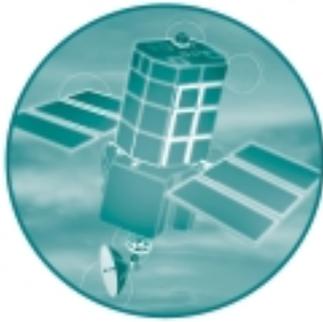


Defra/Environment Agency Flood and Coastal Defence R&D Programme



Scoping Study for an Environmental River Engineering Design Manual (EREDM)

R&D Technical Report

WA5-060



ENVIRONMENT
AGENCY

**Defra / Environment Agency
Flood and Coastal Defence R&D Programme**

**Scoping Study for an
Environmental River Engineering Design Manual
(EREDM)**

November 2004

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Statement of use

This document provides information for Defra and Environment Agency Staff about consistent standards for flood defence and constitutes an R&D output from the Joint Defra / Environment Agency Flood and Coastal Defence R&D Programme.

EXECUTIVE SUMMARY

This scoping study reports on the work required to develop a digital Environmental River Engineering Design Manual (EREDM). The Manual should provide guidance and supporting information on the most widely used river enhancement techniques employed by the Environment Agency and others.

The scoping study briefly explores what information currently exists, in what format and for what purpose. From this a core of 26 easily accessible publications (Appendix A) were chosen to help demonstrate the range of techniques available and their applicability to the UK situation

Selection of the methods and techniques to be included is addressed. It is recommended that these consist of those:

- Most commonly undertaken techniques;
- Techniques applicable to a wide range of UK rivers.

For each technique the study proposes that there is an assessment of:

- Robust scientific evidence. Reject those found lacking as being unfounded;
- Expert opinion support. Where scientific evidence is lacking this may prove an adequate surrogate.

From this study over 150 different design specifications were found for river enhancement techniques. Appendix B lists these techniques. The designs ranged from detailed practical diagrams to theoretical descriptions. The design layout for the EREDM must be detailed, easily understood and pictorial. Two principal options are proposed; firstly, a compendium of the most comprehensive and complete designs or secondly, a new 'synthesis' of the most desirable elements of many designs.

Options for the format of the Manual include electronic via Intranet, Internet and CD-ROM or a combination of these. Estimated costs are provided, together with the relative merits of each.

To demonstrate the EREDM to others (including potential funding partners) a proof of concept has been developed (attached CD-ROM). This proof takes the user through a series of web pages featuring selected techniques.

The scoping study also looked at the potential interest in this tool from the other UK Environmental Agencies. Many of these indicate they could potentially provide funding towards the design phase, should the output be available to their staff. There is also a common request to be consulted at a very early stage to enable the EREDM to meet their requirements.

An outline specification has been provided to allow the Project Manager to progress quickly to the design phase (Appendix J). Potential collaborators are also suggested.

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CD-ROM

**Design Manual for Environmental River Engineering November 2004 version 1
– Produced for the Environment Agency by the River Restoration Centre and
HR Wallingford**

1. INTRODUCTION

This study is aimed at scoping the practicalities of creating a manual that provides access to best practice designs for environmental river engineering. The purpose of such a manual is to feature those techniques appropriate to UK Rivers and provide an easily accessible inventory, which helps the user to determine the best options for a specific environmental engineering objective. It should also encourage engineers to think about alternative options for river improvements.

The study will suggest a layout that it is appropriate for the needs of Agency staff from a range of disciplines (e.g. landscape architects, ecologists, hydrologists and consents officers).

2. KEY OBJECTIVES AND ASSUMPTIONS

The intention of this report is to scope out the practicalities of a manual and to outline some key ways to develop the appropriate content. In the first instance the target audience is expected to be Agency staff, including those who are involved in consenting proposals, to modify river morphology. The report will also discuss if such a product might be beneficial to the Agency's term consultants, other consultants, other government agencies, and NGOs all of whom are equally involved with implementing river rehabilitation schemes and environmental engineering.

2.1 Objectives

- Suggest a *project structure* which outlines a conceptual model of how to identify what techniques should be part of the manual;
- Develop a prototype (*proof of concept*) of the manual that can be used to demonstrate the concept to others;
- Identify any *potential R&D* projects (gaps in knowledge);
- Assess what *added value* it will offer;
- *Ensure* that any output from the final project is *relevant to the Fluvial Design Guide update*;
- Outline the *costs implications* associated with creating such a tool;
- Provide a *specification* for the design manual;
- Provide a list of *potential partners* that have shown an interest in forwarding this project.

These objectives form the basic structure of this report.

2.2 Assumptions

A basic appreciation of the benefits of conservation and biodiversity of rivers will be assumed for the purpose of this manual, although the need to adhere to 'best practice' development and design both in terms of sustainability and habitat enhancements will be reiterated as an important requirement.

This design manual is intended to guide users through commonly implemented ‘best practice’ environmental river engineering techniques. It is not intended to be a decision making tool. With the complexity and uncertainty associated with natural (river) systems, it is deemed impractical (and potentially dangerous) to attempt such a prescriptive guide. Through the manual the user could: a) find the best available information on the techniques they are specifically looking to implement (e.g. a design engineer); or b) arrive at a number of potentially suitable techniques which they can further research and seek expert advice on (e.g. a biodiversity officer).

Environmental river engineering techniques have become part of modern river management. They are sometimes historical (Roman brushwood faggots), sometimes adapted (US fishery vortex weirs) and sometimes ‘good ideas’ based on many years of experience. They differ from traditional engineering techniques because most (if not all) do not have standard specifications for design life, tolerances, etc. This causes concerns for design engineers who must judge their appropriateness on available design information, risk and empirical evidence. If risk is low and evidence is limited, many techniques are implemented on advice by experts or ‘on faith’. There is little to confirm that they will do the job and achieve the level of success desired.

This manual will seek to identify evidence or state when it is lacking, provide expert opinion, and reiterate the need for more concerted project (and technique) appraisal.

3. PROJECT STRUCTURE DIAGRAM

The diagram shown in Figure 3.1 has been developed to suggest how the contractor might approach determining which examples, from a wealth of literature and information, should be heralded as best practice examples. Its structure covers both this scoping project and the proposed full study.

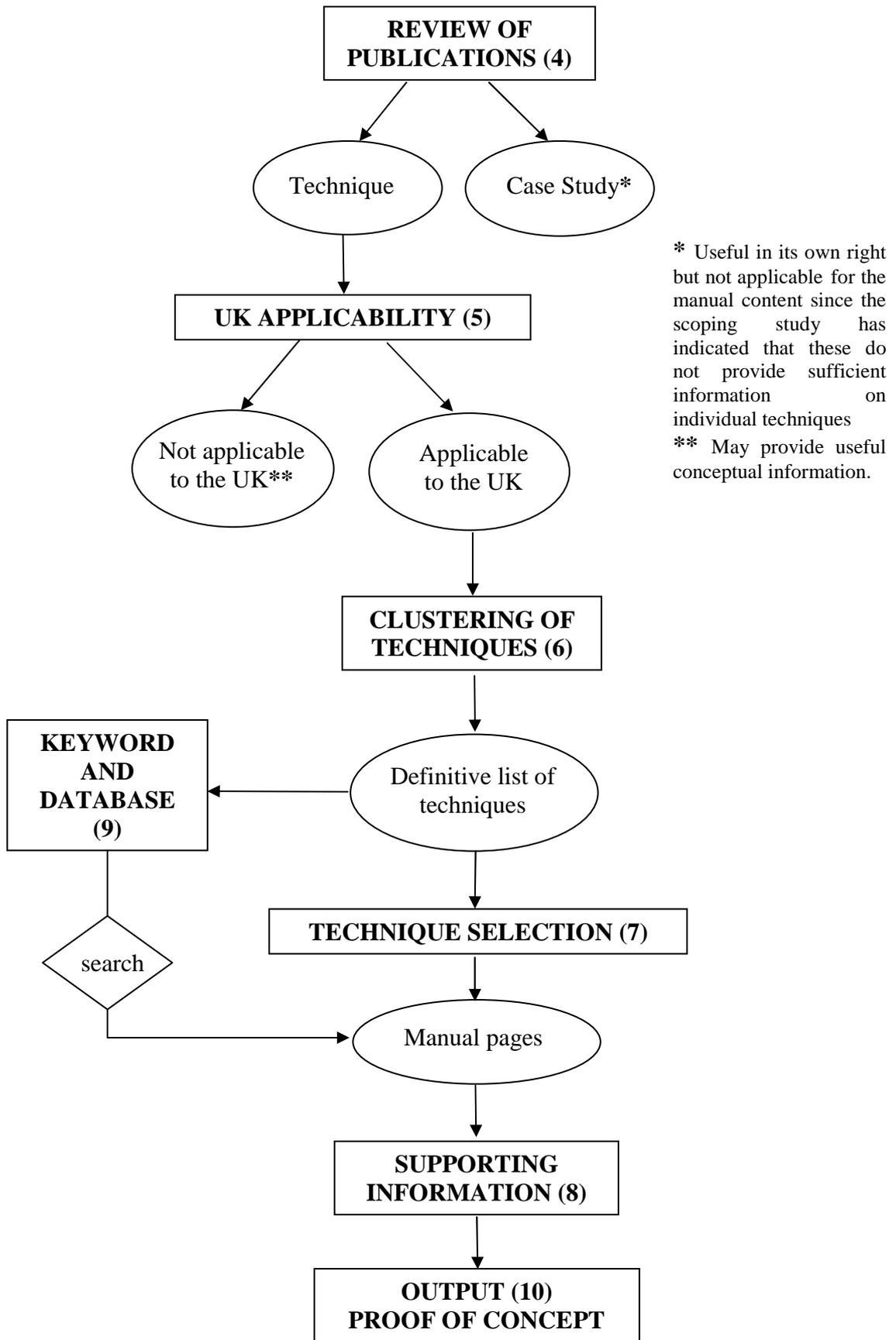


Figure 3.1 Project structure diagram

4. REVIEW OF PUBLICATIONS

There are a large number of design techniques available to choose from, contained in various literature, in addition to some just at the conceptual stage. The literature reviewed in this study of 26 publications, demonstrates a great degree of variation in the quality of explanation of techniques. In some cases, for example, everything from the design drawing to the written explanation is well communicated and can provide a ‘best example’ in its entirety. In other cases information is sketchy and incomplete.

A list of available publications is displayed in tabular form with the following headings:

Publication Information

- Publication title
- Author
- ISBN
- Date
- Country of origin
- Main focus
- Format
- Style of publications

Preparation of the manual will require a critical review of all available material. As part of this scoping study this has been based on a series of criteria, which the RRC consider to be most important in defining the usefulness of environmental engineering design information.

Criteria

- Cost implications
- Ease of accessibility
- Ease of use
- Number of design techniques
- Number of case studies
- Types of techniques
- Indication of design technique success
- Applicability to UK rivers

It is important to reiterate that the table of publications (Appendix A) is not comprehensive, but indicative for the purpose of this scoping study; the final study will require a more extensive search and more detailed evaluation.

The 26 publications of the most widely used and/or available in the UK were selected for this scoping study sourced from the RRC library, discussions within Agency staff and using information provided by an ‘international survey of river restoration’ undertaken by Joe Wheaton, Southampton University as to which channel or habitat classification schemes people use to help guide restoration design (http://www.geog.soton.ac.uk/users/WheatonJ/RestorationSurvey_Cover.asp). Few multi-disciplinary design manuals exist, with the majority being fisheries, ecology or habitat driven. Since the remit of the proposed design manual is to provide examples suitable for environmental engineering purposes, design manuals that include

engineering techniques have also been included as well as river restoration and habitat enhancement publications. Bank protection publications have also been included, as some of the techniques they propose come under the umbrella of environmental engineering. It is essential that where bank protection is necessary, sustainable solutions are available.

The key publications (those that supplied the majority of techniques found within this scoping study) are listed below with their assigned abbreviations (used in bold within this report). Full details of these key texts and others can be found in Appendix A).

RRC (MOT) - Manual of River Restoration Techniques (Vivash, 1999; Vivash, 2002)
NR&WH - New Rivers & Wildlife Handbook (Ward et al. 1994)
ARM2 - Australian Rehabilitation Manual - Volume 2 (Rutherford et al. 2000)
WTT guide - WTT guide to improving trout streams (Holloway et al. 2001)
SCUS - Stream Corridor Restoration USA (USDA, 1998)
WBPB - Waterway bank protection guide (Environment Agency, 1999)
SEPAF - Managing river habitats for fisheries (Soulsby, 2002)
GRMF - Guidelines for rehabilitation and management of floodplain (Wolters et al. 2001)
FWMH - Farming and Watercourse management Handbook (WWF-Scotland, 2000)
RRTH - Restoration of Riverine Trout Habitats (Environment Agency, 1996)
CD - Channel Diversions (HRW) (Fisher & Ramsbottom, 2001)
HAHP - Handbook for assessment of hydraulic performance of environmental channels (Fisher, 2001)
RRSH - Restoration of Riverine Salmon Habitats (Environment Agency, 1997)

Table 4.1 Key publications and abbreviations used in text

4.1. Ease of accessibility and cost implications

The cost of hard copy publications ranged from £12 to £100, with the majority of publications in hard copy, rather than freely available on the web. This may have significant cost implications depending on the format of the information that is to go into the design manual. If the publication is readily accessible in digital format, then it will be straight-forward to include that information in the digital design manual. If the publication is in hard copy only, it may be costly to reproduce it in digital format. To reproduce pages from other manuals and texts we would require permission from the copyright holders. The task of contacting them all is quite onerous and one cannot predict how particular copyright holders will react. A selection of copyright holders has been contacted to assess the likely responses. The alternative would be to synthesis and re-draft the information which would avoid copyright issues but would also have cost implications in terms of the manual completion.

The issues that were raised were:

- a) Who will have access to the information? If the information is internal to the Agency then there will be fewer problems than if it is more freely available.
- b) Will anyone be profiting from this information? It will need to be made clear that no one will be charging for this information and so no one will be making money directly.

- c) What are the precise details of the information to be reproduced? Some of the publications themselves reproduce copyright material from other publications. In this case permission can only be given to reproduce material whose copyright is held by the organisation that the contractors are in touch with. This means that for the contractor to be given copyright permission it will be necessary to specify exactly which pages are going to be reproduced. It will not be possible for a blanket permission to reproduce, say, up to ten pages.

HR Wallingford's experience of obtaining copyright permission in the past is that it is a slow and time-consuming process, though with persistence one is normally successful in the end.

The implications for preparing the complete EREDM are:

- a) Before seeking copyright permission it will be necessary need to identify precisely the copyright material that is to be included.
- b) When seeking copyright permission it will be necessary to specify who will have access to the material and under what conditions. If at some later date, access is widened then permission may need to be requested again unless this has been anticipated in the original request.
- c) Adequate time and cost to obtain the necessary copyright permissions will have to be included in the proposal to produce the complete EREDM.

4.2. Ease of use

The ease of publication use is dependent on presentation; clear, concise, pictorial and well-structured publications are deemed most usable. The quality of these varied significantly depending on the style of publication. In most cases books and reports appear to be generally less usable for the purpose of a design manual, often with heavy text and few pictures or diagrams (e.g. Channel Restoration Design for Meandering Rivers (UACE) in comparison with manuals, guides and handbooks (e.g. **SEPAF**). Publications such as the **RRC (MOT)** and the **NR&WH** clearly categorise techniques into various chapters and concentrate on the practicalities, rather than having techniques discussed sporadically through the entire text (e.g. Restoration of Aquatic Ecosystems (NRC)).

4.3. Techniques and case studies

Through reviewing the publications used in this study, design information has been divided into techniques (161 designs found) and case studies (more than 139 clearly identified and shown in Appendix B). Case study material is useful and should be catalogued for future reference, but is ultimately not sufficient in its own right to inform the design process. Techniques, on the other hand, encompass relevant material that should allow an experienced engineer to produce a technical design (though likely needing expert input).

The type of techniques varied significantly between all publications depending on the focus. For example, the **WTT guide** concentrates on techniques solely for the benefit

of fisheries. Furthermore, the level of design detail on particular techniques differed between publications, from simply outlining the use of a technique (e.g. Restoration of Aquatic Ecosystems (NRC)) to detailed design specifications and drawings (e.g. **RRC (MOT)**). The number of case studies within the publications (textbook and manuals) also varied, from those based on numerous case studies (e.g. **RRC (MOT)**) to those with short examples within the text (e.g. **SCUS**).

5. APPLICABILITY TO THE UK

The above review has identified that there are a range of techniques that have been applied in other countries. These may not necessarily be appropriate for the UK because for example, the type of river (gradient, bed type) or materials suggested are not directly relevant to the UK. This scoping study has identified that whilst there is literature available about a range of techniques the importance of ascertaining their suitability for different situations, specifically in the UK, is often not stated. Therefore it is essential that the main study includes experts in the field of environmental engineering who are capable of evaluating techniques and stating under what conditions they would be applicable.

6. CLUSTERING OF TECHNIQUES

Once identified, techniques should be clustered into different approaches. This helps the user narrow down his search. For the purposes of this scoping study the categories devised by the **RRC (MOT)** have been adapted to form these clusters. Through discussion with Agency staff and using information kindly provided by Joe Wheaton, Southampton University, this manual appears to be the most widely used reference in the UK. It is proposed that this list, as outlined below (comprised from Appendix B), is a good starting point for this clustering process. It should however be recognised that this is by no means comprehensive. For example bank protection measures may be deemed to need a category of its own. Furthermore, there may be some techniques that apply to more than one category. The manual will need to ensure that these are adequately cross-referenced.

6.1 List of initial technique clusters

- Restoring Meanders to straightened rivers
- Enhancing redundant river channels
- Enhancing straightened rivers
- Enhancing over-widened rivers
- Enhancing dredged rivers
- Restoring free passage
- Provision of bankside and in-channel habitat
- Enhancing the river bed
- Re-vetting and supporting river banks
- Controlling river bed levels, water levels and flows
- Managing overland floodwaters

- Creating floodplain wetland features
- Providing public, private and livestock access
- Enhancing outfalls to rivers
- Utilising spoil excavated from rivers
- River Diversions

6.2 Access routes

A manual of this type needs to consider whether to have one or more access routes. This will need to be informed by the user's end requirement but since initial discussions with Agency staff have indicated that personnel from a range of disciplines and expertise are likely to use such a tool, more than one access route is predicted to be the appropriate way forward. Critically any solutions need to be robust enough that the end user can use the look up tables and search engines easily and effectively.

One route to accessing the techniques could be by browsing the contents of the manual, given by the technique cluster headings listed in section 6.1. Having selected one of the categories in this listing, the user is taken to a page listing the techniques in this category. For users who are less familiar with technique types, it is useful to provide a route to the techniques that is based on searching for an area of interest. The search should be restricted in order to focus the user's thought process; a first level search is provided to find techniques that provide a specific function. A second level search could be provided to narrow the techniques in that function heading, based on the range of applicability of the technique. See section 9 for further detail.

7. TECHNIQUE SELECTION

The main study will need to make a decision about the precise role of the manual and the rationale behind the techniques chosen. The environmental river engineering techniques chosen to be included will be based on expertly assessing the main criteria set out in the bullet points below. This should enable a balanced decision to be made about which techniques provide a combination of detailed information and supporting evidence of success.

- Most commonly undertaken techniques;
- Techniques applicable to a wide range of UK rivers;
- Robust scientific evidence. Reject those found lacking as being unfounded;
- Expert opinion support. If scientific evidence is lacking this may prove adequate.

The project itself must be designed to collect all available information, to aid this decision. Funding and/or national Agency priorities may also influence the size and scope of the final manual. It is suggested that an interim meeting should be held to discuss the relative merits of the different approaches, in terms of initial findings, funding and priorities. Once decided, a selection process (outlined below) will need to be put in place to assess the information available for each of the proposed entries.

Initially, it is suggested, that a pragmatic approach should be taken about the number of entries to be included. Based on knowledge of existing technique usage in the UK it is predicted that this will result in between 10 and 20 entries. In order to support all Agency staff, the product needs to address commonly used techniques. This should be the first priority. Supporting this, information on applicability, scientific evidence, expert opinion and information available can then be included, such that the user is as fully informed as possible.

7.1 Section criteria

Any technique design robust enough to be used in its entirety will need to consist of:

- A design concept;
- Technical drawing(s);
- The materials required for construction;
- Method of construction.

A photograph of the technique is deemed essential to inform the design, and where not initially available one will need to be sourced. Table 7.1 provides a simple tick box for determining the usefulness of each technique.

	Clarity of design			
	Good	Average	Poor	None
Design elements	✓			
Design outline		✓		
Drawing	✓			
Materials information	✓			
Method of construction	✓			
Photographs				✓

Table 7.1 A simple tick box table to aid selection of best designs

A design that has all of these available will score highest. Similarly, a design that is easy to interpret will rate above one that is difficult to follow.

7.2 Design page construction

Two approaches to displaying the best technique designs have been suggested. One relies on selecting the single best design option whilst the other takes a more proactive, but costly, approach and produces a synthesis of the best elements of a number of designs.

7.2.1 Option 1 - The ‘off the shelf’ option

This simply relies on using the above table to identify the clearest and most complete design. This is relatively straightforward as it does not involve any modification of

existing information. The disadvantage of this option is that a clear and complete design may not exist.

7.2.2 Option 2 - The 'synthesis' option

Similarly to the off the shelf option, a good design would be used in its entirety. However, in cases where no one design can provide all the essential elements required, a new design will be compiled. Table 7.1 can be used to select the best elements available from each existing design. It will then be the responsibility of the contractor to pull together the various sections to create the final technique design page. If there are a few manuals that contain only a little information on the technique, it may be useful to include the full entry for that technique from each manual so that the user has full access to the information.

7.3 Final pages

The final design pages for each technique must still include some basic form of guidance that states implicitly the need for expert advice, even after using this manual. The guidance is aimed at providing information on those techniques that could be used in a variety of situations. It will also provide information on when not to use a technique. It will not make the reader an expert in environmental river engineering design.

8. SUPPORTING INFORMATION

Environmental river engineering is still developing, both in its acceptance as a plausible alternative to traditional engineering techniques and in the number and quality of these alternatives. Information that supports the decision to use new techniques is often difficult to locate and invariably not sufficiently covered within a guide or manual. To enable river engineers to undertake best practice river management, this design manual needs to provide relevant justification and credibility for its designs in terms of scientific evidence and/or expert opinion. Also, to combat the designs being poorly interpreted and used in inappropriate situations/locations, advice on applicability should accompany each entry.

8.1 Scientific Evidence

Evidence of the success of techniques, for the purpose of this study, has been divided into qualitative and quantitative approaches. In broad terms this means those projects that have been audited by experts to provide an overview of the success of project and those which have had standard scientific methods applied to provide detailed measurements of success for specific criteria (e.g. geomorphological assessments, macro-invertebrate monitoring etc).

The 26 publications gave little indication of the success of the suggested techniques, rather most simply commented on lessons and benefits, drawbacks and effectiveness or

advantages and disadvantages. Project case studies which address post-project appraisal with respect to design techniques are also limited, with only 135 out of a total of 975 projects, on the RRC database having been audited.

Scientific literature on appraising design techniques is also limited. Studies on the appraisal of techniques used for fisheries improvements (e.g. riffles, pools and gravels) are most prevalent (e.g. Pretty *et al.* 2003; Hendry *et al.* 2003; Pasternack *et al.* 2004). On the evidence so far, the success of most techniques is difficult to quantify.

Ultimately, for the purpose of this design manual, practitioner's expert opinion/professional judgement will be required to bolster this lack of scientific evidence.

8.2 Expert Opinion

Where little or no quantitative evidence is available expert opinion will be sought. In these cases the aim is to provide a summary of the views of experts from a range of disciplines which can then inform the use of a best practice technique.

The Delphi technique for converging expert opinion is one such methodology for gaining input from recognised sources of expertise and reducing the need for multiple face to face meetings. Nevertheless, the experience of the RRC is that whilst there is value in reducing the need for numerous workshops, a combination of discussion fora is the most effective. To coordinate the expert input it is therefore suggested that at least one or two workshops should be held to evaluate opinion on each manual entry although it is recognised that the consultant will need to summarise this.

It is recommended that once the techniques have been chosen by the consultant, the draft design, applicability of the information and scientific evidence is sent to the chosen experts. These should be accompanied by a series of questions aimed at drawing out initial concerns relating to reliability, sustainability, etc. Responses can then be collated, summarised and circulated. This information should then be used as the basis for the workshop discussion. An approach like this should ensure that all final generic statements about the technique can be agreed with the minimum of meetings.

8.3 Applicability

In the initial trawl for suitable techniques, applicability will be assessed broadly in terms of transferability to UK rivers (see Section 5). Subsequently, each entry in the manual should have specific information on the applicability of that technique. For each, it is suggested that the following points are identified:

- Geographical context (upland/lowland, rural/urban);
- River bed type (clay, chalk, gravel, silt, clay);
- Bed gradient and energy profile (high or low energy);
- Naturalness (does it work with natural processes).

Whilst typologies for Scottish rivers have been explored by Chris Soulsby (Aberdeen University) and for US rivers (Rosgen 1996) there is at present no published equivalent for UK rivers (Newson, *pers comm*). It is suggested that this project should not seek to develop an appropriate typology (a significant piece of work in itself) and trying to assign techniques to river types. Instead it would be more effective to look at the techniques themselves and derive their applicability, based on the above broad criteria, with expert opinion.

9. KEYWORD SEARCH

It is proposed that a key word search facility will be the best way to guide an end user to a suite of techniques applicable to a particular project. Search facilities are often fraught with difficulties especially when the user has no prompts. Therefore, it is recommended that in this case keyword searches are confined to words/statements in dropdown lists thus focusing the users search. The proof of concept provides an example of this system, but it is essential that the main study includes sufficient funding to test and modify prototypes to achieve the appropriate level of searches.

The first level search provided in the proof of concept is a search by technique function, or restoration objective. The key words that are provided are:

Fisheries
Flood Protection
Biodiversity
Landscape
Access
Erosion control

On selection of one of these words, the user will be taken to a page displaying links to all the techniques that are relevant to the function that they have selected. It is worth considering whether it would be desirable to refine lists by searching for techniques in the list that are relevant to a second function (and third function and so on) as well.

The proof of concept also shows how a second level search could be presented, although it does not provide this functionality. Having been presented with a list of techniques that provide a function selected by the first level search, the user could refine this list to show techniques that are applicable to the particular type of river that they are working with. The categories of river type could be provided as a check list. The user can then supply information about all or just some of the specified river characteristics. The key words provided for this second level search are:

Upland	Urban	Gravel bed	High gradient
Lowland	Rural	Sand bed	Low gradient
		Silt bed	
		Chalk bed	
		Clay bed	

After the user has selected the characteristics of the river that they are working with, they will be presented with all the techniques that can be used for the function they have

specified and that are applicable to the river types they have selected. These search facilities support a decision making process for technique selection for a specific project with known objectives on a particular river.

10. DESIGN MANUAL MEDIA FORMAT

There are a number of options for the digital development of the EREDM. These have been investigated through consultation with Hugh Derwent and Jannie Perrins from the Agency's intranet team in Bristol.

The choice of option depends on the target audience of the manual and the functionality that it is necessary for the digital version to provide. The following sections describe three options and explain the benefits and constraints to these factors. All options are web-enabled services as the presentation of the manual is in web page format in order to allow ease of navigation to different section of the manual, however there are three levels of providing this service;

Option 1:

Intranet: for the Agency computer network, so only accessible to staff.

Option 2:

Internet: published on the World Wide Web, accessible for anyone with access to the internet, but could be password protected to restrict access.

Option 3:

CD-ROM: web pages saved to files on a CD-ROM so that any computer with a web browser can access the manual if the CD-ROM is used.

10.1 Intranet

The Agency intranet is developed by a number of publishers across the different regions, and every page must be approved by the intranet team at Bristol before going on to the site. The system of approval ensures that the design of the intranet pages follows guidelines for design, layout and functionality. The layout that the intranet adheres to is simple and consistent with no flashing animation or pop ups. Pages must use standard text font, size and colour; background and tool bar colour, logos, links and search facilities, for example. The guidelines are set in place so that all pages on the intranet are consistent and easy to use and are familiar with staff already using the intranet.

The Content Management System uses Easinet software to publish pages. Agency staff only are trained in publishing with Easinet; it is not for use by external consultants. Publishers in the Agency are sent reminders every 6 months to review the content of their intranet pages to ensure they are kept up to date.

For a target audience of Agency staff only, the intranet is the best option for the design manual because their access to the intranet is considerably faster than their access to the internet. This is a significant issue, especially when the user is carrying out searches or linking to different pages, since this takes so long with internet sites.

Using the intranet for the design manual will also have the advantage that it will be easier to maintain. It would require somebody in the Agency to be responsible for the maintenance of the pages, but the task of doing so would be simpler than maintaining an external site.

In addition to these benefits, Agency staff are already familiar with the intranet and will readily use and access the information on it. The quickness and ease of use of any facility or information source is important to ensure maximum uptake of the tool.

In order to develop the manual on the intranet, it would require the consultant to define a clear and precise specification for the digital version of the manual. The text, pictures and diagrams would have to be provided and the specification would also have to define the format and layout of each page, including the links that would be required.

It would be possible to link from a page in the manual to an intranet forum that has already been set up, which would allow the users to give feedback on the usability of the site and the usefulness of the content of the site.

The design manual pages on the intranet would have the facility to link to external internet sites, although the use of the internet is slow so it may be desirable to minimise the use of internet sites. It would also be possible to link to, and download, documents from the intranet, such as pdf files. There is a 1MB limit on the files that can be linked to, and access to larger documents within this limit is likely to be slow.

The one significant drawback of using the intranet for the manual is that external consultants would not have access to it. To make the manual accessible to a wider audience, externally to the Agency, the intranet pages would then have to be made available on the internet in standard web page format. This would involve copying pages from Easinet to Dreamweaver, or some other standard publishing software. With the original design specification for the intranet pages to assist the process as well, it should not be too difficult a job but it is not as efficient as publishing it on standard web pages from the start of the project.

10.2 Internet

Internet pages can be published by anyone, so this option allows the flexibility of an external consultant developing the manual on line. A variety of software packages exist for publishing web pages, such as Dreamweaver and Microsoft Front Page.

The main advantage of developing the manual for the internet is that it would be accessible to external consultants as well as people within the Agency. To limit access to a selected group rather than having the tool freely available to all internet users, it would be possible to password protect the site.

An external site would have to be hosted and maintained by somebody. Options that would be worth investigating would be having a link from the Agency's web site, with password access to the manual. Alternatively it could be hosted by the consultant that develops the internet version of the manual. If the site was hosted by an external

consultant this would tie the Agency to a financial commitment for the site maintenance, which may be undesirable.

The constraints of having the manual on external web pages are mainly technological. As previously discussed, internet access is slow for most Agency staff. It would probably be desirable to link to the external site from the Agency's intranet home page, but this may be considered an application and the Agency are currently aiming to reduce the number of applications on their intranet. If it is not possible to link to the manual from the intranet, and if using the intranet was excessively slow, this may reduce the potential uptake of the use of the manual.

If the online manual was developed for the web and afterwards it was necessary to convert the pages to be published on the intranet, it would be necessary to use Easinet. The process of conversion would not be simple, especially if the specification had not been clearly defined.

10.3 CD-ROM

The production of a CD-ROM version of the design manual allows the manual to be disseminated to a specific range of people. In order to store the web page files on a CD-ROM, it would be necessary to produce the files as for the internet option. If the internet option is chosen, then it will be very easy to produce CD-ROMs after the web pages have been created and the cost of doing so will simply have to cover the small amount of time to copy files and the cost of the CD-ROMs.

If the intranet option is chosen, production of the CD-ROMs is rather more costly. The web pages would need to be constructed in standard web publishing software as for the internet option, and then saved to CD-ROM instead of (or as well as) making available on the world wide web. As discussed above, this process would involve copying pages from Easinet to alternative publishing software, and would have to be done by Agency staff.

The value in producing a CD-ROM is only significant if it is necessary for the manual to be accessible to computers that cannot be linked to the intranet or internet. So, for example, if it would be desirable to use the manual from a laptop on site, or show the manual to people in a meeting room with no connection, then it would be useful to be able to access the manual from CD-ROM. If this is not necessary, then access via the intranet or internet can be restricted by using password protection.

10.4 Assessment

- Since it is understood that *initially* the manual will just be for use by Agency staff, it is recommended that the full development of the manual is carried out for the intranet rather than the internet.
- The primary reason for this recommendation is to allow faster access to the manual and ensure standard formatting to encourage wide uptake of the tool.

- If it is decided that it is important to show the manual to a wider audience, then it will be necessary to convert the intranet pages into internet pages which can be published on the World Wide Web or saved to CD-ROM.
- For the scoping study, the proof of concept will be developed using web page publishing software in order to demonstrate the concept and show how the digital version of the manual might work and what it could look like.

11. OUTPUT (PROOF OF CONCEPT)

The output from this scoping study is the accompanying proof of concept. Four techniques have been used as examples (see associated CD-ROM). The choice of techniques used has been informed by the review of information. The objective of using these four techniques was to show that the suggested framework should work equally well for all cases whether the technique is well reported in available manuals or scientific papers, or equally where information is scant.

The digital design manual presents each technique on an individual web page. The layout of the web page for each technique should be the same so that the manual is consistent and easy to use. A bold title identifies the technique name, followed by a scroll box where the user can see the best manual example with design information directly on the page. Below this there are boxes for scientific evidence, applicability and expert opinion, which contain information as outlined in previous sections of this report. The scientific evidence box contains a link that opens a new window with links to pdf versions of scientific papers if the user wants to access more detailed information about the technique.

The following list outlines the four techniques that are used as examples in the proof of concept:

1. *Narrowing of an over-widened channel using low cost groynes*

This technique comes under the cluster heading for 'enhancing over-widened rivers'. The manual information that is inserted into the page is from the **MOT (RRC)** section 3.5. The scientific evidence box links to the papers (see for example Biron *et al* (2003) and Pretty *et al* (2003)).

2. *Croys*

This technique comes under the cluster heading 'provision of bankside and in-channel habitat'. The manual example is from **SEPAF**, page 26. The scientific evidence box contains links to the same pdfs referenced for the groynes example, as both of these techniques are a type of generic deflector.

3. *Willow spiling*

Willow spiling is an example of a technique in the 'revetment and supporting river banks' cluster. The manual example is from section 4.1 of **MOT (RRC)**. There are no pdf documents available for the scientific evidence referenced.

4. Gabion dams

Gabion dams are covered in the cluster on ‘controlling river bed levels, water levels and flows’. This technique example shows how more than one manual example can be displayed in the scroll box and uses information on gabion dams from **ARM2** (p269) and the **SCUS** manual. There are no pdfs to link to for the scientific evidence box.

12. QUESTIONNAIRE

Designing a manual of this nature requires input from potential end users. The extent of this scoping study was not sufficient to enable a full scale questionnaire to be sent widely within the Agency. Instead a series of questions were compiled and these were discussed with staff identified from across a range of functions, with a known interest in this type of guidance. Representative from both northern and southern area offices were contacted.

12.1 Summary of comments

The development of an EREDM would provide a useful tool and would be of benefit to a range of Agency staff. Most importantly it was felt that it would serve as a catalyst for promoting best practice ideas and examples. It was felt that critical to its success would be the inclusion of good photographic evidence and clear design drawings. Operational staff commented that if they could provide a sketch diagram of the type of measures being proposed, then this would often significantly help with the internal consenting process.

Using the Agency’s intranet to host such a manual could be slow at times and sites were sometimes difficult to find at first (though once found they could easily be bookmarked). However, in its favour it did provide relatively easy access for a wide range of staff. The notion of those outside the Agency having access to such a tool was also discussed. Most staff interviewed were in favour of external contractors, NGOs, etc. having access to this information. However, if made available outside the Agency, it would require the addition of a series of caveats that emphasised the need to ‘speak to Environment Agency staff’, earlier rather than later in the development of a project. Password protection was discussed as a possibility to limit access to trusted organisations. Generally, the use of the Agency’s intranet was seen as a positive step.

At present the **RRC (MOT)** appears to be the most widely used manual of environmental river engineering techniques, although others were also flagged as extremely useful texts, including Boon *et al* (1992) and Cowx and Welcomme (1998).

Although most staff confirmed their interest in such a tool, some interviewees expressed concerns that money should be spent on other issues first. In particular, it was felt that for many (especially new staff) a basic understanding of rivers, how they work and the concept of river restoration, was missing. Regular training or a manual outlining basic principles, would be welcomed before, or at least in addition to, this design manual. In

particular, the need for a basic understanding of all the issues and disciplines that should be consulted before embarking on a project, was most urgent.

The questions used to prompt discussion were:

- Would such a manual be of use in the proposed format? (brief description given).
- Would it be used by Agency staff and if so who is likely to find it helpful?
- Is the Agency's intranet the most appropriate medium for hosting the manual – is the system used accessible enough? Would an alternative format would be more appropriate – if so, what?
- Does such a manual go far enough by helping to find best practice environmental engineering solutions, or is there a need to a more detailed step by step training guide as well?
- Would a manual, as outlined, be useful to users outside the Agency - if so who do you think might/should use it?
- Is there still too much uncertainty attached to the design of techniques? Is there a need to first ensure that there is more project appraisal to underpin them, or would such guidance be useful even with the uncertainty?
- Will it help with the Agency's consents process?
- Do you think that such a project would be wise use of resources?
- What manuals/research you know about and/or commonly use?
- Are you aware of any groups either within or outside the Agency who would be interested in being involved in the subsequent phase either in terms of quality control or design?
- If there anyone else in the Agency that you think we should speak to?

13. CONTRIBUTORS AND BENEFICIARIES

The main objective of this scoping study is to evaluate not only the need for this design manual (EREDM), initially with the requirements of the Agency staff in mind. In addition, part of the remit is to scope which other organisations might be interested in being involved with either the production or the financing of the manual. The focus has mainly been on statutory Agencies and NGOs with a specific interest in river restoration techniques. Links with URBEM and potential input from Geodata are also included because of current project work being undertaken by these organisations. Responses are outlined below and summarised in Table 13.1. In some cases, it is has not yet been possible to obtain a definitive answer despite considerable effort. RRC will continue to sound out potential collaborators and feed back responses to the Project Manager.

It is worth mentioning that many of the Agencies require an early input to the scoping and design of the product, if they are to make a financial commitment in the future.

This requirement conflicts somewhat with the manual being an Agency-only resource until proven to be useful, workable, and robust in its advice. If this is the case, perhaps a compromise would be to invite all of the relevant Agencies, at an early stage, to comment on this scoping study and input into the design, but retain the product as an Agency only output initially (funded solely by the Agency).

13.1 Agencies

Environment Agency (EA)

The Agency would be the sole, or lead funder. A number of those who were asked for initial feedback expressed their interest in being involved with the full study. Chris Robinson, Fisheries Team Leader, Thames, West Area, was very keen to be part of the project team. Allan Frake, Fisheries Technical Specialist, Dorset and Hampshire, Joe Stevens, Biodiversity Technical Specialist, Hants and Isle of Wight, and Tony Burch, Flood Defence, Hants and Isle of Wight, Ian Hirst, Paul Jose, Chris Randall, Andy Hinds (all fisheries technical specialists) were all happy to contribute further to the design manual as they saw great potential for its use.

Scottish Environmental Protection Agency (SEPA)

Initial enquiries within SEPA have produced very positive responses to the concept of a manual. They would very much like to be involved with the scoping and development of the tool and have indicated that there is a high likelihood of some financial commitment. The concept of the EREDM fits well with SEPA's current priorities for the Water Framework Directive (WFD). Work is now being undertaken to support staff and external organisations requiring technical 'river engineering guidance'. This includes a trawl of all available literature on best practice design and implementation (Appendix C).

Financial commitment could be on a small scale from a variety of budgets or on a larger scale requiring a business case, or linked directly to a core budget area such as the WFD.

Scottish Natural Heritage (SNH)

RRC currently provides detailed site specific advice to SNH staff through a grant agreement and reference to the **RRC (MOT)**. Any similar tool such as the EREDM would be of benefit to this organisation. However, to date we have been unable to discuss this in more detail with Iain Sime, their newly appointed Freshwater Group Manager.

River Agency (RA)

The Rivers Agency is looking at ways to aid the implementation of the WFD. However, at present they feel that the scope of the proposed manual would not necessarily address their current objective of reducing flood risk although they appreciate that this emphasis may change with the implementation of the WFD. At present, therefore, the feeling is that without adding substantially to the scope of the output and hence the cost of the project they are unable to commit any resources at present (Appendix D).

Environment and Heritage Service (EHS)

Initial discussion confirms that EHS would be interested in such a manual. Again, their requirement under the WFD calls for a degree of guidance to be made available for those undertaking works to rivers. EHS see this type of manual as a useful tool to deliver this advice. Any financial contribution would need to be discussed on the basis of a more definite scope and timeframe for delivery, with an output useable by EHS staff and others.

Countryside Council for Wales (CCW)

CCW is very interested in extending its knowledge of river restoration techniques and improving its links with the River Restoration Centre (RRC). As such they are keen to be involved with such a project see merit in being involved potentially at the financial level and can see benefit of such a tool for them. Currently CCW are looking at funding of projects over the next 3-5 years, and will propose the EREDM as a potential project.

English Nature (EN)

EN is investing a considerable amount of resources into their designated sites to ensure that degraded ones are brought up to favourable condition. This has required a swift learning process for the area staff and reliance upon RRC and others to provide expert input. The EREDM would further provide a valuable resource to aid staff in this work and EN see the benefits in providing this to a wide audience.

Funding of either the initial design or a subsequent follow-up (intranet to internet) is a realistic possibility. EN would like to be more involved in the scoping and design of this tool.

13.2 NGOs

The River Restoration Centre (RRC)

As a promoter of best practice, and authors of the Manual of River Restoration Techniques, RRC could provide expert judgement and its knowledge of river restoration techniques, successes, and failures. In addition it can play a key role in the dissemination of information and links with key individuals where specific expertise is required to drive the project forward.

Other NGO's

The following organisations all have an interest in such a tool and the wider dissemination of best practice. None are willing to commit to any degree of financial support at this time, though all would like to be kept informed of developments. The World Wildlife Fund (WWF), the Association of Rivers Trust (ART) and the Wild

Trout Trust (WWT) are all important outlets for advice to smaller trusts, associations and voluntary groups who carry out a large volume of small scale works every year.

13.3 Other organisations

There are a range of individuals who work for different organisations and consultancies who could contribute a wealth of expertise. These individuals would be worth including on correspondence lists for input and suggestions into the project. These people have not been contacted directly at present. Details of all those with an interest in river restoration techniques are held on the RRC's database and it is recommended that an update of current experts should be sought as part of the project.

Southampton University/the Geodata Institute

David Sear and Joe Wheaton are currently involved with a number of initiatives, including research on uncertainty in river restoration which has involved a detailed international survey of over 500 river restoration practitioners, and has derived information on the use of published restoration approaches and manuals. In addition David is jointly editing a book entitled 'River Restoration: Managing the Uncertainty in Restoring Physical Habitat'. They also have experience of floodplain forest restoration and debris dam restoration, plus monitoring of 20 restoration sites in the mid 1990's. The Institute's input into this project should prove very helpful.

13.4 HR Wallingford/the URBEM Project

HR Wallingford is leading an EC fifth framework project called Urban River Basin Enhancement Methods (URBEM), which involves thirteen European partners and covers a range of objectives including:

- Research on case studies of previous river restoration schemes;
- Monitoring and data collection on river restoration schemes;
- Developing a methodology for the aesthetic evaluation of urban rivers;
- Developing a tool to assess the rehabilitation potential of an urban river;
- Developing a social appraisal tool;
- Developing new techniques for urban river rehabilitation;
- Developing indicators of success for urban river rehabilitation;
- Training and dissemination of the project outputs.

It will be beneficial for the design manual and URBEM to retain strong links since their outputs are complimentary and both project outputs will have more value if they have taken on board the findings of the other project. Appendix E shows the links between the URBEM project and the design manual. The diagram shows the framework that has been developed by URBEM (and that will be refined by the end of the project in November 2005) to help decision makers enhance urban rivers. It shows the processes of the generic approach to managing urban river rehabilitation that has been developed by work package 5 as well as the support guidance and decision guidance, including new tools and methods that have been developed by the other work packages.

As illustrated, URBEM can be of benefit to the design manual in a number of ways. The research on river restoration case studies (S2.1) can provide scientific evidence, applicability and expert opinion information on a range of techniques. The development of new techniques (S2.3) may provide design information on techniques that are not found in other manuals. The reporting of lessons learnt (3.5) as a result of monitoring the rehabilitation scheme could provide information to the applicability and expert opinion boxes of the design manual, if the manual was updated in the future. In addition to these explicit links, other URBEM work packages may be of some value to the design manual. For example, the data collection from case study restoration schemes (S1.2) and the work on developing indicators of success (D2.1) will both promote post project appraisal and will be able to inform the scientific evidence, applicability and expert opinion boxes in the design manual.

Likewise, the design manual will have benefits for URBEM. The generic approach to assessing and managing river rehabilitation developed for work package 5 outlines the processes involved in defining what objectives the rehabilitation aims to achieve, what option would best meet the objectives and how to monitor the scheme. The design manual will explicitly contribute to process 2a.2, identifying options, as together with work package 8 (S2.3), it will provide information on techniques for river rehabilitation. That the design manual will be an easy-to-use digital reference is a huge advantage and it is likely to be the most important source of information for river managers (and perhaps planners) in the UK that face tackling this process of identifying options. In addition, the design manual will support work package 11, training and dissemination (S1.3). The structure of the training material produced for the URBEM work packages has now been developed by the responsible URBEM partner and it is proposed that each work package will present their tools, methods and report findings in presentations to three types of audience: (a) decision makers, (b) technical specialists, and (c) general public and stakeholders. The design manual will provide an essential tool for disseminating best practice environmental river engineering to audiences (a) and (b).

Organisation	Expertise	Funding	End user	Main contacts
EA	Y	Y	Y	Chris Robinson, Allan Frake Joe Stevens, Tony Birch
SEPA	Y	Y	Y	Roy Richardson Dave Corbelli Joanne Lambert
SNH	N	Maybe	Y	Iain Sime
RA	N	N	Maybe	Jim Martin
EHS	N	Maybe	Y	Deirdre Quinn
CCW	N	Y	Y	Tristan Hatton-Ellis
EN	Y	Y	Y	David Withrington
RRC	Y	Y	Y	Martin Janes, Jenny Mant
WWF			Y	Mike Donaghy
WWT	Y		Y	Simon Johnson
ART	Y		Y	Arlin Rikard, Ian Gregg
Southampton University	Y	N	Y	David Sear
URBEM/ HR Wallingford	Y	N (but info in kind)	N	Roger Bettess, Valerie Bain

Table 13.1 Outline of Agencies/organisations potentially interested in contributing to the EREDG

14. FLUVIAL DESIGN GUIDE – UPDATE

As part of the scope of this study it was necessary to assess the compatibility of this proposed EREDM with the Fluvial Design Guide. The full comments from Charles Rickard are attached as Appendix F. In summary however, it was felt that ideally the manual should be available to all professional staff involved in river engineering work, and not just Agency staff. The main reason it was suggested, is that it will be difficult to have Agency staff referring to a design guidance that is not available to their consultants. In addition it was identified that the proposed approach has elements in common with the proposals for Standard and Typical Details for flood and coastal defence which has been developed in parallel with the Fluvial Design Guide scoping study. Overall, the scoping of the two projects has indicated that they should complement each other in terms of advice.

15. RESEARCH AND DEVELOPMENT

Through this scoping study a future research need of Post-Project Appraisal (PPA) of environmental river engineering, and river restoration techniques has been identified.

There is a lack of definitive scientific evidence that techniques implemented for river restoration and enhancement actually meet their objectives, and are more sustainable than traditional methods. A possible causal factor for this lack of information is that there is no standard, multi-disciplinary methodology available, specifically for PPA of river restoration projects. Therefore, appraisal of projects has not been well documented. Most appraisal methods are single-discipline, focusing generally on either geomorphological or ecological techniques. Practitioners currently use a range of physical habitat assessments, fisheries surveys and geomorphological surveys or ‘in-house’ devised methodologies for evaluating project performance. This lack of PPA has implications not only for the justification of techniques already used in the UK, but also when interpreting international publications, assessing which techniques may be transferable to the unique problems and typology of UK rivers.

This emphasises the need for more PPAs of river restoration projects and the techniques used, in order to inform best practice guidance. As major implementers of river restoration and enhancement projects, the Agency could apply a standard formula for planning, funding, and delivering PPAs for all projects. R&D will be needed to devise an appropriate methodology (or suite of methodologies) and the rules for application to schemes of varying scale and complexity.

16. SPECIFICATION

The following specification has drafted to provide a brief to consultants. It is proposed that the consultants should also be provided with a copy of this scoping report to give greater background to the project, though some elements may need to be omitted. The specification is also attached as Appendix J.

Objective:

To develop a digital design manual for environmental river engineering that gives design guidance and supporting information on the most widely used techniques in the Agency for environmental river engineering.

1.1 Main Tasks:

- Research on techniques
- Organise and facilitate expert consultation
- Design and develop digital design manual
- Produce brief report on approach and user guidelines

16.1 Research on techniques

The project must define which techniques should be included in the design manual. These will be selected based on the techniques that are currently the most used within the Agency.

The selected techniques will be clustered so that the manual is presented with several sections (rather than just as one long list of techniques). The sections will aid ease of navigation around the manual and will be based on the RRC Manual of River Restoration Techniques chapters.

The design manual will provide the following information on each technique:

- Design guidance: this will be specific design instructions. It will be necessary to identify sources of information that will be used in this section. The scoping study has identified a number of manuals that contain design information on each technique. The design guidance given in the digital manual will either be copied and pasted from the best design manual reference that has been found, or will be reformatted so that the best information from each manual is used.
- Scientific evidence: this section will list journal papers and other scientific references that contain research on the technique including its use, applicability and any post project appraisal information. The section will include a short literature review of these papers and should link to the original sources where possible.
- Applicability: this section will outline the river environments that the technique is suitable for. It will specify any limitations to the applicability of the technique and will describe the types of catchments and rivers where the technique is likely to be successful.
- Expert Opinion: this will contain information collected during the workshops, see next section.

16.2 Expert consultation

In order to ensure that the information on each technique reflects current knowledge and is supported by expert opinion, it is necessary to consult with experts in the field of

river restoration techniques to collect and collate information and experience on the techniques. This may take the form of a workshop, questionnaires, interviews or an element of each. The invited experts will specialise in the following fields:

- hydrology
- fluvial geomorphology
- fisheries
- ecology
- river restoration
- navigation
- operations and maintenance
- flood defence

In addition, there should be two people who work in the Agency in a relevant field and who could influence the national level uptake of the manual after production.

If a workshop format is used to ensure that the time available is used most effectively, that draft material should be sent out to participants prior to the meeting. Each expert should have one day for preparation prior to the 1day workshop attendance.

This consultation is a vital component of the development of the manual as it will provide the most up to date view on each technique and will populate the design manual with practical information. It will also ensure that key practitioners in the UK are involved in the production of the manual which will increase the uptake of the manual once it is produced.

The findings from any workshop will be drawn together for inclusion in the digital design manual.

16.3 Developing digital manual

The design manual will be delivered in digital format. The scoping study has outlined three options for this:

- Agency internal intranet pages
- Internet pages
- CD-ROM

It is recommended that the design manual is developed for the internet since this will increase the potential uptake to the use of the manual. It also means that there is more opportunity for other funding contributions since they will be able to use the manual. In order to overcome the problem that Agency staff generally have slow access to the internet, the manual could be provided in CD-ROM version as well and these distributed within the Agency.

The web pages will be designed in a user-friendly format, based on the Agency intranet publishing guidelines. This will ensure ease of use and quick navigation around the manual. One web page per technique plus required contents/search pages is recommended.

The digital manual will contain a search functionality as outlined in the scoping study. This must be designed so that the user can search by technique of interest and also by river type.

16.4 Reporting

The project will also deliver a final report, outlining the approach of the development of the design manual and presenting users' guidelines for using the digital manual. It will not be necessary to produce a users' guide as the manual will be easy to use and not require in depth explanation.

16.5 Organisations to involve

The development of the design manual will be of interest to a wide audience of river engineers, ecologists and water quality managers. There are a number of organisations that the Agency may want to involve in different aspects of the project as summarised in Table 13.1 of this study.

In addition RRC should be involved as an advisor given its expertise in river restoration and production of a manual of techniques. Furthermore, the Centre can provide up to date details on all experts with an interest in commenting on this project. Similarly, HR Wallingford should be consulted especially with regard to pursuing links with the URBEM project which should be able to assist in the production of this project.

16.6 Output format

Section 10 of this report outlines the possible options for presenting the output of the manual. The costings in Table 16.1 below show a summary of the three format options and two combinations of options. The decision for selecting an option will be governed by the target audience of the manual and the required functionality. Appendix K should be viewed in conjunction with this table. The appendix provides an alternative set of costings based on the HR Wallingford framework agreement rates. The Intranet option is cheaper as the consultant cannot publish the web pages, but it will require Agency staff time to do this instead.

The internet option is more expensive but does not require Agency staff to work on the web pages. The production of a CD-ROM would cost the same as the internet option as the web pages are produced in the same way, but it also has the added cost of the consumables and time for copying CD-ROMs. The combination options require more Agency staff time to copy sections from their Easinet publisher to internet publishing software.

		10 techniques	20 techniques	Agency time
Intranet	Cut and paste	44525	81448	5
	Reformat	50727	93851	8
Internet	Cut and paste	47468	87333	
	Reformat	53669	99736	
Both	Cut and paste	49819	92036	10
	Reformat	56020	104438	16

Production of CDs

Information is copied from web pages so CDs can be produced for the internet option, or the 'both' option. If CDs are needed with the intranet option, then it will be necessary to select the 'both' option.

CDs are produced at rates specified. E.g. for 250 CDs, add £550 to any of the totals above.

Agency time

Agency staff will need to input data into publishing package for the intranet. If the 'both' option is selected, they may have to spend more time to convert format to other publishing software. This may not be necessary if it is quicker to work straight from the format that HRW provide.

Table 16.1 Cost of full development of design manual

16.7 Cost of full development of design manual

Table 16.1 together with Appendices G, H, I & K, give costings based on current knowledge of the design manual requirements, anticipating that the final design will not be too dissimilar to the proof of concept produced for this scoping study. The costs have been given for both 10 and 20 techniques. The proposed costs are valid until 1st January 2005.

The intranet option assumes that the Agency staff will publish the web pages and the combination options assume that Agency staff will transfer intranet formatting into internet web pages.

17. COMMENT ON RRC MANUAL OF TECHNIQUES

The **RRC (MOT)** as discussed within this scoping studying is already widely used to help advice practitioners on the types of techniques that could be used to enhance or restore rivers. Discussion with various Agency staff and those from other organisations, together with RRC's knowledge of the use of the river restoration techniques in the UK, indicate that the 20 most widely used/enquired about at present are those outlined in Table 17.1. The majority of these 20 techniques are already covered within this manual. Based on the time taken to produce the 20 studies that form the manual 'update', and using daily rates consistent with the costs in appendices G, H, I & K and Table 16.1., the total cost of producing these today would be approximately £35,500.

The figures in table 17.1 provides an indication of the number of Agency projects which specify they have used this precise technique. Some of the techniques are linked to very few projects as they may be more common to Scotland than England or Wales (e.g. log and Christmas tree), and some have recently received a great deal of interest, without actual implementation (e.g. channel lining). Others may simply reflect the wording of the project summary, for example narrowing using faggots could also be reported as brushwood bundles, hazel bundles, woody ledge creation, berm creation, etc. Some techniques such as willow spiling are more commonly implemented by landowners and thus do not show as Agency projects.

Although there is some inherent difficulty reporting on specific techniques when they may have multiple derivations, the figures do highlight the most commonly implemented. This is then supported by the RRC expert judgement on the present and future direction of design and construction.

RRC would likely look to produce a similar Update in 2005/6. Any such update of the manual may provide an opportunity to include comments on scientific evidence and expert opinion. This is raised as a potential option if the funding for the full EREDM project is not available, as it would have the benefit of covering the 'top 20' techniques and add to an already existing and well used publication. Additionally, the **RRC (MOT)** is freely available on the internet and as a hard copy.

Technique	Number of EA projects
Backwaters**	25
Faggot narrowing	6
Berm creation**	11
Deflectors	6
Riffles**	23
Log & Christmas tree	0
By-pass Channel	3
Willow Spiling	3
Re-meandering	8
Re-connecting	1
Re-profiling banks	5
Weir removal**	29
De-culverting**	10
Bed-raising	3
Overshading/Pollarding	6
Flood storage	8
Wetland ledges	5
Bank protection	9
Stock watering	1
Channel Lining	1
Re-introduction of gravels	7
Total EA projects on RRC database	346

*NB. Not all EA projects are on the RRC database

**Top 5 highlighted

List of techniques compiled by RRC expert opinion (based on database, and those most commonly enquired about)

Table 17.1 Main types of techniques used within the UK as compiled from the RRC database

18. CONCLUSIONS

A variety of possibilities exist for creating an overarching EREDM. This manual would coalesce all of the relevant design information applicable to UK river management techniques in one publication. In addition, it would bridge the current gap between practitioner manuals and scientific research to provide justification for these works.

A project structure has been suggested for the full study, trialled within this scoping study. It combines a number of activities, many with their own valuable 'quick win' outputs, indicated in the table below.

Activity	Outputs
Global review of design advice publications	<ul style="list-style-type: none"> • Publication resource and comprehensive reference listing, • Comprehensive case study resource list, • Comprehensive environmental river engineering techniques listing.
Review of the applicability of techniques to UK rivers	<ul style="list-style-type: none"> • Reference list of conceptual techniques, not necessarily directly applicable to the UK (designs to be wary of) • Reference list of all appropriate techniques for the UK. • A basic methodology for determining applicability to UK river systems.
Clustering of techniques according to their purpose	<ul style="list-style-type: none"> • Statistics on the most widely reported/promoted techniques, • Understanding of variability in design methodologies and materials' • Full listing of all possible ERE techniques that could be used in river management schemes.
The design manual techniques	<ul style="list-style-type: none"> • A critical examination of current 'best-practice' design guidance.
Supporting information	<ul style="list-style-type: none"> • A critique of relevant scientific studies carried out on river engineering designs and projects, • The extent of, and need for, appropriate PPA to build confidence in environmental solutions, • A consensus view of UK experts on the potential benefits and failures of common river engineering techniques.

Table 18.1 Table of 'quick win' outputs generated throughout the construction of the EREDM.

Each of these outputs could be significantly expanded with a small overall increase in funding, providing a huge resource for UK river management. Equally, they could be pursued as further R&D or separate contract work.

This scoping exercise has highlighted the probable lack of scientific evidence, combined with its poor availability (for practitioners). The manual would seek to combat both aspects by summarising all available evidence, referencing key papers for further reading, and providing expert opinion to support any lack of published material.

The final output should concentrate on commonly used techniques, to ensure these are being designed according to best available information. More entries could be added, depending on funding and perceived need. The format is flexible, with options proposed for Agency 'only' Intra-net, Internet and CD-ROM. The benefits and constraints of each are summarised.

The cost of undertaking the full design manual reflects the activities required to arrive at a consistent and full picture of global environmental river engineering, and provide UK practitioners with a single complete reference guide. The cost is offset somewhat by the many valuable deliverable highlighted in table 18.1.

The study could be undertaken in a phased approach. Either phased in terms of the number of entries per 'edition', or phased to deliver elements of the project and specified outputs at the end of each phase (e.g. phase 1, the collation of publications and review of applicability to the UK).

19. RECOMMENDATIONS

The recommendations are based on a combination of a brief assessment of the available technical information and discussions with key Agency staff. These staff are likely to be the end users/or have a specific interest in the area of environmental river engineering.

19.1 New design concepts

It is recommended that any future manual should first concentrate on existing techniques. Conceptual ideas, whilst being incorporated in the reference lists, should be analysed in more detail at a later date.

19.2 EREDM updates

Updating of the manual is essential on a number of levels:

- Increase the resource by adding more designs, based on need and new developments;
- Update the information to ensure it remains as up-to-date best practice design guidance;
- Review the expert opinion and scientific evidence to account for PPA developments and further scientific studies;
- Review the format to ensure it remains the most appropriate medium for promoting good environmental river engineering within the UK (Uptake by SEPA, Rivers Agency, EHS)

Updating should be considered and costed as an essential element of the project. Without this provision the manual will quickly become redundant, and at worse may promote old or poor practice.

20. REFERENCES

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Ward, D., Holmes, N. & Jose, P. (1994) *The New Rivers and Wildlife Handbook*. Sandy, Bedfordshire

WWF - Scotland, (2000) *Farming and Watercourse Management Handbook*. WWF

Appendix A

Proof of concept review of publications table

Reference number	Name	Author/Editor	Publisher
1	River Restoration Manual of Techniques*	Richard Vivash (Riverscapes Consultancy) & Martin Janes (RRC)	the RRC
2	The New Rivers and Wildlife Handbook	Ward D, Holmes N, Jose P	RSPB
3	A Wild Trout Trust Guide to Improving Trout Streams*	Ron Holloway, Simon Johnson and Edward Twiddy	WWT
4	A Rehabilitation Manual for Australian Streams Volume 1 & 2 + CD*	Rutherford et al	Cooperative research centre for catchment hydrology & Land & Water Resources
5	Stream Corridor Restoration Manual ~ U.S. Principles, Processes and Practices*	Federal Interagency Stream Corridor Restoration Working Group	National Technical Information Service (NTIS)
6	Applied River Morphology	Dave Rosgen	Wildland Hydrology
7	River Channel Restoration: Guiding Principles for Sustainable Projects	Andrew Brookes (Editor), F. Douglas Shields (Editor)	Wiley
8	Wetland Restoration Manual	Bardsley L, Giles N and Crofts A	The Wildlife Trusts
9	Waterway Bank Protection: a guide to erosion assessment and management*	Cranfield University	Environment Agency
10	Riparian Land Management Technical Guidelines Volume 1 & 2	Lovett, S. and Price, P.	Land and Water Resources Research and Development Corporation (LWRRDC).
11	Channel Restoration Design for Meandering Rivers	Soar, P.J and Thorne C.R	US Army Corps of Engineers (Engineer Research and Development Center)
12	Design manual on river and channel revetments	Escarameia M	HR Wallingford
13	Manual for the Hydraulic Design of Side Weirs	RWP May, BC Bromwich, Y Gasowski and CE Rickard	HR Wallingford
14	River Diversions: Design Guide	Ramsbottom D / Fisher K	HR Wallingford
15	Managing river habitats for fisheries*	Professor Chris Soulsby	SEPA
16	Guidelines for rehabilitation and management of floodplains - ecology and safety combined*	Wolters H.A, Platteeuw M and Schoor M.M (EDS.)	NCR/IRMA
17	Habitat Enhancement Initiative (HEI) : Farming & Watercourse Management Handbook (PDF)*	WWF-Scotland	SEPA/SNH/FWAG/WWF Scotland/SAC
18	Daylighting: New life for buried streams	Richard Pinkham (Rocky Mountain Institute)	Rocky Mountain Institute, Old Snowmass, Colorado
19	Upper Kennet Rehabilitation Project - Technical CD	Thames Water / RWE Group	Thames Water / RWE Group
20	Urban River Basin Enhancement Methods	JT Tourbier, A Olfert, I Gersdorf & T Schwager	Leibniz Institute of Ecological and Regional Development & Technische Universitat Dresden
21	Restoration of Riverine Salmon Habitats: A Guidance Manual (Fisheries technical manual 4)	Dr K Hendry & Dr D Cragg-Hine	Environment Agency, Rio House, Bristol
22	Restoration of Riverine Trout Habitats - A Guidance Manual	Dw Summers; N Giles & Dj Willis	Environment Agency, Rio House, Bristol
23	River Crossings and migratory fish: Design Guidance (Part 3 design)	Sarah Boyack MSP & John Home Robertson MSP	Scottish Executive Rural Affairs Department.
24	Handbook for assessment of hydraulic performance of environmental channels - Report SR490	HR Wallingford	HR Wallingford
25	River Training Techniques Fundamentals, Design and Applications	B. Przedwojski, R. Blazejewski & K.W Pilarczyk	A.A Balkema
26	Restoration of Aquatic Ecosystems	National Research Council	National Research Council

Appendix A

Proof of concept review

Reference number	ISBN	Date	Country of Origin	Main focus/discipline catered for	Format	Style of publication	Cost implications to use/buy	Ease of accessibility
1	1 902872 00 2 / 1 902872 01 0	1999/2002	UK	A range of disciplines (ecology, fisheries, geomorphology etc..)	web/hard copy	Manual	free on web / ~ £32.50 - £36.50	linked to direct
2	0 903138 70 0	1994	UK	River management - flood defense, wildlife and river interests	hard copy	Handbook	£19.95	No direct link / need to reproduce
3	N/A	2001	UK	Fisheries	web/hard copy	Guide	£10 + £2 p&p	No direct link / need to reproduce
4	N/A	2000	Australia	A range of disciplines (ecology, fisheries, geomorphology etc..)	web/hard copy/CD	Manual	\$25 black and white copy	linked to direct
5	0 934213 / 59 3 (book) 60 7 (CD)	1998	USA	A range of disciplines (ecology, fisheries, geomorphology etc..)	CD/hard copy	Manual	Hard copy \$142 / CDROM \$90	linked to direct
6	N/A	1996	USA	A range of disciplines (ecology, fisheries, geomorphology etc..)	CD/hard copy	Book	\$89.95	No direct link / need to reproduce
7	0-471-96139-6	1996	UK	A range of disciplines (ecology, fisheries, geomorphology etc..)	hard copy	Book	£115.00	No direct link / need to reproduce
8	0-902484-92-3	2001(P1) / 2003 (P2)	UK	Wetlands & A range of disciplines	web/hard copy	Manual	£45	linked to direct
9	0 11 310160 0	1999	UK	Conserving the Land/flood defense	hard copy	Manual	£95	No direct link / need to reproduce
10	0 642 26775 8	2002	Australia	Riparian land management/influence on ecology	web/hard copy	Manual	\$13.75 each	linked to direct
11	N/A	2001	USA	Geomorphology	hard copy	Report/book	not known	No direct link / need to reproduce
12	727726919	1998	UK	River bed and bank protection - Revetment systems	hard copy	Manual	£45	No direct link / need to reproduce
13	072773167X	2003	UK	Hydraulic design of side weirs	hard copy	Manual	£35	No direct link / need to reproduce
14	727729594	2001	UK	River diversions	hard copy	Manual	£45	No direct link / need to reproduce
15	1 901322 23 8		Scotland	Fisheries	hard copy	Manual/guide	free on web	linked to direct
16	ISSN 1568-234X	2001	Netherlands	Management for floodplains	hard copy	Report/book	N/A	No direct link / need to reproduce
17	N/A	1998	Scotland	Farming and watercourse management	web	Handbook	free on web	linked to direct
18	N/A	2000	USA	De-culverting rivers	web/hard copy	Report/book	free on web	linked to direct
19	N/A	2004	UK	A range of disciplines (ecology, fisheries, geomorphology etc..)	CD	CD/Guide	Free on CD	No direct link / need to reproduce
20	N/A	2004	GERMANY	Urban river basins	hard copy	Report	N/A	No direct link / need to reproduce
21	HO-11/97-B-BAHB	1997	UK	Fisheries (Salmon)	hard copy	Manual	£50	No direct link / need to reproduce
22	N/A	1996	UK	Fisheries (Trout)	hard copy	Manual	£15	No direct link / need to reproduce
23	N/A	2000	Scotland	Fisheries	web copy	Guide	free	linked to direct
24	N/A	2001	UK	Hydraulic performance of channels	hard copy	Handbook	N/A	No direct link / need to reproduce
25	90 5410 1962	1995	Netherlands	A range of disciplines (ecology, fisheries, geomorphology etc..)	hard copy	Book	N/A	No direct link / need to reproduce
26	0-309-04534-7	1992	USA	Ecology/Aquatic ecosystems	hard copy	Book	\$44.96	linked to direct (no pdf)

Appendix A

Proof of concept review

Reference number	Ease of use	No of design techniques	No of case studies	Applicability to UK rivers	Indication of success
1	Clear, concise, pictorial	11 Parts (~ 47 techniques)	17 case studies	yes	subsequent performance - subjective
2	Clear, concise, pictorial	1 Part (Part 3) ~ 14 techniques	41 case studies	yes	Partially through case studies
3	Clear, concise, pictorial	1 Part (9 Techniques)	7 case studies	yes	Advantages and Disadvantages
4	Clear, well-structured	1 Part (Part 3) ~14 types of techniques (volume 2)	within the text/no defined chapter	Some aspects	Appraisal techniques discussed
5	not very concise, slightly confusing	1 Part - Appendix Techniques (short summaries)	within the text/no defined chapter	Some aspects	Appraisal techniques discussed
6	unknown - no hard copy	No of techniques unknown (field techniques evident in book)	unknown (no chapter dedicated to case studies)	unknown	not evident
7	more of a text book rather than a manual	2 chapters focus on techniques	6 case studies (some more within the text)	yes	not evident
8	Clear, concise, pictorial	10 chapters focus on techniques for wetland features (e.g. reedbeds, wet woodland etc)	9 case studies (part 1)	yes (wetlands mostly)	not evident
9	Clear, concise, pictorial	non-engineering and engineering solutions / Appendix: guide to solutions	within the text/no defined chapter	yes	not evident
10	Clear, concise, pictorial	Volume 2 (7 sections of techniques)	within the text/no defined chapter	unknown	not evident
11	Not clear, very mathematical, no pictures	Not really techniques - design theories/principles (channel design framework)	1 case study - Whitemarsh Run	yes	not evident
12	Clear, mathematical, pictorial	4 revetment types (rock, gabions, block & others) / granular filters & geotextiles	no case studies	yes	N/A
13	Mathematical, graphical, pictorial	focuses on different types of weirs (4 types) in different situations	no case studies	yes	N/A
14	Clear, concise, pictorial	2 chapters focus on techniques (In-channel structures & detailed channel design)	no case studies	yes	N/A
15	Clear, concise, pictorial	8 parts in 1 chapter 7	within the text/no defined chapter	yes	Partially
16	Colour, clear, pictorial	8 parts	2 case studies (Rhine/Meuse)	yes	Yes - Attention points for design
17	b/w, clear, concise, pictorial	Section 6 - 9	within the text/no defined chapter	yes	not evident
18	Clear, pictorial, very texty	Not clear - Techniques/actions discussed in case studies	19 case studies / very detailed	unknown	challenges/lessons
19	Clear, video clips, interactive	3 main techniques (narrowing, shallowing & deflecting + numerous others)	1 case study - Kennet	yes	Lessons & benefits
20	Report style, lots of graphs, no pictures	No specific design techniques - focuses on case studies	23 case studies (international)	yes	not evident
21	texty, colored diagrams	Split into life cycle stages Part II	a few within the text/no defined chapter	yes	Critical evaluation of techniques
22	b/w, texty, few pictures	Habitat restoration techniques Part 8 (~31 techniques)	a few within the text/no defined chapter	yes	Drawbacks/effectiveness
23	text, no pictures, bullet points	General design principles	no case studies	yes	not evident
24	Mathematical, graphical, pictorial	Part 3 (numerous techniques)	a few within the text/no defined chapter	yes	worked examples
25	texty, mathematical, graphical	Part 2 (numerous techniques)	no case studies	unknown	not evident
26	texty, few pictures	Not clear - Techniques/actions discussed in text	13 case studies	unknown	not evident

Appendix A

Proof of concept review

Reference number	Types of techniques	Links
1	soft-eng / natural regeneration / river restoration	http://www.therrc.co.uk/manual.php
2	soft-engineering / natural regeneration	N/A
3	river restoration / habitat enhancement	http://www.wildtrout.org/WTT/projects/riverRestoration.asp
4	soft-eng / natural regeneration / river rehabilitation	http://www.rivers.gov.au/publicat/rehabmanual.htm
5	river restoration / habitat enhancement	http://www.usda.gov/stream_restoration/
6	soft-eng / natural regeneration / river rehabilitation	http://www.wildlandhydrology.com/html/applied.htm
7	soft-eng / natural regeneration / river rehabilitation	http://www.wileyurope.com/WileyCDA/WileyTitle/productCd-0471961396_descCd-tableOfContents.html
8	habitat restoration / rehabilitation	http://www.waterpolicyteam.org/Wetland%20Habitats%20&%20Species/Publications/The%20Wetland%20Restoration%20Manual/wetland_restoration_manual.htm
9	non-engineering/engineering solutions	http://www.eareports.com/ea/rdreport.nsf/Report/6C8E3F4F40969833802567980058FE58?OpenDocument
10	riparian management/river rehabilitation	http://www.rivers.gov.au/acrobat/techguidelines/tech_guidelines_vol_1.pdf / http://www.rivers.gov.au/acrobat/techguidelines/tech_guidelines_vol_2.pdf
11	river engineering methods/river restoration	None
12	river engineering methods/river restoration	http://www.hrwallingford.co.uk/downloads/projects/design_manual.pdf
13	river engineering methods	http://www.hrwallingford.co.uk/publications/rivers.html#RiverChannel
14	river engineering/restoration	http://www.hrwallingford.co.uk/publications/rivers.html#RiverChannel
15	soft-eng / natural regeneration / river rehabilitation	http://www.sepa.org.uk/guidance/hei/pdf/fisheries.pdf
16	river rehabilitation	N/A
17	non-engineering/engineering solutions	http://www.sepa.org.uk/guidance/hei/pdf/wwf.pdf
18	river restoration/engineering	http://www.rmi.org/images/other/Water/W00-32_Daylighting.pdf
19	soft-eng / natural regeneration / river rehabilitation	N/A
20	urban rehabilitation	N/A
21	habitat restoration / rehabilitation	http://www.eareports.com/ea/rdreport.nsf/Report/3B8CBAA6D78C59EB802567980058FD86?OpenDocument
22	habitat restoration / rehabilitation	http://www.eareports.com/ea/rdreport.nsf/Report/5D693E645D929090802567980058FD2C?OpenDocument
23	non-engineering/engineering solutions	http://www.scotland.gov.uk/consultations/transport/rcmf-05.asp
24	non-engineering/engineering solutions	N/A
25	non-engineering/engineering solutions	N/A
26	restoration/rehabilitation	http://www.nap.edu/openbook/0309045347/html/

Appendix B

Proof of concept clusters and individual techniques

Techniques	Publication/Author
1. Restoring Meanders to straightened rivers	
Meander reinstatement	RRTH HAHP
New meandering channel through open fields	MOT (RRC) FWMG
New channel meandering either side of existing	MOT (RRC)
New meander in an impounded river channel	MOT (RRC)
New meanders to one side of an existing channel	MOT (RRC)
New meandering channel replacing concrete weirs	MOT (RRC)
Opening up a culverted stream	MOT (RRC)
Reconnecting remnant meanders	MOT (RRC) ARM2
2. Enhancing redundant river channels	
Creation of backwaters	MOT (RRC) NR&WH
3. Enhancing straightened rivers	
Multi-stage channels	RRTH NW&RH HAHP
Stone riffle/permanent riffles	MOT (RRC) ARM2
Excavation of pools	RRTH CD HAHP
Creation of gravelly shallows/natural riffle form	WTT guide ARM2 RRTH CD HAHP
Boulder placement (fisheries)	WTT guide
Boulders clusters	SCUS
Radical re-design from uniform, straight channel to a sinuous	MOT (RRC)
Replacing a concrete drain with a natural channel	MOT (RRC)
Creation of online bays	MOT (RRC)
4. Enhancing over-widened rivers	
Current deflectors (including wing, multiple, straight deflectors and submerged vanes)	MOT (RRC)
Narrowing with aquatic ledges	MOT (RRC)
Narrowing through silt removal	NR&WH
Narrowing using limestone blocks backfilled with excavated soil	NR&WH
Narrowing of an over-widened channel using low cost groynes	MOT (RRC)
Creating a sinuous low-flow channel in an over-widened channel	MOT (RRC)
Planting water plants - narrow stream/protect banks	WTT guide
Traditional retards (a series of piles)	ARM2
Pin retards	ARM2
Brush retards	ARM2
5. Enhancing dredged rivers	
Introducing gravel to inaccessible reaches	MOT (RRC)
Reprofiling channel margins	NR&WH
6. Restoring free passage	
Rock ramp fishways	ARM2
Fish Passageway	SCUS RRTH
7. Provision of bankside and in-channel habitat	

Techniques	Publication/Author
Rock Shelters	SCUS
Lunker structures (cells of heavy woodland planks and blocks)	SCUS
Boulder emplacements/ woody debris and bankside planting (increase fish cover)	SEPAF
Croys	SEPAF
Overhangs	RRTH
Artificial spawning channel (off-line)	RRSH
8. Enhancing the river bed	
Sediment Traps	RRTH
Gravel Traps	RRTH
Gravel Jetting	RRTH
Spawning bed profile	RRSH
Creation of spawning habitat/gravel planting	SEPAF RRTH RRSH RRSH
Gravel loosening	RRTH
9. Revetting and supporting river banks	
Willow spilling	MOT (RRC)
Willow mattress revetment	MOT (RRC)
Rock revetment	RRTH
Log toe and geotextile revetment with willow slips	MOT (RRC)
Toe geotextile	WBPG
Plant role revetment	MOT (RRC)
Grass composites (geotextile/asphalt)	WBPG
Grass revetment	WBPG
Reed planting	WBPG
Supporting bank slips and exposed tree root	MOT (RRC)
Hurdle and coir matting revetments	MOT (RRC)
Bank revetment using low steel sheet piling and coir rolls	MOT (RRC)
Live fascines	ARM2
Woody bank material secured along stream banks	WTT guide
Rock rip-rap	WTT guide
Log crib structures (log wall)	WTT guide
Groynes	ARM2
Benching	ARM2
Longitudinal peaked stone toe protection (LSTP)	ARM2
Faggoting	WBPG
Tree and shrub planting	WBPG
Filled sack barrier	WBPG
Stake and batten/log barriers (barrier to form a breakwater)	WBPG
Pocket fabric/reinforced vegetative bank protection	WBPG
Buffer Strips (Trees/Grass)	FWMH
Log and Christmas tree	FWMH
Retaining barriers (camp sheeting/logs)	RRTH
Dormant post plantings	SCUS
Bank cover structures (solid artificial platforms)	RRTH
Jacks (low-cost stream stability tool)	ARM2
10. Controlling river bed levels, water levels and flows	
Bifurcation weir and sidespill	MOT (RRC)
Drop-weir structures	MOT (RRC)
Restoring and stabilising over-deepened river bed levels	MOT (RRC)
Simulated bedrock outcrops	MOT (RRC)
Raising river bed levels	MOT (RRC)
Rock-boulder structures (low dam)	ARM2
Gabion dams	ARM2
Gabion baskets	FWMH
log dams (instead of rocks)	ARM2
Schauberger sills (gentle V-notched weir)	ARM2
Mangfall sills (boulders of arches/ can incorporate a fishway)	ARM2

Techniques	Publication/Author
Vertical pin ramp (increase deposition)	ARM2
Low profile weirs (diagonal, V & drop-over)	RRTH
Low stone weirs	CD
11. Managing overland floodwaters	
Floodplain spillways	MOT (RRC)
Profiling of land between meanders	MOT (RRC)
Removing and setting back floodbanks	MOT (RRC)
Removal of minor embankments/lower floodplains	GRMF
12. Creating floodplain wetland features	
floodplain scrapes	MOT (RRC)
floodplain wetland mosaic	MOT (RRC)
13. Providing public, private and livestock access	
Fords and stock watering point	MOT (RRC)
watercourse crossings	MOT (RRC)
access paths suitable for disabled users	MOT (RRC)
Restoring a ford as a atock and vehicular crossing point	MOT (RRC)
Urban riverside access	MOT (RRC)
Fencing	ARRM
	FWMH
	RRSH
14. Enhancing outfalls to rivers	
surface water outfalls	MOT (RRC)
Reedbed at Raglan Stream	MOT (RRC)
15. Utilising spoil excavated from rivers	
Landforms at keepsafe and Rockwell	MOT (RRC)
Landform areas	MOT (RRC)
Cost effective silt removal from an impounded channel	MOT (RRC)
16. River Diversions	
Diversion of a river valley	MOT (RRC)
Clay lined river	MOT (RRC)

KEY

MOT (RRC) - Manual of River Restoration Techniques

NR&WH - New Rivers & Wildlife Handbook

ARM2 - Australian Rehabilitation Manual - Volume 2

WTT guide - WTT guide to improving trout streams

SCUS - Stream Corridor Restoration USA

WBPG - Waterway bank protection guide

SEPAF - Managing river habitats for fisheries

GRMF - Guidelines for rehabilitation and management of floodplain

FWMH - Farming and Watercourse management Handbook

RRTH - Restoration of Riverine Trout Habitats

CD - Channel Diversions (HRW)

HAHP - Handbook for assessment of hydraulic performance of environmental channels (HRW)

RRSH - Restoration of Riverine Salmon Habitats

Appendix C

Contributors and Beneficiaries

Initial comments to the proposed EREDM.

Scottish Environment Protection Agency.

From: Corbelli, David

To: 'River Restoration Centre'

Cc: 'Kirsty Irving'; Harley, David (Stirling); Richardson, Roy; Graham, June; Greig, Stuart; Lambert, Joanne

Subject: RE: SEPA interest in an Environmental Engineering Guide

Martin,

Thanks for the email the study looks very interesting and potentially of great importance to SEPA, just the sort of thing we need!

I am particularly interested in the scientific basis and justification for restoration works (in relation to the delivery of hydromorphological and biological improvements) and we need a tool to support our regulatory decision making process.

I am copying this response to David Harley/Roy Richardson/June Graham who are leading the development and implementation of our engineering regulatory regime, Stuart Greig our Hydromorphologist and of course Joanne Lambert who is leading the Habitat Enhancement Initiative all of which may want to comment on the project.

I think SEPA would be very interested in becoming involved and we would be keen to see more details and become involved early on in the process. Can you send me more details regarding project aims, plan, timescales and resources please?

Regarding funding, depending on the further detail it may be likely that we can find funds to contribute to this project, I'll start looking into this. If funding is available I'd stress the requirement for SEPA's early involvement and the opportunity to shape this work.

Re. SNIFFER, Rebecca Badger is currently on maternity leave her replacement is Kirsty Irving (kirsty@sniffer.org.uk)

Look forward to hearing from you

Best wishes

Dave.

Appendix D

Rivers Agency (Northern Ireland)

Jim.Martin@dardni.gov.uk
Environmental River Engineering Design Manual.

Martin

I have discussed the design manual concept with Dr Jenny Mant in your absence.

I understand that the proposed manual would be aimed primarily at river restoration techniques rather than specifically environmentally sensitive solutions to flood related problems. Such techniques would not necessarily address Rivers Agency current objectives of reducing flood risk although this may change as the implementation of the WFD develops. There may well be techniques in the manual that could be adopted by the Agency in certain situations. However I would suggest that currently, Rivers Agency aims for such a document would be different from those of the Environment Agency. A compromise may be difficult without adding substantially to the scope and hence the cost of the project.

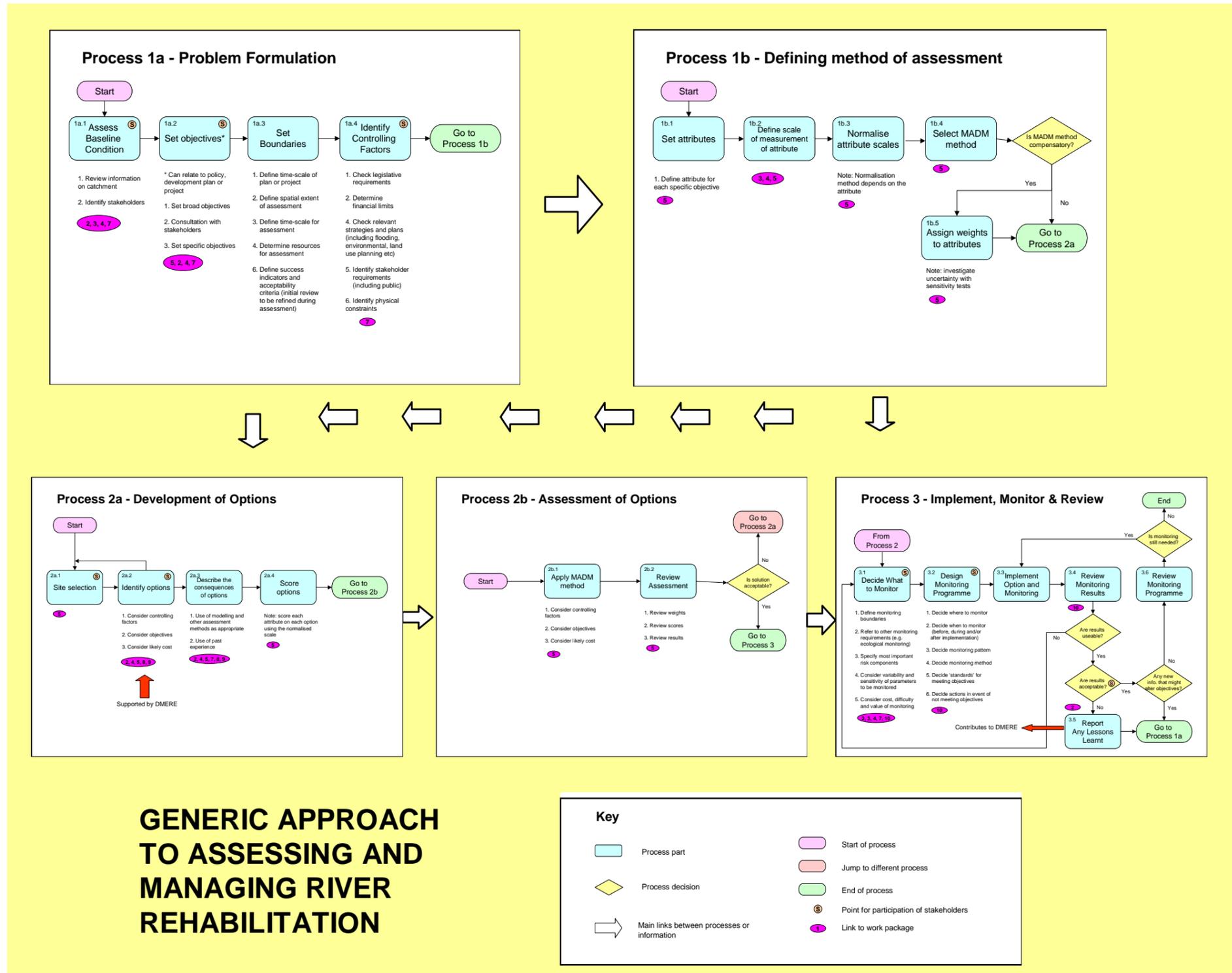
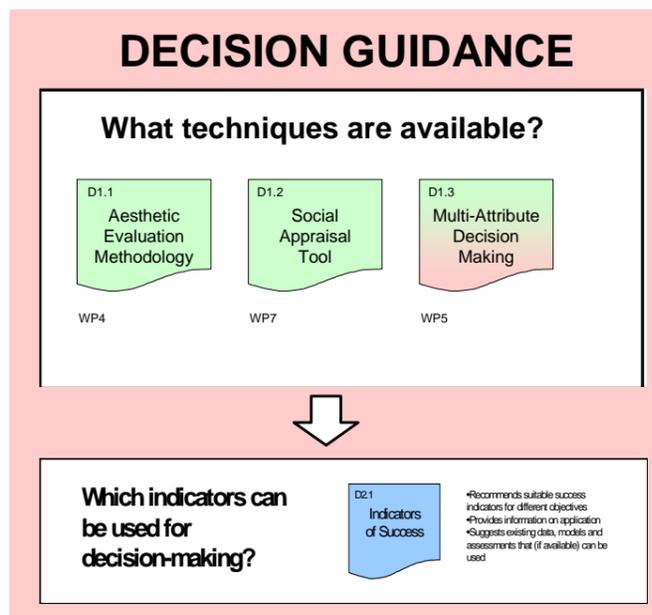
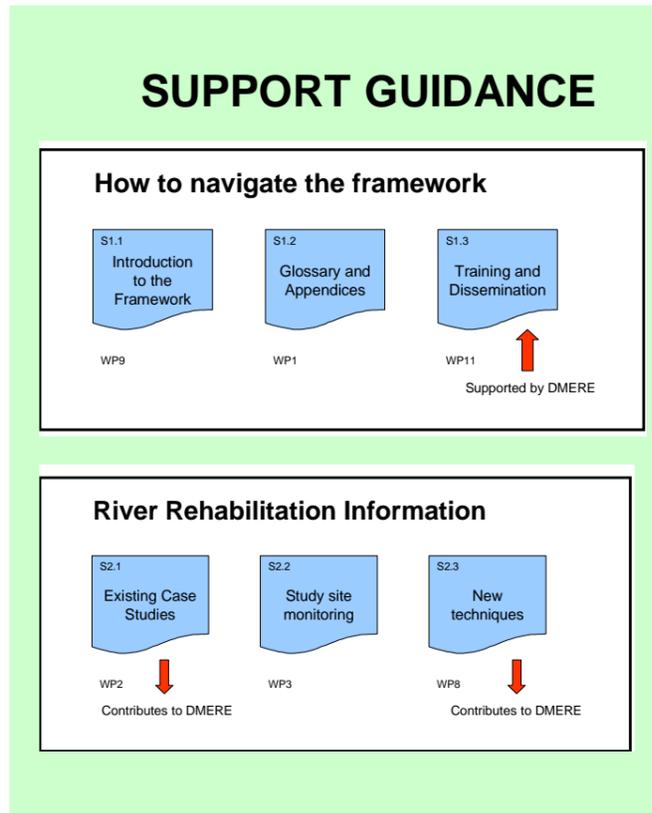
I would therefore propose that the River Restoration Centre proceed with the Environment Agency Brief. Rivers Agency could provide RRC with a broad indication of the type of content that would be applicable to us within our current remit if you feel it would be of benefit. This would possibly allow RRC to take informed decisions on the broader relevance of the content. Rivers Agency would then assess the usefulness of the document on completion.

If you wish to discuss give me a ring.

Regards
Jim

Design Manual for Environmental River Engineering (DMERE): Links with Urban River Basin Enhancement Methods (URBEM)

Activity Chart



Appendix F

Comments on the Draft Report on the Environmental River Engineering Manual

General Comments:

I think that the manual should be available to all professional staff involved in river engineering work, and not just Agency staff. It will be unacceptable to have Agency staff referring to design guidance that is not available to their consultants.

I note that the manual will not be a “decision-making tool”. I agree wholeheartedly with this.

Specific comments:

Fig 3.1 and Section 4.3 – I think that the manual should provide easy access to case studies. Designers of engineering works often examine similar examples of works in developing their designs, and this is especially true in the case of works that cannot be precisely defined by drawings and specifications (as is often so for environmental river works).

Section 6.1 – Clustering may present some practical problems in that many of the common techniques will appear in more than one cluster group. This could lead to repetition, but may be overcome by good cross-referencing.

Section 7.1 – all techniques should be illustrated by at least two photographs, and preferably more. This will help to convey the variation in application each of the techniques.

Section 10 – the proposed approach has elements in common with my proposals for Standard and Typical Details for flood and coastal defence (developed in parallel with the Fluvial Design guide scoping study). CER to send details to MJ.

10.1 – Intranet is too restrictive, see first general comment above.

10.2 – Why is access to the Internet slow for Agency staff?

10.4 – I believe it would be a mistake to provide a manual only for use by Agency staff.

Section 15 – I agree strongly with the recommendation that PPAs are carried out routinely for river works. This requires a policy decision by the Agency, backed up by the allocation of funds.

Section 16.2 – I would like to be involved in any workshops.

16.3 – see my recommended S&TD format.

Table 16.1 Costs – not clear. Why does the production of 100 CDs cost more than both internet and intranet options plus 100 CDs?

Section 17 – I agree that the initial focus should be on commonly-used and/or proven techniques.

Appendix A – two omissions:

River Weirs – Good Practice Guide (Rickard, Day and Pursglove). Pub WRc 2003
Manual of Scour at Bridges and other Hydraulic Structures. CIRIA, 2002.

C E Rickard

7 September 2004

Appendix G

Design Manual for Environmental engineering - INTRANET BASED

	Staff rate £/day	RRC Experienced Staff	RRC Junior Staff	HRW senior technical advisor*	HRW junior technical staff / media production*	Experts	Total	Total 10 techniques	Total 20 techniques
		350	320	705	427.5	500		1 workshop	2 workshops
ACTIVITY									
Cut and paste manual info, prepare scientific evidence and applicability sections. 1 technique.	days	1	3	0.25	1		5.25	52.5	105
	cost	350	960	176.25	427.5		1913.75	19137.5	38275
Reformat manual info, prepare scientific evidence and applicability sections. 1 technique.	days	2	3	0.25	1.5		6.75	67.5	135
	cost	700	960	176.25	641.25		2477.5	24775	49550
2 Meetings (for project team and with client)	days	4	1	2	2		9	9	9
	cost	1400	320	1410	855		3985	3985	3985
Reporting	days	2	1.5	1	1.5		6	6	6
	cost	700	480	705	641.25		2526.25	2526.25	2526.25
Compiling notes for workshop and admin of workshop	days	1	0.5	0.5	0.5		2.5	2.5	5
	cost	350	160	352.5	213.75		1076.25	1076.25	2152.5
1 Workshop: attendance and 10 experts prep (1 day reading)	days	2	1	1	1	20	25	25	50
	cost	700	320	705	427.5	10000	12152.5	12152.5	24305
Travel and subsistence (£100 per meeting)	cost	300		300		1000	1600	1600	2800
TOTALS									
Total days cut and paste		10	7	4.75	6	20		95	175
Total cost cut and paste		3800	2240	3648.75	2565	11000		40477.5	74043.75
Total with contingency	10%							44525	81448
Total days reformat		11	7	4.75	6.5	20		110	205
Total cost reformat		4500	3200	3825	3206.25	11000		46115	85318.75
Total with contingency	10%							50727	93851

NB

* See appendix K for HR Wallingford costs agreement with the Environment Agency

Appendix H

Design Manual for Environmental engineering - INTERNET & CD's

	Staff rate £/day	RRC Experienced Staff	RRC Junior Staff	HRW senior technical advisor*	HRW junior technical staff / media production*	Experts	Total	Total 10 techniques	Total 20 techniques
		350	320	705	427.5	500		1 workshop	2 workshops
ACTIVITY									
Cut and paste manual info, prepare scientific evidence and applicability sections. 1 technique.	days	1	2.5	0.25	2		5.75	57.5	115
	cost	350	800	176.25	855		2181.25	21812.5	43625
Reformat manual info, prepare scientific evidence and applicability sections. 1 technique.	days	2	2.5	0.25	2.5		7.25	72.5	145
	cost	700	800	176.25	1068.75		2745	27450	54900
2 Meetings (for project team and with client)	days	4	1	2	2		9	9	9
	cost	1400	320	1410	855		3985	3985	3985
Reporting	days	2	1.5	1	1.5		6	6	6
	cost	700	480	705	641.25		2526.25	2526.25	2526.25
Compiling notes for workshop and admin of workshop	days	1	0.5	0.5	0.5		2.5	2.5	5
	cost	350	160	352.5	213.75		1076.25	1076.25	2152.5
1 Workshop: attendance and 10 experts prep (1 day reading)	days	2	1	1	1	20	25	25	50
	cost	700	320	705	427.5	10000	12152.5	12152.5	24305
Travel and subsistence (£100 per meeting)	cost	300		300		1000	1600	1600	2800
TOTALS									
Total days cut and paste		10	6.5	4.75	7	20		100	185
Total cost cut and paste		3800	2080	3648.75	2992.5	11000		43153	79394
Total with contingency	10%							47468	87333
Total days reformat		11	6.5	4.75	7.5	20		115	215
Total cost reformat		4500	2880	3825	4061.25	11000		48790	90669
Total with contingency	10%							53669	99736
								Totals with CD production	
Cut and paste									
CD production cost	100 CDs				220			47688	87553
	250 CDs				550			48018	87883
	500 CDs				950			48418	88283
	700 CDs				1330			48798	88663
Reformat									
CD production cost	100 CDs				220			53889	99956
	250 CDs				550			54219	100286
	500 CDs				950			54619	100686
	700 CDs				1330			54999	101066

NB

* See appendix K for HR Wallingford costs agreement with the Environment Agency

Appendix I

Design Manual for Environmental engineering -intranet, Internet and CDs

	Staff rate £/day	RRC Experienced Staff	RRC Junior Staff	HRW senior technical advisor*	HRW junior technical staff / media production*	Experts	Total	Total 10 techniques	Total 20 techniques
		350	320	705	427.5	500		1 workshop	2 workshops
ACTIVITY									
Cut and paste manual info, prepare scientific evidence and applicability sections. 1 technique.	days	1	2.5	0.25	2.5		6.25	62.5	125
	cost	350	800	176.25	1068.75		2395	23950	47900
Reformat manual info, prepare scientific evidence and applicability sections. 1 technique.	days	2	2.5	0.25	3		7.75	77.5	155
	cost	700	800	176.25	1282.5		2958.75	29587.5	59175
2 Meetings (for project team and with client)	days	4	1	2	2		9	9	9
	cost	1400	320	1410	855		3985	3985	3985
Reporting	days	2	1.5	1	1.5		6	6	6
	cost	700	480	705	641.25		2526.25	2526.25	2526.25
Compiling notes for workshop and admin of workshop	days	1	0.5	0.5	0.5		2.5	2.5	5
	cost	350	160	352.5	213.75		1076.25	1076.25	2152.5
1 Workshop: attendance and 10 experts prep (1 day reading)	days	2	1	1	1	20	25	25	50
	cost	700	320	705	427.5	10000	12152.5	12152.5	24305
Travel and subsistence (£100 per meeting)	cost	300		300		1000	1600	1600	2800
TOTALS									
Total days cut and paste		10	6.5	4.75	7.5	20		105	195
Total cost cut and paste		3800	2080	3648.75	3206.25	11000		45290	83669
Total with contingency	10%							49819	92036
Totals with CD production									
Total days reformat		11	6.5	4.75	8	20		120	225
Total cost reformat		4500	2880	3825	4488.75	11000		50928	94944
Total with contingency	10%							56020	104438
Cut and paste									
CD production cost	100 CDs				220			50039	92256
	250 CDs				550			50369	92586
	500 CDs				950			50769	92986
	700 CDs				1330			51149	93366
Reformat									
CD production cost	100 CDs				220			56240	104658
	250 CDs				550			56570	104988
	500 CDs				950			56970	105388
	700 CDs				1330			57350	105768

NB

* See appendix K for HR Wallingford costs agreement with the Environment Agency

Appendix J

Specification for the Environmental River Engineering Design Manual.

Objective:

To develop an environmental river engineering design manual that gives design guidance and supporting information on the most widely used techniques in the Agency for environmental river engineering.

Main Tasks:

- Research on techniques
- Organise and facilitate expert consultation
- Design and develop digital design guide
- Produce brief report on approach and user guidelines

1 Research on techniques

The project must define which techniques should be included in the design manual. These will be selected based on the techniques that are currently the most used within the Agency and the list will be agreed by the client.

The selected techniques will be clustered so that the manual is presented with several sections (rather than just as one long list of techniques). The sections will aid ease of navigation around the manual and will be based on the RRC Manual of Techniques chapters.

The design manual will provide the following information on each technique:

- **Design guidance:** this will be specific design instructions. It will be necessary to identify sources of information that will be used in this section. The scoping study has identified a number of manuals that contain design information on each technique. The design guidance given in the digital manual will either be copied and pasted from the best design manual reference that has been found or will be reformatted so that the best information from each manual is used.
- **Scientific evidence:** this section will list journal papers and other scientific references that contain research on the technique including its use, applicability and any post project appraisal information. The section will include a short literature review of these papers and should link to the original sources where possible.
- **Applicability:** this section will outline the river environments that the technique is suitable for. It will specify any limitations to the applicability of the technique and will describe the types of catchments and rivers where the technique is likely to be successful.

- Expert Opinion: this will contain information collected during the consultation/workshops, see next section.

2 Expert consultation

In order to ensure that the information on each technique reflects current knowledge and is supported by expert opinion, it is necessary to consultant with experts in the field of river restoration techniques to collect and collate information and experience on the techniques. This may take the form of a workshop, questionnaires, interviews or an element of each. The invited experts will specialise in the following fields:

- hydrology
- fluvial geomorphology
- fisheries
- ecology
- river restoration
- navigation
- operations and maintenance
- flood defence

In addition, there should be two people who work in the Agency in a relevant field and who could influence the national level uptake of the manual after production.

If a workshop format is used to ensure that the time available is used most effectively, that draft material should be sent out to participants prior to the meeting. Each expert should have one day for preparation prior to the 1day workshop attendance.

This consultation is a vital component of the development of the manual as it will provide the most up to date view on each technique and will populate the guide with practical information. It will also ensure that key practitioners in the UK are involved in the production of the manual which will increase the uptake of the manual once it is produced.

The findings from the workshop will be drawn together for inclusion in the digital design manual.

3 Developing digital manual

The design manual will be delivered in digital format. The scoping study has outlined three options for this:

- Agency internal intranet pages
- Internet pages
- CD-ROM

It is recommended that the design manual is developed for the internet since this will increase the potential uptake to the use of the manual. It also means that there is more opportunity for other funding contributions since they will be able to use the manual. In order to overcome the problem that Agency staff generally have slow access to the

internet, the guidance could be provided in CD-ROM version as well and these distributed within the Agency.

The web pages will be designed in a user-friendly format, based on the Agency intranet publishing guidelines. This will ensure ease of use and quick navigation around the manual. One web page per technique plus required contents/search pages is recommended.

The digital manual will contain a search functionality as outlined in the scoping study. This must be designed so that the user can search by technique of interest and also by river type.

4 Reporting

The project will also deliver a final report, outlining the approach of the development of the design manual and presenting users' guidelines for using the digital manual. It will not be necessary to produce a users' manual as the guidance will be easy to use and not require in depth explanation.

5 Organisations to involve

The development of the design manual will be of interest to a wide audience of river engineers, ecologists and water quality managers. There are a number of organisations that the Agency may want to involve in different aspects of the project as summarised in Table 13.1 of this study.

In addition RRC should be involved as an advisor given its expertise in river restoration and production of a manual of techniques. Furthermore, the Centre can provide up to date details on all experts with an interest in commenting on this project. Similarly, HR Wallingford should be consulted especially with regard to pursuing links with the URBEM project which should be able to assist in the production of this project.

6 Output format

Section 10 of the RRC/HR scoping report outlines the possible options for presenting the output of the manual. The decision for selecting an option will be governed by the target audience of the manual and the required functionality.

The Intranet option is cheaper as the consultant cannot publish the web pages, but it will require Agency staff time to do this instead. The internet option is more expensive but does not require Agency staff to work on the web pages. The production of a CD would cost the same as the internet option as the web pages are produced in the same way, but it also has the added cost of the consumables and time for copying CDs. The combination options require more Agency staff time to copy sections from their Easinet publisher to internet publishing software.

Appendix K

Design Manual for Environmental River Engineering Note on HR Wallingford costs

HR Wallingford have a framework agreement with the Environment Agency whereby we can carry work out using discounted rates, should the terms of the framework agreement be met. The main terms of the framework are:

- HR Wallingford's subcontract with the RRC will use HR Wallingford terms and conditions (just as we have done for the scoping study).
- HR Wallingford is paid for the proposal time at these framework rates (not an issue as has been done under scoping study budget).
- It is a non-competitive tender.
- HR Wallingford's liability will be limited to 6 times the HR Wallingford fee.
- HR Wallingford's Professional Indemnity insurance \leq £1 million.

The discounted rates will revise the estimate of the costs specified previously in the scoping study as follows:

		10 techniques	20 techniques	Agency time
Intranet	Cut and paste	43205	79229	5
	Reformat	49159	91136	8
Internet	Cut and paste	45653	84124	
	Reformat	51607	96031	
Both	Cut and paste	47757	88331	10
	Reformat	53710	100239	16

The HR Wallingford costs are included in this. The HR Wallingford costs would be as follows:

		10 techniques	20 techniques
Intranet	Cut and paste	11492	17432
	Reformat	13596	21640
Internet	Cut and paste	15700	25847
	Reformat	17804	30055
Both	Cut and paste	17804	30055
	Reformat	19907	34262

V. Bain
16/11/04