# Safeguarding the waterway environment:

## Priorities for research

Report of the AINA Working Group on the Environmental Impacts of Waterways Uses

Association of Inland Navigation Authorities

# Foreword

It is clear that there are gaps in our knowledge of the environmental impacts (positive and negative) of waterways use. This report goes some way towards identifying those gaps and proposes specific measures to fill them for the benefit of waterway managers and all waterway stakeholders.

As the representative body for navigation authorities nation-wide, AINA believes it is well placed to procure and coordinate the required research work and to convert the outputs in the form of guidance for good waterway management practice.

Funding the proposed work will inevitably be an issue. Currently there is inadequate provision of funding for the management and operation of inland waterways and the need to integrate requirements for use and the natural environment will place an even greater demand on limited resources.

However, the benefits to be gained from undertaking the research recommended in this report are such that new income will be created for re-investment in the waterways contributing to the sustainability of the waterways and their environs for the benefit of all.

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**Chairman**

April 2003

# About AINA

The Association of Inland Navigation Authorities (AINA) was set up in December 1996 with strong encouragement from Government to provide, for the first time ever, a single voice on waterway management issues. The broad purpose of AINA is to facilitate the management, maintenance and development of the inland waterways for navigation as an economic, environmental, recreational and social resource.

AINA has 29 members including the three large Government-sponsored navigation authorities – British Waterways, the Environment Agency, the Broads Authority – and also local authorities, drainage commissioners, property development companies, port authorities, original canal companies, national parks, the National Trust, and other charitable trusts.

Between them, AINA members own, operate and manage some 5,000 km of waterway representing almost a complete UK coverage. Each member has its own constitution, aims and objectives and, in many cases, Acts of Parliament regulating the operation of its waterways.

AINA's key objectives are to:

- provide a forum for the sharing of best practice, advice and expertise,
- represent the views of the Association to Government, EU, statutory agencies and other relevant bodies,
- develop links with its European neighbours,
- secure adequate investment in inland waterways,
- promote public awareness of the value and potential of inland waterways and gain support for their development and conservation,
- enhance the amenity and environmental quality of inland waterways,
- coordinate aspirations and to plan, in the context of a national strategy, for exploiting the potential of inland waterways.

Association of Inland Navigation Authorities

# Contents





# 1. Introduction

1.1 Today, the inland waterways are used for many purposes. Each use has the potential to interact with the interests of the natural environment and may, if not well-managed, detract from its value. In many cases this will not only affect efforts to conserve natural resources; users themselves will experience a decrease in the attractiveness and interest of the waterway environment.

1.2 This report reviews current knowledge of the environmental impacts of the many different uses of the UK's inland waterways. It identifies areas in which there is insufficient knowledge and proposes research to remedy these shortcomings.

1.3 Specifically, the report seeks to:

- identify the potential impacts of the many and varied uses of the inland waterways, and their related activities, on the natural environment,
- identify gaps in our existing knowledge on the impacts of various uses,
- offer priorities for research, to be undertaken over the next decade, to fill the major gaps in knowledge and thus enhance the capability of waterway managers to achieve high and sustainable environmental standards, in addition to delivering economic and social benefits.

# 2. The impact of waterway management and use on the environment

2.1 *Waterways for Tomorrow*[1] identifies the considerable potential the waterways have for a wide variety of uses and activities. Most have environmental impacts some of which pose issues of real concern. *Steering a Fresh Course*[2] identifies the issues relevant to the natural environment as:

- the effects of navigation on the natural environment, including those due to craft movement and those due to creating and maintaining navigability,
- the impacts of non-navigational uses, e.g. access for walking and development such as the building of marinas stimulated by the presence of navigation,
- the need for environmental appraisal for all projects and full environmental impact assessments for major projects,
- the recognition of major gaps in knowledge of the natural environment in the context of waterways, and of the complexity and fragility of natural systems,
- the need to determine the ecological balance for those waterways with significant environmental interest while understanding the maintenance requirements for a safe navigation,
- the need to balance the needs of navigation and wildlife,
- the use of the waterways as a major resource for environmental education.

2.2 The *Waterways for Tomorrow National Conference report*[3] states that there is a need for more research to achieve greater understanding of the human impacts on the waterways environment. Specifically, the report states that:

- there has been much research into the impacts of leisure and recreation uses on canals, although there are still gaps in our knowledge,
- there is insufficient objective information available in relation to effects on rivers which are not hydraulically uniform and are self-scouring,
- better co-ordinated research is needed to understand the direct and indirect effects of the variety of waterways uses,
- more work is needed to determine protocols for environmental impact assessments,
- there is a perception that environmental impact assessment on navigable rivers is under-developed.

2.3 Before assessing the environmental impacts associated with the uses of waterways it is important to understand that canals and river navigations are inherently managed environments. Canals are wholly man-made and navigable rivers have been subject to significant human modification.

2.4 It follows that any use of or development along waterways needs to be considered on the basis that the existing system is not entirely natural. Moreover, continuing human intervention will often be necessary to maintain the quality of the habitats and biodiversity which have developed in them.

2.5 The successful integration of environmental conservation with other waterways uses requires an adequate knowledge of waterway ecology, its management and the effects of each use of the system on habitats and their populations of plants and animals. Many of the past conflicts between nature conservation and waterway development have arisen through uncertainty about the effects of the changes being proposed. Greater ecological understanding and hence ability to predict impacts and provide mitigation for them, can go a long way towards removing such conflicts. The need for this greater ecological understanding is the major driving force behind this report.

2.6 The wildlife value of the waterway environment is a major attraction to many users. Indeed, the natural environment is fundamental to the character of the waterways.

2.7 There is significant scope for introducing imaginative management tools to assist in the interpretation and enjoyment of the natural environment for waterway users, without compromising environmental quality. This will raise the status of the wildlife component in users' minds and help to justify its maintenance in cases where this ultimately requires some restriction of other aspects of waterway use and development.

2.8 Ultimately the yardstick for measuring success must be sustainable development - development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In the case of the waterways, this can be interpreted as making sure that the economic growth of the waterways is achieved in such a manner that will not jeopardise, and could even enhance, natural resource systems.[4]

[1] *Waterways for Tomorrow.* Department of the Environment, Transport & The Regions, June 2000.

[2] *Steering a Fresh Course: A Strategy for the Inland Navigations of the United Kingdom.* AINA 1999

[3] *Waterways for Tomorrow National Conference 19 March 2001. Conference Report,* Department of the Environment, Transport & The Regions May 2001

[4] *Recreational Navigation and Nature.* International Navigation Association (PIANC). Report of Working Group 12 of the Recreational Navigation Commission, 2000.

# 3. The approach

3.1 The Working Group which has produced this report was set up by AINA in February 2002. The members are listed in Appendix 1 and the Group's terms of reference are set out in Appendix 2.

3.2 The Working Group considered that 'impacts' can be both detrimental and beneficial and that the term 'environment' should be used in its widest sense to embrace not only nature or 'green' issues, but also economic and social issues. In addition, the Group decided to concentrate not only on the uses of the waterway itself, but also on the wider waterway corridor and its environment.

3.3 The Group set out to consider practical issues and practical solutions, but to do so within the context of a broader vision for the waterways - taking into account their potential for leisure, recreation and commercial activities; their potential to promote social inclusion; their role in conserving nature; and their role as catalysts for urban and rural regeneration.

3.4 Much of the existing knowledge on impacts of waterways use is derived from previous research from many sources which has, where appropriate, been translated into waterway management practice. An illustration of some of this material is given as a bibliography in Appendix 3. However, the Working Group made no attempt to catalogue or critically assess all the research material that exists, as this was considered to be beyond its remit.

3.5 Rather, the Group first undertook to identify and classify the principal uses of inland waterways in the UK. It then used its collective knowledge and experience of waterway management and related research to assess whether sufficient objective information existed to permit prediction of the environmental impacts of each use and to inform management practices designed to minimise the effects of those uses upon waterway ecosystems. Where there was a perceived deficiency of information, proposals for further research were prepared and these are presented in Section 6.

3.6 Appendix 4 catalogues the negative and positive impacts on the natural environment of a wide variety of uses of inland waterways. Uses and specific related activities are classified under the following generic headings.

- recreation,
- management, maintenance and construction,
- service routes (e.g. cables),
- freight and commercial,
- waterway development,
- agriculture and adjacent land use.

3.7 Analysis of Appendix 4 enabled the identified uses/activities of the waterways to be classified under four headings as follows:

- Navigation activities
  - Motor cruising
  - Commercial freight carriage
  - Moorings – online
  - Moorings – offline
  - Boat maintenance – online
  - Boat maintenance – offline
  - Boat launching
  - Canoeing
  - Un-powered boating
  - High powered boating
  - Lock operation
- Bank uses
  - Coarse fishing
  - Game fishing
  - Walking
  - Dogs
  - Cycling
  - Horse riding
  - Bird watching/feeding
  - Unauthorised uses
- Operational uses
  - Waterway maintenance
  - Engineering projects
  - Dredging
  - Bank hardening
  - Vegetative bank protection
  - Weed cutting
  - Herbicides
  - Towpath maintenance
  - Tree management
- Other uses or activities
  - Fish stocking
  - Water transfer
  - Routing utilities
  - Canal restoration
  - River navigation restoration
  - Development/land use
  - Drainage/discharges
  - Agriculture
  - Water abstraction
  - Fly tipping

3.8 Further analysis of the principal uses of waterways and the ways in which they had an impact on the natural environment, made it possible to classify the negative impacts as follows:

- Impacts on flora and fauna
  - Plants (aquatic/marginal)
  - Trees and hedgerows
  - Birds – over-wintering
  - Birds – breeding
  - Mammals
  - Invertebrates
  - Fish and habitats
- Water-related impacts
  - Transfer of biota
  - Increased turbidity
  - Sediment movement
  - Water quality
- Bank-related impacts
  - Erosion
  - Path erosion
  - Loss of bank vegetation
  - Litter
- Other impacts
  - Noise
  - Air quality
  - Damage to adjacent land

3.9 The Working Group then addressed the task of assessing whether sufficient objective information existed to predict the impacts of each use and to support the development and application of appropriate management practices to minimise negative environmental impacts. For each use/activity and the corresponding potential impact, a further classification was given according to the Group's assessment of the following scenarios, the markings for which relate to Appendix 5.

○ major negative impact likely, although little or no research has been undertaken to verify this,

○ minor negative impact likely, with little or no research having been published to verify this,

● major negative impact likely, supported by the findings of published research,

● minor negative impact likely, supported by the findings of published research.

3.10 The four matrices in Appendix 5 summarise the results of this assessment in which cross-references are made, where appropriate, to Appendix 4. Descriptions of terms used in Appendix 5, along with a glossary of terms used throughout this report are given in Appendix 6.

3.11 For the purposes of this study, the Working Group focused on those uses/activities that are likely to cause major negative environmental impacts, and on which little or no research has been carried out or published. The results of the Working Group's assessments are incorporated in Section 6 in which ten proposals are made for research projects to fill the most obvious gaps in knowledge over the next decade.





# 4. Socio-economic benefits

4.1 Appendices 4 and 5 show the negative and positive impacts of waterways use on the natural environment. These suggest that inappropriate and extensive use of the waterway corridor has the potential to cause considerable damage to the wildlife components. However, these must be balanced against positive impacts and against the potential for waterways to deliver considerable social and economic benefits.

4.2 The traditional use of the waterways has been for the carriage of freight but they now provide the basis for numerous activities. In addition to benefits gained specifically from the uses/activities shown below, they have the potential to provide more general benefits, including:

- a better quality of life,
- appreciation of the wider countryside,
- the opportunity for wildlife observation,
- youth group activities,
- health enhancement,
- the opportunity for educational activities.

**Cruising**
Excursions for the physically challenged.
Tourist custom from outside the UK.
A boat can be a 'second home' in the UK.
Boat building and marina development can assist economic regeneration and provide interest to preserve traditional skills.
Family holidays can help develop an interest in wildlife and the industrial heritage of the waterways.

**Other Boating**
Canoes or rowing boats, for example, can offer an understanding of water safety and team working.

**Walking and Running**
Waterways offer safe and pleasant routes away from roads and traffic.

**Angling**
Angling is an outdoor activity that can appeal to all ages and encourage general care of the waterway environment.

**Cycling**
The waterways provide safe cross country and commuter routes and the opportunity to work with national bodies such as Sustrans.
Cycling also offers a relatively safe pastime for many people

**Education**
People of all ages can learn about ecology and wildlife management.
New skills and knowledge can be acquired in relation to boat handling, water safety and the built heritage of the waterways

4.3 Furthermore, the waterways can provide:

- a green corridor through urban areas,
- assistance in the passage of water for flood alleviation and drainage,
- water resource benefits such as storage and water transfer,
- Routes for fibre optic cables and other services.

4.4 The benefits of the active participation of young people, either on a voluntary, or paid basis to assist with projects, or be involved in activities on the waterways encourages community spirit and develops learning of new skills and responsibilities.

4.5 Given the co-operation of all the agencies involved, it is possible to manage these activities to minimize the damage to, or even enhance, wildlife and its supporting habitats. A balance must be struck between the need to protect or enhance the environment and the equally important needs of an increasing human population.

4.6 The waterway corridor is a community amenity with huge potential for use by many people of all ages and groups. It is important that activities are not seen by authorities or the general public as elitist or benefiting a minority of users. Rather, the waterway corridor must be seen more and more as a precious facility owned by all, to be cared for by all. It is an extensive linear park with the potential to provide a wide range of activities and a beneficial environment for very many people. Providing that a balance is struck between the need to protect or enhance the environment and the equally important needs of an increasing human population, the benefits can outweigh any potential detrimental consequences of use.

# 5. Legislation concerning nature conservation and waterways

5.1 The biodiversity value of waterways is reflected in the number of stretches and adjacent areas protected by nature conservation designations. Furthermore, many reservoirs that supply water to the waterway system have significant wildlife value and some canal cuttings have exposed geological formations which are of national significance in terms of both conservation and education.

5.2 The loss of many natural freshwater habitats has resulted in the waterways now being an important refuge for a number of rare plants and animals, some of which are protected by national or international legislation. This statutory protection means that, in many areas, habitats and species should not be subject to some of the adverse impacts identified in this report. It is important that navigation authorities are aware of the statutory protection affecting (or likely to affect) habitats and species present in their area and recognise that actions taken outside protected areas still have the potential to impact on those sensitive habitats and species. Further information on the statutory position regarding nature conservation in the UK is given in Appendix 7.



# 6. Recommendations

6.1 In the light of its research, the Working Group makes the following recommendations for government-funded research, with contributions from other parties, for AINA to procure over the next decade. The details of each proposal are given in the following pages.

- **assessment of the ecological value of offline moorings**
- **boat design in relation to waterway ecology**
- **comprehensive valuation of the benefits and costs of inland waterways**
- **development of best practice in incorporating ecological components into the design and maintenance of navigation channels**
- **ecological and social gains from widening the waterway corridor**
- **environmental impact assessment of navigation on rivers**
- **impact of user activity on waterway birds and mammals**
- **management of trees alongside navigations**
- **manual of waterway ecology for navigation managers**
- **transfer of biota by navigational activities**

6.2 The proposals are derived from analysis of Appendix 5 and take into account the huge potential for greater social and economic benefits from increased waterways use. They focus on those uses or activities where there is perceived to be a real or potential major negative environmental impact, and on which little or no research has, to date, been undertaken or published. They are not placed in any particular order, but, taken together, they represent the priorities in terms of need for research.

6.3 Other uses or activities exposed in Appendix 5 as having major negative environmental impact and on which little is known are identified below. These have not been translated into research proposals for the following reasons:

- Fish

The impacts identified relating to fish are likely to be included in present or proposed research work, particularly by the Environment Agency. It is important to note that some of the research proposals recommended in this report refer to habitat improvement. This work would be of benefit to fish, both directly and by enhancing the food web supplying the fish.

- Path Erosion

Path erosion caused by, for example, cycling is more an issue of asset maintenance and budget allocation rather than one requiring research.

- Litter

Litter is a growing nation-wide problem that touches almost every walk of life. It is a serious issue for all places with public access, including waterways. Disposing of litter is not a research issue. Rather, it is an expensive operation and one that is proving to be difficult for those authorities who have statutory obligations in this regard. Preventing litter calls for education and a big culture shift. Navigation authorities should take a lead role in building partnerships with the private, public and voluntary sectors to find practical solutions to the control of litter in the waterway environment. The Working Group notes that the Government is soon to carry out a review of litter legislation.

- Damage to adjacent land

As with litter, damage to adjacent land caused by, for example, discarded fishing tackle or fly-tipping is not an issue requiring research. Rather it is an operational management issue involving education and enforcement.

# Assessment of the ecological value of offline moorings

**The need**

A number of benefits have been attributed to the development of offline moorings. These include easier control of pollution during boat servicing, visual improvement to main navigation channels by reduction of linear moorings and provision of potential wildlife refuges and fish overwintering areas. There has not, however, been any assessment of the actual ecological effects of implementing an offline moorings policy. Are new habitats created? What scope is there for building habitat enhancement into the design of offline waterbodies? Are there water quality problems in offline areas, due to the concentration of boats and maintenance activities in them? Do mainline linear moorings offer refuge areas or detract from habitat quality?

There is a need to assess the actual and potential ecological value of present offline moorings, to inform their management and the design of future new areas.

**Scope**

- Review literature on the ecological aspects of offline areas along navigations.
- Assess by field survey the current ecological status of offline moorings as compared with adjacent on-line channels with and without linear moorings. Consider water quality, flora and fauna in relation to site design.
- Assess summer/winter use of offline areas by fish, for refuge and breeding.
- Collate the above to produce an overall assessment of offlines and of best practice in their design and the potential for further enhancement of their ecological functioning in relation to the main navigation.

**Outputs**

Best practice guidance on the incorporation of ecological benefits into the design and maintenance of offline moorings.

Advice on any further research that may be needed to test novel habitat enhancements in offline areas.



# Boat design in relation to waterway ecology

**The need**

Most British inland navigations have rather small channels relative to the size of boats which use them. Consequently they function hydraulically as "constraint channels", i.e. their width and depth constrain craft movement. The resulting physical resistance to passage creates waves and suction uplifts which are the major cause of both bank erosion and ecosystem disruption. There is little scope for increasing channel size, so the main potential for mitigating damage is in adjusting craft design to shapes and propulsion systems which minimise resistance to passage along the channel.

There have been a number of attempts over the years to design "ecofriendly" boats. Tests have been carried out by the Broads Authority, British Waterways and some boat building and hire companies, amongst others. There is also a substantial amount of technical literature on the hydraulics of movement of large craft on ship canals. Potential economic restraints on the development of recreational boats exist in that

- fuel is cheap, so higher energy efficiency offers little economy in running costs,
- research and development is, by comparison, expensive,
- hydraulically efficient hulls may be more expensive to manufacture than conventional ones and offer less living space within them,
- navigation authorities do not generally offer reductions in licence fees as a reward for increased hydraulic efficiency, although worthwhile reductions in bank erosion and hence in waterway maintenance costs might be secured.

There is therefore a need to collate and integrate present knowledge on this important topic, to assess the potential for improving hydraulic efficiency of recreational craft and thus realising the substantial channel engineering and ecological gains which could come from this. Clearly the replacement of existing craft by better designed ones would be a long term process, but the need is to catalyse its start, both technically and economically.

**Scope**

- Review literature and unpublished technical reports on trials of hydraulically improved recreational craft designs on inland waters.
- Consult boat builders, hirers and owners with existing experience of improved craft designs on both technical and economic issues.
- Consult naval architects and channel engineers to assess the applicability of published research on ship canals and harbours.
- Consult navigation authorities on the scope for relating licence fees to hydraulic efficiency, particularly in relation to bank protection costs.
- Determine what gaps in knowledge exist on both technical and economic issues, defining and costing any further research that may be needed.

**Output**

A summary report on the scope for improving craft design, covering technical and economic aspects, with any further research needs identified and costed.
A technical report collating literature and records of consultations.

# Comprehensive valuation of the benefits and costs of inland waterways

**The need**

Government, local authorities and funding bodies need accurate and comprehensive valuations in order to make wise decisions about investing in waterways projects. To date analyses have been mostly cost/benefit studies with limited scope. They compare actual or predicted costs with relatively direct economic benefits, mainly to navigation-related activities. Wider social and environmental gains have received less attention. However current thinking about inland navigations sees:

- significant potential for their enhancement or extension in the context of the wider waterway corridor, not just the waterway,
- benefits going far beyond those directly provided for boating and angling to major social and environmental gains.

There is, therefore a need to extend valuation methodology to include these wider and in many cases less economically tangible benefits.

**Scope**

There is opportunity to:

- identify the full range of potential benefits of a waterway corridor, including, for example, provision of navigation, angling, traffic-free walking and cycling routes, educational resources and such intangible public goods as social inclusion, and conservation and enhancement of environmental quality, including landscape and wildlife gains,
- analyse the value of such benefits and the likely associated costs of providing and sustaining them.

This calls for an innovative approach drawing on and applying existing internationally accepted research, together with the limited individual studies already made in Britain, to create a more comprehensive valuation procedure for waterways and their corridors. This would consider, for example, one young cyclist not being killed on a road because he/she used a safer waterside cycle route; a family persuaded by the facilities and environmental quality of the waterways to holiday in the UK rather than abroad; young people motivated, occupied and learning new skills on the waterway or perhaps helping to manage it instead of engaging in vandalism or other antisocial behaviour; the provision of habitat for wildlife gain and the social and property value gains from changing ordinary or ugly landscapes into attractive ones.

**Output**

A methodology for comprehensive valuation of a waterways corridor, which could be tested in a series of contrasting situations, the results monitored and evaluated.



# Development of best practice in incorporating ecological components into the design and maintenance of navigation channels

**The need**

Historically, as canals and some river navigations changed from all-the-year-round freight routes to recreational waterways carrying increasing densities of mainly summer boat traffic, their aquatic habitats were degraded by a progression of influences. Bank erosion increased, leading to loss of marginal vegetation and the addition of eroded materials to the channel. This in turn shallowed the navigation and the passage of boats fractionated the materials such that a layer of soft, easily disturbed silt blanketed the bed.

The erosion was often countered by sheet steel or concrete bank hardening, thereby creating a channel with hard, vertical sides which reflected the incoming wave energy from boats back into the channel. This, together with the shallowness and soft silty nature of the bed, resulted in an intensely disturbed habitat. With no firm anchorage for roots, most of the aquatic vegetation was lost along with its associated aquatic invertebrates. The food web and habitats supporting fish thus deteriorated and a poor fishery resulted. With no reed fringes, brown silt-laden water and little wildlife interest, the channel became visually unattractive. Many heavily trafficked lengths remain in this state today.

In recent years a number of trials have been made of construction and maintenance methods aimed at reversing the impoverishment. Planting of root-protected reeds, use of energy-absorbent bank materials, underwater re-profiling of the channel and stoning of the bed to create firm rooting medium have all been attempted. Most trials have been local and assessments of their success are not readily available. There is a need to develop best practice in this area, first by evaluating what has already been attempted and secondly by drawing on this, together with recent technical innovations in channel construction materials, to conduct properly monitored trials.

**Scope**

- Assess the outcomes of existing trials in Britain and Ireland, by field analyses where necessary; review international technical literature; consider applicability to British conditions of technologies developed for larger waterways, especially in The Netherlands.

- Design, construct and monitor statistically robust replicated trials.

**Outputs**

A report summarising findings from the two phases of the scope including engineering and field data, together with a bibliography of literature reviewed.

A practical manual setting out best practice in channel design and maintenance, with methods for assessing the ecosystems they achieve.

# Ecological and social gains from widening the waterway corridor

**The need**

The original navigation companies purchased only sufficient land for their immediate operational needs. Consequently the historic waterway corridor is usually narrow. Boundary fences and hedges are close to the towing path and to the offside edge of the channel. The corridor is only wider where topography originally required greater land take, for example in cuttings and on embankments, or where former industrial or loading areas have gone out of use and have become assimilated into the waterway environment.

Heavy recreational use of both the channel and the towing path nowadays often leaves little undisturbed habitat for flora and fauna. Although good management of hedges and channel margins can maintain some biodiversity, the overall corridor usually consists of, at best, a parallel set of very narrow linear habitats which are under considerable stress from boats, walkers, cyclists and anglers. Any widening of the corridor will be ecologically beneficial in that it will extend habitats into areas away from the stress generators. Also many species require a certain minimum area of habitat for their survival, so as the corridor is widened more of these will be able to establish themselves. The need is to develop and test ecologically ways in which such widening can be achieved. (Linkage here with the project on impact of user activity on waterway fauna.)

**Scope**

High land prices and the presence of built structures will limit the scope for widening along urban lengths. In rural areas, however, there may be considerable opportunities where current trends are towards less intensive farming and to taking some land out of production. Management of river corridors, for example by fencing out livestock to stop heavy grazing and erosion of banks and to encourage riparian vegetation, has been the subject of a number of recent trials. This approach could be customised to enhance navigation corridors, yielding gains in biodiversity and also in landscape quality.
Subjects for research would be: -

- field assessment of biodiversity versus corridor width at a range of existing sites,
- review of current river improvement schemes, their organisation, partnerships, ownership issues, relation to the structure of agricultural funding and the ecological success of the schemes,
- development of ecological specifications for widenings, e.g. offline connected waters and isolated ponds, marsh, woodland etc.
- a series of trial widenings, covering a range of conditions and ecological aims.

**Outputs**

A report setting out model habitat specifications and expected ecological gains; guidance on setting up partnerships including issues of transfer and non-transfer of land ownership; agricultural grant funding options; and gains for waterway users. The approach, as part of rural (and to a lesser extent urban) regeneration strategies, would be aimed at developing waterways as linear parks with potential for broadening social inclusion. Additional outputs could be demonstration widenings with associated interpretation.

# Environmental impact assessment of navigation on rivers

**The need**

The introduction, restoration or increase of navigation on rivers causes a range of ecological impacts which are complex, interlinked and difficult to distinguish from those introduced by other uses of the waterway, especially flood control. The dynamic nature of river habitats, in both space (diversity of channel morphology in successive lengths) and time (flood and drought flows and their erosion and siltation effects) all combine to make rivers difficult subjects for environmental impact assessments (EIAs) of single proposed developments. Despite this, the controversial and potentially far-reaching effects of introducing or re-introducing navigation on rivers and of increasing usage of existing routes does make urgent the need for a means to evaluate such proposals objectively and with confidence that outcomes can be predicted with some accuracy before schemes are assessed.

**Scope**

Hatcher & Eaton (2003) provide some assessment of the scope and needs for developing a protocol for river navigation EIA, building on existing mostly Environment Agency procedures. This supplies a phased draft research programme aimed at separating the effects of preparing and maintaining a river for navigation from the effects of boat traffic per se. It also considers ways in which navigation impacts could be distinguished from the effects of flood control measures. This work should be extended to review impacts of existing navigations on the ecology of their routes, noting (i) adverse impacts, (ii) cases where those impacts have been mitigated and (iii) examples of enhancements associated with navigations.

**Outputs**

A protocol for assessing impacts of navigation on the habitats, flora and fauna of rivers, distinguishing between effects of making the channel navigable and the direct, density-dependent effects of boat traffic, in the context of other uses of the river.

A technical report setting out the data and analyses used in developing the protocol, with a supporting literature review and bibliography.

Good practice guidance on the incorporation of ecological considerations into river navigation developments, including case studies.

# Impact of user activity on waterway birds and mammals

**The need**

Recreational inland waterways are nowadays popular with a range of users, including walkers, cyclists, anglers and boaters. National policies are directed towards increasing public appreciation of the 'linear park' nature of the network and hence increasing user densities into the future. Human users do however disturb and interrupt the natural behavioural patterns of birds and mammals along the waterways. Disturbance can occur through visual, noise, vibration and scent cues. Substantial research elsewhere has shown that, as a generalisation, disturbance to fauna can cause loss of feeding, breeding and anti-predator control, thus leading to population decline of the affected species. The severity of the impact depends upon the nature, intensity and timing of the disturbance, the availability of refuge habitat and the capacity of the species for adapting to the disturbed environment, for example by behavioural conditioning.

The waterways form a nationally important habitat network for a range of fauna, valued for its diversity and some conservationally important species, as well as for its interest to users of the system. Some understanding of the impact of use on this fauna is therefore important in informing management decisions on such matters as where to concentrate promotion of increases in facilities and attractions, the location of lengths of particular importance for faunal conservation, and the provision and maintenance of refuge habitats. Until recently there was no acknowledged methodology for assessing disturbance impacts on birds and mammals along waterways. This has now been remedied with the development of optical/electronic surveillance and analysis systems and the adaptation of them to operate along the linear habitats provided by waterways (Gill, Kay & Eaton 2002). The need now is to implement this methodology, initially to define the main features of user disturbance on waterway fauna. Site specific and issue specific analyses could then follow as required on a local basis.

**Scope**

- Assess the impacts of the range of user disturbance types and densities on the various species of birds and mammals which live on or depend upon waterways.
- Assess the utility of refuge habitats in mitigating adverse effects and the behavioural conditioning capacity of the species involved.

**Outputs**

A report giving guidance on the impacts of user activities upon waterway fauna, together with advice on how habitat and use management can mitigate adverse effects.

Guidance on how to analyse and respond to local issues involving conservation of bird and mammal species in relation to waterway development.



# Management of trees alongside navigations

**The need**

On most river and canal navigations, as freight carrying decreased so maintenance standards were reduced. One consequence was that trees were allowed to establish along banks to a much greater extent than had been permitted previously. Comparison with old photographs shows that on many lengths extensive tree cover appeared during the 20th Century. Concern about this change has so far centred mainly on engineering risks of root damage to embankments and cuttings and on obstruction dangers to waterway users.

However, although the presence of some trees is ecologically beneficial, when dense shade and heavy leaf input into the water develop, overall effects are adverse. Aquatic vegetation is eliminated by light deficiency and the benefits of the vegetation to invertebrates and fish are lost. Leaf fall deoxygenates the water, smothers aquatic organisms and reduces habitat diversity. Dense growth may promote spread of tree diseases. Historically, pollarded trees marked river banks in some areas. Encouragement should be given to managing veteran trees taking note of potential roosts for protected specious such as bats.

Tree control by felling is expensive and needs careful justification if public opinion is not to be offended. There is a need to develop clear guidance, which takes account of ecological issues as well as those of engineering and user safety and which recognise the long timescales of forestry management.

**Scope**

A field survey will establish the effects upon the channel ecosystem of a range of tree densities. The species and age structures of the tree populations will be included here. Surveys will also be made of lengths along which tree clearance has been undertaken, where these can be compared with adjacent uncleared lengths. Using this database and forestry management principles, a predictive guidance system will be developed which takes account of present state, proposed state, ecological, bank protection and safety gains and landscape gains and losses. Issues to be considered will include clearance and maintenance costs and the timescales of different options, such as continuous sapling control to stop regeneration, leaving trees to mature before removal for timber versus selective and clear felling.

Guidance will also be assembled on the positive ecological effects of trees, education of public opinion, tree preservation legislation and funding options. The role of tree clearance in returning towards the historic navigated waterway landscape may also be worth including. On some rivers consideration will be needed of a potential conflict of aims between those of navigation and those of restoring the waterways towards 'naturalness'. The latter was historically mostly a tree-lined state which was probably only changed where navigation was introduced.

**Outputs**

Clear guidance to waterway managers on options for tree management; costs versus ecological, bank protection and safety gains, timescales and public education.

# Manual of waterway ecology for navigation managers

**The need**

Although a substantial amount of research has been published on the effects of navigation on waterway ecology, this has been in the form of technical reports and scientific journal papers not readily accessible to waterway managers. In addition there is other information of potential practical value, which is currently recorded only in university theses and internal research reports. This is even less accessible to managers.

Nevertheless, ecological considerations loom large in the present day management of inland waterways. Nature conservation aspirations and their associated legislation, the needs of fisheries and of maintaining and improving landscape quality all feature along with the engineering and economic issues involved in bank protection, dredging and weed control.

Although the details of waterway ecology, like those of channel engineering, will remain areas in which specialist advice will have to be sought, the manager needs to have available a straightforward, non-technical source of information on the general workings of the ecosystem being managed. The connection between basic ecology and advice on conservation and vegetation control should be made clear. Similarly the reasons behind some of the concerns of conservationists need setting out, together with the scope for positive responses to those concerns. There is, for example, a particular need to emphasise the dependence of the biodiversity of some channel and bankside ecosystems on periodic management intervention. A simple summary of nature conservation legislation is another possible need.

**Scope**

- Review existing published literature.
- Search out relevant internal reports and theses; extract information of practical value from them.
- Collate the above.
- Draft text with illustrations covering basic waterway ecology in straightforward non-technical terms, leading on to guidance on ecological aspects of the main day-to-day issues facing waterway managers. Summarise current legislation.
- Compile a bibliography of easily accessible sources of more detailed information on particular aspects, together with contact details of relevant statutory and other organisations.
- To test the intelligibility, scope and usefulness of the draft, put it out to consultation with a number of waterway managers, statutory and voluntary organisations.
- Edit and publish manual.

**Output**

A manual for waterway managers which will be a reference source on ecological matters.



# Transfer of biota by navigational activities

**The need**

Within naturally functioning rivers and water courses, biota will, where habitat conditions allow, spread to increase their range and be transferred from place to place by water movements. Biota transferred by both normal water flows and floods may include invasive plants, introduced fish species, crayfish plague, fish diseases, bacteria and parasites. Many canals and other artificial waterways cross natural catchment boundaries and thus have the potential to transfer biota between river catchments and around the country. The transfer of invasive species, parasites or diseases into sensitive habitats may have serious detrimental effects upon natural ecosystems.

Natural vectors such as birds transfer biota most between river catchments. However, a range of human activities may enormousley speed up this process. Existing practices of waterway management and maintenance, along with leisure activities such as fishing and boating have the potential to transfer biota from one site to another. For example, fragments of plants frequently become attached to fishing equipment or boats and may be carried to new sites. A number of exotic aquatic plants have become established in the UK following historic introductions with freight movements on the canals. In addition, engineering and maintenance works, which involve the movements of heavy plant and machinery may transfer biota between waterways. Other new initiatives including navigational restoration of disused waterways and increased water transfer for water sales have the potential to increase the rate of spread of biota.

Therefore, there is a need to assess the actual and potential ecological effects of the existing and future transfer of biota around the country and to inform waterway management teams of the precautions and working practices that will limit the level of damage that may occur to natural ecosystems.

**Scope**

- Review existing literature and research
- Search relevant internal reports of navigation authorities and academic theses and extract key issues.
- Review of relevant legislation
- Field survey and research (genetic fingerprinting) to investigate the rate of spread through and between waterways.
- Review of working practices during maintenance and engineering works, assessing the transfer of biota.

**Outputs**

- A report summarising the main transfers of biota that occur during existing navigational use of the waterways, including an assessment of the potential transfer of biota during future restorations and water transfer.
- Best practice management guidelines for use during management and maintenance works, restorations, water transfer planning.
- An outline environmental impact assessment protocol for works which may result in the increased transfer of biota.

# APPENDIX 1

**Members of the Working Group**

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Chairman, Bude Canal Trust
Vice-Chairman, AINA

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Ms Cath Wilson
Trinity Broads Project Manager, Broads Authority





# APPENDIX 2

**Terms of Reference**

***Background***
The first phase of AINA research stemming from *Steering a Fresh Course* and part-sponsored by DEFRA includes a requirement to identify gaps in our knowledge of the environmental impacts of different uses of the waterways. The Working Group should be concerned with all uses of the waterways, including leisure, recreation and commercial uses.

***Context***
Recent years have seen a renaissance in the use of the country's inland waterways. This has been acknowledged and promoted further by Government in its policy document, Waterways for Tomorrow, the first such statement by the Government for over 30 years. This renaissance is adding to the diversity of waterways' use. As Waterways for Tomorrow explains, the key features of the waterways are as follows:

- The majority of navigable waterways are the responsibility of British Waterways, the Environment Agency, and the Broads Authority, who manage 51 per cent, 17 percent and 3 per cent by length respectively. Around 30 other navigation authorities – including local authorities, trusts and charitable bodies, and private sector companies – manage the remaining 29 per cent, a significant proportion.

- Geographically, the waterways transcend conventional physical and administrative boundaries; they are found in metropolitan areas, urban areas, coalfield areas, market towns, and accessible and more remote rural areas. In cities such as London, Sheffield, Manchester and Birmingham, they run through areas of severe urban deprivation and areas of affluence. In the countryside, they link agricultural land, market towns, upland and lowland areas, and areas of considerable environmental, conservation, heritage and ecological value.

- The waterways support a multitude of leisure and recreational uses, providing opportunities for boating (there are around 100,000 licensed boats on the system), angling (over 300,000 anglers), water sports, and recreational walking and cycling. Their inherent amenity, environmental and heritage value attracts an estimated 160 million tourism visits per year generating income for both urban areas and rural towns and villages, as well as enormous, but less tangiable social benefits.

- The waterways still perform, in some areas, their traditional role as movers of freight. The towpaths provide valuable links for walkers and cyclists. Canal towpaths are increasingly being used as routes for telecommunications infrastructure.

- Many navigable rivers, are a source of water supply and all are central to land drainage and flood alleviation. Canals too, have a role in land drainage and make a useful contribution to water supply in some localities.

- The waterways support an array of important habitats and wildlife. In England, some 40 stretches of canal have been notified as Sites of Special Scientific Interest (SSSI) because of the presence of unusual or exceptionally diverse aquatic plant species. In addition, many waterways support a variety of animal species with individual conservation value. Waterway corridors also form important linear habitats, sustaining wildlife in urban and intensively managed agricultural areas, and linking fragmented habitats.

- The waterways are very rich in heritage value, with a diverse range of historic buildings and examples of innovative civil engineering. The British Waterways estate alone contains 130 scheduled ancient monuments and some 2,800 listed structures – a portfolio second only in number to that managed by the National Trust. Some selected locations on the canal system are currently under consideration for World Heritage status. Moreover, the waterside buildings and wider landscape are as important components of the fabric of the historic waterways as the waterway infrastructure itself.

- The waterways are increasingly important corridors for development, often being priority areas for regeneration and renewal, especially where they pass through areas of redundant land or buildings.

***Method of Working***
A small Working Group will be convened to consider, relatively quickly, the extent of relevant research undertaken or planned by the main navigation authorities, universities, statutory bodies and other agencies. Following this initial exercise, the Working Group will identify and categorise gaps in our knowledge and propose a prioritised list of specific projects which should be undertaken over the coming years to fill those gaps in order to improve our understanding of waterways management.

The Working Group will report to the AINA Steering Group.

# APPENDIX 3

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# APPENDIX 4

## NEGATIVE AND POSITIVE IMPACTS OF RECREATIONAL AND COMMERCIAL USES OF WATERWAYS, THEIR MAINTENANCE AND DEVELOPMENT

### A. RECREATIONAL USES

| Use | Activity | Environmental Losses | Environmental Benefits | Notes |
|---|---|---|---|---|
| **Navigation** | | | | |
| A.1 | Motor cruising | Boat wash can cause physical damage to biota and increase erosion. Consequently, this may increase the need for bank protection measures which can reduce habitat diversity.<br>Propeller action causes turbidity which can reduce light for submersed plant growth and resultant siltation smothers fauna.<br>Potential transfer of biota on the hulls of craft moving between waterways.<br>Noise, vibration and boat presence may cause faunal behavioural patterns to change.<br>Engine exhausts and other emissions may be toxic. | On canals, low density boat traffic curbs competitive exclusion of flora and maintains biodiversity. | The effects of boat movements per se have not been analysed on rivers due to difficulty in distinguishing them from structural and operational modifications to channels for flood control and water supply purposes, together with the complexity of the river environment.<br>Consideration should be given to the development of electric boats, improved hull design and other environmentally friendly craft. |
| A.2 | On-line mooring | Informal mooring, as opposed to mooring at constructed sites, can damage banks and water's edge habitat.<br>Pollution can result from grey water discharge.<br>Uncontrolled long-term mooring may result in pollution from anti-fouling paint leachate, fuel spills and litter. | Local shade and refuge for fishes. | The potential loss of re-fuelling sites may lead to increased fuel spills from portable cans. |
| A.3 | Offline mooring | Localised impairment of water quality. | The water's edge habitat in the navigation channel is not damaged. | The potential value of mooring basins as wildlife habitats is insufficiently assessed. |
| A.4 | Boat maintenance | Maintenance on-line can create pollution issues as in A2. | | Maintenance is best undertaken professionally on offline waters where pollution can be regulated and contained more easily than in the navigation channel. |
| A.5 | Boat launching | Informal launching can cause bank damage and problems associated with vehicle access. | | This usually applies only to trailer boats. |
| A.6 | Lock operation | Interrupts water flow and causes lowering of pounds and flow surges, disrupting biota. | Aids oxygenation of the water column. | Misuse of locks may result in serious destabilisation of water levels. |
| **Unpowered boating** | | | | |
| A.7 | Canoeing | Can cause disturbance to marginal vegetation, breeding birds and mammals.<br>Potential for transfer of biota, e.g. bacteria, crayfish plague, parasites and invasive plants. Extensive damage can be caused to banks through launching. | | |

| Use | Activity | Environmental Losses | Environmental Benefits | Notes |
|---|---|---|---|---|
| A.8 | Whitewater canoeing | At purpose-built sites, e.g. Holme Pierrepoint on the River Trent, may cause disruption to the natural flow of the river. | | Only applies to rivers. |
| A.9 | Raft racing | Possible damage to banks, as in A7. | | Rare occurrences. |
| A.10 | Casual boating (paddle boats, rowing boats etc.) | As for canoeing above. | | |
| A.11 | Sailing | As for canoeing above. Sometimes trees are removed to increase wind currents. | | Does not apply to canals. |
| A.12 | Model boats | Operators may damage the bankside. | | |
| **High powered boating** | | | | |
| A.13 | Water skiing; jet skis | As for A1 and A7 but potentially more destructive. | | Only occurs at designated sites and is illegal on canals. |
| **Angling** | | | | |
| A.14 | Fish stocking | Can distort the aquatic food web. Bottom feeding fish such as carp, can cause habitat damage. | | In canals, key groups such as dragonflies may be reduced by increased fish predation at their aquatic larval stages. |
| A.15 | Coarse fishing | Discarded tackle is extremely hazardous to wildlife.<br>The behaviour to birds and mammals may be disturbed by human presence.<br>'Digging in' by anglers has a major impact on bankside vegetation and habitat, and causes erosion.<br>Other losses include trampling of soft margins, vehicle access and parking, lack of toilets and litter problems. | Anglers can be the 'eyes and ears' to help safeguard the waterway environment. | Properly constructed fishing platforms alleviate problems.<br>Fishing from boats may cause disturbance to over-wintering birds on e.g. reservoirs. Fishing during the close season, e.g. on SSSIs is often inadequately baliffed. |
| A.16 | Game fishing | As for coarse fishing plus back casting and issues for birds and wildlife from broken line. | | Only on some rivers, lakes and reservoirs. |
| **Waterside paths** | | | | |
| A.17 | Walking and associated uses e.g. picnicing and camping. | The behaviour of birds and mammals may be disturbed by human and canine presence.<br>Vegetation and path margins may be damaged. Problems associated with litter and dog fouling. | As for A15. | Ecologically sensitive areas may be damaged by increased use and the promotion of waterside paths.<br>Paths are often too narrow and poorly surfaced. Potentially more of a problem by rivers where there are no designated paths. |
| A.18 | Cycling | As for A17 but potentially more damaging. | | Increased use brings user conflict but this could be reduced by widening paths. |
| A.19 | Horse riding | As for A18. | | Illegal on canal towpaths. |
| A.20 | All other uses, including feeding of birds by the public. | Intensive supply to waterbirds of unsuitable food leads to malnutrition, localised water quality issues, distortion of aquatic food web and the proliferation of vermin.<br>Other losses are associated with litter and general disturbance as mentioned above. | | |
| **Unauthorised sports** | | | | |
| A.21 | Board sailing, jet skiing, shooting/ hunting/ trapping/ ferreting. | As for other uses above. | | There is nor real need for research, but there is a major requirement for better and more extensive supervision. |

| B. MANAGEMENT, MAINTENANCE AND CONSTRUCTION | | | | |
|---|---|---|---|---|
| **Use** | **Activity** | **Environmental Losses** | **Environmental Benefits** | **Notes** |
| **Navigation** | | | | |
| B.1 | Presence of artificial structures instream and maintenance of locks, weirs and sluices and new engineering works | Can disrupt the continuity of the water corridor. | The maintainance of water levels sustains habitats. Some habitat diversity can be created in bypass channels. It also aids oxygenation. | Losses especially in freedom of movement of some fish. Particular drawdown problems in some canal reservoirs. |
| B.2 | Dredging | Can cause disturbance to and reduction of biodiversity. The disposal of dredgings may cause land contamination problems. There may be problems associated with hydrodynamic dredging – specifically, the environmental impacts urgently require assessment. | Removal of soft silt eases blockage ratio (canals). Toxic sediments may be removed. Sensitive dredging may halt succession and suppress competition benefiting less competitive plant species. Some disposed dredgings may be beneficial to agriculture. | In rivers, may reduce flooding and thus hydrological connectivity with floodplains. |
| B.3 | Bank hardening | Reflection of boat wash back into the channel increases the possibility of damage to biota.<br>Reduction of bankside habitats, e.g reed fringes and animal burrows. The movement of mammals/ amphibians/young birds between channel and bank is made more difficult. | Reduces silt load being carried by the waterway. Sensitive work through 'soft' engineering may create opportunities for new habitats, especially in rural areas. | The geomorphological processes within rivers can be altered by bank hardening.<br>Constructed ramps can mitigate animal access problems.<br>There is scope for developing more ecologically beneficial hardening design and materials. |
| B.4 | Reinforced reed planting | | Absorption of boat wash energy. Provides organic supply and habitat for fauna. | Enhances the landscape value. |
| **Vegetation control** | | | | |
| B.5 | Work in the channel – weed and invasive species control | Heavy control may reduce biodiversity and cause habitat limitations for flora and fauna.<br>The use of herbicides may have adverse effects.<br>Mechanised weed cutting can kill fish and remove spawning substrate and invertebrates. | Flora and fauna are not excluded by a dominant species thereby benefitting biodiversity. It maintains an open channel. | Timing as well as method and extent are critical to resultant biodiversity. |
| B.6 | Work on banks or in corridor | Heavy control of vegetation (including tree works) may reduce biodiversity and cause habitat limitations for flora and fauna.<br>The use of herbicides may have adverse effects. | There is scope for biodiversity e.g. herb-rich grass verges, hedgerows, pollarding, tree and shrub management. Maintains towpath widths.<br>Tree control is crucial for curbing shading and hence maintaining aquatic biodiversity in canals and regulated rivers and there is scope for selective planting. | Tree control is essential for unobstructed navigation, and for abating water loss through transpiration.<br>The timing and phasing of works is important.<br>Disposal of the tree cuttings is a major problem. |
| **Waterside paths** | | | | |
| B.7 | Work on towpaths | Causes a reduction of grassland habitat construction. Maintenance of path edges may use use herbicides. Any work may impact on hedge and tree roots and hedge bottom vegetation. | A good surface concentrates usage and reduces trampling damage in adjacent areas. | |

| C. SERVICE ROUTES | | | | |
|---|---|---|---|---|
| **Use** | **Activity** | **Environmental Losses** | **Environmental Benefits** | **Notes** |
| C.1 | Water transfer | There is possible movement of fish disease organisms and alien plant and animal species between catchments. In rivers, the natural seasonal discharge pattern may be altered. Energy may be needed to pump water. There may be ecological effects of increased flows in canals. | Water quantity and quality can be improved in some areas. Water supply is more likely to be assured in dry weather conditions. | The whole functioning of geomorphological processes within a river may be changed. For canals, in practice, the movement of species between catchments is an intensification of processes that have operated since the canals were built.<br>Implementation requires comprehensive pollution control along the waterway to maintain quality. |
| C.2 | Utility works | Laying of underground cables or pipes can cause disturbance during construction. There are likely to be impacts on hedgerow and tree roots from trenching. | Presents opportunities to improve paths and enhance marginal vegetation. | Includes gas, electricity, water and telecoms services and may involve the erection of masts adjacent to waterways. Construction may present issues for the conservation of historic structures. |

| D. FREIGHT AND COMMERCIAL | | | | |
|---|---|---|---|---|
| **Use** | **Activity** | **Environmental Losses** | **Environmental Benefits** | **Notes** |
| D.1 | Inland waterway vessels | As for A1 but more serious. With the possibility of fuel or chemical spillages | | A significant environmental benefit nationally in taking freight off the roads. |
| D.2 | Coasting vessels | As D1 plus the possibility of transfer of biota from salt water to fresh water and vice-versa. | | Ditto |
| D.3 | Wharfage | As A2, A3 and A4 but to a greater extent. | | Ditto |

| E. WATERWAY DEVELOPMENT | | | | |
|---|---|---|---|---|
| **Use** | **Activity** | **Environmental Losses** | **Environmental Benefits** | **Notes** |
| E.1 | Waterside housing and other development, including marinas. | Can result in the destruction of and increased pressure on existing bankside habitats. There is potential for pollution incidents during construction and post development. There is a potential loss of opportunity for other waterside use. | | Development in river floodplains increases flood risks downstream, although PPG25 restricts this. On canals, all new drainage, including that from gardens/amenity grassland, should be directed to sewer, not to waterway, to avoid accepting fertiliser-rich drainages. |
| E.2 | Canal restoration and enhancement | There could be major impacts on aquatic and terrestrial flora and fauna along the restored corridor. High wildlife value sites may suffer as a result of increased navigation or access. Additional water resources may be required. Other issues may include waste management, dredging and disposal. | Sensitive work may enhance the wildlife and habitat value of waterways. Opportunities for habitat creation. | Environmental Impact Assessment guidelines apply. |
| E.3 | River restoration and enhancement | Hydraulic and channel alterations are likely to alter ecosystems away from naturalness. | Some navigation requirements may counteract adverse impacts of other river uses, e.g. water levels may be kept up despite heavy abstraction upstream. Opportunities for habitat creation. | |

| F. AGRICULTURE AND ADJACENT LAND USE | | | | |
|---|---|---|---|---|
| **Use** | **Activity** | **Environmental Losses** | **Environmental Benefits** | **Notes** |
| F.1 | Land use and associated impacts | Chemical and nutrient run-off from land have a potential for causing aquatic damage and increased algal growth. Intensive use of land can cause major damage. | | |
| F.2 | Agriculture | Bank disturbance and erosion can be caused by livestock drinking from the waterway. Agrochemical runoff into waterway causes pollution. | Extensification of farmland and arable cropping can bring benefits.<br>There is potential for the planting of buffer strips buffer strips on agricultural land and for appropriate hedgerow management. | Agri-environment schemes should assist in balancing the environmental losses. |
| F.3 | Water abstraction | Likelihood of impacts on water resources biodiversity. | | |
| F.4 | Fly tipping | The dumping of fridges, TVs, cars etc. causing chemical and physical pollution. | | Potential to increase in light of revision to the list of defined hazardous wastes. |

# APPENDIX 5

## The AINA Navigation Matrix

**This matrix shows the groups of flora and fauna negatively impacted and the nature of impacts, for the various activities on British inland waters.**
**It should be noted that very different types of water bodies are represented, including canals, navigable rivers, tidal rivers and The Broads.**
**This matrix should be read in conjunction with Appendices 4 and 6.**

| The AINA Navigation Matrix | Motor Cruising | | Freight/commercial | | Moorings Online | | Moorings Offline | | Boat Maintenance online | | Boat Maintenance offline | | Boat Launching | | Canoing | | Unpowered Boating | | High Power Boating | | Lock Operation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IMPACTS ON FLORA AND FAUNA** | | | | | | | | | | | | | | | | | | | | | | |
| Plants (Aquatic/Marginal) | ● | A1 | O | A1/D1 | O | A2 | | | o | | | | o | | O | A7 | O | A11 | O | A13 | o | A6 |
| Trees/Hedgerows | | | | | | | | | | | | | | | | | o | | | | | |
| Birds - overwintering | o | | | | | | | | | | | | | | | | o | | o | | | |
| Birds - Breeding | O | | | | o | | | | | | | | o | A5 | O | A7 | O | A11 | O | A13 | o | |
| Mammals | o | | | | o | | | | | | | | o | | o | | | | O | A13 | | |
| Invertebrates | O | A1 | | | | | | | o | | | | | | | | | | | | o | |
| Fish/Habitat | O | | | | o | | | | o | | | | | | | | | | o | | | |
| **WATER RELATED IMPACTS** | | | | | | | | | | | | | | | | | | | | | | |
| Transfer of biota | o | | O | D2 | | | | | o | | | | | | O | A7 | o | | o | | | |
| Increased turbidity | O | A1 | O | A1/D1 | | | | | | | | | | | | | | | o | A13 | | |
| Sediment movement | O | A1 | o | | | | | | | | | | | | | | | | | | | |
| Water Quality | ● | A1 | o | D3 | o | A2 | O | A3 | O | A4 | o | | | | | | | | | | ● | |
| **BANK RELATED IMPACTS** | | | | | | | | | | | | | | | | | | | | | | |
| Erosion | ● | A1 | o | D1 | | | | | | | | | | | | | | | ● | A13 | | |
| Path erosion | | | | | | | | | | | | | | | | | | | | | | |
| Loss of bank vegetation | | | | | ● | | | | | | | | | | | | | | ● | | | |
| Litter | | | | | O | A2 | | | O | A4 | | | | | o | | o | | o | | | |
| **OTHER IMPACTS** | | | | | | | | | | | | | | | | | | | | | | |
| Noise | O | A1 | o | | | | | | | | | | | | O | A7 | O | A11 | O | A13 | | |
| Air Quality | o | A1 | o | | | | | | | | | | | | | | | | | | | |
| Damage to adjacent land | | | | | | | | | | | | | | | | | | | | | | |

| LEGEND | |
|---|---|
| O | Major impact with little or no reseach |
| o | Minor impacts with little or no research |
| ● | Minor impact but published work |
| ● | Major impact but published work |

# APPENDIX 5
## The AINA Bank Matrix

**This matrix shows the groups of flora and fauna negatively impacted and the nature of impacts, for the various activities on British inland waters. It should be noted that very different types of water bodies are represented, including canals, navigable rivers, tidal rivers and The Broads. This matrix should be read in conjunction with Apprendices 4 and 6.**

| The AINA Bank Matrix | Coarse Fishing | | Game Fishing | | Walking | | Dogs | | Cycling | | Horse Riding | | Bird Watching/feeding | | Unauthorised sports | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IMPACTS ON FLORA AND FAUNA** | | | | | | | | | | | | | | | | |
| Plants (Aquatic/Marginal) | o | | | | | | | | | | | | | | o | |
| Trees/Hedgerows | o | | | | | | | | | | | | | | | |
| Birds - overwintering | o | | o | | • | | • | | • | | • | | O | A20 | o | |
| Birds - Breeding | O | A15 | o | | O | A17 | O | A17 | O | A18 | O | A19 | o | | O | A21 |
| Mammals | O | A15 | | | O | A17 | O | A17 | O | A18 | O | A19 | o | | O | A21 |
| Invertebrates | | | | | | | | | | | | | | | | |
| Fish/Habitat | o | | o | | | | | | | | | | | | | |
| **WATER RELATED IMPACTS** | | | | | | | | | | | | | | | | |
| Transfer of biota | O | A15 | O | A16 | | | | | | | | | | | O | A21 |
| Increased turbidity | | | | | | | | | | | | | | | | |
| Sediment movement | | | | | | | | | | | | | | | | |
| Water Quality | O | A15 | | | | | | | | | | | | | | |
| **BANK RELATED IMPACTS** | | | | | | | | | | | | | | | | |
| Erosion | ● | A15 | | | | | | | | | | | | | | |
| Path erosion | | | | | o | | | | O | A18 | o | | | | o | |
| Loss of bank vegetation | ● | A15 | | | o | | | | o | | o | | | | o | |
| Litter | O | A15 | O | A16 | O | A17 | O | A17 | O | A18 | o | | O | A20 | O | A21 |
| **OTHER IMPACTS** | | | | | | | | | | | | | | | | |
| Noise | | | | | o | | o | | | | | | o | | O | A21 |
| Air Quality | | | | | | | | | | | | | | | | |
| Damage to adjacent land | O | A15 | | | o | | | | o | | o | | | | | |
| | | | | | | | | | | | | | | | | |
| **LEGEND** | | | | | | | | | | | | | | | | |
| O | Major impact with little or no reseach | | | | | | | | | | | | | | | |
| o | Minor impacts with little or no research | | | | | | | | | | | | | | | |
| • | Minor impact but published work | | | | | | | | | | | | | | | |
| ● | Major impact but published work | | | | | | | | | | | | | | | |

# APPENDIX 5
## The AINA Operations Matrix

**This matrix shows the groups of flora and fauna negatively impacted and the nature of impacts, for the various activities on British inland waters. It should be noted that very different types of water bodies are represented, including canals, navigable rivers, tidal rivers and The Broads. This matrix should be read in conjunction with Appendices 4 and 6.**

| The AINA Operations Matrix | Waterway Maintenance | | Engineering Projects | | Dredging | | Bank Hardening | | Vegetative bank protection | | Weed Cutting | | Herbicide | | Towpath Maintenance | | Tree Management | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IMPACTS ON FLORA AND FAUNA** | | | | | | | | | | | | | | | | | | |
| Plants (Aquatic/Marginal) | • | | ● | B1 | ● | B2 | ● | B3 | • | | ● | B5 | ● | B5 | | | O | B6 |
| Trees/Hedgerows | • | | ● | B1 | | | ● | B3 | | | | | | | ● | B7 | O | B6 |
| Birds - overwintering | • | | ● | B1 | | | | | | | | | | | | | | |
| Birds - Breeding | • | | ● | B1 | O | B2 | O | B3 | • | | O | B5 | o | | ● | B7 | • | |
| Mammals | • | | ● | B1 | O | B2 | ● | B3 | • | | O | B5 | | | ● | B7 | o | |
| Invertebrates | • | | ● | B1 | O | B2 | ● | B3 | | | O | B5 | • | | | | O | B6 |
| Fish/Habitat | • | | ● | B1 | O | B2 | ● | B3 | | | O | B5 | • | | | | O | B6 |
| **WATER RELATED IMPACTS** | | | | | | | | | | | | | | | | | | |
| Transfer of biota | O | B1 | O | B1 | O | B2 | | | | | O | B5 | | | | | | |
| Increased turbidity | O | B1 | O | B1 | ● | B2 | | | | | O | B5 | | | | | | |
| Sediment movement | O | B1 | O | B1 | O | B2 | | | | | o | | | | | | | |
| Water Quality | O | B1 | O | B1 | O | B2 | | | | | o | | • | | | | o | |
| **BANK RELATED IMPACTS** | | | | | | | | | | | | | | | | | | |
| Erosion | | | | | | | | | | | | | | | | | o | |
| Path erosion | | | | | | | | | | | | | | | | | | |
| Loss of bank vegetation | • | | ● | B1 | O | B2 | ● | B3 | | | • | | • | | ● | B7 | o | |
| Litter | | | | | | | | | | | | | | | | | | |
| **OTHER IMPACTS** | | | | | | | | | | | | | | | | | | |
| Noise | • | | • | | | | | | | | | | | | | | | |
| Air Quality | | | | | | | | | | | | | | | | | | |
| Damage to adjacent land | | | • | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| **LEGEND** | | | | | | | | | | | | | | | | | | |
| O | Major impact with little or no reseach | | | | | | | | | | | | | | | | | |
| o | Minor impacts with little or no research | | | | | | | | | | | | | | | | | |
| • | Minor impact but published work | | | | | | | | | | | | | | | | | |
| ● | Major impact but published work | | | | | | | | | | | | | | | | | |



Association of Inland Navigation Authorities

# APPENDIX 5

## The AINA Other Uses or Activities Matrix

**This matrix shows the groups of flora and fauna negatively impacted and the nature of impacts, for the various activities on British inland waters.**
**It should be noted that very different types of water bodies are represented, including canals, navigable rivers, tidal rivers and The Broads.**
**This matrix should be read in conjunction with Appendices 4 and 6.**

| The AINA Other Uses or Activities Matrix | Fish Stocking | | Water Transfers | | Routing Utilities | | Canal Restoration | | River Navigation Restoration | | Development/Land Use | | Drainage & discharges | | Agriculture | | Water Abstraction | | Fly Tipping | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IMPACTS ON FLORA & FAUNA** | ● | A14 | O | C1 | | ● | | E2 | O | E3 | ● | E3 | O | E1 | ● | F1 | O | F2 | O | F3 | O | F4 |
| Plants (Aquatic/Marginal) | | | | | ● | C2 | ● | E2 | ● | E3 | ● | E3 | O | E1 | ● | F1 | O | F2 | O | F3 | O | F4 |
| Trees/Hedgerows | | | | | | | | | | | • | | | | | | | | | | | |
| Birds - overwintering | | | | | • | | ● | E2 | ● | E3 | • | | | | • | | | | | | | |
| Birds - Breeding | | | | | • | | ● | E2 | ● | E3 | • | | | | • | | | | | | | |
| Mammals | O | A14 | O | C1 | | | ● | E2 | ● | E3 | | | ° | | ● | F1 | O | F2 | O | F3 | O | F4 |
| Invertebrates | ● | A14 | O | C1 | | | ● | E2 | ● | E3 | • | | | | | | | | | | | |
| Fish/Habitat | | | | | | | | | | | | | | | | | | | | | | |
| **WATER RELATED IMPACTS** | O | A14 | O | C1 | | | O | E2 | O | E3 | ● | E3 | O | E1 | ● | F1 | O | F2 | O | F3 | O | F4 |
| Transfer of biota | • | | | | | | | | ● | E3 | | | | | | | | | | | | |
| Increased turbidity | | | | | | | | | ● | E3 | | | | | | | | | | | | |
| Sediment movement | ● | A14 | • | | | | • | | • | | | | | | | | | | | | | |
| Water Quality | | | | | | | | | | | | | | | | | | | | | | |
| **BANK RELATED IMPACTS** | | | | | | | | | | | ● | E3 | O | E1 | ● | F1 | O | F2 | O | F3 | O | F4 |
| Erosion | | | | | ● | C2 | ● | E2 | ● | E3 | | | | | | | | | | | | |
| Path erosion | | | | | | | | | | | | | | | | | | | | | | |
| Loss of bank vegetation | | | | | | | | | • | | • | | | | | | | | | | | |
| Litter | | | | | | | | | | | | | | | | | | | | | | |
| **OTHER IMPACTS** | | | | | | | | | | | • | | | | ● | F1 | O | F2 | O | F3 | O | F4 |
| Noise | | | | | | | | | | | | | | | | | | | | | | |
| Air Quality | | | | | | | | | | | | | | | | | | | | | | |
| Damage to Adjacent Land | | | | | | | | | | | | | | | | | | | | | | |

**LEGEND**

**O Major impact with little or no reseach**
**o Minor impacts with little or no research**
**• Minor impact but published work**
**● Major impact but published work**



# APPENDIX 6

**Glossary of terms**

## The Navigation Matrix

| | |
|---|---|
| Motor Cruising | - general leisure motor boat cruising, including diesel engines |
| Lock Operations | - the everyday use of locks for navigation |
| Moorings Online (Formal) | - it refers to the use of formal online moorings, with a constructed hard edge, mooring bollards and possibly facilities. It does not refer to the construction of moorings. |
| Moorings Online (Informal) | - it refers to the use of soft banks for online moorings, with no formal mooring rings or facilities. Usually involves the use of mooring stakes driven into the bank to secure the boat. |
| Moorings Offline | - this is the use of offline moorings, such as marinas, and not the construction of the marina/moorings. |
| Boat Maintenance (Online) | - general boat maintenance including toilet disposal, grey water discharges, painting, engine maintenance and bilge operations, whilst carried out online. |
| Boat Maintenance (Offline) | - general boat maintenance including toilet disposal, grey water discharges, painting, engine maintenance and bilge operations, carried out whilst in an offline/marina situation. This would provide waste disposal facilities, separate drainage and greater control of pollution incidents. |
| Boat Launching (Trailed) | - the informal launching of boats along waterway banks, such as canoes and rowing boats, not those launched at formal slipways. |
| Canoeing | - general canoe activity, including launching and use of fast flowing water (ie/ weirs) |
| Un-powered Boating | - includes paddle boats, rowing boats and sailing |
| High Powered Boating | - this includes both legitimate high powered craft on designated river sections and the unauthorised use of jet skis, power boats and water skiing |
| Freight/Commercial | - includes issues of wharfage, craneage and the use of sea going vessels on inland waterways (ie/Caledonian Canal, Broads) |

## The Bank Matrix

| | |
|---|---|
| Coarse Fishing | - including use of banks, toilet issues, parking and general disturbance, as well as digging of banks and clearance of swims. |
| Game Fishing | - including toilet issues, parking and general disturbance, as well as the broken lines causing damage. |
| Walking | - general use of formal river paths and towing paths for casual walking. May include events and long distance walks and informal use of river sides. |
| Dogs | - including the presence of dogs (with and without lead) and issues relating to dog mess. |
| Cycling | - general use of towing paths on permitted routes for cycling, including formal river paths and towing paths. May include events and long distance rides. Issues relating to the construction of wider cycle routes are included. |
| Horse Riding | - includes formal use of paths and informal use of river and canal banks |
| Bird Feeding/Watching | - including the significant problems in localised areasUnauthorised Sports - including board sailing, jet skiing, shooting, hunting, ferreting, trapping, barbeques etc. |
| Unauthorised Sports | - including board sailing, jet skiing, shooting, hunting, ferreting, trapping, barbeques etc. |

## The Operations Matrix

| | |
|---|---|
| Waterway Maintenance | - includes the general operation of navigations, such as lock maintenance and greasing, sluice gates, overflows, water control and offside tree works. |
| Engineering Projects | - Major engineering projects to repair and upgrade existing navigations. Assumes good practice applied throughout the works, including the appropriate environmental assessment. |
| Dredging | - assumes good best practice applied throughout the works, including the appropriate environmental assessment. |
| Bank Protection | - including revetments, bank hardening, steel sheet piling, etc. |
| Soft Engineering | - includes a range of soft bank protection works |
| Weed Cutting | - includes the mechanical and chemical forms of weed control within the channel. |
| Herbicide | - includes both the aquatic and terrestrial use of herbicides. Assumes best practice. |
| Towpath Maintenance | - includes the general works on the towing path, including grass cutting, hedge cutting, pot hole works etc. |
| Tree Management | - includes general works to trees such as pruning, lopping, pollarding, felling and dead-wooding. Particular regard is paid to the backlog of maintenance. Assumes best practice in tree works and the most appropriate timing and phasing of works. |

## The Other Uses or Activities Matrix

| | |
|---|---|
| Fish Stocking | - includes the re-stocking of rivers, canals, reservoirs and lakes |
| Water Transfers | - relates to inter-catchment transfers of water. Quantity and increase in speed of flow are all considered. |
| Utilities | - includes cable works, mast construction, electricity overhead and underground, thrust boring techniques. |
| Canal Restoration | - includes the future restoration to navigation of derelict and disused canals and the construction of new canals. Assumes best practice applied throughout the works, including the appropriate environmental assessment. |
| River Navigation Restoration | - includes the future restoration and enhancement of river navigations. This is entirely separate from "river restoration" in the sense of the reinstatement of natural river processes including the beneficial restoration of natural river systems. |
| Development/Land Use | - considers small scale development alongside waterways. Assumes best practice throughout the works, including the appropriate environmental assessment. |
| Drainage/Discharges | - discharges into navigations, both licenced and not, including industrial, trade, boating, diffuse agricultural discharges and accidental discharges. |
| Agriculture | - considers changing agricultural practices, agri-environment schemes, drainage and irrigation uses. |
| Abstractions | - abstraction of water from navigations, both licenced and not, including industrial, trade and agricultural irrigation. |
| Fly Tipping | - the illegal tipping of a variety of goods including trade waste, household waste, fridges and white goods, garden waste, vehicles and sharps. |



# APPENDIX 7

**Nature Conservation Legislation and Waterways in the UK**

Significant areas of the waterway network and adjacent land are protected through a range of statutory designations and legislation. The overall aim of these statutory designations is to conserve and protect valuable habitats, geological features and assemblages or populations of species from loss or damage by neglect or wilful or inadvertent damage. Statutory site designations arise from national, local or international legislation and there are also a number of species which are afforded protection through national and international laws.

**National Legislation**

The national-level statutory designations which apply in the UK arise from the National Parks and Access to the Countryside Act 1949, the Wildlife and Countryside Act, 1981 and more recently, in England and Wales, the Countryside and Rights of Way Act, 2000 (CROW). Sites of Special Scientific Interest - SSSIs (or Areas of Special Scientific Interest – ASSIs, in Northern Ireland) are the main designation under these acts and represent the best remaining sites for wildlife or geology; they cover approximately 8% of England. Examples of some waterway SSSIs are given in the table below. SSSIs are identified and protected by the government's statutory conservation agencies but may be owned or occupied by a wide range of individuals and organisations. Management and protection of SSSIs can only be achieved through the conservation agencies and owner/occupiers working together.

The CROW Act has significantly changed the way that SSSIs in England and Wales are protected with a greater emphasis on positive management and has given English Nature and the Countryside Council for Wales stronger powers to protect sites. Important aspects of the CROW Act in relation to SSSIs include: a duty for public bodies (which would include many of those involved in managing and operating waterways) to further the conservation and enhancement of the special features for which a site is notified; and a requirement to consider the impact of activities outside the SSSI boundary upon the interest of the SSSI. This latter requirement is particularly important in waterway situations where there will be a high degree of connectivity.

Other statutory designations include National Nature Reserve (NNR) status and Local Nature Reserve (LNR) status. All 200 NNRs in England are all SSSIs and have been selected as the best examples of a particular habitat type. LNRs are areas which have locally important wildlife or geological features and have been designated to give people the opportunity to enjoy and learn about these natural features. Additionally, there are a range of local level designations made by local authorities such as County Wildlife Sites, Sites of Importance for Nature Conservation and Regionally Important Geological and Geomorphological Sites (RIGS). Non-governmental organisations such as the Wildlife Trusts and the Royal Society for the Protection of Birds also own and manage a number of reserves of their own, although these have no formal legal status many may be protected by SSSI designation.

The 1992 Earth Summit in Rio de Janeiro, Brazil resulted in 159 governments signing the Convention of Biological Diversity, a framework for the development of national strategies to protect and enhance biodiversity. The UK meets its commitment to this through the UK Biodiversity Action Plan (BAP) which has established a range of Habitat Action Plans (HAPs) and Species Action Plans (SAPs) for priority and threatened UK habitats and species respectively. There are SAPs for a number of species associated with the waterway network including aquatic plants, invertebrates, water voles and otters. Furthermore, there are a range of Local BAPs being developed to identify local priorities and which and how local partnerships can help achieve national HAPs and SAPs.

Finally, there are landscape designations which may affect and restrict waterway related activities such as Areas of Outstanding Natural Beauty (AONBs), National Scenic Areas (NSAs) in Scotland and National Park designations.

### European and International Legislation

There are a number of international-level designations which may affect waterways or adjacent land, such as European designations – Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). SACs are areas designated for habitats or species identified as of European significance under the European Union Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) and are intended to complement the SPAs designated under the EU Birds Directive (Council Directive 79/409/EEC on the conservation of wild birds). The Montgomery Canal, the Cannock Extension Canal and the Rochdale Canal are all candidate SACs for their populations of floating water-plantain (see below). Other international designations for wildlife and/or geology include RAMSAR sites, designated under the 1971 convention on wetlands of international importance and World Heritage Sites, designated under the 1972 convention for Protection of World Cultural and Natural Heritage.

### Protected Species

A number of Acts described above also include direct protection for species, a number of which may be present in waterways or affected by waterway related activities. In particular the Wildlife and Countryside Act 1981 and the EU Habitats Directive 1992 have lists of species considered vulnerable and in need of protection. For example, the aquatic plant, floating water-plantain and the white-clawed crayfish are both present in a number of waterways and are protected under the EU Habitats Directive. Activities which involve the disturbance or collection of these species require licensing from the relevant body; in England English Nature is responsible for issuing such licences.

### Canal SSSIs in England notified for in-channel aquatic features

| SSSI | Canal |
|---|---|
| Ashby Canal | Ashby Canal |
| Basingstoke Canal | Basingstoke Canal |
| Cannock Extension Canal | Wyrley & Essington Canal |
| Chesterfield Canal | Chesterfield Canal |
| Coombe Hill Canal | Coombe Hill Canal |
| Cromford Canal | Cromford Canal |
| Derwent Ings | Pocklington Canal |
| Dunsdon Farm | Bude Canal |
| Exe Estuary | Exeter Canal |
| Grantham Canal | Grantham Canal |
| Hollinwood Branch Canal | Ashton Canal |
| Huddersfield Narrow Canal | Huddersfield Narrow Canal |
| Kilby-Foxton Canal | Grand Union Canal |
| Kinoulton Marsh and Canal | Grantham Canal |
| Leeds-Liverpool Canal | Leeds & Liverpool Canal |
| Leven Canal | Leven Canal |
| Melbourne and Thornton Ings | Pocklington Canal |
| Montgomery Canal (Aston Locks-Keeper's Bridge) | Montgomery Canal |
| Newport Canal | Newport Canal |
| Pocklington Canal | Pocklington Canal |
| Prees Branch Canal | Llangollen Canal |
| Rochdale Canal | Rochdale Canal |
| Walland Marsh | Royal Military Canal |

## Notes

## Notes