RRC ANNUAL NETWORK CONFERENCE

'ENGINEERING RIVER REHABILITATION'

SUMMARY OF PAPERS

29TH - 30TH APRIL 2002
SWALLOW HOTEL, STOCKTON-ON-TEES

CONTENTS

Session 1: R & D: RELEVANT AND DEMONSTRABLE

Session 2: ENGINEERING SUCCESS

Session 3: FROM THE NATURAL TO THE CREATED, TO THE URBAN COMPROMISE

- Terry Langford (University of Southampton)
  'Bends, trees and biodiversity in streams – A Study of Two Confluent Streams'

- Peter Worrall (Penny Anderson Associates)
  'Kelham Bridge: Putting Function back into the Floodplain'

- Marta Gonzalez del Tanago (University of Madrid, Spain)
  'Rehabilitation of the Pozuelo Stream, Madrid'

- Caroline Jackson (Binnie, Black and Veatch)
  'The River Medlock Rehabilitation Scheme'

Session 4: OVERCOMING OBSTACLES FOR SPECIES, SPORT AND SOCIETY

- Gert Jan Akkerman (Royal Haskoning)
  'Fishpasses in the Netherlands'

- Carol Holt and Gary Jones-Wright (Environment Agency)
  'The Padiham Weir Project'

- Paolo Negri (CIRF: Italian Centre for River Restoration)
  'The New Engineering Approach to Italian River Restoration'

KEYNOTE ADDRESS
'ENGINEERING IN RIVER REHABILITATION'

Dr Mervyn Bramley, CEng, FICE, FCIWEM– Flood Defence Development Manager, Environment Agency – Head Office, Bristol

Mervyn Bramley is a chartered civil engineer by training. His first job was lecturing in drainage and irrigation with VSO in Malaysia where he met people with a vision of "sustainable river engineering". He then spent his early career with Binnie & Partners where he became a Chief Engineer working on river, irrigation and water resource management. Work there included "drawing trapezoidal cross-sections for river improvements". He moved to CIRIA in as Research Manager for Water Engineering in 1983. Among the work he initiated there were the CIRIA Guides on "Protection of River and Canal Banks" and "Use of Vegetation in Civil Engineering". These strongly promoted the three "Es" (Engineering, Environment, Economics) as starting points for planning and design of river works (as distinct from environment being tacked on at the end!)

Mervyn was appointed to Head of R&D with the new National Rivers Authority where he was instrumental in promoting the River Restoration Project (Rivers Cole and Skerne) as national demonstration sites and in gaining national funding for these. He worked closely with the RRP Team in maintaining the national focus of river restoration and establishing the River Restoration Centre. In 2000, he moved from Head of R&D in the Environment Agency to Flood Defence where has helped to set up the new joint Flood and Coastal Defence R&D Programme with DEFRA. He leads the Engineering Theme in this.

……

The Keynote Address draws on glimpses from the past in establishing where engineering in river restoration has come from as well as the clearer understanding that we now have of the principles of river restoration. Engineering fits into this as both an art and a science. An "art" as we are managing an uncertain environment where cause and effect is not always clear. A "science" as we have enough principles, tools and techniques to achieve "sustainable river engineering". In particular, we have a wealth of information on the success and failures of past schemes.

Reference will be made to the updated edition of the River Restoration Manual that the RRC and the Environment Agency have just completed as an R&D Project. This is now available on the Environment Agency's new web site for Flood Defence R&D outputs (http://www.environment-agency.gov.uk/subjects/flood/211195/264395/286585/). (This will be hot linked to the RRC site in due course).

The Keynote Address goes on to examine the key drivers in the future development of engineering in river restoration. These include the better synthesis of information into practical tools for river management (note the EA's forthcoming web-based river restoration tool kit), a clearer understanding of functional design (e.g. for flood resilience, ecological value, landscape amenity), the EU Water Framework Directive, and the need to manage for extreme events (and the risk and uncertainty that accompanies these).

The final point is that while the engineer is a key player in river restoration, he / she is above all a player in a team alongside other practitioners and the other forms of life that live in the river environment!!

ECONOMICS OF WASHLAND CREATION

Professor Joe Morris, Institute of Water and Environment, Cranfield University at Silsoe,

Joe Morris, is Professor of Resource Economics and Management in the Institute of Water and Environment, Cranfield University at Silsoe. He has particular experience of cost-benefit analysis applied to rural flood defence programmes. Recently, this has focused on opportunities to reconcile agricultural, environmental and flood defence objectives through wetland creation schemes.

……

Context

Flood defence for farm land, along with high levels of subsidies, was for many years an important element of Britain's production oriented agricultural policy. Many flood plain areas benefited from publicly funded flood defence and land drainage schemes which reduced crop damage and facilitated a change to more intensive farming systems.

Recently, however, policy emphasis has been placed on environmental enhancement, on greater diversity of economic activity as a basis for sustainable rural livelihoods, and on public enjoyment of the countryside. Funds previously committed to support farm output are increasingly diverted to encourage land managers to deliver environmental benefits.

Benefits of Washland and Flood Storage Creation

In this context, there is reduced justification for high standards of flood defence for agriculture. Indeed, there may be substantial benefits if some flood plain land is returned to its previous unprotected, un-drained condition. In some areas, the positive creation of washland and/or flood storage facilities could: provide relief to areas presently subject to unacceptable flooding; reduce the need for expensive flood defence measures elsewhere in the catchment; help the management of scarce fresh water resources; provide wildlife and amenity benefits, and, through credits for flood storage and extensive farming methods, provide alternative sources of income to land managers.

Feasibility and Costs of Washland and Flood Storage Creation

The feasibility and location of washland/flood storage facilities vary according to catchment and floodplain characteristics, particularly topography, hydraulic performance and the purposes to be served, whether predominantly environmental or flood management. Flood water depths may vary from relatively shallow flooding where habitat is a priority through to 2.5 m or so on predominantly storage sites. Sites should be easy to fill and to empty, be cheap to construct, be free of buildings and infrastructure, and offer scope for habitat improvement.

Costs per m^3 of storage capacity vary considerably according to site conditions, with significant economies of depth where the main purpose is storage capacity. Land acquisition land costs can vary from about £0.50 to £1.50/m^3 of storage capacity, equivalent to between £0.04 and £0.12/m^3 per year. Design and construction costs also vary considerably, but, depending on scale, will probably double these costs to about between £0.10 and £0.25/m^3 capacity per year. Smaller scale on-farm type storage reservoirs probably cost about £0.50/m^3 per year storage capacity. But these generalisations are dangerous because so much depends on local conditions.

Environmental Benefits

Washland areas can support wintering wildfowl, breeding waders, and aquatic invertebrates and plants, and species rich grassland. Although flooding in winter suit visiting wildfowl, excessive

flooding in spring is detrimental to breeding waders, invertebrates, small mammals and some plant communities. For this reason, careful management of surface flooding and groundwater levels is needed to reconcile the different water regime requirements of these environmental features throughout the year.

Financial Impacts

The creation of washland/flood storage on farm land will impact on land use, farming practice, productivity and farm incomes, depending on the change in flood regime (both surface flooding and waterlogging of soils) and the degree to which existing land use is sensitive to this change. Much depends on the frequency, seasonality, duration, and to a lesser extent the depth of flooding on farm land. Short duration flooding on grassland in winter has little impact, but a month's flooding on improved grass in spring can severely limit productivity. Arable crops are generally unsuited to frequently flooded areas. Furthermore, waterlogged soils, as well as directly depressing crop yields, have reduced strength and this reduces field access by machines or grazing animals.

Income loss will depend on land use and profitability before and after the introduction of the washland option, and on particular farm circumstances, such as whether whole farms or parts of farms are involved. A switch to extensive grassland would probably reduce annual financial returns by between £200/ha and £300/ha, although this would be less if farms could save overhead costs over the longer term. For these reasons, payments to farmers may be necessary to compensate for loss of income and provide an incentive to adopt washland options.

In some designated Environmentally Sensitive Areas, such as the Somerset Moors and Levels, farmers already receive annual payments of about £125/ha to retain permanent grassland, and between £200/ha and £430/ha to maintain wet grassland. The higher rate applies for permanently raised field water levels. It is possible that a similar payment regime could be designed for washland creation/flood storage.

Economic Consequences

Although, in the absence of compensatory payments, farmers may incur 'financial' losses due to washland creation, there is potential 'economic' benefit from moving to extensive washland systems. This is because in existing grassland areas, livestock production is heavily dependent on subsidies, and after removing these, many livestock enterprises show negative returns. Hence, reducing the intensity of farm production in some areas would be beneficial from the viewpoint of the national economy as a whole. Given the opportunity to achieve economic and environmental benefits, and to sustain farm communities through targeted support, it would appear in the public interest to redirect funding, both from the agricultural and flood defence budgets, into washland creation and flood storage.

Administrative Options

There are four main options for the administration and management of washlands, namely: land purchase, easements, management agreements and leaseback partnership. Their suitability varies according to the purposes to be achieved, the longevity of the commitment to change, and linked to these, the preferred link between the farming community and the management of the land. The range of circumstances in flood plain areas implies that a diversity of approaches may be required.

Conclusion

It is apparent that there is considerable scope and potential benefit from the development of washlands and flood water storage on farm land. However, there is a need to confirm practical ways to reconcile the flood storage, environmental and farming objectives in washland areas, and to join up the various arms of agricultural, environmental and flood defence policy to support this process.

SETTING 'PHYSICAL QUALITY OBJECTIVES' FOR RIVERS

Jim Walker, Senior Scientist, River Habitat Survey, Environment Agency – North West Region, Warrington.

Author and speaker: Jims's current job role in RHS is to lead the development of Physical Quality Objectives for England and Wales as a 3 year Research and Development project. He is also leading the national development of Geomorphology within RHS and in other areas of the Environment Agency

Other Authors: Mark Diamond Fisheries, Recreation, Conservation and Biology Manager and Marc Naura, National RHS Coordinator (Both Environment Agency – North West Region, Warrington.)

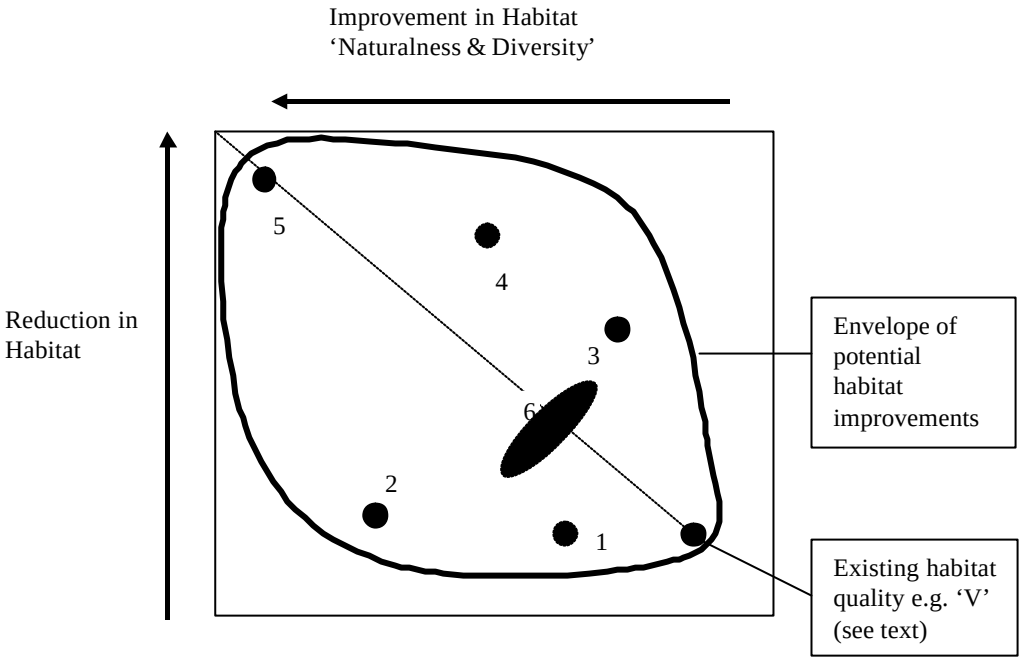
……

- The Environment Agency's Environmental Vision, states that "*habitats will improve in their extent and quality to sustainable levels…"*. To achieve this goal we need to assess the Physical Quality of existing habitats and set habitat improvement objectives. The Agency Corporate Plan states that we will *"publish habitat targets for all watercourses by 2003"*. PQOs will help to deliver these targets. The Water Framework Directive also sets the need to assess hydromorphology, and by inference River Habitat, in the context of establishing river types and assessing ecological status, objectives and the influence of pressures such as river engineering. Physical Quality Objectives will form part of the UK response to the WFD by providing a system to assess and improve the hydromorphology of rivers. As such they will form a valuable step towards the sustainable development of the management of river.

- Physical Quality Objectives will provide a classification of the existing physical forms of watercourses in England and Wales, including river habitat quality and the connectivity of natural river processes. The PQO project reviews current approaches to setting objectives for river restoration at a catchment and national scale in the UK. It will also provide objectives for improving the quality of river habitats for every watercourse in England and Wales. These objectives will be supported by a 'tool-box' of different methods to restore and enhance habitats. This will include a range of river restoration options from 'assisted natural recovery' to detailed engineering options.

- The 'tool-box' is currently in the early stages of development. It will include catchment tools that will guide the user through the consideration of management (stakeholder) interests and social, environmental and economic benefits. These tools will produce and prioritise appropriate river management options at a broad scale. A series of reach scale tools will then help the user through the selection and implementation of river restoration, rehabilitation and enhancement options as appropriate on a site by site basis. Such options will include a broad range of methods including a range of techniques for engineering river rehabilitation. Examples of potential options for improving, rehabilitating and engineering rivers are presented in figure 1 below. These options involve improving the diversity and 'naturalness' of habitat at the site and/or reducing the extent of habitat modifications.

Figure 1: Different Options for Habitat improvements Under PQOs



Option 1: Vegetation regeneration / planting
Option 2: Rehabilitation of channel form
Option 3: Removal of minor engineering works
Option 4: Removal of major engineering works
Option 5: Full restoration of river form and processes
Option 6: Assisted natural recovery

- Strategies for applying the PQO framework will also be investigated, including:
  - A) simple national scale 'rules' such as the global maintenance of 'good' habitat and the improvement of lower classifications,
  - B) applications to individual reach-based projects, in an iterative approach to habitat improvement throughout catchments,
  - C) applications to reaches within a catchment context, identifying opportunities and constraints for improvements in terms of different 'management areas', and
  - D) ecological strategies, such as the functional division of catchment areas and objectives based upon significance of habitats for key species.

- Physical Quality Objectives are based upon River Habitat Survey data and the Environment Agency's River Habitat Survey Lead Region is responsible for their development. For more information on Physical Quality Objectives contact:
  Jim Walker, Senior Scientist, River Habitat Survey, Environment Agency, Warrington, WA4 1HG. Tel: 01925 653999, Fax: 01925 415961
  E-Mail: jim.walker@environment-agency.gov.uk

THE RIVER RESTORATION CENTRE:

ACHIEVEMENTS 4 YEARS ON

Martin Janes, Centre Manager and Karen Phillip, Information Officer, both River Restoration Centre, Silsoe

Martin Janes is the Centre Manager at RRC with responsibilities for the day to day management of the Centre. Prior to this role, Martin was Project Co-ordinator for the River Restoration Project, principally co-ordinating the two EU LIFE funded demonstration projects on the Rivers Cole and Skerne.
Karen Phillip is the Information Officer at the Centre and joined the team in Oct 2000. Karen is responsible for managing the RRC projects database as well as supporting the work of the Centre Manager.

……..

The River Restoration Centre– UK Information and Advisory Centre
The River Restoration Centre has now been operational for 4 years, becoming the successor body to the River Restoration Project (Rivers Cole and Skerne Demonstration Projects), in April 1998. The Centre provides a focal point for the exchange of information and expertise relating to river restoration and enhancement in the UK. RRC's primary role is to disseminate information on river restoration and enhancement projects and to provide advice on site-specific technical issues supported by a network of experienced river restoration practitioners. The Centre's day to day activities can be spit into 2 main areas:

1. Information - Collection and Dissemination
Organisations with responsibilities for river restoration and enhancement often don't have the resources to record what projects are happening in their region and which techniques are being used. For this reason advances in design and construction can remain localised and 'in-house'.

Collection
The RRC collates information on UK river restoration and enhancement projects and stores them in a central database which is maintained at Silsoe. We hold details of over 800 projects. The RRC 'projects' database is an inventory of past, current and planned projects in the UK ranging from brief summaries to more detailed case studies. Projects include:

- small-scale local bank enhancements,
- community-based initiatives,
- catchment-wide projects
- large scale demonstration projects.

Information is collated by site visits to projects by RRC Staff, and by the completion of standard proformas by Project Managers.

Dissemination
Project information is disseminated in a number of ways; through searches on the database to find examples of 'best practice' schemes, through the hosting of workshops, and the distribution of the RRC newsletter to over 1000 river restoration practitioners.

Workshops and Conferences
Themed workshops have been organised in response to a recognised need to focus on a particular area of river restoration and to bring together practitioners within that area. Themed workshops held to date include:

- River Restoration and Geomorphology, Coventry, April 2001
- River Restoration and Chalk Streams, Hatfield, January 2001

- Rural River Rehabilitation and Sustainable Land Management, Perth, December 1999

We have also provided 9 'training' workshops, which to date have been largely held in Scotland with mixed audiences of SEPA and SNH staff, as well as representatives from fisheries boards, councils, conservation bodies etc.

We are now of course into our 3rd Annual Network Conference. The Conference represents RRC's commitment to broadening the river restoration network and to provide a forum for river restoration practitioners to share their experiences

2. Advice - Projects and Techniques

Rivers and their environment are steadily creeping up the agenda of the public and those organisations who have a responsibility to the public. In recent years this has come to pose problems for inexperienced staff and non-specialist organisations.

Advice

Since 1998 RRC has advised a variety of organisations (councils, conservation bodies and government agencies) on rivers and their restoration, enhancement and management. Common needs include:

- Identifying degraded watercourses and their potential;
- Integrating a more natural river environment with the built environment;
- Contacts and expertise, examples and demonstrations;
- Supporting and 'mentoring' inexperienced staff.

The nature of much of the advice given is generic and simply seeks to guide the enquirer to look at the 'issues' in a more detailed manner. Often this is all that is achievable from what usually consists of a brief phone discussion or email. Where more information is available, more detailed site-specific advice has been given.

Advice on specific projects:

- Upland, high energy
- Mineral extraction and diversions
- Low cost techniques and maintenance cost savings
- Wet woodland and valley enhancement
- Flood defence storage designs
- Re-development and deculverting
- And many more

The Centre also advises on the effectiveness of already implemented works, with over 20 'independent audits' of schemes against their stated objectives. In this way successes can be 'recognised' more widely and lessons highlighted for the future.

Techniques Manual

The aim of RRC has always been to promote river restoration and best practice management. To this end in 1999 the Centre produced a Manual of River Restoration Techniques, based on the experiences from the Rivers Cole and Skerne. This Manual has proved extremely popular and effective. Over 300 were distributed and a further 500 sold in the last three years. Originally produced as a printed version this manual has this year been updated to include a further 15 UK projects demonstrating 20 additional techniques whose principle can be applied elsewhere.

The interleaved Manual (original and update) is now available on the Environment Agency's new website for Flood Defence R&D outputs (http://www.environment-agency.gov.uk/subjects/flood/211195/264395/286585/). and through the RRC website (www.theRRC.co.uk). The update will also be available as a printed version to insert into the original version, later this year.

LOWER COLNE IMPROVEMENT SCHEME – STANWELL DIVERSION FLOOD ALLEVIATION SCHEME

Andrew Pepper, Director, ATPEC River Engineering Consultancy, Surrey

Andrew Pepper, BSc CEng MICE FCIWEM, has been an independent river engineering consultant for over ten years, following a previous 20 years experience on large and small flood alleviation and drainage schemes in the UK and abroad. His work has ranged from the hydraulic design of the Jubilee River at Maidenhead, to providing expert evidence on small drainage disputes.

……

The Lower Colne Improvement Scheme (LCIS) is a £20M river improvement scheme in the Lower Colne system of rivers, all tributaries of the River Thames to the west of London. The River Colne catchment varies in shape, topography, land use and hydrological and hydraulic complexity perhaps more so than any other catchment in the Thames Region of the Environment Agency. The analysis of the system is therefore also complex, and the solutions to flooding problems, whether local or strategic, are rarely straightforward.

The LCIS study found that the capacities of Stanwell Upper Mill and Silverbeck Weir, close to Heathrow Airport, were well below the 1 in 100 year design flow of about 20m³/s, as was the capacity of the River Colne channel downstream, which had a high environmental value for both channel and corridor. The flood risks identified in the study were realised in 1993, when up to 50 houses in Stanwell Moor Village were inundated by overtopping of the raised river banks upstream of Stanwell Upper Mill. This was repeated in October 2000, when again a similar number of houses were flooded from this cause, with further houses flooded from overtopping towards the downstream end of the village. Similar levels occurred in December 2000 and February 2001, but sandbags and other emergency works just prevented further problems. The return period of the highest flow over the 2000/2001 winter was in the order of 1 in 20 years.

Any major enhancement of the capacity of the River Colne channel itself, by either widening or deepening, was ruled out on environmental grounds, because of the high ecological and landscape value of the river and its corridor in this area. A two-stage channel was also rejected on similar grounds - and because in many areas there was simply insufficient land available. The option of raised defences was ruled out on cost and aesthetic grounds, and also because without extensive cut-off walls through the gravel there could be no guarantee that they would, in fact, prevent flooding. While a diversion channel was generally acceptable from an environmental aspect, much of the land surrounding the village comprises former gravel pits that were subsequently used as landfill, prior to the current standard of control over such sites. This meant that most diversion channel routes would have been extremely expensive to construct. To minimise the length of contaminated ground to be excavated a route was eventually chosen which involved two diversion channels in series - an upstream one on the right bank, then a downstream one on the left bank with a short length of River Colne being upgraded between the two. Only a part of the upstream channel was through contaminated ground, and this length is lined with clay.

The new channel, although constrained in many places, does have varying slopes and bed levels, and will be planted appropriately. A sweetening flow will be allowed through at all times, and mammal runs have been incorporated into all road crossings. New planting of indigenous species not only replaces that lost but also reinforces the existing vegetation.

The Agency's access track along the new channels doubles as a new bridleway, and two new timber bridleway bridges have been constructed to enable the bridleway to be continuous across the River Colne. Both bridges incorporate bat nesting areas, as do the roof spaces of the two control buildings for the two offtake sluices. Alongside the new bridleway will be two new wetland areas (in addition to the lake), which will attract even more wildlife to the area once they become established.

A new lake forms part of the flood channel, and was excavated by the landowner (a gravel company) in advance of the main works. Even prior to planting around the lake, this new area has proved a great attraction for birdlife. During 2001 a pair of swans raised eight cygnets by nesting on one of the islands, which is now a favourite haunt of cormorants. Up to five herons have also been seen here, as well as a flock of about 50 lapwings, and the usual mallards, coots and moorhens. Swifts and martins frequented the lake last summer, as did a pair of terns, who also nested on one of the islands. This lake is now also proving very popular with local residents, who are keen to walk around it to see the new wildlife.

HARBERTONFORD FLOOD DEFENCE SCHEME: THE BENEFITS OF AN INTEGRATED APPROACH TO FLOOD DEFENCE DESIGN

Matt Jones, Environmental Scientist, Halcrow Group Ltd, Exeter

Speaker: Matt Jones is a freshwater environmental scientist specialising in the design and assessment of riverine flood defence schemes and restoration projects. Although working predominantly in the UK, he has also worked overseas in Australia, the Caribbean and continental Europe. Matt is currently working for Halcrow Group Ltd, where he is managing the environmental science team based at the Exeter office.

Other Authors: Warren Bradley, Project Engineer, Halcrow Group Ltd, Exeter, and Deborah Dunsford, Regional EIA Co-Coordinator, Environment Agency-South West Region, Exeter

……

The village of Harbertonford in South Devon has been flooded 21 times in the past 60 years, including six times since 1998. Due to this repeated disruption and misery caused to the local residents, the flood defence scheme was given 'accelerated status' by DEFRA - one of only nine such schemes in the UK. In January 2002, the scheme received full grant aid from DEFRA (£2.03 million; total scheme cost: £2.25 million). Construction commenced in February 2002 and is set to be completed by October 2002.

The scheme was designed through an integrated approach of environmental, engineering and cost considerations. The presentation will discuss how this was achieved (including successes and failures!) and the inherent benefits of such an approach. Key concepts are as follows:

- Establishing engineering, cost and environmental (including geomorphological) scheme objectives at project inception. These formed the foundation of the scheme design against which scheme options were assessed;
- Allowing scheme design to be an iterative approach between engineering, cost and environmental considerations at all times;
- A wide range of options - land management approaches, storage options, localised defences.
- Considering the 'environment' as an opportunity, not a constraint. Possibilities for 'environmental gain' were identified early on and developed as the project progressed;
- Beginning consultation with the public, statutory bodies and non-statutory organisations at project inception. This informed scheme design and also allowed 'ownership' of the scheme by respective 'stakeholders'. Partnership opportunities were also identified;
- Contracting specialists at appropriate stages of design. e.g. the River Restoration Centre; and
- Engaging contractors into the design team at an early stage. As well as improving the quality and buildability of scheme design, adverse environmental effects were either 'designed-out', 'programmed out' or identified for management.

It is considered that a cost-effective scheme (benefit: cost ratio 2.3:1) has been designed that integrates with the geomorphology of the river, whilst also preserving and enhancing the natural and built environment. The presentation will seek to demonstrate this and also convey the underlying fundamental theme to design, namely ‘integration, integration, integration’!

DIVERSION OF THE RIVER NITH TO ALLOW THE EXTENSION OF AN OPENCAST MINE, AYRSHIRE

Dr Pascal Lardet, Halcrow Group Ltd, Edinburgh

Pascal Lardet is a senior hydrologist with specific experience in catchment modelling, groundwater modelling and river hydraulic modelling. His main interest is in engineering hydrology including flooding and water resources studies. He is project manager of a number of flood appraisal and flood alleviation projects in Scotland.

……

In 2000, the River Nith Diversion works were carried out to allow the extension of an opencast mine in Ayrshire (about 35 miles south of Glasgow). They involved the permanent diversion of 3km of upland river and the creation of a new environmentally acceptable river channel through an old mining area with difficult ground conditions.

The River Nith is an important salmon and trout fishery supporting an abundance of wildlife such as otters and sand martins. However overgrazing, agriculture and previous opencast mining upstream have had some detrimental affects on invertebrate communities and fish spawning grounds. This project was viewed therefore as a significant opportunity to improve the spawning and nursery potential of the Nith Fishery and to create a more diverse river corridor habitat.

The first task of the design team was to establish the route of the diversion, taking into account the existing constraints (e.g., mining areas, topography) and the various design criteria, in particular:

- Flood hydrology – design a new channel and flood plain to convey a 1 in 50 year flood event
- Low flow hydrology – the river should not become dry in drought periods
- Geomorphology – mimic the existing river system, recreating similar meandering, slopes, pool-riffle-run sequences and channel profiles
- Erosion protection – avoid significant erosion where the rivers runs close to the mining area
- Ecology – provide biodiversity and enhance the existing conditions

The next stage included the hydraulic modelling of the diversion and the design of the channel profile. A clay-lined two-stage channel profile was adopted incorporating pool-riffle-run sequences modelled on those in the existing river channel morphology to generate suitable habitats for fish and other species. The liner varied up to 1 metre in thickness and was required for some 80% of the diversion length. Materials suitable for the construction of the clay liner, river bedding, riffle construction, scour protection and in-stream feature construction were identified from the adjacent opencast excavations (resulting in considerable cost savings).

A flood containment bund was required over the full length of the river diversion to protect the opencast workings from inundation in a 1 in 50 year flood event. A 600mm thick bentonite slurry cut-off wall founded at rock-head was integrated into the containment bund to prevent groundwater from entering the opencast excavations.

Other significant aspects of the project were:

- The support of an Environmental Working Group lead by the Ayrshire Council planning department and including SEPA (who appointed the RRC to review the design and construction works)

- The excellent working relationship between the Contractor (Morrison), the designer (Halcrow) and the Environmental Working Group throughout the design and construction phases. All parties worked to respect the challenging 8 month timetable of the diversion works to enable rapid access to the mining operations and to ensure that the works in the diversion channel were completed prior the start of the start of the salmon spawning season in early October.
- The geomorphological performance and ecological recovery of the diverted channel is being monitored under a PhD programme at the University of Stirling. It is hoped that this information will aid future projects of this nature.

OUT OF SIGHT, OUT OF MIND
LIABILITY OR OPPORTUNITY?
DECULVERTING THE RIVER RAVENSBOURNE

Trevor Odell, Flood Defence Improvements Engineer, Environment Agency – Thames Region, Camberley, Surrey

A Civil Engineer by training and am currently employed dealing with 'improvement' works on the Thames and its tributaries in the SE Thames Area (Surrey, South London and parts of Berkshire, Hants, Bucks and Sussex). This involves all types of work from maintenance of lock houses and weirs on the River Thames to Pre feasibility studies for future Capital Flood Alleviation Schemes and River Rehabilitation where it can be justified on Flood Defence Grounds. Currently am the Chairman of the Area River Rehabilitation Group and managed / supervise the implementation of many of the schemes.

……..

Scheme Background

The Ravensbourne is a spring-fed stream flowing from its source near Keston, on the North Slope of the North Downs northwards through Bromley, Catford and Lewisham to join the Thames at Deptford Creek. Its flow being from Four SE London Boroughs, Greenwich, Bromley, Lewisham and Croydon. The upper catchment is still relatively rural but becomes very urban for more than 50% of its length. At many locations the river is now constrained completely by concrete channel and culverts with buildings overhead.

Description of works

The site in question is at Norman Park just south of Bromley in Kent. Here the river was culverted in a large park (many hectares), probably in the 1970's. The justification was presumably to increase the area available for sports (cricket and football) and potentially to resolve what may have been seen as a liability / safety risk in the 'jargon' of the time. Prior to the works the Ravensbourne flowed for 300m through a 1m diameter concrete-lined steel culvert. Smaller land drains, which had been ditches before the area was levelled to form the park, flow into the culvert at intervals along its length. The site is virtually the last 'opportunity' before the river 'disappears' into several km's of mostly culvert under buildings in Bromley itself.

The scheme that removed much of the culvert and allowed public access to the channel was completed in the spring / summer 2000. The presentation will cover the issues of: -

- Site selection
- Justification of works
- Scheme details & design issues (do Engineers or Nature know best?)
- Lessons learned (quick fix or leave to nature?)
- Future projects (Lower Ravensbourne concrete channels)

The works were carried out by Agreement with the Borough at a construction cost of £127k and funded at 15% by them. Currently the project is in the second year of its environmental, Flood Defence, Landscape and Sediment Transport (Geomorphology) monitoring. These issues being an integral part of the funding package of the scheme and are necessary to ensure any relevant issues/lessons are learned to improve knowledge and best practice in the future.

Details on this and other schemes are available from the speaker and the River Restoration Centre.

BENDS, TRESS AND BIODIVERSITY - A STUDY OF TWO CONFLUENT STREAMS

Dr. T.E.L. Langford, Centre for Environmental Sciences, University of Southampton

Speaker: *Terry Langford was a research biologist and environmental manager with power industry before retiring and becoming a part-time Visiting Research Fellow and Tutor at Southampton University. His current research is into effects of stream form, land use and timber debris on fish and invertebrates in streams. He is also a consultant ecologist working for both water users and regulators.*

Other author: *Cora Taylor (Research Associate) completed her MSc at Southampton and is at present completing a course on identification of plants and animals. She is interested in working in conservation or environmental protection*

……

The restoration of river channels often involves the reinstatement of sinuosity in channels previously straightened for land drainage purposes. Restoration may also involve the replacement or sometimes the removal of riparian trees depending upon the objectives. Most studies of effects of riparian trees and of restoration of sinuosity in river have been carried out on newly restored streams or where logging has removed trees in relatively recent times. This study is looking at the effects of a stabilised system to try to establish the effects of tree removal and channel alteration in the longer term.

In the streams of the New Forest, some reaches of channels have been highly modified for land-drainage over the past 200 years such that sinuous reaches now alternate with straightened reaches in many streams. Also, tree clearance for animal grazing, has been carried out on some streams since the Bronze Age. The streams have, therefore had many years to develop their ecosystems, theoretically to a relatively stable state. The streams are chemically very similar but with different sinuosities and riparian tree cover.

This study reports the results of observations on the diversity and composition of the invertebrate and fish faunas two confluent streams, the Oberwater and Highland Water each with reaches of different sinuosity along their length and riparian tree cover. Both streams have been partly channelised and modified over many years. The streams show very different fish and invertebrate faunas related both to tree cover, channel form and overall disturbance in the sub-catchment. The Ober Water with little tree cover has the more diverse flora and fauna, including fish. The Highland Water with its heavily wooded catchment has the less diverse fauna and practically no flora. The fish fauna comprises six species while that of the Ober Water comprises at least 13. There are no records of the "additional" species penetrating the Highland Water though there is no obstruction.

We believe the Highland Water represents the original state of the streams and the Ober Water the disturbed state. There are indications that the effects of sinuosity are small and dominated by the effects of tree cover. It is also possible that the effects of forestation are reversible to some extent. The data are discussed with reference to river restoration schemes.

KELHAM BRIDGE – PUTTING FUNCTION BACK INTO THE FLOODPLAIN

Peter Worall, Technical Director, Penny Anderson Associates Ltd, Buxton, Derbyshire

Penny Anderson Associates Ltd is a leading practice of consultant ecologists. One of Peter's roles is to promote wetland habitat restoration, rehabilitation and creation throughout the British Isles. Together with a team of expert ecologists, geomorphologists and hydrologists, the Penny Anderson Associates wetlands group is pursuing partnership projects with clients and contractors in order to develop more cost effective and ecologically appropriate approaches to river, flood plain and wetland enhancements.

Kelham Bridge is found within the floodplain of the River Sence, (south of Coalville in Leicestershire) and is part of the upper catchment of the River Trent. Covering 10 hectares, the site has been much modified by land subsidence related to coal mining, the use of the area for the disposal of sewage sludge and past efforts at habitat creation.

Downstream of the site, former open-cast colliery workings have been landscaped and developed into a forest park by Leicester County Council and the National Forest Company, and the channel of the River Sence has been rehabilitated towards a more natural system by the Environment Agency.

At Kelham Bridge a partnership between The National Forest, Severn Trent Water (the original owners of the land), and the Leicestershire and Rutland Wildlife Trust has developed a scheme to address regional biodiversity targets; demonstrate the integration of diverse habitat types into National Forest projects, and extend the rehabilitation of the River Sence into its floodplain.

The project has developed as two phases. In Phase I (2.5ha), the former area of sewage sludge disposal has been transformed into a mosaic of reedbeds, wet grassland, a wader scrape and a series of river berms with on-line and off-line water features. A critical factor in the development of this part of the project was an understanding of the river regime and how this could be harnessed to restore a functional relationship between the river and its floodplain. Additionally, it was recognised that in order to establish semi-natural habitat features it would be necessary to remove the accumulation of nutrient enriched sediments derived from decades of sludge disposal. Not only was the top soil contributing to high nutrient levels in the runoff to the river but it was preventing anything other than a nettle dominated habitat from becoming established.

In the Phase II area (7.5ha), the land has been subjected to subsidence giving rise to ponds and a modified river channel form. In 1995 Severn Trent Water enabled the Leicestershire and Rutland Wildlife Trust to create additional open water bodies in what had become an area of significant wildlife interest. The spoil from the newly created ponds was used to create bunds along the riverside to maintain water levels within the water bodies and as a mean of limiting access and disturbance to the site. The river channel is narrow (c2m), incised and densely shaded, and has little physical or ecological connection to its floodplain. The aim of Phase II is to provide a means of gaining hydraulic control over the water bodies and enhance the contribution the river makes to biodiversity. To this end, berms and in-channel features are proposed together with the realignment of sections of channel and the creation of floodplain reedbeds.

Although biodiversity targets have been set for the site, including otter, water vole, crayfish, invertebrates and birds, the key criteria has been to re-establish the functional links between the river and its floodplain.

REHABILITATION OF THE POZUELO STREAM, MADRID

Marta González del Tánago, Senior Lecturer of Hydrology at E.T.S. Ingenieros de Montes, Universidad Politécnica de Madrid, Spain

Marta González del Tánago works on the assessment on river and stream engineering projects, dealing with environmental enhancement and rehabilitation. Her work also involves colaborating with Madrid municipality (Water and Environmental Department) in rehabilitating urban streams.

.....

Traditionally, the majority of the rivers and streams crossing urban areas of Madrid and its surroundings have been piped and buried. The aims of this have been (1) to avoid serious problems of pollution and lack of aesthetics, especially in summer when natural mediterranean conditions produce very reduced flows, and pollution and physical degradation of channels are much more evident; and (2) to occupy fluvial space for urban purposes.

A new more environmentally sensitive approach has been followed by the Water and Environment Department of Madrid city during the last few years, trying to rehabilitate some urban streams where the space is still available.

The case of the Arroyo de Pozuelo is presented as an example. A bigger sewage pipe has had to be constructed near the stream and the civil engineering project has been developed simultaneously with the rehabilitation works.

The horizontal lay out of the pipe has been constrained by the presence of old trees and the designed channel morphology of the Pozuelo stream. A sinuous channel with enlarged cross-sections and small lateral slopes (1V:3-4 H) has been created, replacing the old ditch-type channel. The fluvial space has been planted with native riparian species and equipped with wooden benches, footbridges and streetlamps along a sinuous pedestrian path by the stream. These rehabilitation works have amounted to half of the cost of the total project.

Although the physical structure of the channel has been clearly ameliorated, ecological recovery presents many constraints. Much of the runoff is diverted to the pipes and by-passes the urban reach of the stream. The scarcity of flowing water limits fauna recovery and fluvial dynamics, being one of the biggest limitating factor to achieve urban stream restoration in dry regions.

THE RIVER MEDLOCK REHABILITATION SCHEME

Caroline Jackson, Graduate Engineer, Binnie Black and Veatch, Chester

Caroline Jackson has worked for Binnie Black and Veatch for three and a half years. During this time she has worked primarily on hydraulic modelling for Section 105 Floodplain Mapping projects. She was recently Site Supervisor on the River Medlock Rehabilitation Scheme in Manchester.

……

The River Medlock rises North East of Oldham and flows south-westerly through Manchester before joining the River Irwell. The Rehabilitation Scheme described in this paper concentrated on 1.5km of reach at Clayton Vale, located within walking distance of Manchester's new Commonwealth Games Stadium.

The area surrounding the reach is owned by Manchester City Council and formally housed a printworks and a hospital and in more recent times was a landfill site. Approximately 30 years ago when tipping ceased the area was landscaped and is now a green corridor serving a local population of approximately 17,000 people.

The upstream end of the 'study reach' was canalised with masonry revetments. Further downstream the banks of the channel are more natural. At the downstream end of the study reach is a weir and close to the river a fishing pond, classified as a Site of Biological Interest.

The objectives of the Rehabilitation scheme were:

- to improve the fishing pond and fishing pegs to encourage anglers to the pond,
- to increase recreational use of the 'park' by adding footpaths and viewpoints,
- to improve the visual appearance and encourage a greater diversity of wildlife by additional planting,
- to create a dipping pond to be used for educational purposes by local schoolchildren,
- the installation of a footbridge to link the existing visitors centre to the dipping pond,
- to improve the watercourse by creating riffles, adding riprap to reduce bank erosion and converting the weir at the downstream end of the reach to a Hurn weir to encourage fish migration upstream.

The scheme cost a total of £250,000 and was jointly funded by the Mersey Basin Campaign, who obtained Landfill Tax Credit funding from The Onyx Environmental Trust, and by the Environment Agency. Manchester City Council Leisure Department agreed to carry out maintenance of the scheme on completion of the works. In addition to contacting statutory bodies, consultations took place with the local community to promote the scheme as much as possible and local schools were invited to the site during Mersey Basin week to help with the planting.

The scheme was carried out late in 2001. Although it is too soon to see the full effects of the extra planting the improvements made by the scheme, particularly around the fishing pond and the new footpaths, are obvious to see. The opening ceremony for the scheme will be held on 10th May.

FISHPASSES IN THE NETHERLANDS

Gert Jan Akkerman, Senior Consultant, Coastal and Rivers, Royal Haskoning, the Netherlands

Speaker: Gert Jan Akkerman,(MSc. Eng. Delft), has been a senior consultant at Royal Haskoning in the Netherlands for 3 years, after a career of 25 years as researcher and consultant at Delft Hydraulics. He has been involved in many river rehabilitation schemes such as fishpasses, and he contributed to the final design of the large fishpass at the weir of Driel.

Other author: Wiel Muyres (BSc. Eng.), OVB, the Netherlands
Wiel Muyres has been the major promoter of the fishpasses with V-shaped weirs in The Netherlands over more than two decades. He has been involved in nearly all large fishpass implementation schemes and specialised in the fish biological aims and performances of the passes. At present he is a senior consultant at the OVB, the Dutch institute for improvement of inland fisheries.

……

This presentation deals with the experiences of fishpasses in the Netherlands, as well as a description of the design and implementation of a large fishpass in the Netherlands, i.e. at the weir of Driel, where the fishpass bypasses the weir which is located on one of the tributaries of the Rhine.

In recent decades a lot of experience has been gained with fishpasses with V-shaped weirs and stilling basins in between. Recently these passes are commonly provided with small apertures ('vertical slots'). The presentation will give a short overview of the functions and functioning of the fishpasses, typical types of fishpasses in the Netherlands as well as the performance of the structures. Reference is also made to the future fish rehabilitation schemes.

The large fishpass at Driel is the longest in Europe (510 m long) and was completed at the end of 2001. This fishpass is the first of three large schemes in the Lower Rhine Branch within the framework of an overall-project aiming at flood mitigation and nature restoration ('the salmon back into the Rhine river'). This fishpass is practically effective during all the time that the weir is in operation. To cover a large range of conditions, the structure has been provided with two water entrances. The lower entrance acts only in the range of lower water levels at the river and is closed-off at higher water levels. The higher entrance is permanently open. The maximum discharge during operation is 10 m^3/s and is attained just before the moment that the lower entrance is closed.

The fishpass has been in operation since the end of 2001 after successful completion. A monitoring programme will be carried out during the next summer period after which some adjustment of the individual weir levels can be applied when needed.

THE PADIHAM WEIR PROJECT

Carol Holt, Environment Protection Team Leader and Gary Jones-Wright, Project Manager – NCPMS, both Environment Agency – North West Region

Carol Holt is an Environment Protection Team Leader covering the Ribble Catchment. Gary Jones-Wright is a Project Manager for the National Capital Programme Management Service, which is the national team set up to deliver major flood defence projects and other large Environment Agency schemes. Gary has worked on a number of fish pass projects and is a keen angler.

……

The Environment Agency is project managing the construction of the Padiham Weir Canoe Facility near Burnley. The British Canoe Union (BCU) has designated the facility as a Sport England Category 2 facility, the only one in the North West of England – and sees the facility as critical to the long-term development of canoeing in the North West. A Sport England Category 2 facility is in general terms, something that can be used by anybody at anytime, and is of regional and national importance.

Padiham Weir will be used by the BCU Performance Programme and will be complementary to the existing Category 2 facility at Teesside and the Category 1 Facility at Holme Pierrepoint. The Padiham Weir facility therefore has a crucial role to play in the development of canoeing in England.

The canoe facility will produce a number of direct and indirect benefits to a deprived area of East Lancashire. The benefits likely to accrue from the facility are outlined here and covered in more detail in the remainder of this document, the Sport England application form and the supporting information provided:

Direct Sporting Impacts

- A modern Category 2 white water canoeing facility for the North West region.
- A facility that will be used by existing canoeists to improve their skills, and by newcomers to the sport. The facility would be open to everyone, all-year round.
- A safe environment for coaching of novices and beginners, especially school children.
- Greatly enhanced access to rivers for canoeists in an area where a general lack of access is apparent.
- Provision of a new, prestigious sporting facility serving a deprived catchment area in East Lancashire.

Indirect Impacts

- Revitalisation of a stretch of river that will encourage informal recreational use and access to the countryside.
- Removal of a barrier to fish movement in the river and re-colonisation of around 100 hectares of upstream habitat by Atlantic salmon and sea trout.
- Enhanced scope for anglers to have access to the river.

Context

Padiham Weir was constructed on the River Calder in the 1950s to control the abstraction of cooling water to the adjacent, and now demolished, Padiham Power Station. Since the closure

and subsequent demolition of the power station in the early 1990s, the weir has been defunct and serves no useful or operational purpose in its current state.

The former Padiham Power Station site has recently been decontaminated and brought back into economic use. A green business park – Shuttleworth Mead – has been constructed on the site and acts as a focus for stimulating economic development in the area.

Through incorporating the abandoned weir into the proposal for the canoe facility, the transformation of the site will be complete and leisure, recreation and community benefits will be brought to the area to complement the economic benefits derived from the new Business Park. The weir stands as a man-made barrier to public enjoyment of the river; as well as being a barrier to the migration of fish in the River Calder.

Incorporation of the weir into the proposed canoe facility would, therefore, bring a series of direct benefits in terms of sports development. Simultaneously, it would also deliver indirect benefits in terms of improving the movement of fish along the river, improving opportunities for anglers and acting as a catalyst for further water quality and environmental improvements in the area.

As a sport, canoeing embraces a variety of disciplines and, at the simplest recreational level requires only 10cm of water to float a canoe. The BCU has about 22,000 members participating in recreational canoeing, sprint racing, slalom and many other types of canoeing and kayaking activities. In a Sport England Planning Bulletin (*Planning for Water Sports*, February 2001), it was noted that:

> "Perhaps the discipline with the highest current profile is the white water canoe slalom as seen at Holme Pierrepoint in England and the Sydney Olympics venue at Penrith. Britain's Paul Ratcliffe won a silver medal in the men's K1 slalom class in Sydney while Tim Brabants won a bronze medal in the men's K1 1,000m sprint racing event on the adjacent regatta course."

It is clear therefore, that canoeing is a hugely popular recreational activity in the UK as well as a serious sport in which Great Britain excels. The Padiham facility will bring new sporting and recreational opportunities to a deprived part of East Lancashire, whilst simultaneously providing the North West with a Class 2 white water facility.

THE NEW ENGINEERING APPROACH TO ITALIAN RIVER RESTORATION

Paolo Negri, Cirf - Centro Italiano per la Riqualificazione Fluviale

***Paolo Negri**: degree in Environmental Sciences at the University of Venice in 1997 with a one year in field thesis regarding riparian areas as buffer strips. In 1998 he joined as scientist the river section of HR Wallingford, an environmental engineering company based in Oxfordshire. After almost three years Paolo moved back to Italy and since 2000 is consultant at the Water Resources Office, Regional Environmental Agency of Veneto. Italy. He collaborates also with the "Centro Italiano per la riqualificazione fluviale" (the Italian River Restoration Centre) and with WWF on river protection and restoration issues Email: paolo.neg@libero.it*

www.cirf.org **info@cirf.org**

.....

Cirf is the acronym for "Centro Italiano per la Riqualificazione fluviale which means "Italian Centre for River Restoration". This name no doubt indicates what an important example the RRC has been to us. Cirf was established in July 1999 by a small group of professionals with different backgrounds in order to create a focus point in Italy to promote river restoration and all knowledge related to it.

Cirf is a non-profit, non-political democratic and equal opportunity association of professionals with its own statute, regular meetings, a board of directors and president.
The Objectives of Cirf are:

- the promotion of river restoration in Italy
- to give information, training and documentation about projects in Italy and abroad
- close collaboration with other Italian and international groups dedicated to river restoration
- to create an applied research network of professionals
- to carry out actions to improve the knowledge and awareness of those persons who are responsible for river management
- a meeting place for ideas and discussion
- support and co-ordination of demonstration projects

In two and half years Cirf has been growing visibly in terms of numbers of members (240 in April 2002) and activities which range from training courses to technical publications (i.e. the translation in Italian of the RRC Manual of River Restoration Techniques), from the newsletter for members to the participation in a EU Life river related project.

The need for an improvement in aquatic environmental quality in Italy is closely related to the potential for restoring rivers. The main river and water quality problems in Italy are mainly caused by two factors: human impact throughout the centuries (canalisation and straightened rivers, occupation of the floodplain for urbanisation and agriculture, abuse of water abstraction for various uses, pollution) and the mosaic of Authorities in charge of fluvial management.

Starting with central government down to local city councils, it is extremely difficult to reconcile the various visions of rivers. In most cases they are still seen as a problem either because of flood risk or an obstacle for the agricultural or urban development which should be possibly reduced or even better covered or diverted. In the past, engineers were the only specialists involved in river related-problems and therefore the solutions were just engineering. The river was considered purely as fluid driven by hydraulic formulas. This approach is in some cases integrated with the use of "soft" or "green" works such as the use of vegetation or local rock that is seen as a

cosmetic enhancement, without adding anything to the ecological functionality of the rivers. It is important to distinguish between real bio-engineering (which is the use of inert and "live" material together as combined work elements) and pure cosmetics.
In Italy the need to improve the quality of aquatic environments has caused a growing interest in bio-engineering applied to rivers. This is a common technique used in river restoration projects but remains a technique and not what is often seen as the final goal, which is water course re-naturalisation.

Along with engineering and bio-engineering there are other disciplines which must be involved and to help provide a full understanding of the river processes that are desired to be recreated in new schemes. This involvement of different specialists should be totally integrated not just as part of a multi-disciplinary team but as part of an inter-disciplinary team. Our engineers will always find a place in this team, their contribution is fundamental but they will need to able to understand different "languages" and work in synergy with others for the successful restoration of our beloved Italian rivers.