duckweed	E S W NI			
Lemna minor	Le.m	Common duckweed	E S W NI			
Lemna trisulca	Le.t	Ivy-leaved duckweed	E S W NI			
Limosella aquatica	Li.a	Mudwort	E S W NI	NS	Sch8 IRL	
Luronium natans	Lu.n	Floating water-plantain	E W (intro S & Broadland)	HD Sch8 NS		

	Code		UK distribution	British status	NI status	Quality indicator
Lythrum portula	Ly.p	Water purslane	E S W NI			
Menyanthes trifoliata	Me.t	Bogbean	E S W NI			
Myosotis scorpioides	Ms.s	Water forget-me-not	E S W NI			
Myriophyllum alterniflorum	My.a	Alternate water-milfoil	E S W NI			
Myriophyllum spicatum	My.s	Spiked water-milfoil	E S W NI			
Myriophyllum verticillatum	My.v	Whorled water-milfoil	E W NI	NS		
Nuphar lutea	Nu.l	Yellow water-lily	E S W NI			
Nuphar pumila	Nu.p	Least yellow water-lily	S	NS		
Nymphaea alba	Ny.a	White water-lily	E S W NI			
Nymphoides peltata	Nd.p	Fringed water-lily	E (native south east) (intro S W NI)	NS		
Oenanthe aquatica	Oe.a	Fine-leaved water-dropwort	E W NI			
Oenanthe crocata	Oe.c	Hemlock water-dropwort	E S W NI			
Oenanthe fistulosa	Oe.f	Tubular water-dropwort	E S W NI			
Persicaria amphibia	Pe.a	Amphibious bistort	E S W NI			
Phalaris arundinacea	Pl.a	Reed canary-grass	E S W NI			
Phragmites australis	Ph.a	Common reed	E S W NI			
Pilularia globulifera	Pi.g	Pillwort	E S W	NS	Sch8 IRL	
Potamogeton acutifolius	Po.ac	Sharp-leaved pondweed	E	VU		
Potamogeton alpinus	Po.al	Red pondweed	E S W NI			Q
Potamogeton berchtoldii	Po.be	Small pondweed	E S W NI			
Potamogeton coloratus	Po.cl	Fen pondweed	E S W NI	NS		
Potamogeton compressus	Po.cm	Grass-wrack pondweed	E S W	NS		
Potamogeton crispus	Po.cr	Curled pondweed	E S W NI			
Potamogeton filiformis	Po.fi	Slender-leaved pondweed	E(north-east) S NI	NS		
Potamogeton friesii	Po.fr	Flat-stalked pondweed	E S W			Q
Potamogeton gramineus	Po.gr	Various-leaved pondweed	E S W NI			
Potamogeton lucens	Po.lu	Shining pondweed	E S W NI			
Potamogeton natans	Po.na	Broad-leaved pondweed	E S W NI			
Potamogeton obtusifolius	Po.ob	Blunt-leaved pondweed	E S W NI			
Potamogeton pectinatus	Po.pc	Fennel-leaved pondweed	E S W NI			
Potamogeton perfoliatus	Po.pf	Perfoliate pondweed	E S W NI			
Potamogeton polygonifolius	Po.pl	Bog pondweed	E S W NI			

	Code		UK distribution	British status	NI status	Quality indicator
Potamogeton praelongus	Po.pr	Long-stalked pondweed	E S W NI			Q
Potamogeton pusillus	Po.pu	Lesser pondweed	E S W NI			
Potamogeton trichoides	Po.tr	Hairlike pondweed	E S W	NS		
Potamogeton sp (not determined)	Po.sp					
Potamogeton hybrid	Po.hy					
Potentilla palustris	Pt.p	Marsh cinquefoil	E S W NI			
Ranunculus aquatilis	Ra.a	Common water-crowfoot	E S W NI			
Ranunculus baudotii	Ra.b	Brackish water-crowfoot	E S W			Q
Ranunculus circinatus	Ra.c	Fan-leaved water-crowfoot	E S W NI			
Ranunculus flammula	Ra.f	Lesser spearwort	E S W NI			
Ranunculus hederaceus	Ra.h	Ivy-leaved crowfoot	E S W NI			
Ranunculus omiophyllus	Ra.o	Round-leaved crowfoot	E S W			
Ranunculus peltatus	Ra.p	Water crowfoot	E S W NI			
Ranunculus penicillatus subsp. *pseudofluitans*	Ra.ps	Stream water-crowfoot	E S W			
Ranunculus trichophyllus	Ra.tc	Thread-leaved water-crowfoot	E S W NI			
Ranunculus tripartitus	Ra.tt	Three-lobed crowfoot	E W	VU		
Ranunculus sp.	Ra.sp					
Rorippa amphibia	Ro.a	Great yellow-cress	E W NI (intro S)			
Rorippa microphylla	Ro.m	Narrow-fruited water-cress	E S W NI			
Rorippa nasturtium-aquaticum	Ro.n	Water-cress	E S W NI			
Rorippa sp. (*R. microphylla*/ *nasturtium-aquaticum* agg.)	Ro.sp	Water-cress	E S W NI			
Rumex aquaticus	Rm.a	Scottish dock	S	VU		
Rumex hydrolapathum	m.h	Great water-dock	E S W NI			
Ruppia cirrhosa	Rp.c	Spiral tasselweed	E S NI	NS		
Ruppia maritima	Rp.m	Beaked tasselweed	E S W NI			Q
Ruppia sp.	Rp.sp					
Sagittaria sagittifolia	Sa.s	Arrow-head	E W NI (intro S)			
Schoenoplectus lacustris	Sc.l	Common bulrush	E S W NI			
Schoenoplectus tabernaemontani	Sc.t	Grey bulrush	E S W NI			
Sium latifolium	Si.l	Greater water-parsnip	E NI	NS		
Sparganium angustifolium	Sp.an	Floating bur-reed	E S W NI			

	Code		UK distribution	British status	NI status	Quality indicator
Sparganium emersum	Sp.em	Unbranched bur-reed	E S W NI			
Sparganium erectum	Sp.er	Branched bur-reed	E S W NI			
Sparganium natans	Sp.na	Least bur-reed	E S W NI			Q
Spirodela polyrhiza	Sd.p	Greater duckweed	E W NI (intro S)			
Stratiotes aloides	St.a	Water-soldier	E (native in east) (intro S W NI)	NS		
Typha angustifolia	Ty.a	Lesser reedmace / lesser bulrush	E S W NI			
Typha latifolia	Ty.l	Great reedmace / great bulrush	E S W NI			
Utricularia australis	Ut.a	Bladderwort	E S W NI			Q
Utricularia intermedia agg. (*U. intermedia*/*ochroleuca/stygia*)	Ut.i	Intermediate bladderwort	E S W NI			Q
Utricularia minor	Ut.m	Lesser bladderwort	E S W NI			Q
Utricularia vulgaris	Ut.v	Greater bladderwort	E S W NI			Q
Utricularia vulgaris agg. (*U. australis/vulgaris*)	Ut.av		E S W NI			Q
Veronica anagallis-aquatica	Ve.a	Blue water-speedwell	E S W NI			
Veronica beccabunga	Ve.b	Brook-lime	E S W NI			
Veronica catenata	Ve.c	Pink water-speedwell	E S W NI			
Wolffia arrhiza	Wo.a	Rootless duckweed	E W	NS		
Zannichellia palustris	Za.p	Horned pondweed	E S W NI			
Mosses						
Fontinalis antipyretica	Fo.a					
Sphagnum sp.	Sp.sp					
Other fully aquatic species	Moss					
Liverworts						
Riccia fluitans	c.f					
Ricciocarpos natans	Ro.n					
Charophytes						
Chara sp.	Cha					Q
Nitella sp.	Nit					Q
Tolypella sp.	Tol					Q
'Seaweeds'						
Large species	Seaw	(e.g. *Ascophyllum*, *Fucus* spp.)				

Appendix 2 notes

1. **Codes** (abbreviations of scientific names) are given for use in filling in field recording forms, where this is convenient.

2. **UK distribution** 1987 to 1999 (Preston *et al*, 2002)

E	England
S	Scotland
W	Wales
NI	Northern Ireland

3. **British status**

HD	listed in Annexes II and IV of the EC Habitats Directive and Bern Convention Appendix I
Sch8	listed in Schedule 8 of the Wildlife and Countryside Act, 1981
CR	Red List Critically Endangered category (Wigginton, 1999)
EN	Red List Endangered category (Wigginton, 1999)
VU	Red List Vulnerable category (Wigginton, 1999)
NS	Nationally Scarce (i.e. not Red List but occurring as native in 16 to 100 10 x 10 km squares in Great Britain and listed as Scarce in Stewart *et. al.*, 1994)

4. **Northern Ireland status**

Sch8	listed in Schedule 8 of the Wildlife (Northern Ireland) Order, 1985
IRL	Irish Red List (Curtis & McGough, 1988)

5. **Quality indicator** Q plants occurring in 101 to 250 10 x 10 km squares in Britain and/or indicative of good water quality

6. For the purpose of counting the number of taxa in a 20 m length of channel, use only genus for charophytes.
   Some charophytes are Nationally Scarce, Nationally Rare or on the British Red List. If such a species is known to be present on a site its continued presence should be checked during the assessment for 'Indicators of local distinctiveness'. (Unless it is a notified interest feature in its own right, in which case the monitoring guidance specific to that species should be followed.)

7. When counting the number of taxa in a 20 m length of channel, hybrids of any of the vascular species listed above should be regarded as separate taxa.

8. Where identification is only possible to genus (e.g. for some *Callitriche*, *Utricularia* or *Potamogeton* species when not flowering) use genus when counting the number of taxa in a 20 m length of channel.

10. Appendix 3. Non-native aquatic vascular plants established in UK ditches

			UK distribution
Acorus calamus	Ac.ca	Sweet-flag	E S W NI
****Azolla** spp.	Az.sp	Water fern	E S W NI
****Crassula helmsii**	Cr.he	Australian swamp stonecrop	E S W NI
Elodea callitrichoides	Ed.cl	South American waterweed	E
Elodea canadensis	Ed.cn	Canadian waterweed	E S W NI
Elodea nuttallii	Ed.nu	Nuttall's waterweed	E S W NI
****Hydrocotyle ranunculoides**	Hy.ra	Floating pennywort	E W
Lagarosiphon major	La.ma	Curly water-thyme	E S W NI
Lemna minuta	Le.ma	Least duckweed	E S W
****Myriophyllum aquaticum**	My.aq	Brazilian water-milfoil	E S W NI
Nymphaea spp. (exotic species, cultivars etc)	Ny.sp	Water lilies	
Sagittaria latifolia	Sa.la	Duck potato	E

** the most invasive species

UK distribution 1987 to 1999 (Preston, Pearman & Dines, 2002)

E	England
S	Scotland
W	Wales
NI	Northern Ireland

Codes (abbreviations of scientific names) are given for use in filling in field recording forms.

11. Appendix 4. Native vascular plant species of saline ditches

Aquatic vascular plant species tolerant of or confined to brackish water		UK distribution
***** *Bolboschoenus maritimus*	Sea club-rush	E S W NI
Ceratophyllum submersum	Soft hornwort	E W NI
Myriophyllum spicatum	Spiked water-milfoil	E W S NI
Phragmites australis	Common reed	E S W NI
Potamogeton pectinatus	Fennel-leaved pondweed	E S W NI
Potamogeton pusillus	Lesser pondweed	E S W NI
***** *Ranunculus baudotii*	Brackish water-crowfoot	E S W NI
***** *Ruppia cirrhosa*	Spiral tasselweed	E S NI
***** *Ruppia maritima*	Beaked tasselweed	E S W NI
Schoenoplectus tabernaemontani	Grey bulrush	E S W NI
Typha angustifolia	Lesser reedmace	E S W NI
Zannichellia palustris	Horned pondweed	E S W NI

Several charophyte species (e.g. *Chara aspera*, *Chara curta*) are tolerant of brackish water.

Widespread bankside species that are good indicators of saline conditions		
Apium graveolens	Wild celery	E S W NI
Aster tripolium	Sea aster	E S W NI
Atriplex prostrata	Spear-leaved orache	E S W NI
Carex distans	Distant sedge	E S W NI
Isolepis cernua	Slender club-rush	E S W NI
Juncus gerardii	Saltmarsh rush	E S W NI
Juncus maritimus	Sea rush	E S W NI
Oenanthe lachenalii	Parsley water-dropwort	E S W NI
Parapholis strigosa	Hard-grass	E S W NI
Puccinellia distans	Reflexed saltmarsh grass	E S W NI
Puccinellia maritima	Common saltmarsh-grass	E S W NI
Spergularia marina	Lesser sea-spurrey	E S W NI
Spergularia media	Greater sea-spurrey	E S W NI
Suaeda maritima	Annual sea-blite	E S W NI
Triglochin maritimum	Sea arrowgrass	E S W NI

***** plants restricted to brackish or saline situations

UK distribution 1987 to 1999 (Preston, Pearman & Dines, 2002)

E	England
S	Scotland
W	Wales
NI	Northern Ireland

12. Appendix 5. Monitoring and assessing the condition of ditch systems: recording form for the structured walk.

Site name: **Date:** **Recorder:**

Attribute	**Assessment method (Record required)**	**Results for sub-section reviews** **1** **2** **3** **4** **5** **6** **7** **8** **9** **10**	**Overall result**		**Favour-able (Yes/No)**
Extent of feature	Ditch length (Tick if no loss, or record length lost for each sub-section)			No loss of channel length caused by active intervention	
Water availability	Water levels (Tick if target met on average for each sub-section. Targets may be modified)			Water at least 0.5 m deep (minor drains), 1 m (major drains). 90% of channel length must conform	
Water quality: 1. water clarity 2. algal dominance	1. - % length clear - % slight turbidity - % marked turbidity (Enter % length to nearest 5%) 2. Freshwater ditches (Enter % cover to nearest 5%)			1. 90% of channel length with clear or slightly turbid/ discoloured water 2. Mean cover of macro-algae in freshwater ditches no more than 10%	
Indicators of local distinctive-ness	Rare/quality species/ communities (name) (Tick if present; x if expected but absent.)			Named quality indicators characteristic of site present	
Habitat structure: 1. channel form 2. in-channel vegetation 3. bankside	1. Channel form (Enter % length non-trapezoidal) 2. In-channel veg: - % length early - % length mid - % length late (Enter % length)			1. At least 25% channel length non-trapezoidal (see Guidance) 2. Succession: 10-25% early 35-75% mid 10-25% late	

cover	3. Bankside cover (Enter % length (to nearest 5%) heavily shaded)			3. Heavy shading not more than 10% of ditch length	
Attribute	**Assessment method (Record required)**	**Results for sub-section reviews** **1 2 3 4 5 6 7 8 9 10**	**Overall result**	**Target**	**Favourable (Yes/No)**
Indicators of negative trends: non-native/introduced plants	Non-native/introduced plant cover: - enter % cover of each of the 4 most aggressive species - enter combined % cover (to nearest 5%) of all non-native/ introduced species. *Name any species included in the above.*			1. Mean cover of any of 4 most aggressive species not more than 1%; mean combined cover of all species less than 30%. 2. No gross habitat damage by introduced animals	
Salinity gradient (if appropriate)	Conductivity (Record conductivity value)			Conductivity range both < 2000 µmhos cm^3 and > 2000 µmhos cm^3	
Other records and observations					

13. Appendix 6. Monitoring and assessing the condition of ditch systems: recording form for 20 m sampling sites.

Site name: **Date:** **Recorder:**

Attribute	Assessment method **(Background info.)**	**Results for individual 20 m sampling lengths** **1 2 3 4 5 6 7 8 9 10**		**Target - 20 m sample**	**Favourable**
Water availability	Water depth (Record depth in cm)			No target	N/A
Water quality	1. Water clarity: - whole 20m clear - slight/limited turbidity/colour - marked/extensive turbidity/colour 2. Macro-algae (Record DAFOR)			No target No target	N/A N/A
Salinity gradient (if appropriate)	Conductivity: < 2000 µmhos cm^3 > 2000 µmhos cm^3 (Enter value)			No target	N/A
Habitat structure	1. Channel form: - trapezoidal - non-trapezoidal (Tick type) 2. Successional stage: (Enter mid/late) 3. Heavy shade: - none			No target No target No target	N/A N/A N/A

	- up to 50% of length - over 50% of length (Tick % length)				
Indicators of negative trends: non-native/ introduced plants	*Azolla* spp. *Crassula helmsii* *Hydrocotyle ranunc.* *Myriophyllum aquat.* *Elodea canadensis* *Elodea nuttallii* *Lagarosiphon major* Other named species (Record DAFOR)			No target	N/A
Attribute **(Vegetation recording)**		**Results for individual 20 m sampling lengths** **1 2 3 4 5 6 7 8 9 10**		**Target**	**Favourable (Yes/No)**

Aquatic vegetation composition: native species richness	(List species present. Record DAFOR values) Number of species: - freshwater ditches - brackish ditches (Record total in 20 m)			Fresh water: mean number of species (see checklist) at least 7 Brackish water: mean number of species (see checklist) at least 5	
Salinity gradient (if a feature of the site)	Plant assemblage: - freshwater - brackish (Tick type)			Both vegeta-tion types present	
Other records and observa-tions	Photograph (Tick) Voucher specimens Other information				