2023

THE RIVER RESTORATION PROJECT

BACKGROUND INFORMATION

OCTOBER 1992

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1. INTRODUCTION AND BACKGROUND

In September 1990 at the NCC's conference on 'The Conservation and Management of Rivers' a group of delegates met to establish a project team for a demonstration **River Restoration Project for the UK**. The group comprised:

Jeremy Biggs, Andrew Brookes, Alastair Driver, Nigel Holmes, Chris Spray, John Steel and Richard Vivash

Since that time five more people have become closely involved with the group: Lyndis Cole, John Garland, John Hanley, Valerie Holt and Anne Powell.

The Core Group combines professional expertise in many areas including: biological surveying and monitoring, conservation, fluvio-geomorphology, river engineering, planning, water chemistry, amenity fisheries, wildlife conservation, landscape architecture and practical river management. In addition, there are many other people who have shown an interest in helping the project, offering expertise and specialist advice in many spheres.

Personal profiles of the Core Group are attached as Appendix 3.

The formal structure of the River Restoration Project is outlined in Fig.1. The Core Group comprises seven Executive members with five NRA staff forming a closely linked Technical Group. The Executive is in turn supported by a Steering Group and a Network of interested people.

Phase 1 of the River Restoration Project is already underway with the Core Group obtaining finance from British Coal to embark upon a Feasibility Study . ECON (the University of East Anglia) have been appointed to undertake the Feasibility Study in 1992. The Terms of Reference for their work are given in Appendix 2.

2. OBJECTIVES OF THE RIVER RESTORATION PROJECT

In the last few years baseline research has suggested a wide variety of methods which could be used to restore rivers for nature conservation. The aims of the River Restoration Project are to implement and test these methods in a series of demonstration sites in the UK and elsewhere.

The objectives of the River Restoration Project are to encourage the restoration of rivers in Britain by:

1) Establishing a **Demonstration Project** which applies state-of-the-art restoration techniques to the re-establishment of natural ecosystems in badly damaged rivers.

2) Demonstrating techniques for restoring rivers following diversion.

3) Increasing understanding of the effect of restoration work on nature conservation value, water quality, visual amenity, recreation and public perception.

4) Encouraging agencies and individuals to undertake river restoration by dissemination of knowledge and assistance in areas not covered by others at present.

5) International demonstration.

The active restoration of riverine environments must inevitably be achieved through landowning interests and the project aims to motivate such interests in a pro-active manner. The NRA shares this aim but its permissive powers generally restrict its ability to physically lead such works to larger ('main') rivers. The history of river degradation has often involved first the larger rivers, which then facilitates drainage of smaller watercourses. The process of rehabilitation may act in reverse, with the permissive role of the NRA being the key for main rivers, and farmers and landowners (i.e. local authorities, Forestry Commission, British Coal, Church Commissioners) responsible for smaller watercourses. The River Restoration Project aims to extend and complement the initiatives of the NRA for main rivers by assisting landowners to restore river interests. It is hoped that MAFF will be supportive by linking these opportunities to initiatives for sympathetic land management through ESA, setaside, etc.

3. OUTLINE OF THE AIMS OF THE PROJECT

3.1 THE DEMONSTRATION PROJECT

The Demonstration Project will involve the restoration of one or two straightened and highly modified river reaches, 2-10km long. The site(s) should have a flood plain at least 50-100m wide on either side of the river. Unmodified lengths of river at both ends of the renovated section need to be included within the project to act as controls for monitoring work and to provide a contrast with the renovated area. At least one of the demonstration sites will be carried out in an area currently used for intensive agriculture, probably in the Anglian or Thames NRA regions.

3.2 MONITORING

Extensive monitoring before, during, and after the renovation work will be vital to demonstrate the effect of restoration works on conservation, water quality and public perception. There is considerable scope for collaboration in this area and we could consider setting the site up as a national monitoring facility so that other organisations or individuals with investigations compatible within the project and its objectives can use the site.

In addition restoration site(s) will provide an opportunity for us to improve and refine river enhancement techniques by undertaking a **small** number of experimental manipulations.

3.3 EDUCATION AND INFORMATION

One of the main aims of the project is to inform and motivate those who have the power to influence or undertake river restoration projects e.g.:

(a) water organisations who are likely to have the motivation, equipment and financial backing to undertake restoration work.

(b) landowners who own and control access to waterways and their margins.

(c) major developers (e.g., those involved in mineral development or road building projects).

(d) those with political influence who have legal and ultimately financial power to encourage river restoration.

(e) the general public who can provide a popular driving force.

This will be achieved by encouraging active involvement in the project, giving talks and site visits, publishing and publicising the results of the Project widely, active lobbying and providing general press coverage.

4. GENERAL FUNDING

The initial stages of the project are being planned by the Core Team and will be funded from BCO. However much more funding will be essential for detailed planning, drawing-up of site plans, undertaking physical works, monitoring and experimental work and demonstrating and publicising the project. Potential sources of funding for principal parts of the project may include EC, MAFF, WWF, NRA, EN, research councils and further BCO funding. Many other smaller organisations could be approached for individual parts of the project (e.g. for funding of small research projects, publication of information leaflets). The RRP will address the wider question of funding river restoration works and need for financial incentives to encourage the promotion of private schemes. Part of this will be to stimulate contributions from principal beneficiaries.

FIGURE 1 STRUCTURE OF THE RIVER RESTORATION PROJECT

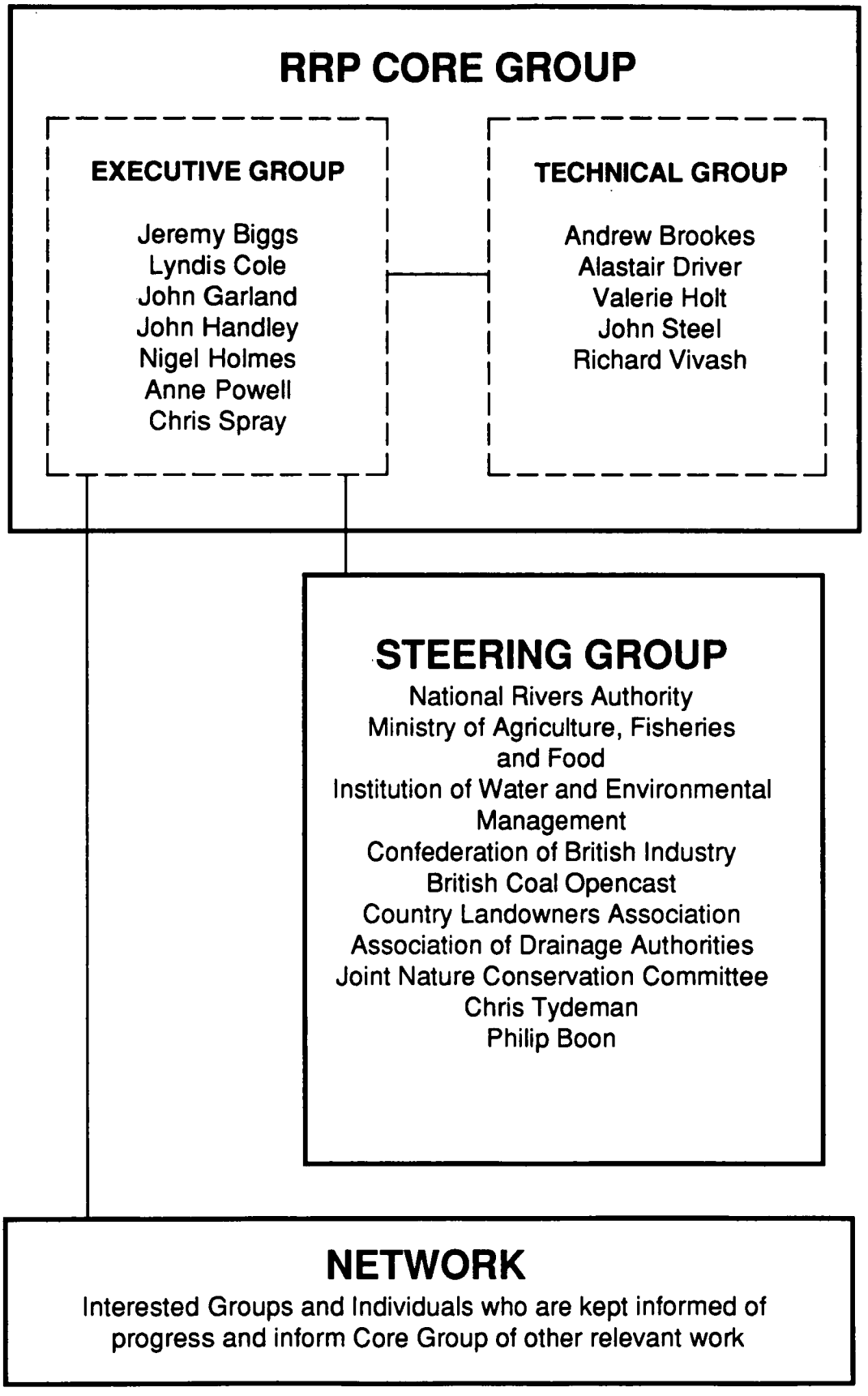


TABLE 1 BRIEF OUTLINE OF THE WORK INVOLVED IN PHASES 2 & 3

PHASE 2: PLANNING THE WORKS

1. Detailed site survey to describe physical parameters of the site and assess its current conservation value.

2. Collation of other information about the site including: scan of pertinent aerial photographs and historical information; collection of biological, chemical, physical and management records from the site; visits to adjacent, more semi-natural sites.

3. Outline design for discussion with landowners, locals, and other interested parties.

4. Detailed design and planning of site; detailed consultation between ecologists and engineers; detailed planning of any experimental work and post-construction management work; detailed costing. Drawing up the plans using landscape architects to produce top quality (publicity quality) drawings.

5. Pre-restoration monitoring: 2 years monitoring of the site (and adjacent up and downstream reaches) encompassing a wide range of biological and physico/chemical parameters.

6. Modification of plans following completion of monitoring work. Producing bill of works. Organising and timing the construction work.

7. Publicity

PHASE 3: CONSTRUCTION, MONITORING, PUBLICITY AND EDUCATION

1. Engineering work.

2. Supervision of the engineering work.

3. Monitoring the ecological and physico/chemical affects of the engineering works.

4. Planting.

5. Experimental work.

6. Appraisal of the success of physical, biological and publicity work.

7. Development of a programme of demonstration visits, professional training courses. Development of information about the work being undertaken.

8. Publicity to maintain interest in, and awareness of, the project.

APPENDIX 1

DETAILED DESCRIPTION OF THE PROJECT

The various stages of the project need very different amounts of effort and publicity, and are likely to involve very different groups and organisation to undertake or fund the work. The various aspects are therefore split up below:

1. SETTING UP THE PROJECT

There needs to be an initial desk study which is likely to include visits to see rehabilitation programmes which have already been undertaken or are underway. This phase should attempt to:

(a) collect and collate relevant published and unpublished information to form the basis of a library/ data base.

(b) ascertain the nature of experimental work being undertaken in this area.

(c) identify successes and failures which other schemes have encountered.

(d) use information from the above to more specifically define the requirements of the scheme.

2. IDENTIFYING SUITABLE SITES

Suitable sites should ideally comprise a block of land with a variety of severely engineered/polluted channels of varying sizes. These should include:

(i) A stretch of Main River.

Since rivers are important as landscape and recreation features; are potentially more spectacular as wildlife habitats; and because they are 'main river' (and therefore likely to be of greater relevance to the NRA) they are the most likely candidates for renovation.

(ii) Small streams and ditches.

Small streams should also be included if possible because they are important wildlife habitats, are particularly susceptible to damage, offer the possibility of 'gaining' a lot of land and are likely to be of greatest relevance to the largest number of landowners.

Sites should fit the criteria listed below as fully as possible:

- sites must give us a reasonable length of river/stream to work with (2-10K).
- sites need to have been severely modified (e.g., straightened lengths, trapezoidal banks, intensively managed surrounds).
- they must be accessible (ie not too far from a motorway/main road).
- the landowner must be fully committed to the project because of:
  (a) the large amount of land that the scheme is likely to take up and (b) the amount of disturbance his/her land is likely to receive during and after construction.

Other criteria/constraints are likely to be defined as more detailed planning is undertaken.

3. FINDING SITES

The key to the success of the project is an interested landowner, willing to make available land for restoration works. Severn-Trent and Danish experiences indicate there is no shortage of available land, but it is time-consuming finding suitable locations and explaining to the landowner what is suggested.

Initial approaches to landowners could be made through personal contacts, large companies, Crown Commissioners, local authorities, insurance companies etc. Large land owners such as the National Trust, the Forestry Commission, the Oxford and Cambridge colleges could also be approached. FWAG Demonstration Farms may be a relatively easy option - although they may not have the sort of damaged rivers that we want to restore.

In order to give landowners and farmers a simple explanation of the aims of the project a short leaflet should be produced which describes the reasons for the programme and its objectives in clear language. It should ask for support in terms of land available and restate the Petersen-type message (Appendix 4).

4. RESTORATION WORK

Prior to detailed planning of the restoration scheme there needs to be an initial site survey to describe in detail the physical, hydrological and biological features of the site. This should include collation of all physical, biological, chemical and management records for the site, use of aerial photographs and if possible study of more semi-natural rivers adjacent to the site. Following this detailed planning can begin but further monitoring work will need to be continued over the site (including adjacent up- and downstream reaches) over at least one year to provide full baseline information for future comparative and experimental work (see section 6 below).

The design phase itself will require considerable consultation between ecologists, engineers, hydrologists and landscape architects to ensure that the final design and its implementation:

a) ensures sufficient hydraulic stability of the river.
b) retains existing conservation interest.
c) fully incorporates conservation and experimental design features.
d) has top quality (publicity quality) drawings.

During this phase full consultation with land owner(s), locals and others involved in using or managing the site will be essential.

5. UNDERTAKING THE RESTORATION

The NRA is likely to be to be critical here although groups like the BTCV/Groundwork Trust could help with labour on jobs which don't need heavy machines.

The excavation work may need to be extended over more than one year and this will need to be carefully planned and timed. It will be essential that the engineering work is regularly supervised during the construction phase.

The ecological and physico/chemical effects of the renovation work should be monitored during the construction phase, particularly on downstream reaches.

6. MONITORING THE IMPACT OF THE RESTORATION

A key requirement is to utilise objective scientific methods to demonstrate the change from highly modified and almost certainly impoverished conditions to much more semi-natural physical, chemical and biological conditions following the completion of the works.

The following are likely to be a basic minimum for regular monitoring:

Physical nature of the channels (including sediments and hydrology)
Water and sediment chemistry
Plant communities
Macroinvertebrates
Birds
Fish
Amphibians (in ponds alongside)
Mammals
Improvements in landscape, recreational amenity and public perception.

Many of these broad monitoring topics (e.g., plants, aquatic macroinvertebrates, chemistry) we could and should handle 'in house' to ensure a high standard and continuity of work. For others (e.g., birds) we could probably bring in specialists, e.g., RSPB/BTO, and there would seem to be a lot to be said for involving other groups, e.g., IFE , who have long-established expertise in this area.

In addition we can break these topics down into detailed monitoring related to target groups of organisms or to specific processes (like nutrient cycling) and extend them into other areas (e.g., microorganisms, organic matter budgets). Here there is the potential for considerable collaboration with other workers who have projects compatible with the main ideals. We might consider setting the site up as a national monitoring facility so that anybody with compatible ideals can come to work on it.

We also need to decide on, and plan in, a **small** number of core experiments to incorporate in the scheme e.g., (i) the effects of putting in a land buffer zone on water qualit; (ii) effects of marginal vegetation width on water quality and wildlife value; or (iii) effects of channel width/flow regime on invertebrate conservation value. Only a very few of these will be possible at any one site because of the need to minimise other variables if we are to get meaningful results.

7. CONSERVATION, EDUCATION, PROMOTION, DEMONSTRATING THE PROJECT

For the programme to succeed as a stimulus for change we need to consider and target the main groups that we seek to influence (e.g., professional water industry, landowners, politicians, conservation organisations etc.). This will need a well organised publicity/PR strategy.

It will be vital to produce good visual aids and simple leaflets at various stages of the project and these must be timed in with any major press release or publicity drive in order to handle the large amounts of interest and enquiries which the scheme could generate.

In the short term we can produce a list of references (as a bibliography) containing information on tried and tested techniques of river restoration, including information on the restoration of rivers of various size, flow characteristics, land use and geology. We could also begin to build up a library facility particularly of papers and reports which may be difficult to acquire.

In the medium term we should aim to be producing a guide (rather like the NCC guide on drainage channel management and other supporting documents) combining state of the art information on river conservation ecology and restoration techniques and summarising what constitutes 'value for money'. Ultimately this could be translated to design techniques for new works and ordinary maintenance activities. The guide should be updated as our information becomes available. Co- production with the NRA might be possible.

In the longer term we should be concentrating on demonstrating the results of the work and in mobilising other schemes, perhaps targeting particular areas or rivers which have been very badly managed. We are likely to need to take positive action to influence sectors which don't seem to be responding sufficiently e.g., passing information to farmers and landowners, offering invitations to see the restoration site, giving talks and so on.

8. FUNDING MONITORING, EXPERIMENTAL AND PUBLICITY WORK

Monitoring and publicising the sites on the scale necessary will need considerable funding. This is likely to come from a variety of agencies geared to individual parts of the project.

These could include NRA (particularly for water quality), English Nature, the European Commission, Department of the Environment, Countryside Commission, World Wide Fund for Nature, Welsh Office, Ministry of Agriculture Fisheries and Food, the research councils and commercial sponsors.

APPENDIX 2

PHASE I FEASIBILITY STUDY - OUTLINE BRIEF

1. SUMMARY OF THE AIMS AND OBJECTIVES OF THE FEASIBILITY STUDY

The Feasibility Study forms part of Phase 1 of the River Restoration Project (RRP) and is divided into three stages. Its requirements are set out below.

1.1 Description and Assessment of Current River Restoration Measures

(i) A description of the broad range of restoration techniques that could be applied to British rivers.

(ii) Identification of the **benefits/successes** and **disbenefits/failures** of river restoration measures in terms of ecology and conservation, water quality, channel stability, hydrology, river management, recreation and conservation and public amenity. In each case a clear distinction should be drawn between scientific evidence of success/failure and subjective impressions of success/failure obtained from the people involved.

The following subject headings under which measures/techniques should be discussed are suggested but could be modified in consultation with the RRP Executive:

(a) In-channel modifications (including enhancements).
(b) Bank modifications (including enhancements).
(c) Channel re-shaping.
(d) Buffer strips.
(e) River corridor enhancement/habitat creation.
(f) Hydrological/flood water management.
(g) 'Reed-bed' and other biological methods of pollution control. This section should **not** include descriptions of other standard water pollution control measures (e.g., traditional sewage works, solids settling tanks in industrial complexes, urban runoff control structures).
(h) Catchment planning/control (including agricultural land-use legislation).

(iii) Brief descriptions of current **research** and **practical projects** relevant to river restoration. This section will focus on projects undertaken in the UK which break new ground; have original ideas or are of large scope. Major projects in Europe and the USA should also be included.

This section should include:

(a) a brief (1 page) review of river restoration activities in each region of the NRA. Consultants should bear in mind that is not likely to be possible for NRA staff to provide complete descriptions of *all* river enhancement projects in their regions.

(b) a brief review of river restoration works being undertaken by other organisations (e.g., MAFF, EN/CCW/SNCC, NT, WWF, RSNC (as representatives of County Wildlife Trusts), RSPB, IFE, DOE).

1.2 Brief Review of River Restoration Techniques

Brief summaries of:

(i) Restoration techniques which **are**, and which **are not**, being applied in Britain (and elsewhere).

(ii) Techniques which seem to be the most fruitful or valuable for:

(a) immediate implementation in practical restoration work.
(b) monitoring or experimental work to assess their effectiveness.

(iii) Potential sites for future river restoration work.

1.3 Other Information

(i) A list of names and addresses of relevant contacts made during the Feasibility Study (cross-referenced to projects described in Section 2.1).

(ii) A library containing the papers and reports reviewed during the Study. (this will provide source material for undertaking the detailed planning stages of Phase 2 of the RRP). Papers, reports and books of which copies are not obtained should be included in the reference list.

2. RECOMMENDED PRIMARY INFORMATION SOURCES

Information for the Feasibility Study should come from three main sources: (i) thorough literature reviews (ii) discussions with practitioners (iii) site visits. The consultant should note that work of members of the RRP Executive will provide a starting point for much of this work.

2.1 The RRP Executive

Information and ideas from the RRP Executive will be the primary source of information for the project. RRP Executive members should be interviewed for contacts and direct experience in relevant projects. They also have a access to a wide range of relevant literature, and the first stage of the project will consist of detailed consultation with each of these people.2

2.2 Scientific and Technical Literature

The scientific and technical literature (this should be accessed by a computer based literature searches, preferably in consultation with the IFE/FBA library). Except in the areas outlined below, the consultant should **not** attempt to review literature describing fundamental aspects of river ecology.

2.3 Information from Others Working in this Area (including both research and those undertaking practical restoration work e.g., NRA and NRA-funded projects).

A contacts list should be prepared in discussion with the RRP Executive and contacts then made in consultation with the RRP Executive.

2.4 Site Visits to Significant Restoration Programmes Undertaken in Britain

3. OUTCOMES OF THE FEASIBILITY STUDY

The results of the Feasibility Study will be reported using the following format:

(i) A report on the assessment of river restoration measures (described in 2.1 & 2.2 above). X copies of the final report should be provided including two copies on floppy disc, compatible with Apple Macintosh computers/IBM computers.

(ii) A list of contacts and library of documents (described in 2.3 above).

(iii) A non-technical summary (produced in the form of a non-glossy B&W A5 or A4 leaflet, illustrated as necessary) listing successful river restoration techniques and new ideas. This will be used to provide non-technical information about the project for BCO staff and by the RRP Executive to give preliminary information about Phase 2 of the River Restoration Project.

4. SUPERVISION OF FEASIBILITY STUDY

The Feasibility Study will be undertaken by consultants appointed and supervised by the RRP Executive.

APPENDIX 3

PROFILES OF CORE GROUP MEMBERS OF THE RIVER RESTORATION PROJECT

EXECUTIVE GROUP

DR JEREMY BIGGS
Jeremy Biggs is the Manager and co-founder of the freshwater conservation group Pond Action. The group undertakes applied research and advisory work on all aspects of freshwater conservation, specialising in the design and management of wetlands and the conservation of ponds (the group is currently developing a national classification of ponds, using macroinvertebrates and wetland plants). Jeremy Biggs is an Honorary Research Fellow at Oxford Polytechnic and a member of the World Wide Fund for Nature's UK Species Conservation Theme Advisory Group.

LYNDIS COLE
Lyndis Cole has worked for Land Use Consultants (a planning and environmental design practice) for over eighteen years and has been a Principal of the Company for the last eight years. Having started in the field of land reclamation and subsequently developed the NCC's strategy for urban nature conservation, her time is now divided between undertaking research contracts for the DoE and work with the NRA. Involvement with the water environment has included the design of environmentally sensitive flood alleviation schemes, the design of river enhancement works, the assessment of the impact of new development on the water environment, and strategic planning including the writing of catchment management plans.

JOHN HANDLEY
Trained as an ecologist, John Handley joined the Groundwork Trust in 1982 shortly after its formation as its first Executive Director. The Groundwork Trust leads Operation Groundwork, a project which seeks to restore damaged and neglected land to beneficial use and to make the most of the countryside in the urban fringe around Liverpool. It aims to build a co-operative approach to land restoration and land management through bringing together central and local government, business and industry and the voluntary sector. There is now a national network of 28 Trusts based on the Operation Groundwork model and coordinated by the Groundwork Foundation. Before this John Handley worked as Natural Resources Officer with Merseyside County Council. He was responsible for survey work on the County's natural resources, policy formulation and devising countryside management schemes. In 1989 he received an award from the United Nations Environment Programme for services to the environment.

DR NIGEL HOLMES
Freshwater ecologist. Specialism in macrophytes and algae through twenty years of working experience at Durham University, Nature Conservancy Council and as a private Environmental Consultant. He was responsible for developing the river corridor survey methodology and his work on macrophytes culminated in the development of a new system of river classification in Britain used both for site evaluation and in SSSI selection. He has spent considerable time working with engineers in developing sensitive river management techniques, and written several papers on the subject. As a private consultant for nearly ten years he has worked on numerous projects ensuring that river valley conservation receives a high profile from the start and given similar status as other disciplines.

DR ANNE POWELL
Anne Powell is the NatWest Project Officer in the External Relations Centre, Oxford Polytechnic. She is a co-founder and Advisor of Pond Action and Partner in Hamlet Partnership, aquatic environmental consultants. She has experience in technology transfer, project and financial management, water pollution and conservation. For ten years Anne Powell headed a research group investigating biological relationships in gravel-pit lakes and other man-made water bodies. She is author and editor of four semi-popular aquatic biology books and several natural history pamphlets and guides. Anne Powell is a member of World Wide Fund for Nature's Conservation Review Group, a member of the Council of the Freshwater Biological Association, Chairman of the Academic Industry Links Organisation (AILO) and a member of the NRA Thames Region, Regional Fisheries Advisory Committee.

DR CHRIS SPRAY
Recreation and Conservation Manager, Northumbrian Water Limited. Past experience includes Conservation Officer, N.R.A. (Anglian), Recreation and Conservation Officer (Anglian Water), Research Fellow in Zoology (Aberdeen University). Wetland ecologist and ornithologist. Member of Scientific Advisory Committee of Wildfowl and Wetlands Trust, British Ornithologists' Union, British Trust for Ornithology, etc.

TECHNICAL GROUP

DR ANDREW BROOKES
Dr Andrew Brookes graduated from the University of Southampton. A geomorphologist and ecologist by training, he has over ten years experience in the research and management of rivers. He worked for the Danish Ministry of Environment during 1983 and 1984 and was responsible for initiating a programme of river restoration. He now works for the National Rivers Authority Thames Region and is responsible for the environmental assessment of flood defence works and for negotiating environmental solutions with external developers and riparian owners. He is project leader for several national NRA research and development projects. He has undertaken working visits to several countries, including Australia, Japan and North America. He is the author of over thirty technical publications on river management.

ALASTAIR DRIVER
Conservation Manager for the Thames Region of the National Rivers Authority. He worked as a river corridor surveyor for the Nature Conservancy Council and the Gloucestershire Trust for Nature Conservation in the late 1970s and became Thames Water Authority's first Conservation Officer in 1984. He joined the NRA at its inception in 1989 and now oversees a multimillion-pound budget. In addition to these commitments, he is also involved in lecturing, training courses, radio and television programmes, contributions to books, articles for magazines and generally promoting environmentally-sensitive river management.

VALERIE HOLT
Currently Area Conservation and Recreation Officer with Severn Trent Region of National Rivers Authority, she has twenty years' experience in the water industry, primarily in water recreation with fisheries and conservation for the last ten years. She has managed a 300-acre country park and been involved in many river enhancement schemes. She is a Fellow of the Institute of Fisheries Management and an active member of their Council.

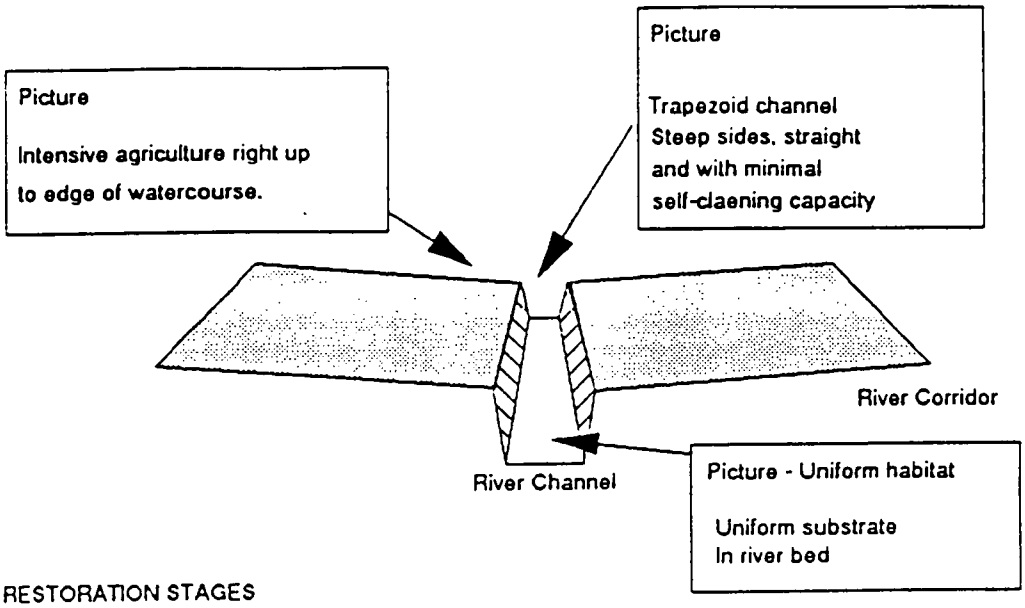
JOHN STEEL
Has been working in the field of water pollution control for twenty-one years. He is experienced in chemical analysis of pollution-related samples (four years) and biological sampling and evaluation of both freshwater and marine ecosystems (seventeen years). At present he is area biologist for the National Rivers Authority Thames Region, responsible for managing a group of eight staff. The group is involved in assessing environmental quality in the freshwater River Thames catchment. The work areas of his group include comment on local planning applications, land drainage schemes and flood alleviation measures. Fish pathology examinations, microbiological analysis, algological surveys and invertebrate monitoring are undertaken by the group.

RICHARD VIVASH
Chartered Civil Engineer. Thirty years' experience in river engineering across most of England and Wales. Driving motivation has been to demonstrate that the essential engineering and management of rivers can be most effectively achieved through environmentally sensitive methods.

APPENDIX 4

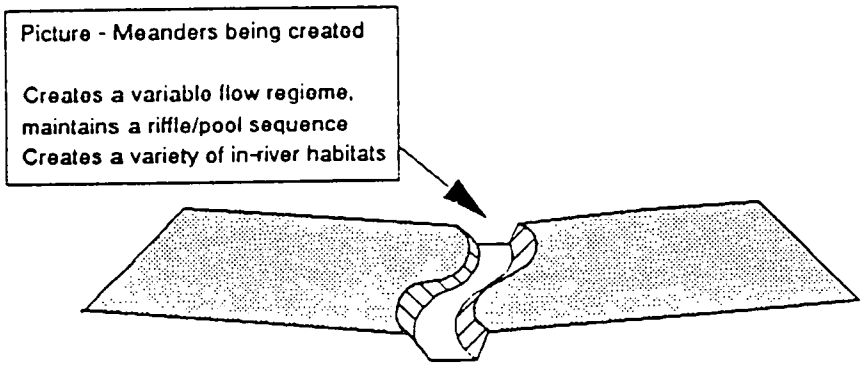
RIVER RESTORATION - THE MAIN STAGES

UNRESTORED CONDITION

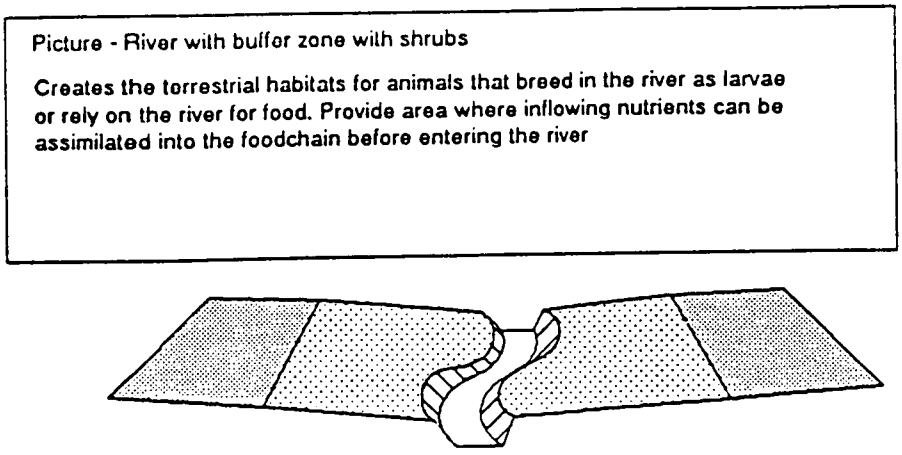


RESTORATION STAGES

A: Creation of more natural, meandering channel



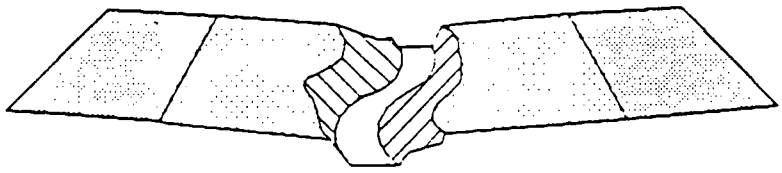
B: Addition of buffer zone in which river meanders naturally



C: Variations in bank slope to create habitats

Creates a variety of habitats for bankside vegetation an animals
Reduces bank damage by erosion

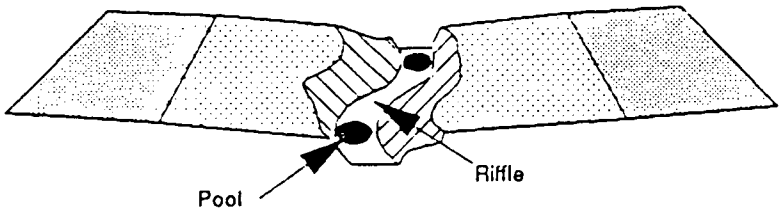
Picture - Good banksie vegetation



D: Variations in river bed to create pools & riffle sequence

Habitats variability aids all aquatic life

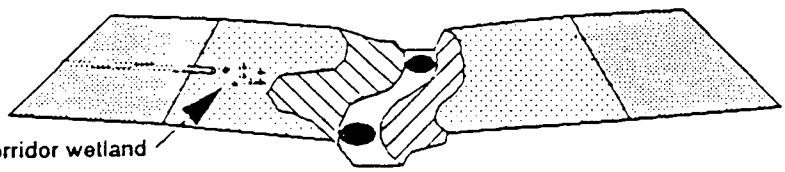
Picture - Pool/riffle sequence



E: Terminate land drain at buffer zone edge to create wetlands

Creates wetland habitat for animals and plants

Picture - wetland habitat



G: Create shallow wetlands and tree-plant river loops

Creates extensive habitats and cover for mammals & birds - the top end of the food chain.

Picture - mature planted river loops