POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATER

REGIONAL APPENDIX
ANGLIAN REGION

NRA

National Rivers Authority

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1. INTRODUCTION

1.1 Purpose of the Regional Appendix

This Regional Appendix to the NRA "Policy and Practice for the Protection of Groundwater" provides information specific to Anglian Region. Details are given on the following subjects:-

- Description of the Anglian Region.
- Geology and hydrogeology
- Main office locations and contacts relevant to groundwater matters.
- How to use the "Policy and Practice for the Protection of Groundwater" prior to the introduction of new Groundwater Vulnerability Maps and new Source Protection Zones.

This is one of ten Appendices, each one specific to a different NRA region. Although the main document is a national one there are certain considerations, within the headings listed above, that are only relevant to particular regions. Each Appendix is produced to the same format with the necessary extra information included. The Appendices should be read in conjunction with the main document. Emphasis is given to regionally important factors such as the vulnerability of particular strata.

1.2 Anglian Region

The Anglian Region is geographically the largest of the NRA regions, covering an area nearly a fifth of England and Wales (27,000 square kilometres). Its boundaries range from the Thames in the south to the Humber estuary in the North and from the Norfolk coast inland to Northampton (See Figure 1).

The Region is predominantly rural with a low density of population, but includes several important centres of population growth and industrial activity such as the M11 'corridor', Thameside, South Humberside and expanding centres like Peterborough and Milton Keynes.


Figure 1. Regional Location Map
NRA Sea Defences
Regional HQ
Area Office
District Office
Area Boundaries
District Boundaries
NORTHERN AREA
CENTRAL AREA
EASTERN AREA
LINCOLN
GRIMSBY
MANBY
BOSTON
GRANTHAM
SPALDING
STAMFORD
PETERBOROUGH
KINGS LYNN
NORWICH
GT YARMOUTH
LOWESTOFT
ELY
KETTERING
BRAMPTON
HUNTINGDON
NORTHAMPTON
BEDFORD
CAMBRIDGE
IPSWICH
COLCHESTER
KELVEDON
CHELMSFORD
SOUTHEND-ON-SEA
NRA
Anglian Region

The Region is mostly low-lying with one third lying either below normal river levels or below high tide levels. The rich agricultural land of the Fens is on average one metre below sea level (dropping to a maximum of three metres below sea level) and this as far as 48 kilometres inland. Upland areas are formed of limestones, from the Lincolnshire Wolds in the north to the Chilterns in the south.

1.2.1 Anglian River Catchments

Anglian Region is made up of a number of separate river catchments including the Witham, Welland and Ancholme (part of the Humber catchment) in Lincolnshire, the Nene in Northamptonshire and the Great Ouse in Cambridgeshire, all except the River Ancholme drain to the Wash. Other important waters include the Norfolk Broads, the Rivers Bure, Yare and Waveney in Norfolk, Gipping and Stour in Suffolk and the Colne, Chelmer and Blackwater in Essex.

1.3 The Importance Of Groundwater In Anglian Region : Demand

The Region's population exceeds five million and is the fastest growing in the country, at about 1% per year. Water use per person is increasing constantly and total public supplies are currently forecast to increase from 1,850 tcmd to over 2,400 tcmd(thousand cubic metres per day) by 2011. Groundwater currently accounts for half of public supply.

Demands for industry and agriculture from groundwater could rise substantially by 2011, most of the potential increase being for spray irrigation. The Region is the most intensively farmed area of the country. About two thirds of the fruit and vegetable acreage of England and Wales is in the Region which also has more than half the potato and sugar beet acreage. Cereals are widely grown and in many areas there is intensive pig rearing. Half of the UK's spray irrigation takes place in the Region, mostly at times and places where water is scarcest. Irrigation helps to improve both the quantity and quality of many crops, and to stabilise prices by sustaining production in drought years.

There are also very substantial but largely unquantified summer demands to maintain drain water levels in the Fen areas.

Oil refining, chemical, paint and plastics industries are concentrated on the coast particularly the Thames and Humber estuaries. Canning and food processing plants are widespread and other important regional industries include mineral extraction by suface mining, brick works at Peterborough and Bedford, sugar refining and light engineering. High technology research and development companies are associated with a growing number of centres and the holiday industry is a significant influence in parts of the region.

Water is also needed 'in the river' for purposes of amenity, ecology, fisheries, navigation and to maintain water quality. Groundwater supports springs, baseline river flows and wetlands, some of which are designated as sites of special scientific interest. (See Section 1.5)

The Region also contains several thousand private unlicensable domestic wells.

1.4 Rainfall and Recharge

Anglian Region has less rainfall than any other part of the country - under 600 mm/year on average, compared with 940 mm/year in the rest of England and Wales. However, it is 'effective rainfall' (rainfall minus evaporation) which sustains rivers and groundwaters and provides for all of our water supplies. Table 1 shows that on average Anglian has only one third of the effective rainfall experienced by the rest of England and Wales, and that in a severe drought year this can fall to one eighth.

Table 1. Rainfall and Evaporation

	AVERAGE YEAR		DROUGHT YEAR*	
	Anglian	Rest of England & Wales	Anglian	Rest of England & Wales
Rainfall - mm/year	595	940	463	770
Evaporation - mm/year	448	453	423	450
Effective Rainfall mm/year	147	487	40	320
Effective Rainfall tcmd +	10870	-	2960	-

* Defined as happening, on average once in 50 years.
+ tcmd: thousand cubic metres per day.

Even so, this works out at about three times the highest forecast of future water need. If it occurred at a steady rate, throughout the year and from year to year, there would be no problem. Unfortunately it does not. Even in an average summer, evaporation (448 mm) greatly exceeds rainfall (300 mm). In Anglian Region every summer is a drought and all our water, in the tap and in the river, has to come from stored winter rainfall.

The years 1988 to 1992 proved to be the longest dry period this century with only 78% of normal rain. The 'cumulative deficit' during this period was 500mm. This is equivalent to the loss of more than nine months' rainfall which is very serious. Although this type of event is supposed to occur only once in 100 years, prolonged periods of drought are not new in eastern England. The droughts of 1899-1902 and 1970-1973 were of almost similar duration although less severe.

At the end of the current period groundwater levels were still exceptionally low and in some parts of the region at record low levels.

1.5 River Protection and Support

In the Anglian Region a number of schemes have been developed many involving groundwater, which conserve, redistribute, and/or augment water resources.

Ely Ouse-Essex System

Water in the River Ely Ouse flowing to the Wash is diverted in a reverse direction into existing channels built to cope with winter flood waters. It is then pumped through 20 kms of two and a half metre diameter tunnels, and 24 kms of pipelines into the Essex rivers, Stour and Blackwater. From these it is re-abstracted and pumped to water company reservoirs, as well as supporting river flows and meeting other local demands en route.

Trent-Witham-Ancholme System

Rapidly rising water demands in North Lincolnshire in the early 1960s, particularly those arising from industrial expansion along the South Humber Bank, prompted development of the Trent-Witham-Ancholme system. These demands are met by supplies from the River Ancholme, and to ensure adequate flows in the Ancholme in dry spells, water is transferred to it from the River

Witham, which in turn is augmented by pumping water from the River Trent into the Fossdyke Navigation Canal which carries it to the River Witham. Again the system also supports the rivers and helps meet local abstraction demands *en route.*

Great Ouse Groundwater Scheme

Flows in the Ely Ouse and its tributaries the Cam, Lark, Little Ouse and Wissey, and many important wetland sites, are subject to pressure from the increasing demands for water. Fortunately this area contains a major part of the regional Chalk aquifer, and a comprehensive scheme has been devised to develop the aquifer not only for water supplies, but also to artificially support low flows in the rivers. The scheme may eventually comprise 300 boreholes, of which over 50 are already constructed. These will meet increasing public supply needs, provide river support pumping to compensate the river for abstractions, maintain wetland sites, allow more flexible use of raw water and augment river flows for public supplies in Essex.

Other Schemes

Similar, though smaller scale, groundwater schemes exist to make maximum use of groundwater resources, and at the same time to sustain and support flows in the rivers Waveney, Bure, Deben, Stour, Blackwater and others.

2. GEOLOGY AND HYDROGEOLOGY

The stratigraphy of the Anglian Region, consisting of sedimentary strata which range in age from the Jurassic period to the Recent, is shown in map form in Figure 2. The main stratigraphic units, including a description, flow mechanism and Geological Classification are given in Table 2. A summary of information regarding the Geological Classification of strata is given in Table 3.

Vulnerability of groundwater resources is much dependent on the distribution of outcrops, the nature of the overlying soils, their relationship with clay strata, and their depth below ground level. A Groundwater Vulnerability Map is shown in the main document of the 'Policy and Practice for the Protection of Groundwater'.

TABLE 2. GEOLOGY AND HYDROGEOLOGY OF ANGLIAN REGION

Age/Strata Type	Main Locations	Description	Flow Mechanism	Geological Classification
Holocene aeolian sand, river and terrace gravels silts and peats	Ubiquitous	Variable thickness and distribution makes it difficult to assess exact extent of protection offered to aquifer.	Intergranular	Minor Aquifer
Pleistocene glacial tills boulder clay, fluvio glacial sands and gravels	Ubiquitous	As above.	Varied	Minor Aquifer
Icenian Crag: silts, sands clays	Norfolk Suffolk	Groundwater movement in Crag is rapid. Outcrops often covered with sandy soils which drain rapidly, providing little or no attenuation of contaminants.	Varied - Icenian	Minor Aquifer
Red Crag: sands, silty and shelly, ironstone beds in places			Predominantly Intergranular in Red Crag	Minor Aquifer
Neogene Coralline Crag: shelly sands	Norfolk Suffolk	As above.	As above	Minor Aquifer
Palaeogene				
Bagshot Beds	)) Essex))	Fine grained sands, occasionally pebbly and seams of clay. Small yields of 80-200 m^3/d. Numerous small springs supporting local requirements.	Intergranular	Minor Aquifer
Claygate Beds	)) Essex)	Interbedded sands and clays. Sandy above, clayey below. Transition into London Clay.	Intergranular	Non Aquifer
London Clay	) Norfolk) Suffolk)	Bluish grey clay, sandy at base weathers brown, often fissured in weathered zone.	Predominantly Intergranular	Non Aquifer

TABLE 2. GEOLOGY AND HYDROGEOLOGY OF ANGLIAN REGION

Age/Strata Type	Main Locations	Description	Flow Mechanism	Geological Classification
Lower London Tertiaries Blackheath Beds, Woolwich and Reading Beds (Thanet Beds)	) Essex) Suffolk))))	Interbedded clays and sands. Perched water tables possible. Blackheath Beds support a few local springs. Woolwich and Reading Beds acts as non-aquifer. Thanet Beds are in hydraulic continuity with Chalk.	Intergranular	Non Aquifer
Thanet Beds	) As above, but) recognised as a) discrete unit in) certain places	Glauconitic sands, basal flint, conglomerate. Locally important sources.	Intergranular	Minor Aquifer
Cretaceous				
Upper Chalk Middle Chalk Lower Chalk	) Essex) Bedfordshire) Cambridgeshire) Lincolnshire) Norfolk) and Suffolk	Fine grained fissured white limestone. Major aquifers, yields are often in excess of 100 l/s, random flows in top 80m, rapid movement of contaminants. L. Chalk, is marly at base.	Fissure	Major Aquifer
Red Chalk or Hunstanton Red Rock	Norfolk and Lincolnshire	Pink nodular chalk, sandy and pebbly at base.	Predominantly Fissure	Minor Aquifer
Cambridge Greensand	Cambridgeshire	Thin pebble bed.	Intergranular	Non Aquifer
Gault Clay	Bedfordshire Cambridgeshire Norfolk	Stiff dark grey clay plus limestone and marl layers and concretions. Extensively mined for making bricks. Weathered zone is often fissured.	Varied	Non Aquifer
Lower Greensand	Cambridgeshire Bedfordshire	Sands and ferruginous sandstone. Used in Bedfordshire for filter bed material and glass making.	Intergranular	Major Aquifer

TABLE 2. GEOLOGY AND HYDROGEOLOGY OF ANGLIAN REGION

Age/Strata Type	Main Locations	Description	Flow Mechanism	Geological Classification
Lower Greensand (Carstone ((Woburn Sands)	) Cambridgeshire) Lincolnshire	Sands & ferruginous sandstone used in the past for building in W. Norfolk. Heavily jointed in places.	Intergranular	Minor aquifer
(Dersingham (Beds with (Snettisham clay	) Norfolk	Fine ferruginous sands, overlain by clays and silts. Mined for making bricks.	Intergranular	Minor Aquifer
Tealby Formation) Sutterby Marl) Skegness Clay) Fulletby Beds	Lincolnshire	) Almost entirely clay, phosphatic) bed at base. Predominantly clay, variable sand & iron content. Central member - Roachstone - a ferruginous sandstone is quite permeable, never exploited as an ironstone.	Intergranular Varied	Non Aquifer Non Aquifer
) Tealby) Beds	Lincolnshire	Lower & Upper Tealby Clays separated by Tealby Limestone. LTC is a dark plastic clay often glauconitic. UTC is green when fresh, ferruginous near top. TL is a muddly/sandy limestone.	Varied	Non Aquifer
) Claxby) Ironstone	Lincolnshire	Brown to purple oolitic ironstone, mined in at least two places, becomes shaley in S.E. Lincs.	Intergranular	Minor Aquifer
Spilsby Sandstone	Lincolnshire	Predominantly intergranular flow, outcrops often covered with sandy soils which drain rapidly, providing little attenuation of contaminants.	Intergranular	Major Aquifer

TABLE 2. GEOLOGY AND HYDROGEOLOGY OF ANGLIAN REGION

Age/Strata Type	Main Locations	Description	Flow Mechanism	Geological Classification
Jurassic				
Sandringham Sands (Roxham Beds)	Cambridgeshire Norfolk	White quartz sands. Local supplies.	Intergranular	Minor Aquifer
) Kimmeridge) Clay	Bedfordshire Cambridgeshire Lincolnshire Norfolk	Mainly dark bluish grey clay, shaley and bituminous in places, and containing cementstones. Fissures in weathered zone raise permeability.	Intergranular	Non Aquifer
Ancholme Group) Ampthill Clay	Cambridgeshire Bedfordshire Lincolnshire	Calcareous grey mudstones, cementstone bands, and phosphatic nodules.	Varied	Non Aquifer
) West Walton) Beds	Cambridgeshire	Grey silty mudstones & thin cementstonebands; at Upware limestone is present.	Varied	Non Aquifer
) Oxford Clay	Bedfordshire Cambridgeshire Lincolnshre	Greenish bluish clay grey when fresh, brown when weathered, variable beds of limestone, some sand, calcareous cementstones, pyrite & selenite concretions. Extensively mined for brick manufacturing. Some fissure flow in limestones, and in fissured weathered zone of clays.	Mainly Intergranular	Non Aquifer
)Kellaways Beds	Bedfordshire Cambridgeshire Lincolnshire	Bluish clay overlain by Kellaway Rock - sandy beds, water bearing, locally important.	Varied	Minor Aquifer

TABLE 2. GEOLOGY AND HYDROGEOLOGY OF ANGLIAN REGION

Age/Strata Type	Main Locations	Description	Flow Mechanism	Geological Classification
) Cornbrash)))))		Brown/grey limestone with thin clay bands. Locally important.	Fissure	Minor Aquifer
) Blisworth Clay)(Great Oolite Clay) Great) Oolite) Blisworth Series) Limestone)(Great Oolite) Limestone))) Upper Estuarine) Series	Bedfordshire Cambridgeshire Leicestershire Lincolnshire Northampton- shire	Grey, green and purple clays with ironstone and limestone bands. Grey/bluish limestone and thin beds of clay and marl. Provides local supplies. Grey and green mudstones, minor limestone bands. Mined at Ketton for cement manufacture.	Intergranular Fissure Varied	Non Aquifer Minor Aquifer Non Aquifer
Lincolnshire Limestone	Cambridgeshire Lincolnshire Leicestershire Northampton- shire	Shelley limestone and calcaraeous sandstone. Major aquifer yields up to 80 l/s. Karstic. Mined at Ketton for cement manufacture.	Fissure	Major Aquifer
Grantham Formation (Lower Estuarine Series)	As above	Sands with clay seams, low grade ironstone.	Varied	Non Aquifer
Northampton Sand & Ironstone	Leicestershire Lincolnshire Northampton- shire	Siderite mudstones, sandstones, limestones, chamosite & limonite oolites. Mined for its high iron content in Lincs & Northants.	Varied	Minor Aquifer

TABLE 2. GEOLOGY AND HYDROGEOLOGY OF ANGLIAN REGION

Age/Strata Type	Main Locations	Description	Flow Mechanism	Geological Classification
Lias	Cambridgeshire Lincolnshire	Upper Lias: clay, mudstones, shales. Middle Lias: ironstone, sands and clays. Lower Lias: mainly clays with limestone beds. Fordingham Ironstone mined in North Lincs.	Varied	Non Aquifer
Mercia Mudstone Group	Near Gainsborough	Mudstone, siltstone, clay, subordinate sandy horizons. No hydrogeological significance in Region.	Intergranular	Non Aquifer

TABLE 3. SUMMARY CLASSIFICATION OF TYPES OF AQUIFER

Major Aquifers	Minor Aquifers		Non Aquifers
Highly permeable formations usually with the known or probable presence of significant fracturing. Highly productive strata of regional importance. Often used for large potable abstractions.	Fractured or potentially fractured but without high intergranular permeability Generally only support locally important abstractions.	Variably porous/permeable but without significant fracturing. Generally only support locally important abstractions.	Formations with negligible permeability Only support very minor abstractions, if any.
Chalk Lower Greensand Spilsby Sandstone Lincolnshire Limestone	Red Chalk Cornbrash Blisworth Limestone Northampton Sand and Ironstone	Aeolian Sand, River and River and Terrace Gravels Glacial Tills Fluvio-glacial sands and gravels Crag deposits Bagshot Beds Thanet Beds Carstone Dersingham Beds Sandringham Sands Claxby Ironstone Kellaways Beds	Claygate Beds London Clay Lower London Tertiaries Cambridge Greensand Gault Clay Snettisham Clay Sutterby Marl Skegness Clay Fulletby Beds Tealby Beds Kimmeridge Clay Ampthill Clay West Walton Beds Oxford Clay Blisworth Clay Upper Estuarine Beds Grantham Formation Lias Mercia Mudstone Group

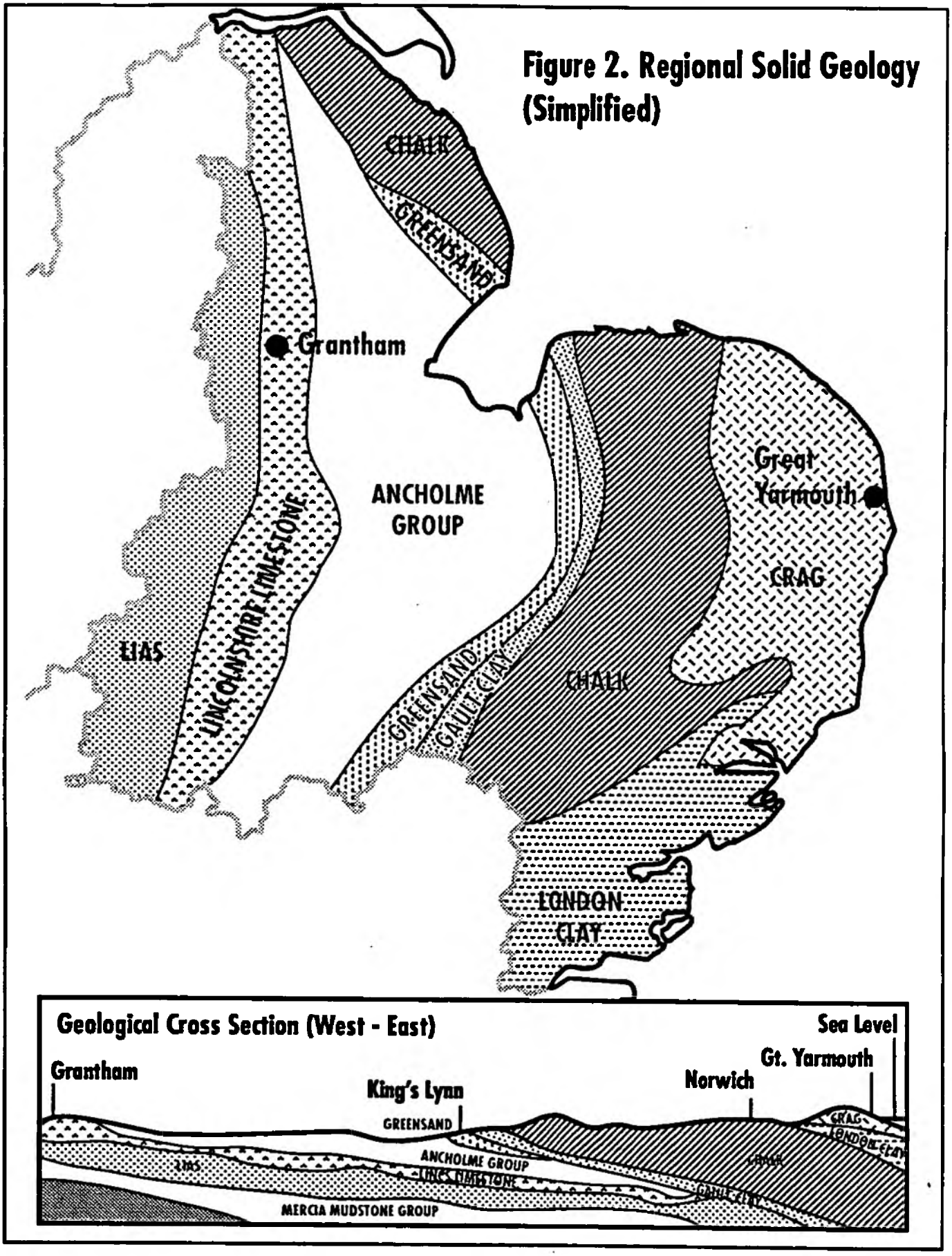


Figure 2. Regional Solid Geology (Simplified)
CHALK
GREENSAND
Grantham
ANCHOLME GROUP
LINCOLNSHIRE LIMESTONE
LIAS
GREENSAND
GAULT CLAY
CHALK
Great Yarmouth
CRAG
LONDON CLAY
Geological Cross Section (West - East)
Grantham
King's Lynn
Norwich
Gt. Yarmouth
Sea Level
GREENSAND
ANCHOLME GROUP
LINCS LIMESTONE
LIAS
CHALK
CRAG
LONDON CLAY
GAULT CLAY
MERCIA MUDSTONE GROUP

3. GROUNDWATER PROBLEMS IN THE REGION RELATED TO POLICY STATEMENTS

Groundwaters are generally of higher quality than surface waters, but once contaminated are much more difficult to clean up. Many of the rivers in the region are dependent on groundwater for base flows in summer.

Policy A (Resources)
Groundwater provides spring flows to rivers and wetlands, which are potentially vulnerable to over abstraction, and some rivers and wetlands have been affected historically by abstraction under 'licences of right' over which the NRA's predecessors had no control. Increasing abstraction could further exacerbate the situation.

The NRA's approach to solving this problem is two-fold:

1. Abstraction licences continue to be issued only if the water environment is not adversely affected. Variations are sought to existing licences that currently cause an adverse affect on the water environment.

2. Development of river to river transfer schemes, and of river support pumping from groundwater. (See Section 1.5)

Policy B (Physical Disturbance)
Surface mineral exploitation is the main form of physical disturbance. The Region, historically a provider of minerals, has resources of potential or actual economic value including limestones, sandstones, clay, sand and gravel. Ironstone has been extracted extensively from parts of the region in the past. Dewatering activities pose a threat to both quality and quantity of groundwater.

Policy C (Waste Disposal)
Virtually all landfill sites, distributed throughout the region, are located at disused mineral extraction sites. The majority of these historical landfill sites have been located, and designed on the 'dilute and disperse' principle, without the same regard for groundwater that is at present required.

Policy D (Contaminated Land)
Contamination problems are associated with the areas that have undergone industrialisation, associated with Thameside and Humberside, the main urban areas and military installations.

A number of sites have been identified as having polluted groundwaters, several of these having potable sources which have been polluted by organic industrial chemicals and subsequently have had to be withdrawn from use or have had treatment provided.

Policy E (Disposal of Sludges)
The Water Companies apply sewage sludge as a fertiliser to agricultural land in many parts of the Region. This requires careful control to avoid the risk to polluting groundwater mainly by bacteria.

Policy F (Discharges to Underground Strata)
There are many minor consented discharges to underground strata from septic tanks and soakaways. Small numbers of more significant discharges within this category include, for example, boreholes used for industrial cooling purposes.

Policy G (Diffuse Pollution)
Extensive agriculture and use of agrochemicals, in particular nitrate and pesticides, have been detrimental to the quality of some of the region's groundwaters. Nitrate concentrations in groundwater are rising across a large area of the UK, and some of the most severely affected groundwater supplies are those of the Jurassic Limestone aquifer of central Lincolnshire.

Nitrate concentrations in these areas usually exceed the EEC guideline of 25 mg/l nitrate, often exceed the EEC maximum acceptable concentration of 50 mg/l and have been linked to farming practices associated with intensive arable cropping. In addition, point pollution sources may intensify the problem locally.

Following consultations between the NRA and the Ministry of Agriculture, Fisheries and Food, the Nitrate Sensitive Areas (Designation) Order, 1990, came into force on 1st June 1990. This order, in accordance with Section 112 of the Water Act 1989(a), designated two Nitrate Sensitive Areas (NSAs) in the Anglian

Region at Branston Booths and Sleaford. In these Areas, farmers and landowners are compensated for making significant changes to agricultural practices to reduce nitrate leaching. The NRA in conjunction with MAFF is assessing the effects of changing farming practices in these areas over a period of five years.

The Branston Booth's NSA, south-east of Lincoln, covers an area of approximately 2000 hectares, corresponding to the catchment area for the public water supply boreholes. The Sleaford NSA is located west of Sleaford, covering an area of approximately 3000 hectares.

In addition to the NSAs, eight Nitrate Advisory Areas (NAAs) have been designated in the Anglian Region at Hillington, Gayton, Congham, Bircham, Fring, Sedgeford, Fowlmere, and Cringle Brook. These are areas where farmers are advised how to farm in such a way as to minimise nitrate leaching.

Other issues which are best described under 'Policy G' which constrain the use of some groundwater resources for public supplies are:

a) Saline intrusion from the sea in some coastal areas.

b) Naturally high fluoride, iron and manganese concentrations.

Policy H (Additional Threats to Groundwater Quality)

The importance of agriculture in the Region, the existence of several major ports at Ipswich, Harwich and along Thameside and Humberside, their proximity to North Sea hydrocarbon production areas, and continental trading ports like Rotterdam, has lead to the establishment of chemical industries, areas for storage of chemicals and farm wastes, and distribution pipelines. As the Region's population grows, development of its infrastructure leads to higher demand for water supply. All of these activities pose a potential threat to groundwater resources.

4. MAIN OFFICE LOCATIONS AND CONTACTS RELATING TO GROUNDWATER MATTERS

Within Anglian Region all consultations for planning permission are administered by the Planning Liaison Sections within the three area offices, providing the opportunity to give advice about prevention of pollution of groundwater at a very early stage in the planning process. Waste disposal licences and applications to make a direct discharge to groundwater are dealt with by the Environmental Managers' Departments at the three area offices.

The locations of the relevant offices are given in Figure 1 and Table 4.

It is the policy of the Authority wherever possible, to discuss proposals with planning officers, waste disposal officers and developers at an early stage. In this way the specific aspects of each proposal can be investigated and the interested parties made aware of the Authority's interests and concerns.

TABLE 4. MAIN OFFICE LOCATIONS AND GROUNDWATER CONTACTS

Area	Address, Tel. No. Fax No.	Principal Staff and Responsibilities	Pollution Control Catchment	Local Planning Authority
Regional Headquarters	Kingfisher House Goldhay Way Orton Goldhay Peterborough PE2 5ZR Tel: 0733 371811 Fax: 0733 231840 Emergency contact 24 hours a day Tel: 0345 125309	**Regional Freshwater Officer** Management and co-ordination of work on the prevention of pollution of fresh waters. Ensure that obligations are met in respect of the Water Act, EC Directives, International Agreements, and Statutory Standards. **Principal Groundwater Quality Officer** Provide Regional expertise on the quality and protection of groundwaters. Ensure that obligations are met in respect of the Water Act, EC Directives, International Agreements, and Statutory Standards. **Principal Hydrogeologist** Assess groundwater resources, advise on development and co-ordinate common hydrogeological practices and procedures in the Region.	Rivers*:- All rivers listed in Areas *includes groundwaters	All Authorities listed for Areas

TABLE 4. MAIN OFFICE LOCATIONS AND GROUNDWATER CONTACTS

Area	Address, Tel. No. Fax No.	Principal Staff and Responsibilities	Pollution Control Catchment	Local Planning Authority
Central Area	Bromholme Lane Brampton Huntingdon Cambridgeshire Tel: 0480 414581 Fax: 0480 413381 Emergency Contact 24 hours a day Tel: 0345 125309	**Principal Quality Officer** Management of the Area Water Quality Section, concerning the development and implementation of environmental protection policies and the setting and administration of discharge consents and groundwater protection. **Principal Hydrologist** Management of the Area Hydrology Section concerning the regulation and control of water resources and the setting and administration of abstraction licences. **Groundwater Protection Officer** Provides advice on the assessment, maintenance and improvement of quality, pollution prevention and control of groundwater resources in the area. Also within each Area Office are flood defence, land drainage, conservation and fisheries staff.	Rivers*:- Ouse Bedford Ouse Great Ouse Rhee Cam Ely Ouse Little Ouse and their tributaries and drains *includes groundwaters	Mid Suffolk North Beds St. Edmundsbury Mid Beds Milton Keynes N. Hertfordshire South Beds S. Northants South Cambs Stevenage Uttlesford Kings Lynn & West East Cambs E. Northants Fenland Forest Heath Huntingdonshire Aylesbury Vale Cambridge City Breckland Cherwell Bedfordshire Cambridgeshire Hertfordshire Norfolk Oxfordshire Suffolk

TABLE 4. MAIN OFFICE LOCATIONS AND GROUNDWATER CONTACTS

Area	Address, Tel. No. Fax No.	Principal Staff and Responsibilities	Pollution Control Catchment	Local Planning Authority
Eastern Area	Cobham Road Ipswich IP3 9JE Tel: 0473 727712 Fax: 0473 724205 Emergency Contact 24 hours a day Tel: 0345 125309	**Principal Quality Officer** Management of the Area Water Quality Control Section, concerning the development and implementation of environmental protection policies and the setting and administration of discharge consents and groundwater protection. **Principal Hydrologist** Management of the Area Hydrology Section concerning the regulation and control of water resources and the setting and administration of abstraction licences. **Groundwater Protection Officer** Provides advice on the assessment, maintenance and improvement of quality, pollution prevention and control of groundwater resources in the area. Also within each Area Office are flood defence, land drainage, conservation, and fisheries staff.	Rivers*:- Burn Stiffkey Glaven Yare Bure Waveney Blyth Alde Deben Gipping Stour Colne Pant Wid Crouch Roach Mardyke (Upper Reaches) and their tributaries *includes groundwaters	Mid Suffolk Norwich Rochford St. Edmundsbury North Norfolk Southend-on-Sea Suffolk Coastal Thurrock Waveney South Norfolk Tendring Uttlesford Kings Lynn & West Norfolk Ipswich Epping Forest Gt. Yarmouth Malden Basildon Braintree Brentwood Chelmsford Babergh Breckland Broadland Castle Point Colchester Essex Norfolk Suffolk

TABLE 4. MAIN OFFICE LOCATIONS AND GROUNDWATER CONTACTS

Area	Address, Tel. No. Fax No.	Principal Staff and Responsibilities	Pollution Control Catchment	Local Planning Authority
Northern Area	Aqua House Harvey Street Lincoln LN1 1TF Tel: 0522 513100 Fax: 0522 512927 Emergency Contact 24 hours a day Tel: 0345 125309	**Principal Quality Officer** Management of the Area Water Quality Control Section, concerning the development and implementation of environmental protection policies and the setting and administration of discharge consents and groundwater protection. **Principal Hydrologist** Management of the Area Hydrology Section concerning the regulation and control of water resources and the setting and administration of abstraction licences. **Groundwater Protection Officer** Provides advice on the assessment, maintenance and improvement of quality, pollution, prevention and control of groundwater resources in the area. Also within each Area Office are flood defence, land drainage, conservation and fisheries staff.	Rivers*:- Nene Welland Witham Ancholme E Halton Beck Buck Beck Waithe Beck Great Eau Steeping and their tributaries and drains/ canals *includes groundwaters	Newark & Sherwood North Kesteven Northampton Peterborough Rutland Scunthorpe South Kesteven South Northants West Lindsey South Holland Wellingborough East Northants Fenland Glanford Great Grimsby Lincoln East Lindsey Harborough Kettering Cleethorpes Corby Bedfordshire Leicestershire Lincolnshire Nottinghamshire Northamptonshire

5. HOW TO USE THE POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATER PRIOR TO THE INTRODUCTION OF NEW GROUNDWATER VULNERABILITY MAPS AND NEW SOURCE PROTECTION ZONES

5.1 Introduction

Prior to introduction of the national NRA policy, Anglian Region had its own Aquifer Protection Policy. Maps outlining the extent of the original Aquifer Protection Areas are available for consultation at Area offices. These maps were prepared using the best information available at the time of drafting.

There is a considerable amount of work involved in producing the new Groundwater Vulnerability maps and the definition of Source Protection Zones. This programme of work has already started but will continue for many months. Until the new maps are available the existing Aquifer Protection Policy maps will be used. This section explains how these maps can be used with the new Policy.

5.2 The Technical Basis of the Original Anglian Region Aquifer Protection Policy

The land was divided into four different categories, in order to control activities, development and land-use changes according to the risk of pollution posed to aquifers. The four categories were:

Protection Area A: around potable groundwater sources.
Protection Area B: : over the exposed parts of aquifer outcrop.
Protection Area C: : over the remaining aquifers covered by low permeability deposits.
Non-Aquifer Area: the remaining low permeability areas.

Protection Area A comprised:

(i) the land within a 0.25km radius of a potable source.

(ii) all land where the vertical time of travel to the water table is less than a year and where the horizontal travel time within groundwater to a potable source is less than 50 days.

'Potable source' includes all public water supply sources and those private

sources licensed to abstract over 100 mega litres per annum (Ml/a)and which require water of high quality. The 50 day travel time boundary or isochrone allows time for appreciable reduction of microbial organisms by natural processes.

Within Protection Area A, the Authority opposed all development proposals or changes in land-use which posed an unacceptable risk to either the microbiological or chemical quality of the underlying groundwater or threatened the continued use of groundwater sources.

Protection Area B comprised all the remaining land where the vertical travel time to the water table is less than a year and where the aquifer cover is non-existent or is overlain with relatively shallow, permeable deposits. The groundwaters underlying Protection Area B are the outer catchment areas contributing to those sources within Protection Area A, as well as unused parts of aquifer where the groundwater quality is to be maintained for future uses.

Within Protection Area B, the Authority opposed all development proposals which, either individually or in combination with similar developments, posed an unacceptable risk to the underlying groundwaters from either degradable or non-degradable materials.

Protection Area C comprised that land where the vertical time of travel from surface to groundwater is greater than a year and usually exceeds 20 years. The aquifer under this area is covered by significant thicknesses of clay. The area excludes the land within 0.25km of potable water sources which is included within Protection Area A.

Within Protection Area C, the Authority opposed all development proposals that could have potentially polluted the underlying groundwater and involving toxic, persistent or non-degradable materials. The degree of protection sought within Protection Area C was generally less stringent than in Protection Area B. However, all proposals involving direct or indirect discharges to the aquifer were only considered in the light of a prior investigation as outlined in the Department of Environment Circular 4/82 (Department of Environment 1982).

Non-Aquifer Area protection measures are designed more to safeguard the quality of surface water than groundwater.

Small, isolated, domestic groundwater sources may exist within this area. The Authority opposed all development proposals that could have led to a deterioration in the quality of such supplies.

Falling within Protection Areas B and C were a number of small licensed (<100 Ml/a) and unlicensed domestic groundwater sources. These required additional protection from the disposal of potentially polluting wastes.

Activities within the immediate surroundings of a borehole or well present the greatest risk of contamination to the abstracted groundwater. These areas are often in the ownership of the abstractor, who should be able to minimise the risks of groundwater contamination through control of the activities located within this area.

5.3 Transitional Arrangements for Introduction of the New Policy and Practice for the Protection of Groundwater Using Existing Maps

As explained above, until maps are available showing the new Source Protection Zones the existing Aquifer Protection Maps will be used in conjunction with the new Policy.

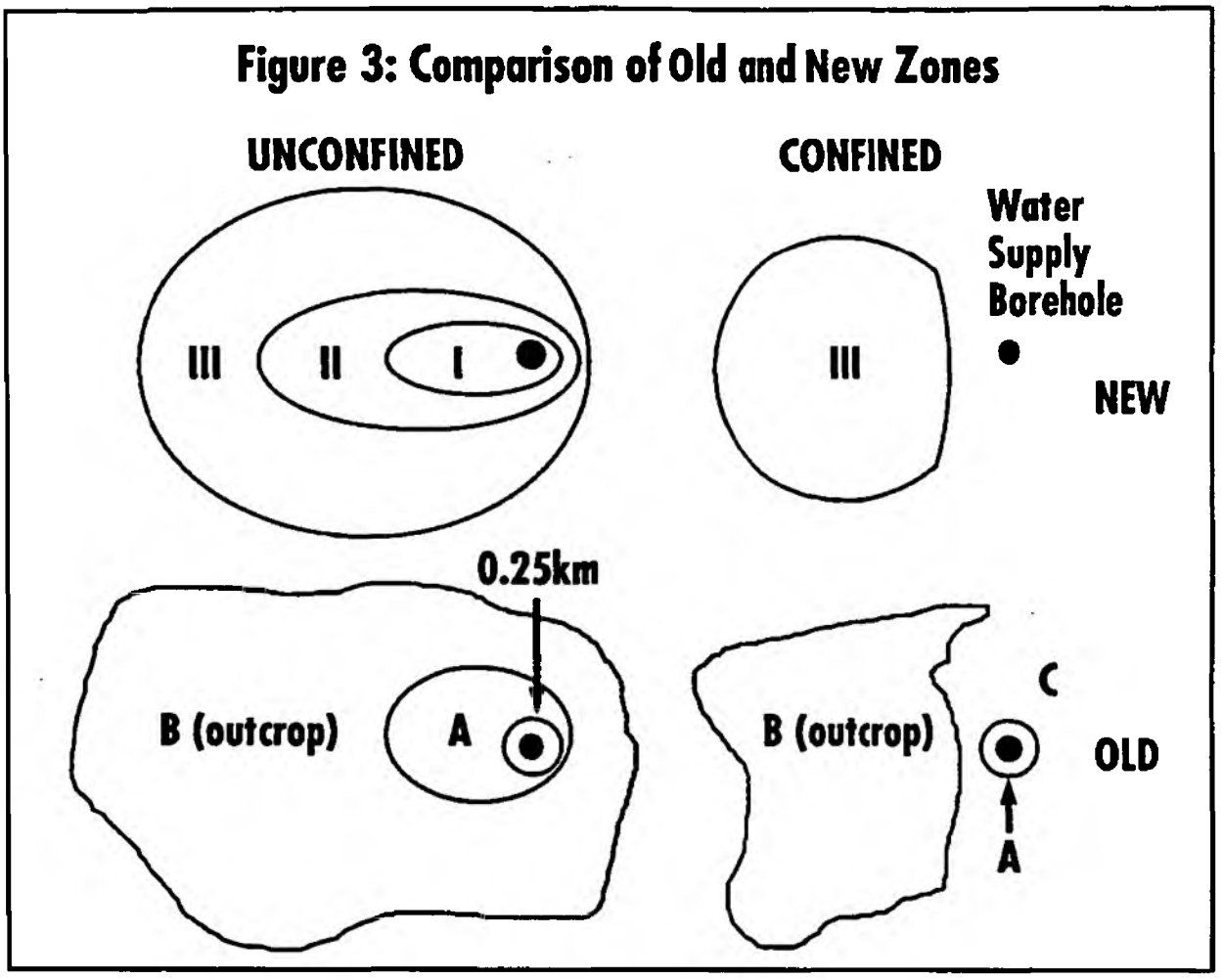
Table 5 and Figure 3 shows the approximate relationship between the old Aquifer Protection areas and new Source Protection Zones.

Table 5. Comparison of Old and New Protection Zones

Old Aquifer Protection Areas	New Source Protection Zones	Geological Classification*
A	I	Major and Minor Aquifer
B	II, III	Major and Minor Aquifer
C		Non-Aquifer
Non-Aquifer		Non-Aquifer

* See Table 3 for definitions

Figure 3: Comparison of Old and New Zones



5.3.1 Changes to Zone Definition

Due to the different definitions associated with the new Policy, changes will have to be made in the position of boundaries of existing protection areas. These changes will be made over a period of several years.

5.3.2 Current Vulnerability Maps

Vulnerability Maps were drawn in 1983, 1987 and 1991 at different scales. These maps were produced in conjunction with the Soil Survey and British Geological Survey and consider the vulnerability of groundwater to contamination from a diffuse pollutant such as nitrate. The soil characteristics, geology and hydrogeology were combined to produce areas of high, intermediate and low vulnerability.

These maps will remain usable with the original Aquifer Protection Policy maps until the new Groundwater Vulnerability Maps have been produced.

5.4 The Maps Proposed for the New Policy

A series of Geological Classification Maps will be produced on a scale of 1:100,000 with each sheet covering one county area. These maps will be produced after considering the vulnerability of the groundwater, the geology and also soil type. This will result in a sub-division of Major Aquifers into high, intermediate and low vulnerability.

The Source Protection Zones will not be shown on these maps, but will be detailed on larger scale maps and in reports held in the regional NRA offices. It will be possible for any proposed developer to discuss the definition of the zones in relation to a particular proposal. The outlines of the zones will not however be altered without detailed hydrogeological information to the contrary.

Summary maps will be produced to relate the Source Protection Zones to the Groundwater Vulnerability maps.

5.5 Conclusion

When applying the new Policy Statements the original Aquifer Protection maps will be used as far as possible for the interim period until the new Source Protection Zones have been drawn. Some interpretation will be required as the new Source Protection Zones and Geological Classification are not wholly comparable to the original Aquifer Protection Areas A, B, C and Non-Aquifer.

Each proposal for development will be considered in relation to the risk it poses to the abstraction in question. The first group of Source Protection Zones will be produced for the NRA by July 1993. Priority has been given to those sources considered vulnerable to nitrate contamination. Beyond this time, the remaining Source Protection Zones will be defined as soon as possible and when the necessity arises.

NRA

National Rivers Authority

To obtain copies of any of the following documents, please send cheque (made payable to the National Rivers Authority) or postal order to:

National Rivers Authority
Newcastle-Upon-Tyne X
NE85 4ET

- Policy & Practice for the Protection of Groundwater (including the Groundwater Vulnerability Map) — Price £15
- Individual copies of the Groundwater Vulnerability Map — Price £5
- Summary Leaflets for the Groundwater Protection Policy Document — No Charge

Regional Appendices can be obtained from the appropriate regions free of charge

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Fax: (0454) 624409

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