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Department of Transport: MWU
M4 Widening: widening within land Junction 8(9) to 10.
Plant survey of motorway ditches.

A report to Nicholas Pearson Associates

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June 1994

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Summary

This report describes a survey of the aquatic and marginal wetland macrophytes recorded from six motorway ditch sites between Junctions 8(9) and 10 of the M4 in Berkshire.

The survey was undertaken in order to: (i) record the species of aquatic and marginal wetland macrophytes in the sections (ii) assess the conservation value of the plant communities and (iii) give recommendations for appropriate mitigation measures following a proposed widening of the motorway.

Assessment of the ditches suggests that they were 'poor' or 'fair' in terms of species diversity. None of the plant species recorded were uncommon in either a national or regional context. Overall the conservation value of the plant communities in the ditches was therefor considered to be either low or low/moderate (on a four point scale, low, moderate, high, very high).

Adequate recompense for destruction of the existing ditches during motorway widening could be made by the recreation of similar, non-culverted ditches adjacent to the new road. From the existing evidence no special mitigation measures appear to be needed to protect uncommon species or unusually diverse plant communities.

Improvements in the structure of new ditches could be made by locally widening and deepening some portions to give areas of more permanent open water.

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1. Introduction

1.1 Background

This report describes a survey of the aquatic and marginal wetland macrophytes recorded from six motorway ditch sections between Junctions 8(9) and 10 of the M4 in Berkshire.

1.2 Objectives of the study

The objectives of the study were:

(i) to record the species of aquatic and marginal wetland macrophytes in selected sections of motorway ditch between Junctions 8(9) and 10;

(ii) to assess the conservation value of the plant communities recorded;

(iii) to give recommendations for appropriate mitigation measures following a proposed widening of the motorway.

2. Study area and methods

2.1 Study area

The study area covered a 10 km length of the M4 in Berkshire, between Junctions 8(9) and 10. Within this area, six motorway ditch sites were surveyed varying in length between 0.2km and 1km. A seventh section (between SU820725 and SU812720) could not be surveyed because, for safety reasons, access was not authorised by Thames Valley Police.

2.2 Plant survey methods

Macrophyte surveys were carried out on the 10th and 13th June 1994. Details of the duration of visits are given in Appendix 1.

Field survey work involved compilation of a list of all wetland macrophyte species recorded at each of the six survey sites. In addition, at each site the number of plant species in one (typical) 20m ditch section was noted to enable a assessment of ditch species richness using the system developed by Alcock and Palmer (1985). At each site brief notes were made on the abundance of wetland vegetation in the ditch and the dominant vegetation on the bankside. Taxa which can be difficult to identify in the field (particularly Water-starworts *Callitriche* spp., Water-cresses *Nasturtium* spp. and Sweet-grasses; *Glyceria* spp.) were returned to the laboratory for identification using a binocular microscope.

Note that plant species defined as 'wetland macrophytes' in this report are those listed in the Pond Action Wetland Plant List (see Appendix 2). Stace (1992) and Rich & Rich (1988) were the principal texts used for identification. The terminology for scientific and English plant names used in this report follows Dony et. al. (1986).

2.3 Methods for assessing the conservation value of plant communities.

The conservation value of the plant community at each ditch site was assessed using two criteria:

(i) Numbers of species present. In each standardised 20m survey section the number of species recorded was compared with the national criteria given in NCC (1989). See Table 1 below.

Table 1. Assessment of the species richness of ditches based on their macrophyte communities

Diversity	No. of wetland macrophyte species per 20m
Exceptional	15 or more
Good	10-14
Fair	6-9
Poor	5 or fewer

(ii) The occurrence of uncommon or rare species. To enable consistent comparisons between ditches of different length, rarity was assessed using an index of 'average species rarity' (the Species Rarity Index).
The Species Rarity Index (SRI) is calculated in the following way:

- All species present are given a numerical value depending on their national rarity status (i.e. Common = 1, Local = 2. Nationally Notable B = 4, Nationally Notable A = 8, Red Data Book 3 = 16, Red Data Book 2 = 32, Red Data Book 1 = 64).
- The values of all the species present are added together to give a total rarity score.
- The total rarity score is divided by the number of species present to give the Species Rarity Index.

Sites with a high proportion of uncommon species therefore have high index values; sites with few or no uncommon species have low values. The SRI system, whilst being relatively objective, should be regarded only as an **aid** to assessing conservation value, and **not** as an **absolute** measure. Hence it should not be used uncritically or in isolation, but always in conjunction with all other available information.

Using information about species richness and rarity, sites can be placed in one of the conservation categories given in Table 2 below.

Table 2	Provisional system for assessing the nature conservation value of plant and aquatic macroinvertebrate communities
Conservation category	**Description of the type of community**
Very High	Typically supporting a very rich community of plant and/or macro-invertebrate species, including local and rare (RDB) species (though note that some sites with rare species can be relatively species-poor). Sites in this category would normally have Species Rarity Indices (SRIs) in excess of 1.5.
High	Supporting a rich community of common plants and/or macro-invertebrate species. Generally an above-average number of local species recorded. No RDB species. Sites in this category would normally have SRIs between 1.2 and 1.5.
Moderate	Supporting a moderately-rich or rich community of common plant and/or macroinvertebrate species with at least one local species. Sites in this category would normally have SRIs between 1.01 and 1.19.
Low	Supporting a species-poor community of common plants and macro-invertebrates. No rare or local species. Sites in this category will have SRIs of 1.00.

3. Results and Discussion

3.1 Overview

3.1.1 Abundance of vegetation in the ditches

The abundance of wetland macrophytes varied considerably both within and between sites. Overall, Sites 1, 2 and 6 were relatively poorly vegetated with total cover of 10-20%. In contrast, Site 5 supported extensive stands of wetland plants which occupied up to 80% of the total length of the channel. The abundance of vegetation was strongly influenced by a combination of tree shade, ditch permanence and ditch width, with heavily shaded, narrow and/or very temporary ditches the most poorly colonised.

3.1.2 Species richness of the ditches

The number of species recorded from the sites ranged from 18 (Site 2) to 33 (Site 4). However these numbers are not strictly comparable since the length of sections varied from 0.2km to 1km. The number of species recorded from 20m survey lengths in each section gives a more representative view. This indicates that the least diverse sections were Sites 1 and 2 (both with three species). The most diverse section was Site 5 with nine species (see Table 3).

The majority of plants recorded during the survey were marginal/emergent species, with Soft Rush (*Juncus effusus*), Hard Rush (*Juncus inflexus*), Bulrush (*Typha latifolia*), Creeping Bent (*Agrostis stolonifera*), Common Fleabane (*Pulicaria dysenterica*) and Water-plantain (*Alisma plantago-aquatica*) the most commonly occurring plants. Very few aquatic species were recorded from the ditches and only Common Water-starwort (*Callitriche stagnalis*) was abundant. The small number of aquatics almost certainly reflects the temporary nature of most of the sites. However, shade and probably water quality may also have adversely affected the aquatic plant community.

3.1.3 Species rarity

None of the plant species recorded were regionally or nationally uncommon.

3.1.4 Overall conservation value of the plant communities.

Using NCCs national criteria for assessing the diversity of ditch communities (see Table 1) the ditch sites rate as either 'poor' or 'fair'. Since none of the species recorded were uncommon in either a national or regional context all have a Species Rarity Index of one.

Using the overall conservation categories given in Table 2 all ditch sites fall into the 'Low' value, category with the exception of Site 5, which borders on 'Moderate', because of its slightly higher species-richness.

In using this assessment however, it should be noted that the data were gathered during a single early-season visit. Many wetland plant species are late growing and a further survey later in the year would be expected to record and additional 20-30% more species. Amongst these could be uncommon plants which would increase the current conservation rating of the communities.

Table 3.	Conservation value of the plant communities: summary information					
	Site 1	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**
Number of species per 20m section	3	3	6	6	9	5
NCC diversity rating based on number of species per 20m section*	Poor	Poor	Fair	Fair	Fair	Poor
Number of uncommon species	0	0	0	0	0	0
Species Rarity Index*	1	1	1	1	1	1
Overall conservation rating**	Low	Low	Low	Low	low/mod	Low

* See Section 2.3 and Table 1. ** See Table 2.

3.2 Description of individual sites

Site 1 (SU880782 - SU882783)

Overall, approximately 30% of the Site 1 ditch was overhung by Grey Willow (*Salix cinerea*), Pedunculate Oak (*Quercus robur*) and Bramble (*Rubus fruticosus*). However the southerly 30m (abutting the adjacent wood) was more heavily shaded by Alder (*Alnus glutinosa*). In unshaded sections, the upper banks of the ditch were dominated by grasses, particularly False Oat-grass (*Arrhenatherum elatius*), with areas of Bramble (*Rubus fruticosus*) and Nettle (*Urtica dioica*). A large proportion of the ditch was dry.

Within the ditch the cover of wetland vegetation was low to moderate (approximately 20% for the section as a whole). Cover was lowest in areas where the ditch was dry and/or overhung by trees and shrubs. A total of 21 species were recorded from the site, and three from the 20m survey section. All were species which are nationally and regionally common. The most abundant species were Soft Rush (*Juncus effusus*), Hard Rush (*Juncus inflexus*), Bulrush (*Typha latifolia*) and Water Mint (*Mentha aquatica*).

Site 2 (SU857758 - SU854752)

(Note that no ditch was present at the northern end of the section between SU857758 and SU857757).

The ditch at Site 2 was narrow (generally <0.5m) and locally impersistent. Some sections were dry at the time of the survey and most of the length is likely to be temporary at some time of the year.

The channel was variably shaded by young Ash (*Fraxinus excelsior*), Grey Willow (*Salix cinerea*) , Hawthorn (*Crataegus monogyna*), Pedunculate Oak (*Quercus robur*) and Elm (*Ulmus sp.*) and some sections were completely obscured by Bramble (*Rubus fruticosus*). The narrow channel was often heavily overhung by bankside grasses and herbs, particularly Nettle (*Urtica dioica*) and Hogweed (*Heracleum sphondylium*) and locally by wetland species such as Hemlock (*Conium maculatum*), Meadowsweet (*Filipendula ulmaria*) and Hemlock Water-dropwort (*Oenanthe crocata*). Overall, the cover of wetland plants associated with the channel was low (less than 10% of the ditch length). Species richness was also low, with a total of 18 wetland species recorded from the whole site, and only three from the 20m survey section. Hard Rush (*Juncus inflexus*), Soft Rush (*Juncus effusus*) and Hemlock Water-dropwort (*Oenanthe crocata*) were the most abundant wetland plants recorded.

Site 3 (SU853751 - SU846744)

Site 3 was divided into two areas: Area 1 - SU854752- SU851748 to the north and Area 2 - SU851748 - SU846744 to the south).

Area 1

The ditch here had a marked flow and was heavily shaded by Grey Willow (*Salix cinerea*) and Birch (*Betula pendula*). Upper ditch banks supported a sparse cover of grasses, ruderals and Brambles (*Rubus fruticosus*). Wetland plants in the channel were largely limited to occasional single plants or small stands of Common Water-starwort (*Callitriche stagnalis*) and Common Duckweed (*Lemna minor*). The main exception was the far north of the site below the M4 bridge, where an unshaded 10m length of the ditch supported dense stands of Common Water-cress (*Nasturtium officinale*) and Bulrush (*Typha latifolia*).

Area 2

The channel in Area 2 had no flow and was locally temporary. It was also more open than the northern area with only 30-40% of the ditch overhung (predominantly by Grey Willow (*Salix cinerea*) and Birch (*Betula pendula*) on the eastern bank). Vegetation on the upper ditch banks was dominated by Bracken (*Pteridium aquilinum*), Nettle (*Urtica dioica*) and Bramble (*Rubus fruticosus*). The channel itself was moderately well vegetated (approximately 20%) with locally extensive stands of common wetland and aquatic species particularly Common Water-starwort (*Callitriche stagnalis*), Bulrush (*Typha latifolia*), Water Plantain (*Alisma plantago-aquatica*) and Soft Rush (*Juncus effusus*).

Overall, a total of 28 wetland plant species were recorded from Site 3, of which six were present in the 20m survey length. All of the species recorded were nationally and regionally common.

Site 4 (SU846744 - SU837738)

At the time of survey approximately 80% of the Site 4 ditch contained standing water, but it is likely that only a small pond adjacent to a culvert in Area 2 (see below) retains water permanently. In terms of vegetation this was a varied section which was divided into three areas:

Area 1. SU846744 to SU843742.

The channel was 30-40% shaded by Grey Willow (*Salix cinerea*) and Birch (*Betula pendula*), predominantly on the eastern bank. The upper bank vegetation in unshaded areas was dominated by bramble (*Rubus fruticosus*), grasses, and typical road verge ruderals (eg Common Chickweed, *Stellaria media*, Teasel, *Dipsacus fullonum*, and Creeping Buttercup, *Ranunculus repens*). The lower ditch banks and channel were moderately well vegetated (approximately 30%) with locally extensive stands of common wetland species, particularly Common Water-starwort (*Callitriche stagnalis*), Bulrush (*Typha latifolia*), Common Water-plantain (*Alisma plantago-aquatica*) and Soft Rush (*Juncus effusus*).

Area 2 (SU843742-SU840740)

This was the least shaded of the three areas, although the channel was locally overgrown by Bramble (*Rubus fruticosus*) and small Grey Willow (*Salix cinerea*), especially towards the southern end. The upper ditch banks were dominated by Bramble (*Rubus fruticosus*), occasional gorse (*Ulex europaeus*) and tall herbs or grasses including False Oat-grass (*Arrhenatherum elatius*), Creeping Thistle (*Cirsium arvense*), Nettle (*Urtica dioica*) and Hogweed (*Heracleum sphondylium*). Wetland bank species included Wild Angelica (*Angelica sylvestris*) and Hemlock Water-dropwort (*Oenanthe crocata*).

Wetland vegetation in the ditch was dominated by Bulrush (*Typha latifolia*), but Great Willowherb (*Epilobium hirsutum*), Water Mint (*Mentha aquatica*), Tufted Forget-me-not (*Myosotis laxa*), Gipsywort (*Lycopus europaeus*) and Common Water-starwort (*Callitriche stagnalis*) were locally frequent. Overall the cover of wetland vegetation in the ditches was moderate (approximately 35%). The most diverse area was a ponded section adjacent to a culvert running beneath the M4.

Area 3: (SU840740 - SU837738)

The ditch in the most southerly part of section 4 ran through the edge of woodland. The channel here was heavily shaded by Grey Willow (*Salix cinerea*) and Birch (*Betula pendula*). Upper banks had a sparse cover of grasses, ruderals (e.g. Cleavers,*Galium aparine*, and Bramble *Rubus fruticosus*). The channel was often dry and excepting very occasional plants of Wavy Hair-grass (*Deschampsia caespitosa*) and Ragged Robin (*Lychnis flos-cuculi*) almost bare of wetland vegetation.

Overall this rather varied site supported the greatest number of species in any of the ditches surveyed (33). However the number of species in the 20m standard survey was again relatively low (6). No nationally or regionally uncommon species were recorded.

Site 5 (SU851750 - SU846744)

Ditch Site 5 was locally temporary and impersistent, though most areas contained water at the time of the survey. The site was very open with limited (less than 10%) shade from Bramble (*Rubus fruticosus*), shrubby Grey Willow (*Salix cinerea*) and Small Birch (*Betula pendula*).

The upper ditch banks were dominated by Nettle (*Urtica dioica*), Bramble (*Rubus fruticosus*), locally Bracken (*Pteridium aquilinum*) and a wide variety of typical road verge grasses and ruderals including Teasel (*Dipsacus fullonum*).

Wetland vegetation was abundant, with approximately 80% of the ditch channel filled by mixed stands of Common Water-starwort (*Callitriche stagnalis*), Bulrush (*Typha latifolia*), Soft Rush (*Juncus effusus*), Hard Rush (*Juncus inflexus*) and Water Plantain (*Alisma plantago-aquatica*).

A total of 25 wetland plant species were recorded from Site 5, of which nine were present in the 20m survey length. All of the species recorded were nationally and regionally common.

Site 6 (SU842742 - SU837738)

Ditch Site 6 was highly temporary and at the time of survey only 10% contained standing water. Vegetation in the section was divided in to two areas:

Area 1: (SU842742 - SU839741). (from wood edge)

This section was moderately shaded with approximately 40% of channel overhung or overgrown by Grey Willow (*Salix cinerea*) and Bramble (*Rubus fruticosus*). The upper ditch banks also supported shrubby Hawthorn (*Crataegus monogyna*), Blackthorn (*Prunus spinosus*), Dog-rose (*Rosa canina*) and small Pedunculate Oak (*Quercus robur*), together with grasses and tall ruderals; particularly Creeping Thistle (*Cirsium arvense*), Nettle (*Urtica dioica*) and Hogweed (*Heracleum sphondylium*). Occasional wetland species on the upper bank included Hemlock Water-dropwort (*Oenanthe crocata*) and Wild Angelica (*Angelica sylvestris*)

The cover of wetland vegetation in the ditch channel itself was low (approximately 10%). Bittersweet (*Solanum dulcamara*) grew occasionally in the dry sections, and small stands of Bulrush (*Typha latifolia*) and occasionally Common Water-starwort (*Callitriche stagnalis*) occurred where the channel was damp or wet.

Area 2: (SU839741 - SU837738)

In this area the ditch ran adjacent to woodland and was heavily shaded by Grey Willow (*Salix cinerea*) and Silver Birch (*Betula pendula*) or overgrown by Bramble (*Rubus fruticosus*). Upper ditch banks had a sparse cover of grasses and ruderals (particularly Cleavers (*Galium aparine*). However the channel itself was almost totally bare of wetland vegetation, with very occasional plants of Bulrush (*Typha latifolia*) and Common Water-starwort (*Callitriche stagnalis*).

Overall a total of 21 wetland plant species were recorded from Site 6, of which five were present in the 20m survey length. none of the species recorded were nationally and regionally uncommon.

Site 7 (SU820725 - SU812720)

Site 7 was not surveyed because motorway access was not authorised by Thames Valley Police.

4. Mitigation proposals

The plant communities in ditches at all sites surveyed were of low or low/moderate conservation value. Adequate recompense for destruction of the existing ditches during motorway widening can be made by the recreation of similar, non-culverted ditches adjacent to the new road. From the existing evidence no special mitigation measures appear to be needed to protect uncommon species or unusually diverse plant communities in any of the ditches.

When creating new ditches improvement in the standard ditch structure could be made to the benefit of future plant communities. In particular widening and deepening some portions of the ditch would: (i) enable highly temporary sections to retain water for longer periods of the year, and (ii) reduce tree shade and bramble colonisation in some portions of ditch in the long term. Creation of wider channel sections would be particularly beneficial where the ditches run along the base of motorway embankments, and are often very heavily shaded by tall herbs and shrubs on the bank above.

5. References

Alcock, M.R. &. Palmer, M.A. (1985) *A standard method for the survey of ditch vegetation.* Nature Conservancy Council (Cst notes No. 37, unpublished).

Dony, J.G., Jury, S.L. & Perring, F.H. (1986) *English names of wild flowers.* (2nd Ed.) Botanical Society of the British Isles.

Nature Conservancy Council (1989) *Guidelines for the selection of Biological SSSIs.* Nature Conservancy Council.

Rich, T. & Rich, C. (1988) *The plant crib.* Botanical Society of the British Isles.

Stace, C. (1991) *New flora of the British Isles.* Cambridge University Press.

Appendices

Appendix 1. Plant survey dates and durations

Date	Surveyor	Time	Hours
10th June 1994	Penny Williams	9.00-15.00	6
14th June 1994	Penny Williams	7.00-14.00	8

Appendix 2. Wetland Plant Recording List

Aquatic plants

Apium inundatum
Aponogeton distachyos
Azolla filiculoides
Callitriche hamulata
Callitriche hermaphroditica
Callitriche obtusangula
Callitriche platycarpa
Callitriche stagnalis
Callitriche truncata
Callitriche sp. (undetermined)
Ceratophyllum demersum
Ceratophyllum submersum
Crassula helmsii
Egeria densa
Elatine hexandra
Eleogiton fluitans
Elodea canadensis
Elodea nuttallii
Glyceria fluitans
Groenlandia densa
Hippuris vulgaris
Hottonia palustris
Hydrocharis morsus-ranae
Isoetes lacustris
Juncus bulbosus
Lagarosiphon major
Lemna gibba
Lemna minor
Lemna minuscula
Lemna polyhriza
Lemna trisulca
Littorella uniflora
Lobelia dortmanna
Luronium natans
Menyanthes trifoliata
Myriophyllum alterniflorum
Myriophyllum aquaticum
Myriophyllum spicatum
Myriophyllum verticillatum
Nuphar lutea
Nymphaea alba
Nymphoides peltata
Oenanthe aquatica
Oenanthe fluviatilis
Potamogeton alpinus
Potamogeton berchtoldii
Potamogeton coloratus
Potamogeton crispus
Potamogeton friesii
Potamogeton gramineus
Potamogeton lucens
Potamogeton natans
Potamogeton obtusifolius
Potamogeton perfoliatus
Potamogeton pectinatus
Potamogeton polygonifolius
Potamogeton praelongus
Potamogeton pusillus
Potamogeton trichoides
Potamogeton hybrid(s)
Ranunculus aquatilis
Ranunculus baudotii
Ranunculus circinatus
Ranunculus fluitans
Ranunculus hederaceus
Ranunculus omiophyllus
Ranunculus peltatus
Ranunculus penicillatus
Ranunculus trichophyllus
Sagittaria sagittifolia
Sparganium angustifolium
Sparganium emersum
Sparganium minimum
Stratiotes aloides
Subularia aquatica
Utricularia australis
Utricularia intermedia
Utricularia minor
Utricularia vulgaris
Wolffia arriza
Zannichellia palustris

Marginal and emergent plants

Achillea ptarmica
Acorus calamus
Agrostis stolonifera
Alisma lanceolatum
Alisma plantago-aquatica
Alopecurus aequalis
Alopecurus geniculatus
Anagallis tenella
Andromeda polifolia
Angelica archangelica
Angelica sylvestris
Apium nodiflorum
Baldellia ranunculoides
Barbarea intermedia
Barbarea vulgaris
Berula erecta
Bidens cernua
Bidens tripartita
Blysmus compressus
Butomus umbellatus
Calamagrostis canescens
Calamagrostis epigejos
Caltha palustris
Cardamine amara
Cardamine pratensis
Carex acuta
Carex acutiformis
Carex curta
Carex demissa
Carex diandra
Carex disticha
Carex flacca
Carex hostinana
Carex laevigata
Carex lasiocarpa
Carex lepidocarpa
Carex nigra
Carex otrubae
Carex panicea
Carex paniculata
Carex pendula
Carex pseudocyperus
Carex pulicaris
Carex riparia
Carex rostrata
Carex spicata
Carex vesicaria
Catabrosa aquatica
Cicuta virosa
Cirsium dissectum
Cirsium palustre
Cladium mariscus
Conium maculatum
Crepis paludosa
Cyperus longulus
Dactylorhiza fuchsii
Damasonium alisma
Deschampsia caespitosa
Drosera rotundifolia
Eleocharis acicularis
Eleocharis multicaulis
Eleocharis palustris
Eleocharis quinqueflora
Equisetum fluviatile
Equisetum palustre
Epilobium hirsutum
Epilobium nerteroides
Epilobium obscurum
Epilobium palustre
Epilobium parviflorum
Epilobium tetragonum
Epipactis palustris
Erica tetralix
Eriophorum angustifolium
Eriophorum latifolium
Eriophorum vaginatum
Eupatorium cannabinum
Filipendula ulmaria
Galium boreale
Galium palustre
Galium uliginosum
Geum rivale
Glyceria declinata
Glyceria fluitans
Glyceria maxima
Glyceria plicata
Hydrocotyle vulgaris
Hypericum elodes
Hypericum tetrapterum
Impatiens capensis
Impatiens glandulifera
Impatiens noli-tangere
Iris pseudacorus
Isolepis cernua
Isolepis setacea
Juncus acutiflorus
Juncus articulatus
Juncus bufonis agg.
Juncus compressus
Juncus conglomeratus
Juncus inflexus
Juncus subnodulosus
Juncus effusus
Lotus uliginosus
Lychnis flos-cuculi
Lycopus europaeus
Lysimachia nemorum
Lysimachia nummularia
Lysimachia vulgaris
Lythrum hyssopifolia
Lythrum portula
Lythrum salicaria
Mentha aquatica
Mimulus guttatus
Mimulus luteus
Molinia caerulea
Montia fontans
Myosotis laxa
Myosotis scorpioides
Myosotis secunda
Myosoton aquaticum
Myrica gale
Narthecium ossifragum
Nasturtium microphyllum
Nasturtium officinale
Oenanthe aquatica
Oenanthe crocata
Oenanthe fistulosa
Oenanthe lachenalii
Osmunda regalis
Parnassia palustris
Pedicularis palustris
Petasites hybridus
Phalaris arundinacea
Phragmites australis
Pilularia globulifera
Pinguicula vulgaris
Polygonum amphibium
Polygonum hydropiper
Polygonum lapathifolium
Polygonum persicaria
Potentilla erecta
Potentilla palustris
Pulcaria dysenterica
Ranunculus flammula
Ranunculus lingua
Ranunculus sceleratus
Rhynchospora alba
Rorippa amphibia
Rorippa palustris
Rorippa sylvestris
Rumex hydrolapathum
Rumex maritimus
Rumex palustris
Sagina procumbens
Saggittaria sagittifolia
Schoenoplectus lacustris
ssp lacustris
ssp tabernaemontani
Schoenus nigricans
Scrophularia auriculata
Scutellaria galericulata
Senecio aquaticus
Senecio fluviatilis
Sium latifolium
Solanum dulcamara
Sparganium erectum
Stachys palustris
Stellaria alsine
Stellaria palustris
Symphytum officinale
Thalictrum flavum
Thelypteris palustris
Tofieldia pusilla
Tricophorum cespitosum
Triglochin palustris
Typha angustifolia
Typha latifolia
Valeriana dioica
Veronica anagallis-aquatica
Veronica beccabunga
Veronica catenata
Veronica scutellata
Viola palustris

Others

Algae:

Chara sp.
Nitella sp.
Tolypella sp.

Bryophytes:

Fontinalis antipyretica
Riccia fluitans
Ricciocarpus natans
Sphagnum sp.

Trees and shrubs:

Alnus glutinosa
Frangula alnus
Populus sp.
Salix sp.

Appendix 3. Plant species recorded in ditches alongside M4 (Junction 8/9 - 10)

Plant species recorded		Site						Rarity Score	
Scientific name	**English name**	**1**	**2**	**3**	**4**	**5**	**6**	**National**	**Regional**
Agrostis stolonifera	Creeping Bent	+	+	+	+	+	+	1	1
Alisma plantago-aquatica	Water- plantain			+	+	+	+	1	1
Alopecurus geniculatus	Marsh Foxtail		+					1	1
Angelica sylvestris	Wild Angelica				+		+	1	1
Apium nodiflorum	Fool's Water-cress		+				+	1	1
Callitriche stagnalis	Common starwort	+		+	+	+	+	1	1
Cardamine pratensis	Cuckooflower		+	+	+			1	1
Carex otrubae	False Fox-sedge	+	+	+	+	+	+	1	1
Cirsium palustre	Marsh Thistle	+		+			+	1	1
Conium maculatum	Hemlock	+			+			1	1
Deschampsia caespitosa	Tufted Hair-grass				+		+	1	1
Equisetum palustre	Marsh Horsetail			+				1	1
Epilobium hirsutum	Great Willow-herb	+	+	+	+	+	+	1	1
Epilobium obscurum	Short-fruited Willow-herb*			+		+		1	1
Eupatorium cannabinum	Hemp-agrimony				+			1	1
Filipendula ulmaria	Meadowsweet		+		+			1	1
Galium palustre	Common Marsh-bedstraw			+	+	+	+	1	1
Glyceria fluitans	Floating Sweet-grass	+			+	+		1	1
Juncus articulatus	Jointed-rush	+		+	+	+		1	1
Juncus bufonis agg.	Toad Rush			+				1	1
Juncus conglomeratus	Compact Rush	+		+		+		1	1
Juncus inflexus	Hard Rush	+	+	+	+	+	+	1	1
Juncus effusus	Soft-rush	+	+	+	+	+	+	1	1
Lemna minor	Common Duckweed			+				1	1
Lotus uliginosus	Greater Bird's-foot Trefoil			+	+	+	+	1	1
Lychnis flos-cuculi	Ragged-robin				+			1	1
Lycopus europaeus	Gipsywort		+	+	+	+	+	1	1
Lythrum salicaria	Purple-loosestrife	+						1	1
Mentha aquatica	Water Mint	+	+		+	+	+	1	1
Myosotis laxa	Tufted Forget-me-not				+	+	+	1	1
Nasturtium officinale	Water-cress			+	+			1	1
Oenanthe crocata	Hemlock Water-dropwort		+	+	+		+	1	1
Phragmites australis	Common Reed			+				1	1
Polygonum hydropiper	Water-pepper	+		+	+	+		1	1
Pulcaria dysenterica	Common Fleabane	+	+	+	+	+	+	1	1
Ranunculus sceleratus	Celery-leaved Buttercup		+		+			1	1
Sagina procumbens	Procumbent Pearlwort				+	+		1	1
Scrophularia auriculata	Water Figwort	+			+	+		1	1
Solanum dulcamara	Bittersweet	+	+	+	+	+	+	1	1
Symphytum x uplandicum	a Comfrey hybrid				+			1	1
Typha latifolia	Bulrush	+	+	+	+	+	+	1	1
Algae									
Cladophora sp.	Filamentous algae	+	+	+	+	+	+	1	1
Trees									
Alnus glutinosa	Alder	+						1	1
Salix caprea	Goat Willow			+				1	1
Salix cinerea	Grey Willow	+	+	+	+	+	+	1	1
Salix fragilis	Crack Willow						+	1	1
Total Number of species		**21**	**18**	**28**	**33**	**24**	**22**		
Number of species in 20m section		**3**	**3**	**6**	**6**	**9**	**5**		
Species Rarity Index (see Section 2)		**1**	**1**	**1**	**1**	**1**	**1**		

*Note: Young, non-flowering specimens identified partly on the basis of the remains of 1993 fruiting material