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BROADLAND ENVIRONMENTAL SCORING  
METHODOLOGY



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**FINAL REPORT**

**BROADLAND ENVIRONMENTAL SCORING METHODOLOGY**

**ENVIRONMENT AGENCY**

**ANGLIAN REGION**

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# BROADLAND ENVIRONMENTAL SCORING METHODOLOGY

## FINAL REPORT

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Ms Jane E. Harris has kindly provided a copy of her MSc Thesis "A Study of the Ecology, Land-use and Conservation Value of the Ronds of the Broadland Rivers." This document has provided valuable insight into the vegetation systems that are present on the ronds. She also provided the initial lists of plants for the internal plant criterion, and these results from her work provide insight for this part of the proposed methodology. This is acknowledged with thanks.

The insight and approaches provided from the earlier methodologies have been very valuable in the development of this methodology and are gratefully acknowledged.

## 1. NON-TECHNICAL SUMMARY

The proposed method is an environmental scoring methodology, to allow a quality score to be assigned to sections along the rivers (ronds) within Broadland by using the Environment Agency's REDS plant species data and the dimensions of the ronds themselves. It has been designed to support the main purposes of the engineering works and erosion control, but does not include these in assessing environmental (ecological) value. The method proposed includes four categories of quality where a rond is present:

- low, medium, high and exceptional.

A rond or section is assigned a score based on passing three environmental criteria (variables) thresholds. These are based on two biological criteria (for existing quality) and one environmental criterion (for potential quality). The biological criteria are divided into external and internal criteria (relative to Broadland) and relate to species of plants present. The external list refers to the Red Data Species or other nationally recognised species. The internal list is derived from the work by Harris (1992). By passing a threshold for presence of species a rond scores a pass (or possibly a double pass for the external criterion) and moves up a category, e.g. from Low to Medium. The environmental criterion on area proposed is the Edge : Area Quotient (as suggested by the Broadland Environmental Forum) where a quotient of less than 0.12 is a pass of this criterion (e.g. a larger contiguous area relative to its perimeter).

This method has been tested on Compartments 22 (for Freshwater and Brackish Plant Species Criteria and Edge : Area Quotient) and 34 (for Saltmarsh Plant Species Only) along parts of the Rivers Chet, Yare and Waveney with the following results:

Category	Compartment 22		Compartment 34
	Full Test (% of all sections)	Species Test Only (% with Rond)	Species Tests Only (% surveyed with Rond)
No Rond	6 (18%)	6	0
Low	3 (9%)	5 (19%)	6 (46%)
Medium	8 (24%)	13 (48%)	7 (54%)
High	9 (27%)	8 (30%)	0
Exceptional	7 (21%)	1 (4%)	0

This method provides an objective and effective method for segregating ronds (sections) into quality classes using existing data. It is important to read the full report to note the limitations of using the REDS data but the results demonstrate the method provides the range of grading required, by an easy to use method that appears robust.

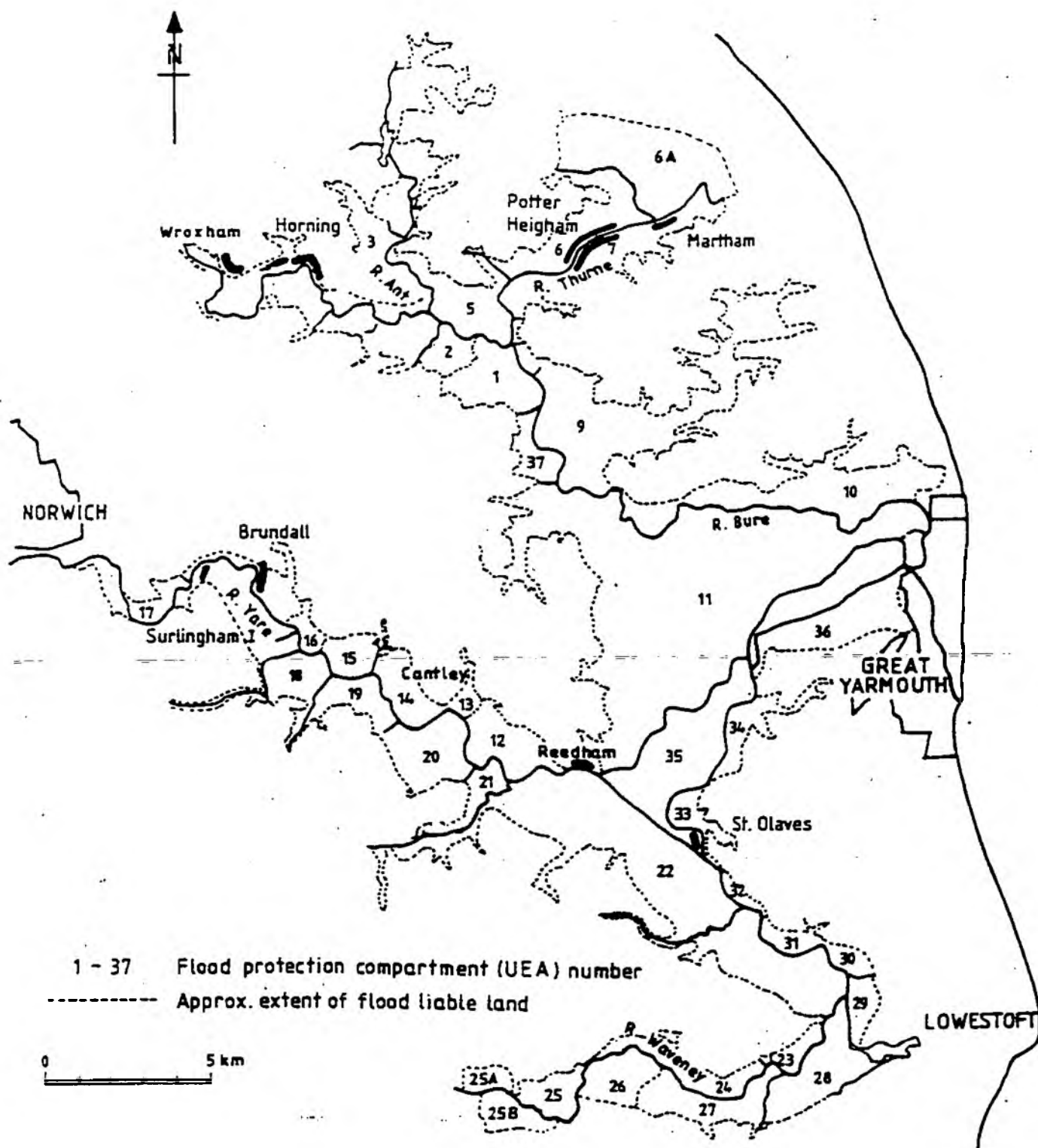
## 2. INTRODUCTION

The Environment Agency - Anglian Region (Environment Agency) is undertaking a programme of flood defence works and erosion protection schemes in Broadland. This is an extended programme of works and will continue for about 10 years in the anticipated schedule. Works are to be carried out in all 37 of the Broadland Flood Compartments to provide increased protection by bank strengthening and other works. As part of the work the Environment Agency desires to improve the conservation value of the area, and to focus this on areas which can be determined to have a greater or potentially greater conservation value.

Engineering studies have previously determined that the minimum width of a rond for flood defence protection is about 2m. However other environmental studies have identified that rond widths greater than 20m have a disproportionately higher conservation value. The Environment Agency therefore would like an environmental scoring methodology to determine which ronds are of greater interest and of what widths, so that where appropriate the ronds could be maintained or protected at widths greater than 2m. It is known that one of the likely engineering methods for bank strengthening can extend to about 6m, where for widths beyond this the work would likely need to be carried out from a barge with associated higher costs. The environmental scoring methodology would allow the Environment Agency to make decisions as to when works beyond 2m or 6m may be acceptable.

The Environment Agency has contracted Dr. John Henry H. Looney to finalise the earlier drafts and methods for the above purposes, providing a reliable and easy to apply classification of the ronds, and also to provide background on the earlier Scoring Methods proposed, to note the limits of the method and to provide comment on its practical application. This report provides this information to the Environment Agency, and a test of the method on Compartments 22 and 34 (Figure 1).

The structure of the report provides this introduction, a background to the method development, a description of the methodology, a worked application of the method with results from two Broadland Compartments, and conclusions and recommendations. A key is that the method has been summarised in an easy to use form in Appendix D, which stands as a separate User Guide. Other appendices provide discussion on the theoretical considerations and results of the tests.



**Figure 1**  
**FLOOD PROTECTION COMPARTMENTS**  
**Showing Test Compartments 22 and 34**  
 (From Binnie 1994)



### 3. BACKGROUND

#### 3.1 General

The history of the development and management of Broadland is a fascinating subject that is not within the context of this study, which is to provide a Broadland Environmental Scoring Methodology to assist the Environment Agency in ascertaining which ronds are of greater value from an ecological/ conservation perspective. Dr Martin George (George, 1992) provides an excellent, broad based and thorough review of most or all matters related to Broadland. It is not attempted here to review the ecology or management of Broadland, its rivers and the existing conditions, both intentional and otherwise, which are affecting the continuing development of the area. George (1992) and others provide such in detail.

The ronds are part of the original floodplain / meanders of the rivers that are now in effect isolated on the river side of the flood defence structures. Originally the ronds were wide as the defences were usually built some distance from the river edge and therefore they provided some flood / tidal storage. George (1992, p 69) comments:

"Those responsible for reclaiming the saltings and fens which once bordered the rivers must have realised, either intuitively, or as a result of experience, that it was best to set the necessary embankments well back from the water's-edge, rather than immediately beside it. The shelf-like ronds (or 'rands') created in this way tend to be widest beside the lower, more strongly tidal reaches of the main rivers, suggesting that their primary function was to provide temporary storage space for water carried upstream on flood tides, and during surges. But the early reclaimers may also have realised that an embankment set back from the river would be stronger, more durable and easier to construct than one placed directly beside it, and that a wide rond would also reduce the amount of leakage through the new flood wall."

Since the establishment of the flood walls the rivers have been constrained within narrower limits and the ronds have been subjected to flows and physical conditions that are different to those that led to the original deposition that formed the floodplain of which the ronds are a part. Additionally, it is well recorded that since the 1940s there have been increasing pressures on the waterways of the broads, mainly from pleasure craft, as well as significant changes in the management of the vegetation of the ronds. The water chemistry has also changed during this period with resulting changes in the ecology. All of these combine, with an increased tidal flow in some of the rivers due to dredging of the rivers and estuaries and also sea level change, to exert significant

physical (and chemical) pressures on the physical and biological components of the ronds.

With the natural erosion that would occur from the hydraulics of the rivers, and these additional factors, it would only be possible to conclude that the rond systems are not static but would naturally undergo some degree of change and movement of their edges over time. This type of process is defined in ecological terms as either succession (here previously prevented from progressing by management) or alternatively cyclical change. These are both longer term processes and are not generally very well accommodated by Management Plans. George (1992) refers to the effects of meander migration over centuries and how the rivers now lie against the flood defences on the outsides of bends, and how on all systems there has been extensive erosion.

George (1992) also ascribes much value to the plant community described as a marginal reedswamp, both from erosion prevention as well as conservation value. The marginal reedswamp consists of *Phragmites* growing in the upper and middle reaches of the rivers, with saltmarsh in the lower reaches. The "gently sloping margins of the river channel would have favoured the growth of a wide band of" this fringing/ marginal community. George (1992) notes that both the littoral-reed (roots in the substrate) and hover-reed (roots in the water only, in mats) variants would have been present. The advantage of this community from an erosion perspective is that it absorbs energy from waves and dissipates this before they reach the bank, thereby protecting the bank. This community also has inherent ecological value from the species present and habitat provided.

The work by Harris (1992) on the Ecology, Land-use and Conservation value of the Broadland rivers provides an appropriate assessment of the plant communities that exist within and on the ronds on the Broadland rivers. The approach and data from this work are more directly relevant to the issues considered here than the data available from the Environment Agency Rivers Environmental Database (REDS), though the REDS data provide useful and valuable input to the scoring methodology. Harris (1992) has surveyed the extent and land use of the ronds, established an initial description and classification and map of the vegetation on the ronds, and described and assessed the extent of the rond habitats..

The Norfolk Broadland Erosion Protection Scheme Environmental Assessment (NBEPSEA), prepared by Binnie and Partners in March 1994, refers to the ronds and their relationship to flood defences (see their page 2-4). They note that on the ronds there are three distinct types of vegetation:

- saltwater vegetation in the lower reaches - this is largely salt marsh
- brackish vegetation - mainly reedbed or fen
- freshwater vegetation in the upper reaches - mainly reedbed or fen

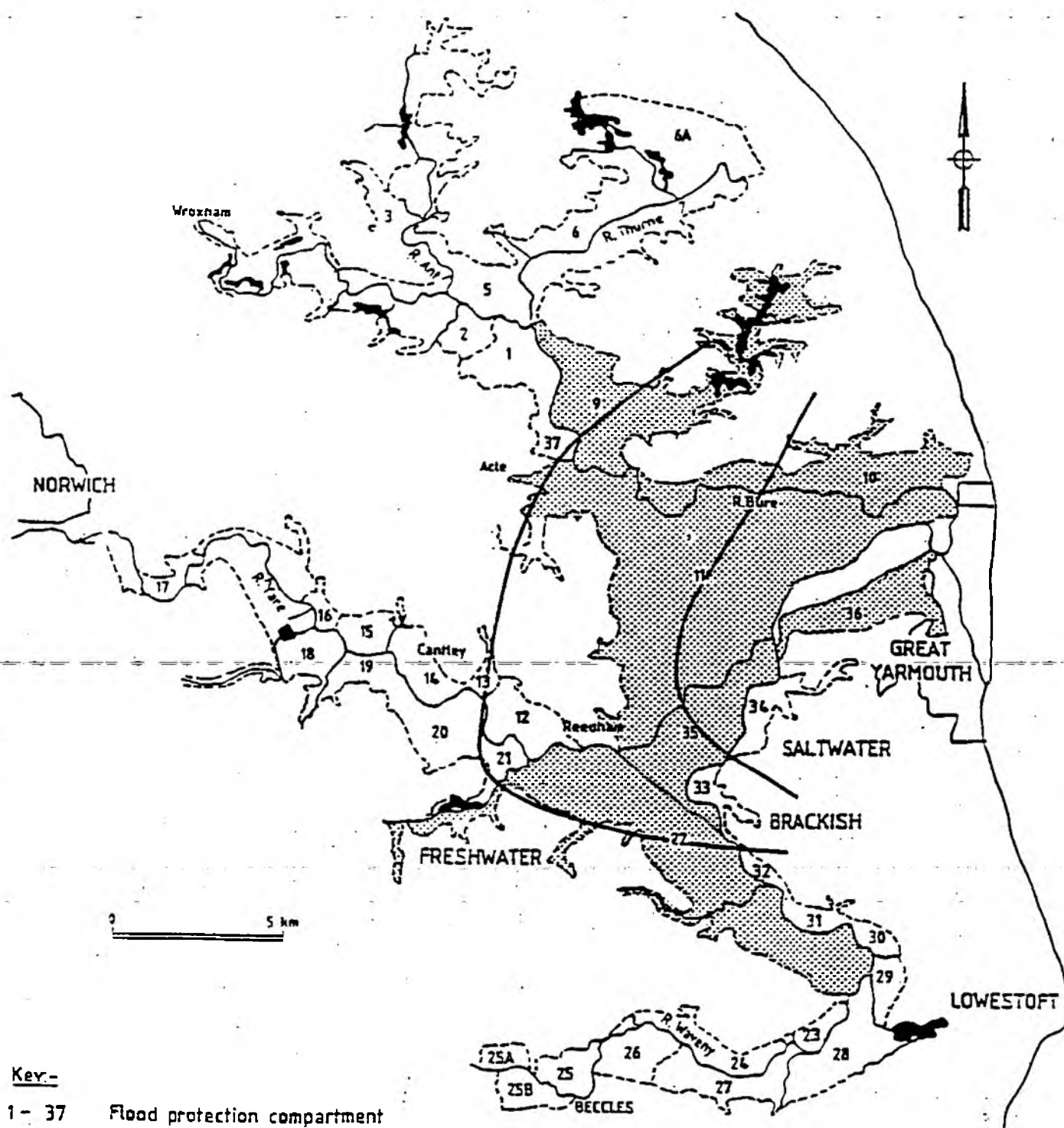
They show the approximate boundaries of these in a figure (Figure 2). This shows that much of Compartment 22 falls within the Brackish zone, with the upper end of the Waveney in the freshwater zone, while Compartment 34 is entirely within the saltmarsh section.

### 3.2 Scoring Systems by Binnies/UEA and the Environmental Forum

#### 3.2.1 Binnies/UEA Environmental Scoring System

The original system by Binnie and the University of East Anglia was based on nine (9) variables, each of which was scaled from 1 to 5. The individual scores were then added together to give an overall score, without any weighting factors applied, with the left and right banks being assessed separately, to fit the compartment's definition. The main source of ecological data is the Environment Agency Rivers Environmental Database System (REDS), which is a survey of 500m sections of the rivers, with both banks reported together. The nine variables Binnies used were:

- |                          |   |
|--------------------------|---|
| • Plant Richness         | the number of plant species in the section  |
| • Bird Richness          | the number of bird species in the section   |
| • Rond type              | a subjective score based on the rond landuse, e.g. high scores for reedbed, with low scores for boat moorings |
| • Rond Width             | the average width from REDS data  |
| • Rond Continuity        | a subjective assessment of the proportion of a section with a rond wide enough to provide continuity          |
| • Threatened Plant Score | the number of such species - not defined  |
| • Threatened Bird Score  | the number of such species - not defined  |
| • Habitat Score          | Based on a subjective assessment of the number of habitats in a section, from the REDS map                    |
| • Hinterland Score       | Based on the landuse behind the floodbank, from the REDS map  |



**Key -**

- 1 - 37 Flood protection compartment (UAE) number
- Approx extent of flood liable land

**Figure 2**  
**FLOOD PROTECTION COMPARTMENTS**  
 Showing Salinity Zones  
 (From Binnie 1994)

The Binnie scores could therefore range from 0 to 45, where:

Score	Environmental Value
0 - 15	Low
16 - 25	Medium
26 - 35	High
36 - 45	Exceptional

Further detail is provided in the Binnie report.

The environmental objectives set were to:

- conserve and enhance the ecological value of the ronds
- have the appearance of the finished works harmonise with its surroundings
- have the finished works not interfere with other activities in the area

The results for the Binnie Environmental Scoring Method for Compartment 22 as the number of 500m reaches are:

- Low 7
- Medium 15
- High 10
- Exceptional 0

The results for all six compartments studied showed that there were not any exceptional ronds, which has been regarded as unlikely by the Broads Environmental Forum. In use of the results, when compared to the work by Harris, it was determined that the 20m width criterion was important for species richness and that reduction below this was significant. Therefore ronds where the environmental score was greater than 17 (the medium value, medium is quoted by the Forum, not median) and the rond width was less than 20m were given the highest priority for erosion protection.

This approach was reviewed by the Broads Environmental Forum, consisting of individuals from Norfolk County Council, the Broads Authority, the Environment Agency, English Nature and the RSPB. Their comments were summarised by Claire Redmond, then of the Environment Agency (personal communication). These include:

- the approach should centre on the health of the rond
- the scoring should allow some ronds to be in the exceptional category
- the landscape contribution needs to be more carefully considered - but others think it should be deferred until later
- management should be considered

- habitat objectives should be for compartments not all of Broadland
- small isolated ronds may be more important, also increase the minimum width from 2m to 10m
- the presence of specialist bird species should be a prime indicator of the importance of a stretch of reed rond, not diversity
- wider ronds are likely to be of greater ecological diversity, especially for red data book bird species

The conclusions were that:

- landscape should be included
- weighting factors should be used for more critical factors, e.g. specialist bird species
- different scores for different compartments should be expected
- agree priorities, e.g. is 20m the critical width
- integrate erosion rates into the scheme

Following the above there were additional comments by the Forum, with agreement that the size would relate to the 500m river corridor sections, and that indicator species would be used which related to the rond.

### 3.2.2 Environmental Forum Environmental Scoring Method

From the above a revised methodology was prepared by Debbie Dunsford of the Broads Authority, dated 29 July 1994. This is a more sophisticated system, based on an ecological score consisting of rond size (edge : area ratio - expressed as a quotient), indicator species birds, indicator species plants, and rarity weightings. Additionally a landscape score based on land use of the hinterland and the isolation of the rond was used. Finally an erosion score was used, based on bank profile. These were then amalgamated into a priority scoring system for action. The overall methodology was generally regarded by the users as too complicated, but had many good features that would provide useful information for environmental scoring.

This method was then reviewed in August 1994 by the Forum, with additional notes added in November 1994. The environmental score was combined with the landscape score but kept separate from the erosion rate. The environmental score was based on five components:

- the size (edge to area ratio - e.g. quotient)
- indicator plant species
- indicator bird species
- rare plant species
- rare bird species

These were then divided by percentages into five classes, with the top 20% scoring 5. A final comment was on the need to look at the continuity of ronds and not just via 500m REDS sections.

It was at this stage that Dr J.H.H. Looney was asked to review the methodology and produce a working draft, this was carried out in 1995. The landscape and erosion components were not included in the method as data were not consistently available, nor was an appropriate method available to combine these with the ecological scores. After further review it was agreed to finalise Dr. Looney's methodology for use in the project.

#### 4. PROPOSED SCORING METHODOLOGY

##### 4.1 Purpose

As the two approaches to developing an Environmental Scoring Methodology discussed above did not meet their goals, largely by attempting too much, e.g. erosion, ecology and landscape together in one and too many variables in the other, the Environment Agency wanted to design a scoring method with the following purpose. This is to:

'define an Environmental Scoring Methodology to provide a reliable and easy to apply classification of the ronds, for the purpose of improving conservation alongside the required flood defence works.'

Included in Appendix A is a supporting review of issues related to the theoretical and practical considerations related to this purpose.

##### 4.2 Proposed Method

###### 4.2.1 Approach

The proposed approach to the Environmental Scoring Method is to provide independent criteria for the definition of environmental or ecological value. If no Rond is present, this method is not used and the score of 'No Rond' is recorded. Where a rond is present the three criteria are considered, and by achieving a sufficient score for a pass of any of these the site would be recognised as having value. If more than one of the several criteria were passed then the site would be recognised as having higher value. This approach therefore prevents the compilation of a site score based on different criteria that objectively can not be ranked or combined by letting each part attribute value to the total. The method uses the following levels:

- No Rond
- Low
- Medium
- High
- Exceptional.

It is proposed to accept the REDS data as relevant to the left and right banks (ronds) separately, even though the REDS data are for sections on the rivers for both banks, except where this is known to be incorrect (e.g. for Waveney 176 the Right Bank was not surveyed so the data cannot be used for Compartment 34, see below).



It is proposed to recognise the three different salinity zones (ecological areas) in Broadland and to calculate scores for saltmarsh, brackish and freshwater sections using different indicator species.

The following criteria are proposed:

- External - Plant Species - use of nationally or internationally recognised species - see Appendix A, with data from the REDS database but noting these data apply to both banks;
- Internal - Plant Species - use of Harris (1992) plant lists as revised by Dunsford for this method, through the use of indicator species for a rond applied by REDS' sections. It is here that the 3 areas from salt to fresh will be assessed separately, as much as a section can be correctly assigned to a category from the map.
- Potential/Existing Value - use of the edge to area quotient proposed by the Forum. This variable will identify the larger contiguous ronds that would likely have existing ecological value as well as the potential for ecological value over time.

#### 4.2.2 Methodology

The proposed method is based on the Environment Agency REDS sections, as these data are easily available for the Broadland area. Some awareness will be necessary in the calculation and interpretation of the Environmental Score as these data relate to both banks and it may be that the different banks do differ significantly and therefore the species data in fact primarily relate to one bank. The general method is presented followed by the detailed method for each of the three criteria.

##### **General**

The approach lies in recognising that several different variables are each independently (in effect) able to identify a section as having ecological significance. Trying to amalgamate these into a single score value is not easily attained as they are not strictly comparable, for example is a rare bird worth more or less or is it equal to a rare plant. It is easier to say that both are important.

It is proposed to use a system where a rond is present, based on the three different variables: external plants, internal plants, and potential value from area (edge : area quotient). This system has four quality categories: Poor; Low; Medium; High and Exceptional. It is also proposed that the presence of rare species be given a weighting factor so that the external variable carries more value than the other variables.

Therefore, to use the method first determine if a rond is present. If not, then record 'No Rond' as the score. If a rond is present then the sections (ronds) are tested against the three criteria on a pass/fail basis. A section (rond) is assumed to start in the Low category. If the section passes the external criteria (presence of rare species) it moves up one category, e.g. Low to Medium. If a section gets a double pass on the external criteria it moves up two categories, e.g. Low to High. For each pass of any of the other criteria the section moves up one category, e.g. Low to Medium. The highest category is Exceptional, and this can be achieved through various pass combinations.

The thresholds for these have been determined via a combination of theoretical and empirical approaches. Therefore initial values for scoring a pass were determined from English Nature and other methods and then refined by reviewing the pass rate in the test data sets to achieve results that covered a range and were viewed as correct in Broadland.

#### External - Plants

There are 3 nationally rare species present in Broadland, of those listed the first two are locally frequent on the ronds (Harris 1992). The method for this external (to Broadland) criterion is that if any one of these species are present in a section (rond) then this indicates a pass of this criteria (variable). If two or more are present this indicates a double pass.

Marsh Sow Thistle	<i>Sonchus palustris</i>
Marsh Mallow	<i>Althea officinalis</i>
Least Lettuce	<i>Lactuca saligna</i>

#### Internal - Plants

To assess this criterion the method uses a list of plant species (Tables 1 - 3, see Excel Spreadsheet: Spectest.xls), identified by Harris for the three zones saltmarsh, brackish and freshwater from her work on the ronds of Broadland, as important indicators of good or better ronds. These have been since modified by Dunsford. In a similar fashion to the external criteria the species list for a section (rond) would be compared to the appropriate list e.g. freshwater, brackish or saltmarsh. If more than 21 of the 50 of the species listed are present for the freshwater communities, more than 7 of the 42 for brackish communities or more than 7 of the 17 for saltwater communities then a pass is recorded for that section.

These lists relate to the plant communities identified by Harris (1992) in her work on the ronds of Broadland. She identified 11 communities, with 4 of salt-marsh vegetation, and 7 of freshwater to brackish vegetation. These communities were defined by a

TWINSPAN classification analysis, which identifies both indicator and constancy species. From these data Harris has listed species which can be used to identify the presence of good ronds.

**TABLE 1**  
**INDICATOR PLANT SPECIES ON SALTMARSH ROND HABITATS**  
 (from Harris 1992)

Plant Species
<i>Aster tripolium</i> (Sea Aster agg)
<i>Atriplex prostrata</i> (Hastate Orache)
<i>Cochlearia officinalis</i> (Common Scurvy Grass)
<i>Glaux maritima</i> (Sea Milkwort)
<i>Halimione portulacoides</i> (Sea Purslane)
<i>Juncus gerardi</i> (Saltmarsh Rush)
<i>Juncus maritimus</i> (Sea Rush)
<i>Limonium vulgare</i> (Common Sea Lavender)
<i>Phragmites australis</i> (Common Reed)
<i>Plantago maritima</i> (Sea Plantain)
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)
<i>Salicornia</i> agg. (Glasswort)
<i>Scirpus maritimus</i> (Sea Club Rush)
<i>Spergularia marina</i> (Lesser Sea Spurry)
<i>Spergularia media</i> (Greater Sea Spurry)
<i>Suaeda maritima</i> (Annual Seablite)
<i>Triglochin maritima</i> (Sea Arrow Grass)

**TABLE 2**  
**INDICATOR PLANT SPECIES ON BRACKISH ROND HABITATS**  
 (from Harris 1992)

Plant Species	
<i>Althea officinalis</i> (Marsh Mallow)	<i>Plantago maritima</i> (Sea Plantain)
<i>Apium graveolens</i> (Wild Celery)	<i>Polygonum amphibium</i> (Amphibious Bistort)
<i>Aster tripolium</i> (Sea Aster agg)	<i>Puccinellia maritima</i> (Common Saltmarsh Grass)
<i>Atriplex prostrata</i> (Hastate Orache)	<i>Rumex conglomeratus</i> (Clustered Dock)
<i>Berula erecta</i> (Lesser Water Parsnip)	<i>Rumex crispus</i> (Curled Dock)
<i>Caltha palustris</i> (Marsh Marigold)	<i>Rumex hydrolapathum</i> (Great Water Dock)
<i>Calystegia sepium</i> (Bellbine)	<i>Rumex maritimus</i> (Golden Dock)
<i>Carex riparia</i> (Greater Pond Sedge)	<i>Samolus valerandi</i> (Brookweed)
<i>Cochlearia officinalis</i> (Common Scurvy Grass)	<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)
<i>Epilobium hirsutum</i> (Hairy Willowherb)	<i>Scirpus maritimus</i> (Sea Club Rush)
<i>Galium palustre</i> (Common Marsh Bedstraw)	<i>Sonchus arvensis</i> (Perennial Sow-thistle)
<i>Glaux maritima</i> (Sea Milkwort)	<i>Spergularia media</i> (Greater Sea Spurry)
<i>Glyceria maxima</i> (Sweet Reed Grass)	<i>Suaeda maritima</i> (Annual Seablite)
<i>Iris pseudacorus</i> (Yellow Flag Iris)	<i>Triglochin maritima</i> (Sea Arrow Grass)
<i>Juncus gerardi</i> (Saltmarsh Rush)	<i>Typha latifolia</i> (Greater Reedmace)
<i>Juncus maritimus</i> (Sea Rush)	<i>Veronica beccabunga</i> (Brooklime)
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)	
<i>Lactuca saligna</i> (Least Lettuce)	
<i>Lythrum salicaria</i> (Purple Loosestrife)	
<i>Mentha aquatica</i> (Water Mint)	
<i>Myosotis scorpioides</i> (Water Forget-me-Not)	
<i>Nasturtium officinale</i> (Water Cress)	
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)	
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)	
<i>Phalaris arundinacea</i> (Reed Canary Grass)	
<i>Phragmites australis</i> (Common reed)	

**TABLE 3**  
**INDICATOR PLANT SPECIES ON FRESHWATER ROND HABITATS**  
 (from Harris 1992)

Plant Species	
<i>Althea officinalis</i> (Marsh Mallow)	<i>Nasturtium officinale</i> (Water Cress)
<i>Angelica sylvestris</i> (Wild Angelica)	<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)
<i>Berula erecta</i> (Lesser Water Parsnip)	<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)
<i>Caltha palustris</i> (Marsh Marigold)	<i>Phalaris arundinacea</i> (Reed Canary Grass)
<i>Calystegia sepium</i> (Bellbine)	<i>Phragmites australis</i> (Common reed)
<i>Carex obtrubae</i> (False Fox Sedge)	<i>Polygonum amphibium</i> (Amphibious Bistort)
<i>Carex paniculata</i> (Greater Tussock Sedge)	<i>Polygonum hydropiper</i> (Water Pepper)
<i>Carex riparia</i> (Greater Pond Sedge)	<i>Polygonum mite</i> (Tasteless Waterpepper)
<i>Epilobium hirsutum</i> (Hairy Willowherb)	<i>Ribes nigrum</i> (Blackcurrant)
<i>Equisetum arvense</i> (Common Horsetail)	<i>Rumex conglomeratus</i> (Clustered Dock)
<i>Eupatorium cannabinum</i> (Hemp Agrimony)	<i>Rumex crispus</i> (Curled Dock)
<i>Filipendula ulmaria</i> (Meadowsweet)	<i>Rumex hydrolapathum</i> (Great Water Dock)
<i>Galium palustre</i> (Common Marsh Bedstraw)	<i>Rumex maritimus</i> (Golden Dock)
<i>Glyceria maxima</i> (Sweet Reed Grass)	<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)
<i>Humulus lupulus</i> (Hop)	<i>Scutellaria galericulata</i> (Skullcap)
<i>Impatiens capensis</i> (Orange Balsam)	<i>Solanum dulcamara</i> (Bittersweet)
<i>Iris pseudacorus</i> (Yellow Flag Iris)	<i>Sonchus arvensis</i> (Perennial Sow Thistle)
<i>Juncus inflexus</i> (Hard Rush)	<i>Sonchus palustris</i> (Marsh Sow Thistle)
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)	<i>Stachys palustris</i> (Marsh Woundwort)
<i>Lactuca saligna</i> (Least Lettuce)	<i>Thalictrum flavum</i> (Meadow Rue)
<i>Lycopus europaeus</i> (Gipsywort)	<i>Typha angustifolia</i> (Lesser Reedmace)
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)	<i>Typha latifolia</i> (Greater Reedmace)
<i>Lythrum salicaria</i> (Purple Loosestrife)	<i>Valeriana officinalis</i> (Common Valerian)
<i>Mentha aquatica</i> (Water Mint)	<i>Veronica beccabunga</i> (Brooklime)
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)	
<i>Myosotis scorpioides</i> (Water Forget-me-Not)	

### Potential/Existing Value - Edge to Area Quotient (Rond Size from Forum method)

The Edge : Area Quotient is an appropriate measure of potential value, as shown by Dunsford in the example she provides. Wider ronds score more highly than narrow ones and continuous ronds score more highly than fragmented ones. The edge measurement does not follow every detailed convolution of the rond edge, nor does the area measurement have to be totally accurate. The "best" ronds have smaller edge : area quotients.

The method used to calculate the edge : area quotient was undertaken using:

- Environment Agency River bank cross-sections from the 1993 survey for the Erosion Protection Scheme.
- Ordnance Survey 1:2,500 scale maps of the rivers.
- River Corridor Surveys (REDS) maps, and the
- MS-Excel spreadsheet (rondtest.xls, on the included disk)

To carry out the analysis:

- The 1:2,500, OS Maps, are marked as necessary with the REDS, 500 metre survey segments and the locations of the Environment Agency cross sections (which are every 100 metres).
- Each 100 metre segment was considered at their beginning and end and generalised in-between, thus giving five segments per 500 metre section, considered to be accurate enough for this purpose.
- Using the Environment Agency cross-section for the beginning of the 100m segment, the width of the rond was calculated from the bottom edge of the defence bank up to the water edge. It was decided that the width should be a minimum of 2 metres to qualify as a rond. If the Environment Agency cross-section did not reach up to the water edge the rond width was measured using the O.S. maps. This was repeated for the cross-section at the end of the 100m segment. The REDS survey maps can also be used for reference.
- If there was a rond at the beginning but not the end of the 100m segment, then the maps were used to judge how far along the segment the rond finishes.
- Assuming that the front of the segment is straight, and the back of the segment is also defined by a straight line, the figures will thus describe the dimensions of the rond in that segment. This will be either a rectangle, a triangle, or a combination of both (see diagram; Figure 3)

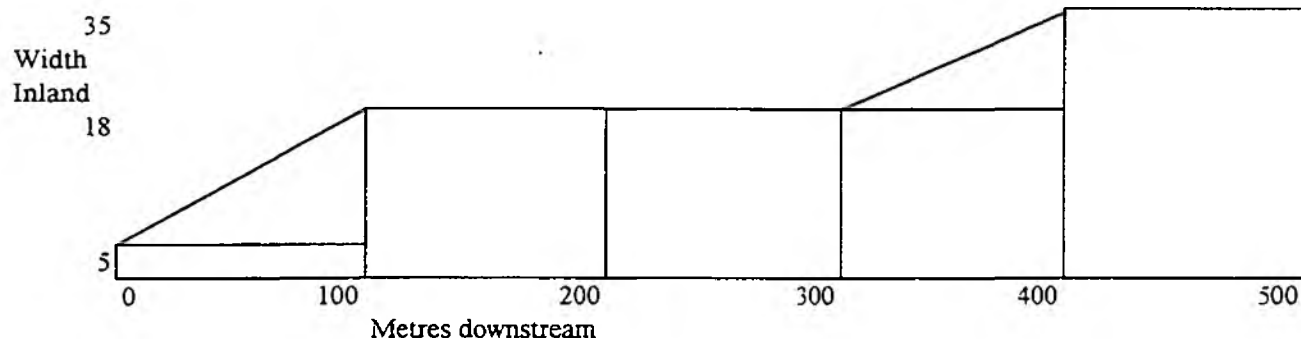
- All the figures were added into the spreadsheet. The spreadsheet calculates the area (by adding triangles and rectangles as required) and perimeter (including only the ends at the 0 and 500 metre mark) of the rond within that 500m section, and finally the edge : area quotient. No account is made for adjoining ronds from one 500m section to the next.

The pass value for the rond quotient value for the purposes of the scoring method has been set at 0.12, any quotient above this score fails. This has been based upon both theory and the statistical spread of the results in order to obtain a reasonable number of passing ronds.

There may be sections where the spreadsheet will have to be manipulated further. For instance, if one rond finishes and another one starts further downstream. If this occurs within the same 100m stretch then the spreadsheet will treat this as a continuous rond of the dimensions specified by the 0 and 100 metre marks, and artificially reduce the quotient.

Examples are given in Tables 4 - 6 (see Appendix C, for further details).





Area	1150	1800	1800	2650	3500
Perimeter:					
Top	101	100	100	101	100
Bottom	100	100	100	100	100
End	5	-	-	-	35

Total Perimeter: 1042

Total Area: 10900

Edge/Area Quotient: 0.10 = Pass

**Figure 3**  
**ASSUMED ROND SHAPES**

**TABLE 4**  
**RIVER WAVENEY - EDGE: AREA QUOTIENT CALCULATIONS**

River Corridor Survey Reference	Env Agency Drawing Section Reference	Segment Width (m)		Segment Length (m)	Rond Area (m <sup>2</sup> )			Rond Perimeter (m)			Rond Quotient Calc for each 500m length		Notes
		Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m <sup>2</sup> )	Perim. (m)	
158	0.1	0.2	0	0	0	0	0	0	0.00	0			Cales for entire Rond:  Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	0.2	0.3	0	0	0	0	0	0	0.00	0			
	0.3	0.4	0	0	0	0	0	0	0.00	0			
	0.4	0.5	6	10	0	30	30	10	11.66	22			
	0.5	0.6	25	100	600	950	1550	100	101.79	202	1580	248	
157	0.6	0.7	25	48	2500	1150	3650	100	102.61	203			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	0.7	0.8	48	78	4800	1500	6300	100	104.40	204			
	0.8	0.9	78	78	7800	0	7800	100	100.00	200			
	0.9	1	78	50	5000	1400	6400	100	103.85	204			
	1	1.1	50	33	3300	850	4150	100	101.43	201	28300	1070	
156	1.1	1.2	33	9	900	1200	2100	100	102.84	203			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	1.2	1.3	9	8	800	50	850	100	100.00	200			
	1.3	1.4	8	8	800	0	800	100	100.00	200			
	1.4	1.5	8	9	800	50	850	100	100.00	200			
	1.5	1.6	9	8	800	50	850	100	100.00	200	5450	1044	
155	1.6	1.7	8	7	700	50	750	100	100.00	200			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	1.7	1.8	7	9	700	100	800	100	100.02	200			
	1.8	1.9	9	14	900	250	1150	100	100.12	200			
	1.9	2	14	15	1400	50	1450	100	100.00	200			
	2	2.1	15	16	1500	50	1550	100	100.00	200	8050	1240	
154	2.1	2.2	16	31	1600	750	2350	100	101.12	201			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	2.2	2.3	31	55	3100	1200	4300	100	102.84	203			
	2.3	2.4	55	75	5500	1000	6500	100	101.98	202			
	2.4	2.5	75	28	2800	2350	5150	100	110.49	210			
	2.5	2.6	28	20	2000	400	2400	100	100.32	200	20300	1066	
153	2.6	2.7	20	19	1900	50	1950	100	100.00	200			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	2.7	2.8	19	63	1900	2200	4100	100	109.25	209			
	2.8	2.9	63	85	6300	1100	7400	100	102.39	202			
	2.9	3	85	100	8500	750	9250	100	101.12	201			
	3	3.1	100	83	8300	850	9150	100	101.43	201			
152	3.1	3.2	83	73	7300	500	7800	100	100.50	200			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	3.2	3.3	73	48	4800	1250	6050	100	103.08	203			
	3.3	3.4	48	18	1800	1500	3300	100	104.40	204			
	3.4	3.5	18	6	600	600	1200	100	100.72	201			
	3.5	3.6	6	8	600	100	700	100	100.02	200			
151	3.6	3.7	8	6	600	100	700	100	100.02	200			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	3.7	3.8	6	10	600	200	800	100	100.08	200			
	3.8	3.9	10	10	1000	0	1000	100	100.00	200			
	3.9	4	10	28	1000	900	1900	100	101.61	202			
	4	4.1	28	43	2800	750	3550	100	101.12	201			
150	4.1	4.2	43	73	4300	1500	5800	100	104.40	204			Rond 1 Total area (m <sup>2</sup> ): 113330 Perimeter: 4070 Waterfront Bankside Top Bottom Total (m) 8214  Rond 2 Total area (m <sup>2</sup> ): 159430 Perimeter: 3930 Waterfront Bankside Top Bottom Total (m) 7901
	4.2	4.3	73	38	3800	1750	5550	100	105.95	206			
	4.3	4.4	38	25	2500	650	3150	100	100.84	201			
	4.4	4.5	25	10	1000	750	1750	100	101.12	201			
	4.5	4.6	10	0	0	300	300	60	60.83	121	13050	1086	

**TABLE 4 Cont'd**  
**RIVER WAVENEY - EDGE: AREA QUOTIENT CALCULATIONS**

River Corridor Survey Reference	Env Agency Drawing Section Reference		Segment Width (m)		Segment Length (m)	Rond Area (m <sup>2</sup> )			Rond Perimeter (m)			Rond Quotient Calc for each 500m length			Notes
	Begin	End	Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m <sup>2</sup> )	Perim (m)	Edge:Area Quotient	
149	4.6	4.7	0	2	20	0	20	20	20	100	40	10770	844	0.08	
	4.7	4.8	2	5	100	200	150	350	100	100.04	200				
	4.8	4.9	5	7	100	500	100	600	100	100.02	200				
	4.9	5	7	16	100	700	450	1150	100	100.40	200				
	5	5.1	16	20	100	1600	200	1800	100	100.08	200				
148	5.1	5.2	20	19	100	1900	50	1950	100	100.00	200	5850	1022	0.17	
	5.2	5.3	19	29	100	1900	500	2400	100	100.50	200				
	5.3	5.4	29	33	100	2900	200	3100	100	100.08	200				
	5.4	5.5	33	45	100	3300	600	3900	100	100.72	201				
	5.5	5.6	45	50	100	4500	250	4750	100	100.12	200				
147	5.6	5.7	50	48	100	4800	100	4900	100	100.02	200				
	5.7	5.8	48	48	100	4800	0	4800	100	100.00	200	23850	1268	0.05	
	5.8	5.9	48	65	100	4800	850	5650	100	101.43	201				
	5.9	6	65	85	100	6500	1000	7500	100	101.98	202				
	6	6.1	85	75	100	7500	500	8000	100	100.50	200				
146	6.1	6.2	75	65	100	6500	500	7000	100	100.50	200				
	6.2	6.3	65	63	100	6300	100	6400	100	100.02	200	34550	1115	0.03	
	6.3	6.4	63	45	100	4500	900	5400	100	101.61	202				
	6.4	6.5	45	44	100	4400	50	4450	100	100.00	200				
	6.5	6.6	44	23	100	2300	1050	3350	100	102.18	202				
145	6.6	6.7	23	38	100	2300	750	3050	100	101.12	201				
	6.7	6.8	38	53	100	3800	750	4550	100	101.12	201				
	6.8	6.9	53	45	100	4500	400	4900	100	100.32	203	25700	1314	0.05	
	6.9	7	45	39	100	3900	300	4200	100	100.18	200				
	7	7.1	39	31	100	3100	400	3500	100	100.32	200				
144	7.1	7.2	31	44	100	3100	650	3750	100	100.84	201				
	7.2	7.3	44	43	100	4300	50	4350	100	100.00	200				
	7.3	7.4	43	35	100	3500	400	3900	100	100.32	200	19700	1082	0.05	
	7.4	7.5	35	50	100	3500	750	4250	100	101.12	201				
	7.5	7.6	50	78	100	5000	1400	6400	100	103.85	204				
143	7.6	7.7	78	50	100	5000	1400	6400	100	103.85	204				
	7.7	7.8	50	40	100	4000	500	4500	100	100.50	200	21550	884	0.04	
	7.8	7.9	40	44	100	4000	200	4200	100	100.08	200				
	7.9	8	44	33	100	3300	550	3850	100	100.60	201				
	8	8.1	33	50	100	3300	850	4150	100	101.43	201				
142	8.1	8.2	50	16	100	1600	1700	3300	100	105.62	206				
	8.2	8.3	16	35	100	1600	950	2550	100	101.79	202	18050	1085	0.06	
	8.3	8.4	35	48	100	3500	650	4150	100	100.84	201				
	8.4	8.5	48	35	100	3500	650	4150	100	100.84	201				
	8.5	8.6	35	2	100	200	1650	1850	100	105.30	205				
	8.6	8.7	2	0	10	0	10	10	10	10.20	20	10160	662	0.07	

**TABLE 5**  
**RIVER YARE - EDGE: AREA QUOTIENT CALCULATIONS**

RIVER YARE

Important: See attached notes and assumptions

ROND Edge : Area Quotient

River Corridor Survey Reference	Env Agency Drawing Section Reference		Segment Width (m)		Segment Length (m)	Rond Area (m <sup>2</sup> )			Rond Perimeter (m)			Rond Quotient Calc for each 500m length			Notes
	Begin	End	Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m <sup>2</sup> )	Perim. (m)	Edge:Area Quotient	
119	112.800k	112.700k	0	0	0	0	0	0	0	0.00	0			Junction rivers Chet and Yare	
	2.7	2.6	0	0	0	0	0	0	0.00	0					
	2.6	2.5	0	0	0	0	0	0	0.00	0					
	2.5	2.4	0	0	0	0	0	0	0.00	0	0	0	NTR		
120	2.4	2.3	0	0	0	0	0	0	0	0.00	0			Cales for entire Rond:  Rond 1 Total area (m <sup>2</sup> ): 16100 Perimeter: 770 Waterfront Bankside Top Bottom Total (m): 1552	
	2.3	2.2	0	0	0	0	0	0	0.00	0					
	2.2	2.1	2	18	20	40	160	200	25.61	46					
	2.1	2	18	1800	0	1800	100	100.00	200	100.00	3800	466	0.12		
121	2	1.9	18	18	100	1800	0	1800	100	100.00	200			Rond 2 Total area (m <sup>2</sup> ): 20683 Perimeter: 1220 Waterfront Bankside Top Bottom Total (m): 2455	
	1.9	1.8	22	22	100	1800	200	2000	100	100.08	200				
	1.8	1.7	31	31	100	2200	450	2650	100	100.40	200				
	1.7	1.6	26	26	100	2600	250	2850	100	100.12	200				
122	1.6	1.5	26	20	100	2000	300	2300	100	100.18	200			Discontinuous Rond Total area (m <sup>2</sup> ): 20683 Perimeter: 1220 Waterfront Bankside Top Bottom Total (m): 2455	
	1.5	1.4	20	20	100	2000	0	2000	100	100.00	200	11800	1039		0.09
	1.4	1.3	20	0	50	0	500	500	50	53.85	104				
	1.3	1.2	0	21	50	0	525	525	50	54.23	104				
123	1.2	1.1	21	13	100	1300	400	1700	100	100.32	200			Rond 1 Total area (m <sup>2</sup> ): 20683 Perimeter: 1220 Waterfront Bankside Top Bottom Total (m): 2455	
	1.1	1	13	21	100	1300	400	1700	100	100.32	200	6475	849		0.13
	1	0.9	21	20	100	2000	50	2050	100	100.00	200				
	0.9	0.8	20	23	100	2000	150	2150	100	100.04	200				
124	0.8	0.7	23	10	100	1000	650	1650	100	100.84	201			Edge:Area Quotient Rond 1 Rond 2 Junction Yare and Haddiscoe Cut	
	0.7	0.6	10	15	100	1000	250	1250	100	100.12	200				
	0.6	0.5	15	16	100	1500	50	1550	100	100.00	200	6840	867		0.13
	0.5	0.4	16	16	15	240	0	240	15	15.00	30				
124	0.4	0.3	16	18	100	1600	100	1700	100	100.02	200			Edge:Area Quotient Rond 1 Rond 2 Junction Yare and Haddiscoe Cut	
	0.3	0.2	18	27	100	1800	450	2250	100	100.40	200				
	0.2	0.1	27	27	60	1620	0	1620	60	60.00	120	7868	935		0.12
	0.1	0	0	21	95	0	998	998	95	97.29	192				
	0	-0.1	21	21	100	500	800	1300	100	101.27	201	7868	935	0.12	



## 5. TEST OF THE METHOD ON COMPARTMENTS 22 AND 34

### 5.1 Data Workup

Compartment 22 is bounded by the rivers, including the south Chet, from Chedgrave to Chet Mouth; the south Yare, from Chet Mouth to the New Cut; the south bank of the New Cut and south Waveney from Burgh St Peter to west of Oulton Broad. This area includes Norton and Burgh Marshes.

Compartment 34 lies on the east bank of the Waveney, upstream of Breydon water.

Each variable (external plants, internal plants, Edge : Area Quotient) was tested independently, with the results collated to give a score value for a particular section (see Section 4.2, Tables 4 - 6 for the edge : area calculations and Appendices B and C for other detail and the vegetation results).

For the river section under consideration, if no rond is present the method is not used and the score of 'No Rond' is recorded. Where a rond is present then the three criteria are considered.

#### **Examples**

1. Section 119 on the River Yare, has no rond and therefore the score is that of 'No Rond'.
2. Section 120 on the River Yare, has a rond and the three criteria were therefore tested to obtain the final score. This section receives a pass (1) for the edge : area quotient as the quotient value was less than 0.12.

The external plants score was obtained by comparing the REDS plant species listing for this section against the nationally rare species present in Broadland (see methods section). There were 2 matches and therefore for this variable the section obtained a double pass (2).

In a similar fashion for the internal plants the REDS species listing was compared to the appropriate list, in this case the Brackish species list (see method section). This section received a pass for this criterion and so with four (4) passes it obtained an overall score of exceptional (see Table 7); moving from Low to Medium to High to Exceptional (with one extra pass therefore as there are three steps). The results obtained for all the sections in Compartment 22 and 34 (species tests only) are given in the results section 5.2.

## 5.2 RESULTS

**TABLE 7**  
**RESULTS OF THE PROPOSED ENVIRONMENTAL SCORING METHOD FOR**  
**COMPARTMENT 22.**

**RIVER YARE**

Section	Classification	Plants		Edge/Area Quotient	Environmental Score
		External	Internal		
119	Brackish	Pass	n	NR	No Rond
120	Brackish	D. Pass	Pass	Pass	Exceptional
121	Brackish	n	Pass	Pass	High
122	Brackish	n	Pass	n	Medium
123	Brackish	n	n	n	Low
124	Brackish	n	n	Pass	Medium

**RIVER WAVENEY**

Section	Classification	Plants		Edge/Area Quotient	Environmental Score
		External	Internal		
142	Freshwater	Pass	n	Pass	High
143	Freshwater	Pass	n	Pass	High
144	Freshwater	Pass	n	Pass	High
145	Freshwater	Pass	Pass	Pass	Exceptional
146	Freshwater	Pass	n	Pass	High
147	Freshwater	Pass	Pass	Pass	Exceptional
148	Freshwater	Pass	Pass	Pass	Exceptional
149	Freshwater	Pass	n	n	Medium
150	Freshwater	Pass	n	Pass	High
151	Freshwater	Pass	Pass	Pass	Exceptional
152	Freshwater	n	n	Pass	Medium
153	Freshwater	Pass	n	Pass	High
154	Freshwater	D.Pass	n	Pass	Exceptional
155	Freshwater	Pass	n	n	Medium
156	Freshwater	Pass	n	n	Medium
157	Brackish	Pass	Pass	Pass	Exceptional
158	Brackish	n	n	n	Low

**TABLE 7** Cont'd  
**RESULTS OF THE PROPOSED ENVIRONMENTAL SCORING METHOD FOR**  
**COMPARTMENT 22.**

**RIVER CHET**

Section	Classification	Plants		Edge/Area Quotient	Environmental Score
		External	Internal		
17	Freshwater	n	n	NR	No Rond
18	Freshwater	n	Pass	NR	No Rond
19	Freshwater	n	n	NR	No Rond
20	Freshwater	Pass	Pass	n	High
21	Freshwater	Pass	n	n	Medium
22	Freshwater	Pass	n	n	Medium
23	Freshwater	D.Pass	n	n	High
24	Brackish	Pass	Pass	NR	No Rond
25	Brackish	n	Pass	NR	No Rond
26	Brackish	n	n	n	Low

**SUMMARY OF THE SCORES FOR COMPARTMENT 22**

Category	No. Sections	Percentage
No Rond	6	18
Low	3	9
Medium	8	24
High	9	27
Exceptional	7	21
Total	33	99



**TABLE 8**  
**RESULTS OF THE PROPOSED ENVIRONMENTAL SCORING METHOD FOR**  
**COMPARTMENT 34 - SPECIES TEST ONLY**

**RIVER WAVENEY**

Section	Classification	Plants		Edge/Area Quotient	Environmental Score **
		External	Internal		
163	Saltmarsh	n	n	ND	Low
164	Saltmarsh	n	n	ND	Low
165	Saltmarsh	n	Pass	ND	Medium
166	Saltmarsh	n	n	ND	Low
167	Saltmarsh	n	Pass	ND	Medium
168	Saltmarsh	n	n	ND	Low
169	Saltmarsh	n	Pass	ND	Medium
170	Saltmarsh	n	Pass	ND	Medium
171	Saltmarsh	n	Pass	ND	Medium
172	Saltmarsh	n	Pass	ND	Medium
173	Saltmarsh	n	n	ND	Low
174	Saltmarsh	n	n	ND	Low
175	Saltmarsh	n	Pass	ND	Medium
176	Saltmarsh	*	*	ND	*

ND    Not Determined       \*    Bank not surveyed       \*\*    Species Test Only

**SUMMARY OF THE SCORES FOR COMPARTMENT 22**

Category	No. Sections	Percentage
No Rond	0	0
Low	6	46
Medium	7	54
High	0	0
Exceptional	0	0
Total	13	100

The results as above and also as illustrated on Figure 4 show that the method provides a good segregation of the section's into a range of quality scores. An acceptable distribution has been achieved for both the range of scores and also along the rivers.

As a final test of the method a field verification of the above was held for Compartment 22 and the results were confirmed to be correct as determined. It was important in particular to check that the assumptions made for the Edge: Area Quotient were correct and they were correct.

The assumptions are:

- a rond is present if it is  $\geq 2$  m.
- The combined use of the Environment Agency cross section data, with reference to OS 1:2500 scale maps and the REDS field maps for rond presence and dimensions, worked well and field verification is therefore not believed to be required in most cases.

In addition, the Saltmarsh species threshold was tested on Compartment 34 and the values were set to a threshold of  $> 7$  species for a pass.

### 5.3 DISCUSSION

The proposed Broadland Environmental Scoring Method has been shown for Compartments 22 and 34 to be easy to use, provide an appropriate range of results and relate to the conditions observed in the field. The results are based on Environment Agency REDS sections but could also be combined to provide Scores for ronds themselves, for the Edge: Area Quotient but not for the biological criteria. It is recommended the results should be left at the Section level.

The method has been developed to address environmental quality based on existing data and to relate to the erosion and flood defence works being carried out in Broadland. The REDS plant species data have been used as it is available and there are plans to continue to collect similar data, so the Environmental Score could be updated as work and changes occur. The REDS bird data have not been used as there are not plans to continue to collect these in a form that would support this method. Equally earlier approaches to this subject included erosion and landscape variables, but it is easier and more appropriate to rank sites on environmental (ecological) quality and then to compare these to erosion rates rankings and to relate them subjectively to landscape and other environmental quality goals.

The method therefore, appears to be easy to use, using existing data, and produces useful interpretable results. The field test confirmed the validity of the biological criteria subjectively and also the Edge: Area Quotient objectively.



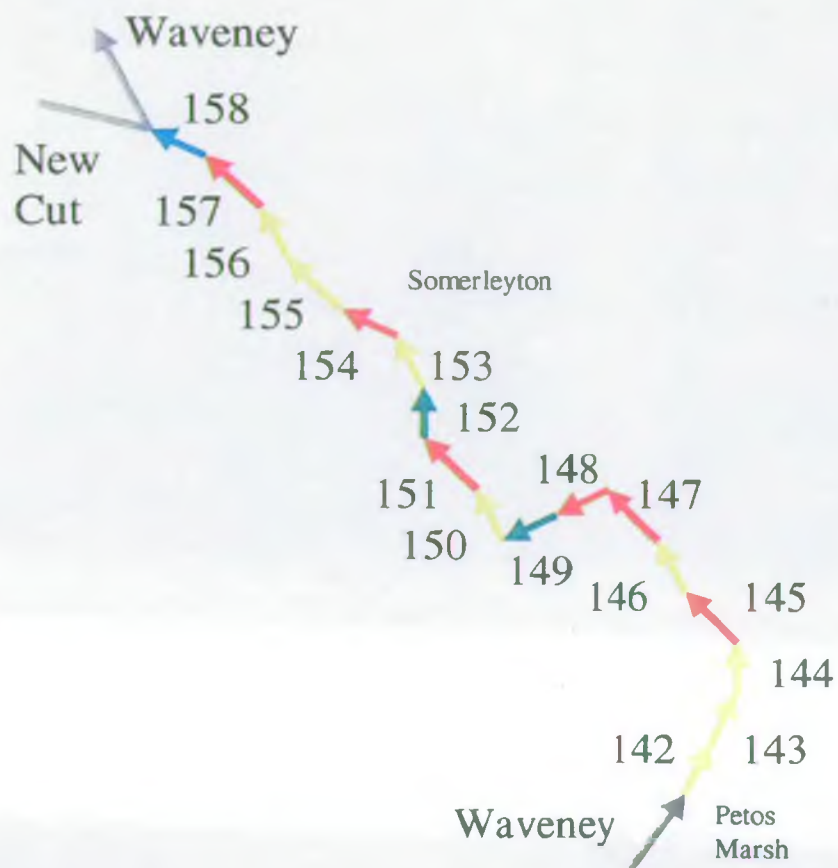
#### Key

-  River
-  No Rond
-  Low
-  Medium
-  High
-  Exceptional

**Figure 4**

#### **RIVERS CHET and YARE -**

Results from the Environmental Scoring  
Methodology - Compartment 22



### Key

- > River
- > No Rond
- > Low
- > Medium
- > High
- > Exceptional

### Figure 4, cont.

#### RIVER WAVENEY -

Results from the Environmental Scoring  
Methodology - Compartment 22

6. CONCLUSIONS AND RECOMMENDATIONS

The derived Broadland Environmental Scoring Methodology has produced a method that is easy to use, uses existing data, delivers results that relate to observed field conditions and that are also spread over a reasonable distribution of categories. A test of the method on Compartments 22 and 34 produced results that were examined by a field visit (for Compartment 22) and were found to relate well to a subjective interpretation of environmental quality. The field visit also confirmed that the assumptions for the desk based method for the Edge : Area Quotient were valid. Therefore, the method based on the two biological criteria and the Edge: Area Quotient has produced satisfactory results.

The Environmental Scoring Methodology has been designed to help define which Ronds are of better environmental quality to allow this information to be used in the planning and works associated with the Broads Flood Protection Projects. However, the method can be used directly for other Flood Defence issues, for assisting quality determination as part of Environmental Assessments and to allow monitoring of environmental quality over time.

A Methods Guidance Document is provided as Appendix D to this report.

## REFERENCES

- |                             |   |
|-----------------------------|---|
| Binnie and Partners (1994a) | Norfolk Broadland Erosion Protection Scheme<br>Environmental Assessment, Compartment 22         |
| Binnie and Partners (1994b) | Norfolk Broadland Erosion Protection Scheme<br>Environmental Assessment, Main Report            |
| Binnie and Partners (1993)  | A Flood Alleviation Strategy for Broadland  |
| George, M (1992).           | The Land Use, Ecology and Conservation of Broadland:<br>Packard Publishing Ltd                  |
| Harris, J. (1992).          | A Study of the Ecology, Land-use and Conservation<br>Value of the Ronds of the Broadland Rivers |

## APPENDICES

- A Theoretical and Practical Considerations
  - B Vegetation Results for Compartments 22 and 34
  - C Rond Edge : Area Quotient Results for Compartment 22, Assumptions and Details
  - D Broadland Environmental Scoring Methodology - Method Guidance Document
-



## **APPENDIX A**

### **Theoretical and Practical Considerations**

## **Theoretical Considerations**

There is a wide range of theoretical issues that should be considered as part of defining an environmental scoring methodology. These include, in no intentional order:

- Internal and External Criteria
- limitation of the REDS data for the compartments
- different ecological areas in the Broads to consider
- the relationship to engineering purpose, in particular marginal reedswamp
- classification vs. ordination issues and approaches
- existing versus potential ecological value and island biogeography

### **Internal and External Criteria**

In defining the ecological value of an area, or classifying its vegetation, it is necessary to define the standards under consideration. Therefore, it would be possible to define a method that only used external considerations, e.g. Internationally or Nationally important species, and other such designations. Under this approach a rond or site would only have a high or exceptional value if it contained species or habitats that were so recognised, its local or regional importance may therefore not matter or be recognised. This approach would also miss sites with potential value if managed differently. Equally an approach could be based on internal criteria only, so that after a rank order was established, say on species diversity (number), the top 20% were considered important. This focuses on local importance and could define a site as important that had little real ecological value from a broader perspective.

For the methodology proposed here it is recommended that external and internal criteria are defined and used. The earlier two methods implicitly had done this via the use of these concepts without clearly stating such. For example they both used rare species and one looked at habitat diversity and the other 'local' indicator species.

### **Limitation of the REDS data for scoring the compartments**

The REDS data were collected for a 500m section of a river, for both banks and for the 4 zones of the riparian environment, the aquatic, the margin, the bank and defence, and the adjacent land. While the write up provides some information on left and right bank species presence these are not intended to be full lists and the species diversity for a section relates to all the habitats and not the rond only and certainly not only one bank. This limitation does not seem to have been fully considered in the earlier methods. However, the REDS data is very useful to look at the section, of which the rond is a part, and to consider both the species present on the rond and those on adjacent land,

which could move onto the rond. The data provided by Harris (1992) is more relevant for definition of the method, with the REDS data providing a data source for the method, though with this limitation acknowledged.

### **Different ecological areas in the Broads to consider**

It has been recognised by earlier work, (see Figure 2) that the vegetation on the ronds and associated habitats differs from the saltmarsh habitats, through the brackish to the freshwater, and the method of defining a score should explicitly recognise this and allow for these three different zones in the classification.

### **The relationship to engineering purpose**

This is essential as it defines the use of the results of the method. It has been suggested that the distance of 2m from the defence is adequate for engineering considerations. However it is also known that the rond, and in particular the marginal reedswamp, also provides protection to the flood defence. Therefore the retention of wider ronds and also the retention or re-establishment of marginal reedswamp could be beneficial to the engineering costs over time. Therefore the scoring method needs to recognise the ultimate use of the results, and consider the value of wider than 2m ronds, or even of wider than 20m ronds. However, this is largely going beyond the ecological scoring method and relates to an environmental/engineering benefit/cost approach.

### **Classification vs. ordination issues and approaches**

Vegetation has often been classified into classes or categories, which are possible to consider as distinct. However, vegetation has also often been analysed by an ordination method, which establishes the distribution of the species as a gradient or continuum, whereon classes can often be recognised simply as groups with more frequent locations on the ground. This area is not appropriate to discuss in detail here, but due to management in the UK vegetation is often recognised as discrete classes, where the intermediate gradation is missing. It is likely, or certain, that a continuum of change in the species present at a site would be found moving upstream from saline to freshwater. However, the use of groups or classes seems more workable or appropriate for the ronds, particularly for scoring.

### **Existing versus potential ecological value and island biogeography**

Finally the existing ecological value of a rond can be defined from the species present. However, the rond habitat also can have a potential value that is not currently recognised by the species present at a given time, but could be present later if managed appropriately. It is for this reason that a measure of rond size, using a quotient of edge to area is useful, as some sites may have greater potential value than actual when sampled. Finally it is recognised from the ecological concept of 'island biogeography' that larger areas usually contain higher species diversities. While this may support the

need for larger, more contiguous ronds it is also true that smaller remnants can have both existing ecological value as well as potential value.

### Practical Considerations

There are also a number of practical considerations that effect the design of the scoring methodology. These relate to the method being reliable and simple to use, as well as using data that already exist or would be cost effective to collect. For these reasons the following need to be considered:

- Relate to Harris's (1992) data for indicator species and classes, recognising the estuarine, brackish, freshwater areas separately. This allows for local variation and local importance where national importance may not be recognised for a rond.
- To save time and effort use indicator species instead of reviewing longer species lists. Also consider presence only and not abundance as presence contains much of the information and is easier to use.
- To provide external reference use the protected species that are present. For plants there are 3 nationally rare species present in Broadland, with the first two locally frequent on the ronds (Harris 1992):

Marsh Sow Thistle	<i>Sonchus palustris</i>
Marsh Mallow	<i>Althea officinalis</i>
Least Lettuce	<i>Lactuca saligna</i>

- The literature that has been considered has indicated that the wider the rond and the larger the contiguous area the greater the ecological value or potential value. The method proposed by the Forum of relating the edge to the area via a quotient is useful. This practical area is important to include as it provides for much of the potential value to be obtained from maintaining or recreating wider ronds.
- The inclusion of landscape criteria is not considered to contribute much at this stage, as there are not established objective values and the assessment would be subjective. Landscape considerations should be included in the Environmental Assessments and would in part be accommodated by the edge to area consideration.
- It is also considered practical to separate erosion from conservation as a criterion for the scoring methodology. It would be appropriate to include in establishing which areas to action first and could be added to the environmental score.
- While the REDS data relates to the River corridor and not the rond, and also that the sections are about 500m which is not necessarily appropriate for continuity

of rond, the REDS data is one of the only available sources of widespread information. It is therefore practical to use it.

Other data, based on Harris (1992) show that the rond widths for greater species diversity, with more or more varied habitats present, are recommended to be (Binnie 1994, Appendix H, NBEPSEA):

Saltwater Vegetation	15 m (1 - 4 m observed in the data however)
Brackish Vegetation	15 m (3 - 12 m observed)
Freshwater Vegetation	25 m (16 - 22 m observed)

## **APPENDIX B**

### **Vegetation Results for Compartments 22 and 34**

## Broadland Environmental Scoring Methodology

### Species Test Spreadsheets

Version Final

Date 26-Aug-99

The three spreadsheets in this workbook are designed to allow easy calculation of the species tests for the Broadland Environmental Scoring Methodology. As defined in the method there is an External Species Test and an Internal Species Test, with different indicator species lists for Saltmarsh, Brackish and Freshwater reaches of a river.

The spreadsheets are used by first determining which of the three is appropriate by reference to the map of Broadlands delineating which type of salinity zone the section falls into, and then by comparing the species list for the section (from the Environment Agency REDS data) to the correct spreadsheet. For example, Compartment 34 on the Waveney is all in the Saltmarsh delineated zone so the Saltmarsh sheet would be used. In other Compartments, e.g. Compartment 22, there are three rivers and these fall into both Brackish and Freshwater Zones. The appropriate spreadsheet is therefore used for each section as determined.

To use the determined spreadsheet, the Compartment Number and River Name are entered in Cells B1 and B2 and then the REDS Section No. as shown (overwriting the lower case letters). By comparison of the alphabetical listing of the REDS plant species (see end of list too for additions) to the alphabetical lists of test species the spreadsheet is completed by entering a 1 for presence and leaving a blank for absence. This is repeated for both External and Internal Species lists. The spreadsheet will calculate the number of passes for you by reference to the test criteria (e.g. > 8 of 17 of the Saltmarsh species listed are needed for an Internal Pass). The spreadsheets allow for up to 20 sections of a salinity type per river per compartment, and when printed out the names will automatically repeat. When comparing the lists some attention needs to be given to plant synonyms (e.g. *Spergularia media* / *S. marginata* Greater Sea Spurry) and reference should be made to the REDS text and map to check the validity of the REDS species list for a Compartment. This final point is because the REDS data are for both banks and for more than the rond for a 500m section, while the focus of the engineering works and this scoring system relates to the rond in a Compartment on only one bank.

The Overall Species Score for the species tests is combined with the Edge:Area Quotient Score as described elsewhere to obtain the Final Section Score.

Compartment:

22

River:

Not

Saltmarsh

Saltmarsh Plant Species	Section No.				
	a	b	c	d	e
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*



Compartment:

River:

Saltmarsh Plant Species	f	g	h	i	j
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*

Compartment:

River:

Saltmarsh Plant Species	k	l	m	n	o
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*

Compartment:

River:

Saltmarsh Plant Species	p	q	r	s	t
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*

Compartment:  
River:

22  
Chet

Yare

Brackish Plant Species	Section No.				
	24	25	26	d	119
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1				1
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	1	0	0	0	1
External Score	1	0	0	0	1
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Apium graveolens</i> (Wild Celery)	1	1	1		
<i>Aster tripolium</i> (Sea Aster agg)			1		1
<i>Atriplex prostrata</i> (Hastate Orache) [1]					1
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)	1	1			1
<i>Carex riparia</i> (Greater Pond Sedge)	1	1	1		1
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Glyceria maxima</i> (Sweet Reed Grass)	1	1	1		
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)			1		
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]	1	1	1		1
<i>Plantago maritima</i> (Sea Plantain)					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)	1				1
<i>Rumex hydrolapathum</i> (Great Water Dock)		1			
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scirpus maritimus</i> (Sea Club Rush)	1	1	1		
<i>Sonchus arvensis</i> (Perennial Sow-thistle)	1	1			
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	8	8	7	0	6
Internal Score	1	1	0	0	0
Overall Species Score	2	1	0	0	1

Older or Alternate Scientific Names

- [1] *Atriplex hastata*  
 [2] *Phragmites communis*  
 [3] *Spergularia marginata*

Compartment:

River:

Brackish Plant Species	120	121	122	123	124
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)	1				
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1				
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	2	0	0	0	0
External Score	2	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)	1				
<i>Apium graveolens</i> (Wild Celery)		1	1	1	
<i>Aster tripolium</i> (Sea Aster agg)	1	1	1		
<i>Atriplex prostrata</i> (Hastate Orache) [1]	1	1	1	1	1
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)	1	1			
<i>Carex riparia</i> (Greater Pond Sedge)	1				
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glaux maritima</i> (Sea Milkwort)				1	
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)				1	1
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)		1	1		
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]	1	1	1	1	1
<i>Plantago maritima</i> (Sea Plantain)			1		
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)	1				
<i>Rumex crispus</i> (Curled Dock)	1	1	1	1	
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Sonchus arvensis</i> (Perennial Sow-thistle)	1	1	1		
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)		1	1	1	
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	9	9	9	7	3
Internal Score	1	1	1	0	0
Overall Species Score	3	1	1	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*

Compartment:

River:

Waveney

Brackish Plant Species	k	157	158	n	o
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)		1			
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	1	0	0	0
External Score	0	1	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Apium graveolens</i> (Wild Celery)					
<i>Aster tripolium</i> (Sea Aster agg)		1			
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)		1			
<i>Carex riparia</i> (Greater Pond Sedge)		1			
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)		1			
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glauca maritima</i> (Sea Milkwort)					
<i>Glyceria maxima</i> (Sweet Reed Grass)		1			
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)		1			
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)		1			
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]		1	1		
<i>Plantago maritima</i> (Sea Plantain)					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)		1			
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)		1			
<i>Scirpus maritimus</i> (Sea Club Rush)		1			
<i>Sonchus arvensis</i> (Perennial Sow-thistle)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	0	11	1	0	0
Internal Score	0	1	0	0	0
Overall Species Score	0	2	0	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*

Compartment:

River:

Brackish Plant Species	p	q	r	s	t
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Apium graveolens</i> (Wild Celery)					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Sonchus arvensis</i> (Perennial Sow-thistle)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*

Compartment:  
River:

22  
Chet

Freshwater Plant Species	Section No.				
	17	18	19	20	21
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)				1	1
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	1	1
External Score	0	0	0	1	1
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Angelica sylvestris</i> (Wild Angelica)	1	1	1	1	1
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)	1	1		1	
<i>Calystegia sepium</i> (Bellbine)	1	1	1	1	1
<i>Carex obtusae</i> (False Fox Sedge)					
<i>Carex paniculata</i> (Greater Tussock Sedge)		1		1	1
<i>Carex riparia</i> (Greater Pond Sedge)	1	1	1	1	1
<i>Epilobium hirsutum</i> (Hairy Willowherb)	1	1	1	1	
<i>Equisetum arvense</i> (Common Horsetail)			1		
<i>Eupatorium cannabinum</i> (Hemp Agrimony)	1	1	1	1	1
<i>Filipendula ulmaria</i> (Meadow-sweet)	1	1	1	1	1
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)	1	1	1	1	1
<i>Humulus lupulus</i> (Hop)			1	1	1
<i>Impatiens capensis</i> (Orange Balsam)	1			1	
<i>Iris pseudacorus</i> (Yellow Flag Iris)	1	1	1	1	1
<i>Juncus inflexus</i> (Hard Rush)	1	1	1	1	1
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)	1	1		1	
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)					
<i>Lythrum salicaria</i> (Purple Loosestrife)	1	1	1	1	
<i>Mentha aquatica</i> (Water Mint)	1	1		1	
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)	1	1			
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)	1	1			
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]	1	1	1	1	1
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Polygonum hydropiper</i> (Water Pepper)					
<i>Polygonum mite</i> (Tasteless Waterpepper)					
<i>Ribes nigrum</i> (Blackcurrant)					
<i>Rumex conglomeratus</i> (Clustered Dock)	1	1	1	1	
<i>Rumex crispus</i> (Curled Dock)					1
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scutellaria galenculata</i> (Skullcap)					
<i>Solanum dulcamara</i> (Bittersweet)				1	1
<i>Sonchus arvensis</i> (Perennial Sow Thistle)	1	1	1	1	1
<i>Sonchus palustris</i> (Marsh Sow Thistle)				1	1
<i>Stachys palustris</i> (Marsh Woundwort)		1	1	1	
<i>Thalictrum flavum</i> (Meadow Rue)		1			1
<i>Typha angustifolia</i> (Lesser Reedmace)					
<i>Typha latifolia</i> (Greater Reedmace)	1	1		1	1
<i>Valeriana officinalis</i> (Common Valerian)	1	1		1	1
<i>Veronica beccabunga</i> (Brooklime)		1			
Total No. - If > 21 of 50 then Score = 1	21	24	16	24	18
Internal Score	0	1	0	1	0
Overall Species Score	0	1	0	2	1



Compartment:

22

River:

Waveney

Freshwater Plant Species	22	23		142	143
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)		1			
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1		1	1
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	1	2	0	1	1
External Score	1	2	0	1	1
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)		1			
<i>Angelica sylvestris</i> (Wild Angelica)					
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)					1
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)	1	1		1	1
<i>Carex obtrubae</i> (False Fox Sedge)					
<i>Carex paniculata</i> (Greater Tussock Sedge)	1			1	
<i>Carex riparia</i> (Greater Pond Sedge)	1	1		1	1
<i>Epilobium hirsutum</i> (Hairy Willowherb)	1			1	1
<i>Equisetum arvense</i> (Common Horsetail)					
<i>Eupatorium cannabinum</i> (Hemp Agrimony)	1	1			
<i>Filipendula ulmaria</i> (Meadow-sweet)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)	1	1		1	1
<i>Humulus lupulus</i> (Hop)	1				
<i>Impatiens capensis</i> (Orange Balsam)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)	1				1
<i>Juncus inflexus</i> (Hard Rush)				1	1
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)					
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)					
<i>Lythrum salicaria</i> (Purple Loosestrife)	1	1			
<i>Mentha aquatica</i> (Water Mint)					1
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)	1				
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]	1	1		1	1
<i>Polygonum amphibium</i> (Amphibious Bistort)		1			
<i>Polygonum hydropiper</i> (Water Pepper)					
<i>Polygonum mite</i> (Tasteless Waterpepper)					
<i>Ribes nigrum</i> (Blackcurrant)					
<i>Rumex conglomeratus</i> (Clustered Dock)	1				
<i>Rumex crispus</i> (Curled Dock)		1			1
<i>Rumex hydrolapathum</i> (Great Water Dock)				1	
<i>Rumex maritimus</i> (Golden Dock)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scutellaria galericulata</i> (Skullcap)					
<i>Solanum dulcamara</i> (Bittersweet)	1				
<i>Sonchus arvensis</i> (Perennial Sow Thistle)	1	1		1	
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1		1	1
<i>Stachys palustris</i> (Marsh Woundwort)					
<i>Thalictrum flavum</i> (Meadow Rue)				1	
<i>Typha angustifolia</i> (Lesser Reedmace)				1	1
<i>Typha latifolia</i> (Greater Reedmace)				1	1
<i>Valeriana officinalis</i> (Common Valerian)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >21 of 50 then Score = 1	15	11	0	13	13
Internal Score	0	0	0	0	0
Overall Species Score	1	2	0	1	1

Compartment:

River:

Freshwater Plant Species	144	145	146	147	148
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1	1	1	1
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	1	1	1	1	1
External Score	1	1	1	1	1
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Angelica sylvestris</i> (Wild Angelica)					
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)				1	1
<i>Caltha palustris</i> (Marsh Marigold)		1			
<i>Calystegia sepium</i> (Bellbine)	1	1		1	1
<i>Carex obtusae</i> (False Fox Sedge)	1			1	
<i>Carex paniculata</i> (Greater Tussock Sedge)				1	
<i>Carex riparia</i> (Greater Pond Sedge)	1	1	1	1	1
<i>Epilobium hirsutum</i> (Hairy Willowherb)	1	1	1	1	1
<i>Equisetum arvense</i> (Common Horsetail)					
<i>Eupatorium cannabinum</i> (Hemp Agrimony)	1	1		1	1
<i>Filipendula ulmaria</i> (Meadow-sweet)	1	1	1	1	1
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)	1	1	1	1	1
<i>Humulus lupulus</i> (Hop)					
<i>Impatiens capensis</i> (Orange Balsam)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)	1	1		1	1
<i>Juncus inflexus</i> (Hard Rush)	1	1	1	1	1
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)				1	
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)					
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)		1			1
<i>Lythrum salicaria</i> (Purple Loosestrife)	1	1	1	1	1
<i>Mentha aquatica</i> (Water Mint)			1	1	1
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)			1	1	1
<i>Nasturtium officinale</i> (Water Cress)					1
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)				1	1
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)	1	1	1	1	1
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]	1	1	1	1	1
<i>Polygonum amphibium</i> (Amphibious Bistort)					1
<i>Polygonum hydropiper</i> (Water Pepper)					
<i>Polygonum mite</i> (Tasteless Waterpepper)					
<i>Ribes nigrum</i> (Blackcurrant)					
<i>Rumex conglomeratus</i> (Clustered Dock)	1	1	1	1	1
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)	1	1	1	1	1
<i>Rumex maritimus</i> (Golden Dock)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)			1	1	1
<i>Scutellaria galericulata</i> (Skullcap)					
<i>Solanum dulcamara</i> (Bittersweet)	1	1			
<i>Sonchus arvensis</i> (Perennial Sow Thistle)	1	1			1
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1	1	1	1
<i>Stachys palustris</i> (Marsh Woundwort)					
<i>Thalictrum flavum</i> (Meadow Rue)		1	1	1	1
<i>Typha angustifolia</i> (Lesser Reedmace)	1	1	1	1	1
<i>Typha latifolia</i> (Greater Reedmace)	1	1	1	1	1
<i>Valeriana officinalis</i> (Common Valerian)	1	1		1	
<i>Veronica beccabunga</i> (Brooklime)				1	
Total No. - If > 21 of 50 then Score = 1	20	22	17	27	26
Internal Score	0	1	0	1	1
Overall Species Score	1	2	1	2	2

Compartment:

River:

Freshwater Plant Species	149	150	151	152	153
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1	1		1
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	1	1	1	0	1
External Score	1	1	1	0	1
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Angelica sylvestris</i> (Wild Angelica)					
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)			1	1	
<i>Caltha palustris</i> (Marsh Marigold)			1		
<i>Calystegia sepium</i> (Bellbine)	1	1	1	1	1
<i>Carex obtusae</i> (False Fox Sedge)			1	1	1
<i>Carex paniculata</i> (Greater Tussock Sedge)					
<i>Carex riparia</i> (Greater Pond Sedge)	1	1	1	1	1
<i>Epilobium hirsutum</i> (Hairy Willowherb)	1	1	1		1
<i>Equisetum arvense</i> (Common Horsetail)					
<i>Eupatorium cannabinum</i> (Hemp Agrimony)		1			1
<i>Filipendula ulmaria</i> (Meadow-sweet)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)	1	1	1	1	1
<i>Humulus lupulus</i> (Hop)					
<i>Impatiens capensis</i> (Orange Balsam)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)			1		
<i>Juncus inflexus</i> (Hard Rush)			1	1	1
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)					
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)					
<i>Lythrum salicaria</i> (Purple Loosestrife)	1		1	1	
<i>Mentha aquatica</i> (Water Mint)			1		
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)			1	1	
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)			1		1
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)	1	1	1		1
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]	1	1	1	1	1
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Polygonum hydropiper</i> (Water Pepper)					
<i>Polygonum mite</i> (Tasteless Waterpepper)					
<i>Ribes nigrum</i> (Blackcurrant)					
<i>Rumex conglomeratus</i> (Clustered Dock)			1	1	1
<i>Rumex crispus</i> (Curled Dock)		1	1	1	
<i>Rumex hydrolapathum</i> (Great Water Dock)	1		1	1	
<i>Rumex maritimus</i> (Golden Dock)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)			1	1	1
<i>Scutellaria galericulata</i> (Skullcap)					
<i>Solanum dulcamara</i> (Bittersweet)					
<i>Sonchus arvensis</i> (Perennial Sow Thistle)		1	1	1	1
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1	1		1
<i>Stachys palustris</i> (Marsh Woundwort)			1		
<i>Thalictrum flavum</i> (Meadow Rue)	1	1	1		1
<i>Typha angustifolia</i> (Lesser Reedmace)	1	1	1		
<i>Typha latifolia</i> (Greater Reedmace)	1			1	1
<i>Valeriana officinalis</i> (Common Valerian)		1	1		1
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >21 of 50 then Score = 1	12	13	25	15	17
Internal Score	0	0	1	0	0
Overall Species Score	1	1	2	0	1

Compartment:

River:

Freshwater Plant Species	154	155	156
External Species Test			
<i>Althea officinalis</i> (Marsh Mallow)	1		
<i>Lactuca saligna</i> (Least Lettuce)			
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1	1
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	2	1	1
External Score	2	1	1
Internal Species Test			
<i>Althea officinalis</i> (Marsh Mallow)	1		
<i>Angelica sylvestris</i> (Wild Angelica)		1	
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)	1		
<i>Caltha palustris</i> (Marsh Marigold)			
<i>Calystegia sepium</i> (Bellbine)	1	1	
<i>Carex obtusae</i> (False Fox Sedge)			1
<i>Carex paniculata</i> (Greater Tussock Sedge)			
<i>Carex riparia</i> (Greater Pond Sedge)	1	1	1
<i>Epilobium hirsutum</i> (Hairy Willowherb)	1	1	
<i>Equisetum arvense</i> (Common Horsetail)			
<i>Eupatorium cannabinum</i> (Hemp Agrimony)		1	
<i>Filipendula ulmaria</i> (Meadow-sweet)			
<i>Galium palustre</i> (Common Marsh Bedstraw)			
<i>Glyceria maxima</i> (Sweet Reed Grass)	1	1	1
<i>Humulus lupulus</i> (Hop)			
<i>Impatiens capensis</i> (Orange Balsam)			
<i>Iris pseudacorus</i> (Yellow Flag Iris)	1		
<i>Juncus inflexus</i> (Hard Rush)		1	1
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)			
<i>Lactuca saligna</i> (Least Lettuce)			
<i>Lycopus europaeus</i> (Gipsywort)			
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)			
<i>Lythrum salicaria</i> (Purple Loosestrife)	1	1	1
<i>Mentha aquatica</i> (Water Mint)			
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)			
<i>Myosotis scorpioides</i> (Water Forget-me-Not)			
<i>Nasturtium officinale</i> (Water Cress)			
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)			1
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)		1	1
<i>Phalaris arundinacea</i> (Reed Canary Grass)	1	1	1
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]	1	1	1
<i>Polygonum amphibium</i> (Amphibious Bistort)			
<i>Polygonum hydropiper</i> (Water Pepper)			
<i>Polygonum mite</i> (Tasteless Waterpepper)			
<i>Ribes nigrum</i> (Blackcurrant)			
<i>Rumex conglomeratus</i> (Clustered Dock)			1
<i>Rumex crispus</i> (Curled Dock)	1	1	
<i>Rumex hydrolapathum</i> (Great Water Dock)	1		1
<i>Rumex maritimus</i> (Golden Dock)			
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)	1	1	1
<i>Scutellaria galericulata</i> (Skullcap)			
<i>Solanum dulcamara</i> (Bittersweet)			
<i>Sonchus arvensis</i> (Perennial Sow Thistle)	1	1	
<i>Sonchus palustris</i> (Marsh Sow Thistle)	1	1	1
<i>Stachys palustris</i> (Marsh Woundwort)			
<i>Thalictrum flavum</i> (Meadow Rue)	1	1	
<i>Typha angustifolia</i> (Lesser Reedmace)	1	1	
<i>Typha latifolia</i> (Greater Reedmace)	1		1
<i>Valeriana officinalis</i> (Common Valerian)	1	1	
<i>Veronica beccabunga</i> (Brooklime)			
Total No. - If >21 of 50 then Score = 1	19	18	14
Internal Score	0	0	0
Overall Species Score	2	1	1

## Broadland Environmental Scoring Methodology

### Species Test Spreadsheets

Version Final  
Date 26-Aug-99

The three spreadsheets in this workbook are designed to allow easy calculation of the species tests for the Broadland Environmental Scoring Methodology. As defined in the method there is an External Species Test and an Internal Species Test, with different indicator species lists for Saltmarsh, Brackish and Freshwater reaches of a river.

The spreadsheets are used by first determining which of the three is appropriate by reference to the map of Broadlands delineating which type of salinity zone the section falls into, and then by comparing the species list for the section (from the Environment Agency REDS data) to the correct spreadsheet. For example, Compartment 34 on the Waveney is all in the Saltmarsh delineated zone so the Saltmarsh sheet would be used. In other Compartments, e.g. Compartment 22, there are three rivers and these fall into both Brackish and Freshwater Zones. The appropriate spreadsheet is therefore used for each section as determined.

To use the determined spreadsheet, the Compartment Number and River Name are entered in Cells B1 and B2 and then the REDS Section No. as shown (overwriting the lower case letters). By comparison of the alphabetical listing of the REDS plant species (see end of list too for additions) to the alphabetical lists of test species the spreadsheet is completed by entering a 1 for presence and leaving a blank for absence. This is repeated for both External and Internal Species lists. The spreadsheet will calculate the number of passes for you by reference to the test criteria (e.g. > 8 of 17 of the Saltmarsh species listed are needed for an Internal Pass). The spreadsheets allow for up to 20 sections of a salinity type per river per compartment, and when printed out the names will automatically repeat. When comparing the lists some attention needs to be given to plant synonyms (e.g. *Spergularia media* / *S. marginata* Greater Sea Spurry) and reference should be made to the REDS text and map to check the validity of the REDS species list for a Compartment. This final point is because the REDS data are for both banks and for more than the road for a 500m section, while the focus of the engineering works and this scoring system relates to the road in a Compartment on only one bank.

The Overall Species Score for the species tests is combined with the Edge:Area Quotient Score as described elsewhere to obtain the Final Section Score.

Compartment:  
River:

34  
Waveney

	Section No.				
Saltmarsh Plant Species	163	164	165	166	167
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)	1	1	1	1	1
<i>Atriplex prostrata</i> (Hastate Orache) [1]	1	1	1	1	1
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)			1		1
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)	1	1	1	1	1
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)	1				
<i>Phragmites australis</i> (Common Reed) [2]	1	1	1	1	1
<i>Plantago maritima</i> (Sea Plantain)			1		
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					1
<i>Salicornia</i> agg. (Glasswort)					1
<i>Scirpus maritimus</i> (Sea Club Rush)	1	1	1	1	
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					1
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)			1		
Total No. - If >7 of 17 then Score = 1	6	5	8	5	8
Internal Score	0	0	1	0	1
Overall Species Score	0	0	1	0	1

Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*

Compartment:

River:

Saltmarsh Plant Species	168	169	170	171	172
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)	1	1	1	1	1
<i>Atriplex prostrata</i> (Hastate Orache) [1]	1	1	1	1	1
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)	1	1	1	1	1
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)	1	1	1	1	1
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)			1		
<i>Phragmites australis</i> (Common Reed) [2]	1	1	1	1	1
<i>Plantago maritima</i> (Sea Plantain)		1		1	1
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)			1	1	
<i>Salicornia</i> agg. (Glasswort)		1		1	1
<i>Scirpus maritimus</i> (Sea Club Rush)	1	1	1	1	
<i>Spergularia media</i> (Greater Sea Spurrey) [3]				1	
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)	1	1	1	1	1
Total No. - If >7 of 17 then Score = 1	7	9	9	11	8
Internal Score	0	1	1	1	1
Overall Species Score	0	1	1	1	1

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*[4] *Spergularia salina*

Compartment:

River:

Saltmarsh Plant Species	173	174	175	176	0
				**	
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)		1	1		
<i>Atriplex prostrata</i> (Hastate Orache) [1]	1	1	1	1	
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)	1	1	1	1	
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)	1	1	1	1	
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)				1	
<i>Phragmites australis</i> (Common Reed) [2]	1	1	1	1	
<i>Plantago maritima</i> (Sea Plantain)	1		1	1	
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)		1			
<i>Salicornia</i> agg. (Glasswort)			1		
<i>Scirpus maritimus</i> (Sea Club Rush)	1				
<i>Spergularia media</i> (Greater Sea Spurrey) [3]			1		
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)	1	1	1	1	
Total No. - If >7 of 17 then Score = 1	7	7	9	7	0
Internal Score	0	0	1	0	0
Overall Species Score	0	0	1	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*  
 [2] *Phragmites communis*  
 [3] *Spergularia marginata*  
 [4] *Spergularia salina*

\*\*Correct  
 Bank  
 Not  
 Surveyed



Compartment:

River:

Saltmarsh Plant Species	p	q	r	s	t
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

## Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*

## **APPENDIX C**

### **Rond Edge : Area Quotient Results for Compartment 22 Assumptions and Details**

**Broadland Environmental Scoring Methodology****Rond Edge:Area Quotient Test Spreadsheets**

**Version**                Final  
**Date**                    26-Aug-99

Please see attached method notes (Rondmeth.doc) and figure (Rondmeth.xls) which describe how to use the method and this spreadsheet. The assumptions to use the method are given below. The result from this test is combined with the results from the Species Test Spreadsheets to obtain the overall section score.

**Assumptions**

- 1                Environment Agency cross-sections rule for dimensions of segments.
- 2                Each described segment makes up a shape for calculation, either a rectangle, triangle, or a rhomboid comprising a rectangle and a triangle.
- 3                The segment width is taken from the Environment Agency sections from the waters edge to the start of the incline of the bank (see attached diagram). The segment length is actually that part of the segment which is taken up by the rond, which may be all or part of the 100 m segment.
- 4                The river has been cut into 100m length segments. The Environment Agency sections mark the begin and end of the segments. The width of the rond along the segment is judged using the Environment Agency sections for each end and the maps provided.
- 5                The spreadsheet then calculates the area of the rectangle and triangle respectively to give a total area for that segment.
- 6                It then calculates the perimeter, the front of the segment is the waterfront, so this is assumed to be straight and the same as the length of the segment. The bank is the back of the segment. If the segment is a rectangle then this again is the length. If the segment has a triangle aspect then this is calculated using pythagoras' theorem.
- 7                The perimeters are then added up and the two ends added to give the total perimeter. Similarly the area of segments in the rond is added to give the total area. Finally the edge to area quotient is calculated by dividing the perimeter by the area.
- 8                Shaded cells can be used to mark the beginning and end of the actual ronds.
- 9                The quotient is calculated for each 500 metre survey section. This treats each section as if it were a separate rond. No account is taken for adjoining ronds. The results can be assimilated from the section data for a rond as in the worked example.
- 10              Assumes all Environment Agency river sections look downstream.
- 11              In survey section 122, the beginning of one rond and the end of another are both in the section. These parts are amalgamated into one area/perimeter.

## RIVER WAVENEY

ROND Edge : Area Quotient

Important: See attached notes and assumptions

River Corridor Survey Reference	Env Agency Drawing Section Reference		Segment Width (m)		Segment Length (m)	Rond Area (m <sup>2</sup> )			Rond Perimeter (m)			Rond Quotient Calc for each 500m length			Notes
	Begin	End	Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m <sup>2</sup> )	Perim (m)	Edge:Area Quotient	
158	0.1	0.2	0	0	0	0	0	0	0	0.00	0				<u>Calcs for entire Rond:</u>  <b>Rond 1</b> Total area (m <sup>2</sup> ): 113330 Perimeter: Waterfront 4070 Bankside 4144 Top 0 Bottom 0 Total (m) 8214  <b>Rond 2</b> Total area (m <sup>2</sup> ): 159430 Perimeter: Waterfront 3930 Bankside 3971 Top 0 Bottom 0 Total (m) 7901  <u>Edge:Area Quotient</u> Rond 1 0.07 Rond 2 0.05
	0.2	0.3	0	0	0	0	0	0	0	0.00	0				
	0.3	0.4	0	0	0	0	0	0	0	0.00	0				
	0.4	0.5	0	6	10	0	30	30	10	11.66	22				
	0.5	0.6	6	25	100	600	950	1550	100	101.79	202	1580	248	0.16	
157	0.6	0.7	25	48	100	2500	1150	3650	100	102.61	203				
	0.7	0.8	48	78	100	4800	1500	6300	100	104.40	204				
	0.8	0.9	78	78	100	7800	0	7800	100	100.00	200				
	0.9	1	78	50	100	5000	1400	6400	100	103.85	204				
	1	1.1	50	33	100	3300	850	4150	100	101.43	201	28300	1070	0.04	
156	1.1	1.2	33	9	100	900	1200	2100	100	102.84	203				
	1.2	1.3	9	8	100	800	50	850	100	100.00	200				
	1.3	1.4	8	8	100	800	0	800	100	100.00	200				
	1.4	1.5	8	9	100	800	50	850	100	100.00	200				
	1.5	1.6	9	8	100	800	50	850	100	100.00	200	5450	1044	0.19	
155	1.6	1.7	8	7	100	700	50	750	100	100.00	200				
	1.7	1.8	7	9	100	700	100	800	100	100.02	200				
	1.8	1.9	9	14	100	900	250	1150	100	100.12	200				
	1.9	2	14	15	100	1400	50	1450	100	100.00	200				
	2	2.1	15	16	100	1500	50	1550	100	100.00	200				
154	2.1	2.2	16	31	100	1600	750	2350	100	101.12	201	8050	1240	0.15	
	2.2	2.3	31	55	100	3100	1200	4300	100	102.84	203				
	2.3	2.4	55	75	100	5500	1000	6500	100	101.98	202				
	2.4	2.5	75	28	100	2800	2350	5150	100	110.49	210				
	2.5	2.6	28	20	100	2000	400	2400	100	100.32	200				
153	2.6	2.7	20	19	100	1900	50	1950	100	100.00	200	20300	1066	0.05	
	2.7	2.8	19	63	100	1900	2200	4100	100	109.25	209				
	2.8	2.9	63	85	100	6300	1100	7400	100	102.39	202				
	2.9	3	85	100	100	8500	750	9250	100	101.12	201				
	3	3.1	100	83	100	8300	850	9150	100	101.43	201				
152	3.1	3.2	83	73	100	7300	500	7800	100	100.50	200	37700	1107	0.03	
	3.2	3.3	73	48	100	4800	1250	6050	100	103.08	203				
	3.3	3.4	48	18	100	1800	1500	3300	100	104.40	204				
	3.4	3.5	18	6	100	600	600	1200	100	100.72	201				
	3.5	3.6	6	8	100	600	100	700	100	100.02	200				
151	3.6	3.7	8	6	100	600	100	700	100	100.02	200	11950	1087	0.09	
	3.7	3.8	6	10	100	600	200	800	100	100.08	200				
	3.8	3.9	10	10	100	1000	0	1000	100	100.00	200				
	3.9	4	10	28	100	1000	900	1900	100	101.61	202				
	4	4.1	28	43	100	2800	750	3550	100	101.12	201				
150	4.1	4.2	43	73	100	4300	1500	5800	100	104.40	204	13050	1086	0.08	
	4.2	4.3	73	38	100	3800	1750	5550	100	105.95	206				
	4.3	4.4	38	25	100	2500	650	3150	100	100.84	201				
	4.4	4.5	25	10	100	1000	750	1750	100	101.12	201				
	4.5	4.6	10	60	60	0	300	300	60	60.83	121				

River Corridor Survey Reference	Env Agency Drawing Section Reference		Segment Width (m)		Segment Length (m)	Road Area (m2)			Road Perimeter (m)			Road Quotient Calc for each 500m length			Notes
	Begin	End	Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m2)	Perim (m)	Edge:Area Quotient	
	4.6	4.7	0	2	20	0	20	20	20	20.10	40	10770	844	0.08	
149	4.7	4.8	2	5	100	200	150	350	100	100.04	200				
	4.8	4.9	5	7	100	500	100	600	100	100.02	200				
	4.9	5	7	16	100	700	450	1150	100	100.40	200				
	5	5.1	16	20	100	1600	200	1800	100	100.08	200				
	5.1	5.2	20	19	100	1900	50	1950	100	100.00	200	5850	1022	0.17	
148	5.2	5.3	19	29	100	1900	500	2400	100	100.50	200				
	5.3	5.4	29	33	100	2900	200	3100	100	100.08	200				
	5.4	5.5	33	45	100	3300	600	3900	100	100.72	201				
	5.5	5.6	45	50	100	4500	250	4750	100	100.12	200				
	5.6	5.7	50	48	100	4800	100	4900	100	100.02	200				
	5.7	5.8	48	48	100	4800	0	4800	100	100.00	200	23850	1268	0.05	
147	5.8	5.9	48	65	100	4800	850	5650	100	101.43	201				
	5.9	6	65	85	100	6500	1000	7500	100	101.98	202				
	6	6.1	85	75	100	7500	500	8000	100	100.50	200				
	6.1	6.2	75	65	100	6500	500	7000	100	100.50	200				
	6.2	6.3	65	63	100	6300	100	6400	100	100.02	200	34550	1115	0.03	
146	6.3	6.4	63	45	100	4500	900	5400	100	101.61	202				
	6.4	6.5	45	44	100	4400	50	4450	100	100.00	200				
	6.5	6.6	44	23	100	2300	1050	3350	100	102.18	202				
	6.6	6.7	23	38	100	2300	750	3050	100	101.12	201				
	6.7	6.8	38	53	100	3800	750	4550	100	101.12	201				
	6.8	6.9	53	45	100	4500	400	4900	100	100.32	200	25700	1314	0.05	
145	6.9	7	45	39	100	3900	300	4200	100	100.18	200				
	7	7.1	39	31	100	3100	400	3500	100	100.32	200				
	7.1	7.2	31	44	100	3100	650	3750	100	100.84	201				
	7.2	7.3	44	43	100	4300	50	4350	100	100.00	200				
	7.3	7.4	43	35	100	3500	400	3900	100	100.32	200	19700	1082	0.05	
144	7.4	7.5	35	50	100	3500	750	4250	100	101.12	201				
	7.5	7.6	50	78	100	5000	1400	6400	100	103.85	204				
	7.6	7.7	78	50	100	5000	1400	6400	100	103.85	204				
	7.7	7.8	50	40	100	4000	500	4500	100	100.50	200	21550	884	0.04	
143	7.8	7.9	40	44	100	4000	200	4200	100	100.08	200				
	7.9	8	44	33	100	3300	550	3850	100	100.60	201				
	8	8.1	33	50	100	3300	850	4150	100	101.43	201				
	8.1	8.2	50	16	100	1600	1700	3300	100	105.62	206				
	8.2	8.3	16	35	100	1600	950	2550	100	101.79	202	18050	1085	0.06	
142	8.3	8.4	35	48	100	3500	650	4150	100	100.84	201				
	8.4	8.5	48	35	100	3500	650	4150	100	100.84	201				
	8.5	8.6	35	2	100	200	1650	1850	100	105.30	205				
	8.6	8.7	2	0	10	0	10	10	10	10.20	20	10160	662	0.07	

## RIVER YARE

ROND Edge : Area Quotient

Important: See attached notes and assumptions

River Corridor Survey Reference	Env Agency Drawing Section Reference		Segment Width (m)		Segment Length (m)	Rond Area (m2)			Rond Perimeter (m)			Rond Quotient Calc for each 500m length			Notes
	Begin	End	Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m2)	Perim. (m)	Edge:Area Quotient	
119	112.800k	112.700k	0	0	0	0	0	0	0	0.00	0				Junction rivers Chet and Yare
	2.7	2.6	0	0	0	0	0	0	0	0.00	0				
	2.6	2.5	0	0	0	0	0	0	0	0.00	0				
	2.5	2.4	0	0	0	0	0	0	0	0.00	0	0	0	NR	
120	2.4	2.3	0	0	0	0	0	0	0	0.00	0				<u>Cales for entire Rond:</u>  <u>Rond 1</u> Total area (m2): 16100 Perimeter: Waterfront 770 Bankside 780 Top 2 Bottom 0 Total (m) 1552
	2.3	2.2	0	0	0	0	0	0	0	0.00	0				
	2.2	2.1	2	18	20	40	160	200	20	25.61	46				
	2.1	2	18	18	100	1800	0	1800	100	100.00	200				
	2	1.9	18	18	100	1800	0	1800	100	100.00	200	3800	466	0.12	
121	1.9	1.8	18	22	100	1800	200	2000	100	100.08	200				<u>Rond 2</u> Total area (m2): 20683 Perimeter: Waterfront 1220 Bankside 1230 Top 0 Bottom 5 Total (m) 2455
	1.8	1.7	22	31	100	2200	450	2650	100	100.40	200				
	1.7	1.6	31	26	100	2600	250	2850	100	100.12	200				
	1.6	1.5	26	20	100	2000	300	2300	100	100.18	200				
	1.5	1.4	20	20	100	2000	0	2000	100	100.00	200	11800	1039	0.09	
122	1.4	1.3	20	0	50	0	500	500	50	53.85	104	Discontinuous Rond			<u>Rond 2</u> Total area (m2): 20683 Perimeter: Waterfront 1220 Bankside 1230 Top 0 Bottom 5 Total (m) 2455
	1.3	1.2	0	21	50	0	525	525	50	54.23	104				
	1.2	1.1	21	13	100	1300	400	1700	100	100.32	200				
	1.1	1	13	21	100	1300	400	1700	100	100.32	200				
	1	0.9	21	20	100	2000	50	2050	100	100.00	200	6475	849	0.13	
123	0.9	0.8	20	23	100	2000	150	2150	100	100.04	200				<u>Edge:Area Quotient</u> Rond 1 0.10 Rond 2 0.12  Junction Yare and Haddiscoe Cut
	0.8	0.7	23	10	100	1000	650	1650	100	100.84	201				
	0.7	0.6	10	15	100	1000	250	1250	100	100.12	200				
	0.6	0.5	15	16	100	1500	50	1550	100	100.00	200				
	0.5	0.4	16	16	15	240	0	240	15	15.00	30	6840	867	0.13	
124	0.4	0.3	16	18	100	1600	100	1700	100	100.02	200				
	0.3	0.2	18	27	100	1800	450	2250	100	100.40	200				
	0.2	0.1	27	27	60	1620	0	1620	60	60.00	120				
	0.1	0	0	21	95	0	998	998	95	97.29	192				
	0	-0.1	21	5	100	500	800	1300	100	101.27	201	7868	935	0.12	

ROND Edge : Area Quotient

## RIVER CHIEF

Important: See attached notes and assumptions

River Corridor Survey Reference	Env Agency Drawing Section Reference		Segment Width (m)		Segment Length (m)	Rond Area (m2)			Rond Perimeter (m)			Rond Quotient Calc for each 500m length			Notes
	Begin	End	Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m2)	Perim. (m)	Edge:Area Quotient	
26	CH00.km	CH01.km	0	8	100	0	400	400	100	100.32	200			Junction rivers Chet and Yare  <u>Calcs for entire Rond:</u>  Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	0.1	0.2	8	0	40	0	160	160	40	40.79	80				
	0.2	0.3	0	0	0	0	0	0	0	0.00	0				
	0.3	0.4	0	0	0	0	0	0	0	0.00	0				
	0.4	0.5	0	0	0	0	0	0	0	0.00	0				
	0.5	0.6	0	0	0	0	0	0	0	0.00	0	560	281		0.50
25	0.6	0.7	0	0	0	0	0	0	0	0.00	0			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	0.7	0.8	0	0	0	0	0	0	0	0.00	0				
	0.8	0.9	0	0	0	0	0	0	0	0.00	0				
	0.9	1	0	0	0	0	0	0	0	0.00	0				
	1	1.1	0	0	0	0	0	0	0	0.00	0	0	0		NR
24	1.1	1.2	0	0	0	0	0	0	0	0.00	0			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	1.2	1.3	0	0	0	0	0	0	0	0.00	0				
	1.3	1.4	0	0	0	0	0	0	0	0.00	0				
	1.4	1.5	0	0	0	0	0	0	0	0.00	0				
	1.5	1.6	0	0	0	0	0	0	0	0.00	0	0	0		NR
23	1.6	1.7	0	0	0	0	0	0	0	0.00	0			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	1.7	1.8	0	0	0	0	0	0	0	0.00	0				
	1.8	1.9	0	0	40	80	80	80	40	40.00	80				
	1.9	2	0	0	0	0	0	0	0	0.00	0				
	2	2.1	0	0	10	0	35	35	10	12.21	22	115	111		0.97
	2.1	2.2	0	0	50	0	175	175	50	50.49	100				
22	2.2	2.3	0	0	0	0	0	0	0.00	0			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17		
	2.3	2.4	0	0	0	0	0	0	0.00	0					
	2.4	2.5	0	0	0	0	0	0	0.00	0					
	2.5	2.6	0	0	50	150	0	150	50	50.00	100	360		233	0.65
21	2.6	2.7	0	0	10	0	15	15	10	10.44	20			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	2.7	2.8	0	0	0	0	0	0	0	0.00	0				
	2.8	2.9	0	0	0	0	0	0	0	0.00	0				
	2.9	3	0	0	0	0	0	0	0	0.00	0	15	23		1.56
	3	3.1	0	0	10	0	25	25	10	11.18	21				
	3.1	3.2	0	0	100	500	500	1000	100	100.50	200				
20	3.2	3.3	15	15	100	1500	0	1500	100	100.00	200			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	3.3	3.4	0	0	0	0	0	0	0	0.00	0				
	3.4	3.5	0	0	0	0	0	0	0	0.00	0	2525	437		0.17
	3.5	3.6	0	0	0	0	0	0	0	0.00	0				
	3.6	3.7	0	0	0	0	0	0	0	0.00	0				
19	3.7	3.8	0	0	0	0	0	0	0	0.00	0			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	3.8	3.9	0	0	0	0	0	0	0	0.00	0				
	3.9	4	0	0	0	0	0	0	0	0.00	0	0	0		NR
	4	4.1	0	0	0	0	0	0	0	0.00	0				
18	4.1	4.2	0	0	0	0	0	0	0	0.00	0			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	4.2	4.3	0	0	0	0	0	0	0	0.00	0				
	4.3	4.4	0	0	0	0	0	0	0	0.00	0				
	4.4	4.5	0	0	0	0	0	0	0	0.00	0	0	0		NR
	4.5	4.6	0	0	0	0	0	0	0	0.00	0				
17	4.6	4.7	0	0	0	0	0	0	0	0.00	0			Rond 1 Total area (m2) 560 Perimeter: Waterfront 100 Bankside 141 Top 0 Bottom 0 Total (m) 281  Rond 2 Total area (m2) 80 Perimeter: Waterfront 40 Bankside 40 Top 2 Bottom 2 Total (m) 84  Rond 3 Total area (m2) 210 Perimeter: Waterfront 60 Bankside 63 Top 0 Bottom 0 Total (m) 123  Rond 4 Total area (m2) 165 Perimeter: Waterfront 60 Bankside 60 Top 3 Bottom 0 Total (m) 123  Rond 5 Total area (m2) 2525 Perimeter: Waterfront 210 Bankside 212 Top 0 Bottom 15 Total (m) 437  <u>Edge:Area Quotient</u> Rond 1 0.50 Rond 2 1.05 Rond 3 0.58 Rond 4 0.75 Rond 5 0.17	
	4.7	4.8	0	0	0	0	0	0	0	0.00	0				
	4.8	4.9	0	0	0	0	0	0	0	0.00	0				
	4.9	5	0	0	0	0	0	0	0	0.00	0	0	0		NR

## SUMMARY

River	Survey Section	Edge:Area Quotient
Chet	17	NR
	18	NR
	19	NR
	20	0.17
	21	1.56
	22	0.65
	23	0.97
	24	NR
	25	NR
	26	0.50
Yare	119	NR
	120	0.12
	121	0.09
	122	0.13
	123	0.13
	124	0.12
Waveney	142	0.07
	143	0.06
	144	0.04
	145	0.05
	146	0.05
	147	0.03
	148	0.05
	149	0.17
	150	0.08
	151	0.08
	152	0.09
	153	0.03
	154	0.05
	155	0.15
	156	0.19
	157	0.04
	158	0.16
Haddiscoe cut - assumed no ronds		

Spread = 0.09 - 1.56  
Mean = 0.22



**APPENDIX D**

**BROADLAND ENVIRONMENTAL SCORING  
METHODOLOGY**

**METHOD GUIDANCE DOCUMENT**

# BROADLAND ENVIRONMENTAL SCORING METHODOLOGY

## METHOD GUIDANCE DOCUMENT

26 August 1999

### INTRODUCTION AND SUMMARY

This document provides guidance to users of the Broadland Environmental Scoring Methodology. It is intended to stand alone with the attached tables and spreadsheets, but a more interested user may want to read the main report for additional detail, background or the review of theoretical and practical considerations related to an environmental scoring method. The method is designed for use by environmental scientists or engineers without speciality training in ecology or flood defence, by the use of excel spreadsheets that require filled in with the species data and rond dimensions, and which then calculate the environmental scores for the user. The user must combine the scores to obtain the final score for the rond.

The proposed method is an environmental scoring methodology, to allow a quality score to be assigned to ronds within Broadland by using the Environment Agency's REDS plant species data and the dimensions of the ronds themselves. It has been designed to support the main purposes of the engineering works and erosion control, but does not include them in assessing environmental (ecological) value. The method proposed includes four categories of quality where a rond is present:

- low, medium, high and exceptional.

A rond or section is assigned a score based on passing three environmental criteria (variables). These are based on two biological criteria (for existing quality) and one environmental criterion (for potential quality). The biological criteria are divided into external and internal criteria (relative to Broadland) and relate to species of plants present. The external list refers to the Red Data Species or other nationally recognised species. The internal list is derived from the work by Harris (1992). By passing a threshold for presence of species a rond scores a pass (or possibly a double pass for external criterion) and moves up a category, e.g. from Low to Medium. The environmental criterion on area proposed is the Edge : Area Quotient (as suggested by the Broadland Environmental Forum) where a quotient of less than 0.12 is a pass of this criterion (e.g. a larger contiguous area relative to its perimeter). If no rond is present the score No Rond is assigned. This method provides an objective and effective method for segregating ronds (sections) into quality classes using existing data.

## PURPOSE

The Environment Agency wanted to design a scoring method with the following purpose. This is to:

'define an Environmental Scoring Methodology to provide a reliable and easy to apply classification of the ronds, for the purpose of improving conservation alongside the required flood defence works.'

## BACKGROUND

The Environment Agency - Anglian Region (Environment Agency) is undertaking a programme of flood defence works and erosion protection schemes in Broadland. This is an extended programme of works and will continue for about 10 years in the anticipated schedule. Works are to be carried out in all 37 of the Broadland Flood Compartments to provide increased protection by bank strengthening and other works. As part of the work the Environment Agency desires to improve the conservation value of the area, and to focus this on areas which can be determined to have a greater or potentially greater conservation value.

Engineering studies have previously determined that the minimum width of a rond for flood defence protection is about 2m. However other environmental studies have identified that rond widths greater than 20m have a disproportionately higher conservation value. The Environment Agency therefore would like an environmental scoring methodology to determine which ronds are of greater interest and of what widths, so that where appropriate the ronds could be maintained or protected at widths greater than 2m. It is known that one of the likely engineering methods for bank strengthening can extend to about 6m, where for widths beyond this the work would likely need to be carried out from a barge with associated higher costs. The environmental scoring methodology would allow the Environment Agency to make decisions as to when works beyond 2m or 6m may be acceptable.

## METHOD

The method is designed to be used easily by use of spreadsheets produce the scores. To use the method the following steps are followed:

1. Obtain Data from Environment Agency as shown in the method descriptions
  - 1:2,500 Cross Section Survey Maps for the Rivers
  - REDS Base Maps, Survey Reports and Plant Species lists per section
2. Follow method for the Edge : Area Calculation as described below and in the spreadsheet, if no rond is present stop and record score for that section as No Rond (or the spreadsheet will do this for you). Use the spreadsheet RONDTEST.XLS.

3. Follow method for the Species Scores as shown below and in the spreadsheet SPECTEST.XLS
4. Combine edge : area and species scores for the Final Environmental Score

The proposed approach to the Environmental Scoring Method is to provide independent criteria for the definition of environmental or ecological value. If no Rond is present, this method is not used and the score of 'No Rond' is recorded. Where a rond is present the three criteria are considered, and by achieving a sufficient score for a pass of any of these the site would be recognised as having value. If more than one of the several criteria are passed then the site would be recognised as having higher value. The method uses the following levels:

- No Rond
- Low
- Medium
- High
- Exceptional.

It is proposed to accept the REDS data as relevant to the left and right banks (ronds) separately, even though the REDS data are for sections on the rivers for both banks, except where this is known to be incorrect (e.g. for Waveney 176 the Right Bank was not surveyed so the data cannot be used for Compartment 34). It is proposed to recognise the three different salinity zones (ecological areas) in Broadland and to calculate scores for saltmarsh, brackish and freshwater sections using different indicator species.

The following criteria are proposed:

- External - Plant Species - use of nationally or internationally recognised species - with data from the REDS database but noting these data apply to both banks;
- Internal - Plant Species - use of indicator species for a rond applied by REDS' sections. It is here that the 3 areas from salt to fresh will be assessed separately, as much as a section can be correctly assigned to a category from the map.
- Potential/Existing Value - use of the edge to area to identify the larger contiguous ronds that would likely have existing ecological value as well as the potential for ecological value over time.

### General

It is proposed to use a system where a rond is present, based on the three different variables: external plants, internal plants, and potential value from area (edge : area quotient). This system has four quality categories: Poor; Low; Medium; High and Exceptional. It is also proposed that the presence of rare species is given a weighting factor so that the external variable carries more value than the other variables.

Therefore, to use the method first determine if a rond is present. If not, then record 'No Rond' as the score. If a rond is present then the sections (ronds) are tested against the three criteria on a pass/fail basis. A section (rond) is assumed to start in the Low category. If the section passes the external criteria (presence of rare species) it moves up one category, e.g. Low to Medium. If a section gets a double pass on the external criteria it moves up two categories, e.g. Low to High. For each pass of any of the other criteria the section moves up one category, e.g. Low to High. The highest category is Exceptional, and this can be achieved through various pass combinations.

#### **Potential/Existing Value - Edge to Area Quotient (Rond Size from Forum method)**

The Edge : Area Quotient is an appropriate measure of potential. Wider ronds score more highly than narrow ones and continuous ronds score more highly than fragmented ones. The edge measurement does not follow every detailed convolution of the rond edge, nor does the area measurement have to be totally accurate. The "best" ronds have smaller edge : area quotients.

The method used to calculate the edge : area quotient was undertaken using:

- Environment Agency River bank cross-sections from the 1993 survey for the Erosion Protection Scheme.
- Ordnance Survey 1:2,500 scale maps of the rivers.
- River Corridor Surveys (REDS) maps, and the
- MS-Excel spreadsheet (rondtest.xls, on the included disk)

To carry out the analysis:

- The 1:2,500, OS Maps, are marked as necessary with the REDS, 500 metre survey segments and the locations of the Environment Agency cross sections (which are every 100 metres).
- Each 100 metre segment was considered at their beginnings and ends and generalised in-between, thus giving five segments per 500 metre section, considered to be accurate enough for this purpose.
- Using the Environment Agency cross-section for the beginning of the 100m segment, the width of the rond was calculated from the bottom edge of the defence bank up to the waters edge. It was decided that the width should be a minimum of 2 metres to qualify as a rond. If the Environment Agency cross-section did not reach up to the waters edge the rond width was measured using the O.S. maps. This was repeated for the cross-section at the end of the 100m segment. The REDS survey maps can also be used for reference.
- If there was a rond at the beginning but not the end of the 100m segment, then the maps were used to judge how far along the segment the rond finishes.

- Assuming that the front of the segment is straight, and the back of the segment is also defined by a straight line, the figures will thus describe the dimensions of the rond in that segment. This will be either a rectangle, a triangle, or a combination of both (see diagram; Figure 3)
- All the figures were added into the spreadsheet. The spreadsheet calculates the area (by adding triangles and rectangles as required) and perimeter (including only the ends at the 0 and 500 metre mark) of the rond within that 500m section, and finally the edge : area quotient. No account is made for adjoining ronds from one 500m section to the next.

The pass value for the rond quotient value for the purposes of the scoring method has been set at 0.12, any quotient above this score fails. This has been based upon both theory and the statistical spread of the results in order to obtain a reasonable number of passing ronds.

There may be sections where the spreadsheet will have to be manipulated further. For instance, if one rond finishes and another one starts further downstream. If this occurs within the same 100m stretch then the spreadsheet will treat this as a continuous rond of the dimensions specified by the 0 and 100 metre marks, and artificially reduce the quotient.

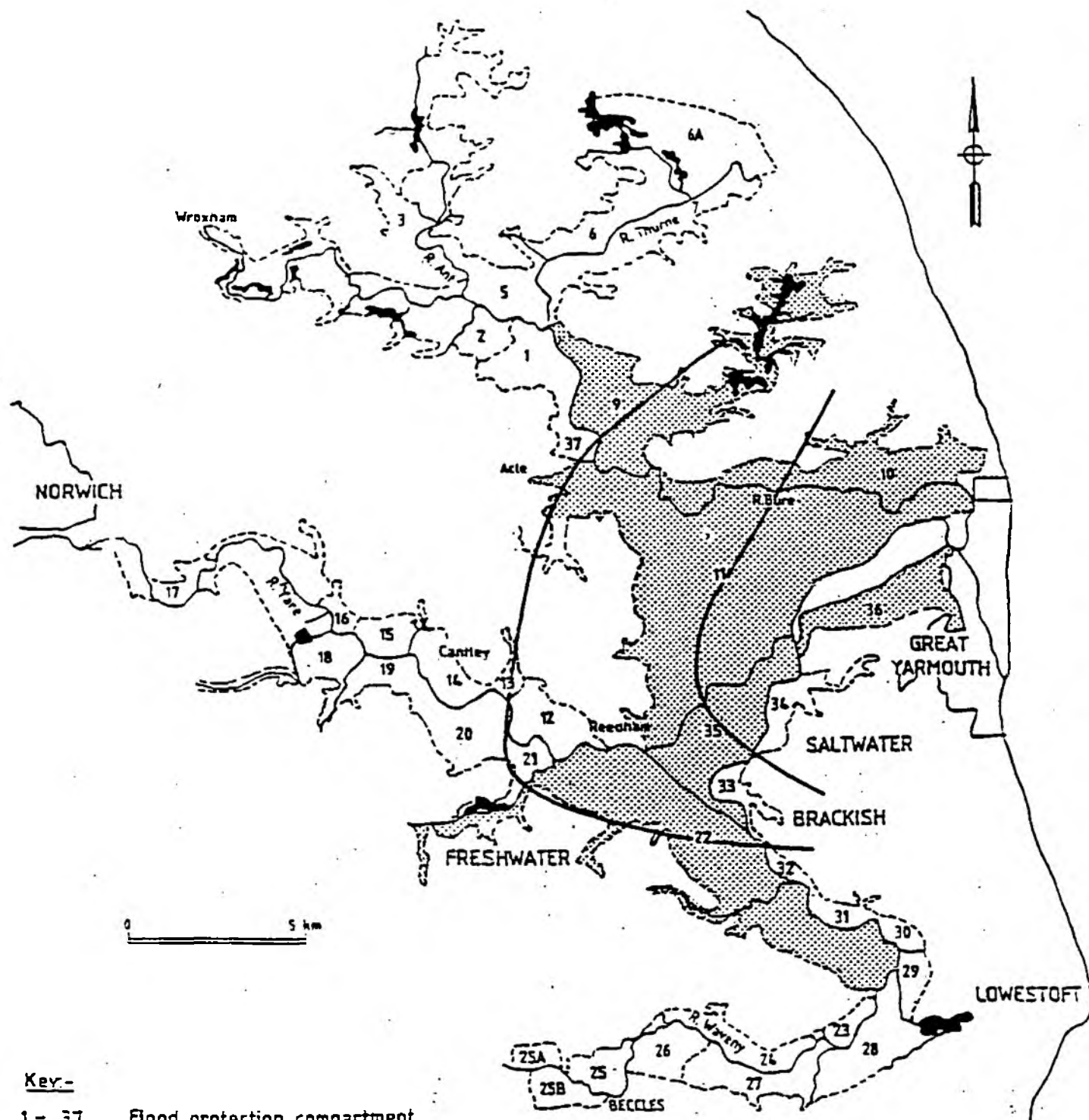
#### External - Plants

There are 3 nationally rare species present in Broadland, of those listed the first two are locally frequent on the ronds (Harris 1992). The method for this external (to Broadland) criteria is that if any one of these species are present in a section (rond) then this indicates a pass of this criteria (variable). If two or more are present this indicates a double pass.

Marsh Sow Thistle	<i>Sonchus palustris</i>
Marsh Mallow	<i>Althea officinalis</i>
Least Lettuce	<i>Lactuca saligna</i>

#### Internal - Plants

To assess this criterion the method uses a list of plant species (Tables 1 - 3, see Excel Spreadsheet: Spectest.xls), identified by Harris for the three zones saltmarsh, brackish and freshwater from her work on the ronds of Broadland, as important indicators of good or better ronds. These have been since modified by Dunsford. In a similar fashion to the external criteria the species list for a section (rond) would be compared to the appropriate list e.g. freshwater, brackish or saltmarsh. If more than 21 of the 50 of the species listed are present for the freshwater communities, more than 7 of the 42 for brackish communities or more than 7 of the 17 for saltwater communities then a pass is recorded for that section.



**Key:-**

- 1 - 37 Flood protection compartment (UAE) number
- Approx extent of flood liable land

**Figure**  
**FLOOD PROTECTION COMPARTMENTS**  
 Showing Salinity Zones  
 (From Binnie 1994)

## BROADLANDS ENVIRONMENTAL SCORING METHODOLOGY

### *Rond Edge: Area Quotient Calculation Methodology*

#### Introduction

This method of calculating edge:area quotient for rond works by dividing the river into 100 metre sections and assuming a certain rond shape within that 100 metres, using the available information. The five shapes are then added to give a quotient for the 500 metre river corridor survey sections (REDS).

The data used to do this are:

1. Environment Agency River bank cross-sections from 1993 survey for Erosion Protection Scheme.
2. Ordnance Survey 1:2500 scale maps of river.
3. MS-Excel spreadsheet (rondtest.xls) on the included disk.
4. River Corridor Surveys (REDS) Maps.

#### Method:

Using the river corridor surveys base maps, make a copy of the relevant 1:2500 maps showing the river corridor. These are already marked with the 500 metre survey segments. Onto this copy mark the locations of the Environment Agency cross sections made every 100 metres, giving approximately five cross-sections per 500 metre survey segment. This can accurately be done by overlaying the copy onto the Environment Agency map showing the cross-section positions, which is at the same scale.

Load the first three columns of an empty spreadsheet (rondtest.xls) with the corridor survey and Environment Agency cross-section numbers, adding rows as required. This is then used as a table to be filled in as progress is made. Each 100 metre segment is considered at the beginning and the end and generalised in-between, thus giving five segments per 500 metre section, considered to be accurate enough for the purpose.

Look at the Environment Agency cross-section for the beginning of the first 100m segment. Calculate the width of the rond from the bottom edge of the defence bank up to the waters' edge. The width should be a minimum of 2 metres to qualify as a rond. If the Environment Agency cross-section does not reach up to the waters' edge then the rond width should be measured from the O.S. maps (4cm = 100m), but the Environment Agency sections take precedence. Repeat for the cross-section at the end of the 100m segment, and complete the spreadsheet accordingly. It is assumed that the Environment Agency sections all look downstream. The REDS survey maps can also be used for reference to obtain widths or to confirm detail.

If there is a rond at the beginning but not the end of the 100m segment, then use the maps to judge how far along the segment finishes, filling the spreadsheet accordingly.



Assuming that the front of the segment is straight, and the back of the segment is also defined by a straight line, the figures will thus describe the dimensions of the rond in that segment. This will be either a rectangle, a triangle, or a combination of both. (See diagram; rondmeth.xls)

The spreadsheet then calculates the area (by adding triangles and rectangles as required) and perimeter (including only the ends at the 0 and 500 metre mark) of the rond within that 500m section, and finally the edge:area quotient. No account is made for adjoining ronds from one 500m section to the next.

The copies of the maps should be marked with the defined rond area for reference.

There may be sections where the spreadsheet will have to be manipulated further. For instance, if one rond finishes and another one starts further downstream. If this occurs within the same 100m stretch, then the spreadsheet will treat this as a continuous rond of the dimensions specified by the 0 and 100 metre marks, and artificially reduce the quotient.

The pass value for the rond quotient value for the purposes of the scoring method has been set at 0.12, any quotient above this score fails. This has been based upon the statistical spread of the results in order to obtain a reasonable amount of passing ronds.

The use of the O.S. maps for direct measurement should be minimised. In addition, the publication date of the maps should be checked and the most recent available used.

At time the Environment Agency REDS hand drawn maps may be needed for reference too, to learn the width of a rond, as some of the Environment Agency survey maps cross sections do not extend to the rond's edge.

## Broadland Environmental Scoring Methodology

### Rond Edge:Area Quotient Test Spreadsheets

Version                      Final  
Date                         26-Aug-99

Please see attached method notes (Rondmeth.doc) and figure (Rondmeth.xls) which describe how to use the method and this spreadsheet. The assumptions to use the method are given below. The result from this test is combined with the results from the Species Test Spreadsheets to obtain the overall section score.

#### Assumptions

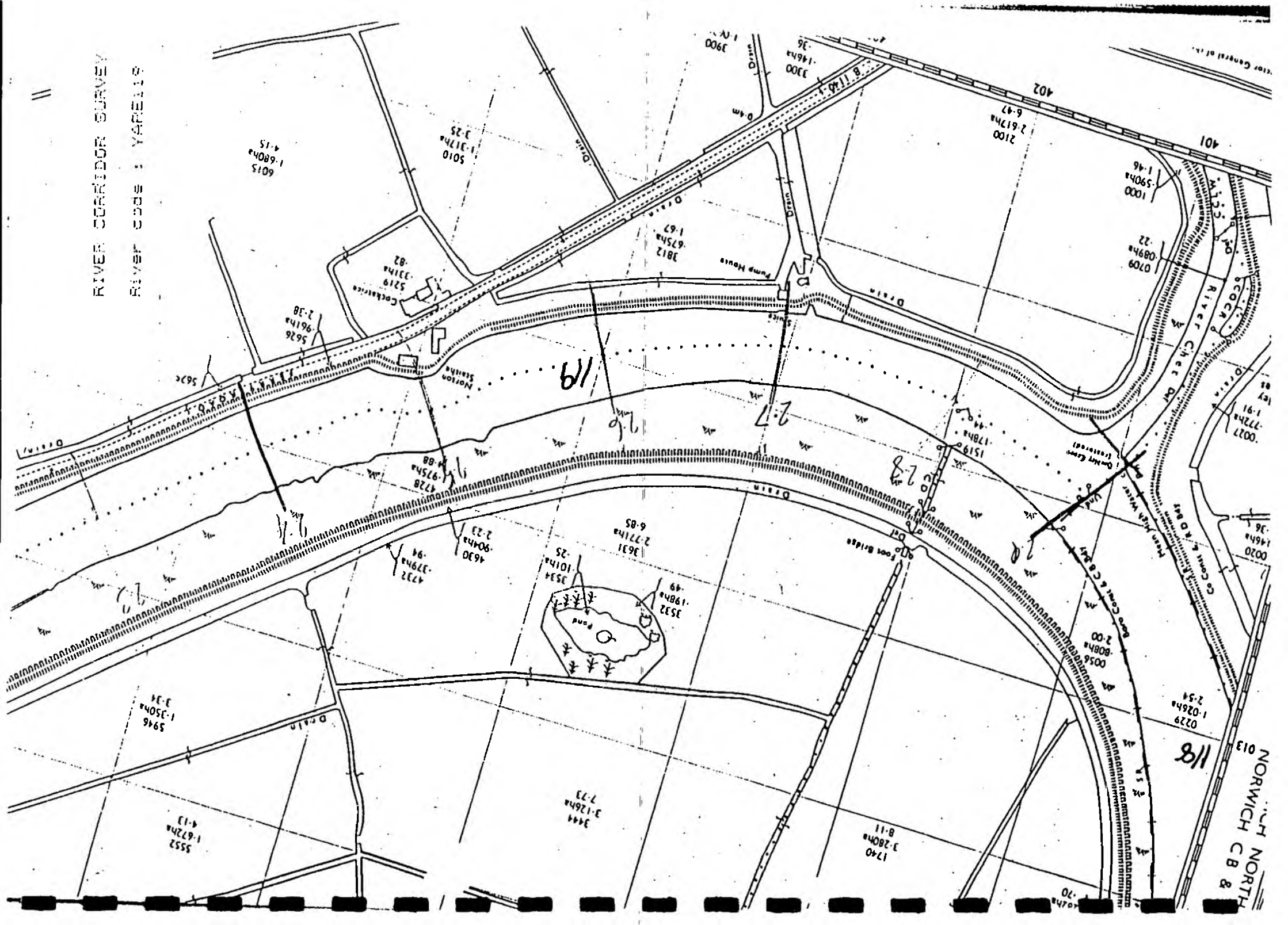
- 1            Environment Agency cross-sections rule for dimensions of segments.
- 2            Each described segment makes up a shape for calculation, either a rectangle, triangle, or a rhomboid comprising a rectangle and a triangle.
- 3            The segment width is taken from the Environment Agency sections from the waters edge to the start of the incline of the bank (see attached diagram). The segment length is actually that part of the segment which is taken up by the rond, which may be all or part of the 100 m segment.
- 4            The river has been cut into 100m length segments. The Environment Agency sections mark the begin and end of the segments. The width of the rond along the segment is judged using the Environment Agency sections for each end and the maps provided.
- 5            The spreadsheet then calculates the area of the rectangle and triangle respectively to give a total area for that segment.
- 6            It then calculates the perimeter, the front of the segment is the waterfront, so this is assumed to be straight and the same as the length of the segment. The bank is the back of the segment. If the segment is a rectangle then this again is the length. If the segment has a triangle aspect then this is calculated using pythagoras' theorem.
- 7            The perimeters are then added up and the two ends added to give the total perimeter. Similarly the area of segments in the rond is added to give the total area. Finally the edge to area quotient is calculated by dividing the perimeter by the area.
- 8            Shaded cells can be used to mark the beginning and end of the actual ronds.
- 9            The quotient is calculated for each 500 metre survey section. This treats each section as if it were a separate rond. No account is taken for adjoining ronds. The results can be assimilated from the sections for a rond as in the worked example.
- 10          Assumes all Environment Agency river sections look downstream.

Compartment: x  
River: y

Important: See attached notes and assumptions

River Corridor Survey Reference	Env Agency Drawing Section Reference		Segment Width (m)		Segment Length (m)	Rond Area (m2)			Rond Perimeter (m)			Rond Quotient Calc for each 500m length			Edge:Area Quotient Score	Notes
	Begin	End	Begin	End		Rectangle	Triangle	Total	Waterfront	Bank	Total	Area (m2)	Perim. (m)	Edge:Area Quotient		
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0					
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				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0	0	0	NR	NR	
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0	0	0	NR	NR	
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0	0	0	NR	NR	
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0	0	0	NR	NR	
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				0		0	0	0	0	0.00	0					
				0		0	0	0	0	0.00	0	0	0	NR	NR	

RIVER CORRIDOR SURVEY  
RIVER CORRIDOR SURVEY



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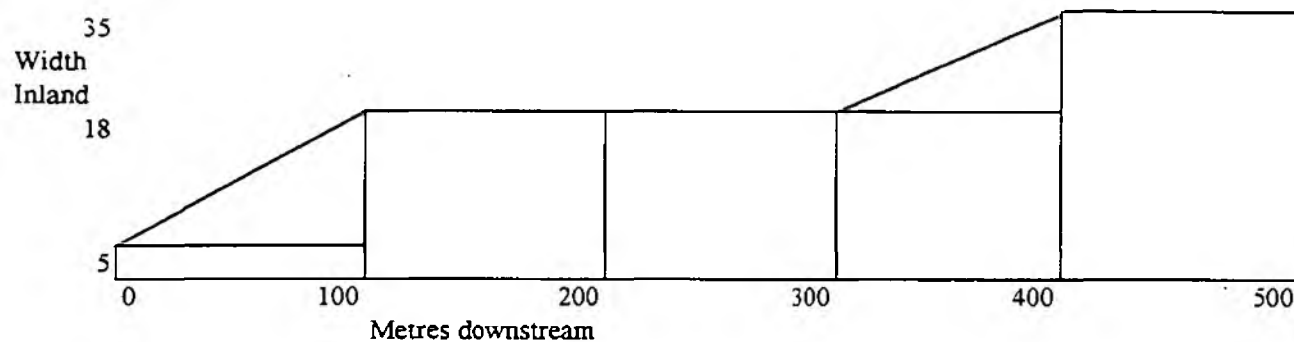
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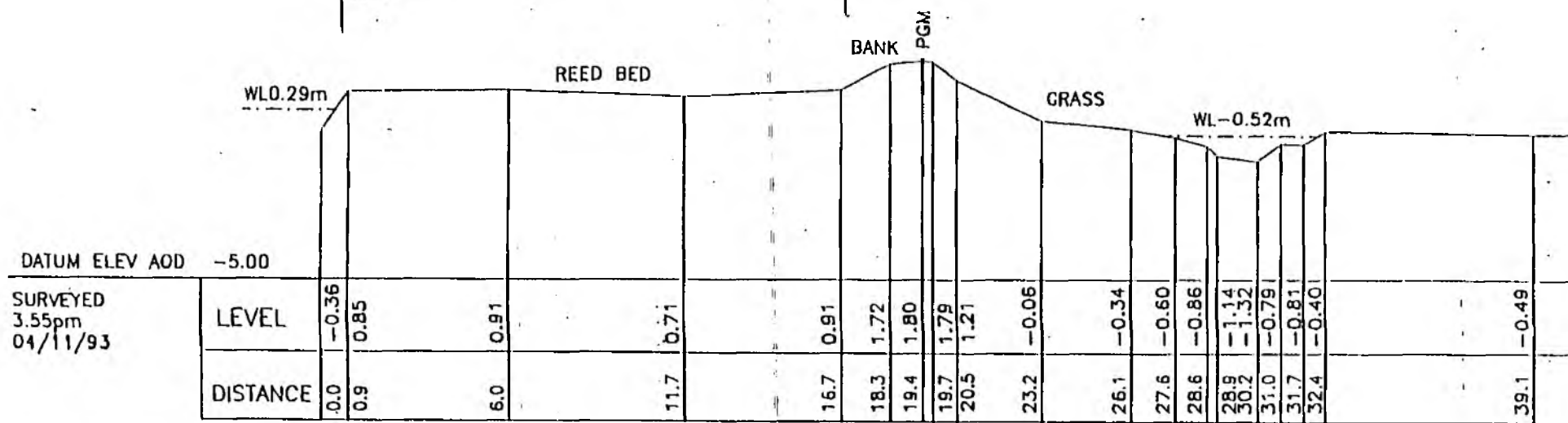
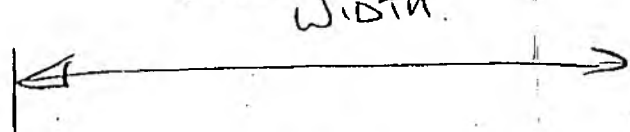
Area	1150	1800	1800	2650	3500
Perimeter:					
Top	101	100	100	101	100
Bottom	100	100	100	100	100
End	5	-	-	-	35

Total Perimeter: 1042

Total Area: 10900

Edge/Area Quotient: 0.10 = Pass

ASSUMED  
ROAD  
WIDTH.



CH0.400km

## Broadland Environmental Scoring Methodology

### Species Test Spreadsheets

Version    Final  
Date       26-Aug-99

The three spreadsheets in this workbook are designed to allow easy calculation of the species tests for the Broadland Environmental Scoring Methodology. As defined in the method there is an External Species Test and an Internal Species Test, with different indicator species lists for Saltmarsh, Brackish and Freshwater reaches of a river.

The spreadsheets are used by first determining which of the three is appropriate by reference to the map of Broadlands delineating which type of salinity zone the section falls into, and then by comparing the species list for the section (from the Environment Agency REDS data) to the correct spreadsheet. For example, Compartment 34 on the Waveney is all in the Saltmarsh delineated zone so the Saltmarsh sheet would be used. In other Compartments, e.g. Compartment 22, there are three rivers and these fall into both Brackish and Freshwater Zones. The appropriate spreadsheet is therefore used for each section as determined.

To use the determined spreadsheet, the Compartment Number and River Name are entered in Cells B1 and B2 and then the REDS Section No. as shown (overwriting the lower case letters). By comparison of the alphabetical listing of the REDS plant species (see end of list too for additions) to the alphabetical lists of test species the spreadsheet is completed by entering a 1 for presence and leaving a blank for absence. This is repeated for both External and Internal Species lists. The spreadsheet will calculate the number of passes for you by reference to the test criteria (e.g. > 8 of 17 of the Saltmarsh species listed are needed for an Internal Pass). The spreadsheets allow for up to 20 sections of a salinity type per river per compartment, and when printed out the names will automatically repeat. When comparing the lists some attention needs to be given to plant synonyms (e.g. *Spergularia media* / *S. marginata* Greater Sea Spurry) and reference should be made to the REDS text and map to check the validity of the REDS species list for a Compartment. This final point is because the REDS data are for both banks and for more than the road for a 500m section, while the focus of the engineering works and this scoring system relates to the road in a Compartment on only one bank.

The Overall Species Score for the species tests is combined with the Edge:Area Quotient Score as described elsewhere to obtain the Final Section Score.

Compartment:

River:

Saltmarsh Plant Species	Section No.				
	a	b	c	d	e
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*



Compartment:

River:

Saltmarsh Plant Species	f	g	h	i	j
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*  
 [2] *Phragmites communis*  
 [3] *Spergularia marginata*  
 [4] *Spergularia salina*

Compartment:

River:

Saltmarsh Plant Species	k	l	m	n	o
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

- [1] *Atriplex hastata*
- [2] *Phragmites communis*
- [3] *Spergularia marginata*
- [4] *Spergularia salina*

Compartment:

River:

Saltmarsh Plant Species	p	q	r	s	t
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Halimione portulacoides</i> (Sea Purslane)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Limonium vulgare</i> (Common Sea Lavender)					
<i>Phragmites australis</i> (Common Reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Puccinellia maritima</i> (Saltmarsh Grass/Sea Poa)					
<i>Salicornia</i> agg. (Glasswort)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Spergularia marina</i> (Lesser Sea Spurrey) [4]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
Total No. - If >7 of 17 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*[4] *Spergularia salina*

Compartment:

River:

Brackish Plant Species	Section No.				
	a	b	c	d	e
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Apium graveolens</i> (Wild Celery)					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Sonchus arvensis</i> (Perennial Sow-thistle)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*

Compartment:

River:

Brackish Plant Species	f	g	h	i	j
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Apium graveolens</i> (Wild Celery)					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bulrush)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Sonchus arvensis</i> (Perennial Sow-thistle)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*

Compartment:

River:

Brackish Plant Species	k	l	m	n	o
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Apium graveolens</i> (Wild Celery)					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Sonchus arvensis</i> (Perennial Sow-thistle)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*

Compartment:

River:

Brackish Plant Species	p	q	r	s	t
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Apium graveolens</i> (Wild Celery)					
<i>Aster tripolium</i> (Sea Aster agg)					
<i>Atriplex prostrata</i> (Hastate Orache) [1]					
<i>Berula erecta</i> (Lesser/Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Cochlearia officinalis</i> (Common Scurvy Grass)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glaux maritima</i> (Sea Milkwort)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus gerardi</i> (Saltmarsh Rush)					
<i>Juncus maritimus</i> (Sea Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [2]					
<i>Plantago maritima</i> (Sea Plantain)					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Puccinellia maritima</i> (Common Saltmarsh Grass)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Samolus valerandi</i> (Brookweed)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scirpus maritimus</i> (Sea Club Rush)					
<i>Sonchus arvensis</i> (Perennial Sow-thistle)					
<i>Spergularia media</i> (Greater Sea Spurrey) [3]					
<i>Suaeda maritima</i> (Annual Seablite)					
<i>Triglochin maritima</i> (Sea Arrow Grass)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >7 of 42 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Older or Alternate Scientific Names

[1] *Atriplex hastata*[2] *Phragmites communis*[3] *Spergularia marginata*

Compartment:

River:

Freshwater Plant Species	Section No.				
	a	b	c	d	e
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Angelica sylvestris</i> (Wild Angelica)					
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex obtusae</i> (False Fox Sedge)					
<i>Carex paniculata</i> (Greater Tussock Sedge)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Equisetum arvense</i> (Common Horsetail)					
<i>Eupatorium cannabinum</i> (Hemp Agrimony)					
<i>Filipendula ulmaria</i> (Meadow-sweet)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Humulus lupulus</i> (Hop)					
<i>Impatiens capensis</i> (Orange Balsam)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus inflexus</i> (Hard Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)					
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Polygonum hydropiper</i> (Water Pepper)					
<i>Polygonum mite</i> (Tasteless Waterpepper)					
<i>Ribes nigrum</i> (Blackcurrant)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scutellaria galericulata</i> (Skullcap)					
<i>Solanum dulcamara</i> (Bittersweet)					
<i>Sonchus arvensis</i> (Perennial Sow Thistle)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
<i>Stachys palustris</i> (Marsh Woundwort)					
<i>Thalictrum flavum</i> (Meadow Rue)					
<i>Typha angustifolia</i> (Lesser Reedmace)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Valeriana officinalis</i> (Common Valerian)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >21 of 50 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0



Compartment:

River:

Freshwater Plant Species	f	g	h	i	j
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Angelica sylvestris</i> (Wild Angelica)					
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex obtrubae</i> (False Fox Sedge)					
<i>Carex paniculata</i> (Greater Tussock Sedge)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Equisetum arvense</i> (Common Horsetail)					
<i>Eupatorium cannabinum</i> (Hemp Agrimony)					
<i>Filipendula ulmaria</i> (Meadow-sweet)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Humulus lupulus</i> (Hop)					
<i>Impatiens capensis</i> (Orange Balsam)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus inflexus</i> (Hard Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)					
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Polygonum hydropiper</i> (Water Pepper)					
<i>Polygonum mite</i> (Tasteless Waterpepper)					
<i>Ribes nigrum</i> (Blackcurrant)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scutellaria galericulata</i> (Skullcap)					
<i>Solanum dulcamara</i> (Bittersweet)					
<i>Sonchus arvensis</i> (Perennial Sow Thistle)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
<i>Stachys palustris</i> (Marsh Woundwort)					
<i>Thalictrum flavum</i> (Meadow Rue)					
<i>Typha angustifolia</i> (Lesser Reedmace)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Valeriana officinalis</i> (Common Valerian)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >21 of 50 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Compartment:

River:

Freshwater Plant Species	k	l	m	n	o
<b>External Species Test</b>					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
<b>Internal Species Test</b>					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Angelica sylvestris</i> (Wild Angelica)					
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex obtusae</i> (False Fox Sedge)					
<i>Carex paniculata</i> (Greater Tussock Sedge)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Equisetum arvense</i> (Common Horsetail)					
<i>Eupatorium cannabinum</i> (Hemp Agrimony)					
<i>Filipendula ulmaria</i> (Meadow-sweet)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Humulus lupulus</i> (Hop)					
<i>Impatiens capensis</i> (Orange Balsam)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus inflexus</i> (Hard Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)					
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
<i>Mentha aquatica</i> (Water Mint)					
<i>Myosotis laxa</i> subsp. <i>caespitosa</i> (Tufted Forget-me-Not)					
<i>Myosotis scorpioides</i> (Water Forget-me-Not)					
<i>Nasturtium officinale</i> (Water Cress)					
<i>Oenanthe fistulosa</i> (Tubular Water-dropwort)					
<i>Oenanthe lachenalii</i> (Parsley Water-dropwort)					
<i>Phalaris arundinacea</i> (Reed Canary Grass)					
<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
<i>Polygonum hydropiper</i> (Water Pepper)					
<i>Polygonum mite</i> (Tasteless Waterpepper)					
<i>Ribes nigrum</i> (Blackcurrant)					
<i>Rumex conglomeratus</i> (Clustered Dock)					
<i>Rumex crispus</i> (Curled Dock)					
<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
<i>Schoenoplectus lacustris</i> subsp. <i>tabernaemontani</i> (Bullrush)					
<i>Scutellaria galericulata</i> (Skullcap)					
<i>Solanum dulcamara</i> (Bittersweet)					
<i>Sonchus arvensis</i> (Perennial Sow Thistle)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
<i>Stachys palustris</i> (Marsh Woundwort)					
<i>Thalictrum flavum</i> (Meadow Rue)					
<i>Typha angustifolia</i> (Lesser Reedmace)					
<i>Typha latifolia</i> (Greater Reedmace)					
<i>Valeriana officinalis</i> (Common Valerian)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >21 of 50 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0

Compartment:

River:

Freshwater Plant Species	p	q	r	s	t
External Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Sonchus palustris</i> (Marsh Sow Thistle)					
Total No. - If 1 Score = 1; If 2 or 3 Score = 2	0	0	0	0	0
External Score	0	0	0	0	0
Internal Species Test					
<i>Althea officinalis</i> (Marsh Mallow)					
<i>Angelica sylvestris</i> (Wild Angelica)					
<i>Berula erecta</i> (Lesser/ Narrow Leaved Water Parsnip)					
<i>Caltha palustris</i> (Marsh Marigold)					
<i>Calystegia sepium</i> (Bellbine)					
<i>Carex obtrubae</i> (False Fox Sedge)					
<i>Carex paniculata</i> (Greater Tussock Sedge)					
<i>Carex riparia</i> (Greater Pond Sedge)					
<i>Epilobium hirsutum</i> (Hairy Willowherb)					
<i>Equisetum arvense</i> (Common Horsetail)					
<i>Eupatorium cannabinum</i> (Hemp Agrimony)					
<i>Filipendula ulmaria</i> (Meadow-sweet)					
<i>Galium palustre</i> (Common Marsh Bedstraw)					
<i>Glyceria maxima</i> (Sweet Reed Grass)					
<i>Humulus lupulus</i> (Hop)					
<i>Impatiens capensis</i> (Orange Balsam)					
<i>Iris pseudacorus</i> (Yellow Flag Iris)					
<i>Juncus inflexus</i> (Hard Rush)					
<i>Juncus subnodulosus</i> (Blunt-flowered Rush)					
<i>Lactuca saligna</i> (Least Lettuce)					
<i>Lycopus europaeus</i> (Gipsywort)					
<i>Lysimachia vulgaris</i> (Yellow Loosestrife)					
<i>Lythrum salicaria</i> (Purple Loosestrife)					
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<i>Phragmites australis</i> (Common reed) [ <i>P. communis</i> ]					
<i>Polygonum amphibium</i> (Amphibious Bistort)					
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<i>Rumex hydrolapathum</i> (Great Water Dock)					
<i>Rumex maritimus</i> (Golden Dock)					
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<i>Valeriana officinalis</i> (Common Valerian)					
<i>Veronica beccabunga</i> (Brooklime)					
Total No. - If >21 of 50 then Score = 1	0	0	0	0	0
Internal Score	0	0	0	0	0
Overall Species Score	0	0	0	0	0