

National Rivers Authority

**NATIONAL R&D PROJECT NO. 431
EMERGENCY SEALING OF BREACHES -
PHASE 1**

Interim Progress Report

May 1993

DDC



ENVIRONMENT AGENCY

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National Rivers Authority

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NRD formal!

ENVIRONMENT AGENCY



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Sir William Halcrow & Partners Ltd Burderop Park Swindon Wiltshire
SN4 0QD UK Tel 0793 812479 Telex 44844 Halwil G Fax 0793 812089

NATIONAL RIVERS AUTHORITY

NATIONAL R&D PROGRESS PROJECT NO 431

EMERGENCY SEALING OF BREACHES - PHASE 1

INTERIM REPORT

CONTENTS

		Page No
1	INTRODUCTION	1
2	METHODOLOGY	2
	2.1 Questionnaire	2
	2.2 Site Visits	2
	2.3 Sources of Data	3
	2.3.1 NRA Data	3
	2.3.2 Halcrow Data	4
	2.3.3 Industry Data	4
	2.3.4 Other Data Sources	4
3	RESULTS	5
	3.1 Procedures	5
	3.1.1 Documentation	5
	3.1.2 Training and Liaison	6
	3.1.3 Inspection	6
	3.2 Review of Breach Sealing Methods	7
	3.2.1 Fluvial Breaches	7
	3.2.2 Tidal Breaches	7
	3.2.3 Coastal Breaches	8
	3.2.4 Alternative Methods of Breach Sealing	8
4	PROGRAMME AND PROGRESS	11
5	FINANCIAL REVIEW	12
6	CONCLUSIONS	13
	APPENDICES	
	A PROJECT INVESTMENT APPRAISAL AND ACTIVITY SCHEDULE	
	B QUESTIONNAIRE	
	C REFERENCE MATERIAL	
	D QUESTIONNAIRE RESPONSE	

ABBREVIATIONS

ASCE	American Society of Civil Engineers
BWB	British Waterways Board
ICE	Institution of Civil Engineers
NRA	National Rivers Authority
R&D	Research and Development

INTRODUCTION

Following submission of proposals in January 1993 the Consultants were advised of award of the Contract by the NRA's letter reference 846/00/51, dated 17 February. Thereafter 8 March was agreed as the start date for the Project and an inception meeting was held on 9 March 1993.

A copy of the Project Investment Appraisal and the agreed Activity Schedule are included as Appendix A. This includes a statement of the objectives and sets out other relevant Project information.

The Project is to be undertaken in two phases and the present contract covers only Phase 1, essentially a scoping study to review the state-of-the-art in this field and R&D avenues worth exploring, and suggesting work programmes for Phase 2. The specific objectives for the two phases are given below:

Phase 1

- (a) To investigate existing methods of sealing breaches in sea, tidal or fluvial flood defences both within the NRA and externally.
- (b) To investigate possible future methods of sealing breaches using new technology and materials.
- (c) To assess and propose the requirements for the production of an operational guidance manual, which will detail the various methods of sealing of breaches in emergencies for defences and advise on best option/practise.
- (d) To suggest possible areas for further R&D.
- (e) To produce a final report which collates the above information and proposes objectives and strategy for Stage 2 to achieve the Overall Project Objective.

Phase 2

- (a) To undertake R&D proposed in the Project Record from Phase 1.
- (b) To produce an operational manual for the emergency sealing breaches.

This report reviews progress during the first two months of the study and the principal findings to date. It also looks at the programme to submission of the draft final report at the end of June 1993, and the costs of the work both to date and to completion of Phase 1.

2 METHODOLOGY

The terms of reference for the study and discussion at the inception meeting stressed that the emphasis of the study is towards practical methods of sealing breaches and not on emergency procedures. The need to refer to such procedures was, however, accepted as being necessary to assess the state of preparedness to act when necessary. This chapter describes briefly the methods used to obtain data for analysis, namely a questionnaire, site visits and other sources of data.

2.1 Questionnaire

The approach put forward and agreed at the inception meeting was to prepare a questionnaire for distribution to NRA offices. In preparing the questionnaire the over-riding concern was to keep the form as concise and simple as possible while at the same time addressing the wide range of procedural and operational matters of interest. A copy of the questionnaire is included as Appendix B and it is in two parts, the first covering general information and procedures for the region/area/district, and the second part being a beach repair proforma to be completed for each breach of which staff have experience.

After agreeing the questionnaire format and content with the Project leader, five copies were sent to each region of the NRA via the contact officer for flood defence R&D projects. Thereafter the questionnaires were distributed to area/district offices for completion, and return to the Consultants in due course. The response was mixed as indicated below:

NRA Region	No of returns
Anglian	4
Northumbrian	1
North West	3
Severn-Trent	0
Southern	1
South West	0
Thames	6
Welsh	0
Wessex	3
Yorkshire	1

Same to come?

The findings of the questionnaire survey are discussed further in Chapter 3.

2.2 Site Visits

In addition to the questionnaire survey, a number of visits have been made to NRA offices to discuss their experience of breach closure. At the inception meeting five NRA regions: Anglian, North West, Severn-Trent, Wessex and Yorkshire, were identified as those likely to have a range of defences and breach closure experience. However, telephone enquiries following distribution of the questionnaires revealed a distinct lack of recent

experience and it was concluded that visits to all five regions were not justified. The offices which have been visited are as follows:

NRA Region	Office
Anglian	Northern Area, Manby
Anglian	North Essex District, Kelvedon
North West	Central Area, Preston
Wessex	Avon & Dorset Area, Blandford Forum

When visiting the Manby District a meeting was also arranged at a nearby sea defence site office for discussions with an ex NRA Area Engineer with relevant experience.

Notes of the discussions have been made and are available if required, but they have not been included in this report. Usually the discussions covered the current emergency procedures for the particular office and their specific experience of dealing with breaches. The findings arising from the meetings are discussed in Chapter 3.

2.3 Sources of Data

During the course of the study to date, several sources of data have been identified. These can be broadly classified under the following categories:

- (a) NRA
- (b) Halcrow
- (c) Industry
- (d) Others

A listing of the reference material is given in Appendix C.

2.3.1 NRA Data

The principle source of data from the NRA has been via responses to the questionnaire sent out to the NRA regions, as discussed in Section 2.1. The questionnaire returns have been sorted onto a database providing information regarding the recipient of the questionnaire and the extent of data provided. A copy of the database is included in Appendix D. Site visits and interviews with key NRA personnel have also provided an insight into the problems concerned with breach management, highlighting key concerns and outlining historic events. The site visits have also provided an opportunity to gain access to regional NRA records, references and documentation on historical events which have helped to supplement the study.

At the request of Halcrow, the NRA have provided several reports on topics including emergency communications, the viability of emergency plant and

vehicles, and river flood forecasting. Although not directly related to the study, these reports have provided an insight into how prepared and capable the NRA could be in the event of a serious breach.

Further data has also been provided by the NRA region in the form of extended incident reports, internal documentation regarding breach sealing and by providing literature references.

2.3.2 Halcrow Data

The main thrust of the Halcrow data review has been via an extensive literature search. Papers published by bodies including ICE, ASCE and Rijkswaterstaat and Kyoto University have been obtained which document various aspects of breach occurrence and sealing for coastal and fluvial structures, dykes and dams.

The Halcrow library has also been able to supply information regarding manufacturers of products which have an appreciation or potential application in the field of breach sealing or breach prevention.

Several other departments within Halcrow have been contacted for their experience in the field of breach sealing or possible breach prevention. The geotechnical unit has been able to suggest slope strengthening methods, dams unit have considerable experience in the inspection and maintenance of existing structures and the coastal department have been able to provide expertise on all aspects of coastal protection.

2.3.3 Industry Data

A review of industrial manufacturers who supply products with present or potential breach sealing applications has been undertaken. Suppliers and current trade literature have been consulted as a result of a search of the Halcrow library and on the recommendation of Halcrow staff. The review revealed few manufacturers who supply products specifically for breach sealing, but products with a potential use in the field of beach sealing have been identified.

2.3.4 Other Data Sources

The other data sources contacted for information are bodies with either extensive or recent experience in the field of breach sealing. To date, these external data sources include British Waterways Board (BWB), British Rail and Tayside Water Services. Questionnaires have been sent to personnel with these bodies, but the response so far has been limited. Some regions of BWB have responded and these have been included in the database (Appendix D).

*recent Scottish
Service*

3 RESULTS

This section discusses in general terms the findings of the study to date. It is divided into two basic sections covering procedural aspects and breach sealing methods.

3.1 Procedures

It is accepted that the main emphasis of this study is towards the practical aspects of breach repair. Nevertheless it is almost impossible to ignore procedural aspects in the context of the work and, if nothing else, they do give some indication of the degree of preparedness in any area or region.

The first part of the questionnaire sent out to the NRA regions covered general information and procedures relating to breach repair. The returns and the discussions held in a number of NRA offices indicate wide variations between regions and sometimes within regions. Some findings from an analysis of the responses are given below.

3.1.1 Documentation

From the responses to date it can be concluded that in all regions there exist emergency procedures in some form. These vary from complete emergency standing orders, which include detailed regional and local information, to a document containing a limited amount of general information. In some areas there are procedures prepared at a regional level, often criticised for being prepared without reference to operations staff, backed up by individually held local data, such as lists of contractors and material suppliers.

Without the benefit of discussion it is difficult to ascertain the completeness of the contingency plans in a particular office. Of the offices visited the emergency procedures held in the Manby office of the Anglian Region (Northern Area) are by far the most comprehensive. In addition to communications information and responsibilities, there is detailed information on all defences which are split into lengths and classified by type and defence level. Normal access is defined but it is accepted that in flood conditions this may not be usable. The document also contains flood warning information, based on the national colour coding system, the details of which have been put together by the local office.

In all areas there is a rota of duty officers. If there is an emergency or the area is on flood or surge tide alert it is normal to open up the local office incident room, usually manned by the District Engineer, and to get other operations staff out patrolling the defences at potential risk.

Most, but not all, areas claim to have a format for reporting incidents. Although not included in the questionnaire, the information from site visits indicates that there is generally an informal post-mortem after an emergency but the lessons learnt from the operation will not usually be written up for future reference.

The availability of historical records of defences is patchy with as built drawings and inspection reports being better provided than maintenance information. Whether it would be a realistic proposition to consult such records in the event of an emergency is questionable. Nevertheless good practice suggests that basic data on the defences and their history should be recorded and be available if required.

3.1.2 Training and Liaison

About half of the questionnaire respondents claim to have had some training in how to deal with emergencies, and this is consistent with the information gathered during site visits. Training can take many forms from workshops to discuss/review procedures to full scale field exercises, sometimes involving outside organisations. Field exercises are expensive but they can be very useful if they are relevant and targeted at the correct staff group.

In the event of an emergency, local councils, the police and sometimes other emergency services will be involved. Certainly it appears that it is the responsibility of the police to order evacuation of properties but they can only do this effectively if they are liaising closely with the NRA. This points to a need for periodic coordination between all parties so that each one is able to perform when an emergency occurs. From the limited sample of site visits the practice varies from regular meetings at regional level to annual meetings at district level and informal local contact.

3.1.3 Inspection

The apparent decrease in occurrence of breaches is generally attributed to strengthening of defences over the years by raising and/or improved construction and equipment availability. Thereafter inspection and maintenance are extremely important to keep defences in good condition. No attempt has been made to study maintenance regimes but questions have been asked about inspection procedures.

From the questionnaires returned, regular inspection of defences is carried out in some 75% of areas. The information gained during site visits indicates that coastal defences are inspected much more frequently than fluvial defences, usually twice a year, before and after winter, and again after an event. In some areas sea defences are also checked for level and cross section twice a year, but in others no surveys are carried out.

In only a few areas are fluvial defences inspected regularly although operations staff observe them during maintenance work and report any problems. In the North West Region the visit to the Central Area revealed that a vermin operative inspects embankments twice a year and reports on any visible problem areas.

One point relating to maintenance, which has come out in most of the discussions, is the need for regular cutting of grass on embankments which are not grazed. Cut grass leads to clean growth, which binds and protects

the bank. Also if the grass is not cut you cannot inspect effectively and will not identify potentially troublesome vermin/rabbit holes or other problems. Another point is that bushes on banks attract animals and it is better to keep banks clear.

3.2 Review of Breach Sealing Methods

By considering historic accounts of breaches and questionnaire returns general trends for sealing methodologies can be obtained. Research to date has found detailed accounts of breaches dating from the 1930's. Since this time the availability of hydraulic plant has significantly changed the approach to the emergency sealing of breaches. Improved construction methods, inspection and maintenance have also had an impact on the occurrence of breaches.

3.2.1 Fluvial Breaches

The majority of fluvial defences reported are earth embankments. Failure of these embankments generally occurs during periods of high river flow and are caused either by overtopping leading to back erosion or by percolation through the embankment leading to a piping type of failure. Most failures are avoidable either by design and/or inspection. In some NRA regions embankments have been raised and the rear face of defences protected against overtopping while vermin operatives have been employed to inspect earth embankments and reduce the likelihood of piping type failures via vermin burrows.

Several methods have been employed to seal breaches in fluvial defences including sandbagging, trench sheets and timbers, filling with local or imported material and sinking of barges. The method employed is dependent upon the magnitude and severity of the breach, location and availability of plant and materials. Generally speaking, and with the exception of sandbags, there are very few stockpiled materials specifically held for breaches. Sandbags are often used as a first response to a breach, however vast numbers are often required to facilitate an effective breach seal. A more effective method of breach sealing uses sandbags in conjunction with fence stakes or trench sheets. Materials are ideally available locally and there are several recorded incidents of embankments being rebuilt with alluvial material deposited during floods. If not available, then local materials suppliers such as quarries or nearby construction sites need to be contacted. Invariably heavy plant is not immediately available and in many cases local plant hire firms have to be contacted.

3.2.2 Tidal Breaches

Many tidal defences are earth embankments and hence failure mechanisms are similar to those for fluvial defences with the causes invariably being surge tides and rough weather combined with high river flows in some situations. There are also several accounts of breaches in concrete tidal defences. The earth embankments have been sealed using methods as discussed for fluvial events however the concrete defences have utilised

methods such as concrete filled sandbags and compacted clay to effect a seal.

The sealing of tidal breaches has to be undertaken at periods of low tide and hence the timing of operations is crucial involving substantial planning of resources to repair the breach and limit any flooding to the region. There is sometimes a need to stockpile materials on site ready for filling during the next low tide cycle.

3.2.3 Coastal Breaches

During the east coast floods of 1953 there were numerous breaches of coastal defences. Many of these defences were constructed from concrete or earth embankments with revetment protection and failure occurred due to overtopping and back scour during the exceptionally high tide and heavy seas. At that time, with little heavy hydraulic plant and difficult access, breach sealing was a labour intensive operation relying heavily on sandbagging as a first response.

Since 1953 the east coast defences have been improved considerably and few breaches of coastal defences have been experienced recently. In cases where breaches have occurred a temporary sealing method has been to fill the breach with chalk and face it with concrete. In other cases imported stone has been used.

Access - Materials/Plant.

- locally available materials.

- appropriate plant.

- Temporary measures may be needed.

A method of breach sealing employed with success during the 1953 breaches was the construction of ring walls on the landward or seaward side of the breach. Since 1953 there have been few recorded uses of this method.

Many sea defences take the form of shingle ridges. There have been several incidents of these being overtopped and lowering the crest of the ridge. In such incidents the repair method is to use heavy plant to reshape the ridge using material from the beach or nearby areas.

The timing of repairs is crucial when sealing coastal defences. Repair work can only be carried out at low tide and it is often the case that flood water can be trapped behind repairs and hence plans have to be made to allow this water to escape at the relevant point in the tidal cycle.

3.2.4 Alternative Methods of Breach Sealing

Several potential methods of beach sealing have been researched during the course of this study.

- Stone Filled Gabions

Stone filled wire mesh gabions have been used to seal breaches in embankments and river training works on the River Po in Italy. Cylindrical shaped gabion baskets were filled with stone on site, with each completed gabion weighing 900kg. The gabions were

loaded onto a barge and then dropped into place to seal the breach. 40,000 gabions were used to seal a 400m long breach.

In many breach situations emergency sealing is not totally necessary. Unless property is at risk it is often better to wait and make a permanent sealing when water levels subside.

On the River Po the stone filled gabions were used as a permanent repair. It would however, be feasible for emergency repairs to be carried out using this method if the gabion baskets and stone are readily available.

- **Large Bags**

Large sand bags have a potential in emergency breach sealing. Large fertiliser type bags filled on site and weighing 1/1½t have been used in some breach instances in the UK. However the criticism that they do not bond well has often been made. Shoreline Erosion Arrestor Bags (SEA bags) are semi porous polypropylene containers designed to be filled with a sand and water slurry via a self sealing valve. The permeable fabric allows the water to escape leaving the sand in the bag. When filled these bags weigh approximately 3t. The bags have been used in the USA as a form of beach erosion protection but it is possible that they could be applicable for use as an emergency sealing method.

Nicobags, marketed by MMG Civil Engineering Systems Ltd (MMG) are a synthetic type of sandbag. Various sized sandbags are available and they are filled and stitched up on site.

Another product marketed by MMG is the Geocontainer which is a large sized geotextile bag. The bag is placed into a barge, filled with granular material, sealed and then dropped into place where required. The size of the bag is variable and has many potential uses including the emergency sealing of breaches.

Flexible transportable bulk bags are available from FPT Industries. These bags are intended to be lashed onto a trailer and filled with liquid via a valve. The bags can be tailor made and are very durable. Such bags filled with water could have a potential use in breach sealing.

- **Emergency Boxes**

Some NRA regions have considered the use of emergency boxes built from plywood in a steel frame. The boxes, sized 2.4m x 1.2m x 1.2m are intended to be positioned in a breach and filled with any material on site. It is anticipated that these boxes could form the core of a permanent repair.

- **Slope Stabilisation**

Although not strictly a breach sealing method, slope stabilisation by methods such as soil nailing and soil cement represent means of preventing the occurrence of breaches.

Soil nailing involves driving rigid rods into a slope to improve the strength of the soil mass hence making it less likely to fail. In soil cement, cement is mixed into the soil to form a much stronger and resistant concrete like soil.

PROGRAMME AND PROGRESS

The Activity Schedule as agreed at the inception meeting is included in Appendix A. From this it is seen that submission of this Interim Report is almost two weeks late, because of an unfortunate illness suffered by one of the key team members.

Following the inception meeting in March the first task was to prepare and distribute the questionnaire. This was done by 24 March and after allowance for the Easter Holiday period, return by 19 April was requested. This was some three weeks later than envisaged in the programme and in fact very few questionnaires were returned by the due date. It is also to be noted that some site visits were difficult to arrange at short notice and those that were made were not completed until 27 April.

Notwithstanding the above the work is generally on programme and should continue as such. The outstanding work is to finalise the data search and review, and to collate and consolidate the information gathered. The Draft Final Report is due for submission at the end of June.

5 FINANCIAL REVIEW

The agreed budget for Phase 1 of the study is £15,000, made up of £13,400 staff charges and £1,600 expenses. These figures were built up from an assessment of the time required to complete the various activities shown in the programme. A comparison of the estimated and actual charges to submission of the Interim Report is given below:

	Estimated	Actual Charges
Staff Charges	7,300	6,000
Expenses	1,200	600
TOTAL	8,500	6,600

This shortfall of charges to date against the estimate can largely be attributed to two factors:

- delayed start to data collection and assessment; and
- fewer site visits and meetings than anticipated.

In terms of the future work to completion of Phase I and submission of the Draft Final Report we anticipate making up some of the shortfall by additional work on data assessment. Enquiries are also being made to try to establish the value of further site visits, but this may not be worthwhile. In conclusion we estimate that total charges for Phase I will meet or be marginally below the contract price.

CONCLUSIONS

Some basic conclusions of the study to date are given below.

- (a) There is a limited amount of recent experience in dealing with breach repair. This is generally attributed to raising and strengthening of defences, particularly since 1953, and to improved construction techniques and hydraulic equipment.
- (b) Emergency procedures are available in some form in all NRA regions, but their coverage and level of detail vary considerably.
- (c) Inspection of coastal and tidal defences, usually twice a year, appears to be common practice, but less attention is paid to fluvial defences. The importance of maintenance, especially to grassed embankments, is widely accepted.
- (d) Often the first decision to take in the event of a breach is whether or not to carry out emergency repairs or to wait until conditions improve and permanent repairs can be made. This will depend on whether property is at risk, and possibly drainage from behind the defences.
- (e) It is difficult to generalise about breach sealing methods. There is inevitably a need to treat each case on its merits, taking into account location, access, prevailing weather and tidal/water level conditions, and availability of materials and plant.
- (f) When dealing with earth embankments, which constitute the majority of defences, and also shingle banks, the use of locally won material is the preferred practice. Imported clay or stone are sometimes used. With exposed coastal defences the use of dumped rock is more common.
- (g) Sandbags are the only materials kept in stock for emergencies in all NRA regions. They have a use for sealing relatively small breaches, or temporary raising of defences to prevent overtopping.
- (h) Trench sheets have been used widely and effectively in combination with sand bags or earth fill, to seal breaches. Their advantages are availability, transportability and ease of driving. Fence posts or similar, which can be closely driven, can also be used.
- (i) Although submission of the Interim Report is almost two weeks late, the study is progressing generally to programme and Phase 1 should be finished on time at the end of June.
- (j) Charges to date are below those estimated and it is anticipated that the final cost for Phase 1 will be close to or a little below budget.

Appendix A

**PROJECT INVESTMENT APPRAISAL
AND ACTIVITY SCHEDULE**

NATIONAL RIVERS AUTHORITY: R&D PROJECT INVESTMENT APPRAISAL

1. Title: Emergency sealing of breaches

R&D Commission: C - Flood Defence
Topic: C08 - Response to Emergencies
Proposal No: C08(91)03 Project No: 0431
R&D Classification: Applied Strategic/Development
Primary purpose: Operational Effectiv

2. Project Leader: Mr A Bullivant

Post title: District Engineer
Region: Anglian
Address: Central Area,
Prickwillow Road
Ely, Cambs.
Postcode: CB7 4TX
Telephone: 0353 666660
Fax: 0353 666897

3. Research Contractor: Sir William Halcrow & Pts

Address: Burderop Park
Swindon
Wiltshire
Postcode: SN4 0QD
Telephone: 0793 812479
Fax: 0793 812089

Contract signatory:

Project manager: Mr E Evans

4. Contract Details

Start Date: 03/93 Status: As Proposed
End Date: 08/93 Status: As Proposed

5. Objectives

Overall Project Objectives

To undertake a state-of-the-art review of emergency sealing of breaches in sea, tidal and fluvial flood defences for the production of an operational manual.

Specific Objectives

Phase 1

1. To investigate existing methods of sealing breaches in sea, tidal or fluvial flood defences both within the NRA and externally.
2. To investigate possible future methods of sealing breaches using new technology and materials.
3. To assess and propose the requirements for the production of an operational guidance manual, which will detail the various methods of sealing of breaches in emergencies for defences and advise on best option/practise.
4. To suggest possible areas for further R & D.
5. To produce a final report which collates the above information and proposes objectives and strategy for Stage 2 to achieve the Overall Project Objective.

Phase 2 (to be tendered in mid to late 1993/94)

1. To undertake R&D proposed in the Project Record from Phase 1
2. To produce an operational manual for the emergency of sealing breaches

6. Background

Due to major flood defence improvement works as a result of the floods in 1947 and 1953, etc, breaches only occur in flood defences infrequently. This situation results in any one Region having limited experience of dealing with breaches due to changes in staff. The issue of relevant experience for present staff is further compounded by a lack of documentation on previous breaches in many instances.

Reductions in the NRA's own manual labour-force has resulted in a loss of expertise in dealing with breaches. The resultant increased use of external contractors will necessitate the Authority to be assured of contractor performance. A manual will be of major significance in this respect.

New technology and materials will present possible scope for improving and extending the methods which can be employed to deal with the sealing of breaches.

Context

This project has some links with other emergency R&D projects, but is essentially it is a stand alone project.

There will be links to the "Dam Break Analysis" project which is being developed and "flood maps" (not produced in every Region) which are likely to be one of the recommendations coming out of the "Emergency Response Levels of Service" project in defining the risks of relating to breaches in defences.

Documentation (as a possible reference manual) is timely due to:

1. Loss of expertise
2. Infrequent nature of events
3. Greater contracting out in the future.

Do-nothing option

The NRA will not have an overall review of the methods of sealing of breaches and may miss the opportunity to evaluate and use new technology/materials.

Expertise is being lost as staff with previous experience of breaches are retiring and their expertise is not documented. The change towards the use of external contractors may result in uncertain performance in emergency breach sealing situations. The Authority may not be able to provide a consistent level of service with respect to emergency sealing of flood defence breaches without the outputs proposed from this project.

7. Strategy

Method

Overall Approach

The proposed approach is for the project to be phased. Phase 1 will yield a scoping study, establishing the current state-of-the-art in this field and R&D avenues worth exploring, and suggesting work programme for Phase 2. Phase 2 may address the R&D proposed in Phase 1 but will produce the Operations Guide for Emergency Sealing of Breaches.

Project Organisation

The project is lead by a District Engineer who has experience of leading in-house work force and contractors in operations work. He reports to the Topic Leader who will circulate the outputs for wider comment within Flood Defence expert groups.

Never heard of this one

Project Monitoring

Project monitored by Project Leader, Topic Leader and Regional

R&D Scientist during the external research phase. The Topic Leader will circulate outputs to Flood Defence contacts

Undertake Research - Phase 1

- 1 ✓ Collate data and reference information, from NRA and industry, using questionnaires as appropriate
- 2 ✓ Research external literature, recent publications and seminar data and in particular, new innovations in the field of flood defences
- 3 ✓ Undertake site visits, as agreed with the Project Leader, for appraising the full spectrum of examples of constructed breach closures
- 4 ✓ Assess the data collected, classify and identify acceptable methods, establish broad criteria for categories of works within each classification and assess environmental impact of each
- 5 Appraise the various options in terms of construction methods performance, cost and impact: categorise in priority order. (outlining appropriate logistics and order of magnitude of Operations and the required standby resources).
- 6 Assess the merits of a database system for an organised documentation of the collated data and the use of records as a streamlined approach to future work involving closure of breaches
- 7 Produce a Draft Final Report including detailed recommendations for the structure of an Operational Manual, review of closure techniques, details of further R&D and a proposed activity plan for the Phase 2 component of the programme
- 8 Produce a Project record and draft R&D Digest

Uptake Dissemination

The outputs will be targetted towards in-house work-force and contractors for this work. The draft phase 1 output will be circulated by Topic Leader to Flood Defence Business Group "Emergency Response" for comment and decision on content of phase 2 of the project.

One copy of the Phase 1 Project Record will be circulated to each Region, with 10 copies of the R&D Digest.

Implementation

The Project record is a review of the work area and will assess the way forward into Phase 2. As such, it is not a wide dissemination document, with its implementation into the second phase of the project.

Customer Acceptance Level: Function Working Group

8. Targets

WORK ITEM	COMPLETION DATE	MONTH
Start contract	Mar 1993	0
Review external literature, visit selected sites, assess data	Mar/Apr 1993	2
Review of new techniques, assess structure of manual and produce Interim Report	7 May 1993	3
Collate and produce Draft Final Report	30 June 1993	5
Project Record/R&D Digest	after NRA review	

9. Outputs

Deliverables

Phase 1
Short-term

Type	Status		Copies	Date	Produced by
	Int	Ext			
Interim Report	LR	R	5	7 May 1993	Contractor
Draft Final Report	LR	R	10	30 June 1993	Contractor
Draft R&D Digest	RR	R	1	After review	Contractor

Permanent Outputs - Phase 1

Project Record	RR	PD	15+1	After NRA Review	Contractor
R&D Digest	RR	PD	100+	After review	NRA

Project Outputs - Phase 1

Item	Designation	Acceptance level	Uptake Route
Project Record	f, e, o, g	FMG (BG)	c
R&D Digest	f, o, g	FMG (BG)	

11. Benefits

The production of a manual of best practice will be invaluable as an aid to staff dealing with a breach. Recent flooding events have highlighted the urgent need to expedite repairs in the most efficient manner possible. It is a low cost project against the potential damage caused by breaches.

The collation of data spread throughout the Regions will compare overall knowledge with subsequent improvements in the effective response to breach situations. The outputs from this project will compare the levels of service with respect to emergency planning.

Monitoring for benefits

The contractor will propose a method in the Phase 1 report for how the Authority could assess the impact of the project's final output, the Operational manual for Emergency Sealing of Breaches

12. Assumptions/Risks

The overall risks are low as all the selected Research Contractors will be able to assess the available literature and the Regional contacts can be targetted to produce a good response.

No major uncertainties exist in work programme or cost. The phasing of the work has reduced the financial risk to the work, by not committing monies to extensive R&D without scoping the work.

13. Overall Appraisal

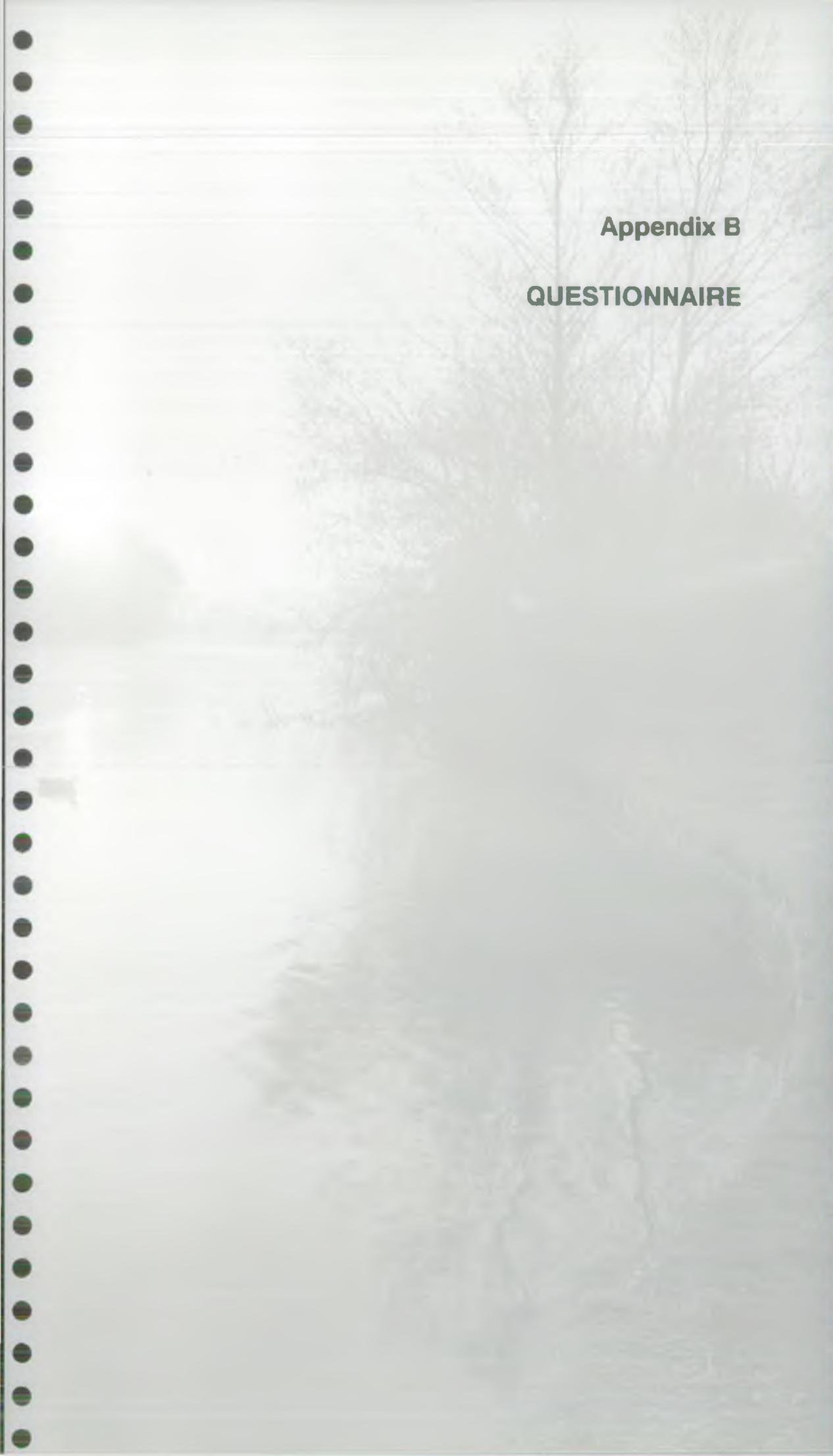
Project justified principally due to a lack of documentation and the very large potential cost of damage as a result of a breach in NRA flood defences.

Risks are limited to the adequacy of contractor performance and the Regional support.

**NRA NATIONAL RESEARCH & DEVELOPMENT PROJECT C08(91)03
EMERGENCY SEALING OF BREACHES - PHASE I
ACTIVITY SCHEDULE**

ACTIVITY	MONTH	MARCH				APRIL				MAY				JUNE				DATE OF SUBMISSION
	WEEK NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Data Collection : NRA Region/Industry		▨	▨															
Research External Literature			▨	▨														
Selected Site Visits				▨	▨													
Assessment of Data					▨	▨												
Review of New Techniques				▨	▨	▨	▨											
Monitoring Logistics							▨	▨										
Proposed Structure of Manual								▨	▨									
INTERIM REPORT								▨	▨									7.5.93
NRA Review										▨	▨							25.5.93
NRA Review Meeting												▨	▨					
Draft Final Report : Research and Collation											▨	▨						
Proposed Classification												▨	▨					
Breach Closure Methods													▨	▨				
Database Proposals														▨	▨			
Guidelines to Manual															▨	▨		
Project Record/Draft Final Report													▨	▨	▨	▨	▨	30.6.93

▨ NRA Input



Appendix B

QUESTIONNAIRE

**NATIONAL RIVERS AUTHORITY
NATIONAL R&D PROJECT C08(91)03**

EMERGENCY SEALING OF BREACHES - PHASE I

QUESTIONNAIRE

You are requested to complete the attached questionnaire with general data about your area and one breach repair pro-forma for each incident of which you have knowledge or records. To enable us to progress the study and to plan any follow up meetings and/or site visits would you please return completed questionnaires to reach the address below by 19 April :

John Palmer (Dept WH)
Sir William Halcrow & Partners Ltd
Burderop Park
Swindon
Wilts SN4 0QD

Tel: 0793 812479 (Ext 2681)
Fax: 0793 812089

If you have any questions or queries on the questionnaire please refer them to the above.

Details of the respondent:

Name
Position
Tel

1. Give approximate lengths (km) of flood defences in your area, defences being artificial construction to protect people and property from flooding:

Construction	Earth Embankment	Sheet Piled Wall	Concrete Wall	Other
Coastal				
Tidal				
Fluvial				

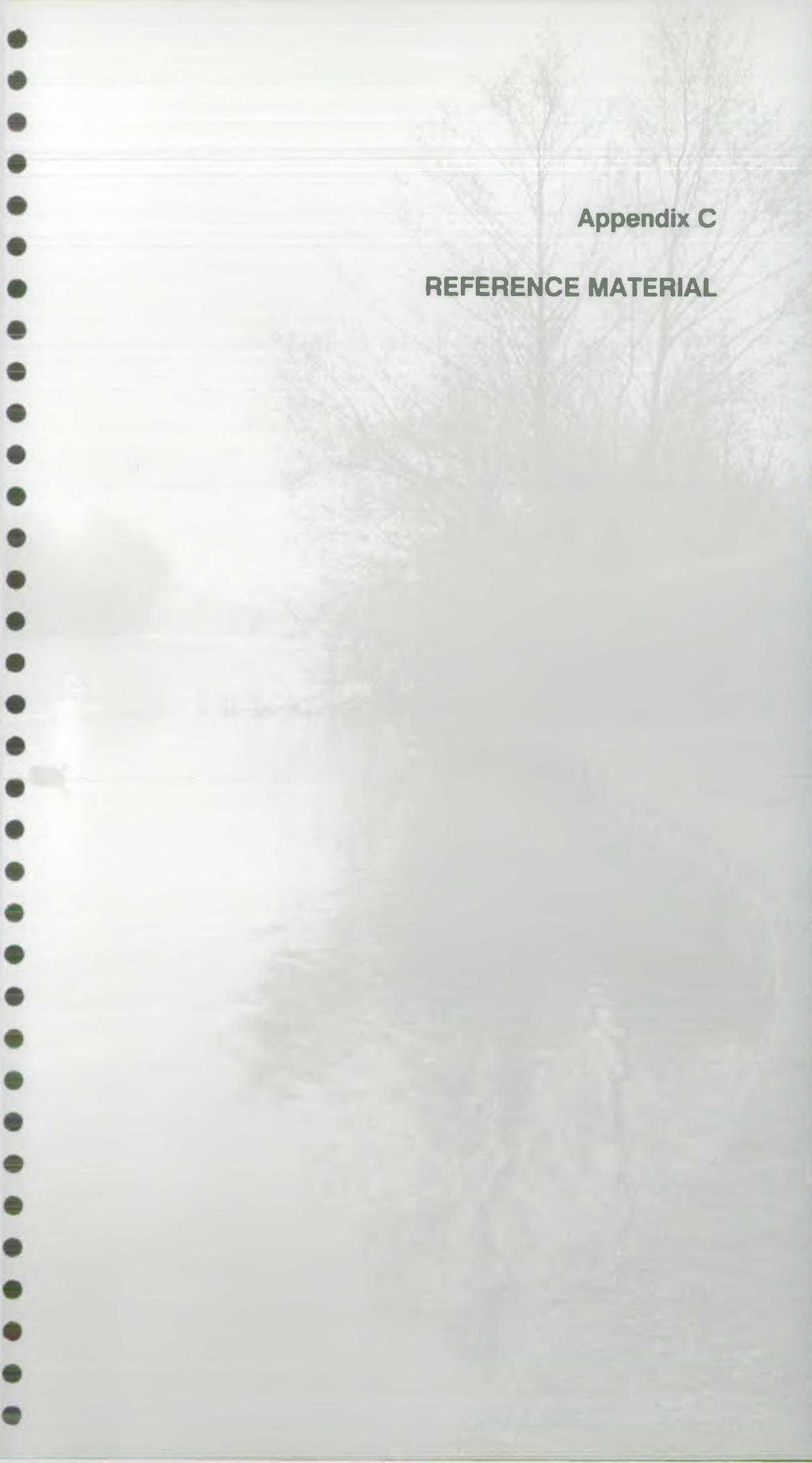
2. Does your region/area have contingency plans for dealing with emergencies? Yes/No
- 2.1 If yes do they include:
- specific procedures for
 - coastal defences Yes/No
 - tidal defences Yes/No
 - fluvial defences Yes/No
 - appraisal of damage Yes/No
 - plant hire contractors Yes/No
 - materials suppliers Yes/No
 - responsibilities (who does what and when) Yes/No
 - budget availability/control Yes/No
 - incident report format Yes/No
 - duty rotas and telephone nos Yes/No
 - external contacts (police, councils etc) Yes/No
 - evacuation procedures - general/regional Yes/No
 - site specific Yes/No
 - site specific access information Yes/No
- 2.2 Have you been trained to deal with emergencies, such as breaches of flood defences? Yes/No
3. Are there historical records of defences in your area
- as built drawings Yes/No
 - maintenance manuals Yes/No
 - maintenance/rehabilitation reports Yes/No
 - inspection reports Yes/No
4. Are the defences in your area regularly inspected? Yes/No
- 4.1 If so, are inspection reports prepared? Yes/No
5. Do you have a system for classification of breaches and their repair? Yes/No
- 5.1 If so briefly describe or attach separate note
6. List any known/useful references related to breaches including: reports, periodicals, papers, memos etc.

EMERGENCY SEALING OF BREACHES - PHASE I

BREACH REPAIR PROFORMA

For any breach of which you have knowledge/experience please describe using the following headings as prompts, but not necessarily restricting your response to these:

- (i) Date of occurrence 0-10, 10-20 or >20 years and year..... (if known)
- (ii) Type of defence coastal/tidal/fluvial
- (iii) Type of construction earth embankment/ sheet piled wall/ concrete wall/other (specify.....)
- (iv) Antecedent conditions (weather/river flow/tide etc)
- (v) Reasons for the breach (design or maintenance problems?)
- (vi) Repair procedure (temporary or permanent works, type of construction, etc)
- (vii) Type of plant used
- (viii) Materials used and were they available from stockpiles
- (ix) Site access (permanent/temporary, landside/waterside etc)
- (x) Consideration of environmental or conservation aspects in repairs
- (xi) Involvement of other parties (local councils etc)
- (xii) Approximate extent of property/people flooded
- (xiii) Property/people evacuated if any
- (xiv) Other comments



Appendix C

REFERENCE MATERIAL

APPENDIX C - REFERENCE MATERIAL

- ICE. 1954. 'Conference on North Sea Floods of 31st January and 1st February 1953 - a collection of papers'. ICE Papers.
- Cerutti G, Lasagni F. 1985. 'Use of cylindrical gabions in the defences of the River Po'. Ministry of Public Works, Parma.
- Berkeley Thorn R, Roberts A G. 1981. 'Sea Defence and Coast Protection Works'. Thomas Telford Ltd.
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- USBR. 1987. 'Design of Small Dams'. US Government Printing Office, Denver, Colorado.
- Geotechnical Control Office, Hong Kong Public Works Department. 1981. 'Geotechnical Manual for Slopes'.
- National Audit Office. 1992. 'Coastal Defences in England'. HMSO, London.
- Hydraulics Research Station. 1980. 'Report on Bank Protection in Rivers and Canals'.
- Mott MacDonald. 1992. 'Viability of Emergency Plant and Vehicles.' NRA.
- C T Marshall. 1991. 'River Flood Forecasting - State of the art review'. NRA.
- Costain Telecommunications and Systems Ltd. 'NRA Communications Strategic Study'. NRA.
- Middlesex University. 1992. 'Flood Defence Emergency Response: National Levels of Service.' NRA.
- Fujita Y, Tamura T. 1987. Natural Disaster Science Vol 9, Number 1, pp.37-60. 'Enlargement of breaches in flood levels on alluvial plans'.

Appendix D

QUESTIONNAIRE RESPONSE

Appendix D Questionnaire Response

Page No. 1
19/05/93

QUES_NO	DATE_REC'D	BODY	REGION	SUB_REGION	NAME	POSITION	COMMENT_1	COMMENT_2
1	20/04/93	NRA	THAMES		NIGEL BRAY	FD OPERATIONAL SERVICES MANAGER	NO BREACH DETAILS	
2	20/04/93	NRA	THAMES	NORTH EAST	M.J.DICKER	ACTING AREA MANAGER	1 TIDAL DEFENCE BREACH	
3	20/04/93	NRA	THAMES		ROGER POWLING	FD BUSINESS MANAGER	1 TIDAL DEFENCE BREACH	
4	20/04/93	NRA	THAMES	WALTHAM CROSS	JOHN MEEKINGS	PRINCIPAL PLANNING ENGINEER	VERY FEW DETAILS	
5	20/04/93	NRA	THAMES		T LEWIS	EMERGENCY PLANNING OFFICER	NO BREACHES	
6	20/04/93	NRA	THAMES	TIDAL THAMES AREA	G HAWES	OPERATIONS MANAGER	BREACH IN TIDAL DEFENCE	
7	14/04/93	NRA	ANGLIAN	SUFFOLK	COLIN BEAZLEY	DISTRICT ENGINEER	TYPICAL COASTAL BREACH REPAIR	TYPICAL TIDAL BREACH REPAIR
8	/ /	NRA	WESSEX	BRISTOL AVON	KEN TATEH	AREA FLOOD DEFENCES ENGINEER	NO BREACH DETAILS	
9	21/04/93	NRA	WESSEX	SOMERSET	H.W.DULWICH	ASSISTANT FLOOD DEFENCE ENGINEER	FLUVIAL BREACH REPORT INCLUDED	
10	21/04/93	NRA	WESSEX	AVON AND DORSET	L.A.MILES	ASST.AREA FLOOD DEFENCE ENGINEER	CHESIL BEACH EMBKT. OVERTOPPING	HISTORICAL ACCOUNT OF CHESIL FLOODS
11	14/04/93	BWW	NORTH WEST		PETER BENTHAM	ENGINEERING MANAGER	NEGATIVE RESPONSE	
12	14/04/93	BWW	TECHNICAL SERVICES		BRIAN HASKINS	CHIEF CIVIL ENGINEER	CANAL BANK BREACH AND RECONSTRUCTION	
13	22/04/93	NRA	ANGLIAN	CENTRAL AREA	L.GRAY	ASSISTANT ENGINEER	1 COASTAL BREACH REPORT	1 FLUVIAL BREACH REPORT
14	22/04/93	NRA	NORTHUMBRIAN	NORTHERN AREA	A.J.CLARKE	NORTHERN AREA ENGINEER	3 FLUVIAL BREACHES	1 TIDAL BREACH
15	22/04/93	NRA	YORKSHIRE	SOUTHERN	K.G.BARTON	AREA ENGINEER	1 FLUVIAL BREACH	
0	/ /							
16	26/04/93	NRA	SOUTHERN		ADRIAN BIGGS	ACTING FLOOD DEFENCE OPS MANAGER	1 TIDAL EMBKT FAILURE LED TO BREACH	ALSO CONTACT ROY CROSSLAND
17	26/04/93	NRA	ANGLIAN	MANBY	EDDIE MARKHAM	DISTRICT ENGINEER	35 BREACH REPORTS, FROM 1795	REPORTS FROM 1930 GIVE REPAIR DETAILS
18	29/04/93	BWW	NORTH EAST		P.J.BARNES	ENGINEERING MANAGER	2 CANAL BREACHES DESCRIBED	NO QUESTIONAIRRE RETURNED
19	27/04/93	NRA	ANGLIAN	NORTH ESSEX	GARY COCKETT	ASST. DISTRICT ENGINEER	NO BREACHES	
20	04/05/93	NRA	NORTH WEST	NORTHERN AREA	G.VAUGHAN	ACTING DISTRICT MANAGER	1 FLUVIAL BREACH	
21	14/05/93	NRA	NORTH WEST	CHESHIRE	JOHN NORTON	DIST. MANAGER FLOOD DEFENCE	NO BREACHES	
22	14/05/93	NRA	NORTH WEST	MANCHESTER SOUTH	P.D.LEWIS	DIST. MANAGER FLOOD DEFENCE	1 FLUVIAL BREACH	
0	/ /							