

National Rivers Authority

**SUPPLEMENTARY SURVEY OF
CONTAMINATED LAND**

Report

September 1992

HALCROW

National Rivers Authority

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CONTAMINATED LAND**

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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

HALCROW

NATIONAL RIVERS AUTHORITY
SUPPLEMENTARY SURVEY OF CONTAMINATED LAND

Report
September 1992

REPORT AUTHORISATION

Prepared by: A R TOFT
Date: 24/9/92

Signature: *AR Toft*

Checked by: C R HOGGART
Date: 24/9/92

Signature: *C. Hoggart*

Approved by: J D LAWSON
Date: 24/9/92

Signature: *J.D. Lawson*

NATIONAL RIVERS AUTHORITY
SUPPLEMENTARY SURVEY OF CONTAMINATED LAND

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CONTENTS AMENDMENT RECORD

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HALCROW

Consulting Engineers

Sir William Halcrow & Partners Ltd
Burderop Park, Swindon,
Wiltshire SN4 0QD, England
Telephone 0793 812479
International Telephone + 44 793 812479
Telex 44844 Halwil G
Fax 0793 812089
International Fax +44 793 812089

And at
Vineyard House, 44 Brook Green,
London W6 7BY, England.
Telephone 071-602 7282.

NRA
Rivers House
Waterside Drive
Aztec West
Almondsbury
Bristol
BS12 4UD

For the attention of Ms G Brophy

25 September 1992

Our Ref WE/NCL/11/031

Your Ref

Dear Sirs

SUPPLEMENTARY SURVEY OF CONTAMINATED LAND Final Report

Enclosed are twenty copies of the final report entitled 'Supplementary Survey of Contaminated Land'.

In finalising this report we have incorporated those comments made on the draft at the meeting on 2nd September. We have also invited comments from all the NRA Regions on the sections providing details of the sites included in the survey, and these have been duly amended. Thus, the information presented in the report is correct given the understanding and involvement of NRA staff in these sites.

With reference to eliciting additional information on contaminated land causing failure of water quality objectives or breach of EC water quality standards, little information was available from the Regions. Of the few responses received, on this issue, the main comment was that pollutants from contaminated land are generally not reflected in the assessment of River Quality Objectives or for compliance with EC Directives.

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(Chairman)
D Buckley FICE
(Chief Executive)
A C Cadwallader BA
(Secretary)
D O Lloyd BSc FICE
H G Johnson BSc FICE
D J Pollock PhD MICE
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J Weaver PhD FICE
D S Kennedy BSc FICE
M R Stewart OBE FICE FIHE
J L Beaver FICE
P A S Ferguson MASM MICE
C A Fleming PhD MICE
G D Hillier BSc FICE
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N A Trenter MIGEOL MICE
V M Scott BSc FICE
T P Walters BSc FICE

J P Wood BSc FICE
J Ahmed BSc FIE
R N Craig BSc MICE
E P Evans MA FICE
C T K Hepunhall BSc FICE
A J Madden PhD MICE
J C Thorne BSc FICE
P S Godfrey BSc MICE
I C Milar BSc FICE
C P Barnard BSc FIPM
P Jenkin BE MICE

B Walton MICE
A K Allum FICE FIWEM
D H Beasley PhD FICE
J D Lawson MA FICE
J A Strachan MA FICE
P Arnold BSc MICE
A J Runacres BSc MICE
M R Starr PhD FICE

Consultant
Sir Alan Muir Wood FRS FEng FICE

BSI Registered Firm -
Certificate No FS 20242

Registered in England No 1722541
Registered Office
Vineyard House, 44 Brook Green,
London W6 7BY

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25 September 1992

A copy of the report on disc is being sent under separate cover. Should you require any further work to be undertaken in this area please do not hesitate to contact us.

Yours faithfully

Anne Toft

A R TOFT
Project Manager

Enc

NRA SUPPLEMENTARY SURVEY OF CONTAMINATED LAND

CONTENTS

		Page No
1	INTRODUCTION	2
	1.1 Introduction	2
	1.2 Objectives	2
2	METHODOLOGY	4
	2.1 Approach	4
	2.2 Data Collection	4
	2.3 Land Use Activities and Site Categorisation	5
	2.4 Results	6
	2.5 UK Studies	7
3	REGIONAL REVIEW	8
	3.1 Introduction	8
	3.2 Anglian	9
	3.3 Northumbria	10
	3.4 North West	11
	3.5 Severn Trent	12
	3.6 Southern	13
	3.7 South West	13
	3.8 Thames	14
	3.9 Welsh	15
	3.10 Wessex	16
	3.11 Yorkshire	17
4	UK STUDIES	18
	4.1 Introduction	18
	4.2 Treatment of Contaminated Groundwater	18
	4.3 Contaminated Land Remediation in England and Wales	20
5	CONCLUSIONS AND RECOMMENDATIONS	23
	5.1 Conclusions	23
	5.2 Recommendations	26
REFERENCES		
APPENDIX		
A	Terms of Reference	
B	Briefing Note and Questionnaire	
C	List of Contaminated Land Sites	
D	Summaries of More Problematic Sites	
E	NRA Personnel	

LIST OF FIGURES

- 3.1 Anglian NRA Region**
- 3.2 Northumbrian NRA Region**
- 3.3 North West NRA Region**
- 3.4 Severn Trent NRA Region**
- 3.5 Southern NRA Region**
- 3.6 South West NRA Region**
- 3.7 Thames NRA Region**
- 3.8 Welsh NRA Region**
- 3.9 Wessex NRA Region**
- 3.10 Yorkshire NRA Region**

LIST OF TABLES

- 5.1 Contaminative Land Use Categories**
- 5.2 Target Water Bodies**
- 5.3 Remedial Measures**

NRA SUPPLEMENTARY SURVEY OF CONTAMINATED LAND

SUMMARY

The overall objective of the study was to investigate the extent of pollution of the water environment from contaminated land sites, in each of the ten NRA Regions. As part of this objective the more problematic sites in each of the Regions have been identified and details of the contaminative use, the nature of the contaminants, the development status of the sites, the water bodies affected and of remedial actions, both undertaken and proposed, have been given.

In the course of this study 139 sites were identified as causing or having potential to cause pollution of the water environment. This however, is only a selection from the total number of such sites across England and Wales. It was reiterated in many Regions that the sites put forward for inclusion in this study were merely a sample and representative of a much larger problem. In the earlier study undertaken by Severn Trent some 186 contaminated land sites were identified.

Of the land uses identified, landfills were the main cause of pollution, accounting for 35% of the sites. Other significant land uses were chemical works, 20%, and gas works/coal carbonisation sites, 10%. Over 60% of the sites were related to a historical land use.

In assessing target water bodies some 75% of the sites are associated with surface water courses, 33% with groundwaters and 24% with coastal or estuarine waters (many sites impact upon more than one water body). In the course of the study there was much evidence of surface water pollution whilst groundwater pollution was more suspected than actually established. In many cases groundwater is not specified as a problem largely because investigative work is less easy to undertake.

Many of the sites have or are undergoing investigatory work, with the aim of establishing the exact nature and extent of the problem, prior to proposals for remediation and subsequent redevelopment. Less than 25% of the sites have been subject to actual remediation. Of the remedial measures implemented the commonest involves isolation of the contaminated material from the water environment, by either removal of material, installation of liners or capping.

1 INTRODUCTION

1.1 Introduction

In July 1992 Sir William Halcrow and Partners Ltd were appointed by the NRA to undertake a supplementary survey of contaminated land. The survey was conducted over a six week period and had as its prime aim to provide information to complement a forthcoming water quality series publication on Contaminated Land and the Water Environment. This consultation document will provide the basis from which guidelines on policy and practice for the protection of groundwater and surface waters can be derived.

The water quality implications of contaminated land have been the subject of much concern, in particular in light of recent publicised pollution incidents and also as a result of the proposed Environmental Protection Act, Section 143 Registers of Contaminative Land Use. The result is a heightened awareness of the potential risk that contaminated land sites can pose to both surface and groundwaters. It is also more widely recognised that such land can constitute a risk at various stages of its use or redevelopment; for instance ongoing activities may be adding to an existing water quality problem whilst a derelict site may contain an accumulation of contaminated material that could be released into the water environment by subsequent development or site investigation activities. Thus consideration of such factors should be incorporated into the consultation process and planning procedures so as to ensure that appropriate measures are taken on board prior to the development or redevelopment of such sites and that remedial actions are implemented.

1.2 Objectives

The overall objective of the NRA project is to develop guidelines on policy and practice for the protection of the water environment. Thus the first step in implementing this is to identify those contaminated land sites that pose a threat either immediately or potentially in the future. The overall objectives can thus be summarised in the following three points:

- to investigate the extent of contaminated land which is considered to have an impact on the water environment within each of the ten NRA Regions;
- to produce a list of the most problematic sites; and
- to indicate the need and likely scope of any remedial action at these sites.

The specific objectives, as defined in the Terms of Reference (Appendix A) are to:

- use the in-house project as a starting point

- **determine for each NRA Region the scale of the problem through interviewing pollution control staff**
- **consider in more detail five sites per Region**
- **determine the lengths of watercourses affected and extent of groundwater contamination (if known) for each Region**
- **categorise the sites identified**
- **summarise relevant UK studies that have been undertaken into groundwater remediation.**

This survey was not intended to provide a complete list of all contaminated land, impacting on surface and groundwaters, but to provide a list of the more problematic or potentially problematic sites, with associated information on site history, nature of the contamination, site investigations undertaken and whether remedial action is planned.

2 METHODOLOGY

2.1 Approach

To undertake this survey, within the six week period, the following approach was adopted:

- (a) Identification of key senior water quality personnel within each Region by the NRA
- (b) Preparation and circulation of a briefing note and questionnaire (Appendix B) to key senior officers in each Region, who in turn identified appropriate field staff and circulated the note and questionnaire to them
- (c) Meetings and interviews with appropriate senior officers and field staff in each Region.
- (d) Follow up on incomplete questionnaires, and those sites for which more information is required, and categorisation of sites
- (e) Preparation of summary tables for all sites identified and more detailed descriptions of five sites per Region

This approach built upon similar work undertaken in Severn Trent NRA (reported in The Severn Trent Phase One Report on Contaminated Land) and the results of a questionnaire circulated by Dick Flavin (Southern NRA) and Bob Harris (Severn Trent NRA) in 1991. From the previous studies undertaken the knowledge and experience held by the field staff, on contaminated land sites which do have an adverse impact upon the water environment, was recognised as being an important factor to the success of this survey.

2.2 Data Collection

As stated above the principle means of data collection was via a questionnaire sent to key water quality personnel in each Region. This questionnaire was based heavily upon that used in the previous survey thus enabling those questionnaires that had been completed in 1991 to be incorporated into the current study. The questionnaire was structured into seven self explanatory categories:

- general
- site use details
- water quality implications
- site investigations
- proposed actions
- priority scoring
- any other relevant information

The priority scoring was done on a scale of 1 (marginal) to 5 (imperative) to indicate the importance of the site in terms of undertaking proposed remedial actions. This was a very subjective evaluation and was used only to ascertain the perceived seriousness of that site. Due to the highly subjective nature by which sites were scored little importance was placed upon this parameter in the subsequent site assessments and categorisations.

Each Region was requested to identify approximately 10 contaminated land sites and arrange for the most knowledgeable officer to complete a questionnaire for each site. Where this was done prior to the meeting these questionnaires formed the basis for discussion. In those instances where completed questionnaires were not available prior to the meeting, either because less notice was given of the survey or personnel were on leave, the discussions were aimed more at the identification of appropriate sites and obtaining background information. Also during the meetings an attempt was made to estimate lengths of surface water affected and the extent of groundwater contamination (if known).

Throughout the course of the study, on the whole, little data on lengths of surface waters affected or the extent of groundwater contamination was available. In the case of surface waters this inability to determine the length of watercourse affected by a specific site was due to one or more of the following reasons:

- other discharges within the same reach causing EQO or EC directive failures.
- the synergistic effect of a number of discharges causing RQO or EC directive failure.
- contaminants not considered in the calculation of RQO's or addressed in EC directives.

The determination of the extent of groundwater contamination was considered to be even more problematic because of the intrinsic difficulties of monitoring groundwater quality. On many sites identified groundwater contamination is suspected with evidence being provided from site investigation work or analysis of groundwater from existing boreholes.

2.3 Land Use Activities and Site Categorisation

As an aid to the identification of contaminated land that may be impacting on the water environment the following land use activities, both current and historical, were highlighted for consideration:

- metalliferous mining spoil
- coal mining spoil
- steel/iron manufacture
- copper manufacture
- industry

- gas works
- sewage works (disused)
- landfill
- timber treatment
- chemical manufacture
- lime manufacture
- oil refinery/storage

This survey specifically excluded contamination arising from mines whether active or abandoned. Also, because of the abundance of operational landfill sites in each Region, emphasis was placed on disused landfills where pollution problems are long established and liability for remedial work is more problematic.

The categorisation of sites has been addressed in two ways. The first approach was to categorise the sites based upon the status of the contaminative land use. For this the following four categories were defined;

- derelict
- operational
- currently being developed
- redeveloped

The purpose of this categorisation is at a very general level to provide an indication as to the likely extent and nature of any site investigation or remedial works. It will also indicate whether the contaminants are still being accumulated within the environment from an ongoing activity or whether the contaminants are a legacy of some past process and are not being added to.

The current status of the site on its own was felt to have very limited usefulness in terms of assessing impact upon the water environment and thus a further categorisation scheme was developed.

This second form of categorisation was based upon the status of the contamination of the site as defined by the following three categories:

- continual migration of contaminants from site
- contaminants stable and not being released into the water environment if undisturbed
- contaminants contained or permanently isolated.

2.4 Results

To present the results of this supplementary survey summary tables of all sites identified in the course of this study were produced (Appendix C) whilst for five sites per Region more detailed descriptions were prepared (Appendix D). In selecting sites for the more detailed reports overall consideration was given to the presentation of a range of sites in terms of

the contaminative use, the nature and scale of the impact upon the water environment, the degree of investigation and remedial schemes implemented.

This survey was not intended to provide a complete list of all contaminated land, impacting on surface and groundwaters, but to provide a list of known more problematic sites, with associated information on site history, nature of the contamination, and whether remedial action is planned.

2.5 UK Studies

In addition to the work conducted on a regional basis a review was undertaken of appropriate case studies into remedial measures associated with the clean up of contaminated groundwater and contaminated land in the United Kingdom.

This review was initiated by performing a literature search to identify particular sites in the United Kingdom where treatment of land or groundwater has been performed. Despite the fact that the literature search was extensive, few instances where groundwater or land had been treated were discovered. This is undoubtedly due to the fact that such treatment has not so far been deemed necessary in the United Kingdom and little has been done, therefore.

3 REGIONAL REVIEW

3.1 Introduction

In conducting this supplementary survey of contaminated land, each NRA Region was asked to identify and complete questionnaires on at least 10 sites where a contaminative land use is impacting upon the water environment or has potential to do so in the future. Due to the importance of this issue many Regions provided information on more than 10 sites and in total 139 sites were included.

Summaries of all the sites are tabulated in Appendix C. These tables provide information on the site name and contaminative use, location, current status, main contaminants, target water body, status of contamination, remedial work proposed and remedial work undertaken. The entries summarising remedial works exclude site investigation and survey work. This has been omitted from the table as all the sites have been subject to some level of investigation ranging from limited water quality analysis to detailed site surveys. Furthermore the true extent of these surveys is not always made known to the NRA. Information on known site investigatory work is given in the more detailed site reviews.

From each Region five sites were selected for presentation in more detail (Appendix D). The selection of these sites was based upon considering, from a National perspective, a range of contaminative land uses, contaminants, scale of impact and remedial measures proposed or implemented. The overall aim being to present a cross section of sites, contaminants, proposed measures or work undertaken.

In undertaking this survey an attempt was made to determine lengths of watercourses affected and the extent of groundwater contamination.

It was proposed to achieve this, for surface waters, by consideration of the water quality objectives and change of class. This however, proved problematic as determination and assessment of objectives does not adequately reflect the types of contaminants released from the sites in question. Furthermore the presence of other consented discharges make it difficult to ascribe deterioration in water quality to a particular site. In some instances it is possible to establish that a particular piece of land is the source of contamination. In these circumstances it would be possible, in the absence of analytical evidence, to estimate the likely length of watercourse affected from knowledge of site layout, points of discharge and connections to the surface drainage. This on its own however would not indicate the scale of the problem in each Region. In light of these difficulties only a subjective assessment can be made. All the Regions are aware to some degree of the problems associated with contaminated land and the potential impact upon the water environment.

Assessment of groundwater contamination is even more difficult, because of hydrogeological complexities and the sparseness of monitoring data.

Even at sites of known groundwater contamination, the actual extent is unknown.

In the following Regional summaries, this issue of lengths of watercourses and extent of groundwater affected has been addressed at a very general level through consideration of prevalence of a particular contaminative activity and the extent of aquifers. Surface waters affected or potentially affected by contamination have been grouped to show the most common types of condition in each region. Assumptions can be made on the affect of pollutants on waters in these groups. For example, contamination entering a stream at or close to the source is likely to remain at a critical concentration over a longer stretch of water course than a point source of contamination on the bank of a larger river.

Although specific information on the length of water courses affected by contamination is frequently not available the location of sites with respect to surface and groundwater bodies has been studied for this report and sites have been classified into five groups on the basis of the type of water body affected:

- A Those which occur on or close to the banks of rivers.
- B Sites at or near the sources of tributaries of rivers.
- C Sites which are located on tidal estuaries or coastal waters.
- D Sites located in coastal marshes.
- E Sites located on aquifers.

The inclusion of Class E, sites located on aquifers, will typically occur jointly with one of the other four, surface related, classes.

The numbers of sites in each grouping as reported in the questionnaire is given in each of the following regional descriptions.

3.2 Anglian

Anglian NRA identified 16 contaminated land sites which either constitute an ongoing pollution problem or pose a serious threat to the water environment. The region as a whole is predominantly rural with pockets of industrial activity where many of the contamination problems exist. The region has the largest number of boreholes for public supply sources and it is in connection with these that many of the sites have been identified. One activity, common to the region, that causes pollution of the aquifers is that of landfilling. This is particularly so for many of the disused landfills that operated on a dilute and disperse principal. The main geographical areas where contaminated land problems are concentrated include Thameside, again problems relating to landfill activities, Humberside and the main urban centres.

Of the 16 sites four related to current landfill operations and have been included because of the extent of groundwater contamination of public supply boreholes and are illustrative of the scale of the problem encountered in the Region. In one instance the level of pollution was so great that it resulted in the loss of three drinking water sources. The other sites identified cover a range of current and historic activities. Historical activities include an extensive area of old railway sidings, agrochemical works, landfill sites and a tannery. Current activities include a timber treatment site, a tyre dump, a laundry and an RAF base. Sites selected for a more detailed report were:

- Thorpe Railway Sidings (redeveloped)
- Brit Agg Agrochemicals (derelict)
- Calders and Grandidge Timber Treatment (Operational)
- Laundry, Hardwich Industrial Estate (Operational)
- RAF Honington (Operational)

Due to the extent to which groundwater is used for public supply in the Region a number of R&D projects have been initiated to deal with specific aspects of groundwater pollution. One such project is aimed at investigating the impact of petrol spillages from assessing the profile of the petrol additives.

Under the classification of the type of surface water body affected, out of the 16 sites, ten come under class A, three under class B, one under class C and none under class D.

Eight sites in this region have been identified as potentially or actually polluting a groundwater resource (Class E). The Chalk is the aquifer at risk in all these examples.

3.3 Northumbria

The area of Northumbria NRA is primarily rural with a number of heavily industrialised areas associated with the major towns of the area with particularly high concentration of current and historical contaminative activities adjacent to the estuaries such as the Tyne and the Tees.

Northumbria NRA identified 10 sites within the Region. Of these sites, nine were associated with an historical use of the land with the site currently lying derelict; with the exception of one site which is due to be developed. These sites are characteristic of an old industrialised area and include former colliery sites, coke works, iron and steel works, town gas works etc. The tenth site identified is that of Battleship Wharf which is an active ship breaking yard.

Sites selected for a more detailed report were:

- Bishop Middleham landfill (derelict)
- Derwenshaugh cokeworks (derelict)
- Queens Park Gas Works (demolished and capped)
- Primrose Hill iron works (derelict)
- Battleship Wharf ship breakers (operational)

Under the classification of the type of surface water body affected, out of the 10 sites, four come under class A, three under class B, three under class C and none under class D.

One of these sites was recorded as being a threat to groundwater resources in Class E. The aquifer affected is the Magnesian Limestone.

3.4 North West

Of the 10 sites put forward by North West NRA for consideration in this survey, eight related to a historic contaminative land use, with all but three either undergoing redevelopment or already partly redeveloped. The historical land uses identified included waste disposal, various chemical works, and a colliery spoil tip.

The two sites identified where operational activities are currently causing contamination are a chemical works producing chlorinated organic compounds and a chemical works with a waste disposal site.

Sites selected for a more detailed report were:

- Moat Lane Petrochemicals (derelict)
- William Blythe Chemicals (operational)
- Commonsides Farm Chemicals (derelict)
- Sankey Brook waste disposal (derelict)
- Trimpell Petrochemicals (derelict).

Under the classification of the type of surface water body affected, out of the 10 sites, two sites come under class A, seven under class B, four under class C and none under class D. Several of the sites fall in more than one category.

None of the sites in this region were identified as polluting a groundwater body (class E).

3.5 Severn Trent

The area of Severn Trent NRA was central to the industrial revolution primarily as a result of the close proximity of coal, iron ore and limestone. Thus there is a long history of heavy engineering, coal mining, iron foundries, coal gas production, chemical manufacture etc. The area is also renowned for its potteries, centred around Stoke-on-Trent. The consequence of all those activities over a significant length of time has resulted in significant areas of contaminated land and associated water quality problems.

The extent of contaminated land impacting upon the water environment has already been the subject of a detailed programme of work by Severn Trent NRA. The initial phases of the work are reported in 'Contaminated Land Severn Trent Region' Phase 1 and Phase 2 reports, dated February and June 1992 respectively.

The activities of Phase 1 were to identify and prioritise contaminated land sites causing pollution problems to the water environment. In total 186 sites were identified and priorities were ascribed with respect to environmental hazard.

Phase 2 of the work was aimed at assessing in greater detail the top 30 priority sites to identify four or five for which detailed site investigations would be recommended.

Due to the amount of information directly available on contaminated land within the Region and to minimise duplication of work, 11 sites are summarised in this report. These comprise the top 10 ranked sites plus one other.

Of the 11 sites selected for this survey, the activities causing the contamination can be summarised as chemical works, coal carbonisation, mining and landfill sites. Five of the sites are operational with chemical processing being the contaminative use at four of the sites. The fifth operational site is a landfill which, although falling into a land use category excluded from the survey, has been included because of the special circumstances surrounding it and the serious surface water quality problem it generates.

Sites selected for a more detailed report were:

- Bentley Mill Lane Tip (derelict)
- Van Lead Mines (derelict spoil tips)
- Carless Solvents (operational chemical works)
- Synthetic Chemicals (operational)
- Heyope Tyre Tip (operational with underground fire).

Under the classification of the type of surface water body affected, out of the 11 sites, six sites come under class A, four under class B, none under class C and none under class D.

Five of the sites in this region were identified as a hazard to the Triassic Sandstone aquifer (class E) of the Region.

3.6 Southern

Southern NRA region is primarily agricultural with pockets of industry and densely population centres concentrated mainly around the major estuaries such as the Solent, Medway and Swale. There are a large number of landfills, primarily in Kent, many of which closed about 20 years ago with the introduction of the Poisonous Waste Act. These sites, when operational, were not restricted by licences and thus will have taken a range of materials, including toxic wastes; no records exist regarding what wastes were landfilled or the quantities. There are estimated to be eight to 10 such sites across the Region.

The 10 sites identified for this survey included a number of landfill sites, both operational and derelict, which are currently causing concern in which the NRA have an involvement. Other contaminative uses include gas works, tar works and solvent recovery, timber treatment, agrochemicals manufacture, engineering works and a dockyard.

Sites selected for a more detailed report were:

- CMR Ltd Solvent Recovery (operational)
- Cryalls Lane Insecticides (derelict)
- Hellerman Deutsch Metal Platers (operational)
- Chatham Naval Dockyards (derelict)
- Coney Hill Landfill (derelict).

Under the classification of the type of surface water body affected, out of the 10 sites, one site comes under class A, four under class B, three under class C and none under class D.

Seven of the sites in this region were identified as a hazard to Chalk groundwater resources (Class E).

3.7 South West

The south west area has a long history of extensive mining activities with associated contamination problems. Due to the extensive nature of these, somewhat unique, problems in the area South West NRA are shortly due to commence the compilation of a comprehensive data base of all the mines and associated lands within the Region. Furthermore, at a National level a

forthcoming study is planned on mining and mineral processing activities and the impact upon the water environment. Thus, in identifying the ten sites for this region emphasis was placed upon other contaminative uses although a number of mining related contaminated sites were included as indicative of the types of problems that are prevalent throughout the Region.

In total 11 sites were identified and questionnaires completed. The contaminative activities identified included operational activities such as a port, china clay works and ball clay extraction and a number of derelict sites such as abandoned mine spoil, landfill site and copper and tin mining areas. Also two river catchments were identified, one on the basis of extensive contamination of the soil and surface waters through applications of pesticides and the other through contamination of the groundwaters with nitrates. A further site was identified where farming practices have resulted in the leaching of metals.

Sites selected for a more detailed report were:

- Falmouth Container Terminal (operational)
- South Crofty tin mine (abandoned mine spoil)
- Devon Great Consuls (derelict mineral extraction and refining)
- Bourton Barn Farm (induced metalliferous leaching)
- Newlyn River Catchment (agricultural application of pesticides)

Under the classification of the type of surface water body affected, out of the 11 sites, two sites come under class A, six under class B, five under class C and none under class D. Two of the sites are in more than one class.

None of the sites in this region were identified as a hazard to groundwater resources (class E).

3.8 Thames

The area of Thames NRA has a historical problem with landfills, of which it has a significant number. Many of these problems are being solved through improved site management during the operational phase, more effective liner materials and improved site restoration. Also the geology of the landfill sites across the Region typically involves the presence of a clay layer which protects the underlying aquifer. Where the clay layer has been penetrated the protection afforded is seriously reduced and extensive pollution of the aquifer can result.

Thames NRA identified 13 sites for the survey of which three related directly to problems from landfill sites; on some of the other sites the presence of

a waste dump, used by that site, contributed to the contamination problem but did not constitute the prime source of contaminants.

In addition to landfill sites, other contaminative activities included a tank farm, former gas works, chemical and agrochemical works, printing ink manufacturer, a munitions site and a railway engineering works.

Sites selected for a more detailed report are:

- Thames Matex tank farm (operational)
- Thames Industrial Estate (operational)
- AEA Harwell Landfill (derelict)
- British Rail Engineering Works (derelict/redeveloped)
- Redland Bricks (redeveloped chemical works).

Under the classification of the type of surface water body affected, out of the 13 sites, two sites come under class A, five under class B, two under class C and one under class D.

Nine of the sites in this region were identified as a hazard to Chalk groundwater resources (Class E).

3.9 Welsh

In response to the 1991 survey of contaminated land Welsh NRA submitted 15 completed questionnaires and in this latest survey a further 15 were submitted. Of these 31 sites the majority are derelict with only a few being redeveloped or still operational. The derelict sites are those that were associated with waste disposal, coal carbonization, chemical works and historical metalliferous mining. Operational contaminated sites identified are predominantly linked to the oil industry and include oil refineries, storage and transfer stations.

Historically many of the heavily industrialised area developed adjacent to the estuaries, such as the Dee and the Neath. In this situation contaminated sites, whether historical or operational, will impact both individually and collectively upon the receiving waters. Thus in proposing remedial measures in these areas a holistic approach needs to be adopted.

Although South Wales is renowned for extensive coal mining activities there are perceived to be few water pollution problems arising from abandoned spoil tips; the main problem arises from increased suspended solids. Acid mine drainage is a more serious issue but is not addressed within the scope of this survey. A further mining related water quality problem identified is that associated with acidic run off from heavily contaminated lead mine spoil.

Sites selected for a more detailed report include:

- Neston Tank Cleaners (derelict)
- Cwm Ystwyth lead mine (derelict)
- Lower Swansea Valley (derelict)
- Mechema Chemicals (derelict)
- BP Llandarcy Refinery (operational)

It was stressed, whilst conducting this survey, that the sites identified are illustrative of the types of problems encountered in Wales and that there are numerous other sites which pose an equal threat to the water environment.

Under the classification of the type of surface water body affected, out of the 31 sites, nine sites come under class A, 11 under class B, seven under C and two under class D.

Fourteen of the sites in this region were identified as Class E, a hazard to groundwater resources. Two of these were on the Triassic Sandstone aquifer in the north east and the others are on minor carboniferous aquifers.

3.10 Wessex

Wessex NRA identified 17 sites for inclusion in this survey. Of these three sites were derelict or abandoned, eight were either redeveloped or being redeveloped and the remaining seven were operational. The historical contaminative activities included old gas works, landfill sites, tanneries, chemical works and an MOD storage area. Operational sites with associated water quality problems include timber yards, an MOD site and a chemical works.

Sites selected for a more detailed report were:

- Fox Brothers (partly developed land disposal site)
- Merck Chemical Plant (operational)
- Monkton Farleigh Mine (abandoned underground storage area)
- Cuprinol wood preservative site (redeveloped)
- Pasmenco Europe (former smelter).

Under the classification of the type of surface water body affected, out of the 17 sites, nine sites come under class A, four under class B, three under class C and one under class D.

One of the sites in this region was identified as a hazard to groundwater resources (class E), with a reference to spring contamination. This is thought to be only a local effect and the problem does not affect an aquifer.

3.11 Yorkshire

The area of Yorkshire NRA has contrasting areas of land use from moorland to high densely industrial/manufacturing sites.

For this survey 10 sites were identified and questionnaires submitted. The sites included a range of derelict, redeveloped and operational sites, with contamination arising from landfills, chemical refinery, coking works and a lead mine.

Sites selected for a more detailed report were:

- John Carr Joinery (operational)
- Pilkington glass-waste disposal (operational)
- Coalite Chemicals, Bolsover Refinery (derelict)
- Coalite, Grimethorpe (partly derelict)
- Coal Products Ltd, Chesterfield (operational)

The target water bodies identified as being affected by these sites were primarily the surface water courses where elevated concentrations of pollutants including list 1 substances were recorded; causing failure of the river quality objective and the EC surface water directive.

Under the classification of the type of surface water body affected, out of the 10 sites, six sites come under class A, seven under class B, none under class C and none under class D.

None of the sites in this region were identified as Class E, a hazard to groundwater resources.

4 UK STUDIES

4.1 Introduction

There have been various estimates of the total area of contaminated land in England and Wales ranging from 13,500 hectares of derelict land (Ecotec 1987) to 50,000 hectares, including land still in use (Taylor and Mclean 1992). This latter figure, although seemingly large, is actually quite a small percentage (0.33%) of the approximately 15 million hectares which is the total area of land of England and Wales.

When new developments are considered, however, contaminated land takes on a greater significance, as a large percentage of such developments are undertaken on previously contaminated sites. In these cases there are a essentially three options for land remediation as follows:

- Removal of some or all of the contaminated material from the site
- Cover or encapsulation of the contaminated material
- Treatment of the soil to reduce contamination to acceptable levels

However, in the United Kingdom, removal and encapsulation have accounted for by far the greatest percentage of land remediation work carried out to date.

Instances where contaminated groundwater has been treated are also not common in the United Kingdom. Remediation techniques, in this case, consist mainly of the two techniques given below, which attempt to prevent further contamination of underground water:

- Containment
- Leachate drainage

In the latter case, some treatment of the leachate may be attempted or it may be drained to the foul sewer and hence to a sewage treatment works.

4.2 Treatment of Contaminated Groundwater

As stated above, there are few sites in the United Kingdom where contaminated groundwater has been treated. However, a number of cases are listed in the literature as follows:

Foxhall Landfill

(Palmer and Young, 1991)

Foxhall is, in fact, a number of landfill sites in Suffolk where contaminated groundwater was seen to be flowing towards an adjacent watercourse.

Remediation measures consisted of the following:

- (a) Collection of the contaminated water in a cut-off trench consisting of six independent sections
- (b) Designation of the collected water as 'clean' or 'dirty'
- (c) Passing of 'clean' water to river via a continuous monitoring station
- (d) Routing of 'dirty' water to an irrigation plot to allow evaporation and absorption to occur
- (e) Monitoring of the irrigation area

As at the date of publication in December 1991, the site was still under construction, thus no details of the effectiveness of the system were available.

Southern Water

(Anon, 1989)

This case is one where solvent contamination was found in a water supply borehole belonging to Southern Water. The water was subsequently treated for potable supply purposes. However, there is no reason why this technique could not be used solely for the treatment of solvent contaminated groundwater.

Investigations following a complaint from a member of the public, soon established that the borehole in Hampshire was contaminated with 1,1,1 trichloroethane. To treat the water, Southern Water used an air stripping plant which removed the trichloroethane by interaction with counter-current air in a polypropylene-packed tower. The quoted performance of the system was as follows:

• Inlet trichloroethane ($\mu\text{g/l}$)	max	139.5
	min	20.0
	ave	73.8
• Outlet trichloroethane ($\mu\text{g/l}$)	max	8.39
	min	0.68
	ave	3.7

In addition, Lee Valley Water Company have also installed air stripping towers at three sites to treat similar chemical contaminants. (NCE, 1990)

Reedham Station

(Hoare et al, 1979)

Following the spillage of over 50,000 litres of kerosene resulting from a railway accident south of Reedham Station in Purley, Surrey, a novel technique was used to treat the resulting contaminated groundwater.

A looped polypropylene rope mop which selectively absorbs hydrocarbons but rejects water, was lowered into a pre-drilled borehole. The continuous rope was driven down, into the kerosene layer and up to the surface. The rope then passed through a wringer mechanism to remove the kerosene.

Between October 1978 and March 1979 over 15% of the spilled kerosene had been recovered using this method.

4.3 Contaminated Land Remediation in England and Wales

For reasons discussed above (Sec 2.5) virtually no treatment of contaminated land has been carried out in the UK. Remediation techniques have therefore been almost entirely removal or encapsulation.

A useful review of sites where such techniques have been carried out in England and Wales is included in volume two of the United States Environmental Protection Agency's publication, Reclamation and Redevelopment of Contaminated Land (EPA 1992). Examples from this document are given below:

Beckton Alps

The so-called 'Beckton Alps' is an area of approximately 5 hectares which stands some 16 metres above the natural land surface in East London. The 'Alps' were formed from approximately 430,000 cubic metres of waste from a gas (and associated by-products) works which was founded beside the Thames Tideway in 1868.

Remediation work on site was carried on from 1975 and included the following:

- Reformation of the 'Alps' followed by covering with clay (1.2 metres) and then top soil (300mm)
- Removal of area of high contamination (tar lagoon)
- Protection of permanent site works (eg concrete drainage pipes)
- Provision of drainage blankets/gas paths within the reformed 'Alps'

The estimated cost of this work was £1.7 million.

Malkins Bank, Cheshire

Malkins Bank was the 30 hectare site of a salt and chemical works from the late nineteenth century until 1932. Following this, the site was covered with lime sludge, the stream running through the site was culverted and the area was used as a dump for all kinds of industrial waste.

Remediation measures at the site, carried out in 1974, consisted of burial and removal of waste, combined with capping with clean material to a depth of 0.5 metres. Following installation of a surface drainage system the site was used as a public golf course.

Beaumont Leys, Leicester

Beaumont Leys, an 800 hectare site on the outskirts of the city of Leicester, was used as a sewage farm and treatment works from 1890 to 1964. At this site, liquid sewage was treated by land irrigation whilst sludge was dried on land and then ploughed into the soil. This resulted in heavy metal contamination of the area, particularly that part which had been used for sludge disposal.

Site remediation in this case consisted of grading of the soil to ensure that the highest contaminant levels were placed beneath several metres of uncontaminated subsoil. Areas to be grassed were then covered in topsoil which had been previously tested to ensure it contained less than 12 mg/l of cadmium.

Corby Steel works

The town of Corby in Northamptonshire was dominated by the British Steel Corporation (BSC) plant until most of the steelmaking facilities were closed in 1980. Following this closure, Corby District Council acquired 138 hectares of the former BSC site. Contamination found on this property included heavy metals, phenols, oil, asbestos, cyanides, polycyclic aromatic hydrocarbons (PAHs), naphthalene and sulphur compounds.

Remediation measures consisted of removal of the large underground slurry pits together with the most heavily contaminated material to a licensed tip. The holes remaining after removal of the slurry were then filled with the less heavily contaminated soil. The site was completed by ensuring that all contaminated materials were placed at least four metres below ground level or one metre below the level of the site sewers whichever was the lower.

Wandsworth Gas Works

This 16 hectare site in the London Borough of Wandsworth was a gas works from 1860 to approximately 1960. Other associated activities were also carried out but the exact nature of these could not be established.

At this location, remedial measures included excavation and removal of the most heavily contaminated material to a licensed disposal site at Aylesbury,

Buckinghamshire - the 1983 cost of this transport and disposal being £20 per cubic metre. Following this removal, clean fill was used to cover the site to a depth of 1.1 metres.

Lieners gelatin

This site in Pontypridd, Wales was the location of a plant where animal products were processed to produce gelatin. During the operation time of this plant, twelve workers contracted anthrax from the imported raw materials. Thus, once the plant had closed, there was the possibility that the area was contaminated with anthrax spores. Chemical degradation and contamination of the site sewers was also present due to the discharge of acidic substances during the plant's operational period.

In this case, polluted material from the site was removed and buried at a licensed disposal site, whilst any residual microbiological contamination was treated by washing all surfaces with an acid solution. Finally, the site was covered with 0.5 metres of clean fill.

The Lower Swansea Valley

The Lower Swansea Valley Project, initiated in 1961 to plan future development in the area, included some 480 hectares of industrial dereliction. Former industries in the area included copper and zinc smelting; silver, cobalt, nickel and lead production; steel manufacture; coal processing and other industries associated with all of the above. Contaminants included all of the heavy metals referred to above.

Reclamation and remediation was most often carried out by means of removal of material and regrading of the various tip sites. Clean fill material was used to cover the more contaminated ground to ensure that no human exposure to the hazardous material was possible.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this supplementary survey of contaminated land a total of 139 sites were considered. These being a small sample of the total number of contaminated land sites either impacting or having potential to impact upon the water environment. The sites considered in this survey have been included on the basis of contaminative land use, scale of problem, contaminants and remedial measures proposed or implemented. The objective has been to present a range of sites and circumstances.

Of the sites identified the contaminative land uses fall into the following categories:

Table 5.1 - Contamination in Land Uses

Contaminative Use	Number of Sites
Landfill	48
Chemicals/Petrochemicals	27
Gas Works/Coal Carbonisation	14
General Engineering	8
Timber Treatment	8
Mining	Metals 7
	Clay 3
	Coal 2
Iron and Steel	5
Tanneries	3
Docks	3
MOD Sites	3
Others	8
TOTAL	139

Of these sites 88 were associated with a historical land use and 51 with a current land use. In some Regions all the sites related to past activities which have left a legacy of contamination for current and future generations. Such activities are largely those associated with gas/coal carbonisation sites and mining activities.

Operational sites causing problems include chemical works, engineering works, wood/timber treatment processes, docks, MOD establishments, landfill, mining etc. A further land use also known to cause groundwater pollution is that of petrol retail facilities. Of these a number of potential problem sites are known but were not included in this survey due to the paucity of information.

Each site identified in this survey was assessed on the basis of its actual or potential for pollution of the water environment. For this assessment five target waterbodies were identified. Table 5.2 summarises, by Region, the number of sites impacting upon each water body. From this it can be seen that about 75% of the sites are associated with surface watercourses and only 33% with aquifers and 24% with coastal/estuary environments; many sites impact upon more than one receiving water body. However, the ratio of groundwater to surface water is likely to be distorted by the degree to which pollution of surface waters are more readily detected than that of groundwaters. From the perspective of the receiving watercourse and its ability to dilute or assimilate the pollution the more problematic sites are going to be those that impact upon surface water stretches that are close to the source or in a tributary where dilution is at a minimum or on groundwaters where pollutants will be retained within the systems.

Table 5.2 - Target Waterbodies

Region	Number of Sites	Number of Sites by Class				
		A	B	C	D	E
Anglian	16	10	3	1	0	8
Northumbria	10	4	3	3	0	1
North West	10	2	7	4	0	0
Severn Trent	11	6	4	0	0	5
Southern	10	1	4	3	0	7
South West	11	2	6	5	0	0
Thames	13	2	5	2	1	9
Welsh	31	9	11	8	2	14
Wessex	17	9	4	3	1	1
Yorkshire	10	6	7	0	0	0
TOTAL	139	51	54	29	4	45

Note: Some Sites will have entries under more than one class

- A Close to River Banks
- B Near sources of tributaries or rivers
- C On tidal estuaries or coastal waters
- D Close to coastal marshes
- E Located on aquifers

The assessment of lengths of surface watercourses affected by contaminated land is extremely difficult to determine. This is due largely to the pollutants themselves and the common water quality parameters monitored, which do not readily reflect the impact of a specific site. The other main factor is that many of these sites do not occur in isolation, there being other discharges, some consented, which add to the overall pollution of a particular receiving water body.

In most cases the extent of groundwater contamination at sites which are known to effect aquifers is not known. Aquifers have been identified but data is insufficient to identify the lateral extension of contamination.

In terms of remediation, only 32 sites have commenced implementation of remedial works with many more currently undergoing investigation and proposals being formulated. In addition many sites have had modifications to the surface water courses.

The remediation measures either implemented or in the process of being implemented are summarised in Table 5.3

Table 5.3 - Remedial Measures

Regrading/capping	8
Water treatment	7
Removal of material from site	5
Groundwater pumped to sewer	4
Bioremediation	2
Soil water scavenging	2
Installation of liners	2
Activated charcoal filtration	1
Separation of volatiles	1
TOTAL	32

In light of the revised draft regulations for the Section 143 Register of contamination land use, an initial assessment has been made, of the sites identified in this survey, to determine the extent to which these sites, either causing or having potential to cause water pollution, would have been included. Based on the May 1991 draft schedule of contaminated uses an estimated 134 of the 139 survey sites would have been registered. Sites that would not have been included would have been those relating to the application of pesticides/insecticides/soil conditioners and MOD bases. Under the latest proposed schedule an estimated 92 sites would be included. The main activities excluded include timber treatment, tanneries, mining activities, docks and ports, textiles and the printing industry.

5.2 Recommendations

To implement national policy on contaminated land and the water environment the first step shall be to identify all sites throughout the Regions and to prioritise them on a National basis. This prioritisation should highlight those that are most serious and moves towards remediation should be instigated. These moves will, in some cases, of necessity involve legal actions and will provide a framework for deciding liability.

The first step therefore, shall be to identify all appropriate sites. The recent reintroduction of the Environmental Protection Act's Section 143 Registers of Contaminative Land Use will go some way to identifying those most seriously contaminated sites. Although the draft regulations list only a small subset of the land use activities originally proposed for inclusion in the Register, the findings of this survey indicate a more extensive range of land uses as causing pollution of the water environment. Consequently, although the Section 143 Register will identify many sites the NRA will need to compile its own more extensive register of sites that would include for example tanneries, mines etc.

Severn Trent NRA have already undertaken this task and have developed a scheme for prioritising sites for further consideration. This should be repeated for the other nine Regions to derive a list of the worst sites nationally. The ranking system derived by Severn Trent is based upon some subjective assessments. Thus to ensure compatibility of assessments from each Region, a central team of researchers should be established who will be supported in the survey by the appropriate Regional staff.

The volumes of information that such a National survey would generate would be extensive and thus would necessitate a computer database for ease of storage and retrieval. The task is more appropriate to a GIS solution onto which surface water drainage and groundwater data can be stored. The advantages of this approach are that sites can be located specifically and impacts upon the water environment more readily assessed. The system can be extended to incorporate groundwater protection zones and water quality monitoring stations.

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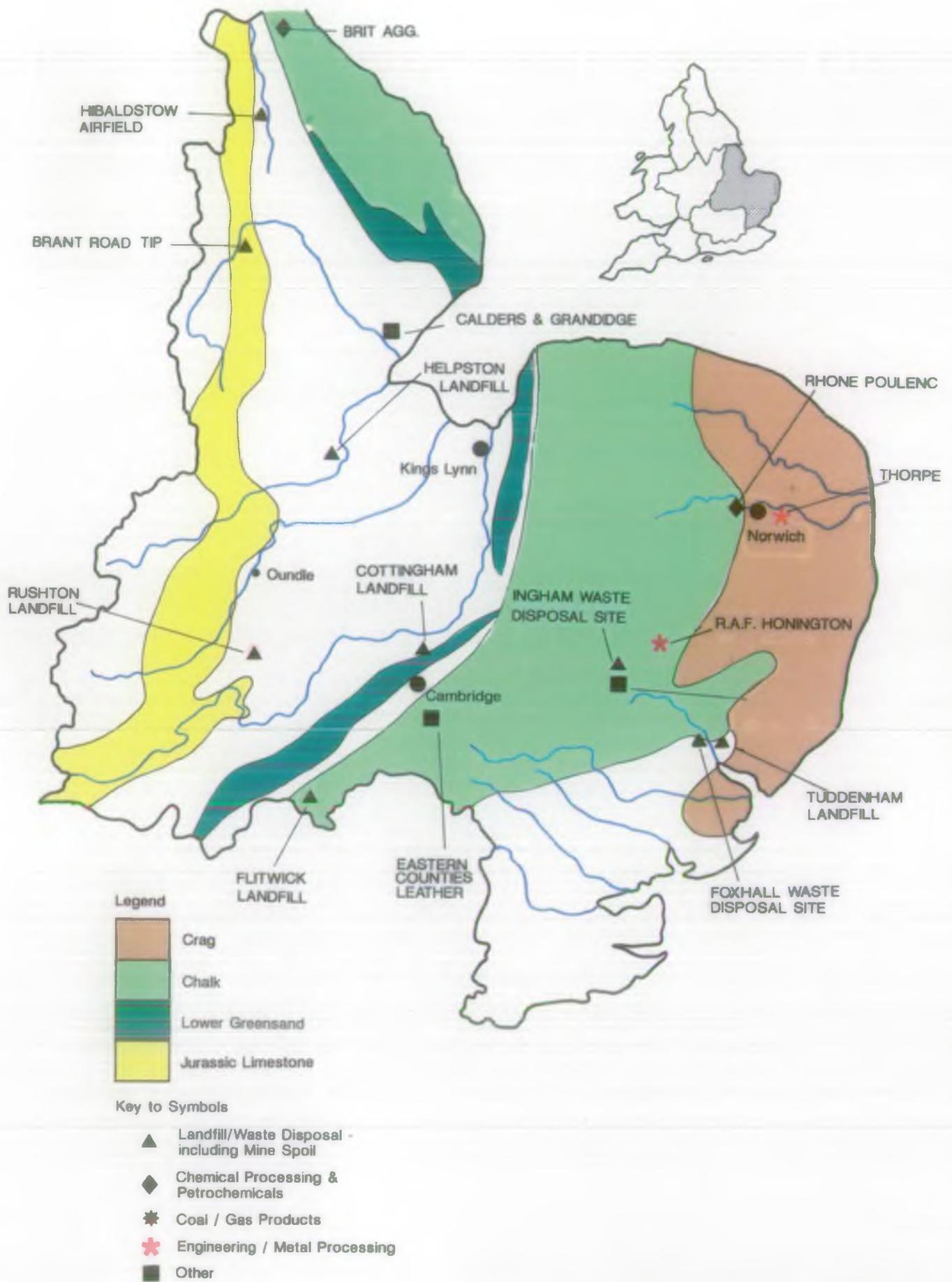
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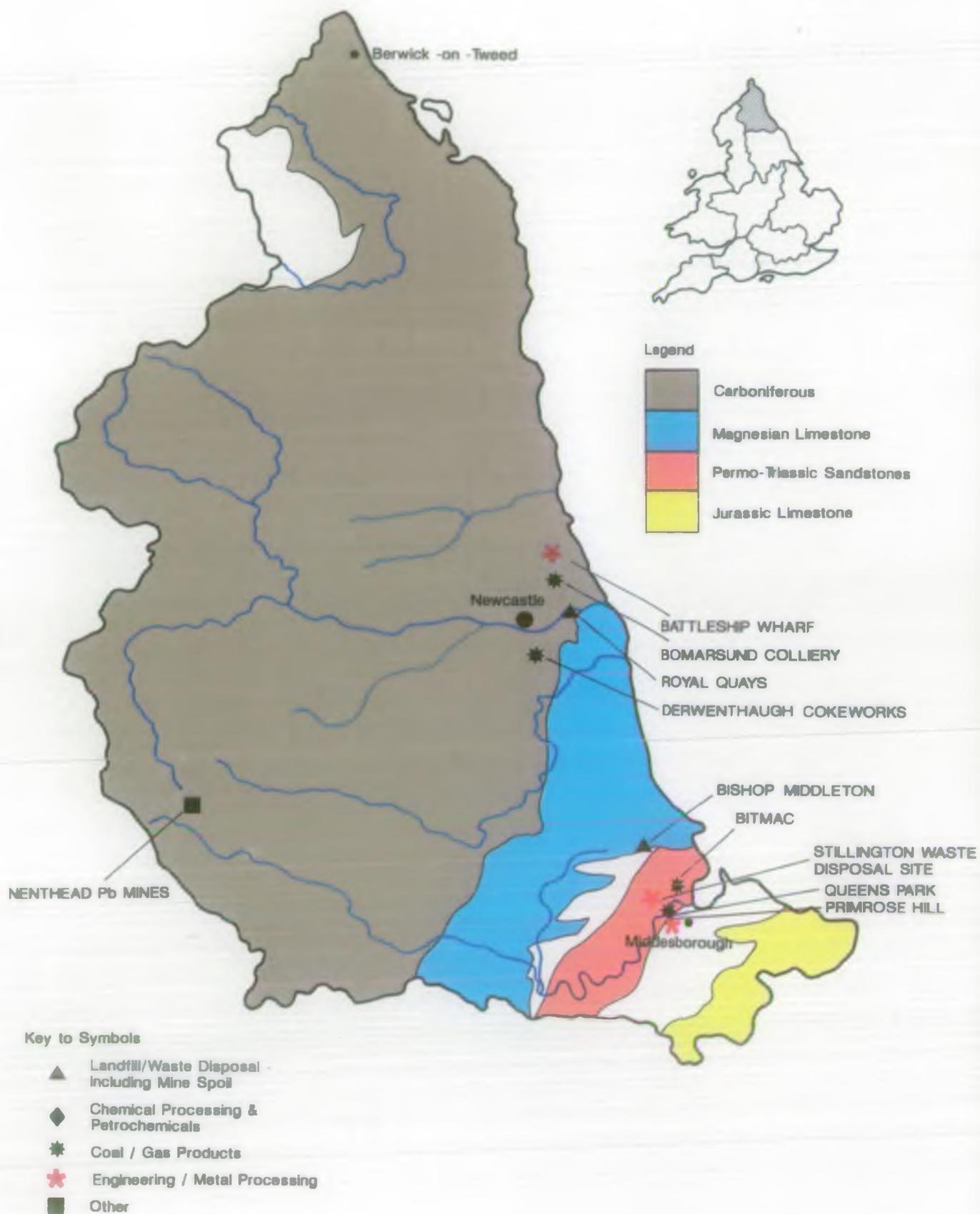
Figure 3.1



ANGLIAN N.R.A. REGION



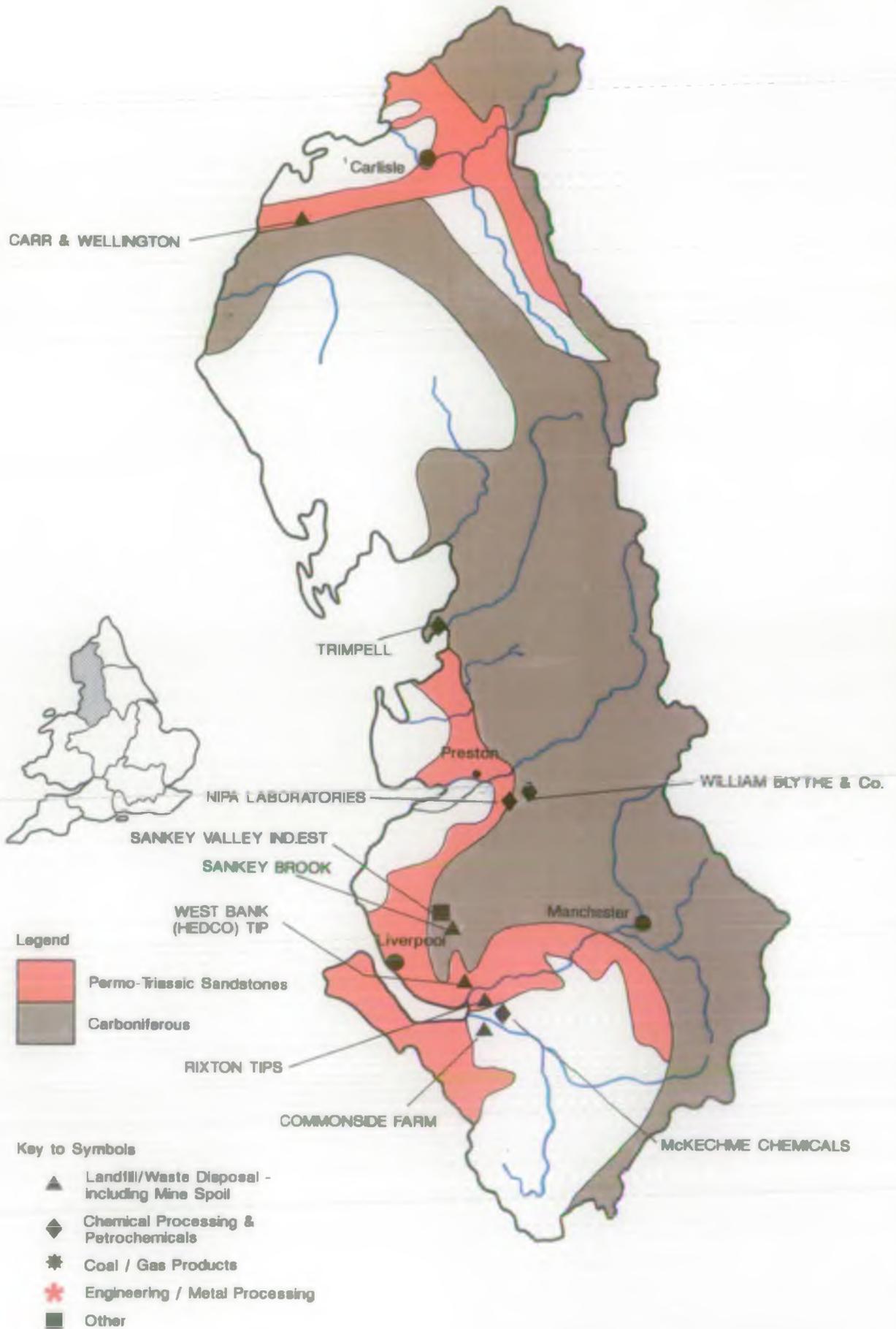
Figure 3.2



NORTHUMBRIA N.R.A. REGION



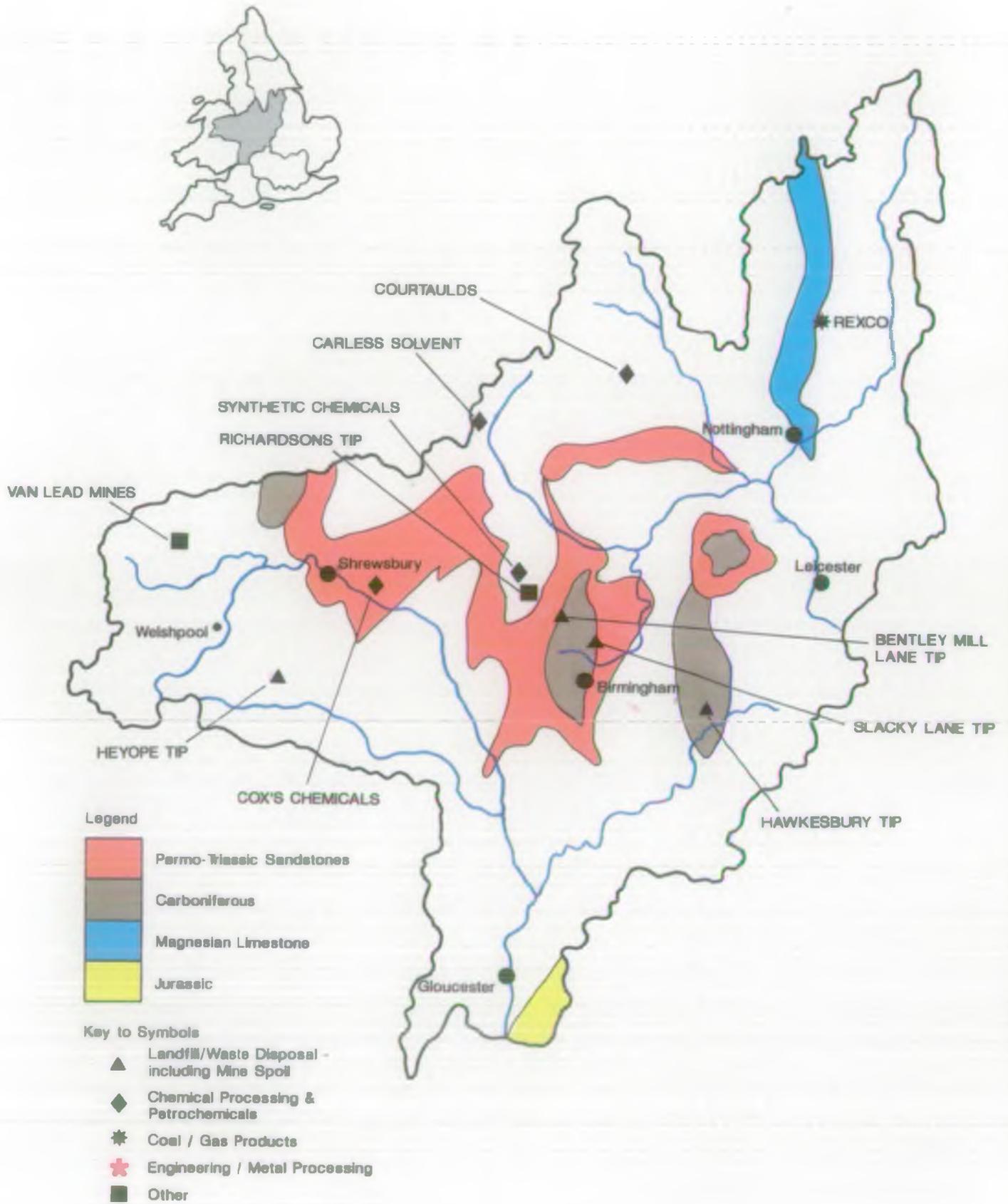
Figure 3.3



NORTH WEST N.R.A. REGION



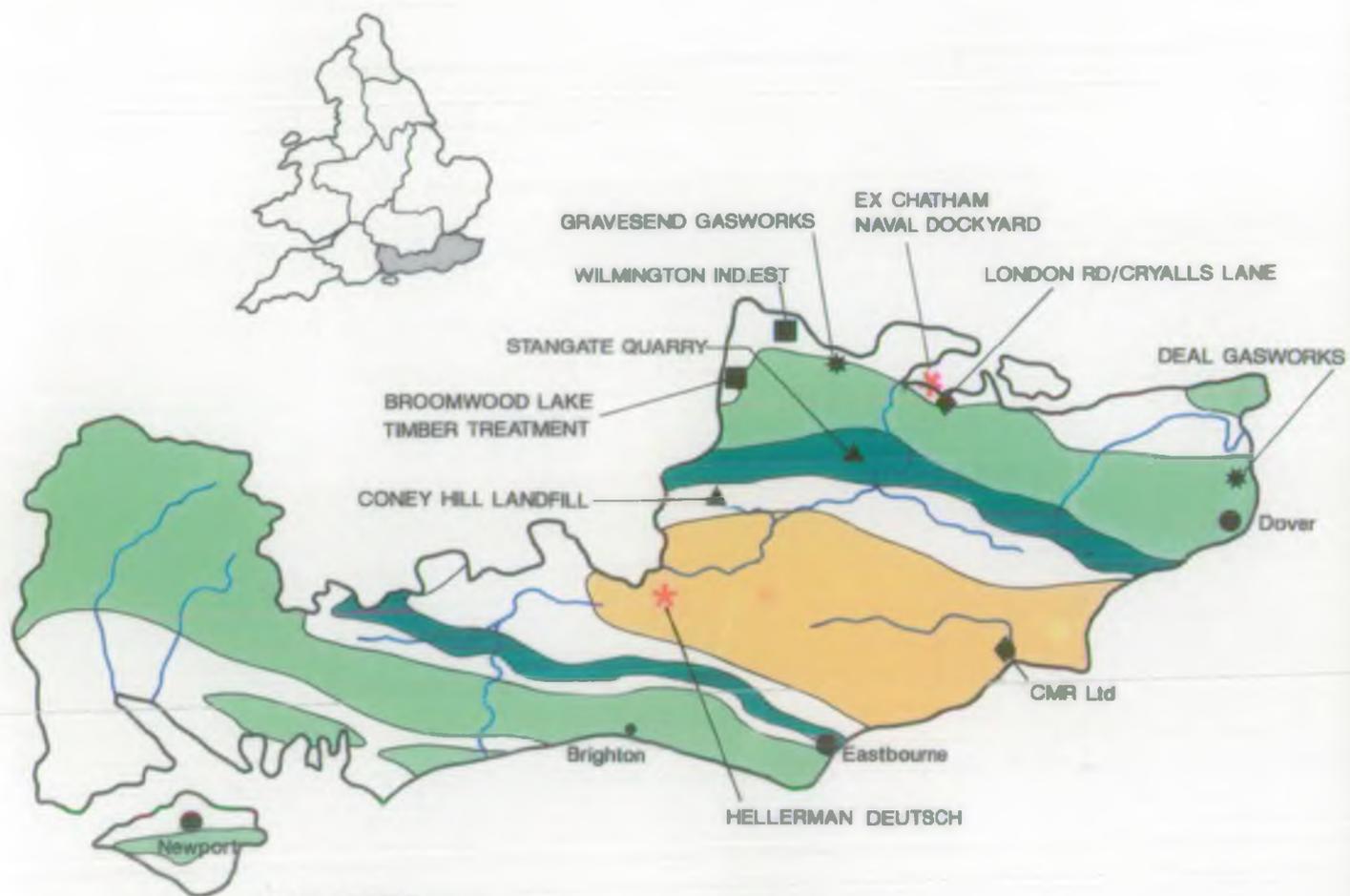
Figure 3.4



SEVERN TRENT N.R.A. REGION



Figure 3.5



Key to Symbols

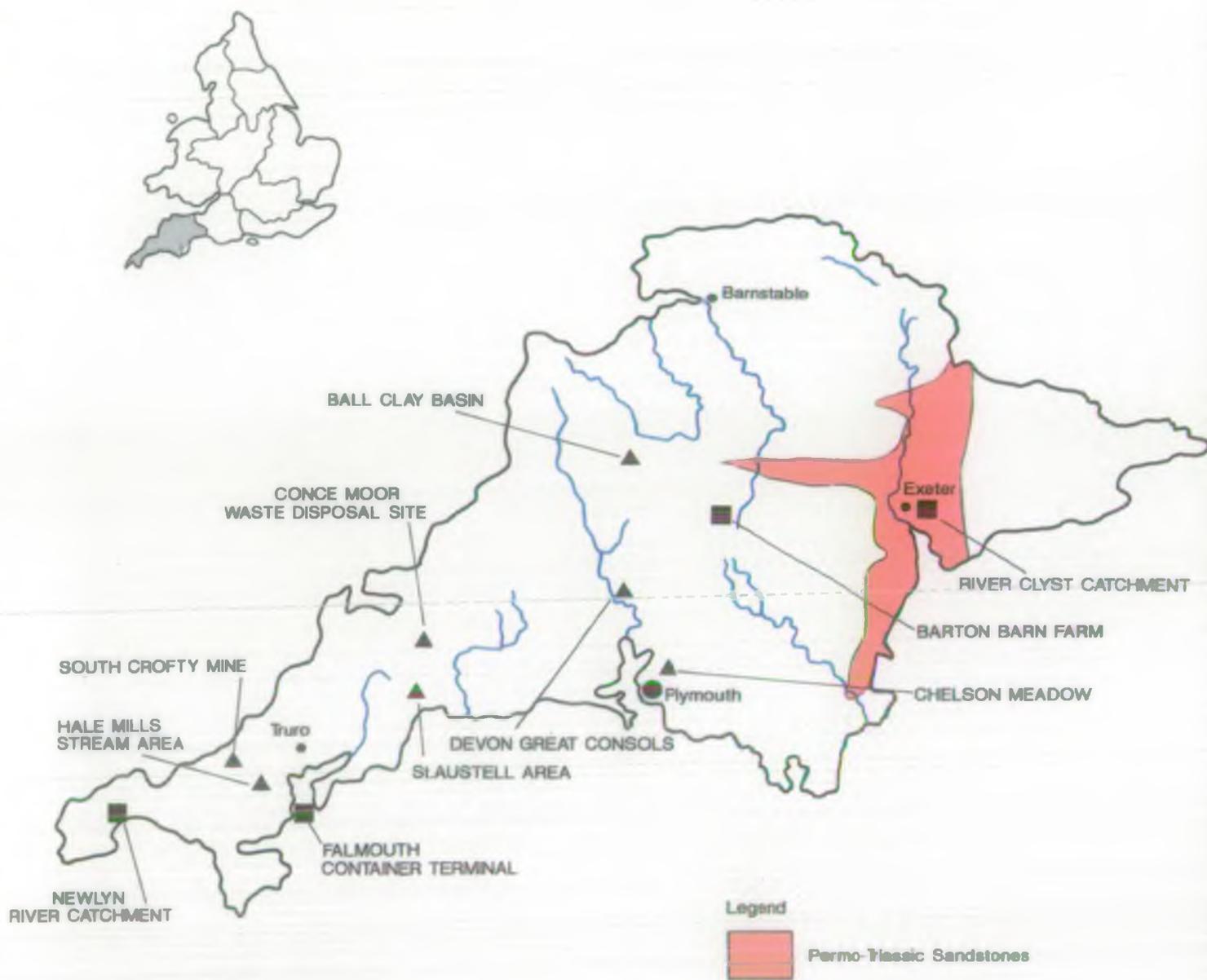
- ▲ Landfill/Waste Disposal - including Mine Spoil
- ◆ Chemical Processing & Petrochemicals
- ★ Coal / Gas Products
- ★ Engineering / Metal Processing
- Other

Legend

- Chalk
- Lower Greensand
- Hastings Beds

SOUTHERN N.R.A. REGION





Key to Symbols

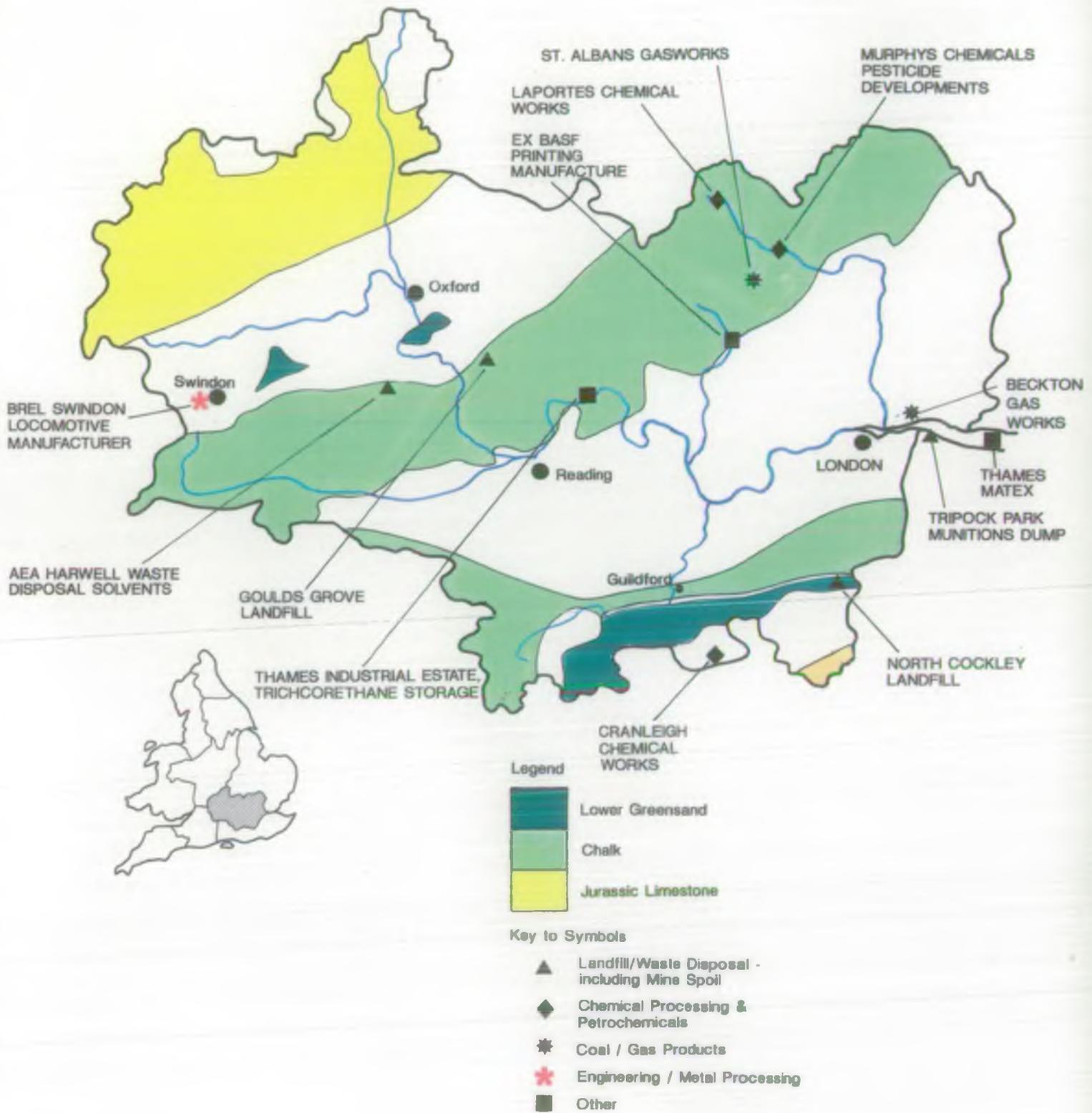
- ▲ Landfill/Waste Disposal - including Mine Spoil
- ◆ Chemical Processing & Petrochemicals
- ⊛ Coal / Gas Products
- ★ Engineering / Metal Processing
- Other

Legend

- Permo-Triassic Sandstones



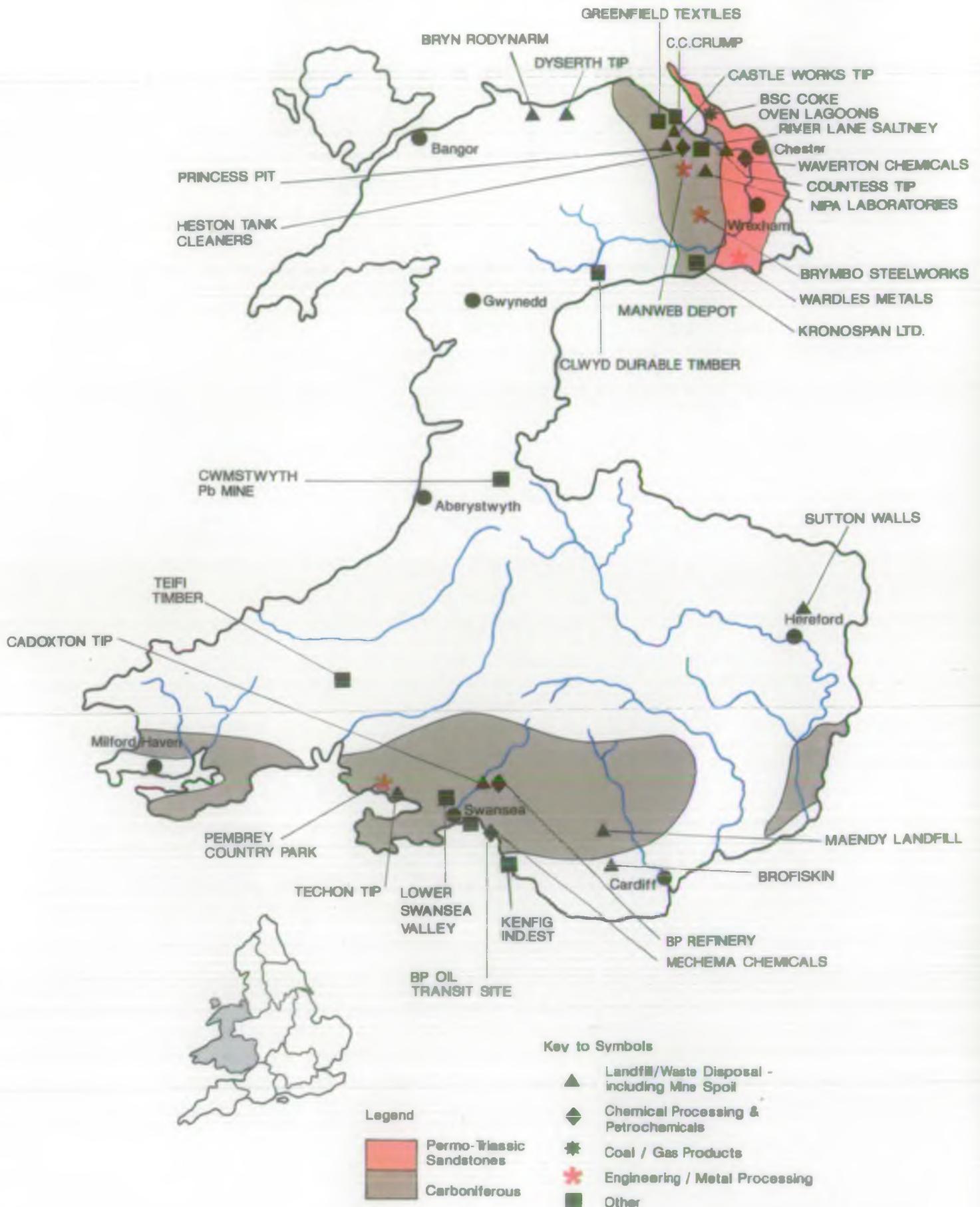
Figure 3.7



THAMES N.R.A. REGION



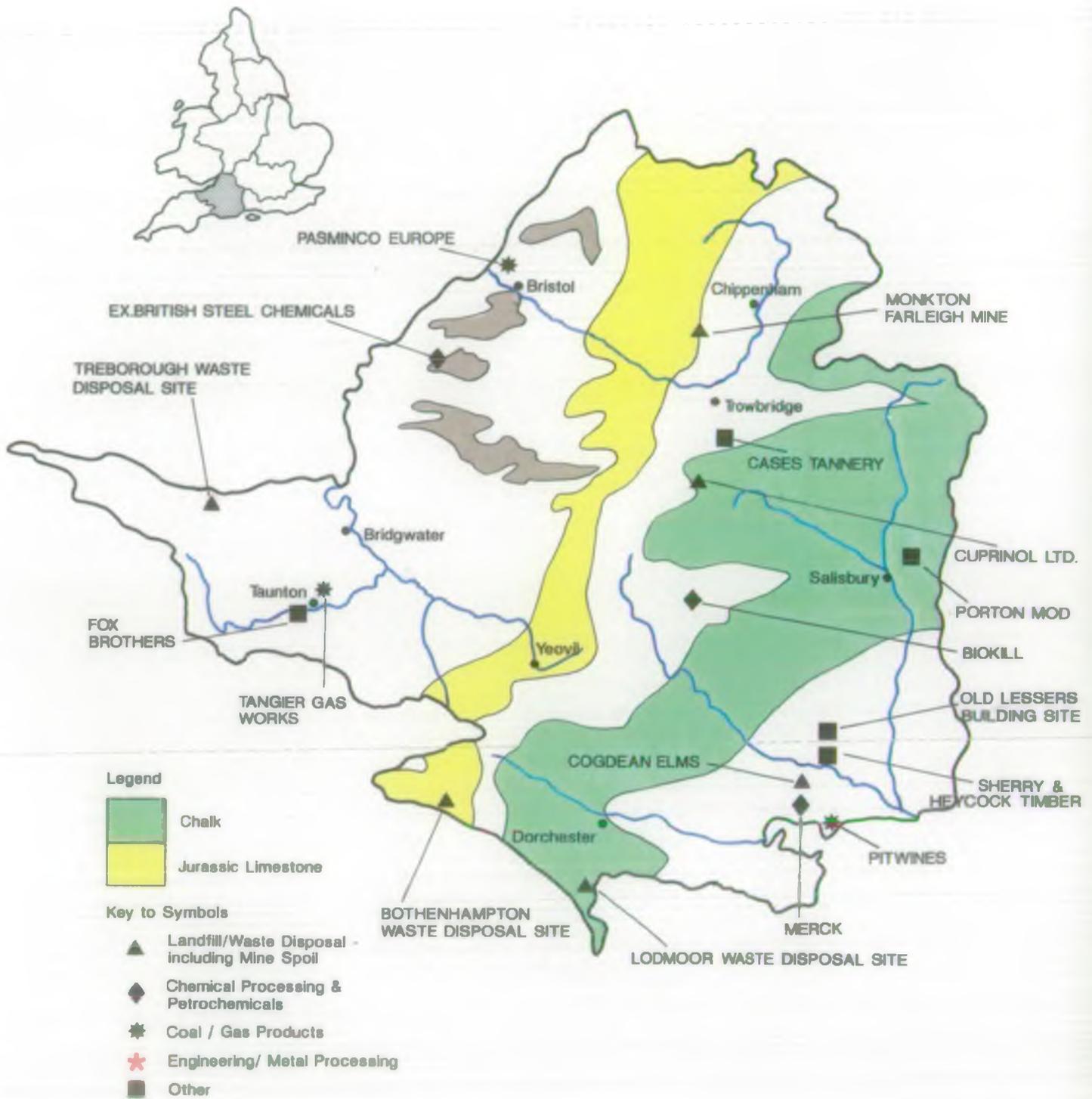
Figure 3.8



WELSH N.R.A. REGION



Figure 3.9



WESSEX N.R.A.REGION

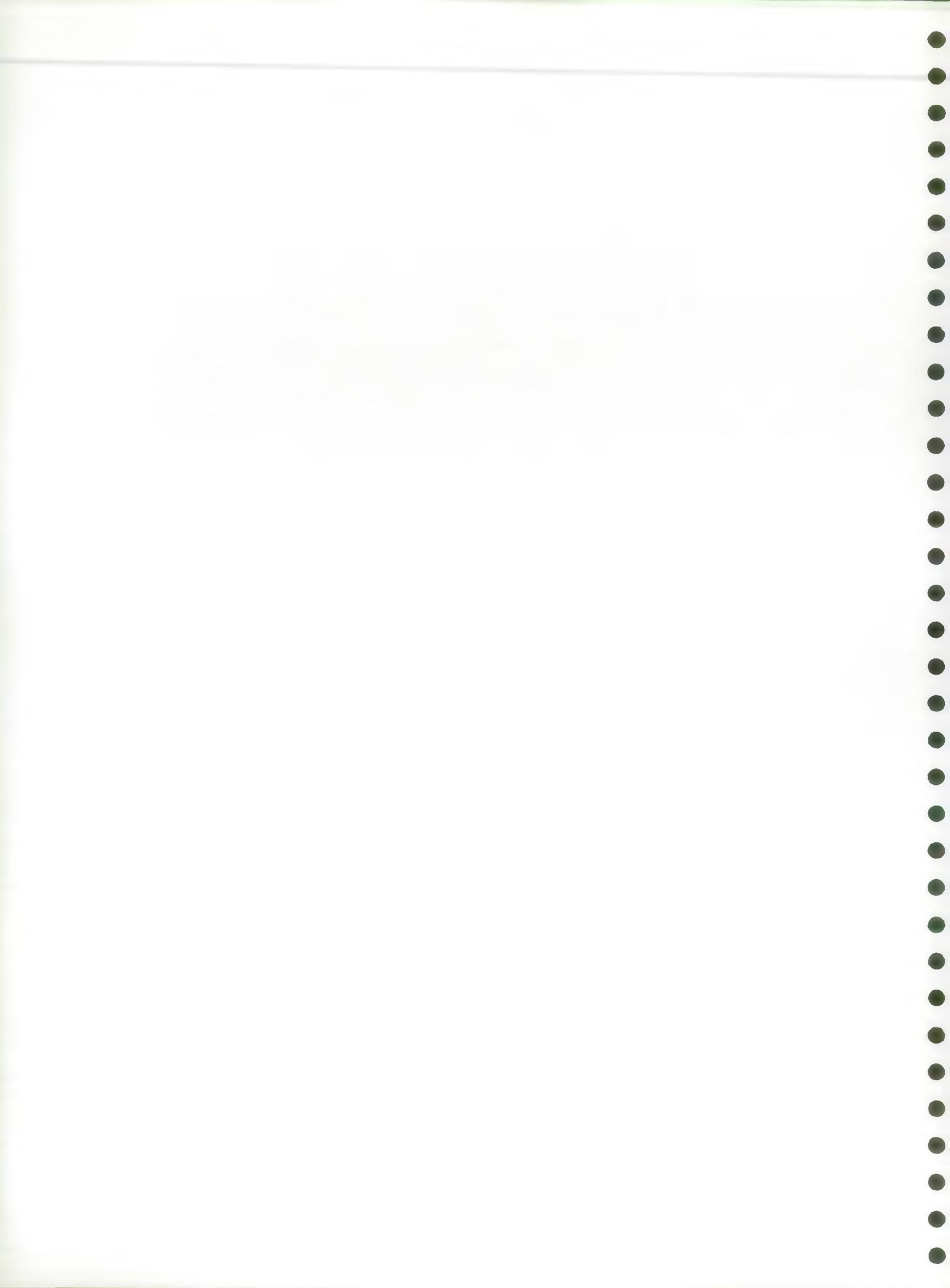
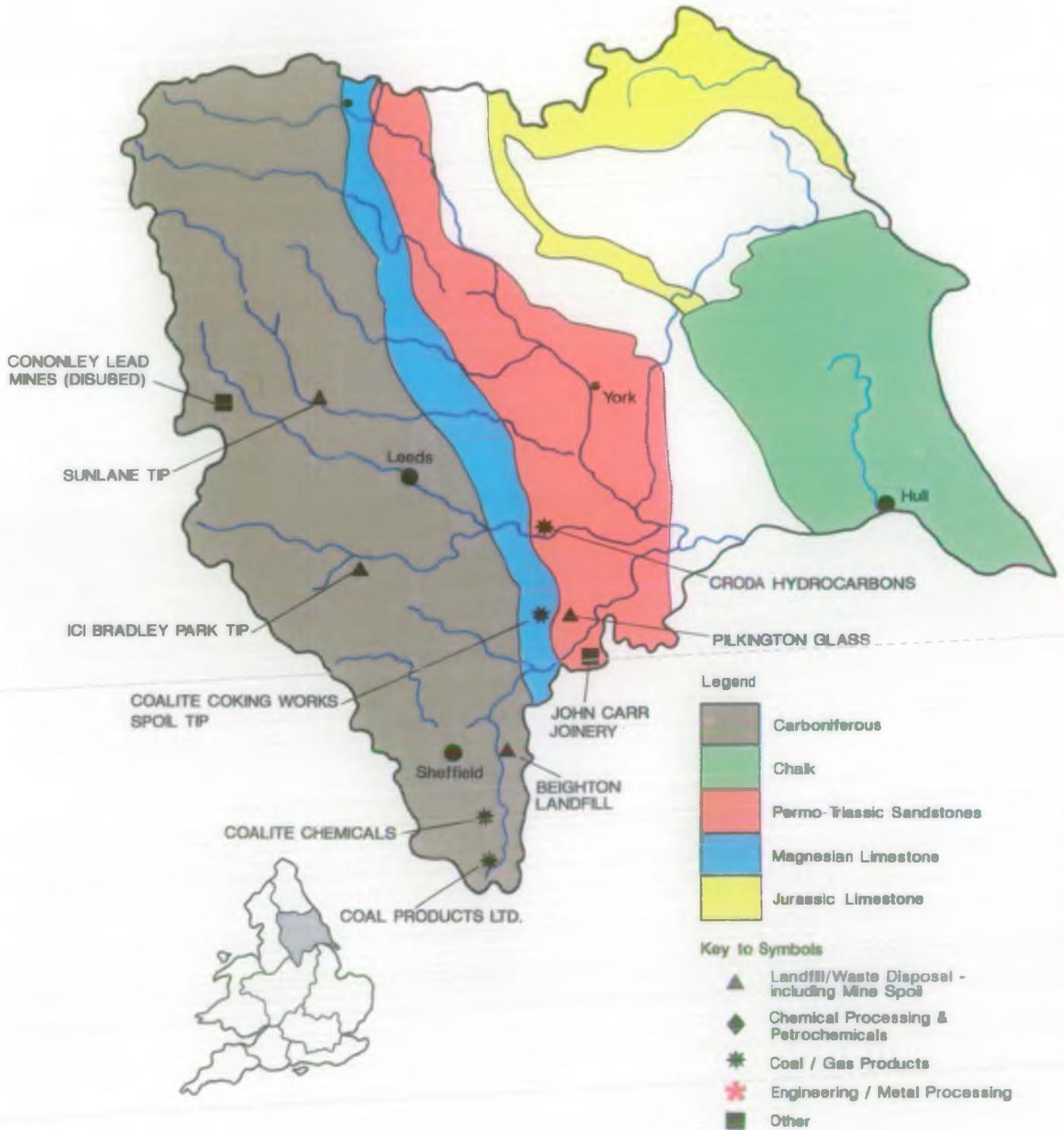
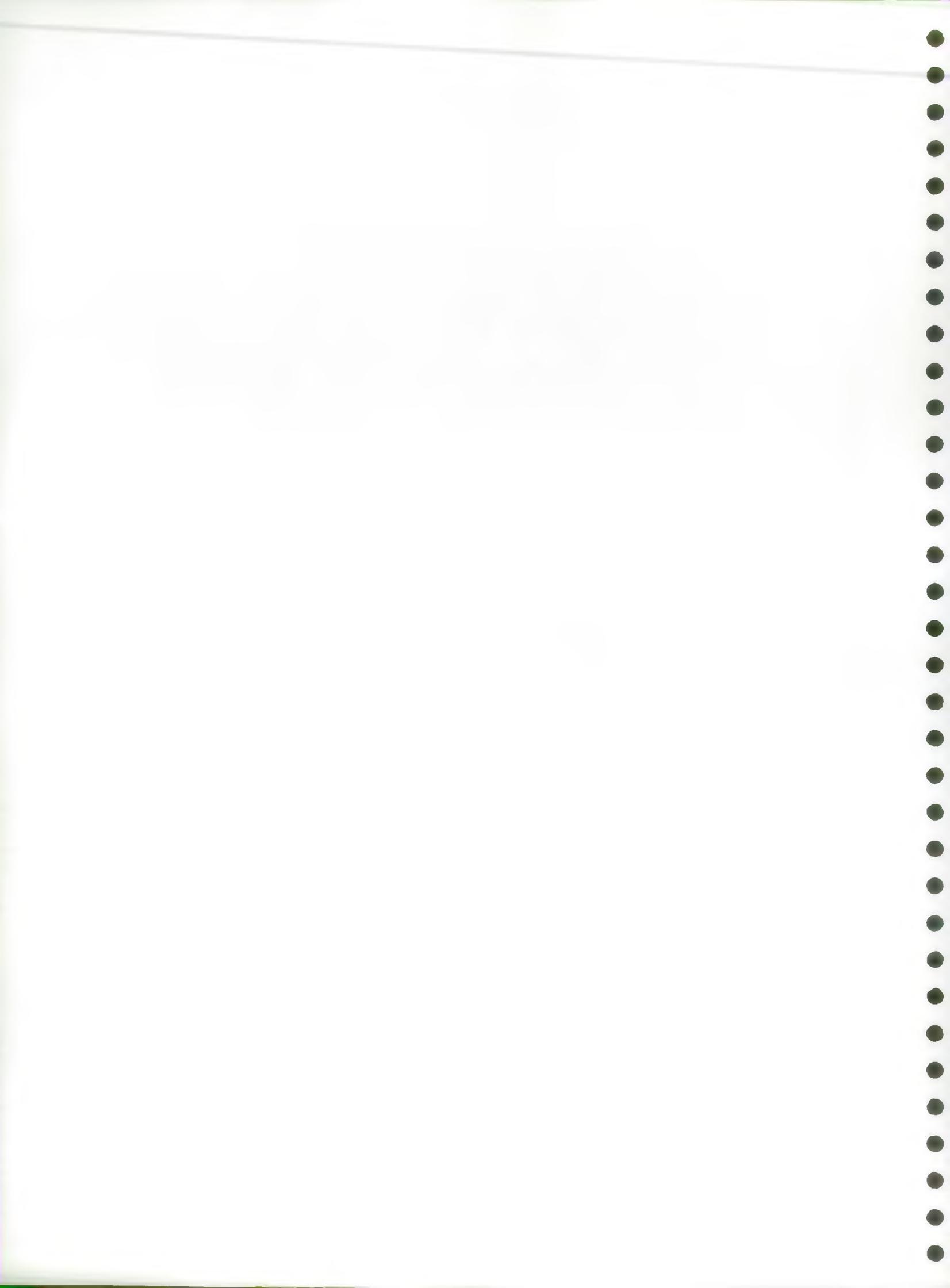


Figure 3.10



YORKSHIRE N.R.A. REGION



Appendix A

TERMS OF REFERENCE



18 May 1992



Mr C Fleming
Sir William Halcrow and Partners Ltd
Burderop Park
Swindon
Wiltshire
SN4 0QD

Dear Mr Fleming

INVITATION TO QUOTE

The National Rivers Authority (NRA) is inviting quotations to carry out a supplementary survey to complement a forthcoming consultation document on Contaminated Land and the Water Environment. Detailed Terms of Reference are attached. If you would like to submit a quotation, please provide the following information:

- i. a brief of your proposed approach to this research;
- ii. your quoted price for the work with a statement of whether it is inclusive or exclusive of VAT; and
- iii. your company's standard terms and conditions for contract engagements.

All quotations should be sent to Mr P Chave at the address below by noon on Monday 8 June 1992. Quotations received after this date may not be considered.

The NRA reserves the right not to accept any offer of tenders and to negotiate the extent and terms of reference subsequent to any offer.

I look forward to receiving your quotation.

Yours sincerely

MR P CHAVE
HEAD OF WATER QUALITY

National Rivers Authority

Rivers House Waterside Drive Aztec West Almondsbury Bristol BS12 4UD Tel: 0454 624400 Fax: 0454 624409



TERMS OF REFERENCE

INTRODUCTION

The management, clean-up, control and future prevention of contaminated land in the UK has of late been a highly debated environmental issue. Despite the specific title of the problem, contaminated land is very much an issue which affects water quality and the NRA has been striving both for recognition of this fact and the possible avenues of action which may be taken to help alleviate the threats to the water environment from contaminated land sites. This it will endeavour to achieve both through its statutory powers under the Water Resources Act 1991 (WRA'91) to clean up and prevent any pollution arising affecting controlled waters, and its proposals under the recent NRA Groundwater Protection Policy Consultation Document. With the setting of Statutory Water Quality Objectives (SWQOs), the NRA needs to address the issue of contaminated land if such quality objectives are to be achieved. As a preliminary measure, the NRA is currently preparing a consultation document on contaminated land and the water environment and the purpose of tendering out this work is to supplement and complement the contents of this in-house work.

OVERALL OBJECTIVE

To investigate the extent of contaminated land in each of the ten NRA Regions, which it is considered to have an impact on the water environment; and subsequently to produce a list of the most problematic sites identified, giving some detail of site history etc, and what, if any remedial action is being taken or is planned by each Region.

SPECIFIC OBJECTIVES

1. To use an in-house project - The Severn Trent Phase One Report on Contaminated Land - as a starting point and to discuss the project with Bob Harris (Severn Trent) and Dick Flavin (Southern) before commencement.
2. To visit each NRA Region to interview pollution control staff (identified by the NRA) to determine the scale of the problem. All Regions have had a questionnaire circulated; the completed questionnaires could be used as the basis for discussion.
3. To visit and interview NRA field staff (identified as a result of above interview)



to discuss the scale of the problem and to identify specific sites, their assumed impacts on the water environment and how they are being addressed, including any action - remedial, legal or other. (At least five of the more problematic sites should be considered in greater detail).

4. To obtain information on the lengths of watercourses affected (class change) and the extent of groundwater contamination per Region (if known).
5. To categorise sites causing problems into:-
 - (a) dormant
 - (b) operational
 - (c) undergoing development.
6. To summarise briefly what studies have been undertaken in the UK, or elsewhere on possible amelioration of polluted groundwater from contaminated land and what the possible solutions are. This area of research should also include the costs of clean-up and the nature of these costs, that is, capital only or capital and revenue.

A draft report should be submitted within six weeks of the date of awardment of the contract. Twenty copies of the final report will be required following acceptance of the draft.



Appendix B

BRIEFING NOTE AND QUESTIONNAIRE



NRA SUPPLEMENTARY SURVEY OF CONTAMINATED LAND

BRIEFING NOTE

16 July 1992

This briefing note has been prepared to inform Senior Water Quality and Pollution Control Officers and their field staff as to the objectives of the above survey and their role in its undertaking.

INTRODUCTION TO SURVEY

Sir William Halcrow and Partners Ltd have been appointed by the NRA to undertake a supplementary survey of contaminated land. The prime aim of this project is to investigate the extent of contaminated land, in each of the ten NRA Regions, which is considered to have an impact on the water environment. This work builds upon similar work undertaken in Severn Trent NRA (reported in The Severn Trent Phase One Report on Contaminated Land) and the results of a questionnaire circulated by Dick Flavin (Southern NRA) and Bob Harris (Severn Trent NRA) in 1991.

METHODOLOGY

This supplementary survey is to be undertaken within a six week period and a draft report is due to be submitted to the NRA on Friday 21st August. To complete this task within this tight time schedule Halcrow propose to obtain the necessary information from the Regions through the following approach:

- 1 Circulation of this briefing note and questionnaire to key senior officers in each Region, who in turn will identify appropriate field staff and circulate the note and questionnaire to them.
- 2 Meetings and interviews with appropriate senior officers and field staff in each Region. These should be scheduled such that they can all be conducted in one day.
- 3 Follow up on incomplete questionnaires and those sites for which more information is required.

From the previous studies undertaken the knowledge and experience held by the field staff, on contaminated land sites which do have an adverse impact upon the water environment, is recognised as being an important factor to the success of this survey.

This survey is not intended to provide a complete list of all contaminated land, impacting on surface and groundwaters, but is to provide a list of the more problematic sites, with associated information on site history, nature of the contamination, and whether remedial action is planned. Thus, it is intended that each Region will identify some 10 contaminated land sites for each of which a questionnaire should be completed by the field officer responsible. These questionnaires will then form the basis of discussion at the subsequent meeting and interviews.

As an aid to the identification of contaminated land that may be impacting on the water environment consideration should be given to the following land use activities both current and historical:

- metalliferous mining spoil
- coal mining spoil
- steel/iron manufacture
- copper manufacture
- industry
- gas works
- sewage works (disused)
- landfill
- timber treatment
- chemical manufacture
- lime manufacture
- oil refinery/storage

(this survey excludes contamination from mines whether active or abandoned)

The attached questionnaire details the information that is required on each site identified. This information falls into 7 categories:

- general
- site use details
- water quality implications
- site investigations
- proposed actions
- priority scoring
- any other relevant information

Not all of this information will be available for each site however, it would be beneficial if as much of the information that is available is obtained prior to the interviews.

3.3 Nearest Groundwater Abstraction (km)

3.4 Nearest Public Water Supply Borehole (km)

3.5 Nearest Watercourse (km)

NAME

CLASS

3.6 Evidence of Water Pollution (summarise analysis if available)

4 SITE INVESTIGATION

4.1 What Site Investigations Have Been Carried Out

5 PROPOSED ACTIONS

5.1 What Proposals Have Been Put Forward for Remediation

**5.2 What actions Do You Think The NRA Should Demand or Undertake
(indicate costs if possible)**

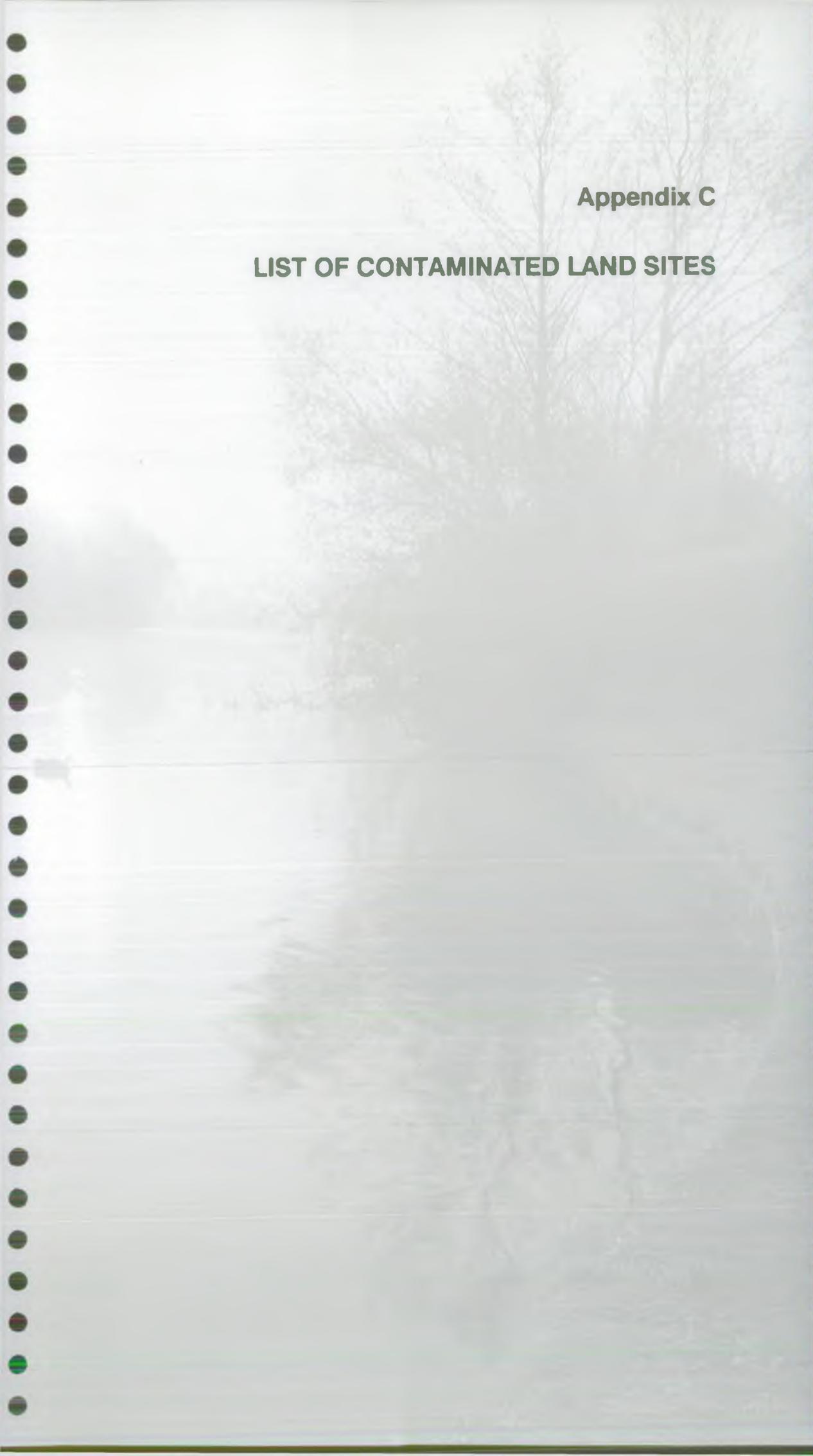
5.3 Is The Owner Likely to Comply or Cooperate

5.4 What Are The Likely Consequences of Doing Nothing

6 PRIORITY RATING SCORE

On a scale of 1-5 how important is it to the NRA that action discussed above is taken. 1 = marginal, 5 = imperative.

7 ANY OTHER INFORMATION
(Please append any relevant analysis results)

A faded, grayscale background image of a river with trees on the banks, serving as a backdrop for the text.

Appendix C

LIST OF CONTAMINATED LAND SITES



SUMMARY TABLES OF CONTAMINATED LAND SITES

Key to Tables

Site Use Category:

- D Derelict**
- O Operational**
- C Currently being developed**
- R Redeveloped**

Status of Contamination:

- C Continued migration of contaminants from site**
- S Contaminants stable and not being released into the water environment if undisturbed**
- I Contaminants contained or permanently isolated**

TABLE C.1 CONTAMINATED LAND SITES REPORTED ON DURING SURVEY

NRA Region: Anglian

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
A1	Thorpe Electrical engineering industry, old railway sidings	TG 245 078 200 ha	D/R	Trichloroethene, tetrachloroethene, tetrachloroethane, carbon tetrachloride	River Wensum, Chalk Groundwater High	C	Protect public water supply	Activated charcoal filtration at PWS borehole
A2	Rhone Poulenc, Norwich chemical and agrochemical manufacture	TG 205 104 5 ha	O/R	Ammonia, copper, mercury, bromide, sulphate	River Wensum, High Groundwater Chalk High	Being cleared		Groundwater pumped to sewer to reverse flow and clear contamination
A3	Tuddenham Waste Disposal Site Landfill (commercial)	TM 193 492 1 ha	O/D	Ammonia, sulphate	River Fynn High Roo failure	C	Divert effluent to sewer or lagoon	None
A4	Foxhall Waste Disposal Site Landfill (domestic and industrial)	TM 238 435 4 ha	O/D	leachate	Groundwater, High Bucklesham Mill River	I		Interception of contaminated groundwater
A5	Helpston Landfill sites Landfill	TF 122 032 70 ha	O	agrochemicals	Groundwater High	C	Consultants report due shortly	Extensive NRA investigations

TABLE C.1 CONTAMINATED LAND SITES REPORTED ON DURING SURVEY

NRA Region: Anglian

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
A6	Brit Agg Fertiliser and agrochemical manufacture	TA 035 232 50+	D	Various Copper, zinc, arsenic	Humber Estuary unknown	C	Remove contaminated soil (cost £1M+)	
A7	Calders and Grandidge Timber treatment	TF 326 427 20 ha	O	Chromium, pesticides	Surface watercourse High	C	Remove hot-spots of contamination and treatment plant	None to date
A8	Hibaldstow Airfield Tyre dump	SE 985 010 20 ha	O	Fire-fighting (potential)	River Ancholme None at present	S	Remove tyres	
A9	Brant Road Tip Landfill	SK 972 668	D	leachate	Drain* to River Witham not stated	C		
A10	Cottingham Landfill Site Landfill	SP 848 895	O	Leachate	Middleton Brook Low	C		Retrospective liner installed
A11	Rushton Landfill Site Landfill	SP 855 835	O/D	Leachate	River Ise Low	C	Treatment plant for groundwater	
A12	Eastern Counties Leathers Tanning	TL 488 482 4 ha	O/R	perchloro- ethylene	Chalk Groundwater High	C	Scavenger borehole (cost £60k +)	Legal proceedings undertaken - findings in favour in E.C.L

TABLE C.1 CONTAMINATED LAND SITES REPORTED ON DURING SURVEY

NRA Region: Anglian

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
A13	Flitwick Landfill Site Landfill and soakaway lagoons	TL 033 353	D	Oil, phenol, chlorinated solvents, organic carbon	Chalk Groundwater River Flit Moderate	C/S	Remove contaminated fill, clay cap and regrade surface	
A14	Ingham Waste Disposal Site Landfill and soakaway lagoons	TL 848 717 10 ha	O/R	oils	Chalk Groundwater Low River Lark	C/S	None	
A15	Hardwick Industrial Estate Dry cleaning	TL 857 632 <0.1 ha	0	Perchloro- ethylene	River Linnet, River Lark Moderate	C/S	Proposals awaited	
A16	RAF Honington	TL 875 759 Unknown	0	Chlorinated hydrocarbons	River Sapiston, Chalk Groundwater High	C	None	

TABLE C.2
 NRA Region: Northumbria

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
N1	Bishop Middleham Landfill site Domestic Waste tip	NZ 335 315 0.5 ha	D	Cyanide	River Skerne, Groundwater Magnesian Limestone High	C	Removal of cyanide bearing waste to suitable site	observation boreholes
N2	Bomarsund Colliery spill tip	NZ 264 846 2 ha	D	Iron, Manganese & Aluminium	Sleek Burn Low	C	Leachate pretreatment or capping	Flow measurements undertaken to assess quantity of water for pretreatment. Cleaned stream bed
N3	Derwenthaugh Cokeworks Coke Works	NZ 193 615 3ha	D	Benzene, Cokework Volatiles, Cyanide, Phenols, Oil and Tars	River Derwent Moderate	C	Dig up and clean. Replace or landfill Containment	By Gateshead MBC (imminent) by separation of volatile organics from aqueous phase.
N4	Nenthead Mines Lead mines and spoil heap	NY 785 430 NY 768 451	D	Heavy metals	River Nen Low	C	None	Post war regrading

TABLE C.2
NRA Region: Northumbria

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
N5	Stillington Waste disposal site Iron and steel works	NZ 375 237 21.4 ha	D/C	Metals	Culvert to Bishopton Beck Low	C/S	Identify route of pollutants. Clay cap	Site Investigations
N6	Queens Park Town gas works	NZ 443 197 1.1ha	D	Phenol, Cyanide, toluene- extractable	Lustrum Beck Moderate	S	Removal, treatment or total containment	Capped with clay/topsoil Site investigations by developer including hydrogeology
N7	Primrose Hill Iron works and slag heaps	NZ 442 200 5 ha	D/C	Lead, Arsenic, Cadmium, Zinc, Copper, Mercury	Lustrum Beck Low	C/S	Clay capping, create preferential drainage alongside beck	Stockton B.C. applying for Derelict Land Grant
N8	Royal Quays, Albert Edward Dock - former Leather and wood treatment	NZ 347 669 2.5 ha	C	Leather processing & curing waste	River Tyne Low	I	Membrane encapsulation	Agreed membrane encapsulation of former leather processing
N9	Bltmac Benzol recovery	NZ 513 217 30 ha	R/D	Oils, tar distillation products	River Tees Low	C	Subsurface water remediation	Installation of new waste disposal site
N10	Battleship Wharf, Cambois Shipbreaking	NZ 309 828 0.2 ha	O	PCB's up to 35.3ppm	River Blyth High	C	Removal and disposal of PCBs	Several detailed surveys by NRA, MAFF and owners

TABLE C.3 CONTAMINATED LAND SITES REPORTED ON DURING SURVEY

NRA Region: North West

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
NW1	Rixton Tips Landfill (industrial & toxic)	SJ 685 915 - SJ 682 909 7 ha	D	petrochemicals, fly ash and arsenic	Marsh Brook High	C	Owner wishes to pay for remediation by re-tipping	Partial capping- unsuccessful
NW2	St Michaels Jubilee Golf Course and West Bank (HEDCO) Tip Landfill (chemical waste)	SJ 500 842 SJ 498 852	D/R (golf course)	Odour, sulphorous deposits, chemical waste	Stewards Brook, Ditton Brook High	C	Preliminary report produced	None
NW3	NIPA Laboratories, Oswaldtwistle Chemical works	SD 728 270 4.5 ha	O/R	Chlorinated organics, leachate	Lottice (White Ash) Brook Low	C	Diverting overflow of contaminated minewater to treatment plant	Collection of seepage from site and pumping to trade effluent discharge pit
NW4	William Blythe & Co, Holland Bank Works, Church, Accrington Inorganic chemical manufacture	SD 737 286 7 ha	O	Zinc, copper, tin, lead, arsenic, cadmium, other metals	Tinker Brook Hyndburn Brook White Ash Brook Moderate Improving	C	Improvements to trade effluent treatment plant and storm tanks on site. Diversion of treated trade effluent including tip leachate to sewer interception of contaminates. Drainage from site of collection sumps and treatment drains work mostly completed	

TABLE C.3 CONTAMINATED LAND SITES REPORTED ON DURING SURVEY

NRA Region: North West

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
NW5	Commonside Farm Aluanley Frodsham Landfill (fly ash)	SJ 504 745 2.5 ha	D	PCBs	Commonside Brook High	C	Remove and incinerate waste/ cap site and divert watercourse/ treat PCBs in situ (cost £2M+)	Cheshire CC diverted watercourse
NW6	Ex McKechnie Chemicals Site Copper sulphate manufacture	SJ 506 847 5 ha	D, R	Copper, sulphate	Marsh Brook High	C	Elimination of contaminated run- off from site (cost £1-2M)	None
NW7	Sankey Brook Landfill (chemical waste)	SJ 534 942 SJ 524 949 SJ 520 951 50 ha	C, R	COD, sulphide, ammonia	Sutton Brook, Sankey Brook, Hardshaw Brook High RQO failure	C	Elimination of leachate seepage to controlled water (cost £10M+)	None
NW8	Sankey Valley Industrial Estate, Newton-Le-Willows sugar refinery, oil recovery	SJ 572 946 6 ha	D,R	organic matter	Sankey Brook High	C	Elimination of leachate seepage (cost £1M+)	None Enforcement Action Pending

TABLE C.3 CONTAMINATED LAND SITES REPORTED ON DURING SURVEY
NRA Region: North West

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
NW9	Trimpell site, Heysham Petrochemical refinery	SD 417 589 51 ha	D	Hydrocarbons	Trimpell Dyke Storage - Pumped to sea Low-High variable	C	Some of this work on-going	New pump installation to protect Trimpell Dyke from gravity drainage 10,000m ³ sludge removed, bacterial treatment
NW10	Carr and Wellington Woods Coal spoil heap	NY 160 437 11 ha	D, R	Colliery spoil runoff, Iron	Sandwith Beck High RQO failure	C	Treatment of spoil with organic matter. Liming, diversion of watercourse away from spoil	

TABLE C.4
NRA Region: Severn Trent

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
ST1	Courtauld's Leek Chemicals	SJ 975 571	O	organic chemicals, acetone etc	Triassic sandstones R Chumet High	C	investigation of extent of pollution by Company	None to date
ST2	Rexco Smokeless Fuels Smokeless fuels	SK 576 616	D	coal carbonisation liquor	Triassic sandstones High localised	C	none	none
ST3	Bentley Mill Lane Tip Landfill	SO 991 981	D	copper and nickel	R Tame High	C	investigation proceeding	preliminary investigation undertaken by NRA
ST4	Van Lead Mines Lead mining	SN 942 887 2 ha	D	lead/spoil and zinc	Afon Cerist High RQO failure	C	re landscape and removal of some waste and capping	investigation/ feasibility study
ST5	Carless Solvents, Stoke on Trent Solvent manufacture	SJ 851 504 10 ha	O	organic chemicals	Fowlea Brook High RQO failure	C	implementation of remedial scheme to be developed	site investigation and pilot water treatment plant
ST6	Slacky Lane Tip Landfill	SK 017 023 10 ha	D	copper and nickel	Rough Brook High	C	none proposed	site investigation by NRA

TABLE C.4
NRA Region: Severn Trent

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
ST7	Hawkesbury Tip, Coventry Landfill	SP 364 847 45 ha	D	elevated BOD, ammonia and metals	culverted tributary watercourse, and adjacent to Coventry Canal Moderate	C	none	none
ST8	Synthetic Chemicals, Four Ashes, Wolverhampton	SJ 916 090	O	various organics	Triassic sandstones Saredon Brock Moderate/ High	C	none	site investigation nearing completion
ST9	Richardsons Tip, Pendeford Landfill	SJ 909 040	D	Zinc wastes and various organics	Waterhead Brook. Triassic sandstones None known	S	possible redevelopment	none
ST10	Heyope Tyre Tip Landfill (tyres)	SO 224 748 2 ha	O	byproducts of tyre combustion	Tributary of River Ffrwdwen High	C	ongoing investigation	site investigation

TABLE C.4
NRA Region: Severn Trent

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
ST 11	Cox's Chemicals, Shropshire Chemical production	SJ 608 105	O	organic solvents and pesticides	Triassic sandstones, small tributary streams close by Moderate	C	removal of some buried wastes	limited site investigation and waste removal

TABLE C.5
NRA Region: Southern

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
S1	Cannon Street/Golf Road, Deal Gasworks	TR 376 533 1 ha	D/R	petrochemicals	Groundwater Upper chalk No evidence	S	Developer: sealing NRA: removal of contaminants	
S2	CMR Ltd Railway sidings former tar works	TQ 931 195 1 ha	D/R	ammonia, phenols, solvents	River Rother (estuary), nearby lake - moderate	I		Membrane lining
S3	Stangate Quarry landfill	TQ 604 560 20 ha	O	chloride, ammonia	Groundwater Hythe Beds Low Intermittent	C (intermittent)	None	
S4	Canal Basin, Gravesend Gas Works	TQ 659 741 1.5 ha	D/R	ammonia, coal tar, sulphate, phenols, cyanide	Groundwater, Thames Estuary Gravel & Chalk Low	C	Groundwater scavenging, removal of contaminated material	
S5	Broomwood Lake Timber treatment	TQ 472 690 20 ha	C	creosote	Broomwood Lake, River Cray Low	C from spillage In 1977	Isolate contaminated area. Assess need for permanent remediation	

TABLE C.5
NRA Region: Southern

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
S6	London Road/Cryalls Lane Insecticide production	TQ 982 638 1 ha	D	Phenols ammonia, polyaromatic hydrocarbons	Milton Creek (River Swale), Groundwater Chalk High localised	C	Remove "hot spots" of contamination, surface with impermeable material	
S7	Hellerman Deutsch Metal plating	TQ 391 391 1 ha	O	trichloro- ethylene, freon	Hastings Beds Groundwater Moderate	being cleared		soil water scavenging
S8	Wilmington Industrial estate	TQ 543 729 5 ha	O	trichloro- ethylene	Groundwater Chalk Low/ Intermittent	intermittent		G.A.C installed of water treatment works. New handling system installed
S9	Former Chatham Naval Dockyard: Dockyard, tip (general and Incinerator)	TQ 765 705 75 ha	D	asbestos, heavy metals, toluene extractables	Medway Estuary Low little evidence	S/I		Removal of contaminated material
S10	Coney Hill Landfill	TQ 375 524 10 ha	D	ammonia, chloride	Tributary of River Eden Folkestone Beds Groundwater Moderate	C/I	scavenging and treatment of leachate (cost £200k)	capped, lined, leachate collection drains

TABLE C.6

NRA Region: South West

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
SW1	Falmouth Container Terminal Proposed Bund construction across estuary	SW 30 80	C/O	Heavy Metals TBT	Carrick Roads and NWC 1A estuaries High	S	Insert clauses into Private Parliamentary Bill	N/A
SW2	St Austell area china clay mines and spoil heaps	SW 95 55 10,320 ha	O	Kaolin colloids	Falmouth, St Austell, Par, Luxulyan High RQO failure	C	under discussion	
SW3	South Crofty Mine Tin mine spoil heap	SW 665 415 5 ha	D/C	Arsenic, copper, zinc	Red River Low	S	Control through Local Plan policies	
SW4	Conce Moor Waste Disposal Site Domestic refuse tip	SX 040 620 25 ha	D	Leachate	Lanivet Stream (River Camel) Low/localised /Intermittent	C intermittent	None	
SW5	Devon Great Consols Mining of heavy metals	SX 430 730 200 ha	D	Heavy metals	River Tamar High	C	Increased monitoring	
SW6	Barton Barn Farm Land drainage for grazing	SX 599 963 9 ha	O	Low pH copper, iron, zinc, cadmium, nickel	Brightley stream High	C	Liming Fields, damming stream during critical periods	As proposed

TABLE C.6
NRA Region: South West

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
SW7	Carnon River/Hale Mills Stream area copper and tin spill heaps	SW 75 42 500 ha	D/R	Low pH, zinc, iron, nickel, cadmium, lead, copper, arsenic	Carnon River Hale Mills stream High RQO failure	C	None until Wheal Jane pollution resolved	
SW8	Newlyn River Catchment Daffodil bulb growing	63 ha+	R (some) O (others)	Aldrin, dieldrin	Newlyn River High RQO failure	C	Banning Aldrin, encourage anti- runoff measures	Fields proven to be polluting watercourses converted to grazing
SW9	River Clyst Catchment Agriculture	15,675 ha	O	Nitrate	River Clyst High RQO failure	C	Designate buffer zones and Nitrate Sensitive Areas	
SW10	Chelson Meadow Landfill site	SX 510 548	O	TBT, ammonia, others	Plym Estuary Moderate	C	Review of discharge consent and Waste Discharge Site Licence	Estuary Impact Survey
SW11	River Mere Ball Clay Basin Ball Clay extraction, spoil heaps	SS 540 100 200 ha	O/D	Suspended solids	River Mere Moderate RQO failure	C	Settlement of solids prior to release of water	On-going settlement

TABLE C.7
NRA Region: Thames

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
T1	Thames Matex Tank Farm on made ground	TQ 579 766 Unknown	O	BOD	Thames Estuary consent failure	C	Separate drainage system from groundwater	
T2	Former St Albans Gas Works Gas Works	TL 146 062 8.5 ha	D/R/C	Sulphate, ammonia, cyanide, phenols, metals	River Ver, Chalk, Groundwater Localised/ Variable	C localised/ variable	Groundwater cleanup	Removal of most contaminated land
T3	Thames Industrial Estate Trichloroethylene storage	SU 856 866 3 ha	R/C	Trichloro- ethylene	River Thames Chalk, Groundwater	C	Groundwater clean up	
T4	Former Laportes Chemical Works Chemical works	TL 064 220 20 ha	D/R	Sulphate, ammonia, iron, barium, chloride,	Chalk, Groundwater High	C	bioremediation, excavation groundwater scavenging	Bioremediation, excavation
T5	Murphy's Chemicals Pesticide development	TL 180 143 3 ha	D	Pesticides including lindale, aldrin, dieldrin	River Lee, Chalk, Groundwater High	C	Excavation, site capping, groundwater remediation	

TABLE C.7
NRA Region: Thames

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
T6	Beckton Gas Works Gas Works	TQ 445 815 100 ha	D/R	Chloride, sulphate, phenol, ammonia, cyanide	Thames Estuary High	C/S	Excavate hot-spots Capping	
T7	ex-BASF site, Watford printing ink manufacture	TQ 108 974 2 ha	D	Organic solvents, eg acetone, butane, toluene, xylene	River Colne Organics detected Chalk, Groundwater	C	Extract volatiles, remove or treat contaminated ground and groundwater	Some contaminated chalk removed
T8	North Cockley Landfill landfill	TQ 298 510	O/D	Leachate	Redhill Brook Low Groundwater High/ Moderate	C/I	Capping	
T9	Tripcock Park Disposal of munitions waste	TQ 455 805	D	Leachate	Thames estuary, Low Chalk, Groundwater Low	C	Capping and restoration, leachate collection	
T10	Goulds Grove Landfill Landfill (Incl, paint wastes)	SU 64 90 30 ha	O	chlorinated solvents	Chalk, Groundwater Low	C/S	Consultants report awaited	

TABLE C.7
NRA Region: Thames

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
T11	AEA, Harwell Waste disposal, solvents	SU 47 86 30 ha	D	Chlorinated solvents, esp carbon tetrachloride	Chalk, Groundwater High	C	Groundwater scavenging and cleaning	Equipment ordered
T12	BREL, Swindon Locomotive manufacture	SU 13 84 100 ha +	D/R	Solvents, oils, metals	River Ray High	C	Removal of contaminated material	
T13	Cranleigh Works (Redland Brick Ltd) chemical works	TQ 069 355 35 ha	D	Zinc, ammonia, bromide, bromate	Cranleigh waters High	C	Collect and treat run-off	Run-off collected and treated

TABLE C.8
NRA Region: Welsh

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
W1	Brofiskln, nr Groesfaen Landfill (chemical/Industrial waste)	ST 069 813	D	variety of chemicals	Low/ Intermittent local stream, Carboniferous limestone aquifer	C	None as yet	None
W2	Sutton Walls Landfill (chemical and Industrial waste)	SO 525 464	D	Ferruginous leachate	Lugg Moderate Groundwater Moderate	C (occasional)	Suggested recap with impervious cap	None
W3	Maendy Landfill (chemical/Industrial waste)	ST 075 877	D	Organics, including phenols, PCBs, formaldehyde	local stream River Ely, High	C	Impervious cap and leachate treatment, if necessary	None
W4	Dyserth Tip, nr Rhyl Landfill (domestic)	SJ 057 796 1 ha	D	Metals, sulphate, boron	Afon Glanfyddlon, Low	C	Re-profile, cap properly	Site completed prior to CoPA
W5	Castle Works Tip, Flint Tipping of List 1 substances	SJ 245 738 20 ha	D	Leachate	River Dee None Groundwater Low	Unknown	None as yet	
W6	River Lane Saltney Fullers earth site	SJ 381 653 1.5 ha	D	Organic	River Dee None Estuary Unknown	C/S	None as yet	

TABLE C.8
NRA Region: Welsh

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
W7	Ciwyd Durable Timber, Llandrillo wood treatment	SJ 027 377	O	creosote, copper, chromium, arsenic	local stream High	C	Bunding of site	Mitigation Pending
W8	Bryn Rodyn Farm inert waste tip	SH 576 767 1 ha	D	non-inert materials	local stream Low/localised	C	None as yet	
W9	Waverton Chemicals Solvent recovery	SJ 454 644 1 ha	D/C	Solvents, PCBs	Groundwater Triassic Sandstone Moderate	C	Remove cover, Clay/concrete cap	
W10	Kronospan Plasticiser manufacture (Formerly Ferro (UK) Ltd)	SJ 287 388	D/R	Cadmium	Afon Bradley, None Groundwater High	unknown	Remove contamination	
W11	Former BSC Coke Oven lagoons coke oven	SJ 304 721	D	Ammonia	Finger Post Drain, Dee Estuary High	C	Proposals being compiled	
W12	Neston Tank Cleaners chemical production	SJ 324 684 30 ha	D	PCBs, chlorinated solvents	River Dee Low Groundwater High	S	Capping, removal of contaminants, and treatment or groundwater	
W13	Brymbo Steel Works coal + oil waste tip	SJ 290 535 1 ha	C	PCBs	not specified None	S	Removal and incineration of most contaminated materials	Removal of most highly contaminated material

TABLE C.8
NRA Region: Welsh

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
W14	MANWEB depot storage and reconditioning of transformers	SJ 326 683 <0.5 ha	O	PCBs, copper, cadmium	Dee estuary None Groundwater Triassic sandstone Moderate	S	Removal of contaminated soil	
W15	NIPA Laboratories lagoon pharmaceutical waste disposal	SJ 333 678 1 ha	D	not specified	River Dee None Groundwater Low	C	Biological treatment	
W16	Wardles Metals tipping aluminium refinery waste	SJ 505 386 2 ha	O	Ammonia, Iron, solids	Red Brook, High Groundwater	C	Dewatering by recirculation	Discharge to Red Brook ceased
W17	Countess Tip, Chester landfill	SJ 395 686 8 ha	D	Ammonia, Iron solids	Finchetts Gutter Moderate/ Seasonal	C	Further investigation	
W18	Greenfield Textile production	SJ 213 778 20 ha	D/C	Sulphide/zinc	Dee Estuary Unknown	C		
W19	Princes Pit, Connah's Quay Landfill (incl nitrogenous fertiliser)	SJ 693 295 3 ha	D	Ammonia	Dee Estuary Unknown	C		
W20	C C Crump, Connah's Quay various	SJ 297 698 4 ha	O	Oil, chromium, rayon waste	Dee Estuary None	S	Excavate contaminated areas	

TABLE C.8
NRA Region: Welsh

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
W21	Cwm Ystwyth Mine lead mining	SN 805 746 50 ha	D	Zinc, cadmium, arsenic, lead and other toxic metals	River Ystwyth High	C	Being examined by consultants	
W22	Telfi Timber Timber yard	SN 479 401 2.5 ha	O	Copper, chromium, arsenic	Maesycruglan (River low Telfil) affects Hotel private supply	C	Better site management	On site spillages prevented
W23	Lower Swansea Valley non-ferrous metal smelting	SS 675 967 500 ha	R/D	toxic metals	Nant-y- Fendrod (River Tawe) High RQO failure	C	None as yet	
W24	Cadoxton Tip landfill (domestic)	SS 763 988 2 ha	D	not specified	Tennant Canal, Neath estuary Low	C/S	None (only localised effects)	
W25	Kenfig Industrial Estate Carbide factory	SS 79 83 100 ha	R	high pH, calcium, magnesium, zinc	River Kenfig Low/localised	C	None	
W26	Techon Tip Site Landfill (domestic)	SS 540 992 3 ha	D	ammonia, BOD, red coloration	Afon Goch Low/ intermittent	(C)	None	

TABLE C.8
NRA Region: Welsh

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
W27	Pembrey Country Park Munitions production	SN 405 005 20 ha	amenity	Tetryl	Coastal waters and Groundwater not confirmed	S	None as yet	
W28	Mechemma Chemicals non-ferrous metal salts production	SS 758 890 5 ha	D	Arsenic, cobalt, manganese	Port Talbot docks Groundwater Carboniferous Localised	C	Encapsulation	
W29	BP Oil Transit site oil and chemical storage	SS 700 928 15 ha	O	oils, benzene	Swansea Bay, Coastal Water and Groundwater Unknown	C	Removal of floating oil	
W30	BP Llandarcy Refinery Oil refinery	SS 718 960 200 ha	O	Oils	Crymlyn Bog SSSI Unknown	C	None as yet	
W31	MOD former fuel depot	SM 95 03 1-2 ha	D	Oils, PAH's, toluene extractables	Pembroke Dock Groundwater Limestone Moderate	C	Further site investigation	Site investigation and consultation with NRA

TABLE C.9
NRA Region: Wessex

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
WX1	Tangler, Taunton gasworks	ST 222 247 3 ha	D/C	Phenols, PAH, Sulphate, low pH	River Tone Low	S	Encapsulation or removal	None unless further development
WX2	Fox Brothers, Wellington wool scouring	ST 128 220 0.5 ha	D/C	Permethrin, dieldrin	River Tone Moderate	C	Further investigation to determine sources of pollutants	Majority of grease cake removed upon development
WX3	Treborough Waste Disposal Site landfill	ST 015 367 1 ha	D	none confirmed to date	Washford River Zero	I	Monitoring	Monitoring Capped
WX4	Sherry and Haycock Timber Yard Timber yard	SU 061 016 1 ha	O	Low level pesticides	Moors River Low	S/C	None	
WX5	Porton Down MOD site	SU 207 374 100 ha+	O	Organics, esp carbon tetrachloride	River Boume No evidence Groundwater Low	C	Code of practice on disposal of solvents	Code of Practice implemented. Borehole aeration
WX6	Merck, Poole chemical manufacture	SZ 007 906 2 ha	O	Chemicals released during fire	Poole Harbour Low	S	None	
WX7	Blckill chemical processing	ST 808 259 1 ha	O	Pesticides	River Stour low/variable	C	None monitoring underway	

TABLE C.9
NRA Region: Wessex

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
WX8	Pitwines gasworks site Gasworks	SZ 018 904 20 ha	D/R	Gaswork liquors, phenols etc	Poole Harbour Not known	C/I	Surface drainage separated from groundwater	
WX9	Site of Lessers Buildings wood treatment	SU 075 090 10 ha	D	Pesticides	River Crane Zero Lagoon Low	C	Excavate waste and contaminated soil	None-site in receivership
WX10	Bothenhampton Waste Disposal Site Landfill	SY 472 915 20 ha	O	Ammonia	River Brit Moderate	C	Redesign of site and diversion of stream	Redesign work commenced
WX11	Lodmoor Waste Disposal Site Landfill	SY 680 816 20 ha	D	Metals, ammonia	Tidal marsh Moderate	C	If problems recur, sealing and leachate removal	Site closed Legal warnings
WX12	Cogdean Elms Landfill	SY 993 98 5 ha	D/R	Organic matter, ammonia, trace organics	Springs, River Stour Low	C	Repair sewer, divert surface drainage	
WX13	Site of Cases Tannery Tannery	ST 858 501	D	none	River Biss None	S - pollution incident	None	
WX14	Site of British Steel Chemicals chemical plant and waste disposal	ST 630 723 1-2 ha	D/R	Not detailed	River Avon Low Intermittent	C	Strict site control	Strict site control on redeveloped area

TABLE C.9
NRA Region: Wessex

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
WX15	Monkton Farleigh Mine Wartime MOD use	ST 805 660	D	Possible PCBs	Bybrook, River Avon None confirmed	unclear	confirm problem	
WX16	Cuprinol, Adderwell Wood preservative manufacture, old industrial landfill site	ST 782 470	O	Pesticides	River Frome High	C	Improve leachate interception	Basic leachate interception enforcement action pending
WX17	Pasminco Europe zinc smelter slag disposal	ST 523 790	D/R/C	Lead, Cadmium, zinc	Severn Estuary Moderate	C	Possible commercial use of tipped slag	

TABLE C.10
NRA Region: Yorkshire

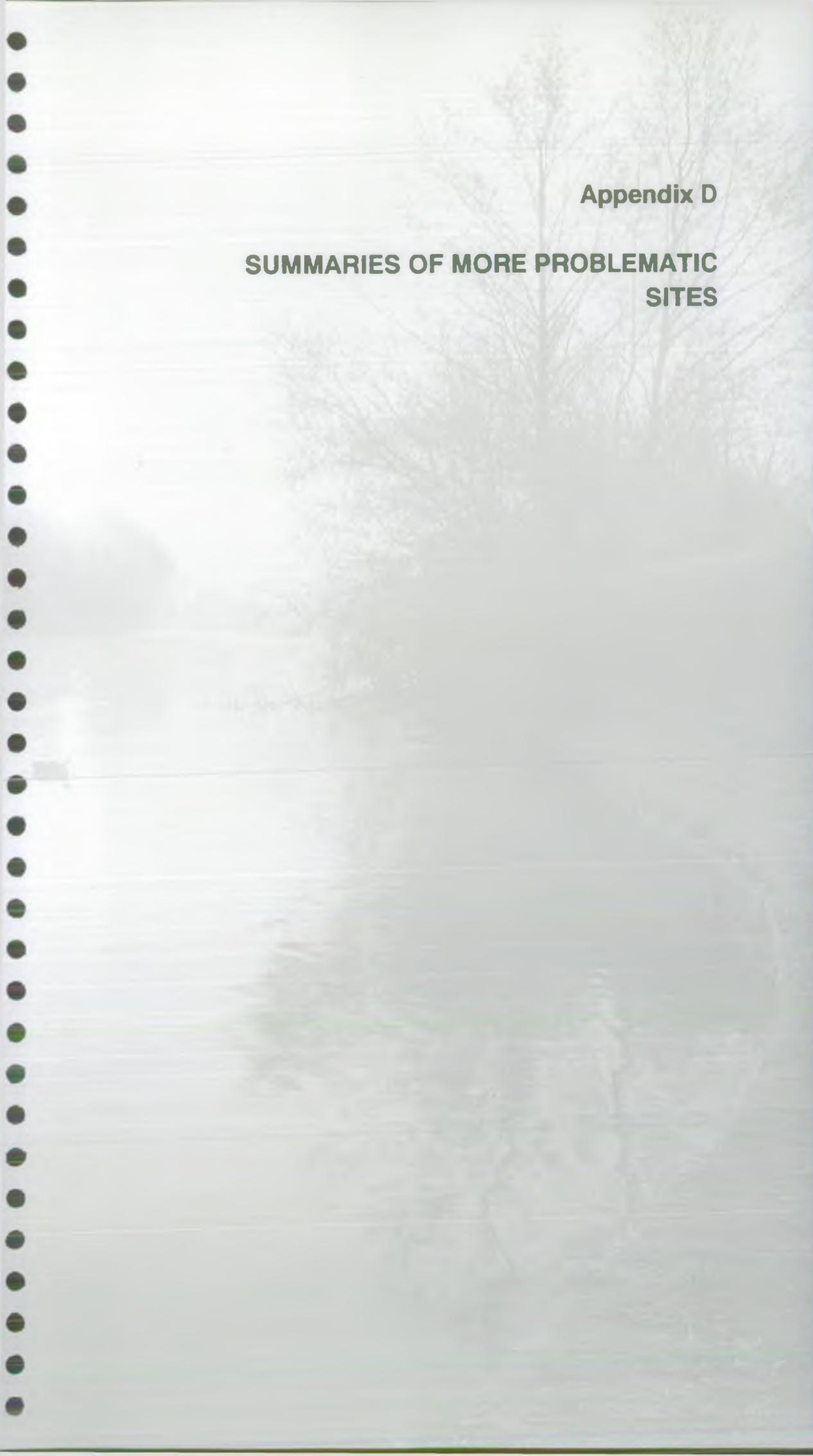
Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
Y1	John Carr, Watch House Lane, Doncaster Joinery	SE 559 049 3-4 ha	O	PCPs, Lindane, TBT	Northswaithe Dyke, Bentley Mill Stream High RQO failure	C	Groundwater to treatment plant (active carbon absorption), site timber processes under cover and contain drainage (cost £150 k)	None
Y2	Pilkington glass Kirksandal	SE 604 082 15 ha	O	Solid residues Southport sand and iron oxide	River Don, Grumblehirst drain Moderate	C	No extra remedial works proposed	Effluent pumped to treatment
Y3	Coalite Chemicals Chemical refinery	SK 457 717 35 ha	D/R	Leachates Dioxins, furans	River Doe Lea High RQO failure	C	Plans for removing dioxins still being considered	Reed bed treatment for tip run-off collection and interception system for tar escapes to river now implemented
Y4	Coalite, Grimethorpe coking works spoil tip	SE 415 075 100 ha	O/D	Spoil heap from coking process	River Dearne and Grimethorpe Dyke, Moderate	C - mainly from ongoing processing of smokeless fuels	Find alternative to spoil heap disposal/treatment	None

TABLE C.10
NRA Region: Yorkshire

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
Y5	Beighton landfill Sheffield Landfill (domestic)	SK 425 843 20 ha	O	Leachate	Shire Brook (culverted through site)	C	Retrospective remedial action on culvert required though not decided on	None
Y6	Coal Products Ltd, Chesterfield Coal products	SK 393 680 36 ha	O operations due to cease on 19.9.92	Coal tar	River Rother High RQO failure	C	Isolate river channel and groundwater flow through controlled pumping.	None
Y7	Cononley Lead Mines Lead mining	SD 977 461 10 ha	D	Lead	Cononley Beck Low	C	None	None
Y8	Sunlane tip Landfill (domestic)	SE 157 466 4 ha	D	Leachate	Sunlane Beck Low	C	Divert leachate to sewer	None
Y9	Croda Hydrocarbons Hydrocarbon processing	SE 512 238 1 ha	D/R nature reserve	Tar products	Kellingley main drain (culverted) Low	C	Check for groundwater contamination	None

TABLE C.10
NRA Region: Yorkshire

Site No	Name Contaminative use	NGR Area	Current Status of Site	Pollutant(s)	Target Water Body & Level of Pollution	Current Status of Contamination	Remedial Work Proposed	Remedial Work Undertaken
Y10	ICI Bradley Park tip Landfill (chemical waste)	SE 168 215 35 ha	D/C	Chemical tip leachate	River Calder Low	C	Results of BH's yet to be given ICI have plans for treatment for poor quality groundwater if necessary	None



Appendix D

**SUMMARIES OF MORE PROBLEMATIC
SITES**



APPENDIX D

SUMMARIES OF MORE PROBLEMATIC SITES

CONTENTS

D1	ANGLIAN REGION	D.1
	D1.1 Thorpe Railway Sidings	D.1
	D1.2 Brit Agg	D.2
	D1.3 Calders and Grandidge	D.3
	D1.4 Laundry, Hardwick Industrial Estate	D.4
	D1.5 RAF Honington	D.5
D.2	NORTHUMBRIA NRA	D.6
	D2.1 Bishop Middleton Landfill Site	D.6
	D2.2 Derwenthaugh Cokeworks	D.7
	D2.3 Queens Park	D.8
	D2.4 Primrose Hill	D.9
	D2.5 Battleship Wharf	D.10
D3	NORTH WEST NRA	D.11
	D3.1 Rixton Tips, Moat Lane, Warrington	D.11
	D3.2 William Blythe & Co, Holland Bank Works	D.12
	D3.3 Commonsidge Farm, Alvanley, Frodsham	D.13
	D3.4 Sankey Brook	D.14
	D3.5 Trimpell Site, Heysham	D.15
D4	SEVERN TRENT NRA	D.16
	D4.1 Bentley Mill Lane Tip	D.16
	D4.2 Van Lead Mines	D.17
	D4.3 Carless Solvents, Stoke-on-Trent	D.18
	D4.4 Synthetic Chemicals, Four Ashes	D.19
	D4.5 Heyope Tyre Disposal Site	D.20
D.5	SOUTHERN NRA	D.21
	D.5.1 CMR Ltd, Rye	D.21
	D.5.2 London Road/Cryalls Lane, Sittingbourne	D.22
	D.5.3 Hellerman Deutsch, East Grinstead	D.24
	D.5.4 Former Chatham Naval Dockyard	D.25
	D.5.5 Coney Hill Landfill, Oxted, Surrey	D.26
D.6	SOUTH WEST NRA	D.27
	D.6.1 Falmouth Container Terminal	D.27
	D.6.2 South Crofty Tin Mine, Camborne	D.28
	D.6.3 Devon Great Consols, Tavistock	D.29
	D.6.4 Barton Barn Farm, Okehampton	D.30
	D.6.5 Newlyn River Catchment	D.31

D.7	THAMES NRA	D.32
	D.7.1 Thames Matex Tank Farm, Grays	D.32
	D.7.2 Thames Industrial Estate, Marlow	D.33
	D.7.3 Atomic Energy Authority (AEA), Harwell	D.34
	D.7.4 British Rail Engineering Works, Swindon	D.35
	D.7.5 Redland Brick Ltd, Horsham, Sussex	D.36
D8	WELSH NRA	D.37
	D8.1 Neston Tank Cleaners	D.37
	D8.2 Cwm Ystwyth Mine, Aberystwth	D.38
	D8.3 Lower Swansea Valley	D.39
	D8.4 Mechema Chemicals, Port Talbot	D.40
	D8.5 BP Oil Refinery, Llandarcy	D.41
D9	WESSEX NRA	D.42
	D9.1 Fox Brothers, Wellington	D.42
	D9.2 Merck, Poole	D.43
	D9.3 Monkton Farleigh Mine, Bath	D.44
	D9.4 Cuprinol Ltd, Adderwell	D.45
	D9.5 PASMINGO EUROPE, AVONMOUTH	D.46
D10	YORKSHIRE NRA	D.47
	D10.1 John Carr Joinery, Doncaster	D.47
	D10.2 Pilkington Glass, Kirksandal	D.48
	D10.3 Coalite Chemicals, Bolsover Refinery	D.49
	D10.4 Coalite Grimethorpe	D.50
	D10.5 Coal Products Ltd, Avenue Works, Chesterfield	D.51

D1 ANGLIAN REGION

D1.1 Thorpe Railway Sidings
Site Ref: A1
NGR: TG 245 078
Area: 200 hectares +

SITE HISTORY

The site was historically a major distribution centre for the railways, taking goods from the ports for redistribution around East Anglia. The site has been partly redeveloped as an industrial estate.

WATER QUALITY IMPLICATIONS

The site is underlain by Chalk at depths between 7 and 42 metres and fluvio-glacial sands and gravels. Aquifers are contained within both the chalk and sand and gravel horizons. The nearest public water supply borehole is 500 metres away from the site and there is evidence of contamination. Groundwater samples show:

up to	25,300 µg/l	trichloroethene
up to	58 µg/l	carbon tetrachloride
	10-100 µg/l	tetrachloroethane

SITE INVESTIGATION-REMEDIAL WORKS

As a direct result of contamination by solvents of a public water supply investigations into the nature and extent of groundwater pollution have been undertaken. Investigations involved drilling, test pumping and logging of six boreholes. Action has already been taken at the public supply source where an activated charcoal process has been installed.

D1.2 **Brit Agg**
 Site Ref: A6
 NGR: TA 035 232
 Area: 50 hectares +

SITE HISTORY

This site has a long history of fertiliser and agrochemical formulation processes. The site was established in the late 1920's by a small farming company, the activities were significantly expanded and was subsequently taken over by Albright and Wilson and then by ICI. The site has been derelict since about 1990. The DoE are currently assisting the local authority in the purchase and redevelopment of the area.

WATER QUALITY IMPLICATIONS

The site is located above a major public water supply aquifer in the Chalk which is overlain by a clay layer. Recent surveys of the site have identified a number of old boreholes, backfilled with rubble, that penetrate the Chalk and could provide a pathway for pollutants to enter the aquifer.

The surface waters discharge to the Humber Estuary. Analysis of this discharge shows high levels of Dieldrin (mean of 60.5 ng/l) and arsenic (mean of 1195.4 µg/l).

SITE INVESTIGATION/REMEDIAL WORKS

The DoE are assisting the local authority in the investigation of this site; to date grants totalling £93K have been spent on investigations. The soils beneath the site are contaminated with pockets of heavy chemical contamination - part of the site was also found to have been a landfill. The NRA have been consulted during the investigations and the results will be available shortly.

D1.3 **Calders and Grandidge**
Site Ref: A7
NGR: TF 326 427
Area: 20 hectares

SITE HISTORY

This is the site of a long established timber treatment yard and has been a major UK site over a number of years for the production of telegraph poles. As a result of the timber treatment processes the land is heavily contaminated with creosote, copper chrome arsenates, protlm etc.

WATER QUALITY IMPLICATIONS

The site is underlain by clay and therefore does not pose a risk to groundwaters. The main problems are associated with the runoff from the site and subsequent pollution of the surface waters.

SITE INVESTIGATION/REMEDIAL WORKS

The owners of the site have contracted consultants to investigate the site and to make recommendations on remedial measures. The recommendations included measures to retain runoff from the site and to clean up identified hot spots of contamination. These measures are currently being implemented.

D1.4 Laundry, Hardwick Industrial Estate
Site Ref: A15
NGR: TL 857 632
Area: 180m²

SITE HISTORY

This is the site of a small laundry with a dry cleaning operation. The laundry has been in existence for many years over which time the common practice of throwing waste solvents onto the land at the rear of the premises has resulted in groundwater contamination with chlorinated solvents.

WATER QUALITY IMPLICATIONS

The site is located on the unconfined Middle Chalk and is close to the Rivers Linnet and Lark. There is a very large potable abstraction in Bury St Edmunds. There has been extensive analysis of boreholes in the area and a number of supplies are known to be affected. In an Anglian Water Services borehole 1.5km away chlorinated solvents are found at 0.5 µg/l whilst at a local brewery, 0.75km away, the concentration is 40 µg/l; perchlorethylene concentrations upto 1500 µg/l have been found in boreholes in the area.

SITE INVESTIGATION/REMEDIAL WORK

Consultants have undertaken a soil gas survey and a shallow borehole survey, whilst the NRA has surveyed the drainage system and boreholes in the area. The extent of the contamination is confined to a depth of 7 metres over the 180m² of the site. No proposals have, as yet, been put forward for remediation. Remedial works could include the excavation and removal of material or the pumping of on site boreholes to contain the contamination.

D1.5 **RAF Honington**
 Site Ref: A16
 NGR: TL 875 759
 Area: Unknown

SITE HISTORY

The site is an operational RAF base with adjacent industrial uses such as a historical engineering works which served the base. There are still some discharges on site to the ground.

WATER QUALITY IMPLICATIONS

Activities on the base, and also probably from those associated with the engineering works, have caused contamination of the groundwater within the chalk with chlorinated hydrocarbons. Since 1985 the RAF boreholes have been found to be contaminated and a few private boreholes have also been affected. The nearest public supply borehole is 3.5km away and is being sampled by the NRA.

SITE INVESTIGATION/REMEDIAL WORKS

The MOD have contracted consultants to carry out an investigation but the results are not available to the NRA. Downstream abstractors have also had independent work done in their efforts to seek compensation.

There have been no proposals for remedial works although some local abstractors are treating the water.

D.2 NORTHUMBRIA NRA

D2.1 Bishop Middleton Landfill Site
Site Ref: N1
NGR: NZ 335 315
Area: 0.5 hectares

SITE HISTORY

The site is an old limestone quarry that has subsequently been used as a landfill site by the County Council. The site primarily accepted domestic waste and officially ceased to operate in 1974. An old cokeworks at Fishburn to the east of the tip has been demolished. Prior to demolition a correct disposal route for the waste was agreed between the developer and the Planning Authority. However, some Blue Billy waste has found its way to the Bishop Middleham tip. This waste was dumped illegally on the surface. NRA first discovered that there was Blue Billy waste on the site in 1990. The site is currently derelict.

WATER QUALITY IMPLICATIONS

The site is underlain by a Magnesian Limestone aquifer, leachate from the site has caused cyanide pollution of the groundwater to levels above those specified in the EC drinking water directive, cyanide levels have been recorded at 3 times this limit in one observation borehole.

The nearest public borehole, operated by Hartlepoons Water Company is 4.5 kilometres away. Hartlepoons Water Company have however designated an area nearer the tip as the next phase for extension of their abstraction regime.

SITE INVESTIGATION/REMEDIAL WORKS

The NRA has drilled 6 observation boreholes to monitor the situation. Samples are regularly taken for cyanide analysis. Proposed remedial action is based upon the removal of cyanide bearing waste to a suitable disposal site. Until this action is taken there will be continued migration of cyanide into the aquifer.

Removal of the material was agreed, however concerns over health and safety during the removal operation have delayed the start of the remedial work.

D2.2 **Derwenthaugh Cokeworks**
 Site Ref: N3
 NGR: NZ 193 615
 Area: 3 hectares

SITE HISTORY

The site is an old cokeworks with associated mines which ceased to operate in 1984. The demolition of the works commenced immediately after closure and the present decontamination work is the continuation of this decommissioning operation. The site is derelict but is being cleaned up by Gateshead MBC to enable development to proceed.

WATER QUALITY IMPLICATIONS

The site is located in river terrace deposits adjacent to the River Derwent. The groundwater flows through the site and enters the river via the River gravels at the downstream end. There is a lagoon with a surface layer of oil within the site. The discharge from this lagoon is being intercepted prior to its entering the river.

Volatiles have been found on top of the water table which is 1.0 to 2.0 metres below ground. Other contaminants are present in the column.

There is no ground water abstraction in the vicinity of the site.

SITE INVESTIGATION/REMEDIAL WORKS

Numerous site investigations have been undertaken by Gateshead MBC. Gateshead MBC initially planned to excavate the solid contaminants and encapsulate them in existing concrete tanks on site. However, the operation exposed the groundwater pollution and allowable atmospheric Benzene levels were exceeded.

A bentonite wall is to be installed around this area and solvent abstraction techniques are to be employed. On completion the bentonite wall will be allowed to deteriorate so that groundwater movements can return to normal.

In addition a pilot scheme by a Contractor, Biolytic Systems, has been installed and found to operate successfully.

COMMENTS

This site is likely to be amongst the first in the north-east to use large scale techniques for the separation of volatile organics from the aqueous phases.

D2.3 **Queens Park**
 Site Ref: N6
 NGR: NZ 443 197
 Area: 1.1 hectares

SITE HISTORY

There has been a gasworks on this site since 1899. The gas works were demolished in 1983. The underground gas tanks were buried when the site was levelled immediately after demolition. Stockton Borough Council has told NRA that the site was capped with clay as part of the levelling process. The area is currently open space but Wimpey Homes proposes to develop the site for residential usage. Wimpey Homes approached NRA to discuss the remediation of the site.

WATER QUALITY IMPLICATIONS

There is no ground water abstraction in the vicinity of the site. There is however a watercourse, the Lustrum Beck, two kilometres to the west of the site. The water table, probably perched, has been encountered at 0.9 to 2.1 metres depth. No evidence of pollution of surface water or groundwater has been related back to this site. However NRA has requested that a hydrogeological study of the site be undertaken to assess the problem. NRA is concerned about contaminants migrating along future drainage paths installed to serve the development which could then discharge to the Lustrum Beck.

SITE INVESTIGATION/REMEDIAL WORKS

Two site investigations have been undertaken. The first by Bostock Hill and Rigby Ltd in 1983 found that extracted liquids were floating on top of the groundwater. Toluenes, Coal Tars, Total Cyanide and Phenols were present. The Toluene and Coal Tar contamination exceeds ICRCCL limits over the majority of the site whilst the Phenols exceed ICRCCL limits over half the area. Remediation will depend on hydrogeological investigation, but could be removal, treatment or containment.

COMMENT

Site adjacent to Primrose Hill

D2.4 Primrose Hill
Site Ref: N7
NGR: NZ 442 200
Area: Approximately 5 hectares

SITE HISTORY

In 1899 the site was occupied by West Stockton Iron Works with Westbourne Iron Works lying immediately to the east of the site. Waste slag heaps occupied some of the land and there were railway sidings serving the works. In 1918 the Iron Works were abandoned. The area of the site containing the ironworks and spoil heaps adjacent to the Lustrum Beck has been levelled. The railway tracks have been removed but otherwise the sidings have not altered and are contaminated with heavy metals. The site is currently derelict open space. The site is scheduled for partial industrial redevelopment, the remainder being left as open space.

NRA's involvement commenced at the planning consultation stage and there has been further consultation with Stockton Borough Council.

WATER QUALITY IMPLICATIONS

The Lustrum Beck forms the north west boundary of the site. There is no visible pollution of this watercourse. The ground water table, probably perched on the clay, was encountered at 1.0 to 3.0 metre depths. There are no water abstraction facilities in the area.

The contamination may in time pollute the Lustrum Beck if no action is taken. If development proceeds, contamination may migrate along development drainage paths.

SITE INVESTIGATION/REMEDIAL WORKS

A full site investigation was undertaken by Northern Environmental Consultants in 1990. The western side of the site suffers from slight contamination overall with a few hot spots of coal tar, lead, arsenic and mercury. The eastern side (north sidings) has heavy contamination (Pb - major, As - cd lesser, Cu, Zn) associated with fill material. There are also some hot spots of coal tar.

Remediation proposals suggesting the installation of a capillary breaklayer and subsoil on half the area which is designated as open space have been put forward. For the industrial development concrete foundations and surfacing will be used to minimise water ingress. NRA favours the installation of a 0.5 metre clay capping layer. In addition NRA favours preferential drainage alongside the Lustrum Beck with discharge to the beck only if uncontaminated, otherwise flow should be routed to sewage works.

D2.5 **Battleship Wharf**
Site Ref: N10
NGR: NZ 309 828
Area: 0.2 hectares

SITE HISTORY

The wharf is owned by Blyth Harbour commission, this is in turn equally owned by the two local councils.

The wharf is used for ship breaking. At the time of the oil spillage from the wharf the operator was breaking two Russian Vessels. NRA was notified because of the oil pollution which was contained. Subsequently the operator went bankrupt and another operator was brought in to finish scrapping the vessels. The wharf is currently empty.

WATER QUALITY IMPLICATIONS

PCB contaminated sediments were found on the bed of the wharf and in the main river. The highest concentration being 35.3mg/kg (wet weight). The worst pollution, which is above acceptable levels, is concentrated, 200 metres upstream and downstream of the wharf above the dredged channel, ie. on bench to the harbour wall. The implications are higher concentrations of PCB in the food chain.

SITE INVESTIGATION/REMEDIAL WORKS

Since the oil spillage was from Russian vessels and knowing Russian practice, samples were tested for PCB contamination. NRA undertook the initial investigation by sampling river sediments. There was a subsequent combined NRA/Ministry of Agriculture, Fisheries and Food (MAFF) and further surveys by MAFF including one of the offshore dumping grounds. Wimpey Environmental have undertaken a survey for the Port Authority. The method of remediation is still being assessed but if the waste were to be removed and then incinerated it would cost between ¼ and ½ million pounds.

D3 NORTH WEST NRA

D3.1 Rixton Tips, Moat Lane, Warrington
Site Ref: NW1
NGR: SJ 685 915 - SJ 682 909
Area: 7 hectares

SITE HISTORY

There are three sites here contributing to one problem. The area has been used to win clay and subsequent waste disposal has followed. The sites have received general industrial waste, petrochemical wastes and sludges, fly ash and toxic wastes, especially arsenic. The sites are currently derelict.

WATER QUALITY IMPLICATIONS

The natural drift thickness is between 8 and 12m and is dominated by boulder clay. Where this has been removed for brick and tile manufacture, there may be ingress/egress pathways to the lower drift groundwater confined in underlying sand and gravel.

The nearest public water supply borehole is 5.8km from the claypit abstraction point.

The nearest watercourse is Marsh Brook, which is adjacent to all three sites. It is 3km in length and is unclassified - it is quoted as being in appalling condition and would be Class 4.

SITE INVESTIGATION/REMEDIAL WORKS

The current site owner has commissioned a site survey and wishes to remediate the site, creating another tip to assist with payment for the remedial works. The local planning department is opposing this on political grounds, wishing to discourage further tipping in the area.

The site suffers from a poor cap. Rainfall fills the site and spills out. Remedial works need to include the placement of a proper cap keyed into the existing bund, which will be very expensive.

D3.2 William Blythe & Co, Holland Bank Works
Site Ref: NW4
NGR: SD 737 286
Area: 7 hectares

SITE HISTORY

This site has a long history of use as chemical works with a waste disposal area. At present, the chemical works is active, producing inorganic chemicals: zinc, copper, tin, lead and arsenic compounds are produced.

WATER QUALITY IMPLICATIONS

The site is underlain by boulder clay of unknown depth with possible lenses of sand and gravel. The underlying rock is Carboniferous sandstone which is locally much faulted and fissured or penetrated by coal workings. There would be a danger of leachate escaping to small local aquifers only if the clay cover were removed.

The nearest public water supply borehole is 5.7km distant from the site.

The site is bounded by Tinker Brook and White Ash Brook, both Class 3 watercourses as a result of seepages from the site. These join to form Hyndburn Brook downstream of the site; this too is a Class 3 watercourse with elevated levels of metals. Data available on biological surveys indicates an improvement in these watercourses.

SITE INVESTIGATION/REMEDIAL WORKS

There has been no site investigation carried out. However, there have been improvements made to the trade effluent treatment plant and the storm tanks on the site. The treated trade effluent, including the tip leachate, is now being diverted to the public sewer. Contaminated drainage from the site is intercepted by means of collection sumps and trapped drains (drainage channels formed from geotextiles). Much of this work is now completed, and has cost £300,000 to date.

The NRA is going to continue monitoring the progress of the remedial works and the condition of local watercourse.

D3.3 Commonside Farm, Alvanley, Frodsham
Site Ref: NW 5
NGR: SJ 504 745
Area: 2.5 hectares

SITE HISTORY

The site was originally an unlicensed and uncontrolled Central Electricity Board fly ash tip. The fill was placed over a watercourse which was poorly culverted. Subsequent use of the site has been for tipping industrial wastes, petrochemical sludges, redundant transformers and oil. The site is currently derelict.

WATER QUALITY IMPLICATIONS

The site is underlain by glacial boulder clay of up to 40m in depth, which in turn lies over a sandstone aquifer. Significant levels of PCBs have been found to be present below the point of discharge in the local watercourse.

The nearest public water supply borehole is 0.5km away - there is no evidence of pollution to this.

The nearest watercourse is Commonside Brook which is 0.5km away and 4km in length. This is polluted with PCBs and is unclassified.

SITE INVESTIGATION/REMEDIAL WORKS

The impact of the pollution is monitored on a bimonthly survey basis by the NRA. A geological survey has also been carried out. Vale Royal council have commissioned an independent report on health aspects connected with the site. MAFF have limited the water use for irrigation (presumably abstraction from watercourse). The NRA are continuing to carry out biological monitoring of the watercourse.

The proposed remedial actions are 1) to remove waste from the site and incinerate it, or 2) cap the site properly, divert the watercourse away from the site and treat the PCBs in situ, though the NRA have doubts about this as it would employ new technology from the USA which still requires research, or 3) cap site and leave alone.

D3.4 **Sankey Brook**
Site Ref: NW7
NGR: SJ 534 942
Area: 500 hectares

SITE HISTORY

This site was used for the disposal of chemical wastes, mainly alkalis, from the late 1700s and the early 1800s. It is now a combination of public open space, school playing fields and a partly developed industrial park.

WATER QUALITY IMPLICATIONS

The site is underlain by boulder clay of unknown thickness with terraces of alluvium, mostly sandy silt. There is a major fault in the carboniferous shale that lies beneath the boulder clay. The rock is also locally disrupted by mine workings and may prove to be permeable by fissure flow. There are very minor perched water tables on the site which are likely to be very close to the surface. Groundwater movement is likely to be towards the watercourse.

The nearest public water supply borehole is 4km away - no evidence of pollution.

The nearest water courses are Sutton Brook, Hardshaw Brook and Sankey Brook which all run through the site. These are all Class 4.

SITE INVESTIGATION/REMEDIAL WORKS

There has been no site investigation carried out apart from chemical and biological sampling from the brooks. There have been no proposals put forward for remediation.

D3.5 Trimpell Site, Heysham

Site Ref: NW9

NGR: SD 417 587

Area: 51 hectares

SITE HISTORY

There is no detailed documentation of previous uses of this site, but it was most recently used as a petrochemical refinery which closed in 1978-79 approximately. The site is predominantly derelict with four small developments on the periphery.

WATER QUALITY IMPLICATIONS

The site is underlain with boulder clay with occasional sandy horizons. At a depth of ~67m there are shales. Carboniferous sandstones in the area form minor aquifers which historically have been used extensively, though they are now disused. Locally there seems to be little risk to groundwater in the carboniferous sandstones due to the thickness of low permeability drift and rocks above; however, numerous boreholes have been drilled in the past which may offer a direct conduit.

The nearest public water supply borehole is 14km distant. However, it should be noted that in rural areas there is a high probability of minor domestic unlicensed sources in closer proximity.

The nearest watercourse is Trimpell Dyke which was class 4 prior to pumping. Pumps have now been installed and the Dyke has improved to class 2/3.

SITE INVESTIGATION/REMEDIAL WORKS

There is chemical and biological information available on Trimpell Dyke.

Remedial action has taken the form of a new pump installation, to pump effluent away from site, the protection of gravity drainage to Trimpell Dyke, bacterial treatment of certain areas and the encapsulation of chemical 'hot spots'. Removal of 10,000m³ of sludge and site renovation are currently on-going. During this work a number of oil laden drainage channels were found, these have been capped off with concrete.

D4 SEVERN TRENT NRA

D4.1 Bentley Mill Lane Tip
Site Ref: ST3
NGR: SO 991 981
Area: 10 hectares

SITE HISTORY

The site has been used as a tipping site and transfer station for Copper refinery waste and is located over old mine workings. The site is currently derelict, is part owned by the Earl of Bradford estate, and is adjacent to the IMI James Bride Copper Refinery.

WATER QUALITY IMPLICATIONS

The site is underlain by Middle Carboniferous Coal Measure strata which consists of shales and mudstones, coal measures and fissured sandstones. The underlying coal workings appear to be saturated to the surface. The water table is at ground level in places. A buried drain running across the site facilitates preferential water movement to occur in the direction of the River Tame. The River Tame itself also passes adjacent to the site.

There is evidence of pollution of the River from contaminated groundwater and runoff from the site. Long term chemical analysis of the River, drains and run off show elevated levels of copper, zinc, nickel and iron (upto 10-40 mg/l).

SITE INVESTIGATIONS/REMEDIAL WORKS

There has been considerable monitoring of the surface waters by the NRA. A more detailed site investigation has been undertaken; this has been financed jointly by the NRA and IMI. At present no proposals for remediation have been proposed, but further investigations are proposed at the refinery site. It is considered that contamination from the vicinity of the refinery site (operating since 1917) has polluted groundwater in the Coal Measures which is migrating into the River Tame.

D4.2 Van Lead Mines
Site Ref: ST4
NGR: SN 942 887
Area: 2 hectares

SITE HISTORY

This is the site of a nineteenth century lead mine. Wastes from the mine are present in large waste heaps (tailings) and 'slimes'. The major contaminants are lead, zinc and iron whilst cadmium, copper, nickel, chromium, silver and barium are also present in elevated amounts.

The site is currently derelict. Old gas works waste has been tipped in isolated pockets.

WATER QUALITY IMPLICATIONS

The main water quality impact of this site is upon the Afon Cerist, a Class 1a watercourse, that passes through the site and changes to Class 4 as a result of leached metals. There is available historical, chemical and biological analysis which indicates a long term serious metals pollution problem.

SITE INVESTIGATION/REMEDIAL WORKS

Comprehensive investigatory work has been undertaken into the site and water quality implications. Provisional schemes for remediation include:

- capping
- diversion of stream
- transportation

A further proposal, to extract lead and silver from the spoil tips has also been put forward. This however, is likely to have potential pollution implications arising from extensive disturbance of the site and the processing activities.

D4.3 Carless Solvents, Stoke-on-Trent
Site Ref: ST5
NGR: SJ 851 504
Area: 10 hectares

SITE HISTORY

The site was established in 1873 and has been used for a variety of chemical processing activities since then. The site is still operational and is owned by Carless Refinery and Marketing Ltd. and Esso have an LPG depot adjacent to the site.

WATER QUALITY IMPLICATIONS

The site is located on alluvium overlying bands of Carboniferous Green Marl. Groundwater samples, taken from the solvents site, show concentrations of phenols and cyanides which have accumulated as a result of a previous site use; neither material is stored on site. BOD's have been recorded in concentrations of thousands of milligrams/litre. There are also high concentrations of organics.

The Fowlea Brook flows through the site. This is a Class 4 watercourse with a river quality objective of 3. The deterioration of water quality is likely to be directly as a result of pollution from this site.

SITE INVESTIGATION/REMEDIAL WORKS

Consultants have been engaged by Carless to investigate the problem. Proposals for remediation and implementation plans are currently being awaited.

D4.4 Synthetic Chemicals, Four Ashes
Site Ref: ST8
NGR: SJ 916 090
Area: not known

SITE HISTORY

This site was previously used for tar distillation and is currently an operational chemical production site.

WATER QUALITY IMPLICATIONS

The site is within a zone 2 Aquifer Protection policy area and is underlain by the Triassic Bromsgrove Sandstone. The nearest borehole abstraction is 0.5km away, with the nearest public water supply borehole 1.5km away. There are also 3 boreholes on site for monitoring purposes. Analysis of the site groundwater shows contamination with various organics and there is a risk of long term contamination of the public water supplies. At present there is no contamination of the surface watercourse, the Saredon Brook, 0.5km away.

SITE INVESTIGATION/REMEDIAL WORKS

A site investigation is nearing completion and the NRA are in discussion with the owners of the site with respect to the groundwater contamination.

D4.5 Heyope Tyre Disposal Site
Site Ref: ST10
NGR: SO 224 748
Area: 2 hectares

SITE HISTORY

The site is an operational tip for the disposal of tyres. A fire started in October 1989 and is still burning underground.

WATER QUALITY IMPLICATIONS

The site is underlain by Silurian Strata which contain only minor aquifers. There are no groundwater abstractions in the vicinity.

A tributary of the Ffrwdwen flows through the site and is culverted beneath the tip. The downstream quality of this stream has been assessed as Class 4 and elevated levels of oils, organics, zinc and iron have been recorded. There has been a considerable degree of monitoring of this site by the NRA.

SITE INVESTIGATION/REMEDIAL WORKS

As a result of the on-going underground fire at this site and the severe risk that this poses, there has been extensive site investigation work undertaken. A detailed site-survey is nearing completion and will propose measures for dealing with the fire and for improving surface water quality.

D.5 SOUTHERN NRA

**D.5.1 CMR Ltd, Rye
Site Ref: S2
NGR: TQ 931 195
Area: 1 hectare**

SITE HISTORY

The site is located adjacent to Rye Harbour and has a long history of potentially contaminating uses. Operations commenced on the site in the 1870's when it was part of the railway and sidings which supplied a tar works. It currently houses a solvent recovery operation with temporary storage of recovered solvents.

The area to the south of the works was subject to gravel extraction in the 1940s and 1950s. These workings now form an extensive lake which has subsequently been developed as an SSSI and a bird sanctuary.

WATER QUALITY IMPLICATIONS

The site is located on shingle and tidal alluvium and the hydrogeology is heavily influenced by the estuary of the River Rother, which is 400 m to the north of the site. The nearest groundwater abstraction is 2.5 km away from the site and there is no hydraulic continuity with the alluvium in the Rye Harbour area.

There is evidence of surface water pollution of the freshwater lakes 100 m to the south of the site. This was reported in the late 1980s and elevated BODs, ammoniacal nitrogen, phenols and organic solvents were detected. Subsequent monitoring indicates that the contamination appears to be diminishing.

SITE INVESTIGATION/REMEDIAL WORKS

To establish the extent of the contamination and to formulate appropriate remedial measures, site investigation work has been carried out. In 1991 a series of pits were dug between the site and the freshwater lake. This revealed contaminated water in the gravels with concentrations reducing towards the lake. It was also established that groundwater levels on the site are generally below the lake level. Thus there is no hydrostatic head towards the lake and contaminants are unlikely to migrate in that direction. However, the evidence of pollution indicates that under certain conditions the contaminants will move towards the lake.

To contain the contaminants arising from the site an impermeable synthetic membrane has been employed along the boundary of the site. The lake is currently monitored on a monthly basis.

D.5.2 London Road/Cryalls Lane, Sittingbourne
Site Ref: S6
NGR: TQ 982 638
Area: 1 hectare

SITE HISTORY

The site was used extensively from 1926 to 1979 for the production of insecticides and from 1979 to 1988 for the manufacture of natural glues and gelatines. The various wastes from the insecticide plant, primarily liquids, were disposed of on site to a pond. The site has been derelict since 1988. Planning permission has been granted for development as a non-food retail outlet, subject to NRA approval.

WATER QUALITY IMPLICATIONS

The site is located on made ground and lead deposits overlaying flinty chalk. The flow in the chalk aquifer is in a north easterly direction. The nearest groundwater abstractions lie 1 km to the ENE and 2 km to the east and are both for industrial uses. The nearest public supply borehole is 2 km WNW and is unlikely to be affected.

Investigations into groundwater beneath this site indicate localised 'hot spots' in the area of the former pond which has migrated laterally and vertically. Analysis of this groundwater indicates high concentrations of phenols, ammonia and polyaromatic hydrocarbons.

The nearest surface watercourse is Milton Creek, 1.25 km away, which is designated as poor in the estuary classification. The main concerns for surface water and groundwater quality arise from the potential release of contaminants during redevelopment.

SITE INVESTIGATION/REMEDIAL WORKS

In the course of proposing redevelopment plans for the site a range of investigations have been undertaken since circa 1989. This has largely been restricted to chemical investigations on the site itself although some work has indicated an adjacent infilled chalk pit is also contaminated. In the summer of 1992 further work was undertaken which included the installation of a number of permanent monitoring boreholes.

With the proposed redevelopment of the site as a large retail outlet a number of remedial measures have been put forward which will need to be implemented to prevent further pollution of the groundwater or surface waters. These proposals include:

- removal of hot spots of contamination
- use of hard landscape to minimise percolation of water
- intermittent pumping of boreholes

- modifications/improvements of service conduits

Planning approval for the site is conditional upon approval of remedial measures by the NRA

COMMENTS

A detailed consultant's report has just been submitted to the NRA and is currently being assessed.

D.5.3 Hellerman Deutsch, East Grinstead
Site Ref: S7
NGR: TQ 391 391
Area: 1 hectare

SITE HISTORY

This is an Industrial site involving a metal plating process which has resulted in a gradual accumulation of contaminants over a number of years.

WATER QUALITY IMPLICATIONS

The site is the cause of some concern because of the close proximity of a number of groundwater abstractions in the Hastings Beds and in particular a public water supply 0.25 km away. There is however no evidence of this supply being affected at present, although an on site borehole indicates high levels of trichloroethylene.

The Eden brook, a class 1B watercourse, is 0.25 km away from the site but shows no evidence of pollution.

SITE INVESTIGATION/REMEDIAL WORKS

Due to the threat this site poses to a potable groundwater supply, the NRA have been involved in all stages of site investigation and remediation. Evidence from an on site borehole indicated trichloroethylene contamination up to 50,000 $\mu\text{g/l}$ in the top five metres. As a result of the degree of contamination identified, a number of remedial measures have been put in place. These measures involve soil water scavenging and positive soil venting.

D.5.4 **Former Chatham Naval Dockyard**
Site Ref: S9
NGR: TQ 765 705
Area: 75 hectares

SITE HISTORY

The site, on the River Medway Estuary, was formerly a naval dockyard and has historically been used for the disposal of various wastes over many centuries. Activities associated with the dockyard included disposal of oils, incinerator ash and metallic wastes.

The site is currently being decontaminated prior to development.

WATER QUALITY IMPLICATIONS

The site is known to be heavily contaminated with asbestos, heavy metals and toluene extractables although there is very little evidence of water pollution. There is however major potential for release of these pollutants into the water environment and in particular to the Medway which is within 10 m of the site boundary.

SITE INVESTIGATION/REMEDIAL WORKS

The site has been taken over from the MOD by a Development Consortium who have commissioned intensive investigations and site surveys. As a result major remedial actions are currently being implemented. This primarily involves the removal of several hundred thousand m³ of material, which is being disposed of to an appropriate clay pit landfill in Bedfordshire.

COMMENTS

Extensive analytical data are available on this site.

D.5.5 Coney Hill Landfill, Oxted, Surrey
Site Ref: S10
NGR: TQ 375 524
Area: 10 hectares

SITE HISTORY

This is the site of an old sand quarry which has been recently landfilled. Landfilling operations have ceased, the site has been capped and is currently awaiting final restoration to agricultural use.

WATER QUALITY IMPLICATIONS

The installation of a liner to the site was problematic and has subsequently been found to be ineffective, with some perimeter monitoring boreholes showing elevated concentrations of ammonia (20 mg/l) and chlorides (500 mg/l). This is causing concern over maintaining water quality in a public water supply borehole in the Folkestone Beds aquifer, which is 0.5 km away and a tributary of the River Eden, a class 1B watercourse, which is 100 m from the site.

SITE INVESTIGATIONS/REMEDIAL WORKS

In response to problems associated with the integrity of the liner of this site there have been a number of surveys aimed at assessing the mechanism for contamination, with considerable on-going site monitoring. Remedial actions already completed are:

- reinstatement of liner drainage system
- construction of perimeter leachate collection drains.

A further proposal has been made for the scavenging and treatment of the leachate and for monitoring of the aquifer at a greater distance from the landfill to establish the speed and movement of the pollutants.

D.6 SOUTH WEST NRA

**D.6.1 Falmouth Container Terminal
Site Ref: SW1
NGR: SW 30 80**

SITE HISTORY

A proposal has been put forward to convert the existing commercial port on the Fal Estuary into a container terminal. This development would involve the construction of a bund across part of the estuary mouth.

WATER QUALITY IMPLICATIONS

The estuary collects flows from the River Fal, Carnon River, River Allen and River Kenwyn; of which the Fal is occasionally contaminated with china clay wastes whilst the Carnon has high concentrations of metals as a result of the long history of mining in the area. Consequently the estuary sediments are similarly contaminated. The construction of the bund may increase tidal velocities which in turn may cause the contaminated sediment to be mobilised. Should this happen the metals could seriously damage a national marine reserve off St Mawes. There is also concern over substantial quantities of TBT that have accumulated in the sediments.

SITE INVESTIGATION/REMEDIAL WORKS

Falmouth Container pic have undertaken a desk study of the estuary hydraulics and also a preliminary environmental impact assessment. Prior to proceeding with the proposed development it will have to be demonstrated that there will be no long term deterioration of the water quality, fisheries or ecosystems.

- No increased risk of flooding.
- No short term adverse effects during construction works.

The NRA in association with South West Water propose to implement this through insertion of protection clauses into a private parliamentary bill.

D.6.2 South Crofty Tin Mine, Camborne
Site Ref: SW3
NGR: SW 685 415
Area: 5 hectares

SITE HISTORY

The site in Camborne is adjacent to the currently operational South Crofty Tin Mine and has, until recently, been subject to intensive tin mining and processing activities. The site is consequently heavily contaminated with abandoned mine spoil. There are currently proposals for a residential development.

WATER QUALITY IMPLICATIONS

The spoil on the site has concentrations of arsenic, copper and zinc well in excess of ICRCL threshold levels, see table below:

Contaminants	Concentrations (mg/kg)			ICRCL threshold trigger for Gardens
	Max	Min		
As		4876	181	10
Cu		1426	246	130
Zn		726	131	300

For the proposed development some 10,000 cubic metres of contaminated material will need to be excavated and removed from the site. Disturbance of the spoil will cause increased pollution of the surface waters. There is also the potential for the contamination of other catchments from landfill sites receiving the material.

SITE INVESTIGATION/REMEDIAL WORKS

No NRA site investigations have been carried out to date. It is proposed to control the development through the local plan policies and to apply the 'no deterioration of water quality' principle with reference to EC Directives.

D.6.3 Devon Great Consols, Tavistock

Site Ref: SW5

NGR: SX 430 730

Area: 2 sq km

SITE HISTORY

Devon Great Consols is an extensive area which has been contaminated as a result of the extraction and refining of heavy metal ores including tin, copper and arsenic. The site is now derelict with large areas un-vegetated. Around the periphery of the site is a commercial forest.

WATER QUALITY IMPLICATIONS

The site gives rise to severe metallic contamination of the streams within the site and there is potential for gross pollution of the River Tamar in the event of underground or surface slippage. This has severe implications on a major public water supply on the River Tamar downstream of the site.

SITE INVESTIGATION/REMEDIAL WORKS

Water quality has been monitored for the last thirty years and more recent studies have been undertaken in the last two years to investigate the stability and leaching of contaminants from un-vegetated spoil.

Proposals for remediation include stabilisation of the slopes, to minimise the risk from spillage of the mine waste tips, and work on certain adits, again to ensure slope stability. However, the cost implications are such that this work will not proceed although increased sampling frequencies and additional monitoring, with automatic water quality monitors are being progressed.

D.6.4 **Barton Barn Farm, Okehampton**
Site Ref: SW6
NGR: SX 599 963
Area: 9 hectares

SITE HISTORY

The site was originally a peat bog which was subsequently drained for grazing.

WATER QUALITY IMPLICATIONS

The drainage of the bog has caused the mineral deposits beneath the peat fields to be exposed to oxygen. There has been subsequent leaching of very acidic metalliferous water. This has resulted in acid/metal pollution of Brightley Stream and there have been a number of pollution incidents following droughts. In 1989 an estimated 100,000 fish were killed. The following table illustrates the contamination observed on 18 September 1989.

Water quality parameter	Concentration
pH	3.4
Total copper	1.42 mg/l
Total iron	21.3 mg/l
Total cadmium	25 µg/l
Total zinc	6.3 mg/l
Total nickel	3.7 mg/l

SITE INVESTIGATION/REMEDIAL WORKS

The NRA have been involved in investigations and pollution control exercises since 1976. Other studies were done in 1985/86 and 1990 and reports are available.

Remedial measures are based upon neutralisation of the water using lime; either spread onto the fields or through damming the stream in combination with spray irrigation of the river water onto lime treated fields. The latter was undertaken in 1990 and 1991 but is not considered to be a permanent solution.

More permanent solutions proposed include reverting the area and stream valley into a wetland.

D.6.5 Newlyn River Catchment
Site Ref: SW8
Area: 63 hectares

SITE HISTORY

The Newlyn River Catchment is an area that was historically used for daffodil bulb growing. As a result of this activity aldrin powder was applied to the land to control the narcissus fly. During harvesting, colluvium containing high concentrations of aldrin and dieldrin was washed off into the surface watercourses causing contamination of the water, sediments and biota. The use of tractors exacerbated the problem. Effected parts of the catchment are now put to alternative uses and where possible laid to grass to minimise run-off.

WATER QUALITY IMPLICATIONS

There is evidence of aldrin and dieldrin contamination in the surface waters, river sediments and biota. No groundwater monitoring has been carried out. The table below gives concentrations that have been detected in the various media:

	Aldrin	Dieldrin
Surface water	200 ng/l	100 ng/l
River Sediments	1200 µg/kg	300 µg/kg
Eels		22,000 µg/kg
Soil and Colluvium	2100 µg/kg	1,200 µg/kg

SITE INVESTIGATION/REMEDIAL WORKS

There have been a considerable number of investigations conducted into the impacts of aldrin and dieldrin on water, soil, colluvium, river sediments and biota. Considerable monitoring has been undertaken. As a result of the problems, associated with the application of aldrin and the proven pathway to surface water and aquatic life, in 1989 it was banned for all uses.

Remedial measures are based upon preventing existing soil contamination from becoming mobilised physically and contaminating the watercourses. Fields treated with aldrin have been documented and in high risk areas returned to grass. All activities involving soil disturbance should be discouraged, although this is difficult in an actively farmed area. Other proposed measures include the removal and disposal of the top soil; costs are likely to be excessive.

COMMENTS

A comprehensive report was prepared by SW NRA in 1991 entitled 'Reduction in Aldrin and Dieldrin concentrations in the Newlyn River'.

This situation can also be found in the Hayle and Mounts Bay catchments where similar treatments were used.

D.7 THAMES NRA

D.7.1 Thames Matex Tank Farm, Grays
Site Ref: T1
NGR: TQ 579 766
Area:

SITE HISTORY

This is the site of an operational tank farm used for the bulk storage of oil and organic chemicals. The area was originally marshland, which was raised using sea-dredged sand and industrial fill; investigations into the type of fill have indicated that the materials used would not detrimentally affect groundwater quality.

WATER QUALITY IMPLICATIONS

The main area of concern is the impact of this site upon surface waters and in particular on the tidal River Thames. Evidence of surface water pollution emanating from this site is provided by the chronic failure of BOD consent conditions; the average BOD of the discharge is between 800 and 1,000 mg/l.

A survey of aerial photographs taken in 1960, 1970, 1981 and 1990 shows the replacement of the natural water courses by a system of drainage ditches and culverts. Examination of some of these pipes revealed that they could provide a pathway for contamination of the groundwater.

An investigation of the groundwater beneath the site revealed high levels of suspended solids and BOD, with locations recording higher loadings where there was visual evidence of hydrocarbon contamination.

SITE INVESTIGATION/REMEDIAL WORKS

The company have commissioned an investigation into the problems and a full report is available. The recommendations of the report were to:

- separate the ground and site drainage thus reducing the volume of groundwater to treat
- consider the disposal or recycling of the site effluent
- improve existing treatment plant.

The NRA consider that the effluent should be diverted to foul sewer.

D.7.2 Thames Industrial Estate, Marlow
Site Ref: T3
NGR: SU 856 866
Area: 3 hectares

SITE HISTORY

Thames Industrial Estate at Marlow is a partly developed complex which includes the storage of trichloroethylene. This storage originally used open tanks and it is as a result of spillage from the storage area that the groundwater became heavily contaminated. It is also likely that over the history of the site a gradual build up of contamination would have occurred. Storage of trichloroethylene is now achieved within a closed structure and with appropriate bunds.

WATER QUALITY IMPLICATIONS

The site is within 1 km of the River Thames and the nearest public water supply borehole is 1.5 km across the hydraulic gradient; this supply is at present unaffected. The site is underlain by a shallow gravel aquifer in which trichloroethylene has been found present in concentrations in the order of 200 mg/l.

SITE INVESTIGATION/REMEDIAL WORKS

There are currently two permanent groundwater monitoring points on the site and a study, investigating the extent of groundwater contamination, of the site is due to be completed shortly.

Objections have been lodged, by the NRA, because of the sensitivity of the site, against current planning applications for the phased redevelopment of the site pending a full site investigation.

D.7.3 Atomic Energy Authority (AEA), Harwell

Site Ref: T11

NGR: SU 47 86

Area: 30 hectares

SITE HISTORY

The site was originally an RAF airfield which has subsequently been developed into an extensive research establishment into atomic energy. The areas of concern regarding land use activities impacting upon the water environment, are two waste disposal facilities; the western storage area and the southern storage area. Beneath the landfill areas contamination has reached a depth of 20 m.

WATER QUALITY IMPLICATIONS

The site is on the lower chalk aquifer with a contaminated groundwater abstraction, for the site, 0.75 km down the hydraulic gradient.

The nearest public water supply boreholes are at Upton 2.5 km away and Blewbury 4.5 km away. Carbon tetrachloride exceeds the drinking water standard at the Blewbury public supply. Elevated levels of chloroform, carbon tetrachloride and other solvents are regularly detected in boreholes between Harwell and Blewbury.

SITE INVESTIGATION/REMEDIAL WORKS

There have been detailed hydrological investigations on the site which has included the drilling of boreholes and regular monitoring of groundwater quality. As a result of the urgent need to protect the potable supplies and to prevent further contaminant inputs to groundwater and movement off site, the NRA have required AEA to install air strippers to reduce solvent levels. An activated carbon filter is also proposed for the removal of PCBs and traces of aldrin, lindane and DDT.

Running costs for these measures are estimated to be about £120,000 per year, with an expected operation period of 10 or more years.

Further remedial measures are also being considered, including the removal of the landfills and excavation of the contaminated ground. This is likely to be expensive because of the depth to which contaminants have penetrated.

D.7.4 **British Rail Engineering Works, Swindon**
Site Ref: T12
NGR: SU 13 84
Area: 100 hectares

SITE HISTORY

The site of the former British Rail Engineering works in Swindon incorporated extensive heavy engineering involving the manufacture and repair of locomotives from raw materials. The site also had its own gas works. The site has been partly developed, with further phases on-going.

WATER QUALITY IMPLICATIONS

The site is located on alluvium and made ground overlying Kimmeridge clay with the water table perched above the clay. There are no groundwater abstractions in hydraulic connection with the area. The River Ray, a class 2B watercourse, flows through the site.

Evidence of pollution has been found in the perched aquifer and contaminated water flowing from part of the site; the source is unknown. There is potential for contaminated water to enter the watercourse.

SITE INVESTIGATION/REMEDIAL WORKS

As a result of the extensive size of the site and the piecemeal development, site investigations and groundwater analysis have been sparse. A number of hot spots of contamination have been identified and proposals have been put forward to remove these. It is recognised that the presence of contaminated material of the sites poses a significant threat to the water environment, at present and in the future.

D.7.5 Redland Brick Ltd, Horsham, Sussex
Site Ref: T13
NGR: TQ 069 355
Area: 35 hectares

SITE HISTORY

Bricks have been made on this site for many years before chemical manufacturing, which started during the War. The site was developed as a chemical works from the time of the second World War. The activities engaged in included production of sulphur for vulcanised rubber and manufacture of zinc and bromate salts. As a result of these activities the area around the plant has become contaminated with zinc, ammonia, bromide and bromate. There are also localised areas of very high and very low pH. Part of the site was also used for waste disposal, although no records exist indicating what was tipped or the extent of the tip area.

WATER QUALITY IMPLICATIONS

The groundwater of the site is not in continuity with any groundwater abstractions. The main impact of this site, however, is on the surface water courses: Collins Brook, unclassified and Cranleigh Waters, class 2A. There is evidence of some contamination of the surface waters resulting in failure of the RQOs and there is also impact upon a standby water abstraction point. The site would cause serious water pollution if the discharges were not collected and treated prior to discharge.

SITE INVESTIGATION/REMEDIAL WORKS

There has been little investigative work done on the site although the current owners are planning to carry out some surveys. The remedial measures in place consist of a large butyl lined collection lagoon where water is collected, prior to being treated for removal of zinc, bromate and ammonia, with pH adjustment before discharge.

D8 WELSH NRA

D8.1 Neston Tank Cleaners
Site Ref: W12
NGR: SJ 324 684
Area: 30 hectares

SITE HISTORY

Over the last 100 years this site has been used extensively for chemical production, coal tar products, oil formulation, tank cleaning and for some illegal dumping of waste. The site is currently largely derelict with a section being used for storage.

WATER QUALITY IMPLICATIONS

The site is adjacent to the Dee Estuary and Queensferry Drain; classes 1A and 4 respectively. There is no analytical data to assess the impact on water quality, although the presence on the site of heavy contamination, including tars, phenols, PCBs and chlorinated solvents, is indicative of the potential for serious pollution of the estuary. The risk of pollution will be increased during development of the site and disturbance of the contaminated ground.

SITE INVESTIGATION/REMEDIAL WORK

There has been very little site investigation work undertaken although this will be essential if proposed redevelopments are to be pursued. Preliminary remedial measures proposed include stabilisation of certain contaminants by chemical agents, removal of gross contaminants and capping of the worst affected areas, in particular the abandoned oil/tar pit.

D8.2 Cwm Ystwyth Mine, Aberystwth
Site Ref: W21
NGR: SN 805 746
Area: 50 hectares

SITE HISTORY

The site was subject to intensive lead mining activities up until 1915. It is currently derelict and comprises old mine adits and four waste tips.

WATER QUALITY IMPLICATIONS

The underlying geology is faulted shale which results in the minewater drainage flowing directly into the river Ystwyth, a Class 3 watercourse. There are private springs and farm abstractions within 2km, but no data on contamination. The site is the main factor to the continued low NWC classification. There is evidence of water pollution in the river where elevated levels of zinc, cadmium, other toxic metals and low pH have been recorded. It is difficult to differentiate between the contribution to the pollution from surface run off from the tips and that which arises directly from the mine drainage.

SITE INVESTIGATIONS/REMEDIAL WORKS

The site is currently being investigated and some preliminary proposals for amelioration have been developed.

COMMENTS

This site is typical of the problems arising from abandoned lead mines of which there are a at least a further 200 in the Region. Although the great majority are considerably smaller than this site, there are a further 10 or 50 of comparable size in the Region. There has also been an instance where proposals to abstract river gravels downstream of such a site has been opposed because of the high level of contamination of toxic metals that had accumulated within the resource.

D8.3 **Lower Swansea Valley**
 Site Ref: W23
 NGR: SS 675 967
 Area: 500 hectares

SITE HISTORY

The lower Swansea Valley has in the past been subject to extensive deposition of non-ferrous metal smelting spoil. This activity has affected an enormous tract of land which is currently being redeveloped as the Swansea Enterprise Zone.

WATER QUALITY IMPLICATIONS

The NRA are involved in monitoring the watercourses and in particular the Nant-y-Fendrod (River Tawe) which flows through the site. This is a Class 3 watercourse which, as a result of contamination by toxic metals from the site, fails to meet its water quality objective and also fails to comply with the dangerous substances directive.

SITE INVESTIGATION/REMEDIAL WORKS

The extent to which site investigatory work has been undertaken is not known although Swansea University have gathered extensive data on the area.

As yet no proposals for remedial measures have been put forward.

D8.4 Mechem Chemicals, Port Talbot
Site Ref: W28
NGR: SS 758 890
Area: 5 hectares

SITE HISTORY

The site was formerly a chemical works producing non-ferrous metallic salts and oxides including arsenic oxide, cobalt, copper, lead, manganese, zinc and timber treatment chemical. The main contamination is from arsenic, cobalt and manganese. All chemical processes have now ceased and a prohibition notice is in force on the site.

WATER QUALITY IMPLICATIONS

There is proven localised contamination of the groundwater which is in continuity with the dock water. Analysis of contaminated borehole water indicates elevated levels of arsenic up to 240 mg/l, chromium upto 53 mg/l, cobalt upto 231 mg/l and manganese upto 7.7 mg/l.

The close proximity of Port Talbot Dock/Afan Estuary to this site and the hydraulic connectivity that exists indicates an on-going release of contaminants into the coastal waters.

SITE INVESTIGATION/REMEDIAL WORKS

An independent survey has been undertaken into the effects on groundwater; this is available in draft form and has established the flow of groundwater. The true extent of the contaminated area has not been established.

Proposals for remediation include installing a liner and impermeable surface covering to the process area, thus encapsulating the most heavily contaminated zones. This does not however, address areas affected by the spread of contaminants, in particular those that have migrated beyond the site boundary. One of the key proposals is to establish the nature and extent of contamination and to evaluate the effectiveness of containment works.

D8.5 **BP Oil Refinery, Llandarcy**
Site Ref: W30
NGR: SS 718 960
Area: 200 hectares

SITE HISTORY

The site is an operation oil refinery that was established in the 1920's. Originally the main processes were crude oil distillation; this activity ceased in 1985. Current primary processes involve directment of lubricating oils and bitumen.

Throughout the operational life of the site, various activities have resulted in an accumulation of contaminants. This has arisen from leakages from storage tanks and pipelines, occasional spillages due to poor house-keeping and seepage from an in-house tip area used for waste oils.

WATER QUALITY IMPLICATIONS

The site is underlain by superficial deposits on a sandstone bedrock, Hughes Beds. The Hughes Beds are a principal aquifer. There is evidence of contaminated groundwater within the superficial deposits as indicated by oil contamination of springs. There is also visual evidence of oil pollution from a spring line at the nearby beach. The BP transit site also contributes to this visual pollution.

The closest surface watercourses are Crymlyn Brook, unclassified, a tributary of the River Neath 500m away and Crymlyn Bog, an SSSI, 20m away. There is a significant threat to these bodies from contaminated groundwater originating from the site.

SITE INVESTIGATION/REMEDIAL WORKS

A desk study has been completed on the groundwater implications of this site and it was concluded that this is likely to adversely affect both Crymlyn Bog and the Neath River. The actual extent of groundwater contamination is not known.

At present no proposals have been put forward for remediation.

D9 WESSEX NRA

D9.1 Fox Brothers, Wellington
Site Ref: WX2
NGR: ST 128 220
Area: 0.5 hectares

SITE HISTORY

Site was historically used to dump greasecake from the wool scouring operation of Fox Brothers. The site has now been partly developed as an industrial estate.

WATER QUALITY IMPLICATIONS

The hydrogeology of the area is unknown, the main concern however, is the impact upon the surface waters and in particular the abstractions at Hele Bridge 7km away. The River Tone flows adjacent to the site and analysis has shown elevated levels of permethrin; also there are detectable levels of Dieldrin. Continued elevation of these pollutants will have a long term impact upon the biology of the River Tone; it is already apparent that the biological health of the Rivers Tone and Brue are less than what would normally be expected.

SITE INVESTIGATION/REMEDIAL WORKS

A survey was conducted in 1984 and high levels of dieldrin were detected. At that time permethrin was not analysed for although this is now the main problem. - Results of a more recent study show permethrin concentrations of <0.01 ug/l at the Fox Brothers discharge point and 0.147 ug/l in the river water sample taken downstream of the discharge. An analysis of the river sediment showed a concentration of 0.33 mg/kg which is indicative of build up over time.

Proposals have been made for further studies and in particular to identify the sources of permethrin and dieldrin.

D9.2 **Merck, Poole**
 Site Ref: WX6
 NGR: SZ 007 906
 Area: 2 hectares

SITE HISTORY

The site was used for large scale chemical manufacture for many years. It was badly damaged by fire in 1988. It is likely that groundwater contamination under the site has been caused by both leakages from the site and contaminated fire fighting water.

WATER QUALITY IMPLICATIONS

The site is adjacent to Poole Harbour into which consented effluents are discharged. Excavations to lay surface water sewers have revealed contaminated groundwater.

SITE INVESTIGATION/REMEDIAL WORKS

In response to problems revealed during excavation for surface water sewers, inspections indicated that gulleys on the site may have been damaged by corrosion. The excavations were made difficult by fumes emanating from contaminated soil. The extent and degree of contamination is unknown and at present is not perceived to be causing water quality problems whilst the site is undisturbed. No proposals have been put forward for remediation.

D9.3 **Monkton Farleigh Mine, Bath**
Site Ref: WX15
NGR: ST 805 660
Area: N/A

SITE HISTORY

The site comprises a series of abandoned underground bath stone quarries. Since quarrying ceased the site has had a variety of uses, primarily during the war. Since the site has been vacated, transformer oil containing PCB's has been spilled as a result of vandalism.

WATER QUALITY IMPLICATIONS

There is no confirmed evidence of water pollution although complaints have been received. The site overlays an aquifer and there is a public water supply borehole 3.5km away.

SITE INVESTIGATION/REMEDIAL WORKS

No remedial work or proposals for remedial work have been put forward. However, because of the biotoxicity of PCB's the extent of the problem should be investigated, in particular the potential for pollution of groundwater sources.

D9.4 **Cuprinol Ltd, Adderwell**
Site Ref: WX16
NGR: ST 782 470
Area:

SITE HISTORY

The site was historically an industrial landfill that has been redeveloped into an active industrial complex manufacturing wood preservatives and decorative products. Parts of the tip are unstable, and this has resulted in the failure of bunds around some of the tanks and subsequent leakage of material.

WATER QUALITY IMPLICATIONS

The site is adjacent to the River Frome and there have been a number of pollution incidents over several years. It has not been ascertained whether the pollution stems from past or current activities on site. Pesticides constitute the area of greatest concern

SITE INVESTIGATION/REMEDIAL WORKS

Some work to intercept leachate has already been undertaken with further actions under consideration. Further improvements to existing leachate/spillage containment will be necessary to reduce the pollution of the River Frome from this site.

D9.5 PASMINGO EUROPE, AVONMOUTH

**Site Ref: WX17
NGR: SS 523 790
Area: 400 hectares**

SITE HISTORY

The Pasmenco smelter site at Avonmouth is owned by RTZ estates and covers some 400 hectares. The site is partially derelict, partially developed with plans for further development. Some disposal of slag from the smelter was done within the site; some slag is still stockpiled. Parts of the site have been raised and slag waste distributed across the area. The site has also been used for disposal of other chemical manufacturing industry residues.

WATER QUALITY IMPLICATIONS

There is known widespread contamination of local surface and groundwaters. The main contaminants being lead, zinc, cadmium and other metals associated with the smelting processes. The site is adjacent to the Severn Estuary, into which the surface waters discharge via the Kingsweston Culvert. There is growing evidence that a significant proportion of the mass flux of cadmium, zinc and lead to the Severn Estuary via the culvert arises from contaminated land. Control over this flux, in line with north sea conference obligations, will need to be examined.

SITE INVESTIGATION/REMEDIAL WORKS

The NRA is currently involved in investigating discharges arising from the site and in particular the contributions from point sources from the contaminated land. No proposals have been made for remedial works, these will be fully explored by the NRA when the extent of the problem is known. It was considered that the site may provide an alternative source of aggregates; the feasibility of this is questionable.

D10 YORKSHIRE NRA

D10.1 John Carr Joinery, Doncaster
Site Ref: Y1
NGR: SE 559 049
Area: 3-4 hectares

SITE HISTORY

The site is used for the manufacture of timber products including timber preservation, using PCP, tributyl tin etc. Lindane has also been used as a preservative in the past. The site is currently operational - the contaminative use is on-going.

WATER QUALITY IMPLICATIONS

There is a perched water table under this site at a depth of 1-2m. This is underlain by Sherwood Sandstone which is a potable supply aquifer. There is no evidence of this aquifer being contaminated at present.

The nearest public water supply borehole is at Armthorpe.

The nearest watercourse is Northswaithe Dyke which is culverted through the site. This has been sampled and elevated levels of List I substances have been detected. The Dyke is unclassified.

SITE INVESTIGATION/REMEDIAL WORKS

The company has drilled shallow boreholes on the site and taken samples. Groundwater overflow to the stream has also been sampled.

The company has proposed that groundwater is pumped through a treatment plant containing active carbon and that the timber treatment processes are placed under cover with a contained drainage system.

D10.2 **Pilkington Glass, Kirksandal**
Site Ref: Y2
NGR: SE 604 082
Area: 15 hectares

SITE HISTORY

This site has been used exclusively for the disposal of solid residues from the Burgy process which is a process of polishing and grinding glass sheets with Southport sand and iron oxide.

WATER QUALITY IMPLICATIONS

There is a perched water table at the surface of this site with a main aquifer in the sandstone that underlies drift below the site. There is no evidence of contamination to this aquifer.

The nearest public water supply borehole is at Hatfield.

The nearest watercourses are the River Don and Grumblehurst Drain which are both adjacent to the site. Grumblehurst drain shows high pH and iron. These are both Class 3.

SITE INVESTIGATION/REMEDIAL WORKS

Samples have been taken from Grumblehurst Drain. Remedial action has already taken place - flow from Grumblehurst Drain is pumped to the main factory for treatment, except in severe wet weather when a direct overflow to the River Don occurs.

COMMENTS

The site has become established as an orchid colony, favouring high lime content, and high pH of waste. Any further "remedial" action may be opposed if this colony were to be jeopardised.

D10.3 **Coalite Chemicals, Bolsover Refinery**
Site Ref: Y3
NGR: SK 457 717
Area: 35 hectares

SITE HISTORY

Historically the company has practised co-disposal of chemical waste on a colliery spoil tip which is now derelict. The current site use is a chemical refinery for coal carbonisation chemicals. The site is partly operational and partly derelict.

WATER QUALITY IMPLICATIONS

The site is underlain by coal measures but no further information on groundwater etc has been supplied.

The nearest watercourse is the River Doe Lea which is a Class 4 river due primarily to effluent disposal from the sites waste water treatment plant.

SITE INVESTIGATION/REMEDIAL WORKS

There has been monitoring carried out at this site. Samples have been taken of sediment, river water and effluent. Excavations have also been monitored.

The company has proposed using reed bed treatment for the tip run off. They have also proposed a collection and interception system for tar leakages to the river. There are plans currently being developed for dealing with the dioxins on site.

COMMENTS

The NRA must establish the source of the dioxins through court action before they are able to insist on any remediation scheme.

D10.4 **Coalite Grimethorpe**
Site Ref: Y4
NGR: SE 415 075
Area: 100 hectares

SITE HISTORY

This site has historically been a coking works with associated tipping facilities. In fact, the original spoil heap disposal system has now been replaced by a biological effluent treatment plant. The site is now partly operational and partly derelict.

WATER QUALITY IMPLICATIONS

The site is underlain by coal measures and the water table is under-drained by coal mining. No further groundwater information has been supplied.

The nearest watercourses are the River Dearne which is Class 3 attributed to upstream inputs of sewage, and Grimethorpe Dyke which is Class 4, attributed to the sewage and to industrial effluents.

SITE INVESTIGATION/REMEDIAL WORKS

There is routine monitoring of outputs being carried out. The problems attributable to contaminated land are considered to be of secondary importance to those attributed to direct inputs from treated or partially treated process wastes. The NRA are seeking an alternative to the spoil heap disposal and treatment method in the longer term.

D10.5 Coal Products Ltd, Avenue Works, Chesterfield

Site Ref: Y6

NGR: SK 393 680

Area: 36 hectares

SITE HISTORY

The site has a history of disposal of waste arising from coke manufacture and by-product processing (coal carbonisation). The site is still in use but closure is expected imminently (29/9/92).

WATER QUALITY IMPLICATIONS

The site is underlain by coal measures (middle & lower). The groundwater levels are suppressed by minewater pumping at the treatment/disposal area.

The nearest groundwater abstraction is less than 1km away. There is no Public Water Abstraction within close proximity of this site.

The nearest watercourse is the River Rother which is 4.3km away. This is a class 4 river, due to both process discharges and contaminated land.

SITE INVESTIGATION/REMEDIAL WORKS

There has been a full site investigation report prepared. This was jointly funded by the NRA and the owner. Further investigative work into sources of surface water pollution and contaminant pathways to groundwater is also being carried out.

Accumulated deposits in the river have been removed to determine source(s) and rate of deposition. It is proposed that the river channel is isolated and the groundwater flow is managed by means of controlled pumping, to reduce hydraulic pressure. Large scale redevelopment is also proposed by means of open cast coal mining. NRA wish accumulated deposits to be removed once the source has been identified.

Appendix E

NRA PERSONNEL

List of NRA Personnel Involved in Each Region

Region	Name	Title
Anglian	Dr Paul Hart	Principal Groundwater Quality Officer
	Paul Waldron	Principal Quality Officer
	John Sweeney	Principal Quality Officer
Northumbria	Sally Gallagher	Scientific Officer
	Tony Coddington	Senior Scientific Officer
North West	Roy Macauley	Area Pollution Control Manager
	Dave Nilsson	Pollution Control Officer
	Terry Walker	Waste Regulation Manager
	Steve Taylor	District Pollution Control Manager
	John Pinder	District Pollution Control Officer
Severn Trent	Bob Harris	Principal Groundwater Officer
Southern	Ian Gascoine	Region Pollution Officer
	Dick Flavin	Senior Resources Officer
South West	Graham Murrell	Pollution Control Planner
	Malcolm Newton	Freshwater Officer
	Barry Milford	Water Quality Planner
	Tony Connell	Strategic Planner
	Peter Lucey	Groundwater Officer
Thames	Phil Chatfield	Principal Pollution Officer
Welsh	David Williams	District Pollution Control Manager
	Helen Williams	Pollution Control Officer
	Bob Merriman	District Pollution Control Manager
	Alan Jones	Pollution Control Officer
	Wayne Davis	Regional Hydrogeologist
	Ian Myers	Assistant Pollution Control Officer
	Simon Neale	Assistant Hydrogeologist
Wessex	Peter McGillivray	Senior Scientific Officer
	Ian Legge	Area Catchment Control Officer
	Steve Woods	Area Catchment Control Officer
	Bob Huggins	Area Catchment Control Officer
Yorkshire	Richard Armitage	Pollution Control Officer
	John Herring	Special Projects Engineer