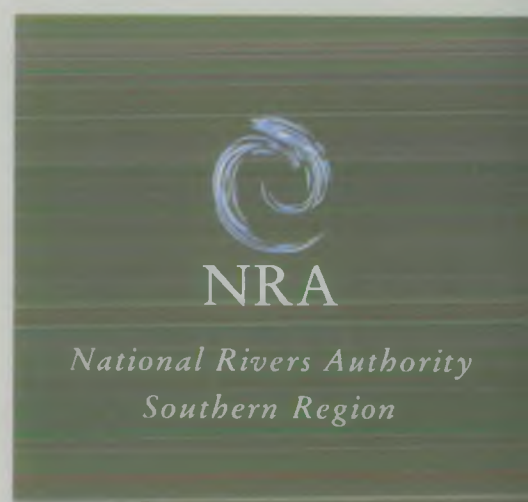
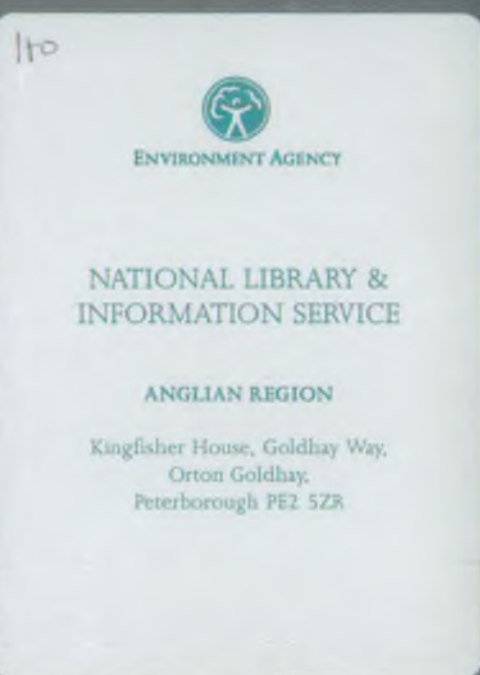
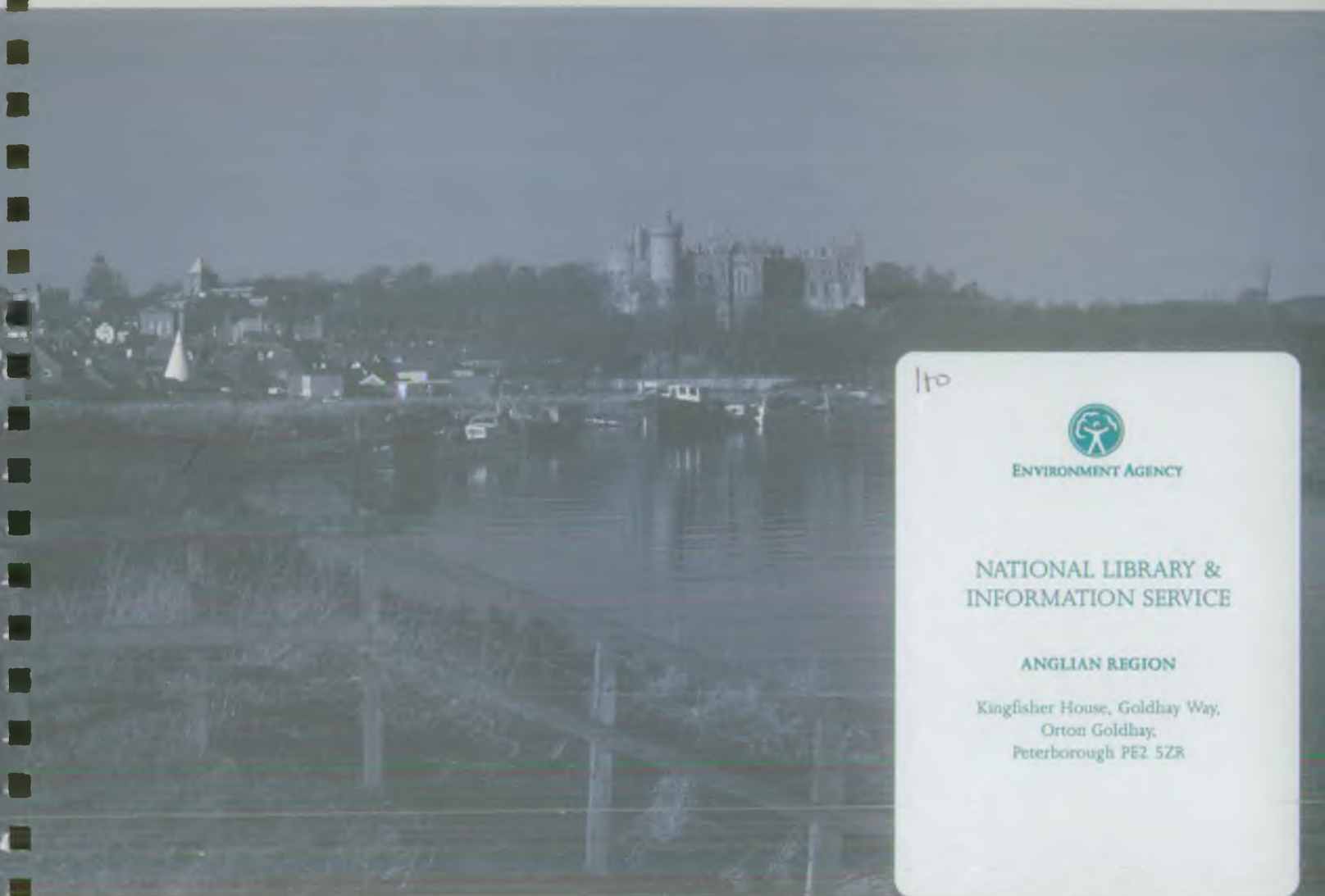


RIVER ARUN CATCHMENT MANAGEMENT PLAN CONSULTATION REPORT



MISSION STATEMENT

The NRA's mission is:

"We will protect and improve the water environment by the effective management of water resources and by substantial reductions in pollution. We will aim to provide effective defence for people and property against flooding from rivers and the sea. In discharging our duties we will operate openly and balance the interests of all who benefit from and use rivers, groundwaters, estuaries, and coastal waters. We will be businesslike, efficient and caring towards our employees".

Our Aims are to:

- Achieve a continuing overall improvement in the quality of rivers, estuaries and coastal waters, through the control of pollution.
- Manage water resources to achieve the right balance between the needs of the environment and those of the abstractors.
- Provide effective defence for people and property against flooding from rivers and the sea.
- Provide adequate arrangements for flood forecasting and warning.
- Maintain, improve and develop fisheries.
- Develop the amenity and recreation potential of inland and coastal waters and associated lands.
- Conserve and enhance wildlife, landscape and archaeological features associated with inland and coastal waters of England and Wales.
- Improve and maintain inland waters and their facilities for use by the public where the NRA is the navigation authority.
- Ensure that dischargers pay the costs of the consequences of their discharges, and, as far as possible, to recover the costs of environment improvements from those who benefit.
- Improve public understanding of the water environment and the NRA's work.
- Improve efficiency in the exercise of the NRA's functions and to provide challenge and opportunity for employees and show concern for their welfare.

The National Rivers Authority will form the major part of a new organisation which will have responsibilities for the environmental protection of water, land and air. The new Environment Agency starts its work of managing the environment in England and Wales on April 1 1996.

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CATCHMENT PLANNING

The Water Act 1989 established the National Rivers Authority (NRA) as the "Guardian of the Water Environment", a non-departmental government organisation with responsibility for regulating and managing water resources, water quality in coastal and inland waters, flood defence, salmon and freshwater fisheries, water recreation and, in some areas, navigation. An additional duty laid on the NRA was to further conservation of the natural environment, seeking opportunities for enhancement wherever possible.

The quality of our water environment (ie, estuaries, coastal waters, rivers, streams, lakes, ponds, aquifers, springs) and the way in which it is managed matters to all of us. Our health depends on the availability and purity of water supplies and the way we dispose of waste water. These pressures call for the strict control of water abstraction and effluent quality. Many householders and businesses rely on flood alleviation works and flood warning systems to reduce their risk of flooding. Visitors as well as local communities benefit from the amenity, recreational and educational opportunities offered by the Region's rivers, canals and lakes. The water environment also supports a wide variety of habitats which are home to a range of plants and animals whose monitoring, conservation and enhancement are vital to sustaining the Region's stock of natural resources.

In managing the water environment the NRA has to consider a wide variety of uses which invariably interact and sometimes conflict with each other. The Catchment Management Planning process has been developed to manage these interactions and conflicts for the overall benefit of the water environment and its users. Catchment Management Plans (CMPs) concentrate on topics where the NRA has a direct interest and are focused mainly on the river corridor although some functions such as water resources management and pollution control inevitably extend over the whole catchment area. Whilst they lack the status of statutory planning documents, it is hoped that CMPs will make a positive input to the Town and County Planning process. The CMP therefore aims to:

- Focus attention on the water environment of a specific river catchment
- Draw attention to the aspirations of the NRA for the improvement of the water environment
- Establish an integrated strategy and action plan that will detail the measures required of the NRA, and others, to solve problems identified in the catchment
- Identify specific action, to which the NRA is committed, for inclusion in its business plans

As users of the catchment, the NRA wants the public and interested parties to contribute to the CMP and so the production of each Plan has two separate phases:

Phase 1, the Consultation Report is produced after extensive internal discussion and study. It identifies the legitimate and realistic management of the catchment and includes a draft outline of work required to remedy any identified problem. The Plan is distributed to the public as part of a wide ranging consultation procedure.

Phase 2, the Action Plan is produced after comments received on the Consultation Plan have been considered and presents the NRA's Action Plan for the future management of the catchment. The Action Plan details the nature of the work required, the cost, timescale and responsible organisation (s).

The Consultation Plan comprises of 4 sections:-

Section A: General Information

This section provides a background to the catchment and explains the NRA's input to development control and planning.

Section B: Catchment Vision

This section highlights the primary objectives of the NRA to protect and develop the catchment.

Section C: Managing the Arun Catchment

This identifies existing uses and management of the catchment related to various interests of the NRA. The text is divided into 2 sections:

- General. This describes some of the general characteristics of the identified interest and any relation to others.
- Local perspective. This describes how the interest manifests itself within the catchment and identifies issues of concern to the NRA relative to identified catchment targets.

Section D: Catchment Issues

This lists the issues identified in Section C.

Section E: Catchment Options

This examines the options available to overcome the issues identified in Section C & D. Also identified are people and organisations who may be responsible for undertaking remedial measures. The options represent the ideas of the Southern Region of the NRA at the time of production of this Consultation Report. They do not represent the policy as this will only be finalised following the public consultation process. Comments on the issues and options and suggestions for additional ideas are positively encouraged.

In developing the Plan the NRA ensures an integrated approach to river catchment management and has placed particular emphasis on planning for environmental sustainability.

Environmental sustainability in terms of river catchment management means that development needs are met without compromising the capacity of future generations to meet their needs. This is an approach that has been backed by the Rio Earth Summit, European Union and the UK Government. This is demonstrated by the following statement from Agenda 21 (Rio Earth Summit). "By the year 2000 all states should have national action programmes for water management, based on catchment basins or sub-basins, and efficient water-use programmes. These should integrate water resources planning with land use planning and other development and conservation activities, demand management through pricing or regulation, conservation, reuse and recycling of water".

This theme has been adopted by the UK Government and is reflected in part by Planning Policy Guidance Note 12 'Development Plans and Regional Guidance' states that "the government has made clear its intention to work towards ensuring that development and growth are sustainable".

A strategy for river catchment management based on environmental sustainability needs to make clear that:

- sustainability is not purely about environmental matters alone;
- sustainability is not about calling a halt to development;
- sustainability is about quality of life not just economic wealth;
- sustainability does not imply that meeting today's needs is less important than the needs of future generations.

Looking to the future there is now the strongest indication that the **Environment Agency** will come into being during 1996 drawing together the responsibilities of the NRA, Her Majesty's Inspectorate of Pollution (HMIP) and certain waste regulation responsibilities. The NRA is currently finalising its response on the boundaries and possible management structures for the Agency centred on an integrated approach based on Regions and Areas following environmental boundaries ie, river catchments. This has been emphasized by The Secretary of State for the Environment, John Gummer, who said of the Agency on the 14th October 1994, **"It will first of all need to take an integrated approach to providing effective environmental protection: integrated to take account of impacts on air, water and land and integrated geographically so that interconnected systems such as river catchments are considered as a whole."** The NRA currently anticipate that the Catchment Management Planning process will play an important role within the Environment Agency.

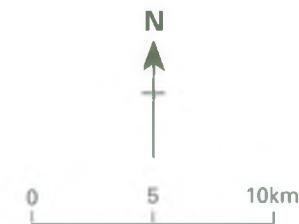
During the consultation period please send any comments in writing to the following address:-

Peter Midgley – Area Manager
National Rivers Authority
Sussex Area Office
Rivers House
3 Liverpool Gardens
Worthing
West Sussex BN11 1TF

All comments should be received by 23 January 1996.

SECTION A:
GENERAL INFORMATION

**River Arun
Catchment Management Plan
Map 1**



The Catchment

KEY

- Catchment Boundary
- Perennial Watercourse
- - - Ephemeral Watercourse
- A Roads
- B Roads
- Built up Area



SECTION A : GENERAL INFORMATION

A1. THE CATCHMENT

This Plan considers the catchments of the River Arun (formerly known as the Tarant), and West Sussex coastal streams, including the River Ems, River Lavant, Chichester and Pagham Harbours. In total the area comprises the south western quadrant of the Weald with its impermeable Clays and Sandstone hills, the Sussex Chalk downland west of the Adur gap and the coastal plain from Lancing to the Hampshire boundary.

The River Arun rises east of Horsham on the Tunbridge Wells Sandstones of St Leonard's Forest, with tributaries from the Greensand hills to the north and west. At Hardham, downstream of the tidal limit, the Lower Arun is joined by the West Sussex Rother which rises from Chalk springs north-west of Petersfield, draining the scarp slope of the South Downs and the Greensand hills eastwards to Stopham.

As a result of the low lying nature of the Sussex coastal plain the tidal limit of the River Arun is 40km (25 miles) from its outfall to the English Channel at Littlehampton and the estuary is subject to strong tidal currents. To the north of Arundel the estuary flows for 10km (6 miles) through a wide valley cutting through the Chalk South Downs, following the silted course of an Ice Age river.

The West Sussex coastal plain lies on London Clay with overlying Tertiary deposits. This area is drained by small streams which rise on the Chalk, many of them winterbournes, the most notable being the River Lavant which flows through Chichester. Despite often being dry for much of the year the Lavant has a history of flooding, the most recent being in January 1994. West of Bognor Regis the coastal plain broadens to become the Manhood peninsula with Selsey Bill at its tip; nowhere higher than 10m AOD, much of this area is below high tide level and at risk to flooding from the sea. On its eastern side, Pagham Harbour is a tidal inlet which was formerly reclaimed for agriculture, as were parts of Chichester Harbour which bounds the peninsula to the north.

The whole coastline of the catchment is low lying and in places has been eroded by several kilometres over the last two thousand years. Urban development covers more than 70% of the coastal frontage, the highest proportion in the UK, and is protected against tidal erosion and flooding by sea defence embankments/walls.

Chalk outcrops constitute an important groundwater resource and being hydraulically isolated by river valleys including the Arun, the individual Chalk blocks can be managed as discrete units. At Hardham water is abstracted from the River Rother to provide water for Horsham and Crawley (in the Thames NRA Region). As treated effluent in Crawley is discharged to the River Mole which flows north to the River Thames, water supplied to Crawley is effectively lost from the Arun catchment. The extensive Lower Greensand aquifer which underlies the Hardham area is recharged naturally by rainfall and percolation from the river, and provides a backup resource which is managed conjunctively with the surface abstraction for public water supply.

Water quality is generally good and the headwater streams support wild populations of brown trout. Sea trout migrate through the Arun estuary to their spawning grounds in the tributaries,

especially the Chalk streams feeding the River Rother, and are found in small streams flowing into Chichester Harbour. Elsewhere, ponds and streams support productive coarse fisheries which are extensively used by anglers. Suitable lakes have been developed commercially as "put and take" trout fisheries and a number of spring-fed sites are managed as fish farms, producing trout for restocking angling waters.

Wildlife conservation features strongly in the area. Chichester and Pagham Harbours are noted for their wildfowl, the Royal Society for the Protection of Birds (RSPB) has a regional reserve at Pulborough Brooks, and the Wildfowl and Wetlands Trust operates a visitor centre at Arundel. The wetlands of the Arun and Rother valleys are regionally important for their flora, insect and bird life, and the River Arun between Billingshurst and Pulborough supports a diverse dragonfly fauna which warrants its designation as a Site of Special Scientific Interest (SSSI).

The Downs were occupied and exploited by Neolithic Man (Boxgrove Man preceded him by several millennia), the coastal plain has been cultivated for more than two thousand years and many modern settlements can be traced back to pre-Roman times. Chichester (Noviomagus) was the capital of a Celtic kingdom and a Roman seat of government. There is large Roman villa at Bignor, a Roman palace at Fishbourne and the area is also rich in more recent historic monuments.

A2. HYDROLOGY AND RAINFALL

A2.1 General

This section considers the natural water resources within the catchment. Sections B1, B2 and B3 examine the use of these resources for water supply.

A proportion of the rainfall which falls on the catchment is lost through direct evaporation and transpiration from plants and trees. The remainder is termed the effective rainfall and is the total water resource available to the catchment. It may be utilised as surface water run-off to streams and rivers or as recharge to groundwater aquifers.

The implication of rainfall on surface water drainage systems and groundwaters is largely dependant on the surface geology of the catchment. Where low permeability clay and silt catchments prevail there is a relatively high rate of surface water run-off from the land to surface water drainage systems. These drainage systems in the form of streams and rivers are well developed in such areas. On chalk and sandstone catchments, the porous characteristics of the land allow a high proportion of recharge to groundwater with very limited surface water run-off during normal conditions. In these areas surface water drainage systems are not so developed and a large part of any stream or river flow is derived from groundwater as springs or upflow through the river bed. Such flow is known as the "base flow" of a stream or river.

As surface flows in clay/silt catchments respond rapidly to high rainfall and drought periods, there is a considerable seasonal variation in the water resource available at a river intake. The low-flow yield of such "flashy" catchments can be enhanced by the storage of water in reservoirs abstracted during periods of high river flow.

Aquifers provide natural water storage within a catchment and because groundwater systems react to rainfall much more slowly than surface waters they generally provide a more reliable resource during drought periods. However, recovery from drought may also take longer.

A.2.2 Local Perspective

The catchment area is defined as the surface catchment of the Rivers Arun, Rother, Lavant and Ems, together with the Chichester Rifes. The groundwater catchment comprises the Worthing and Chichester Chalk Blocks together with the Sandstone beds of the Rother catchment. Surface and groundwater catchments do generally coincide.

The River Arun rises on the Tunbridge Wells Sandstones, although as it runs over Weald Clay the upper reaches tend to be flashy, with rapid run-off and high peak flows in response to rainfall.

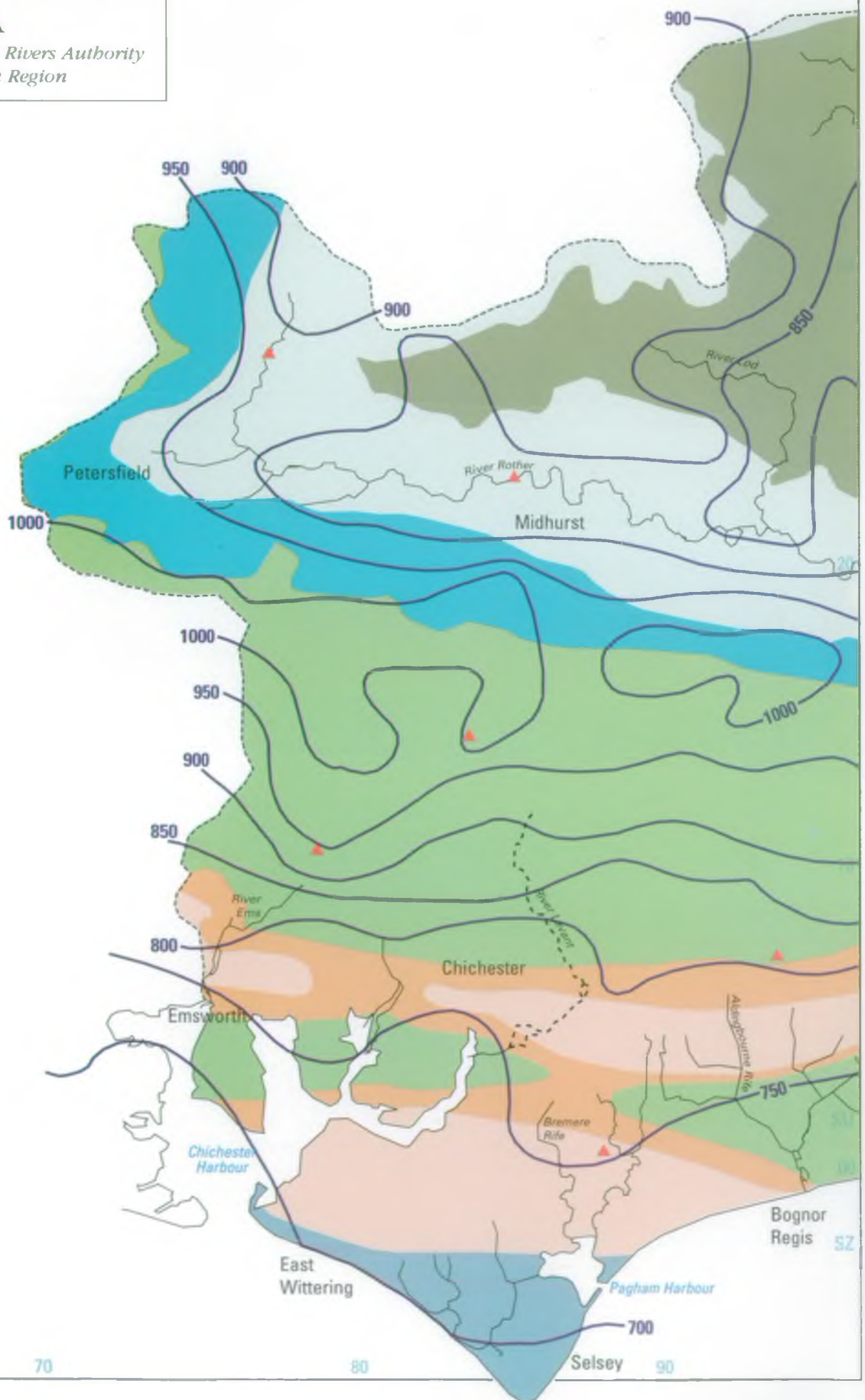
The River Rother is primarily groundwater fed, the majority of its flow originating from the scarp slope of the Chichester Chalk together with a substantial Sandstone feed from the hydraulically linked Chichester Chalk and Upper Greensand beds. These two together with the Lower Greensand (mainly Folkstone beds) provide substantial baseflow with significantly less marked seasonal differences.

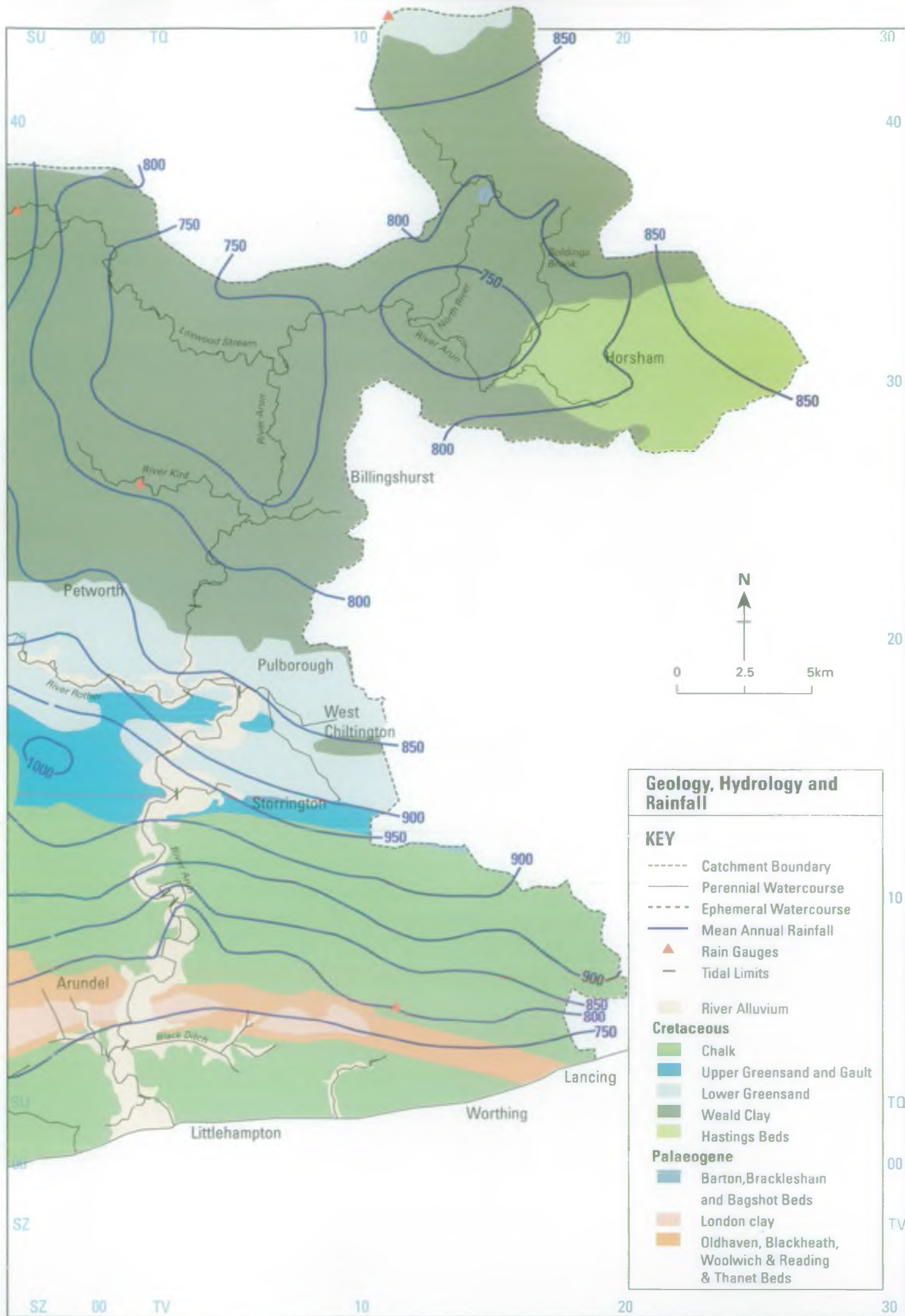
**River Arun
Catchment Management Plan
Map 2**



NRA

*National Rivers Authority
Southern Region*





The Rivers Lavant and Ems are ephemeral – rivers only flow when groundwater levels in the chalk are high. These rivers traditionally flow from November to July.

A.2.3 Recent Meteorological Effects

The average annual rainfall across the catchment ranges typically from 714mm on the south coast to 958mm on the South Downs ridge. North of the Downs annual rainfall drops to around 850mm (Rother valley). Between 1989 and 1992 records show a sequence of drought years with recharge of groundwater levels in the chalk by winter rainfall being only about 60% of the long term average (LTA). Evaporation during this period was recorded at around 570mm per annum as compared with the average evaporation for this area of about 440mm per annum. Total rainfall was also less than average in 1973, 1976 and 1989.

By contrast the winter of 1993/94 was wetter than average and led to significant flooding across West Sussex. Rainfall was broadly 150% of long term average for the four months September to January. Flows on the River Lavant were higher than previously recorded during the lifetime of the gauging station at Graylingwell (1971 to date). Many boreholes also gave the highest values on record, with the water level at Chilgrove (1834 to date) overtopping the ground for 18 days (artesian effect).

A3 THE NRA'S ADVISORY ROLE IN DEVELOPMENT PLANNING

A3.1 General

The NRA is regularly consulted by planning authorities on the preparation of statutory development plans and in connection with individual applications for planning permission. The need for close liaison between the Planning Authorities and the NRA has been highlighted and strengthened in recent guidance from the Department of the Environment to the Planning Authorities.

In making decisions regarding particular development, planning authorities must have regard to the contents of relevant development plans namely:

- i) County Structure Plan. This provides the broad strategic planning framework and should ensure that the provision for development is realistic and consistent with national and regional policy.
- ii) Borough/District Local Plan. This plan sets out detailed policies and specific proposals for the development and use of land. The local plan should be in general conformity with the Structure Plan and it makes proposals for specific allocations of land as well as setting out the policies for the control of development.
- iii) Minerals Local Plan. Although County Structure Plans will address broad strategies, the Minerals Plan should cover these in more detail. It should indicate the areas where provision is made for mineral working and the disposal of mineral wastes as well as the areas where mineral resources are to be safeguarded for future working. The plans should also set out development control criteria and requirements for the restoration and aftercare of such sites.
- iv) Waste Local Plan. The 1974 Control of Pollution Act places a duty on the Waste Regulation Authority to licence disposal sites and ensure that the sites do not endanger public health, cause water pollution or cause serious detriment to the local amenity. The 1990 Environmental Protection Act also introduced stricter controls on the closure and aftercare of waste disposal sites. A waste disposal operator will have to acquire a certificate of completion from the Waste Regulation Authority before they are able to hand back their licence and exonerate themselves of any further legal responsibility. The Waste Regulation Authority can integrate waste disposal policies into the Minerals Local Plan or prepare a separate Waste Local Plan. The Plan should examine land use implications and identify suitable locations for further facilities.

The NRA is a statutory consultee on development plans and through close liaison with local authorities ensures that adequate provisions are made for the protection of its interests.

Catchment Management Plans are complementary to the statutory Plans of Local Authorities. By stating clearly the NRA vision it is hoped that Catchment Management Plans will make a positive input to the formal planning process.

The NRA is also consulted on new road schemes put forward by the Highways Agency and County Councils. It is ensured through early discussions on a scheme, NRA consent requirements and input to the public inquiry and Environmental Impact Assessment, that the interests of the NRA are protected.

A3.2 Local Perspective

A3.2.1 The Plan Area

The Plan Catchment extends into Hampshire at its western extremity and straddles the West Sussex/Surrey and West Sussex/East Sussex boundaries on its northern and eastern extremities respectively. The Catchment includes the whole areas of the Councils of Chichester District, Arun District and Worthing Borough, the majority of Horsham district and parts of Waverley District, Mole Valley District, Adur District, East Hampshire District and Havant Borough.

A3.2.2 Development Control – General Requirements

The consultation requirements of the NRA Southern Region have been identified in tables and maps sent to the Planning Authorities. In assessing an application the NRA seeks to ensure that its interests are protected through the giving of timely and effective advice. Expert evidence would be given at any appeal inquiry following an objection made to a planning application. Proposals of particular concern to the NRA in the Plan area include:

- a) Development including new roads within the inner source protection areas around boreholes for the abstraction of potable water – an objection would normally be made to industrial development and any sewage treatment plants in such areas.
- b) Commercial development, industrial processes and sewage treatment plants which could pollute surface and groundwaters – special precautions are normally required to ensure the protection of such waters.
- c) Development of contaminated land – unless special precautions can be incorporated to protect surface and groundwaters an objection would be made.
- d) Residential development along the undeveloped coast in areas at risk to tidal flooding – an objection would normally be made to new residential development in areas of risk to deep tidal flooding.
- e) The extension of use of holiday accommodation outside the summer months in areas at risk to tidal flooding – such development can give rise to special problems due to restricted access and instability of caravans and an objection would be made to any extension of use. Of particular concern in this respect are the holiday parks in the low lying areas adjacent to the sea defences at Selsey, Pagham and Bracklesham.
- f) Development within fluvial flood plains – such development would normally be opposed as flooding to third parties would be exacerbated as well as the new development itself being at risk to flooding.
- g) Development from which surface water run-off discharged to a watercourse could create or exacerbate flooding – flow attenuation measures would be required to limit rate of run-off.

- h) Development which could restrict or impede NRA access for maintenance and improvement works to classified watercourses and sea defences – it is essential that access is maintained to ensure integrity of defences and effectiveness of drainage systems to ensure flooding is not created or exacerbated.
- i) Development which could be detrimental to the integrity of sea, tidal and fluvial defences – objection would be made to any proposal which would reduce effectiveness of defences thus posing greater risk of flooding to existing development and land.

Opportunities are taken in assessing any planning application to enhance the water environment. The enhancement of river corridors and the creation of water related features within a development are particularly promoted. The NRA also has a general presumption against the culverting (piping) of watercourses beyond that required for access and would also promote the use of wet ponds for any surface water attenuation facilities required, ensuring, through appropriate design and maintenance, that there is no conflict between the conservation and engineering requirements of the pond.

A3.2.3 Housing and Employment

Strategic planning for the majority of the catchment plan area is provided by the Replacement West Sussex Structure Plan which was adopted in March 1993. This plan is under review and a draft consultation will be available in 1995.

The Surrey Structure Plan provides strategic planning for the small part of the catchment covered by Waverley and Mole Valley District Councils. The Hampshire Structure Plan provides strategic planning for again a small part of the catchment covered by East Hampshire District Council and Havant Borough Council.

Identified in Table A3.1 are the housing provisions for the Councils within West Sussex which covers the majority of the Plan area. It should be noted that the housing provision shown is for the entire Boroughs/Districts, not all of which might be allocated within the plan catchment.

Table A3.1 – Housing Provisions

District/Borough Council	Housing Provision		
	1989-1996	1996-2001	2001-2006
Adur	900	400	400
Arun	6700	3100	2400
Chichester	4400	2100	2100
Horsham	500	2700	2300
Worthing	2600	1800	1600

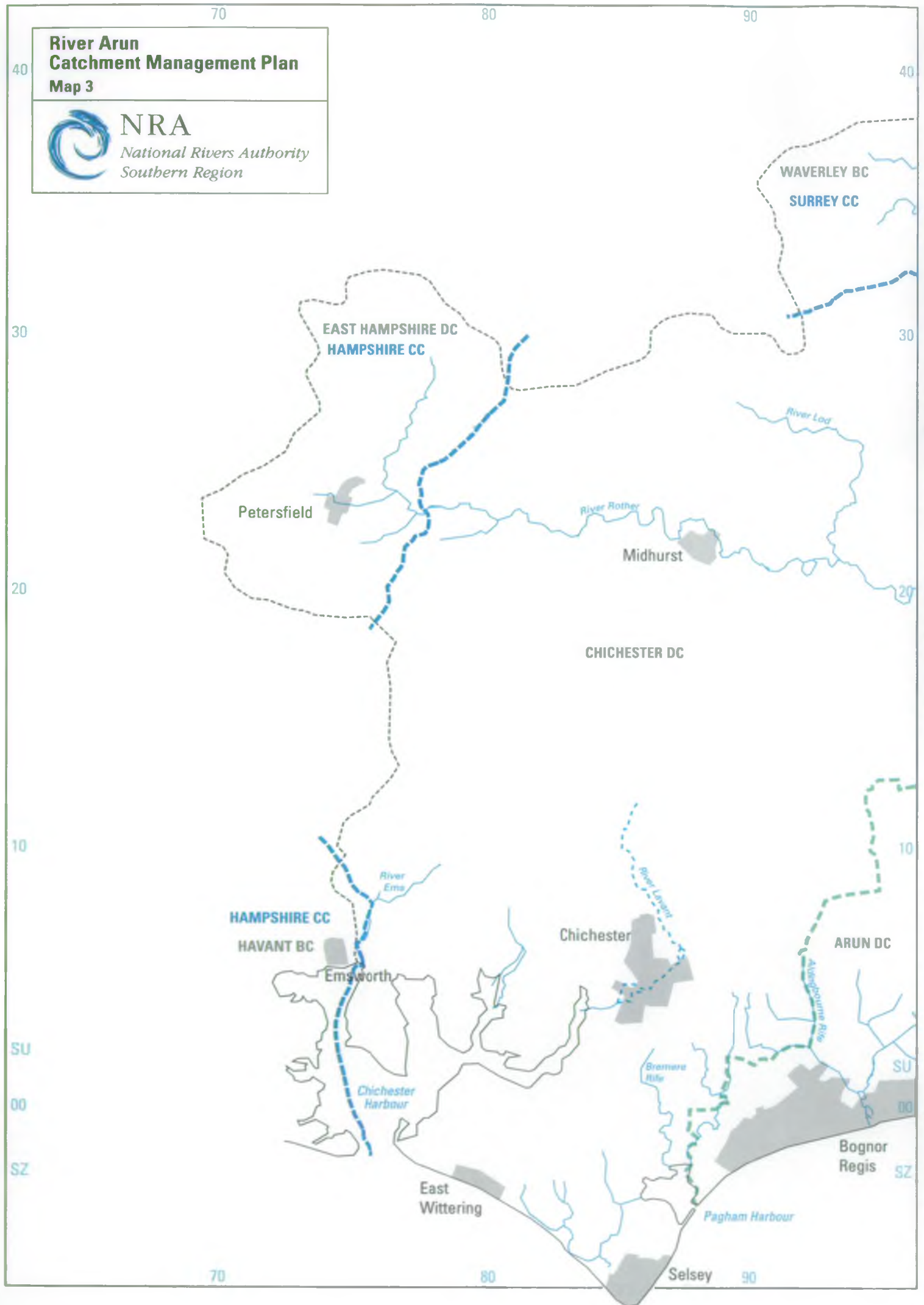
The majority of the housing allocated will be centred around existing urban areas. The total West Sussex population is forecast to rise from 712,600 (1992 figure) to 780,000 (2006 figure).

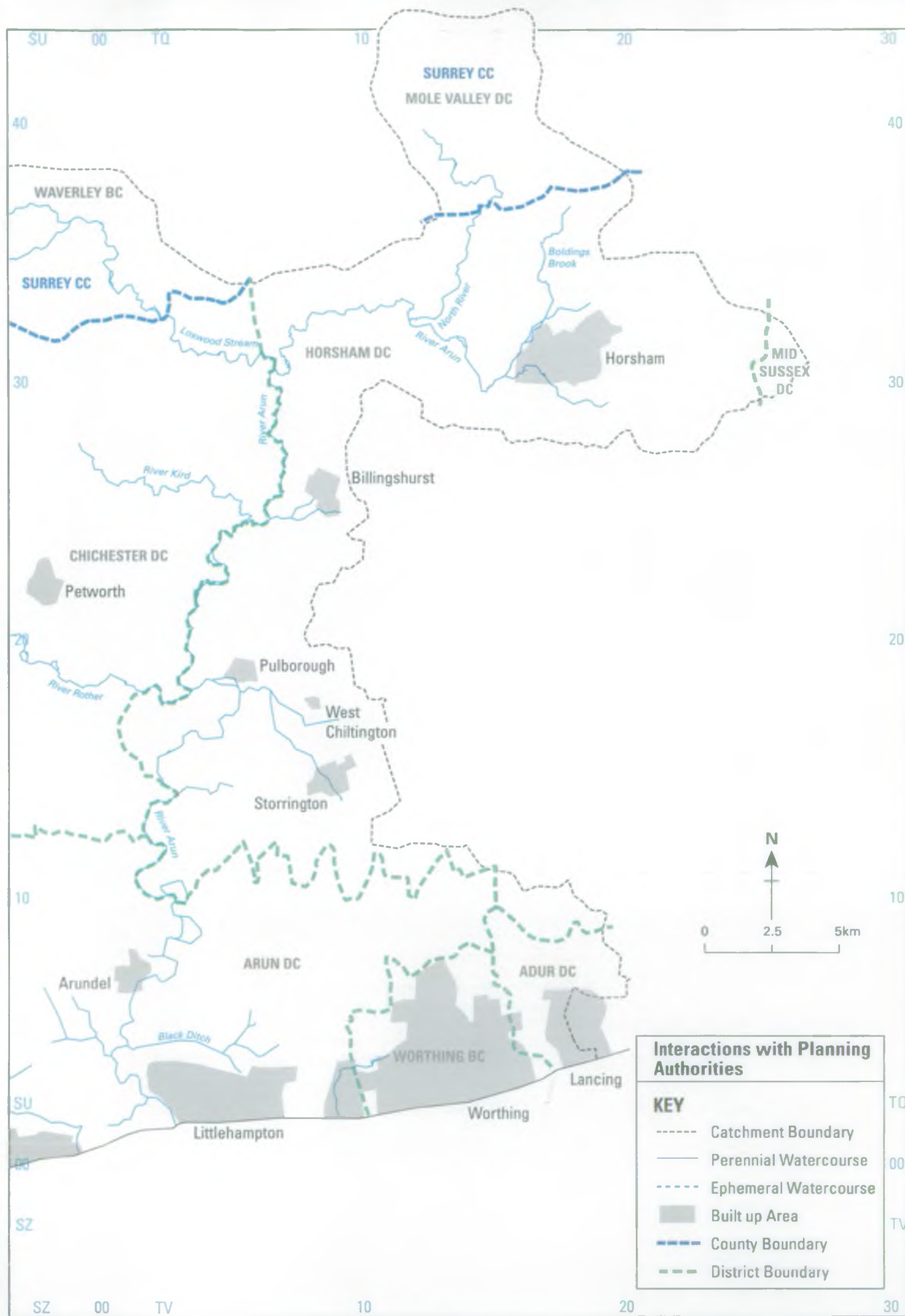
**River Arun
Catchment Management Plan
Map 3**



NRA

*National Rivers Authority
Southern Region*





Interactions with Planning Authorities

KEY

- Catchment Boundary
- Perennial Watercourse
- - - - - Ephemeral Watercourse
- Built up Area
- - - - - County Boundary
- - - - - District Boundary

Allocation has also been made for increased floorspace for business, industry and warehousing within the West Sussex Structure Plan. This will be distributed within the Borough/District Councils as shown in Table A3.2.

Table A3.2 – Allocated Business Floorspace

District/Borough Council	Floorspace ('000m ³)
Adur	110
Arun	230
Chichester	190
Horsham	250
Worthing	170

The allocation of housing, commercial and industrial sites is highlighted within Local Development Plans produced by the Borough/District Councils. NRA concerns with respect to the protection of its interests do impose constraints on development and hence the NRA liaises very closely with Councils to ensure such interests are protected through:

1. The promotion of guidance statements for inclusion in Development Plans for the protection of the water environment.
2. The issuing of maps indicating areas at risk to tidal or fluvial flooding and source protection areas.
3. The allocation of appropriate sites for development within the plan.

A3.2.4 Waste Disposal

The West Sussex Waste Disposal Plan was approved in 1984 and was supplemented by Monitor Reports in 1992 and 1994. Consultation for a new plan began in summer 1995.

Of particular concern to the NRA in assessing any waste disposal proposal is its implications upon:

1. The quality of groundwater – special design requirements are needed to protect groundwaters. The NRA would normally object to the disposal of non-inert waste within inner source protection areas.
2. The quality of surface water – special precautions are required to protect surface water in particular to ensure no leachate discharges to a watercourse. Lagoons may be required to settle silt prior to the discharge of surface water run-off to a watercourse.
3. Groundwater flow – the creation of an impermeable barrier by the clay or other lining to an infill cell can raise the water table upgradient of the site. This could create or exacerbate flooding/drainage problems in the area.

4. Surface water run-off – the creation of a clay bund over a tip site can increase the rate of surface water run-off to a watercourse thus creating or exacerbating flooding downstream. Surface water attenuation ponds may be required to alleviate such problems.
5. Fluvial floodplains – the NRA would normally object to any infilling within the floodplain of a watercourse – as this could create or exacerbate flooding to third parties – unless compensatory waterway area/storage can be provided to alleviate such flooding.

The requirements as stated in the NRA's publication "Policy and Practice for the Protection of Groundwater" are particularly relevant to waste disposal proposals.

A3.2.5 Minerals

National Policy proposed that each County should provide for 10 years extraction of construction aggregates from local sources, at current rates of demand. A draft Minerals Plan is due to be released in late 1995.

Exploitation of gravel deposits can be restricted by the implications of mineral workings upon groundwater movement in the area. This is particularly applicable to the Chichester area, where old mineral workings may have contributed to raised water tables (refer to Section C4.2). Mineral exploitation can also be restricted by NRA requirements to ensure the protection of the source protection areas for water supply, and the requirements of the NRA's publication "Policy and Practice for the Protection of Groundwater" are particularly relevant in this respect (see Section C5.4).

In assessing any proposal careful consideration must also be given to ensure that any pumped discharge of groundwater to a watercourse, required to permit dry working conditions, does not create or exacerbate flooding and drainage problems downstream. It also has to be ensured that no stockpiling of minerals takes place in floodplains, as this would reduce the waterway area or the storage capacity thus exacerbating flooding.

A3.2.6 Road Schemes

Discussions are presently taking place with the West Sussex County Council and the Highways Agency on several road schemes.

In assessing any proposal the NRA seeks to ensure that surface water is directed away from any soakaway drainage system within an inner source protection area and would normally recommend that the route of a new road is not located in such areas. The recommendations of the NRA's publication "Policy and Practice for the Protection of Groundwater" are applied in this respect. Recommendations are also made for the provision of anti-pollution devices to ensure the protection of both surface and groundwaters.

New roads also have implications on the flood defence interests of the NRA. The following matters are taken into account in assessing any proposal:

- 1) The large impermeable area created can result in the increased surface water run-off to a watercourse which can result in flooding problems being created or exacerbated downstream. Surface water attenuation facilities may be required to restrict flows to a watercourse.

- 2) The construction of a road across a river flood plain can result in the loss of flood storage capacity and /or flood waterway area which would create or exacerbate flooding to third parties. Compensatory measures must be included in any design.
- 3) The route of the road may obstruct NRA access along a watercourse to undertake maintenance or improvement works. Measures to ensure future NRA access must be incorporated in the design.
- 4) It must be ensured that bridge structures are designed such that there is no impact on the integrity of any fluvial or tidal defence.

The NRA also seeks to ensure that compensatory features are provided with respect to the water environment for those lost due to the bridging or culverting of watercourses or infilling of floodplains. These can be incorporated in the creation of wet ponds provided to attenuate surface water run-off from the road.

In the Plan area the following proposed schemes have particular implications upon the interests of the NRA:

Arundel Bypass
Angmering Bypass
Bognor Bypass
Capel - Horsham Road
Worthing Bypass
Billingshurst Bypass

SECTION B:
CATCHMENT VISION

B1 INTRODUCTION

This section identifies the primary objectives of the NRA so as to protect and develop a catchment with respect to water quality, water quantity and river topography. These will help the NRA to highlight any concerns it has relative to the Arun catchment when managing the interests identified in Section C.

The NRA will in all its interests work towards a sustainable water environment in the Arun Catchment.

B2 WATER QUALITY

The NRA is responsible for water quality and will aim to:

- ensure water quality is appropriate for the current and potential uses of the Catchment
- reduce nitrate and phosphate input from sewage treatment works and agricultural sources such that the ecology of the river is closer to the natural state and to reduce the potential for blue-green algae formation
- seek the removal or upgrading of unsatisfactory storm sewage overflows in urban areas
- ensure the surface and groundwater resources in the catchment are protected from the effects of new development by close liaison with Local Authorities and Developers

B3 WATER QUANTITY

The NRA is responsible for managing water resources and will aim to:

- ensure the flow in a river is not taken below an environmentally acceptable level by abstractions from the river or groundwater sources
- seek to ensure that abstractors develop sufficient resources to meet their reasonable requirements, promoting the re-distribution of water resources and demand management techniques rather than the development of new sources
- ensure new development does not increase the risk of flooding by increased surface water run-off or loss of floodplain
- ensure new mineral workings and waste disposal sites do not impede groundwater flow such that there is increased risk of flooding and/or derogation of flow elsewhere
- ensure natural flow regimes are not altered to the detriment of the conservation of the water environment or to inhibit the migration of fish
- promote water use efficiency in industry, commerce, agriculture and the home

B4 RIVER TOPOGRAPHY

The NRA protects people, development and land from flooding and has a duty to promote the conservation and enhancement of the natural water environment. It will aim to:

- provide flood defences to people and property at risk of flooding where this is cost effective, taking into account environmental implications of such works
- ensure new development does not reduce the conservation value of the river corridor
- conserve natural river features such as bankside trees, emergent vegetation, meanders and pool riffle sequences where consistent with the requirements of effective flood defence
- promote the development of a buffer strip of uncultivated bankside vegetation
- promote the provision of fish passes
- operate flood defence structures in a manner which has due regard to fisheries and conservation interests
- conduct river corridor surveys of "main rivers" to identify current use and features
- encourage further conservation and recreation use of the catchment where this is compatible with other uses of the river
- enhance wildlife throughout the catchment
- maintain and develop the existing coarse and game fisheries

SECTION C:
MANAGING THE WATER ENVIRONMENT

C1. INTRODUCTION

This section highlights the interests of the NRA in the Arun catchment. General information is given on the roles and responsibilities of the NRA together with information and guidance on the Arun catchment. Concerns of the NRA relative to its interests today and to the future development of the catchment are highlighted as ISSUES which are addressed later in the Plan.

C2. USE OF THE WATER RESOURCE

C2.1 General

The NRA is responsible for the management of surface and groundwater resources. In undertaking this duty, it has to consider the overall use of water within the catchment with the available resource and achieve a sustainable balance between the needs of the environment and those of the public and private water companies and other abstractors. In particular it must ensure that the loss of a water resource does not lead to water quality problems due to less dilution for effluents.

The catchment is divided into resource areas defined on the basis of size and common characteristics. The available water resource for each area is dependent upon its annual effective rainfall and any inflow from an upstream resource area. A licence is generally required from the NRA for the abstraction of water from surface and groundwaters.

In some cases water abstracted from a river is returned directly with minimal losses (eg, cooling waters and gravel washing). Some of the water abstracted to supply customers within a catchment may be returned to the river via effluent discharges, and this can make a significant contribution to the maintenance of river flows.

The difference in volume between the water abstracted from a catchment and that returned constitutes the "consumptive use". In theory this is assessed for a resource area by subtracting the total consented discharge from the total licensed abstraction. In practice consumptive use is assessed using actual abstraction and discharge data for a typical year.

Future growth in demand for water may be influenced by a number of factors: for example, by increasing water use in the home, population growth, local government pressures and economic trends which may affect commercial water usage. The NRA Southern Region publication "Sustaining Our Resources The Way Forward", published in November 1994, sets out a strategy for the future planning and sustainable management of water resources to meet the reasonable needs of public water supplies; industry and agriculture in the region. This concludes that "where the impacts of a scheme are uncertain the NRA will take a precautionary approach".

Controlling growth in demand for water is a critical feature of the strategy for the longer term. Control of losses through leakage from mains and encouraging more efficient use of water at work and at home can significantly reduce growth in demand for water. In this way it may be possible to delay the need for major new strategic water resource schemes, hence minimising environmental impact.

ISSUE 1

In assessing proposals for new development it must be ensured that adequate provisions are made for the proper use and conservation of water resources.

C.2.2 Local Perspective

Groundwater abstraction dominates the public water supply usage in the Arun catchment. With only one surface source the Chalk and Lower Greensand aquifers provide some 83 % of the licensed abstraction total.

Whilst rainfall totals vary across the catchment, an overall approximate annual average of 862 mm can be expected to fall. Of that it is estimated that 354 mm (40 %) provides recharge to the aquifer in that it passes through the soils to replenish groundwater, the balance being the run-off to rivers and the loss due to evapotranspiration and plant growth.

There are five resource areas in the catchment, however, as the River Adur resource only makes up 0.2% it is not further considered. The recharge equivalent of the resource areas are given in Table C.2.1.

Table C2.1 – Resource Areas and Recharge Equivalent in Catchment

Resource Area	Recharge Ml/d	Licensed Groundwater Abstraction	Percentage of licensed totals
Worthing	148	106	72
River Arun	438	40	9
Western Rother	323	29	9
Chichester Chalk	438	183	42

However, if a drought occurs then the recharge equivalent increases as shown in Table C2.2. This indicates the reason why the NRA has a policy of embargo for any further consumptive use on the Chalk aquifers.

Table C.2.2 – Drought Recharge Equivalent

Resource Area	Recharge in 1-5 drought yr (Ml/d)	% of licensed total
Worthing	115	93
River Arun	341	12
Western Rother	251	12
Chichester Chalk	340	54

ISSUE 2

The NRA currently operates a policy of presumption against licensing new consumptive abstractions from the Worthing and Chichester Chalk Blocks. For the Lower Greensands of the Rother, applications are judged on their merits. However, the Chichester Block is known to be at a point where abstraction has an impact on the water dependent environment which the NRA considers unacceptable. Future NRA policy is likely to reflect this.

ISSUE 3

Abstraction from the Hythe beds by Mid Southern Water is thought to impact upon the Ashford Stream. Fed by spring flow from the Hythe beds any upward variation in licence quantities may effect the stream's hydrology. The company is currently undertaking a study following the issuing of a time limited licence variation. This has caused considerable correspondence between local residents, the Authority, the company and its agents, Dynamco.

The majority of abstracted groundwater is used relatively locally to the source of supply although some water is exported out of the catchment particularly to the Sussex Coastline.

The surface water source within the catchment is located at Hardham which was used in a pilot groundwater recharge scheme in the early seventies. Two methods of recharge were tried, lagoons with a permeable bed and borehole injection. Neither provided results which justified continuing the project, so the treatment works presently operates surface and groundwater as individual consumptive purposes. Current licences control abstraction by aggregating the two sources.

The NRA Southern Region Resources Strategy "Sustaining Our Resources, The Way Forward" (1994) identifies the Hardham source as a potential supply for the future, moving water south to the coastal conurbations and additional water north of the Crawley area. The sources of supply development are expected to be both ground and surface water.

ISSUE 4

SWS intend to develop the existing source at Hardham to its full potential by re-examining the groundwater option. The first stage would be to obtain the quantity available under the current groundwater licence by drilling new boreholes. The second stage would be to expand that development beyond the agreed yield of 65 Ml/d is reached. Questions concerning the potential environmental impact must, however, be addressed as a number of conservation projects have commenced since the initial trials in the seventies.

Overall no shortfall in public water supply is predicted for the catchment on an annual basis, but peak abstractions – often caused by hot summer weather, may cause problems later in the planning period (1992 -2021). Much of this depends on how population, industry and agriculture grow over the period and the level of investment from the water company.

Whilst the scope for further control of leakage and demand management within the catchment is being explored, to cope with future growth alternative supplies have been identified:–

1. Develop Hardham groundwater to supply the coast and the north.
2. Import water to the catchment from the River Itchen and other Hampshire sources. Up to 15 Ml/d may be required starting around 2011 but this figure may be reduced and the timescale extended if the Hardham source can be developed beyond 65 Ml/d.

C3. PUBLIC WATER SUPPLY

C3.1 General

In managing water resources the NRA must have particular regard for the statutory duty of the Water Companies to supply water, but must also consider the implications of any loss of water resource, and hence the dilution available for effluents, on the existing water quality, ensure the quality of water abstracted is suitable for drinking water and to further the conservation and enhancement of the natural environment. The Water Resources Act 1991 sets out a system of Abstraction Licences which allow the NRA to control the abstraction of water. The Act also sets out what matters the NRA must take into account when considering an application for a licence (eg, whether the requirements of the applicant are reasonable; the impact on other water users; the impact on river flows/groundwater levels) and describes the procedures which must be followed when applying for a licence. The licence will stipulate maximum annual, daily and sometimes hourly volumes. Private groundwater supplies for larger scale domestic use are also included here, although these are generally very small and not significant from a resources stand point.

Water supply sources in use before 1963 were granted Licences of Right under the Water Resources Act (1963). Since then, new sources have been licensed on the basis that abstraction neither adversely affects existing sources nor impairs the natural environment. Licences issued after 1963 may carry conditions identifying Prescribed Flows or water levels, so as to maintain flows in rivers and require abstraction to cease once the river falls below these levels.

Compensation flows may also be included in licence conditions, requiring the pumping/release of water from groundwater or reservoir sources to augment low river flows. The NRA is carrying out research into Ecologically Acceptable Flows, which will help our understanding of what a living river needs to survive.

At times of extreme water shortage Water Companies may apply to the Department of Environment for a Drought Order to relax abstraction licence conditions or the level of service they provide to their customers. This may allow, for example, the temporary reduction in mains pressure or even periodic closure of the supply. The terms of a Drought Order usually require the Water Company to introduce demand reduction measures, such as hose-pipe bans, at the same time.

The extended dry period from 1989 to 1992 has increased public awareness and concern about the impact of abstraction on river flow and spring sources within the catchment area. It is important however to distinguish between the impacts of abstraction and impacts of drought which are beyond our control. The NRA nationally is developing a methodology for assessing the severity of low flow conditions resulting from excessive but authorised abstraction.

C3.2 Local Perspective

The Arun Catchment comprises five resource areas however, the River Adur resource area only makes up 0.2% of the catchment and is not further considered. The areas are broadly defined along hydrological boundaries for resource assessment and are identified on Table C3.1 together with their hydrological unit numbers.

Table C3.1 – Resource Areas

Resource Areas	Hydrological Unit Number
Worthing Chalk	24
River Arun	25
Western Rother	26
Chichester Chalk	27

Three water companies: Southern Water Services, Portsmouth Water and Mid Southern Water abstract from the Arun Catchment for public water supply using both surface and groundwater sources, although five companies supply water to customers within the catchment.

Table C3.2 – Licensed Abstractions for Water Supply

Resource Area	Mean Licensed Abstractions Ml/d		
	Surface	Groundwater	Total
Worthing	0	106.5	106.5
River Arun	0	40.7	40.7
Western Rother	75.0	29.0	104.0
Chichester Chalk	0	183.1	183.1
CATCHMENT TOTAL	75.0	359.3	434.3

Water is primarily abstracted from groundwater and the licensed and actual abstraction volumes for public water supply for each of the four main resource areas subdivided into surface and groundwater abstractions are presented in Table C3.2.

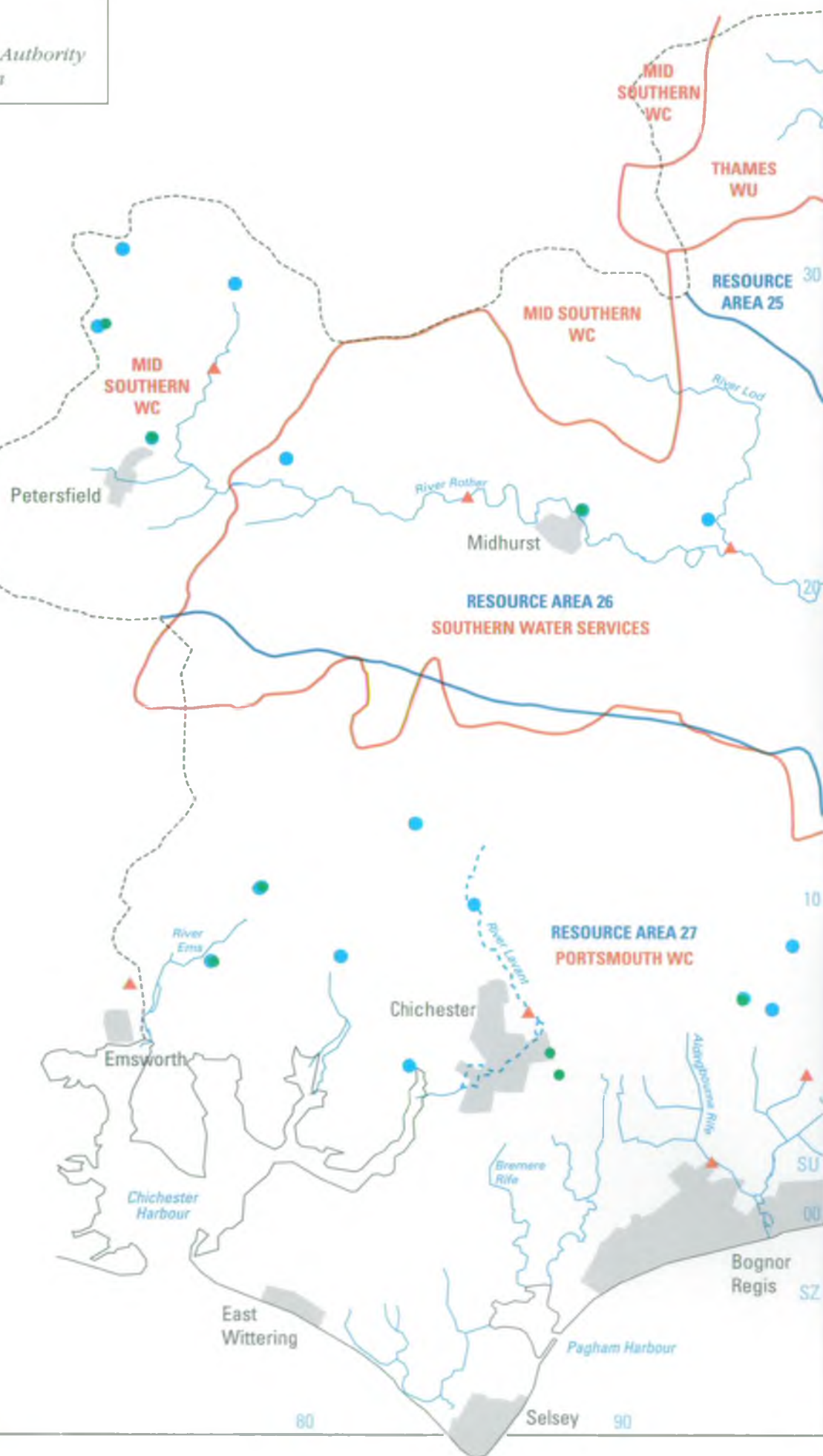
Groundwater is known to move from west to east across the eastern half of the Chichester Chalk Block, the divide being through Goodwood Park and Tangmere, with much of the water discharging to the Arun in the Arundel area. Swanbourne Lake, an SSSI and the Wildfowl Trust on the old water meadow system at Arundel depend upon this water. The Arundel Estate and Wildfowl Trust have expressed concern that current licensed abstractions are damaging the area and that any increase in water abstraction from the ground would exacerbate problems.

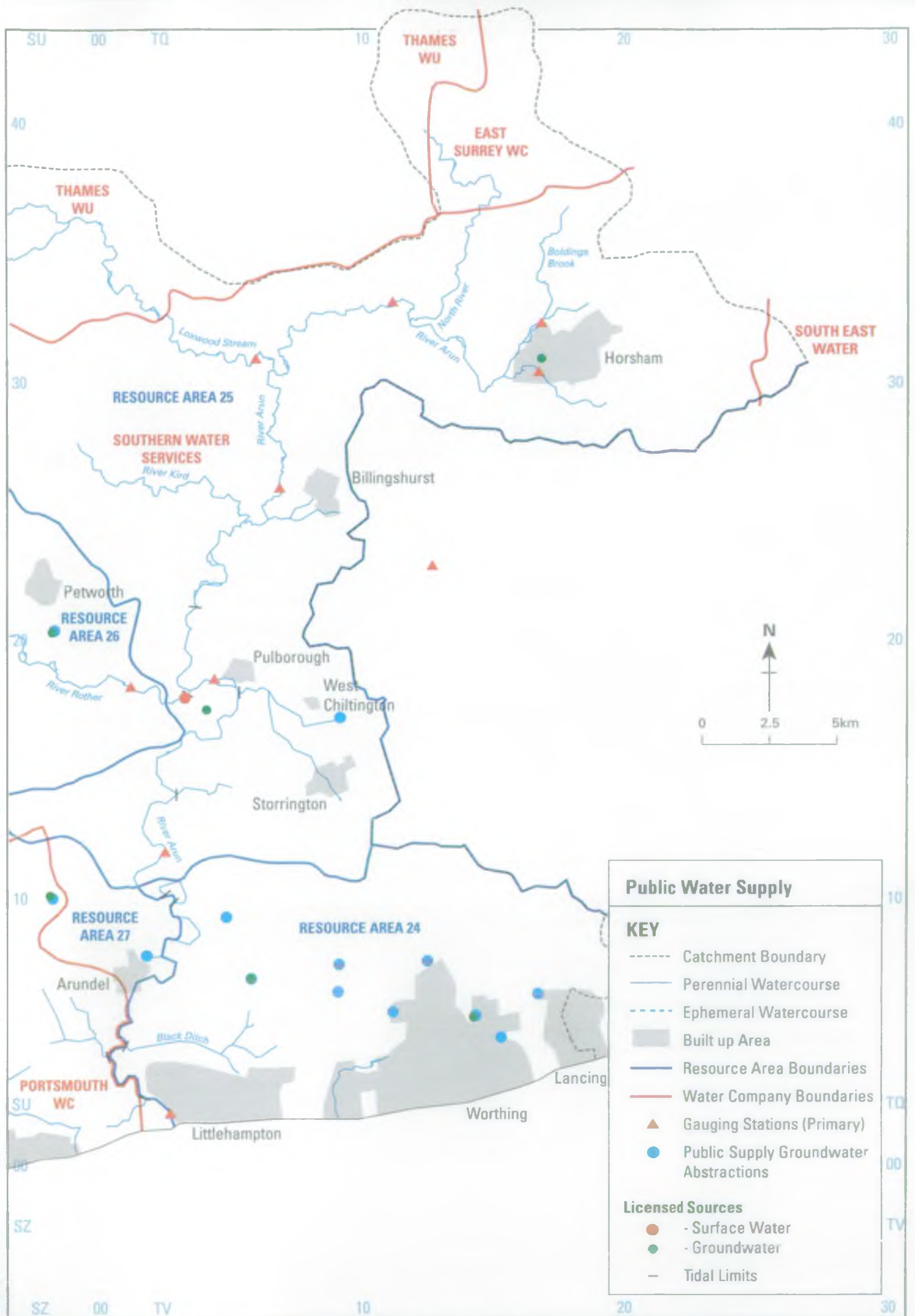
**River Arun
Catchment Management Plan
Map 4**



NRA

National Rivers Authority
Southern Region





During 1995 the NRA refused two applications from water companies for additional consumptive abstractions from the eastern end of the Chalk Block.

ISSUE 5

Recent computer modelling of the Chalk Block indicated that current public water supply abstractions impact upon groundwater dependent features, such as Swanbourne Lake at Arundel. Water companies are currently attempting to address summer demand peaks by the use of additional groundwater sources. Under the Water Resources Act 1991 it is the duty of the NRA to determine whether further abstraction can be permitted.

ISSUE 6

The Portsmouth Water Company public water supply source at Mid Lavant utilises water which would otherwise remain in the Lavant. Even during the floods of 1993/94 the impact of the pumping regime could clearly be discerned. The investigations should be carried out to determine the scale of the impact that pumping makes and produce proposals to lessen these.

C3.2.1 Surface Water Sources

Only one surface public water supply source is operated within the catchment plan area, that of Hardham on the Rother. The source is operated by Southern Water Services, the abstraction being controlled by a minimum residual flow (MRF) at Hardham river gauging station (NGR TQ 034178). The MRF is a cut off volume of water which shall remain untouched. The volume may reduce during the year reflecting the low availability of resources in the summer. The controlling protected limit is that water shall not be abstracted so that the flow in the River Rother falls below 63.6 Ml/d (14 million gallons per day).

ISSUE 7

A minimum residual flow (MRF) has been stipulated for the River Rother at Hardham. The condition was stipulated when the licence was determined, and new environmental analysis techniques could be used to examine the impact of the MRF upon the ecology of the river.

C3.2.2 Groundwater Sources

Groundwater abstraction dominates this catchment as a source of supply accounting for 83% of the authorised total of 434 Ml/d. Of that authorised total 44% was abstracted in 1991. The fact that less is abstracted than is authorised in any one year is not unusual.

The percentage of licensed groundwater abstraction held by the water companies is as follows:

Southern Water	48.6%
Portsmouth Water	46%
Mid Southern Water	5.4%

The first large-scale public water supplies from the Chichester Chalk block (resource area 27) were initiated in about 1874 at Fishbourne and Bognor Regis.

The Fishbourne Source was run by the Chichester Waterworks company and in 1882 records show that 0.27 MI/d (60,000 gallons per day) were supplied. Bognor Water Company constructed a deep well in the town centre in 1879 but this became saline and was replaced by a source at Eastergate which still operates today. Other sources were developed in the following years and ownership consolidated to today's position.

Portsmouth Water Company abstract groundwater via 3 boreholes near Walderton in the parish of Stoughton. Abstracted water is used to augment the flow in the River Ems when this falls below 2.23 MI/d (500,000 gallons/day). A discharge of 1.12 MI/d (250,000 gallons/day) is made to the river below Walderton and this continues until flow in the River Ems recovers to 2.68 MI/d (600,000 gallons/day).

C4 WATER SUPPLY FOR INDUSTRY AND AGRICULTURE

C4.1 General

The NRA manages, through licensing, surface and groundwater supplies abstracted for industrial and agricultural purposes. Industrial abstractions include all licensed supplies for industrial process uses, cooling water and gravel washing. Agricultural abstractions include all supplies for spray irrigation and general agricultural use.

C4.2 Local Perspective

The uses of water for agriculture and industry vary across the catchment and are summarised in Table C4.1

Table C4.1 – Water Uses

Resource Area	Uses of Water
Worthing	Spray Irrigation, Horticulture
River Arun	Gravel Washing, Agriculture and some Industrial Uses
Western Rother	Industrial uses related to Aggregates plus Agriculture and Spray Irrigation
Chichester Chalk	Industrial uses related to Aggregates, Agriculture, Water Cress Farming and Spray Irrigation

Very high groundwater levels in the gravel deposits to the north, east and south of Chichester during the winters of 1993/94 and 1994/95, have raised questions over the efficiency of groundwater movement in the area.

The hydraulic interactions between the River Lavant and the legacy of disused gravel pits (both back filled and open) must be examined to determine flood risk. Water levels recorded at Church Farm Pit, as disused gravel pit to the north of the A27 (T) Westhampnett by-pass, indicate a trend of rising groundwater levels. The pit is confined to the west and east by old landfills and is bunded by low permeability deposits to the south. However there is good hydraulic connection with the River Lavant and unworked gravels to the north. In turn these gravels are in connection with the Chalk at the foot of the Downs.

The NRA has expressed concern that groundwater movement through the gravels is restricted to those deposits left undeveloped to date and has questioned whether further exploitation should take place.

ISSUE 8

Investigations into the legacy of gravel extraction in the Chichester area indicate a trend of rising groundwater. It is thought that the backfilling of old pits and the siltation of pits

left as open water present a barrier to groundwater moving through the gravels from the foot of the Downs to the sea. The winter of 1993/94 indicated how important the gravels are. Any proposed gravel extractions in the area may be opposed by the NRA on the grounds of enhanced flood risk from groundwater.

Seventeen licences are held for private water undertakings, where often one source supplies a number of buildings, usually as part of a large estate with tied residences.

The coastal plain has a large development of horticultural use, mostly under glass. There are also a number of salad vegetable growers supplying supermarket chains, who rely on spray irrigation.

ISSUE 9

Significant agricultural abstractions are made in the coastal strip for market gardening under glass, much of the water being administered via trickle irrigation which is not licensable under the Water Resources Act 1991. The NRA has therefore no control over quantities of water used in this way with implications for derogation of other users.

The total licensed abstractions for each of the resource areas is given in Table C4.2.

Table C4.2 – Licensed Abstractions for Industry and Agriculture

Resource Area	Mean Licensed Abstractions MI/d		
	Surface	Groundwater	Total
Worthing	7.0	8.5	15.5
River Arun	120.0	4.3	124.3
Western Rother	52.9	5.9	58.8
Chichester Chalk	24.2	103.8	128.0
CATCHMENT TOTAL	204.1	122.5	326.6

One topic which has implications upon many of the NRA's functions is the proposal by the Wey and Arun Canal Trust to link London with the South Coast ports by re-opening the canal cut during the last century. A number of isolated sections are to open and the Trust currently holds two licences which allow the filling of the canal with water.

The Trust has been supported by a number of local government bodies aiming to enhance recreation and boating activities on the re-opened canal.

Both the Southern and Thames Regions of the NRA sit as observers of the Trust's Steering Committee meetings in recognition of the fact that, whilst supportive of the recreational aims of the project, the NRA may have to oppose proposals which conflict with its policies. The Trust is proposing to apply to the Millennium Fund for monies to complete the renovation.

ISSUE 10

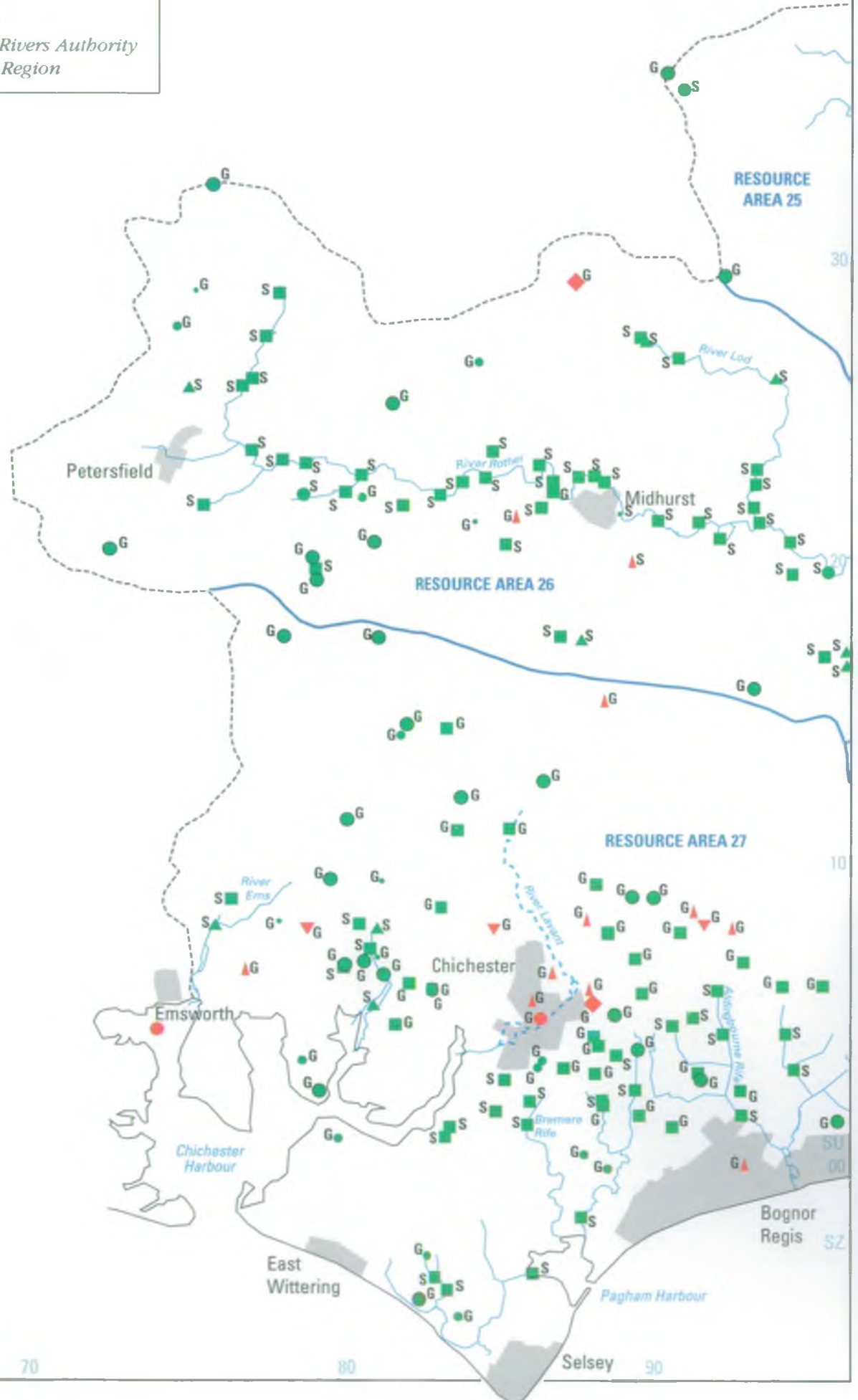
Water related issues for the Wey and Arun Canal Trust include obtaining a reliable water supply for the length of the waterway, reducing leakage and losses from locks to a minimum, and reinstating river crossings without compromising floodplain waterway area/storage.

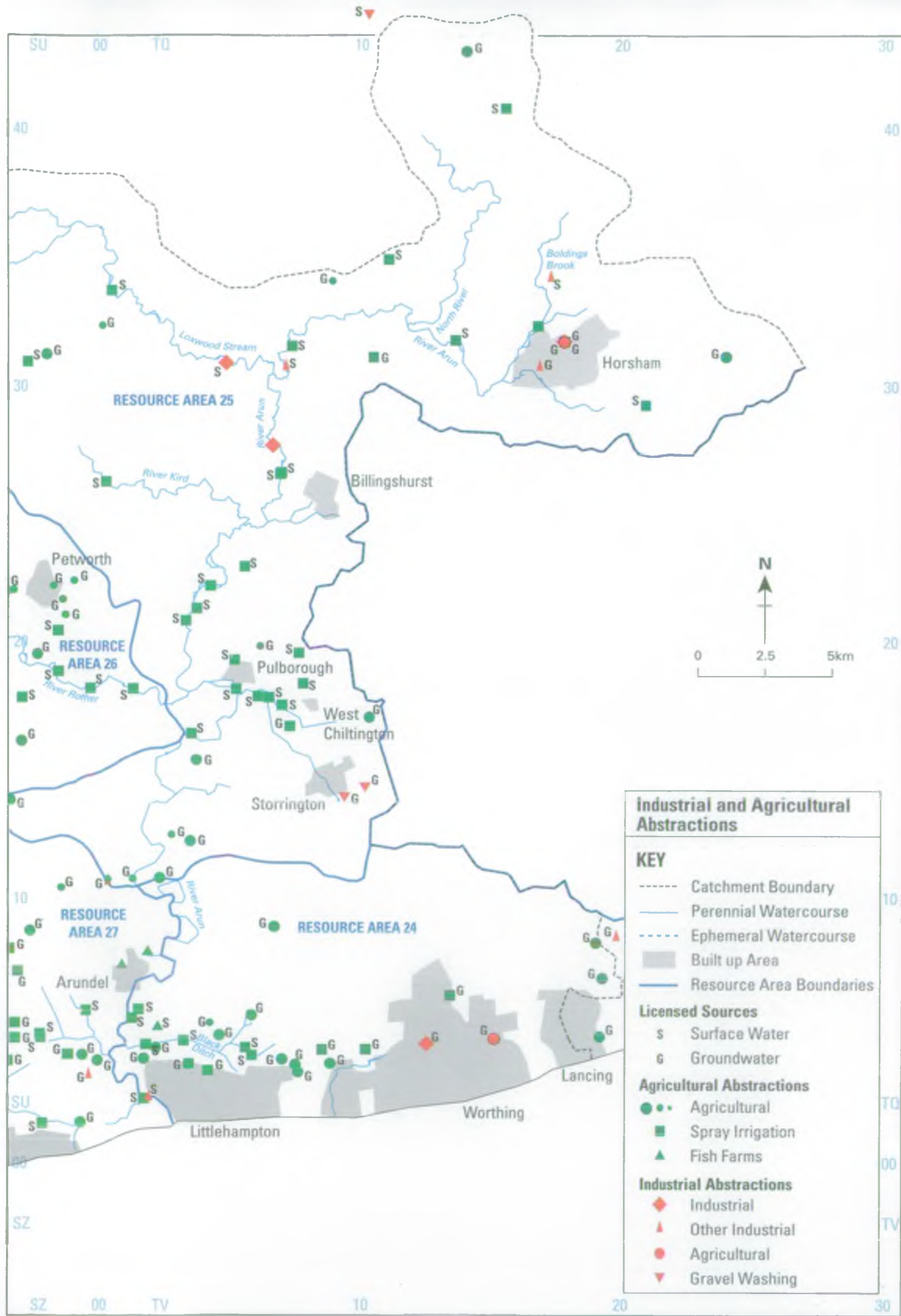
**River Arun
Catchment Management Plan
Map 5**



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C5 WATER QUALITY

C5.1 General

The NRA is responsible for water quality in all controlled waters in England and Wales. These comprise of surface freshwaters (rivers, lakes), underground waters, estuaries and coastal waters to the 3 mile limit. The NRA's aim is to achieve a continuing improvement in the quality of these waters, as such it will seek to maintain waters that are already of high quality, to improve waters of poorer quality and to ensure that all waters are of an appropriate quality for their agreed uses. The effective control of pollution by the NRA is paramount in achieving its aim.

The NRA undertakes periodic assessments of the quality of river water, through the analysis of samples either taken throughout the year, in order to report on the geographical and temporal trends in water quality.

Water quality is primarily assessed against a number of control measures which superseded the former National Water Council (NWC) target classes, namely the General Quality Assessment (GQA) and the River Quality Objective (RQO) Scheme which will form the basis of the Statutory Water Quality Objectives (WQO). These schemes introduce a clear separation, between the dual purpose of periodic assessment of river quality and of target setting for the river quality to protect specific river uses, each of which requires different quality standards and methods of statistical analysis.

In addition there are several EC Directives relating to water quality which have been translated into UK law by Regulations. These contain Environmental Quality Standards (EQS) for rivers and streams which identify quality criteria against which the NRA are obliged to secure compliance through the control of discharges.

The NRA is empowered to decide if water quality is up to prescribed standards, and if not, can determine the most immediate and practical way to ensure water is brought back to a satisfactory standard.

C5.2 Water Quality Assessment

The NRA uses a range of chemical and biological techniques to assess water quality in rivers and canals.

C5.2.1 Chemical Monitoring

Until recently the quality of a river has been reported according to a classification scheme devised by the former National Water Council (NWC). In this scheme, rivers were assigned to one of six classes from "good" to "poor" based principally on a knowledge of the biochemical oxygen demand (BOD) and the concentrations of dissolved oxygen (DO) and ammonia. The NWC scheme was considered unsuitable as it was based on a limited range of chemical parameters only, it was open to subjective interpretation and tended to confuse a general classification system with use-related aspects. It has been replaced by a scheme called the General Quality Assessment (GQA) which identifies sets of standards for the consistent measurement of water quality irrespective of uses applying to a river stretch and hence provides

measurement of water quality irrespective of uses applying to a river stretch and hence provides a nationally consistent mechanism for assessment the overall state of the water environment over time. It consists of a number of separate water quality assessments namely:

- General Chemistry
- Nutrients
- Aesthetics
- Biology

The first of these to be developed is the chemical component which comprises of six tiered classes defined by standards for BOD, DO and ammonia. In the future it is intended that the 3 other components will be added, but this will be dependent upon successful development of suitable classification systems. Predictive techniques to support the biological component of the GQA are being developed through the NRA's research and development programme. It is intended that the biological component will be finalised for the forthcoming river quality survey in 1995. In addition to this, assessment schemes for estuaries, coastal waters and lakes are also currently under development so that the GQA Scheme will eventually embrace all types of surface waters.

The six classes assigned to identify the quality of water in a river under the GQA Scheme are:

CLASS A	-	water of very good quality
CLASS B	-	water of good quality
CLASS C	-	water of fair quality (suitable for high class coarse fish populations)
CLASS D	-	water of fair quality (suitable for coarse fish populations)
CLASS E	-	water of poor quality
CLASS F	-	water of bad quality

C5.2.2 Biological Monitoring

The health of rivers is reflected in the variety and abundance of plants and animals which they support. A major component of this aquatic life is the macroinvertebrates which are small animals visible by eye such as mayfly nymphs, snails and worms which live in or on the river bed. Some of these animals are more sensitive to pollution than others and hence can only live in clean water whilst others can tolerate high levels of pollution.

If a particular animal group is present in a river it is given a score. The score ranges from 10 for those animals which are most sensitive to pollution, to 1 for those which are most tolerant. This method of scoring was put forward by the Biological Monitoring Working Party (BMWP) and is known as the BMWP score. The NRA routinely monitors the macroinvertebrates life in rivers and streams at a network of sampling sites and each site is given a score worked out by adding the scores for all the animals found in a sample. The higher the score, the cleaner the water and the better the biological quality.

A computer program is then used to predict the probable score if the site was in good condition. The observed and predicted scores are compared to produce a Biological Class from A (good) to D (bad). If the BMWP score is less than predicted then it means that the stretch being sampled is affected by pollutants including those which are intermittent, are present at low flow levels or are not looked for in the chemistry classification scheme. The biological quality can therefore be used as a check on the chemical quality at a site and is extremely valuable in assessing water quality.

C5.3 Water Quality Objectives

Water Quality Objectives (WQO) will establish clear water quality targets for controlled waters. The Government has made its intention to apply these on a statutory basis, to provide a commonly agreed framework for regulating bodies and dischargers alike to ensure the protection of all controlled waters. The WQOs will be use-related, based upon a range of water quality standards appropriate for the protection of the "uses" to which the waters may be put. Five river uses are envisaged:-

- River Ecosystem
- Special Ecosystem
- Abstraction for Potable Supply
- Abstraction for Industry and Agriculture
- Water Sports

Utilising the above information the NRA will calculate a permitted pollution load and determine consent conditions to be applied to any discharge approval given for each watercourse.

To date, however, regulations have only been produced for the River Ecosystem and five classes have been established within the use:

- | | |
|--------------|---|
| CLASS RE1 | – water of very good quality suitable for all fish species |
| CLASS RE2 | – water of good quality suitable for all fish species |
| CLASS RE3 | – water of fair quality suitable for high class coarse fish populations |
| CLASS RE4 | – water of fair quality suitable for coarse fish populations |
| CLASS RE5 | – water of poor quality which is likely to limit coarse fish populations |
| UNCLASSIFIED | – water of bad quality in which fish are unlikely to be present or insufficient data available by which to classify water quality |

In the interim therefore the existing system of non-statutory River Quality Objectives (RQOs) will continue to play a key role in water quality planning. The RQOs must be translated from the principles of the old NWC scheme and will, together with the Environmental Quality Standards identified for each watercourse, form the principal basis of the statutory WQOs.

C5.4 Groundwater Protection

The prevention of groundwater contamination is a major objective of the NRA. It has therefore produced a policy document for the protection of groundwater called "Policy and Practice for the Protection of Groundwater".

The document reviews all the potential impacts on groundwater quality and flow due to pollution from new development, contaminated land, disposal of sludge and slurries onto land, diffuse pollution and the physical disturbance of aquifers and groundwater flow. Its application is dependent on the circumstances of each case, but the document gives guidance on the risk in relation to the nature of the aquifer and location with respect to Public Water Supply abstractions from groundwater.

Three zones of protection are defined around each groundwater supply source as follows:-

Zone One – Within the 50 day groundwater travel-time to the supply source

Zone Two – Between 50 and 400 days groundwater travel-time to the supply source

Zone Three – Within the source catchment area but more than 400 days groundwater travel-time to the supply source.

The NRA is to define and map Groundwater Protection Zones (GPZ) for potable water supply abstraction sources in Southern Region to support the commitment given in the NRA Groundwater Protection Policy for national completion of GPZ definitions by 1998.

The NRA is also in the process of producing a set Groundwater Vulnerability Maps on a national basis; the relevant sheet for the Arun catchment should be available from October 1995. These maps are designed to offer guidance regarding the vulnerability of groundwater to pollution from surface activities in relation to the nature of the aquifer and cover material, using the following basis.

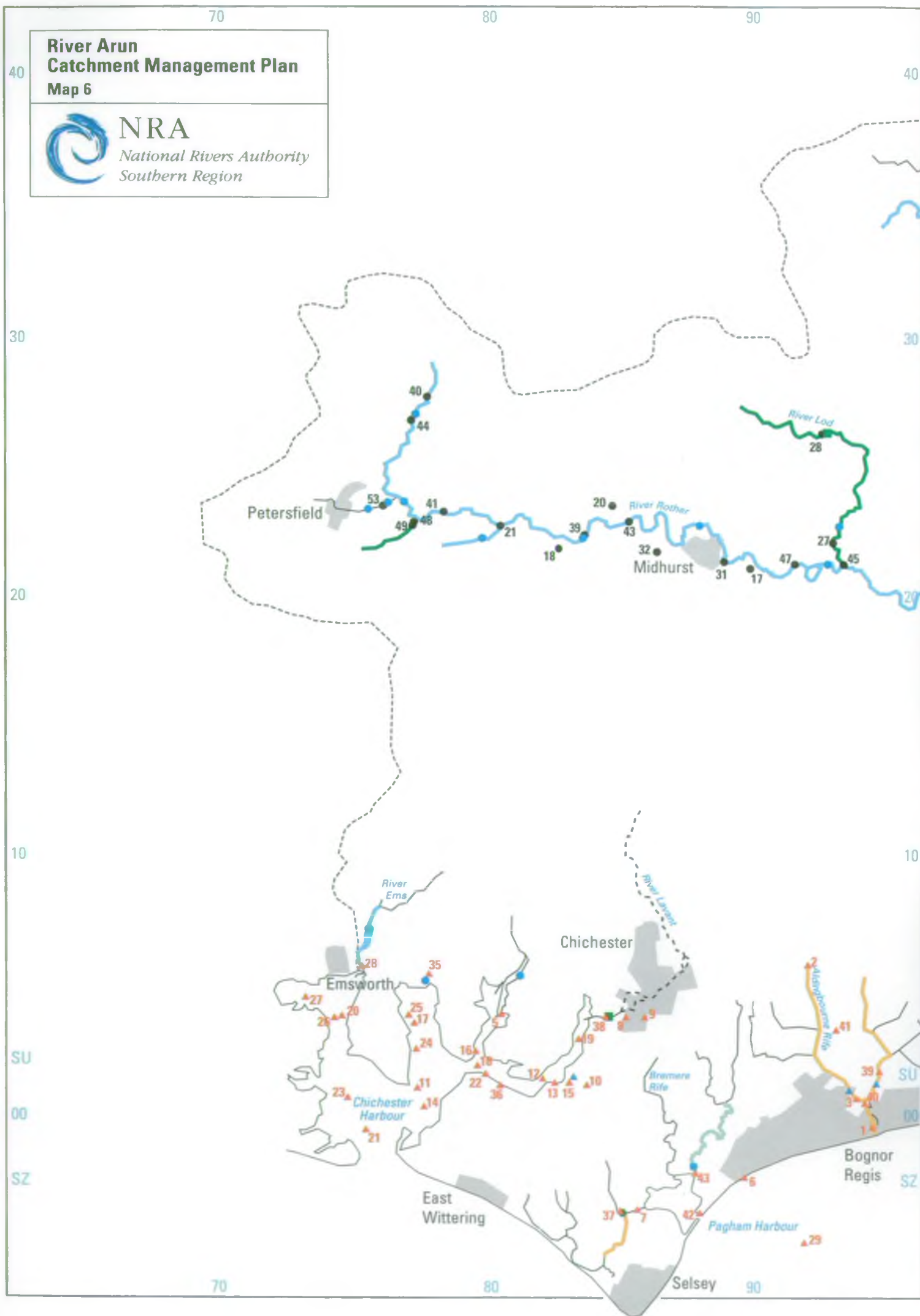
- Nature of the soil cover (high, intermediate or low leaching potential; high leaching potential soils are further sub-divided according to the physical processes controlling water movement through them).
- Nature of any drift cover.
- The value of the bed-rock as an aquifer (major, minor, non-aquifer).

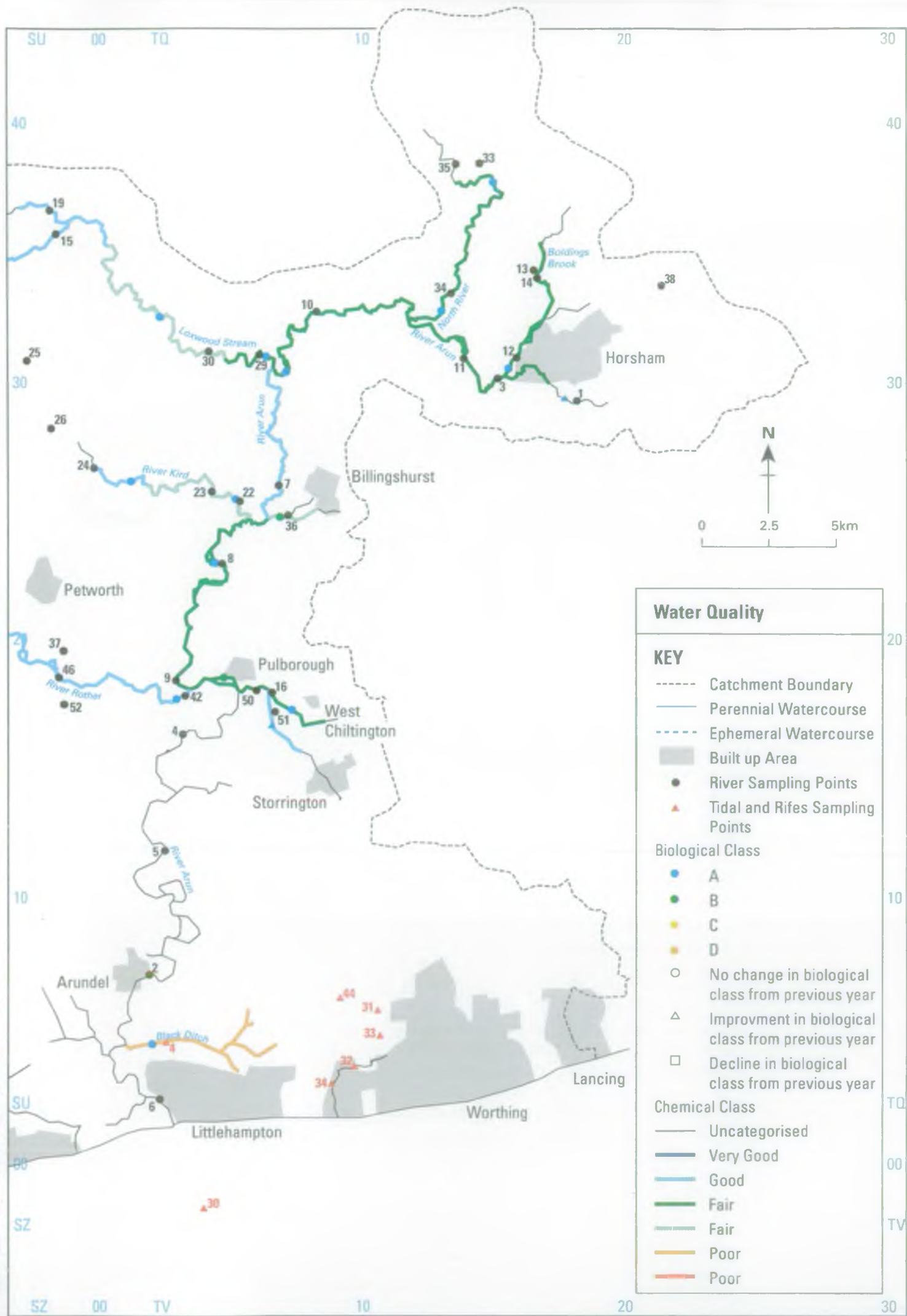
**River Arun
Catchment Management Plan
Map 6**



NRA

*National Rivers Authority
Southern Region*





C5.5 Local Perspective

The current GQA chemical quality of the Arun catchment is shown on the map.

The General Quality Assessment for 1994 (which is based on data from 1992-1994) shows the majority of the River Arun to be of fair/good quality. In certain river stretches and particularly in the Rifes, a combination of low, slow flows and excessive algal growths in summer, can cause low dissolved oxygen levels and subsequently poorer quality gradings. It should also be noted that the catchment is primarily agricultural land and rivers are characterised by diffuse, nutrient rich inputs which encourage algal growth.

The upper reaches of the River Arun including its tributaries the Boldings Brook and North River are of Class C. The Loxwood Stream is a Class B in the upper reaches, but due to slow flows and excessive algal growths there is a length of Class D downstream of Loxwood Bridge.

Downstream of the confluence with the Loxwood Stream the River Arun rises to a Class B at New Bridge. The Par Brook, however, is of a Class D quality downstream of Billingshurst, due to the low dilution available for the effluent from the Billingshurst sewage treatment works, and the River Arun falls to Class C downstream of the confluence with the Par Brook.

The River Kird is Class B in its upper reaches but drops to Class E at Green Bridge due to slow flow and excessive algal growth.

The River Rother is the largest tributary of the River Arun and its quality, and that of its tributaries, is either Class B and C. Similarly the last significant tributary of the River Arun, prior to its tidal limit, the River Stor which, together with its tributary the River Chilt, is of either Class B or C quality.

Low summer flows and excessive algal growth result in the Black Ditch (the only other graded tributary of the River Arun) and the coastal rifes being of either Class D or E quality.

The Ham Brook and the River Ems to the west of the catchment are Class A and B respectively reflecting their spring origins.

The biological quality of the Sussex Rother is good (Class A) throughout its length with a wide range of pollution sensitive animals such as caddisfly larvae and mayfly nymphs. As in many rivers, diversity tends to increase downstream as the river becomes bigger and more habitats are available for the animals to exploit.

Downstream of Rogate the character of the river is affected by several weirs which give low current speed upstream and faster water downstream. In the slow sections large, unstable deposits of sand can accumulate. These curtail the growth of river plants thus reducing habitat variety. The communities found here are still diverse but are adapted to the conditions and are generally different from those in the faster sections.

In its lower reaches the Rother is deep and slow flowing with a silty substrate which supports exceptionally diverse macroinvertebrate communities including the nationally rare dragonfly *Gomphus vugatissimus*.

The tributary streams of the Sussex Rother also exhibit good biological quality although the Minsted Stream, the upper reaches of the Lod, and the Midhurst and Stanbridge Streams support a fauna which is sometimes restricted compared to other streams in the catchment.

Like the Rother, the River Arun catchment is largely rural and this is reflected in the biological quality of many sites (Class A or B). The most rural areas, such as the tributaries of the North River and Loxwood Stream, have diverse and pollution sensitive communities.

Biological quality upstream of Horsham is good but deteriorates temporarily as the river flows through the town. The river improves further downstream at Gibbons Mill, and by Pallingham Manor supports a diverse fauna adapted to reedy, slow flowing habitats, including a wide range of dragonflies. The Par Brook and the River Stor (downstream of Pulborough Sewage Treatment Works) support more variable and restricted communities respectively. Black Ditch has a reduced, ditch type fauna which, nevertheless, indicates good quality.

ISSUE 11

In assessing proposals for new development it must be ensured that adequate precautions are taken to protect the surface and groundwater from pollution.

Table C5.1 – Routine Surface Water Sampling Points

Ref. No.	River/Stream	Sampling Point	Grid Reference
1	River Arun	Amiesmill Farm Bridge, Horsham	TQ 1819 2924
2	River Arun	Arundel Bridge	TQ 0190 0700
3	River Arun	D/S Horsham Bypass	TQ 1519 3012
4	River Arun	Greatham Bridge	TQ 0319 1631
5	River Arun	Houghton Bridge	TQ 0250 1180
6	River Arun	Littlehampton Road Bridge	TQ 0230 0220
7	River Arun	New Bridge, Billingshurst	TQ 0685 2595
8	River Arun	Pallingham Manor (Gauging Weir)	TQ 0468 2292
9	River Arun	Stopham Bridge	TQ 0292 1839
10	River Arun	Wanford Bridge (Bucks Green)	TQ 0830 3270
11	River Arun	Wellcross Bridge, Broadbridge Heath	TQ 1391 3089
12	Boldings Brook	Farthings Bridge, Horsham	TQ 1591 3092
13	Boldings Brook	U/S Warnham STW	TQ 1658 3431
14	Boldings Brook	Warnham Station Bridge	TQ 1671 3401
15	Chiddingfold Stream	White Beech Bridge, Chiddingfold	SU 9835 3570
16	River Chilt	U/S of confluence with River Stor	TQ 0660 1793
17	Costers Brook	Cowdray Estate, Midhurst	SU 8995 2110
18	Elsted Brook	Road Bridge, Elsted	SU 8260 2187
19	Hambledon Stream	Pockford Farm Bridge, Chiddingfold	SU 9811 3662
20	Hammer Stream	Road Bridge, Iping	SU 8468 2352
21	Harting Stream	Mizzards Farm, Rogate	SU 8038 2275
22	River Kird	50m D/S Wisborough Green STW	TQ 0536 2534
23	River Kird	Green Bridge, Wisborough Green	TQ 0430 2571
24	River Kird	Staples Hill, Kirdford	SU 9979 2662
25	Trib. to River Kird	Park Mill Farm Weir, Shillinglee	SU 9720 3080
26	Trib. to River Kird	U/S Wassell Mill, Ebernoe	SU 9815 2815
27	River Lod	Halfway Bridge, Lodsworth	SU 9310 2210
28	River Lod	Lickfold Bridge, Lickfold	SU 9269 2630
29	Loxwood Stream	Drungewick, Loxwood	TQ 0612 3103
30	Loxwood Stream	Loxwood Bridge, Loxwood	TQ 0419 3116
31	Midhurst Stream	Outfall from Midhurst Pond	SU 8895 2136
32	Minsted Stream	A272 Road Bridge, Minsted	SU 8640 2174
33	North River	Eversheds Farm Bridge, Ockley	TQ 1452 3845
34	North River	Slaughter Bridge, Rowhook	TQ 1342 3341
35	North River	Oakwoodhill Bridge, Ockley	TQ 1361 3842
36	Par Brook	Lordings Bridge, Billingshurst	TQ 0720 2480
37	Petworth Brook	Strood Farm, Stopham	SU 9862 1954
38	Rookfield Gill	Rookfield Gill, Faygate	TQ 2142 3372
39	River Rother	A272 Trotton Bridge	SU 8366 2239
40	River Rother	B3006 Road Bridge, Liss	SU 7764 2772
41	River Rother	Durford Bridge	SU 7826 2329
42	River Rother	Hardham Bridge	TQ 0328 1780
43	River Rother	Iping Mill	SU 8531 2291
44	River Rother	Prince's Bridge, Liss	SU 7705 2682
45	River Rother	Selham Bridge	SU 9350 2126
46	River Rother	Shopham Bridge	SU 9845 1851

Table C5.1 – Routine Surface Water Sampling Point *Contd/...*

Ref. No.	River/Stream	Sampling Point	Grid Reference
47	River Rother	South Ambersham Bridge	SU 9165 2127
48	Stanbridge Stream	D/S Petersfield STW	SU 7715 2289
49	Stanbridge Stream	U/S Petersfield STW	SU 7710 2276
50	River Stor	D/S Pulborough STW	TQ 0601 1801
51	River Stor	West Sussex Golf Club Bridge	TQ 0671 1718
52	Sutton Stream	Road Bridge, Sutton	SU 9864 1747
53	Tilmore Brook	Pulens Lane, Petersfield	SU 7601 2352

Table C5.2 – Rifes and Tidal Water Sampling Points

Ref. No.	River/Stream	Sampling Point	Grid Reference
1	Aldingbourne Rife	Felpham Road Bridge (Butlins)	SU 9458 9946
2	Aldingbourne Rife	Sheepwash Cottages, Aldingbourne	SU 9215 0575
3	Aldingbourne Rife	Shripney Road Bridge, Bognor	SU 9398 0058
4	Black Ditch	Lyminster Bridge, Lyminster	TQ 0255 0439
5	Bosham Stream	Discharge to Chichester Harbour	SU 8039 0384
6	Bremere Rife	Halsey Sluice, Sidlesham	SZ 8671 9753
7	Broad Rife	Ferry Sluice, Sidlesham	SZ 8563 9628
8	Broad Rife	U/S Sidlesham STW	SZ 8519 0371
9	Chichester Canal	A27 Road Bridge, Chichester	SU 8591 0371
10	Chichester Canal	Birdham Lock, Birdham	SU 8371 0110
11	Chichester Harbour	Beacon Mark Piles, Thorney Channel	SU 7724 0100
12	Chichester Harbour	Birdham Buoy - Chichester Channel	SU 8195 0135
13	Chichester Harbour	Birdham Yacht Basin, Birdham	SU 8246 0119
14	Chichester Harbour	Camber Buoy - Thorney Channel	SU 7749 0027
15	Chichester Harbour	Chichester Yacht Basin, Birdham	SU 8306 0119
16	Chichester Harbour	Cobnor Buoy - Bosham Channel	SU 7943 0241
17	Chichester Harbour	D/S Great Deeps - Thorney Channel	SU 7713 0350
18	Chichester Harbour	Decpend Buoy - Chichester Channel	SU 7950 0186
19	Chichester Harbour	Dell Quay - Chichester Channel	SU 8341 0288
20	Chichester Harbour	East Branch - Emsworth Channel	SU 7442 0378
21	Chichester Harbour	Fishery Buoy - Stockers Lake	SU 7533 9938
22	Chichester Harbour	Itchenor Hard - Chichester Channel	SU 7980 0153
23	Chichester Harbour	Mill Rithe Buoy - Mill Rithe	SU 7463 0063
24	Chichester Harbour	Thorney Island Sailing Club Jetty	SU 7720 0250
25	Chichester Harbour	U/S Great Deeps - Thorney Channel	SU 7692 0381
26	Chichester Harbour	West Branch - Emsworth Channel	SU 7415 0371
27	Chichester Harbour	Northney - Sweare Deep	SU 7310 0450
28	River Ems	A27 Road Bridge, Emsworth	SU 7518 0572
29	English Channel	Bognor Coastal Sea Outfall Buoy	SZ 9200 9500
30	English Channel	Littlehampton Coastal Outfall Buoy	TV 0400 9800
31	Ferring Rife	Castle Goring, Durrington	TQ 1065 0564
32	Ferring Rife	Ferring Lane Bridge	TQ 0975 0347
33	Ferring Rife	Ferring Rife Footbridge, Durrington	TQ 1074 0465

Table C5.2 – Rifes and Tidal Water Sampling Points *Contd/...*

Ref. No.	River/Stream	Sampling Point	Grid Reference
34	Ferring Rife	Rife Way Bridge, Ferring	TQ 0890 0280
35	Ham Brook	Farm Lane, Southbourne	SU 7768 0539
36	Itchenor Stream	Itchenor Stream	SU 8034 0109
37	Keynore Rife	STW Access Road, Sidlesham	SZ 8496 9624
38	River Lavant	Apuldram Lane Bridge, Chichester	SU 8441 0374
39	Lidsey Rife	Hoe Lane Footbridge, Flansham	SU 9486 0162
40	Lidsey Rife	U/S Conflu. with Aldingbourne Rife	SU 9430 0040
41	Lidsey Rife	U/S Lidsey STW	SU 9431 0325
	Lidsey Tip	North	SU 9265 0340
	Lidsey Tip	East Ditch	SU 9321 0323
	Lidsey Tip	South West	SU 9261 0319
	Lidsey Tip	Old Canal	SU 9261 0311
	Lidsey Tip	U/S Tip	SU 9255 0362
	Lidsey Tip	D/S Canal	SU 9259 0302
42	Pagham Harbour	Pagham Harbour	SZ 8800 9615
43	Pagham Rife	Salthouse Sluice, Pagham	SZ 8785 9769
44	Trib. Black Ditch	Clapham Clay Pit - A280 Culvert	TQ 0922 0611
	Trib. Black Ditch	Clapham Clay Pit - U/S Shutters	TQ 0929 0609
		Pulens Lane, Petersfield	SU 7601 2352

Table C5.3 – Routine Groundwater Quality Monitoring Points

Ref. No.	Sampling Point	Grid Reference
1	Angmering	TQ 058 069
2	Broadwater	TQ 143 054
3	Drayton	SU 881 044
4	Easebourne	SU 888 225
5	Hardham	TQ 041 173
6	Haslingbourne	SU 982 203
7	King and Barnes	TQ 169 309
8	Madehurst	SU 981 101
9	Oakshott	SU 739 284
10	Portfield	SU 878 051
11	Sheet	SU 753 248
12	Walderton	SU 787 104
13	Westergate	SU 939 068
14	Woodmancote	SU 772 080

Table C5.4 – EC Designated Bathing Water Sites

Site	Grid Reference
West Wittering	SZ 7680 9800
Bracklesham Bay	SZ 8050 9630
Selsey	SZ 8680 9370
Pagham	SZ 8920 9720
Bognor Regis	SZ 9230 9850
Middleton on Sea	SZ 9850 9990
Littlehampton	TQ 0400 0130
Worthing	TQ 1390 0210
Lancing	TQ 1830 0360

C.6 EFFLUENT DISPOSAL

C6.1 General

The quality of controlled waters depends on the frequency, volume and types of effluent discharge. This section considers the disposal of domestic, industrial and agricultural effluent to the river system and groundwater. The volumetric and quality conditions to be met by a discharge are set out in a specific discharge consent given by the NRA which is calculated in relation to the quality objective of the receiving water. It follows that if there is any subsequent deterioration in upstream water quality or diminution of river flow below the values used in calculating the consent, then downstream uses and the environment could be put at risk.

C6.2 Local Perspective

The Arun and area catchment comprises a mixture of rural towns and villages, agricultural tracts and large conurbations thus the types of effluent produced and method of disposal vary greatly. Many rural areas are without main drainage and rely on septic tanks, cess pits or small package treatment plants, which are often poorly maintained and can cause localised water quality problems. There are over seven hundred sewage treatment works with consented discharge volumes of less than 15m³/d and nearly one hundred and fifty larger sewage discharges, with six consented discharges more than 5,000m³/d. There are three significant long sea outfalls at Bognor Regis, Littlehampton and Worthing. The sewage discharges at Bognor and Littlehampton are, at present, covered by Deemed Consents which allow the discharges to continue provided that they do not change in quality or quantity. These will be reviewed in due course and the NRA will include conditions relating to the nature, volume and composition of the discharges and to ensure compliance with EC Directives and national policy.

Improvements at Worthing include the provision of a new long sea outfall at East Worthing, transfer of flows from West Worthing, primary treatment and reductions in the numbers and frequency of storm overflows by the provision of storage capacity in the sewerage system.

There are two significant discharges of trade effluent, one from Lec Refrigeration in Bognor Regis and another, through a sea outfall, from Smithkline Beechams at Worthing. Outfall and effluent treatment improvements are currently being undertaken by Smithkline Beechams to improve the quality of and dispersion of effluent.

There are three discharges from sand excavations (Pendean at Midhurst, Heath End at Petworth and Sandgate pits at Storrington), two landfill dewatering discharges (Clockhouse and Brookhurst at Warnham) and one discharge of treated tip leachate from Warnham Claypit.

Several farms have consents for agricultural discharges, although these are undergoing a process of review and, where possible, revocation.

Four significant fish farms and one lobster unit discharge to the catchment. The discharges from these farms are controlled by enforcing consent conditions such that other downstream users are not compromised. There is currently an appeal against the discharge consent conditions from one of these units still awaiting determination by the Secretary of State.

Table C6.1 – Major Consented Discharges in the Catchment

NAME	TYPE	CONSENTED FLOW (m ³ /d)
Horsham	Public STW	16,500
Thornham	Public STW	11,340
Chichester	Public STW	10,100
Petersfield	Public STW	7,040
Sandgate Pit	Pumped Groundwater	6,480
Lidsey	Public STW	5,833
Sidlesham	Public STW	5,800

Studies are currently being undertaken to establish whether Chichester Harbour should be identified as a “sensitive” area under the EC Urban Waste Water Treatment and Nitrate Directive. The first review will be in 1997 and subsequent reviews are required at four yearly intervals.

Achievement of the sensitive area status may require the long-term reduction in nutrient input from existing sewage treatment works. In the meantime it is proposed to continue to impose strict conditions on any new applications for discharge of treated sewage effluent.

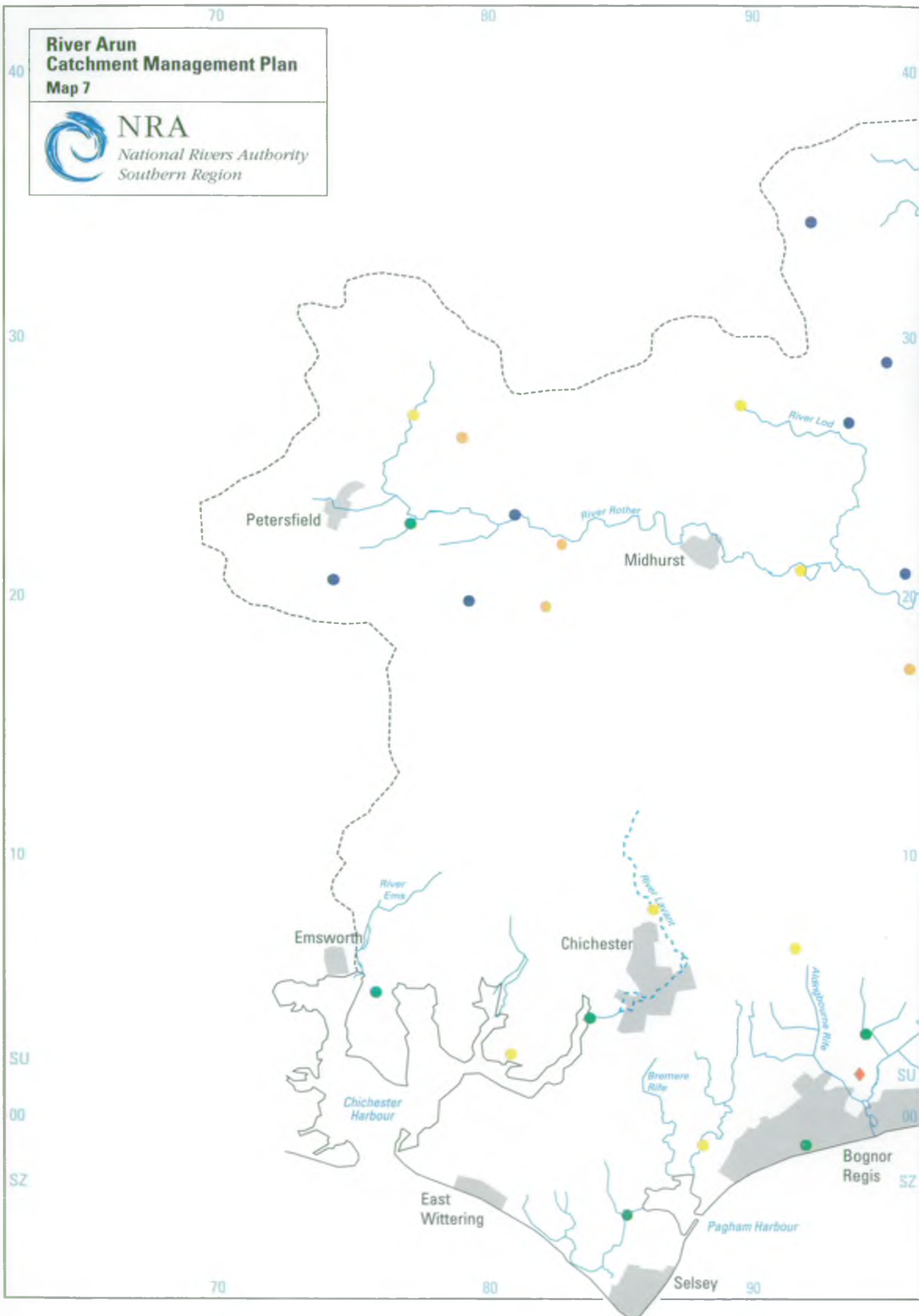
Any required improvements with major sewage discharges will have to form part of the negotiations with Southern Water Services Ltd, OFWAT and the NRA and form part of the 5 and 10 year Management Plans. The next plan is due to be negotiated for the period commencing 2005.

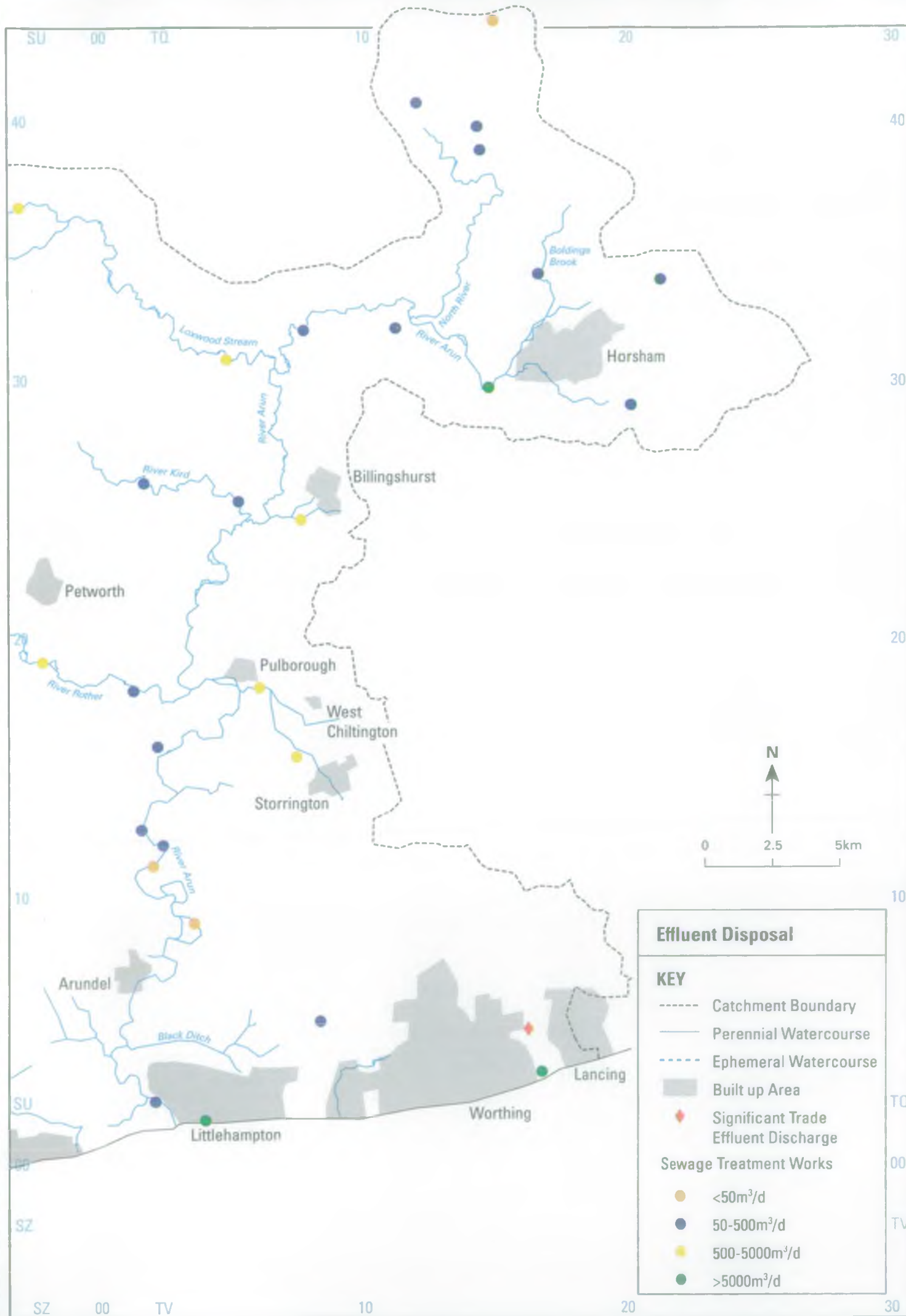
**River Arun
Catchment Management Plan
Map 7**



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C7 INTERMITTENT AND DIFFUSE POLLUTION

C7.1 General

This section examines the wide range of polluting inputs to the catchment not covered by formal discharge consents. These fall into three main categories:-

- 1) **Occasional unconsented discharges from point sources eg accidental and deliberate discharges to a watercourse via surface water outfalls.**

The majority of pollution incidents falling in this category are the result of discharges of either oil or sewage. A small quantity of oil will visibly contaminate a large area of water. Oil emanates from a wide range of sites which includes industrial units, domestic installations and road traffic accidents. Sewage can enter the water environment from many sources ranging from a cess-pit serving one property to a large sewerage treatment works. In rural catchments, accidental discharges from agricultural sources, such as silage liquor or cattle slurry, have a high biochemical oxygen demand and ammonia content and can cause significant pollution, particularly where the discharge is to a small stream offering limited dilution.

- 2) **Intermittent consented point source discharges eg storm sewage overflows.**

This category includes storm sewage overflows from public sewers or sewage treatment works. The overflows are considered necessary to prevent the system being overwhelmed at times of heavy rainfall. The overflow therefore comprises diluted effluent discharging to a stream or river which would normally be in flood. Although polluting implications are minimal, care must be taken in setting the correct level of overflow. A storm water storage facility is often included at sewage works to retain the most heavily contaminated initial flow for later treatment.

ISSUE 12

To minimise implications of storm sewage overflows, it must be ensured that their operation complies with discharge consents and they are adequately maintained.

- 3) **Diffuse inputs.**

Problems arise from discharges from landfill sites and mine tailings, which may or may not operate under NRA consent. The NRA is a statutory consultee for planning applications and shares with Her Majesty's Inspectorate of Pollution (HMIP) and the Waste Regulation Authorities the duty to ensure that the development of such sites does not cause water pollution. However, most closed sites and some which are currently operating, are subject to little control and can pollute surface or groundwater resources.

Agricultural activities frequently result in diffuse pollution of the water environment. High nitrate concentrations are a particular concern in many catchments, caused by fertiliser applications and the ploughing of fallow land. Farmers are encouraged to follow the MAFF Code of Good Agricultural Practice for the Protection of Water, and to seek free advice on pollution control from the NRA or the MAFF Agricultural Development Advisory Service (ADAS).

Together with nitrates, pesticides (fungicides, herbicides, insecticides etc) are of concern as their concentration in drinking water is constrained by EC Directive 75/440/EEC which sets standards for surface water intended for abstraction for drinking water. A significant source of herbicide contamination has been non-agricultural uses such as weed control on roadsides and railway lines, but these are increasingly coming under control.

The NRA publication "Policy and Practice for the Protection of Groundwater" identifies further risks associated to groundwater sources from diffuse pollution.

ISSUE 13

To control intermittent and diffuse pollution in such a way that other uses of the watercourse are not compromised.

C7.2 Local Perspective

As the Arun catchment is a mixture of agricultural, rural and large conurbations the majority of pollution incidents are related to oil spills, agricultural practices and rural sewage drainage.

The first of these originates from the large number of rural properties and industrial premises with oil storage tanks for heating, a combination of poor maintenance and negligence leads to a large number of pollution incidents. In an effort to partially combat this the NRA is promoting a 'Pollution Prevention Pays' campaign directly aimed at industrial and other sites with information, advice and guidelines on such matters as site drainage, storage, disposal, deliveries etc.

ISSUE 14

Leaked or tipped oil from storage tanks serving residential properties, industrial estates and farms leads to pollution of surface and groundwaters.

Agricultural pollution incidents may involve oil but are more usually of an organic nature. The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 were published in the same year as the MAFF Code of Good Agricultural Practice for the Protection of Water and between these two documents advice is given and standards are set for the management of silage and slurry systems and the storage of fuel. Enforcement of the Regulations and pollution prevention in general are aided by a programme of routine site inspections.

ISSUE 15

Surface and groundwaters are susceptible to pollution from farming practices.

The drinking water abstraction at Hardham has had occasional problems with elevated levels of herbicides, above the level for the maximum admissible concentration (MAC) as defined by the European directive relating to the quality of water intended for human consumption (80/778/EEC). Discussions with British Rail, Local Authority Highways Department and local farmers should help control, if not eliminate this problem in the future.

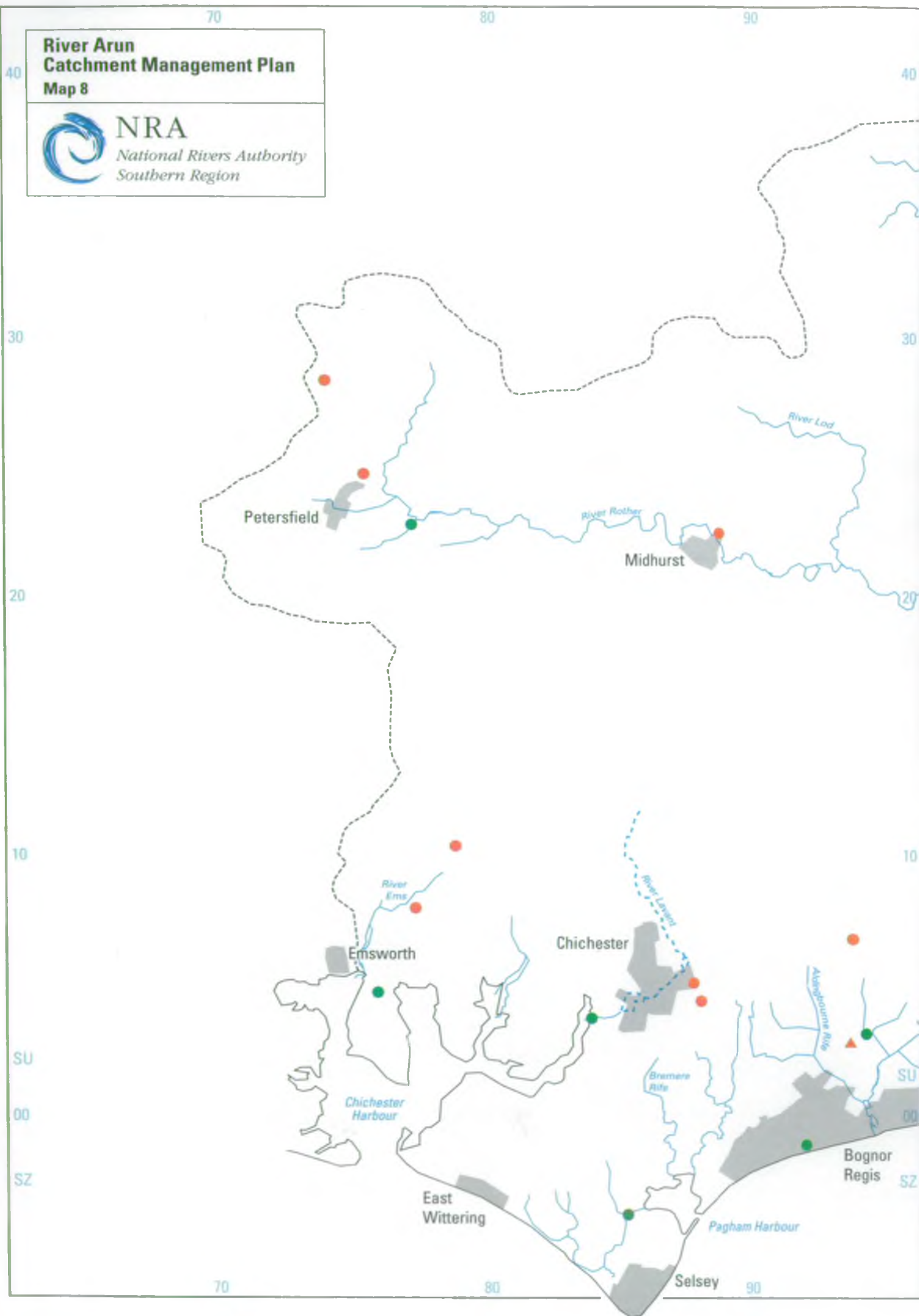
Several Public Water Supply (PWS) abstractions from groundwater in the catchment have nitrate levels which are approaching, or periodically exceed, the MAC for drinking water. Others have nitrate levels which are lower, but are still significantly elevated. Under the Nitrate

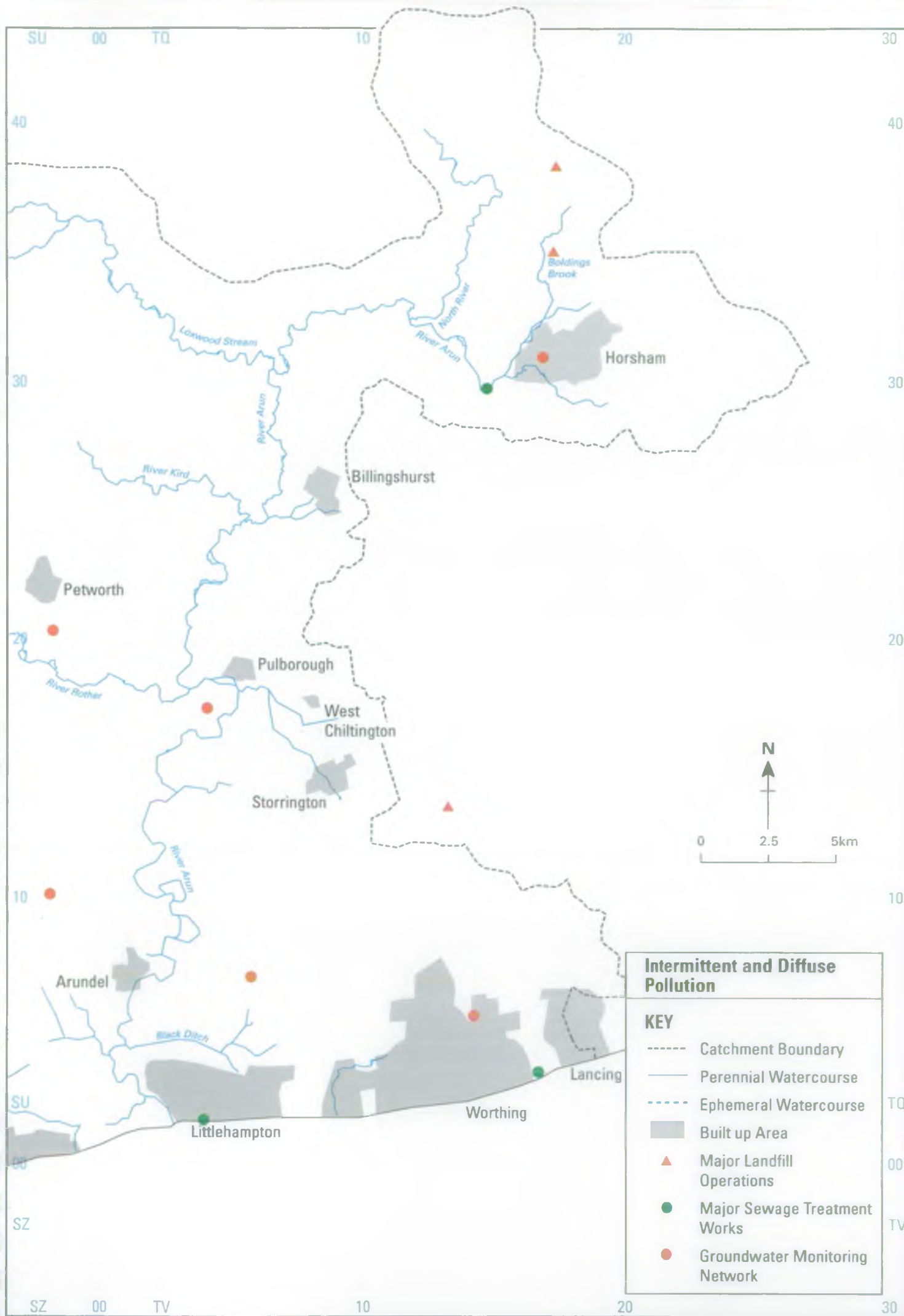
**River Arun
Catchment Management Plan
Map 8**



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Directive (91/676/EEC) action is required by the NRA to attempt to control this problem. The catchments of those PWS sources with elevated nitrate levels will be proposed for designation as Nitrate Vulnerable Zones in 1997 provided they meet certain criteria. This will result in restrictions being placed upon agricultural activities within the catchment of any PWS source designated, particularly on fertilizer application.

ISSUE 16

Groundwater abstracted from chalk and sandstone aquifers for drinking water in the catchment is particularly susceptible to pollution.

ISSUE 17

There is concern that pesticides utilised without due consideration to approved guidelines could contaminate abstraction points at Hardham.

In addition to pollution problems from oil storage, many rural sites cause water quality problems with poorly maintained sewage plants and illegal discharges from cess pits and septic tanks. Where main drainage is provided, there are some areas where reports of surcharging manholes are regular eg, Barnham and Storrington. Discussions are under way with the local sewerage undertaker to remedy this. To control poorly operating private sewage treatment plants, a new enforcement procedure has recently been introduced which will eventually lead to court action.

ISSUE 18

Poor maintenance of cesspits and small treatment plants in areas which are not served by main drainage leads to cumulatively significant water quality problems.

There are ten EC Bathing Beaches in the catchment and compliance with the standards defined in the Directive concerning the quality of bathing water (76/160/EEC) is generally good. Occasional non-compliant samples can usually be attributed to urban run-off following a rainfall event.

There are several landfill sites in the catchment, three of which are currently active and used for the disposal of domestic and commercial waste. All three of these sites operate on a total containment basis and are identified in Table C7.1.

Table C7.1 – Major Landfill Operations (Active)

SITE	TYPE	OPERATOR	WASTE REGULATION AUTHORITY
Lidsley Landfill	Domestic	A J Bull	West Sussex County Council
Brookhurst – Warnham	Domestic	UK Waste	West Sussex County Council
Clockhouse – Capel	Domestic	Surrey Operation Services	Surrey County Council

A project has recently been started to investigate the possibility of re-introducing otters into the Arun catchment. Initially from a water quality aspect this includes looking for organo-chlorine pesticides, PCBs and other chemicals in the potential food of otters. The project will also look at habitat improvement for this animal.

Blue-green algae are organisms with some properties characteristic of both bacteria and algae. They are capable of photosynthesis and the pigment required to do this gives the algae a blue-green colour. Under suitable physical and chemical conditions, particularly in still waters, algal populations may grow to extremely high densities and form a scum which can produce chemicals toxic to mammals including people. Elevated phosphate and nitrate levels can result in high productivity of algal blooms causing oxygen problems. Incidents of algal blooms have occurred in the past at various sites and this information is passed to the local Environmental Health Department who are the competent authority for assessing any subsequent risk to public health.

C8 FLOOD DEFENCE AND LAND DRAINAGE

C8.1 General

Flood defence relates to the provision of effective defence for people and property and land against flooding from rivers and the sea, and to land drainage for agricultural purposes within river valleys and low lying areas of land.

Flooding is a natural hazard usually resulting from extreme climatic conditions such as high winds or very heavy rainfall but which can be exacerbated by blockage of culverts etc or poor maintenance. The severity of a flood is described in terms of its statistical frequency over a long period of time. This is expressed as a return period such as 1 in 50 years ie, in any one year there is a 1 in 50 (2%) chance of flood occurring and the effectiveness of flood defences is measured in the same terms, indicating the frequency with which they can be expected to be breached/overtopped. The Ministry of Agriculture, Fisheries and Food (MAFF) indicative targets for the defence of various land and property against flooding are shown in Table C8.1.

For the purpose of management, certain reaches of the river are formally designated as Statutory Main River. Here, the NRA has special permissive powers under the Water Resources Act (1991) to carry out flood defence and land drainage works, and to control the actions of others to protect these interests. Any proposal that could interfere with the bed or banks, or obstruct the flow in the river, requires formal consent from the NRA. The criteria for designation of Main River are currently under review. Under the Land Drainage Act (1991) the NRA also has a general supervisory duty with respect to land drainage and has powers to control obstructions to and piping of all watercourses.

The drainage of low-lying land may be controlled by Internal Drainage Boards (IDBs). An IDB has permissive powers relative to watercourses within its area, up to the point where they discharge to Main River.

The nature of flood defence works carries the risk of conflict with other river uses - notably fisheries and conservation. This is resolved by consultation and, where feasible, flood protection works are undertaken using methods which enhance the environment. Residential and commercial development and urbanisation can increase the amount and rate of surface water run-off into a watercourse, and hence the risk of flooding. Development in the flood plain is a particular problem as it places additional properties at risk of flooding and reduces the flow attenuation characteristics of the undeveloped land, leading to higher river levels upstream and higher flows downstream of the development. For these reasons development in a catchment requires careful consideration.

The provision of an effective flood warning service is one of the NRA's main priorities with respect to flood defence. Improvements are constantly being sought to provide a more effective service and a major programme of research and development has been established.

Warnings are provided with respect to flooding from both rivers and the sea. NRA staff continuously monitor the weather, rainfall and river levels so that they can predict where river flooding may occur, determine the severity of flooding and the extent of areas that may be affected. Similarly the weather, wave and swell heights, surges and sea levels are monitored to predict where there may be a risk of overtopping or a breach of a sea or tidal defence.

Forecasting of river flood events is aided by the use of weather radar displays showing intensity and distribution of rainfall. Such radar based estimates of rainfall are used to model how rivers will react so that earlier warnings can be issued.

The National Flood Warning Service uses three flood warning codes, each one associated with the type of area and the flood risk. These are briefly summarised below:

YELLOW WARNING

Agricultural land and minor roads likely to be flooded, but flooding of property is not expected.

AMBER WARNING

Agricultural areas and isolated properties are likely to be flooded.

RED WARNING

Residential and commercial properties are likely to be flooded.

Flood warnings are issued to the public via the police. The NRA is investigating further measures to pass such information on to the public.

The NRA's powers to undertake improvement works to watercourses apply primarily to those classified 'main river'. The NRA where it acts as an Internal Drainage Board (IDB) also has similar powers on those watercourses classified as IDB watercourses. On other watercourses, known as 'ordinary' watercourses, the relevant land drainage authority for undertaking improvement schemes would be the Borough/District Councils. No improvement schemes are normally undertaken by the NRA unless a positive cost benefit can be shown. In its supervisory role over land drainage the NRA would advise Councils or the public on any proposals to improve ordinary watercourses, consent for which may also be required.

Table C8.1 – Indicative Standards of Protection (MAFF)

BAND	CURRENT LAND USE	INDICATIVE RETURN PERIOD (Yrs)	
		TIDAL	NON-TIDAL
A	High density Urban Areas	200	100
B	Medium density Urban (may include some agricultural)	150	75
C	Low population density; few properties at risk; highly productive agricultural land	50	25
D	General arable farming, medium productivity, isolated properties	20	10
E	Low population density; low productivity agriculture; grassland	5	1

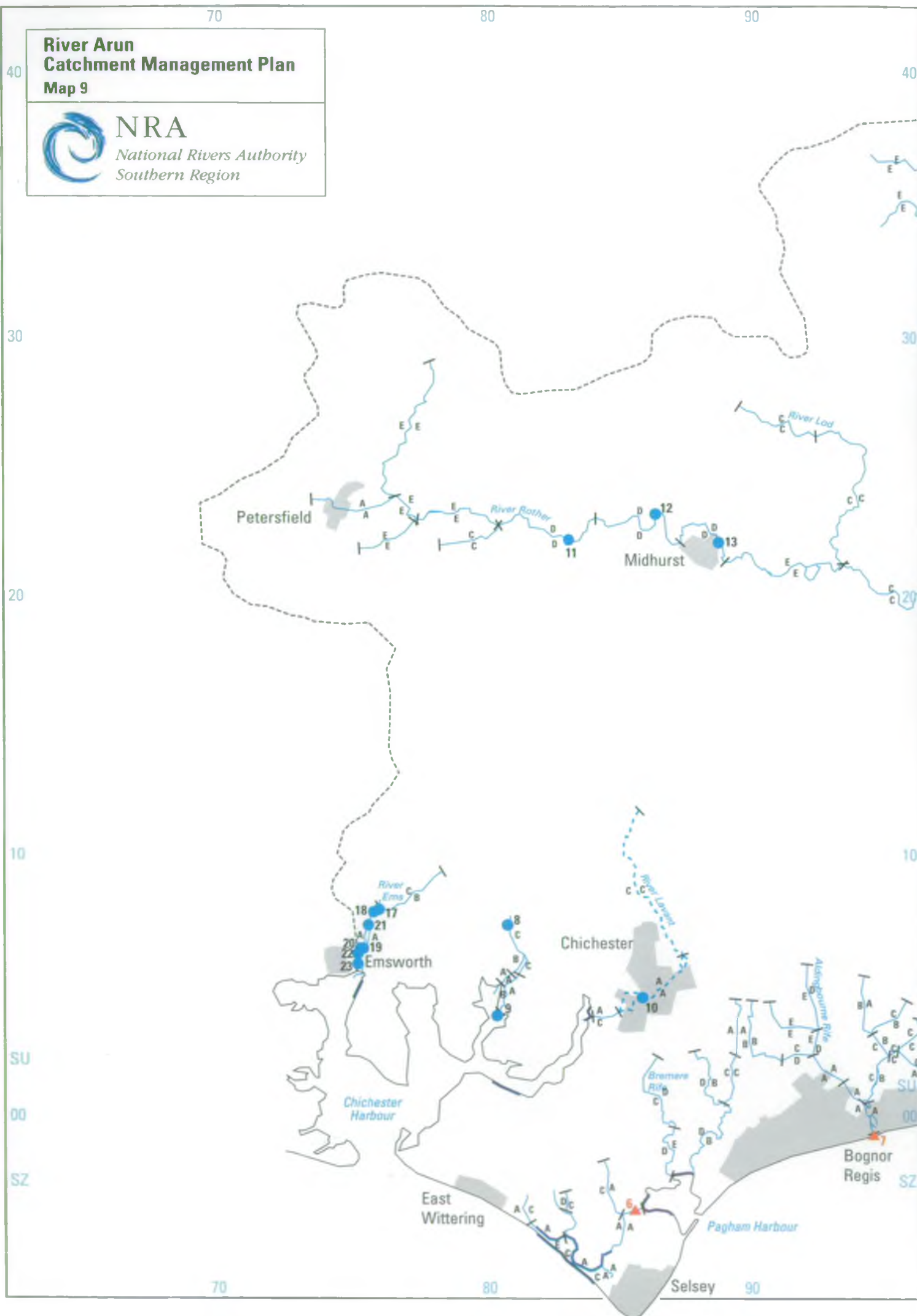
(These MAFF standards are indicative and do not represent an entitlement or minimum level to be aimed at).

**River Arun
Catchment Management Plan
Map 9**



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C8.2 Local Perspective

The powers of the NRA relative to land drainage and flood defence are by way of the Water Resources Act 1991 and Land Drainage Act 1991. These are also complemented locally by the 'Land Drainage and Sea Defence Byelaws' which give further powers relative to main rivers, floodplains and sea defences under the jurisdiction of the NRA, and Internal Drainage District Land Drainage Byelaws which the NRA utilise acting as the Internal Drainage Boards within the catchment.

The plan catchment comprises principally, the catchments of the River Arun, River Ems, River Lavant, Aldingbourne Rife, Pagham Rife and Ferring Rife.

The Arun catchment, with the Rother as its major tributary, is the largest in the catchment and Sussex. It rises between Horsham and Crawley although its upland tributaries namely Boldings Brook, North River and the Loxwood Stream extend the catchment boundaries northwards to Rusper and Ockley and westwards to Haslemere. The River Rother rises north of Liss and flows eastwards to Midhurst and Fittleworth to join the Arun at Hardham. Sandstone and chalk predominate in the Rother catchment leading to a considerable flow contribution from groundwater. Tidal influence on the Arun extends to Pallingham on the Arun and Hardham on the Rother. The middle reaches follow a meandering course from the tidal limit through Pulborough, Houghton and Arundel. The lower reaches then extend to the sea at Littlehampton. Tidal defences are provided from Littlehampton to Pulborough to contain river and tidal waters. The land protected is largely used for agriculture but also includes low-lying urban and industrial areas at Littlehampton, Arundel and Pulborough. Five land drainage pumping stations pump water into the lower reaches of the River Arun.

The tidal defences must be maintained and protected against erosion caused by the exceptional high velocity of flow in the River Arun. The tidal velocities at Arundel Bridge are very high, particularly on the flood tide when they can reach some six and a half knots. This makes the River Arun one of the fastest flowing rivers in the country. However, the freshwater discharge velocities down the river are very much less – about three knots at Arundel.

The Littlehampton Harbour Board operate under powers derived from the Littlehampton Harbour and Arun Drainage Outfall Act of 1927 and the Commissioners Clauses Act of 1847. The Board's powers extend to Arundel Bridge.

The Chichester Harbour Conservancy is responsible for Chichester Harbour within limits specified within their 1971 Act.

The River Lavant catchment extends from the South Downs escarpment in the north to the Chichester Harbour in the south. The stream network comprises basically two separate systems, namely the Lavant and Bosham Streams. The dominant system, however, is that of the River Lavant which is entirely fed by dip-slope chalk springs and flows on average for about six months per year. The Lavant catchment abounds with springs, and the head of the Lavant can rise upstream of East Dean. Other ephemeral watercourses are generated at Bosham, Hambrook, Fishbourne and Chilgrove. Stream water levels in the area generally rise and fall slowly.

The River Ems catchment extends from the South Downs escarpment in the north to the Chichester Harbour at Emsworth in the south. The Ems is a typical dip-slope chalk stream and is naturally ephemeral over most of its length. The Ems rises at a source of springs to the north-east of Stoughton and surprisingly can behave in a flashy manner particularly when the springs are active and producing a steady base flow. Compensation flow is provided by Portsmouth Water Company to augment low flows in the river.

The Pagham Rife and Broad Rife catchments are primarily coastal extending almost to the South Downs in the north, and in the south forming the Selsey Peninsula. The catchments also include Pagham Harbour. The Broad Rife and its tributary the Keynor Rife drain the area north-west of Selsey, and the Pagham Rife and its tributary the Bremere Rife drain the area north of Pagham Harbour. Both Rife catchments outfall to Pagham Harbour, though the Broad Rife system also has a point of outfall into Bracklesham Bay. The Ferry Land Drainage Pumping Station pumps water from the Broad Rife to Pagham Harbour.

The now disused Chichester Canal still contains water in its reach from Chichester City to Chichester Harbour north of Birdham. All channels draining to the sea or Pagham Harbour or Chichester Harbour are provided with flapped outlets and are tidelocked (water in rivers cannot discharge to sea as sea level is higher) for some hours either side of high tide. Owing to the low gradients available, stream velocities are low and water levels rise and fall very slowly.

The Aldingbourne Rife is spring fed from a source to the north of Aldingbourne; it flows to the sea between Bognor Regis and Felpham, collecting tributary flow from Oving and Tangmere in the west. Drainage of the eastern part of the sub-catchment is partly to the Aldingbourne Rife and partly to the Ryebank Rife. A large part of the catchment is below sea level and channels are tidelocked although a proportion of drainage can be pumped to sea at the Felpham Pumping Station. Floodplains associated with the Aldingbourne Rife are utilised for storage of flood water during such conditions. Flows in the streams in the upper parts of the area can rise fairly rapidly particularly when the catchment is saturated as experienced in Barnham in December 1993.

The areas west and east of Worthing are drained by the Ferring Rife and Teville Stream respectively, although only the former is classified 'main river'. The Ferring Rife discharges to the sea and is tidelocked over certain periods. Banks of the Rife have been raised upstream of the outfall to store water during such periods and additional flood storage is provided by 2 lagoons on the western bank. The Teville Stream discharges to sea via the lake at Brooklands.

There are two Internal Drainage Board areas within the plan catchment namely the Arun IDB and the South West Sussex IDB. The powers of the IDBs have been vested in the NRA who now control works within the area.

The coastal plain can be up to four metres below high tide levels. Sea defences under the jurisdiction of the NRA or the Councils acting as Coast Protection Authorities, protect the public, property and land from flooding from the sea. The lengths of sea defence maintained by the NRA consist principally of shingle banks contained within timber groyne fields although at Felpham and Elmer the NRA maintains sea walls and in the latter off-shore rock breakwaters. Preliminary maps identifying areas at risk to tidal flooding have been produced by the NRA for planning purposes. The NRA would normally oppose development outside built up areas in areas at risk to deep tidal flooding.

ISSUE 19

The coastal plains of the catchment are below sea level. The integrity of the sea and tidal defences is paramount in ensuring continued protection to property and land from tidal flooding.

ISSUE 20

Low lying land behind sea defences must be considered at risk to tidal flooding in the event of a breach or overwhelming of the defence. New development on such areas along the existing undeveloped coast should be resisted and restrictions placed on types of development in built up areas so as to minimise the risk to life and property in the event of a severe breach or overwhelming of defences.

The net littoral drift of shingle along the Sussex coastline is from the west to the east, although there are locations where the direction reverses due to local conditions eg to the west of Selsey. There is evidence that the sources from which the shingle is derived are being cut off and the rate of replenishment diminishing. Consequently the NRA has to import shingle to maintain the effectiveness of sea defences and undertake a high level of maintenance and repair work. This is particularly applicable to the frontages at Selsey and Bracklesham where regular replenishment is required throughout each winter. Alternative strategies are to be investigated for these areas following a coastal cell study presently being undertaken on behalf of the NRA and the maritime Councils between Pagham and Portsmouth.

ISSUE 21

The NRA through its aerial survey of the coastline will monitor the volume of beach material forming the sea defences.

A major part of the NRA flood defence budget is allocated to the maintenance and improvement of sea defences. Recently major works have been undertaken to improve defences at Elmer and Felpham to alleviate property flooding at a cost of £3.5 million. The Aldingbourne outfall is in the process of being rebuilt at a cost of £830,000. Improvement works to defences are also hoped to be undertaken along the Shoreham to Worthing frontage at a cost of £15 million and further works at Felpham are also being considered.

ISSUE 22

With further development in the catchment there is an increasing threat to access routes to and along sea defences.

In designing new sea and tidal defences and also in assessing implications of tidal flooding on new development, the NRA gives due consideration to a rise in sea level caused by the "greenhouse effect" and secular rise (due to the southern half of England sinking) of 6mm/year. This figure is the "best estimate" put forward by MAFF. Close liaison is undertaken between the NRA and maritime Councils (those adjacent to coastline) on all sea defence schemes undertaken by either party. To aid future strategies a shoreline management plan is to be produced for the coastal cell between Pagham and Beachy Head (west of Eastbourne) and to coordinate and implement this the NRA, maritime Councils and harbour authorities have formed the South Downs Coastal Group.

ISSUE 23

With the loss of rain forests there is increasing concern regarding the use of timber particularly in sea defence works. The NRA seeks to ensure that all timber is from a sustainable source.

ISSUE 24

Many of the sea and tidal defences date back hundreds of years. There have been many improvements made to these. The combination of sea level rise and sinking of land in south-east England, however, produces an effective annual sea level rise of 6mm per annum. There is also increasing wave attack as levels rise damaging defences and causing a gradual reduction in the standard of protection.

Tables C8.2 and C8.3 identify the pumping stations and primary control structures in the area. Many control structures on watercourses in the plan area are in private ownership and this includes sluice-gates on 'main rivers' which are operated by mill owners. Drainage problems have been associated with the control of such structures by private owners in both flood and low flow conditions. Access to remote sites to operate gates in flood conditions is also a concern.

ISSUE 25

Private sluices need to be operated correctly during flood events to minimise both flood risk and detriment to fisheries and conservation interests.

Maps indicating floodplains of 'main rivers' are kept and utilised by the NRA to assess implications of new development upon flooding. It is planned to update these to include floodplains of ordinary watercourses as part of the survey undertaken by the NRA under S105 of the Water Resources Act 1991. These will also enable a better assessment of the implications of new development on flooding to be made.

ISSUE 26

Flood information in an effective format is essential if relevant advice is to be given with respect to flood risk to new and existing property and land and assessing implications of new development on flooding.

Pressure from new development can exacerbate or create flooding in the catchment due to increased impermeable areas reducing seepage to the ground and increasing quantity and rate of surface water run-off. The creation of attenuation facilities on new development sites to limit the rate of surface water run-off are frequently proposed by developers.

The principal flood areas within the catchment are associated with the floodplains of the River Arun, River Rother, Pagham Rife and Aldingbourne Rife. The floodplain on the lower Arun can be as wide as 3kms (at Amberley Wildbrooks) although it is generally about 1km. On the upper reaches of the River Arun and on the River Rother the floodplain is generally 200-300 metres wide. The floodplain of the Pagham Rife and Aldingbourne Rife can be 200-400 metres wide along the lower reaches but narrows to 100 metres in the upper reaches. The NRA would generally oppose development in a river floodplain.

ISSUE 27

Careful consideration must be given to the implications of increased surface water run-off to watercourses, generated by additional impermeable areas from new development so as to ensure flooding is not exacerbated or created. Development and infilling within fluvial floodplains will be resisted.

ISSUE 28

Attenuation ponds, required to restrict the rate of surface water run-off to watercourses from new developments so as not to exacerbate flooding downstream, can only work effectively if adequately maintained.

The river catchments in the plan are floodprone and the NRA is aware that flooding has occurred in parts of the following towns and villages:

- Pulborough, Houghton, Storrington, Nutbourne in the Lower Arun catchment including flooding at Arundel and Littlehampton due to surface drainage systems being tidelocked.
- Horsham, Billingshurst, Chiddingfold, Slinfold and Wisborough in the Upper Arun catchment. The 1968 flooding was the most severe event in this locality.
- Fittleworth, Midhurst, Petersfield and Sheet in the Rother catchment.
- Chichester, Singleton, Charlton and East Dean in the River Lavant catchment and Fishbourne, Bosham and Appledram in smaller adjacent catchments.
- Westbourne, Stoughton, Walderton and property adjacent to the Slipper Mill Pond in the River Ems catchment.
- Selsey, Earnley, Birdham and Itchenor in the Pagham Rife catchment.
- Shripney, Bersted, Middleton, Barnham, Walberton, Westergate and Yapton in the Aldingbourne Rife catchment.
- Durrington in the Ferring Rife catchment.
- Surface water run-off from the south downs flowing down 'dry' valleys causes flooding in the Sompting area.

The flooding of areas of West Sussex that occurred on or after December 30th 1993 highlighted the need to investigate the standard of service being provided by the NRA on the 'main rivers'. Due to the flooding that occurred at Barnham and Chichester this is particularly being investigated on the main river sections of the Barnham Rife and River Lavant.

At Barnham, where some 90 properties flooded, the culverted section of the Rife under the railway has been assessed to be capable of passing the 1 in 10 year return period flow. The NRA plans to increase the capacity of the Rife at this point to the 1 in 50 year standard in 1995 at a cost of £550,000.

The NRA has also commissioned consulting engineers to investigate the flooding that occurred on the River Lavant and assess the feasibility of providing a flood alleviation scheme for the city of Chichester. The estimated cost of such a scheme is in the region of £5.5 million and provided a positive cost benefit for the scheme can be identified, the NRA will promote the scheme by seeking grant aid from MAFF.

Concerns regarding proposals for development, including the proposed Bognor Regis Bypass, within the Aldingbourne Rife catchment have resulted in the NRA commissioning consultants to investigate the extend of existing flooding and implications of further development. Of particular concern is development within the floodplain of the Aldingbourne Rife.

The NRA operates a 24 hour communication centre at Worthing monitoring weather forecasts, weather radar, rainfall and river and tidal levels within the catchment. In the event of flooding being predicted warnings are issued to the police and some local authorities. Measures are presently being investigated as to alternative/supplementary methods of issuing warnings to the public.

The river level stations utilised for flood predictions are identified in Table C8.4. Rainfall measuring stations are identified in Table C8.5.

ISSUE 29

There is a need to investigate how flood warnings could be more effectively disseminated to the public.

The responsibility for maintaining any stream or river rests with the riparian owner ie, the person who owns the stream or river. The NRA has powers to undertake maintenance and improvement work to main rivers and, in its capacity as IDB within the catchment, rivers within the Board's area. In undertaking such work consideration has to be given to the implications upon river ecology. The NRA would not undertake any works to prevent erosion of river banks unless there was a risk to the integrity of a fluvial or tidal defence.

The continued ability to maintain and improve streams and rivers must be considered when assessing new development proposals.

ISSUE 30

To ensure effective drainage within a catchment, maintenance of streams is required and should be undertaken taking into full account environmental aspects. The prime responsibility for maintenance rests with the riparian owner.

ISSUE 31

To ensure maintenance and improvement works can be undertaken to rivers so as to maintain effective drainage of a catchment, adequate access is required along the river bank tops. The NRA will on 'main rivers' under its jurisdiction require the retention of unobstructed access routes along the river bank top where new development is proposed.

ISSUE 32

Prior to the undertaking of any maintenance or improvements works on rivers the NRA will evaluate implications of such works on the river ecology so as to minimise environmental implications.

A Water Level Management Plan is being produced by the NRA for the SSSI at Amberley Wildbrooks under the guidelines set out in the document "Water Level Management Plans – A Procedure Guide for Operating Authorities" jointly published in June 1994 by MAFF, English Nature, NRA and the Association of Drainage Authorities. Amberley Wildbrooks is a priority site within the Water Level Plan Initiative because of its high conservation importance.

The intention of the plan is to balance and integrate the agricultural, flood defence, water resources and conservation interests of the site, setting out its agreed future management in relation to water level control structures, ditch maintenance and related activities. Hence the plan preparation procedure is essentially one of consultation, discussion, negotiation and technical appraisal. It will take account of all interests with the aim, where possible, to further the conservation of wildlife and the enhancement of the natural water environment.

Table C8.2 – Land Drainage Pumping Stations

Ref.	Location	Name	Description Pumps
1	Hardham (TQ 045168)	Church Farm P.S.	2 no. submersible
2	Greatham (TQ 036164)	Greatham P.S.	3 no. submersible
3	Bury (TQ 016125)	Bury P.S.	1 no. axial
4	Houghton (TQ 023116)	Houghton P.S.	1 no. axial
5	Pulborough (TQ 045185)	Swan Bridge P.S.	2 no. submersible
6	Broad Rife (SU 856963)	Ferry P.S.	2 no. axial
7	Aldingbourne Rife (SU 947992)	Felpham P.S.	3 no. axial

Table C8.3 – Principal River Level Control Structures

Ref.	Location (Grid Ref)	Name	Description
1	River Arun (TQ 169 303)	Provender Mill (Horsham)	Automatic Tilting Gate (Electric)
2	River Arun (TQ 084 327)	Wanford Mill	Automatic Lifting Gate (Electric)
3	River Arun (TQ 071 308)	Gibbons Mill	Manual Triple Lifting Gate
4	River Arun (TQ 071 271)	Rowner Mill	Manual Triple Lifting Gate
5	Boldings Brook (TQ 168 323)	Warnham Mill Gate (Horsham)	Automatic Lifting Gate (Electric)
6	Loxwood Stream (TQ 046 311)	Brewhurst Mill	Manual Triple Lifting Gate, Manual Lift Gate
7	River Kird (TQ 029 259)	Barkfold Mill	Manual Twin Lifting Gates,
8	Bosham Stream (SU 807 073)	West Ashling Mill	Manual Lifting Gate
9	Bosham Stream (SU 803 038)	Bosham Mill	Manual Lifting Gate
10	River Lavant (SU 859 045)	Avenue De Chartres (Chichester)	Manual Lifting Gate
11	River Rother (SU 831 222)	Terwick Mill	Manual Twin Lifting Gates High Level, Twin Lifting Gates Low Level
12	River Rother (SU 864 232)	Stedham Mill	Automatic Lifting Gate (Electric), Manual Triple Lifting Gates
13	River Rother (SU 888 221)	North Mill (Midhurst)	Automatic Radial Folding Gate (incorporating fish ladder - Electric)
14	River Rother (SU 972 194)	Coultershaw Mill	Manual Triple Lifting Gates
15	River Rother (TQ 009 184)	Fittleworth Mill	Manual Private 5 no., 4 no. & 2 no. Lifting Gates
16	River Rother (TQ 033 178)	Hardham Gate	Automatic Tilting Gate (Electric)

Table C8.3 – Principal River Level Control Structures *Contd/...*

Ref.	Location (Grid Ref)	Name	Description
17	River Ems (SU 759 079)	Mill Upstream River Street (Westbourne)	Manual (inclined) Lifting Gate
18	River Ems (SU 757 078)	Mill Upstream North Street (Westbourne)	Manual Triple Lifting Gate
19	River Ems (SU 753 064)	Lumley Mill High Level	Manual Lifting Gate
20	River Ems (SU 752 064)	Lumley Mill Low Level	Manual Twin Lifting Gate
21	River Ems (SU 752 063)	Constant Springs	Manual Lifting Gate
22	River Ems (SU 751 062)	Emsworth Flour Mill (Upstream)	A27 Flood Storage Lagoon
23	River Ems (SU 751 058)	Emsworth Mill Bypass Channel	Manual Twin Lifting Gates

Table C8.4 – River Level Stations on Telemetry System

Ref.	Site	Grid Reference	River
1	Tanbridge, Horsham	TQ 168 304	Arun
2	Alfoldean, Slinfold	TQ 112 331	Arun
3	Drungewick, Loxwood	TQ 060 309	Loxwood Stream
4	Newbridge, Billingshurst	TQ 069 259	Arun
5	Park Mound, Fittleworth	TQ 127 229	Arun
6	Pulborough	TQ 044 185	Arun
7	Houghton Bridge, Bury	TQ 025 811	Arun
8	Littlehampton	TQ 027 017	Arun
9	Princes Marsh, Liss	SU 772 270	Rother
10	Iping Mill, Midhurst	SU 852 229	Rother
11	Lodsbridge, Lodsworth	SU 935 213	Rother
12	Fittleworth	TQ 012 182	Rother
13	Shripney, Bognor Regis	SU 929 016	Aldingbourne
14	Graylingwell, Chichester	SU 871 064	Lavant
15	Westbourne	SU 746 073	Ems
16	Warnham Mill Pond, Warnham	TQ 169 323	Boldings Brook
17	Barnham	SU 959 044	Barnham Rife

Table C8.5 – Rainfall Measuring Stations on Telemetry System

Ref.	Site	Grid Reference
1	Walderton	SU 787 105
2	South Mundam	SU 881 005
3	Princes Marsh	SU 772 270
4	Iping Mill	SU 852 229
5	Chiddingfold	SU 969 366
6	Kirdford	TQ 016 260
7	Holmbury St. Mary	TQ 111 441
8	Durrington	TQ 114 058
9	Barnham	SU 938 070
10	Chilgrove	SU 837 143

C9 CONSERVATION

C9.1 General

The NRA has a statutory duty in undertaking its functions to promote the protection and enhancement of the flora and fauna of the water environment. A healthy river and adjacent corridor environment are characterised by diverse and abundant plant and animal communities which enhance the overall quality of the landscape.

The character of the river and its corridor is highly dependent on the adjacent land use and the type and frequency of river works undertaken. Rivers have been managed and used by man for thousands of years. The creation of water meadows and wet pasture, pollarded willows and mills, all added to the diversity and quality of the environment, both ecologically and visually. However, measures like river realignment, removal of bankside trees and draining of wetlands have significantly altered parts of the water environment. Modern farming has often led to the removal of riverside vegetation and utilisation of the land up to the banks of the watercourse. This practice effectively removes beneficial shading and cover from the river and can often result in increased soil erosion and siltation of the river bed.

The NRA's conservation duties are set in Sections 16 and 17 of the Water Resources Act 1991, and require the NRA, whilst carrying out its own functions or dealing with proposals by others, to further the conservation of flora, fauna, geological and physiographical features of special interest, and the enhancement of natural beauty. Consideration of the impact of all proposals is also required to encompass the impacts on the man made environment including buildings and sites and objects of architectural, historic or archaeological interest.

ISSUE 33

In assessing proposals for new development due regard must be taken of impact on nature conservation, recreation and fisheries interests. River corridors will be promoted and initiatives encouraged which seek to restore or enhance the natural elements of the water environment.

Many other statutory and voluntary bodies have roles and responsibilities regarding conservation. English Nature is the official body primarily responsible for nature conservation and has the functions of establishing, maintaining and managing National Nature Reserves (NNRs), advising the Government, providing general information and advice and giving grants and supporting research. English Nature is also required to notify Sites of Special Scientific Interest (SSSIs) which are protected by the Wildlife and Countryside Act 1981. County Trusts for Nature Conservation or Wildlife Trusts look after County Trust Reserves (CTRs), Local Nature Reserves (LNRs) and Sites of Nature Conservation Interest (SNCIs). The Royal Society for the Protection of Birds also plays an important part in protecting wildlife and has established many reserves.

The Countryside Commission is responsible for conserving and enhancing the natural beauty and amenity of the countryside. It is empowered to designate, for confirmation by the Secretary of State for the Environment, National Parks and Areas of Outstanding Natural Beauty (AONBs). The Commission operates the Countryside Stewardship Scheme which offers grants to landowners for the preservation and re-creation of natural landscapes and wildlife habitats, including waterside areas.

The Commission also advises the Government on the Environmentally Sensitive Areas (ESAs) programme which has similar aims and is managed by the Ministry of Agriculture, Fisheries and Food.

Lists of buildings of special architectural or historical interest are compiled by the Secretary of State for the Environment. English Heritage is responsible for protecting and conserving the architectural and archaeological heritage through managing Ancient Monuments and providing advice and information. Local planning authorities can also designate for special protection 'conservation areas' of particular interest.

The National Trust an independent charity, owns and protects a variety of properties and areas of natural beauty and/or interest and makes these open to the public.

C9.2 Local Perspective

The landscape of the upper catchment is predominantly gently undulating improved pasture with frequent small woods, areas of scrub and some neutral and acidic unimproved pastures. The South Downs, are one of the most striking features in the lower catchment with natural gateways to the coastal plain being formed where rivers have cut through the Downs.

The river catchment supports a variety of habitats ranging from riffles and earth cliffs at one extreme, to extensive lowland wet grasslands at the other. The habitat is also influenced by the tidal movements in the River Arun and saltmarsh species are common below Houghton Bridge where the saline water intrudes.

ISSUE 34

Opportunities exist to minimise saltmarsh damage and in some locations recreate them.

By far the richest habitats for plants in the catchment are the ditches of the lower Arun and the lower end of the Rother. Many of these hold very diverse communities with many uncommon or rare species. Their continued diversity depends on the use of sensitive management techniques. It is in these ditches that many of the rare pondweeds are found, including the nationally rare Sharp-leaved Pondweed. In the summer the ditches are a blaze of colour, with Purple Loosestrife, Yellow Loosestrife and Marsh Woundwort amongst many others.

ISSUE 35

Areas of floodplain grassland in the Arun Valley are of significant conservation importance and require sympathetic water level management to protect and enhance such an environment.

The otter is now a scarce species throughout Southern England and its continued existence is under threat. Within the catchment there have been sightings in the past and recently the distinctive signs of otter activity have been found. It is not clear how many individuals exist but it is likely to be only a few. The NRA is undertaking a project to enhance river habitat to promote the natural recolonisation by otters.

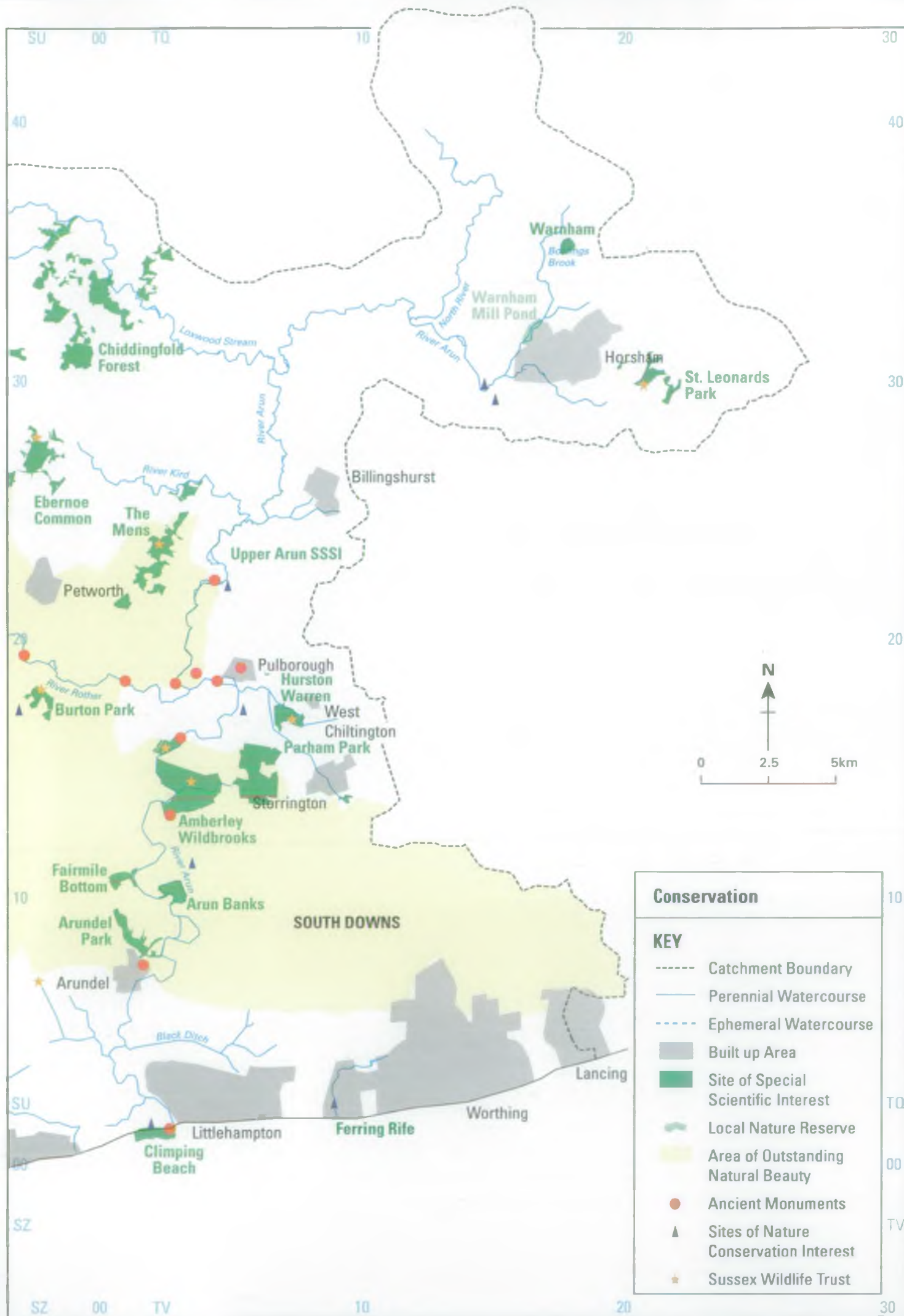
**River Arun
Catchment Management Plan
Map 10**



NRA

*National Rivers Authority
Southern Region*





Conservation

KEY

- Catchment Boundary
- Perennial Watercourse
- - - Ephemeral Watercourse
- Built up Area
- Site of Special Scientific Interest
- Local Nature Reserve
- Area of Outstanding Natural Beauty
- Ancient Monuments
- ▲ Sites of Nature Conservation Interest
- ★ Sussex Wildlife Trust

Both the River Rother and River Arun drainage systems support healthy populations of the kingfisher, being generally more abundant in the upper stretches of the rivers. This is invariably due to the presence of earth cliffs as suitable nesting sites.

There are a wide variety of conservation sites in the catchment including:

- 2 Areas of Outstanding Natural Beauty (AONB) namely the Sussex Downs and Chichester Harbour. (An AONB is a landscape designation by the Countryside Commission).
- 55 Sites of Special Scientific Interest (SSSI) which are nationally important sites.
- 1 National Nature Reserve
- 3 Ramsar/Special Protection Areas. These are internationally important wetland/bird sites.

The Planning Authorities in West and East Sussex have recently set up the Sussex Downs Conservation Board. This is partly funded by the Countryside Commission and is the major statutory authority for landscape and conservation in this area.

The Sussex Downs AONB is also designated as an Environmentally Sensitive Area which enables landowners to enter into management agreements with the Ministry of Agriculture, Fisheries and Food (MAFF). The Countryside Commission and English Nature are also able to enter into management agreements with landowners both outside and within SSSIs respectively. Such management agreements encourage landowners, through the payment of grants, to farm in an environmentally sensitive manner.

C9.3 Sites of Wetland Conservation Interest

The most significant sites of conservation interest are listed below:

The Upper Arun (SSSI) consists of a 13km stretch of the river and its immediate corridor and is notified on the basis of several uncommon species of dragonfly it supports. These include the Scarce Chaser and the nationally rare Club-tailed Dragonfly. The Rother/Arun confluence is a particularly good dragonfly site. The channel is managed so as to retain extensive marginal fringes of tall reeds and sedges, which are the preferred habitat of the dragonflies.

Amberley Wildbrooks (SSSI) is a sizable area of low-lying grassland dissected by numerous drainage ditches. The ecological interest in these ditches is great, with many flowering plants and at least 16 species of dragonfly. This interest is of an international magnitude and has led to the site being proposed as a RAMSAR/Special Protection Area. The whole of the lower Arun floodplain would have probably once supported a similarly rich diversity of species, but the majority of land has now been improved and the quality of the ditches has deteriorated. It is only certain sites therefore such as the Wildbrooks, that have escaped such development (refer to Section 8.2).

ISSUE 36

The loss of wild habitats and species diversity within the Arun catchment reflects more widespread losses of habitat in Sussex and nationally.

ISSUE 37

An apparent decline in the nature conservation value of the Amberley Brooks has been identified.

Also lying in the vicinity of Amberley is Coldwaltham Brooks (SSSI) to the west of the River Arun on poorly drained river alluvium. The site comprises grazing marsh with dissecting ditches and an extensive semi-permanent lake. The site is attractive to large populations of wintering Bewick's Swan, teal and shoveler amongst others. The site is managed by the Sussex Wildlife Trust.

The RSPB owns a wetland reserve at Pulborough Brooks which is managed for the benefit of all wildlife but with an emphasis on encouraging birds to visit and breed. The raising of water levels and the creation of flooded scrapes appear to be achieving increased bird populations (refer to Issue 4).

In the lower Arun there are several large meanders, one of which is now cut off and has developed a wet woodland carr interspersed with open water. This is designated Arun Banks (SSSI) and supports a wealth of flora and fauna typical of such wetlands. The berms of the main river Arun are also included in this site and these support the uncommon Marsh Mallow amongst other fen species.

At Arundel the Arundel Park SSSI includes Swanbourne Lake, which supports uncommon plant species and important numbers of wintering wildfowl.

Pagham Harbour is designated SSSI, Special Protection Area (SPA), RAMSAR and a Local Nature Reserve (LNR). It is owned by the NRA and managed by West Sussex County Council and is a wetland of international importance supporting populations of birds and inter-tidal habitats (saltmarshes, mudflats) as well as vegetated shingle, wet grassland and rifies. Of particular concern to the area is the threatened loss of inter-tidal habitats due to the rise in sea level. The management of this site is currently under review.

Chichester Harbour has for over twenty years been protected and managed by the Chichester Harbour Conservancy. The Harbour is a candidate for SPA and SSSI. It supports a rich and varied wildlife as well as a busy leisure boating industry. The Conservancy ensures that the conservation and recreation requirements of the Harbour are not in conflict.

In addition to these sites there are also SNCIs which are notified by West Sussex County Council on the basis of their ecological and conservation interest. Of most note is the fact that the whole of the Western Rother lying in West Sussex is a SNCI, with several of the tributaries also being notified in part. Parts of the River Arun are soon to be notified as SNCIs. Within the catchment there are also several Local Nature Reserves designated by the local authorities., Sussex Wildlife Trust Reserves a Wildfowl and Wetlands Trust Reserve at Arundel, National Trust sites and the Sussex Downs Area of Outstanding Natural Beauty.

C9.4 Archaeology

The NRA is required to have regard to the desirability of protecting and conserving sites of archaeological interest. As such close liaison with the West Sussex County Council Archaeologist is promoted and the NRA, in proposing capital schemes and maintenance works, ensures that due consideration is given to their implications upon the archaeological resource.

There are over 250 scheduled Ancient Monuments within the catchment. In addition, many areas are identified as having potential archaeological interest. Wetlands form some of these areas since organic remains are likely to be preserved in the anaerobic conditions which prevail in waterlogged soils. Such remains include wood, pollen, food stuffs and animal matter. All can provide vital evidence to archaeologists about man's activities in the past.

Clues to our ancient history are also present in the landscape, which has been shaped by human activity, including agriculture, navigation and settlement.

ISSUE 38

The long-term conservation of wildlife, archaeology and landscape within the catchment can be improved by raising awareness amongst the general public and interest groups of the importance of water in the environment and of the Arun catchment in particular.

C10 FISHERIES

C10.1 General

Under Section 114 of the Water Resources Act 1991 the NRA has duty to maintain, develop and improve fisheries. Section 2 of the same Act confers a more general duty to further the conservation of flora and fauna, which is important for bankside aquatic habitat. Fish populations are affected by both the quality and quantity of water, and by the physical suitability and structure of the aquatic ecosystem. The presence of a thriving fish stock is therefore one of the best possible indicators of a satisfactory water environment.

Freshwater fisheries use covers:-

- 1) Game fisheries – those supporting breeding populations of salmonid fish (Salmon and Brown and Sea Trout)
- 2) Coarse fisheries – those supporting breeding populations of coarse fish (represented mainly by various cyprinid species, together with pike and perch)
- 3) Maintained fisheries – those supporting non-breeding populations of fish maintained solely for recreational exploitation (represented mainly by “put and take” rainbow trout fisheries)
- 4) Fish Farms – those sites supporting the artificial propagation and growing-on of fish under controlled conditions for commercial and/or management purposes.

The NRA would undertake fish rescues in waters where there was a risk to fish life due to lack of dissolved oxygen in the water as a result of pollution. Aeration of a river or lake may be undertaken to maintain high dissolved oxygen levels. Restocking of fish in rivers or streams may also be undertaken.

C10.2 Angling

The NRA has a duty under Section 25 of the Salmon and Freshwater Fisheries Act 1975 to regulate the taking of salmon, trout, freshwater fish and eels by rod and line for recreational (or commercial) purposes, by means of a system of licensing. Freshwater anglers also require permission to fish from the owner or controller of the fishing rights on the water in question. The NRA may with Ministerial approval make byelaws under the Water Resources Act 1991 and the Salmon and Freshwater Fisheries Act 1975 to regulate fishing methods and times.

The capture of brackish or salt water species in estuaries and coastal waters is not regulated by licensing or other means, although certain byelaws enacted by various statutory bodies can impinge on its conduct. There is a public right to fish in virtually all tidal waters, which was established by Magna Carta.

Freshwater angling use covers all interests with the taking of salmonids, freshwater fish and eels by rod and line from all inland waters.

Saltwater angling use covers all interests concerned with the taking of sea fish by rod and line from estuaries and coastal waters.

Income is raised from charges made by the NRA for a licence for angling and other forms of fishing.

C10.3 Enforcement and Regulation

The NRA regulates fisheries and has extensive powers to deal with illegal fishing methods such as poisoning, electric fishing, explosives, snaring and unlicensed netting.

The sale and export of salmon and trout is also regulated by the NRA. It also requires fishermen to make returns detailing their fishing effort and catches of salmon, migratory trout and eels so as to aid the monitoring of fisheries.

The NRA's consent is required for the introduction of fish or spawn into any waters other than fish farms.

The incorporation of fish passes in weirs, dams or any other obstruction to a stream or river may be required to ensure the unobstructed migration of salmon and sea trout between the sea and their spawning grounds.

C10.4 Control of Fish Disease

The NRA has a duty to notify the Ministry of Agriculture, Fisheries and Food suspected of occurrences of notifiable fish disease in waters other than fish farms.

C10.5 Local Perspective

C10.5.1 River Arun

Coarse Fisheries

The River Arun holds a good mixed population of coarse fish in its middle and lower reaches, comprising of predominantly chub, dace, roach and bream. Bullhead, stone loach, minnow, brook lamprey and eels occur in the upper reaches of the river, with bleak, dace, roach, rudd, chub, eels, bream, carp, tench, barbel and pike in the middle and lower reaches. The majority of these species are thought to live and breed successfully in the Arun system.

During periods of high river flow the smaller juvenile fish require relatively slow flowing areas of water in which to shelter in order to avoid being swept downstream. The lack of suitable refuges, such as marginal shallows and tree roots, providing shelter during these periods of high flow is thought to have resulted in the downstream displacement of fish. During periods of exceptionally high flow it is thought that some of the larger fish are also displaced downstream. The scale of this problem is not fully understood and requires further investigation.

Historically a number of weirs and sluices have been constructed within the Arun river system to control water levels. The presence of these weirs and sluices has also meant that many of the coarse fish displaced by high river flows have been unable to move upstream to recolonise previously inhabited stretches of the river. It is thought that the coarse adjustment of sluice gates may also lead to the downstream displacement of fish and the destabilization of banks upstream of the sluice to the detriment of the fishery.

Angling on the River Arun is predominantly coarse, the main river being fished from Horsham as far downstream as Arundel. Downstream of Arundel the river is subject to saline incursions which act as the limit for the coarse fishery. Water levels are tidally affected as far upstream as Pallingham weir.

The Arun has a commercial eel fishery which operates downstream of Pulborough. Some concern has been expressed as to the impact of this fishery on the coarse fish population. Further information is required to evaluate this impact.

Game Fisheries

Fisheries surveys and angling catches have revealed that native brown trout are found throughout the upper and middle reaches of the River Arun and many of its tributaries. Migratory trout (sea trout) are also found in the Arun, but little is known about their numbers.

The distribution and spawning activity of migratory trout is thought to be restricted by a number of weirs and sluices located at various points on the river. Many of these obstructions have no provision for the passage of fish.

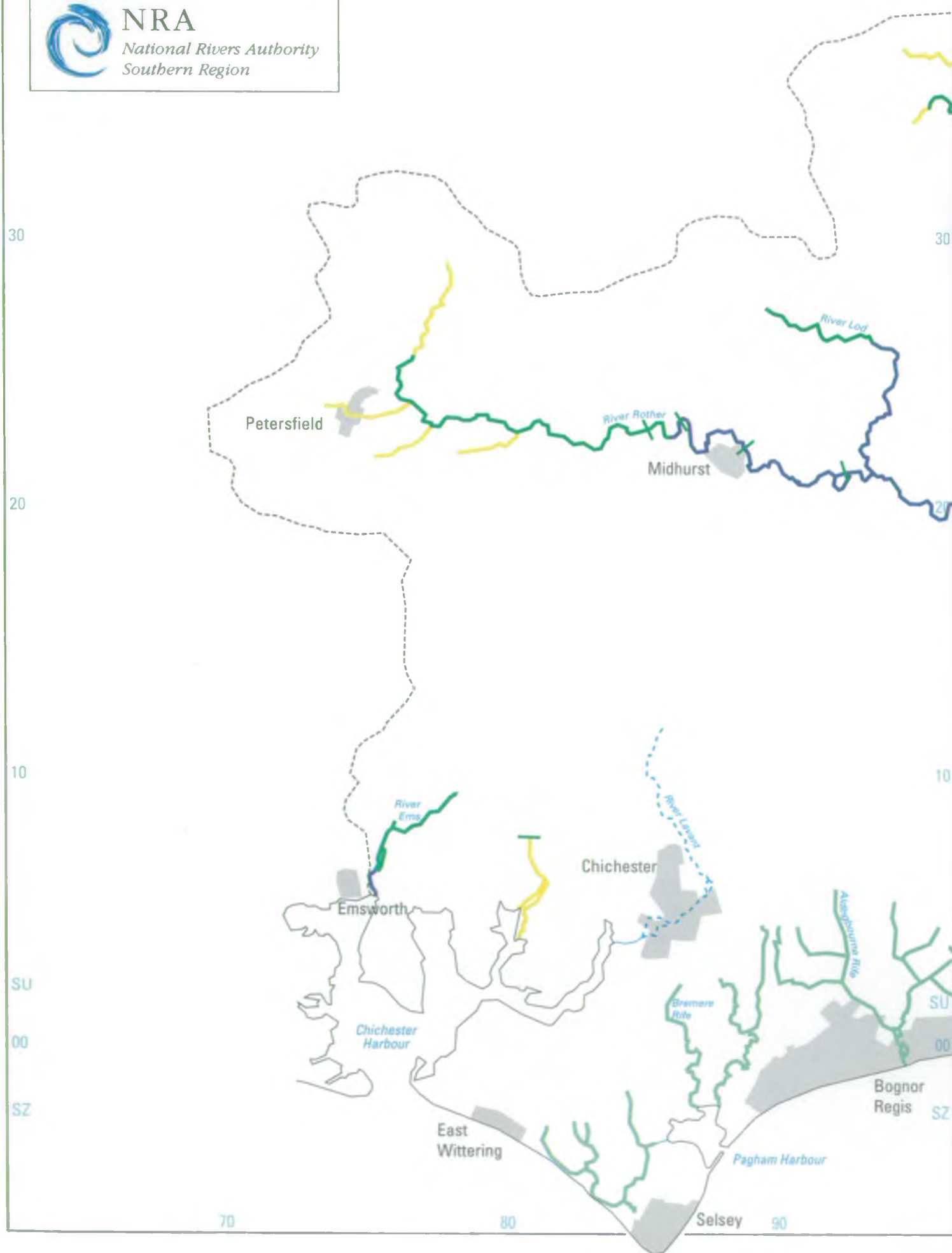
The upstream movement of adult sea trout is thought to be most seriously restricted by a sluice gate located at Oakhurst, which is only passable under extreme high flow conditions. Upstream a further barrier to the migration of sea trout is a sluice located at Gibbons Mill. Other obstructions exist throughout the catchment.

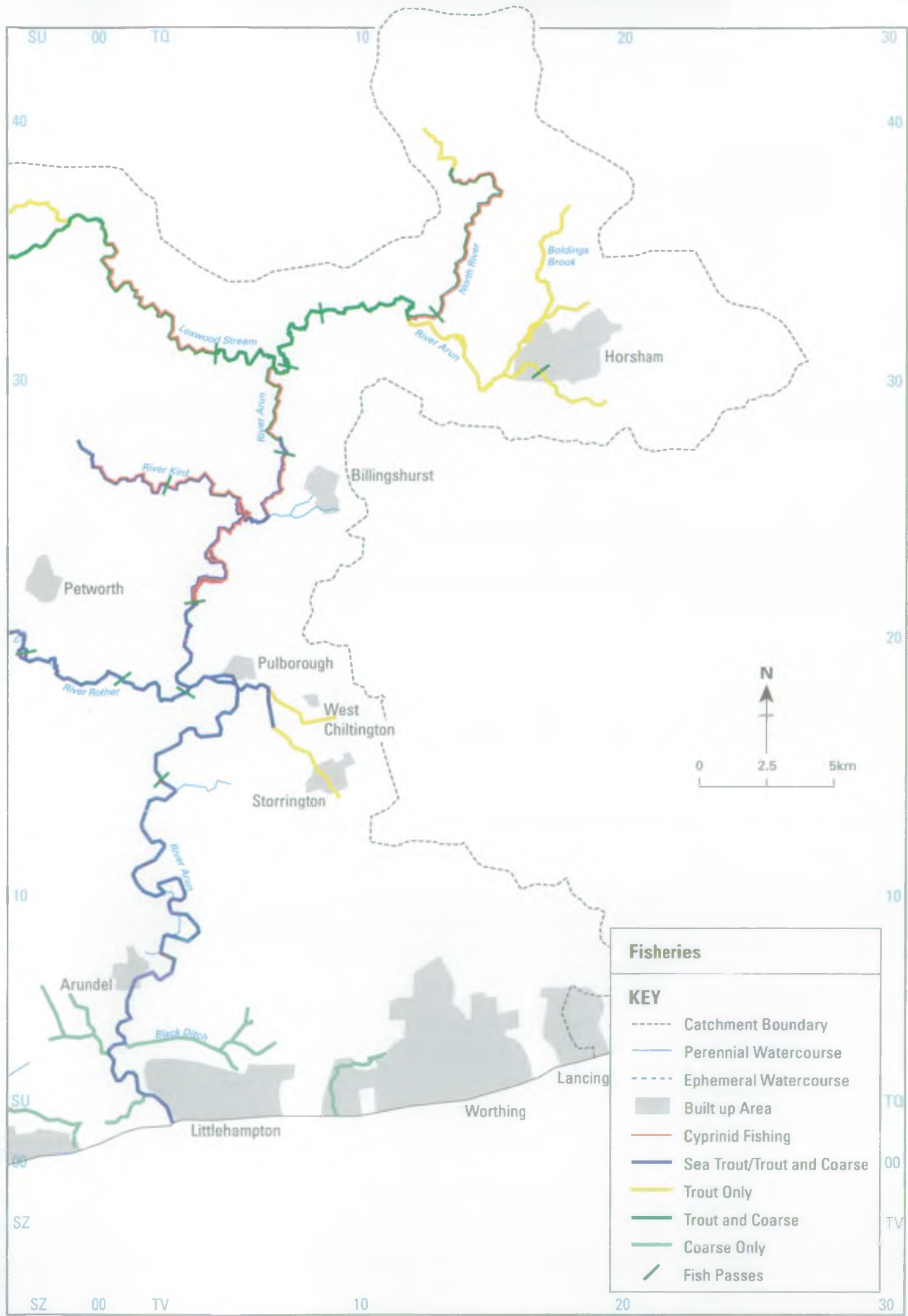
Sea trout are known to spawn in the main river and tributaries downstream of the sluice at Oakhurst, near Billingshurst.

Salmonids require silt-free gravel beds on which to spawn successfully and there is an abundance of such beds in the upper reaches of the Arun and its tributaries, many of which are currently inaccessible.

Exploitation of the brown trout and sea trout stocks is considered to be low, sales of rod licences within Sussex suggesting that the majority of anglers concentrate on coarse fish. In recent years the sea trout population is thought to have been put under pressure as a result of reduced summer river flows making it difficult for the adult fish to reach the spawning areas. It is also believed that changes in land use over recent decades has resulted in increased siltation of the river, with the subsequent loss of some spawning areas.

*National Rivers Authority
Southern Region*





Fisheries

KEY

- Catchment Boundary
- Perennial Watercourse
- - - - - Ephemeral Watercourse
- Built up Area
- Cyprinid Fishing
- Sea Trout/Trout and Coarse
- Trout Only
- Trout and Coarse
- Coarse Only
- / Fish Passes

C10.5.2 River Rother

Coarse Fisheries

The Western Rother holds a mixed population of coarse fish, comprising predominantly chub, dace and roach with some bullhead, stoneloach, minnow and broom lamprey. Dace, roach, chub, carp, bream, eels and pike feature mainly in the middle and lower reaches. A small population of stocked barbel are also present. Good populations of grayling are to be found throughout the upper-middle reaches of the river, following their introduction in early 1970s. In general the coarse fish populations in the Rother show a patchy distribution which is thought to be the result of variations in habitat quality.

In the past few decades the coarse fish populations in the Rother have declined. Reasons for this decline include:

- i) Reduced spawning success and/or fry survival as a result of habitat degradation.
- ii) Lack of suitable refuges for juvenile fish during periods of high flow, resulting in the downstream displacement of individuals
- iii) Reduced in-stream cover and invertebrate diversity caused by sand deposition resulting in reduced productivity
- iv) Increased riparian shading reducing primary productivity and invertebrate diversity

The presence of artificial barriers within the Western Rother system has also meant that coarse fish displaced by high flows have been unable to move upstream to recolonise previously inhabited stretches of the river.

Game Fisheries

Native brown trout are distributed extensively throughout the upper reaches of the Western Rother and many of its tributaries. Migratory sea trout are also found in the Western Rother, but their distribution and spawning activity are restricted by a number of obstructions to migration. The free migration of adult sea trout is heavily dependant on the Mean Residual Flow at Hardham Mill weir. Further upstream, the migration of adult sea trout is severely restricted by a bottom-opening flood gate located at Stedham Mill, which is passable only under flood conditions. Little is known about the extent of spawning activity upstream of this point but reasonable access to the headwaters is available once those two obstructions have been negotiated. The major sea trout spawning area is currently located downstream of the sluice at Stedham, near Petworth.

ISSUE 39

Reduced in-stream cover and invertebrate diversity arising from the extensive deposition of sand, leads to a reduction in the productivity of the coarse and game fish populations.

ISSUE 40

Restricted spawning habitat for both coarse and game fish species leads to low recruitment within these populations. Limited refuge areas for juvenile and adult fish during periods of high flow leads to the downstream displacement of stock and depletes upstream populations. The problem is compounded by the presence of obstructions preventing recolonisation of previously inhabited sections of the river.

C10.5.3 River Lavant

The River Lavant has no fisheries interest as the river only flows during the autumn and winter months.

C10.5.4 River Ems

Historically, the River Ems is known to have held good populations of coarse fish, specifically roach. However, during recent years the coarse fishery has deteriorated significantly, principally as a result of low flows. The river now holds a small mixed coarse fish and trout population.

Evidence suggests that a small number of salmon and sea trout enter the river on high tides, but access is severely restricted by flows and a series of obstructions.

C10.5 Rifes

The Rifes generally support impoverished fisheries. Low summer flows combined with extensive weed growth, frequently lead to deoxygenation problems. The problems of water quality are further compounded by the brackish nature of some Rifes.

The upper reaches of Pagham Rife hold a small population of brown trout. Successfully managed coarse fisheries also exist in some of the Rifes, for example Pagham Rife which holds moderate populations of rudd, common carp, cels and flounder. In general, angling interest is minimal. A small amount of localised commercial eel fishing takes place.

Some of the Rifes are utilised as nursery areas by estuarine fish species, namely bass, flounder and mullet. However, access to many of the Rifes is restricted by tidal flap valves which prevent salt water ingress on high tides

C11 RECREATION AND AMENITY

C11.1 General

This section considers activities such as walking, canoeing, swimming, boating, fishing and bird watching, which attract people to the river corridor.

The recreation and amenity duties of the NRA are set out in Section 8 of the Water Act 1989 which were consolidated in Section 16 and Section 24 of the Water Resources Act 1991, which empowers the NRA to conserve and enhance the natural beauty and amenity of inland and coastal waters and associated land, as well as the use of such waters and land for recreational purposes. The NRA is required to have regard to the desirability of preserving public freedom of access, and may actively promote the development of recreation and amenity where it is considered desirable. The NRA has produced a "Strategy for Recreation" which sets out its aims for the future.

In tidal waters there is usually a public right of navigation, but such rights do not exist in non-tidal stretches of water unless they have been established through historical usage, by dedication from the riparian owners or by statute. The extent of freshwater navigation rights is limited, there may be restrictions on the parts of rivers which can be used and the type of craft, and there is usually no right to land as the banks above tidal limits are privately owned.

C11.2 Local Perspective

The water environment features predominantly in the various forms of recreation undertaken by the public. The Arun catchment caters for a wide range of recreational activities ranging from simply walking along river banks to rather more active sports such as canoeing. The catchment, however, tends towards the quieter and informal recreation types.

Walking is widely acknowledged as the most popular form of recreation in the country and is certainly very popular in the Arun catchment. Footpaths along floodbanks of the lower Arun provide quite long walks between the coast at Littlehampton up to Pulborough. Further paths lead off to explore surrounding areas and also serve as access points to the river. Arun District Council have produced a pack of six walks in the lower Arun Valley. The floodbank paths also join with the South Downs Way which runs roughly West to East along the spine of the South Downs. This formerly crossed the main Arun at Houghton Bridge although recently a special footbridge has been installed some distance upstream.

ISSUE 41

The NRA will promote access to the water environment for the disabled where compatible with other duties and interests.

ISSUE 42

The use of tidal defences as bridleways and public footpaths is of particular concern as consequent erosion and localised settlement can lead to a reduction in the overall integrity of the defence. There is also a potential risk to life if a person fell into the fast flowing river.

The provision of substantial access along the river facilitates the use of other recreational features. Of significant note are the lowland wet grasslands of the valley which are very good for birdwatching. Particular areas of interest are the Amberley Wildbrooks SSSI and the Pulborough Brooks RSPB Reserve. A footpath crosses both of these sites. Amberley is also frequently visited by enthusiastic entomologists and botanists. Also of some note is the Wildfowl and Wetlands Trust Reserve which is situated adjacent to the River Arun upstream from Arundel. It caters for birdwatchers and naturalists of all ages and abilities.

The Upper Arun is generally not so accessible, neither is the River Rother. Here access is largely restricted to crossing points. Many of these crossing points are over ancient bridges which are now Scheduled Ancient Monuments, such as Woolbeeding Bridge on the Rother.

Walking along the rivers often provides breathtaking views of the river valley, such landscapes often providing the subject matter for artists. Similarly there are several picturesque villages in the vicinity of the river valleys. Villages and towns such as Petworth, Midhurst and Arundel are popular with tourists whilst those such as Amberley and Fittleworth are tucked away off the beaten track. Many have friendly village pubs which are popular with walkers and tourists. More directly associated with the water environment are the many riverside pubs such as the White Hart at Stopham Bridge and the Black Rabbit at Arundel.

There are several major tourist attractions situated close to the rivers, including Arundel Castle and park, Petworth House and park, and Midhurst Castle and the Cowdray Estate as well as many other scheduled buildings and monuments.

Horse-riding is obviously permitted on bridleways within the catchment, there being several lying within the Arun and Rother valleys although generally not running alongside the river for any great distance.

Cycling, particularly off-road, is a recreation form that has increased dramatically within the catchment. Cycling along designated rights of way is restricted to bridleways and not permitted on footpaths.

ISSUE 43

The increased leisure time available to the public will impose increased pressure on the water environment as recreational needs conflict with conservation concerns.

The Arun is navigable along its tidal length up as far as Pallingham, although the size of the craft able to negotiate the upper reaches is severely limited by the depth of water, the weed growth in the channel and height restrictions under bridges. There are frequent river cruises, departing both from Arundel and Littlehampton. These trips are very popular with tourists visiting these towns. Canoeing is permissible in the navigable lengths of the river. There are no navigation rights in the non-tidal rivers and streams.

ISSUE 44

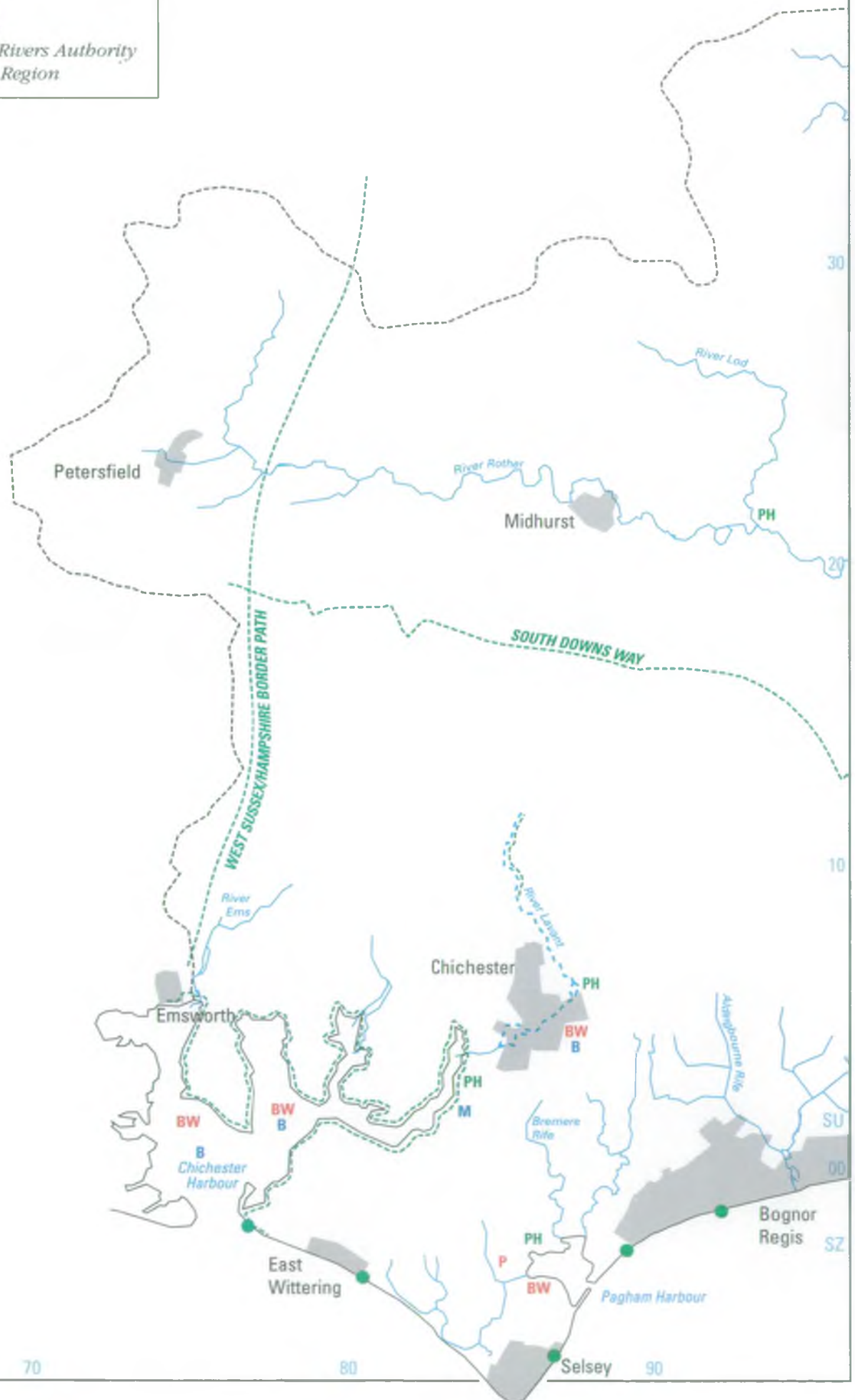
Erosion of banks, disturbance of wildlife and danger to river users caused by speeding and large water craft along the navigable lengths of the River Arun are of great concern to the NRA.

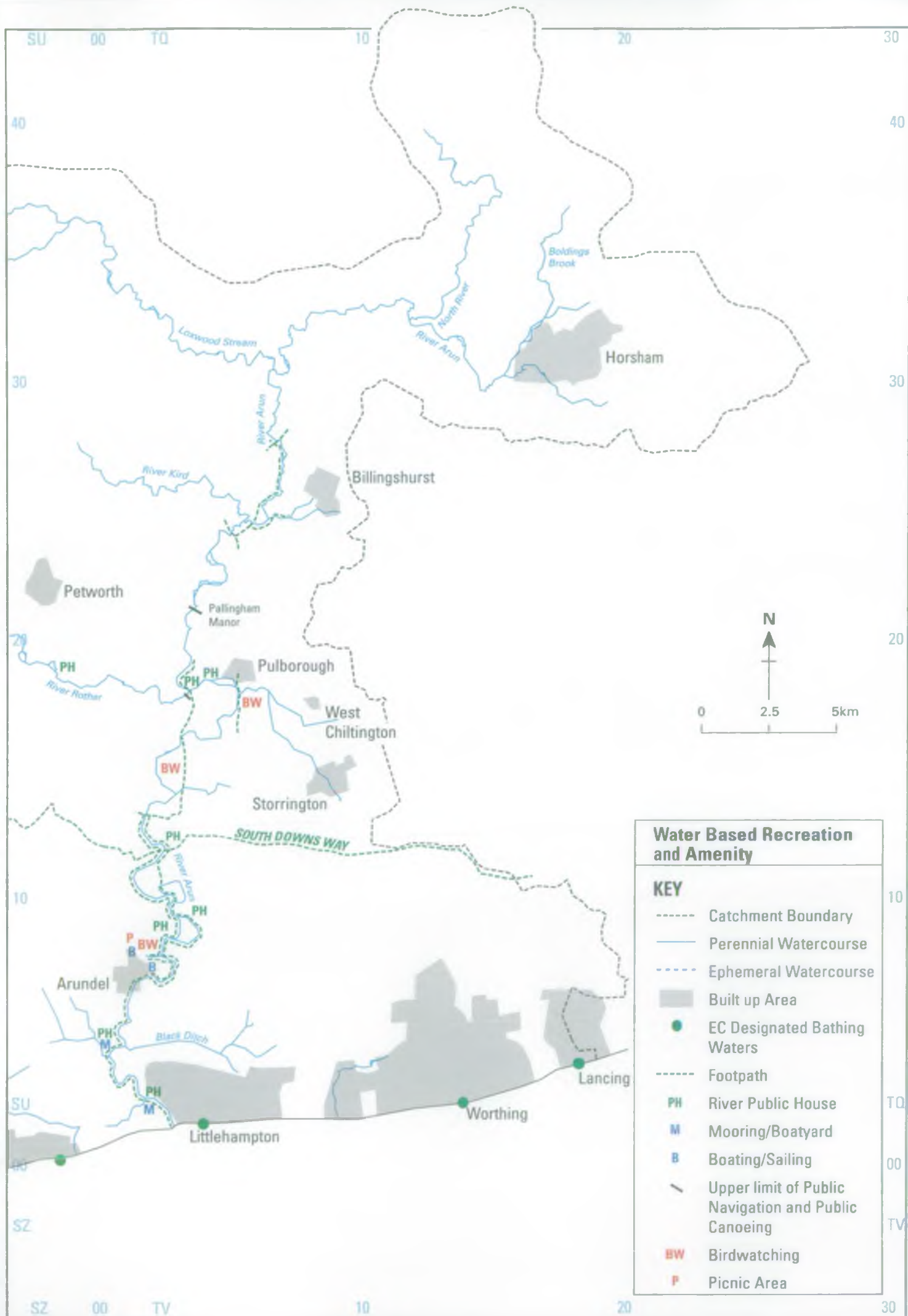
River Arun
Catchment Management Plan
Map 12



NRA

National Rivers Authority
Southern Region





The Wey and Arun Canal Trust is working on a £12-13 million project to restore the navigation of the canal. This is likely to take many years, although considerable funds have already been invested. (Refer to Issue 10).

Angling is very popular on the Rother and upper reaches of the Arun. It is largely co-ordinated through angling clubs. It is probably most frequent on the Rother where both coarse and salmonid fishing occurs, the latter being in the lower reaches. The Sussex rivers are, however, best noted for their coarse fishing.

ISSUE 45

The numerous demands on the use of rivers can lead to conflict between users, particularly where fishing and navigation rights are available.

The Arun catchment includes both Chichester and Pagham Harbours. Chichester Harbour is used to varying degrees for yachting (sailing and motor boating), windsurfing, sailboarding, canoeing, angling (shore and boat), swimming, jet-skiing and sub aqua diving as well as for horseriding. Pagham Harbour caters only for informal recreational activities such as walking, birdwatching and dog-walking as well as picnicking, swimming, sunbathing and fishing at the beach areas. These beach areas also support windsurfing. Cycling and horseriding take place infrequently. Wildfowling has been discontinued as it is incompatible with the nature conservation interest of the site. Only a handful of local people are permitted to sail within the reserve.

SECTION D:
CATCHMENT ISSUES

SECTION D: CATCHMENT ISSUES

Issues Identified

The following list of issues for the catchment have been extracted from the plan:

- 1 In assessing proposals for new development it must be ensured that adequate provisions are made for the proper use and conservation of water resources.
- 2 The NRA currently operates a policy of presumption against licensing new consumptive abstractions from the Worthing and Chichester Chalk Blocks. For the Lower Greensands of the Rother, applications are judged on their merits. However, the Chichester Block is known to be a point where abstraction has an impact on the water dependent environment which the NRA considers unacceptable. Future NRA policy is likely to reflect this.
- 3 Abstraction from the Hythe beds by Mid Southern Water is thought to have impact on the Ashford Stream. Fed by spring flow from the Hythe beds any upward variation in licence quantities may effect the stream's hydrology. The Company is currently undertaking a study in support of a licence variation. This has caused considerable correspondence between local residents, the Authority, the company and its agents, Dynamco.
- 4 Southern Water Services intend to develop the existing source at Hardham to its full potential by re-examining the groundwater option. The first stage would be to obtain the quantity available under the current groundwater licence by drilling new boreholes. The second stage would be to expand that development beyond the agreed yield of 65 Ml/d until the current licenced quantity of 75 Ml/d is reached. Questions concerning the potential environmental impact must, however, be addressed as a number of conservation projects have commenced since the initial trials in the seventies.
- 5 Present computer modelling of the Chalk Block indicates that current public water supply abstractions impact upon groundwater dependent features, such as Swanbourne Lake at Arundel. Water Companies are currently attempting to address summer demand peaks by the use of additional groundwater sources. Under the Water Resources Act 1991 it is the duty of the NRA to determine whether further abstraction can be permitted.
- 6 The Portsmouth Water Company public water supply source at Mid Lavant utilises water which would otherwise remain in the Lavant. Even during the floods of 1993/94 the impact of the pumping regime could clearly be discerned. Investigations should be carried out to determine the scale of the impact that pumping makes and produce proposals to lessen these.
- 7 A minimum residual flow (MRF) has been stipulated for the River Rother at Hardham. The condition was stipulated when the licence was determined, and new environmental analysis techniques could be used to examine the impact of the MRF upon the ecology of the river.
- 8 Investigations into the legacy of gravel extraction in the Chichester area indicate a trend of rising groundwater. It is thought that the backfilling of old pits and the silation of pits left as open water present a barrier to groundwater moving through the gravels from the foot of the Downs to the sea. The winter of 1993/94 indicated how important the gravels are. Any proposed gravel extractions in the area may be opposed by the NRA on the grounds of enhanced flood risk from groundwater.

- 9 Significant agricultural abstractions are made in the coastal strip for market gardening under glass, much of the water being administered via trickle irrigation which is not licensable under the Water Resources Act 1991. The NRA has therefore no control over quantities of water used in this way with implications for derogation of other users.
- 10 Water related issues for the Wey and Arun Canal Trust include obtaining a reliable water supply for the length of the waterway, reducing leakage and losses from locks to a minimum, and reinstating river crossings without compromising floodplain waterway area/storage.
- 11 In assessing proposals for new development it must be ensured that adequate precautions are taken to protect the surface and groundwater from pollution.
- 12 To minimise implications of storm sewage overflow, it must be ensured that their operation complies with discharge consents and they are adequately maintained.
- 13 To control intermittent and diffuse pollution in such a way that other uses of watercourses are not compromised.
- 14 Leaked or tipped oil from storage tanks serving residential properties industrial estates and farms leads to pollution of surface and groundwaters.
- 15 Surface and groundwaters are susceptible to pollution from farming practices.
- 16 Groundwater abstracted from chalk and sandstone aquifers for drinking water in the catchment is particularly susceptible to pollution.
- 17 There is concern that pesticides utilised without due consideration to approved guidelines could contaminate abstraction points at Hardham.
- 18 Poor maintenance of cesspits and small treatment plants in areas which are not served by main drainage leads to cumulatively significant water quality problems.
- 19 The coastal plains of the catchment are below sea level. The integrity of the sea and tidal defences is paramount in ensuring continued protection to the property and land from tidal flooding.
- 20 Low lying land behind sea defences must be considered at risk to tidal flooding in the event of a breach or overwhelming of the defence. New development on such areas along the existing undeveloped coast should be resisted and restrictions placed on types of development in built up areas so as to minimise the risk to life and property in the event of a severe breach or overwhelming of defences.
- 21 The NRA through its aerial survey of the coastline will monitor the volume of beach material forming the sea defences.
- 22 With further development in the catchment there is increasing threat to access routes to and along sea defences.
- 23 With the loss of rain forests there is increasing concern regarding the use of timber particularly in sea defence works. The NRA seeks to ensure that all timber is from a sustainable source.

- 24 Many of the sea and tidal defences date back hundreds of years. There have been many improvements made to these. The combination of sea level rise and sinking of land in south-east England, however, produces an effective annual sea level rise of 6mm per annum. There is also increasing wave attack as levels rise damaging defences and causing a gradual reduction in the standard of protection.
- 25 Private sluices need to be operated correctly during flood events to minimise both flood risk and detriment to fisheries and conservation interests.
- 26 Flood information in an effective format is essential if relevant advice is to be given with respect to flood risk to new and existing property and land and assessing implications of new development on flooding.
- 27 Careful consideration must be given to the implications of increased surface water run-off to watercourses, generated by additional impermeable areas from new development, so as to ensure flooding is not exacerbated or created. Development and infilling within fluvial floodplains will be resisted.
- 28 Attenuation ponds, required to restrict the rate of surface water run-off to watercourses from new development so as not to exacerbate flooding downstream, can only work effectively if adequately maintained.
- 29 There is a need to investigate how flood warnings could be more effectively disseminated to the public.
- 30 To ensure effective drainage within a catchment, maintenance of streams is required and should be undertaken taking into full account environmental aspects. The prime responsibility for maintenance rests with the riparian owner.
- 31 To ensure maintenance and improvement works can be undertaken to rivers so as to maintain effective drainage of a catchment, adequate access is required along the river bank tops. The NRA will on 'main rivers' under its jurisdiction require the retention of unobstructed access routes along the river bank top where new development is proposed.
- 32 Prior to the undertaking of any maintenance or improvement works on rivers the NRA will evaluate implications of such works on the river ecology so as to minimise environmental implications.
- 33 In assessing proposals for new development due regard must be taken of impact on nature conservation, recreation and fisheries interests. River corridors will be promoted and initiatives encouraged which seek to restore or enhance the natural elements of the water environment.
- 34 Opportunities exist to minimise saltmarsh damage and in some locations recreate them.
- 35 Areas of floodplain grassland in the Arun Valley are of significant conservation importance and require sympathetic water level management to protect and enhance such an environment.
- 36 The loss of wild habitats and species diversity within the Arun catchment reflects more widespread losses of habitat in Sussex and nationally.

- 37 An apparent decline in the nature conservation value of the Amberley Brooks has been identified.
- 38 The long-term conservation of wildlife, archaeology and landscape within the catchment can be improved by raising awareness amongst the general public and interest groups of the importance of water in the environment and of the Arun catchment in particular.
- 39 Reduced in-stream cover and invertebrate diversity arising from the extensive deposition of sand leads, to a reduction in the productivity of the coarse and game fish populations.
- 40 Restricted spawning habitat for both coarse and game fish species leads to low recruitment within these populations. Limited refuge areas for juvenile and adult fish during periods of high flow leads to the downstream displacement of stock and depletes upstream populations. The problem is compounded by the presence of obstructions preventing recolonisation of previously inhabited sections of the river.
- 41 The NRA will promote access to the water environment for the disabled where compatible with other duties and interests.
- 42 The use of tidal defences as bridleways and public footpaths is of particular concern as consequent erosion and localised settlement can lead to a reduction in the overall integrity of the defence. There is also a potential risk to life if a person fell into the fast flowing river.
- 43 The increased leisure time available to the public will impose increased pressure on the water environment as recreational needs conflict with conservation concerns.
- 44 Erosion of banks, disturbance of wildlife and danger to river users caused by speeding and large water craft along the navigable lengths of the River Arun are of great concern to the NRA.
- 45 The numerous demands on the use of rivers can lead to conflict between users, particularly where fishing and navigation rights are available.

SECTION E:
MANAGEMENT OPTIONS

SECTION E: MANAGEMENT OPTIONS

The management options in this section represent the ideas of the NRA at the time this Consultation Report was prepared for resolving the issues identified in Section C and highlighted in Section D. They do not constitute NRA policy as this will not be finalised until the public consultation process is complete.

Management options identify the agencies with an interest in the issue concerned, recognising that some functions are outside the specific responsibility of the NRA. The final choice of management action will involve many interests working together to fulfil the common strategy represented by the Catchment Management Plan.

TABLE OF OPTIONS

ISSUE 1: Ensure adequate provisions are made for the proper use and conservation of water resources
<ul style="list-style-type: none">• Promote the principles of the NRA Regional Strategy "Sustaining our Resources, The Way Forward" (NRA, Water Companies, Local Authorities (LAs))• Provide effective response to development proposals (NRA)
ISSUE 2: Need to protect Chichester and Worthing Chalk Blocks from over abstraction of groundwater
<ul style="list-style-type: none">• Presumption against further abstraction (NRA, Water Companies)• Promote the Management of water resources as set out in the NRA Regional Strategy "Sustaining Our Resources, The Way Forward" (NRA)
ISSUE 3: Need to determine implications of increased water abstraction from the Hythe beds upon flows in the Ashford Stream.
<ul style="list-style-type: none">• Assess study undertaken by Mid Southern Water in support of a licence variation (NRA)• Liaise with local residents, the water company and it's agents Dynamco (NRA)
ISSUE 4: Assess implications of developing groundwater abstraction at Hardham
<ul style="list-style-type: none">• Collect baseline data and audit Southern Water Services (SWS) investigations (NRA)• Determine licence application taking into full account environmental implications (NRA)
ISSUE 5: Need to ensure the protection of the water environment at Swanbourne Lake, which is an SSSI, and surrounding area in assessing applications for further groundwater abstractions from the Chichester Chalk Block.
<ul style="list-style-type: none">• Determine licence applications taking into full account the need to protect existing licence holders from derogation (NRA)
ISSUE 6: The implications of water abstraction on flows in the River Lavant
<ul style="list-style-type: none">• Investigate impact of pumping by Portsmouth Water Company on river flows (NRA)

ISSUE 7: There is a need to support the minimum residual flow at Hardham by environmental study.
<ul style="list-style-type: none"> • Determine and collate relevant environmental information (NRA, SWS) • Undertake relevant environmental impact analysis (NRA, SWS)
ISSUE 8: Impact of gravel workings and after use in the Chichester area upon groundwater movement levels
<ul style="list-style-type: none"> • Investigate and record groundwater levels (NRA, LAs, Mineral Companies) • Resist further extraction in the area through representations on the West Sussex County Council Minerals Plan (NRA)
ISSUE 9: NRA has no effective control over use of water resource for trickle irrigation
<ul style="list-style-type: none"> • Promote legislative changes possible under Deregulation proposals (NRA)
ISSUE 10: Implications of river crossings and restrictions on surface and groundwater abstraction on the restoration of the Wey and Arun Canal
<ul style="list-style-type: none"> • Exploration of potential original water sources for the canal (NRA, Canal Trust) • Identification of specific water resource requirements, location and timing (NRA, Canal Trust) • Quantify resultant increase in flood levels due to crossing of floodplains (Canal Trust, NRA)
ISSUE 11: Ensure new development is not detrimental to the quality of surface and groundwater.
<ul style="list-style-type: none"> • Promote the principles of the NRA's Groundwater Protection Policy to Local Authorities, developers and public (NRA, LAs) • Provide effective response to development proposals (NRA) • Provide Local Authorities with maps indicating revised source protection areas as soon as feasible (NRA)
ISSUE 12: Storm Sewage overflows and discharges of sewers during periods of heavy rainfall
<ul style="list-style-type: none"> • Enforcement to ensure overflows are within the terms of the discharge consent (NRA) • Check emergency overflows from sewerage systems to protect properties. Formulate a policy of action/enforcement (NRA, SWS)
ISSUE 13: Control intermittent and diffuse pollution
<ul style="list-style-type: none"> • Undertake pollution prevention inspections of industrial units and farms (NRA) • Promote public awareness and education (NRA)
ISSUE 14: Many pollution incidents in the catchment are attributable to oil
<ul style="list-style-type: none"> • Conduct pollution prevention campaigns to promote awareness of the potential problems associated with oil storage (NRA) • Implement the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 and encourage the bunding of all liquid storage tanks (NRA, farmers) • Support the introduction of oil regulations for industry to ensure the satisfactory storage of liquids (NRA, industry)

ISSUE 15: Accidental discharges from farming activities cause localised water pollution incidents
<ul style="list-style-type: none">• Continue the NRA farm inspection programme to advise farmers on best practice for waste management (NRA)• Implement the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 (NRA, farmers)• Encourage the public to report pollution incidents (NRA)• Maintain the capacity to make an appropriate response to pollution incidents (NRA)
ISSUE 16: The unconfined chalk aquifer is vulnerable to pollution
<ul style="list-style-type: none">• Enforce the NRA Groundwater Protection Policy (NRA, Planners)• Raise public awareness of the risks posed by pollution and groundwater contamination (NRA)
ISSUE 17: The drinking water abstraction point at Hardham is vulnerable to pesticide contamination
<ul style="list-style-type: none">• Encourage reduced pesticide use, and adherence to approved guidelines when using pesticides (NRA, MAFF, farmers, LAs, Railtrack)
ISSUE 18: Poor maintenance of cess pits, septic tanks and small treatment plants
<ul style="list-style-type: none">• Ensure effluent compliance with discharge consents (NRA, Discharger)• Review discharge consents where appropriate (NRA)• Liaise with Local Authorities and dischargers to prevent illegal overflows from cess pits (NRA, LAs, Public)
ISSUE 19: Ensure continued standard of defence provided by sea defences under jurisdiction of the NRA
<ul style="list-style-type: none">• Assess standard of defences provided by existing structures (NRA, LAs)• Object to proposals which would adversely affect the integrity and continuity of sea and tidal defences (NRA, LAs)• Assess implications of rising sea levels on future effectiveness of sea defences (NRA, MAFF)• Ensure NRA access to and along sea and tidal defences is retained for maintenance/improvement works (NRA, LAs)• Collate information relative to any breach or overwhelming of sea defences and tidal flooding (NRA, LAs, Public)• Promote liaison with Local Authorities on Coastal and Shoreline Management Plans (NRA)• Identify and assess effectiveness of secondary sea defences (NRA)

ISSUE 20: Development in tidal risk areas
<ul style="list-style-type: none">• Assess standard of defence provided• Identify extent and degree of risk tidal flooding• Resist development within areas at risk to tidal flooding along the undeveloped coast• Recommend a minimum 2 storey construction for residential dwellings within areas at risk to deep tidal flooding• Advise caravan and holiday accommodation in areas at risk to tidal flooding are only occupied over the months of May to August inclusive
ISSUE 21: Monitor volume of beach material forming sea defences
<ul style="list-style-type: none">• Continue annual aerial survey of the coastline (NRA)• Progress shoreline management plans (relevant coastal forums)
ISSUE 22: Access to and along sea defences
<ul style="list-style-type: none">• Identify access routes for NRA plant to and along sea defences (NRA)• Assess full implications of new development upon access requirements and ensure these are protected through effective liaison and advice (NRA)
ISSUE 23: Use of timber, particularly hard woods, in sea defence constructions
<ul style="list-style-type: none">• Ensure timber is obtained from a sustainable source (NRA, LAs)• Investigate the use of alternative materials including soft woods and rock groynes (NRA, MAFF, LAs)
ISSUE 24: Concern over the effects of sea level rise on sea and tidal defence
<ul style="list-style-type: none">• Investigate standard of defence presently available and implications of sea rise (NRA, LAs)• Evaluate cost benefit of undertaking improvement works on NRA defences (NRA)• Monitor information relative to sea level rise due to greenhouse effect (NRA)• Investigate condition and level of tidal embankments on the River Arun (NRA)• Consider implications of do nothing and managed retreat options (NRA, MAFF, Landowners)
ISSUE 25: Operation of private sluices
<ul style="list-style-type: none">• Identify all Mill Structures and other controls on watercourses (NRA)• Identify operational procedures undertaken and assess implications to NRA and public interests (NRA, riparian owners)• Determine responsibilities and powers with respect to structures and their operation (NRA)
ISSUE 26: Obtain and collate flood information for future reference and flood assessment
<ul style="list-style-type: none">• Undertake S105 survey (NRA)• Promote public awareness of flooding (NRA, LAs)• Promote liaison with Local Authorities (NRA)• Review flood recording systems available (NRA)

ISSUE 27: Ensure proposed development does not exacerbate fluvial flooding
<ul style="list-style-type: none">• Ensure no detriment to NRA access requirements (NRA, LAs)• Oppose to development in fluvial floodplains (NRA, LA)• Require surface water attenuation facilities to be provided where necessary to ensure peak flows in receiving watercourses are not increased (NRA, LAs)• Update flood risk maps and flood information, to include the undertaking of the Section 105 survey (NRA)• Ensure updated flood maps are sent to Local Authorities (NRA)
ISSUE 28: Long term maintenance of surface water attenuation ponds
<ul style="list-style-type: none">• Ensure a responsible body maintains ponds (NRA, LAs, developers)• Location of ponds to be within open recreational land (NRA, LAs, developer)• Minimise future maintenance requirements within design (NRA, LAs, developer)• Ensure safety is considered in all designs (NRA, LAs, developer)
ISSUE 29: Dissemination of NRA flood warnings to the public
<ul style="list-style-type: none">• Investigate methods of communication available (NRA)• Promote awareness of flood risk areas (NRA, LAs)
ISSUE 30: Promote the need to effectively maintain watercourses
<ul style="list-style-type: none">• Promote awareness of riparian responsibilities for maintenance (NRA, LAs)• Encourage use of Local Authority powers (NRA, LAs)
ISSUE 31: Ensure NRA access requirements to maintain/improve watercourses under its jurisdiction are retained
<ul style="list-style-type: none">• Identify access routes for NRA plant to and along rivers (NRA)• Assess full implications of new development upon NRA's access requirements and ensure these are fully protected (NRA)
ISSUE 32: Consider the impact of maintenance work on river ecology
<ul style="list-style-type: none">• Adopt sensitive maintenance techniques which have minimum environmental impact (NRA, LAs, riparian owners)• Where good river management practice exists, ensure that it continues and is developed for other areas (NRA, LAs)
ISSUE 33: Promote the conservation and enhancement of the water environment in assessing development proposals
<ul style="list-style-type: none">• Promote the concept of river corridors and their retention and enhancement (NRA)• Retain and enhance natural water features in development proposals (NRA, LAs)• Support water-based and water-side recreation where this is not detrimental to flood defence and conservation duties (NRA, LAs)• Presumption against culverting except for access requirements (NRA, LAs)• Support use of wet-ponds for surface water attenuation facilities provided on site (NRA, LAs, SWS)

ISSUE 34: Concern about the loss of saltmarsh

- Consider managed retreat options (NRA, MAFF, Landowners)
- Await outcome of research into causes of saltmarsh depletion (NRA, MAFF, Landowners)
- Seek protection of existing saltmarsh from development pressures (NRA, LAs)
- Take physical interim measures (NRA)

ISSUE 35: Protection and enhancement of floodplain grassland

- Identify target areas where management of water levels is required and where changes to existing management are likely to be successful (NRA, MAFF, conservation bodies)
- Assess ecological and environmental effects of existing water management of identified sites (NRA)
- Determine other requirements for these sites including flood defence and farming (NRA, farmers)
- Promote the production and implementation of water level management plans for sites where flooding of property would not be exacerbated (NRA, MAFF)

ISSUE 36: The loss of wild habitats and species diversity

- Determine target species which require positive management to prevent further decline (NRA, conservation bodies)
- Identify current distribution and formulate action programme to protect existing populations and encourage recolonisation to areas where these species have been lost (NRA, conservation bodies)

ISSUE 37: There is widespread concern about the decline in the nature conservation value of Amberley Wildbrooks

- Prepare water level management plan for the SSSI (NRA, MAFF)
- Work in close consultation with all interested parties and seek to obtain agreement where possible (NRA, farmers, conservation bodies)
- Work with MAFF and English Nature to achieve satisfactory implementation of the water level management plan (NRA, MAFF, English Nature)

ISSUE 38: The long term conservation of the water environment in the catchment can be improved by raising public awareness

- Promote and support the development of new education materials (NRA)
- Investigate new outlets for publicity literature (NRA)
- Support work of visitor centres, schools etc to increase awareness of the importance of water in the environment (NRA)

ISSUE 39: Deposition of sand, leading to a reduction in the productivity of the coarse and game fish populations

- Evaluate channel management practices to minimise sand deposition at vulnerable locations (NRA)
- Identify areas with degraded habitat due to sand deposition (NRA, angling clubs)

ISSUE 40: Restricted spawning habitat and refuge areas for both coarse and game fish species may lead to reduced natural populations
<ul style="list-style-type: none"> • Identify areas where the enhancement of spawning areas and refuge areas would be appropriate (NRA, angling clubs) • Support fishery owners and angling clubs in their involvement with fish enhancement schemes (NRA, angling clubs, fishery owners)
ISSUE 41: Promote disabled access to the water environment
<ul style="list-style-type: none"> • Identify areas where access for the disabled could be improved (NRA, LAs) • Liaise fully with interested parties (NRA, LAs) • Provide and support appropriate initiatives where necessary (NRA, LAs)
ISSUE 42: There is concern at the use of tidal defence embankments along the River Arun as bridleways and public footpaths
<ul style="list-style-type: none"> • Assess safety implications to the public (NRA, LAs) • Assess implications of such use of the integrity of the embankments (NRA) • Determine implications upon maintenance and future improvements of the defences (NRA)
ISSUE 43: Increased leisure time for the public will place increased demands on the catchment
<ul style="list-style-type: none"> • Ascertain trends in available leisure time and in favoured recreational pursuits (NRA, LAs) • Assess level of existing provision of recreation facilities within the catchment (NRA, LAs) • Work in consultation with other organisations to ensure any increases in the access do not adversely affect the nature conservation value of the catchment (NRA, conservation bodies, LAs) • Plan for requirements in future (NRA, LAs, conservation bodies)
ISSUE 44: Wash from larger boats navigating the Arun is leading to erosion of banks and disturbance of wildlife
<ul style="list-style-type: none"> • Assess areas of significant erosion (NRA, Littlehampton Harbour Authority) • Increase speed patrols in identified areas (NRA, Littlehampton Harbour Authority)
ISSUE 45: Conflict between the use of the river for navigation and fishing
<ul style="list-style-type: none"> • Identify existing rights of navigation (NRA, Harbour Authorities) • Encourage sensitive use of rivers by boaters and canoeists (NRA, Harbour Authorities, LAs) • Promote education of anglers to respect other users rights (NRA, Angling Clubs)

APPENDIX 1 : STATISTICS FOR THE ARUN CATCHMENT

1. GENERAL INFORMATION

Surface Catchment Area 148,402 Ha (1405 km²)

Groundwater Catchment Area 150,920 Ha (1509 km²)

Topography Maximum Level 294m AOD
 Minimum Level 0m AOD

Geology

From the north-east to south-west the catchment geology follows the sequence of the Wealden deposits (Tunbridge Wells Sands, Weald Clay, Lower Greensand and Gault Clay), Chalk and Eocene deposits (Woolwich Bed gravels, London Clay and Bracklesham Beds). The Chalk of the South Downs is an important aquifer.

Estimated Catchment Population

Year	Population	Change Per Decade
1991	480,000	+ 8.3%
2001	520,000	+ 8.3%

Districts and Estimated Population (1991)

District	Persons per Hectare	Ha in Catchment	% Area of Catchment	Population in Catchment
<i>West Sussex CC</i>	3.2	128,900	86.86	407,200
Adur	13.9	1,800	1.21	25,000
Arun	5.9	22,700	15.30	133,900
Chichester	1.3	74,800	50.40	97,200
Horsham	2.0	25,800	17.39	51,600
Mid Sussex	3.6	500	0.34	1,800
Worthing	29.6	3,300	2.22	97,900
<i>Surrey CC</i>	3.6	11,600	7.82	41,500
Mole Valley	3.1	4,900	3.30	15,200
Waverley	3.3	6,600	4.45	21,800
Guildford	4.5	100	0.07	4,500
<i>Hampshire CC</i>	2.0	7,900	5.32	15,800
E Hampshire	2.0	7,900	5.32	15,800
TOTAL CATCHMENT	3.1	148,400	100.00	464,500

Note: The population figures are approximate.

2. WATER RESOURCES

Rainfall

Rainfall (mm)	Average Year	1:10 Yr Drought
Mean Annual Total	862	671
Effective Rainfall	354	204

Groundwater

Resource Area	Ref. No.	Area (Ha)	% of Catchment
River Adur (Part)	23	2,800	1.86
Worthing Chalk (Part)	24	16,220	10.75
River Arun	25	48,200	31.94
West Sussex Rother	26	35,520	23.54
Chichester Chalk	27	48,180	31.92
TOTAL (Groundwater Catchment)		150,920	100.00

River Flow (cumecs)

	Q50	Q95
River Arun at Pallingham	1.26	0.32
River Rother at Hardham	2.79	1.06

Authorised Abstraction (Ml/d)

Licensed Abstraction	485.2 (103.7 for water power)
Licensed (excl. water power)	381.5
Actual Abstraction (1989)	218.7 (excl. water power)
% from groundwater	74.4%
% in High/Md Loss category	64.8%

Public Water Supply Companies Serving the Catchment

Water Company	Area (Ha)	% of Catchment
SWS Sussex (West)	65,300	43.98
SWS Sussex (Coast)	16,700	11.25
SE Water (Mid-Southern)	11,100	7.48
SE Water (Mid Sussex)	400	0.27
Portsmouth	43,000	29.00
Thames Water Utilities	9,100	6.13
East Surrey Water	2,800	1.89
TOTAL	148,400	100.00

3. WATER QUALITY

River Designated under EC Freshwater Fish Directive (Km)

Salmonid designation	57.55
Cyprinid designation	73.87

Length of River in each GQA Quality Class (Km)

Class	Description	Achieved
A	Good	3.0
B	Good	76.2
C	Fair	81.9
D	Fair	37.5
E	Poor	24.9
F	Bad	6.0
	Unclassified	6.9
	TOTAL	236.4

EC Designated Bathing Waters 9 (marine)

West Wittering
Bracklesham Bay
Selsey
Pagham
Bognor Regis
Felpham
Middleton on Sea
Littlehampton
Worthing
South Lancing

Effluent Discharges

	Number	Vol (M ³ /d)
To River	128	51,287
To Estuary	8	670
To Sea	5	78,987

Routine Pollution Prevention Monitoring Site Categories

Farm making silage	244
Arable Farms	169
Beef Farms	349
Dairy Farms	224
Sheep Farms	70
Piggeries	40
Goat Farms	6
Poultry Farms	52
Miscellaneous Farms	318
TOTAL	1472

Fish Farms	>10 tonnes/yr	4
	<10 tonnes/yr	2

Sewage Treatment Works (by vol. m³/d)

	< 15	697
	15-49	91
	50-499	23
	500-4999	13
	>5000	8
Combined sewer overflows		50
Private Potable abstractions		101
Public Potable supply abstractions		30
Active Domestic Waste Landfills		3
Oil Exploration Sites		4

4. FLOOD DEFENCE

Length of Coastline (Km)

Coastline to Schedule	142.50
Sea Defences (NRA)	18.81
Sea Defences (LA)	13.74
Tidal Banks (NRA)	65.10
Length of Main River	408.27 (Includes tidal lengths)

Internal Drainage Districts (Ha)

River Arun IDD	3304
South West Sussex IDD	5005
Total Length of IDB Watercourse (Km)	122

5. CONSERVATION

Number of Statutory Designated Sites in the Catchment

Type	Number	Water Dependent
Ramsar Site or SPA	3	—
National Nature Reserves	1	—
SSSIs	55	28
Env. Sensitive Areas	1 (South Downs)	—

6. NAVIGATION

Length (Km)

Length of inland navigation	27
Length of towpath	6
Chichester Canal (LA maintained)	6
Wey & Arun Canal (LA maintained)	
Length restored to date	7
Proposed for restoration	14

APPENDIX II : GLOSSARY OF TERMS

ABSTRACTION

When someone takes water from a river, stream, spring, pond, lake or from groundwater, they are 'abstracting' the water and they are making an 'abstraction'.

ABSTRACTION LICENCE

Licence issued by the NRA under Section 38 of the Water Resources Act 1991 to permit water to be abstracted.

ACTUAL ABSTRACTION

Total actual annual abstractions are returned to the NRA each year. These data are confidential.

ALGAE

Simple plants which may be floating or attached. They can be microscopic or very large plants but they lack true stems. Like all plants they are capable of photosynthesis. Algae can occur in still and flowing water.

AMMONIA

A chemical which is often found in water as the result of the discharge of sewage effluents. It is widely used to characterise water quality. High levels of ammonia adversely affect the quality and use of water for fisheries and abstractions for potable supply.

AOD (Above Ordnance Datum)

Land levels are measured relative to the average sea level at Newlyn in Cornwall. This average level is referred to as 'Ordnance Datum'. Contours on Ordnance Survey maps of the UK show heights above Ordnance Datum.

AQUIFER

Most rocks contain holes, cracks and fissures. When these are interconnected they can store and allow water to pass through them. These rocks are known as aquifers and the water contained within them as 'groundwater'.

BOD – Biochemical Oxygen Demand

This is a measure of the amount of oxygen consumed in water during the breakdown of organic matter. It therefore gives a relative measure of organic pollution.

BOROUGH LOCAL PLAN

Statutory document produced by Borough Council to implement strategy for development set out in the County Structure Plan. Specific land use allocations are identified.

BUFFER ZONE

A strip of land adjacent to the river free from urban development.

CATCHMENT

The area of land draining to a defined point.

CLASSIFICATION/CLASSES

A way of placing waters in categories (classes) according to assessments of water quality based, for example, on measurements of the amount of particular chemicals in the water (especially BOD, dissolved oxygen and ammonia).

COARSE FISH

Freshwater fish other than salmon and trout.

COASTAL PLAIN

Low-lying land adjacent to the coast.

COMPENSATION FLOW

Flow discharged to a river from a groundwater or reservoir source to augment low river flows.

CONSUMPTIVE USE

Difference in volume between the water abstracted from the catchment and that returned.

CONFLUENCE

The point at which two rivers meet.

CONTROLLED WATERS

All rivers, lakes, groundwaters, estuaries, and coastal waters to a distance of three nautical miles from the shore.

COUNTY STRUCTURE PLAN

Statutory document produced by the County Council outlining the strategy for development for a 10-15 year timescale.

CYPRINID

A group of fish of the carp family.

DEVELOPMENT PLANS

Local Plans, Structure Plans

DIFFUSE POLLUTION

Pollution from widespread activities with not one discrete source.

DISCHARGE CONSENT

A statutory document issued by the NRA under Schedule 10 of the Water Resources Act 1991 to indicate limits on conditions on the discharge of an effluent to a controlled water.

DISSOLVED OXYGEN

The amount of oxygen dissolved in water. Oxygen is vital for life, so this measurement is an important, but highly variable, test of the 'health' of a water. It is used to classify waters.

DISTRICT LOCAL PLAN

A statutory document produced by District Council to implement strategy for development set out in the County Structure Plan. Specific land use allocations are identified.

DoE

Department of Environment.

DRIFT COVER

Deposits left after the retreat of glaciers and ice sheets.

DROUGHT ORDER

Order issued by the Secretary of State under which variations to the terms of abstraction licences and/or reductions in the levels of service to consumers are sanctioned.

ECOSYSTEMS

A group of animals and plants which live together within a certain type of surrounding or habitat (eg, woodland, pond).

EC BATHING BEACH

Beach which meets criteria defined by EC Directive concerning the quality of bathing waters.

EC DIRECTIVE

A type of legislation issued by the European Community which is binding on Member States and sets standards and results to be achieved.

EFFECTIVE RAINFALL

Total rainfall minus actual evaporation and transpiration.

EMERGENT VEGETATION

Plants with roots in the river bed but which emerge from the water, often at the banks. Examples include reeds, irises and bullrushes.

ENVIRONMENTAL QUALITY STANDARD

The quantity of a substance found in a body of water which should not be exceeded in order to protect a given use of the water body. An EQS is set by the European Community through EC Directives and the Government.

EPHEMERAL FLOW

River flow not present throughout the entire year.

EVAPOTRANSPIRATION

Direct evaporation plus transpiration.

FAUNA

Animal life.

FISH PASS

A device to permit fish to transverse structures within a river.

FLASHY

River level rises and falls quickly.

FLOOD ALLEVIATION SCHEME

Works proposed or already undertaken to reduce the risk of flooding to property and land.

FLORA

Plant life.

FLOW ATTENUATION

The provision of facilities to reduce the rate of surface water discharge.

FLOW MEASUREMENT

m³/s Cubic metres per second
l/s Litres per second
Ml/d Megalitres per day
mgd Millions of gallons per day

CONVERSION TABLE

m ³ /s	Ml/d	mgd
0.012	1	0.224
0.06	5	1.12
0.12	10	2.24
0.24	20	4.48
0.6	50	11.2
1.2	100	22.4

FLUVIAL

Derived from rivers and streams.

FLUVIAL DEFENCE

Structure providing protection from flooding from rivers.

FLUVIAL FLOODPLAIN

This includes all land adjacent to a river over which water flows or would flow but for flood defences in times of flood.

FRY

Fish which are less than 1 year old.

GAME FISH

Salmonid fish, ie. trout and salmon.

GAUGING STATION

A site where the flow of a river is measured. Sometimes, a weir is used to assist the measurement.

GENERAL QUALITY ASSESSMENT (GQA)

Scheme for assessing the overall state of the water environment over time.

GROUNDWATER FLOW

Movement of water in the ground.

GROUNDWATER PROTECTION ZONES

Identify the proximity of land to a groundwater source.

HABITAT

The natural home of plants and animals. Different plants and animals have different needs, and so live in different habitats.

HEADWATERS

Streams close to their source.

HECTARE

Unit of area equivalent to 2.471 acres.

INTERNAL DRAINAGE BOARD (IDB)

A land drainage authority with powers to carry out and control flood defence works within identified areas.

LAND DRAINAGE AUTHORITY

Bodies with powers to undertake and/or control works on rivers and streams.

LAND DRAINAGE AND SEA DEFENCE BYELAWS

Statutory document giving NRA powers to carry out and control works on main rivers and sea defences under its jurisdiction.

LANDFILL

Site used for waste disposal into/onto land.

LEACHATE

Liquor formed by water passing through waste materials.

LITTORAL DRIFT

The movement of shingle along the coastline.

MACROINVERTEBRATE

Small aquatic animals, such as insects, snails and worms which live in the river bed.

MAIN RIVER

Also known as 'Statutory Main River'. It is a legal definition which defines particular rivers and streams which are defined on special maps. On the 'Main River', the NRA has permissive powers to construct and maintain defences and to control the actions of others through byelaws and the issue of Flood Defence Consents. Any proposal that could interfere with the bed or banks or affect the flow of the river requires formal Flood Defence consent from the NRA.

MARITIME COUNCIL

Councils bounded by the sea.

MINIMUM RESIDUAL FLOW (MRF)

A minimum flow setting at a gauging station, related to the flow requirement for downstream.

NATURAL FLOW REGIME

The natural flow record prior to the influence of man, ie. with no abstraction from or discharge to the catchment.

NITRATE SENSITIVE AREAS (NSA'S)

NSA's have been set up in certain areas to encourage farmers to make changes in crop management in order to reduce nitrate leaching.

NITRATE VULNERABLE ZONES (NVZ)

Areas where water sources are high in nitrate. The EC Nitrate Directive (91/676) requires farmers to observe an action programme of measures designed to reduce nitrate loss from their land and help to reduce nitrate levels in water.

PERENNIAL FLOW

River flow present through the entire year.

PERMISSIVE POWER

The NRA is given various powers to do things by a number of Acts of Parliament. Some of these powers are 'permissive', which means the NRA can do these things, but is not under a DUTY to do them. For example, NRA has permissive powers to construct flood defences, but does not have a duty to do this. In contrast, the NRA has certain statutory duties, ie. things it must do. For example, it must authorise abstractions, effluent discharges and works to the bed or banks of main rivers.

POOL

A distinct, deeper area of slow flowing water, often with an eddying flow and often found between fast flowing stretches which are known as 'riffles'.

POTABLE WATER SUPPLY

Water supplied for domestic use including human consumption.

PRESCRIBED FLOW

A flow setting at a gauging station, incorporated into an abstraction licence, such that abstraction must cease once the flow recorded at the gauging station reduces below this flow. Prescribed flows are set at or above Minimal Residual Flow setting at the gauging station. The prescribed flow is increased periodically for new licences.

PROTECTED RIGHTS

When considering whether to issue an abstraction licence, the Authority must not issue a licence which affects other peoples legitimate rights to use that water. These rights are known as 'protected rights', but do not include every existing use of the water. They do include all licensed abstractions, riparian rights (including livestock watering) and small abstractions for domestic supplies.

RESOURCE AREA

A groundwater catchment based on geological boundaries.

RETURN PERIOD

Refers to the return period of a flood. Flood events are described in terms of the statistical frequency at which, on average, a certain severity of flood is exceeded.

RIFFLE

Fast flowing, shallow water with a distinctly broken or disturbed surface. Riffles are often found between pools.

RIPARIAN OWNER

A person/organisation with property rights on a river bank.

RIVER CORRIDOR

Land which has visual, physical or ecological links to a watercourse and which is dependant on the quality or level of the water within the channel.

RIVER LEVEL STATION

Facility to record river levels.

SALINE

Water with a proportion of salt.

SALMONID

Fish of the Salmon family including Brown and Sea Trout.

SEA DEFENCE

Structure providing protection from flooding from the sea.

SLUICE GATE

Structure to control upstream river levels and downstream flows.

SPATE FLOWS

Periodic fresh water flood flows.

SPRINGS

Source of streams and rivers.

SITE OF SPECIAL SCIENTIFIC INTEREST (SSSI)

A site given a statutory designation by English Nature or the Countryside Council for Wales because it is particularly important, on account of its conservation value.

STATUTORY WATER QUALITY OBJECTIVE

A Quality Objective given a statutory basis by Regulations when made under the Water Act of 1989.

STORM SEWAGE OVERFLOW

An overflow structure which permits a discharge from the sewerage system during storm conditions.

SUSTAINABLE

Capable of being maintained at a steady level without exhausting natural resources or causing ecological damage.

SURFACE WATERS

This is a general term used to describe all the water features such as rivers, streams, springs, ponds and lakes.

SURFACE WATER RUN OFF

Overland flow discharging to a river.

TELEMETRY

River level stations record the levels every 15-minutes electronically at the gauging station. The telemetry system is a computer system that can contact stations and ask it to send the data back to the computer over the public telephone system. The computer then stores the data in its memory. The level data can then be converted to flows automatically by computer. Some raingauge and water quality data is obtained in the same way.

TIDALLY AFFECTED

River level influence by sea level.

TIDAL DEFENCE

Structures along tidal reaches of rivers providing protection from flooding.

TIDAL FLOODPLAIN

Land at risk to flooding from the sea in the event of overtopping or a breach of a sea or tidal defence.

TOTAL RAINFALL

Rainfall measured by rain gauge.

TRADE EFFLUENT

Effluent derived from a commercial process/premises.

WATER ENVIRONMENT

Estuaries, coastal waters, rivers, streams, lakes, ponds, aquifers, springs.

WETLAND

Wet areas of a river catchment where the plants and animals that live there are dependant on that 'wetness' for their survival.

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