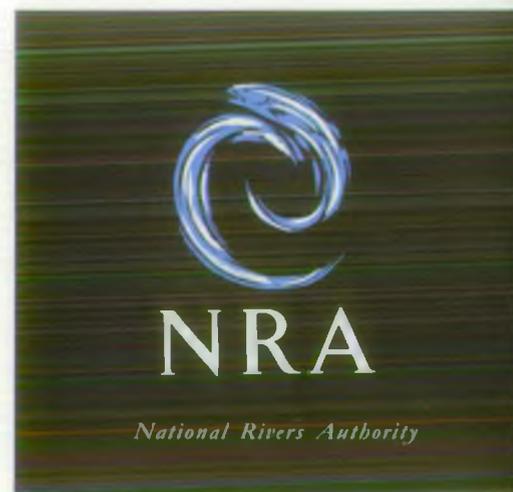


Research and Development 2000  
*A Strategy for the Research and Development  
Support Service*

Version 2

National Rivers Authority  
Rivers House  
Aztec West  
Almondsbury  
Bristol BS17 4UD



National Rivers Authority  
Rivers House  
Aztec West  
Almondsbury  
Bristol BS12 4UD

Tel : 0454 624400  
Fax : 0454 624409

© National Rivers Authority 1992

First Published 1992

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior permission of the National Rivers Authority.

Dissemination Status

Internal : Limited Release

External : Limited Release

Additional Copies

Further copies of this document may be obtained from the R&D Section of NRA Head Office.



ENVIRONMENT AGENCY

NATIONAL LIBRARY &  
INFORMATION SERVICE

**HEAD OFFICE**

Rio House, Waterside Drive,  
Aztec West, Almondsbury,  
Bristol BS32 4UD

ENVIRONMENT AGENCY



092274

**CONTENTS**

	<b>Page</b>
<b>FOREWORD</b>	1
<b>MISSION STATEMENT</b>	3
<b>EXECUTIVE SUMMARY</b>	5
<b>PURPOSE</b>	7
<b>PRESENT STATUS OF THE R&amp;D SUPPORT SERVICE</b>	13
<b>KEY ISSUES</b>	17
<b>STRATEGIC R&amp;D PROGRAMME</b>	29
<b>RESOURCES</b>	55
<b>APPENDIX 1 - PERFORMANCE MEASURES</b>	57
 <b>TABLES</b>	
Table 2.1 Costs of Inherited R&D Programmes (£k)	13
Table 4.1 Core Function Strategic R&D Programmes	29
 <b>FIGURES</b>	
Figure 1.1 Research and Development in the NRA	8
Figure 1.2 The Structure of the R&D Programme	9
Figure 1.3 R&D Management in the NRA	10
Figure 2.1 R&D Project Costs by Commission 1991/92	13
Figure 4.1 R&D Outputs and Associated Uptake	53



## FOREWORD

This R&D support service strategy is one of a series of plans produced for each of the NRA's core functions and support services in 1991. These strategic plans underpin the NRA's overall Corporate Strategy and form a strategic basis for the Corporate Planning process.

The R&D support service strategy was produced by a Working Group which reported to the R&D Committee and comprised :

R J Pentreath	Chief Scientist
M E Bramley	Head of R&D (Chairman)
P D Walsh	Regional Flood Defence Manager, North West Region; formally R&D Commissioner for Flood Defence
P Bird	EC Directives Officer, Head Office; formally Anglian Region
D Clarke	R&D Co-ordinator, Welsh Region
G M Llewellyn	R&D Planning Officer, Head Office

The Working Group was assisted by Professor R Edwards and J Taylor as Board Members with responsibility for Research and Development.



## Mission Statement

The National Rivers Authority will protect and improve the water environment. This will be achieved through effective management of water resources and by substantial reductions in pollution. The Authority aims to provide effective defence for people and property against flooding from rivers and the sea. In discharging its duties it will operate openly and balance the interests of all who benefit from and use rivers, groundwaters, estuaries and coastal waters. The Authority will be businesslike, efficient and caring towards its employees.

## Aims

The Authority's aims are as follows:

- To achieve a continuing improvement in the quality of rivers, estuaries and coastal waters, through the control of water pollution.
- To assess, manage, plan and conserve water resources and to maintain and improve the quality of water for all those who use it.
- To provide effective defence for people and property against flooding from rivers and the sea.
- To provide adequate arrangements for flood forecasting and warning.
- To maintain, improve and develop fisheries.
- To develop the amenity and recreational potential of waters and lands under NRA control.
- To conserve and enhance wildlife, landscape and archaeological features associated with waters under NRA control.
- To improve and maintain inland waterways and their facilities for use by the public where the NRA is the navigation authority.
- To ensure that dischargers pay the cost of the consequences of their discharges, and as far as possible to recover the costs of water environment improvements from those who benefit.
- To improve public understanding of the water environment and the NRA's work.
- To improve efficiency in the exercise of the NRA's functions and to provide challenge and opportunity for employees and show concern for their welfare.



**EXECUTIVE SUMMARY**



## 1. PURPOSE

This chapter explains (a) the purpose of the Research and Development Strategy, (b) the business-related needs which the NRA's R&D programme supports, and (c) the Corporate Planning Framework within which the NRA's Strategic Programme fits.

### 1.1 Introduction

This R&D Strategy sets out the strategic framework within which the R&D support service will develop and operate over the ten year period from April 1992. As a strategic planning document, it explains the long-term objectives of the R&D support service and how these will be attained. It provides broad statements explaining the present position of R&D within the NRA, and identifies the key issues, objectives and targets which the R&D programme will address. It also sets out key issues which the NRA will consider in developing the R&D management framework, particularly the approach to performance monitoring and the links between the customer and the programme management. It identifies the general level of resources needed for implementation of all this.

It is anticipated that the readership of the R&D Strategy will include both NRA staff and external organizations. The strategy sets out an overall approach, not a detailed plan. This detail will be contained by the business plans that will be produced to underpin each core function Strategy. It thus forms a framework within which the R&D programme is reviewed and developed annually, and a basis for the development of the R&D support service within the Corporate Planning Process.

The NRA's annual Corporate Plan will set out the targets and priorities for each core function and support service in any one year, and the resources allocated for achieving these. Details of the programme of individual R&D projects to be undertaken in any year will be given in the Schedule of On-going Projects and Proposed New Starts, which is available internally from the R&D Section, Chief Scientist's Directorate at NRA Head Office. Details of the R&D management framework are explained in Guidance Notes produced by the R&D Section.

Summaries of key details of the R&D programme to be undertaken in the current year and outputs of the R&D programme in the immediate past year will be published annually by the NRA in its Annual R&D Review.

### 1.2 Basis of NRA R&D Programme

To have an effective R&D programme is an essential element in the business of an organization such as the NRA. The overall purpose of the programme is to make the organization more efficient and effective in its operation, and proactive with regard to both the problems it has to tackle and the changing statutory framework within which it operates. As environmental pressures rise and public awareness of the environment increases such an approach will become vital for the successful solution to a wide range of problems.

The importance of ensuring that the NRA has a properly structured approach to R&D - outside, but related to, its day-to-day operational duties - was recognized prior to the NRA's formation. The Water Act 1989 placed a duty on the NRA, in Section 143, to "make arrangements for the carrying out of research and related activities (whether by the Authority or others) in respect of matters to which the functions of the Authority relate". This has been further enhanced by Sections 2 and 3 of the Water Resources Act 1991.

### What is Research and Development?

Research and Development projects generally address processes, principles, procedures or broad approaches concerning matters of national interest to the NRA. R&D work also usually contains an appreciable element of innovation. R&D is funded centrally through NRA Head Office and benefits all Regions.

#### Primary Purposes of R&D

R&D will be undertaken by the NRA for one or more of the following Primary Purposes:

- to improve its ability to carry out statutory duties;
- to improve its efficiency or effectiveness in carrying out its business;
- to support its policy development;
- and
- to increase its general knowledge and understanding, particularly related to the aquatic environment.

It is recognised, however, that more site-specific research, known as Operational Investigations, will be required to address Regional problems. OIs may provide information to aid decision-making an operational strategy or investment in improved facilities. Operational Investigations are funded by the Region concerned through its operational budget.

#### Types of R&D

In common with UK Government departments and agencies, the NRA classifies R&D type by the OECD Frascati definitions. The four categories cover a spectrum ranging from "Basic" research, where the end use of the output is not defined, through "Applied" research, where the output is targeted towards either broad "Strategic" or clearly-defined "Specific" aims, to "Development" which involves drawing together the outputs from research with existing knowledge and/or experience. In addressing its business needs, R&D undertaken by the NRA will fall primarily into (a) Applied Research with Specific objectives, and (b) Development categories. To facilitate more accurate descriptions of research activities the NRA has adopted the practice of joint Frascati classifications such as Applied Specific/Development.

Figure 1.1 Research and Development in the NRA

The NRA's statutory duties and responsibilities are undertaken through seven core functions, which form the "customers" for R&D. For the basic R&D programme structure (shown in Figure 1.2), work supporting each core function has been arranged into Commissions as follows:

- A. Water Quality (Control of Pollution)
- B. Water Resources
- C. Flood Defence
- D. Fisheries
- E. Recreation and Navigation
- F. Conservation
- G. Cross-functional Issues

R&D which supports several function areas - such as catchment management planning and enabling technologies - will be undertaken in Commission G. Each Commission is subdivided into Topic areas, each of which consists of projects which address a common Topic objective.

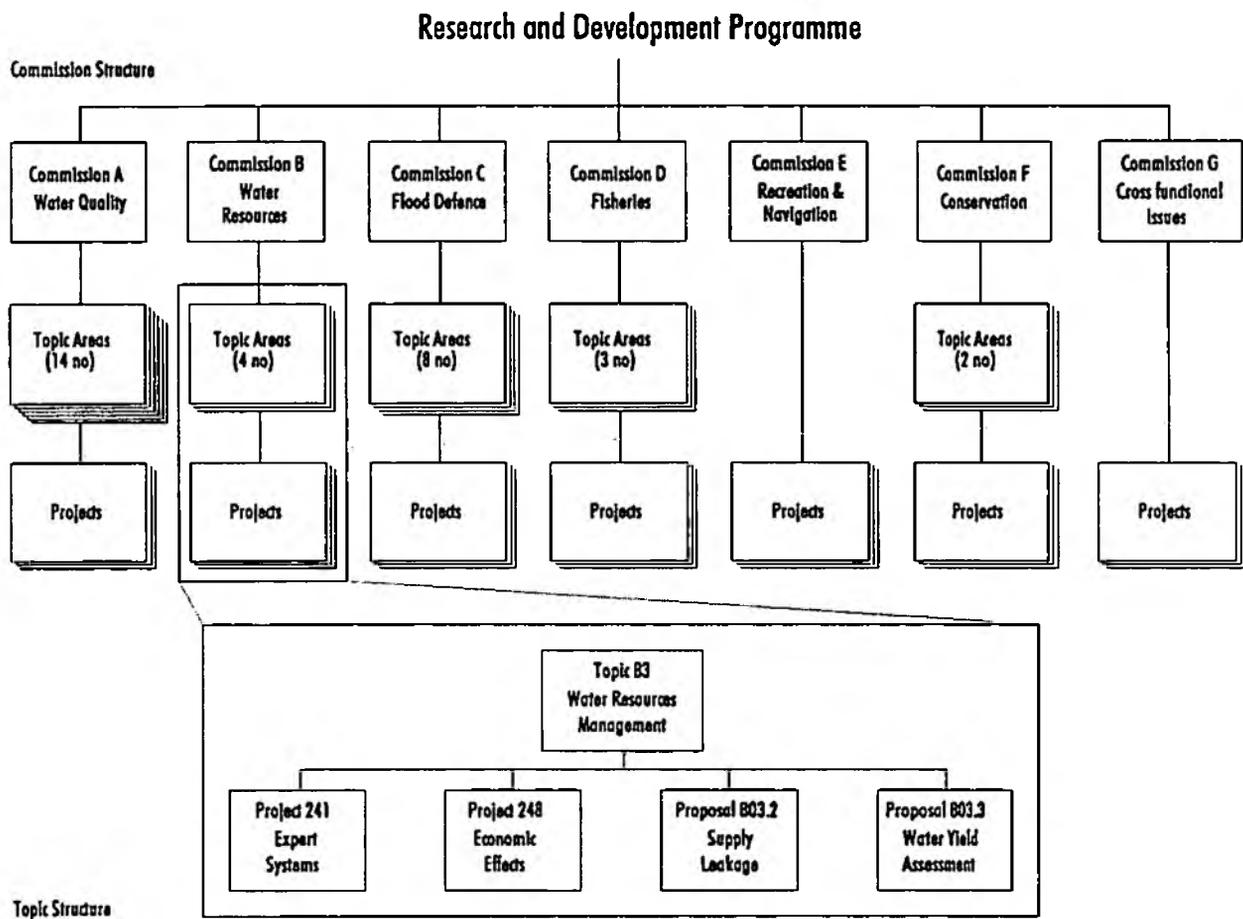


Figure 1.2 The Structure of the R&D Programme

The NRA's core functions are assisted by its support services, such as Finance and Personnel. Research and Development is also classified as a support service. The NRA will generally undertake R&D in support of its core functions, although R&D may be carried out to improve the efficiency or effectiveness of a support service such as a review of legal implications etc.

Overall responsibility for the management of the R&D programme lies with the Chief Scientist's Directorate in Head Office. In keeping with the concept of "customership" within each core function, in the Commission,

responsibility for identification and justification of R&D rests with the relevant Function Committee (FC). Beneath the FC lies a Commission management line of core function staff comprising Commissioner, Topic Leaders and Project Leaders as illustrated in Figure 1.3.

Project Leadership is thus devolved to core function staff in the different NRA Regions. Not to involve core function staff strongly in the identification and supervision of the R&D programme would run the risk of research becoming detached from its intended primary purpose.

The development of management responsibility (technical and financial) of projects to Regional core function staff gives rise to the need of R&D Co-ordinators to co-ordinate R&D management issues in each Region. These staff have been reporting links along a Programme management line through the Regional R&D Contact Points to the Regional Management Teams and are responsible for managing their portfolio of projects (Figure 1.3).

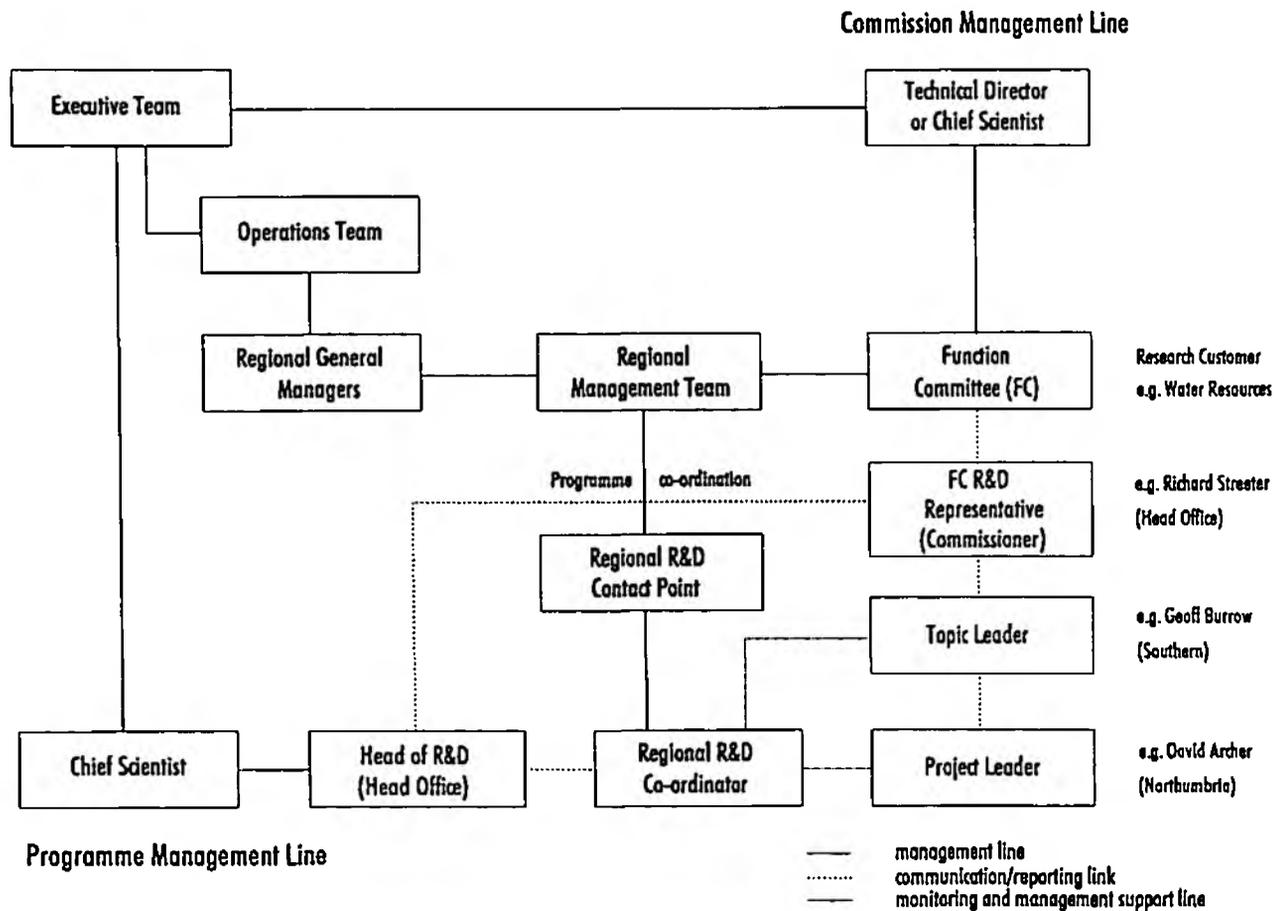


Figure 1.3 R&D Management in the NRA

### 1.3 Corporate Planning Framework

The specific responsibilities of each core function, and certain support services such as R&D, are laid down in the Water Act 1989, Water Resources Act 1991 and related UK and EC statutory requirements. At the strategic and policy level, these are reflected in a hierarchy of:

- (a) Mission Statement - which sets out the NRA's overall purpose and management philosophy.
- (b) Aims - which state in general terms what the NRA is seeking to achieve in each core function and support service.
- (c) Objectives - which state in specific terms what the NRA intends to achieve and where it intends to direct its activities in support of either a core function or support service over a period of time.
- (d) Targets - which are steps, quantified numerically or in time, towards specific objectives or other goals.

Each core function and support service strategy has identified Strategic Objectives and Targets. Those which give rise to programmes of supporting R&D to fill gaps in knowledge currently available to the NRA are discussed in Chapter 3, together with Strategic Objectives and Targets related to the development of the R&D Management Framework.



## 2. PRESENT STATUS OF THE R&D SERVICE

This chapter describes the position with the development of the R&D support service at the time of producing the R&D Strategy in December 1991.

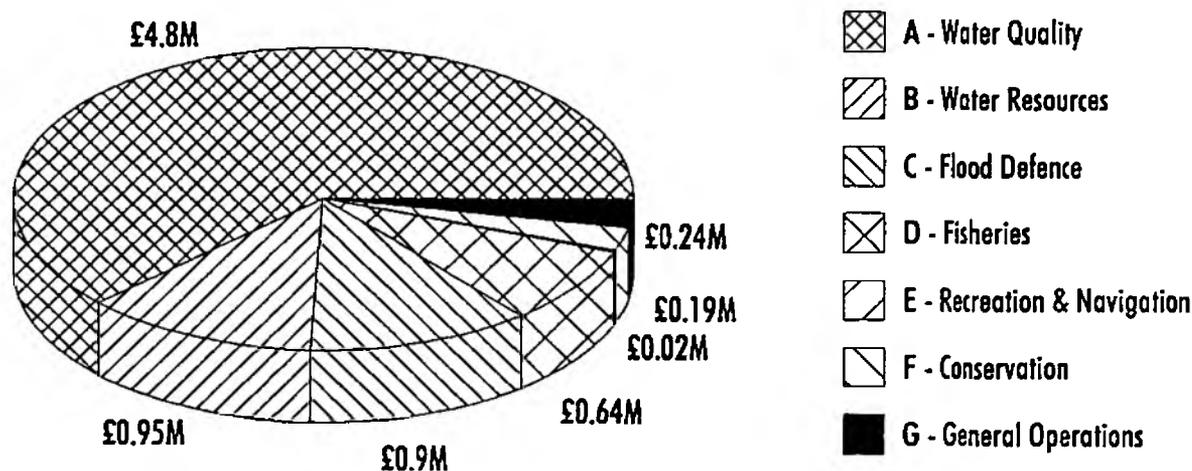
### 2.1 R&D programme

In September 1989 on vesting, the NRA took over from the Regional Water Authorities their own regionally-managed programmes of research and investigations. This included a substantial programme of water quality-related research at WRc together with a varied programme of regional Operational Investigations (as defined in Figure 1.1). In April 1990, the DoE transferred to the NRA a range of projects from their freshwater, marine and groundwater quality programmes. The DoE projects were not operationally-orientated although they did, of course, fall within the NRA's areas of responsibility. The costs of these inherited programmes are shown in Table 2.1.

Table 2.1 Costs of Inherited R&D Programmes (£k)

	1989/90	1990/91	1991/92	1992/93
At WRc	2910	2460	1580	30
DoE	1250	1380	900	30

All core functions have developed, to differing degrees, their Commission programmes. The breakdown of the £7.7M 1991/92 R&D budget in the seven Commission programmes is shown in Figure 2.1. (The budget has been revised from the £9.2M shown in the NRA's second Corporate Plan).



Note: Commission G renamed Cross-functional Issues from 1992/93

Figure 2.1 R&D Project Costs by Commission 1991/92

By far the largest programme is Commission A - Water Quality where not only was there a strong tradition of supporting the WRC programme in similar areas under the Regional Water Authorities but major policy and operational developments such as the Water Quality Objectives scheme are also being underpinned by the NRA's R&D programme. Dealing with the inherited R&D programme has to some extent influenced the resources which the NRA has committed to new research in its initial years. New projects started since vesting have largely been short-term responses to strongly perceived operational needs rather than being part of a long-term strategic programme. Nevertheless, in several areas (such as Flood Defence operational management and Water Quality ecotoxicology), core function staff have identified clear long-term needs for the NRA and have embarked on strategic programmes. Such strategic plans have generally been based on an overview and programme definition study within the Topic Area concerned.

New procedures have been developed to enable Regions to interface effectively their Regionally-driven programmes of Operational Investigations with the R&D programme. Regions are able to designate key Operational Investigations where the results (such as a new method used for a site investigation) are of benefit to other Regions as "Operational Investigations, Reported Nationally". Also, the output from an Operational Investigation may be developed for national benefit with R&D funding as "Part Operational Investigation/part R&D". Nevertheless, there still appears to be many issues which are being considered on a Regional basis, where the basis might usefully be developed as a national initiatives.

All core function Managers and/or their designated representatives have taken an active role in developing, for their Commission, a strategic R&D programme by examining the issues raised by their own core function strategies and identifying the gaps in application which need to be addressed by a strategic R&D programme. There has been notably less strategic development in cross-functional issues where the lack of identifiable "customership" has constrained the development of R&D support.

All core functions have now found that well-targeted R&D projects are able to support the achievement of operational objectives. In this respect, it is only as R&D outputs begin to be used, that confidence in the R&D support service is developed. Also, the sense of "ownership" of each Commission programme by the relevant Function Committee still needs to be developed (and will further improve with the completion of the inherited programme) to the extent that each core function is confident that the R&D programme is fully prioritised and orientated towards its Function targets and objectives.

## **2.2 R&D management**

The development, within the NRA of an effective framework for R&D management has been progressed well. This has been partly because only a few Regions had well-established R&D procedures on vesting. In addition, the management framework has been well described in the various interim procedures which have been issued to staff.

The concept of R&D Assessment (through the ROAME principles) - comprising programme Rationale and Objectives, project Appraisal prior to commencement; Monitoring during the course of the project; and post-project Evaluation - is central to the NRA's approach to R&D Management. In order to provide a common basis for management information across Commissions and Topics, and across Regions and Head Office, a pc-based R&D Information System has been developed. The present R&D Information System runs on dBASE IV, and an upgraded version is being planned for end 1993/94 in conjunction with Phase 2 of the development of the Integrated Personnel and Accounting System.

At present around 95% of the R&D Programme is contracted out to Research Contractors, as distinct from being undertaken in-house by NRA staff. The concept of having acknowledged external Centres of Expertise ("Primary Contractors") for undertaking major programmes of research has been developed, but links between the relevant NRA R&D core function staff and these organizations have yet to develop to the extent that Researcher and Customer each fully understand the other's perspectives.

The proactive approach to R&D programme development within each core function's operational objectives necessarily involves core function staff to a greater degree than would be the case for a programme of less operationally orientated research. Core functions and Regions have yet to fully assimilate this ethos, which

consequently makes it more difficult to resolve related priorities on core function staff time and to accept the need to resource the Commission management line (Section 1.2 and Figure 1.3 refers).

### 2.2.1 Dissemination of R&D outputs

There is a consensus that the effective dissemination of R&D is one of the most important aspects of R&D management. Research reporting in the Water Industry was, in the past, strongly orientated towards the researcher, and the search for scientific knowledge, as distinct from the end-use of the results. The success of the NRA's R&D programme depends on the results being targeted at, vetted by, and taken up through the operational end-user.

Procedures have been introduced to improve reporting style (see NRA Guidelines on R&D Report - R&D Note 1) and to publicise as widely as possible, both internally within the NRA and externally, the current year's R&D Programme and the previous year's outputs through the Annual R&D Review. In addition, procedures have been put in place to ensure that the path by which the R&D output is disseminated is determined at an early stage.

## 2.3 Interfaces with other research-commissioning organizations

The effectiveness of the NRA's R&D programme depends, in part on the extent to which it links into the programmes of other R&D-commissioning organizations, and interfaces with the underlying scientific and technical basic and applied strategic research base. The NRA has already initiated, and intends to maintain, contact with the following organizations:

- DoE (e.g. Water Directorate)
- MAFF (e.g. Acker's Committee)
- Scottish and Northern Ireland regulatory bodies
- Research Councils (NERC, SERC, AFRC and ESRC)
- Water Industry (particularly Foundation for Water Research)
- European Institute of Water

Links need to be developed with European organizations having similar aims to the NRA, and with the EC.

The NRA has recognised the need to support actively the scientific and technical research community which underpins and, in part, sustains its own R&D programme.

The NRA Research Fellowship Scheme was launched in 1991 with the award of six Fellowships to post-doctoral staff at Higher Education Institutes undertaking basic and/or applied strategic research within designated Key Subject Areas.



### 3. KEY ISSUES

#### 3.1 Programme Development

##### 3.1.1 Introduction

The NRA's core functions have, through the Corporate Planning process, identified those issues that are likely to be foremost in their strategic planning and future operations. Certain of these issues represent gaps in current knowledge and information and, as a consequence, will form the basis of a future R&D programme aimed at providing support for the core functions. In addition to those specific issues identified through the core function strategies a number of further key issues have arisen that cover more than one area of the NRA's duties. By their very nature these "pan-NRA" key issues are of prime importance to the NRA and, as a consequence, they have been separated from the more core function-specific issues.

As indicated above the current R&D programme has a short-term tactical bias with many projects producing state-of-the-art reviews, problem definitions, or statements of need. The identification of long-term key issues will assist the development of the R&D programme and provide a basis from which the emphasis of the programme will change towards a more strategic approach. This process will inevitably be one of gradual change with an eventual balance being achieved between the strategic elements and the more tactical aspects of the programme. However, the key issues as identified by the core functions will provide guidance with respect to future project development. The R&D programme itself will not be so rigid as to preclude those areas of tactically-orientated R&D that, whilst not currently apparent, will almost certainly arise over the lifetime of this Strategy.

The key issues that have arisen up to the time of writing this strategy, both from the core functions and as pan-NRA issues are detailed below.

##### 3.1.2 Water Quality

The duties and responsibilities placed on the NRA through Sections 103 to 124 of the Water Act 1989 and Sections 82 to 104 of the Water Resources Act 1991 with respect to its Water Quality core function have provided the primary source of many of the key issues. In addition the NRA has also identified corporate planning aims and objectives which, due to their long-term nature, will require future R&D if they are to be addressed appropriately. The key issues and related R&D will, therefore, support the corporate aims of the NRA.

The main themes of work within each key issue have also been identified and these are set out below.

#### Key Issues

1. Water Quality Objectives and Standards
2. Monitoring Strategies and Technology
3. Consenting Procedures
4. Pollution Prevention and Alleviation
5. Water Quality Processes

#### Corporate Planning Aims

- To achieve a continuing improvement in the quality of river, estuaries and coastal waters through the control of pollution
- To ensure that dischargers pay the costs of the consequences of their discharges and, as far as possible to recover the costs of water environment improvement for those who benefit

### Key Issue 1 : Water Quality Objectives and Standards

The primary issue for Water Quality will be the implementation and subsequent monitoring of water quality objectives and the associated standards. Information and techniques will be required for assessing the chemical and biological quality of controlled waters, the ecotoxicological effects of effluents and the epidemiological effects of contact with fresh and saline waters. Information will also be required to determine the potential benefits of different water quality standards.

### Key Issue 2 : Monitoring

The development and subsequent implementation of future monitoring and analysis programmes is an essential strategic objective for the Water Quality function. New approaches to designing monitoring strategies, more accurate and cost-effective instrumentation, improved analytical methodologies and enhanced data analysis and presentation techniques will be required to support the function in its operational duties.

### Key Issue 3 : Consenting

The "Kinnersley" report identified those areas of current consenting practice that may need revision in the future. Issues such as the use of alternative determinands to BOD and suspended solids and the value of toxicity-based consents for use with complex effluents will require further investigation. The development and use of mathematical models for consent determination together with new procedures for consenting intermittent discharges such as storm overflows will also form part of the consenting issue.

### Key Issue 4 : Pollution Prevention and Alleviation

Enhanced techniques, both managerial and operational, for preventing and alleviating pollution incidents have been identified as essential future requirements by the Water Quality function. The techniques will need to cover the extent and effect of diffuse sources of pollution, the use of water protection zones and other prevention strategies. New information and knowledge will also be required concerning all aspects of eutrophication and the related algal problems.

### Key Issue 5 : Water Quality Processes

It has been recognised that, if improvements are to be made to water quality, an understanding of the fundamental water processes will be a prerequisite. Consequently, information on the fate of chemical contaminants, the natural self-purification properties of water, the aquatic biology and physical processes of water will be required. Catchment accountability models that identify the sources, sinks and budgets of contaminants in a river system will also be needed.

### 3.1.3 Water Resources

The duties and responsibilities placed on the NRA through sections 125 to 135 of the Water Act 1989, Sections 19 to 81 of the Water Resources Act 1991 and the Water Resources Act 1963 with respect to its Water Resources core function have provided the primary source of many of the key issues. In addition the NRA has also identified corporate planning aims and objectives which, due to their long-term nature, will require future R&D if they are to be addressed appropriately. The key issues and related R&D will, therefore, support the corporate aims of the NRA.

The main themes of work within each key issue have also been identified and these are set out below.

**Key Issues**

1. Water Resource Planning and Management
2. Hydrometry
4. Groundwater and Source Protection
3. Low Flows and Abstractions

**Corporate Planning Aims**

- To assess, manage, plan and conserve water resources and to maintain and improve the quality of water for all who use it.

**Key Issue 1 : Water Resources Planning and Management**

The planning for water resource development will be an important issue for the NRA and will require a comprehensive understanding of many widely differing aspects. Methodologies will be required for the forecasting and subsequent management of water demand together with models to provide an enhanced predictive capability. Assessments will also be required of the validity and methods by which water may be transferred from one area to another. Pricing aspects of water resources activities will also be an important area of future work. Improved operational and maintenance practices will be provided as will a water resources database. There will also be a requirement for new assessment methodologies aimed at determining the extent and impact, both in terms of the environment and NRA resources, of drought conditions.

**Key Issue 2 : Hydrometry**

The provision of accurate and precise hydrometric information is and will continue to be essential for the Water Resources core function. There will be four main areas which will be addressed. Appropriate standards for collecting and validating data will need to be determined together with the development of existing instrumentation for measuring the hydrological variables. The development of improved hydrometric networks will also be important as will be the enhanced capability for handling the data collected.

**Key Issue 4 : Low Flows and Abstraction**

The alleviation of low flows caused as result of over abstraction or bed leakage will be a central aspect of Water Resources activities. Methodologies will be required to determine the environmental consequences of low flows and techniques will be required to alleviate the dissipation of water through river beds. A comprehensive understanding of abstraction regimes and the impacts of water impoundments will also be a central theme to this issue.

**Key Issue 4 : Groundwater and Source Protection**

The Water Resources Strategy has identified the protection of the quality of waters as being an important issue in maintaining and developing a sustainable water resources strategy. The development of methodologies for the protection of groundwater supplies will be required as will approaches to specifying water protection zones, vulnerable zones and nitrate sensitive areas. The development of sound sampling regimes capable of providing the NRA with information for water resource management will be essential.

### 3.1.4 Flood Defence

The duties and responsibilities placed on the NRA by the Water Act 1989 and the Land Drainage Act 1976 with respect to its Flood Defence core function have provided the primary source of many of the key issues. In addition the NRA has also identified corporate planning aims and objectives which, due to their long-term nature, will require future R&D if they are to be addressed appropriately. The key issues and related R&D will, therefore, support the corporate aims of the NRA.

<u>Key Issues</u>	
1.	Investment Planning
2.	Standards and Specification
3.	Emergency Planning and Response
4.	Planning and Development Control
5.	Processes

<u>Corporate Planning Aims</u>	
•	To provide effective defence for people and property against flooding from rivers and the sea
•	To provide adequate arrangements for flood forecasting, warning and for responding to flood events.

The main themes of work within each key issue have also been identified and these are set out below.

#### Key Issue 1 : Investment Planning

Effective methods of asset management will be required if the benefit of the NRA's Flood Defence assets are to be maximised. The development of appropriate work programmes within which flood defence works both in the coastal and fluvial environment can be constructed, operated and maintained will enhance the effectiveness of asset management. The most appropriate operational management techniques and maintenance procedures required for the implementation of assets will need to be determined. Procedures will subsequently be required to determine precisely how effective the asset management process is in terms of both post-project appraisal and the operational and maintenance activities.

#### Key Issue 2 : Standards and Specification

The setting and reappraisal of appropriate standards of flood protection for different land use classes will be of prime importance for the Flood Defence core function particularly in the coastal zone where little work has been undertaken to date. To ensure that such standards are met design criteria will be required to provide a framework within which both hard and soft engineering options can be developed. This latter option will become particularly important in the future. The development of procedures to assess a structure's risk of failure and the respective threat of flooding will also be required to assist in the specification of standards of service. Options and strategies for coastal zone management will need to address the sea defence coastal protection interface and will require further research.

#### Key Issue 3 : Emergency Planning and Response

The NRA has a stated aim to provide for emergencies and this has been subsequently identified by the Flood Defence core function as a priority issue for R&D. A strategy and framework within which emergency planning procedures may be developed will be required as will appropriate service requirements to ensure

that emergency plans are implemented successfully. Enhanced capabilities for the forecasting of floods both through weather and tidal forecasting will also be required together with new and improved technology for the provision of subsequent flood warnings.

#### Key Issue 4 : Planning and Development Control

It will be important for Flood Defence to regulate activities in flood-risk areas. The statutory approaches facilitate in this regulation and the planning liaison by which it is achieved will need to be addressed and constantly reviewed. It will also be important to develop new methods of collecting information on the extent of the floodplain and the distribution of developments and those environmentally-sensitive areas within it. Effective measures will also need to be developed to control urban run-off particularly in small catchments. Further development of both the Main and Non-main River Strategies will be also needed to assist the planning and development process as well as to underpin the Standards of Service key issue identified above.

#### Key Issue 5 : Processes

The development of the NRA's understanding of the extent to which environmental change may affect Flood Defence activities will also be a key issue for future R&D. In the coastal and estuarial zone the research will need to address the extent and effects of storms and tidal surges and the progression of waves from offshore to inshore waters. The movement of water in the fluvial environment will also be important and further work will be required to improve the current understanding and ability to model the hydrology and hydraulics of the water environment. A further area to be addressed will be the morphology of rivers and morphodynamics of the coastal zone. The impact of Flood Defence activities upon the water environment will also need to be addressed.

### 3.1.5 Fisheries

The duties and responsibilities placed on the NRA through Section 141 of the Water Act 1989, Sections 114 to 116 of the Water Resources Act 1991 and Section 28 of the Salmon and Freshwater Fisheries Act 1975 with respect to its Fisheries core function have provided the primary source of many of the key issues. In addition the NRA has also identified corporate planning aims and objectives which, due to their long-term nature, will require future R&D if they are to be addressed appropriately. The key issues and related R&D will, therefore, support the corporate aims of the NRA.

The main themes of work within each key issue have also been identified and these are set out below.

<u>Key Issues</u>	
1.	Fisheries Resource
2.	Environmental and Biological Influences
3.	Fisheries Management

<u>Corporate Planning Aim</u>
• To maintain, improve and develop fisheries

#### Key Issue 1 : Fisheries Resource

A feature central to the strategic planning of the Fisheries core function is the baseline data concerning the fisheries resource. There will be a requirement for improved methodologies and instrumentation to

assess the size and health of fish stocks in rivers, estuaries, and , where appropriate, coastal waters and stillwaters. In addition, techniques will also be needed to determine the distribution, both spatial and temporal, of fish stocks. A objective fishery classification scheme will also be developed to enable the periodic evaluation of the fishery resource. In addition the economic aspects of maintaining and improving fisheries resources is an essential factor in decision making. There will be a requirement to place these factors within some framework such that they may become part of the basic decision making process.

#### Key Issue 2 : Environmental and Biological Influences

The identification of the environmental and biological factors that affect the size, distribution diversity and health of fish stocks will be a strategic key issue. Factors such as disease, predators, exploitation and migration patterns are all important in assessing the levels of fish stocks. The impact of water quality upon the fishery resource will need to be assessed as will the effect of water quantity, including the impact of low river flows. In addition further information will be required concerning the factors likely to affect the habitats of both common and rare fish species.

#### Key Issue 3 : Fisheries Management

Fisheries management strategies will be required to protect and, wherever possible, enhance the current fishery resource. It will be important to determine appropriate levels of service for such protection and enhancement. Since rapid response to emergencies that may threaten fish stocks will be essential detailed guidance covering emergency and alleviation procedures will be required. A measured response to longer term problems affecting the fishery resource will dictate the need for methodologies for fishery planning. The development of tracking equipment and methodologies will be essential tools for the effective management of fisheries.

#### 3.1.6 Recreation and Navigation

The duties and responsibilities placed on the NRA through Sections 8, 10 and 157 of the Water Act 1989 with respect to its Recreation, and through section 158 of the Water Act 1989 and various other local Acts with respect to its Navigation core functions, have provided key issues outlined below. In addition the NRA has also identified corporate planning aims and objectives which, due to their long-term nature, will require future R&D if they are to be addressed appropriately. The key issues and related R&D will, therefore, support the corporate aims of the NRA.

<b>Key Issues</b>
1. Recreation Management and Operations
2. Navigation Management and Operations

<b>Corporate Planning Aims</b>
• To develop the amenity and recreational potential of waters and lands under the NRA's control
• To improve and maintain inland waterways and their facilities for use by the public where the NRA is the navigation authority

The main themes of work within each key issue have also been identified and these are set out below.

#### Key Issue 1 : Recreation Management and Operations

The NRA will ensure that existing NRA recreation sites are managed and maintained to an appropriate

standard. Alternative management options and maintenance techniques will be required to maximise the effectiveness and efficiency of these tasks. An assessment of the social and economic costs of recreation activities will assist future prioritisation. Appropriate techniques will also be required to realise the potential of NRA sites not currently used for recreational activities. The promotion of recreation on non-NRA sites will dictate the need for liaison with other organisations and user groups. The best approaches to such liaison will need to be addressed. The incorporation of recreational criteria within the Water Quality Classification Scheme will provide a safeguard for certain types of recreational activity.

#### Key Issue 2 : Navigation Management and Operations

An assessment of the extent and causes of bank erosion will also be required and will give rise to the need for further development of bank protection systems. Improved management and engineering approaches together with operational techniques for the construction and running of navigation facilities will be an important future area of work. The marketing of NRA navigation facilities and activities will give rise to a potential increase in revenue from this area. As a consequence the most promising areas of marketing will need to be investigated.

#### 3.1.6 Conservation

The duties and responsibilities placed on the NRA through Sections 8 and 10 of the Water Act 1989 with respect to its Conservation core function have provided the primary source of many of the key issues. In addition the NRA has also identified corporate planning aims and objectives which, due to their long-term nature, will require future R&D if they are to be addressed appropriately. The key issues and related R&D will, therefore, support the corporate aims of the NRA.

##### Key Issues

1. Conservation Resource Appraisal and Impact Assessment
2. Conservation Management

##### Corporate Planning Aim

- To conserve and enhance wildlife, landscape and archaeological features associated with waters under NRA control

The main themes of work within each key issue have also been identified and these are set out below.

#### Key Issue 1 : Conservation Resource Appraisal and Impact Assessment

To facilitate Conservation surveys improved techniques and strategies need to be developed for inland waters, estuaries and coastal areas. A classification system will also be required for assessing the extent, diversity and health of the conservation resource. In addition to the general survey methodologies indicated above there will also be a requirement for more specialised techniques capable of providing information on the habitats of rare species. There will be a considerable need for assessment methodologies for determining the extent to which various factors affect the conservation resource and wetlands in particular. Predictive capabilities will be required to determine the value of the conservation resource particularly in relation to Environmental Quality Objectives. The influence of both water quality and water quantity on species numbers, health, distribution and diversity will also need to be evaluated. Guidelines will also be required in order to determine the effect of engineering and maintenance activities both in and adjoining a watercourse.

## Key Issue 2 : Conservation Management

In keeping with all activities the NRA will operate its Conservation core function in an efficient and effective manner. To facilitate this improved approaches to the management of the conservation resource will be required. Such approaches will also need to address the specialised problems of managing rare species in order to reduce the impact caused by interfering species. conservation and will be developed in conjunction with outside bodies. Included within these management approaches will be an audit methodology for assessing the effectiveness of conservation activities. The rehabilitation of urban and other degraded habitats is a key issue for the Conservation core function generally and will require research to underpin the functions activities.

### 3.1.8 Pan-NRA Issues

The operational and planning activities of the NRA are centred around the seven core functions and, as described above, the management of the R&D programme is similarly organised. However, there will be issues which face the NRA generally (or more than one core function) and these may also require research in order to address them in an effective manner. Such "pan-NRA" key issues will not fall within the Commissions identified above for the core functions but accommodated in under and General Operations heading. These issues may address a range of corporate planning objectives and yet will be too specific to develop any themes. Those pan-NRA key issues identified as having strategic importance to the NRA are described below.

## Key Issue 1 : Catchment Planning

In undertaking its duties the NRA will need to ensure that problems and opportunities are addressed on the appropriate scale. Effective guidelines will be required to bring together the expertise of all core functions in solving problems or exploiting opportunities on a catchment as opposed to a more local scale. In addition to the guidelines which will need to provide the overall framework for catchment planning the techniques and methods by which the process is undertaken will also need to be addressed. Such methods will include developing standards lists of uses to which the water environment is or will be put together with techniques for assessing the validity of protecting such uses.

<u>Key Issues</u>	
1.	Catchment Planning
2.	Climate Change
3.	Enabling Technologies
4.	Environmental Impact Assessments
5.	Land Use Change & Management
6.	Public Perception & Education
7.	Statutory and Institutional Issues
8.	Social and Environmental Economics

<u>Corporate Planning Aims</u>
<ul style="list-style-type: none"> <li>• To improve public understanding of the water environment and the NRA's work</li> <li>• To improve efficiency in the exercise of the NRA's functions and to provide challenge and opportunity for employees and show concern for their welfare</li> </ul>

## Key Issue 2 : Climate Change

The NRA will need to assess the likely impact of any climate change scenario upon each of the core functions as well as upon other key issues such as land use change. The likely impact of climate change

upon the levels of water in all controlled waters (e.g. in relation to dilution of discharges and abstraction levels) will need to be assessed together with any increase in storminess or sea-level rise (e.g. as it may relate to increased flooding). The rate of erosion will also need to be monitored particularly if farming practices alter as a result of global warming and any changes in species (of fish, plants or invertebrates) or habitats will also require assessment. Evapotranspiration and the implications of climate change upon this process will be investigated.

#### Key Issue 3 : Enabling Technologies

The NRA will need to keep abreast of all technologies that may assist its staff in undertaking their duties more effectively and/or efficiently. Such technologies may include mathematical modelling, information technology, remote sensing and geographical information systems. The incorporation of such technologies will be essential for the effective development of both the staff and the NRA as an organisation.

#### Key Issue 4 : Environmental Impact Assessments

The impact of various forms of development on the water environment will require a coordinated assessment if the NRA is to be able to determine its stance. Such developments may include long-sea sewage outfalls, tidal barrages or marinas. These developments will impact upon all NRA core functions and as such guidelines will be required within which the NRA will be able to assess any likely impact. Such guidelines will enable a coordinated standpoint to be adopted by all Regions in response to similar developments.

#### Key Issue 5 : Land Use Change and Management

Land use change and the management thereof will be particularly important to the NRA since many of the problems experienced by the water environment are as a result of land use practice. Particular importance will be the land use in and surrounding water protection zones and nitrate sensitive areas. Additionally the development of land for non-agricultural purposes will undoubtedly affect the run-off and hydrological characteristics of the area. This will be of prime importance to the Flood Defence core function in relation to its planning and development control responsibilities as well as in preventing and controlling flooding. The changes in land use will also impact upon the conservation value of the area and the diversity and numbers of fish present in adjoining watercourses. An overall assessment will be needed to determine the impact of land use change upon all of the core functions.

#### Key Issues 6 : Public Perception and Education

The NRA will need to ensure the general public are kept apprised of both its actions and its responsibilities. To achieve this effectively the public's perception of the NRA will need to be constantly determined and techniques will need to be developed to ensure that such a perception will be assessed in a coordinated manner across all Regions. The NRA will also need to educate the public in general matters relating to the water environment as well as more specific matters such as the development of flood protection schemes, charging policy, fish returns for example.

#### Key Issue 7 : Statutory and Institutional Issues

The NRA acts within an ever changing legal framework, responding to legislation from the EC and the UK Government. In order that it can operate in the most effective and efficient manner the NRA will need to influence, wherever possible, any relevant legislation and have a substantial input to consultations on European legislation such as EC Directives. A responsive assessment of all consultation documents, parliamentary bills, white papers and EC Directives will be required. To achieve this a framework within which the impact of such issues can be assessed needs to be developed.

## Key Issue 8 : Social and Environmental Economics

All R&D will enable the NRA will discharge its duties in an effective and efficient manner. Further work will be required to directly assess the efficiency of its operations as well as being able to place an economic and/or social cost on activities within the water environment. This work will need to provide a proven approach to assessing such economic variables.

### **3.2 Development of the Management Framework**

This section of the R&D support service strategy sets out the key issues related to the structure and management of the R&D programme which the NRA considers to need to be addressed. These fall within four strategic areas:

- Commission management
- Programme management
- Dissemination and outputs
- Liaison with external organizations

#### **3.2.1 Commission Management**

The NRA has made a major advance in involving its core functions in the ownership and management of its R&D programme. The duties of Commissioner, Topic Leader and Project Leader, however, place additional demands on core function staff who are heavily involved in operational duties. Practical ways need to be developed for assisting with the resourcing of these R&D inputs - both in terms of the cost to the Region concerned and the additional resources needed if these R&D inputs are to be sustained in the long term.

Topic Leadership can place heavy demands on individual core function staff, particularly in keeping abreast of the state-of-the-art. Pressures of other work within the core function can dictate the pace at which Topic programmes are developed. Development of R&D programmes has been observed to work well if the Topic structure is integrated with, and supported by, a function working group which can address both operational and R&D issues. Other Topic programmes have been evolved by the Topic Leader contracting in additional technical expertise from outside the NRA to provide short-term support. Approaches such as these need to be widely considered.

The concept of ownership of the Commission programme needs to be adopted fully by each Function Committee. In addition, ways need to be found to give better recognition to function staff such as Topic Leaders and Project Leaders for their role in the development of the function.

#### **3.2.2 Programme Management**

The NRA needs to ensure that its approach to R&D management works effectively. Project management procedures must ensure that development and supervision of research is both adequate and timely, complies with the Financial Memorandum and without undue bureaucracy. Research assessment procedures are needed which enable the benefits of NRA R&D projects to be appraised and evaluated in the pre- and post-project situations

Post-project evaluation methods need to look at the uptake of R&D results by the NRA's core functions. These need to provide performance indicators which address not simply the effectiveness of R&D project management, but enable the value of the work to the NRA to be assessed. This is necessary to justify continued investment in R&D. The cross-functional approach must enable beneficiaries of R&D to be sufficiently well identified for R&D costs to be charged to the appropriate source of NRA income. Particular attention needs to be given to dissemination as described below.

The R&D Information System needs to be developed further to provide rapid transfer of technical and financial information on the R&D programme throughout the NRA's Regions.

The procedures adopted for the annual review of the programme need to be sufficiently open to enable new opportunities and problems to be addressed, yet must ensure that identified R&D customers develop the programme within the framework that this R&D support service strategy provides. Novel ways need to be considered to help core function staff to identify ways in which R&D can assist them. The programme must build effectively on, and not duplicate, existing knowledge and experience as well as R&D work undertaken by others.

Particular effort is needed to establish a flexible interface between the national R&D programme and Regional Operational Investigations. A screening process is needed to ensure that work appropriate for the R&D programme is not undertaken as a Regional Operational Investigation, and vice versa.

### 3.2.3 Dissemination and Outputs

The dissemination of research information is an essential component of the R&D process. As stated in Section 2.2.1, previous research programmes have produced outputs that have been written principally for the researchers. As the NRA is an operational organization which also has a strong requirement for policy development, outputs need to be identified, wherever possible, at the outset and in a format that can be readily disseminated and are capable of being used by NRA core function staff as the customer. In addition, the paths by which the outputs are disseminated could, in some instances, be more imaginative to ensure that the information gets through to the most appropriate audience.

### 3.2.4 Liaison with External Organizations

The NRA needs to further develop appropriate collaboration and interfacing between its R&D programme and those of other organisations involved in the water environment. Collaboration can provide not only financial benefits but also a broader base on which to develop and influence environmental policy and practice, both for the UK as a whole and within the EC. The NRA must develop an active and recognised position on environmental research internationally both to defend and advance its interests. Its policy on external dissemination needs to be further developed. The NRA must also develop a good understanding with academics and research institutions working in the basic and strategic research fields which underpin its own R&D programme. Particular consideration needs to be given to sustaining and targeting of underpinning research, and to possible ways of providing NRA support. The NRA also needs to ensure that its policy on the use of research contractors not only achieves cost-effectiveness but sustains a sound technical base for its future operations.



## 4. STRATEGIC R&D PROGRAMME

### 4.1 Introduction

This Chapter outlines the future strategic R&D programme that will be required if those key issues identified by the core functions and presented in Chapter 3 are to be adequately addressed. In addition those key issues concerning the management framework within which the R&D programme will be undertaken will also be addressed.

In general the development of an R&D programme is a continuous process. However, the production of best practice reviews, state-of-the-art reviews and project definition studies will form the basis of, and help to focus the initial strategic R&D programme.

The very nature of R&D dictates that many specified end-points will be uncertain and may not always be met. The timescales indicated on the strategic R&D programme will be inherently flexible and will inevitably be dependent upon the strategic targets set by the core functions. As a consequence programme continuation beyond the most distant strategic target will be subject to some uncertainty. The strategic targets will be identified by the core functions in their business plans which underpin the high-level strategies. As a consequence they have yet to be included within this strategy.

The R&D programme will continue to address those key targets identified by the "Customer". Only through this approach can the inherent benefits of the R&D programme be assessed effectively. The setting of strategic targets will, therefore, ensure that the R&D programme addresses the needs of the commissioning core function. They will also serve as convenient review points, in addition to the review period of this strategy, that will clarify or redirect the remaining R&D programme for the theme to which it relates. Such targets have been taken from the relevant core function Strategies. Some key issues addressing more basic areas of work, such as processes, may underpin other, more applied, issues and the strategic targets set will reflect this.

### 4.2 Core Function Strategic R&D Programmes

The preliminary strategic R&D programmes for each of the core functions, together with the cross-functional programme are presented in Table 4.1. Each key issue has been broken down into "Themes", thereby providing more information on what may be a reasonably wide subject area. As outlined above the stated objectives of any R&D programme may be subject to some change during the lifetime of the programme. As a consequence, the objectives provided for each theme should be treated only as a broad indication of the direction of the research.

The "anticipated benefits" provides an assessment of how the research for a particular theme is likely to impact on core function activity. It is recognised that the benefits of undertaking research may also extend to improving the technical knowledge of core function staff and providing improved information for management decision making and these are taken as being implicit in the benefits of all theme programmes.

The "potential outputs" provide an initial indication of how the end-product is likely to be taken up by core function staff. Reference should be made to Section 4.3.3 and Figure 4.1 for clarification of terms used in this section of Table 4.1.

**Table 4.1 Core Function Strategic R&D Programmes**

**Commission:** A - Water Quality

**Key Issue:** 1 - Water Quality Objectives and Standards

**Rationale:** To provide a firm scientific base for the development of Water and Environmental Quality Objectives and their associated standards

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
<p><b>a</b> <u>Chemical and Biological Methods</u> To develop methods for classifying the chemical and biological quality of all controlled waters. The expression of standards as statistics and the protection of aquatic life through appropriate standards will be assessed</p>											<p>The development of standards that are scientifically and economically justifiable. The benefits of early research will be a complete classification scheme and associated standards earlier</p>	<p>PIGN Operational Guidance Computer program Underpinning knowledge</p>
<p><b>b</b> <u>Ecotoxicology</u> To determine the ecotoxicity of substances to enable appropriate standards that protect aquatic life to be set. The ecotoxicity will be related to the health of indigenous species where possible</p>											<p>The effective protection of aquatic life from discharges of a wide range of substances. A sound basis from which to set toxicity-based consents, thereby reducing the cost of analysing for complex substances.</p>	<p>PIGN Operational Guidance Underpinning knowledge</p>
<p><b>c</b> <u>Epidemiology</u> To assess the health effects of water-contact sports in water polluted by sewage effluent. Standards for the microbiological content of waters both in terms of pathogenic and nonpathogenic bacteria and viruses will be developed.</p>											<p>The development of microbiological standards that protect the health of water-users. This will have high public benefit and will assist in the work towards the EC Bathing Waters Directive</p>	<p>PIGN Operational Guidance Underpinning knowledge Guidelines for others</p>
<p><b>d</b> <u>Environmental Cost Benefits</u> To develop methods for the appraisal of the benefits arising from setting particular water quality objectives. The disbenefits of setting inappropriate standards will also be determined</p>											<p>The most efficient use of NRA resources through the setting of appropriately targeted standards.</p>	<p>PIGN Operational Guidance Underpinning knowledge</p>

**Commission:** A - Water Quality

**Key Issue:** 2 - Monitoring Techniques and Strategies

**Rationale:** To enhance the NRA's ability to monitor the quality of controlled waters through improved instrumentation, analytical techniques and monitoring strategies

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Monitoring Strategies</u></b>            To provide guidelines for the design of monitoring programmes for controlled waters and effluents. The major emphasis will be on coastal waters where strategies have been least developed</p>										<p>The design of more effective sampling programmes and more efficient use of NRA resources.            The revision of existing strategies to remove any duplication</p>	<p>Operational Guidance            Procedural manual            Computer program</p>
b	<p><b><u>Instrumentation</u></b>            To develop enhanced instrumentation including hand-held and continuous field monitors to determine water quality. The assessment of all instrumentation at a common standard facility will also continue</p>										<p>Potential reduction in the number of routine samples for laboratory analysis and more effective field monitoring.            Coordinated approach to instrumentation development</p>	<p>Operational equipment            Operational guidance            Procedural manual</p>
c	<p><b><u>Analytical Techniques</u></b>            To enhance and develop analytical methods and quality control procedures for chemical, microbiological and biological determinands. The levels of detection to be lowered for substances of prime importance</p>										<p>Improved levels of detection and precision. Reduction in costs through improved quality control and in contracted services as more samples can be analysed by NRA laboratories</p>	<p>Operational Guidance            Procedural manual            Operational Equipment</p>
d	<p><b><u>Data Handling</u></b>            To develop new and existing approaches to statistical data analysis and information presentation. The work will assess computer presentation of water quality data</p>										<p>The more effective identification of problems and trends in water quality. A consistent national approach to the interpretation of water quality data.</p>	<p>Operational Guidance            Procedural manual            Operational equipment            Computer program</p>

**Commission:** A - Water Quality

**Key Issue:** 3 - Consenting Procedures

**Rationale:** To provide effective approaches to consenting part source discharges in order to achieve Water Quality Objectives

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
a	<p><b><u>Alternative Determinands</u></b>            To develop approaches to the use of alternative determinands in discharge consents. Alternatives to BOD and suspended solids will be assessed as part of the recommendations of the Kinnersley report</p>									More scientifically and environmentally defensible determinands for consenting use. An improved indication of the extent of pollution	PIGN Operational Guidance Procedural manual
b	<p><b><u>Toxicity-Based Consents</u></b>            To determine the appropriate criteria for including toxicity-based requirements within discharge consents. The benefits of toxicity-based consents for chemically-complex discharges will be studied</p>									A more accurate assessment of the toxicity of an effluent to the aquatic environment. A reduction in the number of samples requiring complex chemical analysis reaching NRA laboratories	PIGN Operational Guidance Procedural manual
c	<p><b><u>Mathematical Models</u></b>            To provide enhanced modelling capability through the development of existing and new mathematical models for aiding the setting of discharge consents. Models will be developed for both planning and reactive purposes</p>									More efficiently designed sample programmes and effective setting of consents for discharges. Improved models for assistance during pollution events	Computer program Operational Guidance Procedural manual
d	<p><b><u>Intermittant Discharges</u></b>            To determine appropriate methods of controlling intermittant discharges including combined sewage overflows. consenting procedures that take account of rainfall, retention time, quality and, where necessary, tidal state will be developed</p>									Improved protection for waters currently contaminated through intermittant discharges. Possible improvement in urban water quality in particular. Potential reduction in the costs of remedial action following pollution from such discharges.	PIGN Operational Guidance Procedural manual

**Commission:** A - Water Quality

**Key Issue:** 4 - Pollution Prevention and Alleviation

**Rationale:** To develop procedures for the prevention of pollution from agricultural, industrial and urban sources and remedial techniques where pollution incidents have occurred

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
a	<p><b><u>Prevention and Remedial Measures</u></b>            To develop methods of pollution prevention including hazard assessment together with remedial techniques such as oxygenation, the use of booms, fish rescue, detergents etc.</p>									A coherent pollution prevention strategy that is capable of reducing number of incidents. Effective and rapid measures of alleviating the effects of pollution	PIGN Operational Guidance Operational Equipment Procedural Manual
b	<p><b><u>Diffuse Sources</u></b>            To investigate methods of assessing and controlling the impact of diffuse sources of pollution. Aspects of agricultural practice and the effects of urban run-off on water quality will be determined</p>									An improvement in water quality through improved techniques for controlling diffuse pollution. Potential reduction in costs of remedial measures required for pollution from diffuse sources	PIGN Operational Guidance Guidelines for others
c	<p><b><u>Water Protection Zones</u></b>            To set out appropriate criteria for assigning water protection zones including the designation of nitrate sensitive areas.</p>									A defensible strategy for protecting sensitive areas of water quality. A potential reduction in the costs of any remedial measures required.	PIGN Operational Guidance Guidelines for others
d	<p><b><u>Eutrophication</u></b>            To develop the most appropriate methods of assessing and alleviating eutrophication in all controlled waters. The implications of the Urban Wastewater Directive will also be structured</p>									A reduction in the levels of nutrients entering the water system and associated reduction in the occurrence of toxic and non-toxic algal blooms	PIGN Operational Guidance Guidelines for others

**Commission:** A - Water Quality

**Key Issue:** 5 - Water Quality Processes

**Rationale:** To develop new knowledge and information on those chemical, physical and biological processes affecting the quality of controlled waters

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Chemical Processes</u></b> To determine the behaviour of chemical determinands in rivers, canals, lakes, estuaries, coastal and groundwaters. the processes involved from source to sink will be investigated</p>										A sound scientific basis upon which future consenting and monitoring practices may be based. Advanced warning of potentially difficult dterminands	Operational Guidance Underpinning knowledge
b	<p><b><u>Physical Processes</u></b> To assess the physical processes involved in the distribution and dispersion of pollutants in all controlled waters. The definition of mixing zones, time of travel, dispersion characteristics will be addressed</p>										Improved understanding of the physical processes involved in pollutant transport. More effective approaches to time of travel and other physical phenomena	Operational Guidance Underpinning knowledge
c	<p><b><u>Aquatic Biology</u></b> To improve the present understanding of these factors affecting the aquatic biology. The use of aquatic biology as indicators of water quality and pollution as well as the effect of biological factors on water quality will be investigated</p>										Up-to-date knowledge of biological aspects of the water environment. Improved environmental quality standards based on the protection of aquatic biology	Operational Guidance Underpinning knowledge
d	<p><b><u>Catchment Accountability</u></b> To develop mathematical models to assess the sources, processes and fates of pollutants in order to determine pollutant budgets within a catchment</p>										A enhanced capability for pollutant budgeting and the potential early identification of sites of future pollutant accumulation	Operational Guidance Underpinning knowledge

Commission: B - Water Resources

Key Issue: 1 - Water Resources Planning and Management

Rationale: To provide improved approaches to conserve, redistribute and augment water resources together with enhanced operational practices

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Water Resources Planning</u></b>            To develop techniques for evaluating major water transfers and other water resources schemes. The assessment of management options for the effective distribution of water will also be investigated.</p>										The more effective and efficient useage of water resources available. A potential reduction in the degree of water lost to the end-user	PIGN Operational Guidance Guidelines for others
b	<p><b><u>Drought Management</u></b>            To develop management techniques for dealing with the occurance and consequences of drought conditions. To improve the NRA's capability for predicting and simulating the occurance and likely effects of droughts.</p>										More coherent reaction to drought conditions and a less severe impact on the levels available to abstractors and the environment	PIGN Operational Guidance Guidelines for others
c	<p><b><u>Water Resource Usage</u></b>            To provide assistance in the development of demand management policies and effective pricing strategies for varying demand areas. The research will look at private and commercial uses of water and the varibility of such demand.</p>										An effective assessment of future potential demand and useage. This will assist in the development of future water resource strategies. Increase in revenue to the NRA from water resource	PIGN Operational Guidance Guidelines for others
d	<p><b><u>Operational Practice</u></b>            To provide improved practices for the operation of water resources schemes to achieve the maximum potential benefit for the NRA. The protection of wetlands through good aquifer management will form part of the research.</p>										The more cost-effective operation of water resource schemes. The protection of environmental areas such as wetlands and fisheries through good operational practice	PIGN Operational Guidance Guidelines for others

**Commission:** B - Water Resources

**Key Issue:** 2 - Hydrometry

**Rationale:** To develop improved methodologies and standards for specifying, collecting, validating, and storing hydrometric information

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Instrumentation</u></b> To set appropriate standards for the subsequent development of effective, efficient and robust instrumentation. The research will address water level and flow measuring devices.</p>										The provision of accurate and precise hydrometric information with improved instrumentation reliability. A co-ordinated approach to hydrometric instrumentation development	Operational Guidance Operational equipment Procedural manual
b	<p><b><u>Hydrometric Networks</u></b> To develop criteria and technology for providing improved hydrometric data collection networks. The use of telemetry systems based on land lines, radio, cellular lines and other systems will be investigated.</p>										Through approximately located hydrometric stations there will be the provision of more useful data. A rationalised national hydrometric network with consistently high standards	Operational Guidance Operational equipment
c	<p><b><u>Hydrometric Standards</u></b> To determine and develop appropriate standards for specifying, collecting and validating hydrometric data. The standards will influence the data collection and the instrumentation design criteria.</p>										A coherent approach to all aspects of hydrometric information. To permit defensible comparisons between datasets and effective interpretations of data	Operational Guidance PIGN Procedural manual
d	<p><b><u>Hydrometric Data</u></b> To establish the most effective and efficient approaches to handling large quantities of hydrometric data. The use of such data by other NRA functions and the resultant levels of access required will be assessed.</p>										The reduction in data handling time and computer hardware requirements. The rationalisation of data handling and statistical interpretation techniques	Operational Guidance

**Commission:** B - Water Resources

**Key Issue:** 3 - Groundwater and Source Protection

**Rationale:** To develop strategies and techniques, such as water protection zones and nitrate sensitive areas, required to protect sources of water

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
a	<p><b><u>Groundwater Protection</u></b> To develop a framework and management techniques within which the quality of groundwater may be protected and improved. The identification and quantification of aquifer quality and quantity.</p>									The maximum protection of water resources for the benefit of the abstractors. A firm basis upon which policies may be developed to conserve resources for future development.	PIGN Operational Guidance Guidelines for others
b	<p><b><u>Vulnerable Zones</u></b> To provide methodologies for the specification and subsequent monitoring of vulnerable zones of water. The criteria for designating such zones will also be developed through this research together with the quantification of the impact of substances such as pesticides.</p>									The protection of source quality and the associated increase in the sources available for abstraction. A potential reduction in the costs of protecting water supplies.	PIGN Operational Guidance Guidelines for others
c	<p><b><u>Nitrate Sensitive Areas</u></b> To develop methodologies for assessing the extent and effects of nitrates upon sources areas and to provide appropriate protection techniques. To assist in the designation of NSAs and the necessary criteria for such designation.</p>									A reduction in the eutrophication of waters used for potable abstraction. A reduction in the remedial effort required to improve the quality of trophic water sources.	PIGN Operational Guidance Guidelines for others
d	<p><b><u>Data and Sampling Strategies</u></b> To establish the data requirements and appropriate sampling strategies required to provide information on source status. The research will assess the statistical requirements for data analysis.</p>									Consistent national sampling programmes for groundwater quality resulting in an improved capability for inter-area comparison	Operational Guidance Procedural manual

**Commission:** B - Water Resources

**Key Issue:** 4 - Low Flows and Abstraction Regimes

**Rationale:** To assist in overcoming the problems of over-abstraction and to develop techniques for the alleviation of low flows.

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
a	<p><b><u>Abstraction Regimes</u></b> To develop approaches and criteria for determining sustainable abstraction regimes. The associated issues of licence determination, charging, policing and enforcement will also be investigated.</p>									The maximum protection of water resources for the benefit of the abstractors. A firm basis upon which policies may be developed to conserve resources for future development.	PIGN Operational Guidance Guidelines for others
b	<p><b><u>Impoundments</u></b> To provide procedures for the objective assessment of the impact of impoundments on water regimes. The issues associated with abstraction licenses will also be considered in the context of impoundment licences.</p>									The protection of source quality and the associated increase in the sources available for abstraction. A potential reduction in the costs of protecting water supplies.	PIGN Operational Guidance Guidelines for others
c	<p><b><u>Low Flows &amp; Augmentation Techniques</u></b> To develop methodologies for assessing the extent and effects of nitrates upon sources areas and to provide appropriate protection techniques. To assist in the designation of NSAs and the necessary criteria for such designation.</p>									A reduction in the eutrophication of waters used for potable abstraction. A reduction in the remedial effort required to improve the quality of trophic water sources.	PIGN Operational Guidance Guidelines for others
d	<p><b><u>Data and Sampling Strategies</u></b> To establish the data requirements and appropriate sampling strategies required to provide information on source status. The research will assess the statistical requirements for data analysis.</p>									Consistent national sampling programmes for groundwater quality resulting in an improved capability for inter-area comparison	Operational Guidance Procedural manual

**Rationale:** To develop new procedures for the programming of new investment including scheme design, construction, operation and maintenance

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
a	<p><b><u>Asset Management</u></b>                      To develop new guidelines and frameworks within which the investment programmes and management decisions required for flood defence assets may be made. This research will be closely linked with work on Standards of Service.</p>									A co-ordinated approach to asset management across the NRA. A defensible framework within which the cost effectiveness of asset-related activities may be assessed.	PIGN Operational Guidance Procedural Manual
b	<p><b><u>Scheme Design and Construction</u></b>                      To provide new procedures for assessing various designs of riverine and coastal flood defence schemes. The effectiveness of past designs will also be assessed. This work will be developed with the design philosophy in Standards and Specification.</p>									A cost-effective approach to the design and subsequent appraisal of flood defences. A potential reduction in the level of contracted services required for such design.	PIGN Operational Guidance Procedural manual Underpinning knowledge
c	<p><b><u>Operational Management</u></b>                      To provide new management techniques for addressing the operational requirements of flood defence. These will include operation of weirs, locks, barriers and will propose best practice to be undertaken.</p>									The provision of co-ordinated procedures for operating flood defence assets will ensure that standards of operations are maintained at a high level.	PIGN Operational Guidance Procedural manual
d	<p><b><u>Maintenance Procedures</u></b>                      To develop appropriate procedures for the maintenance of rivers and flood defences. the prioritisation and programming of such work will be assessed as will the physical methods of maintaining rivers.</p>									The development of more effective and efficient approaches to river and flood defence maintenance. Optimised usage of NRA staff and resources in this area.	PIGN Operational Guidance Procedural manual Computer program

Commission: C - Flood Defence

Key Issue: 2 - Standards and Specification

Rationale: To provide new knowledge and information to optimise the standards of service and the specification of flood defence engineering options

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Standards of Service</u></b> To develop and implement effective standards for defending different land use classes against flooding. This work will include developing appropriate standards for the defence of coastal areas</p>										Consistent approach to the defence of land from flooding. Increased public awareness of the threat of flooding in particular areas.	PIGN Operational guidance Guidelines for others
b	<p><b><u>Design Criteria</u></b> To develop a standardised framework within which flood defence schemes may be developed to a consistently high level. The philosophy of the design will be covered and not the detailed designs per se.</p>										A sound basis for the employment of consultants in the design of flood defence schemes. Possible reduction in maintenance costs through consistent design criteria	PIGN Operational guidance Guidelines for others
c	<p><b><u>Soft Engineering Options</u></b> To develop new approaches to environmentally-sensitive of flood defence. The use of beach feeding, saltings, and beach management will be amongst those options investigated</p>										An improved public profile through the design of environmentally-sensitive defences. Reduced capital expenditure.	PIGN Operational guidance Guidelines for others
d	<p><b><u>Coastal Management</u></b> To provide new approaches for the management of flood defences in the seawater/coastal zone interface.</p>										The development of sound management practices and potential for reductions in maintenance of coastal defences	PIGN Operational guidance Guidelines for others

**Commission:** C - Flood Defence

**Key Issue:** 3 - Emergency Planning and Response

**Rationale:** To enhance the NRA's ability to plan for and respond to emergencies and for the warning and monitoring of floods.

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Emergency Planning</u></b> To provide a framework and strategy for dealing with flood-related emergencies including liaison with external organisations. The coordination of emergency response and the roles of each organisation will be addressed.</p>										A consistently high level of response to emergencies. Improved liaisons with external organisations and a reduction in resources required to respond to floods.	PIGN Operational guidance Guidelines for others Procedural manual
b	<p><b><u>Flood Warning</u></b> To provide the NRA with up-to-date capabilities for predicting those weather and tidal conditions most likely to cause flooding. The continued use of weather radar, satellite data and computer models will be studied.</p>										Longer lead times and more accurate prediction of flood events. This will result in improved responses to emergencies when they occur.	Operational guidance Computer program Operational equipment
c	<p><b><u>Flood Monitoring</u></b> To further develop existing technology for the monitoring of floods. This work will investigate flooding from rivers and the sea and will link strongly with the issue of hydrometry within Water Resources.</p>										Improved information concerning the status of floods. More effective use of NRA resources in targetting those areas most in need of protection.	Operational guidance Procedural Manual Operational equipment
d	<p><b><u>Service Requirements</u></b> To determine those approaches and facilities required to enable successful implementation of emergency plans. This will also cover the facilities offered by other organisations.</p>										A sound-basis from which to develop of purchase those facilities required to operate an effective emergency response service.	PIGN Operational guidance Operational equipment

**Commission:** C - Flood Defence

**Key Issue:** 4 - Planning and Development Control

**Rationale:** To develop both existing and new approaches for assess and influencing the impact and extent of development within flood risk areas, and ensure an effective input to local authority planning processes

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
a	<p><b><u>Control of Urban Run-off</u></b> To develop new techniques for reducing the effects of run-off from small urban catchments. The benefits of influencing local authorities in the design of storm-water facilities will be investigated</p>									Improved protection of urban watercourses from flooding and a reduction in the number of properties flooded. A reduction in the level of NRA resources required to respond to urban flood events.	PIGN Operational guidance Guidelines for others
b	<p><b><u>Floodplain Information</u></b> To provide new methods of collecting information on developments within and attributes of the floodplain. This work will assess the environmental impact of developments in the floodplain.</p>									An sound information base on which planning and development control can be effectively implemented. A more targetted response to enquiries from local authorities.	Operational guidance Guidelines for others Computer program Operational equipment
c	<p><b><u>Legal Issues</u></b> To provide new information on byelaws currently in place and those required for the control of developments in the floodplain. This work will have strong links with the Statutory and Legal Issues in Commission G</p>									The potential development of new legislative powers to enable the NRA to reduce environmental damage in the floodplain	PIGN Guidelines for others Operational guidance
d	<p><b><u>Main and Non-main River Strategy</u></b> To provide approaches for the development of an effective strategy on the designation of main and non-main rivers. This theme will link closely to standards and specification and investment planning</p>									Improved investment planning through the designation of appropriate river reaches as main river.	PIGN Operational guidance

Commission: C - Flood Defence

Key Issue: 5 - Processes

Rationale: To further develop the current understanding on the extent to which environmental processes may affect of by affected by Flood Defence planning and operational Management

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Storms, Surges and Waves</u></b> To develop techniques for the prediction of the extent and effects of storms and surges and the movement of waves inshore. The use of computer models for the prediction of tidal phenomena will be investigated.</p>										Improved understanding of the factors affecting coastal defence performance. This information will form the basis of some themes within the standards and specification issue.	Operational Guidance Underpinning knowledge Computer program
b	<p><b><u>Hydrology and Hydraulics</u></b> To provide up-to-date information upon hydrology and hydraulics for the effective operation of river and flood water flow models. The hydraulic factors affecting flood defences will also be studied.</p>										Improved design criteria for flood defences based upon an improved knowledge of the hydraulic forces affecting the defences.	Operational Guidance Underpinning knowledge
c	<p><b><u>Morphodynamics</u></b> To determine those morphological processes that may have an impact upon Flood Defence activities. The research will look at both the geomorphology of the coastal zone and river systems.</p>										Potential reductions in maintenance costs through an improved understanding of the catchment processes likely to affect flood defences and water movement	Operational Guidance Underpinning knowledge
d	<p><b><u>Environmental Influences</u></b> To provide new information on the environmental effects on and caused by Flood Defence activities. This theme will be undertaken in parallel with the issues of environmental impact assessments and climate change in Commission G</p>										The development of environmentally-sensitive practices and designs and a consequential enhancement in public profile	Operational Guidance Underpinning knowledge

**Commission:** D - Fisheries

**Key Issue:** 1 - Fisheries Resource

**Rationale:** To provide information on the status of fish stocks and to a system within which this status may be classified.

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Fish Stock Information</u></b> To assess the distribution, abundance, health and exploitation of both common and rare species. The work will address freshwater and, where appropriate, coastal and estuarine fisheries including salmonids, cyprinids and eels.</p>										Improved knowledge on the current status of fish stocks and a benchmark against which to assess future targets. The information will be essential for developing the fisheries classification scheme.	PIGN Operational Guidance Guidelines for others Underpinning knowledge
b	<p><b><u>Fisheries Classification Scheme</u></b> To assist in the development of an objective classification scheme for fisheries. The research will look at those factors such as numbers, biomass and habitat that may be incorporated within the scheme.</p>										An objective approach for assessing the status of fish stocks. A defensible basis from which management and investment decisions may be made.	PIGN Operational Guidance Guidelines for others Underpinning knowledge
c	<p><b><u>Fisheries Economics</u></b> To provide a framework within which the costs and benefits of maintaining and improving the fisheries resource may be assessed. This will take account of social and environmental factors and will include both narrow and wide definitions of benefits.</p>										The provision of a economic indicators for management decision making. Potential reduction in expenditure in certain areas through the rejection of cost inefficient options.	PIGN Operational Guidance Guidelines for others

**Commission:** D - Fisheries

**Key Issue:** 2 - Environmental and Biological Influences

**Rationale:** To enhance the current knowledge of the influences on fish populations to assist in the effective management of fisheries.

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
a	<p><b><u>Biological Influences</u></b>            To assess the extent of fish disease, avian and mammalian predators as well as other biological factors on the status of fisheries resources. The impact of native and non-native fish species will also be determined.</p>									<p>The early identification of pressures on the fisheries resource and remedial or preventative actions that may be taken. Potential reduction in restocking costs as a result of possible preventative actions.</p>	<p>PIGN            Operational Guidance            Underpinning knowledge</p>
b	<p><b><u>Physical and Chemical Influences</u></b>            To determine the influence of physical parameters such as hydrology, morphology, low flows and levels, and man as well as chemical factors such as water quality, pesticides, agricultural run-off on the status of fish stocks.</p>									<p>An effective understanding of the factors and the extent to which they affect fish stocks. Potential reduction in restocking costs as a result of possible preventative actions.</p>	<p>PIGN            Operational Guidance            Underpinning knowledge</p>
c	<p><b><u>Fish Habitats</u></b>            To provide further information on the pressures upon fish habitats, populations and community structures from factors such as engineering works, recreation and boat wash. The combination of all factors will provide a predictive capability to identify likely sites for fish occurrence.</p>									<p>The implementation of effective management techniques for the protection of fish habitats, populations and community structures. Essential information required to underpin stocking practices.</p>	<p>PIGN            Operational Guidance            Underpinning knowledge</p>

**Commission:** D - Fisheries

**Key Issue:** 3 - Fisheries Management

**Rationale:** To provide improved management practices and strategies assist in maintaining, improving, regulating and developing fisheries

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
a	<p><b><u>Fish Tracking</u></b> To develop fish tracking equipment and associated methodologies to improve the understanding of fish movement, and biology. Techniques such as tags, fish counters, radio-telemetry and acoustic tracking will be evaluated.</p>										<p>A more cost effective and efficient approach to tracking fish through the standardization of methodologies in the NRA. An improved understanding of fish movement will also ensue.</p>	<p>Operational equipment/technique Operational Guidance Underpinning knowledge</p>
b	<p><b><u>Stock Surveying</u></b> To develop stock assessment methodologies and equipment that are applicable for rivers of varying depths, flow regimes and habitat types. The work will develop appropriate survey strategies and assess amongst others electric fishing and hydroacoustic techniques.</p>										<p>A coordinated approach to the assessment of fish stocks. Improved operational and management effectiveness and new equipment designed to maximise the use of NRA resources in this area.</p>	<p>Operational equipment/technique Operational Guidance Underpinning knowledge</p>
c	<p><b><u>Fishery Rehabilitation</u></b> To develop new methodologies for the environmental restoration of habitats that will enable the improvement, development and rehabilitation of damaged fisheries.</p>										<p>A practical capability to reverse the process of fishery damage and an increase in potential for growth in some fish stocks. An improved understanding of the factors affecting fish habitats.</p>	<p>PIGN Operational Guidance Underpinning knowledge</p>
d	<p><b><u>Stocking Practices and Strategies</u></b> To assess the optimum approach to stocking with coarse fish and salmonids and to determine an appropriate strategy for its implementation. The impact of hatchery-reared fish or fish transferred from other waters will be determined.</p>										<p>A sound strategy and operational practices for restocking rivers, for mitigation, restoration, or enhancement following pollution incidents of fishery damage. A cost-effective approach to hatchery usage will also be provided.</p>	<p>PIGN Operational Guidance Underpinning knowledge</p>

**Commission:** E - Recreation and Navigation

**Key Issue:** 1 - Recreation Management and Operations  
2 - Navigation Management and Operations

**Rationale:** To develop new approaches for the management of recreational and navigational activities and marketing the associated NRA facilities.

Theme	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
<p>a <b>Recreation Management</b> To provide new approaches to managing recreational activities on NRA controlled land and promoting recreation on third party land adjoining water. The research will look at marketing NRA controlled land for recreational use.</p>										<p>The provision of effective and efficient management techniques for maximising the use of water for recreational activities in an environmentally sensitive manner.</p>	<p>PIGN Operational Guidance Guidelines for others</p>
<p>b <b>Recreation Operations</b> To assess the impact of recreational activities upon the water environment. The influence on and impact of wildlife together with the effects of wash from recreational craft will be assessed.</p>										<p>Improved understanding of the pressures exerted by and on recreational activities. A sound basis from which future operations may be resources.</p>	<p>Operational Guidance Underpinning knowledge</p>
<p>c <b>Navigation Management</b> To provide new management techniques for navigational activities in areas where NRA is the navigation authority. The marketing of NRA facilities and the financing of the Navigation function will also be investigated.</p>										<p>An improved public profile through enhancements in the overall management of navigation activities in the NRA. Potential for increased revenue as a result of marketing activities.</p>	<p>PIGN Operational Guidance Guidelines for others</p>
<p>d <b>Navigation Operations</b> To provide new operational techniques for effective NRA navigational management. The use of boat hull design to minimise wash, the impact on wildlife and the operation of locks etc. will form part of this theme.</p>										<p>The provision of sound operational practice in keeping with the development of effective and marketable navigational facilities.</p>	<p>Operational Guidance Guidelines for others</p>

**Commission:** F - Conservation

**Key Issue:** 1 - Conservation Resource  
Appraisal and Impact Assessment

**Rationale:** To develop effective survey, monitoring and classification methods for assessing the status of and impact on the conservation resource of inland and coastal waters.

Theme	Strategic Targets										Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000			
<p>a <b>Survey Methodologies</b> To provide effective survey methodologies for assessing the conservation resource. Appropriate monitoring strategies will also be developed. The methods will be capable of identifying the enhancement potential of inland and coastal waters and the associated land.</p>											<p>A co-ordinated approach to conservation surveys providing information of a consistent quality across the NRA. Potential savings may also accrue with the standardization of methodologies.</p>	<p>PIGN Operational Guidance Procedural manual</p>
<p>b <b>Conservation Classification</b> To develop sound classification methods and the associated framework for their implementation to provide an objective assessment of the conservation resource. The methods will link closely with those conservation aspects of the Water Quality Classification Scheme.</p>											<p>An effective classification scheme providing objective assessments of the conservation resource. A sound basis from which key management and investment decisions may be made.</p>	<p>PIGN Operational Guidance Computer program</p>
<p>c <b>Impact Assessment</b> To determine the source and extent of the impacts upon the conservation status and potential of inland and coastal waters and associated lands. Acceptable criteria for monitoring and enhancing such areas will also be developed.</p>											<p>The prevention of damage to the conservation resource through the early identification of pressures upon it. Defensible criteria upon which resourcing and management decisions may be made.</p>	<p>PIGN Operational guidance</p>

Rationale: To develop management strategies and techniques which are effective, consistent and justifiable.

	Theme	Strategic Targets								Anticipated Benefits	Potential Outputs	
		1992	1993	1994	1995	1996	1997	1998	1999			2000
a	<u>Coastal Areas</u> To develop new guidelines and management strategies for the protection of the coastal zone. This work will look at estuaries as well as the coastal margin										Consistent approach to the conservation implications of activities in the coastal zone. More targetted effort in relation to conservation enhancement	PIGN Operational guidance Guidelines for others
b	<u>Wetland conservation</u> To provide strategies for the conservation of wetland areas. The protection, reahbilitation where necessary, and re-creation of previous wetland sites will be studied.										The promotion of wetland protection and efficient targetting of resources to priority areas. Appropriate criteria for determining wetland status.	PIGN Operational guidance Guidelines for others
c	<u>Species management</u> To protect rare aquatic species through the provision of management strategies and identify techniques for the reduction of the impact caused by interffering species										The more effective protection of rare species and co-ordinated approach to species recovery. The consistent use of standard methodologies accros the NRA.	PIGN Operational guidance Guidelines for others
d	<u>Habitat rehabilitation</u> To improve the number and variety of aquatic habitats through the rehabilitation of currently degraded habitats and management technques for subsequent protection.										More efficient use of resources when rehabilitating habitats and an approach to determine those priority areas where resources may be best utilised.	PIGN Operational guidance Guidelines for others

Key Issue	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
5	<p><u>Land Use Change and Management</u> To assess the implications of various scenarios of land use change for all functions. The research will also propose management practices to ensure that any change is to the benefit of the water environment.</p>									An effective basis from which to influence future land use change to the benefit of the NRA. Potential resource savings through the use of buffer zones for water quality control.	PIGN Operational guidance Guidelines for others Computer program Underpinning knowledge
6	<p><u>Public Perception and Education</u> To develop techniques for assessing the public's perception of the NRA, its activities and the water environment generally. Proposals for educating the public and external organizations in the objectives of the NRA will also be made.</p>									An increase in public awareness of the NRA's aims and objectives. A possible increase in the level of public assistance in areas of NRA activity such as pollution response, flood monitoring, conservation etc.	Operational guidance Guidelines for others Underpinning knowledge
7	<p><u>Statutory and Institutional Issues</u> To evaluate the legislative framework within which the NRA operates and to propose amendments to and, where appropriate, new legal instruments. The issue will include local byelaws, legislation and EC Directives and rulings.</p>									A sound basis from which future legislation may be influenced. The degree to which the NRA is consulted over new legislative issues may increase as a result of increased activity in this area.	PIGN Guidelines for other Operational guidance
8	<p><u>Social and Environmental Economics</u> To develop an effective framework and associated methodologies for assessing the social and environmental cost of NRA and third party activities in the water environment. The cost effective management options will be assessed for their potential impact upon the environment and social factors.</p>									Through considering the social and environmental cost of activities the NRA will be better placed to make key management decisions. Potential reductions in costs may also be realised through the removal of cost inefficient options.	PIGN Operational guidance Guidelines for others

Commission: G - Cross-functional Issues

Key Issue	Strategic Targets									Anticipated Benefits	Potential Outputs
	1992	1993	1994	1995	1996	1997	1998	1999	2000		
<p>1 <b>Catchment Planning</b> To develop management techniques for assessing and dealing with problems and opportunities on a catchment scale. An assessment of water and associated land uses together with appropriate standards will form part of the research.</p>										<p>A coherent framework for undertaking operational and planning activities. A potential reduction in expenditure through more effective planning of existing resources.</p>	<p>PIGN Operational guidance Guidelines for others</p>
<p>2 <b>Climate Change</b> To assess the impact of climate change and the consequential implications for all NRA functions. The rise in sea level, global warming, land use change, evapotranspiration and changes in UV radiation will be amongst those aspects investigated.</p>										<p>Advanced warning of impacts of climate change for the NRA. Improvements in NRA planning capability and more effective design of flood defences in the light of any sea level rise.</p>	<p>PIGN Operational guidance Guidelines for others Underpinning knowledge Computer program</p>
<p>3 <b>Enabling Technologies</b> To develop technologies such as GIS, remote sensing and computer modelling that will be of benefit to the NRA. A watching brief on more borderline technologies will be maintained.</p>										<p>Provision of state-of-the-art technologies for NRA staff. Improved operational and management efficiency through the provision of more up-to-date and new types of information.</p>	<p>Operation equipment/technique Operational guidance Computer program</p>
<p>4 <b>Environmental Impact Assessments</b> To develop effective management techniques and practical tools for assessing the potential environmental impact of any construction, operation or maintenance activity in or near a watercourse. The work will include assessments of barrages, marinas, sea outfalls and flood defence schemes.</p>										<p>Consistent implementation of EIA methodologies across all Regions and for all functions. An effective framework within which more efficient use may be made of existing resources in undertaking EIAs.</p>	<p>PIGN Operational guidance Guidelines for others</p>

### 4.3 R&D Management Strategy

The effective management of the R&D programme as a means of assisting the NRA in achieving its corporate goals will be maintained and, where necessary, enhanced. This will be achieved, in particular, through actions in the following areas:

- Commission management
- Programme management
- Dissemination and outputs
- Liaison with external organizations

#### 4.3.1 Commission Management

The R&D Customer, usually the Function Committee, has a central role to play in ensuring its R&D programme is targeted, coherent and effective. The Commissioner, as the Function Committee's representative, will continue to take principal responsibility for the overall management of the Commission programme and in doing so will ensure that the following items are considered:

- i) the R&D programme supports the Function's Strategy and its strategic objectives;
- ii) an appropriate balance is maintained between short-term tactical R&D and that directed at strategic objectives;
- iii) duplications in the programme will be kept to a minimum;
- iv) outputs will be clearly identifiable, will address previously identified needs, and be of a form that enables the function to extract maximum benefit;
- v) Topic Areas where there are evident benefits should be developed further as a part of "reinforcing success"
- vi) adequate liaison with other functions should be maintained over cross-functional issues;
- vii) the status of Project Leaders, and Topic Leaders are recognised as being important in terms of the strategic development of the function.

The instigation of more function working groups will help to ensure that many of the above items are addressed. Members of such groups are often in the forefront of developing the NRA's strategic thinking and, in their function roles, are often best placed to specify the form of outputs that will be most useful to the end-user.

Each Region and Regional Management Team will be able to express its own regionally-perceived R&D needs and influence relative priorities within a Commission programme through Topic Leaders and regional representatives on the respective Function Committees.

#### 4.3.2 Programme Management

The R&D support service will continue to be responsible for the overall management and co-ordination of the R&D programme, which will be undertaken through the Chief Scientist's Directorate at Head Office. In managing the R&D programme, the R&D support service will ensure that:

- i) the overall R&D budget is managed effectively;
- ii) the assessment procedures are adhered to;
- iii) the quality of outputs from the programme is at a consistently high level;
- iv) the results of R&D are disseminated to the end-user in an effective manner;
- v) cross-functional issues are brought to the attention of potential customers;
- vi) links with appropriate research-commissioning organizations are maintained to avoid duplication and achieve effective collaboration, where is likely to be of benefit to the NRA.
- vii) issues of importance to the NRA are brought to the attention of Commission staff; and
- viii) assistance is given to Commission staff as appropriate.

In managing the R&D budget, the R&D support service will continue to work closely with the Finance Directorate and within both the Scheme of Delegation and the Financial Memorandum.

The provision of management support within each Region, through the Regional R&D Co-ordinators and additional technical expertise will continue. This will prevent the core function staff involved in R&D from being unnecessarily involved in routine management aspects of projects.

The consistent implementation of effective and efficient management procedures will be maintained through the provision of an R&D Management Guidance Note to supplement the national project management framework. This will assist core function staff in the development, appraisal and evaluation of projects and ensure the application of best project management practices.

The day-to-day management of the R&D programme as a whole will continue to benefit from the R&D Information System. This computer, database-driven system will be developed further to provide online information on the technical, financial and management aspects of all projects within the R&D programme.

### 4.3.3 Dissemination and Outputs

The form in which information from the R&D programme is presented (Outputs) and the path by which it is passed to the end-user (Dissemination) are essential parts of the R&D process.

Where appropriate the R&D programme will move away from large technical reports to more targeted outputs. The NRA will provide outputs that are in an appropriate form for use by its staff. These outputs may include:

- Information for policy development and policy implementation guidance notes
- Operational guidance and procedural manuals
- Operational techniques and/or equipment
- Computer programs
- Guidelines for use by non-NRA staff
- Underpinning knowledge to assist the NRA in its duties

Figure 4.1 demonstrates both the likely form an Output may take and the way in which the Outputs will feed into with other NRA activities.

The NRA will continue to encourage its staff to put forward papers for publication in the technical and scientific literature and considers this to be an important aspect of the development of its staff. Incentives will be introduced to reward staff making major contributions to the technical advancement of a core function through R&D projects.

In addition to the Outputs from the R&D programme, various activities will be undertaken aimed at disseminating the information to NRA staff and, where appropriate, to the public domain. Seminars, training workshops, model benchmarking, instructional videos and discussion sessions will be amongst those activities employed.

### 4.3.4 Liaison with External Organizations

The NRA will continue to liaise with other research-commissioning organizations through groups such as the DoE's Water Research Coordination Group, the Foundation for Water Research, and MAFF research committees. A proactive stance will be adopted to collaborate with, and benefit from the results of, other research programmes. This will be extended to the programmes of the European Commission where the R&D Section at Head Office will be responsible for developing contacts. Links between R&D staff and academic research establishments will continue to be fostered to provide an overall appraisal of research in any field relevant to the NRA. Topic Leaders will take steps to maintain links with academic groups carrying out related research.

The NRA will continue to look towards Europe and North America for potential solutions to problems where the expertise in these areas are particularly strong.

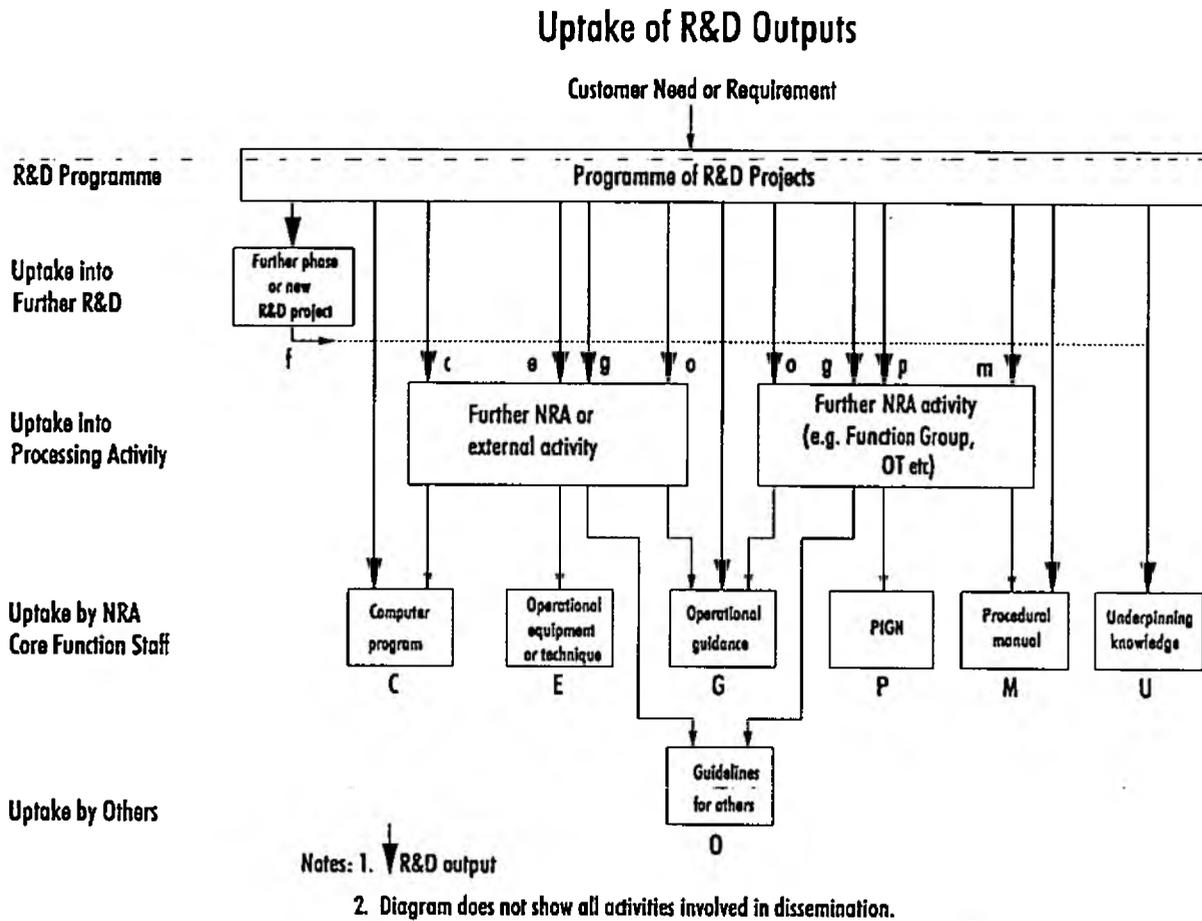


Figure 4.1 R&D Outputs and Associated Uptake

14  
15  
16

## 5. RESOURCES

### 5.1 Introduction

This Chapter outlines the approaches that will be adopted in addressing the resourcing implications of the NRA's R&D programme in the future. The methods by which this resourcing will be achieved will require periodic review to ensure that the R&D support service continues to be managed in an effective and efficient manner.

In general, the resourcing of a strategic, yet applied, R&D programme falls into two areas. Firstly, resources will be required to undertake the individual research projects themselves. In relation to the NRA's R&D programme these resources may also cover further allied contracted services and these will be outlined below. Secondly, there are the inevitable implications for the management of the programme by NRA staff. The concept of the R&D "Customer" is central to the framework within which the NRA's R&D programme will be managed. The implications of resourcing the continuation of the customer concept will also be discussed below.

### 5.2 Programme Resourcing

#### 5.2.1 Project Funding

The R&D programme is, and will continue to be, comprised of a series of discrete projects each with an identified Project Leader and a ring-fenced budget. The source of the funding for the project budget will be dependant upon the core function commissioning the work as well as the perceived R&D customers. The major sources of R&D funding are :-

- a) Grant-in-Aid;
- b) Water Resources;
- c) Flood Defence precept;
- d) Charging for Discharges;
- e) External organisations.

Every project within the R&D programme will receive funding from one or more of the above sources, the latter being the case where projects are of a multifunctional nature.

#### 5.2.2 Technical Services and R&D Fellowships

In addition to these discrete projects the R&D programme will also contain Technical Services placed with specific organisations to address smaller enquiries over a short timescale as well as a number of R&D fellowships.

#### 5.2.3 External Funding

When appropriate the NRA will collaborate with relevant research-commissioning organisations in projects that are of a mutually beneficial nature. In keeping with this aim the NRA will continue to pursue funding from the European Community for appropriate projects. In cases where submissions are successful the NRA expects that the principal of additionality (whereby a sum equivalent to the grant awarded by the EC is withdrawn from the R&D budget by Her Majesty's Treasury) will not be applied.

It is anticipated that annual contributions from external organisations to NRA R&D projects will rise to 15% of the annual R&D programme budget by 1996 and will remain at that level for the duration of this strategy.

### 5.3 Management Resources

The R&D programme will continue to be specified by and orientated towards the R&D Customer. The consequential involvement of core function staff as Commissioners, Topic Leaders and Project Leaders will, therefore, continue. In working on the R&D programme, Regional staff will be acting in a national capacity, a situation which, however, will not be unique to the R&D support service. Through this approach the NRA will make the best use of its staff resources and their technical expertise.

The core function, in acting as an R&D Customer, will provide appropriately experienced Regional staff to manage relevant areas of the R&D programme as is presently the case. The staff time utilised on behalf of the R&D support service will be funded from the core function's operational budgets.

Management coordination will continue to be provided from NRA Head Office through the R&D Section with assistance from Regional R&D Coordinators. Further staff will be required over the duration of this strategy if it is to be successfully implemented and the benefits to the NRA realised. The minimum support for Commissioners, Topic Leaders and Project Leaders within each Region will be one part-time R&D Coordinator with the norm being a full-time employee. Administrative support to the Regional R&D Coordinators will be provided by their resident core function.

The R&D Section at Head Office will continue to be resourced through the Chief Scientist Directorate whilst the resourcing of the Regional R&D Coordinators will be through recharge to the Regions concerned.

### 5.4 Additional Resources

In addition to the programme and management resourcing implications there will be areas which will also require funding if the benefits of the R&D programme are to be fully realised. The R&D programme will continue to generate substantial new information which will require appropriate levels of dissemination to the Regional core function staff. The individual project budget may be used to disseminate information during the lifetime of the project through the production of R&D outputs or seminars for example. However, following the completion of the project the commissioning core function will be responsible for any further dissemination (such as the production of widely distributed booklets or software implementation) and will, therefore require appropriate resources to do so.

The general dissemination of the new information and knowledge that will be generated as a result of R&D will be substantially enhanced through the provision of easily accessible and well organised libraries. Such a provision should be made available to all Regions as well as NRA Head Office.

## APPENDIX 1. PERFORMANCE MEASURES

### A1.1 Introduction

Critical assessment of performance is essential in order to ensure the most effective use of resources within any R&D programme. The NRA also needs to provide specific performance measures for the R&D programme which reflects its Economy, Efficiency and Effectiveness. The approach to performance monitoring fits into the overall framework of R&D Assessment (Investment Appraisal, Monitoring, and Post-project Evaluation) which the NRA has adopted (Section 2). This approach is consistent with Cabinet Office guidelines (Ref: R&D Assessment, A Guide for Customers and Managers of Research and Development, Cabinet Office, HMSO 1989).

The fully-developed approach to performance monitoring will incorporate three levels of R&D assessment:

- (a) Throughput of Activity (General Indicators)
- (b) Programme Management (Economy and Efficiency)
- (c) Value to the NRA (Effectiveness)

The indicators or measures described for items (a) and (b) can readily be obtained from the computer-based R&D Information System.

### A1.2 Throughput or Activity (General Indicators)

These are primary indicators/measures of resource commitment and outputs for each Region, Commission and for the NRA as a whole:

- Number of Projects Underway in period
- Number of Projects Started in period
- Number of Projects Completed in period
- Average Project Size (cost) in period

For each commission and the NRA as a whole:

- Proportion of overall core function or NRA expenditure committed to R&D, expressed as a percentage as (R&D Annual Inputs/Total Annual Expenditure)
- Extent of Co-funding of R&D projects by external organisations, expressed as a percentage as (External Annual Inputs/Total Annual Inputs)

#### Notes

1. Period is typically a financial year.
2. R&D Inputs for performance monitoring comprise an estimate of total R&D cost, based on actual project costs plus a standard adjustment for NRA internal management costs. For each Commission, this adjustment is based on Number of Projects and Average Project Size. This approach is considered to be more appropriate than direct measurement, which would utilise resources beyond the increased value of measure.
3. Total Annual Expenditure includes both Capital and Revenue expenditure.

### A1.3 Programme management

These are measures of whether individual projects and the programme as a whole achieve their own targets. They incorporate measures of Economy and Efficiency. The assessment on which management performance is assessed will normally comprise three parts:

- Cost

- Time to production of identified deliverable outputs
- Achievement of targets (milestones)

Individual projects are assessed by their performance against the targets, timescales and costs which were identified at the time of Project Investment Appraisal. Without this basis, performance monitoring is impracticable.

The basis unit of performance measurement at project level is used to provide further measures of performance at Regional, Topic, Commission and overall Programme level. Performance is assessed every six months. The basic project management performance measures are:

<u>(Original Project Costs - Cost to Date)</u> Estimated Remaining Cost	Economy indicator
<u>(Original Project Duration - Elapsed Time to Date)</u> Estimated Remaining Time	Efficiency indicator

For well-defined and managed projects and programmes, the ratios will remain close to unity.

#### Notes

1. Targets (Duration and Cost) against which progress is assessed must be as identified in the original PIA. Use pro-rata costs by elapsed time to identify interim target costs where explicit cost targets are not identified.
2. Variations for unforeseen circumstances will not normally be adjusted within these figures. It is important, however, that the project programme remains sufficiently flexible to take account of changing priorities and important developments/results. Substantial changes in project objectives will be accompanied by agreed variations to targets, timescales and costs in the Projects Investment Appraisal, and will not, therefore, result in an apparently poor performance index.

### A1.3 Value to the NRA

Sensible and readily-applicable value (effectiveness) indicators are the most problematic to develop for R&D. The general approach identified in this document will be developed over the next-5 year period. Key areas which R&D value indicators will address are:

**Targeting** - Is the programme adequately addressing the NRA's operational duties and the priorities identified in its Function and Corporate Strategies, and related annual Corporate Plan? Is the balance between Strategic R&D and short-term tactical R&D correct?

These questions will become more important as the inherited projects in the programme are completed, and the NRA itself becomes fully responsible for programme content. Simple measures of Customer Satisfaction - e.g. circulating to function managers a standard check sheet to obtain a priority rating of each new project - could be developed. Comparing the responses with similar prioritisation of the existing programme would allow, in addition to a simple performance measure, changes in priority perception to be identified and if necessary corrected.

**Quality** - Is the quality of the outputs (reports, software) high enough?

The question of technical quality of project outputs can only be considered by peer review following project completion. Post-project evaluation methodology, including definition of quality performance measures, will need to be developed. The evaluation must always be done by the R&D "customer" (e.g. an NRA working group) or designated representative (e.g. a technical expert appointed by the Commissioner). The evaluation must address the extent to which the project objectives and specified outputs have been achieved, not simply quality of the science. The evaluation methodology should incorporate a simple qualitative assessment of benefit (see below).

**Uptake** - Are the R&D outputs being effectively disseminated to, and taken up by, NRA staff?

Measures need to be developed (a) to monitor effectiveness of dissemination and (b) to assess uptake. Depending on the Primary Purpose of the R&D, uptake can be difficult to measure and a range of different approaches will need to be considered. Clearly there is no problem in assessing uptake when the output is a clearly-defined procedure or tool which is implemented on a national basis.

**Overall benefit** - What are the benefits accruing from R&D, and is the NRA getting value for money?

Wherever possible the financial benefits accruing from an R&D project need to be estimated, but this may not be practical for some projects, e.g. support of policy development as opposed to operational issues. (In one respect, assessing the benefits of R&D should become easier as the NRA develops methods of placing an economic value on changes to the water environment). Methods and approaches for assessing the benefit of different categories of R&D projects need to be reviewed and practicable methods developed. Initially, cost/benefit assessment will probably need to concentrate on more subjective measures of customer satisfaction, such as ranking approaches.